PROTEGO® Catalog

valid from 2023

Excellence in Safety and Environment

For more product information please visit our website:

www.protego.com

PROTEGO

for safety and environment

Protecting life - preserving value. For over 60 years.

For over 60 years.Welcome to Braunschweiger Flammenfilter GmbH. In your hand is the most recent edition of our catalog.

Braunschweiger Flammenfilter GmbH is a medium sized company with over 600 employees in multiple locations worldwide. With 11 subsidiaries, we are present on all continents. Under the brand name PROTEGO®, we manufacture and distribute a wide range of safety devices and tank accessories and are the market leader in our specialized field.

We are available to our customers worldwide for advice and service. They rely on our products for process plant engineering in the mineral oil chemical, pharmaceutical, and bio-energy industries.

For over 60 years, Braunschweiger Flammenfilter GmbH has stood for high-performance know-how in developing, producing, and manufacturing safety valves and devices, particularly for explosion protection during production, storage, and transport of flammable liquids and gases.

For all customers, we provide a high level of excellence in:

- Problem solving
- Quality
- Consulting/Advising
- Environmental protection

Together with our subsidiaries, sales partners, and PROTEGO® Authorized Repair Centers (PARC), we deliver on this promise worldwide.

As a medium-sized family owned business, we have maintained our strength and flexibility and are a stable and financially independent partner for our customers. We are proud of our highly qualified and motivated staff with whom we build a common future through continuous further development.

Get an overview of our competencies and see the advantages of a collaboration with Braunschweiger Flammenfilter GmbH.

Our Vision & Mission

We think ahead – with enthusiasm

PROTEGO® Vision: Excellence in Safety and Environment.

PROTEGO® Mission: A profitable, independent, international family-owned business that develops and manufactures safety valves and equipment and is a leader in technology, quality, availability, services, engineering, and consulting.

Our core business is explosion protection as well as environmental protection by maintaining and relieving pressure in the exploration, processing, and storage of flammable liquids and gases.

PROTEGO® Product Overview

Type	Name	Section
AL/DK	Vent valve	8
BE/AD	Deflagration flame arrester	2
BE/HK	Deflagration flame arrester	protego.com
BE/HK-E	Deflagration flame arrester	2
BE/HR	Deflagration flame arrester	protego.com
BE/HR 400	Deflagration flame arrester	2
BE/HR-D	Pressure relief valve	7
BE/HR-E	Deflagration flame arrester	2
BR/TS	Detonation flame arrester	protego.com
D/KSM	Pressure relief valve	5
D/SVL	Pressure relief valve	5
D-SVL-EB	Pressure relief valve	7
DA-CG	Detonation flame arrester	4
DA-E	Detonation flame arrester	4
DA-G	Detonation flame arrester	4
DA-SB	Detonation flame arrester	4
DA-SB-PTFE	Detonation flame arrester	protego.com
DA-UB	Detonation flame arrester	4
DA-UCG	Detonation flame arrester	protego.com
DAZ	Detonation flame arrester	protego.com
DE/S	Pressure relief valve	protego.com
DE/S-MK VI	Pressure relief valve	protego.com
DR/ES	Detonation flame arrester	4
DR/ES-PTFE	Detonation flame arrester	protego.com
DR/ES-V	Detonation flame arrester	4
DR/EU	Detonation flame arrester	4
DR/SBW	Detonation flame arrester	protego.com
DR/SV	Detonation flame arrester	protego.com
D/SR	Roof drain valve	8
D/SR-W	Roof drain valve	8
DV/ZT	Pressure/Vacuum relief valve	6
DV/ZT-F	Pressure/Vacuum relief valve	6
DV/ZU	Pressure/Vacuum relief valve	6
DV/ZU-F	Pressure/Vacuum relief valve	6
DV/ZW	Pressure/Vacuum relief valve	6
DV/ZW-F	Pressure/Vacuum relief valve	6
DZ/E	Pressure/Vacuum relief valve	6
DZ/EA	Pressure/Vacuum relief valve	6
DZ/EA-F	Pressure/Vacuum relief valve	6
DZ/E-F	Pressure/Vacuum relief valve	6
DZ/T	Pressure/Vacuum relief valve	6
DZ/T-F	Pressure/Vacuum relief valve	6
E/KS	Vent cap	protego.com
EB	Vent cap	2
EB-Z	Vent cap	protego.com
EF/V	Detonation flame arrester	4
EH/0	Vent cap	protego.com
EH/0S	Vent cap	protego.com
ER/V	Pressure relief valve	protego.com
ER-V-LP	Pressure relief valve	5
ER/V-F	Pressure relief valve	5
ER/VH	Pressure relief valve	5
FA-CN	Deflagration flame arrester	3
FA-E	Deflagration flame arrester	3
FA-G	Deflagration flame arrester	3
FA-I ATEX	Deflagration flame arrester	3
FA-I-PTFE	Deflagration flame arrester	protego.com
ITV-S	In-Tank Valve	protego.com
LA	Air-drying device	protego.com
LA-V	Air-drying device with with check valve	protego.com
LDA	Detonation flame arrester	4
LDA-F	Detonation flame arrester	4
LDA-W	Detonation flame arrester	4
LDA-WF(W)	Detonation flame arrester	4
LH/AD	Deflagration flame arrester	2
LH/AD-T	Deflagration flame arrester	2
LH/EB	Deflagration flame arrester	protego.com
NB/AP	In-Tank Valve	9
P/EB	Pressure relief valve	7
P/EB-E	Pressure relief valve	7
P/EBR	Pressure relief valve	7
P/EBR-E	Pressure relief valve	7
P/EL	Pressure relief valve	5
P/ELR	Pressure relief valve	5
PU-IIA	Gauging pipe	protego.com
PF/K	Gauge hatch with flange	8
PF/TK	Gauge hatch with flange	8
PG/H	Sampling pot	protego.com
PS/K	Gauge hatch with welded nozzle	8
PS/KF	Gauge hatch with flange	8
PS/TK	Gauge hatch with welded nozzle	8
PM(D)S	Pressure/Vacuum relief valve	protego.com NEW
PM-HF	Pressure/Vacuum relief valve	protego.com
PR/0	Gauging and sampling pipe	protego.com
PS/E	Gauging nozzle	protego.com
PV/EB	Pressure/Vacuum relief valve	7
PV/EB-E	Pressure/Vacuum relief valve	7
PV/EBR	Pressure/Vacuum relief valve	7
PV/EBR-E	Pressure/Vacuum relief valve	7
PV/EL	Pressure/Vacuum relief valve	5
PV/ELR	Pressure/Vacuum relief valve	5
R/KSM	Pressure/Vacuum relief valve	6
SA/DA	Floating skimmer system	8
SA/S	Floating suction unit	8
SD/BS-H	Pressure relief valve	5
SE/CK	Floating roof drainage system with swivel joints	8
SE/K	Floating roof drainage system with metal hose joint	8
SI/DP	In-Tank Valve	9
SI/F	Internal safety valve	8
SV/E	Vacuum relief valve	7
SV/E-1-0	Vacuum relief valve	5
SV/T-0-H	Vacuum relief valve	5
TS/E, TS-P, TS/W	Detonation flame arrester	4
UB/DF	Pressure/Vacuum relief valve	7
UB/SF	Pressure/Vacuum relief valve	7
UB/VF	Pressure/Vacuum relief valve	7
V/KSM	Vacuum relief valve	5
V/SV	Vacuum relief valve	protego.com
V/SV-XL	Vacuum relief valve	9
V/SV-XXL	Vacuum relief valve	9
VD/KSM	Pressure/Vacuum relief valve	5
VD/KSM-PA	Pressure/Vacuum relief valve	5
VD/SV	Pressure/Vacuum relief valve	5
VD/SV-AD(L)	Pressure/Vacuum relief valve	7
VD-SV-EB	Pressure/Vacuum relief valve	7
VD/SV-HR	Pressure/Vacuum relief valve	7
VD/SV-HRL	Pressure/Vacuum relief valve	7
VD/SV-PA(L)	Pressure/Vacuum relief valve	5
VD/TS	Pressure/Vacuum relief valve	7
VN-A-PCPF	Pressure/Vacuum relief valve	9
VN-A-PCPM	Pressure/Vacuum relief valve	9 NEW
VP/HK	Gauging and sampling device	8
WV/T	Change-over valve	9
ZE/TK	Condensate drain valve	8
ZE/WU	Sampling and air bleed valve	8
ZM-R	Blanketing valve	6

Information at a glance

Product diversity **Tailored devices are our day-to-day business.**	In this catalogue, you will find a selection from our extensive range of products. We also supply devices which require **special approvals due to** special operating conditions, such as exceptionally high **temperatures and pressures**, or for **specific applications**. Just contact our friendly sales team.	
New additions to our catalogue	New products are marked with the symbol shown on the right.	NEW
QR codes in the catalogue	Scan the QR code for speedy access to additional information online.	
protego.com	If you see this symbol, check out our homepage for more information.	
PARCs	PROTEGO® Authorized Repair Center: PARCs offer skilled regional support to meet your repair and maintenance needs.	
Contact details	If you have any questions or special requests, our friendly and capable sales team will be happy to advise you.	
PROTEGO® QuEST **Quick Engineering & Sizing Tool**	**PROTEGO® QuEST** is the software for sizing and selection of our venting devices.	PROTEGO QuEST
PROTEGO® Engineering Service	**PROTEGO® Engineering Service** is the new engineering consulting branch within the PROTEGO® Group. We assist our customers with detailed tank modeling and safety analyses beyond the sphere of PROTEGO® device application.	

PROTEGO® Engineering Service

We assist our customers with detailed tank modeling and safety analyses.

Our areas of expertise are:

- Tank protection against ordinary and intense weather conditions
- Definition of tank and piping insulation strategies
- Prevention from vapor collapse in tanks
- Safe and cost effective product loss minimization

PROTEGO® QuEST features

- **Venting:** Determine the normal in- and outbreathing as well as the emergency relief flow requirements of storage tanks.
- **Sizing:** Selection of PROTEGO® valves and flame arresters.
- **Quick Sizing:** Checking of in service PROTEGO® devices, f. i. within MOC.

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Catalog

PROTEGO® Technology Center

The PROTEGO® Technology Center offers our customers a wide range of options to meet their specific needs.

- Climatic chamber (simulation of extreme operating conditions from -70°C to +150°C)
- Cryogenic test bench (functional test of valves for cryogenic storage tanks, e.g. LIN-LOX-LAR tanks)
- Salt spray chamber (functional test for maritime operating conditions)
- Valve test bench (set pressure and leakage rate determination, functional test)
- Laboratory (determination of safety-related parameters, material investigations)
- Electrical laboratory (research, development and application of new technologies, e.g. Industry 4.0)
- Low pressure measurement systems (measurement of end-of-line and in-line devices, e.g. volumetric flow rate measurement up to 55000 m^3/h)

Section 1

- **Flame Arresters**
- **Valves**
- **Tank Accessories**

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How to use this catalog

The PROTEGO® catalog has a modular structure.

