PROTEGO® **Pressure/Vacuum Relief Valves**

with Flame Arrester - end-of-line

Volume 7

Volume 7

PROTEGO

for safety and environment

The working principle and location of the installation of valves on tanks and apparatus is discussed in „Technical Fundamentals“ (Vol. 1). In this chapter we present end-of-line pressure/vacuum relief valves with integrated flame arrester units.

Function and Description

These valves are used to protect process units and equipment (e.g. tanks, pipelines) from exceeding maximum allowable operating pressures and vacuum. In addition theses devices protect against atmospheric deflagration. Some of the devices are also designed to protect against endurance burning (Figure 1).

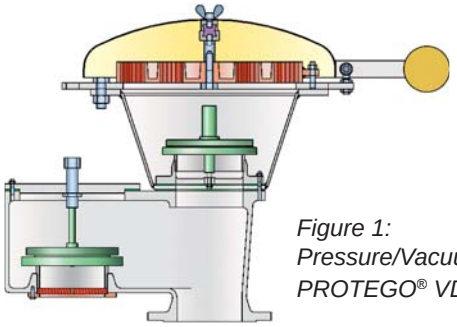


Figure 1:
Pressure/Vacuum Relief Valve
PROTEGO® VD/SV-HRL

PROTEGO® Pressure Relief Valves with an integrated flame arrester unit provide protection against unacceptable overpressure, atmospheric deflagration and endurance burning. In addition the devices reduce emissions almost up to the set pressure.

PROTEGO® Vacuum Relief Valves with an integrated flame arrester unit provide protection against unacceptable vacuum and atmospheric deflagration. In addition they avoid air intake almost up to the set pressure.

PROTEGO® Pressure Vacuum Relief Valves with an integrated flame arrester unit fulfil all the above mentioned functions for pressure and vacuum relief and protect against atmospheric deflagration or against atmospheric deflagration and endurance burning.

The special design of the PROTEGO® valves achieves full lift after 10% overpressure above the set pressure. This “full-lift-type-technology” allows for the use of set pressures just 10% below the maximum allowable working pressure (MAWP or Design Pressure) of the Tank. After just 10% overpressure above set pressure the valve will reach its full capacity to safely relieve the required mass flow. Conventional relief valves for low pressure applications need 80%-100% overpressure (API 2000) for reaching full lift and full relieving capacity. They open later and shut off earlier, which results in unnecessary product losses.

Special features and advantages

Specific investments into research and development allowed PROTEGO® to design a valve for low pressure applications providing you with the following advantages:

- 10% “full-lift-type-technology” reducing product losses (possible reduction of breathing losses greater than 30%)
- PROTEGO® valves open later and shut off earlier than conventional valves, which results in optimized pressure management and reduction of blanketing gas losses
- increased flow performance (result: smaller valves can be installed resulting in capital saving)
- lowest leak rates world wide for low pressure valves
- flame transmission proof for almost any chemical mixture
- valve pallet is guided within the housing to protect against harsh weather conditions
- flame arrester unit is not in contact with product vapour under normal operating conditions, which reduces maintenance intervals
- endurance burning protection against alcohols

To achieve the highest expectations of the industry for the lowest leak rates, our valve pallets and seats are manufactured from high quality stainless steel and are hand lapped in a special process. Air cushion membran technology is utilized for low set pressures.

Valves with integrated flame arrester units are available for substances from explosion groups IIA and IIB3 (NEC D and C) and special approvals are available for alcohols.

Main areas of application: as pressure and vacuum valves, as pressure relief valves, as pressure holding/conservation valves, as simple control valves for storage of flammable liquids

PROTEGO® Diaphragm Valves function as pressure vacuum relief valves. The flexible diaphragm allows them to work as a dynamic flame arrester, which provides endurance burning protection. For additional safety these devices are equipped with a static flame arrester unit. This “one-of-a-kind” diaphragm valve can be used under extreme cold weather conditions below freezing and for problem products, which e.g. tend to polymerize (Styrene, Acrylics). A specially designed valve seat combined with the flexible diaphragm prevents blocking of the valve through freezing product vapours at low temperatures. Ice bridges break and fall off through deformation of the diaphragm if pressure increases.

This device has no guiding elements which are likely to stick and keep the device closed.

Main areas of application: same as above in storage of flammable liquids and specifically for storage of monomers.

PROTEGO® High Velocity Pressure Relief Valves (Jet Valves) open and close almost immediately at set point. This function is achieved by an integrated magnet. Through this the overpressure needed from set point to full lift is practically 0%, which clearly reduces emissions. All PROTEGO® high velocity relief valves are tested for oscillating flow and are equipped with a specially designed valve cone and seat, which produces a vertical upright free jet during pressure relief. This ensures an effective leaning of the discharged vapours and reduces the gas concentration to a minimum in direct proximity (e.g. boat deck) of the valve. The devices function on the working principal of a dynamic flame arrester and are approved for the vapour groups IIA, IIB3 and IIC (NEC D, C and B).

Main areas of application: transport of flammable liquids on tank ships and special on shore applications.

Installation and servicing

All PROTEGO® devices are delivered with detailed installation and maintenance manuals. Please pay special attention to the warnings on how to remove transport protection if this has been installed in the device to prevent damage during transport. Specially developed check lists are available to ensure correct installation and operation of the device.

Selection and sizing

For a safe operation and protection of a plant, the selection and sizing of the correct PROTEGO® device is necessary. The following criteria have to be considered for pre-selection:

Function: Pressure relief, vacuum relief or combined pressure/vacuum relief, protection against atmospheric deflagration, or atmospheric deflagration and endurance burning.

Type of Valve: Weight loaded valve, diaphragm valve, high velocity pressure relief valve or high velocity pressure relief valve with combined vacuum valve.

Design: with horizontal or vertical connection to the protected vessel. These valves are weight loaded, so the pallet has to be installed in an horizontal orientation. The maximum achievable pressure setting will depend on the design of the valve. Metallic sealing or soft sealing are important criteria for low leak rates and have to be chosen based on the intended use.

Explosion group: IIA, IIB3, IIC (NEC D, C, B).

Process of combustion: endurance burning or atmospheric deflagration

Operating conditions: Polymerization, condensation, problems which lead to clogging of the FLAMEFILTER®, operating temperature, operating pressure, oxygen concentration, volume flow.

The **valve size** has to be determined so that the volume flow which has to be discharged does not lead to an increase of internal pressure above the maximum allowable working pressure of the vessel to be protected. For sizing the valves certified pressure/volume flow diagrams are provided. The operating conditions have to be known for correct sizing. Sometimes vessels are already equipped with pre-existing nozzles (e.g. old vessels). In such cases the volume flow may have to be discharge over several valves. For correct sizing superimposed and built-up backpressure must be considered.

Valve sizing:

The valve is sized dependent on the required volume flow, which is calculated (→ Chapter 1), or given.

Given: Volume flow (e.g. in- or outbreathing of a storage tank as sum of the pump rates and thermal breathing) $\dot{V}_{max}$ in m³/h (CFH) and maximum allowable (tank-) pressure p in mbar (inch W.C.).

Desired: Nominal valve size DN

Procedure: The required size of the valve can be taken from the intersection point of $\dot{V}_{max}$ and p valve operating pressure = max. allowable tank pressure. The pressure diagram shows the valves flow performance in relation to the opening pressure and is determined at the full lift position of the pallet.

The set pressure of the valve has to be determined such that the required volume flow can be discharged safely. A valve with 10% overpressure characteristic has to be set 10% below the maximum allowable tank pressure.

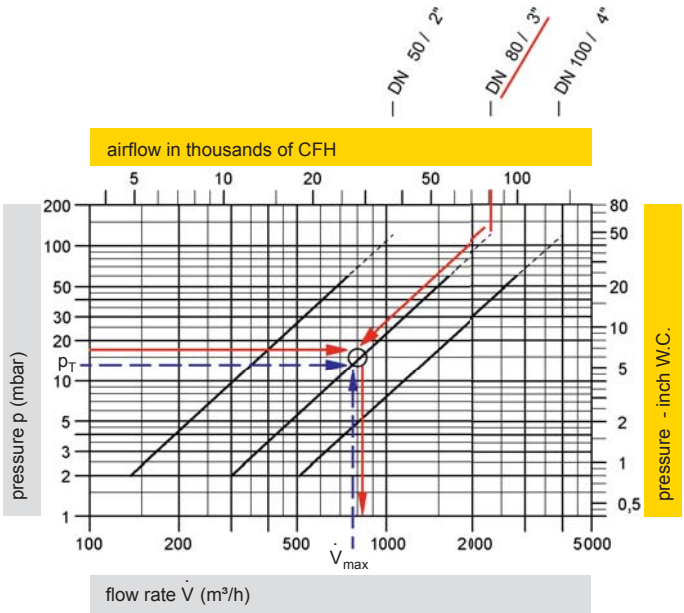
Many conventional valves require 100% overpressure to reach full lift. For these valves the set pressure will be 50% below of the maximum allowable tank pressure. These valves open earlier and shut off later allowing avoidable product losses.

Alternatively the valve performance may have to be checked if the required size and maximum allowable tank pressure are provided.

Given: (Tank-) nozzle size DN and maximum allowable (tank-) pressure p in mbar (inch W.C.)

Desired: flow rate of valve in m³/h (CFH) and set pressure p_{set}

Procedure: The intersection point of the straight line through p and the valve performance curve of the (nozzle-) size DN determine the flow rate $\dot{V}_{max}$. The set pressure p_{set} will be 10% (PROTEGO® - Technology), 40% or 100% below the maximum allowable (tank-) pressure p_T.

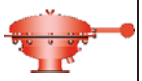
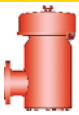
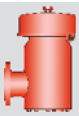


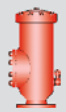
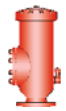
The set pressure of the valve (= valve starts to open) the maximum allowable pressure of the equipment minus the valves characteristic overpressure which is required for the valve to reach full lift.

The overpressure percentage of PROTEGO® valves is 10% (unless supplied otherwise). Within 10% overpressure the device will reach its performance at full lift. A further increase in flow performance will follow the curve in the pressure volume flow diagram.

For choosing the correct material the plant and engineering specifications have to be considered.

PROTEGO® Pressure/Vacuum Relief Valves with Flame Arrester – end-of-line

	Type	Size	Pressure setting positive setting range mbar / inch W.C.	Pressure setting negative setting range mbar / inch W.C.	O = endurance burning proof X = prevent flashback in case of atmospheric deflagrations	Explosion group ATEX	Explosion group NEC	Approvals		Design O = horizontal connection X = vertical connection	O = soft sealing X = metallic sealing	O = for critical medium (polymerisation, corrosion, crystallisation)	O = Heating jacket, heating coil	Page
Pressure Relief Valves, Pallet Type														
	P/EB	50 - 80 2" - 3"	+3.5 up to +210/ +1.4 up to +84		O / X	IIA	D	ATEX		X	O / X		O	298 - 300
	P/EB-E	50 - 80 2" - 3"	+3.5 up to +210/ +1.4 up to +84		O / X	IIB1	–	ATEX		X	O / X		O	302 - 304
	P/EBR	80 - 100 3" - 4"	+3.5 up to +210/ +1.4 up to +84		O / X	IIA, IIB3	D, C	ATEX		X	O / X		O	306 - 308
	P/EBR-E	80 - 100 3" - 4"	+3.5 up to +210/ +1.4 up to +84		O / X	IIB1	–	ATEX		X	O / X		O	310 - 312
	D-SVL-EB	200 10“	+2.0 up to +60/ +0.8 up to +24		O / X	IIA	D	ATEX		X	O / X		O	314 - 316
	BE/HR-D	150 -200 6" - 8"	+2.0 up to +35/ +0.8 up to +14		O / X	IIA	D	ATEX		X	O / X			318 - 320
Vacuum Relief Valves, Pallet Type														
	SV/E	50 - 300 2" - 12"		-2.0 up to -60/ -0.8 up to -24	X	IIB3	C	ATEX IMO		O	O / X		O	322 - 324
Pressure/Vacuum Relief Valves, Pallet Type														
	PV/EB	50 - 80 2" - 3"	+2.0 up to +210/ +0.8 up to +84	-3.5 up to -35/ -1.4 up to -14	O / X	IIA	D	ATEX		O	O / X		O	326 - 328
	PV/EB-E	50 - 80 2" - 3"	+2.0 up to +210/ +0.8 up to +84	-3.5 up to -35/ -1.4 up to -14	O / X	IIB1	–	ATEX		O	O / X		O	330 - 332
	PV/EBR	80 - 100 3" - 4"	+2.0 up to +210/ +0.8 up to +84	-3.5 up to -50/ -1.4 up to -20	O / X	IIA, IIB3	D	ATEX		O	O / X		O	334 - 337
	PV/EBR-E	80 - 100 3" - 4"	+2.0 up to +210/ +0.8 up to +84	-3.5 up to -50/ -1.4 up to -20	O / X	IIB1	–	ATEX		O	O / X		O	338 - 340

	Type	Size	Pressure setting positive setting range mbar / inch W.C.	Pressure setting negative setting range mbar / inch W.C	O X = endurance burning proof / = prevent flashback in case of atmospheric deflagrations	Explosion group ATEX	Explosion group NEC	Approvals		Design O X = horizontal connection / = vertical connection	O X = soft sealing / = metallic sealing	O = for critical medium (polymerisation, corrosion, crystallisation)	O = Heating jacket, heating coil	Page
Pressure/Vacuum Relief Valves, Pallet Type (Continuation)														
	VD/SV-AD and VD/SV-ADL	80 - 150 3" - 6"	+3.5 up to +35/ +1.4 up to +14	-2.0 up to -35/ -0.8 up to -14	X	IIB3	C	ATEX		X	O / X			342 - 344
	VD/SV-HR	80 - 100 3" - 4"	+3.5 up to +35/ +1.4 up to +14	-2.0 up to -35/ -0.8 up to -14	O / X	IIA, IIB3	D, C	ATEX		X	O / X			346 - 349
	VD/SV-HRL	100-150 4" - 6"	+3.5 up to +35/ +1.4 up to +14	-2.0 up to -35/ -0.8 up to -14	O / X	IIA	D	ATEX		X	O / X			350 - 352
	VD-SV-EB	200 10“	+2.0 up to +60/ +0.8 up to +24	-2.0 up to -60/ -0.8 up to -24	O / X	IIA	D	ATEX		X	O / X		O	354 - 356
	VD/TS	50 - 300 2" - 12"	+3.5 up to +50/ +1.4 up to +20	-2.0 up to -25/ -0.8 up to -10	X	IIB3	C	ATEX		X	O / X			358 - 361
Pressure/Vacuum Relief Valves, Diaphragm Valves														
	UB/SF	80 - 150 3" - 6"	+3.5 up to +140/ +1.4 up to +56	-3.5 up to -35/ -1.4 up to -16	O / X	IIB3	C	ATEX		X	O	O	O	362 - 369
	UB/DF	80 - 150 3" - 6"	+3.5 up to +140/ +1.4 up to +56		O / X	IIB3	C	ATEX		X	O	O	O	370 - 375
	UB/VF	80 - 150 3" - 6"		-3.5 up to -35/ -1.4 up to -16	X	IIB3	C	ATEX		X	O	O	O	376 - 379
Pressure Relief Valves, High Velocity Valve														
	DE/S	80 - 150 3" - 6"	+100 up to +500/ +40 up to +200		O / X	IIB3, IIB	C, B	ATEX		X	X			www.protego.com
	DE/S-MK VI	80 - 150 3" - 6"	+60 up to +350/ +24 up to +140		O / X	IIB3, IIC	C, B	ATEX IMO		X	X			www.protego.com

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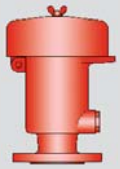
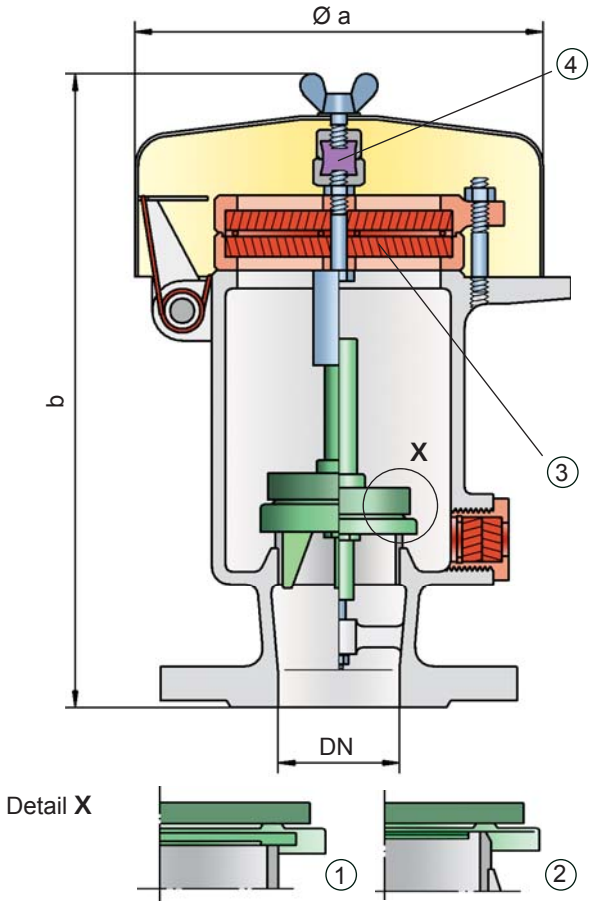


Pressure Relief Valve

deflagration- and endurance burning-proof

PROTEGO® P/EB



Pressure settings:

+3.5 mbar	up to	+210 mbar
+1.4 inch W.C.	up to	+84 inch W.C.

Higher pressure settings upon request.

Function and Description

The deflagration-proof and endurance burning-proof P/EB type PROTEGO® valve is a highly developed pressure relief valve with an integrated flame arrester unit. It is primarily used as a safety device for flame transmission proof outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and prevents product losses almost up to the set pressure; it also protects against atmospheric deflagration as well as endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The P/EB valve is available for substances of explosion group IIA (NEC group D MESG > 0.90 mm).

When the set pressure is reached, the valve starts to open and reaches full lift within 10% overpressure. This unique 10% technology enables a set pressure that is only 10% below the maximum allowable working pressure (MAWP) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range.

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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 a 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 in corrosive fluids. After the excess pressure is discharged, the valve reseats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN 12874 as well as other international standards.

Special Features and Advantages

- requires only 10% overpressure to full lift
- through 10% technology higher set pressures can be used which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- more design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- the valve disc is guided within the housing to protect against harsh weather conditions
- can be used as protective system according ATEX in areas subject to explosion hazards
- PROTEGO® flame arrester unit provides protection against atmospheric deflagration and endurance burning
- flame arrester unit integrated into the valve saves space, weight and reduces cost
- flame arrester unit protected from clogging through product vapour
- flame arrester unit has a low pressure drop
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and valve pallet to be replaced

Design Types and Specifications

The valve disc is weight-loaded. At set pressure >80 mbar (32.1 inch W.C.), an elongated design is used

There are two different designs:

Pressure relief valve, basic design **P/EB - –**

Pressure relief valve with heating jacket **P/EB - H**
(max. heating fluid temperature +85°C / 185°F)

Additional special devices available upon request

Table 1: Dimensions Dimensions in mm / inches

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

DN	50 / 2"	50 / 2"	80 / 3"	80 / 3"
Set pressure	≤ +80 mbar ≤ +32.1 inch W.C.	> +80 mbar > +32.1 inch W.C.	≤ +80 mbar ≤ +32.1 inch W.C.	> +80 mbar > +32.1 inch 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 Relief Valve with heating jacket upon request

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request

Table 3: Material selection for housing

Design	B	C	
Housing Heating jacket (P/EB-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seat	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	

Table 4: Material combination of flame arrester unit

Design	A	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 5: Material selection for valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+3.5 up to +5.0 +1.4 up to +2.0	>+5.0 up to +14 >+2.0 up to +5.6	>+14 up to +210 >+5.6 up to +84	>+14 up to +210 >+5.6 up to +84	Special materials and higher pressure settings upon request
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 6: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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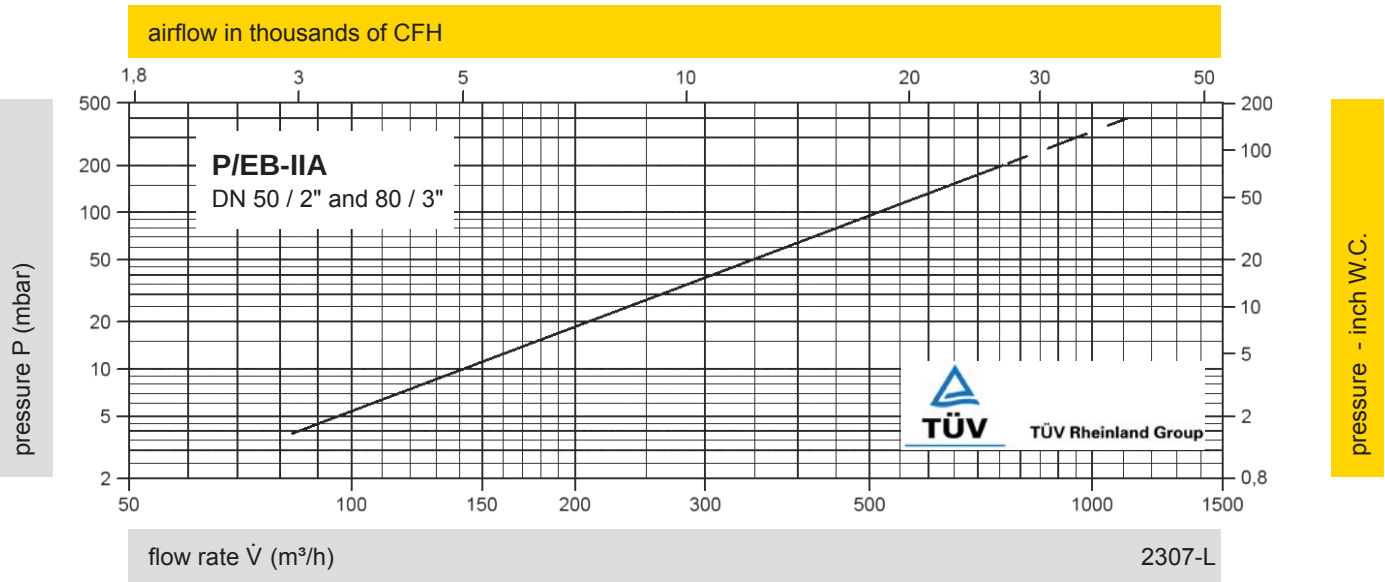


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

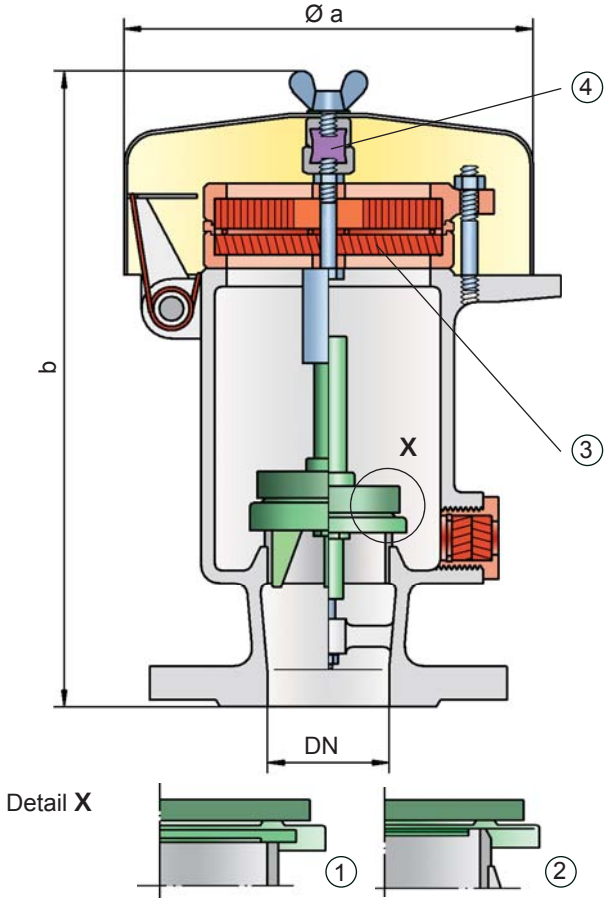
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

Notes:

Pressure Relief Valve

deflagration- and endurance burning-proof

PROTEGO® P/EB-E



Pressure settings:

+3.5 mbar	up to	+210 mbar
+1.4 inch W.C.	up to	+84 inch W.C.

Higher pressure settings upon request.

Function and Description

The deflagration proof and endurance burning-proof P/EB-E type PROTEGO® valve is a highly developed pressure relief valve for large flows with an integrated flame arrester unit that is specially used for applications handling ethanol. It is primarily used as a safety device for flame transmission proof outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and prevents product losses almost up to the set pressure; it also protects against atmospheric deflagration as well as endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The P/EB-E valve is available for substances of explosion group IIB1 (MESG ≥ 0.85 mm) and provides specific protection against deflagration and endurance burning of alcohol/air mixtures (such as ethanol/air).

The valve functions proportional, so the set pressures should be selected in relation to the proportional behaviour (such as a 10%, 40%, or 100% overpressure from the set pressure to the relieving pressure at which the required flow performance is reached).

The tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing. This feature is ensured by the 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.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- selecting set pressure close to relieving pressure results in product loss reduction
- more design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- the valve disc is guided within the housing to protect against harsh weather conditions
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- can be used as protective system according to ATEX in areas subject to explosion hazards
- safe against deflagration and endurance burning of alcohol/ air mixtures from explosion group IIB1
- high flow capacity through large FLAMEFILTER® cross-section, results in low pressure drop
- PROTEGO® flame arrester unit provides protection against atmospheric deflagration and endurance burning
- flame arrester unit integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging caused by product vapours
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and valve pallets to be replaced

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Pressure relief valve with heating jacket **P/EB - E - [H]**
(max. heating fluid temperature +85°C / 185°F)

Additional special devices available upon request

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b	288 / 11.34	453 / 17.83	290 / 11.42	455 / 17.91

Dimensions for Pressure Relief Valve with heating jacket upon request

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,85 mm	IIB1	–	Special approvals upon request

Table 3: Material selection for housing

Design	B	C	
Housing Heating jacket (P/EB-E-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seat	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	

Table 4: Material combination of flame arrester unit

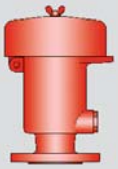
Design	A	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 5: Material selection for valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+3.5 up to +5.0 +1.4 up to +2.0	>+5.0 up to +14 >+2.0 up to +5.6	>+14 up to +210 >+5.6 up to +84	>+14 up to +210 >+5.6 up to +84	Special materials and higher pressure settings upon request
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 6: Flange connection type

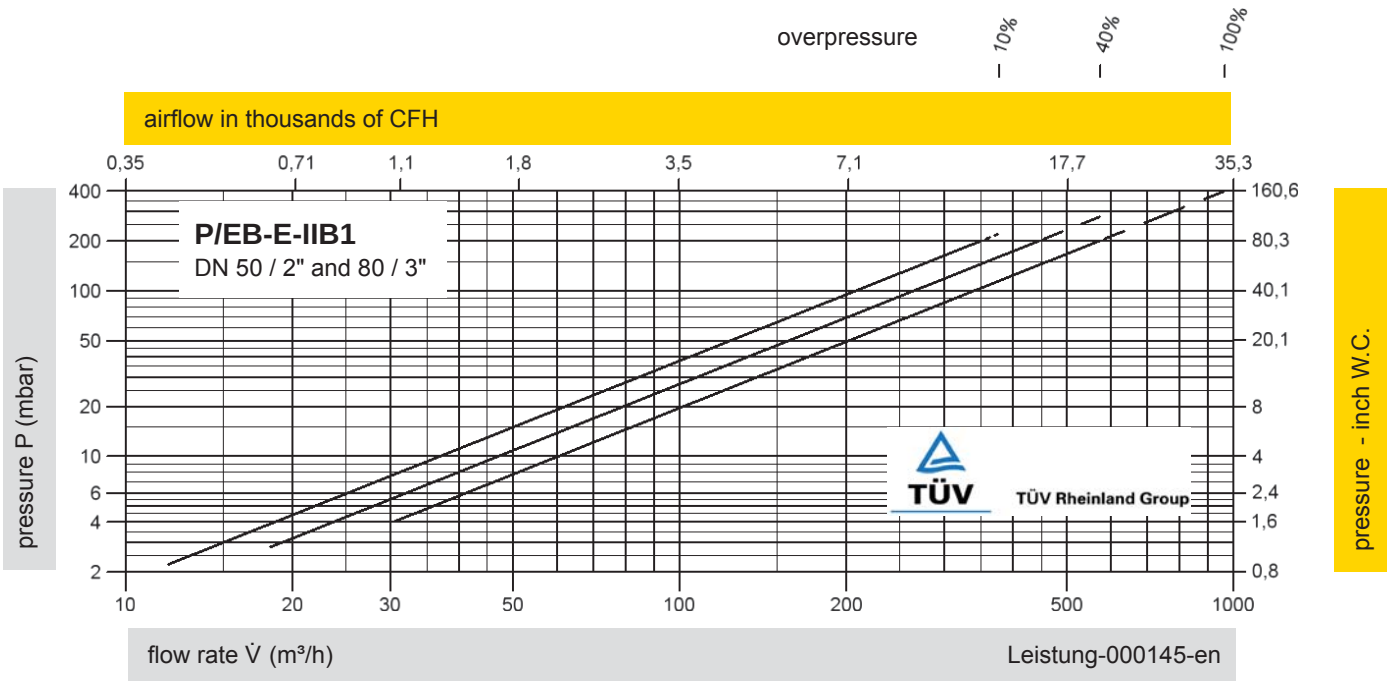
EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	



Pressure Relief Valve

Flow Capacity Chart

PROTEGO® P/EB-E



Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1 + \frac{\text{overpressure \%}}{100\%}}$$

Set pressure = the valve starts to open

Opening pressure = set pressure plus overpressure

Overpressure % = percentage pressure increase over the set pressure

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

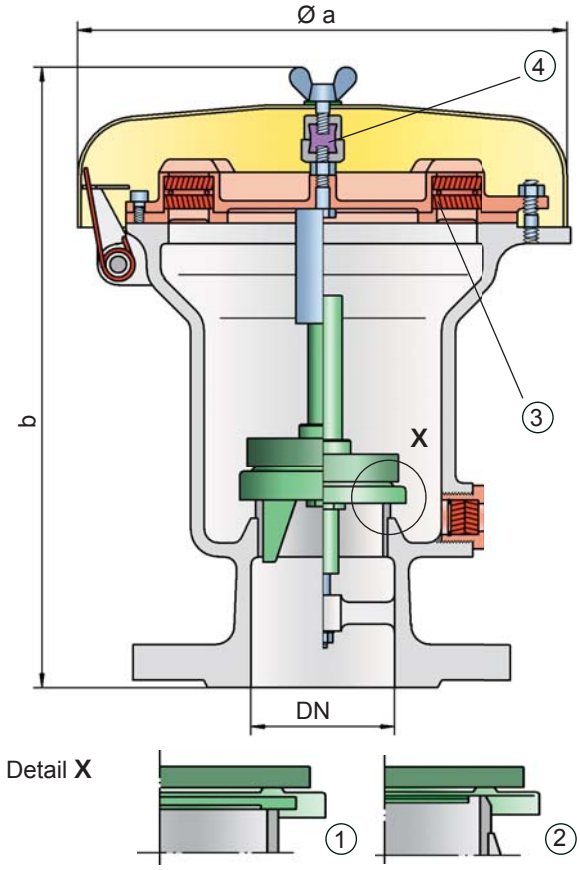
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

Notes:

Pressure Relief Valve

deflagration- and endurance burning-proof

PROTEGO® P/EBR



Pressure settings:

+3.5 mbar	up to	+210 mbar
+1.4 inch W.C.	up to	+84 inch W.C.

Higher pressure settings upon request.

Function and Description

The deflagration-proof and endurance burning-proof P/EBR type PROTEGO® valve is a highly developed pressure relief valve for large flows with an integrated flame arrester unit. It is primarily used as a safety device for flame transmission proof outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and prevents product losses almost up to the set pressure; it also protects against atmospheric deflagration as well as endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. P/EBR valves are available for substances from explosion groups IIA and IIB3 (NEC group D and C MESG ≥ 0.65 mm).

If the set pressure is reached for a valve approved for explosion Group IIA (NEC group D), the valve starts to open and reaches full lift within 10% overpressure. This unique 10% technology enables a set pressure that is only 10% below the maximum allowable working pressure (MAWP) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range. Valves approved for explosion group IIB3 (NEC group C) function proportionally, so the set pressures should be selected in relation to the proportional behaviour (such as a 10%, 40%, or 100% overpressure from the set pressure to the relieving pressure at which the required flow performance is reached).

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive as well as other international standards.

