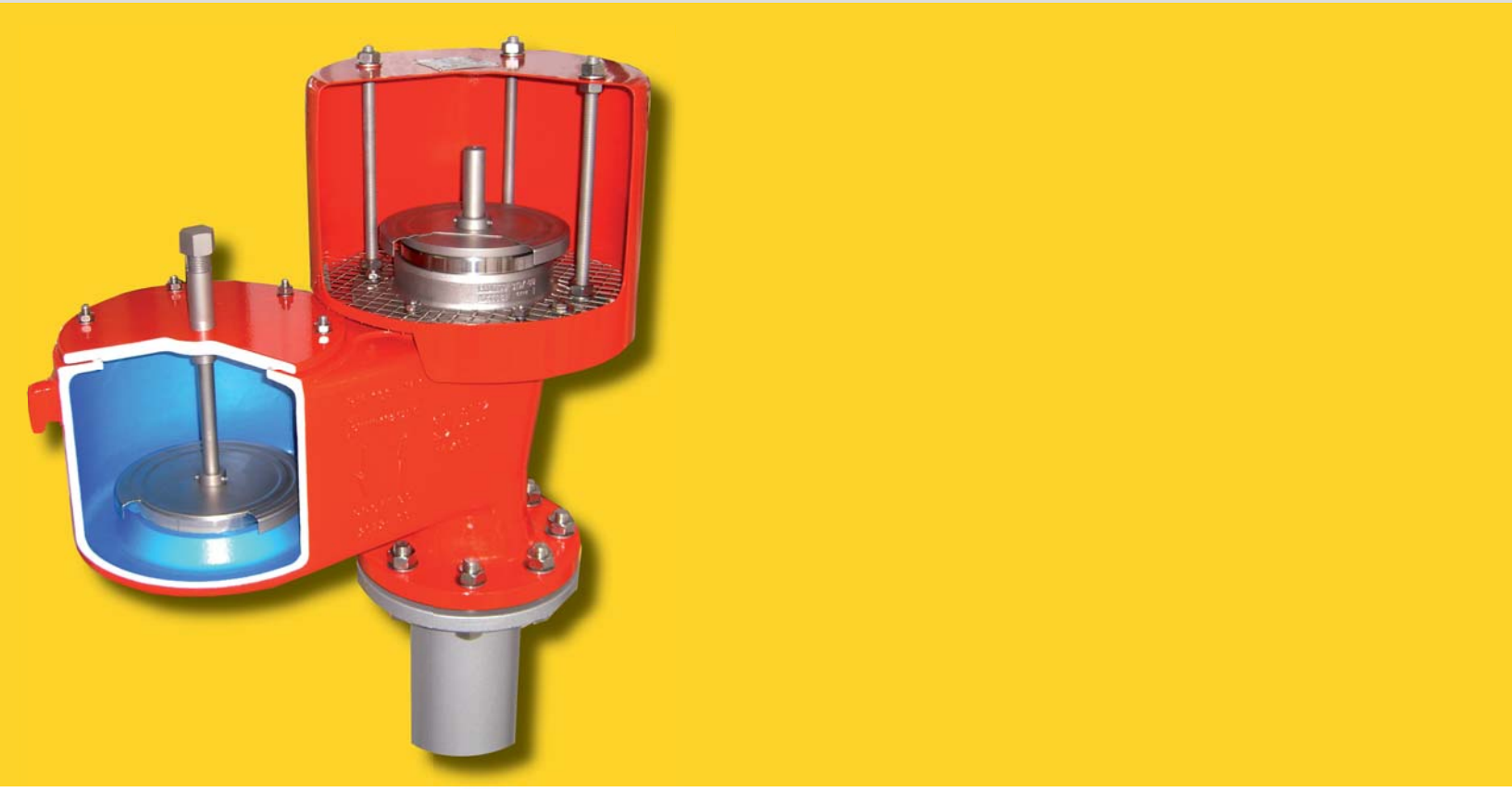
# PROTEGO® **Pressure/Vacuum Relief Valves**

end-of-line



## Volume 5

PROTEGO

*for safety and environment*

Edition 2009

More than 50 years ago, PROTEGO® started developing special devices for protecting systems against explosions as well as pressure and vacuum relief valves that meet the highest standards for performance, pressure conservation, and tight seals. This yielded the original Braunschweiger FLAMEFILTER® (Fig. 1) as well as a series of additional innovations that led to numerous patents and imitators. In close cooperation with scientific institutions, continued technical challenges were overcome to meet the increasing requirements for safety and environmental protection.

Today, these products are used throughout the world under the brand names PROTEGO® and FLAMEFILTER® mainly for the following applications:

1. In tank farms for refineries and chemical plants
2. In processing plants for chemical and pharmaceutical industries
3. In vapour combustion plants
4. In ship building, offshore platforms, in loading facilities
5. In vapour recovery systems
6. As component for machineries and devices
7. In biogas and landfill applications
8. In flare systems

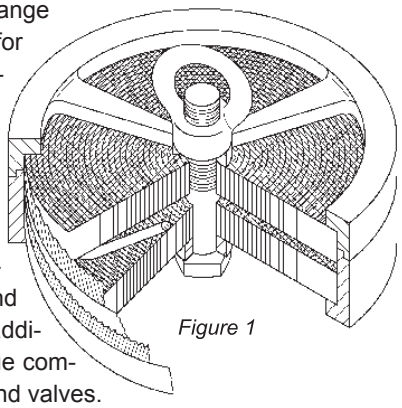


*Figure 1*

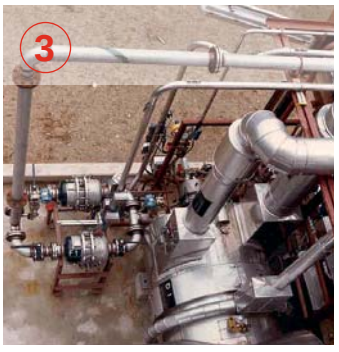
Our comprehensive product range reliably protects systems for generating, storing, and transporting gases and liquids of every hazard category against dangers such as endurance burning, deflagration and detonation. Our complete line of valves enables tank farms to be safely and economically ventilated. In addition, PROTEGO® offers unique combinations of flame arresters and valves.

All of our devices are tested by independent national and international third parties in the world's largest test facility and have got at least one of the many certifications. The actual performance of the devices is determined in a modern flow measuring test rig to obtain reliable data for their practical use.

FM Approvals
Specification Tested













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## Function and Description

The function of pressure/vacuum valves for relief and conservation and the corresponding applications is discussed in „Technical Fundamentals“ (→ Vol. 1). In this chapter PROTEGO®´s product line of pressure/vacuum relief valves in end-of-line application is presented.

These are special devices that function as an **end-of-line valve** to protect against pressure and vacuum. The valves may be designed as pipe away version which can be connected to a vent header to process vapors.

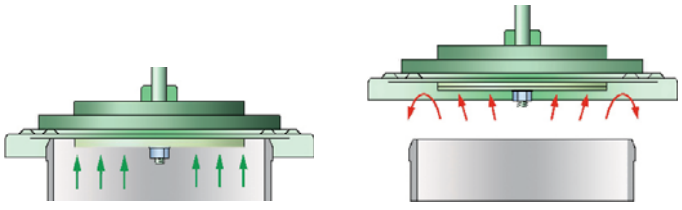
**Pressure relief valves** prevent vapor loss up to the adjusted set pressure and offer reliable protection against excess pressure.

**Vacuum relief valves** prevent the unallowable entrance of air up to the adjusted set pressure and offer reliable protection against vacuum.

**Pressure/vacuum relief valves** perform all of the above tasks.

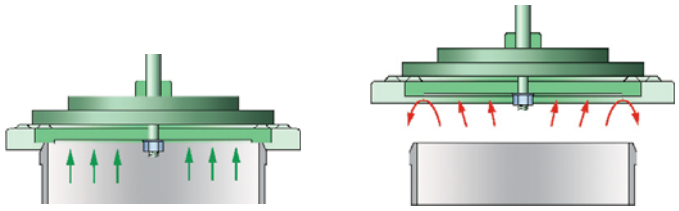
**PROTEGO® pressure/vacuum disc** relief valves have weight-loaded or spring-loaded valve pallets.

**PROTEGO® pressure/vacuum relief valves with a full-lift disc** discharge the volumetric flow within 10% overpressure from the set pressure up to full lift. After the response, the valve pallet immediately transitions to a full lift (Figs. 1 and 2).



*closed* *outflow with full lift*

*Fig. 1: Outflow with a full-lift disc and air cushion seal*



*closed* *outflow with full lift*

*Fig. 2: Outflow with a full-lift disc and metal seal*

This is attained by precisely harmonizing the diameter and height of the valve pallet rim with the adapted, lapped valve seat. In addition, a flow-enhancing design reinforces the overall effect on the outflow side. These valve pallets are used in end-of-line valves and in-line valves. The arrangement of valve pallet guidance and seal is combined in the term valve pallet.

Given the right size, the unique **10% technology** of the valves enables a set pressure that is just 10% below the maximum allowable tank pressure. For tanks with emergency relief vents the openingpressure of the relief valve needs to be below the set pressure of the emergency relief vent. The valve immediately opens to a full lift under a full load like a classic safety valve but in response to minimum changes in pressure. The full-lift discs are the result of years of development. The ingenious engineering enables reliable valve pallet operation at a full load. The highly developed PROTEGO® manufacturing technology has produced a seal that is far superior to the conventional standard. This feature is supported by valve seats made of high-quality stainless steel and individually lapped valve pallets or valve seats with an air cushion seal, among other things.

**Diaphragm valves** are pressure/vacuum relief valves with a flexible diaphragm. Their special design is to satisfactorily handle problem products, even at extremely low temperatures below freezing, a thousand times over.

In addition to their full-lift characteristic, the closing pressure of self-contained **pilot valves** is just below the opening pressure, so that they close quickly to prevent product losses of contents.

Similar to pilot valves, **high-velocity-vent valves** have a pop-upen characteristic after which the flow is discharged corresponding to the flow chart.

## Special features and advantages

- Large flows with only a slight pressure drop
- Pressure setting close to the opening pressure (PROTEGO® 10% technology) for optimum retention of pressure in the system
- Seal superior to the normal standard values, which minimizes product loss
- The valve pallet is guided within the housing to protect against the weather

## Preferred Applications

PROTEGO® pressure/vacuum relief valves are used as inbreathing and outbreathing valves, pressure relief valves, conservation valves, for simple control, and for venting tanks and equipment when an unallowable vacuum or pressure is exceeded. They are used for low pressures, i.e. in pressure ranges in which classic safety valves cannot be used due to their limited performance characteristics. PROTEGO® valves are available as pressure relief valves, vacuum relief valves, or as combined pressure/vacuum relief valves.

PROTEGO® **diaphragm valves** are used for problem products and low temperatures.

**Pilot valves** are advantageous for special control responses or when a tight seal is required up to the point at which the valve starts to open.

**High-velocity-vent valves** are used **on tanker ships and for special land uses.**

## Installation and servicing

The valves come with detailed installation and servicing instructions.
Shipping braces are installed for safe transportation. Make sure that the transportation locks are removed before installing the valves. Startup checklists help to properly set up the valves for use.

## Selection and sizing

To operate the system properly, the right valve is to be selected.

The criteria for selecting the right device are:

**Function** – a pressure relief valve, a vacuum relief valve, or a combined pressure/vacuum relief valve, with a pipe-away connection if needed.

**Design** – a combined end-of-line valve or separate pressure relief and vacuum relief valves with a perpendicular connection or horizontal connection. The devices are weight-loaded; therefore the valves are to be installed vertically.

**The adjusted set pressure** – the standard maximum allowable (tank) pressure minus 10% overpressure; it determines the combination of materials for the disc.

**Type of seal** – for disc valves according to the pressure level, either with an air cushion seal, or with a metal seal to provide an extremely tight seal.

**Special operating conditions** – for viscous and adhesive media, for frost-protected operation, or for use with polymerizing products.

The **nominal diameter** of the valve is generally determined by the connecting flange of the pipe, tank, or system part, or by the design specified in the performance diagram. To size a valve, the flow must be known for the overpressure output (outbreathing) and vacuum output (inbreathing). The nominal diameter or number of valves may have to be adjusted. Take into account potential system counterpressure when connecting a pipe.

## 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 (i.e. for in- or out breathing of a storage tank this is the sum of the pump capacity and the thermal breathing requirement) and maximum allowable opening pressure (i.e. tank pressure) p in mbar / In W.C.

**Requested:** 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 (i.e. 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.

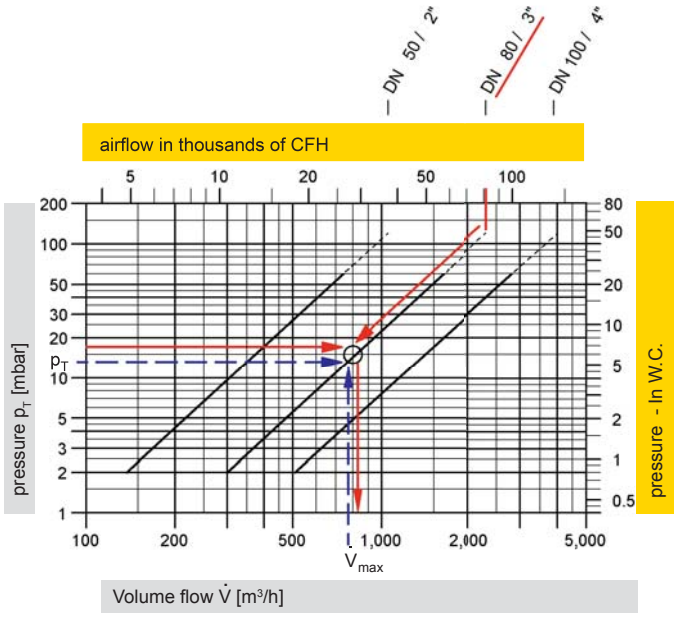
## Example 2

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 (i.e. tank pressure) p in mbar / In W.C.

Required: Volume flow in m³/h / CFH, set pressure $p_A$ in mbar / In 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!

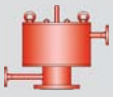
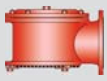


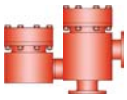

The required set pressure (= start of opening) will be the opening pressure (valve fully open) minus the characteristic overpressure.

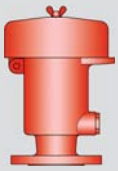
For PROTEGO® valves and end of line devices the overpressure characteristic is 10% unless otherwise stated. Within 10% overpressure the valve pallet will reach full lift. A further increase in flow performance will follow the pressure volume flow diagram.

Material selection is based on plant and engineering specifications.

## PROTEGO® Pressure/Vacuum-Relief-Valves - end-of-line

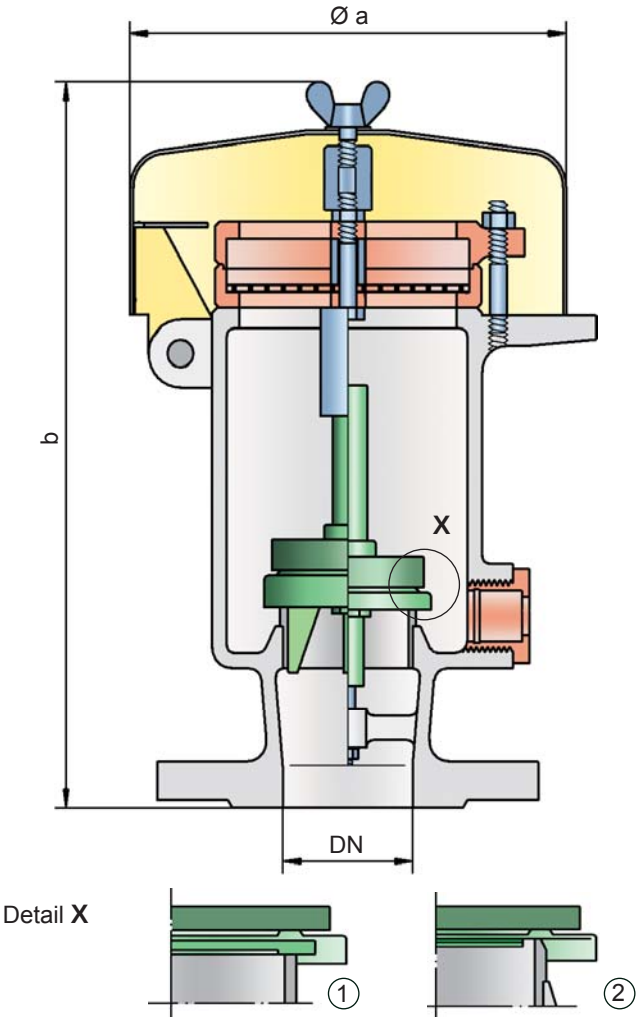
| | Type | Size | pressure setting positive setting range mbar / In W.C. | pressure setting negative setting range mbar / In W.C. | Design O = horizontal connection X = vertical connection | O = soft sealing X = metallic sealing | O = for non-standard operating parameters | O = for critical Medium (Polymerisation, Corrosion, Cristallisation) | O = Heating jacket, Heating coil | Page |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pressure Relief Valves, weight pallet type** | | | | | | | | | | |
|  | P/EL | 50 - 80<br>2" - 3" | +3.5 up to +210/<br>+1.4 up to +84 | | X | O / X | | | O | 8 - 9 |
|  | P/ELR | 80 - 100<br>3" - 4" | +3.5 up to +210/<br>+1.4 up to +84 | | X | O / X | | | O | 10 - 11 |
|  | SD/BS-H | 80-200<br>3" - 8" | +5 up to +210/<br>+2 up to +84 | | X | X | O | | O | 12 - 13 |
|  | D/SVL | 50-300<br>2" - 12" | +2.0 up to +60/<br>+0.8 up to +24 | | X | O / X | | | | 14 - 15 |
|  | ER/V | 200-700<br>8" - 28" | DN 200-350:<br>+5 up to +40/<br>+2 up to +16<br>DN 400-700:<br>+5 up to +25/<br>+2 up to +10 | | X | O | | | O | 16 - 17 |
|  | ER/VH | 200-700<br>8" - 28" | DN 200-350:<br>>+40 up to +60/<br>>+16 up to +24<br>DN 400-700:<br>>+25 up to +60/<br>>+10 up to +24 | | X | O | | | | 18 - 19 |
|  | ER/V-F | 200-700<br>8" - 28" | >+60 up to +500/<br>>+24 up to +200 | | X | O | | | | 20 - 21 |
|  | D/KSM | 50-200<br>2" - 8" | +5.0 up to +100/<br>+2.0 up to +40 | | X | O | O | O | | 22 - 24 |
| **Vacuum Relief Valves, weight pallet type** | | | | | | | | | | |
|  | SV/E-1-0 | 50 - 300<br>2" - 12" | | -2.0 up to -60 /<br>-0.8 up to -24 | O | O / X | | | O | 26 - 27 |
|  | SV/T-0-H | 80 - 250<br>3" - 10" | | -7.0 up to -50 /<br>-2.8 up to -20 | X | X | O | | O | 28 - 29 |
|  | V/KSM | 50-200<br>2" - 8" | | -5.0 up to -100 /<br>-2.0 up to -40 | O | O | O | O | | 30 - 32 |

| | Type | Size | pressure setting<br>positive setting range mbar / In W.C. | pressure setting<br>negative setting range mbar / In W.C. | Design O = horizontal connection X = vertical connection | O = soft sealing X = metallic sealing | O = for non-standard operating parameters | O = for critical Medium (Polymerisation, Corrosion, Cristallisation) | O = Heating jacket, Heating coil | Page |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pressure and Vacuum Relief Valves, weight pallet type** | | | | | | | | | | |
|  | PV/EL | 50 - 80<br>2" - 3" | +2.0 up to +210/<br>+0.8 up to +84 | -3.5 up to -35 /<br>-1.4 up to -14 | O | O / X | | | O | 34 - 37 |
|  | PV/ELR | 80 - 100<br>3" - 4" | +2.0 up to +210/<br>+0.8 up to +84 | -3.5 up to -50 /<br>-1.4 up to -20 | O | O / X | | | O | 38 - 41 |
|  | VD/SV | 50 - 80<br>2" - 3" | +2.0 up to +60 /<br>+0.8 up to +24 | -2.0 up to -60 /<br>-0.8 up to -24 | X | O / X | | | O | 42 - 44 |
|  | VD/SV-PA(L) | 50 - 300<br>2" - 12" | +2.0 up to +60 /<br>+0.8 up to +24 | -2.0 up to -60 /<br>-0.8 up to -24 | X | O / X | | | O | 46 - 49 |
|  | VD/KSM | 50 - 200<br>2" - 8" | +5.0 up to +100 /<br>+2.0 up to +40 | -5.0 up to -100 /<br>-2.0 up to -40 | X | O | O | O | | 50 - 52 |
|  | VD/KSM-PA | 50 - 200<br>2" - 8" | +5.0 up to +100 /<br>+2.0 up to +40 | -5.0 up to -100 /<br>-2.0 up to -40 | X | O | O | O | | 54 - 56 |
| **Pressure and Vacuum Relief Valves, pilot-operated** | | | | | | | | | | |
|  | PM/(D)S | 80 - 300<br>3" - 12" | +10 up to +300 /<br>+4.0 up to +120 | -3.0 up to -7 /<br>-1.2 up to -2.8 | X | X | O | | | 58 - 61 |
|  | PM/F | 80 - 300<br>3" - 12" | +10 up to +300 /<br>+4.0 up to +120 | -3.0 up to -10 /<br>-1.2 up to -4.0 | X | X | O | | | 62 - 65 |



# Pressure Relief Valve

## PROTEGO® P/EL




Detail **X**




### Pressure settings:

+3.5 mbar up to +210 mbar
+1.4 In W.C. up to +84 In W.C.
Higher pressure settings upon request.

### Function and Description

The P/EL type PROTEGO® valve is a highly developed pressure relief valve. It is primarily used as a safety device for relieving pressure in tanks, containers and process engineering equipment. The valve protect against unallowable overpressure and prevents the unacceptable loss of product vapors close to the set pressure.

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 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 they enable the use of corrosive media. After the excess pressure is discharged, 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

- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- the valve pallet is guided within the housing to protect against harsh weather conditions
- can be used in areas subject to an explosion hazard
- self-actuated condensate drain

### Design Types and Specifications

The valve pallet is weight-loaded. At set pressures greater than 80 mbar (32.1 In W.C.), an elongated construction is used.

There are two different designs

Pressure valve in basic design **P/EL - –**

Pressure valve with heating jacket **P/EL - H**

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN | 50 / 2" | 50 / 2" | 80 / 3" | 80 / 3" |
|---|---|---|---|---|
| Set pressure | ≤ +80 mbar<br>≤ +32.1 In W.C. | > +80 mbar<br>> +32.1 In W.C. | ≤ +80 mbar<br>≤ +32.1 In W.C. | > +80 mbar<br>> +32.1 In W.C. |
| a | 218 / 8.58 | 218 / 8.58 | 218 / 8.58 | 218 / 8.58 |
| b | 287 / 11.30 | 452 / 17.80 | 289 / 11.38 | 454 / 17.87 |

Dimensions for pressure valves with heating jacket upon request

**Table 2: Material selection for housing**

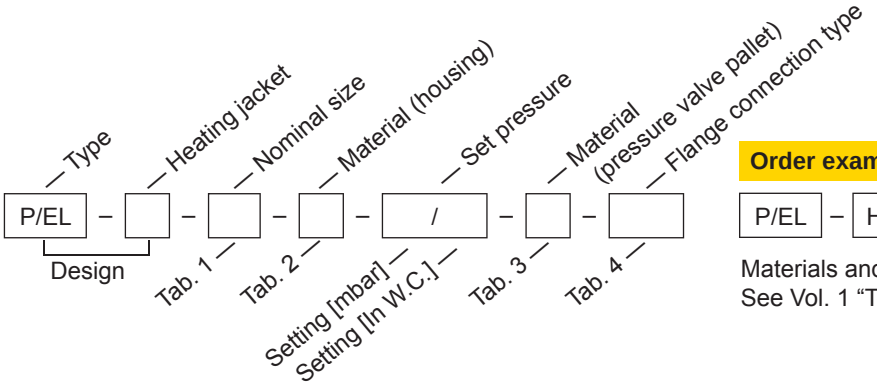
| Design | B | C | |
|---|---|---|---|
| Housing<br>Heating jacket (P/EL-H-...) | Steel<br>Steel | Stainless Steel<br>Stainless Steel | Special materials upon request |
| Valve seat | Stainless Steel | Stainless Steel | |
| Weather hood | Steel | Stainless Steel | |
| Protective mesh screen | Stainless Steel | Stainless Steel | |

**Table 3: Material selection for pressure valve pallet**

| Design | | A | B | C | D | |
|---|---|---|---|---|---|---|
| Pressure range | [mbar]<br>[In W.C.] | +3.5 up to +5.0<br>+1.4 up to +2.0 | >+5.0 up to +14<br>>+1.4 up to +5.6 | >+14 up to +210<br>>+5.6 up to +84 | >+14 up to +210<br>>+5.6 up to +84 | Special materials (Aluminum-coated, Titanium, Hastelloy) and higher pressure settings upon request |
| Valve pallet | | Aluminium | Stainless Steel | Stainless Steel | Stainless Steel | |
| Sealing | | FEP | FEP | Metal to Metal | PTFE | |

**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 | |

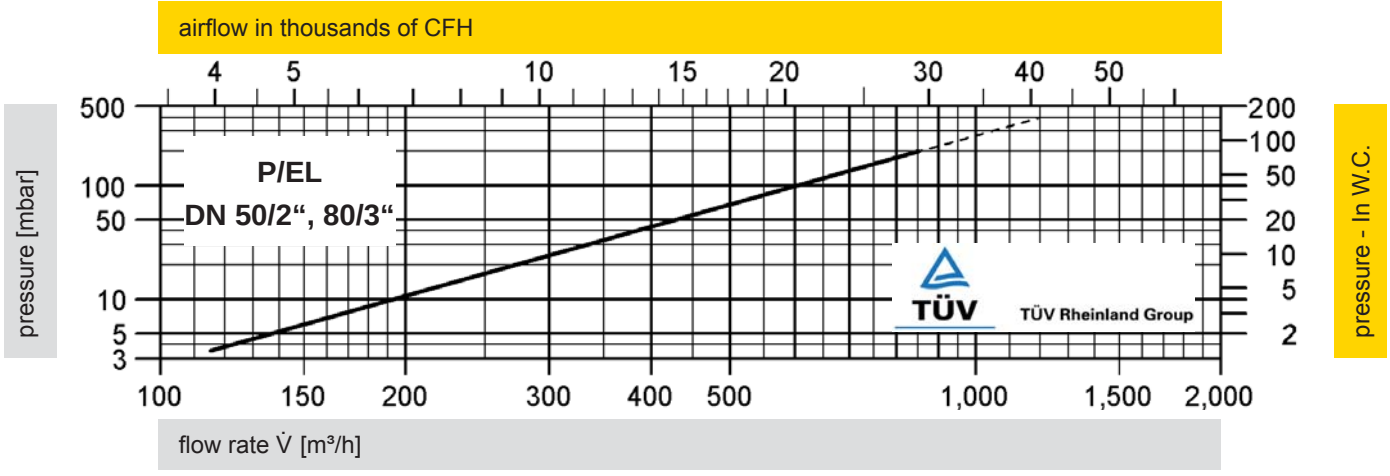



**Order example**

| P/EL | – | H | – | 50 | – | B | – | 50 / - | – | D | – | DIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

## Flow Capacity Chart




The flow capacity curve 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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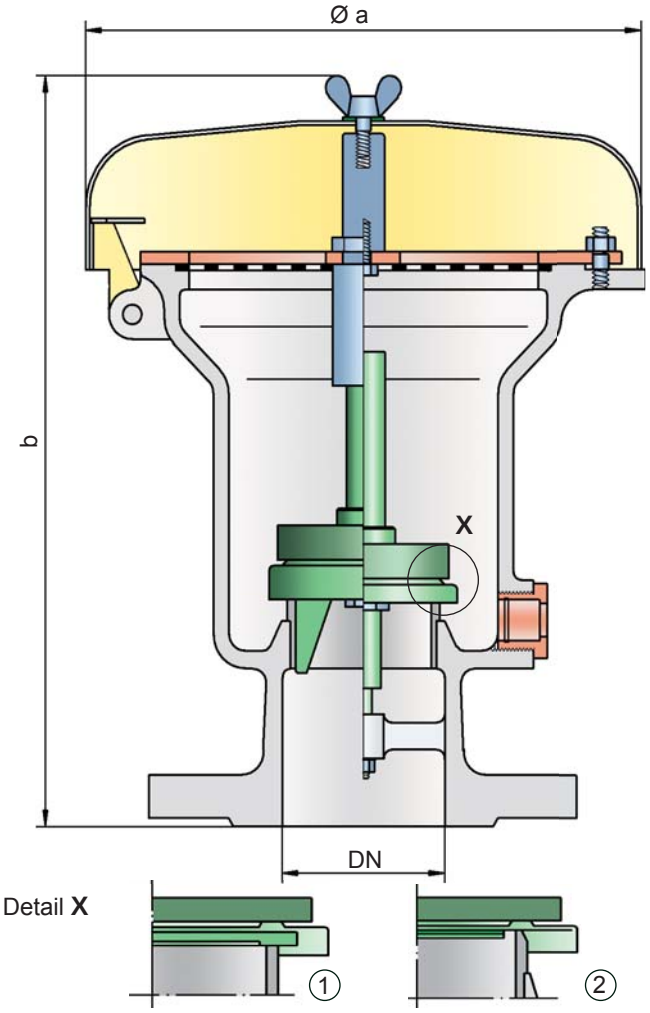
# Pressure Relief Valve

## PROTEGO® P/ELR




### Pressure settings:

+3.5 mbar up to +210 mbar
+1.4 In W.C. up to +84 In W.C.
Higher pressure settings upon request.

### Function and Description

The P/ELR type PROTEGO® valve is a highly developed pressure relief valve with excellent flow performance. It is primarily used as a safety device for relieving pressure in tanks, containers, and process engineering equipment. The valve offers reliable protection against overpressure and prevents the unacceptable loss of product vapors close to the set pressure.

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 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, 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

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- high flow capacity
- the valve pallet is guided within the housing to protect against harsh weather conditions
- Can be used in areas subject to an explosion hazard
- self-actuated condensate drain

### Design Types and Specifications

The valve pallet is weight-loaded. At set pressures greater than 80 mbar (32.1 In W.C.), an elongated construction is used.