Section 1 introduces the company with “Technical Fundamentals” and “Safe Systems in Practice” and provides a basic explanation of the operation and use of PROTEGO® devices.

Sections 2-9 describe the products in detail.











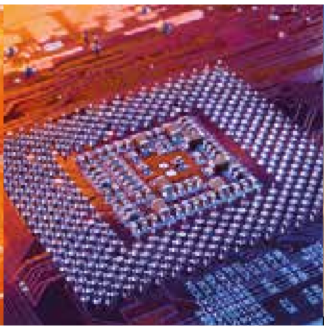


Typical Applications

- Storage Tanks and Loading Facilities
- Vapor-return at Petrol Stations
- Combustion Systems
- Chemical and Pharmaceutical Processing Systems
- Cryogenic Applications (LNG, LIN, LOX)
- Landfill and Biogas Systems
- Wastewater Treatment Systems

Exotic Applications

- Nitrous Oxide Supply in Clinical Applications
- Explosion-proof Surface Drain at Heliports
- Storage of Whisky Barrels
- Production of Brandy

Special Applications

- Food Sterilization under Vacuum
- Wafer Production in IT Industry
- Methane Extraction Fan of Mines
- Vitamin Production
- Production of Toothpaste and Mouthwash

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PROTEGO
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Corporate Video

Our Vision & Mission

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PROTEGO® Mission: A profitable, independent, international family business that, while developing and manufacturing safety valves and equipment, is the top-notch competence source for technology, quality, availability, services, engineering, and consultancy. Our field of operation is explosion protection as well as environmental protection through pressure maintenance and relief in the exploration, processing, and storage of flammable liquids and gases.

PROTEGO® World Team

Providing first-class performance

- Solution-oriented
- High-quality standards
- Consultative
- Environmentally friendly

PROTEGO® is a world market leader operating with a large global network of subsidiaries and representatives. The PROTEGO® team includes 10 distribution and after-sales service companies, as well as 120 representatives on all continents.

Competences *Maintenance & Service* *Contact*

Competence is Top Priority

What can you expect from us? The full range.

PARC´s: PROTEGO® Authorized Repair Centers (PARCs) assist with maintenance on site. PARCs, being certified service partners, meet the requirements of the PROTEGO® Works Standard in the fields of human resources, organization, workshop equipment, and machinery, as well as quality and environmental management.

Spare Parts Service: All our centers hold in stock genuine spare parts for you. Genuine parts and periodical maintenance, geared to the particular field service conditions, guarantee trouble-free operation.

Consultancy: Experienced PROTEGO® experts are available to assist with the various and differentiated application issues. They are trained to consider engineering tasks from a safety point of view.

Maintenance: We can provide you with our trained field service technicians for installation and maintenance, or you can rely on our authorized workshops. All trained personnel have been intensively prepared for their tasks at the manufacturer’s plant.

Our Research & Development Center – the largest in the world

We develop with enthusiasm and success

Our products are developed in close cooperation with users, technical institutes, and notified bodies. The PROTEGO® Research & Development Center – the largest of its kind in the world - not only serves to improve and upgrade our products, but it is also available for general research projects and tailor-made special development work. This includes investigations and testing with nominal sizes up to DN 1000 / 40”, as well as higher pressures, temperatures, and oxygen enrichment.

National and international notified bodies are regularly reassured of our high standards and consult us for support.

From the very beginning, we have developed our products in accordance with the QM system EN ISO 9001:2015 and 14001:2015, which guarantees superior product quality for our customers.

PROTEGO
for safety and environment

Development

Flame arresters protect systems subject to explosion hazards from the effects of explosions. Ever since methane gas explosions in the mining industry at the beginning of the 19th century were successfully suppressed by the development of the Davy screen mining lamp, solutions have been found for making systems safer in modern hydrocarbon chemistry where much more hazardous gases are used.

In addition, filling stations became necessary with the introduction of the automobile. With filling station tanks, the problem arose that potentially explosive vapors consisting of hydrocarbons and air that form around the tanks and loading equipment could ignite. Given the need for safe handling in dangerous atmospheres, major oil companies advanced the development of protective devices for both industrial and military applications.

Initial successes were achieved with gravel pots that were used on fuel tanks. The entrance of an explosion in the atmosphere into the storage tank or into the connected line was stopped by the gravel, and the flame was extinguished. The tank remained protected. The problem with loose gravel, however, is the non-reproducible flame arresting capability and high pressure losses. In 1929, a new development was patented that replaced the loose gravel with wound corrugated strips of metal (Fig. 1a). Together with the patented shock-absorber, a protective device was developed that stopped detonative combustion processes in the pipe with the lowest possible loss. The PROTEGO® detonation flame arrester – developed by Robert Leinemann – was born (Fig. 1b). It was given its name many years later in 1954 when Robert Leinemann founded his company Braunschweiger Flammenfilter.

As chemical processes developed, the requirements on protective devices became increasingly complex. There were also environmental protection requirements. Vapors from processes needed to be disposed of in an environmentally friendly manner and incinerated in incineration plants according to air pollution control regulations. The continuously, or only occasionally explosive mixture, was sent to an ignition source during operation. These particular hazards had to be countered with special measures. PROTEGO® flame arresters offer reliable protection in plant systems. These flame arresters are always state-of-the-art as a result of continuous research and development.

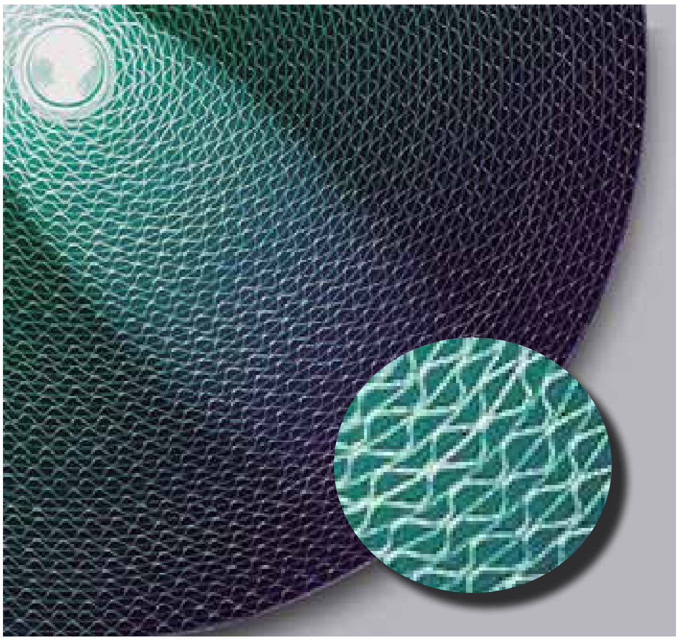


Figure 1a: FLAMEFILTER® wound out of corrugated metal strips

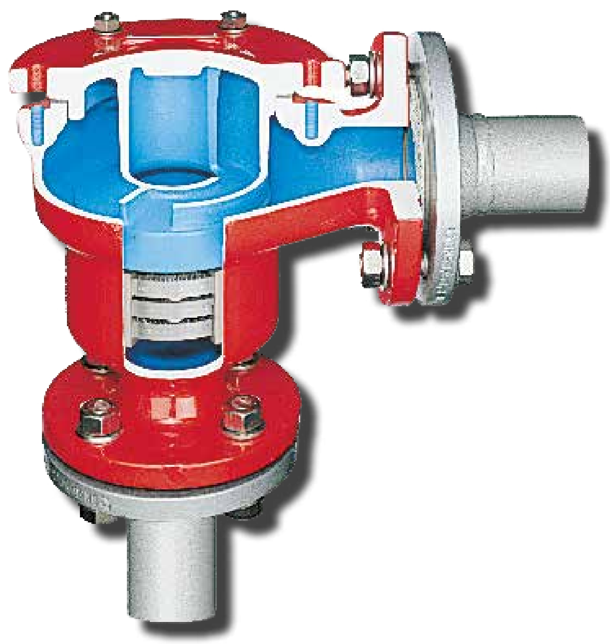


Figure 1b: Detonation Flame Arrester with Shock-Absorber

Combustion Processes

Explosive mixtures can burn in various ways. The following, among other things, can influence the combustion process: the chemical composition of the mixture, possible pressure waves, pre-compression, the geometric shape of the combustion chamber, and the flame propagation speed.

The relevant **combustion processes** for flame arresters are defined by international standards:

Explosion is the generic term for abrupt oxidation or decomposition reaction producing an increase in temperature, pressure, or both simultaneously [also see EN 1127-1].

Deflagration is an explosion that propagates at subsonic velocity [EN 1127-1]. Depending on the geometric shape of the combustion area, a distinction is made between atmospheric deflagration, pre-volume deflagration, and in-line deflagration.

Atmospheric deflagration (Fig. 2) is an explosion that occurs in open air without a noticeable increase in pressure.

Pre-volume deflagration (Fig. 3) is an explosion in a confined space (such as within a vessel) initiated by an internal ignition source.

In-line deflagration (Fig. 5) is an accelerated explosion within a pipe that moves along the axis of the pipe at the flame propagation speed below the speed of sound.

Stabilized burning is the even, steady burning of a flame, stabilized at or close to the flame arrester element. A distinction is made between **short time burning** (stabilized burning for a specific period of time) and **endurance burning** (stabilized burning for an unlimited period of time) (Fig. 4).

Detonation is an explosion propagating at supersonic velocity and is characterized by a shock wave [EN 1127-1]. A distinction is made between **stable detonations** and **unstable detonations** (Fig. 5).

A detonation is **stable** when it progresses through a confined system without a significant variation of velocity and pressure characteristic (for atmospheric conditions, test mixtures, and test procedures typical velocities are between 1,600 and 2,200 meter/second). A detonation is **unstable** during the transition of the combustion process from a deflagration into a stable detonation. The transition occurs in a spatially limited area in which the velocity of the combustion wave is not constant and where the explosion pressure is significantly higher than in a stable detonation. NOTE: The position of this transition zone depends on, among other things, the operating pressure and operating temperature, the pipe diameter, the pipe configuration, the test gas, and the explosion group and must be predetermined by experiments in each case.