Special Features and Advantages

- requires only 10% overpressure to full lift for group IIA (NEC group D >0.9 MESG) vapours
- through 10% technology higher set pressures can be used which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- more design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- the valve disc is guided within the housing to protect against harsh weather conditions
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- can be used as protective system according to ATEX in areas subject to explosion hazards
- safe against deflagration and endurance burning for explosion group IIA and IIB3 (NEC group D and C) vapours
- high flow capacity through large FLAMEFILTER® cross-section, results in low pressure drop
- PROTEGO® flame arrester unit provides protection against atmospheric deflagration and endurance burning
- flame arrester unit integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging caused by product vapours
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and valve pallets to be replaced

Design Types and Specifications

The valve disc is weight-loaded. At set pressures >80 mbar (32.1 inch W.C.), an elongated design is used

There are two different designs:

Pressure relief valve, basic design **P/EBR - [–]**

Pressure relief valve with heating jacket **P/EBR - [H]**
(max. heating fluid temperature +85°C / 185°F)

Additional special devices available upon request

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	≤ +80 mbar ≤ +32.1 inch W.C.	> +80 mbar > +32.1 inch W.C.	≤ +80 mbar ≤ +32.1 inch W.C.	> +80 mbar > +32.1 inch 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 Relief Valve with heating jacket upon request

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request
> 0,65 mm	IIB3	C	

Table 3: Material selection for housing

Design	B	C	
Housing Heating jacket (P/EBR-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seat	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	

Table 4: Material combination of flame arrester unit

Design	A	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 5: Material selection for valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+3.5 up to +5.0 +1.4 up to +2.0	>+5.0 up to +14 >+2.0 up to +5.6	>+14 up to +210 >+5.6 up to +84	>+14 up to +210 >+5.6 up to +84	Special materials and higher pressure settings upon request
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 6: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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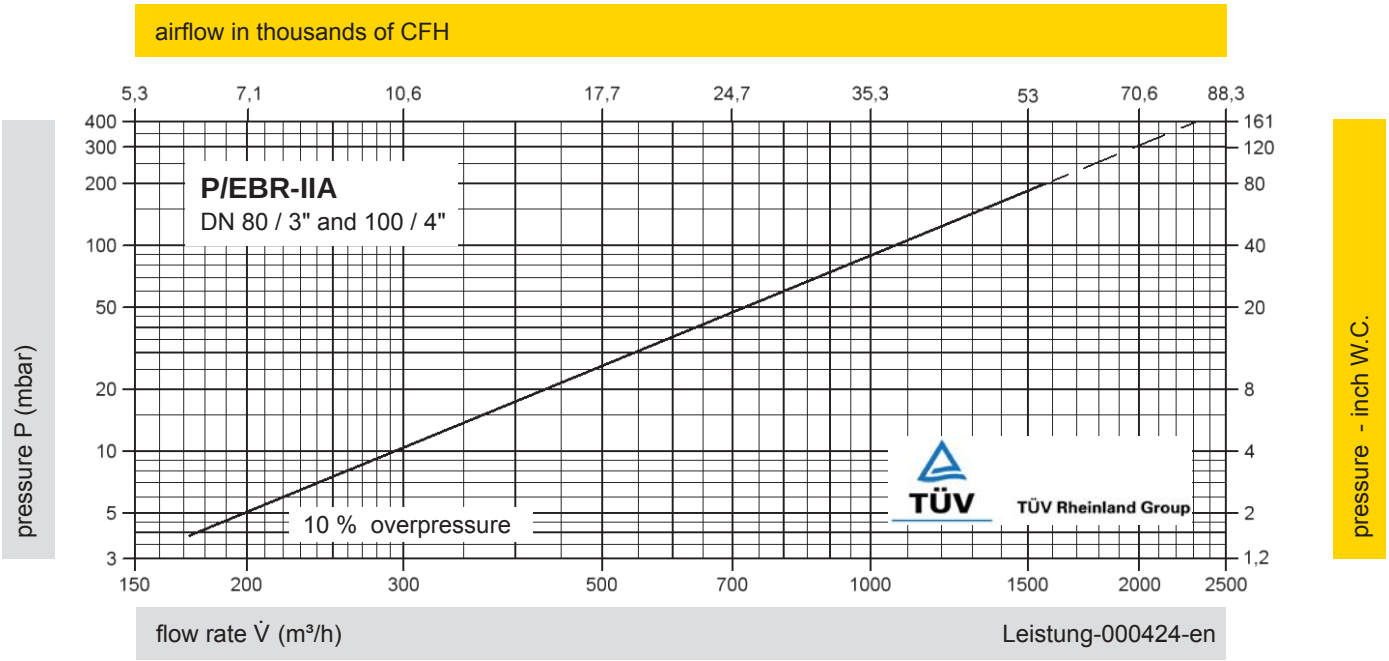
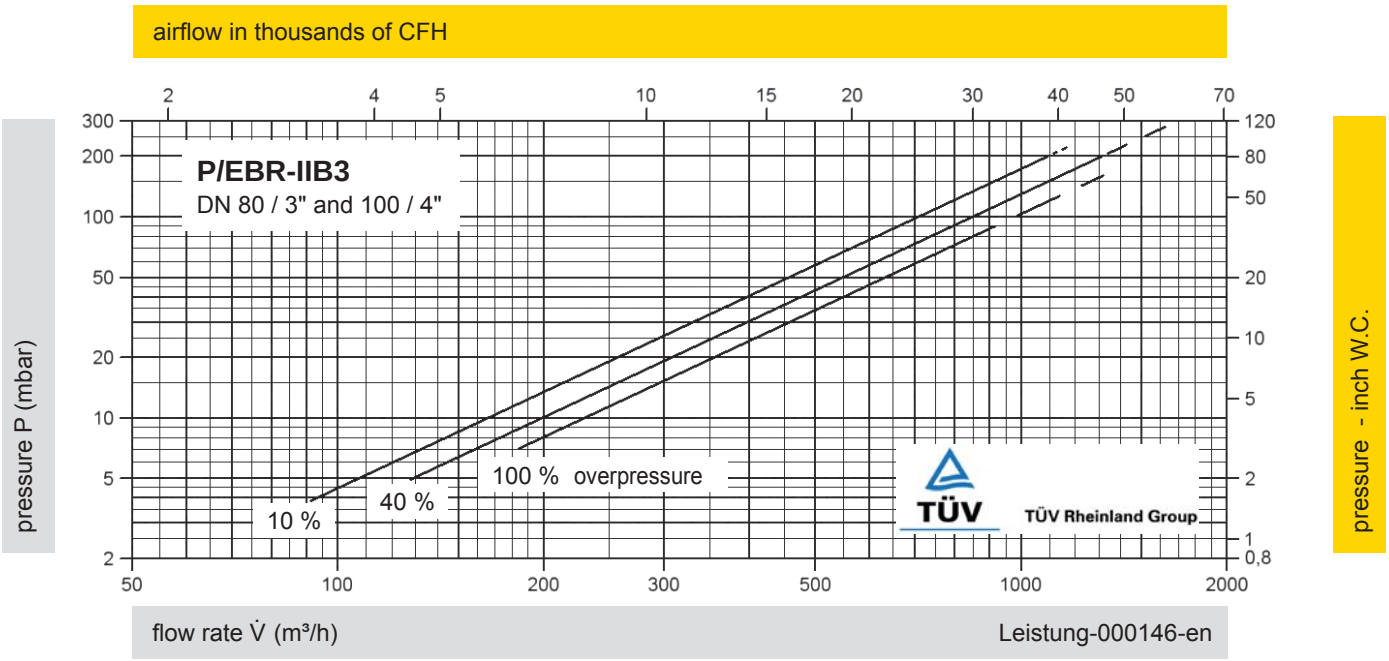
Pressure Relief Valve

Flow Capacity Charts

PROTEGO® P/EBR





Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1 + \frac{\text{overpressure \%}}{100\%}}$$

Set pressure = the valve starts to open

Opening pressure = set pressure plus overpressure

Overpressure % = percentage pressure increase over the set pressure

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

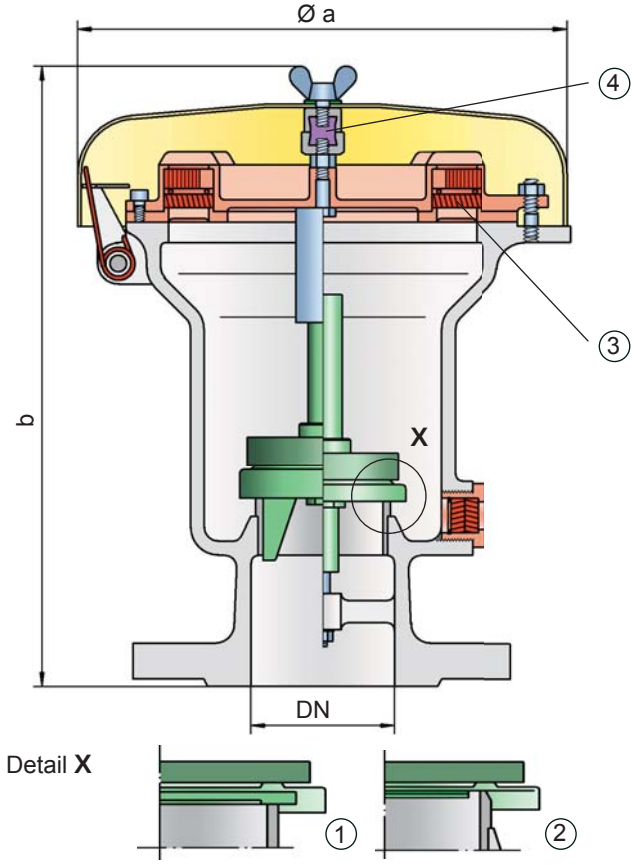
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.

Notes:

Pressure Relief Valve

deflagration- and endurance burning-proof

PROTEGO® P/EBR-E



Pressure settings:

+3.5 mbar	up to	+210 mbar
+1.4 inch W.C.	up to	+84 inchW.C.

Higher pressure settings upon request.

Function and Description

The deflagration proof and endurance burning proof P/EBR-E type PROTEGO® valve is a highly developed pressure relief valve for large flows with an integrated flame arrester unit that is specially used for applications handling ethanol. It is primarily used as a safety device for flame transmission proof outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and prevents product losses almost up to the set pressure; it also protects against atmospheric deflagration as well as endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The P/EBR-E valve is available for substances of explosion group IIB1 (MESG ≥ 0.85 mm) and provides specific protection against deflagration and endurance burning of alcohol/air mixtures (such as ethanol/air).

The valve functions proportional, so the set pressures should be selected in relation to the proportional behaviour (such as a 10%, 40%, or 100% overpressure from the set pressure to the relieving pressure at which the required flow performance is reached).

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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 corrosive fluids. After the excess pressure is discharged, the valve reseats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- selecting set pressure close to relieving pressure results in product loss reduction
- more design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- the valve disc is guided within the housing to protect against harsh weather conditions
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- can be used as protective system according to ATEX in areas subject to explosion hazards
- safe against deflagration and endurance burning of alcohol/ air mixtures from explosion group IIB1
- high flow capacity through large flame filter cross-section, results in low pressure drop
- PROTEGO® flame arrester unit provides protection against atmospheric deflagration and endurance burning
- flame arrester unit integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging caused by product vapours
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and valve pallets to be replaced

Design Types and Specifications

The valve disc is weight-loaded. At set pressures >80 mbar (32.1 inch W.C.), an elongated design is used

There are two different designs:

Pressure relief valve, basic design **P/EBR - E - –**

Pressure relief valve with heating jacket **P/EBR - E - H**
(max. heating fluid temperature +85°C / 185°F)

Additional special devices available upon request

Table 1: Dimensions — Dimensions in mm / inches

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

DN	80 / 3"	80 / 3"	100 / 4"	100 / 4"
Set pressure	≤ +80 mbar ≤ +32.1 inch W.C.	> +80 mbar > +32.1 inch W.C.	≤ +80 mbar ≤ +32.1 inch W.C.	> +80 mbar > +32.1 inch 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 Relief Valve with heating jacket upon request

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,85 mm	IIB1	–	Special approvals upon request

Table 3: Material selection for housing

Design	B	C	
Housing Heating jacket (P/EBR-E-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seat	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	

Table 4: Material combination of flame arrester unit

Design	A	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 5: Material selection for valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+3.5 up to +5.0 +1.4 up to +2.0	>+5.0 up to +14 >+2.0 up to +5.6	>+14 up to +210 >+5.6 up to +84	>+14 up to +210 >+5.6 up to +84	Special materials and higher pressure settings upon request
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 6: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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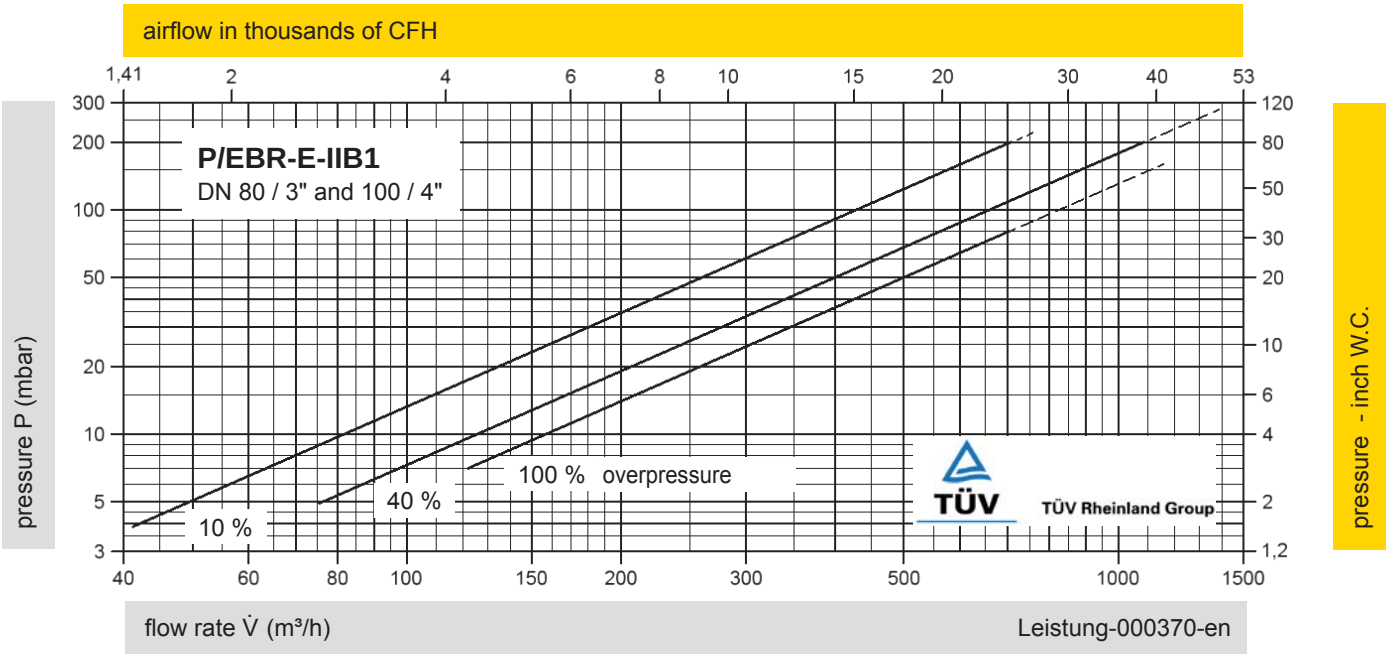
Pressure Relief Valve

Flow Capacity Chart

PROTEGO® P/EBR-E



Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1 + \frac{\text{overpressure \%}}{100\%}}$$

Set pressure = the valve starts to open

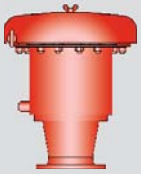
Opening pressure = set pressure plus overpressure

Overpressure % = percentage pressure increase over the set pressure

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”.

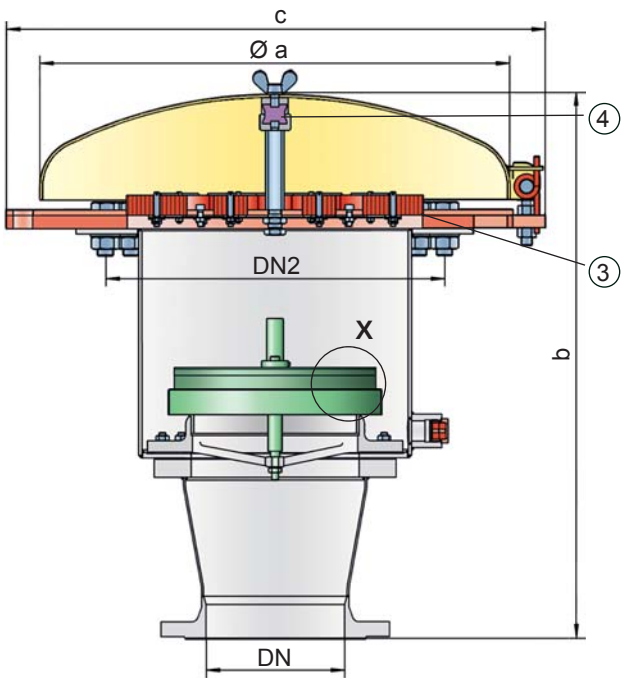
Notes:

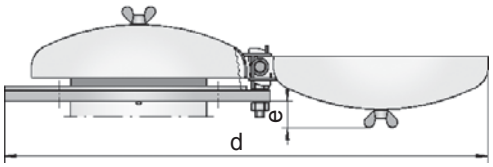


Pressure Relief Valve

deflagration- and endurance burning-proof

PROTEGO® D-SVL-EB-200-IIA





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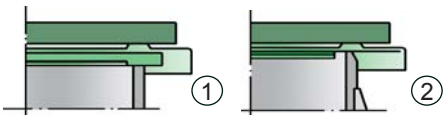

Pressure settings:

+2.0 mbar	up to +60 mbar
+0.8 inch W.C.	up to +24 inch W.C.

Higher pressure settings upon request.

Function and Description

The def agration-proof and endurance burning-proof D-SVL-EB type PROTEGO® valve is a highly developed pressure relief valve for large f ows with an integrated f ame arrester PROTEGO® EB. It is primarily used as a safety device for f ame transmission proof outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and prevents product losses almost up to the set pressure; it also protects against atmospheric de f agration as well as endurance burning if stabilized burning occurs. The PROTEGO® f ame arrester unit is designed to achieve minimum pressure drop with maximum safety . PROTEGO® D-SVL-EB valves are available for substances for substances of explosion group IIA (NEC group D MESG > 0.9 mm).

When the set pressure is reached, the valve starts to open and reaches full lift within 10% overpressure. This unique 10% technology enables a set pressure that is only 10% below the maximum allowable working pressure (MA WP) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range.

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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 a 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 in corrosive f uids. After the excess pressure is discharged, the valve reseats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated f ame arrester PROTEGO® EB (3) prevents f ame transmission into the tank. If additional mixture continues to f ow and stabilized burning occurs, the integrated f ame arrester unit prevents f ashback as a result from endurance burning. The valve is protected and also fulf ls its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- requires only 10% overpressure to full lift
- through 10% technology higher set pressures can be used which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- more design f exibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- the valve disc is guided within the housing to protect against harsh weather conditions
- can be used as protective system according ATEX in areas subject to explosion hazards
- PROTEGO® f ame arrester unit provides protection against atmospheric def agration and endurance burning
- f ame arrester unit integrated into the valve saves space, weight and reduces cost
- f ame arrester unit protected from clogging through product vapour
- f ame arrester unit has a low pressure drop
- f ame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and valve pallet to be replaced

Design Types and Specifications

The valve disc is weight-loaded.

There are two different designs:

Pressure relief valve, basic design **D-SVL-EB - [–]**

Pressure relief valve with heating jacket **D-SVL-EB - [H]**

Additional special devices available upon request

Table 1: Dimensions — Dimensions in mm / inches

DN	DN2	a	b	c	d	e
200 / 8“	400 / 16“	705 / 27.76	846 / 33.31	802 / 31.57	1500 / 59.06	109 / 4.29

Dimensions for Pressure Relief Valve with heating jacket upon request

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request

Table 3: Material selection for housing

Design	A	B	
Housing Heating jacket (D-SVL-EB-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seat	Stainless Steel	Stainless Steel	
Spacer	PTFE	PTFE	
Flange ring	Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	
Flame arrester unit	A	A, B	

Table 4: Material combination of flame arrester unit

Design	A	B	
FLAMEFILTER® cage	Steel	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	Stainless Steel	
Safety bar	Stainless Steel	Stainless Steel	

Table 5: Material selection for valve pallet

Design	A	B	C	D	E	F
Pressure range (mbar) (inch W.C.)	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +35 >+5.6 up to +14	>+35 up to +60 >+14 up to +24	>+14 up to +35 >+5.6 up to +14	>+35 up to +60 >+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 and higher pressure settings upon request

Table 6: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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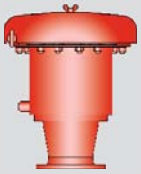
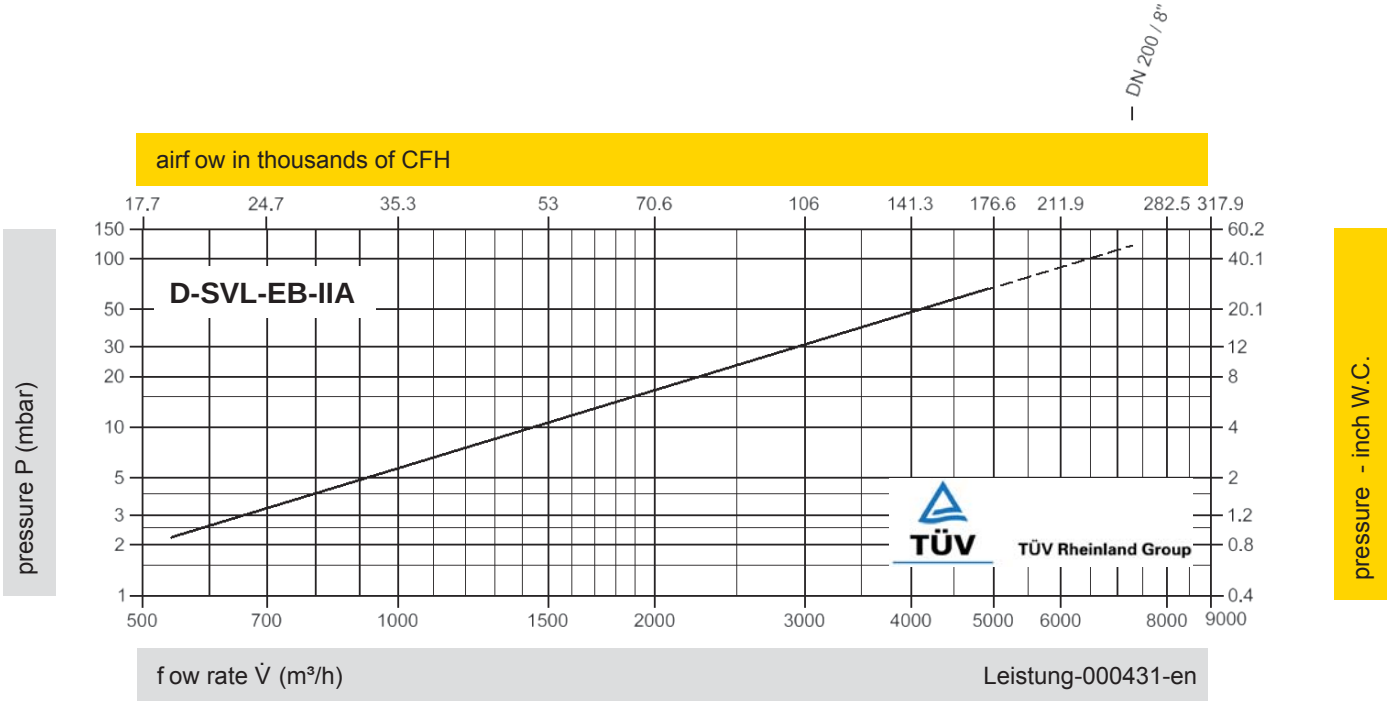


Pressure Relief Valve

Flow Capacity Chart

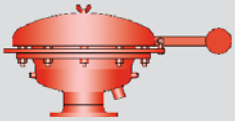
PROTEGO® D-SVL-EB-200-IIA



The f ow capacity charts have been determined with a calibrated and TÜV certif ed f ow capacity test rig.

Volume f ow 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”.

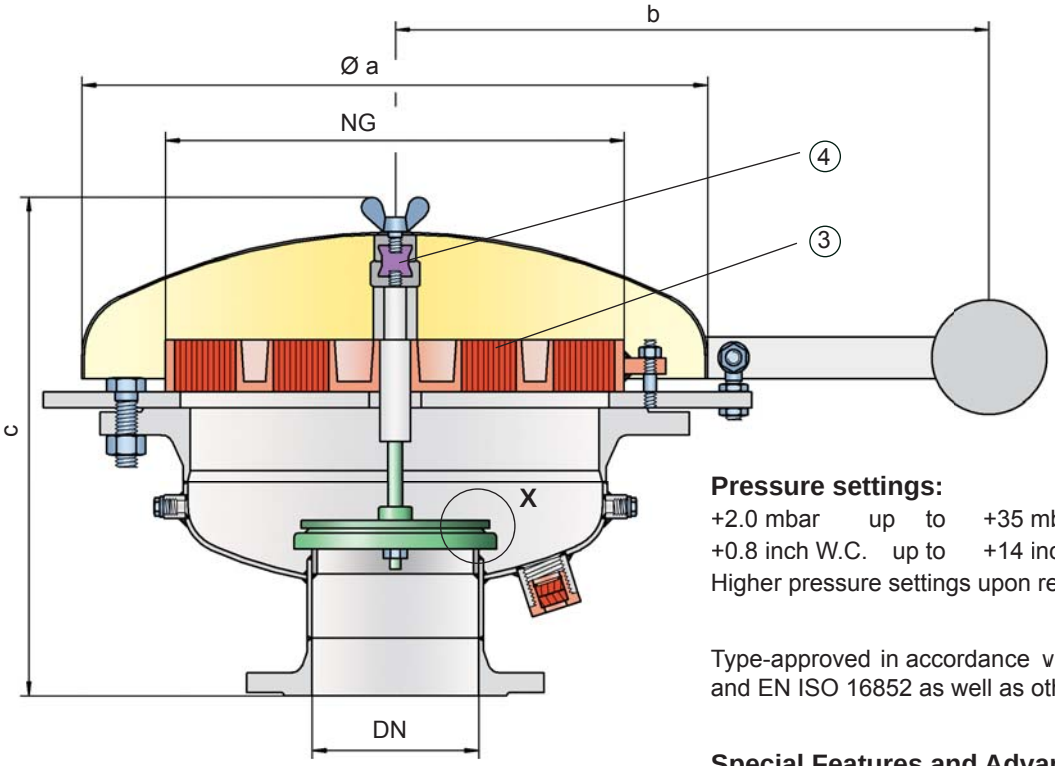
Notes:



Pressure Relief Valve

deflagration- and endurance burning-proof

PROTEGO® BE/HR-D



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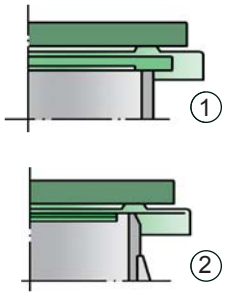

Pressure settings:

+2.0 mbar up to +35 mbar
+0.8 inch W.C. up to +14 inch W.C.
Higher pressure settings upon request.

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Function and Description

The def agration-proof and endurance burning-proof BE/HR-D type PROTEGO® valve is a highly developed pressure relief valve with an integrated f ame arrester unit. It is primarily used as a safety device for f ame transmission proof outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and prevents product losses almost up to the set pressure; it also protects against atmospheric def agration as well as endurance burning if stabilized burning occurs. The PROTEGO® f ame arrester unit is designed to achieve minimum pressure drop with maximum safety. The BE/HR-D valve is available for substances of explosion group IIA (NEC group D MESG > 0.9 mm).

When the set pressure is reached, the valve starts to open and reaches full lift within 40% overpressure. The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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. After the excess pressure is discharged, the valve reseats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® f ame arrester unit (3) prevents f ame transmission into the tank. If additional mixture continues to f ow and stabilized burning occurs, the integrated f ame arrester unit prevents f ashback as a result from endurance burning. The valve is protected and also fulf ls its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Special Features and Advantages

- requires only 40% overpressure to full lift
- through 40% technology higher set pressures can be used which results in product loss reduction compared to conventional 100% overpressure technology vents (compare API 2000)
- more design f exibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- the valve disc is guided within the housing to protect against harsh weather conditions
- can be used as protective system according to ATEX in areas subject to explosion hazards
- high f ow capacity through large FLAMEFILTER® cross-section, results in low pressure drop
- FLAMEFILTER® provides protection against atmospheric def agration and endurance burning
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging through product vapours
- f ame-transmission-proof condensate drain
- maintenance-friendly design

Design and Specifications

The valve disc is weight-loaded.

Pressure relief valve, basic design **BE/HR-D-400/...**

Additional special devices available upon request

Table 1: Dimensions Dimensions in mm / inches

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

DN	150 / 6"	200 / 8"	NG = Nominal size
NG	400 / 16"	400 / 16"	
a	600 / 23.62	600 / 23.62	
b	545 / 21.46	545 / 21.46	
c	485 / 19.09	485 / 19.09	

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	Special approvals upon request
> 0,90 mm	IIA	D	

Table 3: Material selection for housing

Design	A	B	Special materials upon request
Housing	Steel	Stainless Steel	
Valve seat	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	
Flame arrester unit	A	B	

Table 4: Material combinations of flame arrester unit

Design	A	B	Special materials upon request
FLAMEFILTER® cage	Steel	Stainless Steel	
FLAMEFILTER®	Stainless Steel	Stainless Steel	

Table 5: Material selection for valve pallet

Design	A	B	C	Special materials and higher pressure settings upon request
Pressure range (mbar) (inch W.C.)	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +35 >+5.6 up to +14	
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	

Table 6: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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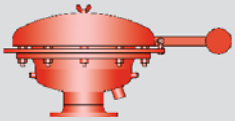
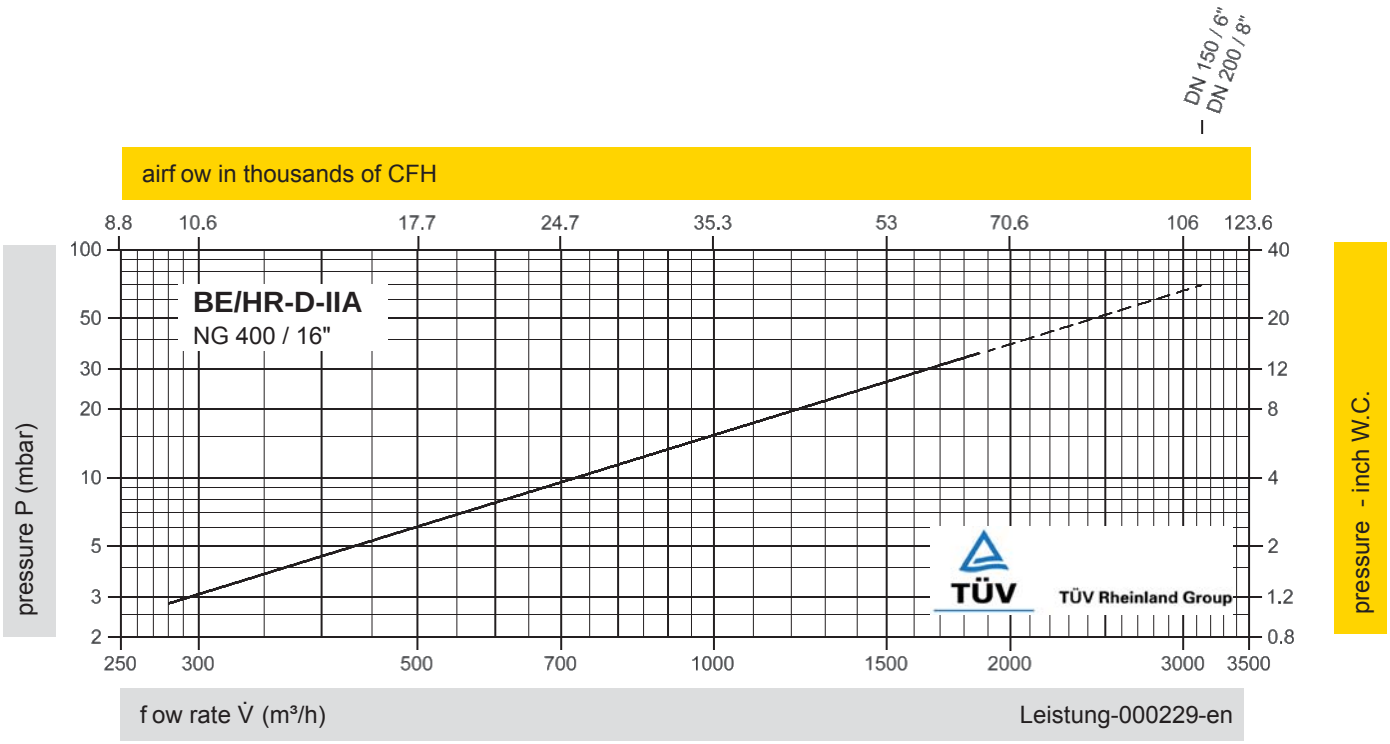
for safety and environment



Pressure Relief Valve

Flow Capacity Chart

PROTEGO® BE/HR-D



Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1{,}4}$$

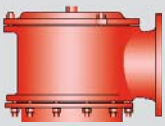
Set pressure = the valve starts to open

Opening pressure = set pressure plus overpressure

Overpressure = pressure increase over the set pressure

The f ow capacity charts have been determined with a calibrated and TÜV certif ed f ow capacity test rig.
Volume f ow 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”.

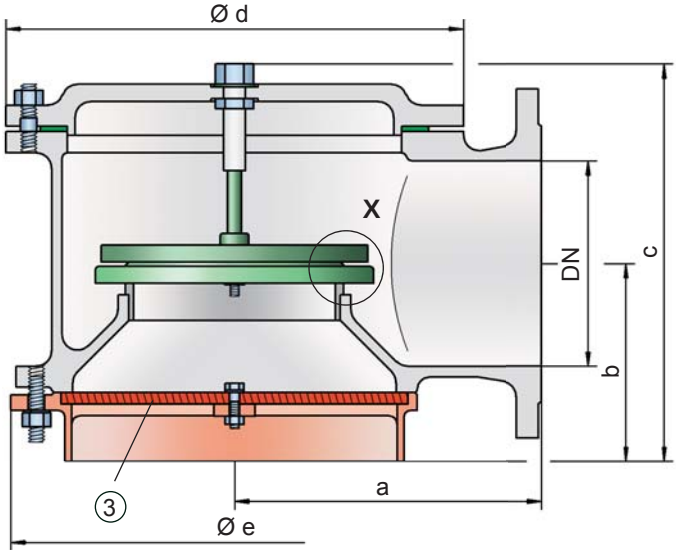
Notes:



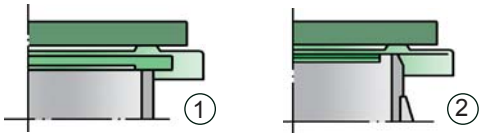
Vacuum Relief Valve

deflagration-proof

PROTEGO® SV/E



Detail **X**



Vacuum settings:

-2.0 mbar up to -60 mbar (-0.2 kPa up to -6 kPa)

-0.8 inch W.C. up to -24 inch W.C.

Higher vacuum settings upon request

Function and Description

The deflagration-proof SV/E type PROTEGO® valve is a state of the art vacuum relief valve with an integrated flame arrester unit. It is primarily used as a safety device for flame transmission proof inbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against vacuum and prevents inbreathing of air almost up to the set pressure; it also protects against atmospheric deflagration. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The PROTEGO® SV/E valve is available for substances from explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

When the set vacuum is reached, the valve starts to open and reaches full lift within 10% overpressure. This unique 10% technology enables a set vacuum that is only 10% above the maximum allowable working vacuum (MAWV) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range.

The tank pressure is maintained up to the set vacuum with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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 corrosive fluids. After the vacuum is equalized, the valve reseats and provides a tight seal.

If the valve is used in atmospheres forming an explosive mixture with air and the mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank.

The standard design is tested at an operating temperature up to +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000). In addition numerous versions for higher operating temperature are available.

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards. Additional certificates from classification associations for use on ships are also available.