There are two different designs

Pressure valve in basic design **P/ELR - [–]**

Pressure valve with heating jacket **P/ELR - [H]**

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN | 80 / 3" | 80 / 3" | 100 / 4" | 100 / 4" |
|---|---|---|---|---|
| Set pressure | ≤ +80 mbar<br>≤ +32.1 In W.C. | > +80 mbar<br>> +32.1 In W.C. | ≤ +80 mbar<br>≤ +32.1 In W.C. | > +80 mbar<br>> +32.1 In W.C. |
| a | 353 / 13.90 | 353 / 13.90 | 353 / 13.90 | 353 / 13.90 |
| b | 345 / 13.58 | 505 / 19.88 | 345 / 13.58 | 505 / 19.88 |

Dimensions for pressure valves with heating jacket upon request

**Table 2: Material selection for housing**

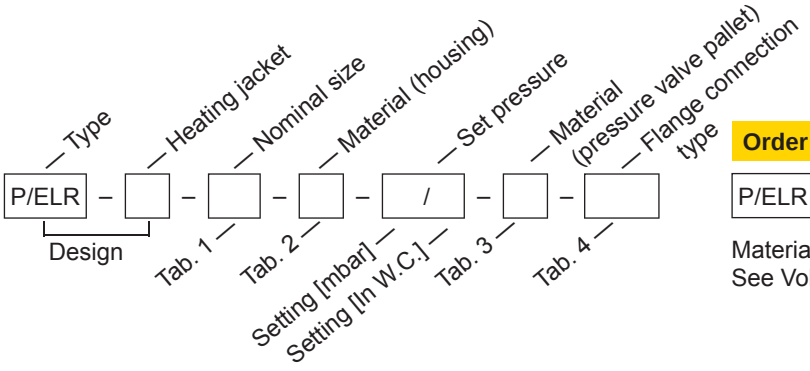
| Design | B | C | |
|---|---|---|---|
| Housing<br>Heating jacket (P/ELR-H-...) | Steel<br>Steel | Stainless Steel<br>Stainless Steel | Special materials upon request |
| Valve seat | Stainless Steel | Stainless Steel | |
| Weather hood | Steel | Stainless Steel | |
| Protective mesh screen | Stainless Steel | Stainless Steel | |

**Table 3: Material selection for pressure valve pallet**

| Design | A | B | C | D | |
|---|---|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | +3.5 up to +5.0<br>+1.4 up to +2.0 | >+5.0 up to +14<br>>+1.4 up to +5.6 | >+14 up to +210<br>>+5.6 up to +84 | >+14 up to +210<br>>+5.6 up to +84 | Special materials (Aluminum-coated, Titanium, Hastelloy) and higher pressure settings upon request |
| Valve pallet | Aluminium | Stainless steel | Stainless steel | Stainless steel | |
| Sealing | FEP | FEP | Metal to Metal | PTFE | |

**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 | |

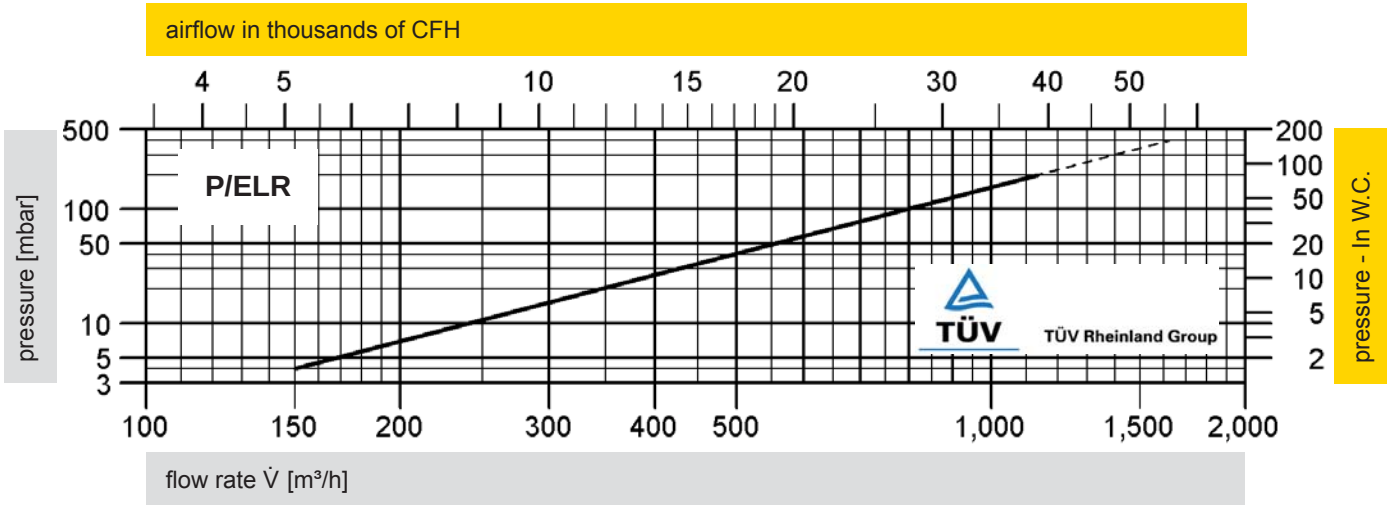



**Order example**

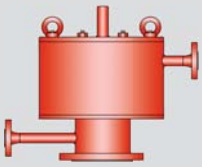
P/ELR – H – 100 – B – 100 / - – D – DIN

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

## Flow Capacity Chart



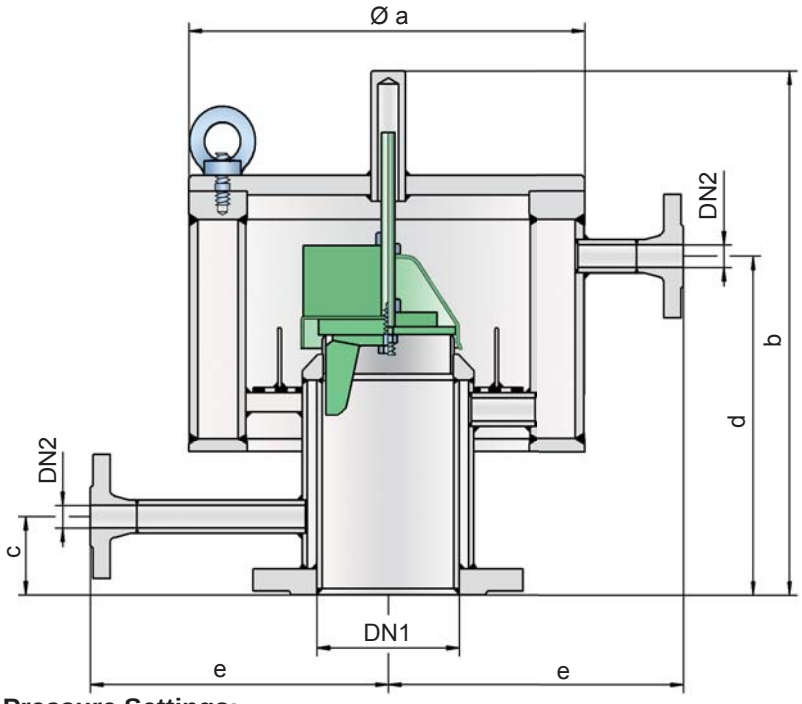

The flow capacity chart has been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in [m³/h] and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.



# Pressure Relief Valve

**in heat jacketed design**

## PROTEGO® SD/BS-H




### Pressure Settings:

+5.0 mbar up to +210 mbar
+2.0 in W.C. up to +84 in W.C.
Higher pressure settings upon request.

### Function and Description

The SD/BS-H type PROTEGO® valve is a highly developed pressure relief valve with a heating jacket down to the flange. It is primarily used as pressure relief device for vessels and process engineering equipment under difficult operating conditions. This includes extreme weather conditions or products that tend to form polymers at certain temperatures, adhere, or form deposits that negatively influence function (such as bitumen, tar, dust). The valve offers reliable protection against overpressure and prevents the unacceptable loss of product vapors close to the set pressure.

When the set pressure is reached, the valve starts to open and is fully open within 10% overpressure. This unique 10% ”full lift type technology” enables a pressure setting that is only 10% below the maximum allowable working pressure or design pressure of the tank. Even in the low pressure range the vent has the opening characteristic comparable to a typical high pressure safety relief valve. The full lift type pallets are a result of many years of development. The reliable engineering enables stable valve pallet operation.

Due to our highly developed manufacturing technology, the tank pressure is maintained up to the set pressure, with a seal that is far superior to the conventional standard. This feature is ensured by valve seats made of high-grade stainless steel with precisely lapped valve pallets and a reinforced housing design. After the excess pressure is discharged, the valve reseats and provides a tight seal again.

### Special Features and Advantages

- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- the valve pallet is guided within the housing to protect against harsh weather conditions
- can be used in areas subject to an explosion hazard
- heating jacketed design down to the flange to avoid cold bridges
- maximum permissible heating medium temperature of 320°C / 608°F (at 6 bar / 87 psi)
- a special design with a heatable valve cover is available
- at low pressure settings, an optimized valve pallet cover prevents the set pressure from being distorted by dust or condensate
- reinforced housing design
- a special design with a mechanical vent pallet lift device is available

### Design Types and Specifications

The valve pallet is weight-loaded. Starting at a set pressure of 30 mbar, a vane guide is also used.

Pressure valve in basic design with heating jacket **SD/BS - H**

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN1 | DN2 | a | b ≤ 30 mbar ≤ 12 in W.C. | b > 30 mbar > 12 in W.C. | c | d ≤ 30 mbar ≤ 12 in W.C. | d > 30 mbar > 12 in W.C. | e |
|---|---|---|---|---|---|---|---|---|
| 80 / 3" * | 15 / ½" | 325 / 12.80 | 400 / 15.75 | 515 / 20.28 | 70 / 2.76 | 250 / 9.84 | 390 / 15.35 | 250 / 9.84 |
| 100 / 4" | 15 / ½" | 325 / 12.80 | 400 / 15.75 | 505 / 19.88 | 60 / 2.36 | 250 / 9.84 | 380 / 14.96 | 250 / 9.84 |
| 150 / 6" | 15 / ½" | 405 / 15.94 | 460 / 18.11 | 595 / 23.43 | 60 / 2.36 | 315 / 12.40 | 470 / 18.50 | 290 / 11.42 |
| 200 / 8" | 15 / ½" | 510 / 20.08 | 470 / 18.50 | 575 / 22.64 | 65 / 2.56 | 305 / 12.01 | 445 / 17.52 | 340 / 13.39 |

* also available with special flange DN 50 / 2"

**Table 2: Material selection for housing**

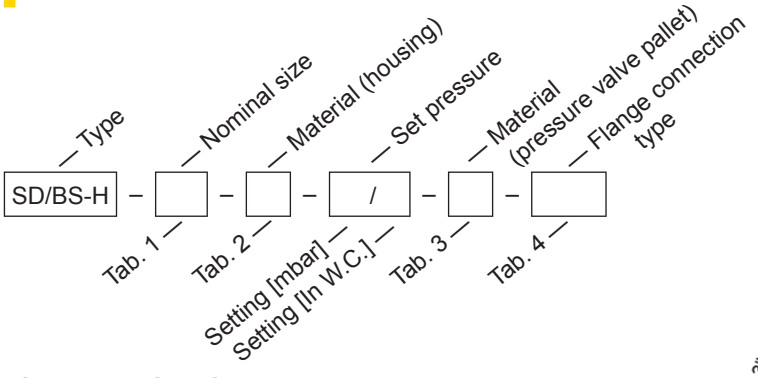
| Design | A | B | |
|---|---|---|---|
| Housing<br>Heating Jacket | Steel<br>Steel | Stainless Steel<br>Stainless Steel | Special materials upon request |
| Valve Seat | Stainless Steel | Stainless Steel | |

**Table 3: Material selection for pressure valve pallet**

| Design | A | B | C | |
|---|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | +5 up to +25<br>+2 up to +10 | >+10 up to +30<br>>+4 up to +12 | >+30 up to +210<br>>+12 up to +84 | Special materials and higher pressure settings upon request |
| Valve pallet | Aluminium | Stainless Steel | Stainless Steel | |
| Valve pallet hood | Stainless Steel | Stainless Steel | - | |
| Sealing | Metal to Metal | Metal to Metal | Metal to Metal | |

**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 | |

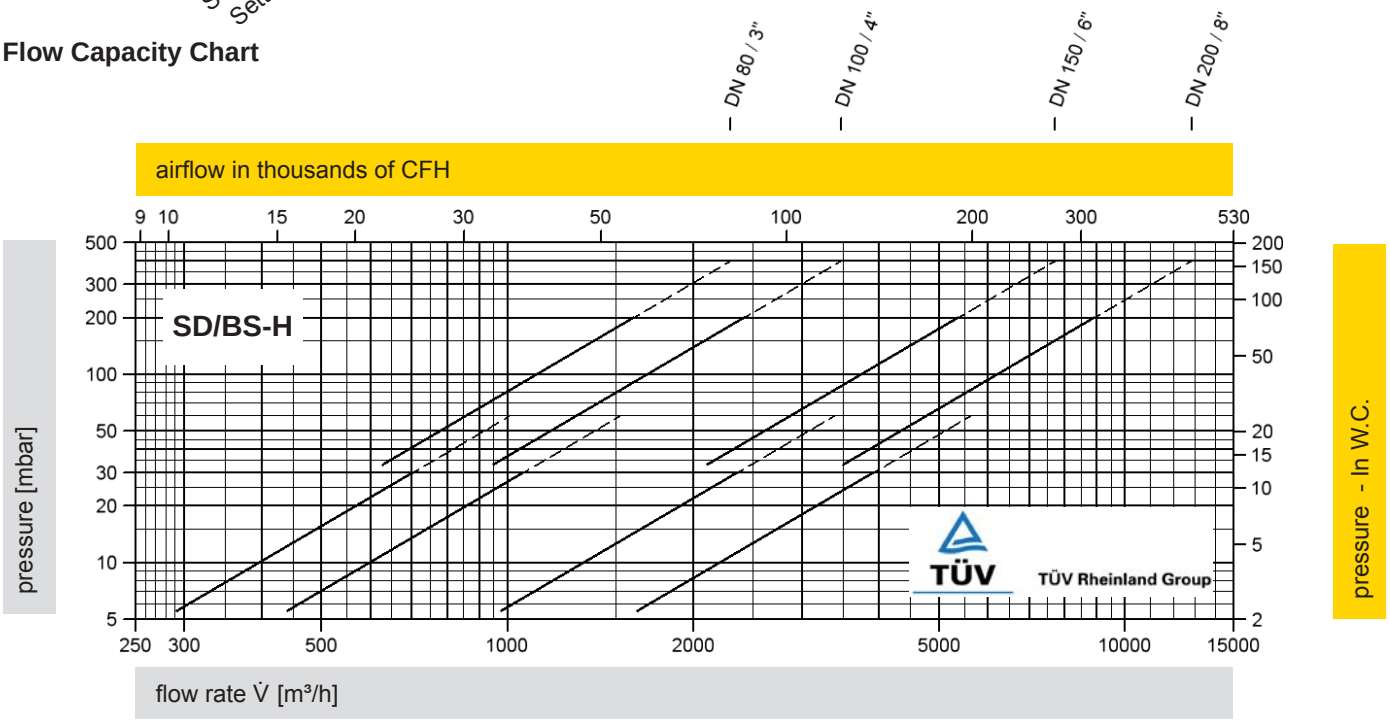



**Order example**

SD/BS-H – 200 – B – 50/ - – B – DIN

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

## 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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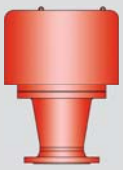
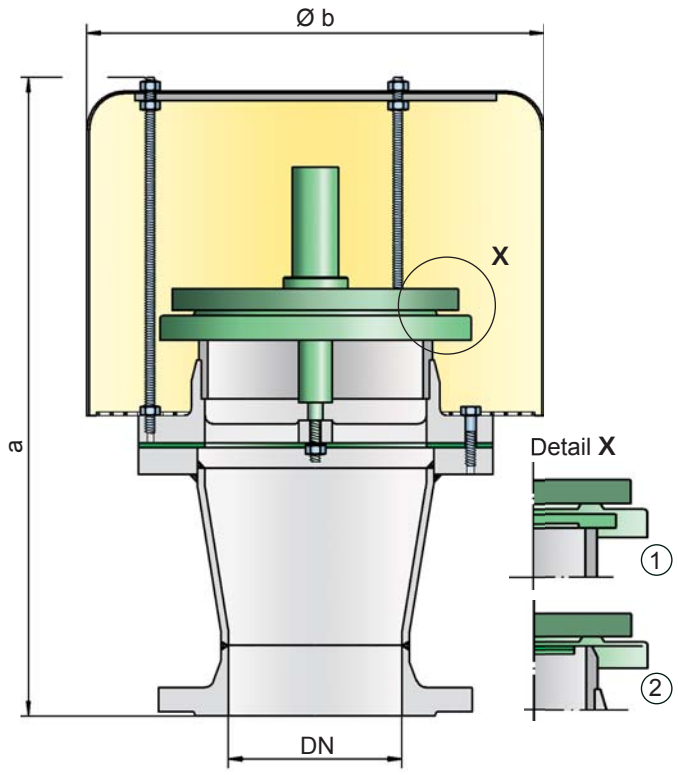


# Pressure Relief Valve

## PROTEGO® D/SVL




### Pressure settings:

+2.0 mbar up to +60 mbar
+0.8 in W.C. up to +24 in W.C.
Higher pressure settings upon request.

### Function and Description

The D/SVL type PROTEGO® valve is a high performance pressure relief valve. It is primarily used as a safety device for relieving pressure in tanks, containers, and process engineering equipment. The valve offers reliable protection against overpressure and prevents the unacceptable loss of product vapors close to the set pressure.

When the set pressure is reached, the valve starts to open and is fully open within 10% overpressure. This unique 10% ”full lift type technology” enables a pressure setting that is only 10% below the maximum allowable working pressure or design pressure of the tank. Even in the low pressure range the vent has the opening characteristic comparable to a typical high pressure safety relief valve. The full lift type pallets are a result of many years of development. The reliable engineering enables stable valve pallet operation.

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set pressure, with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of high grade stainless steel with precisely lapped valve pallets and seats (1) or with an air cushion seal and precisely lapped seats (2). The valve pallets are also available with a PTFE seal to prevent the valve pallet from sticking when sticky products are used, and they enable the use of corrosive media. After the excess pressure is discharged, the valve reseats and provides a tight seal again.

### Special Features and Advantages

- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- extremely high flow capacity
- the valve pallet is guided within the housing to protect against harsh weather conditions
- can be used in areas subject to an explosion hazard

### Design Types and Specifications

The valve pallet is weight-loaded. Higher pressures can be achieved upon request with a special spring-loaded design.

Pressure valve in basic design **D/SVL -**

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" |
|---|---|---|---|---|---|---|---|
| a | 345 / 13.58 | 415 / 16.34 | 445 / 17.52 | 565 / 22.24 | 665 / 26.18 | 690 / 27.17 | 690 / 27.17 |
| b | 200 / 7.87 | 295 / 11.61 | 295 / 11.61 | 465 / 18.31 | 550 / 21.65 | 650 / 25.59 | 650 / 25.59 |

**Table 2: Material selection for housing**

| Design | A | B | Special Materials upon request |
|---|---|---|---|
| Housing | Steel | Stainless Steel | |
| Valve seat | Stainless Steel | Stainless Steel | |
| Sealing | WS 3822 | PTFE | |
| Weather hood | Stainless Steel | Stainless Steel | |

**Table 3: Material selection for pressure valve pallet**

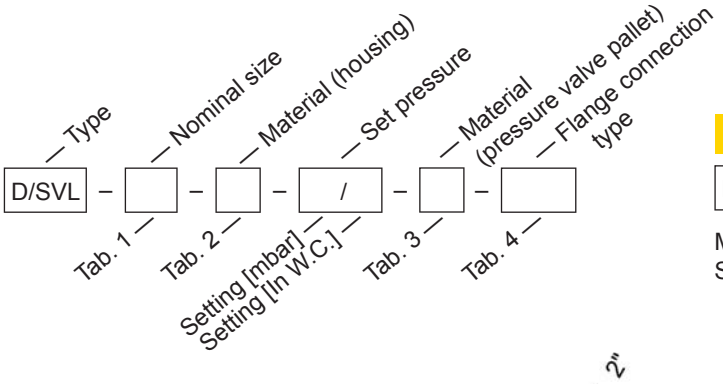
| Design | | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| Pressure range | [mbar] | +2.0 up to +3.5 | >+3.5 up to +14 | >+14 up to +35 | >+35 up to +60 | >+14 up to +35 | >+35 up to +60 |
| | [In W.C.] | +0.8 up to +1.4 | >+1.4 up to +5.6 | >+5.6 up to +14 | >+14 up to +24 | >+5.6 up to +14 | >+14 up to +24 |
| Valve | | Aluminium | Stainless steel | Stainless steel | Stainless steel | Stainless steel | Stainless steel |
| Sealing | | FEP | FEP | Metal to Metal | Metal to Metal | PTFE | PTFE |

Special Materials (Alu-coated, Titan, Hastelloy), higher pressure settings upon request

**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

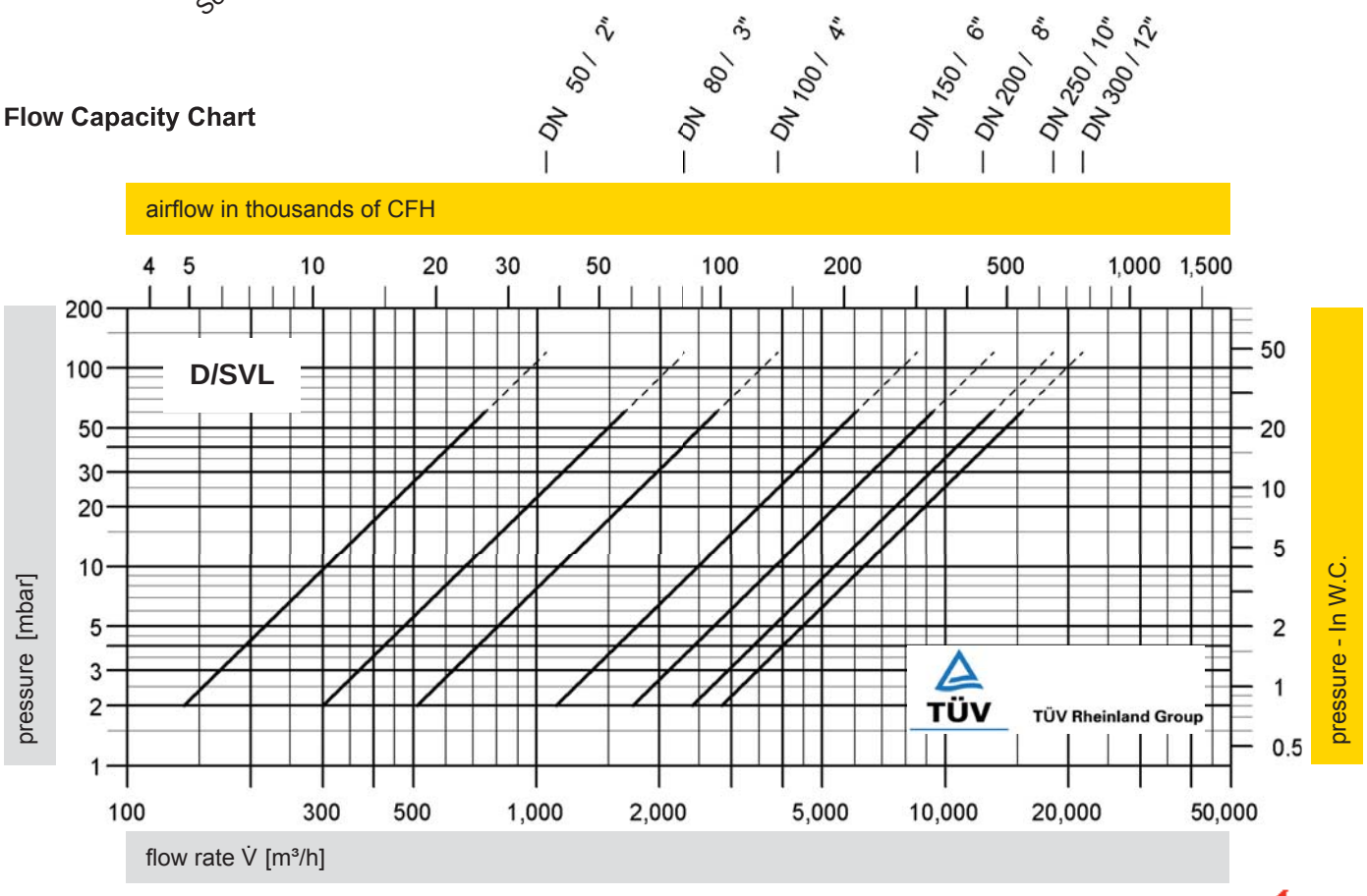



**Order example**

D/SVL – 200 – B – 50/ – F – DIN

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

## 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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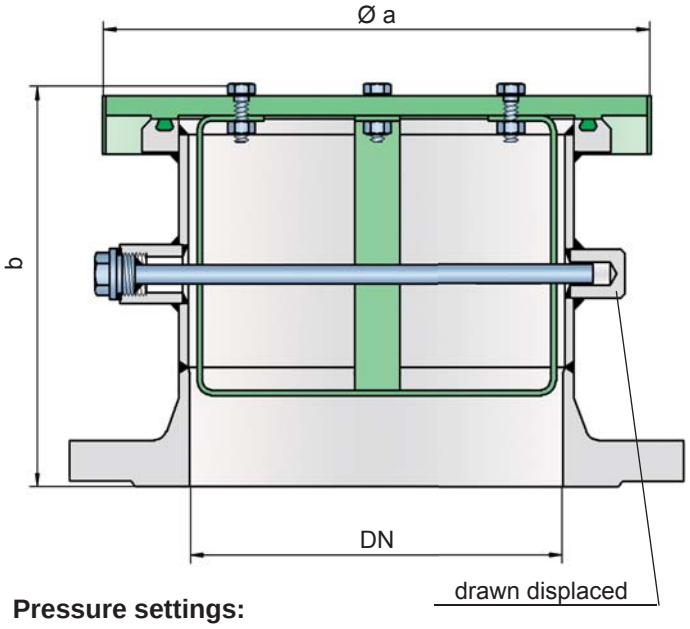
# Emergency pressure relief valve

## PROTEGO® ER/V




### Pressure settings:

| | | | |
|---|---|---|---|
| DN 200 to DN 350: | +5 mbar | up to | +40 mbar |
| | +2 In W.C. | up to | +16 In W.C. |
| DN 400 to DN 700: | +5 mbar | up to | +25 mbar |
| | +2 In W.C. | up to | +10 In W.C |

For higher pressure settings, see types ER/VH and ER/V-F.

### Function and Description

The ER/V type PROTEGO® valve is a highly developed emergency pressure relief valve valve. It is primarily used as a safety device for emergency pressure relief for storage tanks, containers, silos, and process engineering equipment; it offers reliable protection against overpressure and prevents impermissible product vapor loss close to the set pressure. It is designed to relief particularly large amounts to prevent the vessel from rupturing in an emergency case.

When the set pressure is reached, the valve starts to open and is fully open within 10% overpressure. This unique 10% ”full lift type technology” enables a pressure setting that is only 10% below the maximum allowable working pressure or design pressure of the tank. Even in the low pressure range the vent has the opening characteristic comparable to a typical high pressure safety relief valve. The full lift type pallets are a result of many years of development. The reliable engineering enables stable valve pallet operation.

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set pressure, with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of stainless steel with an inserted O-ring seal, a precisely lapped valve pallet, as well as a reinforced housing design. After the excess pressure is relieved, the valve reseats and provides a tight seal again.

### Special Features and Advantages

- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- the valve pallet is guided within the housing to protect against harsh weather conditions
- can be used in areas subject to explosion hazards
- reinforced design
- safely secured housing cover
- best technology for API-tanks

### Design Types and Specifications

The valve pallet is weight-loaded. Higher pressures are achieved with levers (see ER/VH) or with spring-loading (see ER/V-F).

Pressure valve in basic design **ER/V**

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN | 200 / 8" | 250 / 10" | 300 / 12" | 350 / 14" | 400 / 16" | 450 / 18" | 500 / 20" | 600 / 24" | 700 / 28" |
|---|---|---|---|---|---|---|---|---|---|
| a | 305 / 12.01 | 375 / 14.76 | 425 / 16.73 | 445 / 17.52 | 495 / 19.49 | 545 / 21.46 | 615 / 24.21 | 715 / 28.15 | 795 / 31.30 |
| b | depending on pressure setting | | | | | | | | |

**Table 2: Material selection**

| | | | |
|---|---|---|---|
| Design | A | C | * depending on pressure setting |
| Housing | Steel | Stainless Steel | |
| Valve seat | Stainless Steel | Stainless Steel | |
| Valve pallet | Aluminium or Steel-Stainless Steel* | Stainless Steel | Special Materials upon reqest |
| Sealing | FPM | FPM | |

**Table 7: 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 | |

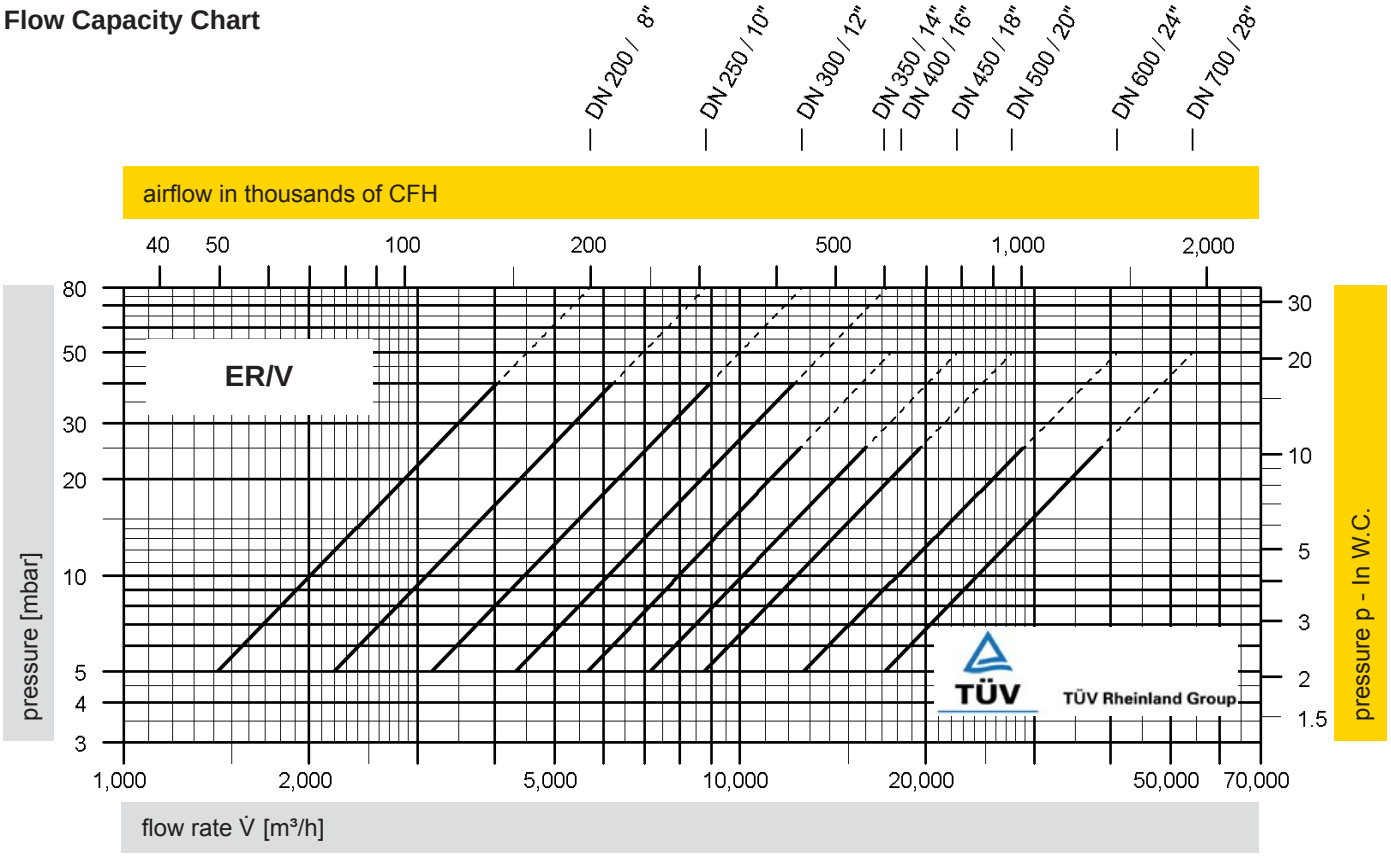
| Type | Nominal size | | Material | | Set pressure | | Flange connection type |
|---|---|---|---|---|---|---|---|
| ER/V | – | | – | | – / | – | |
| | Tab. 1 | | Tab. 2 | | Setting [mbar] / Setting [In W.C.] | | Tab. 3 |

**Order example**

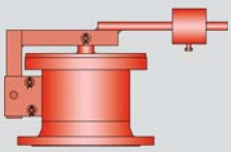
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ER/V | – | 500 | – | C | – | 20/ - | – | DIN |

Materials and chemical resistance: See Vol. 1 “Technical Fundamentals”

## Flow Capacity Chart

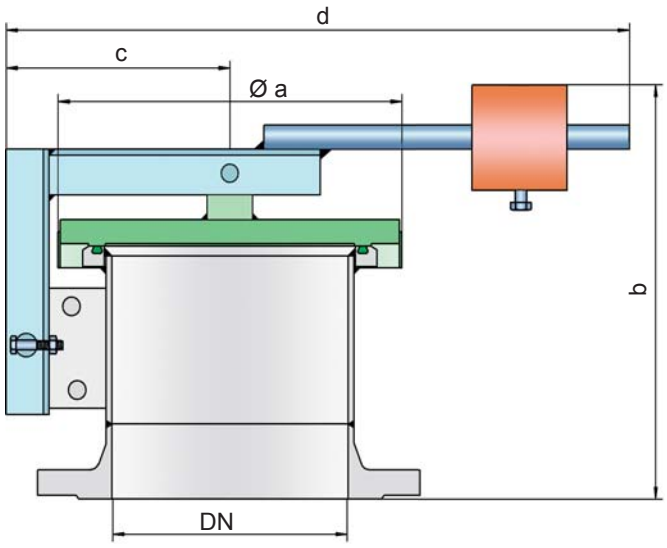



The flow capacity chart has been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in [m³/h] and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.



