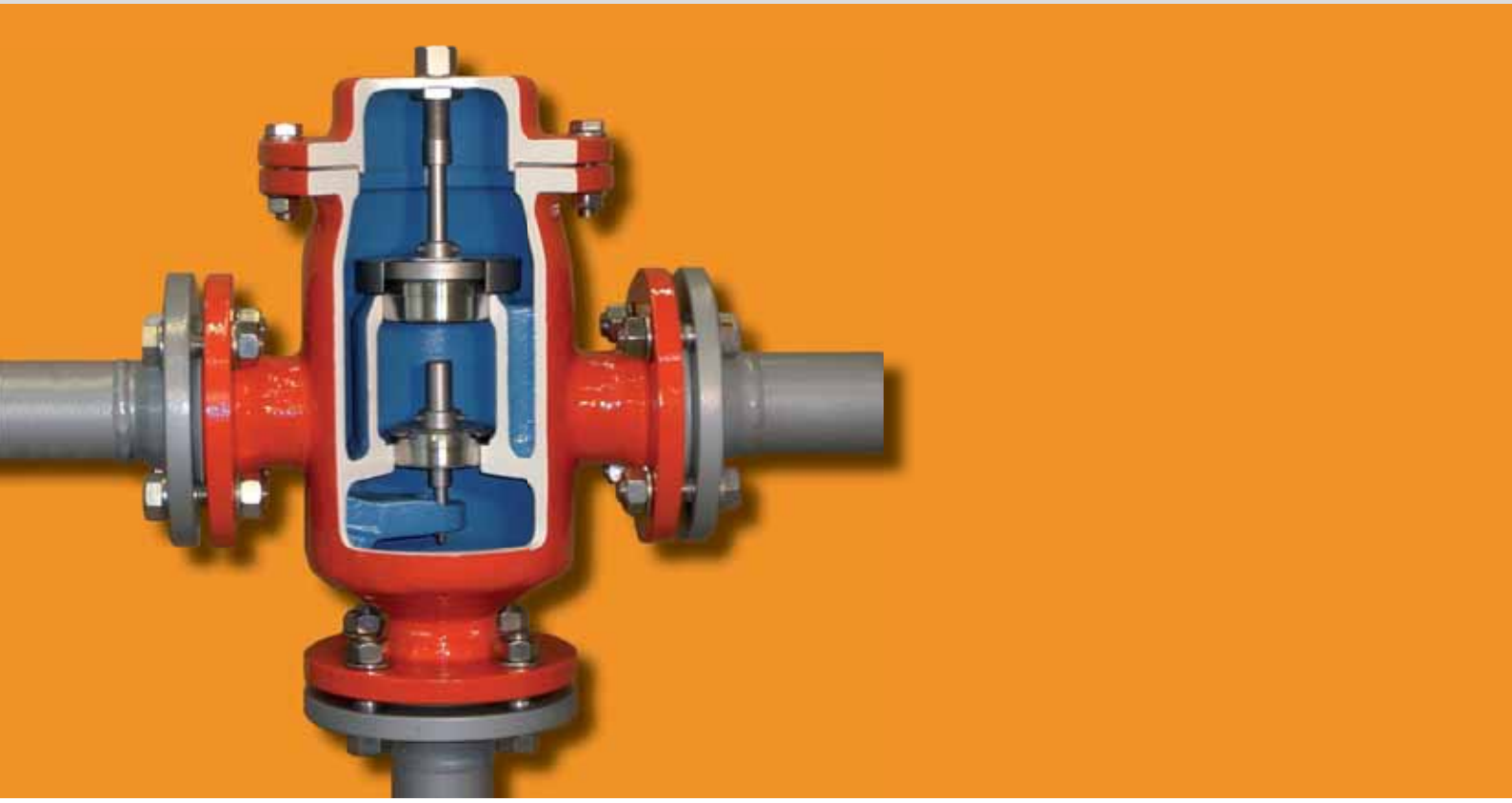
PROTEGO® **Pressure and Vacuum Relief Valves**

in-line



Volume 6

PROTEGO

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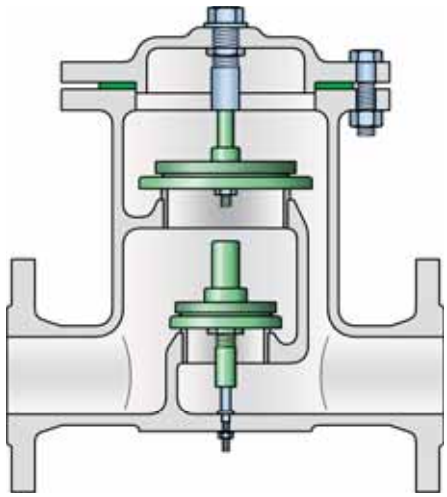
Pressure and Vacuum Relief Valves – in-line

The working principle and application of pressure and vacuum relief valves on tanks and process equipment is discussed in “Technical Fundamentals” (Volume 1). In this chapter we introduce in-line pressure and vacuum relief valves which can act in a pressure containing, relief or back flow protection function if installed on a tank or other process equipment.

Function and Description

These devices are direct acting weight or spring loaded in-line valves, pallet type, used to protect plant equipment (tanks, vessels, process technical apparatus, piping etc.) against unallowable operational high pressure or vacuum. In-line valves may also be installed as end-of-line valves. In end-of-line applications the open area to atmosphere has to be protected against weather impact, dirt particles or animals (Figure 1).

Figure 1:
Pressure and Vacuum Relief Valve
PROTEGO® DV/ZT



PROTEGO® pressure relief valves provide protection against unallowable high pressure and prevent emission losses almost up to set pressure.

PROTEGO® vacuum relief valves provide safety against unallowable low vacuum and prevent intake of air almost up to set vacuum.

Combined PROTEGO® pressure and vacuum relief valves fulfill both of these functions.

The design of the **PROTEGO®** valve pallets allows full lift to be reached at a maximum of 10% overpressure. This full lift type technology allows the valve to be set just 10% below the allowable fully open pressure (consider MAWP and possible pressure drop of piping and other devices) and still safely discharge the required mass flow. Typical overpressure for conventional valves is 40% to 100% (API 2000). These valves open earlier and reseat later which will result in undesirable product losses.

Special features and advantages

Continuous investment in research and development has allowed PROTEGO® to design valve pallets with the following advantages:

- 10% full lift type technology results in product saving (reduction of breathing losses can be more than 30%)
- PROTEGO® valves open later and reseat earlier, thus providing optimized pressure management and additional saving of inert/blanketing gases
- high flow performance allows cost reduction as smaller sized valves can be installed
- tightness superior to the required national and international standards
- the valve pallet is guided within the housing to protect against harsh weather conditions, e.g. preventing freezing of pallet in cold weather conditions
- can be installed in explosion hazardous areas
- maintenance friendly design

To reduce leak rates to a minimum and fulfill the highest expectation of the industry the valve seats and valve pallets are manufactured from high quality stainless steel and lapped in a highly developed manufacturing process. For low pressure settings valve pallets are equipped with high quality FEP-diaphragm.

Preferred applications

- as pressure containment valve e.g. for blanketing systems
- as pressure reducing valve e.g. to connect to nitrogen blanketing systems
- for controlled venting of plant or storage tanks into a vapour header system
- as back flow protection device in exhaust or inerting systems

Installation and servicing

All PROTEGO® devices are delivered with detailed installation and maintenance manuals. Please take notice of the instructions for the removal of the transport protection, if applicable. The special check lists should be followed to ensure the correct installation of the PROTEGO® devices.

Selection

For safely operating and protecting the plant the correct selection and sizing of the PROTEGO® device is necessary. The valves are mainly characterized by the following criteria:

Function: Pressure relief, vacuum relief or combined pressure and vacuum relief

Working principle: Weight or spring loaded valve pallet, depending on set pressure

Design type: Right angle or straight through design, horizontal or vertical connection to the protected object. The devices are spring or weight loaded and therefore have to be installed with the valve pallets in horizontal position. The maximum and minimum pressure settings depend on the specific design.

Sealing: Depending on the set pressures either metal sealing or soft sealing provide an extremely tight seal.

Operating conditions and critical medium: Polymerisation problems, condensation problems, operating temperature, operating pressure, volume flow are the main criteria for choosing the correct devices.

Depending on the application, it may be important to select a device with a **heating jacket**, but please note that not all devices are available with this feature. Electrical trace heating may be an alternative.

Sizing

The **valve size** results from the volume flow which has to be vented to avoid an increase above the maximum allowable pressure or vacuum. Certified volume flow diagrams are used for sizing. For correct sizing the operating conditions and the pressure drops of the piping system (including other installed devices) and superimposed backpressures have to be taken into account.

Detailed procedures and examples for sizing are described in “Technical Fundamentals” (see Volume 1).

Example 1

Given: Volume flow $\dot{V}_{max}$ in m³/h / CFH (e.g. for in- or out breathing of a storage tank this is the sum of the pump capacity and the thermal breathing require ment) and maximum allowable opening pressure (e.g. tank pressure) p in mbar / inch W.C.

Required: Valve size DN

Procedure: The intersection point of $\dot{V}_{max}$ and p_T determines the required valve size. Opening pressure = the maximum allowable tank pressure. The volume flow diagrams show the volume flow as function of the opening pressure for a fully open valve.

The set pressure of the valve has to be determined so that the calculated volume flow can safely be discharged. For a valve which needs 10% overpressure to reach full lift the set pressure may be chosen 10% below the fully open pressure (e.g. maximum allowable tank pressure). Attention: pressure drop of piping systems and other installed devices have to be considered!

Many conventional valves need 100% overpressure to reach full lift. In these cases the set pressure may be just half of the maximum allowable tank pressure. Consequently these valves open earlier and avoidable product losses occur.

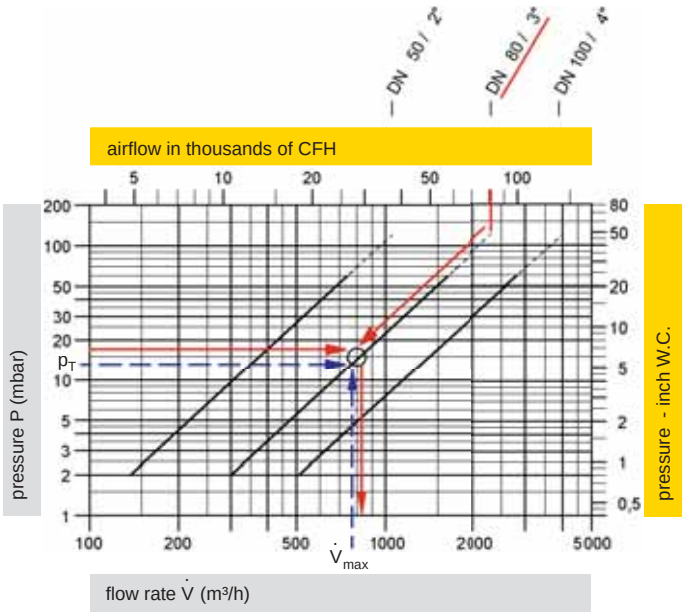
Example 2

Alternatively the valve performance has to be checked if the size and maximum allowable pressure are provided.

Given: Connection nozzle size and maximum allowable opening pressure (e.g. Tank pressure) p in mbar / inch W.C.

Required: Volume flow in m³/h / CFH, set pressure p_A in mbar / inch W.C.

Procedure: From the intersection point of the straight line of p and the valve performance curve of the specific valve size the volume flow $\dot{V}_{max}$ is determined. The volume flow of the set pressure p_A may be 10%, (PROTEGO®-technology) or 40% or 100% below the opening pressure p_T. Attention: pressure drop of piping systems and other installed devices have to be considered!



The required set pressure (= start of opening) will be the opening pressure (valve fully open) minus the characteristic overpressure.

For PROTEGO® valves and end of line devices the overpressure characteristic is 10% unless otherwise stated. Within 10% overpressure the valve pallet will reach full lift. A further increase in flow performance will follow the pressure volume flow diagram.

Material selection is based on plant and engineering specifications.

Guidelines for calculating the volume flow and considering the density influence are given in „Technical Fundamentals“ (see Volume 1).

After completing all steps the device can be completely specified and ordered.

To enable us to provide a quotation we recommend completing the data sheet from Vol.1 with the specific process data.

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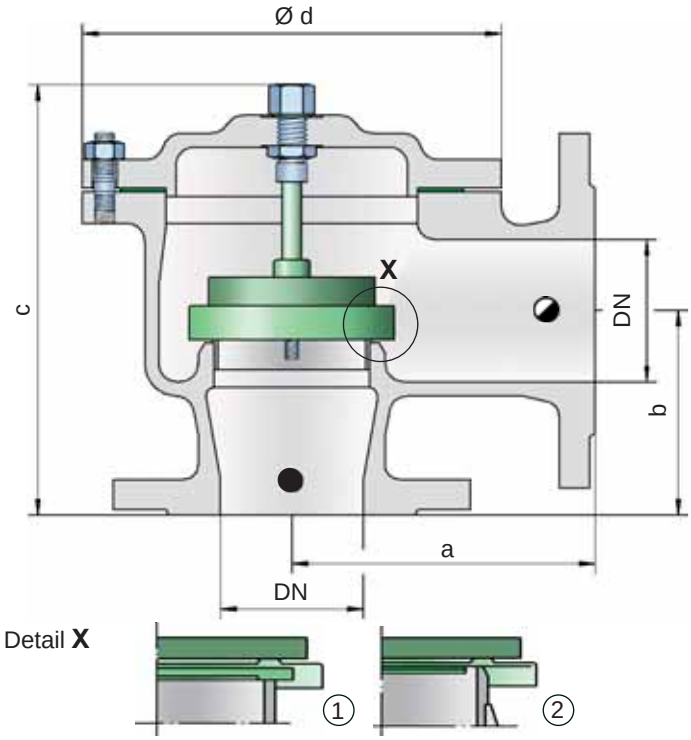
PROTEGO® Pressure and Vacuum Relief Valves – in-line

	Type	Size	Pressure setting positive or negative setting range mbar / inch W.C.	○ = weight loaded X = spring loaded	Design ○ = straight through design X = right angle design	○ = soft sealing X = metallic sealing	○ = for critical medium (polymerisation, corrosion, crystallisation)	○ = heating jacket	Page
Pressure or Vacuum Relief Valves									
	DZ/E	25 - 300 1" - 12"	±2.0 up to ±60 ±0.8 up to ±24	○	X	○ / X		○	238 - 240
	DZ/E-F	25 - 300 1" - 12"	±60 up to ±500 ±24 up to ±200	X	X	X		○	242 - 244
	DZ/EA	50 - 150 2" - 6"	±5 up to ±50 ±2 up to ±20	○	X	X	○		246- 247
	DZ/EA-F	50 - 150 2" - 6"	±60 up to ±500 ±24 up to ±200	X	X	X	○		248 - 250
	DZ/T	25 - 300 1" - 12"	±2.0 up to ±60 ±0.8 up to ±24	○	○	○ / X		○	252 - 254
	DZ/T-F	25 - 300 1" - 12"	±60 up to ±500 ±24 up to ±200	X	○	X		○	256 - 258
	R/KSM	50 - 200 2" - 8"	±5 up to ±100 ±2 up to ±40	○	X	○			260 - 261

	Type	Size	Pressure setting positive setting range mbar / inch W.C.	Pressure setting negative setting range mbar / inch W.C.	○ = weight loaded X = spring loaded	Design ○ = straight through design X = right angle design	○ = soft sealing X = metallic sealing	○= for critical medium (polymerisation, corrosion, crystallisation)	○ = heating jacket	Page
Pressure and Vacuum Relief Valves										
	DV/ZT	40 - 150 1½" - 6"	upper valve pallet ±2.0 up to ±60 ±0.8 up to ±24	lower valve pallet ±3.5 up to ±50 ±1.4 up to ±20	○	○	○ / X		○	262 - 264
	DV/ZT-F	40 - 150 1½" - 6"	+60 up to +500 +24 up to +200	-3.5 up to -50 -1.4 up to -20	X	○	X		○	266 - 268
	DV/ZU	40 - 150 1½" - 6"	+2.0 up to +60 +0.8 up to +24	-3.5 up to -50 -1.4 up to -20	○	○ / X	○ / X		○	270 - 272
	DV/ZU-F	40 - 150 1½" - 6"	+60 up to +500 +24 up to +200	-3.5 up to -50 -1.4 up to -20	X	○ / X	X		○	274 - 276
	DV/ZW	40 - 150 1½" - 6"	+2.0 up to +60 +0.8 up to +24	-3.5 up to -50 -1.4 up to -20	○	○	○ / X		○	278 - 280
	DV/ZW-F	40 - 150 1½" - 6"	+60 up to +500 +24 up to +200	-3.5 up to -50 -1.4 up to -20	X	○	X		○	282 - 284
Blanketing Valve										
	ZM-R	15 - 100 ½" - 4"	up to +500 up to +200	up to -200 up to -80	X	○	○			286 - 291

Pressure or Vacuum Relief Valve, In-Line

PROTEGO® DZ/E



● = Tank connection for pressure relief function

◒ = Tank connection for vacuum relief function

Flow direction marked at the housing by →

Pressure or vacuum settings:

DN 25 and 32	±3.5 mbar	up to	±60 mbar
DN 1" and 1¼"	±1.4 inch W.C.	up to	±24 inch W.C.
DN 40 up to 300	±2.0 mbar	up to	±60 mbar
DN 1½" up to 12"	± 0.8 inch W.C.	up to	±24 inch W.C.

For higher set pressure or vacuum refer to type DZ/E-F

Function and Description

The PROTEGO® in-line valve DZ/E is a state-of-the-art pressure or vacuum relief valve in right angle design. Typically the valve is installed in the in- or outbreathing lines of tanks, vessels and process apparatus to protect against unallowable high or low pressure. The valve prevents emission losses almost up to the set pressure or provides protection from product entry into the system.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This "full lift type" technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The opening characteristic is the same for pressure and vacuum relief. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent the valve pallets from sticking when sticky products are used and to enable the use of corrosive fluids. After the excess pressure is discharged or the vacuum is compensated, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- "full lift type" technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- can be used as pressure or vacuum relief valve
- compact right angle design saves space
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- maintenance friendly design

Designs and Specifications

The valve pallet is weight loaded. Higher set pressures for pressure and vacuum are achieved by using spring loaded type DZ/E-F.

Two different right angle designs are available:

In-line pressure or vacuum relief valve, standard design	**DZ/E -** **–**
In-line pressure or vacuum relief valve with heating jacket	**DZ/E -** **H**

Additional special devices available upon request

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions — Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity chart on the following page

DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	110 / 4.33	110 / 4.33	125 / 4.92	125 / 4.92	170 / 6.69	190 / 7.48	230 / 9.06	275 / 10.83	325 / 12.80	350 / 13.78
b	75 / 2.95	75 / 2.95	90 / 3.54	90 / 3.54	115 / 4.53	120 / 4.72	160 / 6.30	225 / 8.86	275 / 10.83	300 / 11.81
c	180 / 7.09	180 / 7.09	230 / 9.06	230 / 9.06	245 / 9.65	260 / 10.24	335 / 13.19	505 / 19.88	575 / 22.64	630 / 24.80
d	150 / 5.91	150 / 5.91	170 / 6.69	170 / 6.69	235 / 9.25	280 / 11.02	335 / 13.19	420 / 16.54	505 / 19.88	565 / 22.24

Dimensions for pressure or vacuum relief valve with heating jacket upon request

Table 2: Material selection for housing

Design	A	B	C
Housing Heating jacket (DZ/E-H-...)	Steel Steel	Stainless Steel Stainless Steel	Hastelloy Stainless Steel
Valve seat	Stainless Steel	Stainless Steel	Hastelloy
Gasket	PTFE	PTFE	PTFE
Valve pallet **DN 40 - 300 / 1 ½" - 12"**	A, C, E, F	A, C, E, F	B, D, G
Valve pallet **DN 25 - 32 / 1" - 1 ¼"**	H, I, J	H, I, J	–

Option: Housing with ECTFE-lining

Special materials upon request

Table 3: Material selection for valve pallet

DN 40 - 300 / 1 ½" - 12"

Design	A	B	C	D	E	F	G
Pressure range (mbar) (inch W.C.)	±2.0 up to ±3.5 ±0.8 up to ±1.4	±2.0 up to ±3.5 ±0.8 up to ±1.4	±3.5 up to ±14 ±1.4 up to ±5.6	±3.5 up to ±14 ±1.4 up to ±5.6	±14 up to ±60 ±5.6 up to ±24	±14 up to ±60 ±5.6 up to ±24	±14 up to ±60 ±5.6 up to ±24
Valve pallet	Aluminium	Titanium	Stainless Steel	Titanium	Stainless Steel	Stainless Steel	Hastelloy
Sealing	FEP	FEP	FEP	FEP	Metal to Metal	PTFE	Metal to Metal

DN 25 - 32 / 1" - 1 ¼"

Design	H	I	J
Pressure range (mbar) (inch W.C.)	±3,5 up to ±15 ±1.4 up to ±6.0	±15 up to ±60 ±6.0 up to ±24	±15 up to ±60 ±6.0 up to ±24
Valve pallet	PTFE	Stainless Steel	Stainless Steel
Sealing	PTFE	Metal to Metal	PTFE