Special Features and Advantages

- requires only 10% overpressure to full lift
- extreme tightness and hence least possible product losses and reduced environmental pollution
- through 10% technology lower set vacuum can be reached which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- optimized flow performance
- the valve disc is guided within the housing to protect against harsh weather conditions
- can be used as protective system according ATEX in areas subject to explosion hazards
- FLAMEFILTER® provides protection against atmospheric deflagration
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging through product vapour
- PROTEGO® flame arrester unit has a low pressure drop
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and valve pallets to be replaced
- an additional lifting gear can be purchased

Design Types and Specifications

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

There are four different designs:

Vacuum relief valve, basic design	**SV/E- [–] - [–]**
Vacuum relief valve with heating jacket (max. heating fluid temperature +85°C / 185°F)	**SV/E- [–] - [H]**
Vacuum relief valve with lifting gear (ship design)	**SV/E- [S] - [–]**
Vacuum relief valve with lifting gear (ship design) and heating jacket (max. heating fluid temperature +85°C / 185°F)	**SV/E- [S] - [H]**

Additional special devices available upon request

Table 1: Dimensions Dimensions in mm / inches

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

DN	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"	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	105 / 4.13	115 / 4.53	125 / 4.92	165 / 6.50	195 / 7.68	230 / 9.06	280 / 11.02
c	225 / 8.86	240 / 9.45	320 / 12.60	410 / 16.14	460 / 18.11	525 / 20.67	575 / 22.64
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	345 / 13.58	435 / 17.13	470 / 18.50	635 / 25.00

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,65 mm	IIB3	C	Special approvals upon request

Table 3: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	higher operating temperatures upon request
-	Designation	

Table 4: Material selection for housing

Design	B	C	
Housing Heating jacket (SV/E-(S)-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seat	Stainless Steel	Stainless Steel	
Gasket	PTFE	PTFE	
Flame arrester unit	B	B	

Table 5: Material combinations of flame arrester unit

Design	B	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	

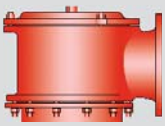
Table 6: Material selection for valve pallet

Design	A	B	C	D	E	F
Vacuum range (mbar) (inch W.C.)	-2.0 up to -3.5 -0.8 up to -1.4	<-3.5 up to -14 <-1.4 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-35 up to -60 <-14 up to -24	<-14 up to -35 <-5.6 up to -14	<-35 up to -60 <-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 and higher pressure settings upon request

Table 7: Flange connection type

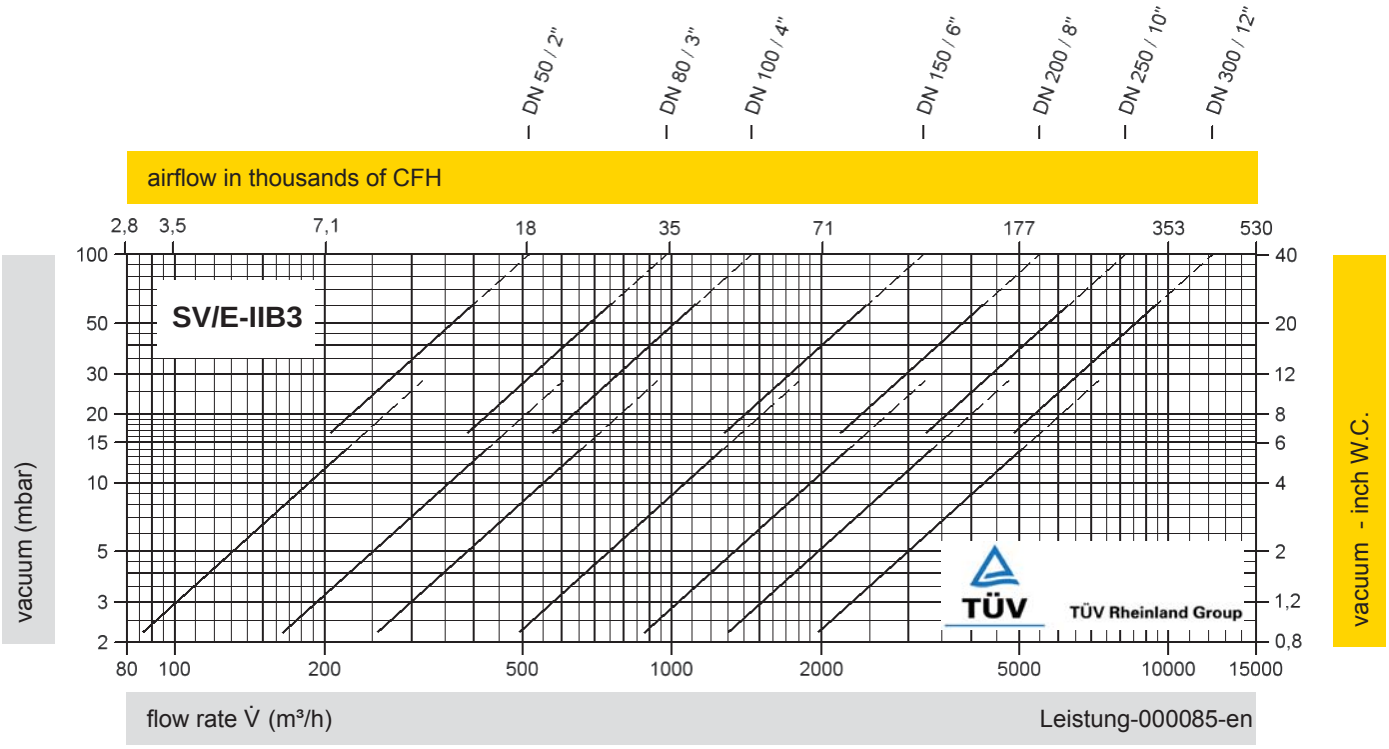
EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	



Vacuum Relief Valve

Flow Capacity Chart

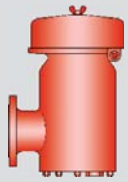
PROTEGO® SV/E



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”.

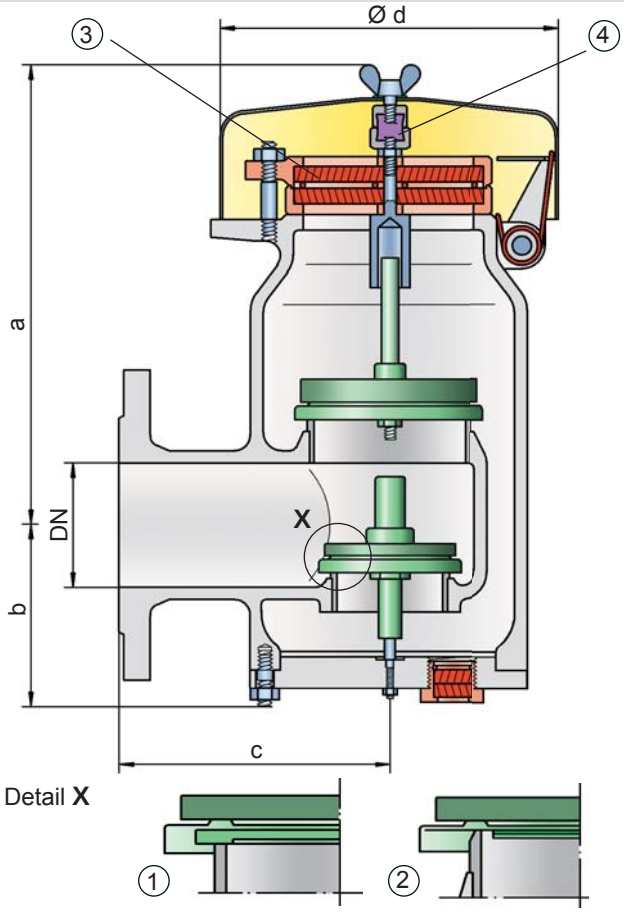
Notes:



Pressure/Vacuum Relief Valve

deflagration- and endurance burning-proof

PROTEGO® PV/EB



Settings:

pressure:	+2.0 mbar	up to	+210 mbar
	+0.8 inch W.C.	up to	+84 inch W.C.
vacuum:	-14 mbar	up to	-35 mbar
	-5.6 inch W.C.	up to	-14 inch W.C.
vacuum:	-3.5 mbar	up to	-14 mbar
	-1.4 inch W.C.	up to	-5.6 inch W.C.

for presssure up to max. + 150 mbar / 60.2 inch W.C.
Higher and lower settings upon request

Function and Description

The atmospheric deflagration and endurance burning proof PV/EB type PROTEGO® valve is a highly developed combined pressure/vacuum relief valve for high flow capacities with an integrated flame arrester unit. It is primarily used as a safety device for flame transmission proof in- and outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, prevents the inbreathing of air and product losses almost up to the set pressure and also protects against atmospheric deflagration and endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The PROTEGO® PV/EB valve is available for substances of explosion group IIA (NEC group D MESG > 0.9 mm).

When the set pressure is reached, the valve starts to open and reaches full lift within 10% over pressure. This unique 10% technology enables a set pressure that is only 10% below the maximum allowable working pressure (MAWP) or maximum allowable working vacuum (MAWV) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range.

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN 12874 as well as other international standards.

Special Features and Advantages

- requires only 10% overpressure to full lift
- through 10% technology higher set pressures can be used which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- increased design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- the valve disc is guided within the housing to protect against harsh weather conditions
- can be used as protective system according ATEX in areas subject to explosion hazards
- FLAMEFILTER® provides protection against atmospheric deflagration and endurance burning
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging through product vapour
- PROTEGO® flame arrester unit has a low pressure drop
- flame transmission proof condensate drain
- maintenance friendly design
- special design with lifting gear can be purchased

Design Types and Specifications

Almost any combination of vacuum and pressure levels can be set for the valve. The valve discs are weight loaded. When the difference between the pressure and vacuum exceeds 150 mbar / 60.2 inch W.C., special valve discs are used.

There are two different designs:

Pressure/vacuum relief valve, basic design **PV/EB- –**

Pressure/vacuum relief valve with heating jacket **PV/EB- H**
(max. heating fluid temperature +85°C / 185°F)
Additional special devices available upon request

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 ≤ +24.1 inch W.C.	> +60 mbar > +24.1 inch W.C.	≤ +60 mbar ≤ +24.1 inch W.C.	> +60 mbar > +24.1 inch 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: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request

Table 3: Material selection for housing

Design	B	C	
Housing Heating jacket (PV/EB-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seats	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	

Table 4: Material combination of flame arrester unit

Design	A	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 5: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +210 >+5.6 up to +84	>+35 up to +210 >+14 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 6: Material selection for vacuum pallet

Design	A	B	C	D	
Vacuum range (mbar) (inch W.C.)	-3.5 up to -5.0 -1.4 up to -2.0	<-5.0 up to -14 <-2.0 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-14 up to -35 <-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 7: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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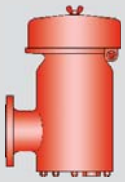
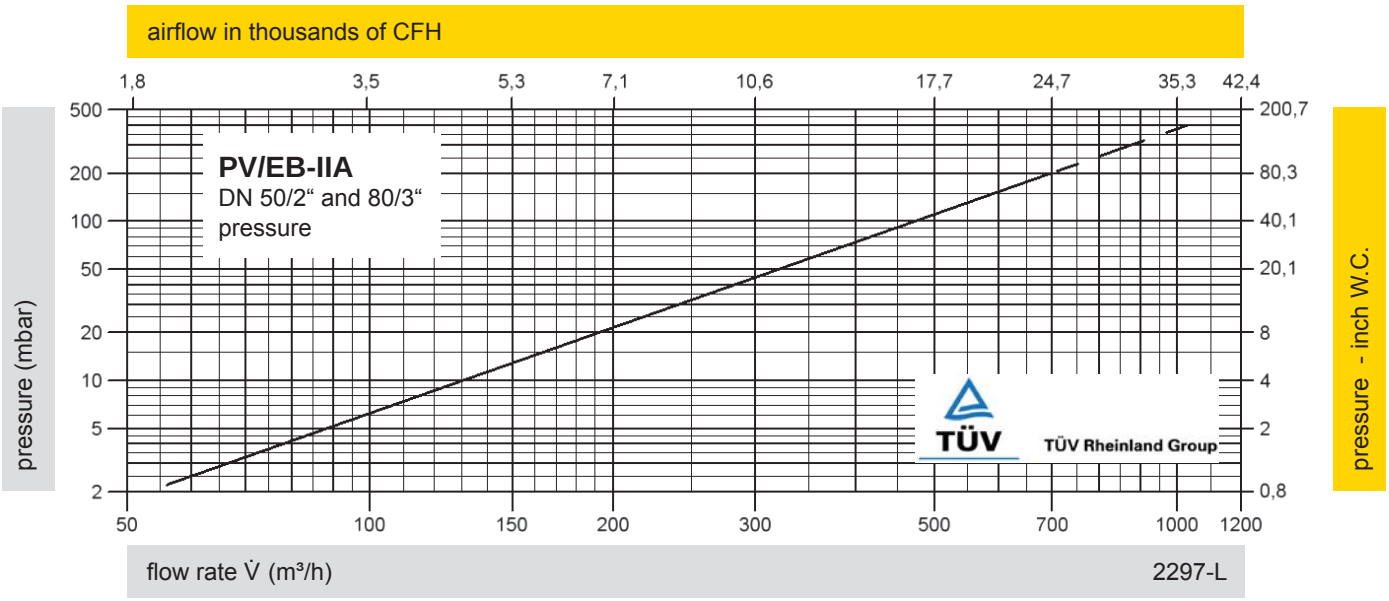
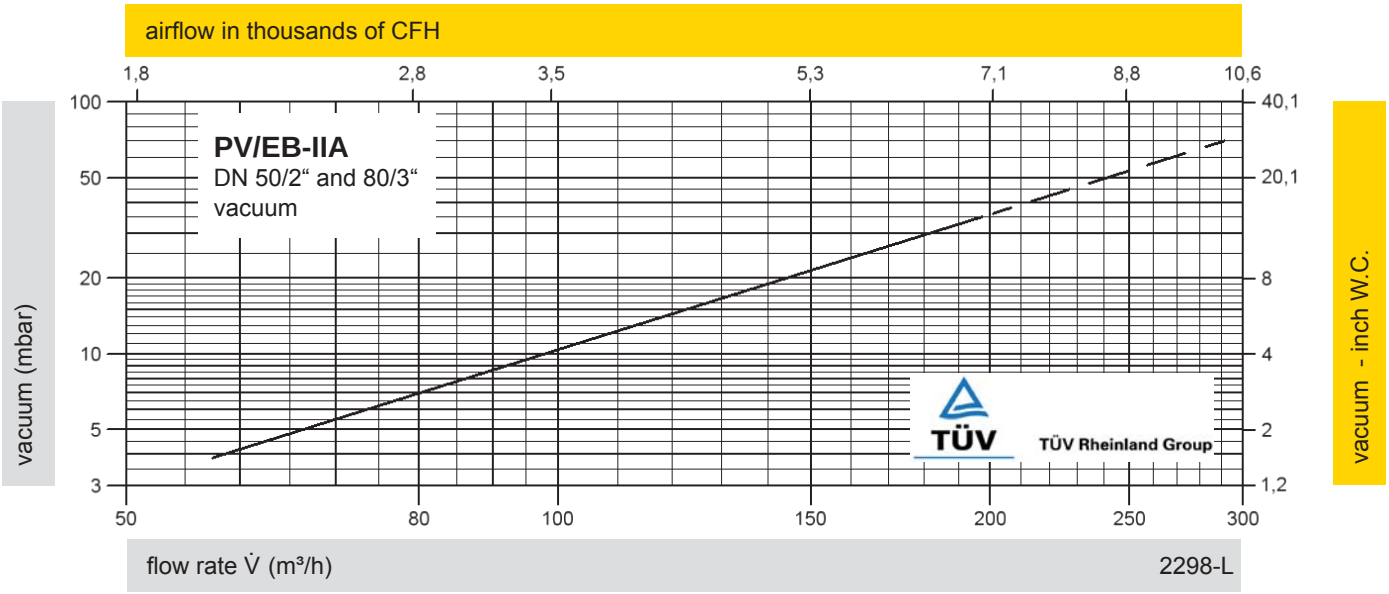


Pressure/Vacuum Relief Valve

Flow Capacity Charts

PROTEGO® PV/EB

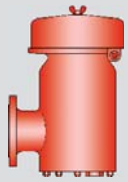




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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”.

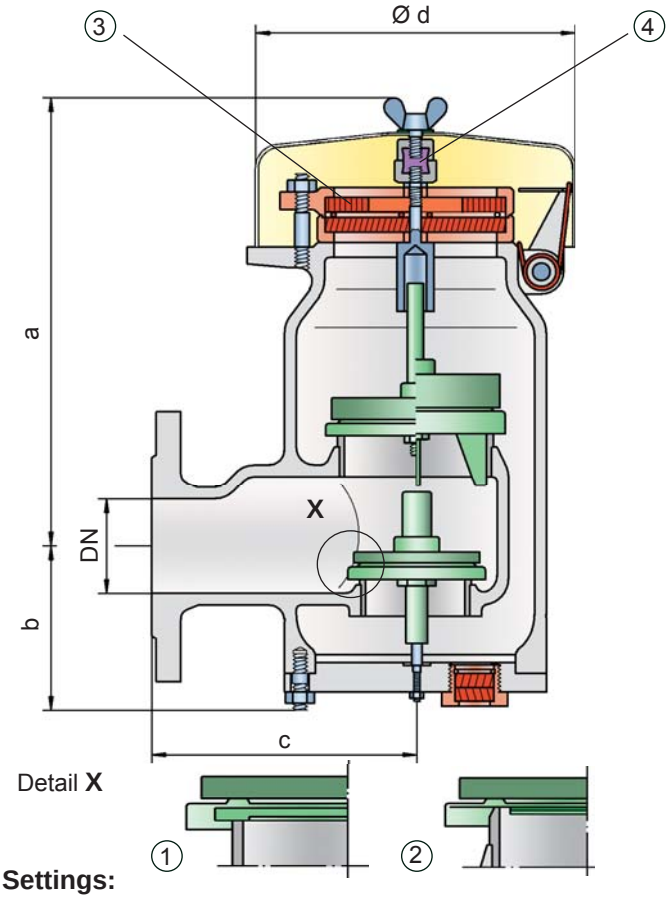
Notes:



Pressure/Vacuum Relief Valve

deflagration- and endurance burning-proof

PROTEGO® PV/EB-E



Settings:

pressure:	+2.0 mbar	up to	+210 mbar
	+0.8 inch W.C.	up to	+84 inch W.C.
vacuum:	-14 mbar	up to	-35 mbar
	-5.6 inch W.C.	up to	-14 inch W.C.
vacuum:	-3.5 mbar	up to	-14 mbar
	-1.4 inch W.C.	up to	-5.6 inch W.C.

for presssure up to max. + 150 mbar / 60.2 inch W.C.
Higher and lower settings upon request

Function and Description

The deflagration-proof and endurance burning-proof PV/EB-E type PROTEGO® valve is a highly developed combined pressure/vacuum relief valve for high flow capacities with an integrated flame arrester unit that is specially used for applications handling ethanol. It is primarily used as a safety device for flame transmission proof in- and outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, prevents the inbreathing of air and product losses almost up to the set pressure and also protects against atmospheric deflagration as well as endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The PROTEGO® PV/EB-E valve is available for substances of explosion group IIB1 (MESG ≥ 0.85 mm) and provides specific protection against deflagration and endurance burning of alcohol/air mixtures (such as ethanol/air).

The valve functions proportionally, so the set pressures should be selected in relation to the proportional behaviour (such as a 10%, 40%, or 100% overpressure from the set pressure to the relieving pressure at which the required flow performance is reached).

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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.

If the set pressure is exceeded, gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- selecting set pressure close to relieving pressure results in product loss reduction
- increased design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- the valve disc is guided within the housing to protect against harsh weather conditions
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- can be used as protective system according to ATEX in areas subject to explosion hazards
- safe against deflagration and endurance burning of alcohol/air mixtures from explosion group IIB1
- high flow capacity through large FLAMEFILTER® cross-section, results in low pressure drop
- FLAMEFILTER® provides protection against atmospheric deflagration and endurance burning
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging caused by product vapours
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and valve pallets to be replaced
- special design with lifting gear can be purchased

Design Types and Specifications

Almost any combination of vacuum and pressure levels can be set for the valve. The valve discs are weight loaded. When the difference between the pressure and vacuum exceeds 150 mbar / 60.2 inch W.C., special valve discs are used.

There are two different designs:

Pressure/vacuum relief valve, basic design **PV/EB-E- –**

Pressure/vacuum relief valve with heating jacket **PV/EB-E- H**
(max. heating fluid temperature +85°C / 185°F)

Additional special devices available upon request

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 ≤ +24.1 inch W.C.	> +60 mbar ≤ +24.1 inch W.C	≤ +60 mbar ≤ +24.1 inch W.C	> +60 mbar ≤ +24.1 inch 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: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,85 mm	IIB1	–	Special approvals upon request

Table 3: Material selection for housing

Design	B	C	
Housing Heating jacket (PV/EB-E-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seats	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	

Table 4: Material combination of flame arrester unit

Design	A	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 5: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +210 >+5.6 up to +84	>+35 up to +210 >+14 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 6: Material selection for vacuum pallet

Design	A	B	C	D	
Vacuum range (mbar) (inch W.C.)	-3.5 up to -5.0 -1.4 up to -2.0	<-5.0 up to -14 <-2.0 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-14 up to -35 <-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 7: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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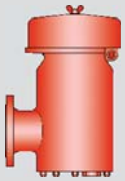
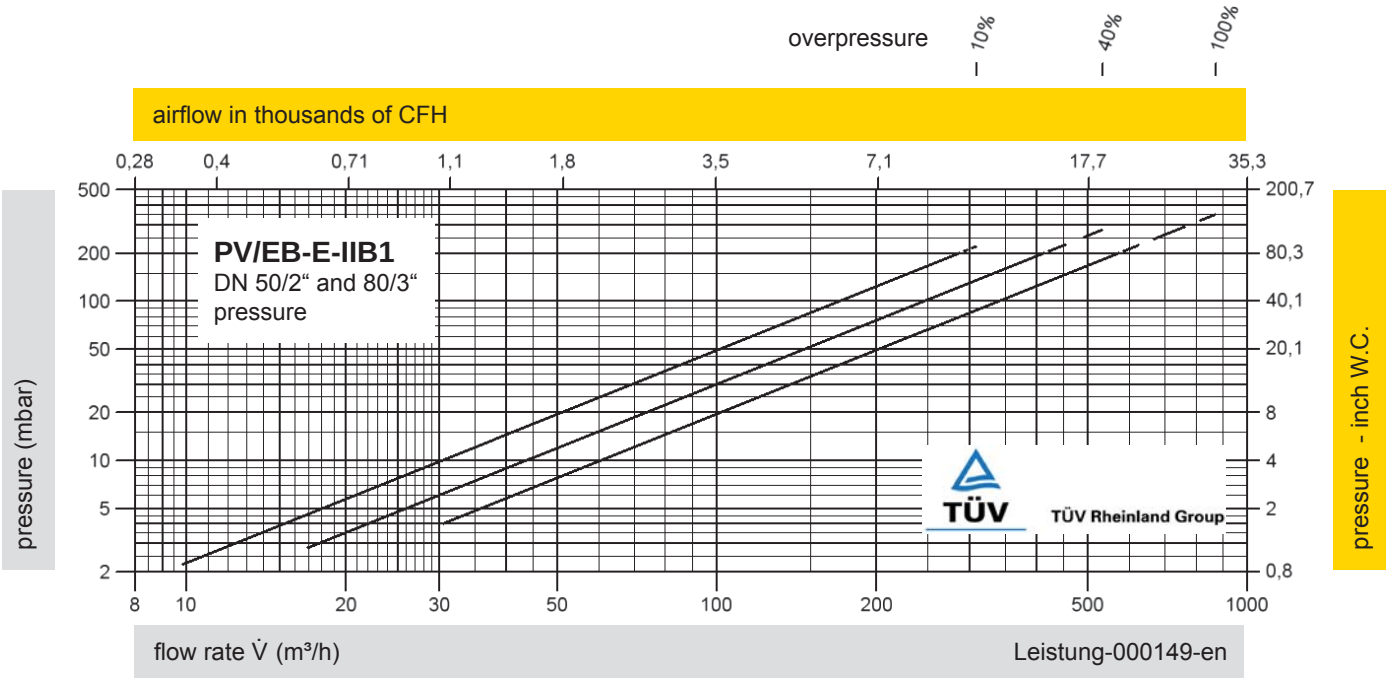
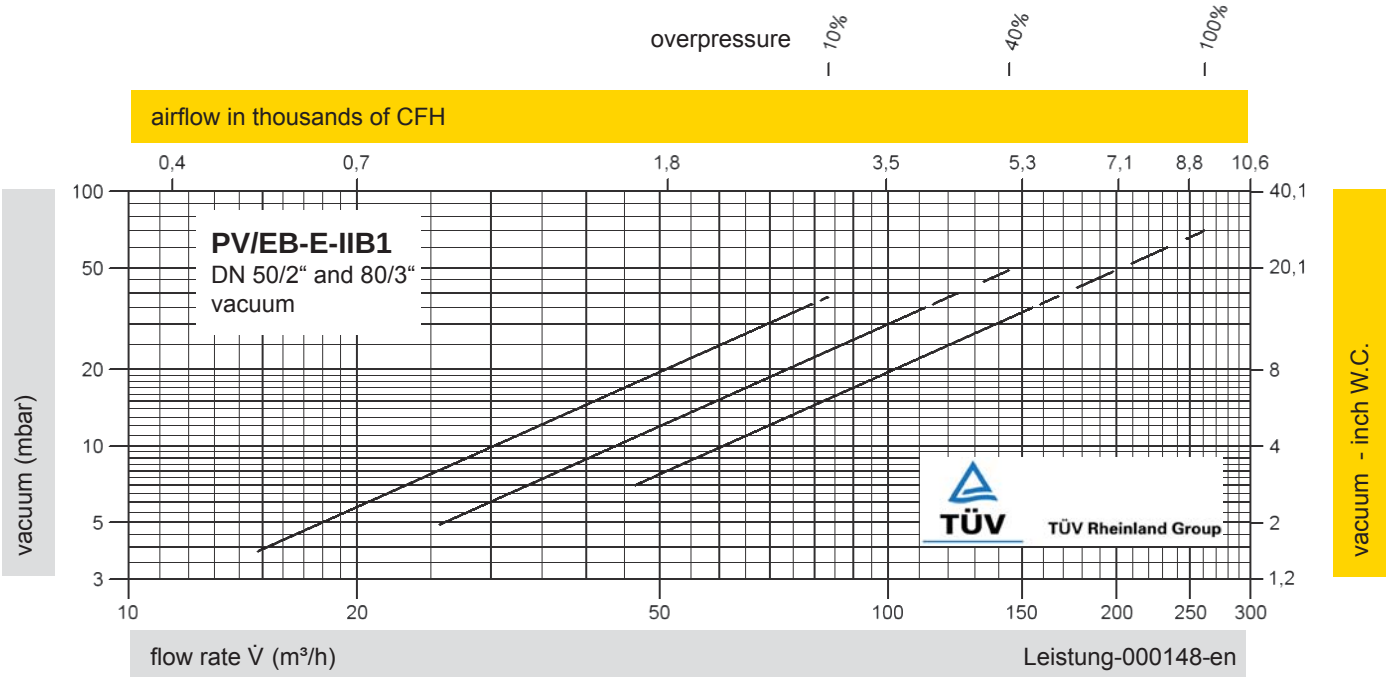


Pressure/Vacuum Relief Valve

Flow Capacity Charts

PROTEGO® PV/EB-E





Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1 + \frac{\text{overpressure \%}}{100\%}}$$

Set pressure = the valve starts to open

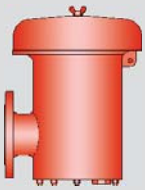
Opening pressure = set pressure plus overpressure

Overpressure % = percentage pressure increase over the set pressure

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”.

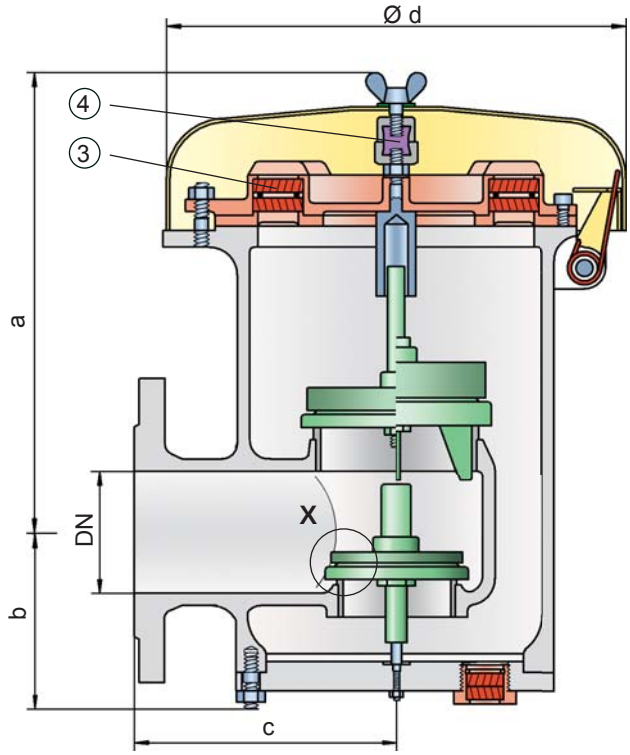
Notes:



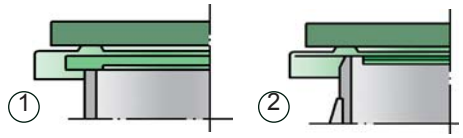
Pressure/Vacuum Relief Valve

deflagration- and endurance burning-proof

PROTEGO® PV/EBR



Detail **X**



Settings:

pressure:	+2.0 mbar	up to	+210 mbar
	+0.8 inch W.C.	up to	+84 inch W.C.
vacuum:	-14 mbar	up to	-50 mbar
	-5.6 inch W.C.	up to	-20 inch W.C.
vacuum:	-3.5 mbar	up to	-14 mbar
	-1.4 inch W.C.	up to	-5.6 inch W.C.

for presssure up to max. + 150 mbar / 60.2 inch W.C.
Higher and lower settings upon request

Function and Description

The deflagration-proof and endurance burning-proof PV/EBR type PROTEGO® valve is a highly developed combined pressure/vacuum relief valve for high flow capacities with an integrated flame arrester. It is primarily used as a safety device for flame transmission proof in- and outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, prevents the inbreathing of air and product losses almost up to the set pressure and also protects against atmospheric deflagration as well as endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. PROTEGO® PV/EBR valves are available for substances from explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

The valve functions proportional, so the set pressures should be selected in relation to the proportional behaviour (such as a 10%, 40%, or 100% overpressure from the set pressure to the relieving pressure at which the required flow performance is reached).

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive as well as other international standards.

Special Features and Advantages

- selecting set pressure close to relieving pressure results in product loss reduction
- more design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- the valve disc is guided within the housing to protect against harsh weather conditions
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- can be used as protective system according to ATEX in areas subject to explosion hazards
- high flow capacity through large FLAMEFILTER® cross-section, results in low pressure drop
- FLAMEFILTER® provides protection against atmospheric deflagration and endurance burning
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging caused by product vapours
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and valve pallets to be replaced
- special design with lifting gear can be purchased

Design Types and Specifications

Almost any combination of vacuum and pressure levels can be set for the valve. The valve discs are weight loaded. When the difference between the pressure and vacuum exceeds 150 mbar / 60.2 inch W.C., special valve discs are used.

There are two different designs:

Pressure/vacuum relief valve, basic design **PV/EBR- –**

Pressure /vacuum relief valve with heating jacket **PV/EBR- H**
(max. heating fluid temperature +85°C / 185°F)
Additional special devices available upon request

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 ≤ +14 inch W.C.	> +35 mbar > +14 inch W.C.	≤ +35 mbar ≤ +14 inch W.C.	> +35 mbar > +14 inch 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: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request
≥ 0,65 mm	IIB3	C	

Table 3: Material selection for housing

Design	B	C	
Housing Heating jacket (PV/EBR-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seats	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	

Table 4: Material combination of flame arrester unit

Design	A	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 5: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +210 >+5.6 up to +84	>+35 up to +210 >+14 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 6: Material selection for vacuum pallet

Design	A	B	C	D	
Vacuum range (mbar) (inch W.C.)	-3.5 up to -5.0 -1.4 up to -2.0	<-5.0 up to -14 <-2.0 up to -5.6	<-14 up to -50 <-5.6 up to -20	<-14 up to -50 <-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 7: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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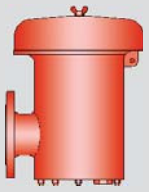
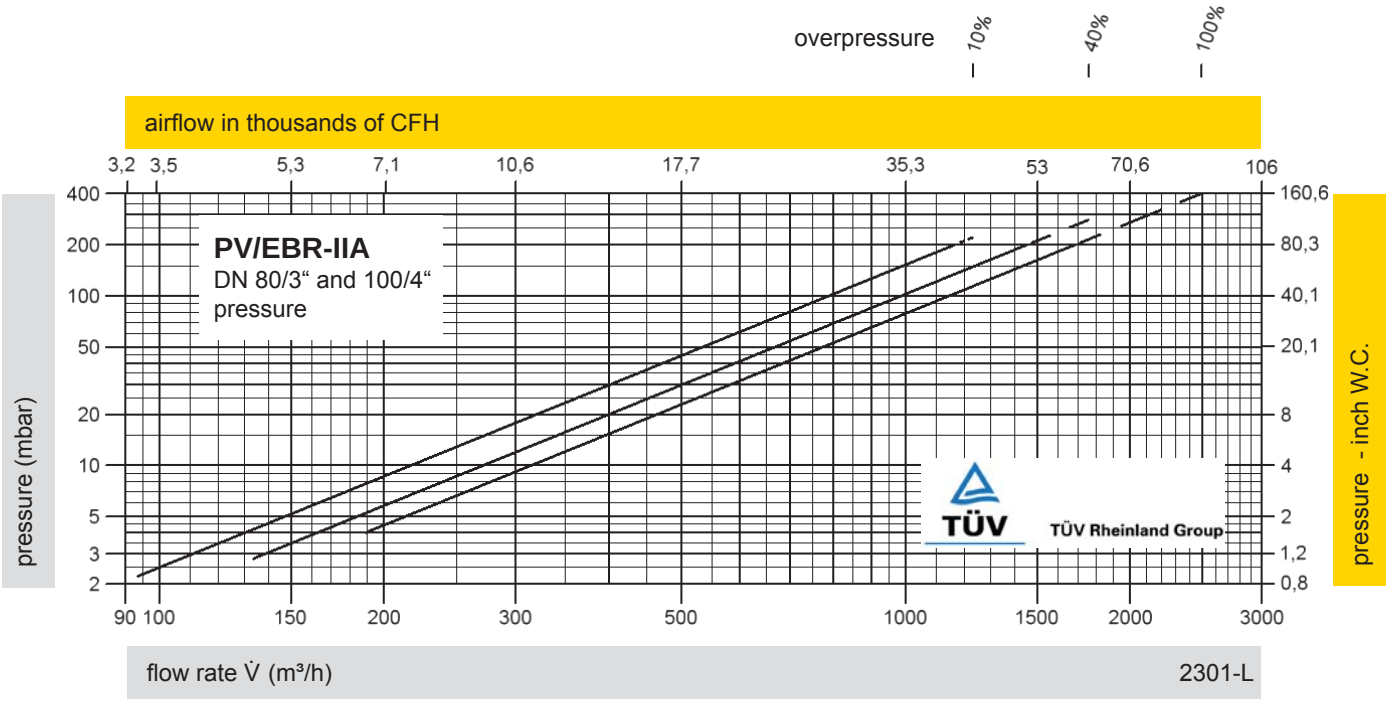
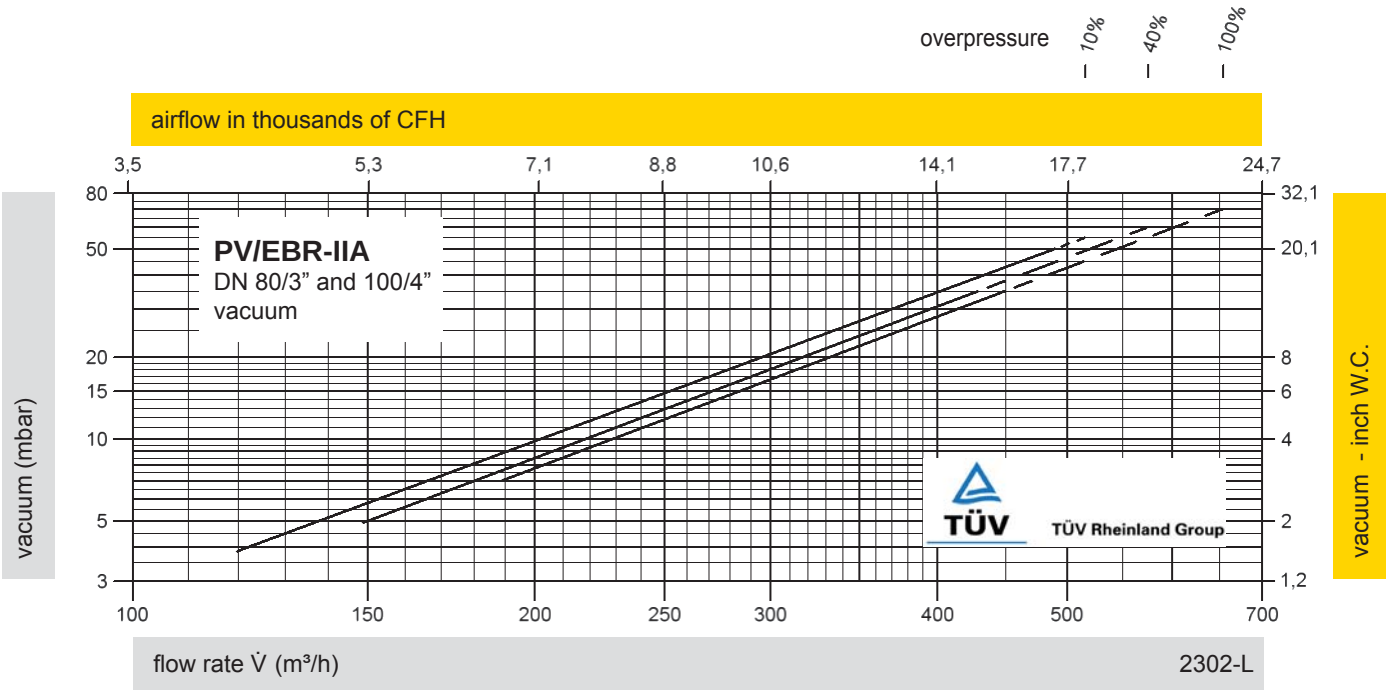