# Pressure Relief Valve

## PROTEGO® ER/VH




### Pressure settings:

| | | | |
|---|---|---|---|
| DN 200 to DN 350: | >+40 mbar | up to | +60 mbar |
| | >+16 In W.C. | up to | +24 In W.C. |
| DN 400 to DN 700: | >+25 mbar | up to | +60 mbar |
| | >+10 In W.C. | up to | +24 In W.C. |

Higher and lower pressure settings, upon request.

### Function and Description

The ER/VH type PROTEGO® valve is a highly developed emergency pressure relief valve. It is primarily used as a safety device for emergency pressure relief for storage tanks, containers, silos, and process engineering equipment; it offers reliable protection against overpressure and prevents impermissible product vapor loss close to the set pressure. It is designed to discharge particularly large amounts to prevent the vessel from rupturing in an emergency case. Higher set pressures are achieved by a lever with lockable weight loading. The position of the weight is factory-marked. Starting at DN 500, the devices can also be used as manhole covers.

When the set pressure is reached, the valve starts to open and is fully open within 10% overpressure. This unique 10% ”full lift type technology” enables a pressure setting that is only 10% below the maximum allowable working pressure or design pressure of the tank. Even in the low pressure range the vent has the opening characteristic comparable to a typical high pressure safety relief valve. The full lift type pallets are a result of many years of development. The valve pallet is mounted on one side.

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set pressure, with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of stainless steel with an inserted O-ring seal, a precisely lapped valve pallet, as well as a reinforced housing design. After the excess pressure is discharged, the valve reseats and provides a tight seal again.

### Special Features and Advantages

- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- can be used in areas subject to explosion hazards
- reinforced housing design
- safely secured housing cover
- best technology for API-tanks

### Design Types and Specifications

The valve pallet is weight-loaded. Lower pressures are generally achieved without a lever design (see ER/V), and higher pressures are realized with spring-loading (see ER/V-F).

| | |
|---|---|
| Pressure valve in basic design | **ER/VH** |

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN | 200 / 8" | 250 / 10" | 300 / 12" | 350 / 14" | 400 / 16" | 450 / 18" | 500 / 20" | 600 / 24" | 700 / 28" |
|---|---|---|---|---|---|---|---|---|---|
| a | 305 / 12.01 | 375 / 14.76 | 425 / 16.73 | 445 / 17.52 | 495 / 19.49 | 545 / 21.46 | 615 / 24.21 | 715 / 28.15 | 795 / 31.30 |
| b | 350 / 13.78 | 365 / 14.37 | 385 / 15.16 | 390 / 15.35 | 390 / 15.35 | 415 / 16.34 | 420 / 16.53 | 450 / 17.72 | 465 / 18.31 |
| c | 200 / 7.87 | 240 / 9.45 | 265 / 10.43 | 285 / 11.22 | 310 / 12.20 | 330 / 12.99 | 360 / 14.17 | 410 / 16.14 | 450 / 17.72 |
| d | 590 / 23.23 | 735 / 28.94 | 780 / 30.71 | 845 / 33.27 | 890 / 35.04 | 1070 / 42.13 | 1090 / 42.91 | 1140 / 44.88 | 1380 / 54.33 |

**Table 2: Material selection**

| | | |
|---|---|---|
| Design | A | B |
| Housing | Steel | Stainless Steel |
| Valve seat | Stainless Steel | Stainless Steel |
| Valve pallet | Stainless Steel or Steel-Stainless Steel* | Stainless Steel |
| Sealing | FPM | FPM |
| Weight | Steel | Stainless Steel |

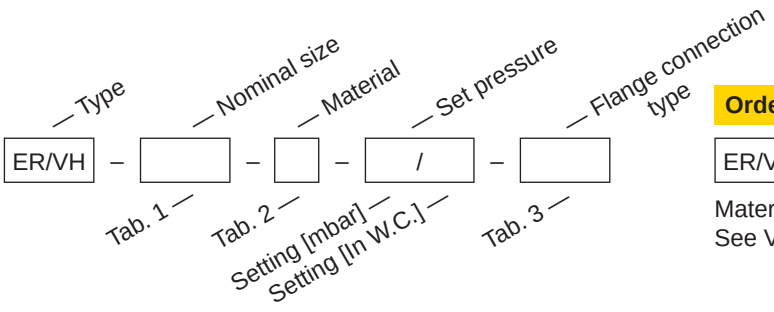
Special materials upon request

* depending on pressure setting

**Table 3: 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

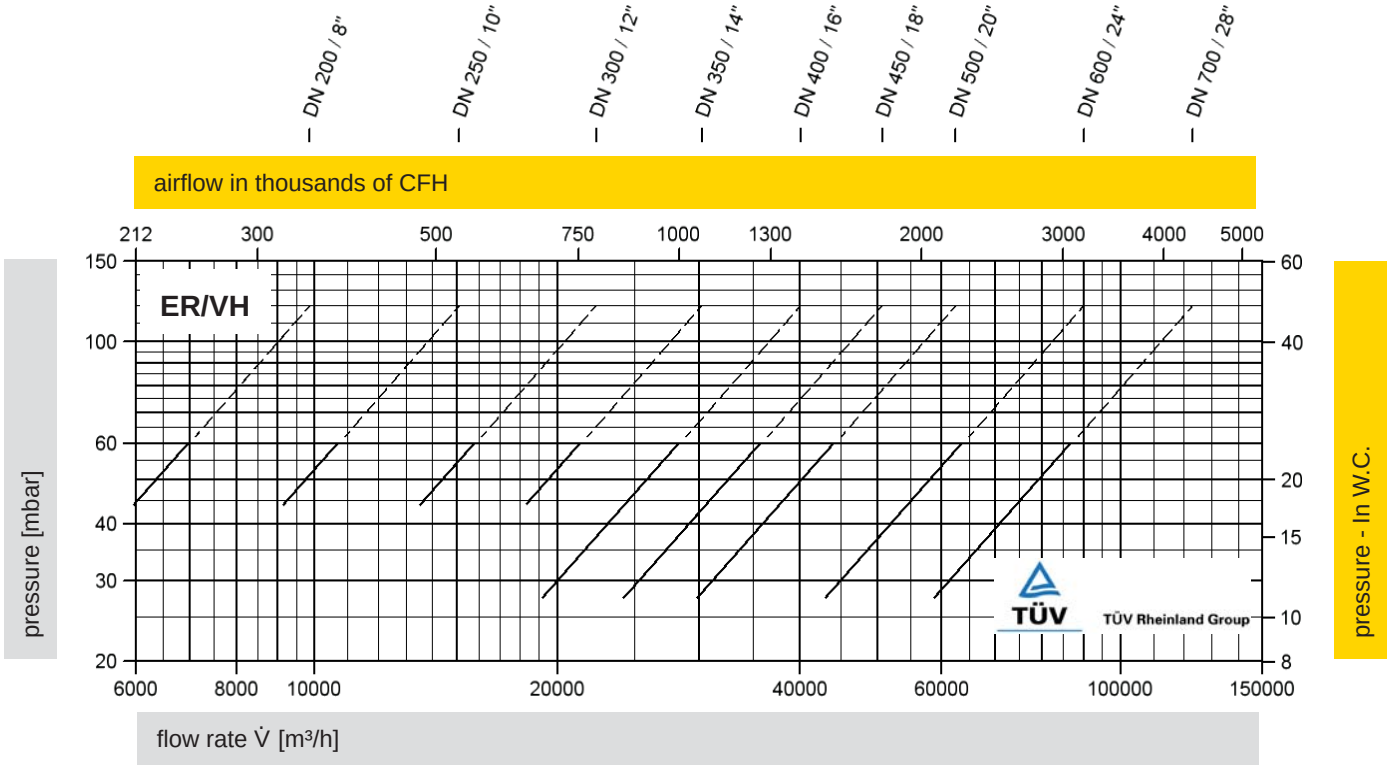



**Order example**

ER/VH – 500 – B – 50 / - – DIN

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

## 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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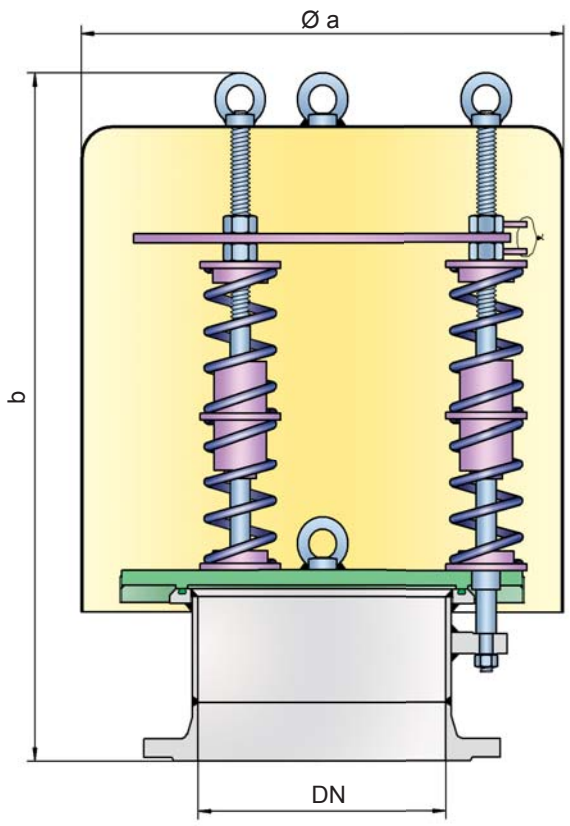
# Pressure Relief Valve

## PROTEGO® ER/V-F




### Pressure settings:

>+60 mbar up to +500 mbar
>+24 In W.C. up to +200 In W.C.
Higher pressure settings, upon request.
Lower pressure settings, see types ER/V and ER/VH.

### Function and Description

The ER/V-F type PROTEGO® valve is a highly developed emergency pressure relief valve. It is primarily used as a safety device for emergency pressure relief for storage tanks, containers, silos, and process engineering equipment; it offers reliable protection against overpressure and prevents impermissible product vapor loss close to the set pressure. It is designed to discharge particularly large amounts to prevent the vessel from rupturing in a emergency case. The spring-loading allows for higher set pressures than those with the ER/V or ER/VH.

When the set pressure is reached, the valve starts to open and is fully open within 10% overpressure. This unique 10% "full lift type technology" enables a pressure setting that is only 10% below the maximum allowable working pressure or design pressure of the tank. Even in the low pressure range the vent has the opening characteristic comparable to a typical high pressure safety relief valve. The full lift type pallets are a result of many years of development. The reliable engineering enables stable valve pallet operation.

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set pressure, with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of high-grade steel with an inserted O-ring seal, a precisely lapped valve pallet, as well as a reinforced housing design. After the excess pressure is relieved, the valve reseats and provides a tight seal again.

### Special Features and Advantages

- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- the valve pallet is guided within the housing to protect against harsh weather conditions
- can be used in areas subject to explosion hazards
- reinforced housing design
- spring-loading for high set pressures
- best technology for API-tanks

### Design Types and Specifications

The valve pallet is spring-loaded. Lower pressures are achieved with the ER/V and ER/VH designs.

Pressure valve in basic design **ER/V-F**

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

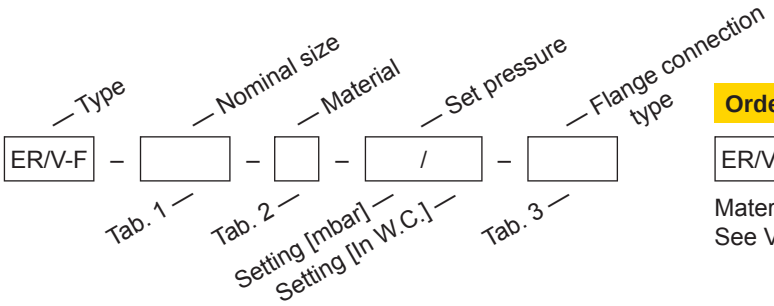
| DN | 200 / 8" | 250 / 10" | 300 / 12" | 350 / 14" | 400 / 16" | 450 / 18" | 500 / 20" | 600 / 24" | 700 / 28" |
|---|---|---|---|---|---|---|---|---|---|
| a | 465 / 18.31 | 550 / 21.65 | 650 / 25.59 | 650 / 25.59 | 800 / 31.50 | 800 / 31.50 | 1000 / 39.37 | 1000 / 39.37 | 1200 / 47.24 |
| b | 860 / 33.86 (≤370 mbar ≤148 InW.C.) | 860 / 33.86 (≤240 mbar ≤96 InW.C.) | 1170 / 46.06 (≤240 mbar ≤96 InW.C.) | 1170 / 46.06 (≤270 mbar ≤108 InW.C.) | 1150 / 45.28 (≤220 mbar ≤88 InW.C.) | 1175 / 46.26 (≤170 mbar ≤68 InW.C.) | 1430 / 56.30 (≤130 mbar ≤52 InW.C.) | 1425 / 56.10 (≤140 mbar ≤56 InW.C.) | 1690 / 66.54 (≤140 mbar ≤56 InW.C.) |
| b | 980 / 38.58 (>370 mbar >148 InW.C.) | 980 / 38.58 (>240 mbar >96 InW.C.) | 1490 / 58.66 (>240 mbar >96 InW.C.) | 1490 / 58.66 (>270 mbar ≤108 InW.C.) | 1490 / 58.66 (>220 mbar ≤88 InW.C.) | 1515 / 59.65 (>170 mbar >68 inW.C.) | 1660 / 65.35 (>130 mbar >52 InW.C.) | 1655 / 65.16 (>140 mbar >56 InW.C.) | 1910 / 75.20 (>140 mbar >56 InW.C.) |

| Table 2: Material selection | | |
|---|---|---|
| Design | A | B |
| Housing | Steel | Stainless Steel |
| Valve seat | Stainless Steel | Stainless Steel |
| Valve pallet | Stainless Steel or Steel-Stainless Steel* | Stainless Steel |
| Sealing | FPM | FPM |
| Pressure spring | Stainless Steel | Stainless Steel |
| Weather hood | Steel | Stainless Steel |

Special materials upon request
* depending on pressure setting

| Table 3: 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

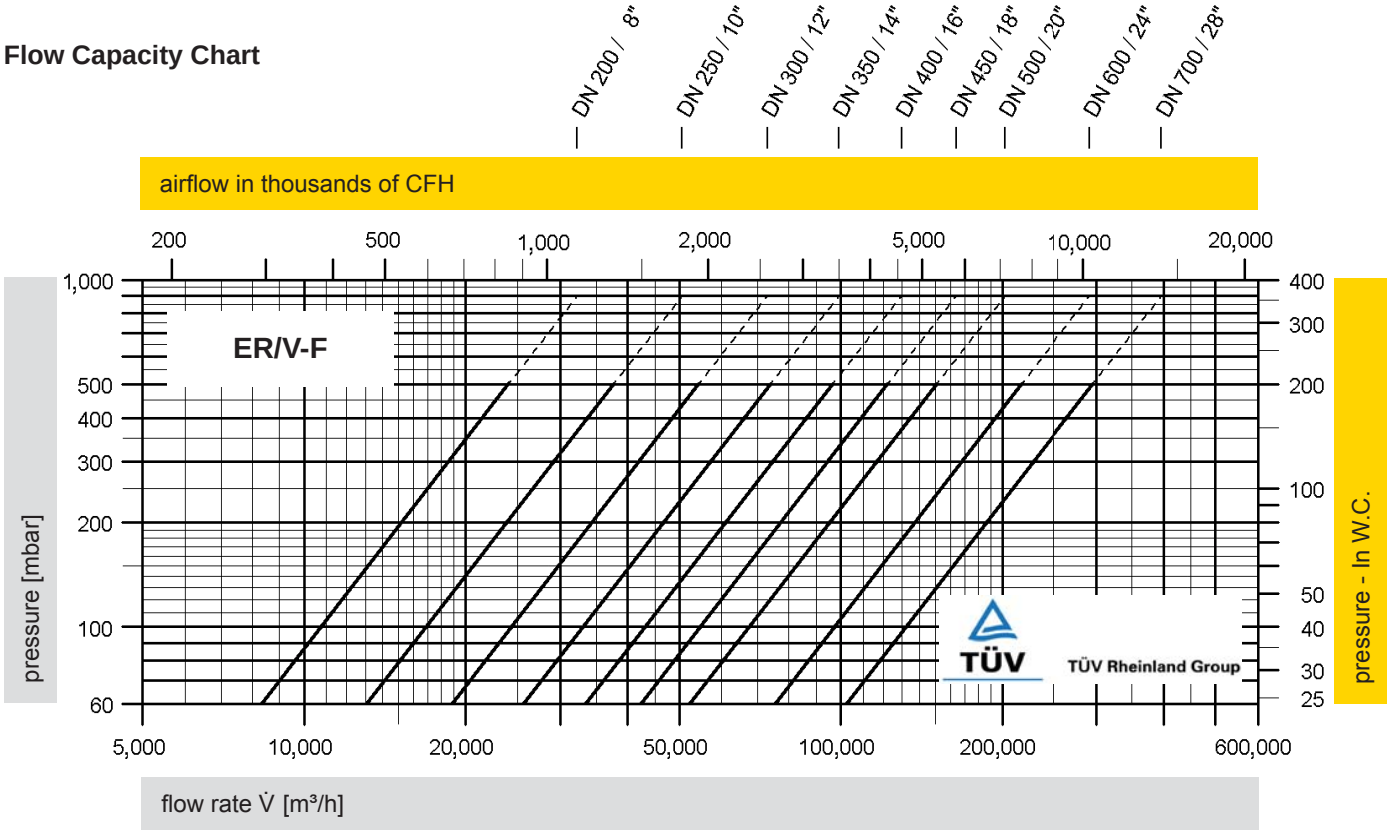



**Order example**

ER/V-F – 500 – B – 300/ - – DIN

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

## 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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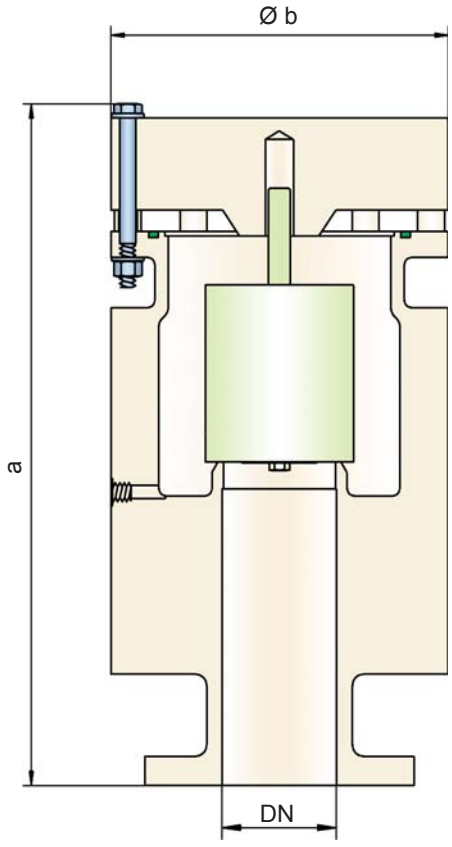
# Pressure Relief Valve

**made of plastic**

## PROTEGO® D/KSM




**Pressure settings:**
+5 mbar up to +100 mbar
+2 In W.C. up to +40 In W.C.
Higher pressure settings upon request.

### Function and Description

The PROTEGO® valve D/KSM is a state-of-the-art pressure relief valve with excellent flow performance made out of highgrade synthetic material. It is primarily used as a safety fitting for relieving pressure in tanks, containers, and process engineering equipment. The valve prevents emission losses almost up to the set pressure. 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 (MAWP) 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 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, 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
- the valve pallet is guided within the housing to protect against harsh weather conditions
- corrosion resistant valve
- weight reduction in comparsion to steel/stainless steel
- smooth surface
- condensate drain
- different plastics can be combined
- maintenance friendly design

### Design Types and Specifications

The valve pallet is weight-loaded, and the highest pressure levels are only attained with metal disks.

| | |
|---|---|
| Pressure valve in basic design | **D/KSM-** |

Additional special devices available upon request.

**Table 1: Dimensions** — Dimensions in mm / inches

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

| DN | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" |
|---|---|---|---|---|---|
| a | 376 / 14.80 | 521 / 20.51 | 563 / 22.17<br>(543 / 21.38)* | 687 / 27.05<br>(681 / 26.81)* | 952 / 37.48 |
| b | 180 / 7.09 | 250 / 9.84 | 300 / 11.81 | 350 / 13.78<br>(405 / 15.94)* | 560 / 22.05<br>(500 / 19.68)* |

* Dimensions in brackets only for PVDF

**Tabelle 2: Material selection for housing**

| Design | A | B | C | |
|---|---|---|---|---|
| Housing | PE | PP | PVDF | |
| Valve seats | PE | PP | PVDF | Special materials upon request |
| Sealing | FPM | FPM | FPM | |
| Valve pallet | A, C, D | B, C, D | C, D | |

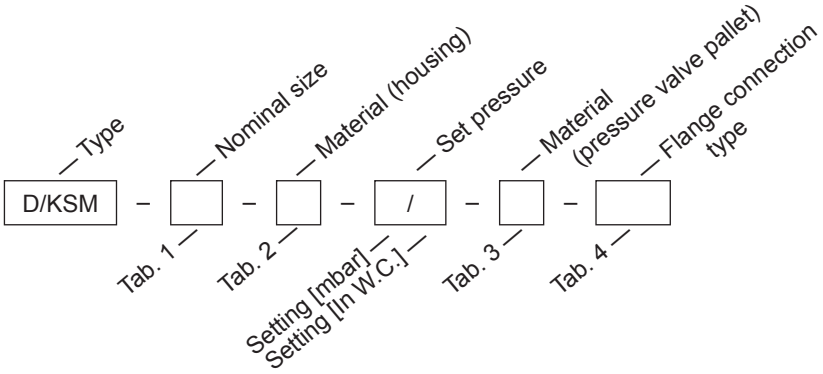
**Table 3: Material selection for pressure valve pallet**

| Design | A | B | C | D |
|---|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | +5.0 up to +17<br>+2.0 up to +6.8 | +5.0 up to +17<br>+2.0 up to +6.8 | +10 up to +32<br>+4.0 up to +12.8 | +30 up to +100<br>+12 up to +40 |
| Valve pallet | PE | PP | PVDF | Hastelloy |
| Sealing | PTFE | PTFE | PTFE | PTFE |
| Spindle guide | PE | PP | PVDF | Hastelloy |
| Weights | PE | PP | PVDF | Hastelloy |

Special materials and other pressure settings are available upon request

**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 | |




**Order example**

| D/KSM | – | 200 | – | A | – | 25 / - | – | C | – | DIN |
|---|---|---|---|---|---|---|---|---|---|---|

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

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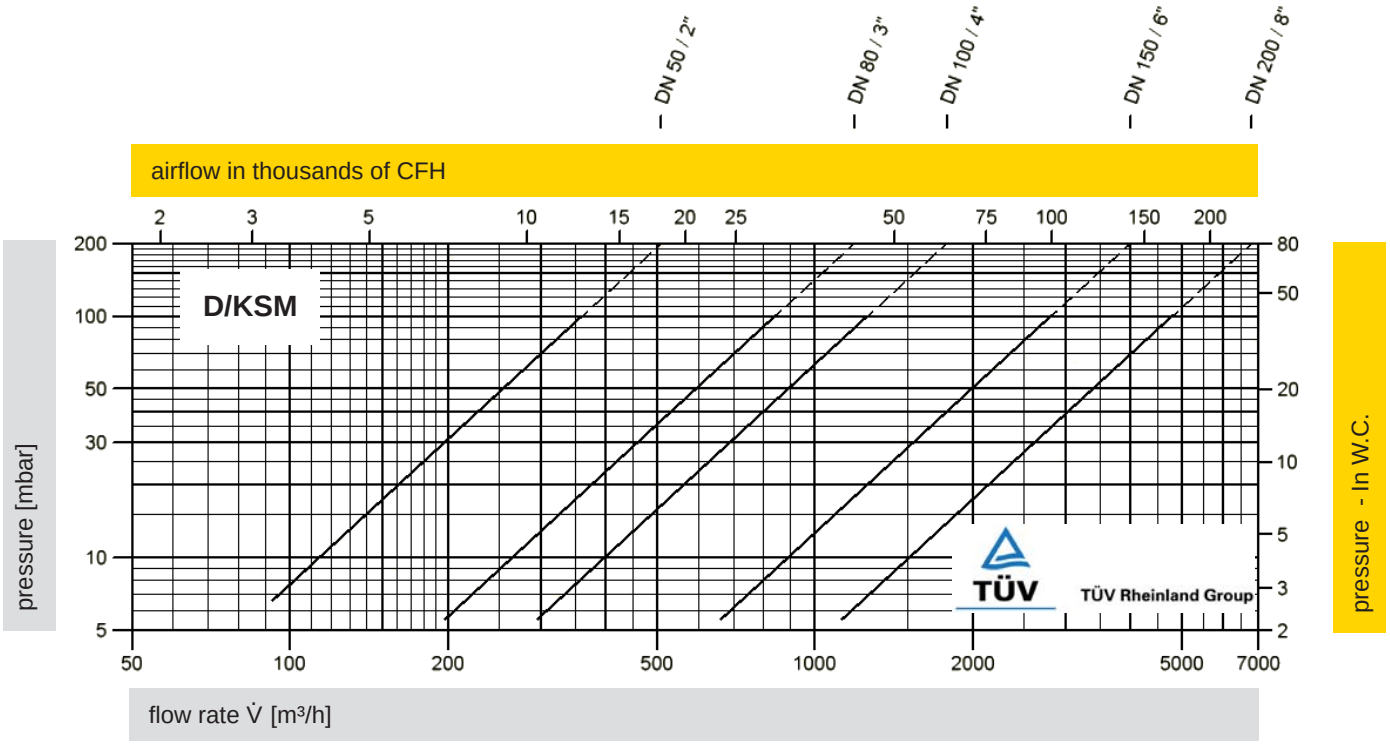
## Pressure Relief Valve

### Flow Capacity Chart

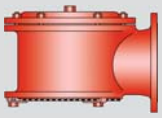
## PROTEGO® D/KSM




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

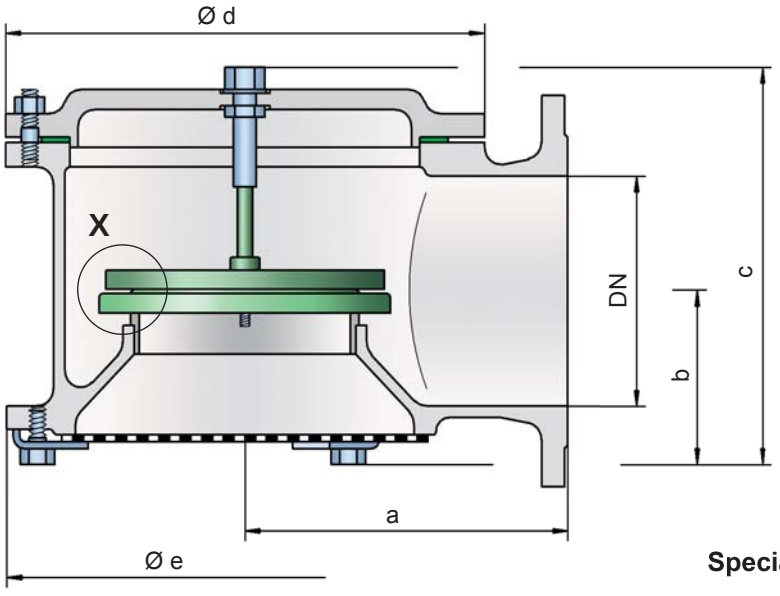
Volume flow V̇ in [m³/h] and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

## Notes:

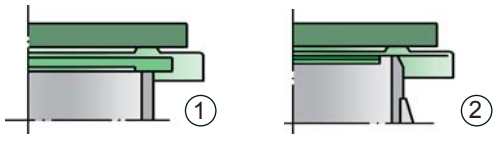


# Vacuum Relief Valve

## PROTEGO® SV/E-1-0




Detail **X**




### Vacuum settings:

-2,0 mbar up to -60 mbar
-0.8 In W.C. up to -24 In W.C.
Higher vacuum settings upon request.

### Function and Description

The SV/E-1-0 type PROTEGO® valve is a highly developed vacuum relief valve with excellent flow performance. It is primarily used as a safety device for relieving vacuum in tanks, containers, and process engineering equipment. The valve offers reliable protection against vacuum, and prevents inbreathing of air close to the set pressure.

When the set vacuum is reached, the valve starts to open and is fully open within 10% vacuum increase. This unique 10% ”full lift type technology” enables a setting that is only 10% below the maximum allowable working or design vacuum of the tank. Even in the low pressure range the vent has the opening characteristic comparable to a typical safety relief valve. The full lift type pallets are a result of many years of development. The reliable engineering enables stable valve pallet operation.

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set vacuum, with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of high grade stainless steel with precisely lapped valve pallets and seats (1) or with an air cushion seal and precisely lapped seats (2). The valve pallets are also available with a PTFE seal to prevent the valve pallet from sticking when sticky products are used, and they enable the use of corrosive media. After the vacuum is relieved, the valve reseats and provides a tight seal again.

### Special Features and Advantages

- 10% technology for minimum accumulation up to full lift
- excellent seal for reducing product losses and emissions
- set vacuum is close to full lift vacuum, which results in high level of design freedom and product savings
- high flow capacity
- the valve pallet is guided within the housing to protect against harsh weather conditions
- can be used in areas subject to an explosion hazard
- self-actuated condensate drain
- best technology for API-tanks

### Design Types and Specifications

The valve pallet is weight-loaded. Higher vacuum can be achieved upon request with a special spring-loaded design.