Special materials upon request

For higher set pressure or vacuum refer to type DZ/E-F

Table 4: Flange connection type

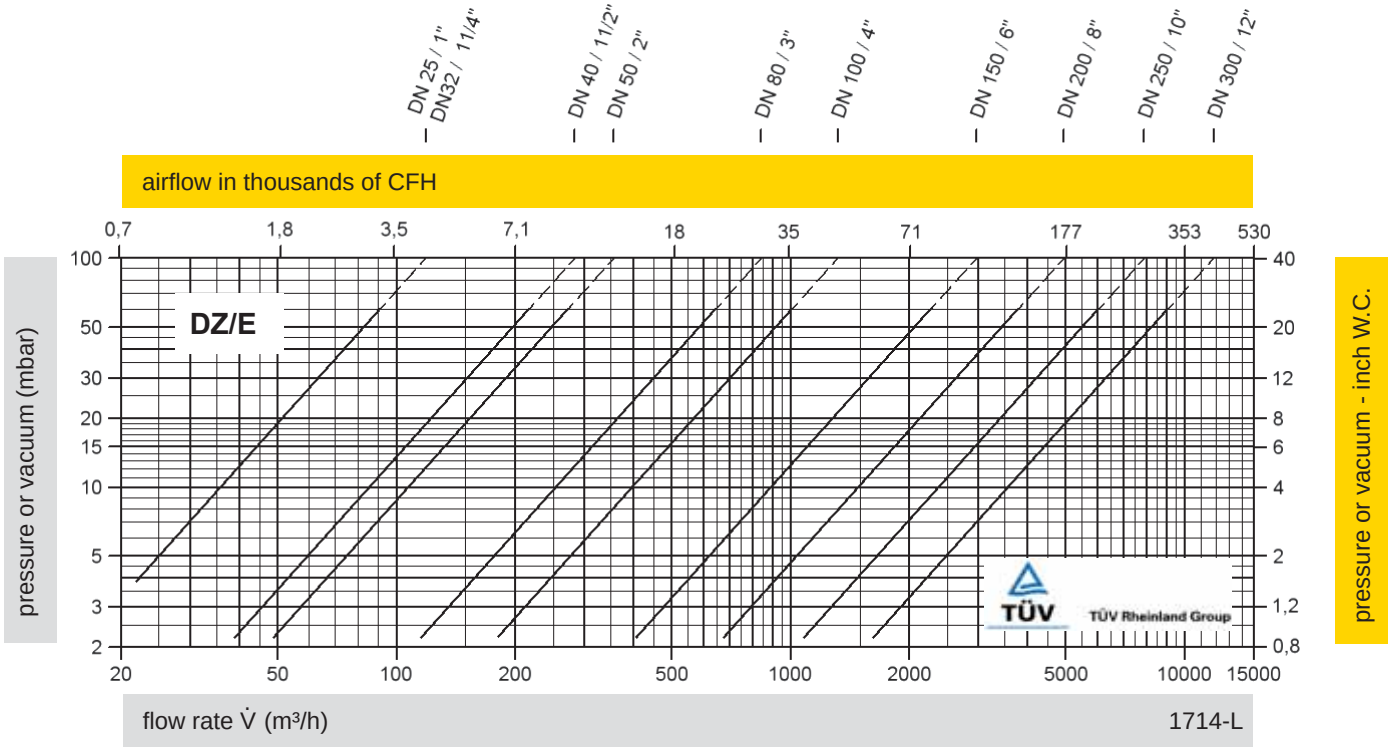
EN 1092-1, Form B1 or DIN 2501, Form C, PN 16; from DN 200 PN 10	EN or DIN
ANSI 150 lbs RFSF	ANSI

other types upon request

Pressure or Vacuum Relief Valve, In-Line

Flow Capacity Chart

PROTEGO® DZ/E



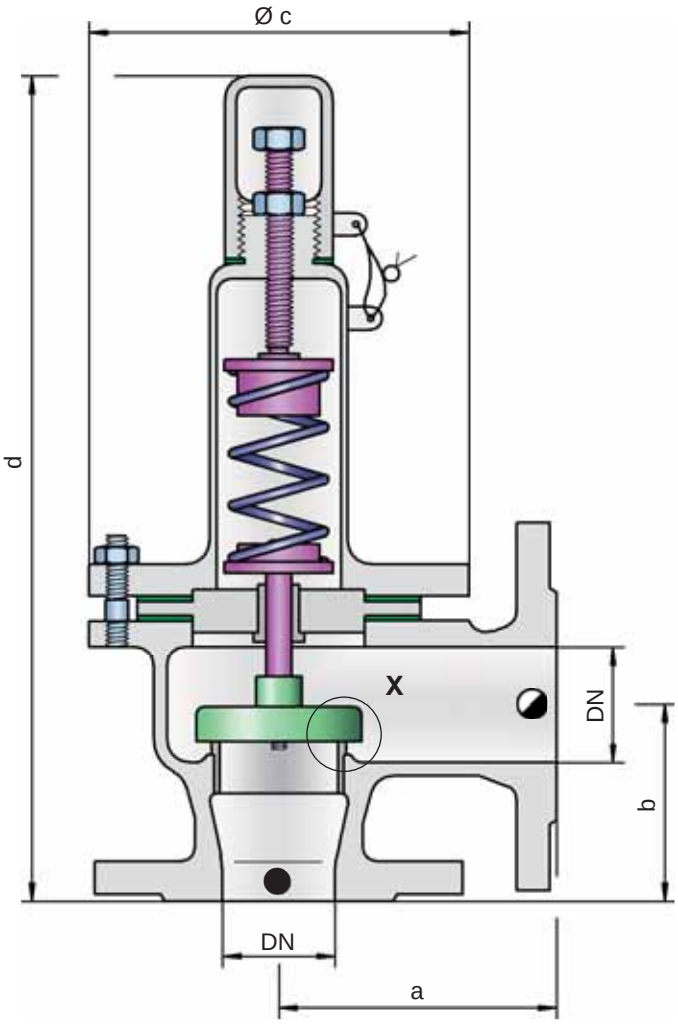
The flow capacity chart has been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Technical Fundamentals.

Notes:

Pressure or Vacuum Relief Valve, In-Line

PROTEGO® DZ/E-F



● = Tank connection for pressure relief function

◒ = Tank connection for vacuum relief function

Detail **X**

Flow direction marked at the housing by →

Pressure or vacuum settings:

±60 mbar	up to	±500 mbar (DN 25/1" up to 200/8")
±24 inch W.C.	up to	±200 inch W.C.
±60 mbar	up to	±400 mbar (DN 250/10")
±24 inch W.C.	up to	±160 inch W.C.
±60 mbar	up to	±300 mbar (DN 300/12")
±24 inch W.C.	up to	±120 inch W.C.

Devices with higher set pressure or vacuum are available upon request, for lower set pressures or vacuum refer to type DZ/E.

Function and Description

The PROTEGO® in-line valve DZ/E-F is a state-of-the-art pressure or vacuum relief valve in right angle design for higher system pressures. Typically the valve is installed in the in- or outbreathing lines of tanks, vessels and process apparatus to protect against unallowable high or low pressure. The valve prevents emission losses almost up to the set pressure or provides protection from product entry into the system. As this device is equipped with a spring higher set pressures can be reached compared to the DZ/E.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The opening characteristic is the same for pressure and vacuum relief. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1) and a rugged valve body. After the excess pressure is discharged or vacuum is compensated, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- can be used as pressure or vacuum relief valve
- compact right angle design saves space
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- spring loaded for elevated set pressures
- maintenance friendly design

Designs and Specifications

The valve pallet is spring loaded. Lower set pressures for pressure and vacuum are achieved by using the weight loaded type DZ/E.

Two different right angle designs are available:

In-line pressure or vacuum relief valve, standard design **DZ/E-F - –**

In-line pressure or vacuum relief valve with heating jacket **DZ/E-F - H**

Additional special devices available upon request.

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity charts on the following pages

DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	110 / 4.33	110 / 4.33	125 / 4.92	125 / 4.92	170 / 6.69	190 / 7.48	230 / 9.06	275 / 10.83	325 / 12.80	350* / 13.78
b	75 / 2.95	75 / 2.95	90 / 3.54	90 / 3.54	115 / 4.53	120 / 4.72	160 / 6.30	225 / 8.86	275 / 10.83	300 / 11.81
c	150 / 5.91	150 / 5.91	170 / 6.69	170 / 6.69	235 / 9.25	280 / 11.02	335 / 13.19	420 / 16.54	505 / 19.88	565 / 22.24
d	435 / 17.13	435 / 17.13	445 / 17.52	445 / 17.52	605 / 23.82	700 / 27.56	970 / 38.19	1205 / 47.44	1275 / 52.36	1330 / 52.36

Dimensions for pressure or vacuum relief valve with heating jacket upon request

* for ANSI 12" = 400 mm / 15.75 inches

Table 2: Material selection for housing

Design	A	B
Housing Heating jacket (DZ/E-F-H-...)	Steel Steel	Stainless Steel Stainless Steel
Valve seat	Stainless Steel	Stainless Steel
Gasket	PTFE	PTFE
Valve pallet	A	A

Option: Housing with ECTFE-lining

Special materials upon request

Table 3: Material of valve pallet

Design	A
Pressure range (mbar) (inch W.C.)	±60 up to ±500 ±24 up to ±200
Valve pallet	Stainless Steel
Sealing	Metal to Metal
Spring	Stainless Steel

Special materials upon request

Devices with higher set pressure or vacuum are available upon request, for lower set pressures or vacuum refer to type DZ/E.

Table 4: Flange connection type

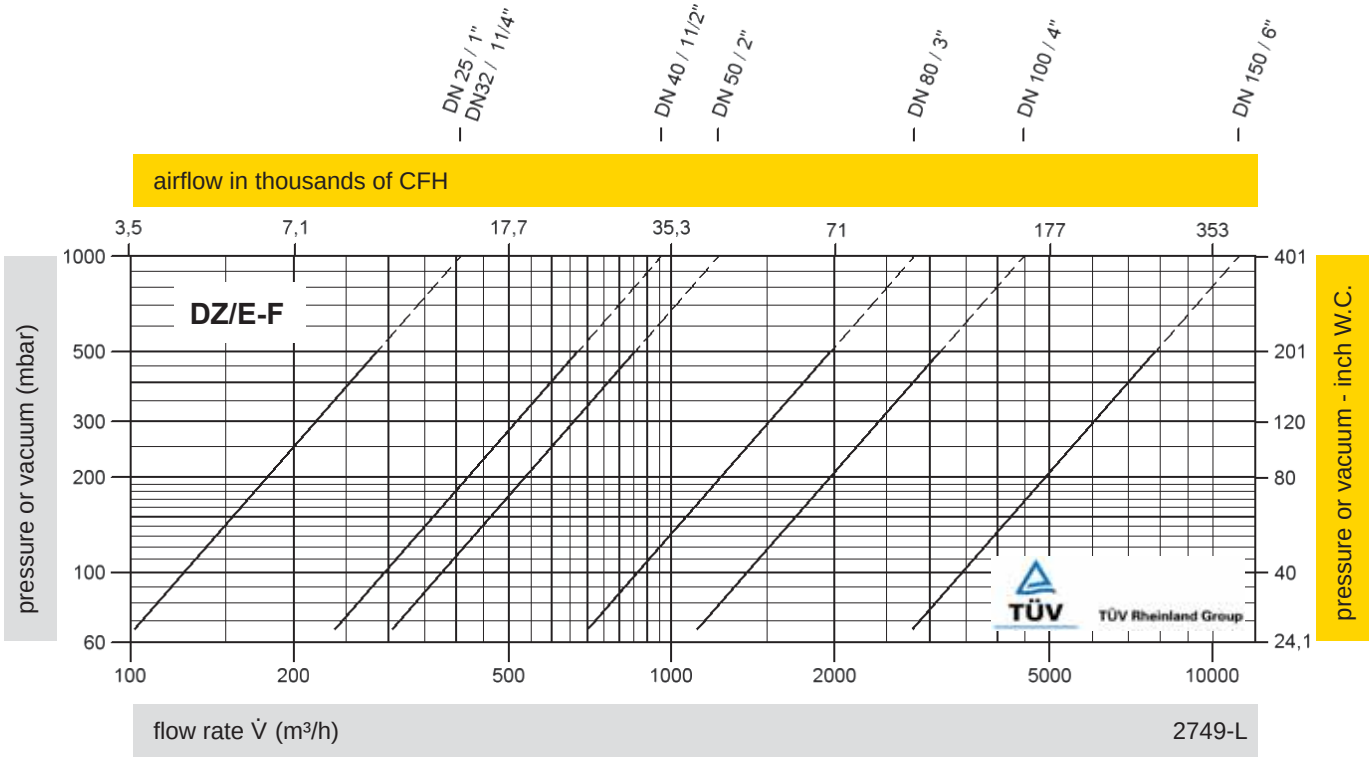
EN 1092-1, Form B1 or DIN 2501, Form C, PN 16; from DN 200 PN 10	EN or DIN
ANSI 150 lbs RFSF	ANSI

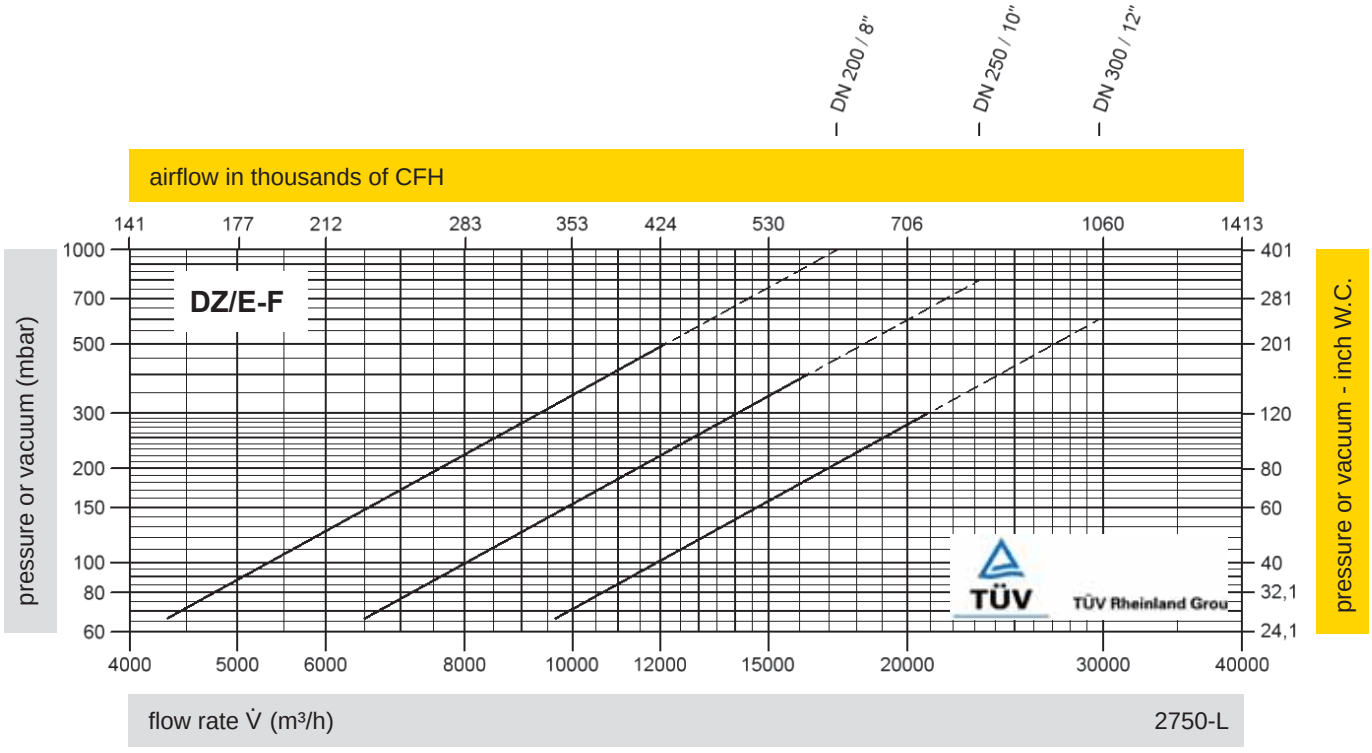
other types upon request

Pressure or Vacuum Relief Valve, In-Line

Flow Capacity Chart

PROTEGO® DZ/E-F





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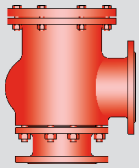
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

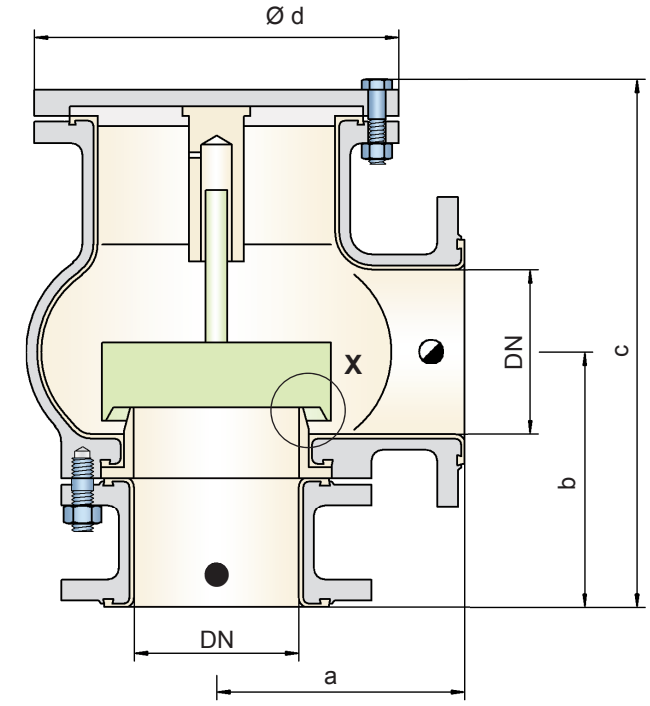
Notes:



Pressure or Vacuum Relief Valve, In-Line

With ETFE Lining

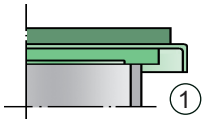
PROTEGO® DZ/EA



● = Tank connection for pressure relief function

◑ = Tank connection for vacuum relief function

Detail **X**



Flow direction marked at the housing by →

Pressure or vacuum settings:

±5.0 mbar up to ±50 mbar
±2.0 inch W.C. up to ±20 inch W.C.

For higher set pressure or vacuum refer to type DZ/EA-F

Function and Description

The lined PROTEGO® in-line valve DZ/EA is a state-of-the-art pressure or vacuum relief valve in right angle design. The lining makes this model a perfect solution for corrosive, polymerizing or sticky media. All internal parts are manufactured from PTFE or other highly corrosion resistant materials. Typically the valve is installed in the in- or out-breathing lines of tanks, vessels and process apparatus to protect against unallowable high or low pressure. The valve prevents emission losses almost up to the set pressure or provides protection from product entry into the system.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The opening characteristic is the same for pressure and vacuum relief. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by specially finished PTFE valve seats or by use of hastelloy valve seats and with individually lapped valve pallets (1). After the excess pressure is discharged or the vacuum is compensated, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- internal lining and correct material selection makes this type the perfect solution for corrosive, polymerizing and sticky media
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- can be used as pressure or vacuum relief valve
- compact right angle design saves space
- housing designed to 150 psi (PN 10)
- maintenance friendly design

Design and Specification

The valve pallet is weight loaded. Higher set pressures for pressure and vacuum are achieved by using spring loaded type DZ/EA-F.

In-line pressure or vacuum relief valve, standard design	**DZ/EA**

Additional special devices available upon request

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity chart on the following page

DN	50 / 2"	80 / 3"	100 / 4"	150 / 6"
a	168 / 6.61	180 / 7.09	200 / 7.87	228 / 8.98
b	167 / 6.57	177 / 6.97	200 / 7.87	232 / 9.13
c	330 / 12.99	390 / 15.35	445 / 17.52	485 / 19.09
d	200 / 7.87	240 / 9.45	280 / 11.02	335 / 13.19

Table 2: Material selection for housing

Design	C	D	Semi-conductive material and special material (e.g. PFA) upon request Special materials upon request
Housing	Steel	Steel	
Lining	ETFE	ETFE	
Cover	Steel	Steel	
Valve seat	PTFE	Hastelloy	
Valve pallet	A	A, B	

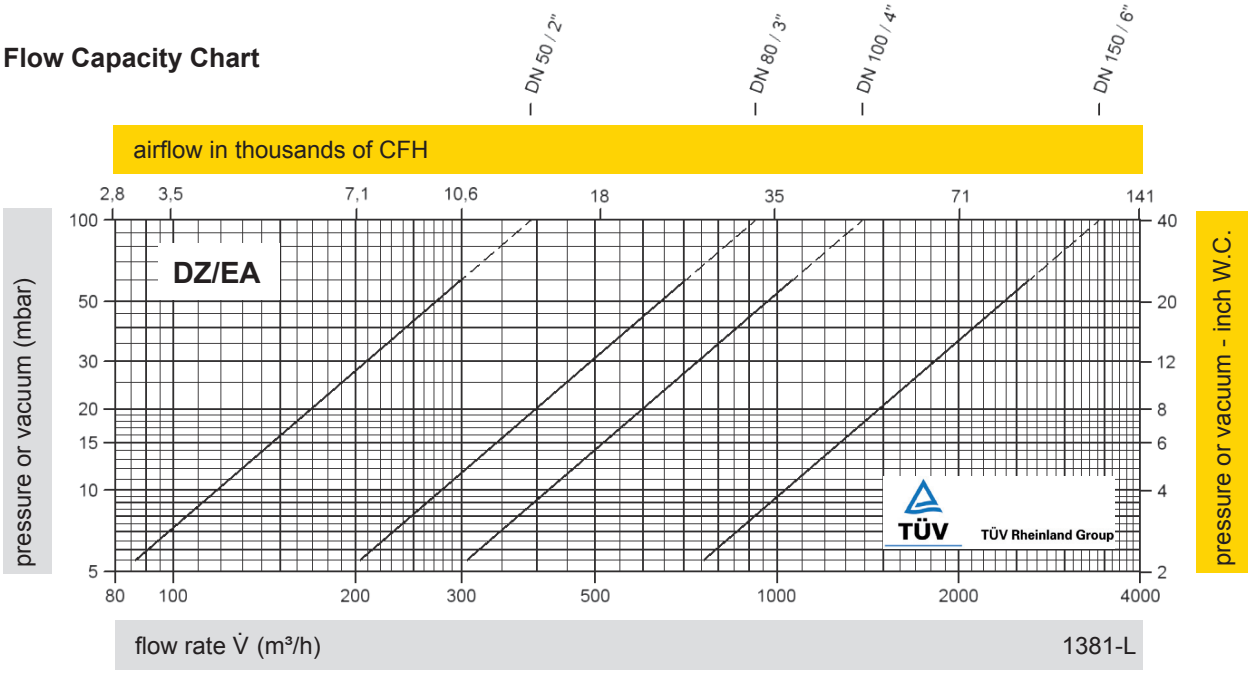
Table 3: Material selection for valve pallet

Design	A	B	Special materials upon request For higher set pressure or vacuum refer to type DZ/EA-F
Pressure range (mbar) (inch W.C.)	±5 up to ±50 ±2 up to ±20	±5 up to ±50 ±2 up to ±20	
Valve pallet	PTFE	Hastelloy	
Sealing	PTFE	Metal to Metal	

Table 4: Flange connection type

EN 1092-1, Form B1 or DIN 2501, Form C, PN 16	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	

Flow Capacity Chart



The flow capacity chart has been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

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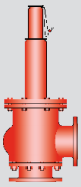
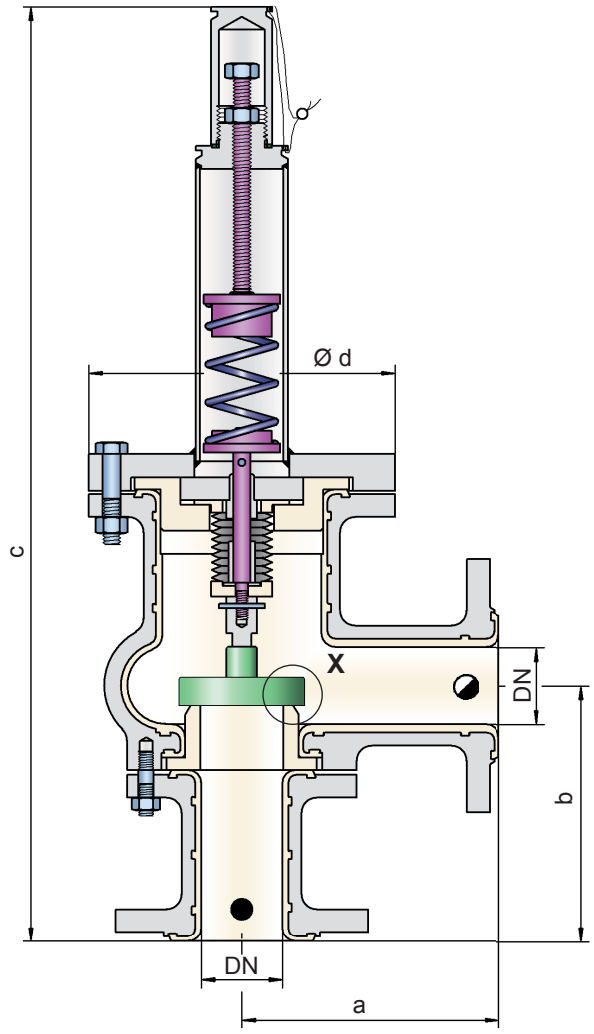


Pressure or Vacuum Relief Valve, In-Line

With ETFE Lining

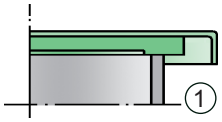
PROTEGO® DZ/EA-F



● = Tank connection for pressure relief function

◒ = Tank connection for vacuum relief function

Detail **X**



Flow direction marked at the housing by →

Pressure or vacuum settings:

±60 mbar	up to	±500 mbar
±24 inch W.C.	up to	±200 inch W.C.