Pressure/Vacuum Relief Valve

Flow Capacity Charts

PROTEGO® PV/EBR





Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1 + \frac{\text{overpressure \%}}{100\%}}$$

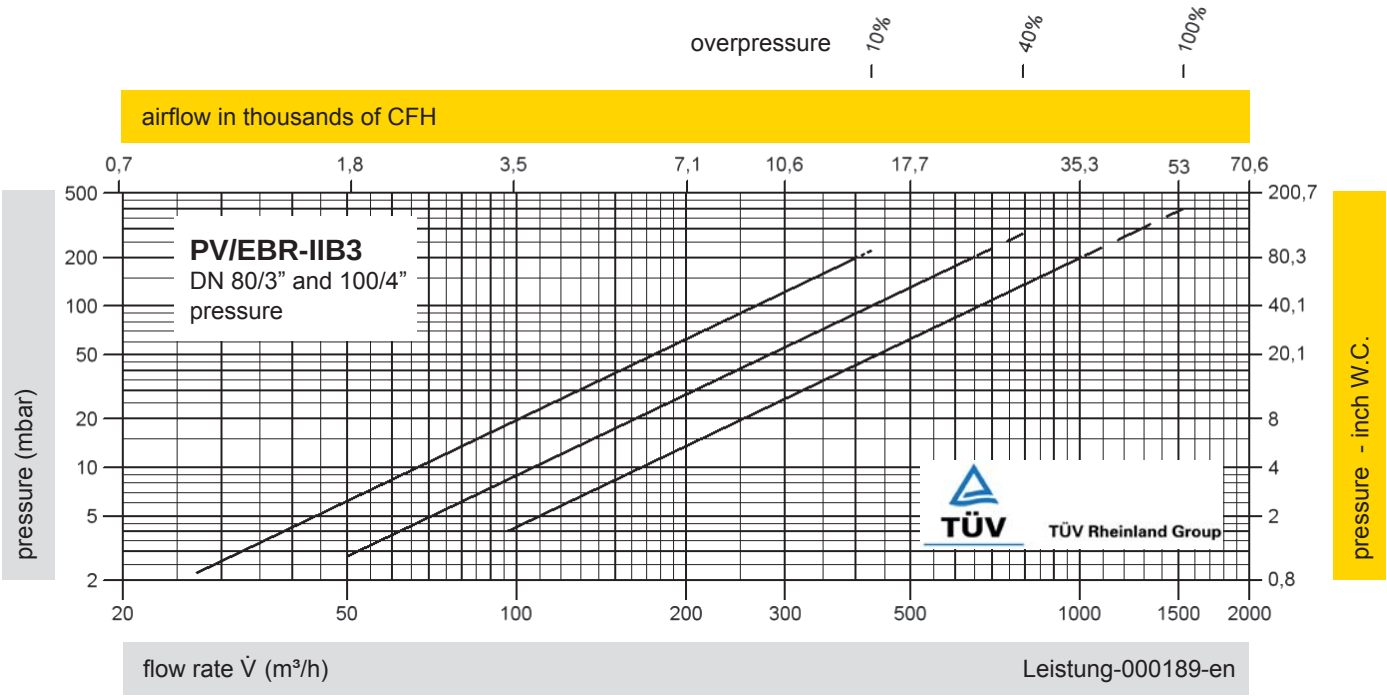
Set pressure = the valve starts to open

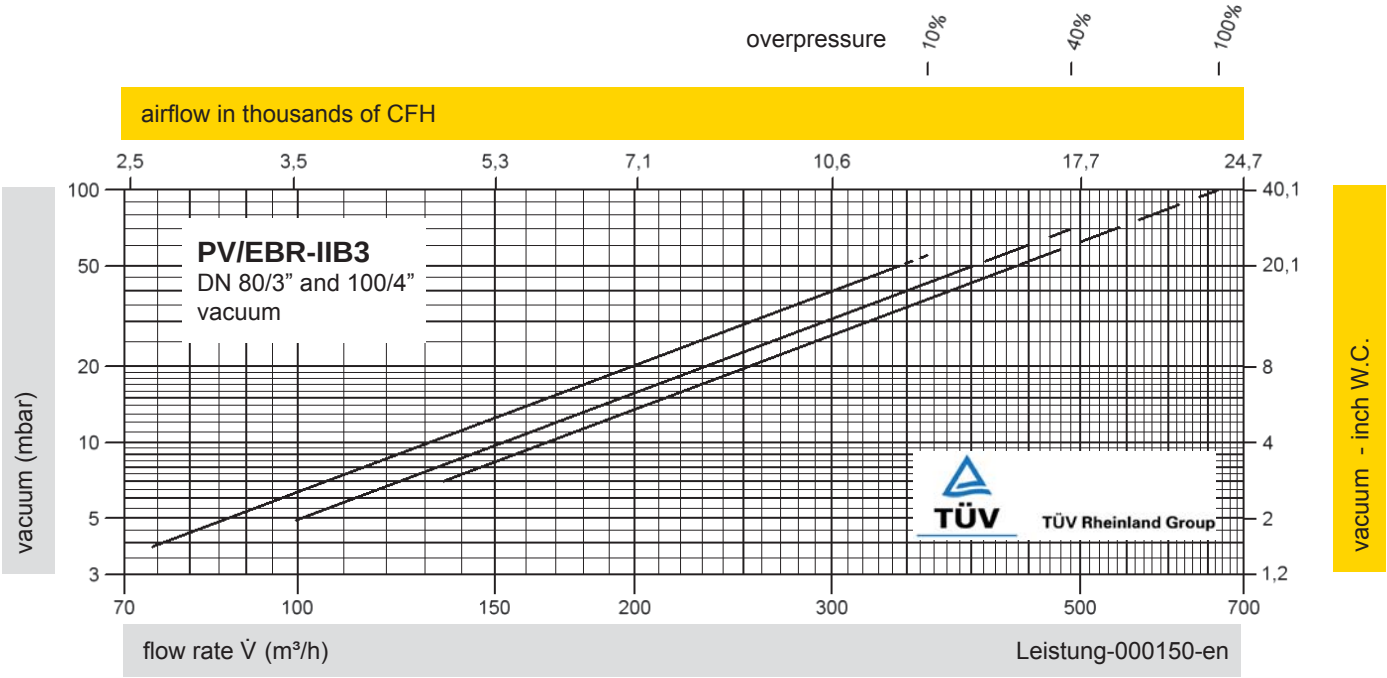
Opening pressure = set pressure plus overpressure

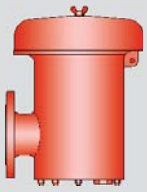
Overpressure % = percentage pressure increase over the set pressure

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”.


overpressure
10%
40%
100%
airflow in thousands of CFH
0,7
1,8
3,5
7,1
10,6
17,7
35,3
53
70,6
PV/EBR-IIB3
DN 80/3" and 100/4"
pressure
pressure (mbar)
500
200
100
50
20
10
5
2
200,7
80,3
40,1
20,1
8
4
2
0,8
pressure - inch W.C.
TÜV
TÜV Rheinland Group
20
50
100
200
300
500
1000
1500
2000
flow rate V̇ (m³/h)
Leistung-000189-en

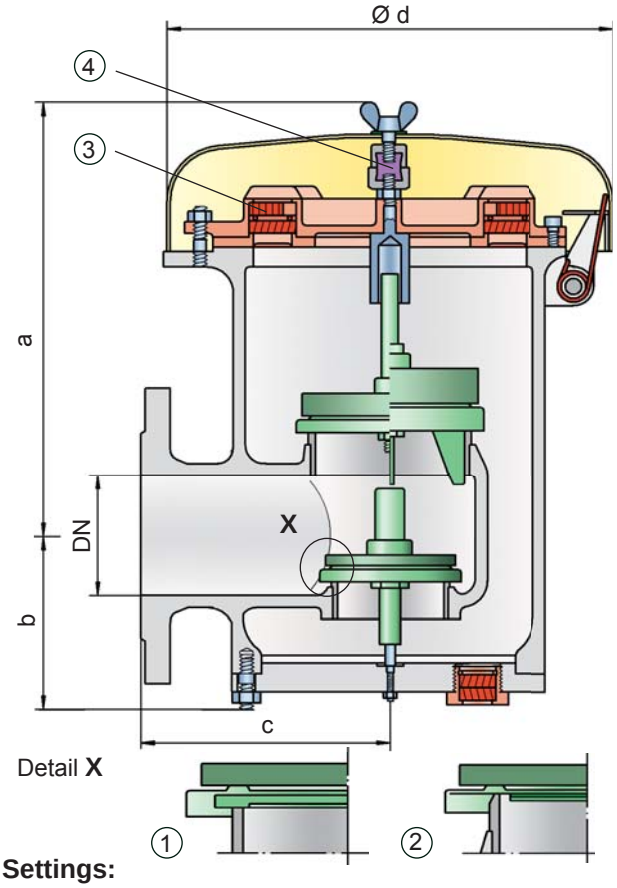

overpressure
10%
40%
100%
airflow in thousands of CFH
2,5
3,5
5,3
7,1
10,6
17,7
24,7
PV/EBR-IIB3
DN 80/3" and 100/4"
vacuum
vacuum (mbar)
100
50
20
10
5
3
40,1
20,1
8
4
2
1,2
vacuum - inch W.C.
TÜV
TÜV Rheinland Group
70
100
150
200
300
500
700
flow rate V̇ (m³/h)
Leistung-000150-en



Pressure/Vacuum Relief Valve

deflagration- and endurance burning-proof

PROTEGO® PV/EBR-E



Settings:

pressure:	+2.0 mbar	up to	+210 mbar
	+0.8 inch W.C.	up to	+84 inch W.C.
vacuum:	-14 mbar	up to	-50 mbar
	-5.6 inch W.C.	up to	-20 inch W.C.
vacuum:	-3.5 mbar	up to	-14 mbar
	-1.4 inch W.C.	up to	-5.6 inch W.C.

for presssure up to max. + 150 mbar / 60.2 inch W.C.
Higher and lower settings upon request

Function and Description

The deflagration-proof and endurance burning-proof PV/EBR-E type PROTEGO® valve is a highly developed combined pressure/vacuum relief valve for high flow capacities with an integrated flame arrester that is specially used for applications handling ethanol. It is primarily used as a safety device for flame transmission proof outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, prevents the inbreathing of air and product losses almost up to the set pressure and also protects against atmospheric deflagration as well as endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The PROTEGO® PV/EBR-E valve is available for substances of explosion group IIB1 (MESG ≥ 0.85 mm) and provides specific protection against deflagration and endurance burning of alcohol/air mixtures (such as ethanol/air).

The valve functions proportional, so the set pressures should be selected in relation to the proportional behaviour (such as a 10%, 40%, or 100% overpressure from the set pressure to the relieving pressure at which the required flow performance is reached).

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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 corrosive fluids. After the excess pressure is discharged, the valve reseats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- selecting set pressure close to relieving pressure results in product loss reduction
- more design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- the valve disc is guided within the housing to protect against harsh weather conditions
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- can be used as protective system according to ATEX in areas subject to explosion hazards
- safe against deflagration and endurance burning of alcohol/ air mixtures from explosion group IIB1
- high flow capacity through large flame filter cross-section, results in low pressure drop
- FLAMEFILTER® provides protection against atmospheric deflagration and endurance burning
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging caused by product vapours
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and valve pallets to be replaced
- special design with lifting gear can be purchased

Design Types and Specifications

Almost any combination of vacuum and pressure levels can be set for the valve. The valve discs are weight loaded. When the difference between the pressure and vacuum exceeds 150 mbar / 60.2 inch W.C., special valve discs are used.

There are two different designs:

Pressure/vacuum relief valve, basic design **PV/EBR-E- [–]**

Pressure/vacuum relief valve with heating jacket (max. heating fluid temperature +85°C / 185°F) **PV/EBR-E- [H]**

Additional special devices available upon request

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 ≤ +14 inch W.C.	> +35 mbar > +14 inch W.C.	≤ +35 mbar ≤ +14 inch W.C.	> +35 mbar > +14 inch 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: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,85 mm	IIB1	–	Special approvals upon request

Table 3: Material selection for housing

Design	B	C	
Housing Heating jacket (PV/EBR-E-H-...)	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request
Valve seats	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	

Table 4: Material combination of flame arrester unit

Design	A	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 5: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +210 >+5.6 up to +84	>+35 up to +210 >+14 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 6: Material selection for vacuum pallet

Design	A	B	C	D	
Vacuum range (mbar) (inch W.C.)	-3.5 up to -5.0 -1.4 up to -2.0	<-5.0 up to -14 <-2.0 up to -5.6	<-14 up to -50 <-5.6 up to -20	<-14 up to -50 <-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 7: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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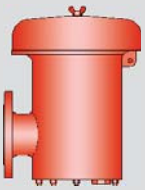
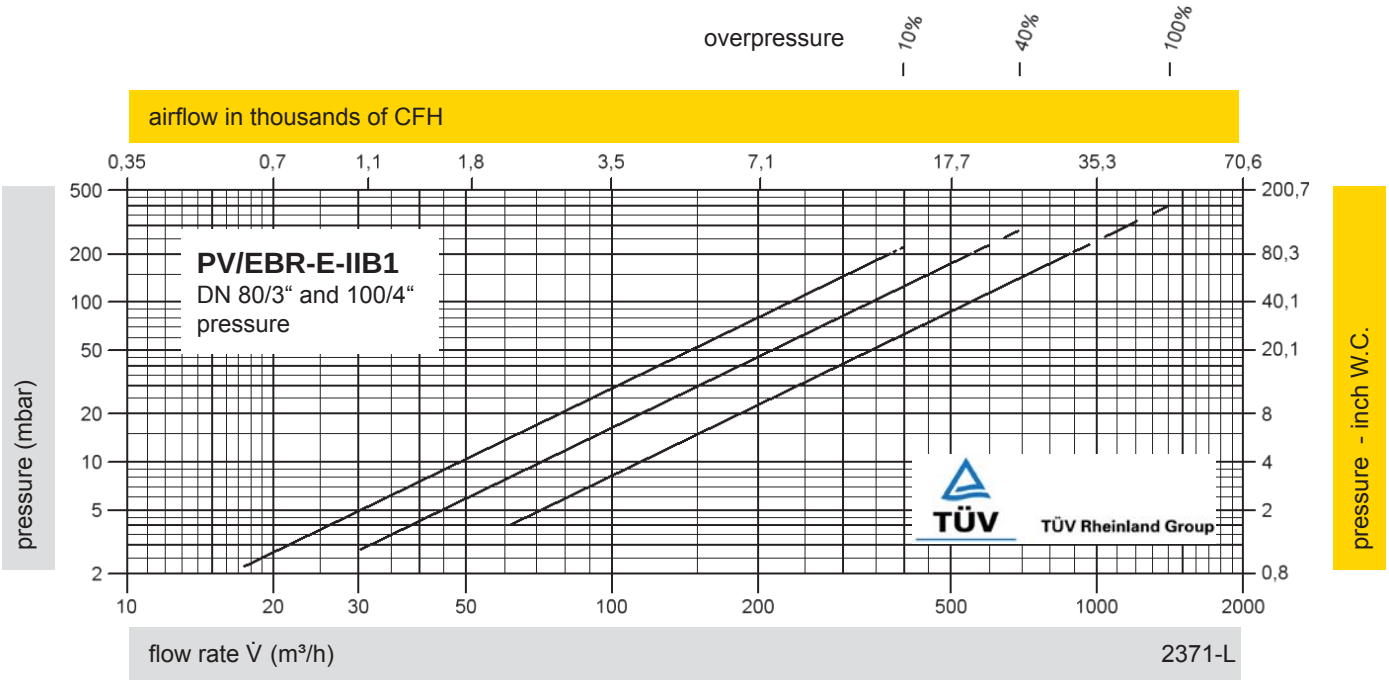
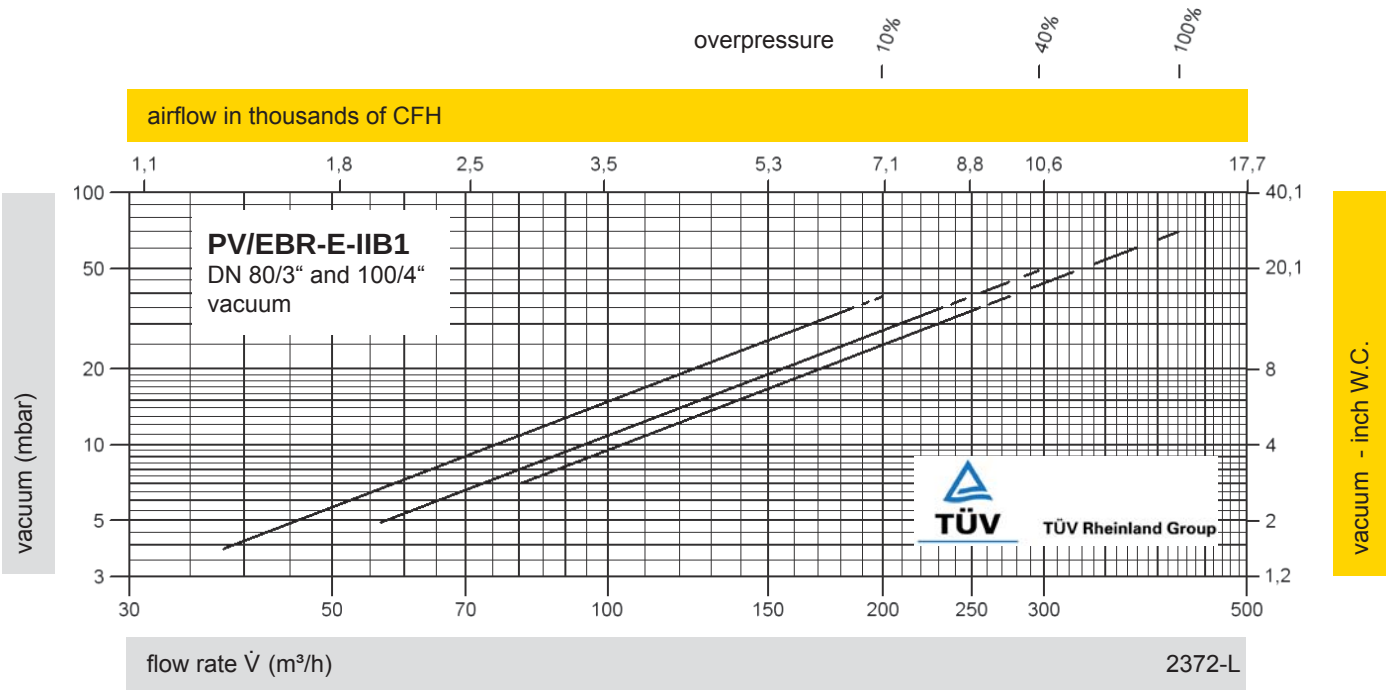


Pressure/Vacuum Relief Valve

Flow Capacity Charts

PROTEGO® PV/EBR-E





Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1 + \frac{\text{overpressure \%}}{100\%}}$$

Set pressure = the valve starts to open

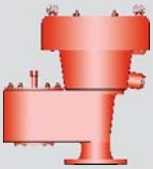
Opening pressure = set pressure plus overpressure

Overpressure % = percentage pressure increase over the set pressure

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”.

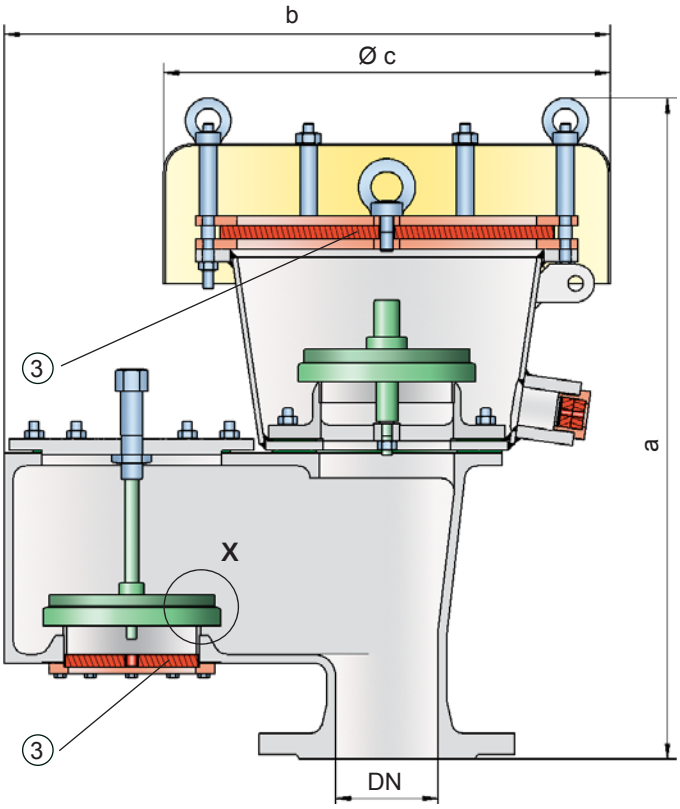
Notes:



Pressure/Vacuum Relief Valve

atmospheric deflagration-proof

PROTEGO® VD/SV-AD and VD/SV-ADL



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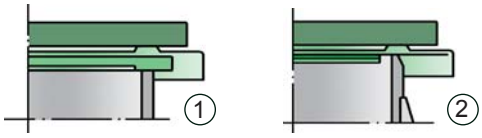

Settings:

pressure:	+3.5 mbar	up to	+35 mbar
	+1.4 inch W.C.	up to	+14 inch W.C.
vacuum:	-2.0 mbar	up to	-35 mbar
	-0.8 inch W.C.	up to	-14 inch W.C.

Higher and lower settings upon request

Function and Description

The deflagration proof VD/SV-AD(L) type PROTEGO® valve is a highly developed combined pressure/vacuum relief valve for high flow capacities with an integrated flame arrester unit. It is primarily used as a safety device for flame-transmission-proof in- and outbreathing in tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, preventing outbreathing of product vapour and inbreathing of air almost up to the set pressure and also protects against atmospheric deflagration. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The deflagration-proof PROTEGO® VD/SV-AD(L) valve is available for substances from explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

When the set pressure is reached, the valve starts to open and reaches full lift within 10% overpressure. This unique 10% technology enables a set pressure that is only 10% below the maximum allowable working pressure (MAWP) or maximum allowable working vacuum (MAWV) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range.

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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 in- and outbreathing is completed the valve reseats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission resulting from atmospheric deflagration into the tank. The vacuum side is also protected against atmospheric deflagration.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- requires only 10% overpressure to full lift
- through 10% technology set pressures and vacuum closer to MAWP and MAWV can be reached which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- more design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- the valve disc is guided within the housing to protect against harsh weather conditions
- can be used as protective system according ATEX in areas subject to explosion hazards
- FLAMEFILTER® provides protection against atmospheric deflagration
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging through product vapour
- FLAMEFILTER® has a low pressure drop
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTER® and the valve pallet to be replaced
- superior technology for API tanks with low MAWP and MAWV

Design Types and Specifications

Any combination of vacuum and pressure levels can be set for the valve

The valve discs are weight-loaded.

There are two different designs:

Pressure/vacuum relief valve with housing, standard design **VD/SV-AD**

Pressure/vacuum relief valve with expanded housing **VD/SV-ADL**

Additional special devices available upon request

Table 1: Dimensions Dimensions in mm / inches

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

	VD/SV-AD		VD/SV-ADL	
DN	80 / 3"	100 / 4"	100 / 4"	150 / 6"
a	540 / 21.26	565 / 22.24	650 / 25.59	760 / 29.92
b	475 / 18.70	575 / 22.64	700 / 27.56	855 / 33.66
c	350 / 13.78	350 / 13.78	600 / 23.62	600 / 23.62

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,65 mm	IIB3	C	Special approvals upon request

Table 3: Material selection for housing

Design	A	B	
Housing	Steel	Stainless Steel	Option: Housing with ECTFE-lining Special materials upon request
Valve seats	Stainless Steel	Stainless Steel	
Gasket	PTFE	PTFE	
Weather hood	Stainless Steel	Stainless Steel	
Flame arrester unit	A, B	B	

Table 4: Material combinations of flame arrester units

Design	A	B	
FLAMEFILTER® cage	Steel	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	Stainless Steel	

Table 5: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+3.5 up to +5.0 +1.4 up to +2.0	>+5.0 up to +14 >+2.0 up to +5.6	>+14 up to +35 >+5.6 up to +14	>+14 up to +35 >+5.6 up to +14	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 6: Material selection for vacuum valve pallet

Design	A	B	C	D	
Vacuum range (mbar) (inch W.C.)	-2.0 up to -3.5 -0.8 up to -1.4	<-3.5 up to -14 <-1.4 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-14 up to -35 <-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 7: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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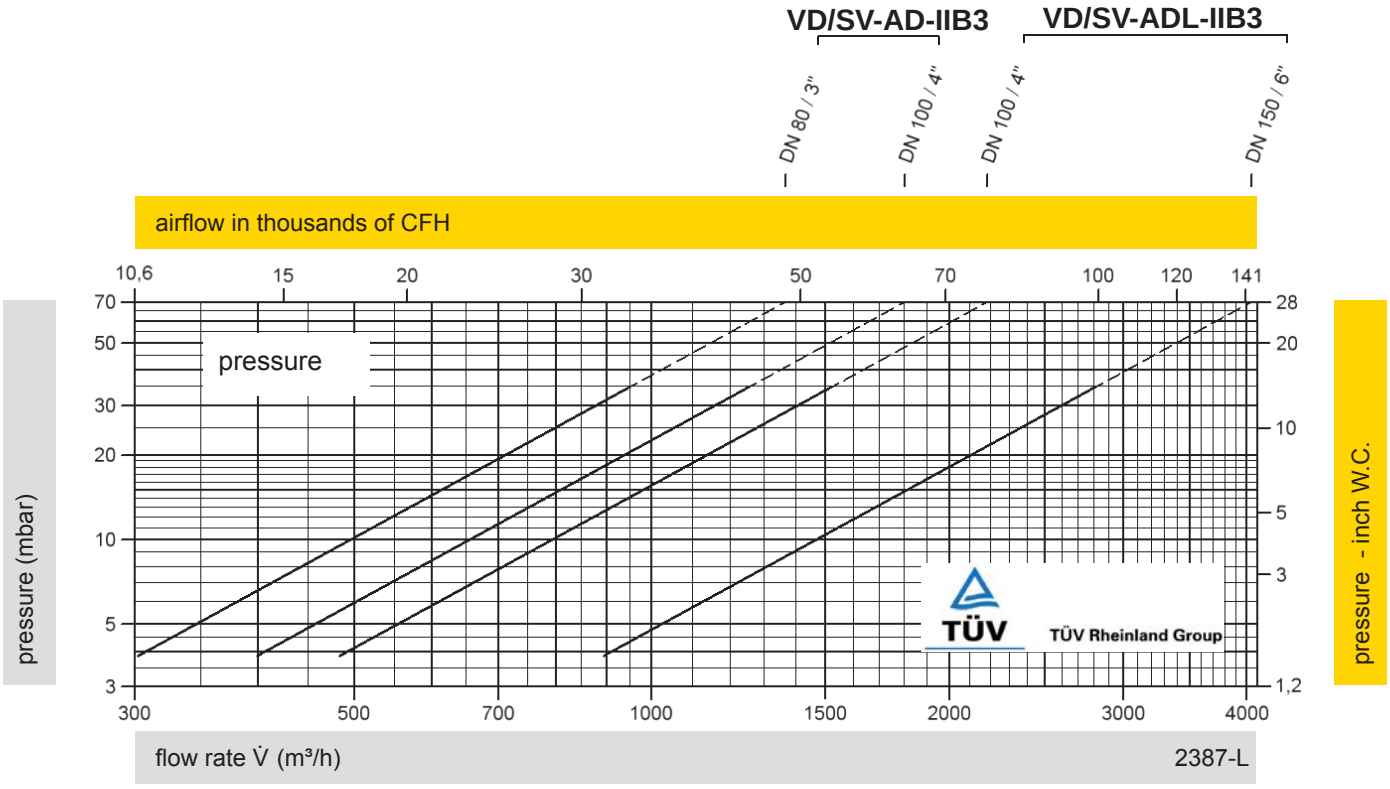
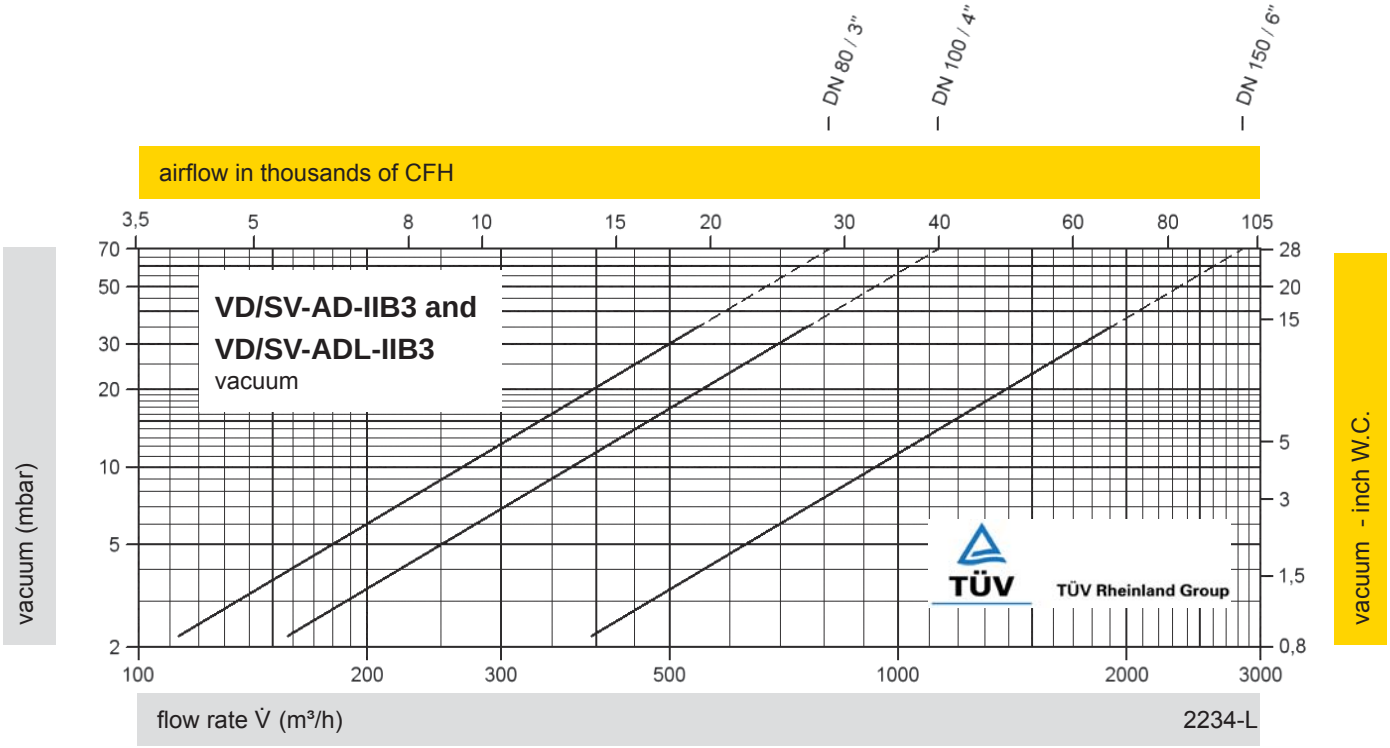
PROTEGO® VD/SV-AD and VD/SV-ADL

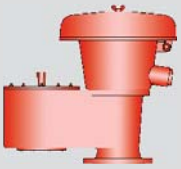




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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”.

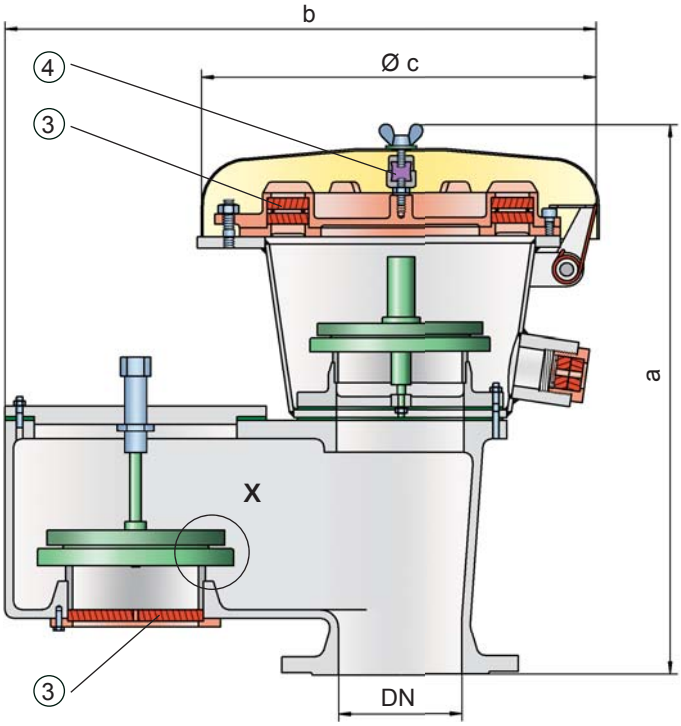
Notes:



Pressure/Vacuum Relief Valve

deflagration- and endurance burning-proof

PROTEGO® VD/SV-HR



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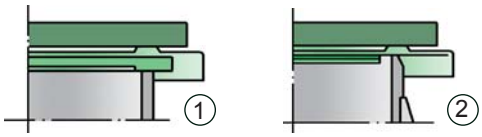

Settings:

pressure:	+3.5 mbar	up to	+35 mbar
	+1.4 inch W.C.	up to	+14 inch W.C.
vacuum:	-2.0 mbar	up to	-35 mbar
	-0.8 inch W.C.	up to	-14 inch W.C.

Higher and lower settings upon request

Function and Description

The deflagration-proof and endurance burning-proof VD/SV-HR type PROTEGO® valve is a highly developed combined pressure/vacuum relief valve for high flow capacities with an integrated flame arrester. It is primarily used as a safety device for flame-transmission-proof in- and outbreathing in tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, preventing outbreathing of product vapour and inbreathing of air almost up to the set pressure and also protects against atmospheric deflagration as well as endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The deflagration and endurance burning proof PROTEGO® VD/SV-HR device is available for substances from explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

If the set pressure is reached for a valve approved for explosion Group IIA (NEC group D), the valve starts to open and reaches full lift within 10% overpressure. This unique 10% technology enables a set pressure that is only 10% below the maximum allowable working pressure (MAWP) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range. Valves approved for explosion group IIB3 (NEC group C) function proportionally, so the set pressures should be selected in relation to the proportional behaviour (such as a 10%, 40%, or 100% overpressure from the set pressure to the relieving pressure at which the required flow performance is reached).

The tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere . If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- requires only 10% overpressure to full lift for explosion group IIA (NEC group D) vapours
- through 10% technology higher set pressures can be used which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- more design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- the valve disc is guided within the housing to protect against harsh weather conditions
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- can be used as protective system according to ATEX in areas subject to explosion hazards
- safe against deflagration and endurance burning for explosion group IIA and IIB3 (NEC group D and C) vapours
- high flow capacity through large FLAMEFILTER® cross-section, results in low pressure drop
- FLAMEFILTER® provides protection against atmospheric deflagration and endurance burning
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging caused by product vapours
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTERS® and valve pallets to be replaced

Design and Specifications

Any combination of vacuum and pressure levels can be set for the valve.

The valve discs are weight-loaded.