There are two different designs

| | |
|---|---|
| Vacuum valve in basic design | **SV/E-1-0 -** **–** |
| Vacuum valve with heating jacket | **SV/E-1-0 -** **H** |

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" |
|---|---|---|---|---|---|---|---|
| a | 140 / 5.51 | 170 / 6.69 | 190 / 7.48 | 230 / 9.06 | 300 / 11.81 | 325 / 12.80 | 425 / 16.73 |
| b | 75 / 2.95 | 85 / 3.35 | 95 / 3.74 | 120 / 4.72 | 140 / 5.51 | 165 / 6.50 | 205 / 8.07 |
| c | 205 / 8.07 | 205 / 8.07 | 285 / 11.22 | 355 / 13.98 | 405 / 15.94 | 460 / 18.11 | 500 / 19.69 |
| d | 170 / 6.69 | 235 / 9.25 | 280 / 11.02 | 335 /13.19 | 445 / 17.52 | 505 / 19.88 | 505 / 19.88 |
| e | 215 / 8.46 | 215 / 8.46 | 255 / 10.04 | 335 / 13.19 | 425 / 16.73 | 460 / 18.11 | 625 / 24.61 |

Dimensions for vacuum relief valves with heating jacket upon request

**Table 2: Material selection for housing**

| Design | A | B | C | D | The housings is also available with an ECTFE-Coating |
|---|---|---|---|---|---|
| Housing<br>Heating jacket (SV/E-1-0-H-...) | Ductail Iron<br>– | Steel<br>Steel | Stainless Steel<br>Stainless Steel | Aluminium<br>– | |
| Valve seat | Stainless Steel | Stainless Steel | Stainless Steel | Stainless Steel | Special materials upon request |
| Sealing | WS 3822 | WS 3822 | PTFE | WS 3822 | |

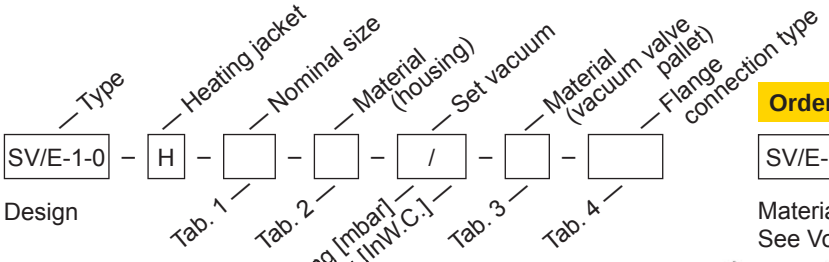
**Table 3: Material selection for vacuum valve pallet**

| Design | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| vacuum range [mbar]<br>[In W.C.] | -2.0 up to -3.5<br>-0.8 up to -1.4 | <-3.5 up to -14<br><-1.4 up to 5.6 | <-14 up to -35<br><-5.6 up to -14 | <-35 up to -60<br><-14 up to -24 | <-14 up to -35<br><-5.6 up to -14 | <-35 up to -60<br><-14 up to -24 |
| 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 (Alu-coated, Titanium, Hastelloy) and higher vacuum settings are available upon request

**Table 7: 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 | |



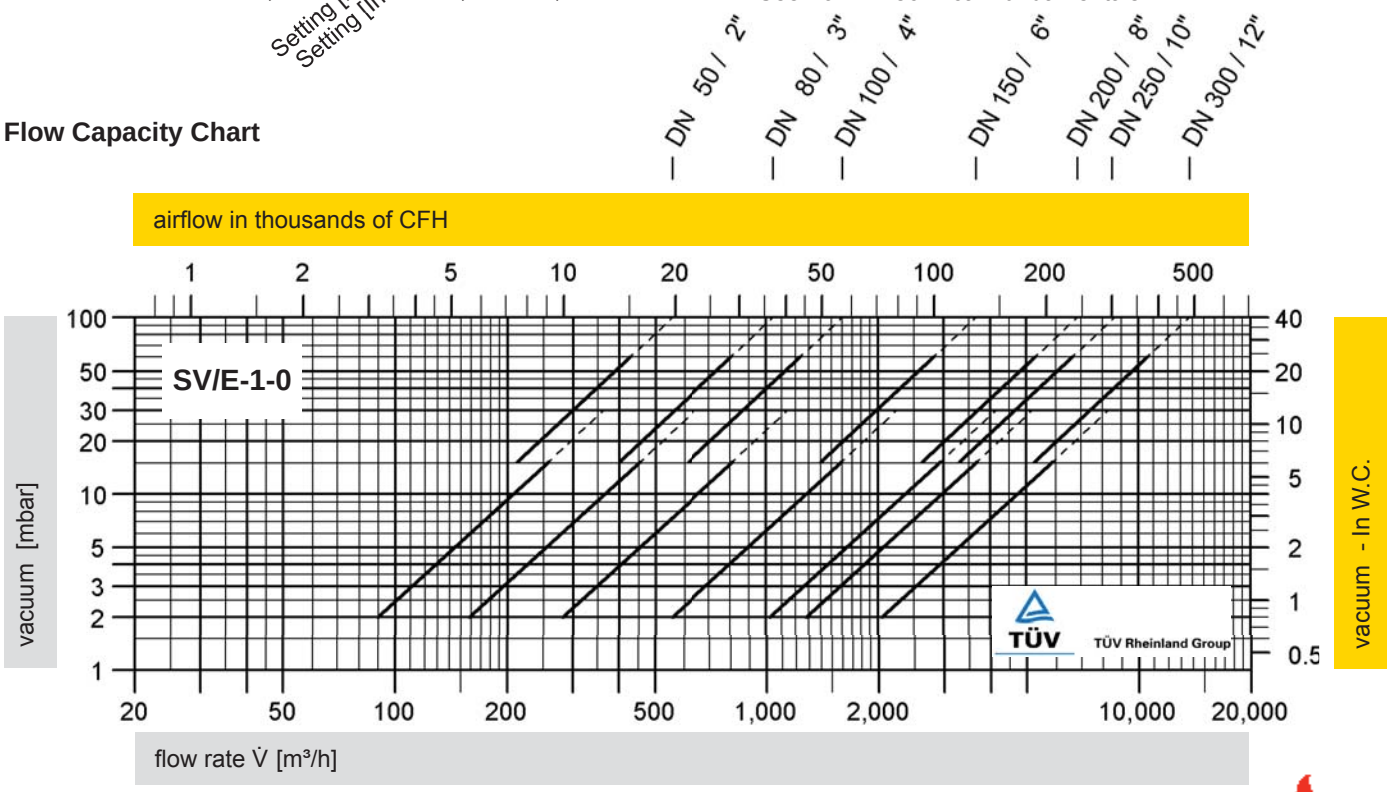

Design

**Order Exmaple**

SV/E-1-0 – H – 200 – B – -5.0 / - – B – DIN

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

## 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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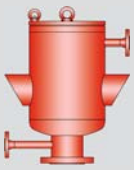
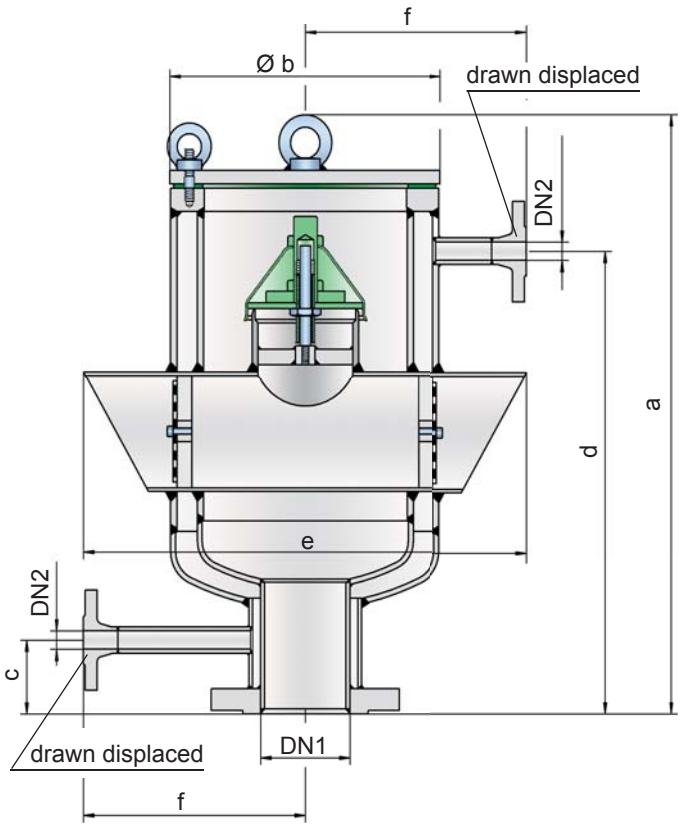


# Vacuum Relief Valve

**in a special heat jacketed design**

## PROTEGO® SV/T-0-H




**Vacuum settings:**
-7 mbar up to -50 mbar
-2.8 In W.C. up to -20 In W.C.
Higher and lower vacuum settings upon request.

### Function and Description

The SV/T-0-H type PROTEGO® valve is a highly developed vacuum relief valve with a valve housing that comes with a heating jacket down to the flange. It is primarily used as a safety device for inbreathing to tanks, containers, and process engineering equipment under difficult operating conditions. This includes extreme weather conditions or products that tend to form polymers at certain temperatures, adhere, or form deposits that negatively influence function (such as bitumen, tar, dust). The valve offers reliable protection against vacuum and prevents the intake of air close to the set vacuum.

When the set vacuum is reached, the valve starts to open and reaches full lift within a 40% vacuum increase. Up to the set vacuum, the tank vacuum is maintained with a seal that is far superior to the conventional standard due to the highly developed manufacturing technology. This feature is ensured by valve seats made of high-grade stainless steel with individually lapped valve pallets and a reinforced housing design. After the vacuum is relieved, the valve reseats and again provides a tight seal.

### Special Features and Advantages

- excellent seal for reducing product losses and emissions
- high flow capacity
- the valve pallet is guided within the housing to protect against harsh weather conditions
- can be used in areas subject to an explosion hazard
- complete heat jacketed design down to the flange to avoid cold bridges
- maximum permissible heating medium temperature of 320°C / 608°F (at 6 bar / 87 psi)
- a special design that preheats incoming air is also available
- a special design with a heatable valve cover is also available
- at low vacuum settings, the valve pallet cover prevents the set pressure from being distorted by dust or condensate (option)
- reinforced housing design
- a special design with a mechanical vent pallet lift device is available

### Design Types and Specifications

The valve pallet is weight-loaded.

| | |
|---|---|
| Vacuum valve in basic design with heating jacket | **SV/T - 0 - H** |

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN1 | 80 / 3" * | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" |
|---|---|---|---|---|---|
| DN2 | 15 / ½" | 15 / ½" | 15 / ½" | 15 / ½" | 15 / ½" |
| a | 570 / 22.44 | 570 / 22.44 | 720 / 28.35 | 920 / 36.22 | 1050 / 41.34 |
| b | 275 / 10.83 | 275 / 10.83 | 355 / 13.98 | 405 / 15.94 | 508 / 20.00 |
| c | 70 / 2.76 | 60 / 2.36 | 60 / 2.36 | 70 / 2.76 | 70 / 2.76 |
| d | 440 / 17.32 | 440 / 17.32 | 590 / 23.23 | 790 / 31.10 | 920 / 36.22 |
| e | 450 / 17.72 | 450 / 17.72 | 650 / 25.59 | 750 / 29.53 | 950 / 37.40 |
| f | 225 / 8.86 | 225 / 8.86 | 260 / 10.24 | 300 / 11.91 | 350 / 13.78 |

* also available with special flange DN 50 / 2"

**Table 2: Material selection for housing**

| Design | A | B |
|---|---|---|
| Housing<br>Heating jacket | Steel<br>Steel | Stainless Steel<br>Stainless Steel |
| Valve seat | Stainless Steel | Stainless Steel |
| Sealing | WS 3822 | WS 3822 |

Special materials upon request

**Table 3: Material selection for vacuum valve pallet**

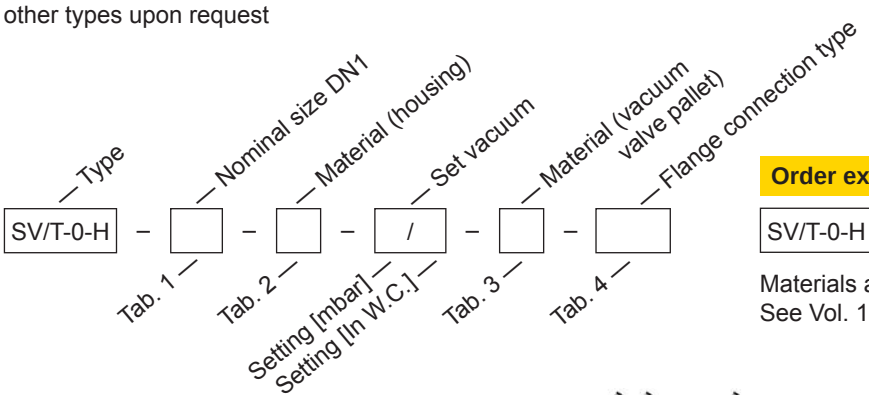
| Design | A | B |
|---|---|---|
| Vacuum range [mbar]<br>[In W.C.] | -7.0 up to -25<br>-2.8 up to -10 | -10 up to -50<br>-4.0 up to -20 |
| Valve pallet | Aluminium | Stainless Steel |
| Valve pallet hood | Stainless Steel | Steinless Steel |
| Sealing | Metal to Metal | Metal to Metal |

Special materials and other vacuum settings are available upon request

**Table 4: Flange connection type**

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

other types upon request

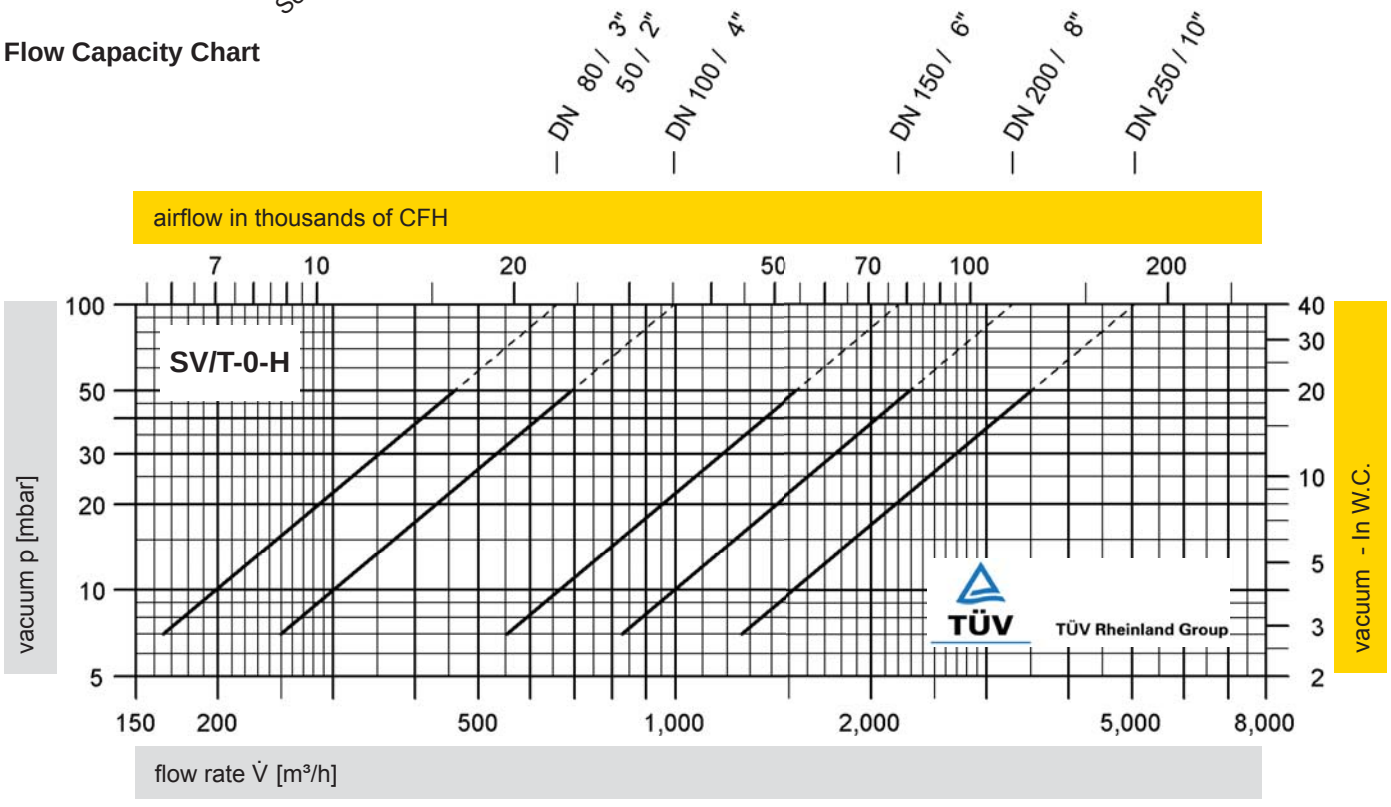



**Order example**

SV/T-0-H – 200 – B – -20/ - – B – DIN

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

## 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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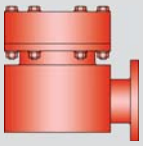
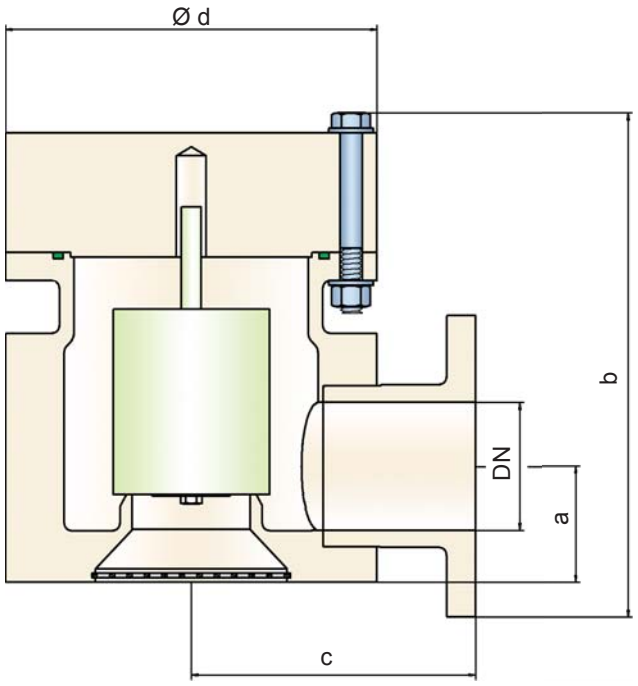


# Vacuum Relief Valve

**made of plastic**

## PROTEGO® V/KSM




### Vacuum settings:

-5 mbar up to -100 mbar
-2 In W.C. up to -40 In W.C.
Other vacuum settings upon request.

### Function and Description

The PROTEGO® valve V/KSM is a state-of-the-art vacuum relief valve with excellent flow performance made of highgrade synthetic material. It is used as a safety device to relieve vacuum in tanks, containers, and process engineering equipment; it prevents the inbreathing of air until reaching the set vacuum. The valve is a perfect solution for corrosive, polymerizing or sticky media.

The device will start to open as soon as the set vacuum is reached and is fully open within 10% vacuum increase. 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 vacuum (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 the set vacuum, with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of high-performance plastics and a high grade PTFE seal. After 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
- extreme tightness and hence least possible product losses and reduced environmental pollution
- based on 10% technology the set vacuum is close to the opening vacuum which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- the valve pallet is guided within the housing to protect against harsh weather conditions
- corrosion resistant valve
- weight reduction in comparsion to steel/stainless steel
- smooth surface
- automatic condensate drain
- different plastics can be combined
- maintenance friendly design

### Design Types and Specifications

The valve pallet is weight-loaded, and the highest pressure levels are only attained with metal discs.

| | |
|---|---|
| Vacuum valve in basic design | **V/KSM-** |

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" |
|---|---|---|---|---|---|
| a | 57 / 2.24 | 77 / 3.03 | 87 / 3.43<br>(115 / 4.53)* | 126 / 4.96<br>(146 / 5.75)* | 180 / 7.09<br>(175 / 6.89)* |
| b | 259 / 10.20 | 376 / 14.80 | 373 / 14.69<br>(338 / 13.31)* | 460 / 18.11<br>(427 / 16.81)* | 469 / 18.46<br>(437 / 17.20)* |
| 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<br>(405 / 15.94)* | 560 / 22.05<br>(500 / 19.68)* |

* Dimensions in brackets only for PVDF

**Table 2: Material selection for housing**

| Design | A | B | C | |
|---|---|---|---|---|
| Housing | PE | PP | PVDF | |
| Valve seat | PE | PP | PVDF | Special Materials upon request |
| Sealing | FPM | FPM | FPM | |
| Valve pallet | A, C, D | B, C, D | C, D | |

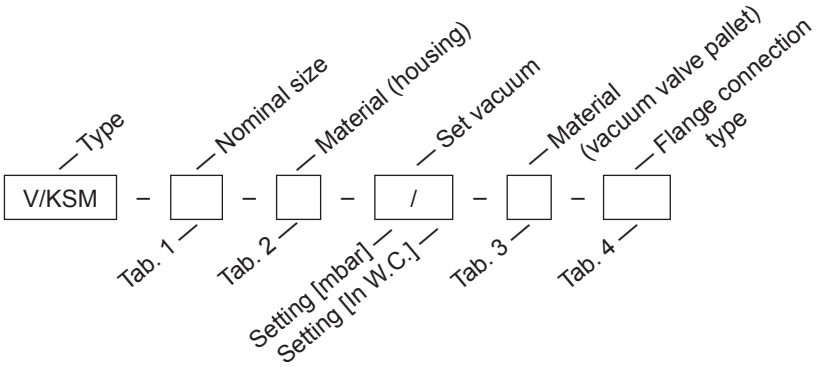
**Table 3: Material selection for vacuum valve pallet**

| Design | A | B | C | D |
|---|---|---|---|---|
| Vacuum range [mbar]<br>[In W.C.] | -5.0 up to -17<br>-2.0 up to -6.8 | -5.0 up to -17<br>-2.0 up to -6.8 | -10 up to -32<br>-4.0 up to -12.8 | -30 up to -100<br>-12 up to -40 |
| Valve pallet | PE | PP | PVDF | Hastelloy |
| Sealing | PTFE | PTFE | PTFE | PTFE |
| Spindle guide | PE | PP | PVDF | Hastelloy |
| Weight | PE | PP | PVDF | Hastelloy |

Special materials and other vacuum settings are available upon request

**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 | |




**Order example**

V/KSM – 200 – A – -8.0 / - – A – DIN

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

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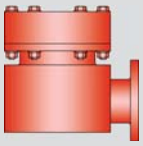
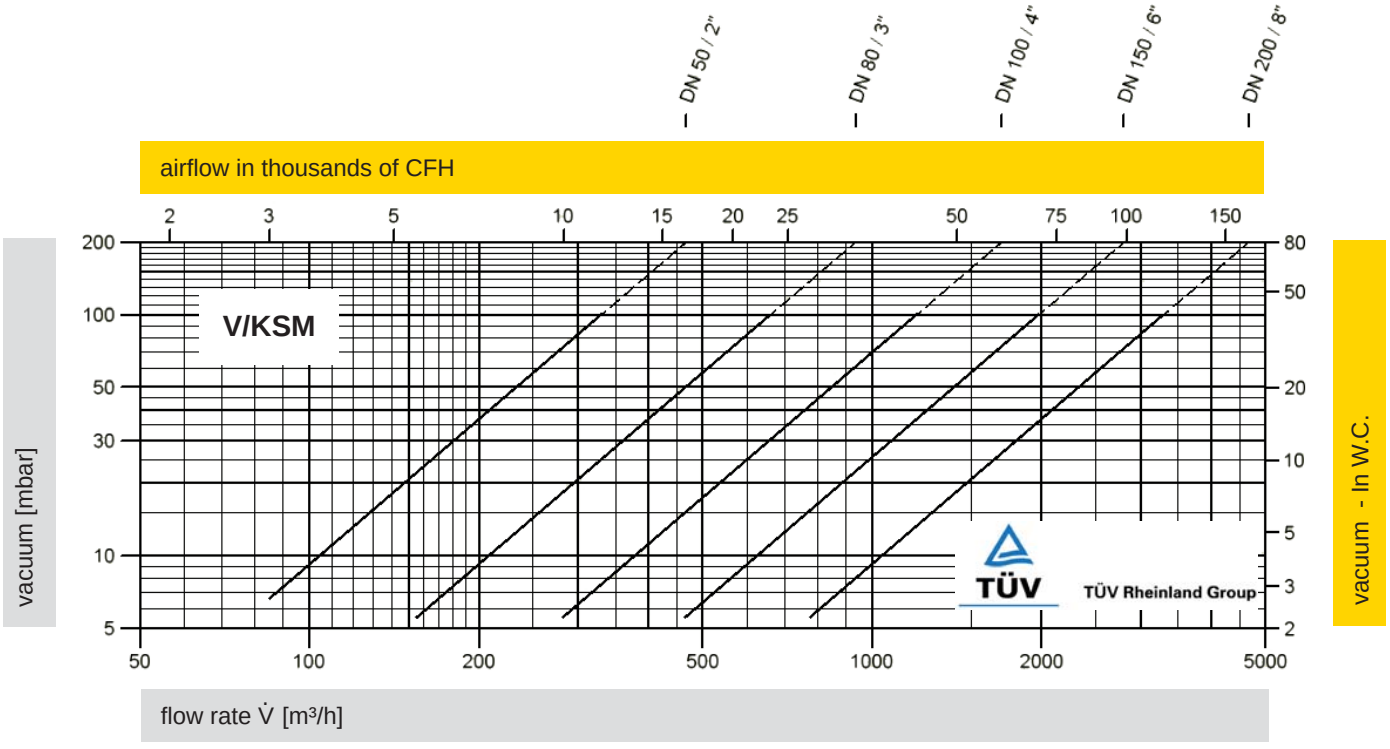


# Vacuum Relief Valve

## Flow Capacity Chart

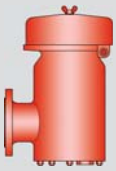
## PROTEGO® V/KSM




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

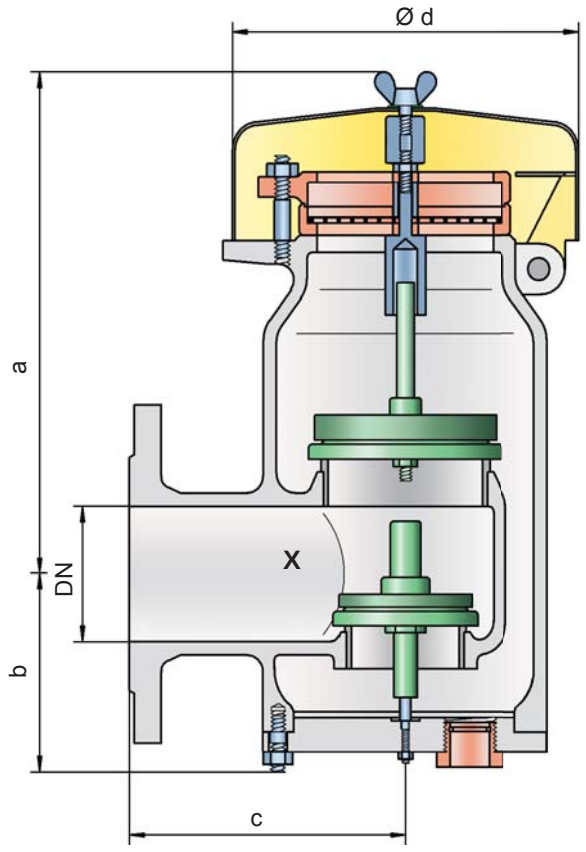
Volume flow V̇ in [m³/h] and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

**Notes:**

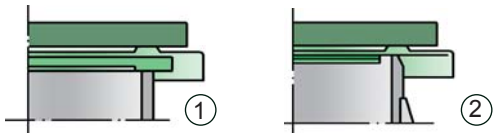


# Pressure and Vacuum Relief Valve

## PROTEGO® PV/EL




Detail **X**




**Settings:**

| | | | |
|---|---|---|---|
| **Pressure:** | +2.0 mbar | up to | +210 mbar |
| | +0.8 In W.C. | up to | +84 In W.C. |
| **Vacuum:** | -3.5 mbar | up to | -35 mbar |
| | -1.4 In W.C. | up to | -14 In W.C. |

Higher and lower settings upon request.

### Function and Description

The PV/EL type PROTEGO® valve is a highly developed combined pressure and vacuum relief valve. It is primarily used as a safety device for relieving pressure and vacuum in tanks, containers and process engineering equipment. The valve offers reliable protection against overpressure and excessive vacuum. It prevents also the impermissible loss of product vapors close to the set pressure as well as the intake of air on the vacuum side close to set vacuum.

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 presssure and vacuum relief.

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set pressure, with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of high grade stainless steel with precisely lapped valve pallets and seats (1) or with an air cushion seal and precisely lapped seats (2). The valve pallets are also available with a PTFE seal to prevent the valve pallet from sticking when sticky products are used, and they enable the use of corrosive media. After the excess pressure is relieved, the valve reseats and provides a tight seal again.

### Special Features and Advantages

- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- the valve pallet is guided within the housing to protect against freezing in cold weather
- can be used in areas subject to an explosion hazard
- self-actuated condensate drain
- special design with lifting gear can be purchased

### Design Types and Specifications

The valve pallets are weight-loaded. At set pressures greate than 60 mbar (24.1 In W.C.), an elongated construction is used.

There are two different designs

Pressure/vacuum relief valve in basic design **PV/EL - [–]**

Pressure/vacuum relief valve with heating jacket **PV/EL - [H]**

Additional special devices available upon request.

Any combination of vacuum and pressure levels can be set for the valve. The valve pallets are weight-loaded. When the difference between the pressure and vacuum exceeds 150 mbar / 60.2 In W.C., special valve pallets are used.