For lower set pressure or vacuum refer to type DZ/EA

Function and Description

The lined PROTEGO® in-line valve DZ/EA-F is a state-of-the-art pressure or vacuum relief valve in right angle design for higher set pressures. The lining makes this model a perfect solution for corrosive, polymerizing or sticky media. All internal parts are manufactured from PTFE or other highly corrosion resistant materials. Typically the valve is installed in the in- or out-breathing lines of tanks, vessels and process apparatus to protect against unallowable high or low pressure. The valve prevents emission losses almost up to the set pressure or provides protection from product entry into the system. This spring loaded model allows higher set pressures than the DZ/EA.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by use of hastelloy valve seats and with individually lapped valve pallets (1). After the excess pressure is discharged or the vacuum is compensated, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- internal lining and correct material selection makes this type the perfect solution for corrosive, polymerizing and sticky media
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- can be used as pressure or vacuum relief valve
- compact right angle design saves space
- housing designed to 150 psi (PN 10)
- spring loaded design for higher set pressures
- maintenance friendly design

Designs and Specifications

The vent pallet is spring loaded. Lower set pressures for pressure and vacuum are achieved by using the type DZ/EA.

In-line pressure or vacuum relief valve, standard design **DZ/EA-F**

Additional special devices available upon request.

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity chart on the following page

DN	50 / 2"	80 / 3"	100 / 4"	150 / 6"
a	168 / 6.61	180 / 7.09	200 / 7.87	228 / 8.98
b	167 / 6.57	177 / 6.97	200 / 7.87	232 / 9.13
c	615 / 24.21	785 / 30.91	915 / 36.02	1160 / 45.67
d	200 / 7.87	240 / 9.45	280 / 11.02	335 / 13.19

Table 2: Material for housing

Design	B
Housing	Steel
Lining	ETFE
Cover	Steel
Valve seat	Hastelloy
Guiding disc	PTFE
Valve pallet	A

Semi-conductive material and special material (e.g. PFA) upon request

Table 3: Material for valve pallet

Design	A
Pressure range (mbar) (inch W.C.)	±60 up to ±500 ±24 up to ±200
Valve pallet	Hastelloy
Spindle / Guiding	Hastelloy
Sealing	Metal to Metal

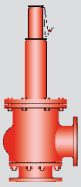
Special materials upon request

Devices with higher set pressure or vacuum are available upon request, for lower set pressures or vacuum refer to type DZ/EA

Table 4: Flange connection type

EN 1092-1, Form B1 or DIN 2501, Form C, PN 16	EN or DIN
ANSI 150 lbs RFSF	ANSI

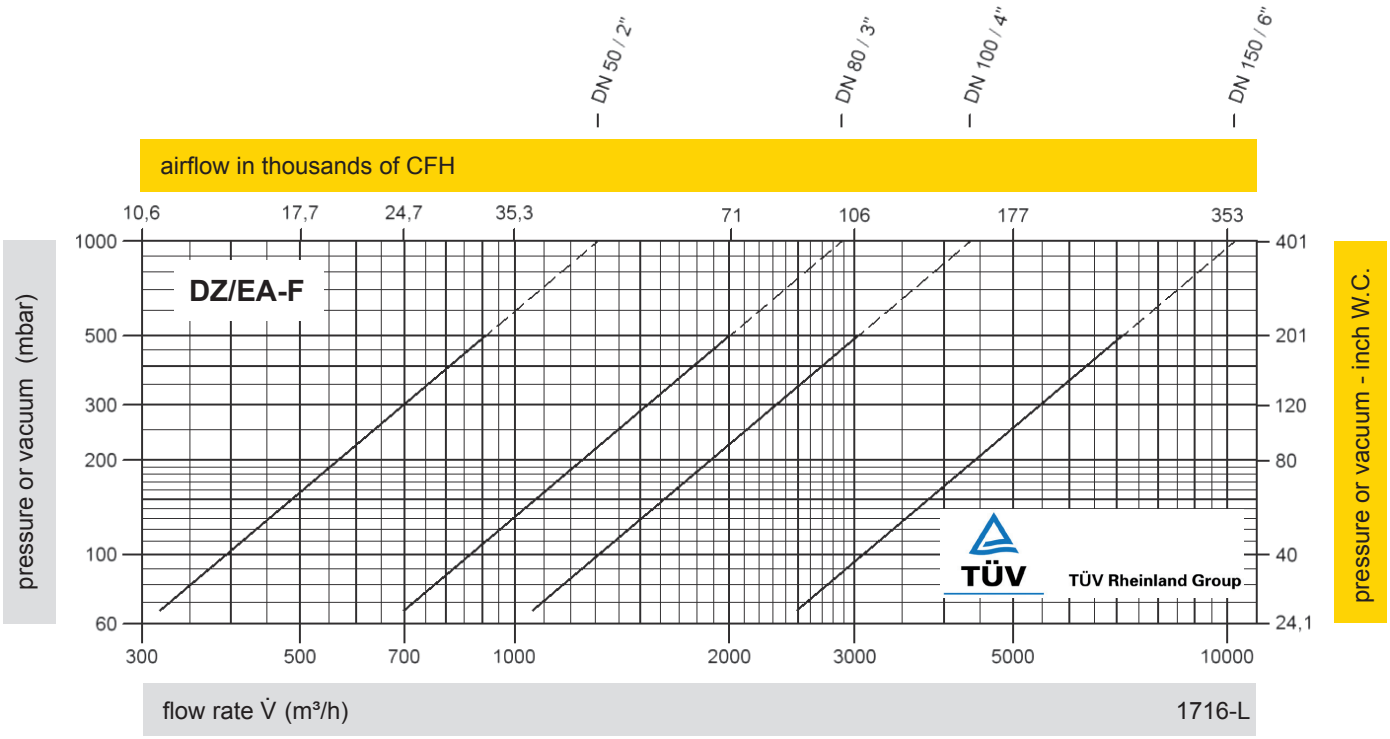
other types upon request



Pressure or Vacuum Relief Valve with ETFE Lining, In-Line

Flow Capacity Chart

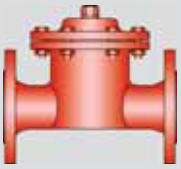
PROTEGO® DZ/EA-F



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

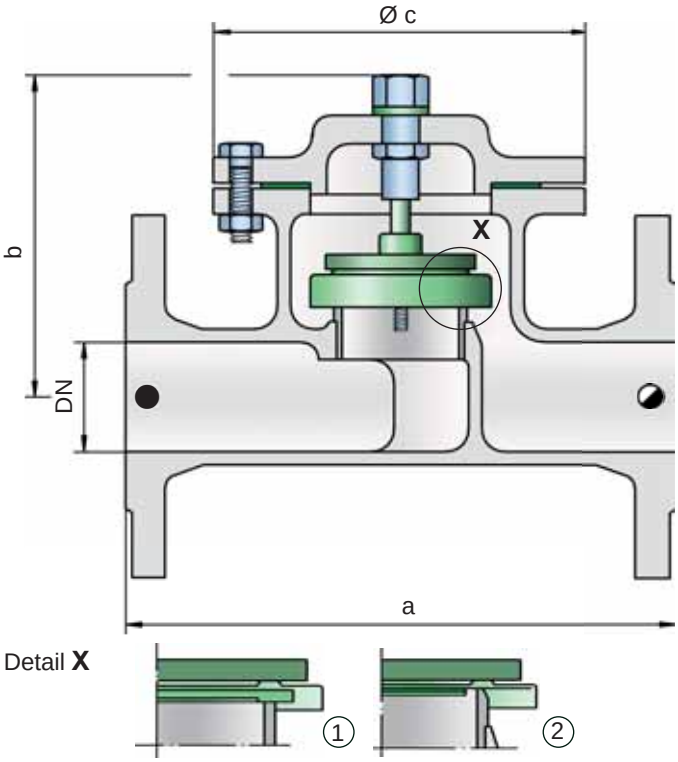
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

Notes:



Pressure or Vacuum Relief Valve, In-Line

PROTEGO® DZ/T



● = Tank connection for pressure relief function

◒ = Tank connection for vacuum relief function

Flow direction marked at the housing by →

Pressure or vacuum settings:

DN 25 and 32	±3.5 mbar	up to	±60 mbar
DN 1" and 1 ¼"	±1.4 inch W.C.	up to	±24 inch W.C.
DN 40 up to 300	±2.0 mbar	up to	±60 mbar
DN 1 ½"up to 12"	±0.8 inch W.C.	up to	±24 inch W.C.

For higher set pressure or vacuum refer to type DZ/T-F

Function and Description

The PROTEGO® in-line valve DZ/T is a state-of-the-art pressure or vacuum relief valve. Typically the valve is installed in the in- or out-breathing lines of tanks, vessels and process apparatus to protect against unallowable high or low pressure. The valve prevents emission losses almost up to the set pressure or provides protection from product entry into the system.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent the valve pallets from sticking when sticky products are used and to enable the use of corrosive fluids. After the excess pressure is discharged or the vacuum is compensated, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- can be used as pressure or vacuum relief valve
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- maintenance friendly design

Designs and Specifications

The valve pallet is weight loaded. Higher set pressures for pressure and vacuum are achieved by using spring loaded type DZ/T-F.

Two different designs are available:

In-line pressure or vacuum relief valve, standard design	**DZ/T -** **–**
In-line pressure or vacuum relief valve with heating jacket	**DZ/T -** **H**

Additional special devices available upon request

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions — Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity chart on the following page

DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	220 / 8.66	220 / 8.66	250 / 9.84	250 / 9.84	340 / 13.39	380 / 14.96	460 / 18.11	550 / 21.65	650 / 25.59	700 / 27.56
b	140 / 5.51	140 / 5.51	190 / 7.48	190 / 7.48	210 / 8.27	240 / 9.45	305 / 12.01	460 / 18.11	515 / 20.28	555 / 21.85
c	150 / 5.91	150 / 5.91	170 / 6.69	170 / 6.69	235 / 9.25	280 / 11.02	335 / 13.19	420 / 16.54	505 / 19.88	565 / 22.24

Dimensions for pressure or vacuum relief valve with heating jacket upon request

Table 2: Material selection for housing

Design	A	B	C
Housing Heating jacket (DZ/T-H-...)	Steel Steel	Stainless Steel Stainless Steel	Hastelloy Stainless Steel
Valve seat	Stainless Steel	Stainless Steel	Hastelloy
Gasket	PTFE	PTFE	PTFE
Valve pallet DN 40 - 300 / 1 ½" - 12"	A, C, E, F	A, C, E, F	B, D, G
Valve pallet DN 25 - 32 / 1" - 1 ¼"	H, I, J	H, I, J	–

Option: Housing with ECTFE-lining

Special materials upon request

Table 3: Material selection for valve pallet

DN 40 - 300 / 1 ½" - 12"

Design	A	B	C	D	E	F	G
Pressure range (mbar) (inch W.C.)	±2.0 up to ±3.5 ±0.8 up to ±1.4	±2.0 up to ±3.5 ±0.8 up to ±1.4	±3.5 up to ±14 ±1.4 up to ±5.6	±3.5 up to ±14 ±1.4 up to ±5.6	±14 up to ±60 ±5.6 up to ±24	±14 up to ±60 ±5.6 up to ±24	±14 up to ±60 ±5.6 up to ±24
Valve pallet	Aluminium	Titanium	Stainless Steel	Titanium	Stainless Steel	Stainless Steel	Hastelloy
Sealing	FEP	FEP	FEP	FEP	Metal to Metal	PTFE	Metal to Metal

DN 25 - 32 / 1" - 1 ¼"

Design	H	I	J
Pressure range (mbar) (inch W.C.)	±3,5 up to ±15 ±1.4 up to ±6.0	±15 up to ±60 ±6.0 up to ±24	±15 up to ±60 ±6.0 up to ±24
Valve pallet	PTFE	Stainless Steel	Stainless Steel
Sealing	PTFE	Metal to Metal	PTFE

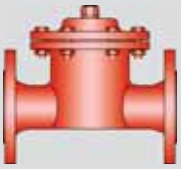
Special materials upon request

For higher set pressure or vacuum refer to type DZ/T-F

Table 4: Flange connection type

EN 1092-1, Form B1 or DIN 2501, Form C, PN 16; from DN 200 PN 10	EN or DIN
ANSI 150 lbs RFSF	ANSI

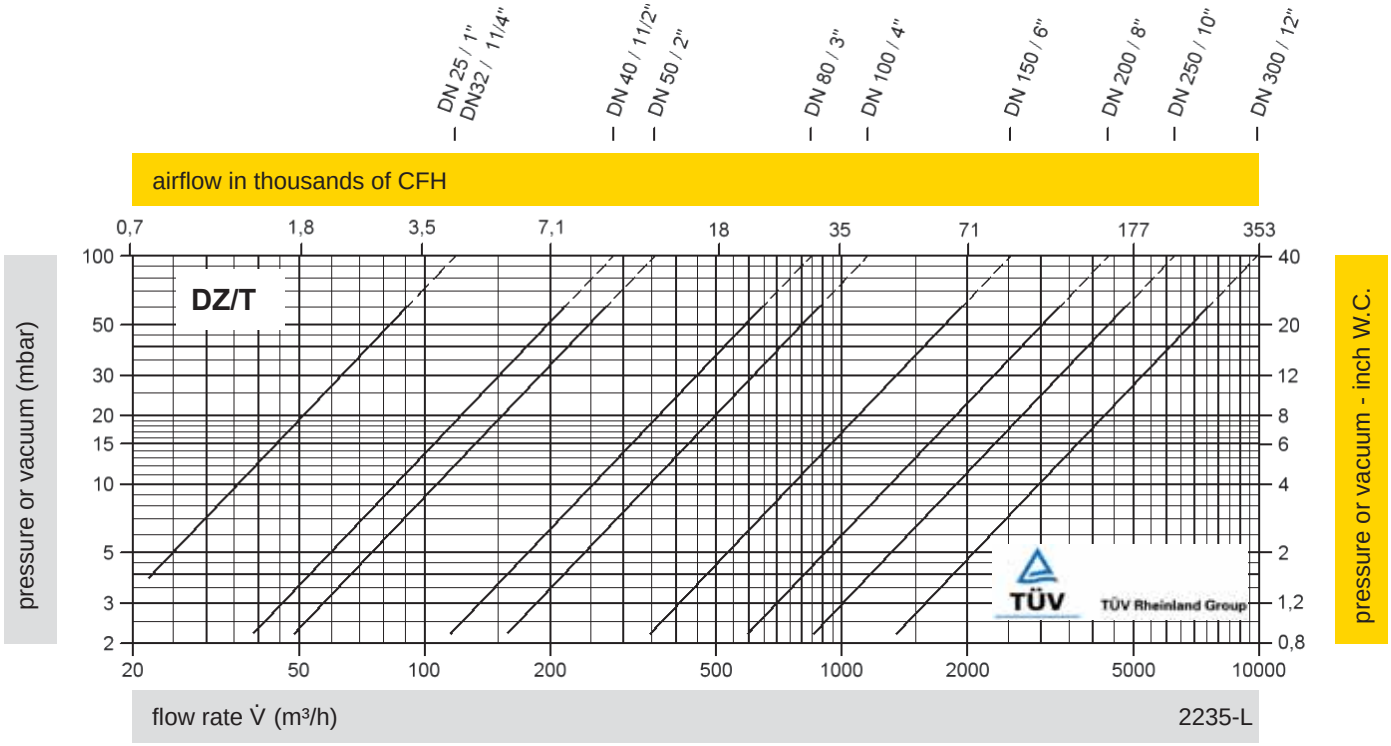
other types upon request



Pressure or Vacuum Relief Valve, In-Line

Flow Capacity Chart

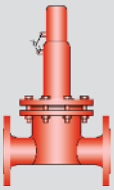
PROTEGO® DZ/T



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

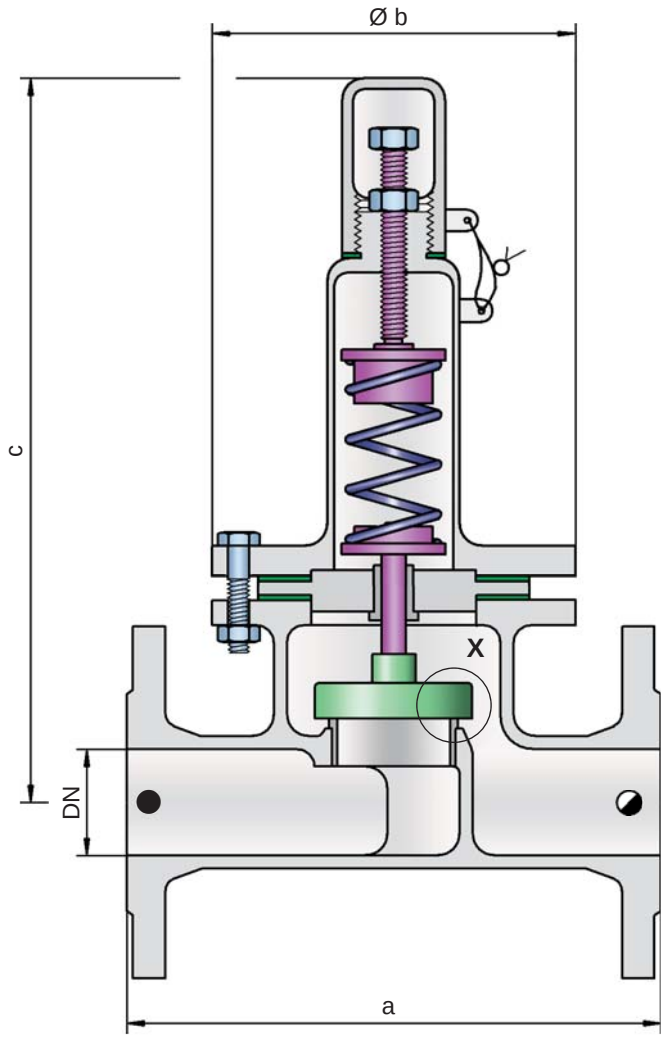
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

Notes:



Pressure or Vacuum Relief Valve, In-Line

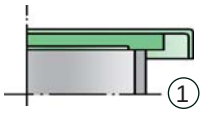
PROTEGO® DZ/T-F



● = Tank connection for pressure relief function

◒ = Tank connection for vacuum relief function

Detail **X**



Flow direction marked at the housing by →

Pressure or vacuum settings:

±60 mbar	up to	±500 mbar (DN 25/1" up to 200/8")
±24 inch W.C.	up to	±200 inch W.C.
±60 mbar	up to	±400 mbar (DN 250/10")
±24 inch W.C.	up to	±160 inch W.C.
±60 mbar	up to	±300 mbar (DN 300/12")
±24 inch W.C.	up to	±120 inch W.C.

Devices with higher set pressure or vacuum are available upon request, for lower set pressures or vacuum refer to type DZ/T.

Function and Description

The PROTEGO® in-line valve DZ/T-F is a state-of-the-art pressure or vacuum relief valve for higher system pressures. Typically the valve is installed in the in- or out-breathing lines of Tanks, Vessels and process apparatus to protect against unallowable high or low pressure. The valve prevents emission losses almost up to the set pressure or provides protection from product entry into the system. As this device is equipped with a spring higher set pressures can be reached compared to the DZ/T.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The opening characteristic is the same for pressure and vacuum relief. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1) and rugged valve bodies. After the excess pressure is discharged or the vacuum is compensated, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- can be used as pressure or vacuum relief valve
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- spring loaded for elevated set pressures
- maintenance friendly design

Designs and Specifications

The valve pallet is spring loaded. Lower set pressures for pressure and vacuum are achieved by using the weight loaded type DZ/T.