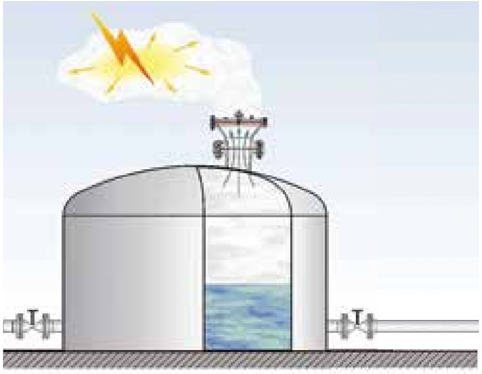


Figure 2: Atmospheric deflagration

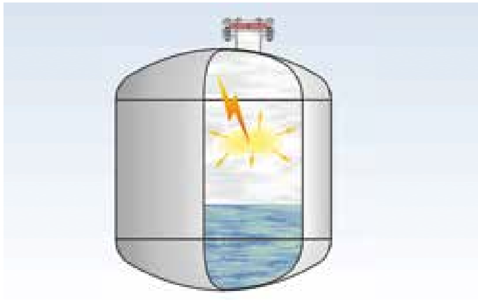


Figure 3: Pre-volume deflagration

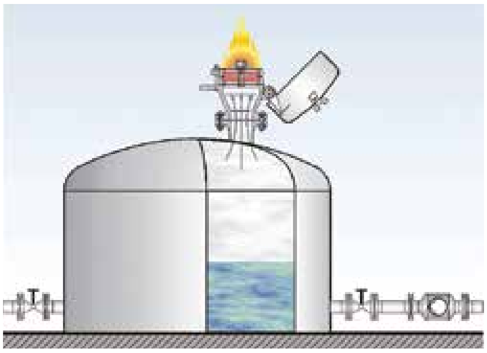


Figure 4: Stabilized burning

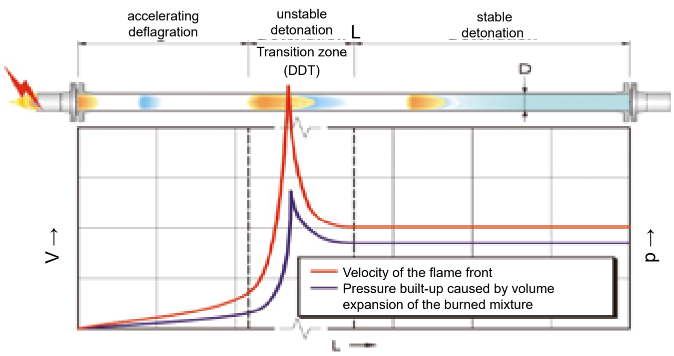


Figure 5: Deflagration – unstable detonation – stable detonation.
L= distance to ignition source
D= diameter of the pipeline
v= velocity of the flame front
p= pressure
DDT = Deflagration to Detonation Transition

Basic Types

Flame arresters are subdivided into different types according to the combustion process (endurance burning, deflagration, detonation, and the various sub-groups) and by type of installation (in-line, end-of-line, in equipment).

They are categorized as:

a) static dry flame arresters
b) static liquid seal flame arresters
c) dynamic flame arresters

Working functions

a) Static dry flame arresters

Flame arrester elements made of wound, corrugated metal strips can be manufactured with consistently reproducible flame quenching gaps. The gap size can be adjusted according to the flash back capability of the explosive mixture.

The FLAMEFILTER® is made of wound, corrugated metal strips and forms the flame arrester element. The principle of flame quenching in narrow gaps is applied in PROTEGO® end-of-line flame arresters and PROTEGO® in-line flame arresters (Sections 2, 3, 4, and 7).

When a mixture ignites in a gap between two walls, the flame spreads towards the non-combusted mixture. The expansion in volume of the combusted mixture pre-compresses the non-combusted mixture and accelerates the flame.

By heat dissipation in the boundary layer "s", transferring it to the large surface of the gap length compared to the gap width "D", and by cooling down the product below its ignition temperature (Fig. 6), the flame is extinguished.

The gap width and the gap length of the flame arrester element determines its extinguishing ability.

The narrower and longer the gap, the greater the extinguishing effectiveness. The wider and shorter the gap, the lower the pressure loss. Experiments can determine the optimum solution between these two conditions.

Original PROTEGO® technology

To protect against all of the previously mentioned combustion processes, PROTEGO® developed static dry flame arresters, optimized their design, and had them undergo national and international certifications in prototype tests (Fig. 7a and b).

All static dry PROTEGO® flame arresters are based on the working principle of the FLAMEFILTER®.

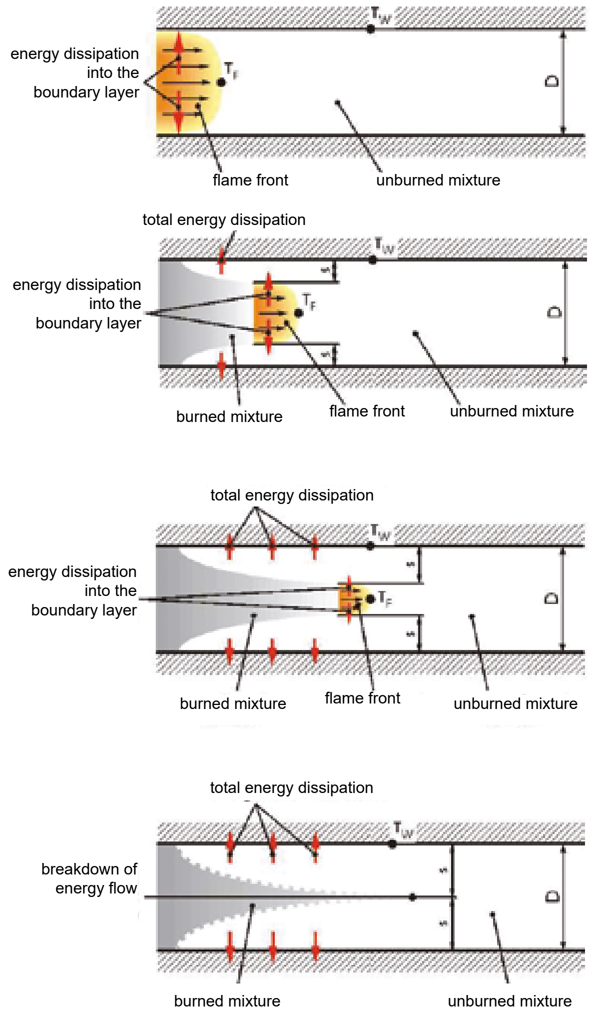


Figure 6:
Extinguishing the flame in the narrow gap (flame quenching) by heat transfer

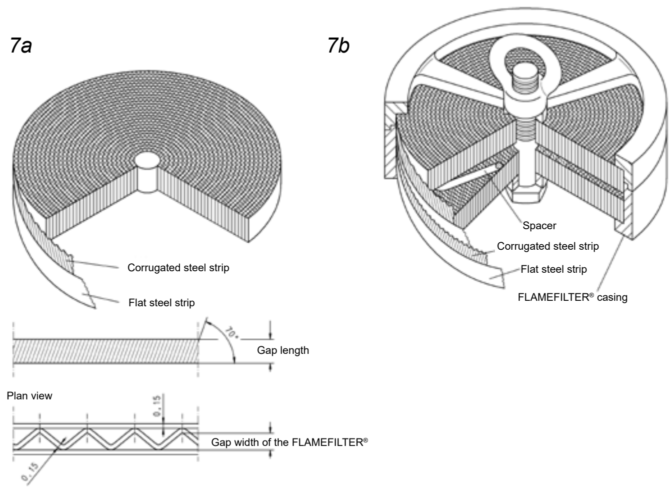


Figure 7:
FLAMEFILTER® (a) with gap widths and gap lengths and PROTEGO® flame arrester unit (b) with FLAMEFILTER®, spacer, and FLAMEFILTER® casing

Definitions

1. **Flame arresters** (Fig. 8a) are devices that are installed at the opening of an enclosure or to the connecting pipe of a system of enclosures. Their intended function is to allow flow but prevent the transmission of flame.

8a

8b

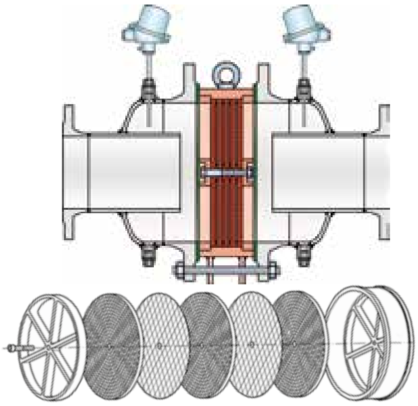


Figure 8: PROTEGO® flame arrester (a) and PROTEGO® flame arrester unit (b - modular design)

2. The PROTEGO® **flame arrester unit** (Fig. 8b and 7b) is the part of a flame arrester with a main task of preventing the transmission of flames.

3. Several **FLAMEFILTER®** components (Fig. 7a) form the PROTEGO® flame arrester unit (Fig. 7b and 8b), together with the spacers and surrounding casing.

4. Either **deflagration flame arresters or detonation flame arresters** are required depending on installation and operating conditions. Depending on the mode of operation, resistance against stabilized burning (short burning, endurance burning) may be necessary.

b) Liquid seal flame arrester

In liquid seal flame arresters, liquid barriers prevent the flames of an incoming deflagration and/or detonation from entering the protected components. Two different types exist:

1. **The liquid product flame arrester:** the liquid product is used to form a liquid seal as a barrier for flame transmission. The PROTEGO® liquid product flame arrester is an in-line or end-of-line detonation flame arrester (Section 4).

2. **The hydraulic flame arrester:** it is designed to break the flow of an explosive mixture into small bubbles flowing through water which act like a liquid barrier. The PROTEGO® hydraulic flame arrester is designed and certified to stop deflagrations, detonations, and endurance burning combustions. It is tailor made to meet the customer's specific requirements (Section 4).

The PROTEGO® hydraulic flame arrester is used both as an in- line flame arrester and as a vent header collection drum and back flow preventer in vapor collecting lines close to the incinerator. Accordingly, important safety measures have to be observed to ensure the required explosion protection.

c) Dynamic flame arresters

High velocity flame arresters are designed to produce flow velocities under operating conditions which exceed the flame velocity of the explosive mixture, and in turn, prevents flame transmission. This principle is applied in PROTEGO® Pressure Relief Diaphragm Valves (Section 7) and in PROTEGO® High Velocity Valves (Section 7) with appropriate high set pressure.

Flame arresters are type-examined **Protective Systems** in accordance with ATEX directive and are marked with CE. They are tested and certified in accordance with EN ISO 16852. Any certification in accordance with other international standards is shown by the appropriate marking.

Explosion groups

Different gases have different flame propagation capacities and are categorized into explosion groups according to their hazard level. The standard for this is the **MESG = M**aximum **E**xperimental **S**afe **G**ap, a characteristic number measured in the laboratory for the flame propagation ability of the product. The MESG, or **standard gap width**, is the largest gap width between the two parts of the inner chamber of a test setup which, when the internal gas mixture is ignited and under specified conditions, prevents ignition of the external gas mixture through a 25 mm long gap, for all concentrations of the tested gas or vapor in the air. The MESG is a property of the respective gas mixture [EN 1127-1]. NOTE: The test setup and methods are specified in EN 60079-20-1. The most explosive composition is close to the stoichiometric mixture of the gas/vapor-air mixture.