Pressure/vacuum relief valve, basic design **VD/SV-HR**

Additional special devices available upon request

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"	100 / 4"
a	500 / 19.69	543 / 21.38
b	477 / 18.78	577 / 22.72
c	353 / 13.90	353 / 13.90

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request
≥ 0,65 mm	IIB3	C	

Table 3: Material selection for housing

Design	A	B	
Housing	Steel	Stainless Steel	Option: Housing with ECTFE-lining Special materials upon request
Valve seats	Stainless Steel	Stainless Steel	
Gasket	PTFE	PTFE	
Weather hood	Steel	Stainless Steel	
Flame arrester unit	A	A	

Table 4: Material combination of flame arrester unit

Design	A	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	

Table 5: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+3.5 up to +5.0 +1.4 up to +2.0	>+5.0 up to +14 >+2.0 up to +5.6	>+14 up to +35 >+5.6 up to +14	>+14 up to +35 >+5.6 up to +14	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 6: Material selection for vacuum valve pallet

Design	A	B	C	D	
Vacuum range (mbar) (inch W.C.)	-2.0 up to -3.5 -0.8 up to -1.4	<-3.5 up to -14 <-1.4 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-14 up to -35 <-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 7: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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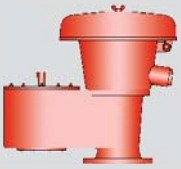
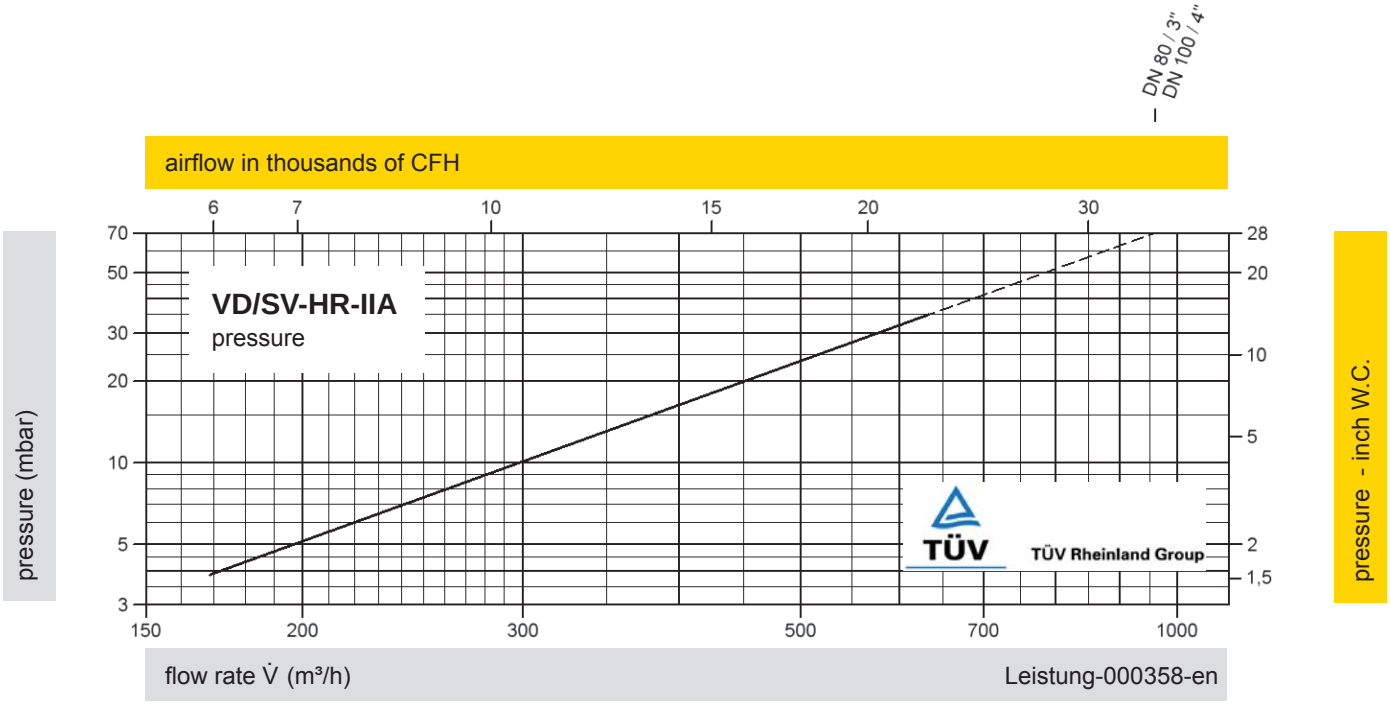
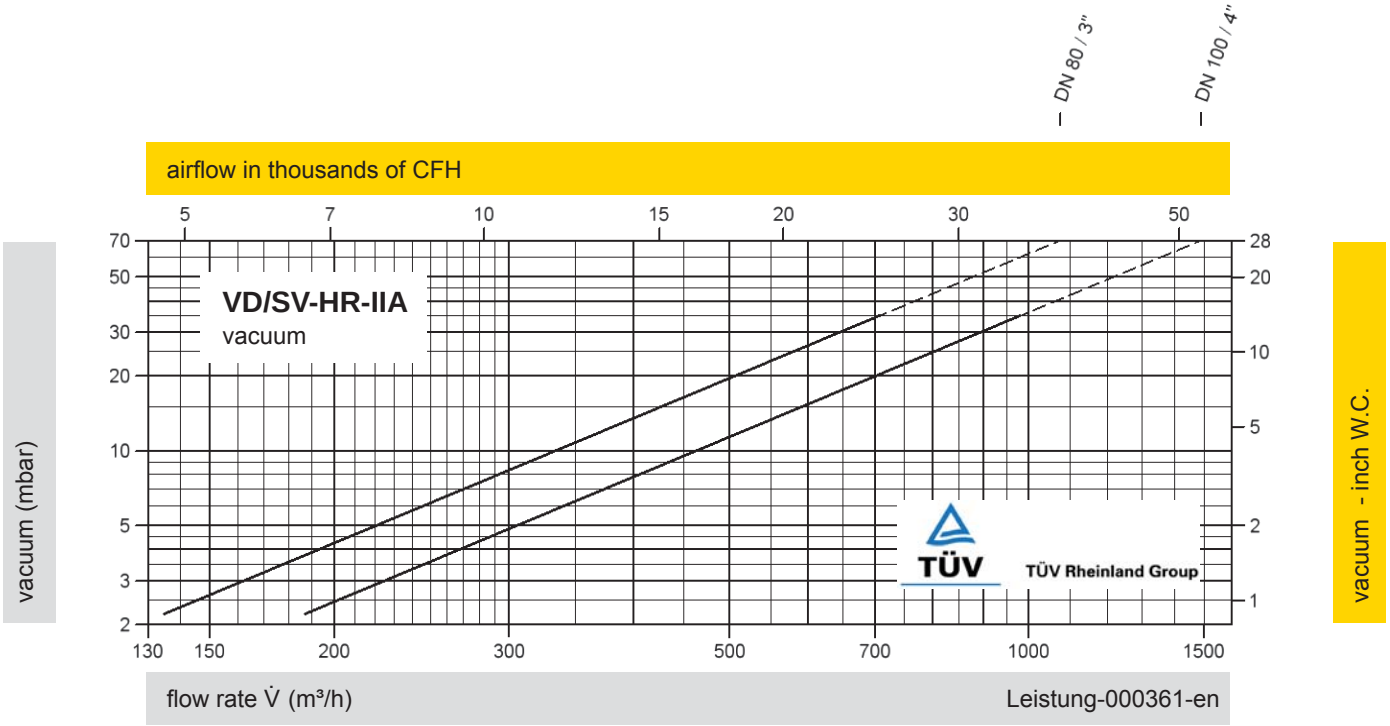


Pressure/Vacuum Relief Valve

Flow Capacity Charts

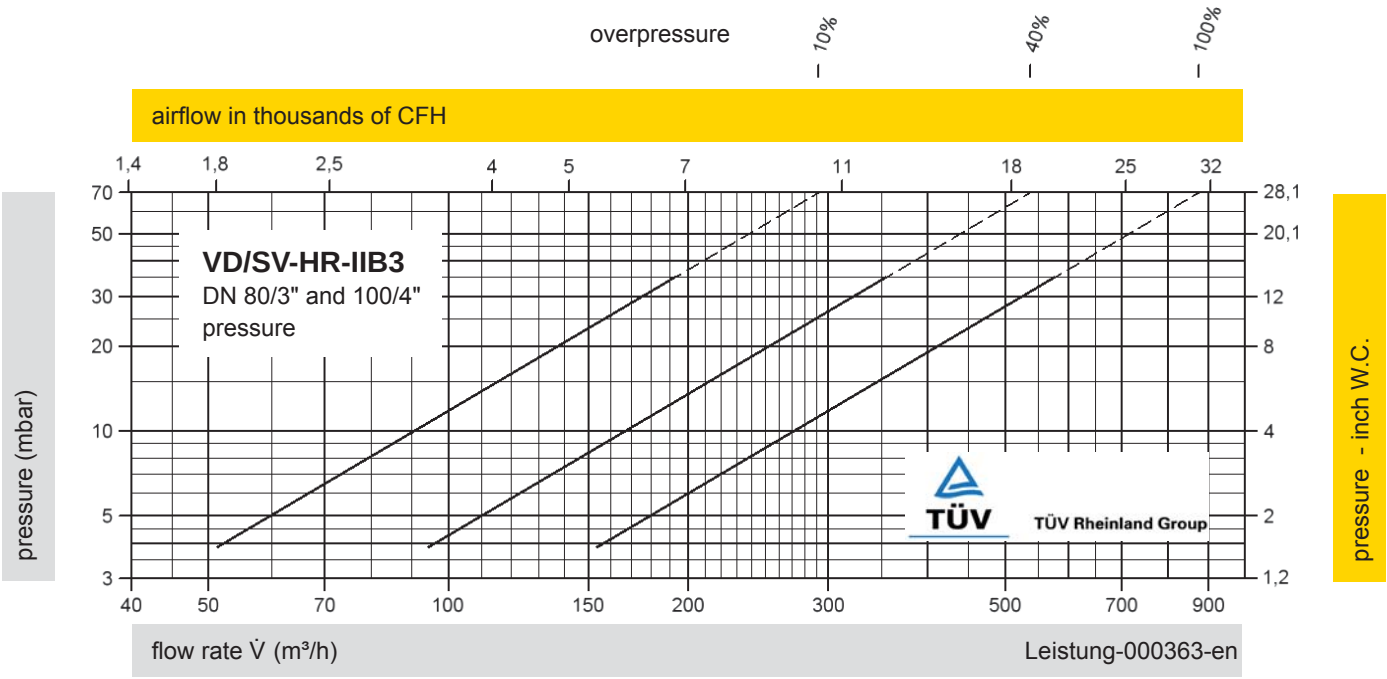
PROTEGO® VD/SV-HR





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”.



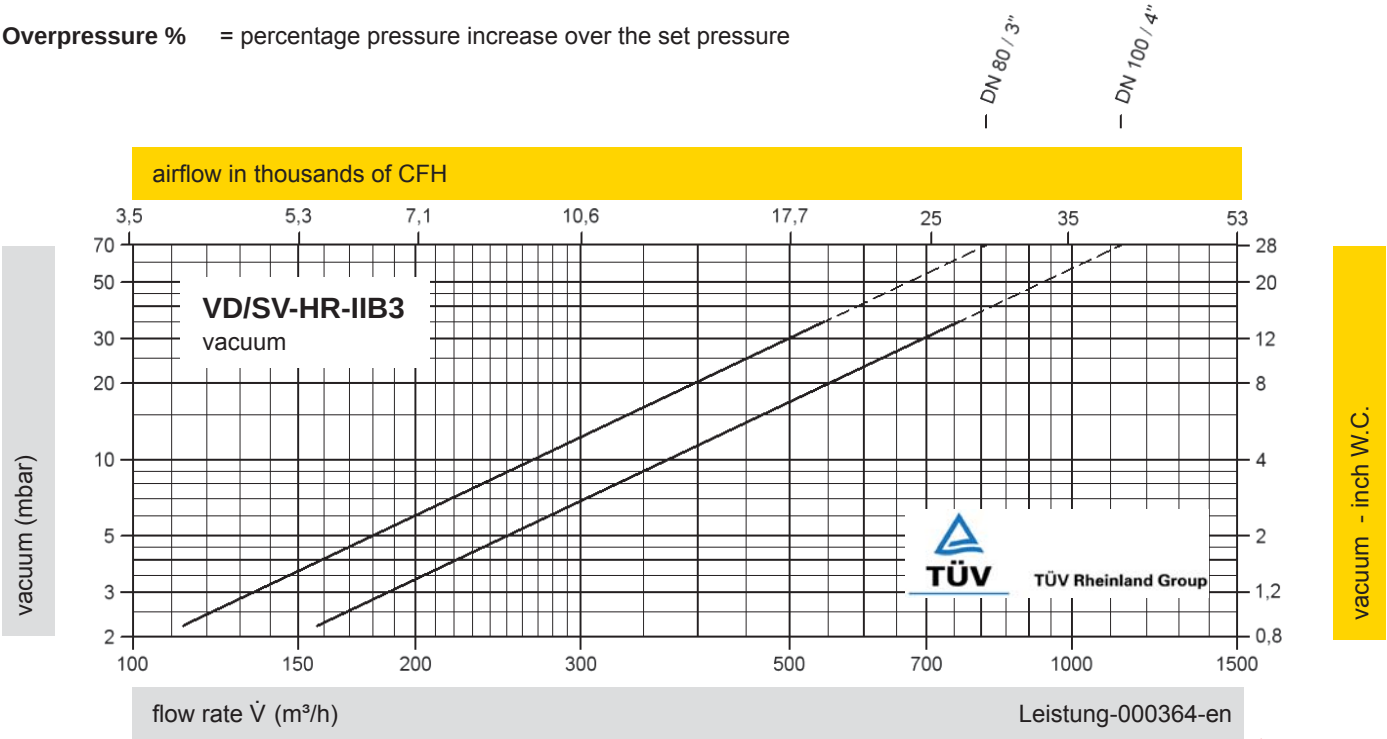
Remark

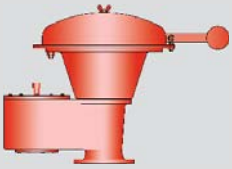
$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1 + \frac{\text{overpressure \%}}{100\%}}$$

Set pressure = the valve starts to open

Opening pressure = set pressure plus overpressure

Overpressure % = percentage pressure increase over the set pressure

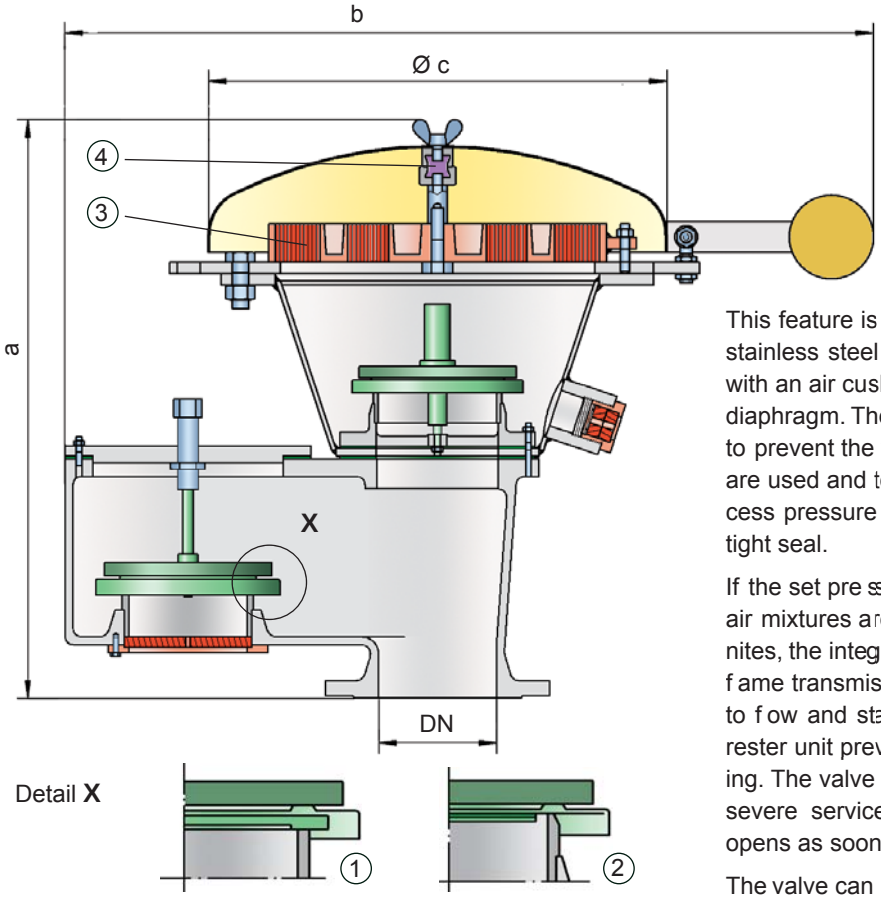




Pressure/Vacuum Relief Valve

deflagration- and endurance burning-proof

PROTEGO® VD/SV-HRL



Settings:

pressure: +3.5 mbar up to +35 mbar
+1.4 inch W.C. up to +14 inch W.C.

vacuum: -2.0 mbar up to -35 mbar
-0.8 inch W.C. up to -14 inch W.C.

Higher and lower settings upon request

Function and Description

The atmospheric de f agration and endurance burning proof VD/SV-HRL type PROTEGO® valve is a highly developed combined pressure/vacuum relief valve for high f ow capacities with an integrated f ame arrester. It is primarily used as a safety device for f ame transmission proof in- and outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, prevents the inbreathing of air and product losses almost up to the set pressure and also protects against atmospheric deflagration and endurance burning if stabilized burning occurs. The PROTEGO® f ame arrester unit is designed to achieve minimum pressure drop with maximum safety. The PROTEGO® VD/SV-HRL device is available for substances of explosion group IIA (NEC group D MESG > 0.9 mm).

When the set pressure is reached, the valve starts to open and reaches full lift within 10% overpressure. This unique 10% technology enables a set pressure that is only 10% below the maximum allowable working pressure (MA WP) or maximum allowable working vacuum (MA WV) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range.

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology . This feature is ensured by the 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 f uids. After the excess pressure is discharged, the valve reseats and provides a tight seal.

If the set pre ssure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® f ame arrester unit (3) prevents f ame transmission into the tank. If additional mixture continues to f ow and stabilized burning occurs, the integrated f ame arrester unit prevents f ashback as a result from endurance burning. The valve is protected and also fulf ls its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- requires only 10% overpressure to full lift
- through 10% technology higher set pressures can be used which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- increased design f exibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- the valve disc is guided within the housing to protect against harsh weather conditions
- can be used as protective system according ATEX in areas subject to explosion hazards
- FLAMEFILTER® provides protection against atmospheric def agration and endurance burning
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost

- FLAMEFILTER® protected from clogging through product vapour
- FLAMEFILTER® has low pressure drop
- f ame transmission proof condensate drain
- maintenance friendly design
- superior technology for API tanks

Design and Specifications

Any combination of vacuum and pressure levels can be set for the valve. The valve discs are weight-loaded.

Pressure/vacuum relief valve, basic design **VD/SV-HRL**

Additional special devices available upon request

Table 1: Dimensions Dimensions in mm / inches

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

DN	100 / 4"	150 / 6"
a	650 / 25.59	760 / 29.92
b	1000 / 39.37	1155 / 45.47
c	600 / 23.62	600 / 23.62

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request

Table 3: Material selection for housing

Design	A	B	
Housing	Steel	Stainless Steel	Option: Housing with ECTFE-lining Special materials upon request
Valve seats	Stainless Steel	Stainless Steel	
Gasket	PTFE	PTFE	
Weather hood	Steel	Stainless Steel	
Flame arrester unit	A, B	B	

Table 4: Material combinations of flame arrester unit

Design	A	B	
FLAMEFILTER® cage	Steel	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	Stainless Steel	

Table 5: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (inch W.C.)	+3.5 up to +5.0 +1.4 up to +2.0	>+5.0 up to +14 >+2.0 up to +5.6	>+14 up to +35 >+5.6 up to +14	>+14 up to +35 >+5.6 up to +14	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 6: Material selection for vacuum valve pallet

Design	A	B	C	D	
Vacuum range (mbar) (inch W.C.)	-2.0 up to -3.5 -0.8 up to -1.4	<-3.5 up to -14 <-1.4 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-14 up to -35 <-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 7: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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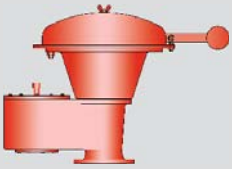
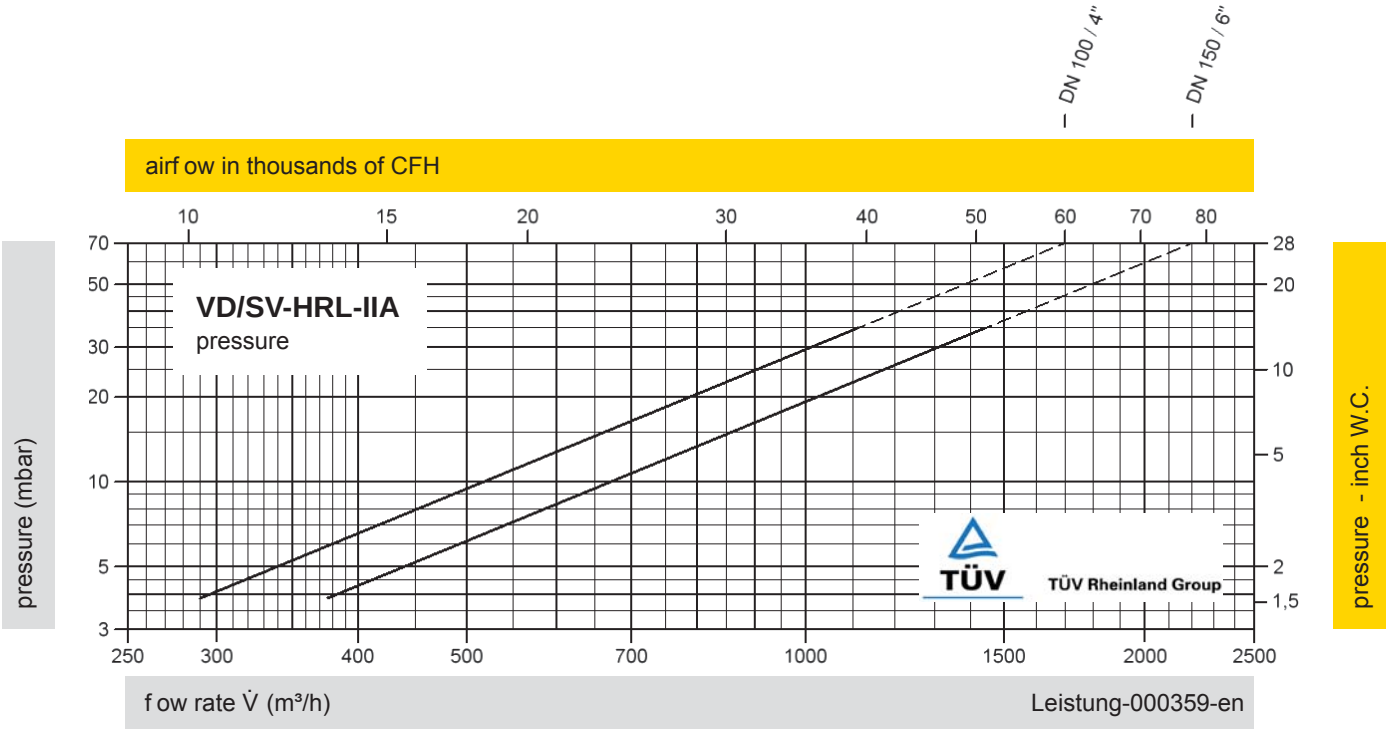
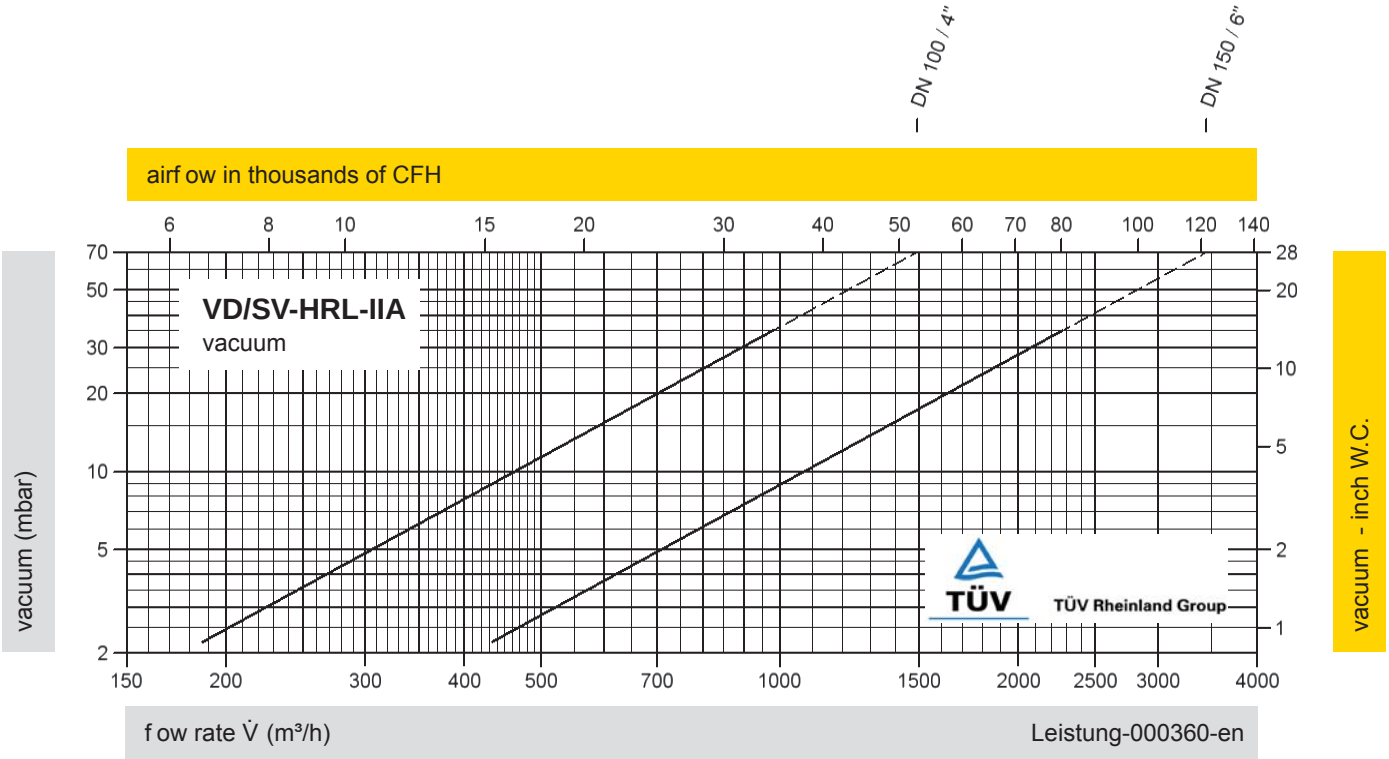


Pressure/Vacuum Relief Valve

Flow Capacity Charts

PROTEGO® VD/SV-HRL

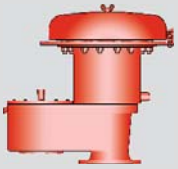




The f ow capacity charts have been determined with a calibrated and TÜV certif ed f ow capacity test rig.

Volume f ow 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”.

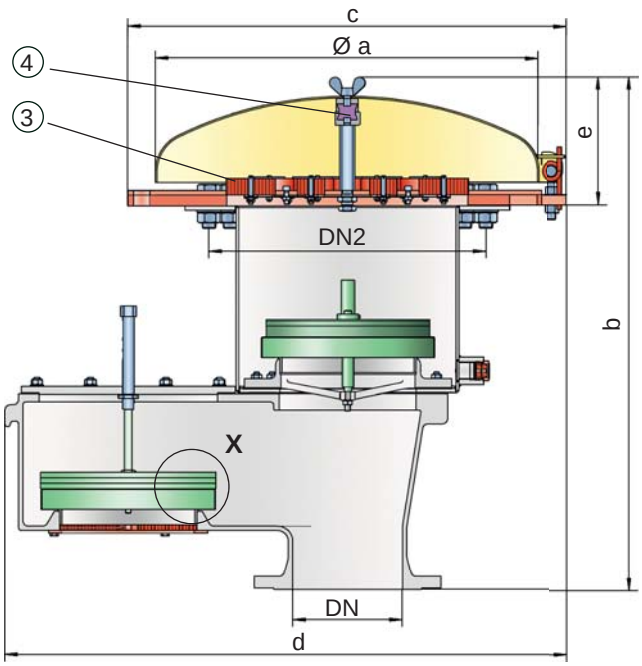
Notes:

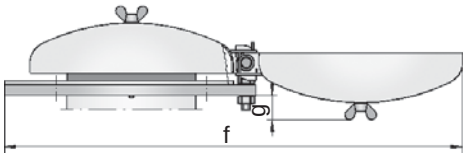


Pressure/Vacuum Relief Valve

deflagration- and endurance burning-proof

PROTEGO® VD-SV-EB





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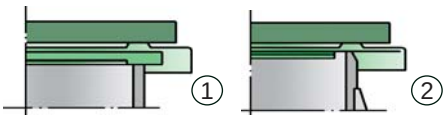

Settings:

pressure:	+2.0 mbar	up to	+60 mbar
	+0.8 inch W.C.	up to	+24 inch W.C.
vacuum:	-2.0 mbar	up to	-60 mbar
	-0.8 inch W.C.	up to	-24 inch W.C.

Higher and lower settings upon request

Function and Description

The deflagration-proof and endurance burning-proof VD-SV-EB type PROTEGO® valve is a highly developed combined pressure/vacuum relief valve for high flow capacities with the integrated flame arrester PROTEGO® EB. It is primarily used as a safety device for flame-transmission-proof in- and outbreathing in tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, preventing outbreathing of product vapour and inbreathing of air almost up to the set pressure and also protects against atmospheric deflagration as well as endurance burning if stabilized burning occurs. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The deflagration and endurance burning proof PROTEGO® VD-SV-EB device is available for substances of explosion group IIA (NEC group D MESG > 0.9 mm).

When the set pressure is reached, the valve starts to open and reaches full lift within 10% overpressure. This unique 10% technology enables a set pressure that is only 10% below the maximum allowable working pressure (MAWP) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range.

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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 a 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 in corrosive fluids. After the excess pressure is discharged, the valve reseats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated flame arrester PROTEGO® EB (3) prevents flame transmission into the tank. If additional mixture continues to flow and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result from endurance burning. The valve is protected and also fulfils its function under this severe service conditions. The spring loaded weather hood opens as soon as the fusible element (4) melts.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- requires only 10% overpressure to full lift for explosion group IIA (NEC group D) vapours
- through 10% technology higher set pressures can be used which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- more design flexibility through higher reseating pressures; vents reseat when conventional vent is still discharging costly product or nitrogen
- the valve disc is guided within the housing to protect against harsh weather conditions
- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- can be used as protective system according to ATEX in areas subject to explosion hazards
- safe against deflagration and endurance burning for explosion group IIA (NEC group D) vapours
- high flow capacity through large FLAMEFILTER® cross-section, results in low pressure drop
- FLAMEFILTER® provides protection against atmospheric deflagration and endurance burning
- FLAMEFILTER® integrated into the valve saves space, weight and reduces cost
- FLAMEFILTER® protected from clogging caused by product vapours
- flame transmission proof condensate drain
- maintenance friendly design
- modular design enables individual FLAMEFILTERS® and valve pallets to be replaced

Design and Specifications

Any combination of vacuum and pressure levels can be set for the valve.
The valve discs are weight-loaded.

Pressure/vacuum relief valve, basic design **VD-SV-EB - –**

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

Additional special devices available upon request

Table 1: Dimensions — Dimensions in mm / inches

DN	DN2	a	b	c	d	e	f	g
150 / 6“	400 / 16“	705 / 27.76	844 / 33.23	802 / 31.57	957 / 37.68	235 / 9.25	1500 / 59.06	109 / 4.29
200 / 8“	400 / 16“	705 / 27.76	939 / 36.97	802 / 31.57	1027 / 40.43	235 / 9.25	1500 / 59.06	109 / 4.29

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request

Table 3: Material selection for housing

Design	A	B	
Housing Heating jacket (VD-SV-EB-H-...)	Steel Steel	Stainless Steel Stainless Steel	
Valve seats	Stainless Steel	Stainless Steel	
Gasket	PTFE	PTFE	Special materials upon request
Flange ring	Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	
Flame arrester unit	A	A, B	

Table 4: Material combination of flame arrester unit

Design	A	B	
FLAMEFILTER® cage	Steel	Stainless Steel	Special materials upon request
FLAMEFILTER®	Stainless Steel	Stainless Steel	
Safety bar	Stainless Steel	Stainless Steel	

Table 5: Material selection for pressure valve pallet

Design	A	B	C	D	E	F
Pressure range (mbar) (inch W.C.)	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +35 >+5.6 up to +14	>+35 up to +60 >+14 up to +24	>+14 up to +35 >+5.6 up to +14	>+35 up to +60 >+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 6: Material selection for vacuum valve pallet

Design	A	B	C	D	E	F
Vacuum range (mbar) (inch W.C.)	-2.0 up to -3.5 -0.8 up to -1.4	<-3.5 up to -14 <-1.4 up to -5.6	<-14 up to -35 <-5.6 up to -14	<-14 up to -35 <-5.6 up to -14	<-35 up to -60 <-14 up to -24	<-35 up to -60 <-14 up to -24
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE	Metal to Metal	PTFE

Special material as well as higher set vacuum upon request

Table 7: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

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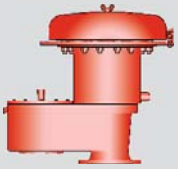
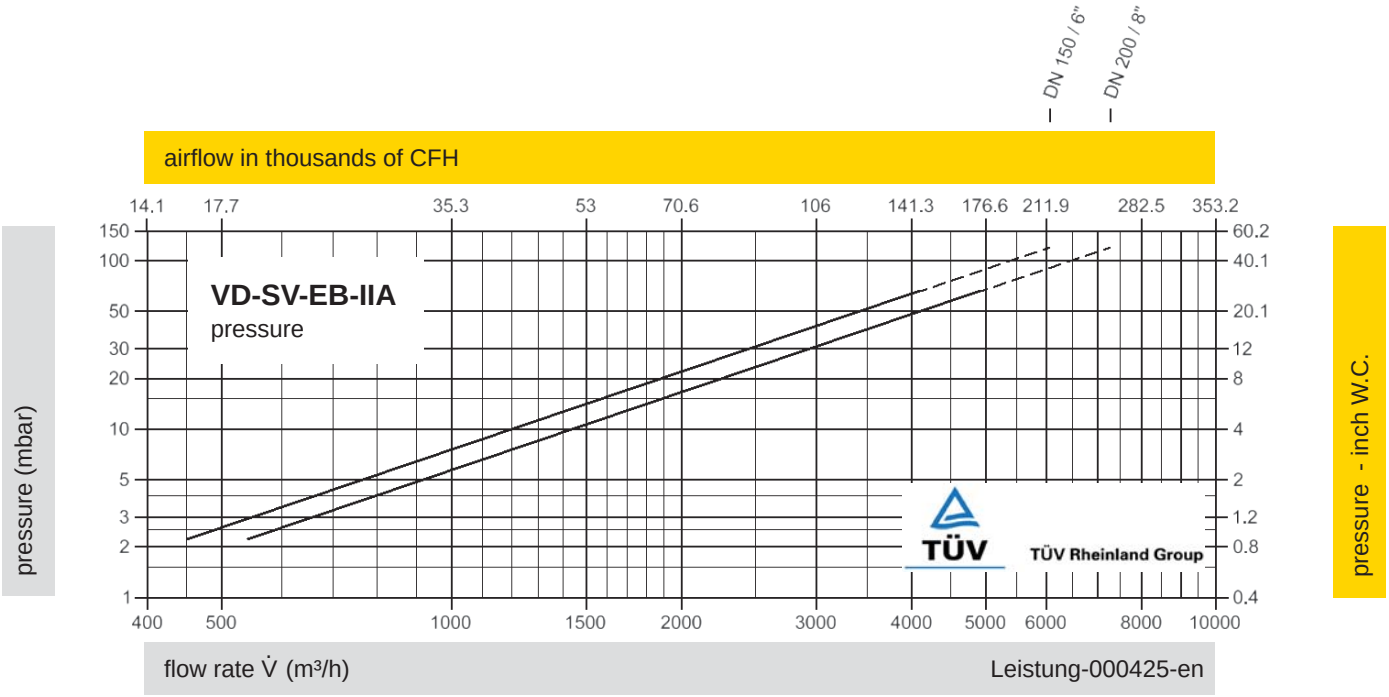
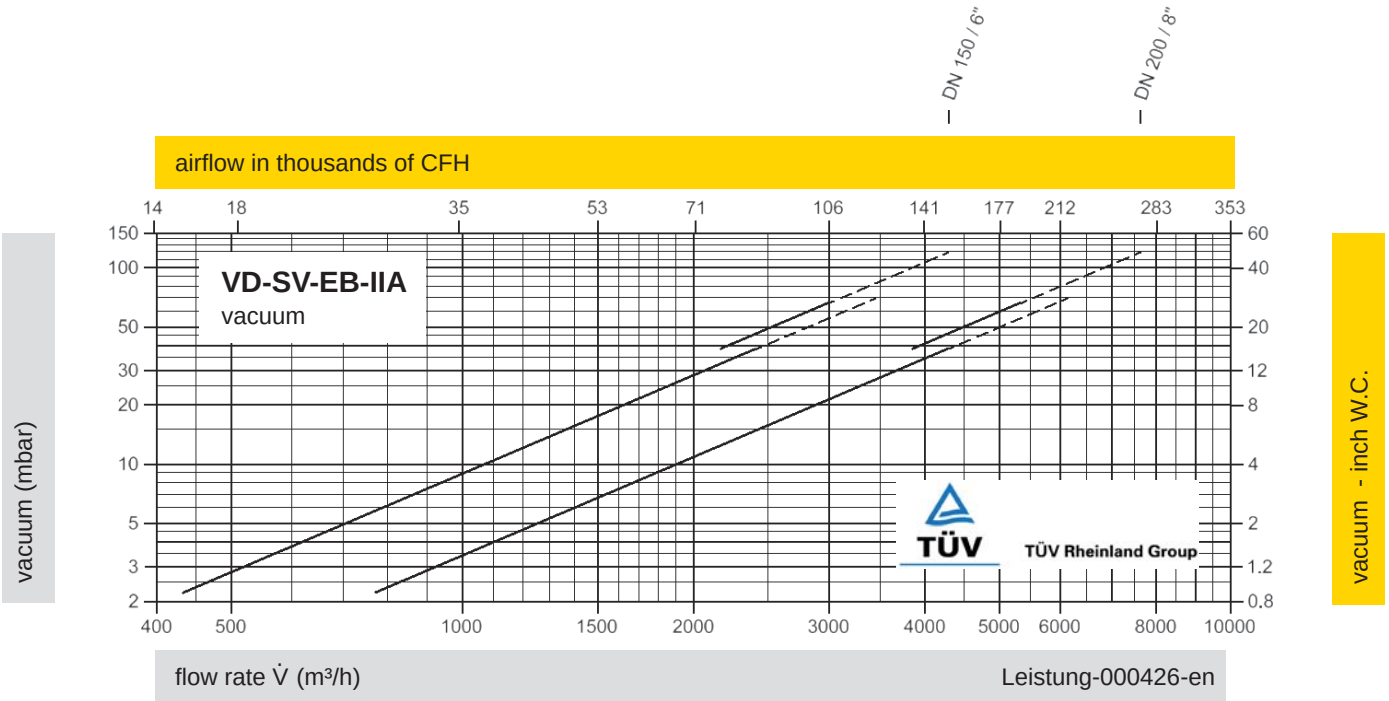


Pressure/Vacuum Relief Valve

Flow Capacity Charts

PROTEGO® VD-SV-EB-IIA

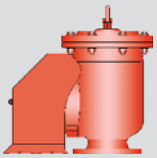




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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”.