Two different designs are available:

In-line pressure or vacuum relief valve, standard design **DZ/T-F - [–]**

In-line pressure or vacuum relief valve with heating jacket **DZ/T-F - [H]**

Additional special devices available upon request

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity charts on the following pages

DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	125 / 5"	150 / 6"
a	220 / 8.66	220 / 8.66	250 / 9.84	250 / 9.84	340 / 13.39	380 / 14.96	460 / 18.11	460 / 18.11
b	150 / 5.91	150 / 5.91	170 / 6.69	170 / 6.69	235 / 9.25	280 / 11.02	335 / 13.19	335 / 13.19
c	395 / 15.55	395 / 15.55	420 / 16.54	420 / 16.54	570 / 22.44	680 / 26.77	940 / 37.01	940 / 37.01

DN	200 / 8”	250 / 10”	300 / 12”
a	550 / 21.65	650 / 25.59	700 / 27.56
b	420 / 16.54	505 / 19.88	565 / 22.24
c	1160 / 45.67	1215 / 47.83	1255 / 49.41

Dimensions for pressure or vacuum relief valve with heating jacket upon request

Table 2: Material selection for housing

Design	A	B	
Housing Heating jacket (DZ/T-F-H-...)	Steel Steel	Stainless Steel Stainless Steel	Option: Housing with ECTFE-lining
Valve seat	Stainless Steel	Stainless Steel	Special materials upon request
Gasket	PTFE	PTFE	
Valve pallet	A	A	

Table 3: Material of valve pallet

Design	A	
Pressure range (mbar) (inch W.C.)	±60 up to ±500 ±24 up to ±200	Special materials upon request
Valve pallet	Stainless Steel	Devices with higher set pressure or vacuum are available upon request, for lower set pressures or vacuum refer to type DZ/T.
Sealing	Metal to Metal	
Pressure spring	Stainless Steel	

Table 4: Flange connection type

EN 1092-1, Form B1 or DIN 2501, Form C, PN 16; from DN 200 PN 10	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	

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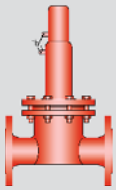
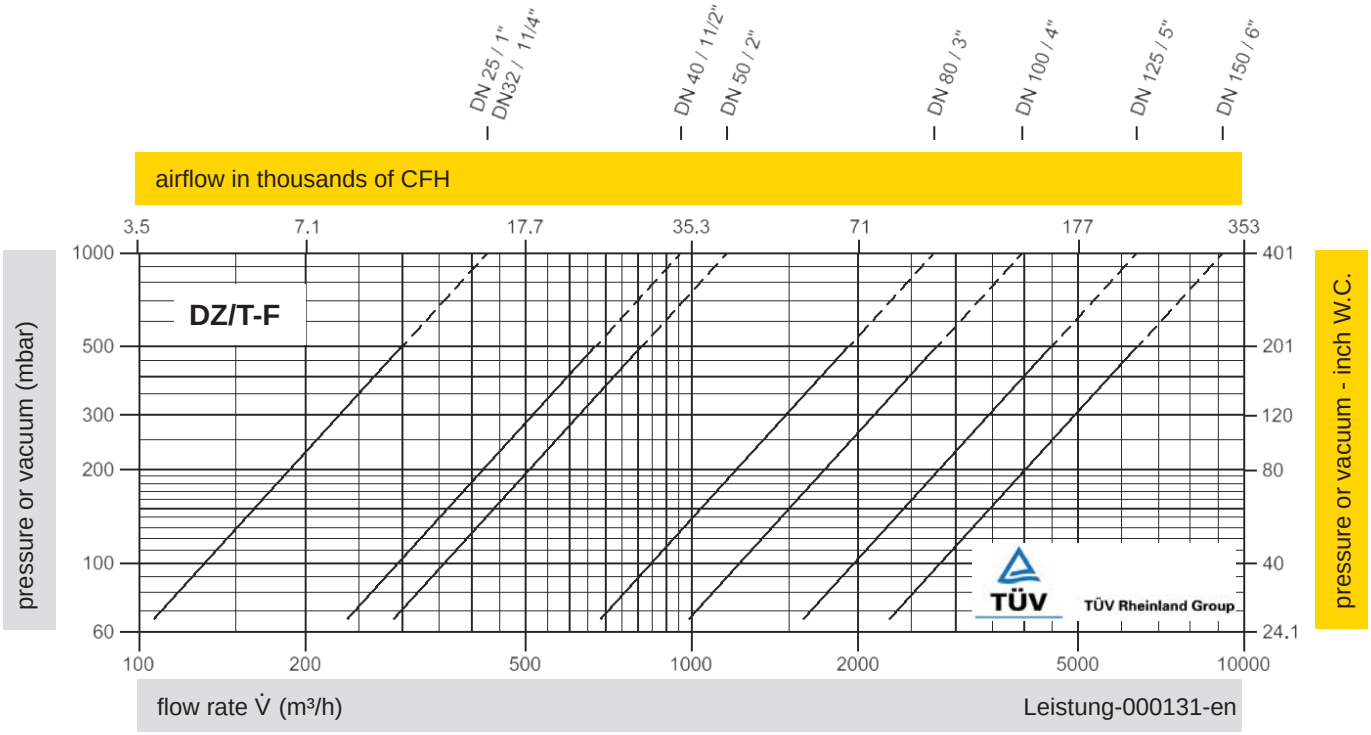
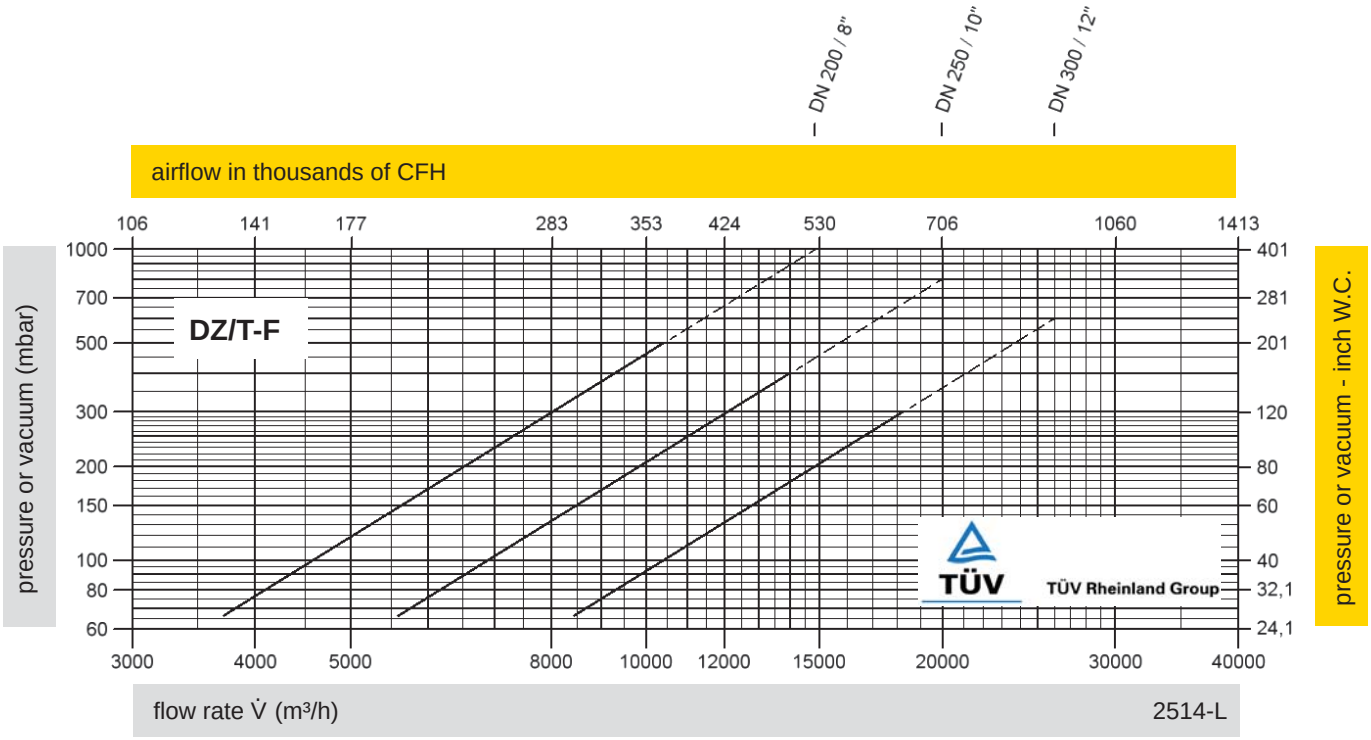


Pressure or Vacuum Relief Valve, In-Line

Flow Capacity Charts

PROTEGO® DZ/T-F





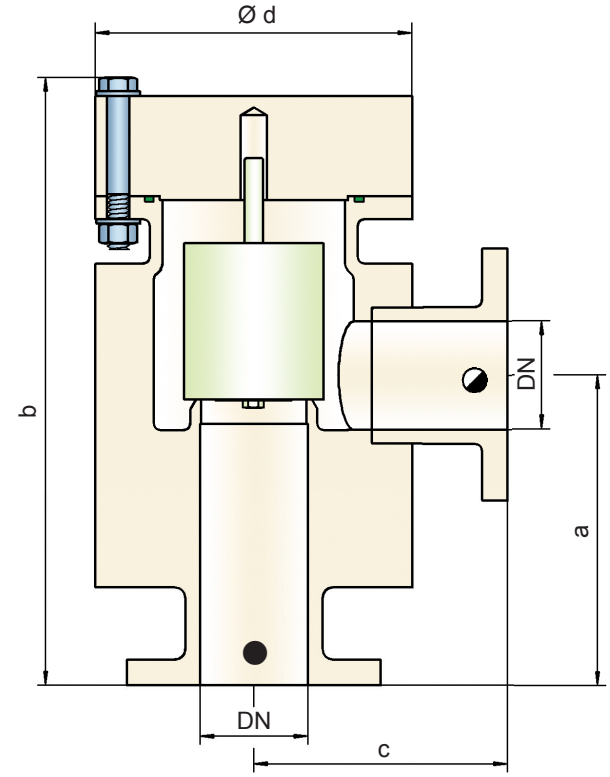
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

Notes:

Pressure or Vacuum Relief Valve, In-Line

PROTEGO® R/KSM



● = Tank connection for pressure relief function

◑ = Tank connection for vacuum relief function

Flow direction marked at the housing by →

Pressure or vacuum settings:

±6.0 mbar	up to	±100 mbar (DN 50/2”)
±2.4 inch W.C.	up to	±40 inch W.C.
±4.0 mbar	up to	±100 mbar (DN 80/3”)
±1.6 inch W.C.	up to	±40 inch W.C.
±4.5 mbar	up to	±100 mbar (DN 100/4” - DN 200/8”)
±1.8 inch W.C.	up to	±40 inch W.C.

Function and Description

The PROTEGO® in-line valve R/KSM is a state-of-the-art pressure or vacuum relief valve in right angle design made out of highgrade synthetic material. Typically the valve is installed in the in- or out-breathing lines of tanks, vessels and process apparatus to protect against unallowable high or low pressure. The valve prevents emission losses almost up to the set pressure or provides protection from product entry into the system. The valve is a perfect solution for corrosive, polymerizing or sticky media.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The opening characteristic for pressure and vacuum side is the same.

Due to our highly developed manufacturing technology, the tank pressure is maintained up to the set pressure, with a tightness that is far superior to the conventional standard. This feature is facilitated by special valve seats made of high quality synthetic material or PTFE. After the excess pressure is discharged or vacuum is compensated, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- extreme tightness and hence least possible product losses and reduced environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- can be used as pressure or vacuum relief valve
- compact right angle design saves space
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- corrosion resistant valve
- weight reduction in comparison to steel/stainless steel
- smooth surface
- different plastics can be combined
- maintenance friendly design

Design and Specification

The valve pallet is weight loaded. Highest set pressure range can be reached with metal valve pallets.

In-line pressure or vacuum relief valve, standard design **R/KSM -**

Additional special devices available upon request

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics.

Table 1: Dimensions — Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity chart on the following page

DN	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"
a	200 / 7.87	245 / 9.65	300 / 11.81	370 / 14.57	625 / 24.61 (650 / 25.59)*
b	376 / 14.80	521 / 20.51	563 / 22.17 (523 / 20.59)*	687 / 27.05 (651 / 25.63)*	914 / 35.98 (912 / 35.91)*
c	150 / 5.91	200 / 7.87	225 / 8.86	280 / 11.02	350 / 13.78
d	180 / 7.09	250 / 9.84	300 / 11.81	350 / 13.78 (405 / 15.94)*	560 / 22.05 (500 / 19.68)*

* Dimensions in brackets only for PVDF

Table 2: Material selection for housing

Design	A	B	C	
Housing	PE	PP	PVDF	Special materials upon request
Valve seat	PE	PP	PVDF	
Gasket	FPM	FPM	FPM	
Valve pallet	A, C, D	B, C, D	C, D	

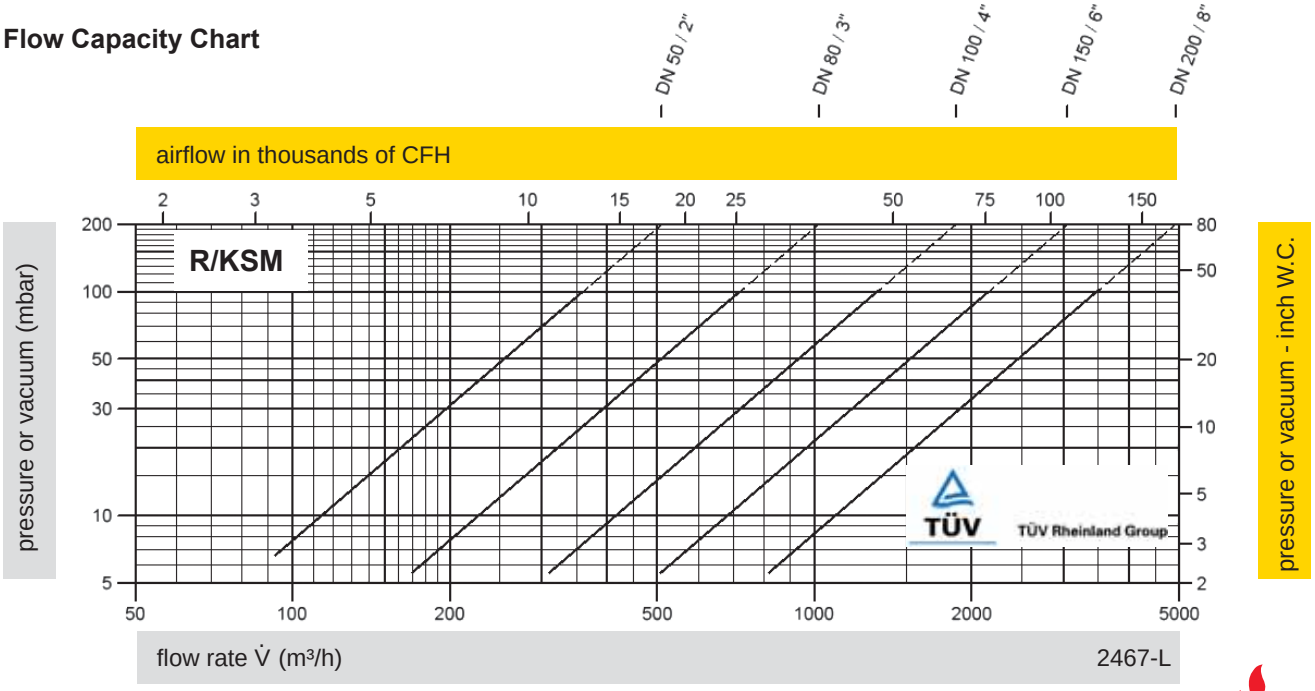
Table 3: Material selection for valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	±6.0 up to ±16 ±2.4 up to ±6.4	±5.5 up to ±16 ±2.2 up to ±6.4	±9.5 up to ±30 ±3.8 up to ±12	±30 up to ±100 ±12 up to ± 40	Special materials and devices with higher set pressure or vacuum are available upon request
Valve pallet	PE	PP	PVDF	Hastelloy	
Sealing	PTFE	PTFE	PTFE	PTFE	
Spindle guide	PE	PP	PVDF	Hastelloy	

Table 4: Flange connection type

EN 1092-1, Form A or DIN 2501, Form B, PN 16; from DN 200 PN 10	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	

Flow Capacity Chart



The flow capacity chart has been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar). Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

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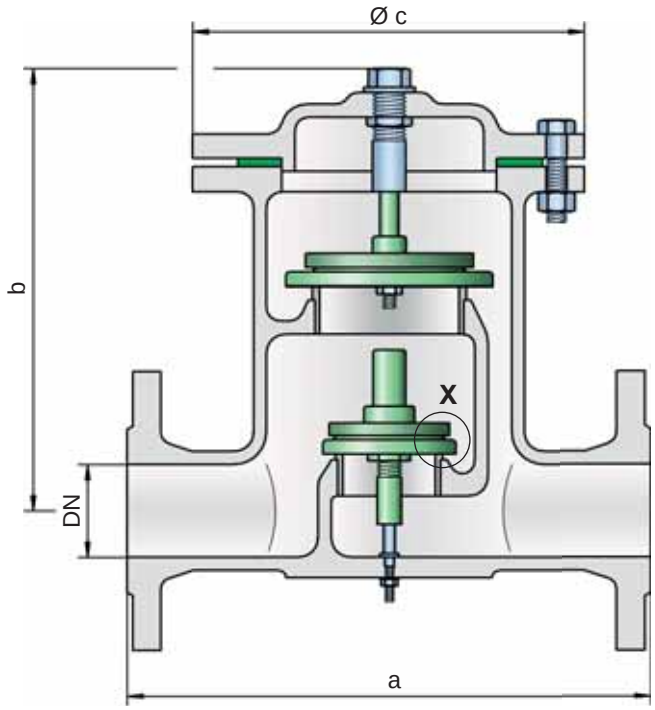
Pressure and Vacuum Relief Valve, In-Line

PROTEGO® DV/ZT



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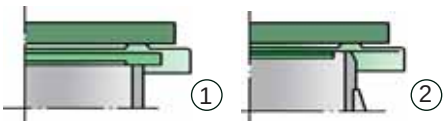

Tank connection depends upon flow capacity, set pressure and set vacuum for in- and outbreathing

Pressure or vacuum settings:

Upper valve pallet:	±2.0 mbar	up to ±60 mbar
	±0.8 inch W.C.	up to ±24 inch W.C.
Lower valve pallet:	±3.5 mbar	up to ±50 mbar
	±1.4 inch W.C.	up to ±20 inch W.C.

For higher set pressure refer to type DV/ZT-F. Lower set vacuum upon request.

Function and Description

The PROTEGO® in-line valve DV/ZT is a state-of-the-art pressure and vacuum relief valve. Typically the valve is installed in the in- and out-breathing lines of tanks, vessels and process apparatus to protect against unallowable high and low pressure. The valve prevents emission losses almost up to the set pressure and provides protection from product entry into the system. Due to its design the lower valve pallet is one size smaller than the upper valve pallet.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent the valve pallets from sticking when sticky products are used and to enable the use of corrosive fluids. After the excess pressure is discharged or vacuum is balanced, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- maintenance friendly design

Designs and Specifications

The valve pallets are weight loaded. Higher set pressures are achieved by using spring loaded type DV/ZT-F

Two different designs are available:

In-line pressure and vacuum relief valve, standard design	**DV/ZT - [–]**
In-line pressure and vacuum relief valve with heating jacket	**DV/ZT - [H]**

Additional special devices available upon request.