Explosion group	Max. Experimental Safe Gap (mm)	NEC	Reference Substances for testing flame arrester
IIA1*	≥ 1,14		Methane
IIA	> 0,90	D	Propane
IIB1	≥ 0,85	C	Ethene
IIB2	≥ 0,75	C	Ethene
IIB3	≥ 0,65	C	Ethene
IIB	≥ 0,5	B	Hydrogen
IIC	< 0,5	B	Hydrogen

* former designation Expl. Gr. I

The above table shows the categorization of substances into the respective explosion group according to their MESG (IEC 79-1, EN ISO 16852).

Please refer to more specific literature (especially for technical information concerning safety ratings) for the MESG of individual substances, additional ratings, and characteristic substance quantities. This information is provided by PROTEGO® upon request.

As the pressure and temperature increases, the load on the flame arresters generally increases. Flame arresters that have been tested under standard conditions are approved for and can be used at temperatures of up to 60°C (140°F) and 1.1 bar (15.9 psi). If the operating temperature and/or the operating pressure is higher, the flame arrester must undergo a special examination for the higher operating parameters.

PROTEGO® offers flame arresters for the above mentioned explosion groups for higher pressures (>1.1bar abs, 15.9 psi) and higher temperatures (>60°C, 140°F) as required by the operating pressure or temperature.

Location of installation

Depending on the location of installation, the flame arresters must fulfill various protective tasks:

At the opening of a system part to the atmosphere
→ **End-of-line flame arrester**
At the opening of a component on a connecting pipe
→ **Pre-volume flame arrester**
In the pipe
→ **In-line flame arrester**

PROTEGO® End-of-line flame arresters protect against atmospheric deflagrations and stabilized burning — either short-time burning or endurance burning. They can only be connected on one side and cannot be installed in the pipe. PROTEGO® end-of-line flame arresters can, however, be combined with valves (see Section 7: Pressure and Vacuum Relief Valves with PROTEGO® flame arresters).

PROTEGO® Pre-volume flame arresters are flame arresters which prevent flame transmission from the inside of an explosion-proof container to the outside or into a connected pipe.

PROTEGO® In-line flame arresters protect against deflagration and stable or unstable detonations in pipes. Stable detonation flame arresters prevent an explosion transmission of deflagrations and stable detonations. In-line flame arresters, which are tested against unstable detonations, protect from deflagrations and stable and unstable detonations.

The flame arresters must be installed according to their specified use. In the case of in-line deflagration flame arresters, make sure that the allowable L/D (L = distance between the ignition source and the installation location of the flame arrester; D = pipe diameter) is not exceeded. The in-line deflagration flame arresters must not be installed too far from the ignition source so that they are not subject to a detonation due to a long starting distance. The allowable L/D is stated in the manufacturers' manual of the flame arrester.

Selection

The effectiveness of flame arresters must be tested and approved. Flame arresters are categorized according to the combustion process and the installation site.

The selection criteria are described in the appropriate sections. The different variations and wide range of types are a result of tailor-made solutions for different applications. PROTEGO® flame arresters are service-friendly due to the modular design of the flame arrester unit. Special details of the design (patented Shock Wave Guide Tube Effect SWGTE or Shock absorber) enable a superior flow due to the minimum pressure loss.

Location of Installation	End-of-line			On-equipment	In-line		
Combustion process	Atmospheric deflagration	Atmospheric deflagration and short-time burning	Atmospheric deflagration, short-time burning, and endurance burning	Pre-volume deflagration	In-line deflagration	Stable detonation and in-line deflagration	Unstable and Stable detonation and in-line deflagration
Application example	→ see Safe Systems in Practice						
Products	→ Section 2	→ Section 2	→ Section 2	→ Section 3	→ Section 3	→ Section 4	→ Section 4

PROTEGO® has the right flame arrester for all applications

- End-of-line flame arresters for atmospheric deflagrations: PROTEGO® Deflagration Flame Arresters, end-of-line, Sec. 2
- End-of-line flame arresters for atmospheric deflagrations and short time burning: PROTEGO® Deflagration Flame Arresters, short-time burning-proof, end-of-line, Sec. 2
- End-of-line flame arresters for atmospheric deflagrations and short-time and endurance burning: PROTEGO® Deflagration Flame Arresters, endurance burning-proof, end-of-line, Sec. 2
- Pre-volume flame arresters on equipment: PROTEGO® Deflagration Flame Arrester units on equipment, Sec. 3
- In-line flame arresters for deflagrations: PROTEGO® Deflagration Flame Arresters, in-line, Sec. 3
- In-line flame arresters for deflagrations and stable detonations: PROTEGO® Detonation Flame Arresters, in-line, Sec. 4
- In-line flame arresters for deflagrations as well as stable and unstable detonations: PROTEGO® Detonation Flame Arresters, in-line, Sec. 4

Development

Closed vessels or tanks filled with liquid products must have an opening through which the accumulated pressure can be released so that the vessel does not explode. Along the same lines, a vacuum must be compensated for when the tank or vessel is drained so that it does not implode. Unallowable overpressure or underpressure can occur during loading and unloading, steam cleaning processes, or blanketing due to thermal effects. Free openings enable a free exchange with the atmosphere or with connected pipe systems that are uncontrolled and unmonitored. Vent caps are used in this case (Fig. 1).

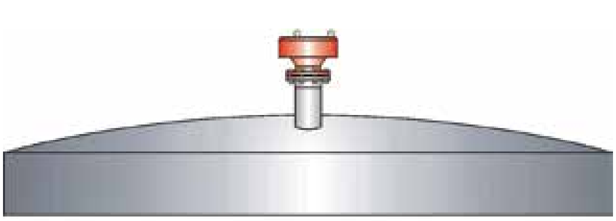


Figure 1: Free venting of the storage tank with PROTEGO® EH/0S

The vented product vapors can be poisonous, odorous, flammable, or simply represent the loss of product. They pollute the atmosphere.

The local concentration of chemical and processing plants and the associated environmental pollution have increased so much over the last 50 years that valves are now to be used, especially in industrially developed countries, to keep the free opening cross-sections closed during operation and only permit emergency venting or relief.

The ventilation devices, which are in the form of pressure and vacuum relief valves, should not be shut off (Fig. 2).

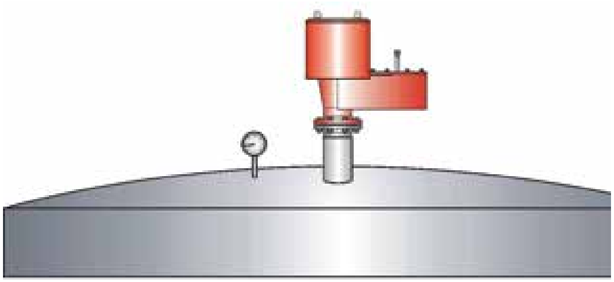


Figure 2: Venting of the storage tank with pressure and vacuum relief valve PROTEGO® VD/SV

These valves need to be simple and robust valves that do not require external control, are trouble-free, and reliably fulfill the expected tasks: maintaining and compensating pressure and vacuum.

Valve Technology

PROTEGO® pressure and vacuum relief valves have weight-loaded or spring-loaded valve pallets. When there is excess pressure in the tank, the pressure valve pallet guided in the housing lifts and releases the flow into the atmosphere (Fig. 3a) until the pressure falls below the set pressure. The valve then re-seats. The vacuum side of the valve is tightly sealed by the additional overpressure load. When there is a vacuum in the tank, the overpressure of the atmosphere lifts the vacuum disc, and the tank is vented (Fig. 3b).

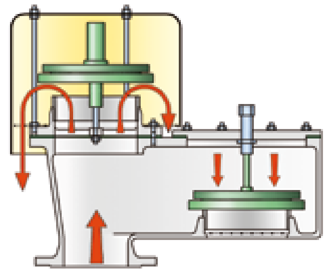


Figure 3a: Operation of the valve under pressure in the tank

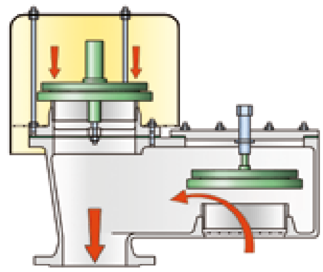


Figure 3b: Operation of the valve under vacuum (negative pressure) in the tank

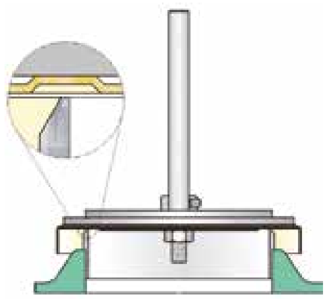


Figure 4: PROTEGO® full-lift pallet with air cushion seal

In principle, the diaphragm valve, which is loaded with liquid (as a weight), and the pilot valve, which is self-controlled, operate in the same manner. The weight-loaded valve pallets have different designs. A distinction is made between the full-lift pallet (Fig. 4 and Fig. 5 a, b) and the normal pallet (Fig. 6).

The sealing between the valve pallet and the valve seat is provided by an FEP air cushion seal, a metal to metal sealing, or a PTFE flat sealing, depending on the set pressure or on the application. The best sealing is obtained with a metal valve disc lapped to be seated on the metal valve seat (metal to metal). When the set pressures are low, an FEP air cushion seal provides a tight seal. The tightness of the PROTEGO® valves is far above the normal standard (API 2000 or EN ISO 28300) and meets the stringent demands of emission control regulations.

PROTEGO® **pressure and vacuum relief valves with full-lift pallet** release the flow within 10% overpressure from the set pressure to a fully opened valve (full-lift).

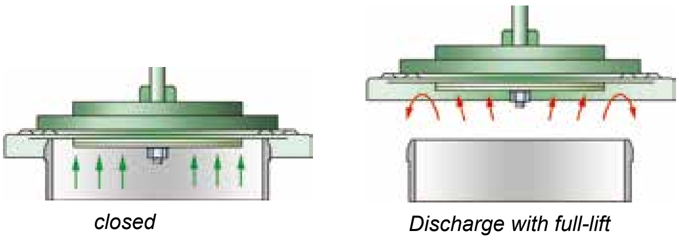


Figure 5a: Discharge with full-lift pallet and air-cushioned seal

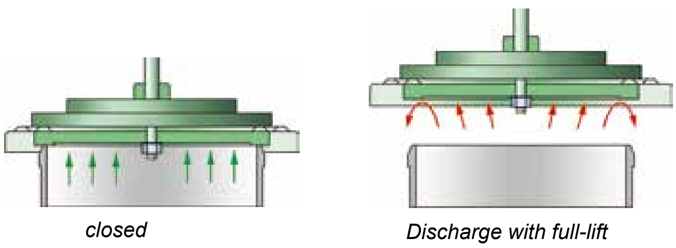


Figure 5b: Discharge with full-lift pallet and metal seal

This is achieved by precisely matching the diameter and height of the valve pallet rim with the adapted machined and lapped valve seat. In addition, the flow-enhancing design reinforces the overall effect on the outflow side. These valve pallets are used in end-of-line and in-line valves.

PROTEGO® **pressure and vacuum relief valves with conventional pallets** release the flow within a 40% pressure (Fig. 6).