**Table 1: Dimensions** — Dimensions in mm / inches

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

| DN | 50 / 2" | 50 / 2" | 80 / 3" | 80 / 3" | |
|---|---|---|---|---|---|
| Set pressure | ≤ +60 mbar<br>≤ +24.1 in W.C. | > +60 mbar<br>> +24.1 in W.C. | ≤ +60 mbar<br>≤ +24.1 in W.C. | > +60 mbar<br>> +24.1 in W.C. | Dimensions for pressure/ vacuum relief valve with heating jacket upon request |
| a | 308 / 12.13 | 443 / 17.44 | 308 / 12.13 | 443 / 17.44 | |
| b | 108 / 4.25 | 108 / 4.25 | 108 / 4.25 | 108 / 4.25 | |
| c | 165 / 6.50 | 165 / 6.50 | 167 / 6.57 | 167 / 6.57 | |
| d | 218 / 8.58 | 218 / 8.58 | 218 / 8.58 | 218 / 8.58 | |

**Table 2: Material selection for housing**

| Design | B | C | |
|---|---|---|---|
| Housing<br>Heating jacket (PV/EL-H-...) | Steel<br>Steel | Stainless Steel<br>Stainless Steel | Special materials upon request |
| Valve seat | Stainless Steel | Stainless Steel | |
| Weather hood | Steel | Stainless Steel | |
| Protective mesh screen | Stainless Steel | Stainless Steel | |

**Table 3: Material selection for pressure valve pallet**

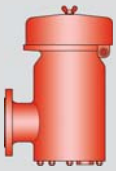
| Design | A | B | C | D | |
|---|---|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | +2.0 up to +3.5<br>+0.8 up to +1.4 | >+3.5 up to +14<br>>+1.4 up to +5.6 | >+14 up to +210<br>>+5.6 up to +84 | >+14 up to +210<br>>+5.6 up to +84 | Special material as well as higher set pressure upon request |
| 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 | |
|---|---|---|---|---|---|
| Vacuum range [mbar]<br>[In W.C.] | -3.5 up to -5.0<br>-1.4 up to -2.0 | <-5.0 up to -14<br><-2.0 up to -5.6 | <-14 up to -35<br><-5.6 up to -14 | <-14 up to -35<br><-5.6 up to -14 | Special material as well as higher set vacuum upon request |
| Valve pallet | Aluminium | Stainless Steel | Stainless Steel | Stainless Steel | |
| Sealing | FEP | FEP | Metal to Metal | PTFE | |

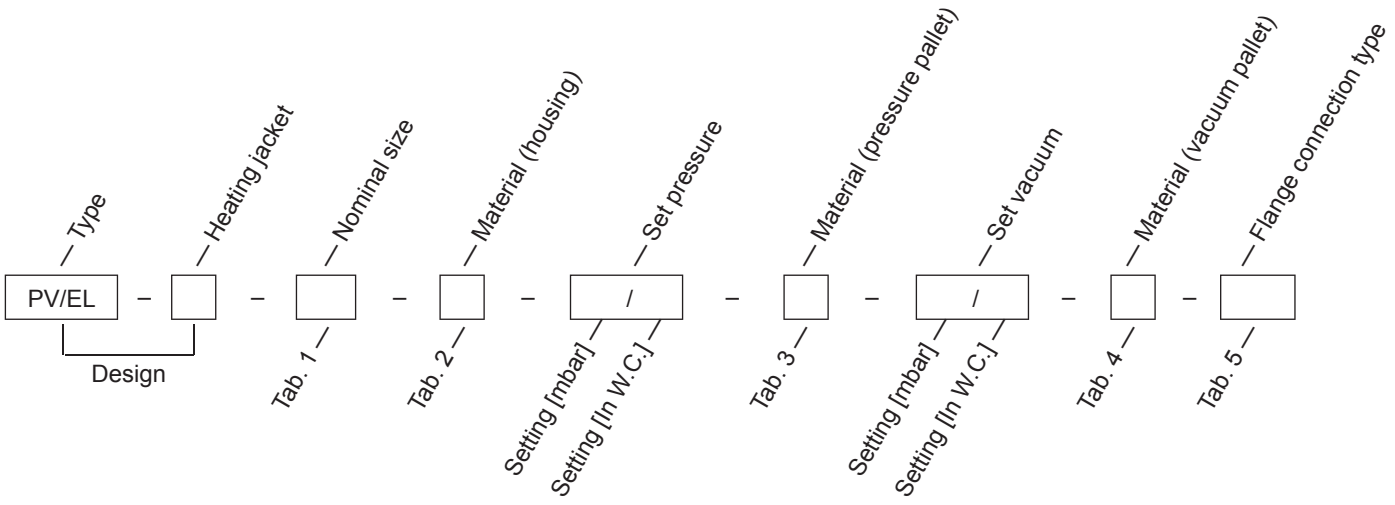
**Table 5: Flange connection type**

| | | |
|---|---|---|
| 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

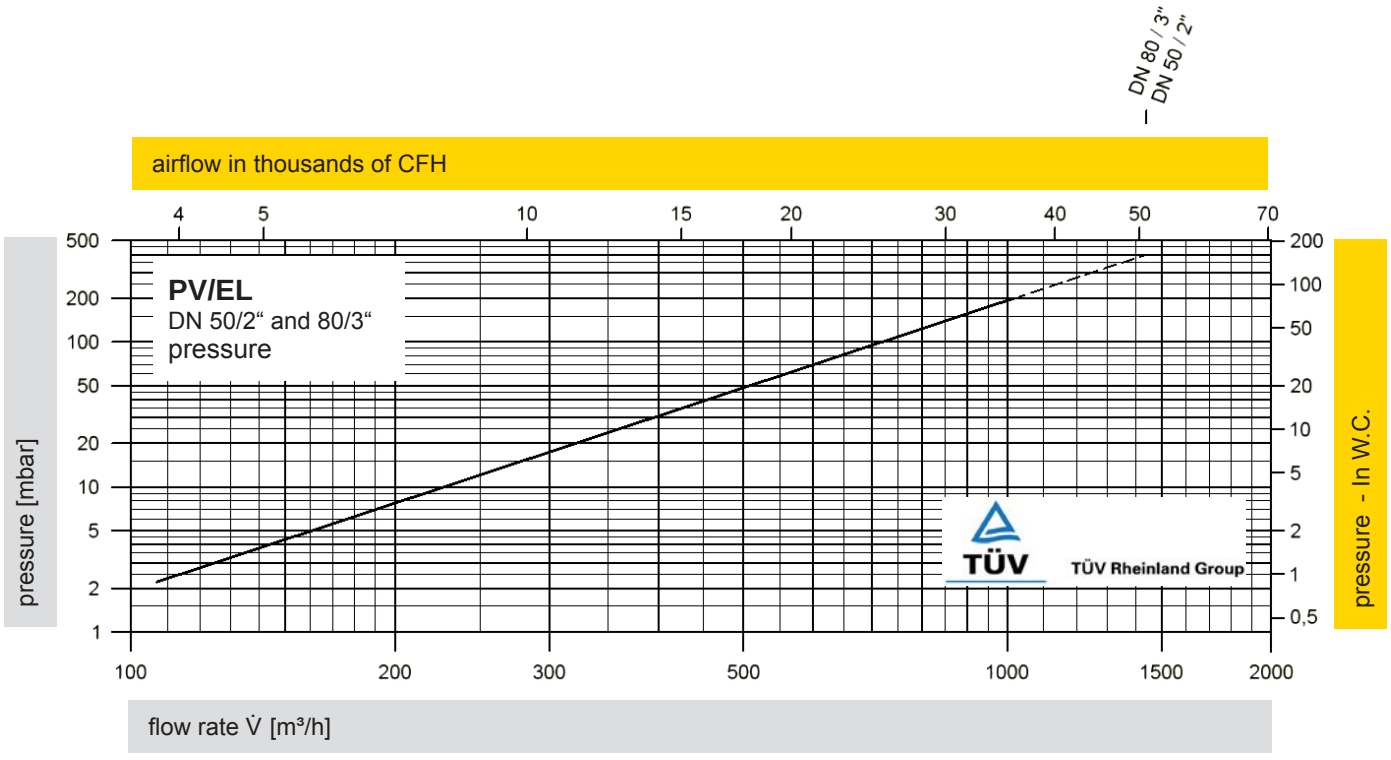
## PROTEGO® PV/EL

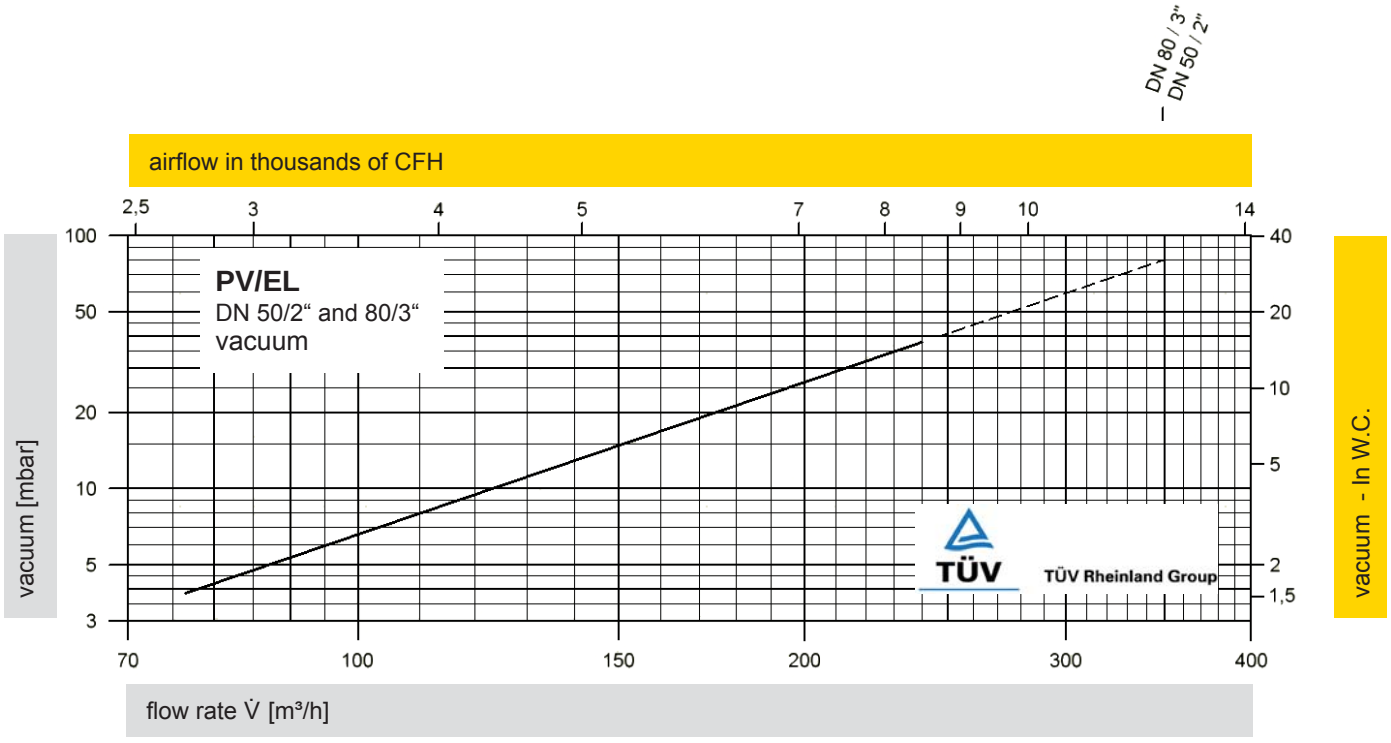



**Order example**

| PV/EL | – | H | – | 50 | – | B | – | 50 / – | – | D | – | -10 / – | – | B | – | DIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

Materials and chemical resistance: See Vol. 1 “Technical Fundamentals”




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”.

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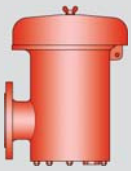
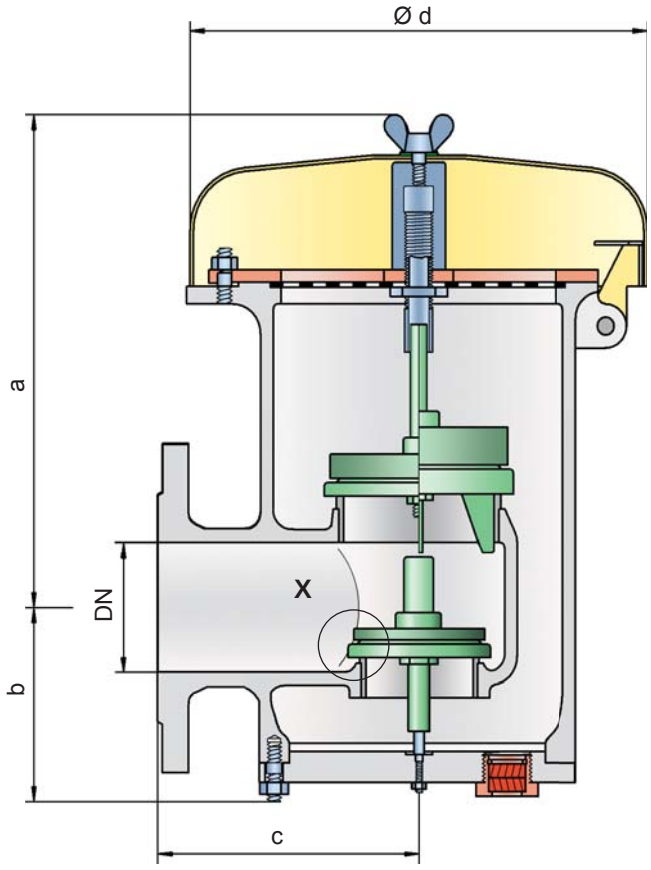
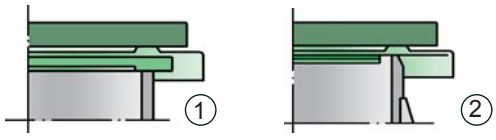


# Pressure and Vacuum Relief Valve

## PROTEGO® PV/ELR




Detail **X**




**Settings:**

| | | | |
|---|---|---|---|
| **Pressure:** | +2.0 mbar | up to | +210 mbar |
| | +0.8 In W.C. | up to | +84 In W.C. |
| **Vacuum:** | -3.5 mbar | up to | -50 mbar |
| | -1.4 In W.C. | up to | -20 In W.C. |

Higher and lower settings upon request

### Function and Description

The PV/ELR type PROTEGO® valve is a highly developed combined pressure and vacuum relief valve with excellent flow performance. 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 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 presssure 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
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- the valve pallet is guided within the housing to protect against freezing in cold weather
- can be installed in explosion hazardous areas
- self-actuated condensate drain
- compact design saves space
- special design with lifting gear can be purchased
- maintenance friendly design

### Design Types and Specifications

The valve pallets are weight-loaded. At set pressures greate than 35 mbar ( 14 In W.C.), an elongated construction is used.

There are two different designs:

Pressure/vacuum relief valve in basic design **PV/ELR - [–]**

Pressure/vacuum relief valve with heating jacket **PV/ELR - [H]**

Additional special devices available upon request.

Any combination of vacuum and pressure levels can be set for the valve. The valve pallets are weight-loaded. When the difference between the pressure and vacuum exceeds 150 mbar/ 60.2 In W.C., special valve pallets are used.

**Table 1: Dimensions** — Dimensions in mm / inches

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

| DN | 80 / 3" | 80 / 3" | 100 / 4" | 100 / 4" | |
|---|---|---|---|---|---|
| Set pressure | ≤ +35 mbar<br>≤ +14 in W.C. | > +35 mbar<br>> +14 in W.C. | ≤ +35 mbar<br>≤ +14 in W.C. | > +35 mbar<br>> +14 in W.C. | Dimensions for pressure/ vacuum relief valve with heating jacket upon request |
| a | 345 / 13.58 | 475 / 18.70 | 345 / 13.58 | 475 / 18.70 | |
| b | 141 / 5.55 | 141 / 5.55 | 141 / 5.55 | 141 / 5.55 | |
| c | 218 / 8.58 | 218 / 8.58 | 218 / 8.58 | 218 / 8.58 | |
| d | 353 / 13.90 | 353 / 13.90 | 353 / 13.90 | 353 / 13.90 | |

**Table 2: Material selection for housing**

| Design | B | C | |
|---|---|---|---|
| Housing<br>Heating jacket (PV/ELR-H-...) | Steel<br>Steel | Stainless Steel<br>Stainless Steel | Special materials upon request |
| Valve seat | Stainless Steel | Stainless Steel | |
| Weather hood | Steel | Stainless Steel | |
| Protective mesh screen | Stainless Steel | Stainless Steel | |

**Table 3: Material selection for pressure valve pallet**

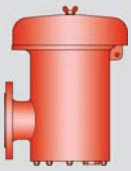
| Design | A | B | C | D | |
|---|---|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | +2.0 up to +3.5<br>+0.8 up to +1.4 | >+3.5 up to +14<br>>+1.4 up to +5.6 | >+14 up to +210<br>>+5.6 up to +84 | >+14 up to +210<br>>+5.6 up to +84 | Special material as well as higher set pressure upon request |
| 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 | |
|---|---|---|---|---|---|
| Vacuum range [mbar]<br>[In W.C.] | -3.5 up to -5.0<br>-1.4 up to -2.0 | <-5.0 up to -14<br><-2.0 up to -5.6 | <-14 up to -50<br><-5.6 up to -20 | <-14 up to -50<br><-5.6 up to -20 | Special material as well as higher set vacuum upon request |
| Valve pallet | Aluminium | Stainless Steel | Stainless Steel | Stainless Steel | |
| Sealing | FEP | FEP | Metal to Metal | PTFE | |

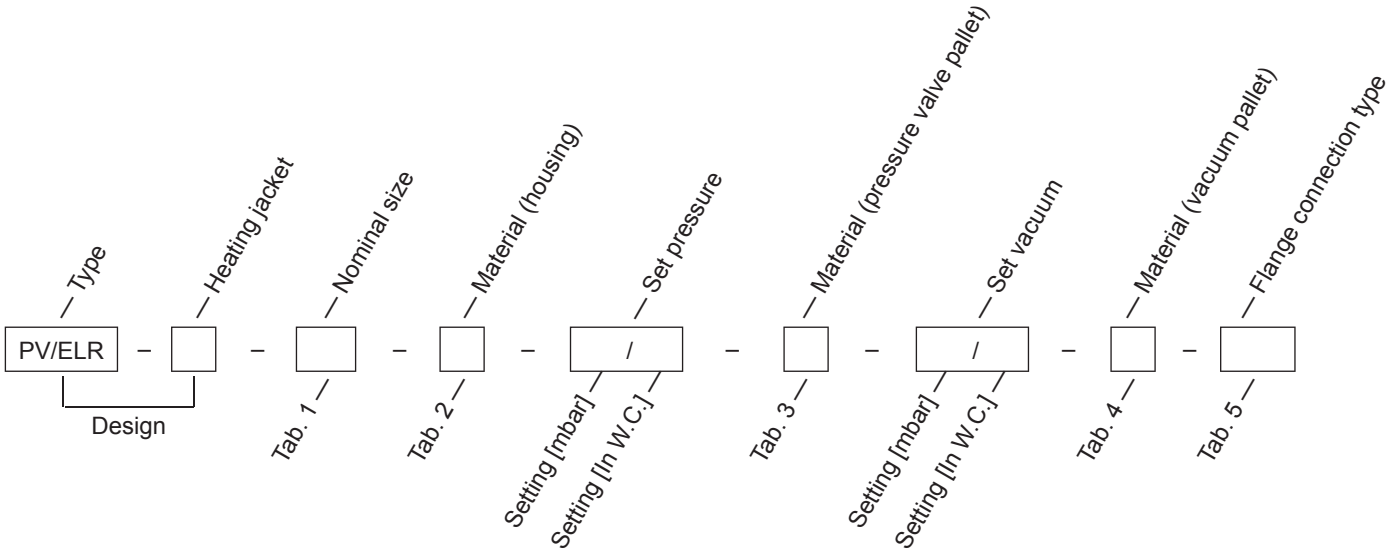
**Table 5: Flange connection type**

| | | |
|---|---|---|
| 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

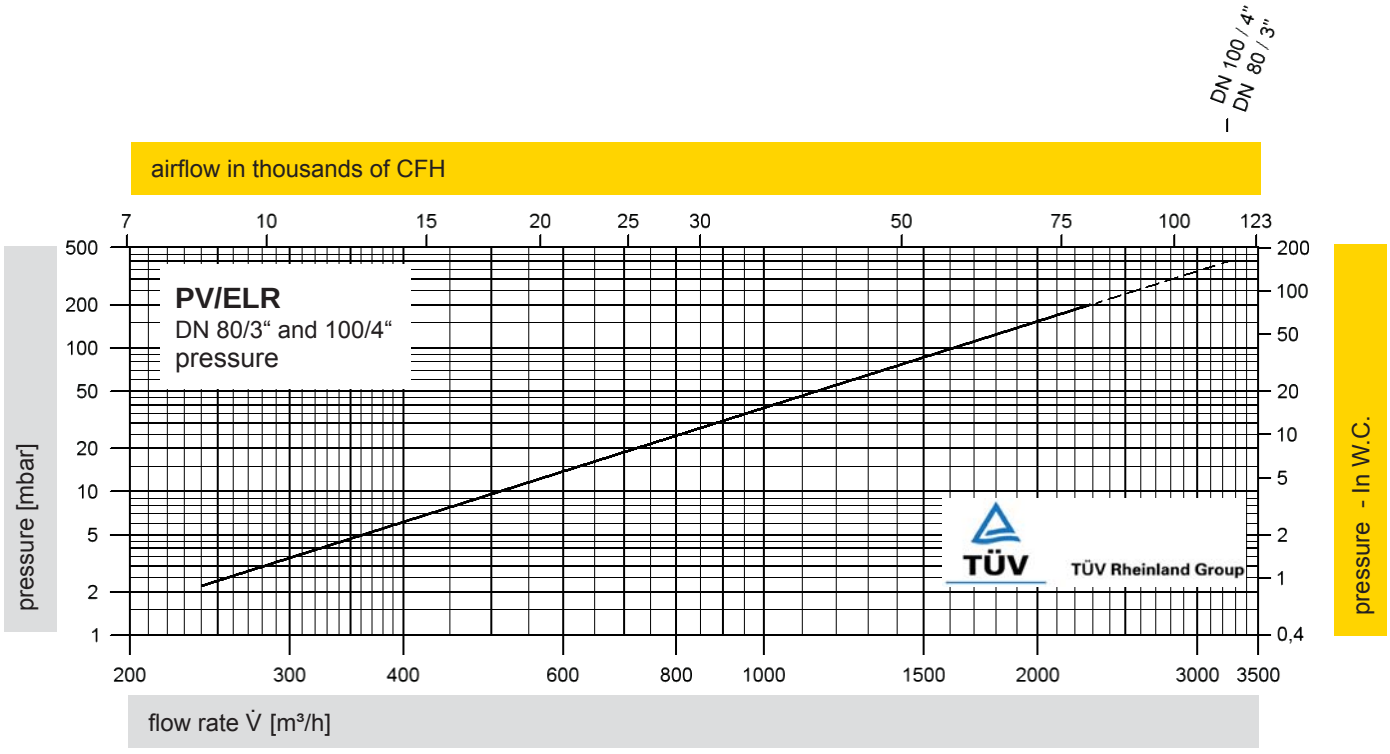
## PROTEGO® PV/ELR

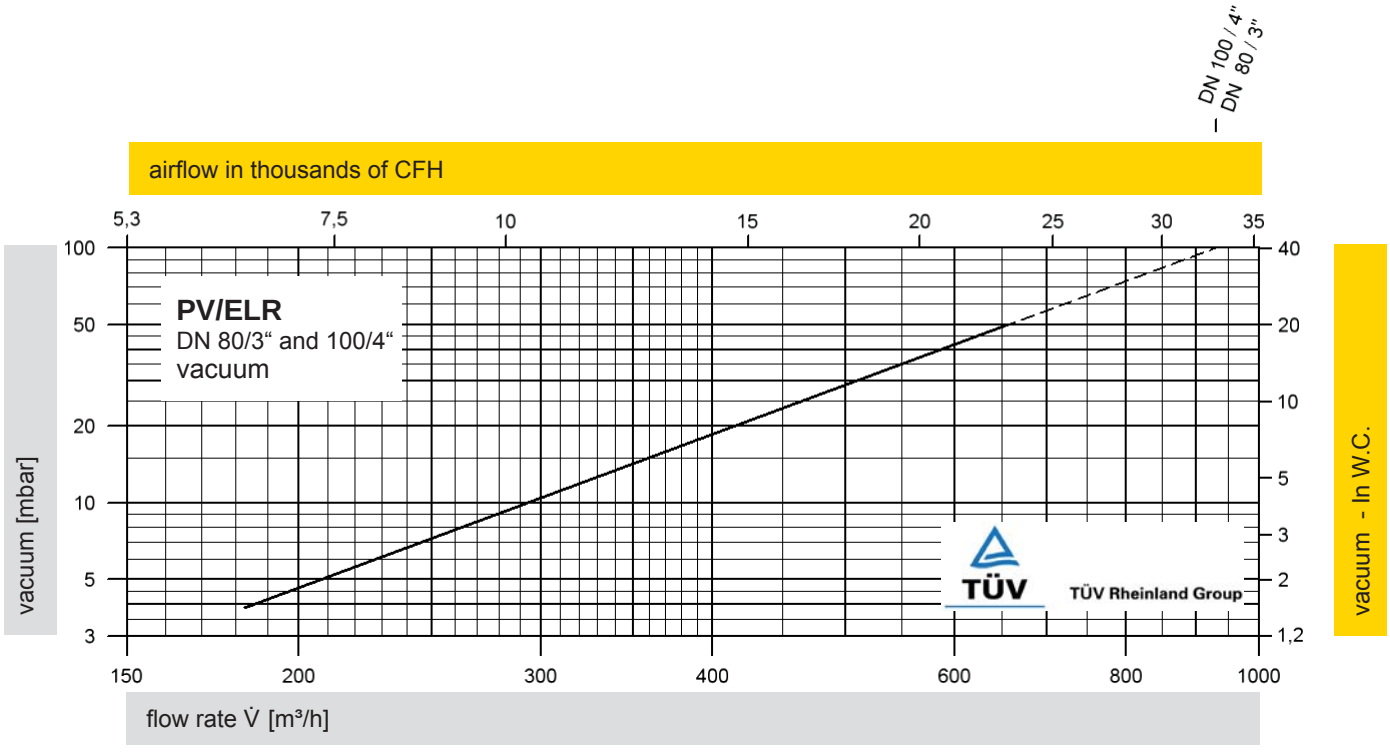



**Order example**

| PV/ELR | – | H | – | 80 | – | B | – | 50 / – | – | D | – | -10 / – | – | B | – | DIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

Materials and chemical resistance: See Vol. 1 “Technical Fundamentals”




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”.

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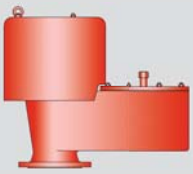
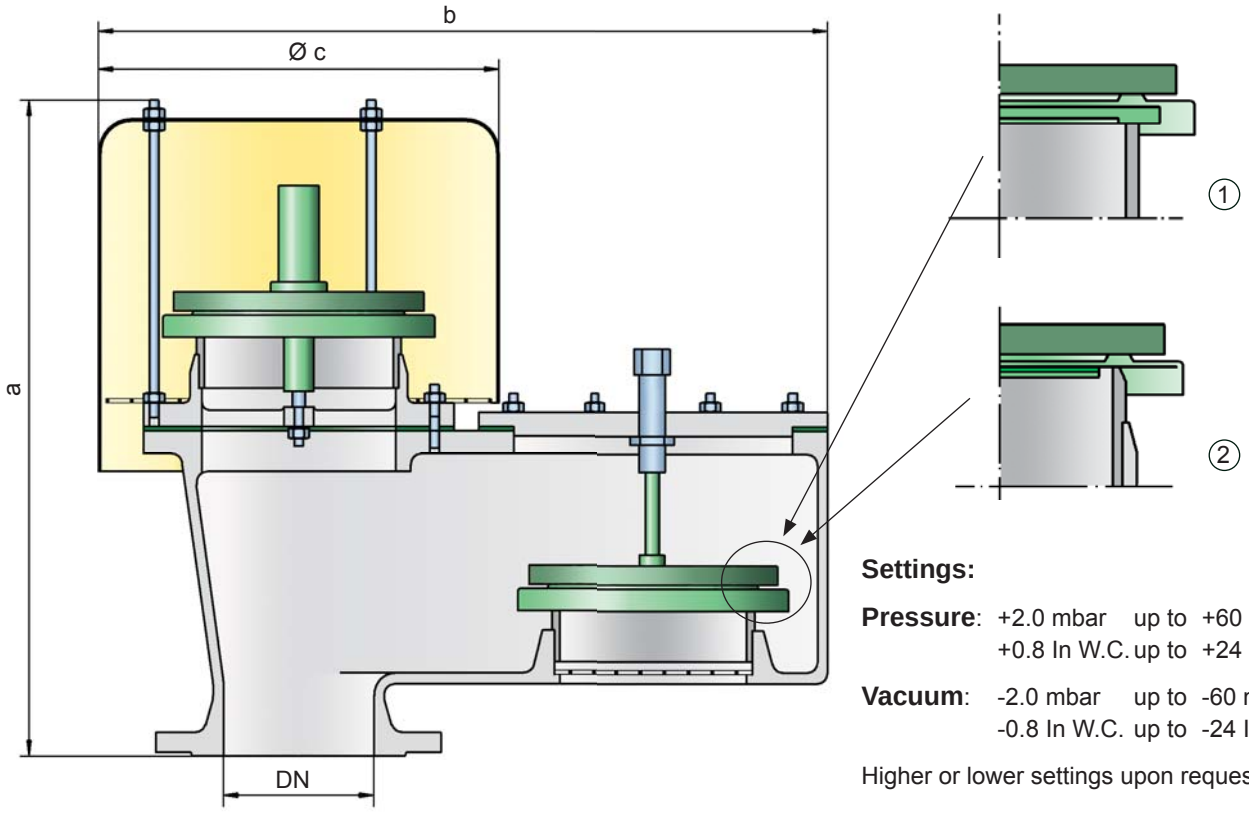


# Pressure and Vacuum Relief Valve

## PROTEGO® VD/SV




**Settings:**

**Pressure**: +2.0 mbar up to +60 mbar
+0.8 In W.C. up to +24 In W.C.

**Vacuum**: -2.0 mbar up to -60 mbar
-0.8 In W.C. up to -24 In W.C.

Higher or lower settings upon request.

### Function and Description

The VD/SV type PROTEGO® valve is a highly developed pressure and vacuum relief valve with excellent flow performance. It is primarily used as a safety device for relieving pressure and vacuum in tanks, containers and process engineering equipment. The valve offers reliable protection against overpressure and excessive vacuum. It prevents also the impermissible loss of product vapors close to the set pressure as well as the intake of air on the vacuum side close to set vacuum.

When the set point is reached, the valve starts to open and is fully open within 10% pressure increase. This unique 10% ”full lift type technology” enables a pressure setting that is only 10% below the maximum allowable working pressure or maximum allowable working vacuum of the tank. Even in the low pressure range the vent has the opening characteristic comparable to a typical high pressure safety relief valve. The full lift type pallets are a result of many years of development. The reliable engineering enables stable valve pallet operation.

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set point, with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of high grade stainless steel with precisely lapped valve pallets and seats (1) or with an air cushion seal and precisely lapped seats (2). The valve pallets are also available with a PTFE seal to prevent the valve pallet from sticking when sticky products are used, and they enable the use of corrosive media.

After the excess pressure is discharged or the vacuum is compensated, the valve reseats and again provides a tight seal.

### Special Features and Advantages

- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- the valve pallet is guided within the housing to protect against harsh weather conditions
- can be used in areas subject to explosion hazards
- self draining
- best technology for API-tanks

### Design Types and Specifications

Any combination of vacuum and pressure levels can be set for the valve. The valve pallets are weight-loaded. Higher pressures can be achieved upon request with a special spring-loaded design. When the difference between the pressure and vacuum exceeds 150 mbar / 60.2 In W.C., special valve pallets are used.

There are two different designs:

Pressure/vacuum valve in basic design **VD/SV- –**

Pressure/vacuum relief valve with heating jacket **VD/SV- H**

Additional special devices available upon request.