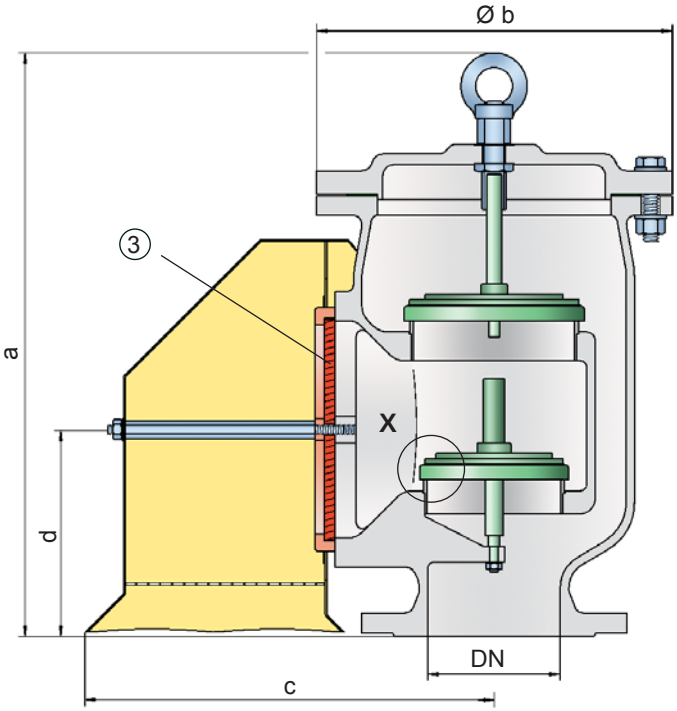
Notes:



Pressure/Vacuum Relief Valve

atmospheric deflagration-proof

PROTEGO® VD/TS



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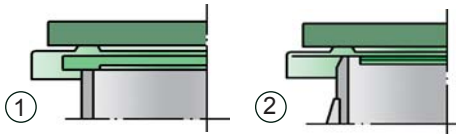


Settings:

pressure:	+3.5 mbar	up to	+50 mbar
	+1.4 inch W.C.	up to	+20 inch W.C.
vacuum:	-2.0 mbar	up to	-25 mbar
	-0.8 inch W.C.	up to	-10 inch W.C.

Higher and lower settings upon request

Function and Description

The atmospheric deflagration-proof VD/TS type PROTEGO® valve is a highly developed combined pressure/vacuum relief valve for high flow capacities with an integrated flame arrester unit. It is primarily used as a safety device for flame transmission proof in- and outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, prevents the inbreathing of air and product losses almost up to the set pressure and also protects against atmospheric deflagration. The PROTEGO® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The PROTEGO® VD/TS device is available for substances from explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

When the set pressure is reached, the valve starts to open and reaches full lift within 10% overpressure. This unique 10% technology enables a set pressure that is only 10% below the maximum allowable working pressure (MAWP) or maximum allowable working vacuum (MAWV) of the tank. After years of development, this typical opening characteristic of a safety relief valve is now also available for the low pressure range.

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our state of the art manufacturing technology. This feature is ensured by the 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.

If the set pressure is exceeded, explosive gas/product-vapour air mixtures are released to the atmosphere. If this mixture ignites, the integrated PROTEGO® flame arrester unit (3) prevents flame transmission into the tank.

The standard design is tested at an operating temperature up to +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000). In addition numerous versions for higher operating temperature are available.

Type-approved in accordance with the current ATEX Directive and ISO 16852 as well as other international standards.

Special Features and Advantages

- requires only 10% overpressure to full lift
- extreme tightness and hence least possible product losses and reduced environmental pollution
- through 10% technology higher set pressures can be used which results in product loss reduction compared to conventional 40% and 100% overpressure technology vents (compare API 2000)
- the valve disc is guided within the housing to protect against harsh weather conditions
- can be used as protective system according ATEX in areas subject to explosion hazards
- FLAMEFILTER® provides protection against atmospheric deflagration
- FLAMEFILTER® integrated into the valve saves space and reduces cost
- FLAMEFILTER® protected from clogging through product vapour
- PROTEGO® flame arrester unit has low pressure drop
- optimized flow performance
- maintenance friendly design
- sturdy housing design
- superior technology for API tanks

Design and Specifications

Any combination of vacuum and pressure levels can be set for the valve. The valve discs are weight loaded.

Pressure/vacuum relief valve, basic design **VD/TS-**

Additional special devices available upon request

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"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	340 / 13.39	430 / 16.93	490 / 19.29	610 / 24.02	610 / 24.02	705 / 27.76	765 / 30.12	930 / 36.61
b	210 / 8.27	280 / 11.02	310 / 12.20	390 / 15.35	390 / 15.35	445 / 17.52	505 / 19.88	560 / 22.05
c	206 / 8.11	277 / 10.91	347 / 13.66	427 / 16.81	427 / 16.81	534/ 21.02	604 / 23.78	823 / 32.40
d	125 / 4.92	150 / 5.91	180 / 7.09	230 / 9.06	230 / 9.06	270 / 10.63	310 / 12.20	445 / 17.52

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,65 mm	IIB3	C	Special approvals upon request

Table 3: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	
-	Designation	higher operating temperatures upon request

Table 4: Material selection for housing

Design	A	C	D	E
Housing	Aluminium	Steel	Stainless Steel	Hastelloy
Valve seats	Stainless Steel	Stainless Steel	Stainless Steel	Hastelloy
Gasket	PTFE	PTFE	PTFE	PTFE
Weather hood	Aluminium	Aluminium	Stainless Steel	Hastelloy
Flame arrester unit	A	A	A	C
Pressure valve pallet	A-F	A-F	A-F	G-I
Vacuum valve pallet	A-E	A-E	A-E	F-H

Special materials upon request

Table 5: Material combination of flame arrester unit

Design	A	C	
FLAMEFILTER® cage	Stainless Steel	Hastelloy	Special materials upon request
FLAMEFILTER®	Stainless Steel	Hastelloy	

Table 6: Material selection for pressure pallet

Design	A	B	C	D	E
Pressure range (mbar) (inch W.C.)	+3.5 up to +5,0 +1.4 up to +2.0	>+5.0 up to +14 >+2.0 up to +5.6	>+14 up to +35 >+5.6 up to +14	>+35 up to +50 >+14 up to +20	>+14 up to +35 >+5.6 up to +14
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	PTFE
Weight	Stainless Steel	Stainless Steel	Stainless Steel	Lead	Stainless Steel

Design	F	G	H	I
Pressure range (mbar) (inch W.C.)	>+35 up to +50 >+14 up to +20	+3.5 up to +5,0 +1.4 up to +2.0	>+5.0 up to +14 >+2.0 up to +5.6	>+14 up to +35 >+5.6 up to +14
Valve pallet	Stainless Steel	Titanium	Hastelloy	Hastelloy
Sealing	PTFE	FEP	FEP	Metal to Metal
Weight	Lead	Hastelloy	Hastelloy	Hastelloy

Special material as well as higher set pressure upon request

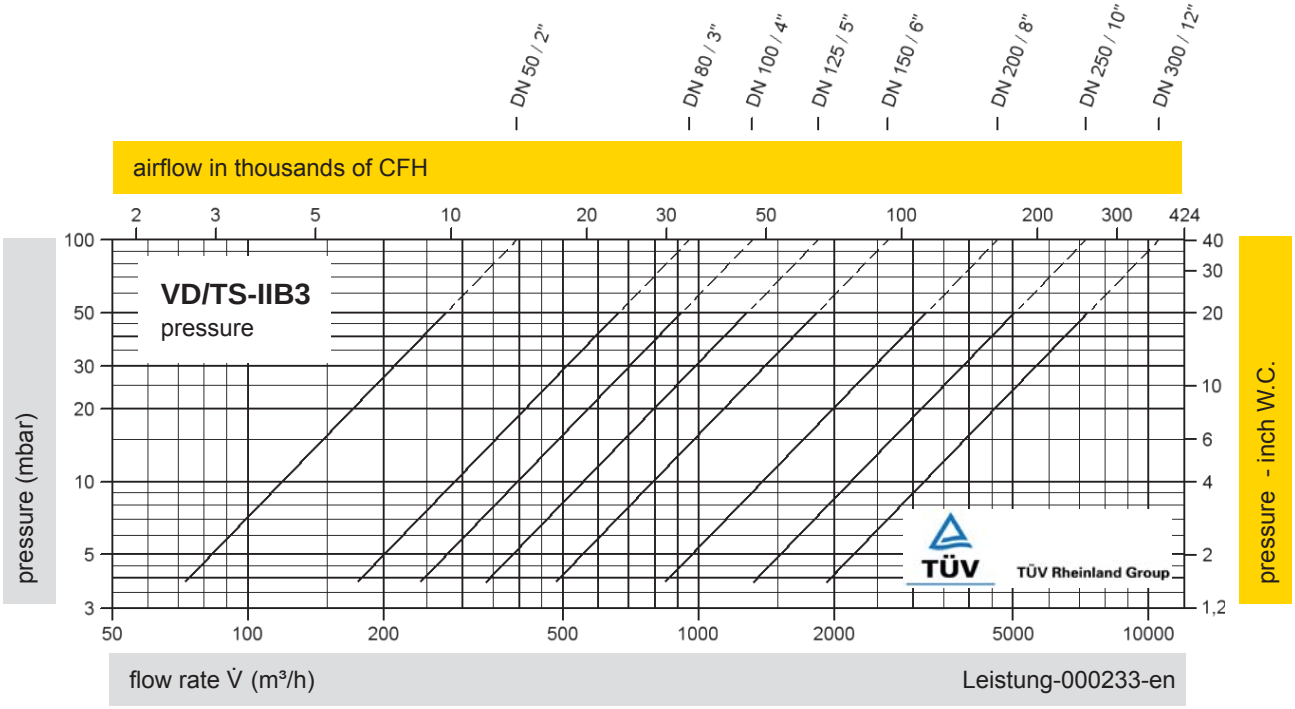
Table 7: Material selection for vacuum pallet

Design	A	B	C	E	F
Vacuum range (mbar) (inch W.C.)	-2.0 up to -3.5 -0.8 up to -1.4	<-3.5 up to -14 <-1.4 up to -5.6	<-14 up to -25 <-5.6 up to -10	<-14 up to -25 <-5.6 up to -10	-2.0 up to -3.5 -0.8 up to -1.4
Valve pallet	Aluminium	Stainless Steel	Stainless Steel	Stainless Steel	Titanium
Sealing	FEP	FEP	Metal to Metal	PTFE	FEP
Weight	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Hastelloy

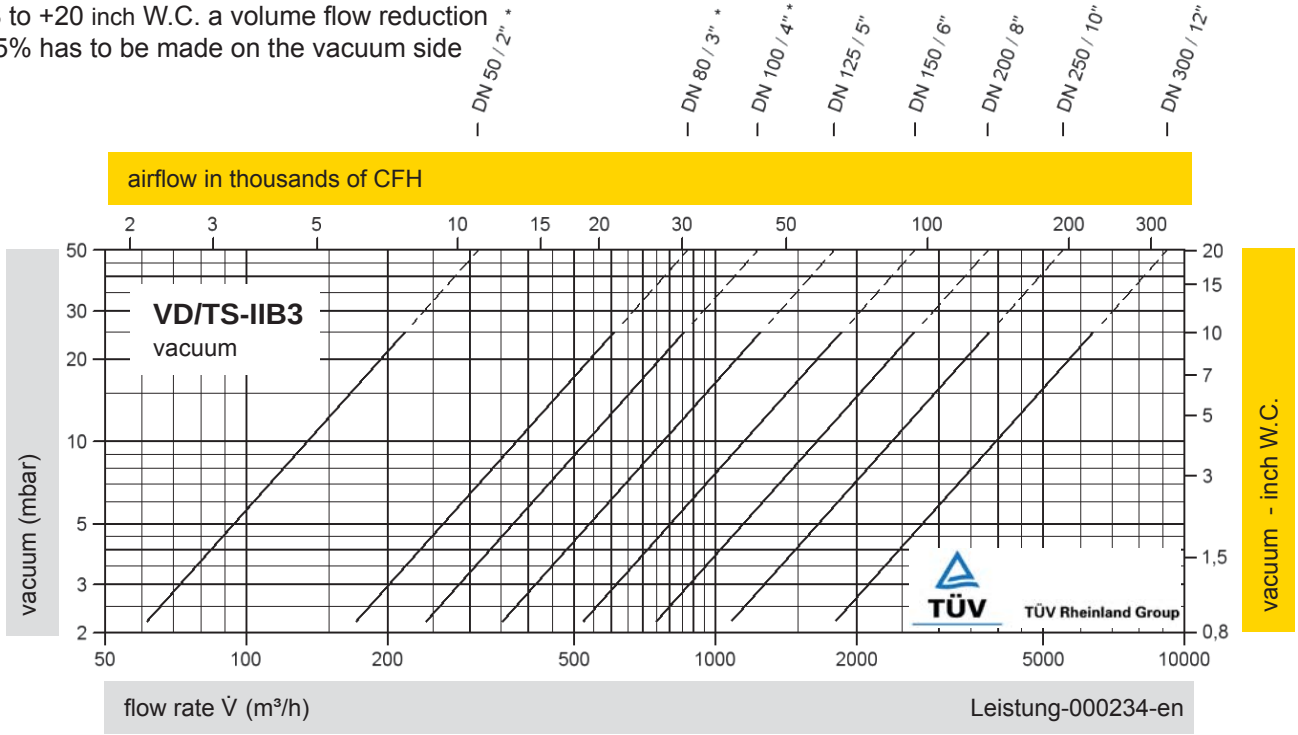
Design	G	H	
Vacuum range (mbar) (inch W.C.)	<-3.5 up to -14 <-1.4 up to -5.6	<-14 up to -25 <-5.6 up to -10	Special material as well as higher set vacuum upon request
Valve pallet	Hastelloy	Hastelloy	
Sealing	FEP	Metal to Metal	
Weight	Hastelloy	Hastelloy	

Table 8: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	



***** at set pressure of +22 to +50 mbar / +8.8 to +20 inch W.C. a volume flow reduction of 15% has to be made on the vacuum side



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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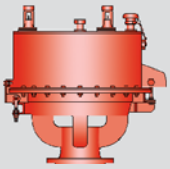
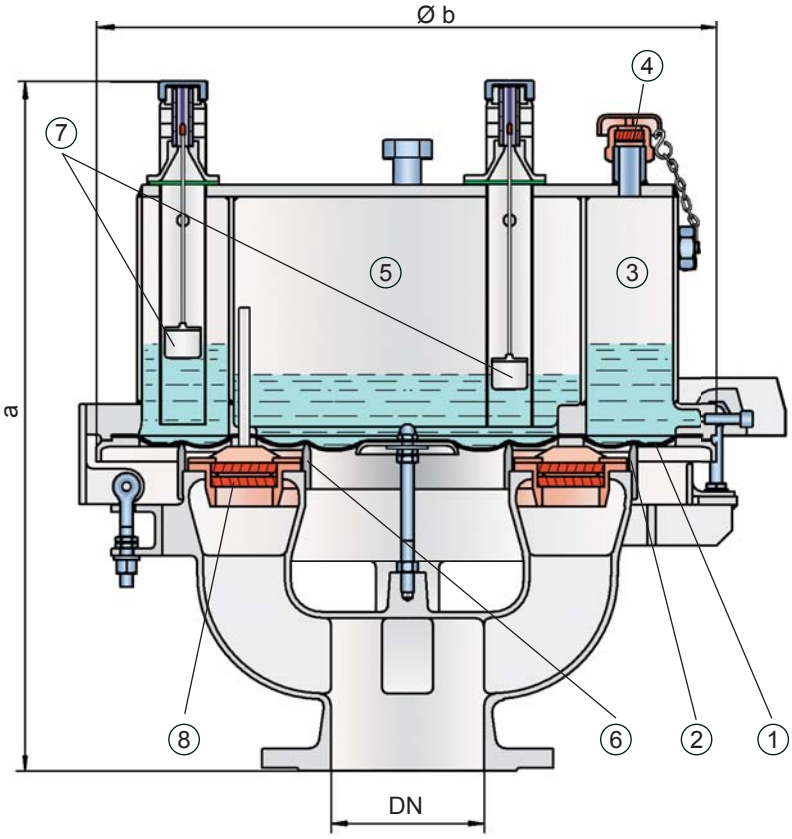


Pressure/Vacuum Diaphragm Valve

deflagration- and endurance burning-proof

PROTEGO® UB/SF



Settings:

pressure:	DN 80	+3.5 mbar	up to	+50 mbar
		+1.4 inch W.C.	up to	+20 inch W.C.
	DN 100	+3.5 mbar	up to	+45 mbar
		+1.4 inch W.C.	up to	+18 inch W.C.
	DN 150	+3.5 mbar	up to	+46 mbar
		+1.4 inch W.C.	up to	+18.4 inch W.C.

Higher pressure settings up to +140 mbar (56.2 inch W.C.) in special design with additional liquid reservoir as well as lower pressure settings upon request.

vacuum:	–3.5 mbar	up to	–35 mbar
	–1.4 inch W.C.	up to	–14 inch W.C.

Higher and lower vacuum settings upon request

Function and Description

The deflagration- and endurance burning-proof UB/SF type PROTEGO® diaphragm valve is a state of the art pressure- and vacuum-relief valve combining the function of a dynamic and static flame arrester. Worldwide this design is unique. It is primarily used as a safety device for flame transmission proof in- and outbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure and vacuum, prevents the inbreathing of air and product losses almost up to the set pressure and protects against atmospheric deflagration and endurance burning if stabilized burning occurs. The PROTEGO® UB/SF diaphragm valve has proven its performance over many years in a great variety of severe applications in the petrochemical and chemical industry. Worldwide it is the only vent which functions in services such as styrene and acrylics.

The set pressure is adjusted with a freeze resistant water-glycol mixture, which assures safe operation under extreme cold weather conditions. The PROTEGO® UB/SF valve is available for substances of explosion group IIB3 (NEC group C MESG ≥ 0.65 mm).

When the pressure in the tank reaches the set pressure, the diaphragm (1) on the outer valve seat ring (2) is lifted and vapours vent to the environment. The set pressure is adjusted by the liquid (water-glycol mixture) column height, which is filled into the outer ring chamber (3). The overpressure chamber is equipped with an opening (4) to keep the pressure in balance with the ambient pressure. The opening is equipped with a FLAMEFILTER® to avoid flame transmission into the overpressure chamber. If a vacuum builds up in the tank, it is transmitted through pressure balancing tubes into the vacuum chamber (5) (inner chamber). If the set vacuum, which depends on the liquid column height in the vacuum chamber, is reached the atmospheric pressure lifts the diaphragm off the inner valve seat ring (6). Ambient air can now flow into the tank. The liquid column heights, which affect the set pressures and vacuum, can be checked by floating level indicators (7).

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our highly developed manufacturing technology. This is achieved because the liquid loaded diaphragm presses tightly around the special designed valve seat surface area, even when the operating pressure increases. This is extremely important to reduce leakage to an absolute minimum. After the excess pressure or vacuum is discharged, the valve reseats and provides a tight seal.

If the tank pressure exceeds the adjusted set pressure, explosive gas/product-vapour air mixtures exit. The speed at which these mixtures exit the annular gap between the diaphragm and the outer valve seat ring while overcoming the set pressure is much faster than the flame speed. If this mixture ignites, flashback into the tank is prevented. If the mixture flow continues, the dynamic flame arresting feature prevents flashback ignition even in the case of endurance burning. Even at relatively low flow rates, which occur during thermal outbreathing, the gap formed by the volumetric flow is so narrow that flames are extinguished in the gap and flashback is prevented. At very low pressure settings the explosion pressures resulting from an atmospheric deflagration may be strong enough to lift the diaphragm off the valve seat rings so that flashback could result. The ignition into the tank can be prevented by installing the PROTEGO® flame arrester unit (8). This flame arrester unit provides additional protection against atmospheric deflagration during regular maintenance and inspection.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- set pressure close to opening pressure enables optimum pressure maintenance in the system
- high flow capacity
- can be used as a protective system according to ATEX in areas subject to an explosion hazard
- protection against atmospheric deflagrations and endurance burning for products up to explosion group IIB3 (NEC group C MESG ≥ 0.65 mm)
- minimum pressure drop of the FLAMEFILTER®
- flame-transmission-proof pressure and vacuum chambers
- freeze protection at sub-zero conditions
- self draining function for condensate
- liquid column height is monitored by level indicators
- easy maintenance through hinged vent cap
- modular design enables individual FLAMEFILTER® discs and valve diaphragm to be replaced
- particularly suitable for problematic products such as styrene, acrylics, etc.

Design Types and Specifications

Almost any combination of vacuum and pressure settings can be utilized for the valve. The diaphragm is pressurized by liquid. Higher pressures can be achieved upon request with a special liquid reservoir. When there is a substantial difference between the pressure and vacuum, special designs with weight-loaded vacuum discs are used.

There are two different designs:

Pressure/vacuum diaphragm valve, basic design **UB/SF - [–]**

Pressure/vacuum diaphragm valve with heating coil **UB/SF - [H]**
(max. heating fluid temperature +85°C / 185°F)

In addition to the standard design, a series of specially developed designs, which are particularly suitable for operating conditions to which these products are subjected, can be provided upon request (for example, for acrylics or styrene storage tanks, etc.).

Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1{,}4}$$

Set pressure = the valve starts to open

Opening pressure = set pressure plus overpressure

Overpressure = pressure increase over the set pressure

Table 1: Dimensions — Dimensions in mm / inches

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

DN	pressure	80 / 3"	100 / 4"	150 / 6"
a	up to +28 mbar / +11.2 inch W.C.	615 / 24.21	645 / 25.39	680 / 26.77
a	> +28 mbar / +11.2 inch W.C.	765 / 30.12	795 / 31.30	830 / 32.68
b		410 / 16.14	485 / 19.09	590 / 23.23

Pressure settings > +50 mbar / +20 inch W.C. (DN 80/3"), > +45 mbar / +18 inch W.C. (DN 100/4"), > +46 mbar / +18.4 inch W.C. (DN150/6") with additional liquid reservoir - dimensions upon request

Dimensions for pressure/vacuum diaphragm valves with heating coil upon request

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	Special approvals upon request
≥ 0,65 mm	IIB3	C	

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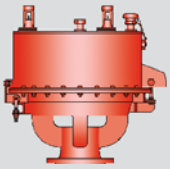


Pressure/Vacuum Diaphragm Valve

deflagration- and endurance burning-proof

PROTEGO® UB/SF

Table 3: Material selection for housing

Design	C	D	
Housing	Steel	Stainless Steel	Option: Housing with ECTFE-lining Special materials upon request
Valve top	Stainless Steel	Stainless Steel	
Heating coil (UB/SF-H-...)	Stainless Steel	Stainless Steel	
Valve seats	Stainless Steel	Stainless Steel	
Gasket	FPM	PTFE	
Diaphragm	A, B	A, B	
Flame arrester unit	C	C	

Table 4: Material selection for diaphragm

Design	A	B	Special materials upon request
Diaphragm	FPM	FEP	

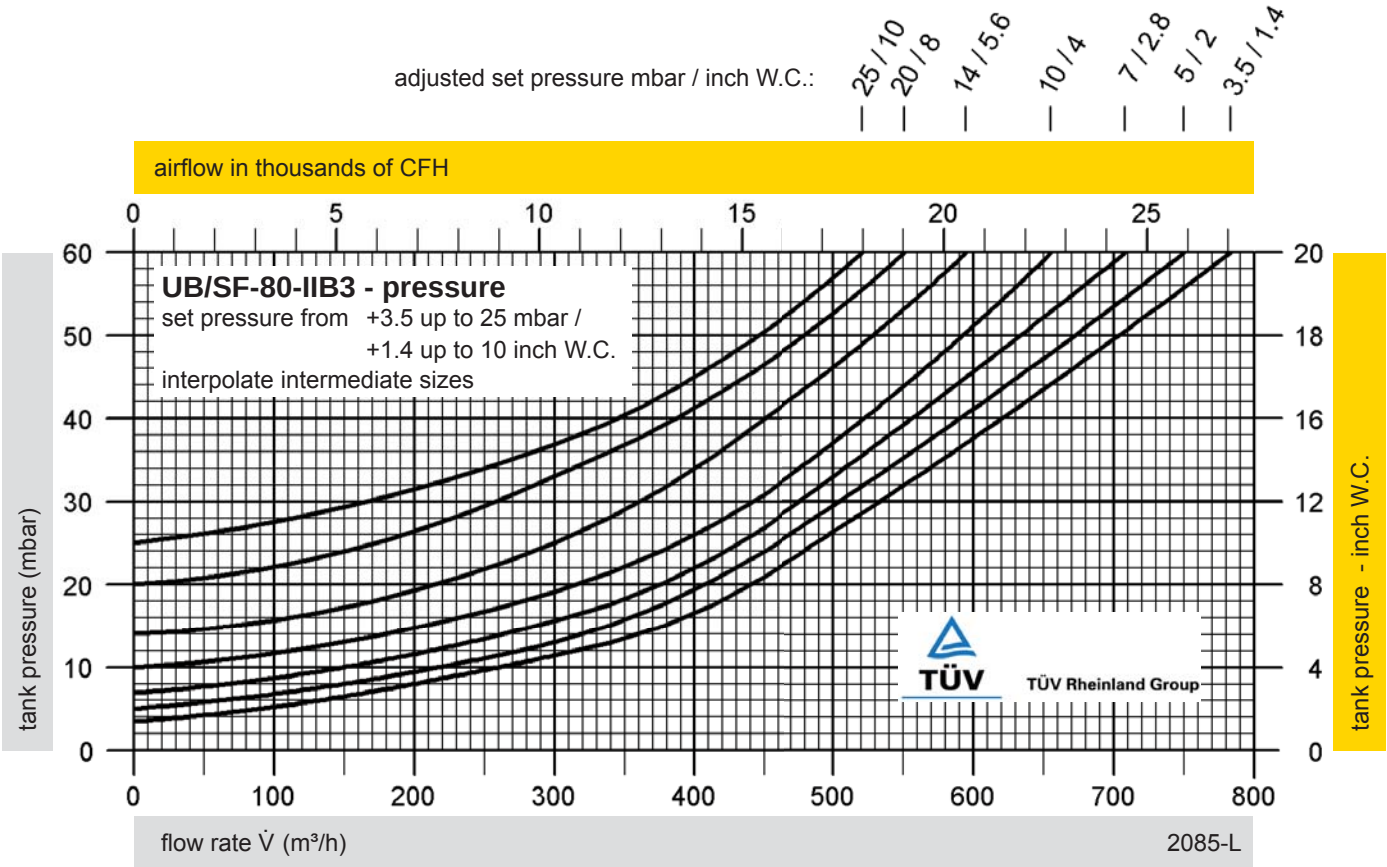
Table 5: Material combinations of flame arrester unit

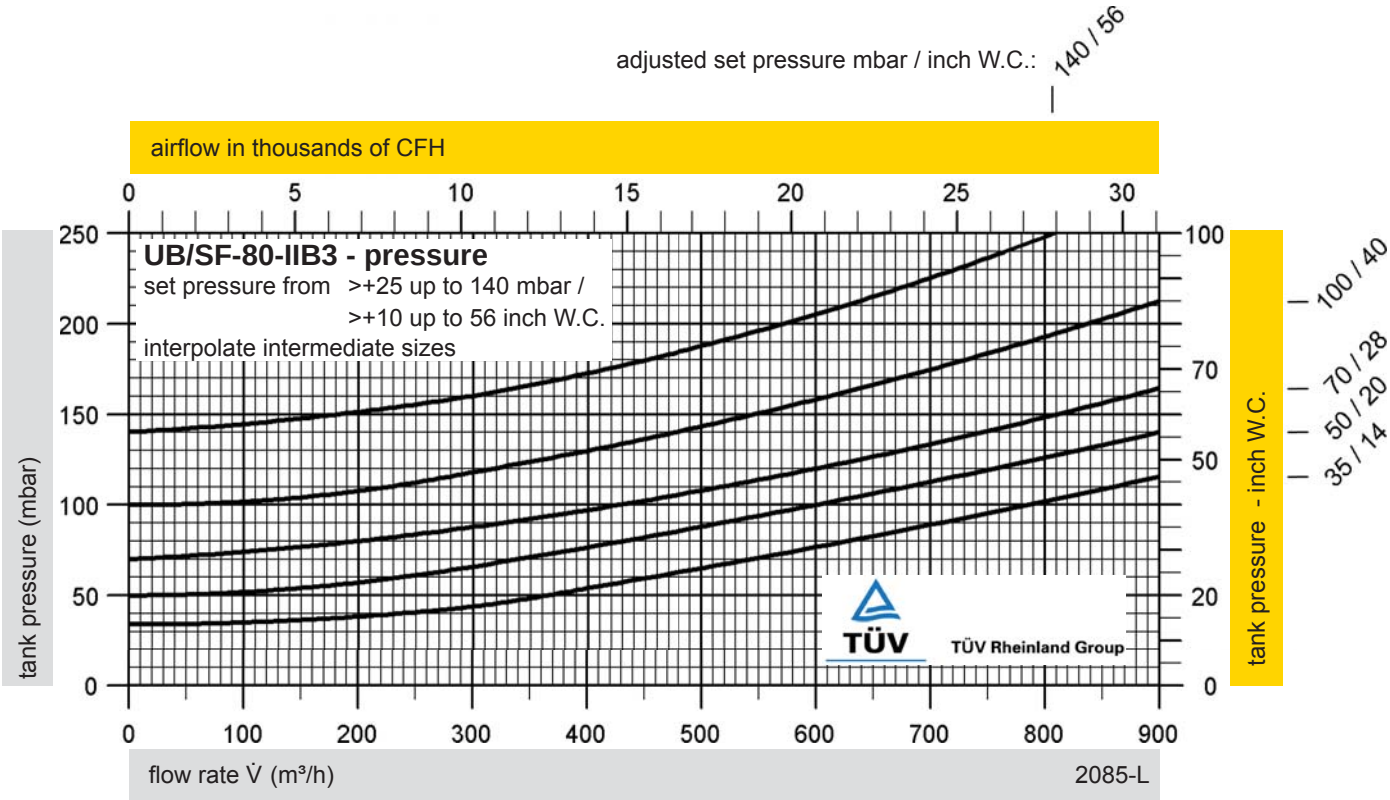
Design	C	Special materials upon request
FLAMEFILTER® cage	Stainless Steel	
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 6: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	