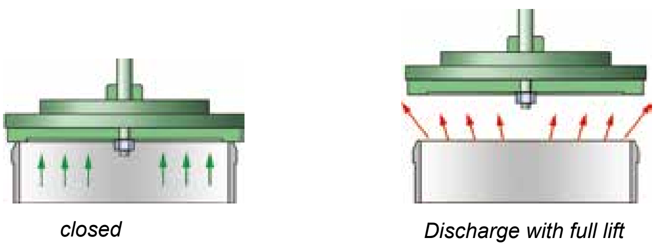


Figure 6: Discharge with normal pallet (flat with metal seal)

After the initial response, the rise in pressure is proportional to the discharged flow up to a full lift. When the back pressure in the connected pipeline is high, or the valve is installed in combination with a pressure control valve, this method provides greater stability for the overall system. However, the overall flow performance is not as good as that of valves with full-lift valve pallets. These valve pallets (Fig. 6) are primarily used in in-line valves when required by operating conditions.

Depending on the design of the valve and the valve pallets, the design pressure and design vacuum (negative gauge pressure) is achieved with different overpressure (Fig. 7). Unless otherwise specified, the standard PROTEGO® valve design is for 10% technology.

Advantages of **PROTEGO® 10% technology**:

- Pressure conservation very close to the maximum allowable tank pressure
- Minimization of product losses
- Reduction of vapor emissions

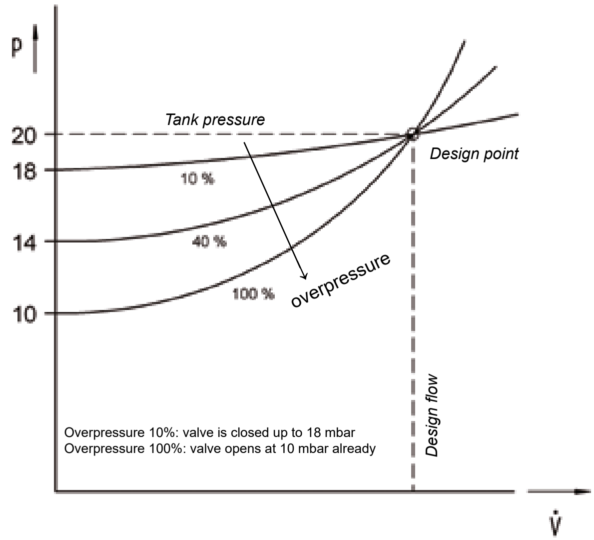


Figure 7: Opening characteristics of valves with different overpressure levels

The PROTEGO® **diaphragm valve** (Fig. 8) has a liquid load above the diaphragm.

The static liquid column is an indication of the set pressure. The flexible liquid-loaded diaphragm adjusts tightly to the metallic valve seat to provide an excellent seal. If the set pressure is exceeded, the diaphragm lifts and releases the cross-section for the flow to release. Due to the flexible diaphragm, these valves are used in weather-related low temperatures and in sticky, polymerizing substances. PROTEGO® diaphragm valves are the only valves worldwide which are frost-proof down to -40°C (-40°F).

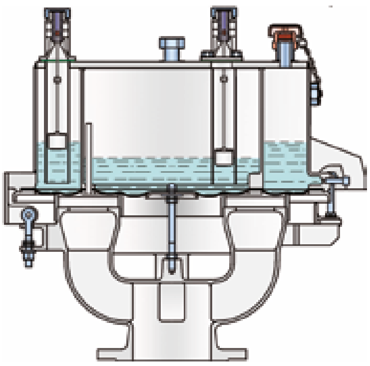


Figure 8: Diaphragm Valve PROTEGO® UB/SF-0

The self-controlled PROTEGO® **pilot operated valve** (Fig. 9) releases the flow without requiring additional overpressure. Up to the set pressure until the pilot reacts, the valve remains sealed. It immediately opens to full-lift after the set pressure is reached without overpressure and releases the cross-section of the valve (set pressure = opening pressure). As the pressure increases, the seal increases up to the set pressure. Once the flow is released and the pressure falls below the opening pressure, the valve recloses. PROTEGO® pilot valves are mainly used as safety relief valves for low-temperature storage tanks or when the valve must be very tightly sealed up to the set pressure.

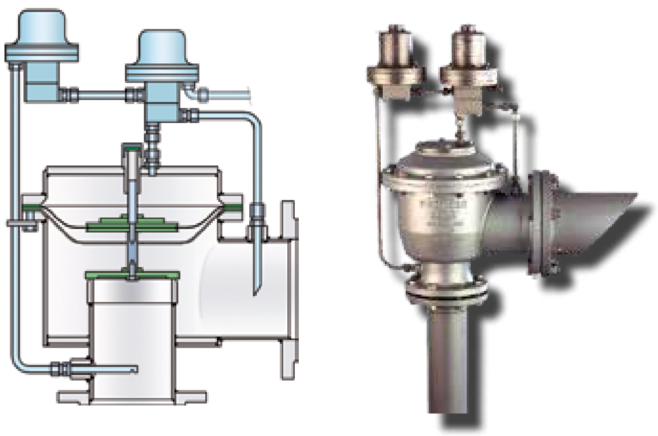


Figure 9: pilot operated pressure relief valve PROTEGO® PM/DS

The operating requirements, regarding the amount of out-breathing and in-breathing capacity, determine whether separate pressure valves and vacuum valves, or combined pressure and vacuum relief valves are used.

Pressure and vacuum relief valves for maintaining pressure (vapor conservation)

Process-related pressure maintenance in systems is ensured by valves that take pressure vessel related parameters into consideration. Conventional safety valves are used for pressures above 0.5 barg (7.25 psig) according to EN-ISO 4126 and Pressure Equipment Directive (PED), API 526 and ASME VIII, Div.1, or other international standards. For pressures below 0.5 barg (7.25 psig), the pressure can be maintained with safety valves that are not subject to the regulations of Pressure Equipment Directive (PED). However, they need to meet other criteria, e.g., provide a good seal, be frost-proof, trouble-free, and easy to maintain. PROTEGO® pressure and vacuum conservation valves meet these requirements with the highest degree of efficiency. And thanks to the 10% technology, they ensure reliable operation and minimum emission losses, even at the lowest setting pressures.

National and international technical regulations for maintaining clean air serve as the basis for calculating savings (such as VDI 3479: “Emission Control - Marketing Installation Tank Farms”, VOC Directive 1999/13/EC and 94/63/EC or API MPMS Chapter 19.1: “API Manual of Petroleum Measurement Standards - Chapter 19, Evaporative Loss Measurement, section 1 - Evaporative Loss from Fixed-Roof Tanks, 3rd Edition”). The design of the tank, the paintwork, the insulation, and the pressure maintenance via the valves have an influence on the emissions reduction.

The effect that pressure maintenance has on the reduction of product (vapor) loss improves as the set pressure of the valve approaches the maximum allowable tank pressure. The flow needs to be reliably released without the tank rupturing. A comparison of product loss at different overpressures clearly shows the advantages of 10% technology compared to 40% overpressure and especially compared to 100% overpressure. The specially developed design yields measurable savings – the required opening pressure differential is lower to the required performance (Fig. 10).

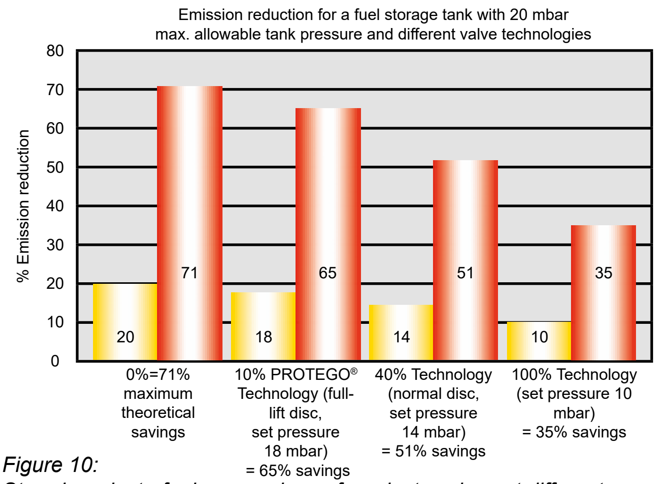


Figure 10:
Stored product - fuel: comparison of product savings at different over-pressure levels versus the free vented storage tank: example of product loss at 20 mbar allowable tank pressure savings in % at different overpressure
0% = up to 20 mbar (8 inch W.C.) the valve is closed (theoretical): more than 70% savings
10% = only at a valve set pressure 18 mbar (7.2 inch W.C.) the valve opens, 65% savings
40% = at a valve set pressure 14 mbar (5.6 inch W.C.) the valve opens, 51% savings,
100% = already at a valve set pressure 10 mbar (4 inch W.C.) the valve opens, only 35% savings.

Pressure and Vacuum Relief Valves for Pressure Relief and Tank Breathing

Outdoor storage tanks and vessels are exposed to weather conditions such as heating up and cooling down (the tank must be able to breathe). These influences must be considered in addition to filling and emptying capacities as well as inert-gas supply. They can be calculated with good approximation (see Venting Requirements of Above-ground Storage Tanks - Sizing and Calculation Formulas). The valve opening pressure must not exceed the maximum allowable tank pressure, which is also called the tank design pressure. The construction and design of the valve determines how this opening pressure is reached. Safety valves with conventional construction designed for pressure vessels with 0.5 bar (7.25 psi) overpressure require an overpressure of 10% above the set pressure to attain the opening pressure. Below 1 bar (14.5 psi) pressure, the maximum overpressure may reach 100 mbar (4 inch W.C.), which is clearly above the 10% level. In contrast, PROTEGO® valves with the relevant technology meet the requirements of conventional safety valves with an overpressure of 10% even at low set pressures down to 0.003 bar (1.2 inch W.C.).

Under normal operating conditions, it must be impossible to block the venting system on the tank. The sizing of the pressure and vacuum relief system must be such that the design pressure, i.e., the pressure and vacuum (negative pressure), in the tank cannot be exceeded under any operating conditions. The **pressure and vacuum relief valve** must be designed for maximum flow arising from the pump capacity, thermal influences, and where the tank is not constructed with a frangible roof. This valve is frequently called the vent valve.

When extremely high venting rates are required due to fire on the outside surface of the tank or malfunctions in special tank equipment (such as tank blanketing gas systems), additional **emergency pressure relief valves** must be used, especially when the tank roof does not have a frangible roof (Fig. 11).

When a blanket gas system fails, large amounts of gas can flow into the tank. The excess gas must be released from the tank through the pressure relief system without exceeding the tank design pressure.