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity charts on the following page

DN	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"
a	280 / 11.02	280 / 11.02	340 / 13.39	390 / 15.35	520 / 20.47
b	270 / 10.63	270 / 10.63	290 / 11.42	355 / 13.98	425 / 16.73
c	210 / 8.27	210 / 8.27	280 / 11.02	310 / 12.20	390 / 15.35

Larger sizes upon request
Dimensions for pressure and vacuum relief valve with heating jacket upon request

Table 2: Material selection for housing

Design	A	B	
Housing Heating jacket (DV/ZT-H-...)	Steel Steel	Stainless Steel Stainless Steel	Option: Housing with ECTFE-lining Special materials upon request
Valve seat	Stainless Steel	Stainless Steel	
Gasket	PTFE	PTFE	

Table 3: Material selection for upper valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	±2.0 up to ±3.5 ±0.8 up to ±1.4	±3.5 up to ±14 ±1.4 up to ±5.6	±14 up to ±60 ±5.6 up to ±24	±14 up to ±60 ±5.6 up to ±24	Special materials upon request For higher set pressures refer to type DV/ZT-F
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 4: Material selection for lower valve pallet

Design	A	B	C	D	E	F
Pressure range (mbar) (inch W.C.)	±3.5 up to ±5.0 ±1.4 up to ±2.0	±5.0 up to ±14 ±2.0 up to ±5.6	±14 up to ±35 ±5.6 up to ±14	±35 up to ±50 ±14 up to ±20	±14 up to ±35 ±5.6 up to ±14	±35 up to ±50 ±14 up to ±20
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	PTFE	PTFE

Special materials and lower set vacuum upon request

Table 5: Flange connection type

EN 1092-1, Form B1 or DIN 2501, Form C, PN 16	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	

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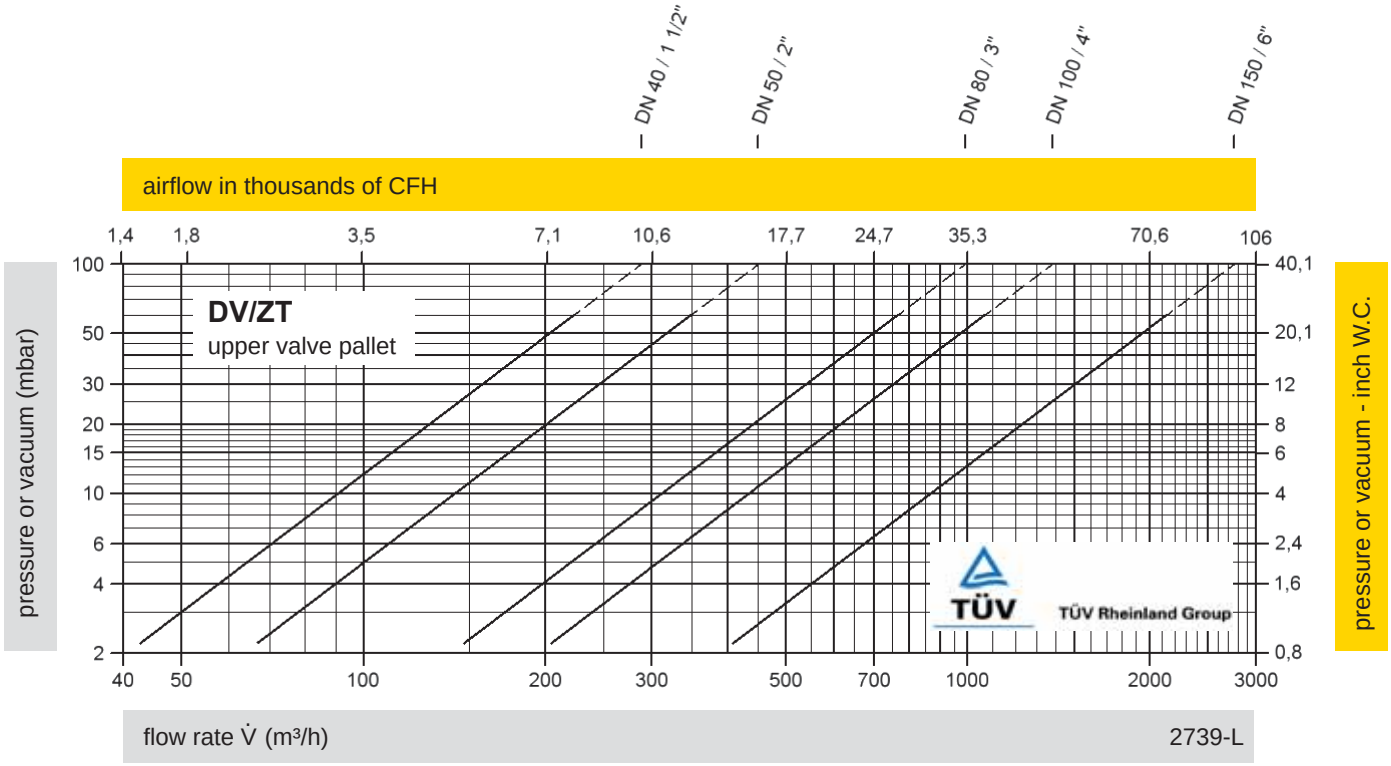
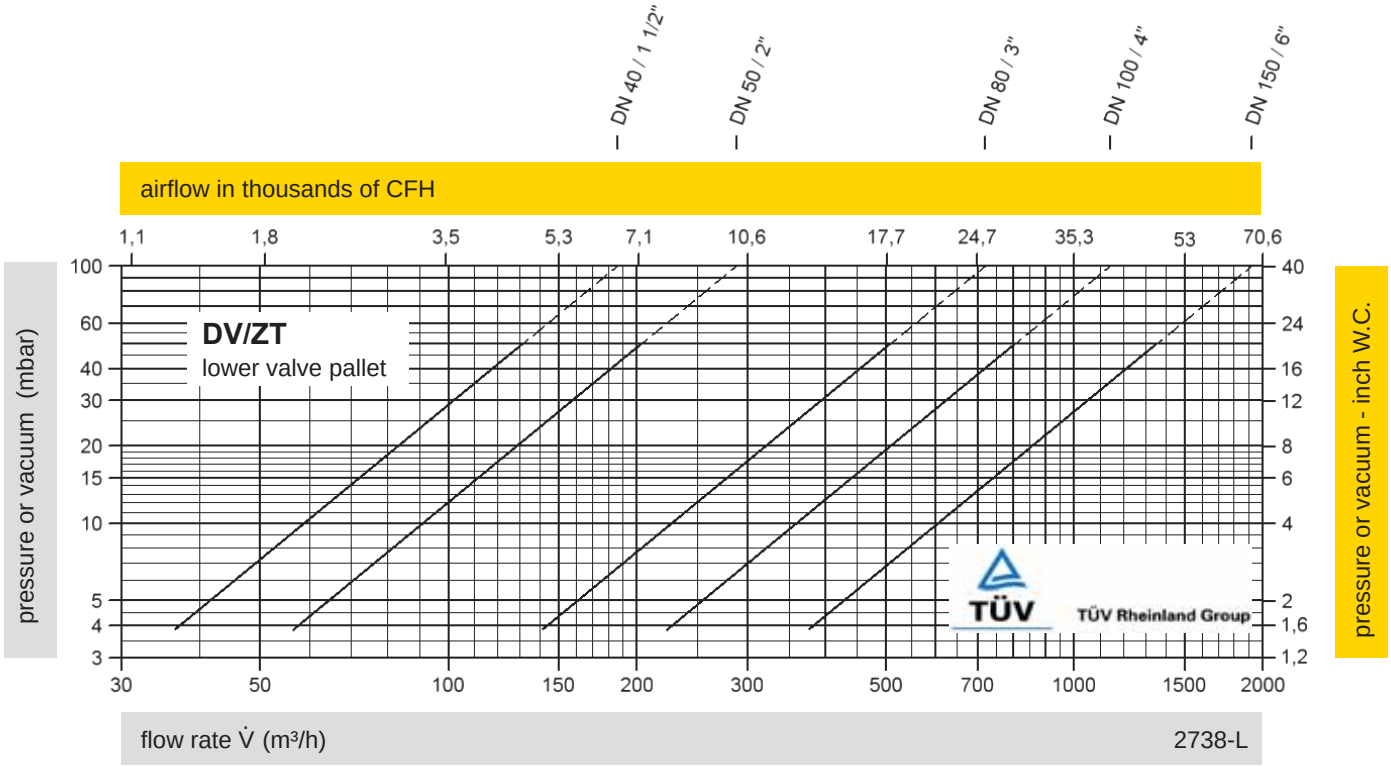
Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

PROTEGO® DV/ZT





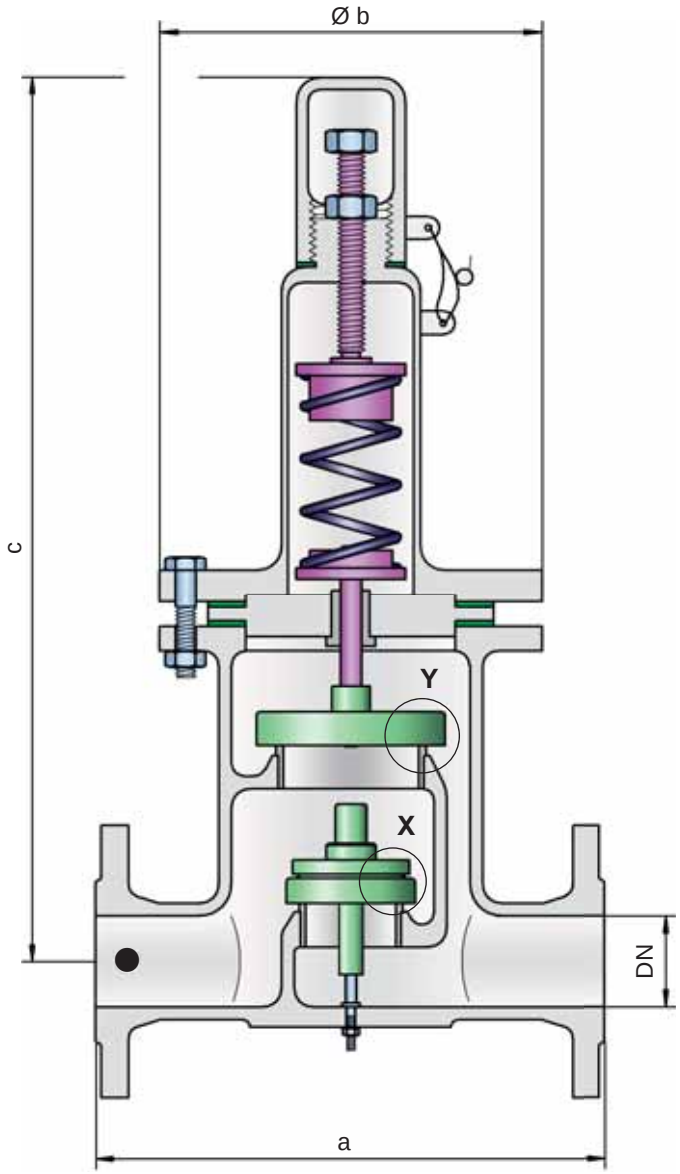
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

Notes:

Pressure and Vacuum Relief Valve, In-Line

PROTEGO® DV/ZT-F



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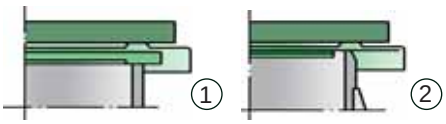

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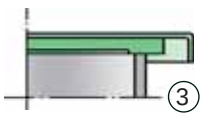

● = Tank connection

Settings:

Pressure:

+60 mbar up to +500 mbar (DN 40/1 ½“ up to 150/6“)
+24 inch W.C. up to +200 inch W.C.
>+60 mbar up to +400 mbar (DN200/8”;DN 250/10”)
>+24 inch W.C. up to +160 inch W.C.

Vacuum: -14 mbar up to -50 mbar
-5.6 inch W.C. up to -20 inch W.C.

Vacuum: -3.5 mbar up to -14 mbar
-1.4 inch W.C. up to -5.6 inch W.C.
by set pressure up to +150 mbar / +60 inch W.C.

For lower set pressure refer to type DV/ZT.
Higher set pressure and lower set vacuum upon request.

Function and Description

The PROTEGO® in-line valve DV/ZT-F is a state-of-the-art pressure and vacuum relief valve. Typically the valve is installed in the in- and out-breathing lines of tanks, vessels and process apparatus to protect against unallowable high and low pressure. The valve prevents emission losses almost up to the set pressure and provides protection from product entry into the system. Due to its design the vacuum valve pallet is one size smaller than the pressure valve pallet. Due to the spring loaded design higher set pressures can be achieved.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1), (3) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm and a rugged valve body. After the excess pressure is discharged or the vacuum is balanced, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- spring loaded on pressure side to achieve higher set pressures
- maintenance friendly design

Designs and Specifications

The pressure valve pallet is spring loaded, the vacuum valve pallet weight loaded. Lower set pressures for the pressure side are achieved through weight loaded type DV/ZT.

Two different designs are available:

In-line pressure and vacuum relief valve, standard design **DV/ZT-F** [–]

In-line pressure and vacuum relief valve with heating jacket **DV/ZT-F -** [H]

Additional special devices available upon request

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity charts on the following pages

DN	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"	250 / 10"
a	280 / 11.02	280 / 11.02	340 / 13.39	390 / 15.35	520 / 20.47	650 / 25.59	750 / 29.53
b	210 / 8.27	210 / 8.27	280 / 11.02	310 / 12.20	390 / 15.35	565 / 22.24	610 / 24.02
c	605 / 23.82	605 / 23.82	730 / 28.74	870 / 34.25	1170 / 46.06	1030 / 40.55	1335 / 52.56

Larger sizes upon request
Dimensions for pressure and vacuum relief valve with heating jacket upon request

Table 2: Material selection for housing

Design	A	B
Housing Heating jacket (DV/ZT-F-H-...)	Steel Steel	Stainless Steel Stainless Steel
Valve seat	Stainless Steel	Stainless Steel
Gasket	PTFE	PTFE

Option: Housing with ECTFE-lining

Special materials upon request

Table 3: Material of pressure valve pallet

Design	A
Pressure range (mbar) (inch W.C.)	>+60 up to +500 >+24 up to +200
Valve pallet	Stainless Steel
Sealing	Metal to Metal
Pressure spring	Stainless Steel

Special materials upon request

For lower set pressure use type DV/ZT.
Higher set pressure and lower set vacuum upon request.

Table 4: Material selection for vacuum valve pallet

Design	A*	B*	C	D
Pressure range (mbar) (inch W.C.)	-3.5 up to -5.0 -1.4 up to -2.0	<-5.0 up to -14 <-2.0 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-35 up to -50 <-14 up to -20
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	Metal to Metal

Special materials and lower set vacuum upon request

* by set pressure up to +150 mbar / +60 inch W.C.

Table 5: Flange connection type

EN 1092-1, Form B1 or DIN 2501, Form C, PN 16	EN or DIN
ANSI 150 lbs RFSF	ANSI

other types upon request

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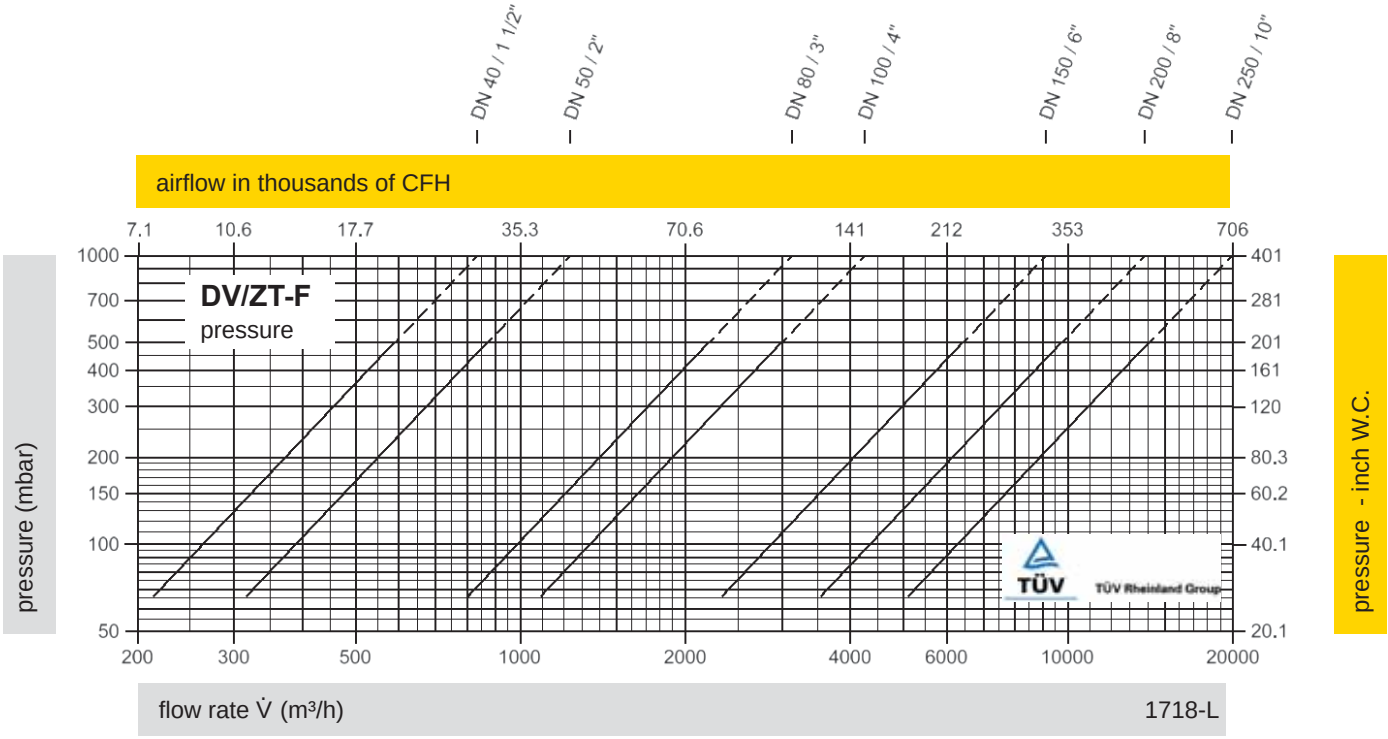
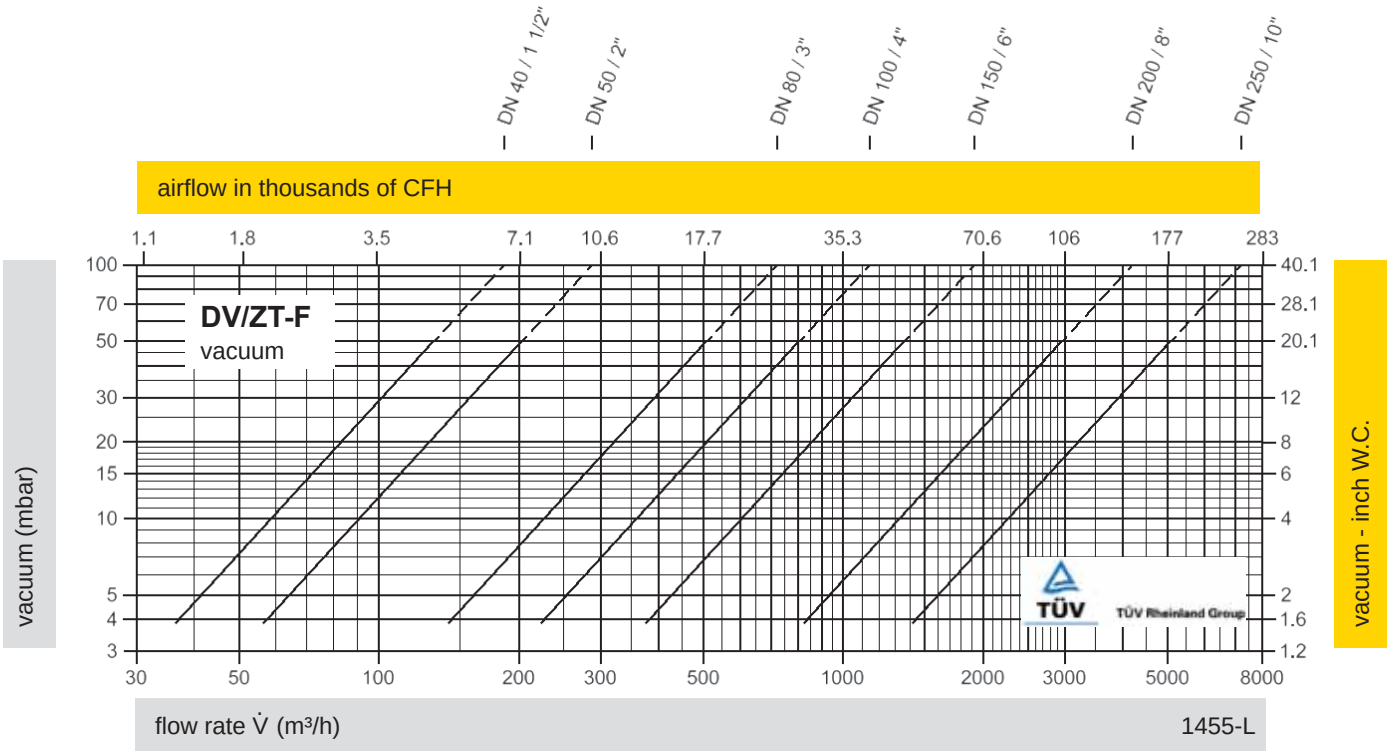
Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

PROTEGO® DV/ZT-F





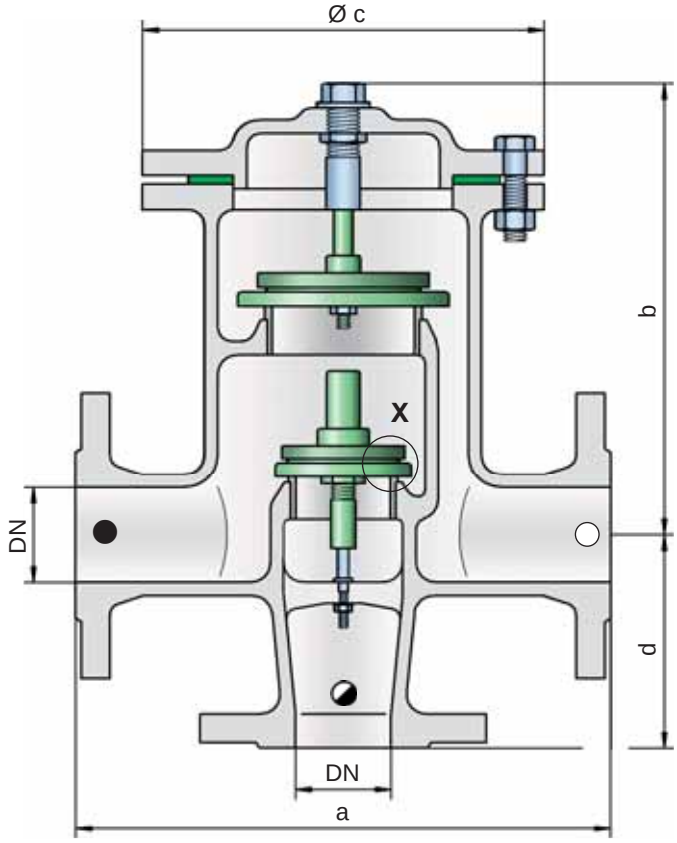
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

Notes:

Pressure and Vacuum Relief Valve, In-Line

PROTEGO® DV/ZU



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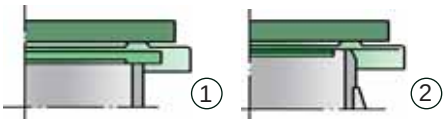


● = Tank connection

◪ = Inbreathing

○ = Outbreathing

Settings:

Pressure:	+2.0 mbar	up to +60 mbar
	+0.8 inch W.C.	up to +24 inch W.C.
Vacuum:	-3.5 mbar	up to -50 mbar
	-1.4 inch W.C.	up to -20 inch W.C.

For higher set pressure refer to type DV/ZU-F.
Lower set vacuum upon request.