**Table 1: Dimensions** — Dimensions in mm / inches

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

| DN | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" |
|---|---|---|---|---|---|---|---|
| a | 400 / 15.75 | 490 / 19.29 | 520 / 20.47 | 660 / 25.98 | 760 / 29.92 | 805 / 31.69 | 805 / 31.69 |
| b | 355 / 13.98 | 450 / 17.72 | 550 / 21.65 | 790 / 31.10 | 900 / 35.43 | 1030 / 40.55 | 1030 / 40.55 |
| c | 200 / 7.87 | 295 / 11.61 | 295 / 11.61 | 465 / 18.31 | 550 / 21.65 | 650 / 25.59 | 650 / 25.59 |

Dimensions of pressure and vacuum relief valves with heating jacket upon request

**Table 2: Material selection for housing**

| Design | A | B | C |
|---|---|---|---|
| Housing<br>Heating jacket (VD/SV-H-...) | Aluminium<br>– | Steel<br>Steel | Stainless Steel<br>Stainless Steel |
| Valve seat | Stainless Steel | Stainless Steel | Stainless Steel |
| Sealing | WS 3822 | WS 3822 | PTFE |
| Cover | Stainless Steel | Stainless Steel | Stainless Steel |

Option: Housing ECTFE-coated

Special materials upon request

**Table 3: Material selection for pressure valve pallet**

| Design | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | +2.0 up to +3.5<br>+0.8 up to +1.4 | >+3.5 up to +14<br>>+1.4 up to +5.6 | >+14 up to +35<br>>+5.6 up to +14 | >+35 up to +60<br>>+14 up to +24 | >+14 up to +35<br>>+5.6 up to +14 | >+35 up to +60<br>>+14 up to +24 |
| 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 material as well as higher set pressure upon request

**Table 4: Material selection for vacuum valve pallet**

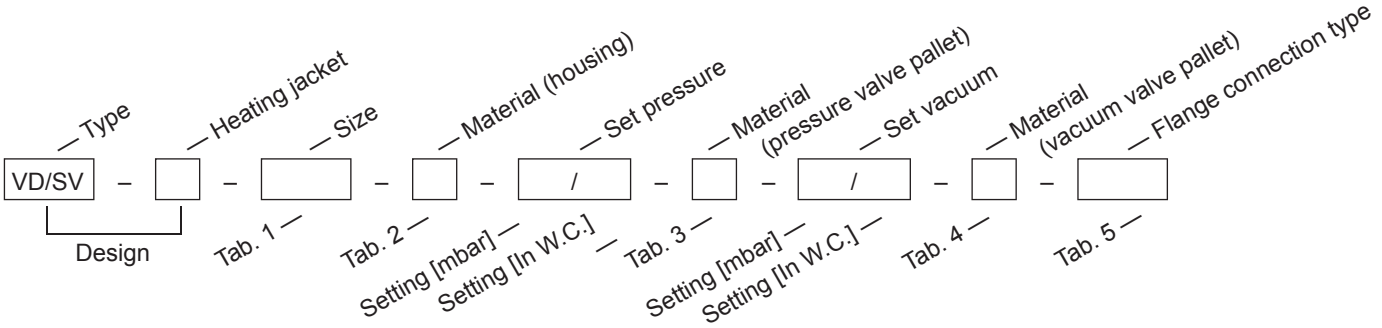
| Design | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Vacuum range [mbar]<br>[In W.C.] | -2.0 up to -3.5<br>-0.8 up to -1.4 | <-3.5 up to -14<br><-1.4 up to -5.6 | <-14 up to -35<br><-5.6 up to -14 | <-35 up to -60<br><-14 up to +24 | <-14 up to -35<br><-5.6 up to -14 | <-35 up to -60<br><-14 up to -24 |
| 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 material as well as higher vacuum upon request

**Table 5: 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




**Order example**

| VD/SV | – | H | – | 200 | – | B | – | 30 / | – | C | – | -4.0 / | – | B | – | DIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

Materials and chemical resistance: See Vol. 1 “Technical Fundamentals”

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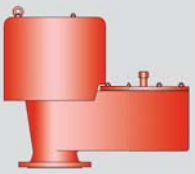
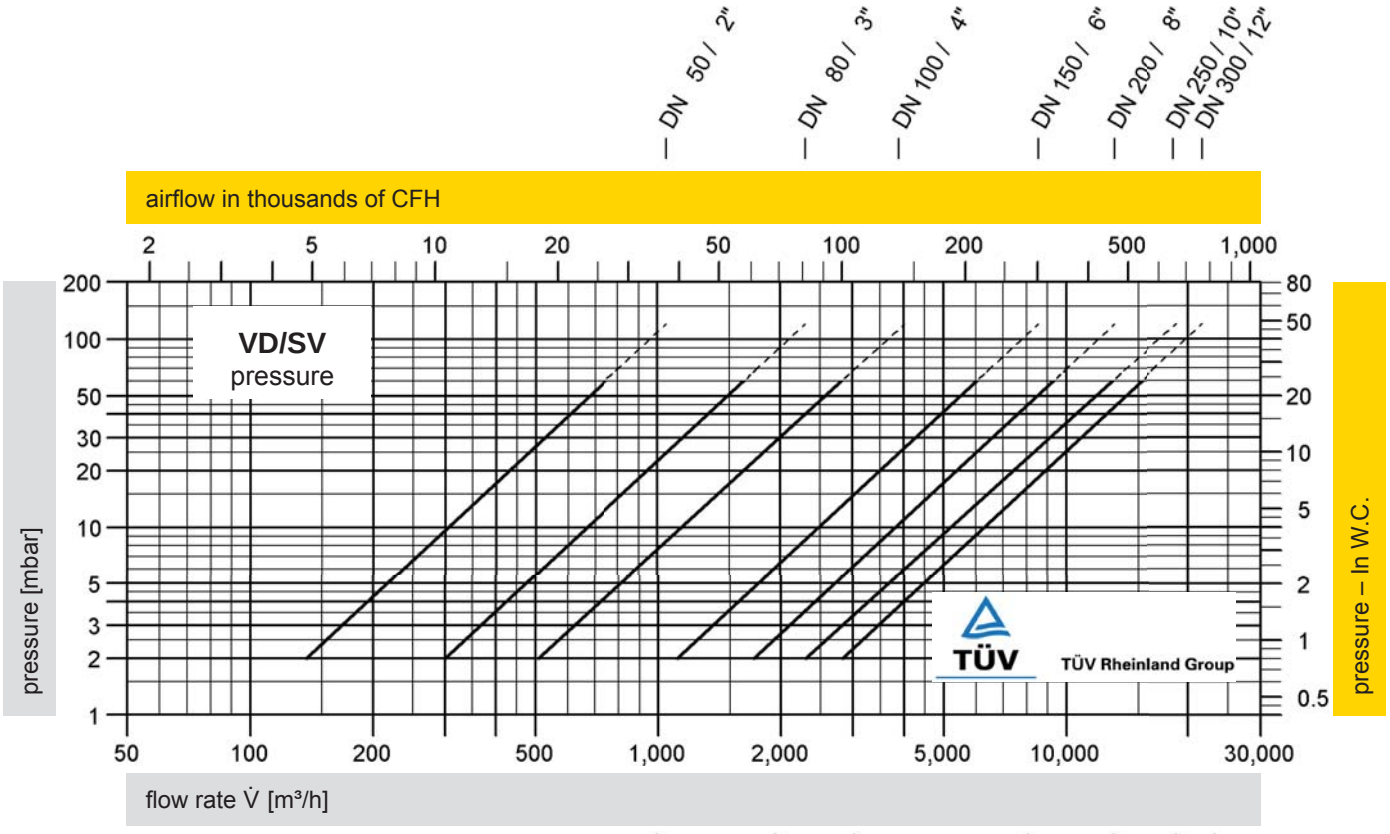
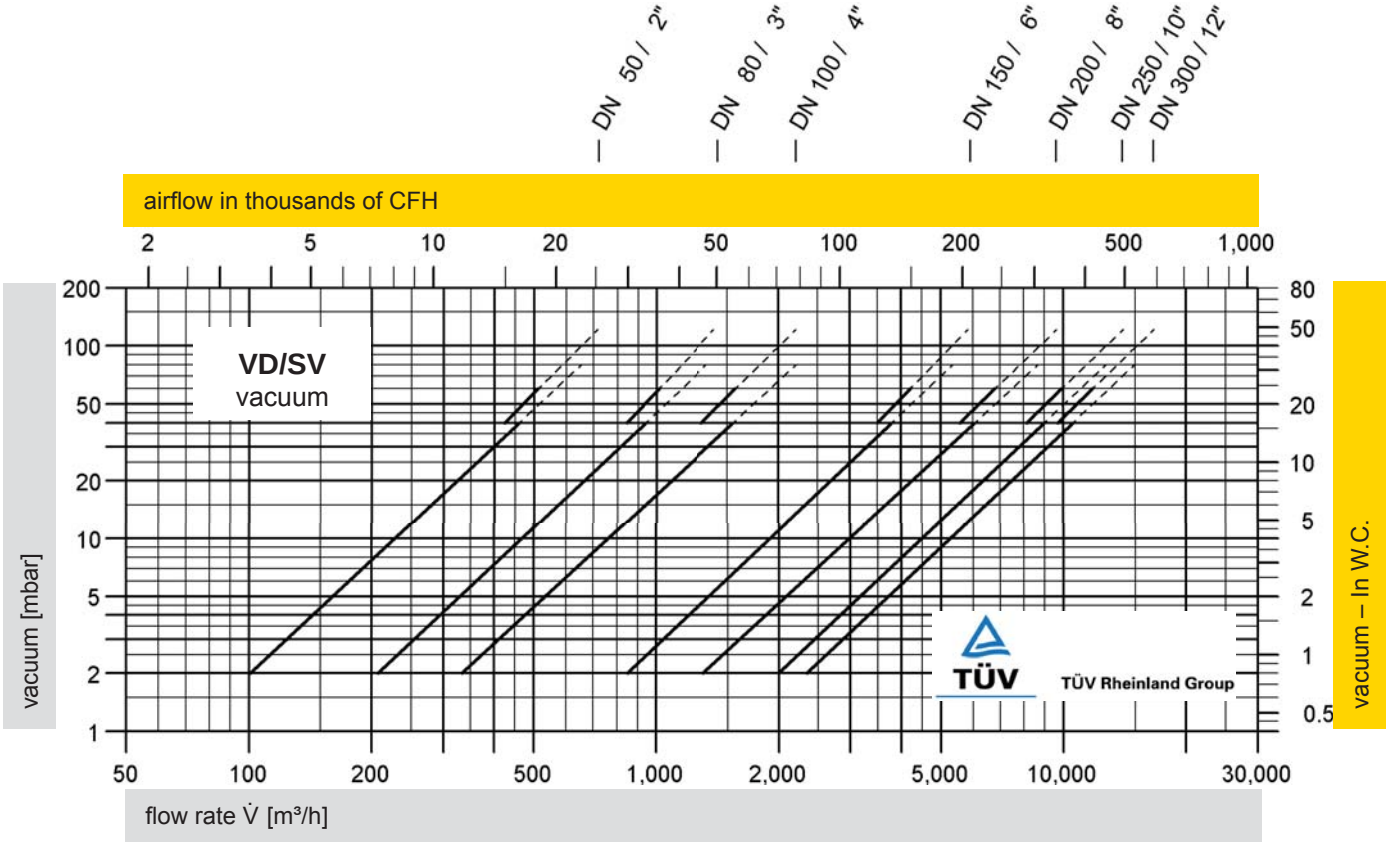


## Pressure and Vacuum Relief Valve

### Flow Capacity Charts

## PROTEGO® VD/SV

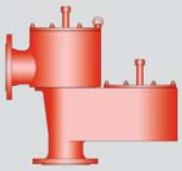



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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”.

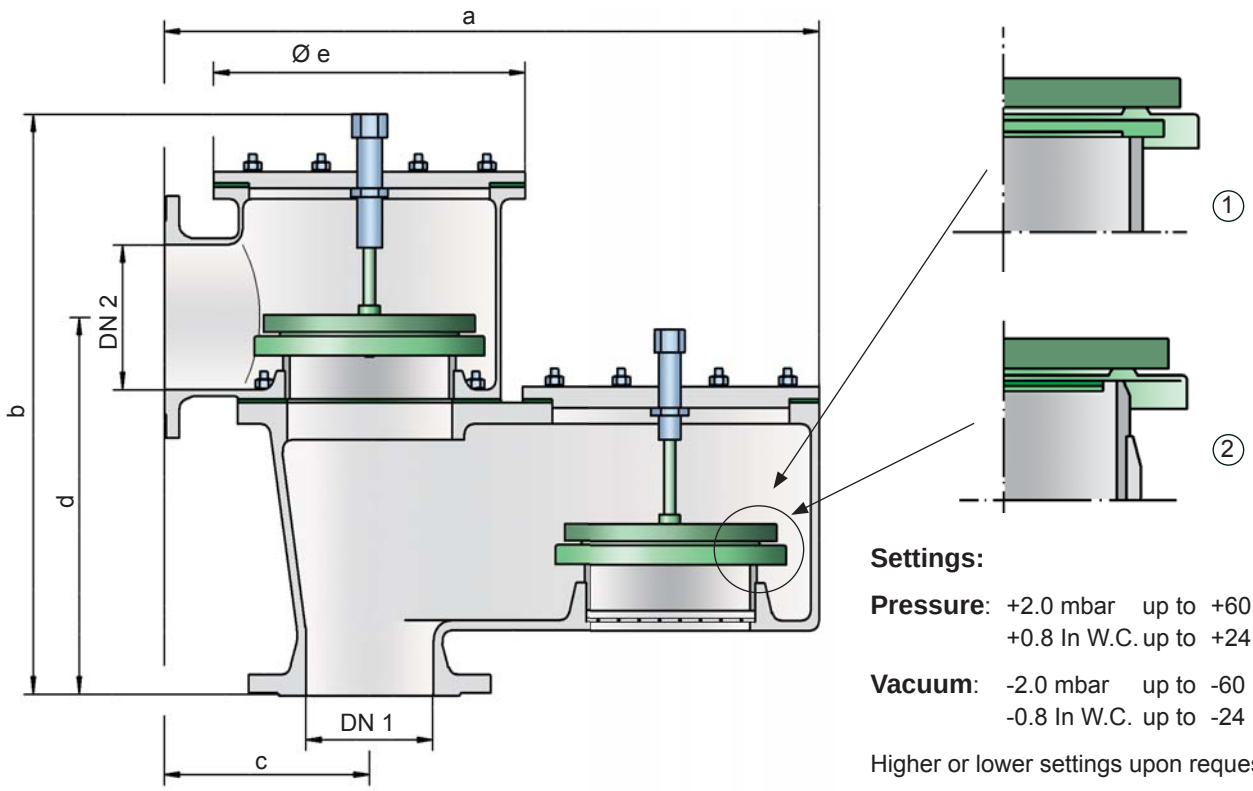
**Notes:**



# Pressure and Vacuum Relief Valve

**with pipe-away connection**

## PROTEGO® VD/SV-PA(L)




**Settings:**

**Pressure**: +2.0 mbar up to +60 mbar
+0.8 In W.C. up to +24 In W.C.

**Vacuum**: -2.0 mbar up to -60 mbar
-0.8 In W.C. up to -24 In W.C.

Higher or lower settings upon request.

### Function and Description

The VD/SV-PA(L) type PROTEGO® valve is a highly developed pressure and vacuum relief valve with excellent flow performance. It is primarily used as a safety device for relieving pressure and breaking vacuum in tanks, containers and process engineering equipment. The valve offers reliable protection against overpressure and excessive vacuum. It prevents also the unacceptable loss of product vapors close to the set pressure as well as the intake of air on the vacuum side close to the set vacuum.

When the set point is reached, the valve starts to open and is fully open within 10% increase. This unique 10% "full lift type technology" enables a pressure setting that is only 10% below the maximum allowable working pressure or maximum allowable working vacuum of the tank. Even in the low pressure range the vent has the opening characteristic comparable to a typical high pressure safety relief valve. The full lift type pallets are a result of many years of development. The reliable engineering enables stable valve pallet operation.

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set point, with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of high grade stainless steel with precisely lapped valve pallets and seats (1) or with an air cushion seal and precisely lapped seats (2). The valve pallets are also available with a PTFE seal to prevent the valve pallet from sticking when sticky products are used, and they enable the use of corrosive media.

After the excess pressure is discharged or the vacuum is compensated, the valve reseats and again provides a tight seal.

### Special Features and Advantages

- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- can be used in areas subject to explosion hazards
- self draining
- best technology for API-tanks

### Design Types and Specifications

Any combination of vacuum and pressure setting can be achieved for the valve. The valve pallets are weight-loaded. Higher pressures can be achieved upon request with a special spring-loaded design. When the difference between the pressure and vacuum exceeds 150 mbar (60.2 In W.C.), special valve pallets are used.

There are two different designs:

Pressure/vacuum valve in basic design **VD/SV-PA**

Pressure/vacuum relief valve with DN2 > DN1 **VD/SV-PAL**

Devices with heating jacket and additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

VD/SV-PA

| DN 1 | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" |
|---|---|---|---|---|---|---|---|
| DN 2 | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" |
| a | 405 / 15.95 | 480 / 18.90 | 600 / 23.62 | 805 / 31.69 | 925 / 36.42 | 1010 / 39.76 | 1010 / 39.76 |
| b | 390 / 15.35 | 485 / 19.09 | 550 / 21.65 | 660 / 25.98 | 780 / 30.71 | 875 / 34.45 | 875 / 34.45 |
| c | 150 / 5.91 | 180 / 7.09 | 200 / 7.87 | 250 / 9.84 | 300 / 11.81 | 305 / 12.01 | 305 / 12.01 |
| d | 240 / 9.45 | 300 / 11.81 | 330 / 12.99 | 390 / 15.35 | 480 / 18.90 | 555 / 21.85 | 582 / 22.91 |
| e | 165 / 6.50 | 192 / 7.56 | 240 / 9.45 | 350 / 13.78 | 390 / 15.35 | 460 / 18.11 | 460 / 18.11 |

VD/SV-PAL

| DN 1 | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" |
|---|---|---|---|---|---|---|---|
| DN 2 | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" | 350 / 14" |
| a | 395 / 15.55 | 445 / 17.52 | 565 / 22.24 | 770 / 30.31 | 895 / 35.24 | 1010 / 39.76 | 1010 / 39.76 |
| b | 400 / 15.74 | 485 / 19.09 | 550 / 21.65 | 655 / 25.79 | 775 / 30.51 | 875 / 34.45 | 885 / 34.45 |
| c | 140 / 5.51 | 143 / 5.63 | 165 / 6.50 | 216 / 8.50 | 267 / 10.51 | 305 / 12.01 | 305 /12.01 |
| d | 255 / 10.04 | 308 / 12.13 | 355 / 13.98 | 417 / 16.42 | 505 / 19.88 | 582 / 22.91 | 603 / 23.74 |
| e | 165 / 6.50 | 192 / 7.56 | 240 / 9.45 | 350 / 13.78 | 390 /15.35 | 460 / 18.11 | 460 / 18.11 |

Dimensions of pressure and vacuum relief valves with heating jacket upon request

**Table 2: Material selection for housing**

| Desing | A | B | C |
|---|---|---|---|
| Housing<br>Heating jacket (VD/SV-PA(L)-H-...) | Aluminium<br>– | Steel<br>Steel | Stainless Steel<br>Stainless Steel |
| Valve seat | Stainless Steel | Stainless Steel | Stainless Steel |
| Sealing | WS 3822 | WS 3822 | PTFE |

Option: Housing with ECTFE-lining

Special materials upon request

**Table 3: Material selection for pressure valve pallet**

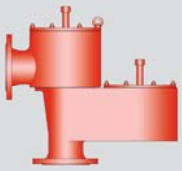
| Design | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | +2.0 up to +3.5<br>+0.8 up to +1.4 | >+3.5 up to +14<br>>+1.4 up to +5.6 | >+14 up to +35<br>>+5.6 up to +14 | >+35 up to +60<br>>+14 up to +24 | >+14 up to +35<br>>+5.6 up to +14 | >+35 up to +60<br>>+14 up to +24 |
| 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 material (alu-coated, titan, hastelloy) as well as higher set pressure upon request

**Table 4: Material selection for vacuum valve pallet**

| Design | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Vacuum range [mbar]<br>[In W.C.] | -2.0 up to -3.5<br>-0.8 up to -1.4 | <-3.5 up to -14<br><-1.4 up to -5.6 | <-14 up to -35<br><-5.6 up to -14 | <-35 up to -60<br><-14 up to -24 | <-14 up to +35<br><-5.6 up to +14 | <-35 up to -60<br><-14 up to -24 |
| 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 material (alu-coated, titan, hastelloy) as well as higher set vacuum upon request



# Pressure and Vacuum Relief Valve

**with pipe-away connection**

## PROTEGO® VD/SV-PA(L)

**Table 5: 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

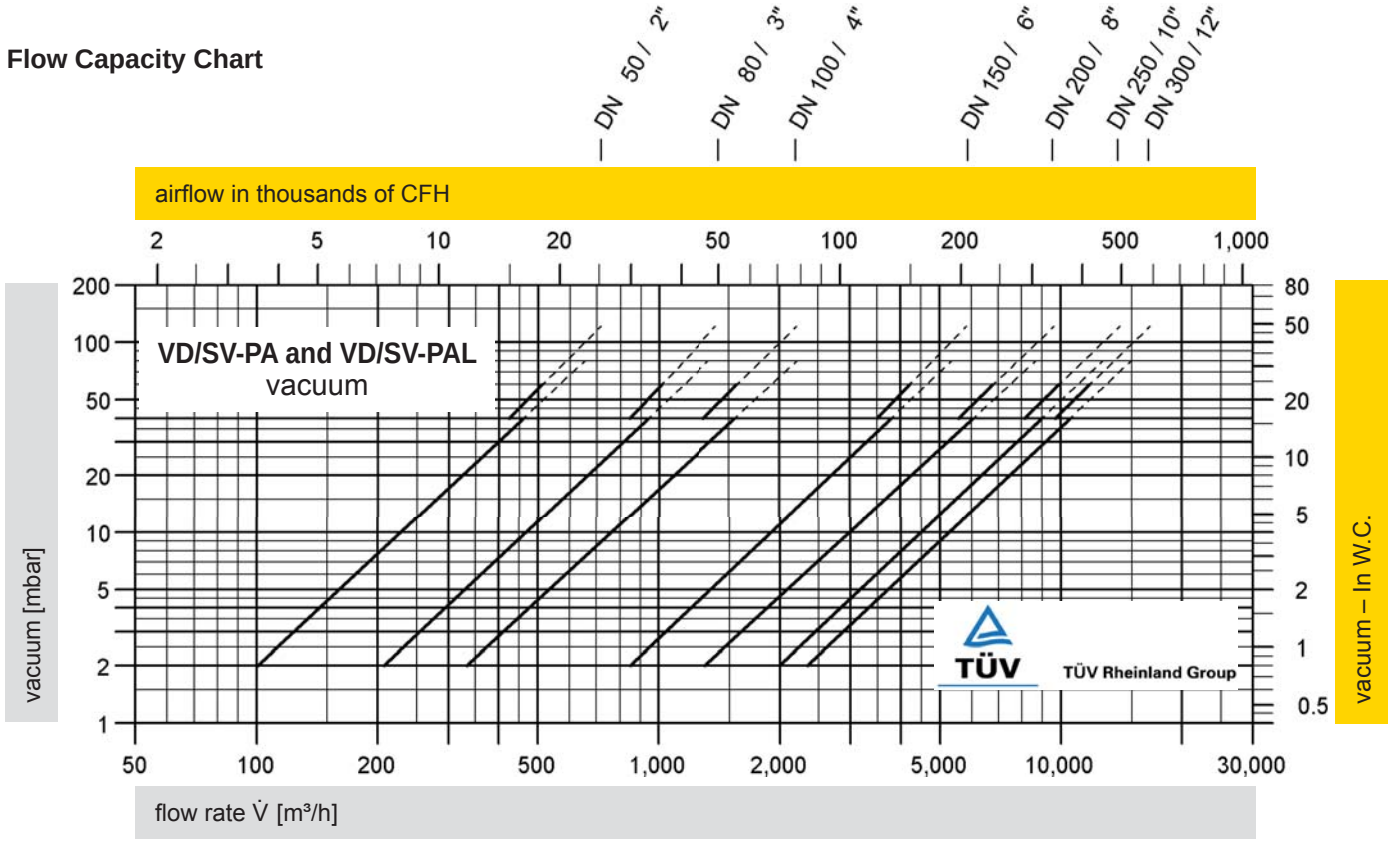
| Type | Nominal size (DN1) | Large outlet (DN2) | Material (housing) | Set pressure | Material (pressure valve pallet) | Set vacuum | Material (vacuum valve pallet) | Flange connection type |
|---|---|---|---|---|---|---|---|---|
| VD/SV-PAL | | | | | | | | |
| VD/SV-PA | – [ ] | – [ ] | – [ ] | – [ ] / | – [ ] | – [ ] / | – [ ] | – [ ] |
| | Tab. 1 | Tab. 1 | Tab. 2 | Setting [mbar] / Setting [In W.C.] | Tab. 3 | Setting [mbar] / Setting [In W.C.] | Tab. 4 | Tab. 5 |

**Order example**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VD/SV-PA | – | 200 | – | | – | B | – | 30 / - | – | C | – | -4.0 / - | – | B | – | DIN |

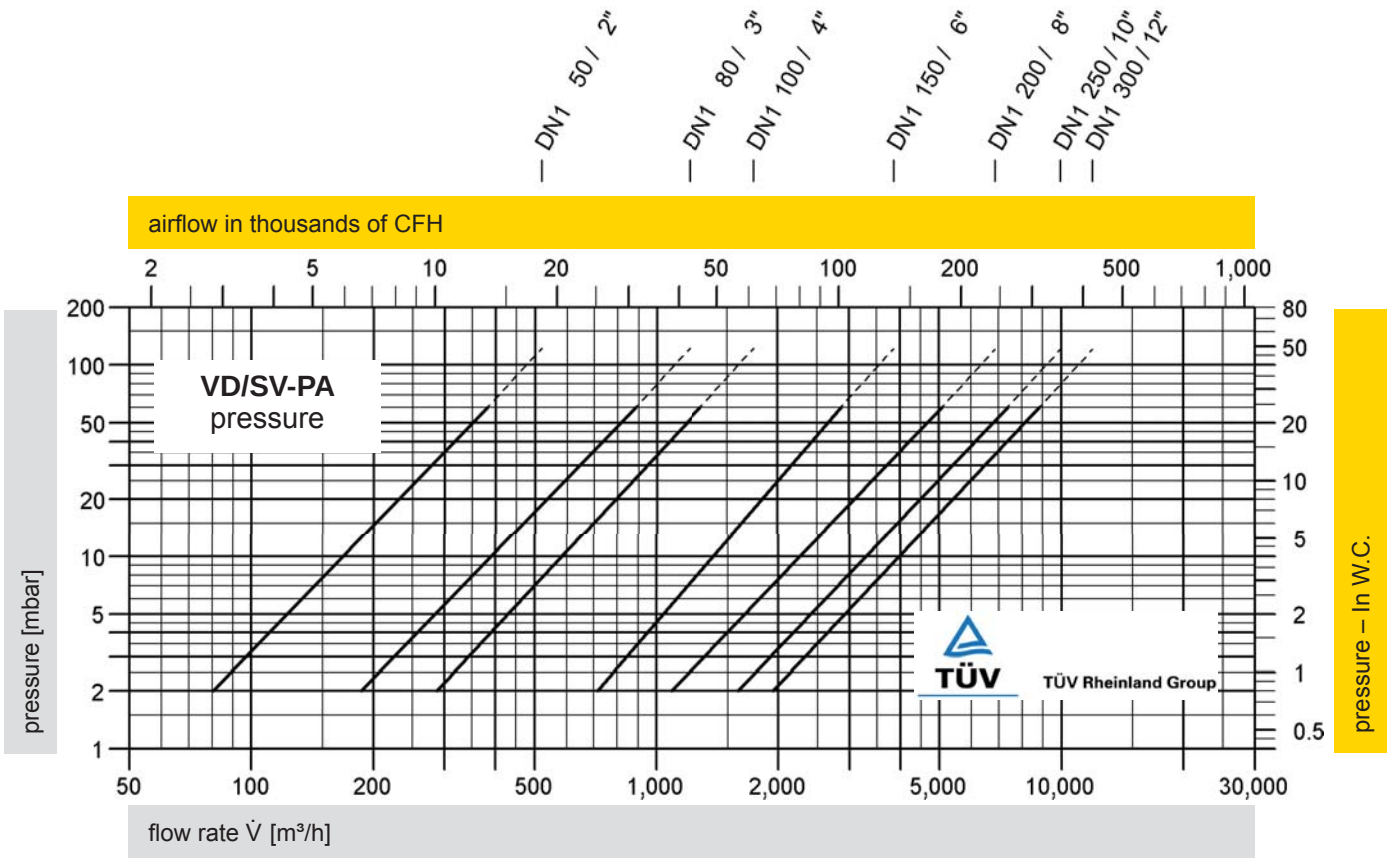
Materials and chemical resistance: See Vol. 1 “Technical Fundamentals”

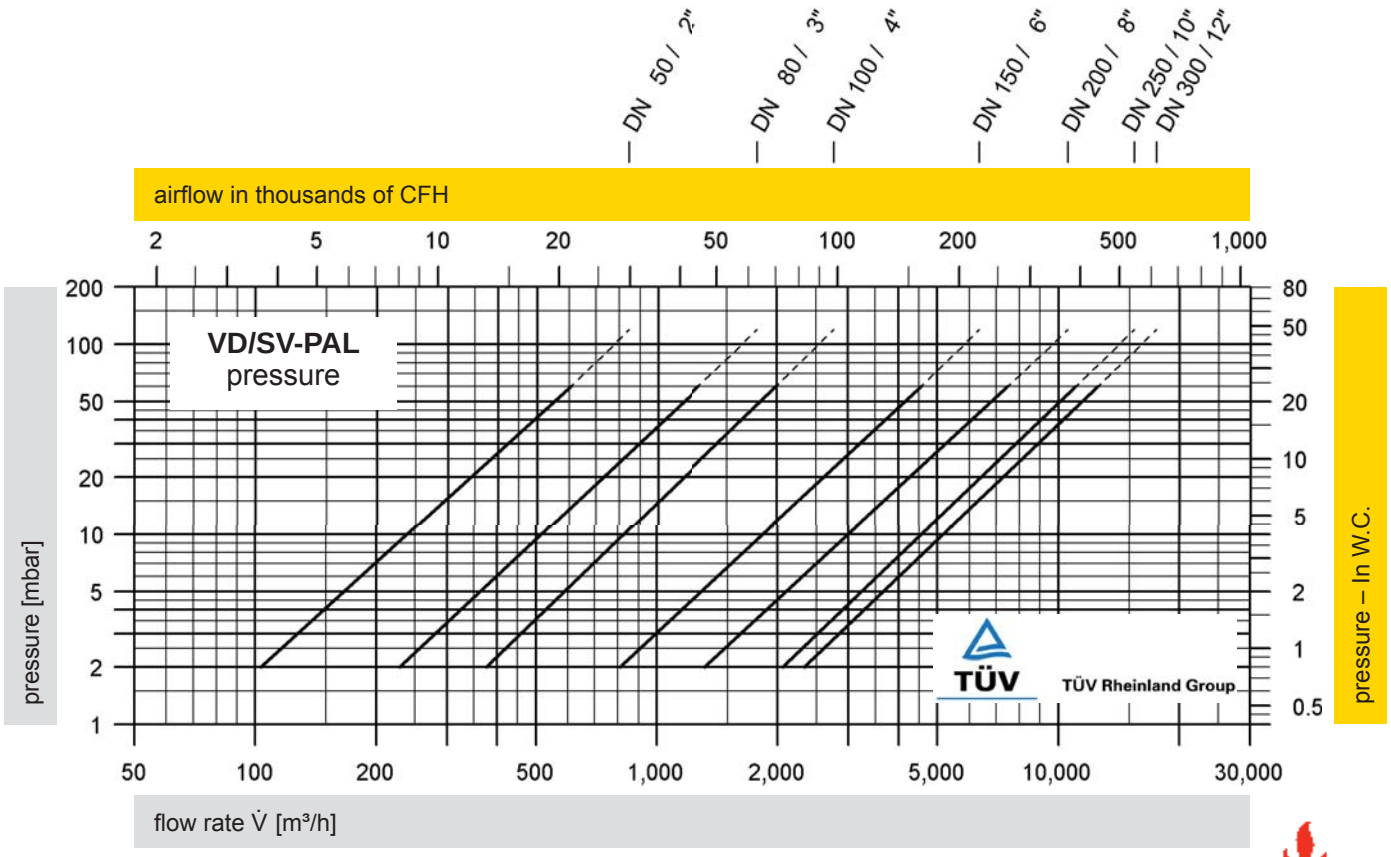
**Flow Capacity Chart**

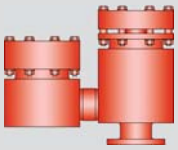



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in [m³/h] and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

## PROTEGO® VD/SV-PA(L)



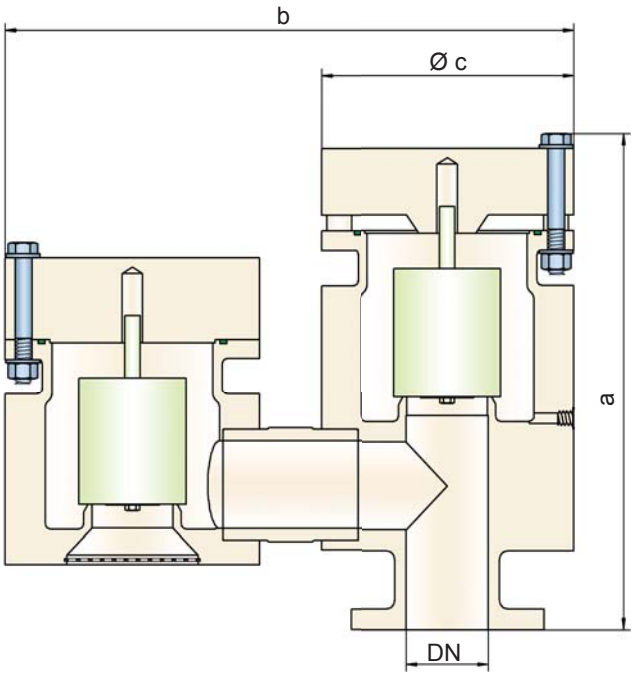





# Pressure and Vacuum Relief Valve

**made of plastic**

## PROTEGO® VD/KSM




**Settings:**

| | | | |
|---|---|---|---|
| **Pressure:** | +5.0 mbar | up to | +100 mbar |
| | +2.0 In W.C. | up to | + 40 In W.C. |
| **Vacuum:** | -5.0 mbar | up to | -100 mbar |
| | -2.0 In W.C. | up to | - 40 In W.C. |

Higher and lower settings upon request

### Function and Description

The PROTEGO® valve VD/KSM is a state-of-the-art pressure and vacuum relief valve with excellent flow performance made of highgrade synthetic material. Typically the valve is installed in the in- and 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. 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 and vacuum (MAWP and 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 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
- the valve pallet is guided within the housing to protect against harsh weather conditions
- corrosion resistant valve
- weight reduction in comparison to steel/stainless steel
- vacuum side self draining and pressure side condensate drain
- smooth surface
- different plastics can be combined
- maintenance friendly design

### Design Types and Specifications

The valve pallet is weight-loaded, and the highest pressure levels are only attained with metal discs.