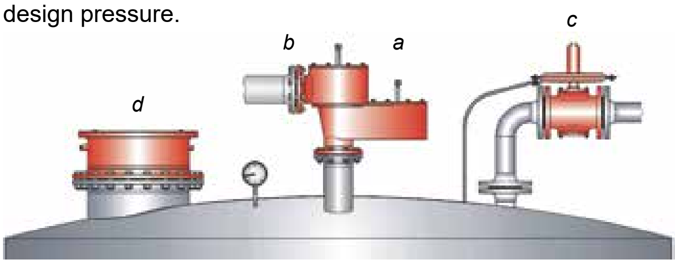


Figure 11: Venting of the storage tank with a pressure and vacuum relief valve PROTEGO® VD/SV-PA (a); piped into the vent header during operation (b); venting during operation via the nitrogen control valve PROTEGO® ZM-R (c); relieving in fire emergency through the emergency pressure relief valve PROTEGO® ER/V (d).

PROTEGO® valves fulfill the above-mentioned functions of maintaining and relieving pressure **as pressure relief valves, vacuum relief valves**, or **combined pressure and vacuum relief valves**.

Location of installation

PROTEGO® end-of-line valves are mainly used for storage tanks, vessels, or for ventilation lines. In pipes, PROTEGO® in-line valves are used for backflow prevention as overflow valves and, occasionally, as control valves. The great advantages are their simple design and large opening cross-sections. These valves operate problem-free. If the flowing products are explosive, in-line valves must have upstream flame arresters to protect the system against accelerated combustions. End-of-line valves must be equipped with an end-of-line flame arrester to protect the system against atmospheric deflagration (see also Section 7).

Sizing of the Valves

The maximum possible volumetric flow, the maximum allowable pressures, and the operating data (process parameters) must be taken into account when sizing pressure/vacuum relief valves.

Definitions:

Set pressure = the valve starts to open = adjusted set pressure of the valve at 0 bar back pressure

Opening pressure = set pressure plus overpressure

Reseating Pressure = Closing pressure = the valve recloses and is sealed

Overpressure = pressure increase over the set pressure

Accumulation (ISO) = pressure increase over the maximum allowable tank pressure of the vessel allowed during discharge through the pressure relief valve

Accumulation (EN) = differential pressure between the set pressure of the valve and the tank pressure at which the required flow rate is reached, or the set vacuum of the valve and the tank internal negative pressure at which the required flow rate is reached (not used in this catalog)

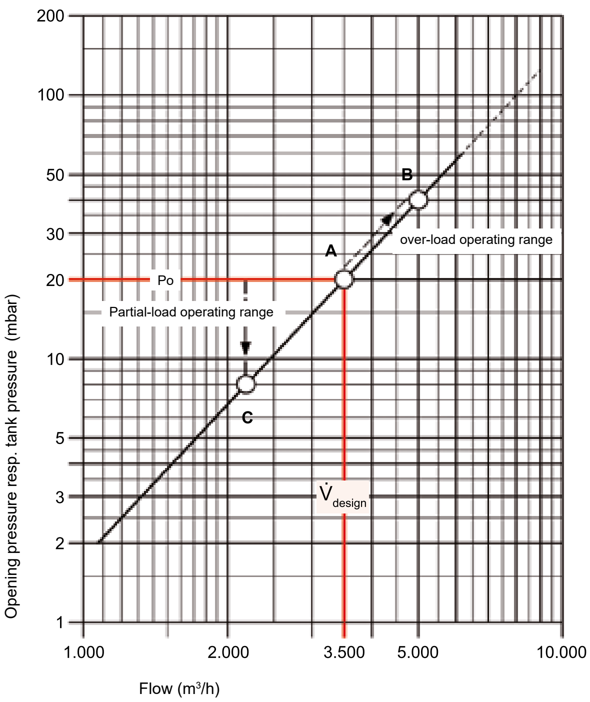
Pressure loss = decrease in pressure within the valve at a given flow

Pressure loss curve (Flow Chart) = pressure loss in mbar as a function of the volume flow in m^3/h (CFH)

Back pressure = pressure in the system that acts against the flow out of the valve and that needs to be included as additional pressure on the valve pallet

The maximum allowable design pressure of equipment, a storage tank, or vessel may not be exceeded. The maximum allowable flow must be safely released through the valve so that the maximum allowable design pressure of the equipment is not exceeded. Safety factors must be considered.

Operating conditions of pressure and vacuum relief valves: The valve is optimally sized when the operating point lies on the performance curve, i.e., when the calculated maximum flow is released with the valve completely open without requiring additional overpressure (with a completely open valve) (full-load operating range A, Fig. 12).



$$\textit{set pressure} = \frac{\textit{opening pressure or tank design pressure}}{1 + \frac{\textit{overpressure \%}}{100\%}}$$

Figure 12: Design and operating points in the flow chart

When the design flow is not being reached during discharge, the valve does not open completely. The valve pallet only lifts briefly, releases the volume, and then recloses when the pressure falls below the set pressure. The reseating pressure depends on the design of the valve pallet and the geometry of the valve. There are partial-load operating ranges in which the full-lift is not reached (over-sized valves) and overload ranges in which additional overpressure is required after a full lift to release the flow (under-sized valves). Within the overload range, the valve is stable; in the partial load range, the valve pallet can flutter due to instability. A proper sizing that considers possible operating conditions into consideration is essential.

Example (Fig. 12):

Valve opening pressure	P_o = 20 mbar
Valve set pressure	P_{set} = 18 mbar (20 mbar - 10%)
A design flow	$\dot{V}_{design}$ = 3.500 m³/h
B over-load	$\dot{V} > \dot{V}_{design}$
C partial-load	$\dot{V} < \dot{V}_{design}$

For sizing of combined single component devices which have not been flow tested as combined devices (e.g., DR/ES with DV/ZT), a special sizing process needs to be considered. Please contact our sales engineers for specific information.

Selection

The valves are selected using the above selection criteria which depends on the **location of installation** and whether the valve is to **function** as a pressure relief valve, vacuum relief valve, or combined pressure and vacuum relief valve.

Location of Installation	End-of-line Valves				In-line Valves		
Function	Pressure Relief Valves	Vacuum Relief Valves	Pressure and Vacuum Relief Valves	Pressure Relief and Vacuum Valves, pilot operated	Pressure or Vacuum Relief Valves	Pressure and Vacuum Relief Valves	Blanketing Valves
Example of Use	→ see Safe Systems in Practice						
Product	→ Section 5	→ Section 5	→ Section 5	→ Section 5	→ Section 6	→ Section 6	→ Section 6

PROTEGO® has the right valve for all applications

For venting of storage tanks and vessels
→ PROTEGO® Pressure and Vacuum Relief Valves, end-of-line (Sec. 5)

As overflow valves or backflow preventers
→ PROTEGO® Pressure or Vacuum Relief Valves, in-line (Sec. 6)

For tanks which store critical substances or where frost protection must be guaranteed:

→ PROTEGO® Pressure / Vacuum Relief Diaphragm Valves, end-of-line (Sec. 5)

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Development

When storing flammable products or processing chemical products that can create explosive mixtures, the opening of the storage tank or vessel must be additionally protected with flame arresters. The task was to develop a device that combined the properties of a flame arrester and a valve into one design.

PROTEGO® valves with integrated flame arrester units have the unique advantage in that the flame arrester units are external, making them easily accessible (Fig. 1 and 2).

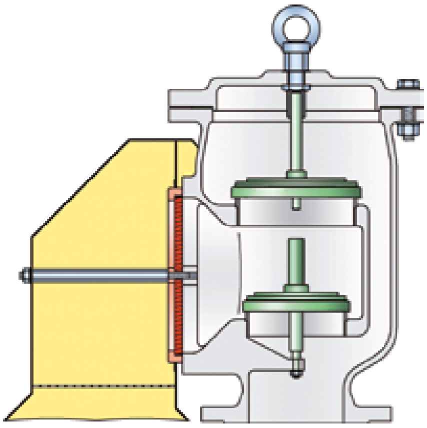

Figure 1: Deflagration-proof pressure and vacuum relief valve PROTEGO® VD/TS

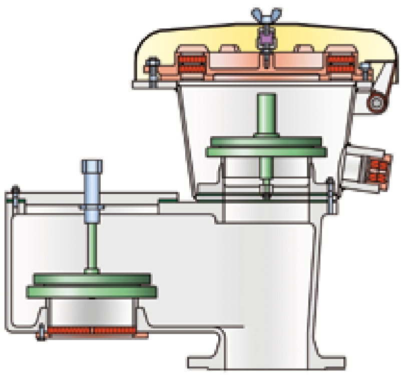

Figure 2: Pressure and vacuum relief valve protecting against deflagration and endurance burning PROTEGO® VD/SV-HR

The operating conditions must be carefully considered. Depending on the possible combustion processes, protection must be provided against atmospheric deflagration, and/or short-time burning, and/or endurance burning.

Valve Technology

The valve technology and function of the pressure and vacuum valves with integrated flame arrester units are equal to those without flame arrester units, through which the down-stream flame arrester unit creates a certain back pressure which has no impact on the set pressure but influences the overpressure difference. This has been considered and is shown in the flow charts.

Pressure and Vacuum Relief Valves with Flame Arrester

Pressure and vacuum relief valves with integrated flame arrester units have the same tasks and functions as valves without flame arrester. They serve to **maintain pressure (vapor conservation) or for pressure relief** and enable **tank breathing**.

Flame Arrester

The valves also have an **integrated flame arrester unit**. The explosion group of the chemical products to be protected needs to be considered in the flame transmission-proof selection of the valve. The chemical products are categorized into explosion groups according to the maximum experimental safe gap (MESG) of the mixtures. The valve is tested and approved for the explosion group.

The PROTEGO® **diaphragm valve** (Fig. 3) has a liquid load above the diaphragm. The static liquid column is proportional to the set pressure. The flexible liquid-loaded diaphragm adjusts tightly to the metal valve seat to provide an excellent seal. If the set pressure is exceeded, the diaphragm lifts and releases the cross-section for the discharging flow. Due to the flexible diaphragm, these valves are used in weather-related low temperatures and for sticky, polymerizing substances.

The PROTEGO® **diaphragm valve** (Fig. 3a) offers dynamic flame-transmission protection against endurance burning and atmospheric deflagrations.

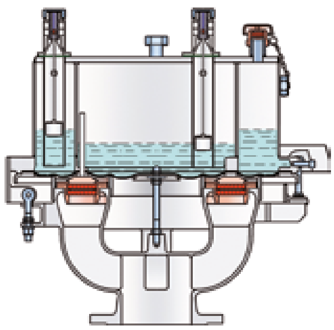

Figure 3: Diaphragm valve PROTEGO® UB/SF protecting against deflagration and endurance burning

Figure 3a: Endurance-burning test with diaphragm valve PROTEGO® UB/SF

The **high velocity valve** (Fig. 4) has special flame transmission protection with a dynamic discharge between the valve cone and valve seat starting at a set pressure of +60 mbar (24 inch WC). The high velocity valve is endurance burning-proof.