Function and Description

The PROTEGO® in-line valve DV/ZU is a state-of-the-art pressure and vacuum relief valve with separate flange connections for pressure and vacuum breathing. Typically the valve is installed in the in- and outbreathing lines of tanks, vessels and process apparatus to protect against unallowable high and low pressure. The valve prevents emission losses almost up to the set pressure and prevents air intake almost up to set vacuum. The valve is designed so that in cases in which the set pressure is exceeded the vapours are vented into a discharge pipe (e.g. vent header). When the set vacuum is exceeded atmospheric air is pulled into the system. Due to its design the vacuum valve pallet is one size smaller than the pressure valve pallet.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The opening characteristic of the pressure and vacuum side is basically the same. However, the inbreathing will start as soon as the differential pressure between the connected inbreathing line and the tank is greater than the set pressure of the vacuum pallet. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent the valve pallets from sticking when sticky products are used and to enable the use of corrosive fluids. After the excess pressure is discharged or vacuum is balanced, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the vent body and vent pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- separate flange connection for in- and out-breathing line
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- maintenance friendly design

Designs and Specifications

The valve pallets are weight loaded. Higher set pressures are achieved by using spring loaded type DV/ZU-F

Two different designs are available:

In-line pressure and vacuum relief valve, standard design **DV/ZU - [–]**

In-line pressure and vacuum relief valve with heating jacket **DV/ZU - [H]**

Additional special devices available upon request

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity charts on the following pages

DN	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"
a	280 / 11.02	280 / 11.02	340 / 13.39	390 / 15.35	520 / 20.47
b	230 / 9.06	230 / 9.06	240 / 9.45	290 / 11.42	330 / 12.99
c	210 / 8.27	210 / 8.27	280 / 11.02	310 / 12.20	390 / 15.35
d	165 / 6.50	165 / 6.50	200 / 7.87	240 / 9.45	300 /11.81

Larger sizes upon request

Dimensions for pressure and vacuum relief valve with heating jacket upon request

Table 2: Material selection for housing

Design	A	B	
Housing Heating jacket (DV/ZU-H-...)	Steel Steel	Stainless Steel Stainless Steel	Option: Housing with ECTFE-lining Special materials upon request
Valve seat	Stainless Steel	Stainless Steel	
Gasket	PTFE	PTFE	

Table 3: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +60 >+5.6 up to +24	>+14 up to +60 >+5.6 up to +24	Special materials upon request For higher set pressures refer to type DV/ZU-F
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 4: Material selection for vacuum valve pallet

Design	A	B	C	D	E	F
Pressure range (mbar) (inch W.C.)	-3.5 up to -5.0 -1.4 up to -2.0	<-5.0 up to -14 <-2.0 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-35 up to -50 <-14 up to -20	<-14 up to -35 <-5.6 up to -14	<-35 up to -50 <-14 up to -20
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	PTFE	PTFE

Special materials and lower set vacuum upon request

Table 5: Flange connection type

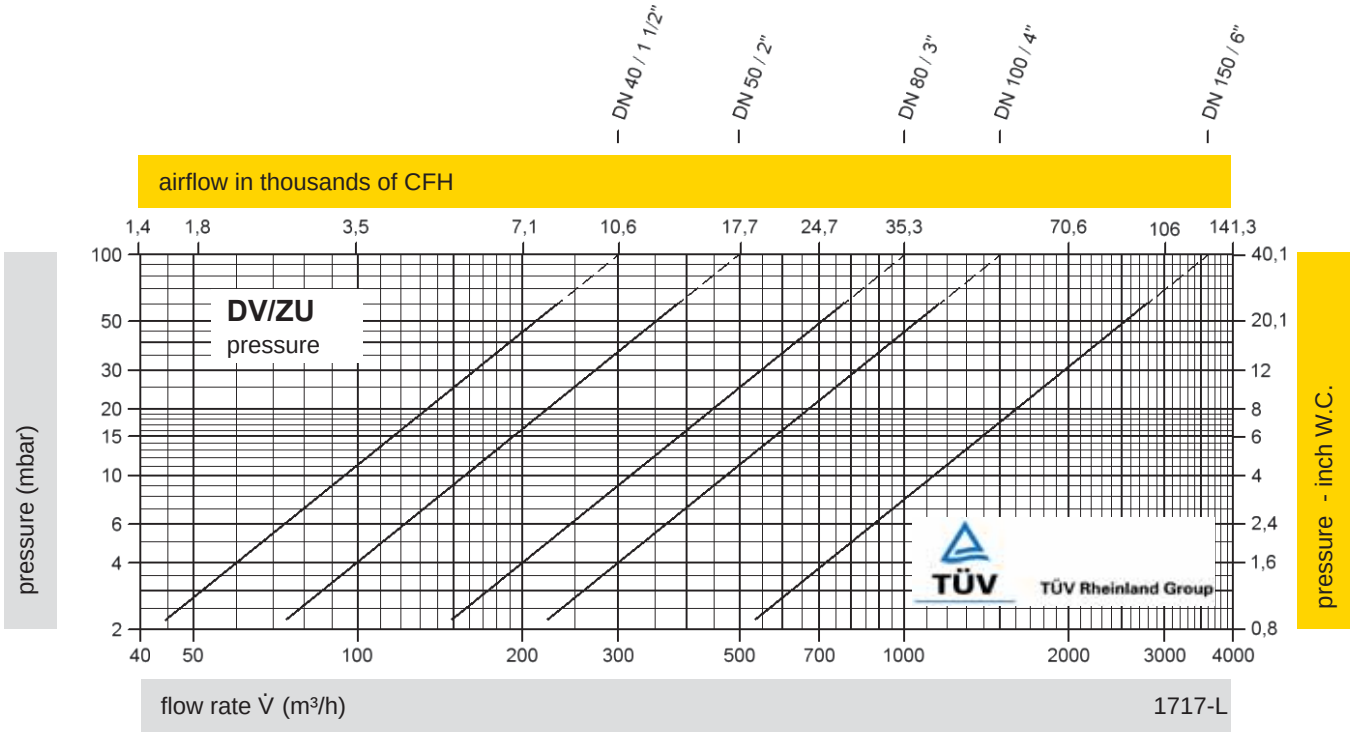
EN 1092-1, Form B1 or DIN 2501, Form C, PN 16	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	

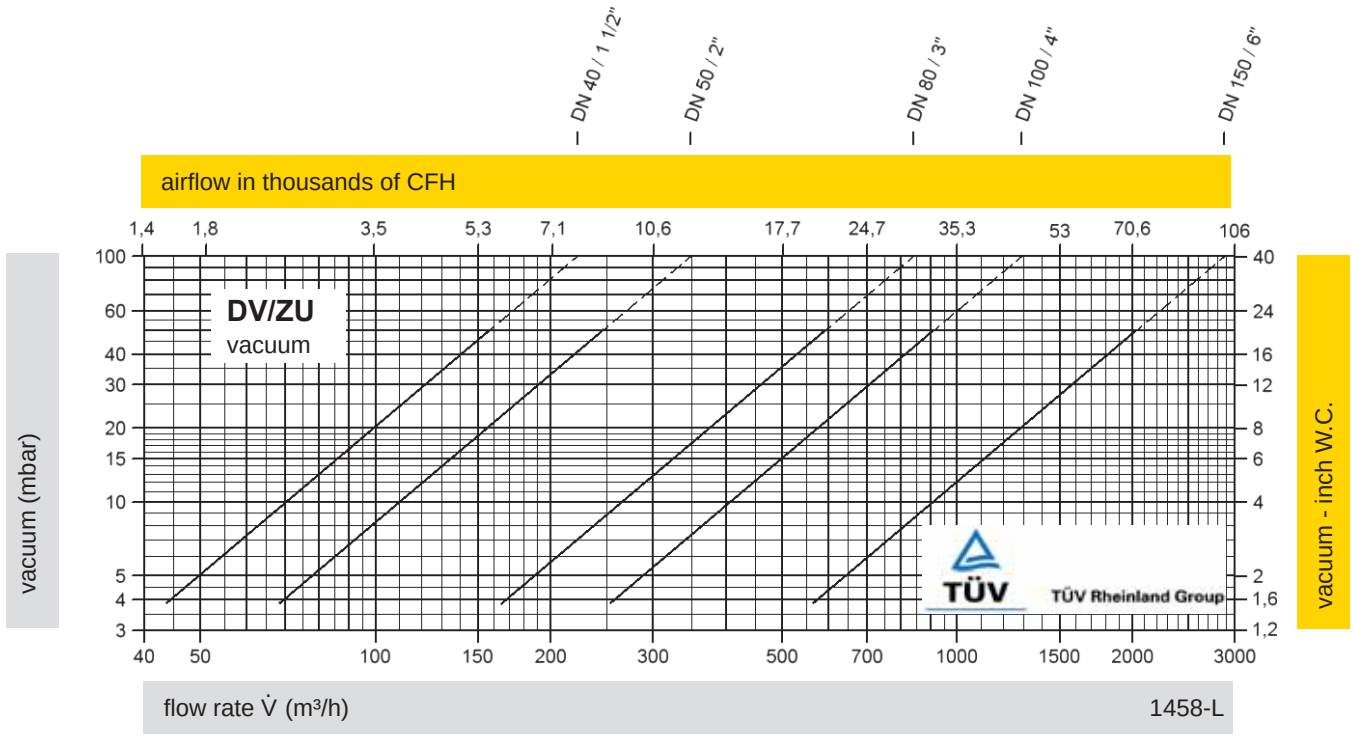
PROTEGO
for safety and environment

Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

PROTEGO® DV/ZU





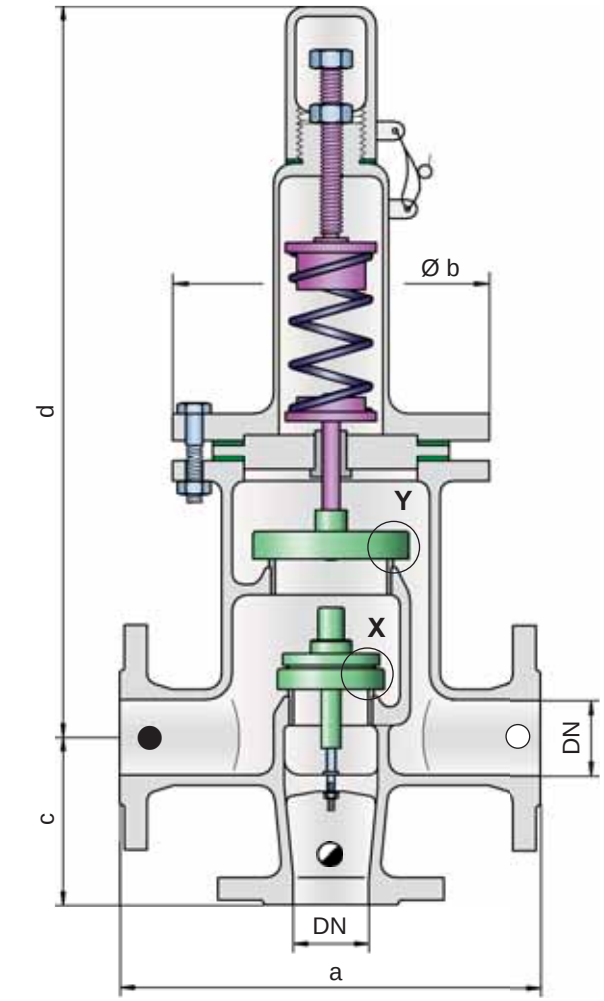
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

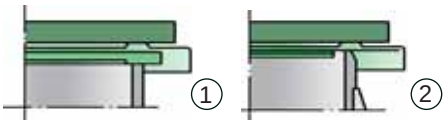
Notes:

Pressure and Vacuum Relief Valve, In-Line

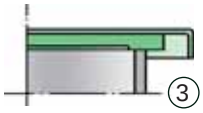
PROTEGO® DV/ZU-F



Detail **X**



Detail **Y**



● = Tank connection
◪ = Inbreathing
○ = Outbreathing

Settings:

Pressure: +60 mbar up to +500 mbar
+24 inch W.C. up to +200 inch W.C.

Vacuum: -3.5 mbar up to -50 mbar
-1.4 inch W.C. up to -20 inch W.C.

Vacuum: -3.5 mbar up to -14 mbar
-1.4 inch W.C. up to -5.6 inch W.C.
by set pressure up to +150 mbar / +60 inch W.C.

For lower set pressure refer to type DV/ZU.
Higher set pressure and lower set vacuum upon request.

Function and Description

The PROTEGO® in-line valve DV/ZU is a state-of-the-art pressure and vacuum relief valve with separate flange connections for pressure and vacuum breathing. Typically the valve is installed in the in- and out-breathing lines of tanks, vessels and process apparatus to protect against unallowable high and low pressure. The valve prevents emission losses almost up to the set pressure and prevents air intake almost up to set vacuum. The valve is designed so that in cases in which the set pressure is exceeded the vapours are vented into a discharge pipe (e.g. vent header). When the set vacuum is exceeded atmospheric air is pulled into the system. Due to its design the vacuum valve pallet is one size smaller than the pressure valve pallet. The spring loaded design of the pressure pallet allows achieving higher set pressures.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The opening characteristic of the pressure and vacuum side is basically the same. However, the inbreathing will start as soon as the differential pressure between the connected inbreathing line and the tank is greater than the set pressure of the vacuum pallet. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1), (3) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm and a rugged valve body. After the excess pressure is discharged or the vacuum is balanced, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- separate flange connection for in- and outbreathing line
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- spring loaded pressure side to achieve higher set pressures
- maintenance friendly design

Designs and Specifications

The pressure valve pallet is spring loaded, the vacuum valve pallet weight loaded. Lower set pressures for the pressure side are achieved through weight loaded type DV/ZU.

Two different designs are available:

In-line pressure and vacuum relief valve, standard design **DV/ZU-F** –

In-line pressure and vacuum relief valve with heating jacket **DV/ZU-F - H**

Additional special devices available upon request

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity charts on the following pages

DN	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"
a	280 / 11.02	280 / 11.02	340 / 13.39	390 / 15.35	520 / 20.47
b	210 / 8.27	210 / 8.27	280 / 11.02	310 / 12.20	390 / 15.35
c	165 / 6.50	165 / 6.50	200 / 7.87	240 / 9.45	300 / 11.81
d	565 / 22.24	565 / 22.24	675 / 26.57	805 / 31.69	1070 / 42.13

Larger sizes upon request
Dimensions for pressure and vacuum relief valve with heating jacket upon request

Table 2: Material selection for housing

Design	A	B	
Housing Heating jacket (DV/ZU-F-H-...)	Steel Steel	Stainless Steel Stainless Steel	Option: Housing with ECTFE-lining
Valve seat	Stainless Steel	Stainless Steel	Special materials upon request
Gasket	PTFE	PTFE	

Table 3: Material of pressure valve pallet

Design	A	
Pressure range (mbar) (inch W.C.)	>+60 up to +500 >+24 up to +200	Special materials upon request
Valve pallet	Stainless Steel	For lower set pressure use type DV/ZU
Sealing	Metal to Metal	Higher set pressure and lower set vacuum upon request
Pressure spring	Stainless Steel	

Table 4: Material selection for vacuum valve pallet

Design	A*	B*	C	D	
Pressure range (mbar) (inch W.C.)	-3.5 up to -5.0 -1.4 up to -2.0	<-5.0 up to -14 <-2.0 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-35 up to -50 <-14 up to -20	Special materials and lower set vacuum upon request
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	

* by set pressure up to +150 mbar / +60 inch W.C.

Table 5: Flange connection type

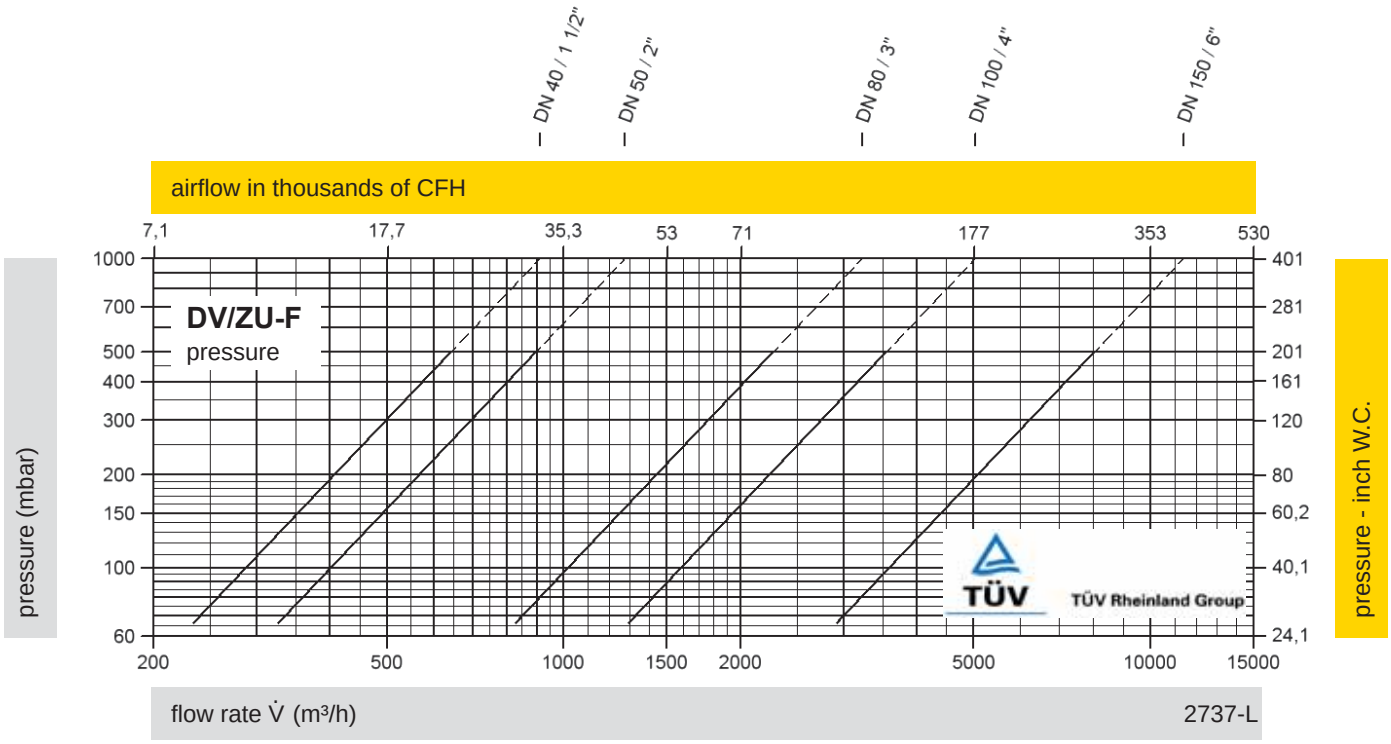
EN 1092-1, Form B1 or DIN 2501, Form C, PN 16	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	

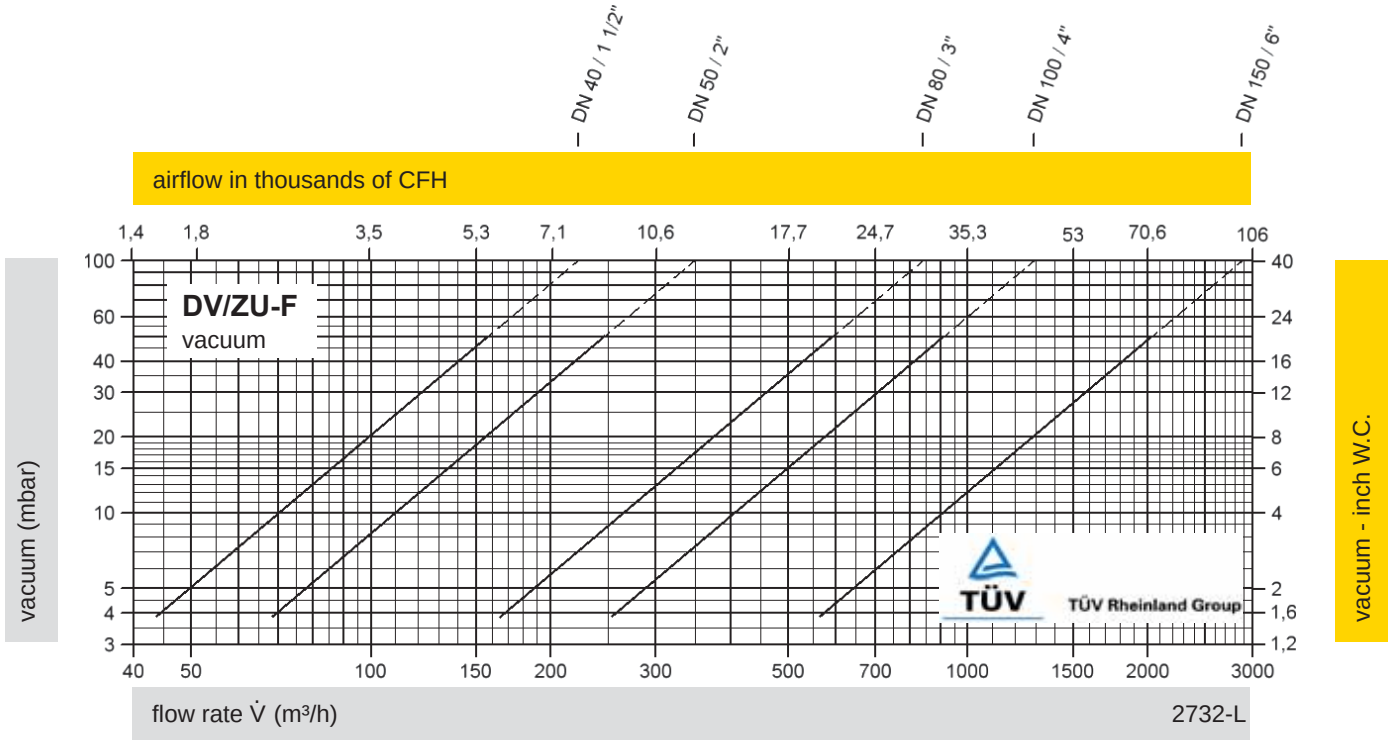
PROTEGO
for safety and environment

Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

PROTEGO® DV/ZU-F





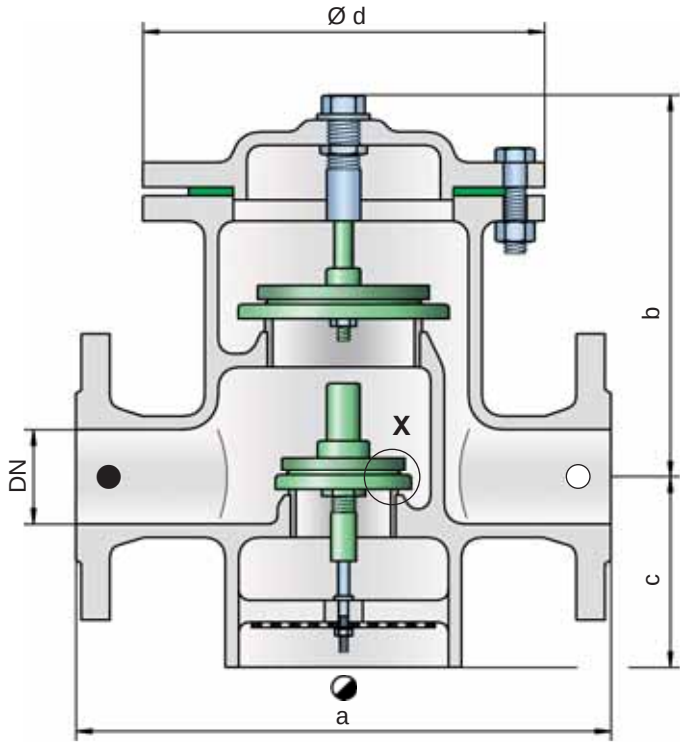
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

Notes:

Pressure and Vacuum Relief Valve, In-Line

PROTEGO® DV/ZW



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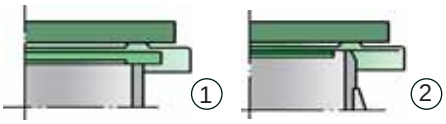


● = Tank connection

◪ = Inbreathing

○ = Outbreathing

Settings:

Pressure:	+2.0 mbar	up to +60 mbar
	+0.8 inch W.C.	up to +24 inch W.C.
Vacuum:	-3.5 mbar	up to -50 mbar
	-1.4 inch W.C.	up to -20 inch W.C.