PROTEGO® UB/SF-80





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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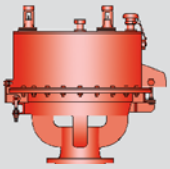
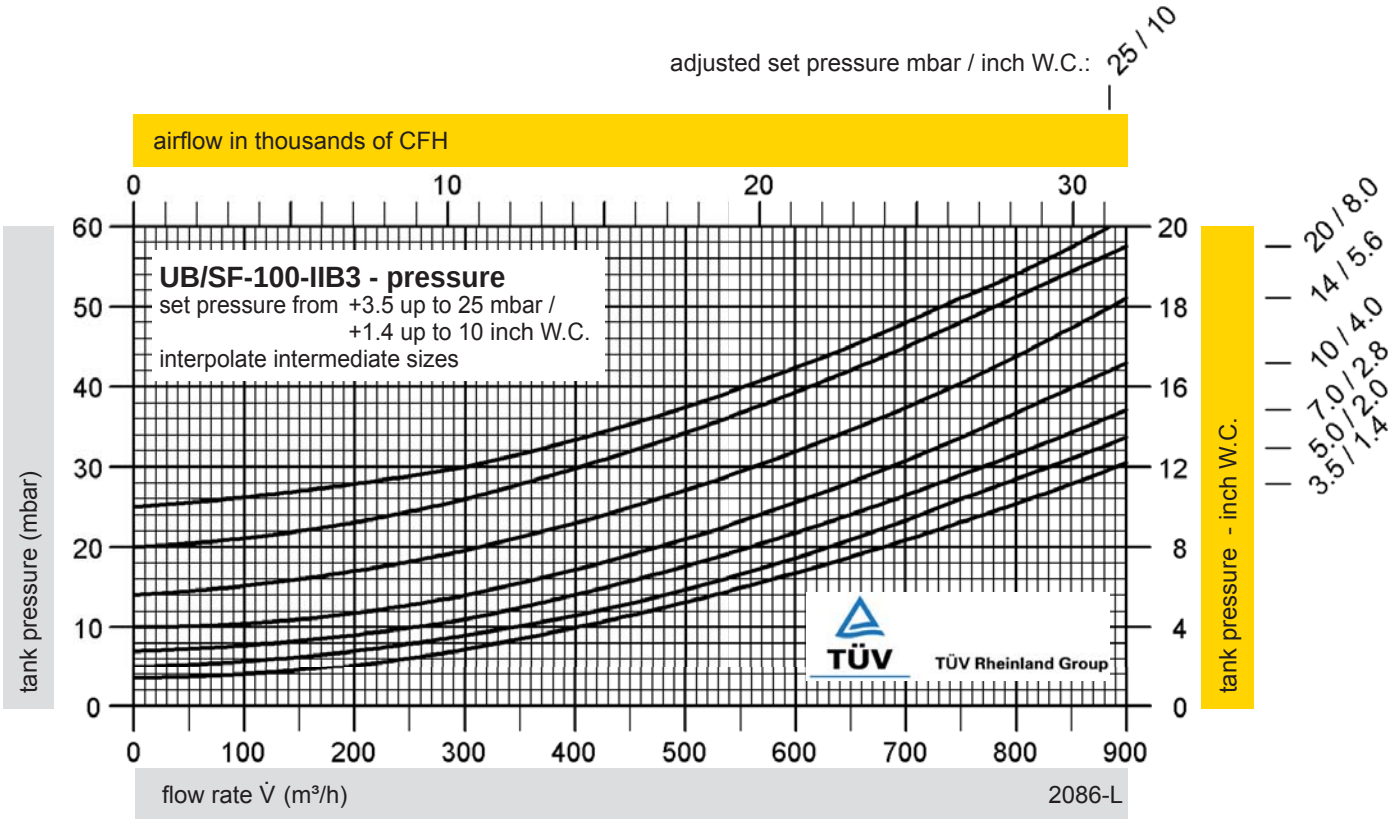
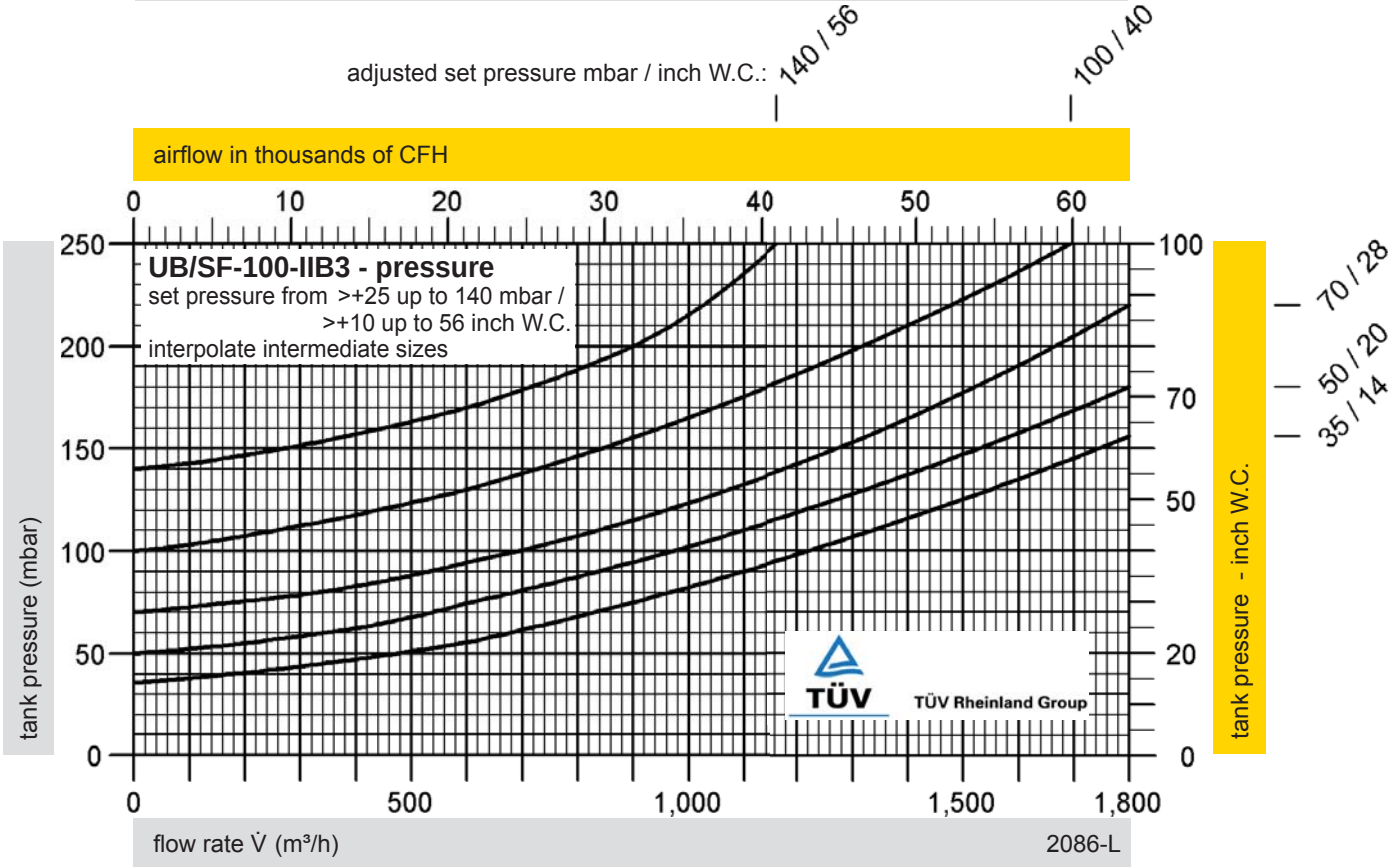


Pressure/Vacuum Diaphragm Valve

Flow Capacity Charts - Pressure

PROTEGO® UB/SF-100





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).
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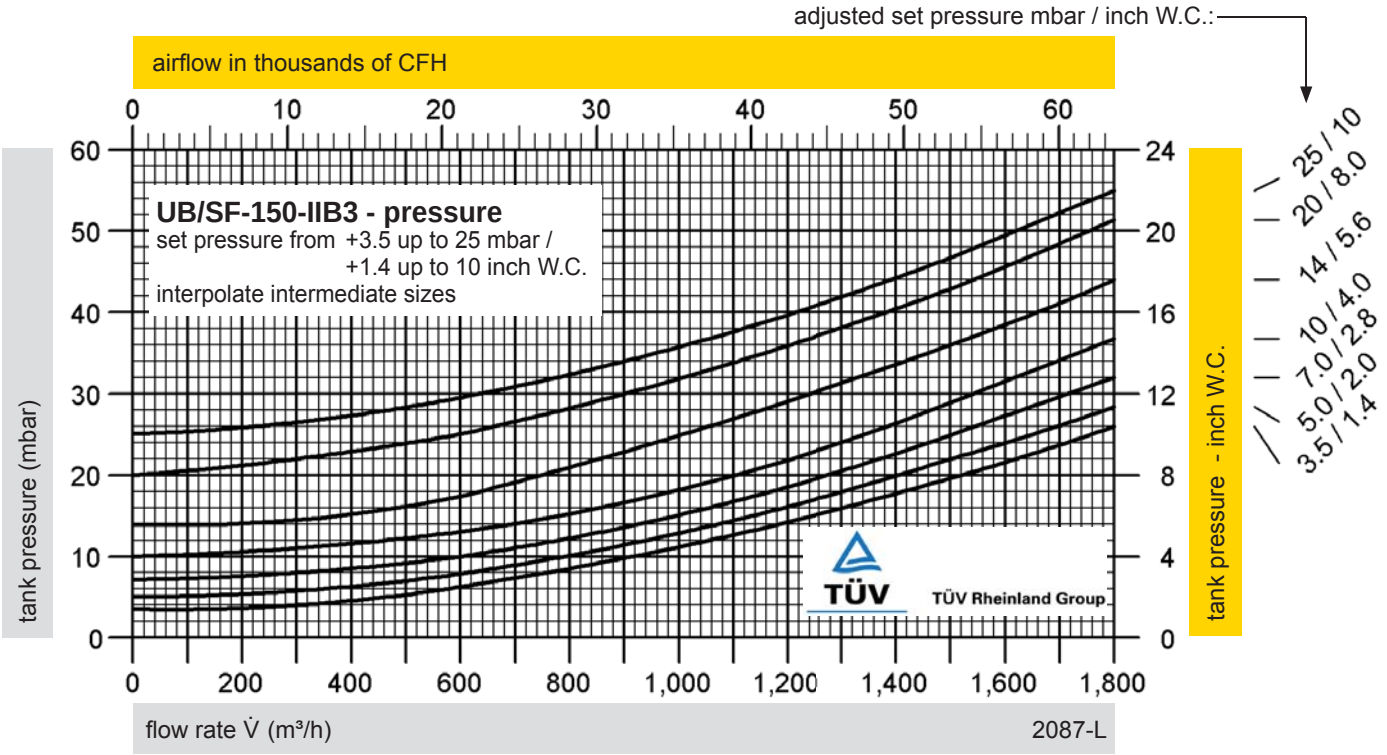
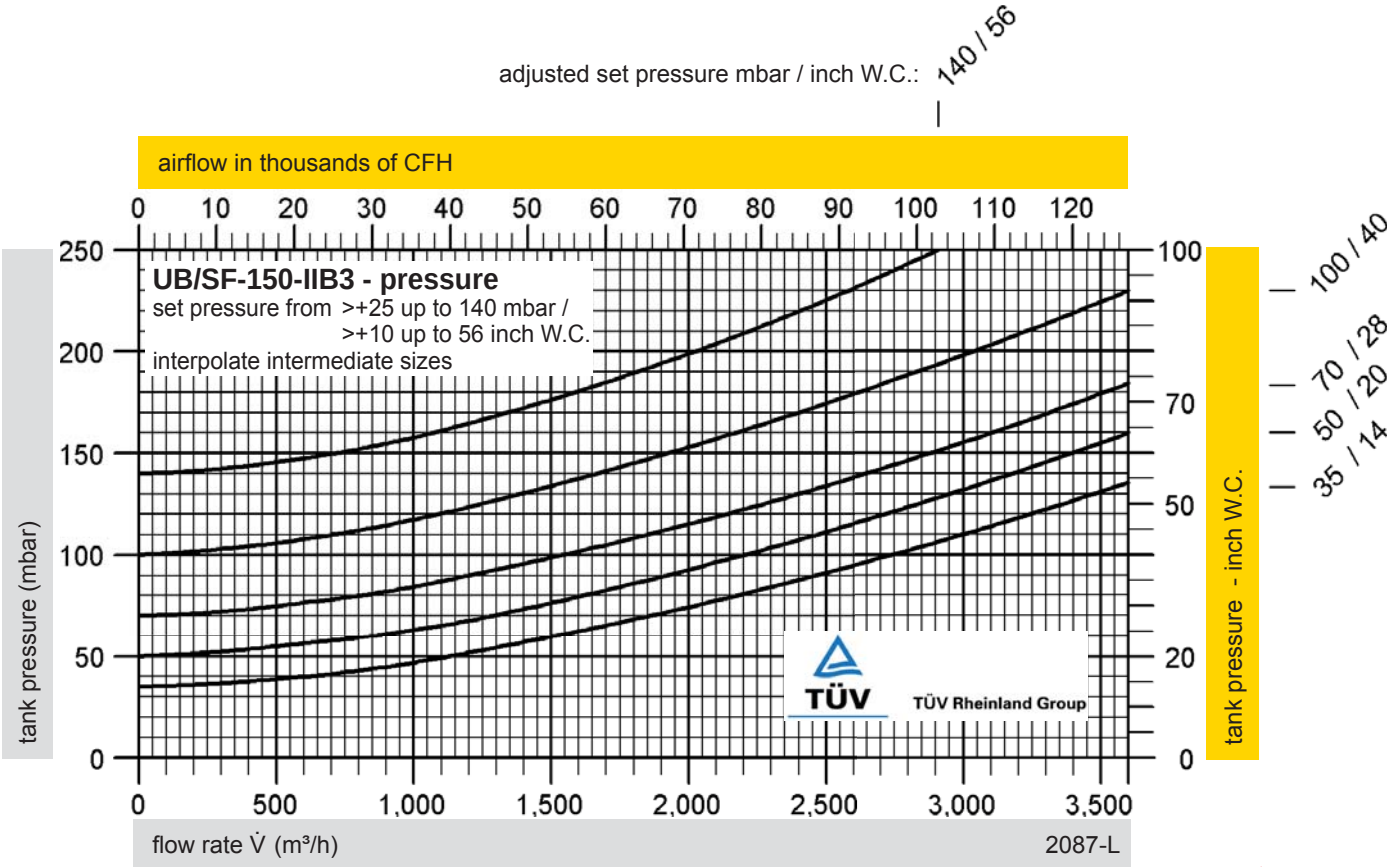
PROTEGO® UB/SF-150





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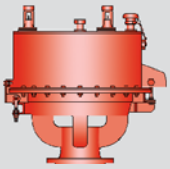
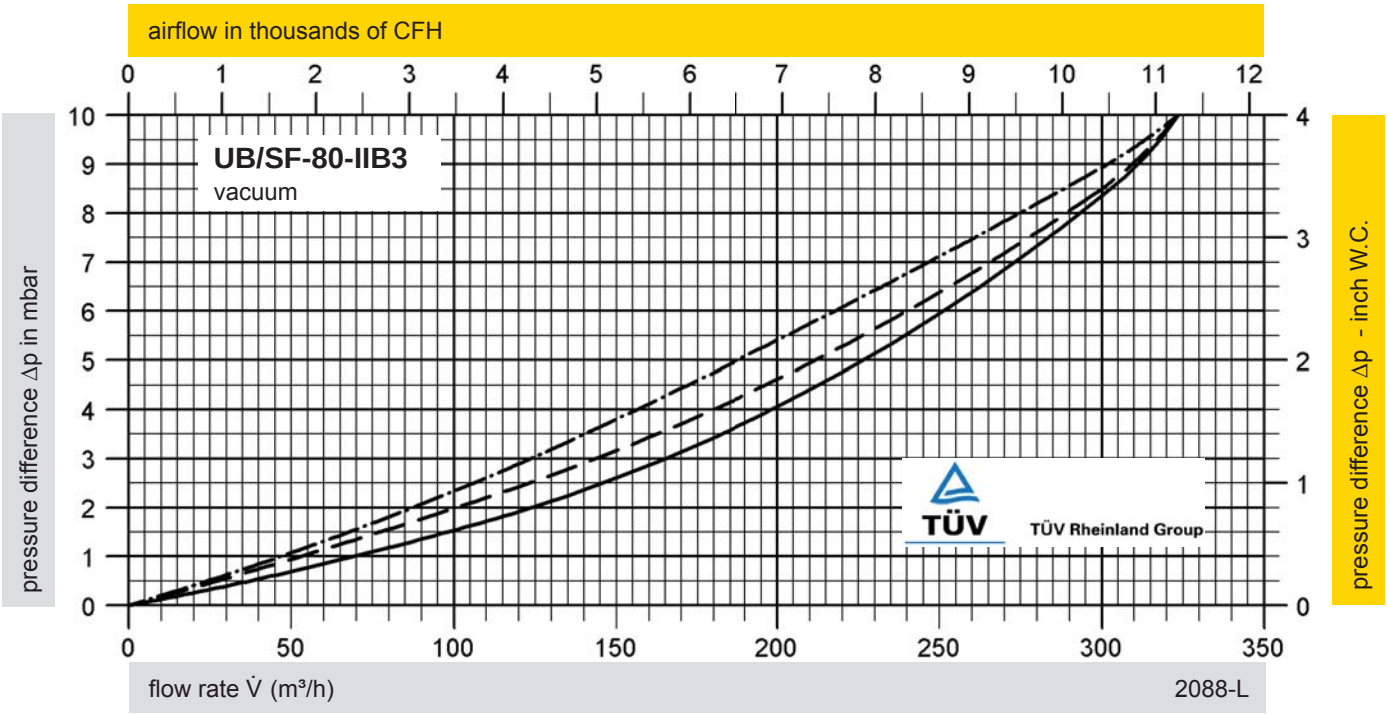


Pressure/Vacuum Diaphragm Valve

Flow Capacity Charts - Vacuum

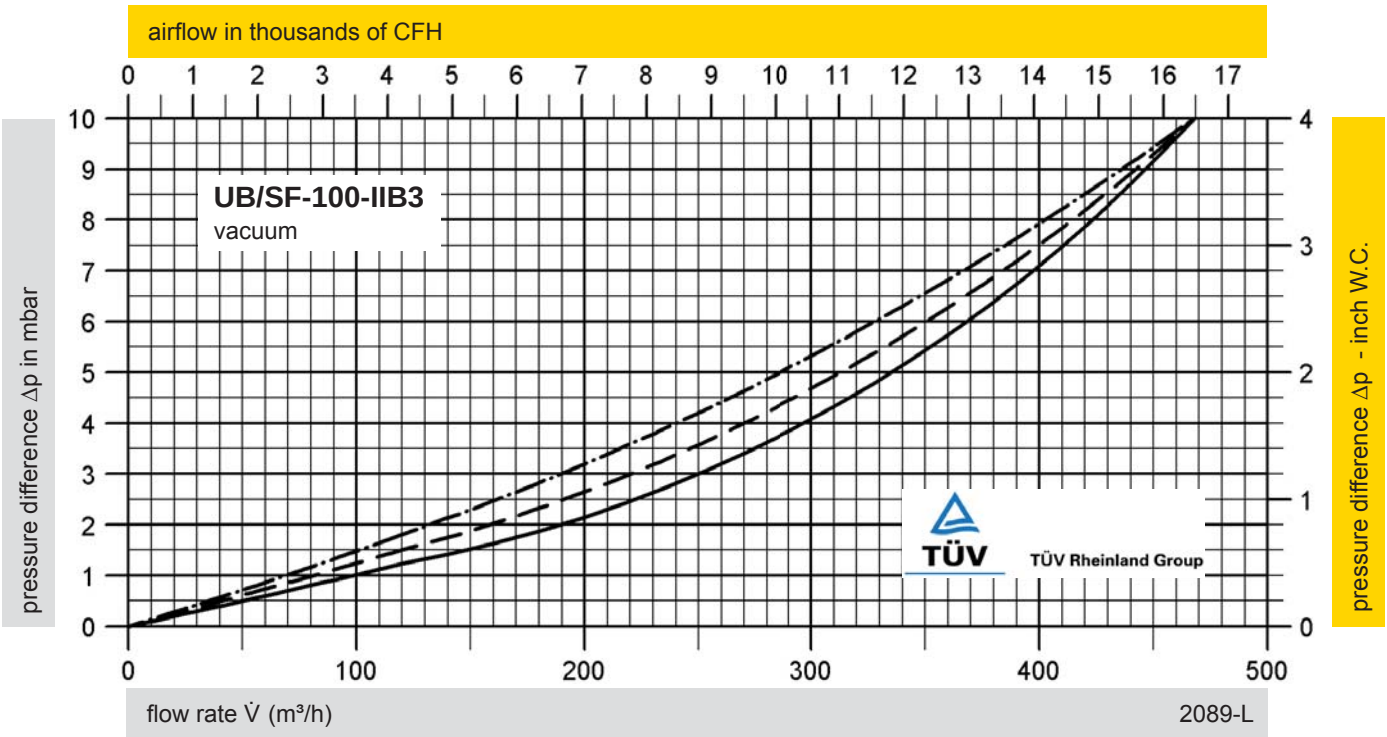
PROTEGO® UB/SF-80 and 100



pressure difference = max. allowable tank design vacuum - valve set vacuum

adjusted set vacuum:

- ≤ -5 mbar / ≤ -2 inch W.C.
- > -5 mbar up to ≤ -7 mbar / > -2 inch W.C. up to ≤ -2.8 inch W.C.
- > -7 mbar up to ≤ -35 mbar / > -2.8 inch W.C. up to ≤ -14 inch W.C.



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).
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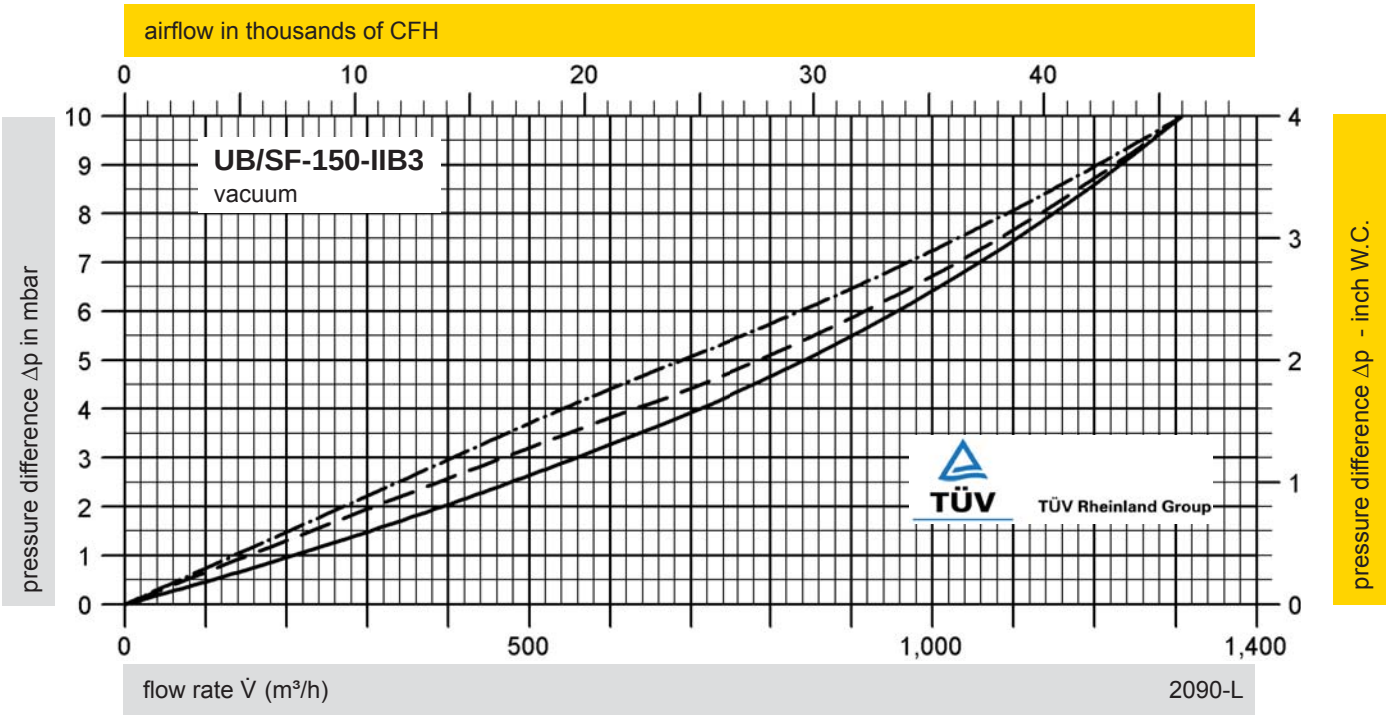
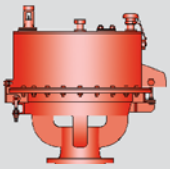
PROTEGO® UB/SF-150



pressure difference = max. allowable tank design vacuum - valve set vacuum

adjusted set vacuum:

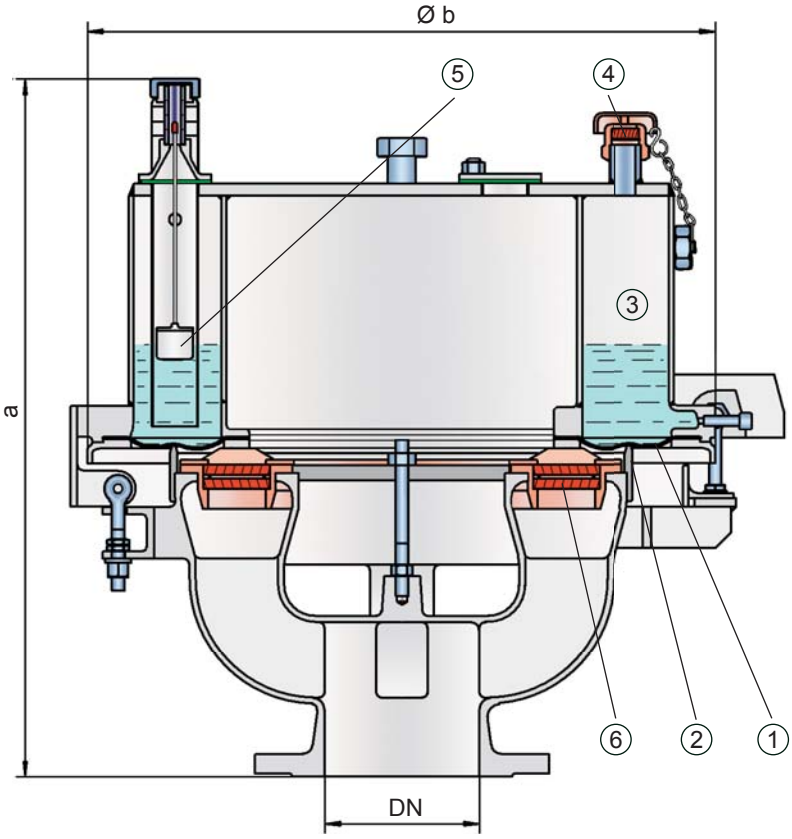
- ═══ ≤ -5 mbar / ≤ -2 inch W.C.
- — — — > -5 mbar up to ≤ -7 mbar / > -2 inch W.C. up to ≤ -2.8 inch W.C.
- —·—·— > -7 mbar up to ≤ -35 mbar / > -2.8 inch W.C. up to ≤ -14 inch W.C.



Pressure Diaphragm Valve

deflagration- and endurance burning-proof

PROTEGO® UB/DF



When the pressure in the tank reaches the set pressure, the diaphragm (1) on the outer valve seat ring (2) is lifted and vapors vent to the environment. The set pressure is adjusted by the liquid (water-glycol mixture) column height, which is filled into the outer ring chamber (3). The overpressure chamber is equipped with an opening (4) to keep the pressure in balance with the ambient pressure. The opening is equipped with a FLAMEFILTER® to avoid flame transmission into the overpressure chamber. Ambient air can now flow into the tank. The liquid column height which affect the set pressures is checked by a floating level indicator (5).

The tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard due to our highly developed manufacturing technology. This is achieved because the liquid loaded diaphragm presses tightly around the special designed valve seat surface area, even when the operating pressure increases. This is extremely important to reduce leakage to an absolute minimum. After the excess pressure is discharged, the valve reseats and provides a tight seal.

If the tank pressure exceeds the adjusted set pressure, explosive gas/product-vapour air mixtures exit. The speed at which these mixtures exit the annular gap between the diaphragm and the outer valve seat ring while overcoming the set pressure is much faster than the flame speed. If this mixture ignites, flashback into the tank is prevented. If the mixture flow continues, the dynamic flame arresting feature prevents flashback ignition even in the case of endurance burning. Even at relatively low flow rates, which occur during thermal outbreathing, the gap formed by the volumetric flow is so narrow that flames are extinguished in the gap and flashback is prevented. At very low pressure settings the explosion pressures resulting from an atmospheric deflagration may be strong enough to lift the diaphragm off the valve seat rings so that flashback could result. The ignition into the tank can be prevented by installing the PROTEGO® flame arrester unit (8). This flame arrester unit provides additional protection against atmospheric deflagration during regular maintenance and inspection.

The valve can be used up to an operating temperature of +60°C / 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Pressure Settings:

DN 80	+3.5 mbar	up to	+50 mbar
	+1.4 inch W.C.	up to	+20 inch W.C.
DN 100	+3.5 mbar	up to	+45 mbar
	+1.4 inch W.C.	up to	+18 inch W.C.
DN 150	+3.5 mbar	up to	+46 mbar
	+1.4 inch W.C.	up to	+18.4 inch W.C.

Higher pressure settings up to +140 mbar (56.2 inch W.C.) in special design with additional liquid reservoir as well as lower pressure settings upon request.

Function and Description

The deflagration- and endurance burning-proof UB/DF type PROTEGO® diaphragm valve is a state-of-the-art pressure-relief valve combining the function of a dynamic and static flame arrester. Worldwide this design is unique. It is primarily used as a safety device for flame transmission proof out breathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against excess pressure prevents the inbreathing of air and product losses almost up to the set pressure and protects against atmospheric deflagration and endurance burning if stabilized burning occurs. The PROTEGO® UB/DF diaphragm valve has proven its performance over many years in a great variety of severe applications in the petrochemical and chemical industry. The set pressure is adjusted with a freeze resistant water-glycol mixture, which assures safe operation under extreme cold weather conditions. The PROTEGO® UB/DF valve is available for substances of explosion group IIB3 (NEC group C MESG ≥ 0.65 mm).

Special Features and Advantages

- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- set pressure close to opening pressure enables optimum pressure maintenance in the system
- high flow capacity
- can be used as a protective system according to ATEX in areas subject to an explosion hazard
- protection against atmospheric deflagrations and endurance burning for products up to explosion group IIB3 (NEC group C ≥ 0.65 mm MESG)
- minimum pressure drop of the FLAMEFILTER®
- flame-transmission-proof pressure and vacuum chambers
- freeze protection at sub-zero conditions
- self draining function for condensate
- liquid column height is monitored by level indicators
- easy maintenance through hinged vent cap
- modular design enables individual FLAMEFILTER® discs and valve diaphragm to be replaced
- particularly suitable for problematic products such as styrene, acrylics, etc.

Design Types and Specifications

The diaphragm is pressurized by liquid. Higher pressures can be achieved upon request with a special liquid reservoir.

There are two different designs:

Pressure diaphragm valve, basic design **UB/DF - [–]**

Pressure diaphragm valve with heating coil **UB/DF - [H]**
(max. heating fluid temperature +85°C / 185°F)

In addition to the standard design, a series of specially developed designs, which are particularly suitable for the operating conditions to which these products are subjected, can be provided upon request (for example, for acrylics or styrene storage tanks, etc.).

Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1{,}4}$$

Set pressure = the valve starts to open

Opening pressure = set pressure plus overpressure

Overpressure = pressure increase over the set pressure

Table 1: Dimensions — Dimensions in mm / inches

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

DN	pressure	80 / 3"	100 / 4"	150 / 6"
a	up to +28 mbar / +11.2 inch W.C.	615 / 24.21	645 / 25.39	680 / 26.77
a	> +28 mbar / +11.2 inch W.C.	765 / 30.12	795 / 31.30	830 / 32.68
b		410 / 16.14	485 / 19.09	590 / 23.23

Pressure settings > +50 mbar / +20 inch W.C. (DN 80/3"), > +45 mbar / +18 inch W.C. (DN 100/4"), > +46 mbar / +18.4 inch W.C. (DN150/6") with additional liquid reservoir - dimensions upon request

Dimensions for pressure diaphragm valves with heating coil upon request

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	Special approvals upon request
≥ 0,65 mm	IIB3	C	

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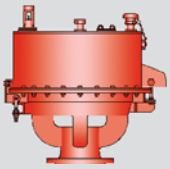


Pressure Diaphragm Valve

deflagration- and endurance burning-proof

PROTEGO® UB/DF

Table 3: Material selection for housing

Design	C	D	
Housing	Steel	Stainless Steel	Option: Housing with ECTFE-lining Special materials upon request
Valve top	Stainless Steel	Stainless Steel	
Heating coil (UB/DF-H-...)	Stainless Steel	Stainless Steel	
Valve seat	Stainless Steel	Stainless Steel	
Gasket	FPM	PTFE	
Diaphragm	A, B	A, B	
Flame arrester unit	C	C	

Table 4: Material selection for diaphragm

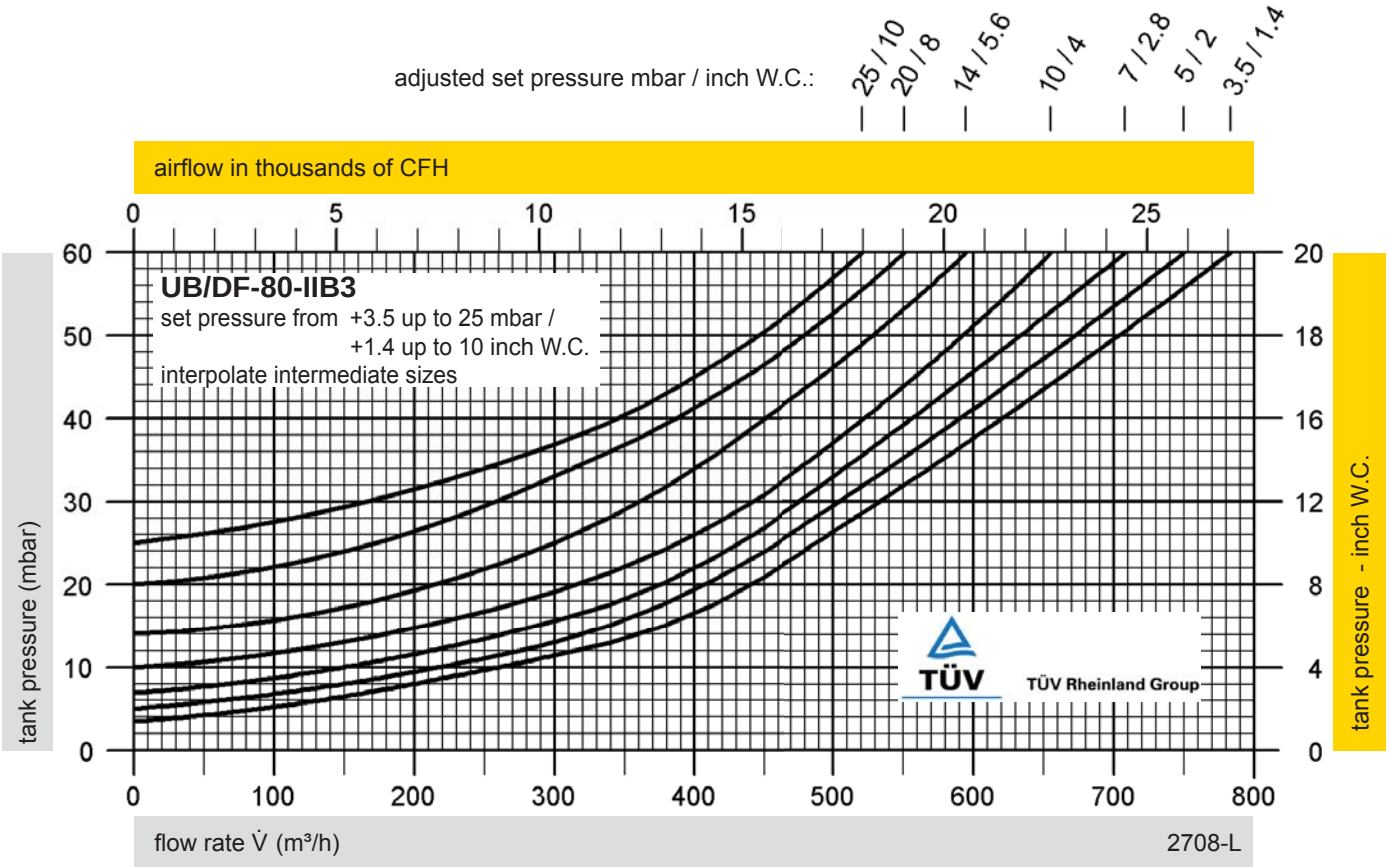
Design	A	B	Special materials upon request
Diaphragm	FPM	FEP	