Figure 4: Endurance burning-proof high velocity valve PROTEGO® DE/S with a connected deflagration-proof vacuum valve PROTEGO® SV/E-S

Location of installation

Valves with flame arrester units are always end-of-line valves since the heat must be released to the environment with no heat build-up to prevent transmission of flame. Otherwise, the unallowable heat build-up would lead to a heat accumulation at the flame arrester, resulting in a flash-back. They are primarily used for storage tanks and containers in which flammable liquids are stored or processed and for relief openings in process containers in which the occurence of explosive mixtures cannot be excluded.

Design and operating conditions of valves

The sizing and operating conditions of the pressure and vacuum relief valves are described on the previous page.

Selection

Since PROTEGO® pressure/vacuum relief valves with flame arrester units are always end-of-line valves, they are selected according to their function as a pressure valve, vacuum valve, or combined pressure and vacuum relief valve.

After the explosion group of the products and the possible combustion process have been determined, the valve can be selected for its flame transmission protection. When selecting PROTEGO® valves with a flame arrester unit, it must be determined whether flame transmission protection is to be provided against atmospheric deflagrations or endurance burning. Endurance burning flame arresters include protection against atmospheric deflagrations. Flame transmission-proof vacuum relief valves are deflagration-proof. There is no danger of a stabilized burning with vacuum relief valves.

Location of Installation	**End-of-line Valve**				
Function	Pressure Relief Valve with Flame Arrester	Vacuum Relief Valve with Flame Arrester	Pressure and Vacuum Relief Valve with Flame Arrester	Pressure- / Vacuum Relief Diaphragm Valve with Flame Arrester	High Velocity Valve
Example of Use	→ see Safe Systems in Practice				
Products	→ Section 7	→ Section 7	→ Section 7	→ Section 7	→ Section 7

PROTEGO® has the right valve for all applications.

For flame transmission-proof pressure and vacuum relief of storage tanks and containers:
→ PROTEGO® Pressure and Vacuum Relief Valves with Flame Arresters, end-of-line

For frost-proof application, for critical products, and for flame transmission-proof pressure and vacuum relief of tanks and containers:
→ PROTEGO® Pressure-/ Vacuum Relief Diaphragm Valves

For flame transmission-proof pressure and vacuum relief of tank ships:
→ PROTEGO® High Velocity Valves

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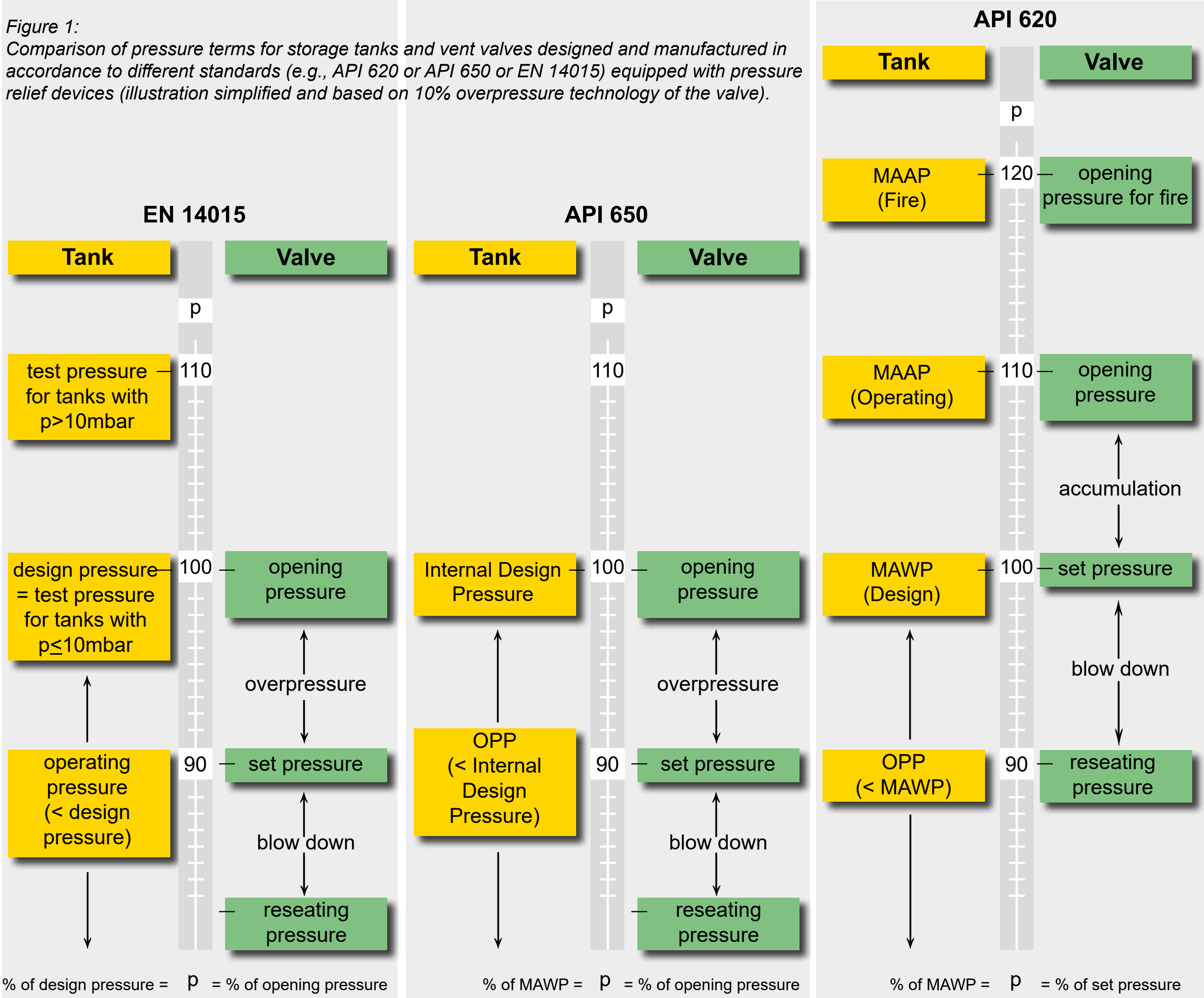
Pressure Terms and Definitions

Tanks storing flammable and non-flammable liquids are designed and manufactured in accordance with different standards: EN 14015, API 620, or API 650 are the most important standards worldwide. Depending on the standard, different maximum tank pressures are allowable where the discharge flow has to be achieved.

Fig. 1 shows the most common terms for tanks and valves. This comparison clarifies the sizing of end-of-line relief valves featuring the 10% overpressure technology with a set pressure of only 10% below the opening pressure. In **EN 14015** and **API 650 (Fig. 1A and 1B)** the design pressure (**MAWP** = **M**aximum **A**llowable **W**orking **P**ressure) of the tank must not be exceeded, not even in fire emergencies or system malfunction. According to **API 620 (Fig. 1C),** the valve must release the required regular flow rate 10% above the design pressure of the tank. For fire or other emergency conditions, an overpressure of 20% is allowable, i.e., the required flow rate must be released after exceeding the MAWP by a maximum of 20%.

Figure 1:
Comparison of pressure terms for storage tanks and vent valves designed and manufactured in accordance to different standards (e.g., API 620 or API 650 or EN 14015) equipped with pressure relief devices (illustration simplified and based on 10% overpressure technology of the valve).



design pressure
= calculated pressure = Maximum Allowable Working Pressure (MAWP) must not be exceeded under any operating conditions. For fire and emergency conditions, a frangible seam or emergency relief valve is required.

opening pressure
≤ design pressure;

set pressure = 0,9 x opening pressure for 10% overpressure technology.

Figure 1A

internal design pressure
= max. relieving pressure under operating condition, fire condition or emergency (max. relieving pressure for valve and emergency valve).

OPP = Operating Pressure

opening pressure
≤ internal design pressure

set pressure = 0,9 x opening pressure for 10% overpressure technology.

Figure 1B

MAAP
= Maximum Allowable Acumulated Pressure = max. relieving pressure under operating condition (max. relieving pressure for valve). Relief Pressure for fire and emergency conditions relieve at 20% above overpressure.

Max. allowable set pressure
= MAWP for 10% overpressure technology.
MAWP = Maximum Allowable Working Pressure

Figure 1C

Engineering Service QuEST - Quick Engineering and Sizing Tool

Fig. 2 shows the procedure to determine the set pressure for valves with different overpressure characteristics by considering the specific tank design pressure. These examples are only for end-of-line relief valves without a back-pressure originated by, e.g., connected pipe-away line. If the tank is designed in accordance with EN 14015 or API 650, the opening pressure must not exceed the design pressure (=MAWP) of the tank (Fig. 2A). The set pressure is a result of the opening pressure minus the overpressure of the valve, which is a characteristic of the specific valve. If the tank is manufactured in accordance with API 620, the opening pressure may exceed the tank design pressure by 10% for regular breathing and 20% for fire emergencies (Fig. 2B). The set pressure is again the result of the opening pressure minus the valve characteristic overpressure. To dertermine the flow rates, the relevant regulations of ISO 28300, TRbF 20, or API 2000 must be applied.

Figure 2:
Selection of the set pressure of the Pressure or Vacuum Relief Valve considering the tank design pressure and the valves characteristic overpressure (e.g. 10%, 40% or 100%). API 620 using the 20% over-pressure allowance for fire emergency.