Pressure/vacuum valve in basic design **VD/KSM-**

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" |
|---|---|---|---|---|---|
| a | 376 / 14.80 | 521 / 20.51 | 563 / 22.17 (542 / 21.34)* | 670 / 26.38 (681 / 26.81)* | 917 / 36.10 (952 / 37.48)* |
| b | 430 / 16.93 | 575 / 22.64 | 700 / 27.56 (675 / 26.57)* | 825 / 32.48 (880 / 34.65)* | 1190 / 46.85 (1100 / 43.31)* |
| c | 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 the housing**

| Design | A | B | C | |
|---|---|---|---|---|
| Housing | PE | PP | PVDF | Special Materials upon request |
| Valve seat | PE | PP | PVDF | |
| Sealing | FPM | FPM | FPM | |
| Pressure valve pallet | A, C, D | B, C, D | C, D | |
| Vacuum valve pallet | A, C, D | B, C, D | C, D | |

**Table 3: Material selection for pressure valve pallet**

| Design | A | B | C | D |
|---|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | +5.0 up to +17<br>+2.0 up to +6.8 | +5.0 up to +17<br>+2.0 up to +6.8 | +10 up to +32<br>+4.0 up to +12.8 | +30 up to +100<br>+12 up to +40 |
| Valve pallet | PE | PP | PVDF | Hastelloy |
| Sealing | PTFE | PTFE | PTFE | PTFE |
| Spindle guide | PE | PP | PVDF | Hastelloy |
| Weight | PE | PP | PVDF | Hastelloy |

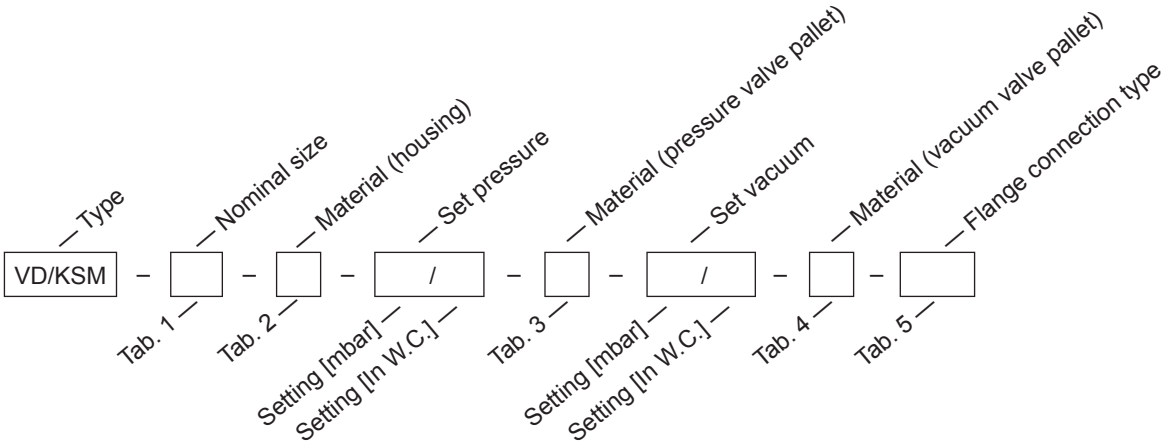
**Table 4: Material selection for vacuum valve pallet**

| Design | A | B | C | D |
|---|---|---|---|---|
| Vacuum range [mbar]<br>[In W.C.] | -5.0 up to -17<br>-2.0 up to -6.8 | -5.0 up to -17<br>-2.0 up to -6.8 | -10 up to -32<br>-4.0 up to -12.8 | -30 up to -100<br>-12 up to -40 |
| Valve pallet | PE | PP | PVDF | Hastelloy |
| Sealing | PTFE | PTFE | PTFE | PTFE |
| Spindle guide | PE | PP | PVDF | Hastelloy |
| Weight | PE | PP | PVDF | Hastelloy |

Special materials and other pressure/vacuum settings are available upon request

**Table 5: 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 | |




**Order example**

| VD/KSM | – | 200 | – | A | – | +15 / | – | A | – | -8.0 / | – | A | – | DIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

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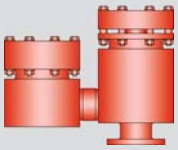
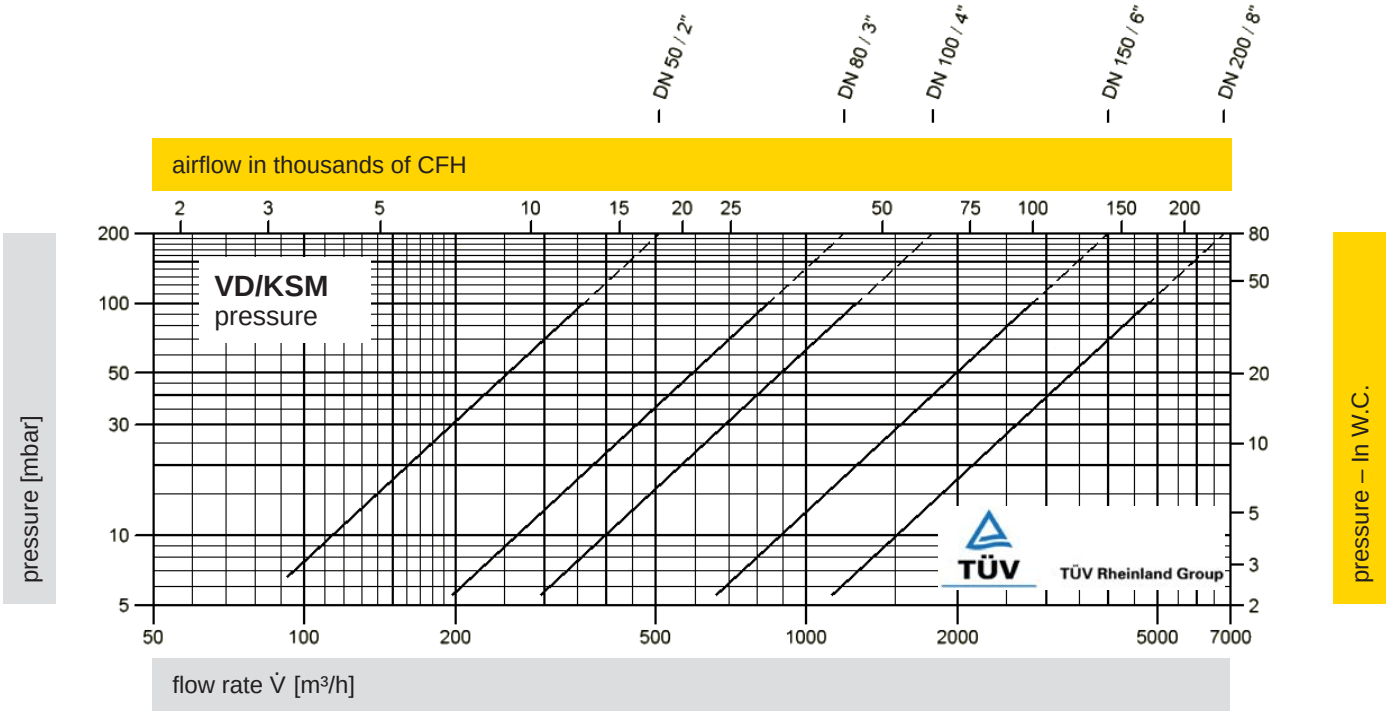
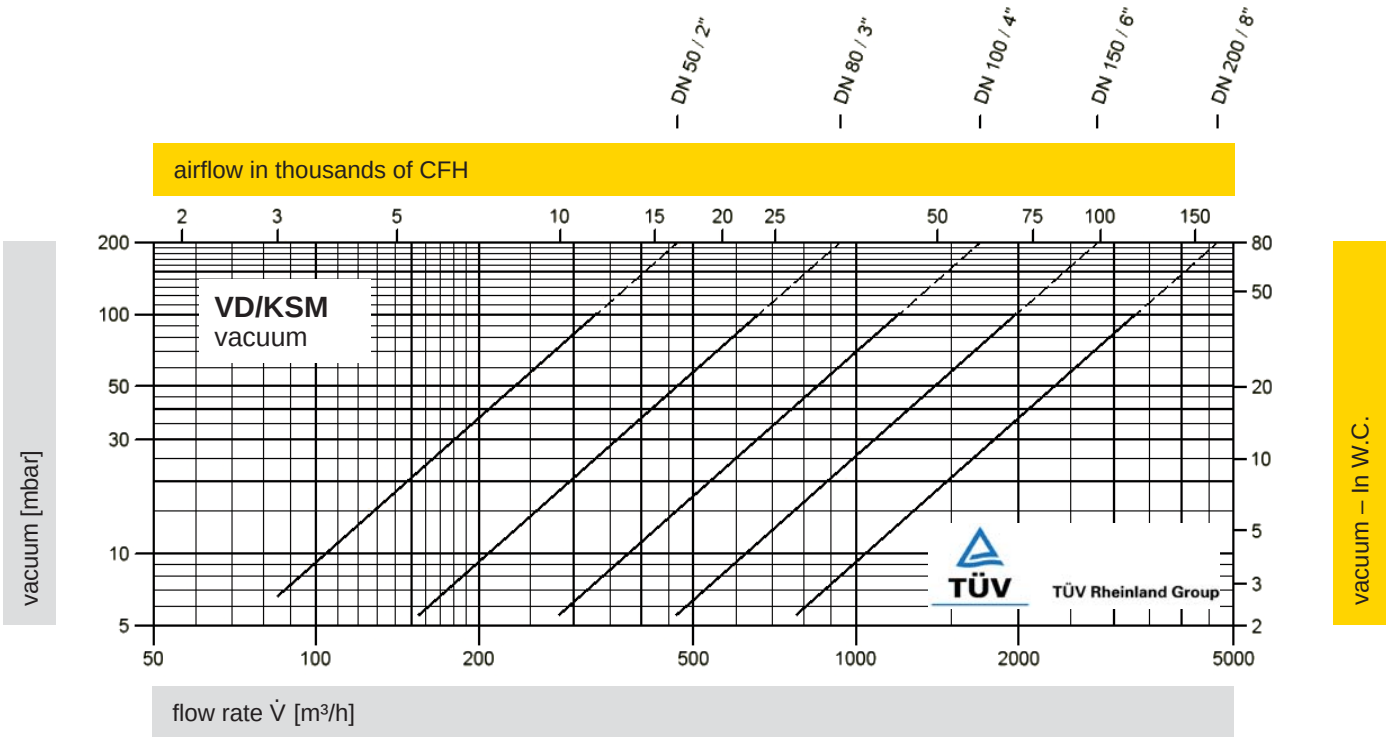


# Pressure and Vacuum Relief Valve

## Flow Capacity Charts

## PROTEGO® VD/KSM

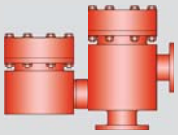



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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”.

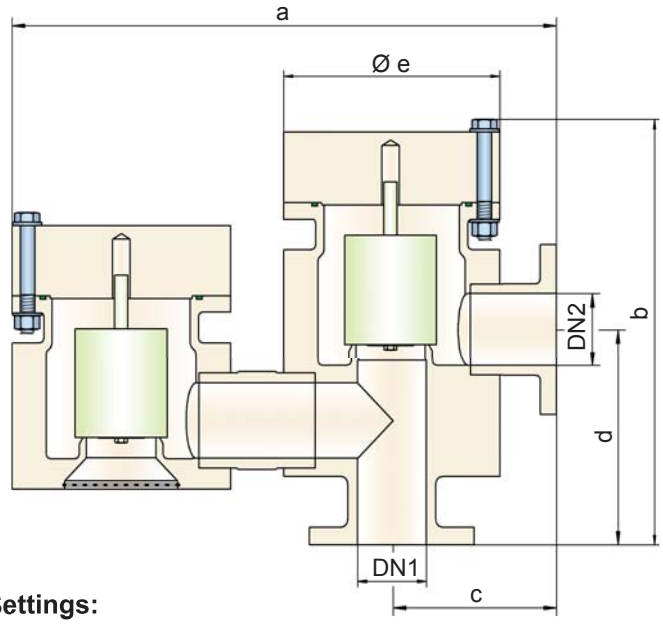
**Notes:**



# Pressure and Vacuum Relief Valve

**made of plastic**

## PROTEGO® VD/KSM-PA




**Settings:**

| | | | |
|---|---|---|---|
| **Pressure:** | +5.0 mbar | up to | +100 mbar |
| | +2.0 In W.C. | up to | + 40 In W.C. |
| **Vacuum:** | -5.0 mbar | up to | -100 mbar |
| | -2.0 In W.C. | up to | - 40 In W.C. |

Higher and lower settings upon request

### Function and Description

The PROTEGO® valve VD/KSM-PA is a state-of-the-art pressure and vacuum relief valve with excellent flow performance made of highgrade synthetic material. Typically the valve is installed in the in- and 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. 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 and vacuum (MAWP and 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 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
- the valve pallet is guided within the housing to protect against harsh weather conditions
- corrosion resistant valve
- weight reduction in comparison to steel/stainless steel
- vacuum side self draining and pressure side condensate drain
- smooth surface
- different plastics can be combined
- maintenance friendly design

### Design Types and Specifications

The valve pallet is weight-loaded, and the highest pressure levels are only attained with metal discs.

Pressure/vacuum valve in basic design **VD/KSM-PA-**

Additional special devices available upon request.

**Table 1: Dimensions** Dimensions in mm / inches

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

| DN1 | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" |
|---|---|---|---|---|---|
| DN2 | 50 / 2" | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" |
| a | 490 / 19.29 | 650 / 25.59 | 775 / 30.51 (750 / 29.53)* | 930 / 36.61 (958 / 37.72)* | 1260 / 49.61 (1200 / 47.24)* |
| b | 376 / 14.80 | 521 / 20.51 | 563 / 22.17 (523 / 20.59)* | 670 / 26.38 (651 / 25.63)* | 879 / 34.61 (912 / 35.91)* |
| c | 150 / 5.91 | 200 / 7.87 | 225 / 8.86 | 280 / 11.02 | 350 / 13.78 |
| d | 200 / 7.87 | 245 / 9.65 | 300 / 11.81 | 370 / 14.57 | 590 / 23.23 (650 / 25.59)* |
| e | 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 the housing**

| | | | | |
|---|---|---|---|---|
| Design | A | B | C | Special Materials upon request |
| Housing | PE | PP | PVDF | |
| Valve seat | PE | PP | PVDF | |
| Sealing | FPM | FPM | FPM | |
| Pressure valve pallet | A, C, D | B, C, D | C, D | |
| Vacuum valve pallet | A, C, D | B, C, D | C, D | |

**Table 3: Material selection for pressure valve pallet**

| Design | A | B | C | D |
|---|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | +5.0 up to +17<br>+2.0 up to +6.8 | +5.0 up to +17<br>+2.0 up to +6.8 | +10 up to +32<br>+4.0 up to +12.8 | +30 up to +100<br>+12 up to +40 |
| Valve pallet | PE | PP | PVDF | Hastelloy |
| Sealing | PTFE | PTFE | PTFE | PTFE |
| Spindle guide | PE | PP | PVDF | Hastelloy |
| Weight | PE | PP | PVDF | Hastelloy |

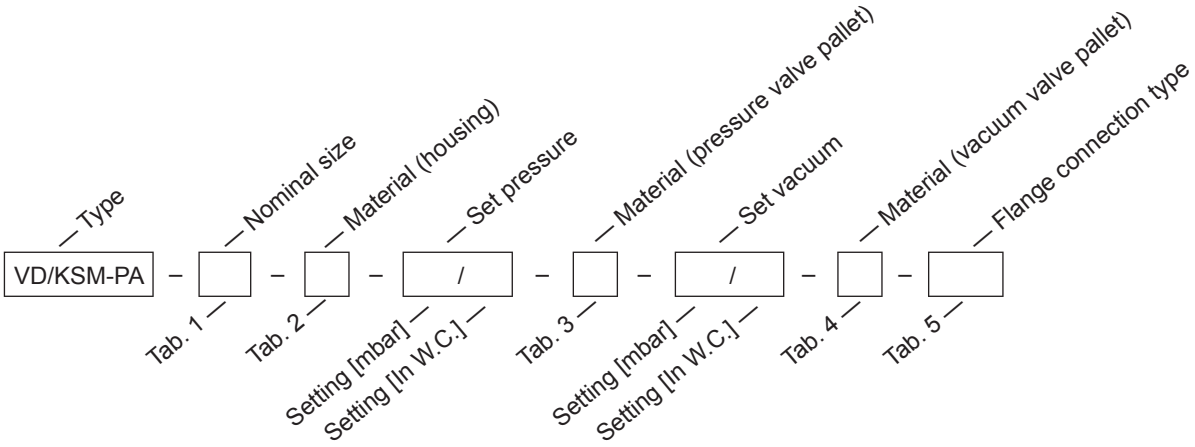
**Table 4: Material selection for vacuum valve pallet**

| Design | A | B | C | D |
|---|---|---|---|---|
| Vacuum range [mbar]<br>[In W.C.] | -5.0 up to -17<br>-2.0 up to -6.8 | -5.0 up to -17<br>-2.0 up to -6.8 | -10 up to -32<br>-4.0 up to -12.8 | -30 up to -100<br>-12 up to -40 |
| Valve pallet | PE | PP | PVDF | Hastelloy |
| Sealing | PTFE | PTFE | PTFE | PTFE |
| Spindle guide | PE | PP | PVDF | Hastelloy |
| Weight | PE | PP | PVDF | Hastelloy |

Special materials and other pressure/vacuum settings are available upon request

**Table 7: 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 | |




**Order example**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| VD/KSM-PA | – | 200 | – | A | – | +15 / | – | A | – | -8.0 / | – | A | – | DIN |

Materials and chemical resistance:
See Vol. 1 “Technical Fundamentals”

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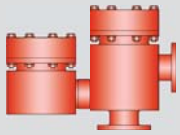
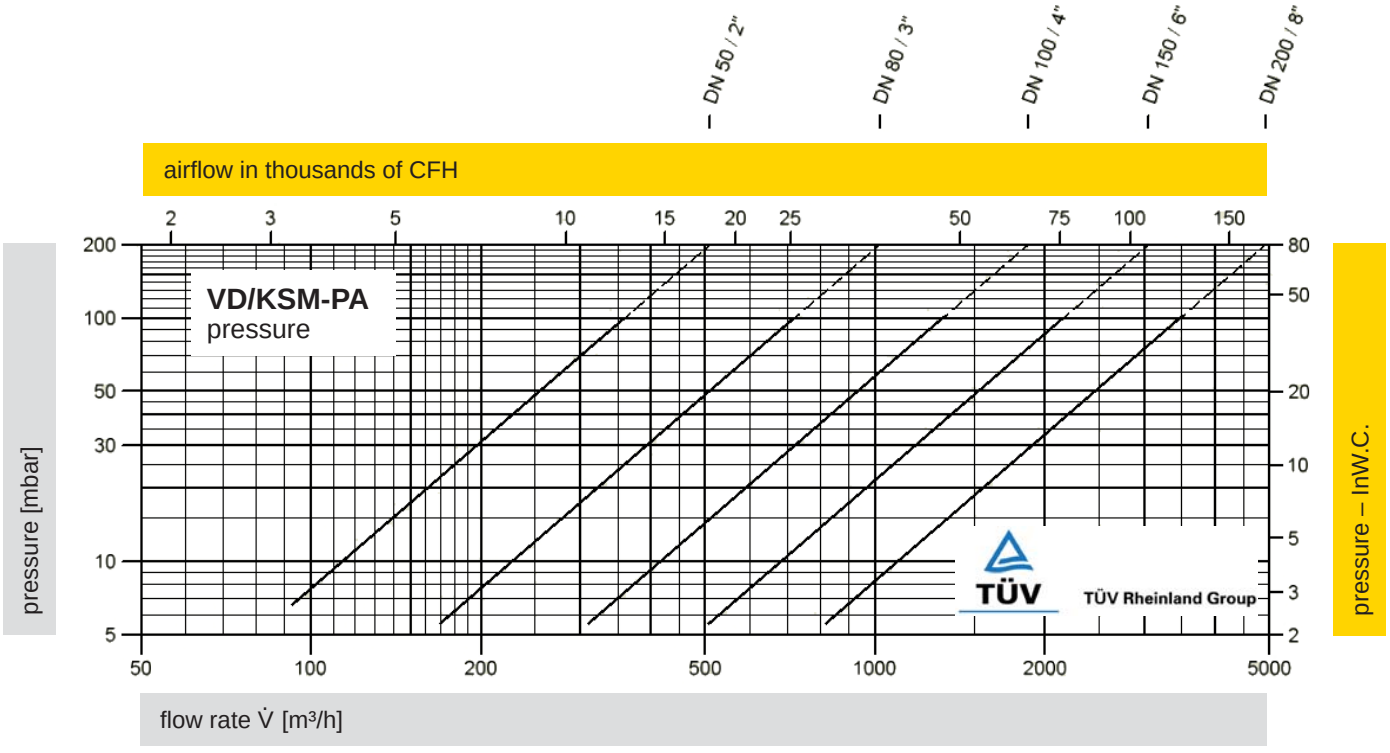
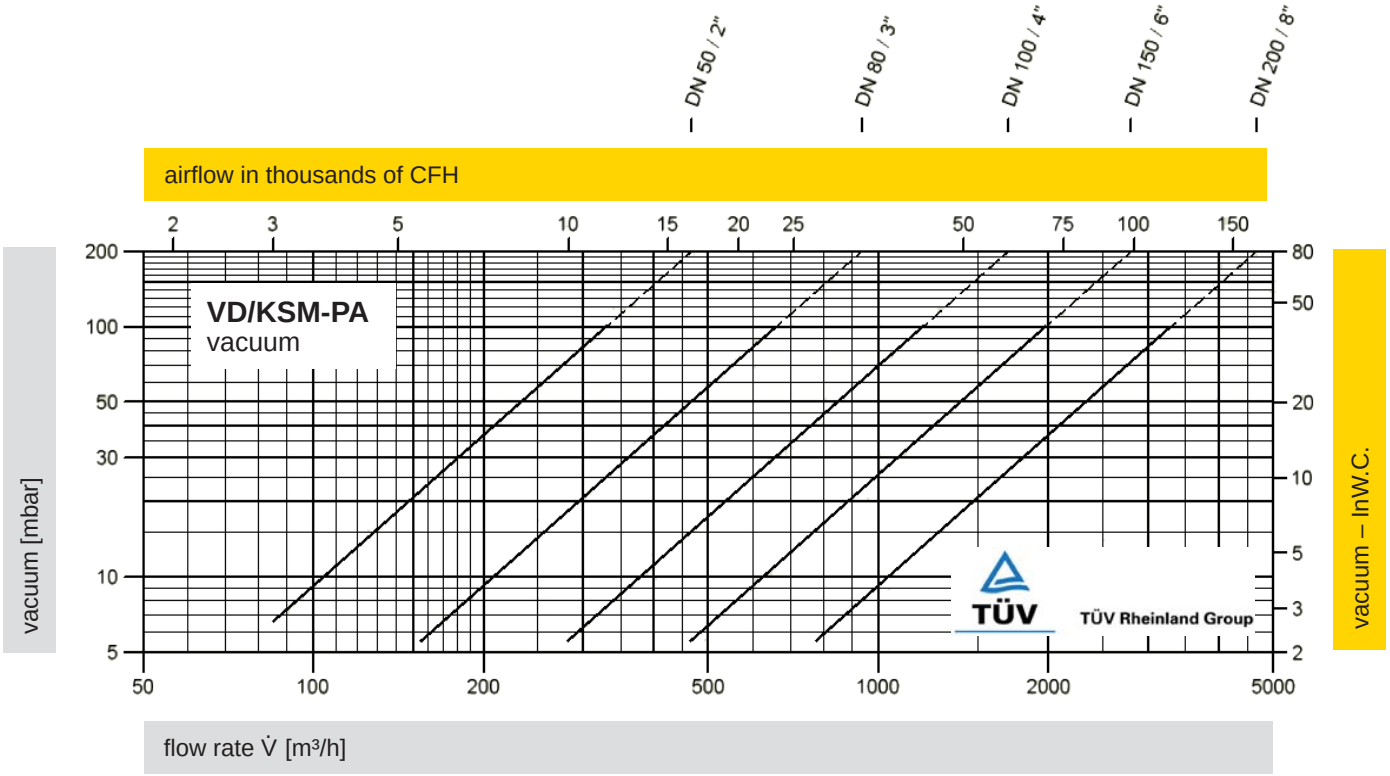


# Pressure and Vacuum Relief Valve

## Flow Capacity Charts

## PROTEGO® VD/KSM-PA

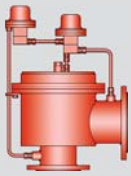



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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”.

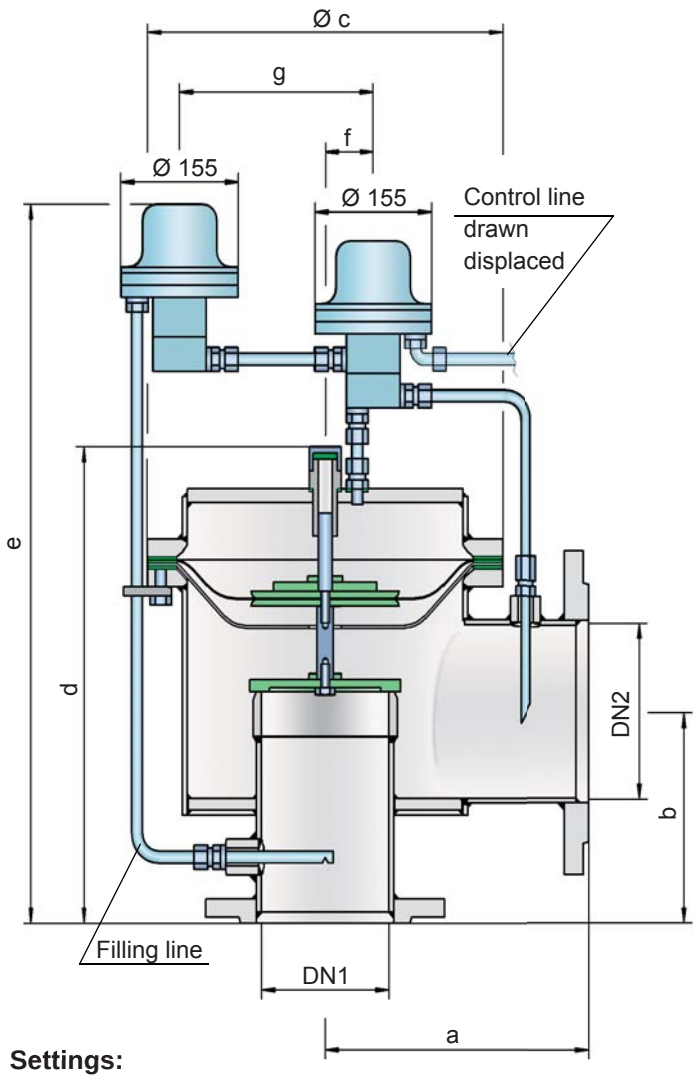
## Notes:



# Pressure/Vacuum Relief Valve

**Pilot-operated diaphragm valve**

## PROTEGO® PM/(D)S




### Settings:

**Pressure**: +10 mbar up to +300 mbar
+4 In W.C. up to +120 In W.C.

**Vacuum**: -3.0 mbar up to -7 mbar
-1.2 In W.C. up to -2.8 In W.C.

Higher or lower settings upon request.

### Function and Description

The PM/(D)S type pilot-controlled PROTEGO® diaphragm valve is a highly developed valve for pressure and vacuum relief. It is primarily used as a safety device for outbreathing in tanks, containers, and process engineering equipment and it also offers reliable protection from vacuum and overpessure. It prevents the intake of air and unacceptable product vapor loss up to the set point. The valve can also be used as inbreathing valve. The main valve is directly controlled when it is exposed to a vacuum; i.e., it functions as a weight-loaded diaphragm valve. This valve is highly suitable under atmospheric conditions and for use in cryogenic service.

The main valve is controlled by a pilot valve. The pilot valve is controlled by the tank pressure. The tank medium does not continuously flow through the pilot. The set pressure is adjusted at the pilot valve by a corrosion-resistant and low-temperature-resistant permanent magnet.

As the operating pressure increases, the closing force acting on the main valve also rises; i.e. the valve tightness increases to prevent leakage until the set pressure is reached. After the valve responds, it immediately opens completely without any significant increase in pressure (pop open characteristic), and the nominal volumetric flow is discharged through a fully open valve. If this level is exceeded, the pressure increase follows the performance curve (Δp / curve). Up to the set pressure, the tank pressure is maintained with a tightness that is far superior to the conventional standard due to the superior manufacturing technology. This feature is ensured by valve seats made of high-grade stainless steel with precisely ground valve pallets. After the excess pressure is discharged, the valve reseats and again provides a tight seal.

### Special Features and Advantages

- high degree of safety due to double pilot
- controlled by corrosion-resistant, low-temperature-resistant permanent magnet
- the tank medium does not continuously flow through the pilot valve
- pop-open characteristic from a minimum pressure rise to full lift
- excellent seal for reducing product losses and emissions
- set pressure is close to full lift pressure, which results in high level of design freedom and product savings
- high flow capacity
- the control diaphragm of the main valve is shielded from low temperatures - high-level durability
- can be used in areas subject to an explosion hazard
- designed for use at low temperatures
- self draining

### Design Types and Specifications

The valve is equipped with either a control pilot valve or with one control and emergency pilot valve to ensure optimum operating safety in case of malfunctions or damage.

Two different designs are therefore available:

Basic design of pressure/vacuum relief valve with a control pilot valve **PM/S-**

Basic pressure/vacuum relief valve with a control pilot valve and additional emergency pilot valve **PM/DS-**

Additional special devices available upon request.

**Table 1: Dimensions** — Dimensions in mm / inches

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

| DN1 | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" |
|---|---|---|---|---|---|---|
| DN2 | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" | 350 / 14" |
| a | 225 / 8.86 | 250 / 9.87 | 325 / 12.80 | 375 / 14.76 | 450 / 17.72 | 500 / 19.69 |
| b | 150 / 5.91 | 175 / 6.89 | 225 / 8.86 | 250 / 9.84 | 270 / 10.63 | 300 / 12.81 |
| c | 275 / 10.83 | 330 / 12.99 | 445 / 17.52 | 550 / 21.65 | 665 / 26.18 | 785 / 30.91 |
| d | 370 / 14.57 | 425 / 16.73 | 515 / 20.28 | 590 / 23.23 | 675 / 26.57 | 765 / 30.12 |
| e | 615 / 24.21 | 685 / 26.97 | 770 / 30.31 | 825 / 32.48 | 935 / 36.81 | 1005 / 39.57 |
| f | 35 / 1.38 | 40 / 1.57 | 40 / 1.57 | 50 / 1.97 | 50 /1.97 | 50 / 1.97 |
| g | 160 / 6.30 | 195 / 7.68 | 250 / 9.84 | 315 / 12.40 | 370 / 14.57 | 425 / 16.73 |

**Table 2: Material selection for housing**

| Design | A | B | |
|---|---|---|---|
| Housing | Aluminium | Stainless Steel | |
| Valve seat | Stainless Steel | Stainless Steel | |
| Sealing | KL-C-4106 | KL-C-4106 | |
| Main diaphragm protection | Stainless Steel | Stainless Steel | Special materials upon request |
| Pilot lines | Stainless Steel | Stainless Steel | |
| Pilot housing | Stainless Steel | Stainless Steel | |
| Pilot diaphragm | FEP | FEP | |

**Table 3: Material selection for valve pallet**

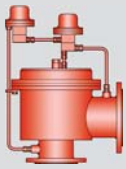
| Design | A | B |
|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | -3.0 up to -5*<br>-1.2 up to -2* | <-5 up to -7*<br><-2 up to -2.8* |
| Valve pallet | Aluminium | Stainless steel |
| Diaphragm | FEP | FEP |

* The indicated vacuum ranges depend on the nominal sizes and can differ.