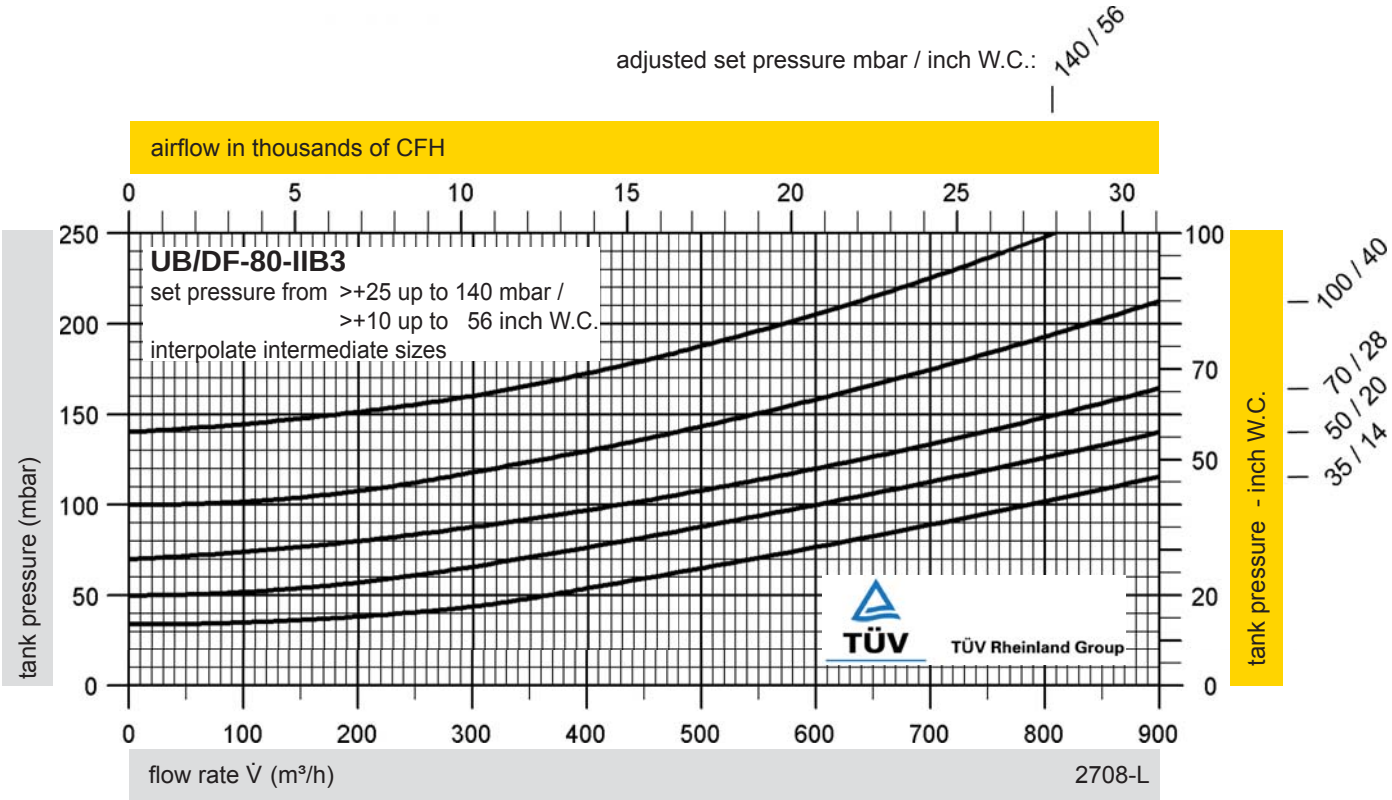
Table 5: Material combinations of flame arrester unit

Design	C	Special materials upon request
FLAMEFILTER® cage	Stainless Steel	
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 6: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	





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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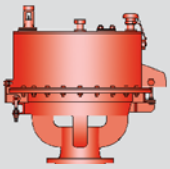
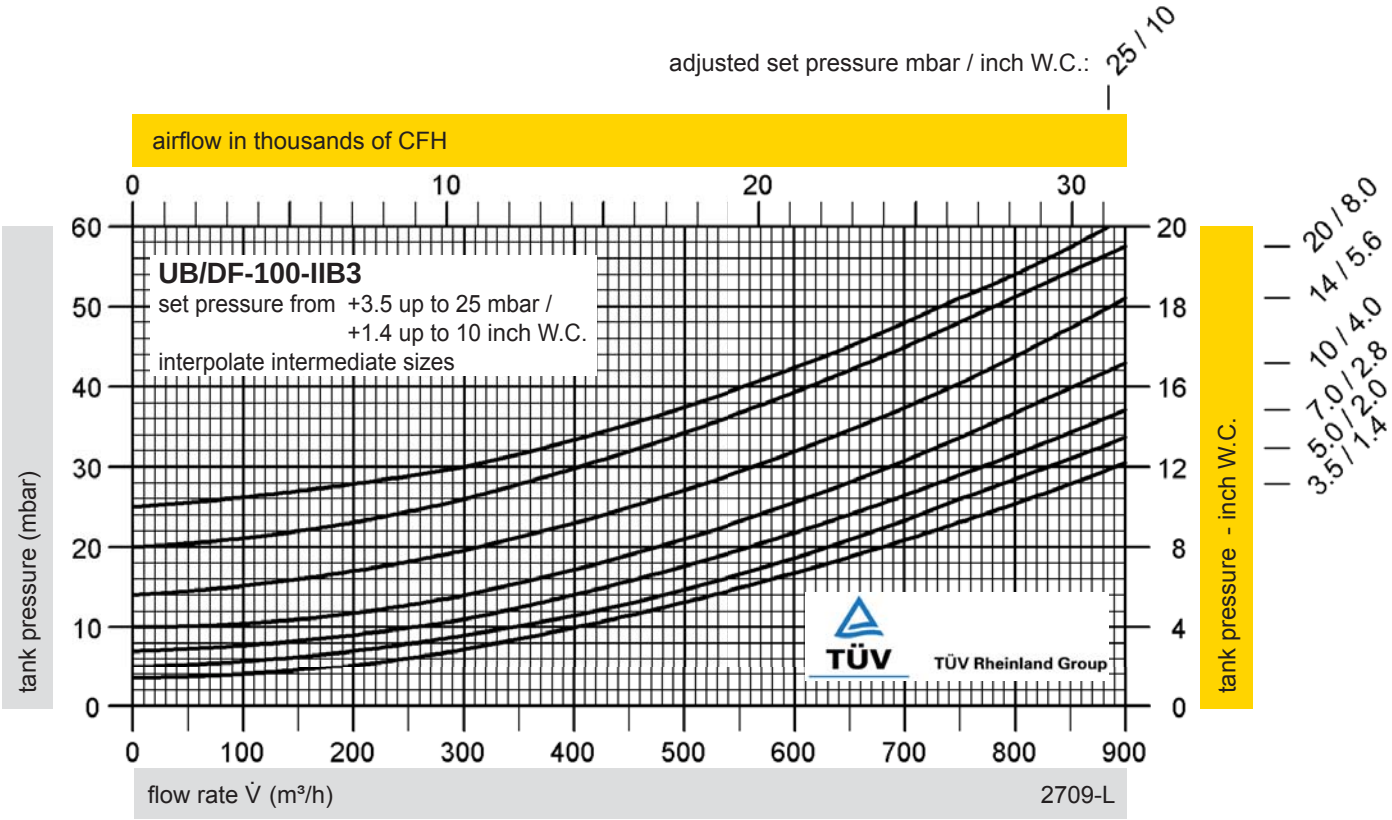
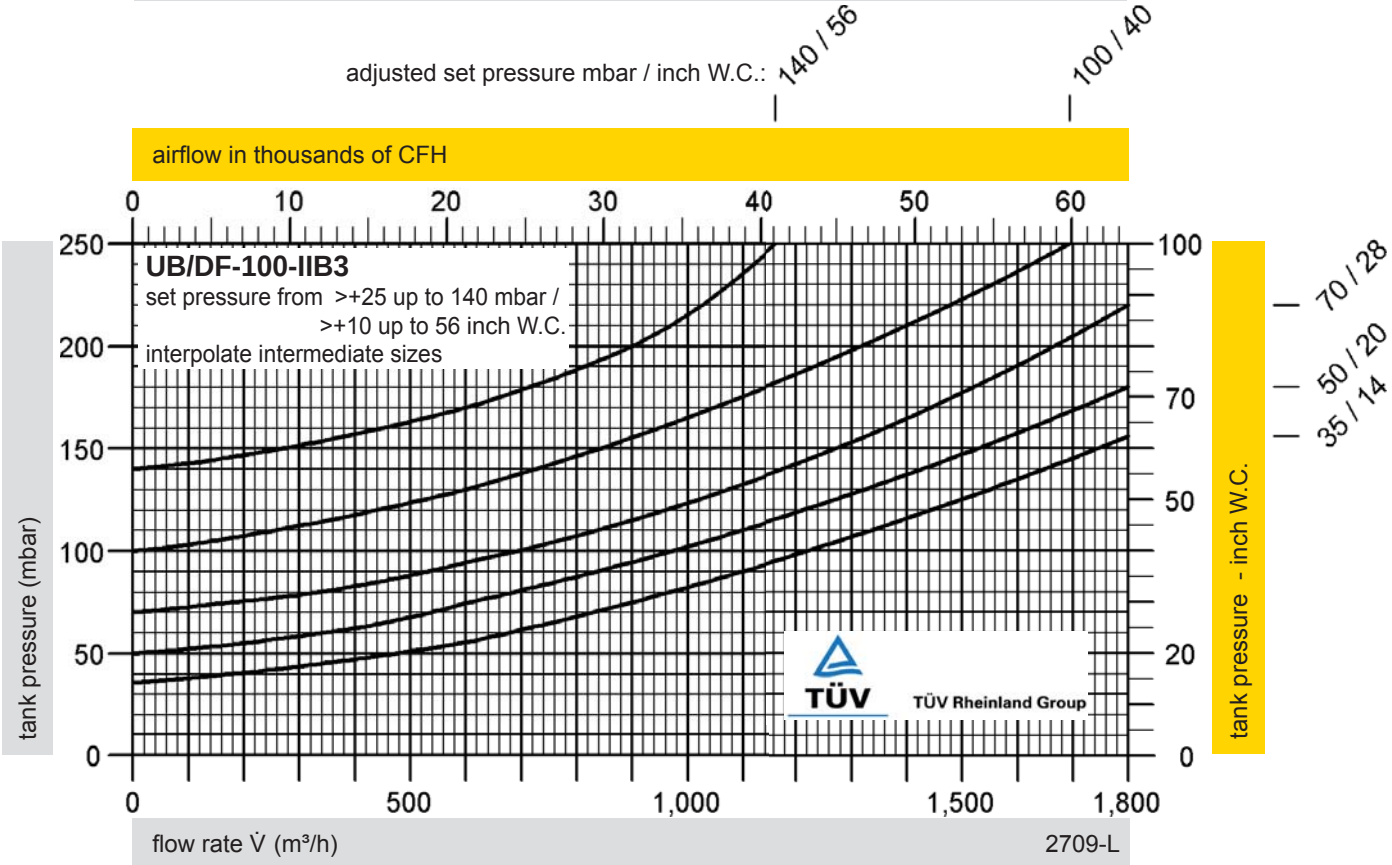


Pressure Diaphragm valve

Flow Capacity Charts

PROTEGO® UB/DF





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).
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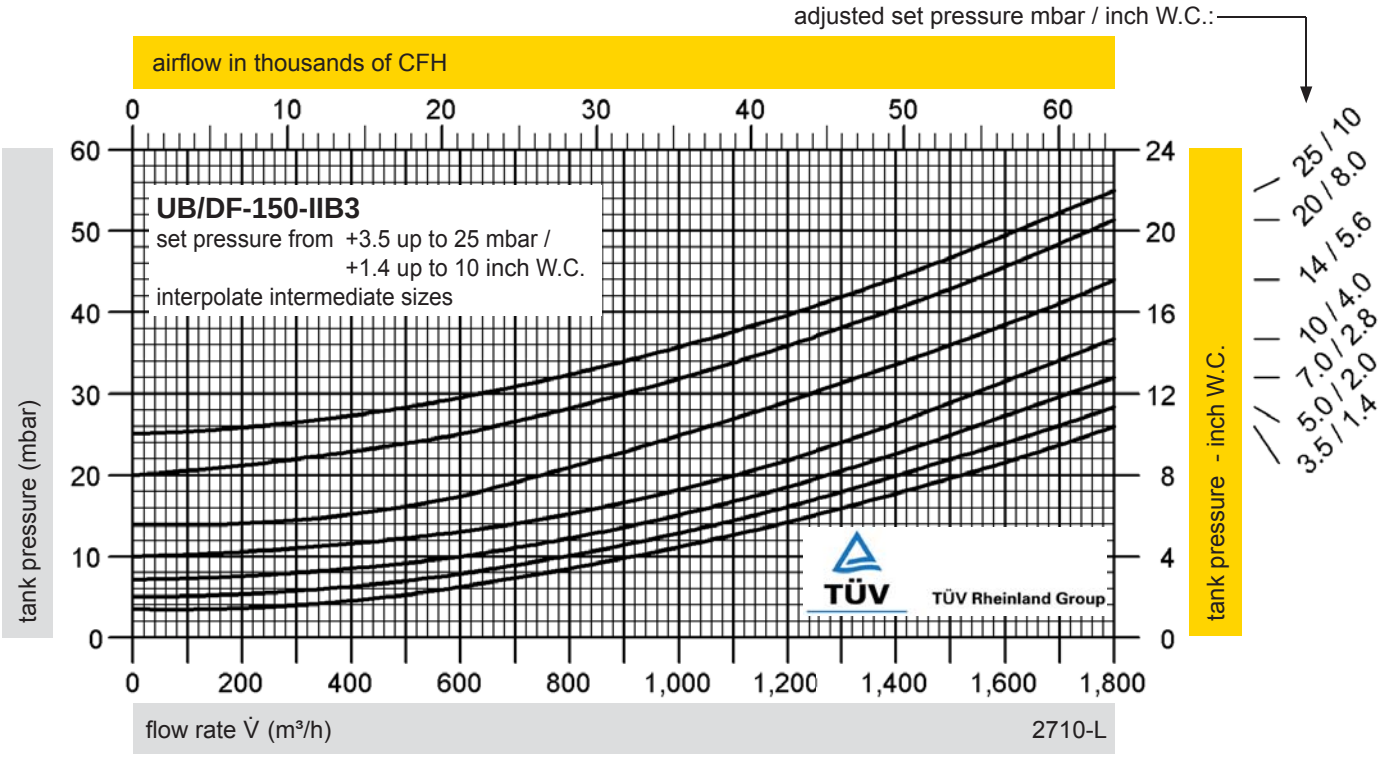

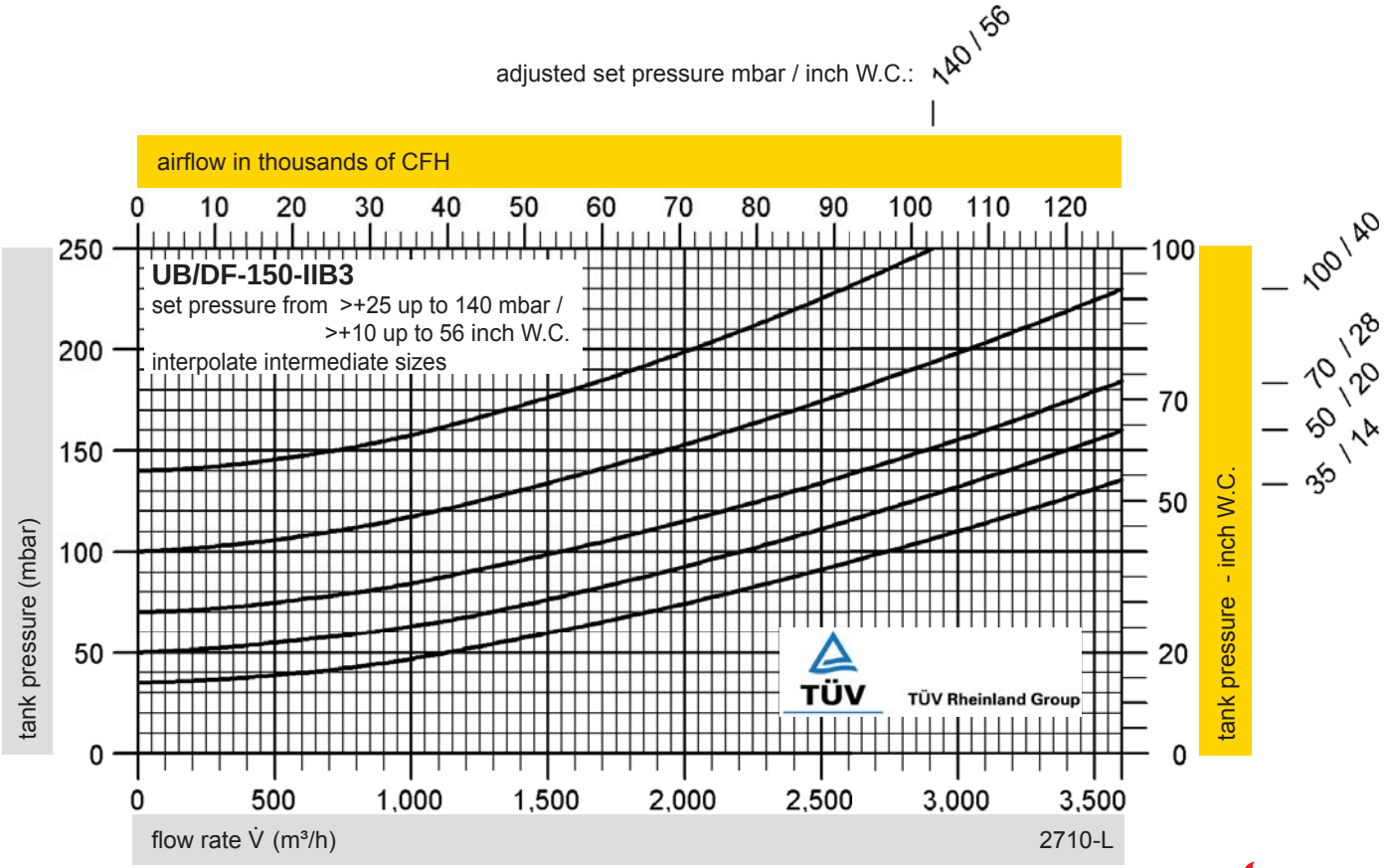

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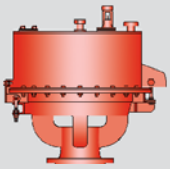
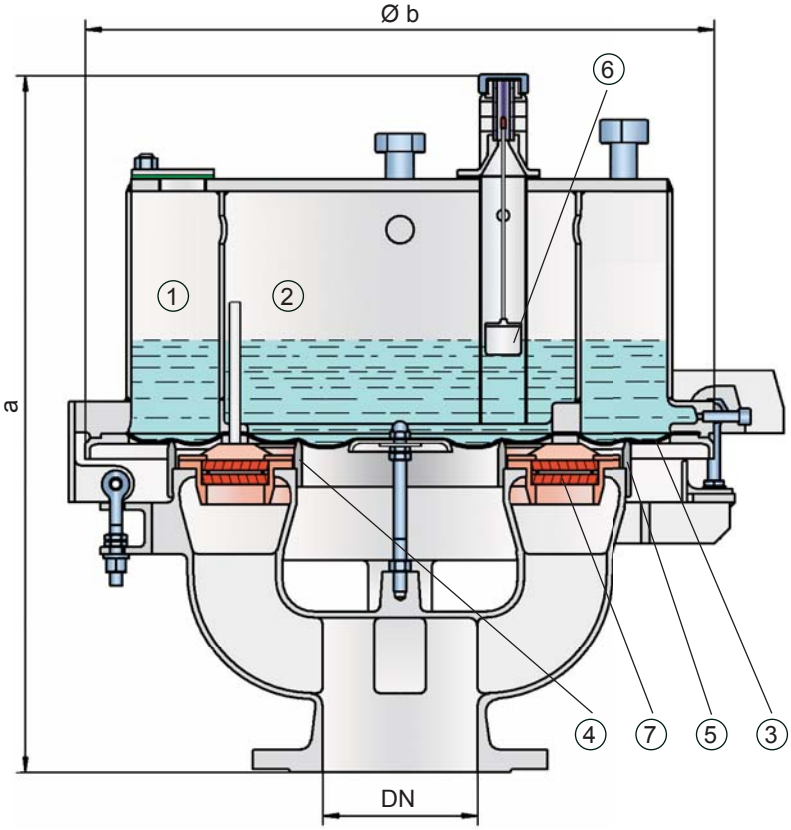


Vacuum Diaphragm Valve

deflagration-proof

PROTEGO® UB/VF



Vacuum Settings: –3.5 mbar up to –35 mbar
–1.4 inch W.C. up to –14 inch W.C.
Higher and lower vacuum settings upon request

Function and Description

The deflagration-proof UB/VF type PROTEGO® diaphragm valve is a state-of-the-art vacuum relief valve combining the function of a dynamic and static flame arrester. Worldwide this design is unique. It is primarily used as a safety device for flame transmission proof inbreathing on tanks, containers and process engineering apparatus. The valve offers reliable protection against vacuum build up, prevents the inbreathing of air and product losses almost up to the set vacuum and protects against atmospheric deflagration. The PROTEGO® UB/VF diaphragm valve has proven its performance over many years in a great variety of severe applications in the petrochemical and chemical industry. Worldwide it is the only vent which functions in services such as styrene and acrylics. The set vacuum is adjusted with a freeze resistant water-glycol mixture, which assures safe operation under extreme cold weather conditions. The PROTEGO® UB/VF valve is available for substances from explosion group IIB3 (NEC group C MESG ≥ 0.65 mm).

If a vacuum builds up in the tank, it is transmitted through pressure balancing tubes into the vacuum chambers (1), (2). If the set vacuum, which depends on the liquid column height in the vacuum chamber, is reached the atmospheric pressure lifts the diaphragm (3) up off the inner and outer valve seat rings (4,5). Ambient air can now flow into the tank. The liquid column heights, which affect the set vacuum, can be checked by a floating level indicator (6).

The tank vacuum is maintained up to the set vacuum with a tightness that is far superior to the conventional standard due to our highly developed manufacturing technology. This is achieved because the liquid loaded diaphragm presses tightly around the special designed valve seat surface area, even when the operating vacuum increases. This is extremely important to reduce leakage to an absolute minimum. After the vacuum is balanced, the valve reseats and provides a tight seal.

At very low vacuum settings the explosion pressures resulting from an atmospheric deflagration may be strong enough to lift the diaphragm off the valve seat rings so that flashback could result. The ignition into the tank can be prevented by installing the PROTEGO® flame arrester unit (7). This flame arrester unit provides additional protection against atmospheric deflagration during regular maintenance and inspection.

The valve can be used up to an operating temperature of +60°C/ 140°F and meets the requirements of European tank design standard EN 14015 – Appendix L and ISO 28300 (API 2000).

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Special Features and Advantages

- high performance seal reducing product loss below EPA's 500ppm rule preventing environmental pollution
- set vacuum close to the design vacuum enables optimum pressure maintenance in the system
- high flow capacity
- can be used as a protective system according to ATEX in areas subject to an explosion hazard
- protection against atmospheric deflagrations for products up to explosion group IIB3 (NEC group C MESG ≥ 0.65 mm)
- minimum pressure drop of the FLAMEFILTER®
- freeze protection at sub-zero conditions
- self draining function for condensate
- liquid column height is monitored by level indicators
- easy maintenance through hinged vent cap

- modular design enables individual FLAMEFILTER® discs and valve diaphragm to be replaced
- particularly suitable for problematic products such as styrene, acrylics, etc

Design Types and Specifications

The diaphragm is pressurized by liquid.

There are two different designs:

Vacuum diaphragm valve, basic design **UB/VF - –**

Vacuum diaphragm valve with heating coil **UB/VF - H**
(max. heating fluid temperature +85°C / 185°F)

In addition to the standard design, a series of specially developed designs, which are particularly suitable for the operating conditions to which these products are subjected, can be provided upon request (for example, for acrylics or styrene storage tanks, etc.).

Table 1: Dimensions — Dimensions in mm / inches

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

DN	vacuum	80 / 3"	vacuum	100 / 4"	150 / 6"
a	up to -28 mbar / 11.2 inch W.C.	615 / 24.21	up to -22 mbar / 8.8 inch W.C.	645 / 25.39	680 / 26.77
a	< -28 mbar / 11.2 inch W.C.	765 / 31.12	< -22 mbar / 8.8 inch W.C.	795 / 31.30	830 / 32.68
b		410 / 16.14		485 / 19.09	590 / 23.23

Dimensions for vacuum diaphragm valve with heating coil upon request

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,65 mm	IIB3	C	Special approvals upon request

Table 3: Material selection for housing

Design	C	D	
Housing	Steel	Stainless Steel	
Valve top	Stainless Steel	Stainless Steel	
Heating coil (UB/VF-H-...)	Stainless Steel	Stainless Steel	Option: Housing with ECTFE-lining
Valve seat	Stainless Steel	Stainless Steel	Special materials upon request
Gasket	FPM	PTFE	
Diaphragm	A, B	A, B	
Flame arrester unit	C	C	

Table 4: Material selection for diaphragm

Design	A	B	
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Design	C	
FLAMEFILTER® cage	Stainless Steel	Special materials upon request
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Table 6: Flange connection type

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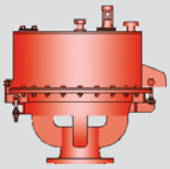
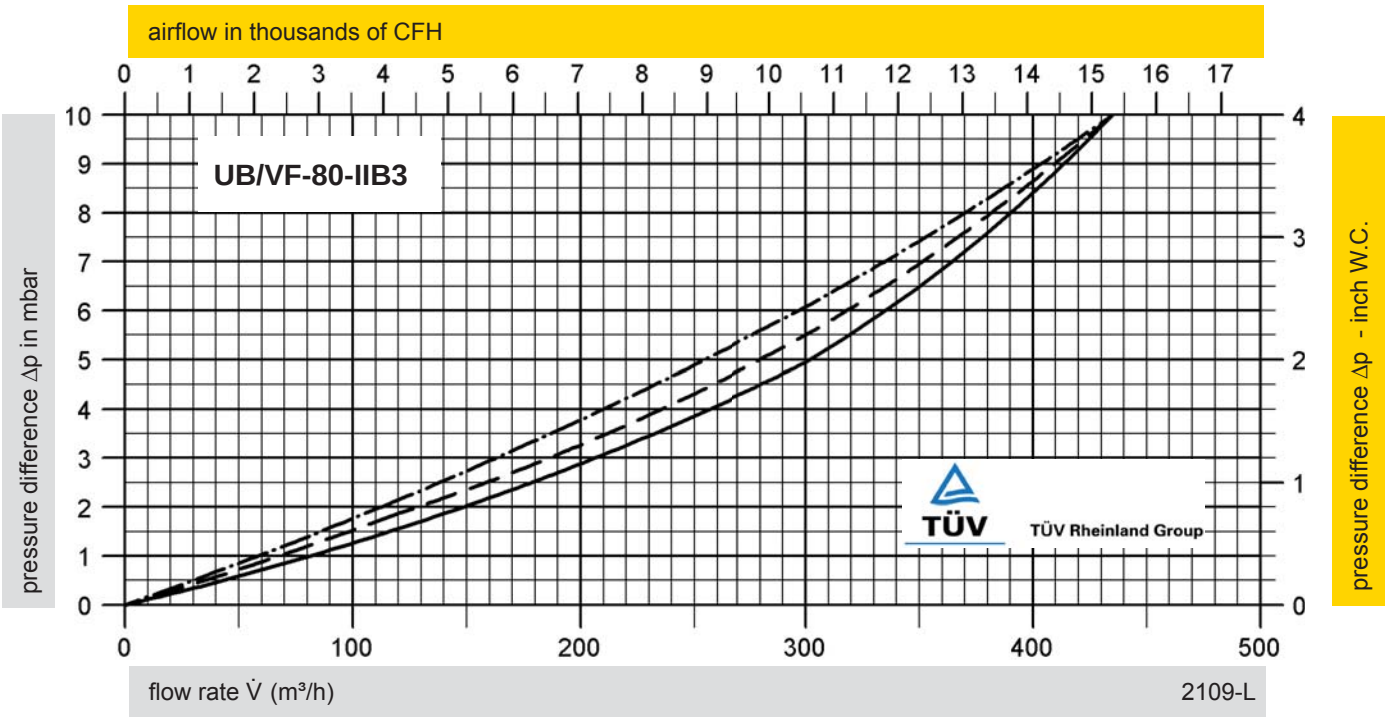


Vacuum Diaphragm Valve

Flow Capacity Charts

PROTEGO® UB/VF



pressure difference = max. allowable tank design vacuum - valve set vacuum

adjusted set vacuum:

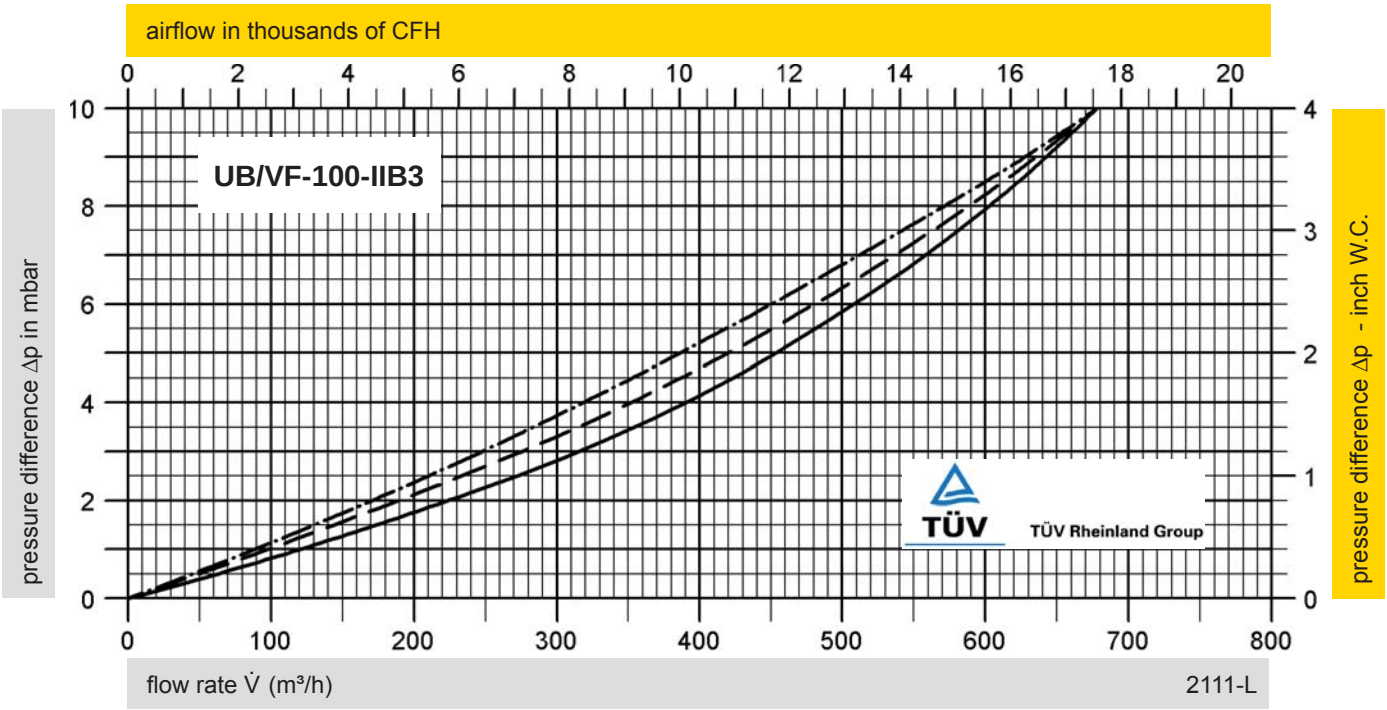
——— ≤ -5 mbar / ≤ -2 inch W.C.

— — — > -5 mbar up to ≤ -7 mbar / > -2 inch W.C. up to ≤ -2.8 inch W.C.

— · — · — > -7 mbar up to ≤ -35 mbar / > -2.8 inch W.C. up to ≤ -14 inch W.C.

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

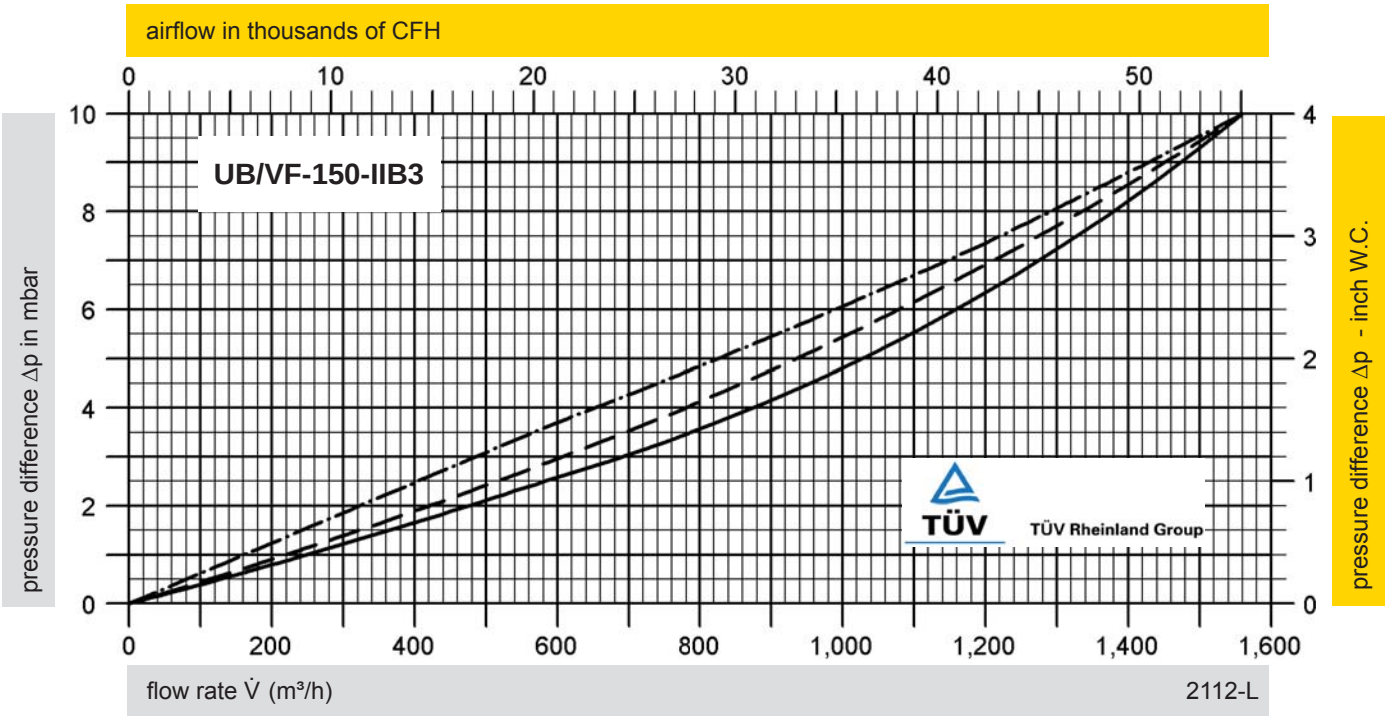
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).
Conversion to other densities and temperatures refer to Vol. 1: “Technical Fundamentals”.



pressure difference = max. allowable tank design vacuum - valve set vacuum

adjusted set vacuum:

- ≤ -5 mbar / ≤ -2 inch W.C.
- > -5 mbar up to ≤ -7 mbar / > -2 inch W.C. up to ≤ -2.8 inch W.C.
- > -7 mbar up to ≤ -35 mbar / > -2.8 inch W.C. up to ≤ -14 inch W.C.



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