For higher set pressure refer to type DV/ZW-F.
Lower set vacuum upon request.

Function and Description

The PROTEGO® in-line valve DV/ZW is a state-of-the-art pressure and vacuum relief valve with separate flange connections for use in a vent line. Typically the valve is installed in the in- and outbreathing lines of tanks, vessels and process apparatus to protect against unallowable high and low pressure. The valve prevents emission losses almost up to the set pressure and prevents air intake almost up to set vacuum. The valve is designed so that in cases in which the set pressure is exceeded the vapours are vented into a discharge pipe (e.g. vent header). When the set vacuum is exceeded atmospheric air is pulled into the system. Due to its design the vacuum valve pallet is one size smaller than the pressure valve pallet.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The opening characteristic of the pressure and vacuum side is basically the same. However, the inbreathing will start as soon as the differential pressure between the atmospheric pressure and the tank is greater than the set pressure of the vacuum pallet. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent the valve pallets from sticking when sticky products are used and to enable the use of corrosive fluids. After the excess pressure is discharged or vacuum is balanced, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology valve utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- flange connection for discharge line
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- maintenance friendly design

Designs and Specifications

The valve pallets are weight loaded. Higher set pressures are achieved by using spring loaded type DV/ZW-F

Two different designs are available:

In-line pressure and vacuum relief valve, standard design **DV/ZW - –**

In-line pressure and vacuum relief valve with heating jacket **DV/ZW - H**

Additional special devices available upon request.

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity charts on the following pages

DN	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"
a	280 / 11.02	280 / 11.02	340 / 13.39	390 / 15.35	520 / 20.47
b	230 / 9.06	230 / 9.06	240 / 9.45	290 / 11.42	330 / 12.99
c	85 / 3.35	85 / 3.35	125 / 4.92	140 / 5.51	185 / 7.28
d	210 / 8.27	210 / 8.27	280 / 11.02	310 / 12.20	390 / 15.35

Larger sizes upon request
Dimensions for pressure and vacuum relief valve with heating jacket upon request

Table 2: Material selection for housing

Design	A	B	
Housing Heating jacket (DV/ZW-H-...)	Steel Steel	Stainless Steel Stainless Steel	Option: Housing with ECTFE-lining
Valve seat	Stainless Steel	Stainless Steel	Special materials upon request
Gasket	PTFE	PTFE	

Table 3: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) [inch W.C.]	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +60 >+5.6 up to +24	>+14 up to +60 >+5.6 up to +24	Special materials upon request For higher set pressures refer to type DV/ZW-F
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 4: Material selection for vacuum valve pallet

Design	A	B	C	D	E	F
Pressure range (mbar) (inch W.C.)	-3.5 up to -5.0 -1.4 up to -2.0	<-5.0 up to -14 <-2.0 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-35 up to -50 <-14 up to -20	<-14 up to -35 <-5.6 up to -14	<-35 up to -50 <-14 up to -20
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	PTFE	PTFE

Special materials and lower set vacuum upon request

Table 5: Flange connection type

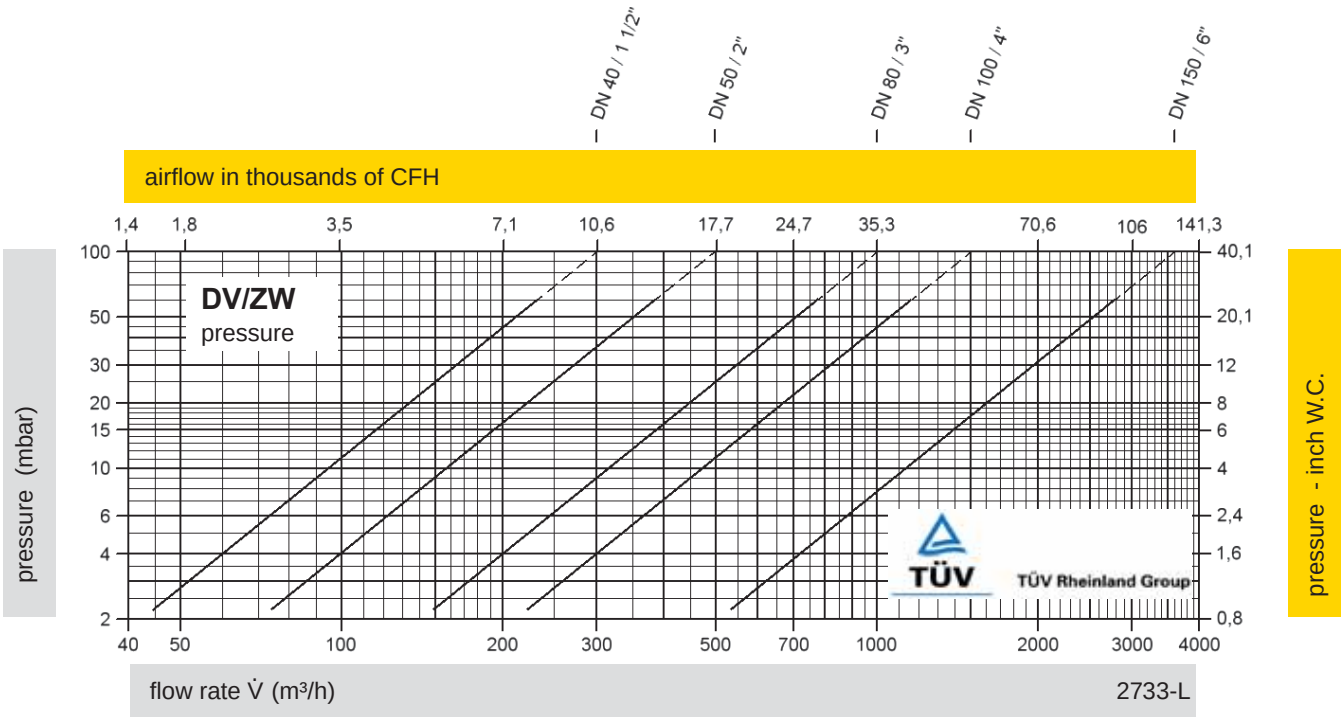
EN 1092-1, Form B1 or DIN 2501, Form C, PN 16	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	

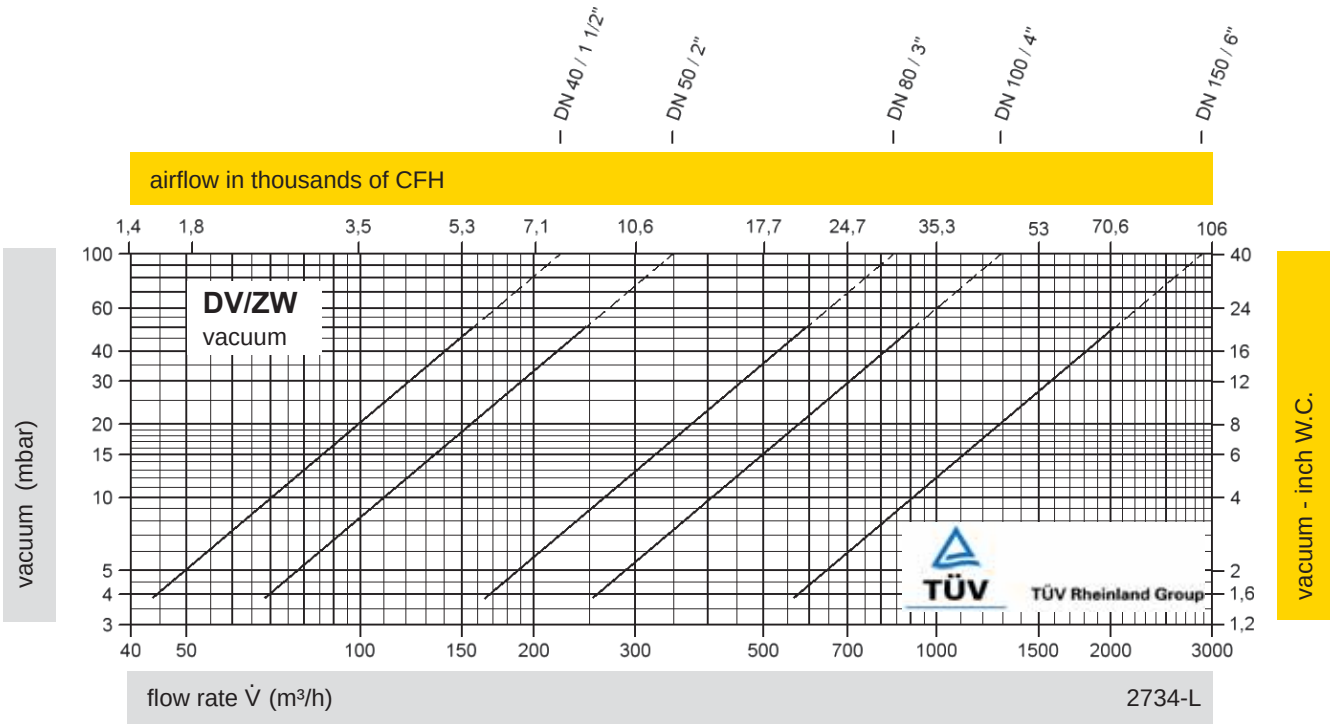
PROTEGO
for safety and environment

Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

PROTEGO® DV/ZW





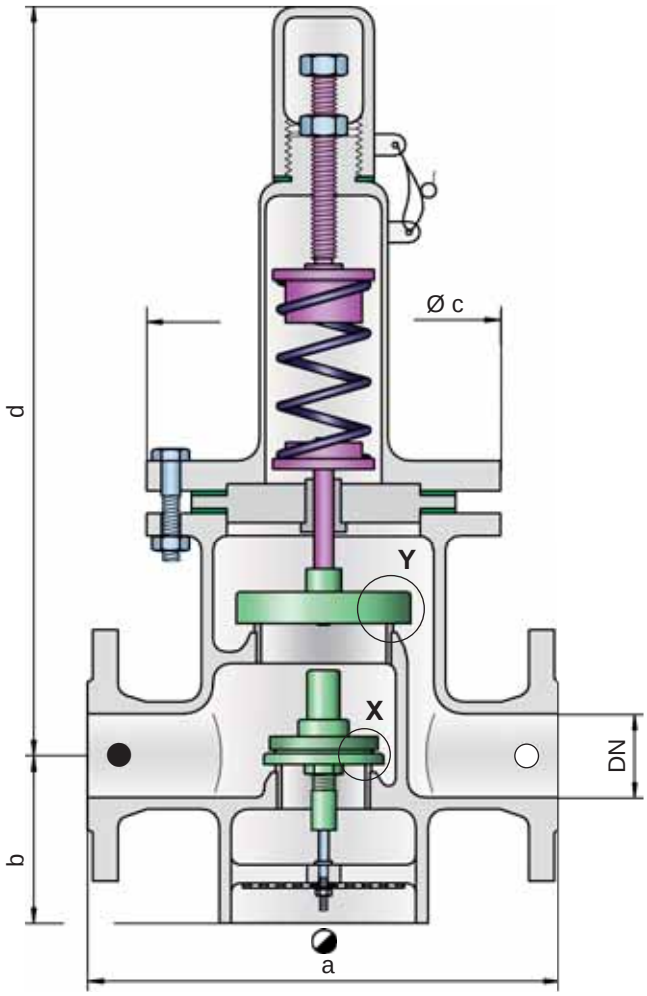
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

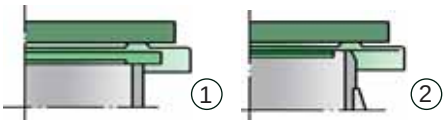
Notes:

Pressure and Vacuum Relief Valve, In-Line

PROTEGO® DV/ZW-F



Detail **X**



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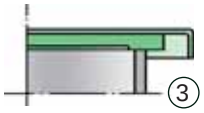

● = Tank connection
◪ = Inbreathing
○ = Outbreathing

Settings:

Pressure: +60 mbar up to +500 mbar
+24 inch W.C. up to +200 inch W.C.

Vacuum: -3.5 mbar up to -50 mbar
-1.4 inch W.C. up to -20 inch W.C.

Vacuum: -3.5 mbar up to -14 mbar
-1.4 inch W.C. up to -5.6 inch W.C.
by set pressure up to +150 mbar / +60 inch W.C.

For lower set pressure refer to type DV/ZW.
Higher set pressure and lower set vacuum upon request.

Function and Description

The PROTEGO® in-line valve DV/ZW-F is a state-of-the-art pressure and vacuum relief valve with flanged connections for use in a vent line. Typically the valve is installed in the in- and out-breathing lines of tanks, vessels and process apparatus to protect against unallowable high and low pressure. The valve prevents emission losses almost up to the set pressure and prevents air intake almost up to set vacuum. The valve is designed so that in cases in which the set pressure is exceeded the vapours are vented into a discharge pipe (e.g. vent header). When the set vacuum is exceeded atmospheric air breathes into the system. Due to its design the vacuum valve pallet is one size smaller than the pressure valve pallet. The spring loaded design of the pressure pallet allows higher set pressures than the DV/ZW model does.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments into research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The inbreathing will start as soon as the differential pressure between the atmospheric pressure and the tank is greater than the set pressure of the vacuum pallet. Due to our highly developed manufacturing technology the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is facilitated by valve seats made of high quality stainless steel and with individually lapped valve pallets (1), (3) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm and a rugged valve body. After the excess pressure is discharged or the vacuum is balanced, the valve reseats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research work, which allow a stable operation of the valve pallet and optimized performance resulting in reduction of product losses.

Special Features and Advantages

- “full lift type” technology vent utilizes only 10% overpressure to reach full lift
- high performance seal reducing product loss below EPA’s 500ppm rule preventing environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- optimized flow performance, which reduces capital cost to a minimum as smaller sized valves may be used
- flange connection for discharge line
- can be installed in explosion hazardous areas
- housing designed to 150 psi (PN 10)
- spring loaded design on pressure side to achieve higher set pressures
- maintenance friendly design

Designs and Specifications

The pressure valve pallet is spring loaded, the vacuum valve pallet weight loaded. Lower set pressures for the pressure side are achieved through weight loaded type DV/ZW.

Two different designs are available:

In-line pressure and vacuum relief valve, standard design **DV/ZW-F** [–]

In-line pressure and vacuum relief valve with heating jacket **DV/ZW-F -** [H]

Additional special devices available upon request

Within piping systems the influence of backpressure has to be considered in deciding the set pressure and opening characteristics. For special design solutions (e.g. partial load operation) the valve can be supplied with standard valve pallets (with proportional opening function).

Table 1: Dimensions Dimensions in mm / inches

To select the nominal size (DN), please use the flow capacity charts on the following pages

DN	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"
a	280 / 11.02	280 / 11.02	340 / 13.39	390 / 15.35	520 / 20.47
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c	210 / 8.27	210 / 8.27	280 / 11.02	310 / 12.20	390 / 15.35
d	565 / 22.24	565 / 22.24	675 / 26.57	805 / 31.69	1070 / 42.13

Larger sizes upon request
Dimensions for pressure and vacuum relief valve with heating jacket upon request

Table 2: Material selection for housing

Design	A	B	
Housing Heating jacket (DV/ZW-F-H-...)	Steel Steel	Stainless Steel Stainless Steel	Option: Housing with ECTFE-lining
Valve seat	Stainless Steel	Stainless Steel	Special materials upon request
Gasket	PTFE	PTFE	

Table 3: Material of pressure valve pallet

Design	A	
Pressure range (mbar) (inch W.C.)	>+60 up to +500 >+24 up to +200	Special materials upon request
Valve pallet	Stainless Steel	For lower set pressure use type DV/ZW
Sealing	Metal to Metal	Higher set pressure and lower set vacuum upon request.
Pressure spring	Stainless Steel	

Table 4: Material selection for vacuum valve pallet

Design	A*	B*	C	D	
Pressure range (mbar) (inch W.C.)	-3.5 up to -5.0 -1.4 up to -2.0	<-5.0 up to -14 <-2.0 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-35 up to -50 <-14 up to -20	Special materials and lower set vacuum upon request
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	

* by set pressure up to +150 mbar / +60 inch W.C.

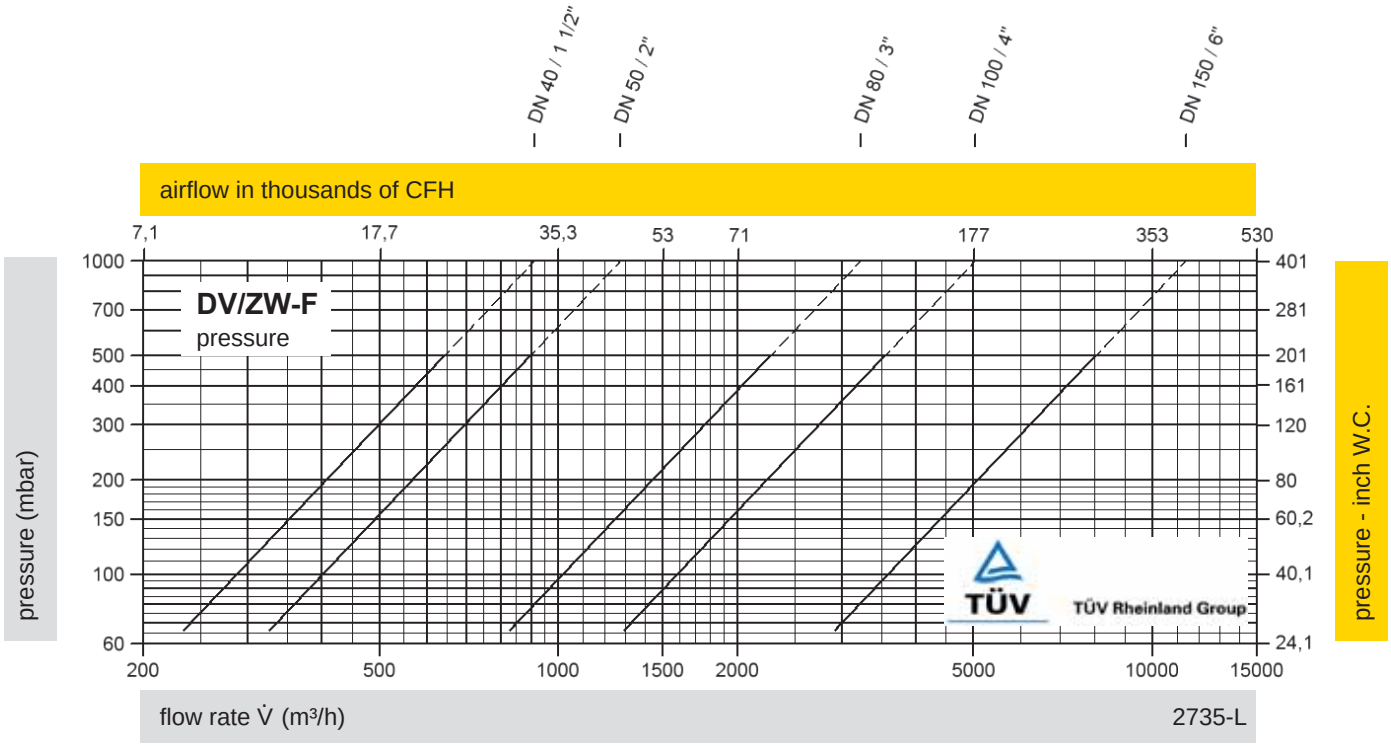
Table 5: Flange connection type

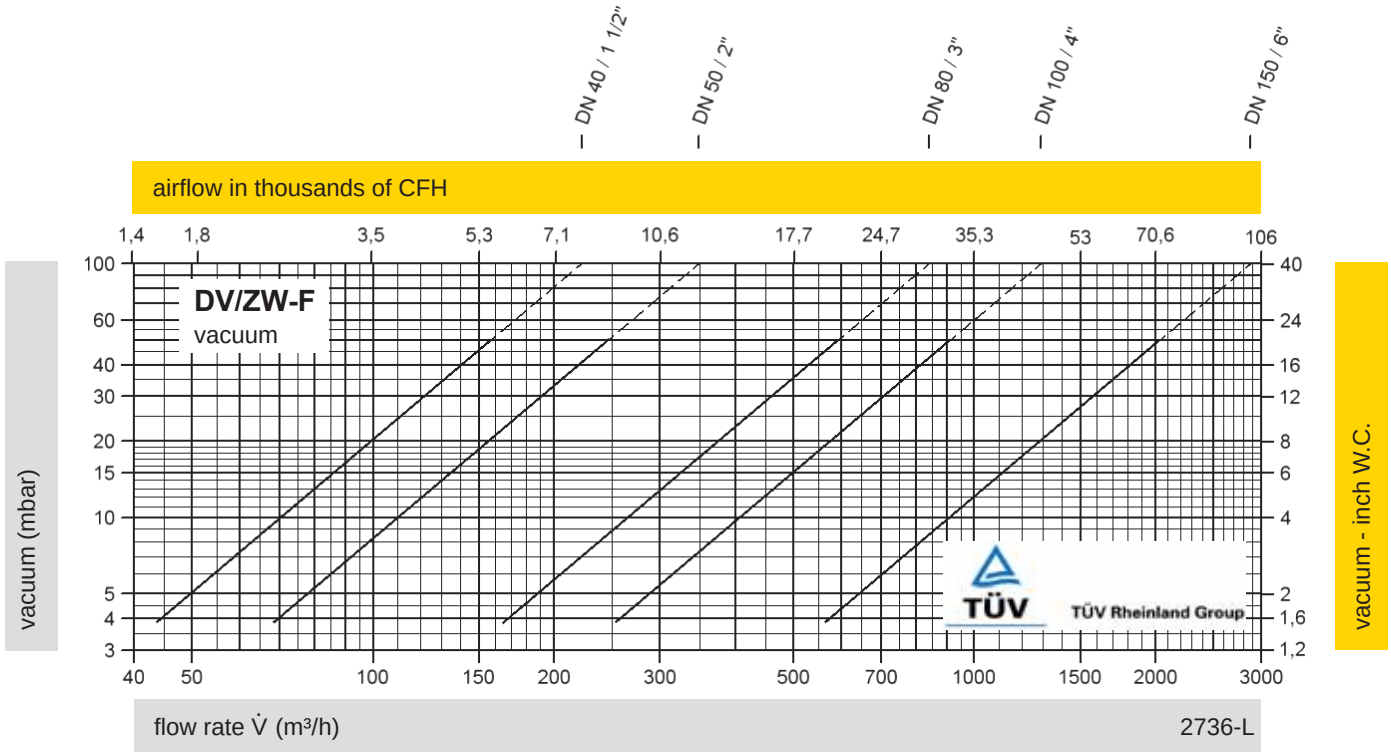
EN 1092-1, Form B1 or DIN 2501, Form C, PN 16	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	

Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

PROTEGO® DV/ZW-F

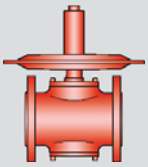




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

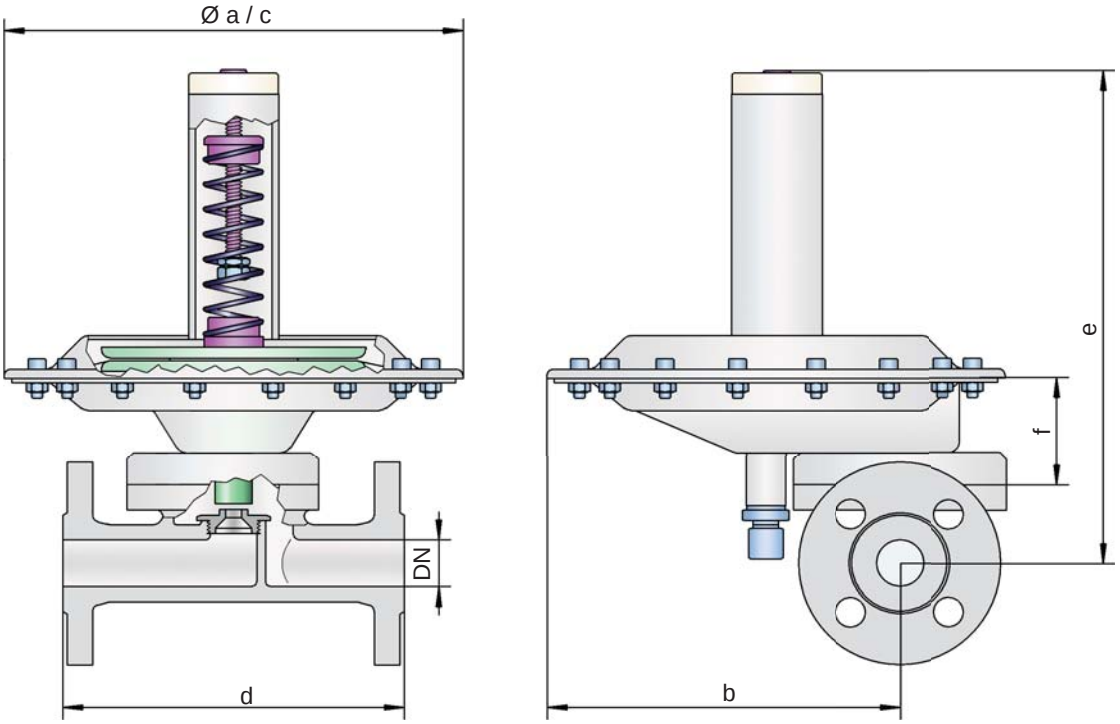
Notes:



Blanketing Valve

low pressure reducing valve

ZM-R



Pressure range:
Supply pressure:
up to +16 bar /
+6424 inch W.C.

Set pressure for
overpressure function:
up to +500 mbar /
+200 inch W.C.

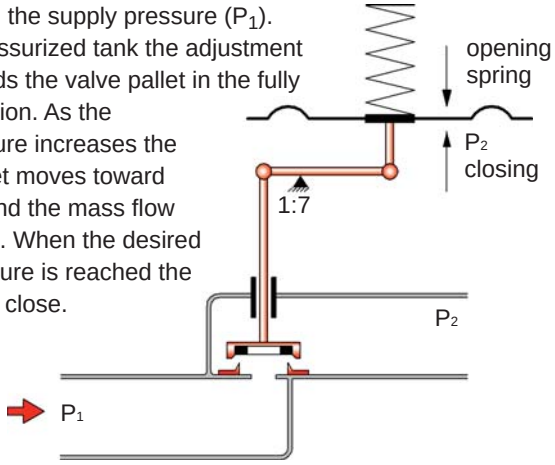
Set pressure for
vacuum function:
up to -200 mbar /
-80 inch W.C.

Function and Description

The blanketing valve type ZM-R is a highly developed low pressure reducing valve. This valve is typically used to inert or blanket tanks, vessels or other process systems with nitrogen or other blanketing gases by controlling the tank pressure to its desired value. High nitrogen or blanketing gas supply pressures up to 16 bar / 232 psi are safely reduced down to only a few mbar / inch W.C..

The ZM-R low pressure reducing valve is a direct acting one stage pressure control device. It is designed as a membrane controlled, spring loaded proportional acting valve. The valve controls the tank pressure by increasing flow as the tank pressure drops. This means that the mass flow through the device depends on the pressure differential of the set pressure to the actual tank pressure. When the actual tank pressure reaches the set pressure the control unit closes and there is no flow.

At the control membrane (which can be made from PTFE or Viton) the tank pressure (P_2) is balanced with the adjustment spring and the supply pressure (P_1).
In a depressurized tank the adjustment spring holds the valve pallet in the fully open position. As the tankpressure increases the valve pallet moves toward the seat and the mass flow is reduced. When the desired tank pressure is reached the device will close.



Should the tank pressure decrease the valve will open. If the plant is operated in a vacuum mode pressures down to -200 mbar / -80 inch W.C. relative pressure can be accommodated.

Special features and advantages

- one stage pressure reduction within a relatively high pressure range
- large membrane surface to increase the closing force
- all functional and wetted parts are made of stainless steel (or hastelloy if required)
- easy adjustment of set pressure (within the pressure range of the specific spring)
- vertical or horizontal installation (set pressure has to be adjusted for horizontal installation)
- no external energy supply required
- optimized flow performance, which reduces capital cost to a minimum as smaller sized vents are needed
- the valve pallet is guided within the housing to protect against harsh weather conditions, e.g. preventing freezing of pallet in cold weather conditions
- reducing within the vacuum range is possible
- high accuracy
- can be installed in explosion hazardous areas
- housing designed to 16 bar / 150 psi
- maintenance friendly design

Design and Specification

Two different designs are available:

Blanketing valve for overpressure, standard design **ZM-R –**

Blanketing valve for vacuum, standard design **ZM-R / N**

Other special devices can be supplied on request

For in-line valves any back pressure, which will influence the set pressure and opening characteristics, has to be taken into account.

Table 1: Dimensions Dimensions in mm | Dimensions in inches

To select the nominal size (DN), please use the flow rates on the following pages

DN	15 / ½"	25 / 1"	50 / 2"	100 / 4"	15 / ½"	25 / 1"	50 / 2"	100 / 4"
a	214	214	–	–	8.43	8.43	–	–
b	168	168	–	–	6.61	6.61	–	–
c*	–	–	214 / 360	360 / 600	–	–	8.43 / 14.17	14.17 / 23.62
d DIN	150	160	150	250 / 250	5.91	6.3	5.91	9.84 / 9.84
d ANSI	180	160	150	250 / 250	7.09	6.3	5.91	9.84 / 9.84
e	214	214	230	275 / 310	8.43	8.43	9.06	10.83 / 12.2
f	87	87	103	148 / 155	3.43	3.43	4.06	5.83 / 6.10

* depends upon size of diaphram

Table 2: Material selection for housing

Design	S	H	
Housing	Stainless Steel	Hastelloy	
Valve seat	Stainless Steel	Hastelloy	
Valve pallet	Stainless Steel	Hastelloy	
Valve seat sealing	FFKM	FFKM	
Gasket	PTFE	PTFE	
Diaphragm P	PTFE	PTFE	Marking P
Alternative: Diaphragm V	Viton	-	Marking V

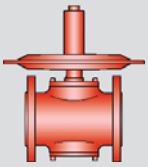
Optional:
Inner part of housing electropolished

Special materials upon request

Table 3: Selection for valve seat (depending on flow rate)

Size	Seat in mm / inches	Kvs	Number
25 / 1"	2,0 / 0.08	0,15	20
	4,5 / 0.18	0,60	45
	7,5 / 0.30	1,20	75
	10,0 / 0.39	1,70	100
	14,0 / 0.55	2,40	140
50 / 2"	14,0 / 0.55	3,00	140
	18,0 / 0.71	7,00	180
	26,0 / 1.02	15,00	260
100 / 4"	42,0 / 1.65	35,00	420
	55,0 / 2.17	70,00	550

* 1 Kvs = 0.86 Cv; 1 Cv = 1.17 Kvs



In-Line Pressure Reducing Valve

low pressure reducing valve

ZM-R

Table 4: Connection type			
FD	DIN 2501, PN 16	DIN	other types upon request
FA	ANSI 150 lbs RFSF	ANSI	
G	Thread	G or NPT	

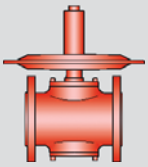
Flow rates for P2 pressure range (Europe – metric units)

ZM-R 15 / ZM-R 25: flow rate (air, 0°C) at ΔP = P1 - P2 and valve full open											
P1 (bar) overpressure / P2 (mbar)	0,15	0,25	0,40	0,65	1,00	1,50	2,50	4,00	6,00	10,00	Seat-Ø
	[Nm³/h]	[Nm³/h]	[Nm³/h]	[Nm³/h]	[Nm³/h]	[Nm³/h]	[Nm³/h]	[Nm³/h]	[Nm³/h]	[Nm³/h]	[mm]
10	6,2	8,1	10,3	13,2	16,5	20,6	28,8	41,1	57,5	90,3	Ø 4,5
	12,4	16,2	20,7	26,5	33,0	41,2	57,6	82,2	115,0	180,7	Ø 7,5
	17,5	23,0	29,3	37,6	46,7	58,4	81,6	116,5	163,0	256,0	Ø 10,0
	24,8	32,5	41,4	53,1	66,0	82,4	115,2	164,5	230,1	361,4	Ø 14,0
20	6,0	7,9	10,2	13,2	16,5	20,6	28,8	41,1	57,5	90,3	Ø 4,5
	12,0	15,9	20,5	26,4	33,0	41,2	57,6	82,2	115,0	180,7	Ø 7,5
	17,0	22,6	29,1	37,5	46,7	58,4	81,6	116,5	163,0	256,0	Ø 10,0
	24,0	31,9	41,1	52,9	66,0	82,4	115,2	164,5	230,1	361,4	Ø 14,0
100	3,8	6,7	9,4	12,8	16,4	20,6	28,8	41,1	57,5	90,3	Ø 4,5
	7,7	13,4	18,9	25,6	32,8	41,2	57,6	82,2	115,0	180,7	Ø 7,5
	10,9	18,9	26,8	36,3	46,5	58,4	81,6	116,5	163,0	256,0	Ø 10,0
	15,4	26,8	37,9	51,3	65,6	82,4	115,2	164,5	230,1	361,4	Ø 14,0
200	-	4,0	8,0	12,1	16,1	20,6	28,8	41,1	57,5	90,3	Ø 4,5
	-	8,0	16,1	24,2	32,3	41,2	57,6	82,2	115,0	180,7	Ø 7,5
	-	11,4	22,9	34,3	45,8	58,4	81,6	116,5	163,0	256,0	Ø 10,0
	-	16,1	32,3	48,4	64,6	82,4	115,2	164,5	230,1	361,4	Ø 14,0
500	-	-	-	7,8	14,2	20,1	28,8	41,1	57,5	90,3	Ø 4,5
	-	-	-	15,6	28,5	40,3	57,6	82,2	115,0	180,7	Ø 7,5
	-	-	-	22,1	40,4	57,1	81,6	116,5	163,0	256,0	Ø 10,0
	-	-	-	31,2	57,0	80,7	115,2	164,5	230,1	361,4	Ø 14,0

ZM-R 50: flow rate (air, 0°C) at ΔP = P1 - P2 and valve full open											
P1 (bar) / overpressure / P2 (mbar)	0,15 [Nm³/h]	0,25 [Nm³/h]	0,40 [Nm³/h]	0,65 [Nm³/h]	1,00 [Nm³/h]	1,50 [Nm³/h]	2,50 [Nm³/h]	4,00 [Nm³/h]	6,00 [Nm³/h]	10,00 [Nm³/h]	Seat-Ø [mm]
10	28,9 70,3 150,0	37,9 92,1 196,5	48,3 117,4 250,4	61,9 150,4 320,8	77,0 187,1 399,1	96,2 233,6 498,3	134,5 326,6 696,5	191,9 466,1 994,0	268,5 652,1 1390	421,6 1024 2183	Ø 14,0 Ø 18,0 Ø 26,0
20	28,0 68,1 145,3	37,3 90,6 193,3	47,9 116,5 248,4	61,7 150,0 319,9	77,0 187,1 399,0	96,2 233,6 498,3	134,5 326,6 696,5	191,9 466,1 994,0	268,5 652,1 1390	421,6 1024 2183	Ø 14,0 Ø 18,0 Ø 26,0
100	18,0 43,8 93,5	31,2 75,9 162,0	44,2 107,4 229,1	59,9 145,5 310,2	76,6 186,1 396,9	96,2 233,6 498,3	134,5 326,6 696,5	191,9 466,1 994,0	268,5 652,1 1390	421,6 1024 2183	Ø 14,0 Ø 18,0 Ø 26,0
200	- - -	18,8 45,8 97,6	37,7 91,6 195,3	56,5 137,4 293,0	75,4 183,2 390,6	96,2 233,6 498,3	134,5 326,6 696,5	191,9 466,1 994,0	268,5 652,1 1390	421,6 1024 2183	Ø 14,0 Ø 18,0 Ø 26,0
500	- - -	- - -	- - -	36,4 88,6 188,9	66,6 161,7 344,9	94,1 228,7 487,8	134,5 326,6 696,5	191,9 466,1 994,0	268,5 652,1 1390	421,6 1024 2183	Ø 14,0 Ø 18,0 Ø 26,0

ZM-R 100: flow rate (air, 0°C) at ΔP = P1 - P2 and valve full open											
P1 (bar) / overpressure / P2 (mbar)	0,15 [Nm³/h]	0,25 [Nm³/h]	0,40 [Nm³/h]	0,65 [Nm³/h]	1,00 [Nm³/h]	1,50 [Nm³/h]	2,50 [Nm³/h]	4,00 [Nm³/h]	6,00 [Nm³/h]	10,00 [Nm³/h]	Seat-Ø [mm]
10	346 703	453 921	587 1174	741 1504	922 1871	1151 2336	1609 3266	2296 4661	3212 6512	5045 10241	Ø 42,0 Ø 55,0
20	335 681	446 906	574 1165	739 1500	921 1871	1151 2336	1609 3266	2296 4661	3212 6512	5045 10241	Ø 42,0 Ø 55,0
100	216 438	374 759	529 1074	716 1455	917 1861	1151 2336	1609 3266	2296 4661	3212 6512	5045 10241	Ø 42,0 Ø 55,0
200	- -	225 458	451 916	676 1374	902 1832	1151 2336	1609 3266	2296 4661	3212 6512	5045 10241	Ø 42,0 Ø 55,0
500	- -	- -	- -	436 886	796 1617	1127 2287	1609 3266	2296 4661	3212 6512	5045 10241	Ø 42,0 Ø 55,0

Flow rates for P2 vacuum range (Type ZM-R/N) upon request



In-Line Pressure Reducing Valve

Flow rates for P2 pressure range (english/american units – non-metric)

ZM-R

ZM-R 15 / ZM-R 25: flow rate (air, 32°F) at ΔP = P1 - P2 and valve full open											
P1 (psi) / overpressure / P2 ("wc)	2.18 [SCFH]	3.63 [SCFH]	5.80 [SCFH]	9.43 [SCFH]	14.50 [SCFH]	21.76 [SCFH]	36.26 [SCFH]	58.02 [SCFH]	87.02 [SCFH]	145.04 [SCFH]	Seat-Ø [inch]
3.94	219	287	366	469	583	728	1018	1453	2032	3191	Ø 0.18
	439	574	732	938	1166	1456	2036	2905	4064	6382	Ø 0.29
	621	814	1037	1329	1652	2063	2884	4116	5758	9042	Ø 0.39
	877	1149	1464	1876	2333	2913	4072	5810	8128	12764	Ø 0.55
7.87	212	282	363	468	583	728	1018	1453	2032	3191	Ø 0.18
	425	565	726	935	1166	1456	2036	2905	4064	6382	Ø 0.29
	602	800	1029	1325	1652	2063	2884	4116	5758	9042	Ø 0.39
	849	1130	1452	1870	2333	2913	4072	5810	8128	12764	Ø 0.55
39.4	137	237	335	453	580	728	1018	1453	2032	3191	Ø 0.18
	273	474	670	907	1166	1456	2036	2905	4064	6382	Ø 0.29
	387	671	949	1285	1643	2063	2884	4116	5758	9042	Ø 0.39
	547	947	1339	1814	2320	2913	4072	5810	8128	12764	Ø 0.55
78.7	-	143	285	428	571	728	1018	1453	2032	3191	Ø 0.18
	-	285	571	856	1142	1456	2036	2905	4064	6382	Ø 0.29
	-	404	809	1213	1617	2063	2884	4116	5758	9042	Ø 0.39
	-	571	1142	1713	2284	2913	4072	5810	8128	12764	Ø 0.55
196.9	-	-	-	276	504	713	1018	1453	2032	3191	Ø 0.18
	-	-	-	552	1108	1426	2036	2905	4064	6382	Ø 0.29
	-	-	-	782	1428	2020	2884	4116	5758	9042	Ø 0.39
	-	-	-	1104	2016	2851	4072	5810	8128	12764	Ø 0.55

ZM-R 50: flow rate (air, 32°F) at ΔP = P1 - P2 and valve full open											
P1 (psi) / overpressure / P2 ("wc)	2.18 [SCFH]	3.63 [SCFH]	5.80 [SCFH]	9.43 [SCFH]	14.50 [SCFH]	21.76 [SCFH]	36.26 [SCFH]	58.02 [SCFH]	87.02 [SCFH]	145.04 [SCFH]	Seat-Ø [inch]
3.94	1023	1340	1708	2188	2722	3398	4750	6779	9483	14892	Ø 0.55
	2486	3254	4149	5314	6610	8253	11536	16462	23030	36166	Ø 0.71
	5300	6939	8846	11332	14094	17597	24600	35104	49109	77119	Ø 1.02
7.87	991	1318	1694	2182	2721	3398	4750	6779	9483	14892	Ø 0.55
	2407	3201	4115	5298	6608	8253	11536	16462	23030	36166	Ø 0.71
	5132	6827	8775	11298	14091	17597	24600	35104	49109	77119	Ø 1.02
39.4	638	1105	1563	2116	2707	3398	4750	6779	9483	14892	Ø 0.55
	1549	2684	3795	5139	6573	8253	11536	16462	23030	36166	Ø 0.71
	3304	5722	8093	10958	14017	17597	24600	35104	49109	77119	Ø 1.02
78.7	-	666	1332	1998	2664	3398	4750	6779	9483	14892	Ø 0.55
	-	1617	3235	4852	6470	8253	11536	16462	23030	36166	Ø 0.71
	-	3449	6898	10347	13796	17597	24600	35104	49109	77119	Ø 1.02
196.9	-	-	-	1288	2352	3327	4750	6779	9483	14892	Ø 0.55
	-	-	-	3129	5713	8079	11536	16462	23030	36166	Ø 0.71
	-	-	-	6672	12181	17227	24600	35104	49109	77119	Ø 1.02

ZM-R 100: flow rate (air, 32°F) at ΔP = P1 - P2 and valve full open											
overpressure P1 (psi) P2 ("wc)	2.18 [SCFH]	3.63 [SCFH]	5.80 [SCFH]	9.43 [SCFH]	14.50 [SCFH]	21.76 [SCFH]	36.26 [SCFH]	58.02 [SCFH]	87.02 [SCFH]	145.04 [SCFH]	Seat-Ø [inch]
3.94	12245 24856	16033 32544	20438 41485	26181 53144	32562 66097	40656 82525	56834 115365	81101 164624	113458 230303	178171 361660	Ø 1.65 Ø 2.17
7.87	11857 24068	15772 32014	20272 41150	26102 52984	32555 66082	40656 82525	56834 115365	81101 164624	113458 230303	178171 361660	Ø 1.65 Ø 2.17
39.4	7633 15494	13221 26836	18697 37952	25316 51387	32384 65735	40656 82525	56834 115365	81101 164624	113458 230303	178171 361660	Ø 1.65 Ø 2.17
78.7	- -	7968 16175	15937 32350	23905 48525	31874 64699	40656 82525	56834 115365	81101 164624	113458 230303	178171 361660	Ø 1.65 Ø 2.17
196.9	- -	- -	- -	15414 31289	28142 57125	39800 80788	56834 115365	81101 164624	113458 230303	178171 361660	Ø 1.65 Ø 2.17

Flow rates for P2 vacuum range (Type ZM-R/N) upon request