The pressure setting can be combined with any vacuum setting

**Table 4: Flange connection type**

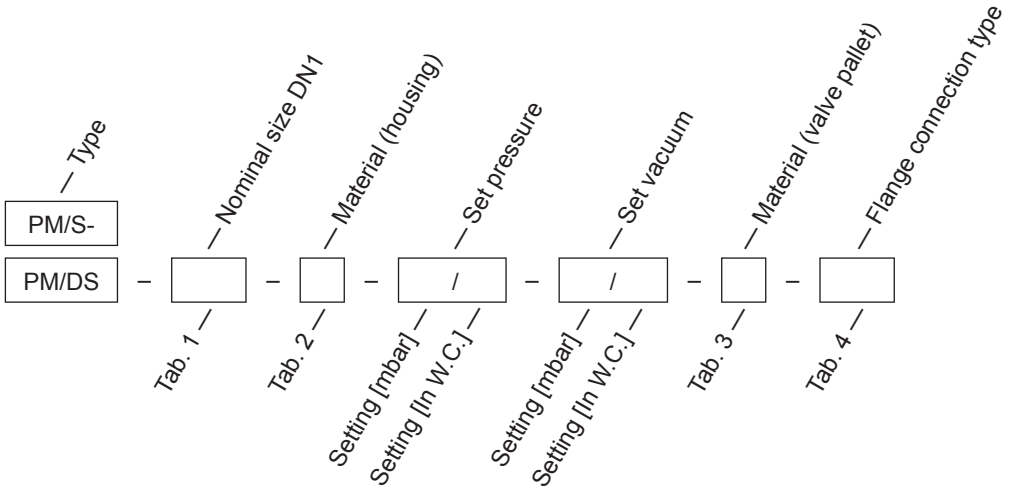
| | | |
|---|---|---|
| EN 1092-1, Form B1 or DIN 2501, Form C, PN 16; from DN 200 PN 10 | EN or DIN | other types upon request |
| ANSI 150 lbs RFSF | ANSI | |



# Pressure/Vacuum relief valve

## Pilot-operated diaphragm valve

## PROTEGO® PM/(D)S

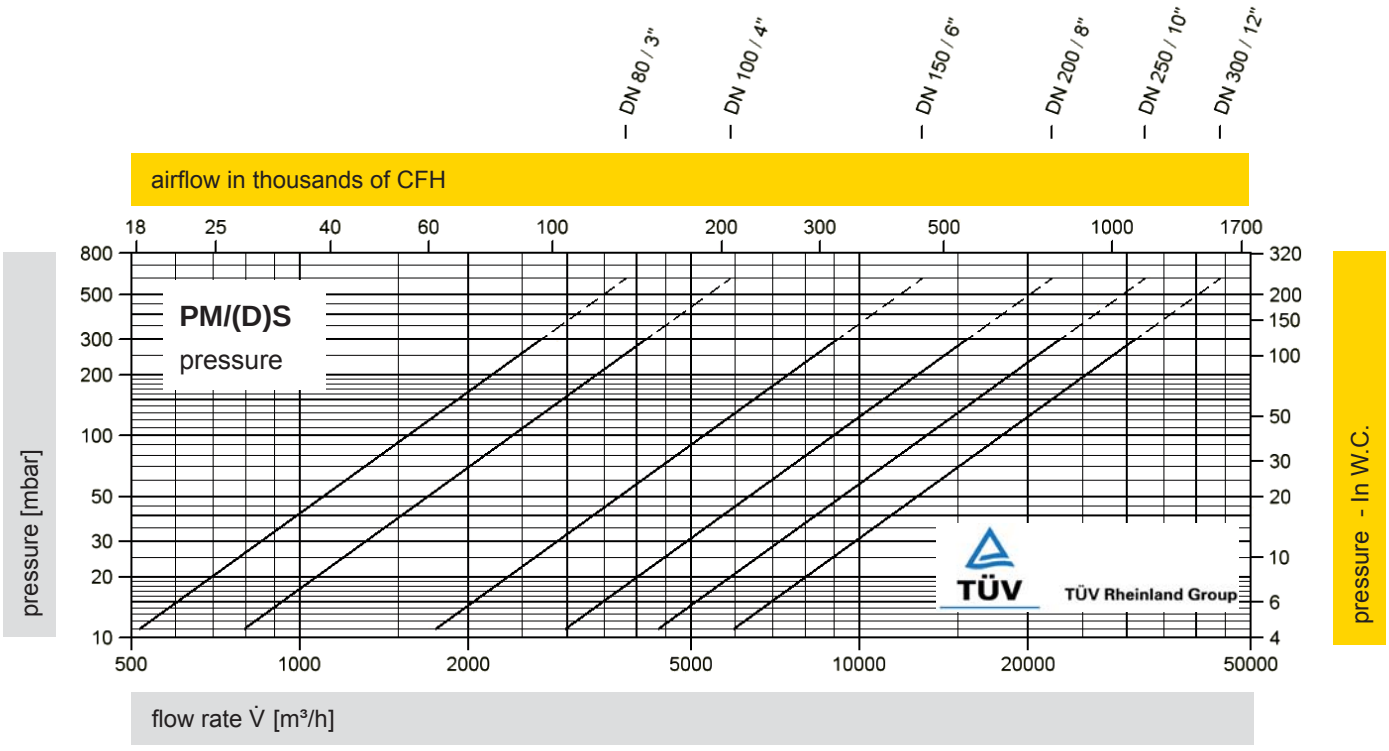


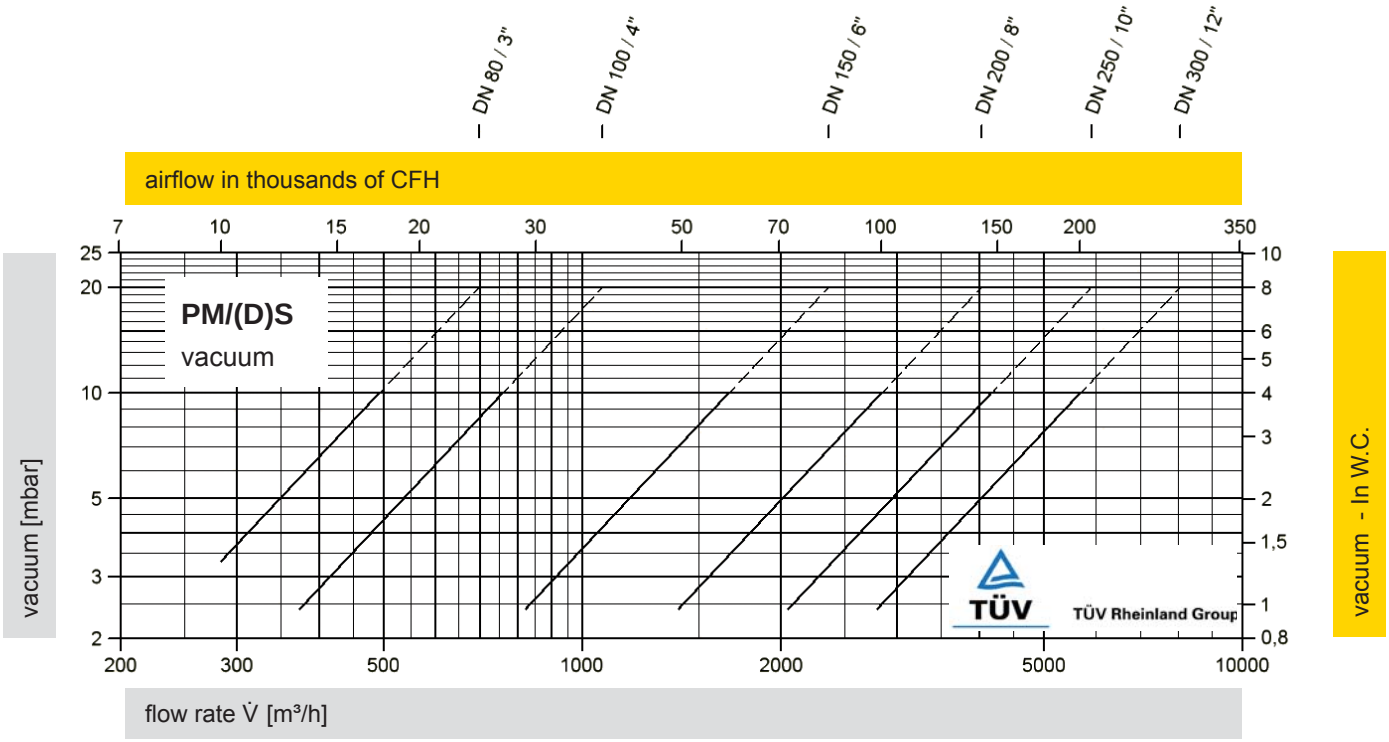

**Order example**

| PM/DS | – | 200 | – | B | – | 100/ - | – | -7.0/ - | – | B | – | DIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Materials and chemical resistance: See Vol. 1 “Technical Fundamentals”

## PROTEGO® PM/(D)S




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”.

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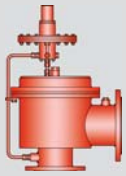
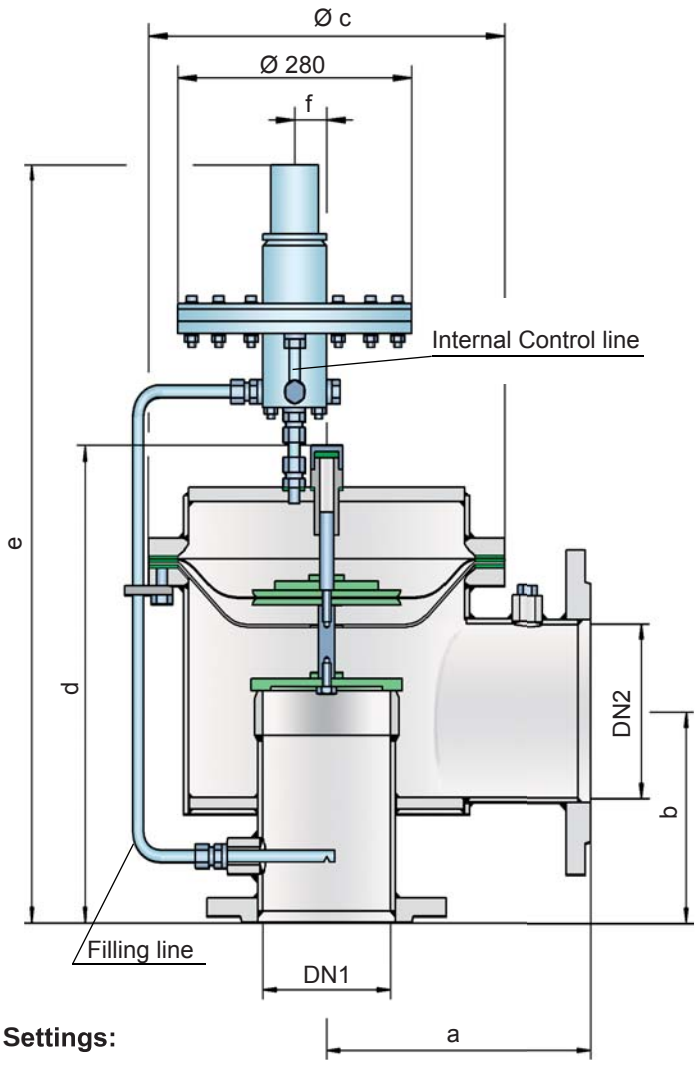


# Pressure/Vacuum Relief Valve

**Pilot-operated diaphragm valve**

## PROTEGO® PM/F




**Settings:**

**Pressure**: +10 mbar up to +350 mbar
+4 In W.C. up to +140 In W.C.

**Vacuum**: -3.0 mbar up to -10 mbar
-1.2 In W.C. up to -4 In W.C.

Higher or lower settings upon request.

### Function and Description

The PM/F type pilot-controlled PROTEGO® diaphragm valve is a highly developed valve for pressure and vacuum relief. It is primarily used as a safety device for outbreathing in tanks, containers, and process engineering equipment and it also offers reliable protection from vacuum and overpessure. It prevents the intake of air and unacceptable product vapor loss up to the set point. The valve can also be used as inbreathing valve. The main valve is directly controlled when it is exposed to a vacuum; i.e., it functions as a weight-loaded diaphragm valve.

The main valve is controlled by a pilot valve. The pilot valve is controlled by the tank pressure. The tank medium does not continuously flow through the pilot. The set pressure is adjusted by stretching or relaxation of the spring.

As the operating pressure increases, the closing force acting on the main valve also rises; i.e. the valve tightness increases to prevent leakage until the set pressure is reached. After the valve responded within 10% pressure rise, it immediately opens completely, and the nominal volumetric flow is discharged through a fully open valve. If this level is exceeded, the pressure increase follows the performance curve (Δp / curve). Up to the set pressure, the tank pressure is maintained with a tightness that is far superior to the conventional standard due to the superior manufacturing technology. This feature is ensured by valve seats made of high-grade stainless steel with precisely ground valve pallets. After the excess pressure is discharged, the valve reseats and again provides a tight seal.

### Special Features and Advantages

- controlled by corrosion-resistant control valve
- the tank medium does not continuously flow through the pilot valve
- 10% technology for minimum pressure rise up to full lift
- excellent seal for reducing product losses and emissions
- due to 10%-technology the set pressure is close to full lift pressure and the tank pressure is maintained up to the set point
- the control diaphragm of the main valve is shielded from low temperatures - high-level durability
- high flow capacity
- can be used in areas subject to an explosion hazard
- self draining

### Design Types and Specifications

The pilot controlled diaphragm valve is equipped with one control valve (pilot valve). For ensuring optimum operation safety in case of any failures or damages, it is recommended to install an emergency pilot valve.

Basic design of pressure/vacuum relief valve with a **PM/F** control pilot valve

Additional special devices available upon request.

**Table 1: Dimensions** — Dimensions in mm / inches

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

| | | | | | | |
|---|---|---|---|---|---|---|
| DN1 | 80 / 3" | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" |
| DN2 | 100 / 4" | 150 / 6" | 200 / 8" | 250 / 10" | 300 / 12" | 350 / 14" |
| a | 225 / 8.86 | 250 / 9.87 | 325 / 12.80 | 375 / 14.76 | 450 / 17.72 | 500 / 19.69 |
| b | 150 / 5.91 | 175 / 6.89 | 225 / 8.86 | 250 / 9.84 | 270 / 10.63 | 300 / 12.81 |
| c | 275 / 10.83 | 330 / 12.99 | 445 / 17.52 | 550 / 21.65 | 665 / 26.18 | 785 / 30.91 |
| d | 370 / 14.57 | 425 / 16.73 | 515 / 20.28 | 590 / 23.23 | 675 / 26.57 | 750 / 29.53 |
| e | 700 / 27.56 | 770 / 30.31 | 860 / 33.86 | 915 / 36.02 | 970 / 38.19 | 1060 / 41.73 |
| f | 35 / 1.38 | 40 / 1.57 | 40 / 1.57 | 50 / 1.97 | 50 / 1.97 | 50 / 1.97 |

**Table 2: Material selection for housing**

| Design | A | B | |
|---|---|---|---|
| Housing | Aluminium | Stainless Steel | |
| Valve seat | Stainless Steel | Stainless Steel | |
| Sealing | KL-C-4106 | KL-C-4106 | Special materials upon request |
| Main diaphragm protection | Stainless Steel | Stainless Steel | |
| Pilot lines | Stainless Steel | Stainless Steel | |
| Pilot housing | Aluminium | Stainless Steel | |
| Pilot diaphragm | FEP | FEP | |

**Table 3: Material selection for valve pallet**

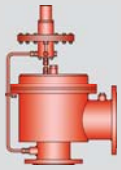
| Design | A | B | |
|---|---|---|---|
| Pressure range [mbar]<br>[In W.C.] | -3.0 up to -5*<br>-1.2 up to -2* | <-5 up to -10*<br><-2 up to -4* | Special materials upon request |
| Valve pallet | Aluminium | Stainless steel | |
| Diaphragm | FEP | FEP | |

* The indicated vacuum ranges depend on the nominal sizes and can differ.

The pressure setting can be combined with any vacuum setting

**Table 4: Flange connection type**

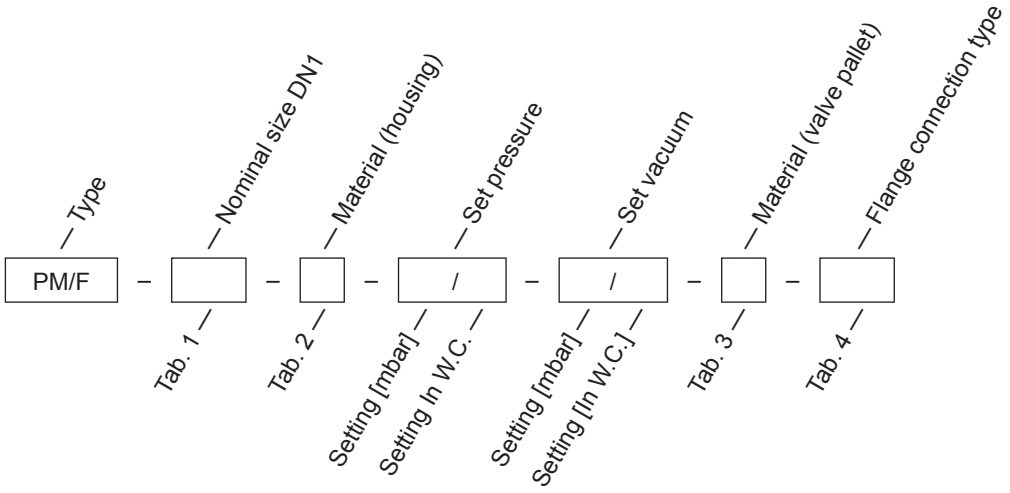
| | | |
|---|---|---|
| EN 1092-1, Form B1 or DIN 2501, Form C, PN 16; from DN 200 PN 10 | EN or DIN | other types upon request |
| ANSI 150 lbs RFSF | ANSI | |



# Pressure/Vacuum relief valve

## Pilot-operated diaphragm valve

## PROTEGO® PM/F

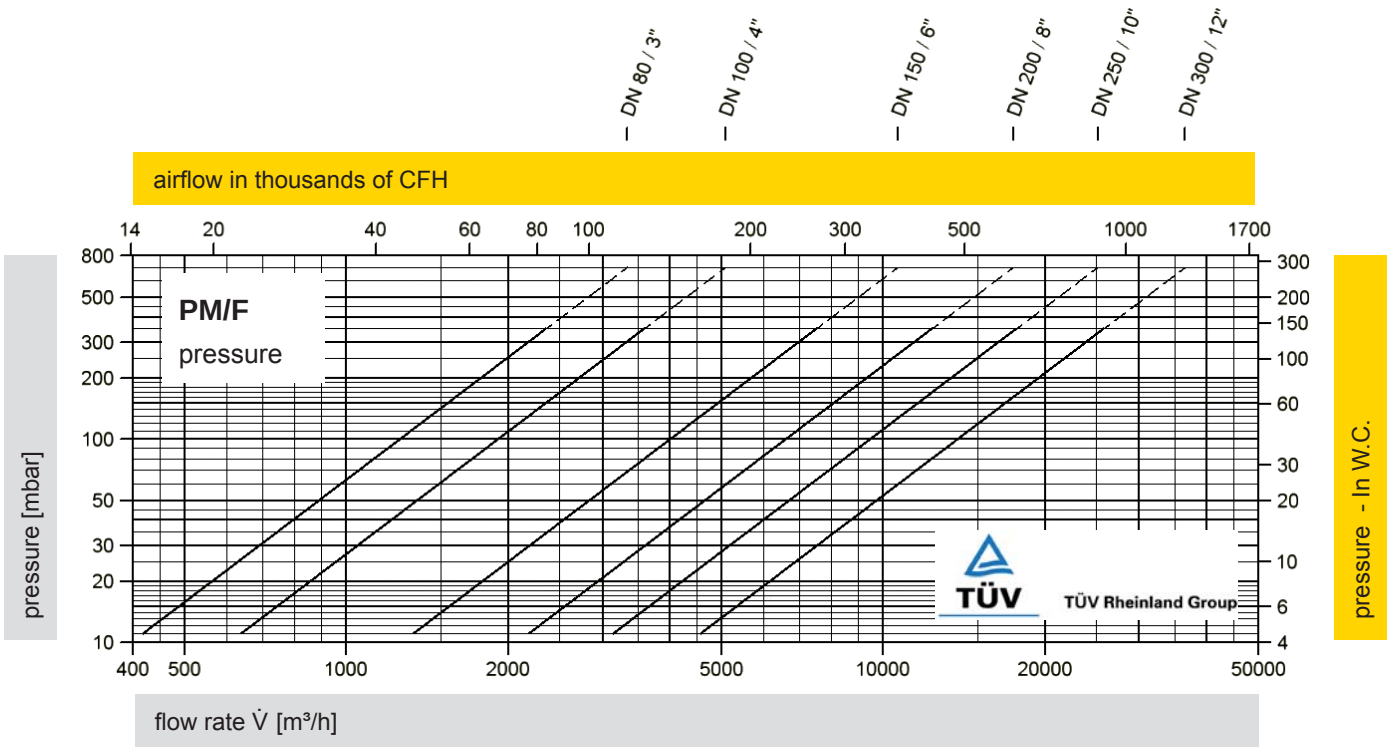


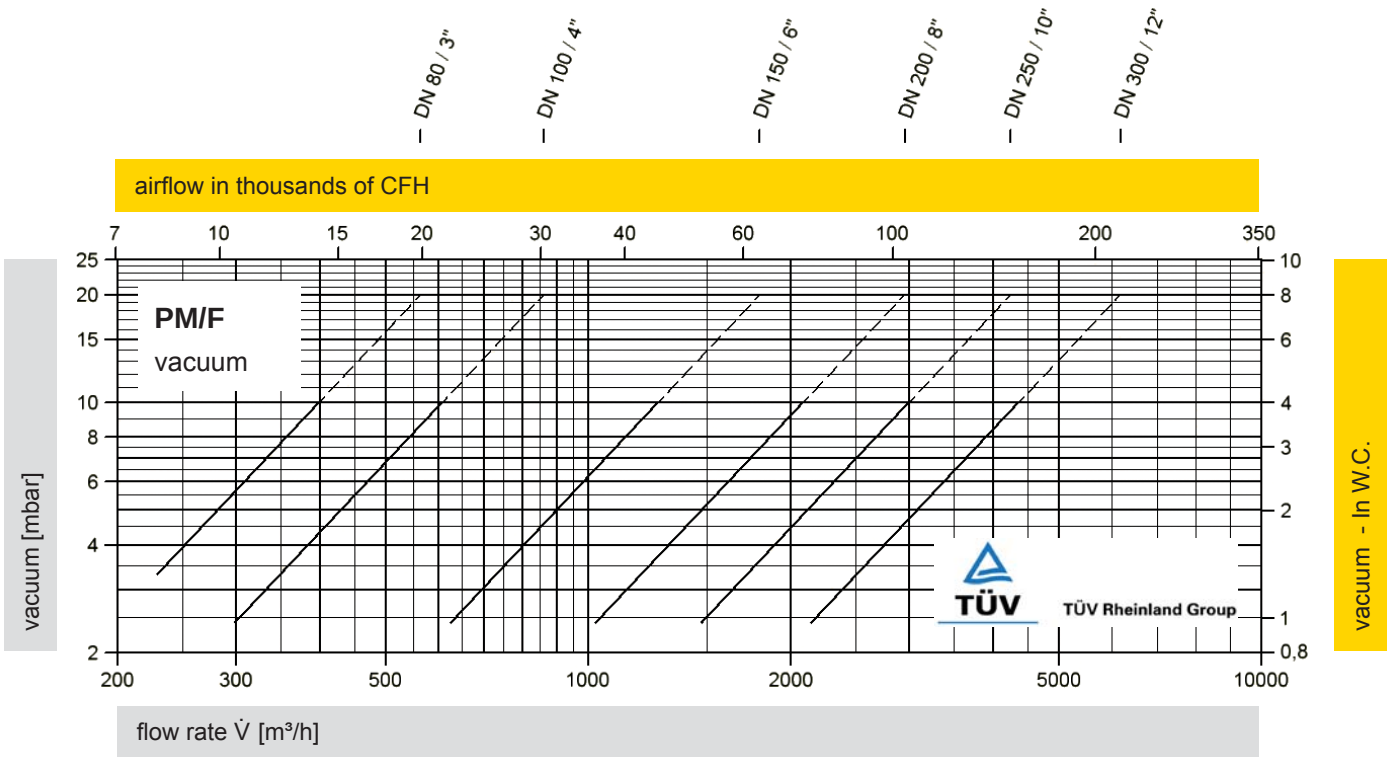

**Order example**

| PM/F | – | 200 | – | B | – | 100/ - | – | -10 .0/ - | – | B | – | DIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Materials and chemical resistance: See Vol. 1 “Technical Fundamentals”

## PROTEGO® PM/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”.

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# Materials, Terms and Conversion Tables

## Pressure

| | | | | |
|---|---|---|---|---|
| 1 bar | = 14.504 psi | 1 lb/ft$^2$ | = | 47,88 N/m$^2$ |
| | = 29.530 inch Hg | | = | 0,4788 mbar |
| | = 0.987 atm | | = | 0,0470 mm WC |
| | = 401.47 inch $H_2O$ | | | |
| 1 mbar | = 0.0145 psi | 1 inch WC | = | 249,08 N/m$^2$ |
| | = 0.0295 inch Hg | | = | 2,4908 mbar |
| | = 0.4019 inch $H_2O$ | | = | 25,4 mm WC |
| | = 2.089 lb/ft$^2$ | 1 inch Hg | = | 33,864 mbar |
| 1 kPa | = 10 mbar | 1 psi | = | 68,94757 mbar |
| 1 inch $H_2O$ | = 2,49089 mbar | 1 inch Hg | = | 33,8639 mbar |
| 1 Pa | = 1 N/m$^2$ | 1 psi | = | 1 lb/in$^2$ |

## Temperature

| | | | |
|---|---|---|---|
| To convert ºC in ºF use | $T_F$ | = | 32 + 1,8 $T_C$ |
| | 0ºC | = | 32ºF |
| | 100ºC | = | 212ºF |
| To convert ºF in ºC use | $T_C$ | = | $^5/_9$ ($T_F$ - 32) |
| | 0ºF | = | -17,8ºC |
| | 100ºF | = | 37,8ºC |

## Material

| DIN Material Number | DIN-Material | ASTM-Material | |
|---|---|---|---|
| 0.6020 | GG 20 | A 278-30 | C.I. |
| 0.7040 | GGG 40 | A 536-77 | C.I. |
| 1.0619 | GS-C 25 | A 216 Gr. WCB | C.S. |
| 1.4301 | X5 CrNi 18 10 | A 240 Gr. 304 | S.S. |
| 1.4408 | G-X6 CrNiMo 18 10 | A 351 Gr. CF 8 M | S.S. |
| 1.0425 | P 265 GH | A 515 Gr. 60 | C.S. |
| 1.4541 | X6 CrNiTi 18 10 | A 240 Gr. 321 | S.S. |
| 1.4571 | X10 CrNiMoTi 18 10 | A 240 Gr. 316 Ti | S.S. |
| 3.2581 | G-Al-Si 12 | A 413 | Alu |
| Ta | Tantal | UNS R05200 | |
| 2.4610 | NiMo 16 Cr 16 Ti | UNS N06455 | C-4 |
| 2.4686 | G-NiMo 17 Cr | UNS N30107 | Casting |
| 2.4602 | NiCr 21 Mo 14 W | UNS N06022 | C-22 |
| 2.4819 | NiMo 16 Cr 15 W | UNS N10276 | C-276 |

The applicable materials are specified in the quotation or the order acknowledgement:
In general the following means
CS (Carbon steel) = 1.0619 or 1.0425
SS (Stainless steel) = 1.4408 or 1.4571
Hastelloy = 2.4686 or 2.4602

## Important differences: US decimals in accordance to SI-System

| | | | | |
|---|---|---|---|---|
| e.g. | 1 m | = 100 cm | = 100,00 cm | (UK/US: 100.00 cm) |
| | 1 km | = 1.000 m | = 1.000,00 m | (UK/US: 1,000.00 m) |

## Sealings and Coatings

| | | |
|---|---|---|
| PTFE | = | polytetrafluoroethylene |
| PVDF | = | polyvinylidene fluoride |
| PFA | = | perfluoroalkoxy polyme |
| FPM 70 | = | fluor carbon rubber |
| WS 3822 | = | aramide and anorganic fibers as well as mineral reinforcement materials bonded with NBR rubber |
| ECTFE | = | ethylene chlorotrifluoro ethylene |
| FEP | = | perfluoroethylene propylene |

| **DN** | 10 | 15 | 20 | 25 | 32 | 40 | 50 | 65 | 80 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Size** | 1/4 | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 4 |

| **DN** | 125 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Size** | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |

| **DN** | 700 | 800 | 900 | 1000 | 1200 | 1400 | 1600 | 1800 | 2000 |
|---|---|---|---|---|---|---|---|---|---|
| **Size** | 28 | 32 | 36 | 40 | 48 | 56 | 64 | 72 | 80 |

## Length

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 cm | = 0.3937 | inch | 1 inch | | = 25,4 | mm |
| 1 m | = 3.2808 | ft | 1 ft | = 12 inch | = 0,3048 | m |
| | = 1.0936 | yards | 1 yard | = 3 ft | = 0,9144 | m |
| 1 km | = 0.621 | miles | 1 mile | | = 1,609 | km |

## Area

| | | | | | |
|---|---|---|---|---|---|
| 1cm$^2$ | = 0.1550 | sq inch | 1 sq inch | = 6,4516 | cm$^2$ |
| 1 m$^2$ | = 10.7639 | sq ft | 1 sq ft | = 0,0929 | m$^2$ |
| | = 1.196 | sq yards | 1 sq yard | = 0,836 | m$^2$ |
| 1km$^2$ | = 100 | hectares | | | |
| | = 0.3861 | sq miles | | | |
| | = 247 | acres | | | |

## Volume

| | | | | | |
|---|---|---|---|---|---|
| 1 cm$^3$ | = 0.06102 | cu inch | 1 cu inch | = 16,3870 | cm$^3$ |
| 1 liter | = 0.03531 | cu ft | 1 cu ft | = 28,317 | liter |
| | = 0.21998 | gal (UK) | 1 gal (UK) | = 4,5461 | liter |
| | = 0.26428 | gal (US) | 1 gal (US) | = 3,785 | liter |
| 1 m$^3$ | = 35.315 | cu ft | 1 cu ft | = 0,028317 | m$^3$ |
| | = 6.299 | petr. barrels | 1 petr. barrel | = 0,15876 | m$^3$ |

## Mass

| | | | | |
|---|---|---|---|---|
| 1 g | = 0.03527 oz | 1 oz | = | 28,35 g |
| 1 kg | = 2.2046 lb | 1 lb | = | 16 oz |
| | | | = | 0,4536 kg |

## Velocity and Volume Flow

| | | | | | |
|---|---|---|---|---|---|
| 1 m/s | = 196.85 | ft/min | 1 ft/min | = | 0,508 cm/s |
| 1 km/h | = 0.6214 | mph | 1 mph | = | 1,60934 km/h |
| 1 m$^3$/h | = 4.403 | gal/min (US) | 1 gal/min (US) | = | 0,227 m$^3$/h |
| | = 3.666 | gal/min (UK) | 1 gal/min (UK) | = | 0,273 m$^3$/h |
| | = 0.5886 | cu ft/min | 1 cu ft/min | = | 28,317 liter/min |
| 1 kg/h | = 0.0367 | lb/min | 1 lb/min | = | 27,216 kg/h |
| | | | 1 cu ft/h | = | 0,028317 m$^3$/h |

## Torsion

| | | | |
|---|---|---|---|
| 1 Nm | = 0.723 lbf ft | 1 lbf ft | = 1,38 Nm |

## Density

| | | | |
|---|---|---|---|
| 1 kg/dm$^3$ | = 62.43 lb/cu ft | 1 lb/cu ft | = 0,016 kg/dm$^3$ |

Safety devices are installed to prevent damage. The requirements need to be defined as early as the engineering stage so that a suitable device can be specified. After delivery and startup, function must be ensured at all times. The comprehensive PROTEGO® program range requires preventive services, assistance during start-up, and qualified maintenance for long term trouble-free operation.

## Technical Advice

Experienced PROTEGO® professionals are available to answer the many and complex questions regarding application. They are trained to consider issues relating to process engineering from a safety perspective. Standard and tailored solutions are generated based on current regulations and state-of-the-art information.

## Training

By offering continuing education and regular training for the employees of our domestic and foreign customers, we make sure that state-of-the-art knowledge is incorporated into system engineering. We regularly conduct training seminars that cover the theory of technical fundamentals, examples of applications and practice in installing and servicing PROTEGO® devices. The seminars can be offered either at our place of business or at the customers.

## Installation and Servicing

We value service and maintenance just as highly as product quality. Qualified operating and service instructions are sufficient for trained professional technicians to perform maintenance tasks. We can provide our trained field service technicians for installation and servicing, or you can use our authorized workshops. The key is trained personnel who are sufficiently prepared for their tasks in our manufacturing plant. Trained qualified professional shops are given a certificate and are authorized to perform maintenance on PROTEGO® devices. We will provide you with contacts in your region.

## Research and Development

Our R&D center continuously reviews and develops our devices and incorporates product features relevant to safety engineering. In addition, we develop devices jointly with the customer for customer-specific requirements. The result: Continuous improvement of the performance and quality of flame arresters and valves as well as superior knowledge from basic research, which is incorporated into the design of process engineering systems.

## Spare Parts Service

We have original spare parts for you in our headquarter as well as in support centers worldwide. Original spare parts and regular servicing tailored to the respective operating conditions guarantee trouble-free operation.

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