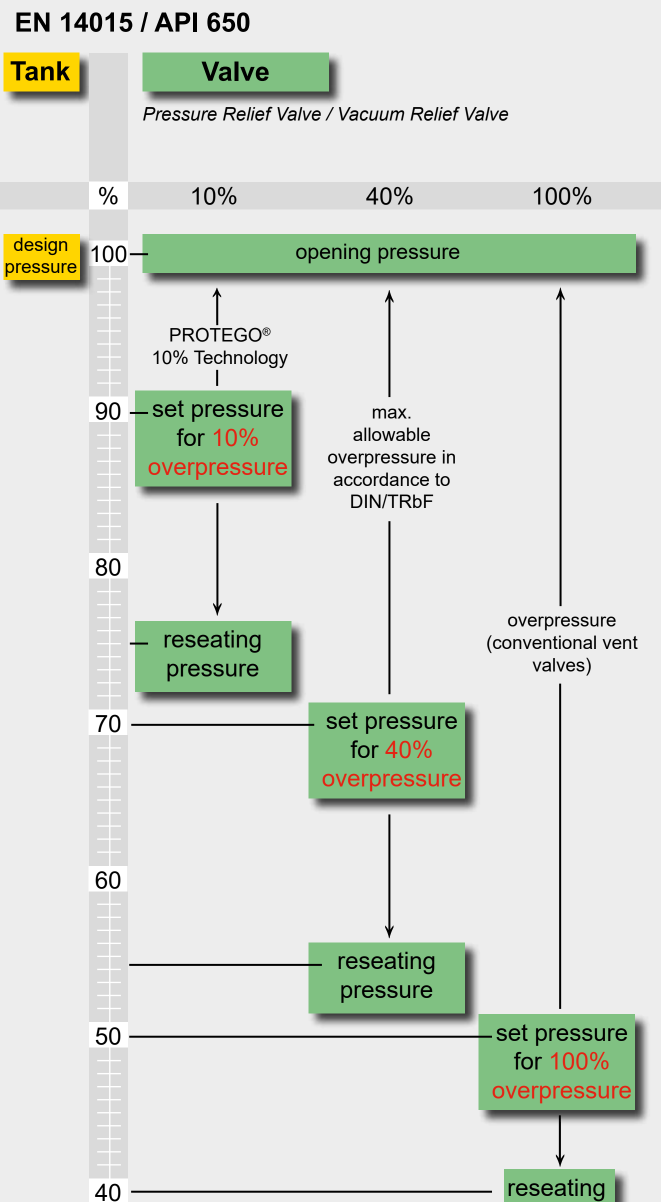


Figure 2A: Design in acc. with EN 14015 or API 650

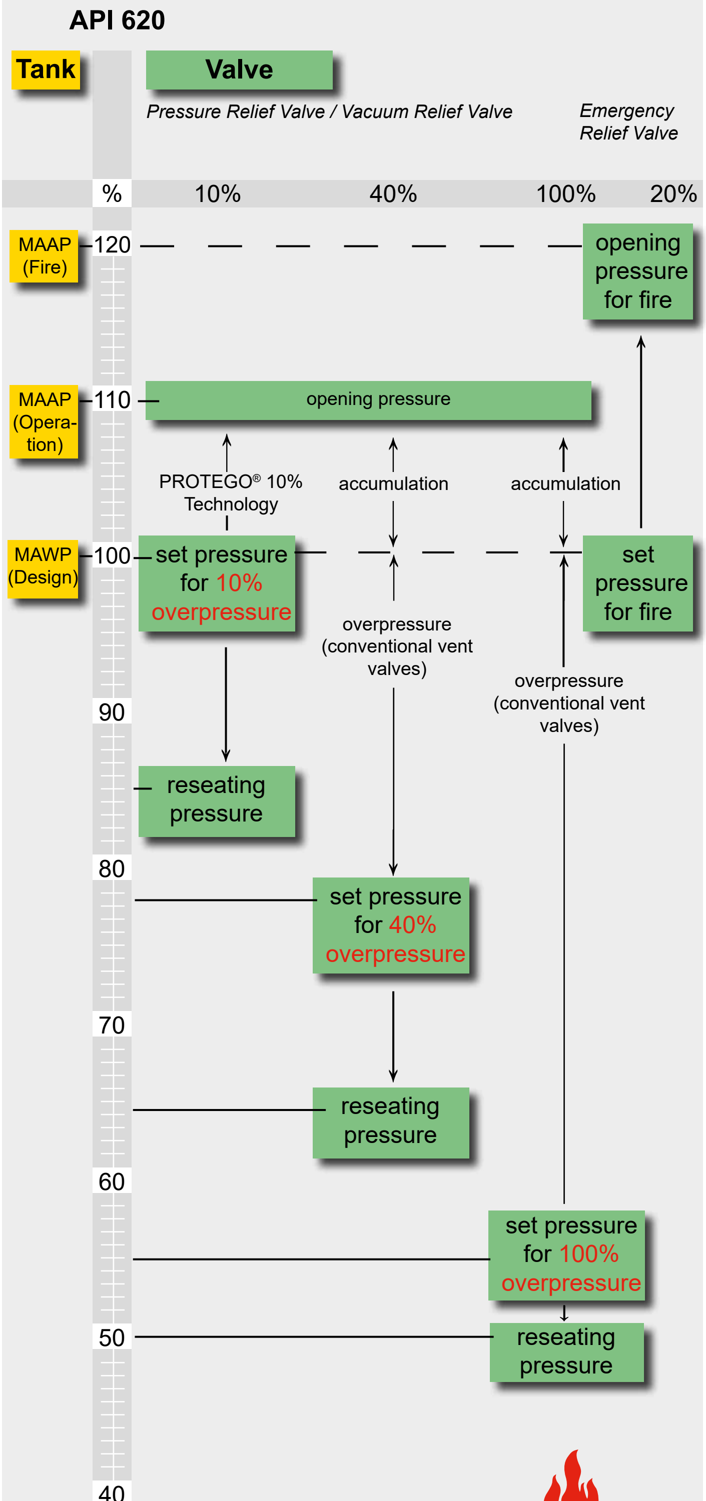


Figure 2B: Design in acc. with API 620

PROTEGO
for safety and environment

Calculation of the Out-breathing and In-breathing venting capacity in acc. with ISO 28300/API 2000:

The maximum required venting capacity is the total amount of pump capacity and thermal capacity due to weather related conditions:

$$\dot{V}_{\text{out}} = \dot{V}_{\text{thermal out}} + \dot{V}_{\text{pump in}}$$

$$\dot{V}_{\text{in}} = \dot{V}_{\text{thermal in}} + \dot{V}_{\text{pump out}}$$

The calculation of the maximum required capacity from weather related conditions is based on ISO 28300 with regard to above-ground storage tanks with or without insulation.

Thermal capacity for heating up $\dot{V}_{\text{thermal out}}$ in m^3/h

$$\dot{V}_{thermal\ out} = 0{,}25 \cdot V_{\text{tank}}^{0.9} \cdot R_{\text{i}}$$

Thermal capacity for cooling down $\dot{V}_{\text{thermal in}}$ in m^3/h

$$\dot{V}_{thermal\ in} = C \cdot V_{\text{tank}}^{0.7} \cdot R_{\text{i}}$$

- V_{tank} is the volume of the tank in m^3

  $V_{\text{tank}} = 0{,}7854 \cdot D^2 \cdot H$
- R_i is a reduction factor for insulation (see ISO 28300/API 2000)
- $\dot{V}_{\text{pump in}}$ is the filling rate to calculate the out-breathing capacity out of the maximum pump capacity in m^3/h for products stored below 40°C and a vapor pressure p_{vp} < 50 mbar. For products stored at a temperature above 40°C or with a vapor pressure p_{vp} > 50 mbar, the out-breathing rate must be increased by the evaporation rate.
- $\dot{V}_{\text{pump out}}$ is the emptying rate to calculate the in-breathing capacity of the pump in m^3/h.
- C=3 for products with equal vapor pressure as hexane and storage temperature < 25°C
- C=5 for products with vapor pressures higher than hexane and/or storage temperature above 25°C (if vapor pressure not known, then C=5)

The mentioned calculation formulas apply to latitudes of 58° to 42°. For other latitudes, see ISO 28300/API 2000.

Particular influences to be considered are:

- Failure of the nitrogen blanketing valve – Installation of an additional emergency relief valve to vent the non calculated flow which was not foreseen under operation
- Filling the empty hot tank with cold liquid product – Considering the additional flow due to the sudden cooling down when calculating the necessary vacuum capacity
- Exceeding the maximum given pump out capacity – Considering a safety factor when calculating the required in-breathing capacity

Calculation of the Out-breathing and In-breathing venting capacity in acc. with TRGS 509:

To calculate the out-breathing and in-breathing capacity of storage tanks (e.g., tanks in acc. with DIN 4119 for above-ground, flat-bottom storage tanks, or DIN 6608 for underground or underground horizontal tanks), the calculation formulas of TRGS 509 (as of 1 January 2013, VdTÜV-Merkblatt Tank-anlagen 967) are to be applied.

Calculation of the required capacity due to thermal influences:

Heating up	$\dot{V}_E = 0{,}17 \times \left(\frac{H}{D}\right)^{-0{,}52} \times V_{tank}^{0{,}89}$
Cooling down	$\dot{V}_A = 4{,}8 \times V_{tank}^{0{,}71}$

H = Height of the Tank in m; D = Diameter in m

Calculation of Out-breathing and In-breathing venting capacity in acc. with API 2000, 5th Edition / ISO 28300 Annex A:

The out-breathing and in-breathing capacity of petroleum storage tanks can be calculated in acc. with ISO 28300 Annex A (approximately equivalent to API 2000 5th Edition) if specific boundary conditions are fulfilled (see ISO 28300).

If specified and if the tanks are designed and manufactured in accordance with **API 650,** the venting capacity for in-breathing and out-breathing, as well as for fire emergencies, is to be calculated in accordance with **API 2000**.

When calculating the required capacities in accordance with API 2000, 5th Edition / ISO 28300 Annex A, the flammable liquids must be verified with regard to their flashpoint. Different formulas must be applied for liquids with a flashpoint < 100°F (< 37,8°C) and for liquids with a flashpoint ≥ 100°F (≥ 37,8°C). The maximum required venting capacity is the total amount of pump capacity plus thermal capacity of weather-related conditions. In contrast, the calculation of the pump capacity must consider a factor for the in-breathing rate and the different flashpoints for the out-breathing rate.

Calculation of the in-breathing capacity:

$$\dot{V}_{in} = \dot{V}_{pump\ out} \times 0{,}94 + \dot{V}_{thermal\ in}$$

The thermal capacity thermal$_{In}$ is rated in API 2000, 5th Ed. **(Fig. 2A,** English units and **2B,** Metric units) depending on the tank volume. The maximum pumping capacity $\dot{V}_{pump\ out}$ is rated in accordance with the specified operating rates for draining.

Calculation of the out-breathing capacity:

For liquids with flashpoint <100°F (<37,8°C)

$$\dot{V}_{out} = \dot{V}_{pumping\ in} \times 2{,}02 + \dot{V}_{thermal\ out}$$

For liquids with flashpoint ≥100°F (≥37,8°C)

$$\dot{V}_{out} = \dot{V}_{pumping\ in} \times 1{,}01 + \dot{V}_{thermal\ out}$$

The thermal capacity $\dot{V}_{thermal\ out}$ is rated in API 2000, 5th Ed. (**Fig. 2A,** English units **and 2B,** Metric units) depending on the tank-volume and the flashpoint. The maximum pumping capacity $\dot{V}_{pump\ in}$ is rated in accordance with the specified operating rates for filling.

In case there is no frangible seam, emergency venting for fire emergencies is to be carried out through an emergency pressure relief valve. The required capacity for fire emergencies $\dot{V}_{Fire}$ is rated in accordance with API 2000 **(Fig. 3A**, English units and **Fig. 3B,** Metric units) depending on the wetted surface area of the tank.

Simplified formula for estimating calculation:

$$\dot{V}_{fire} = 208{,}2 \times F \times A^{0{,}82} \text{ for Metric units in Nm}^3\text{/h}$$

$$\dot{V}_{fire} = 1107 \times F \times A^{0{,}82} \text{ for English units in SCFH}$$

Insulation is considered with a factor F in API 2000 **(Fig. 4A,** English units and **4B**, Metric units).

Requirements for Thermal Venting Capacity (English Units)

Tank Capacity	Tank Capacity	In-breathing *thermal $_{in}$*	Out-breathing *thermal $_{Out}$*	
			Flashpoint ≥ 100°F	Flashpoint < 100°F
Barrels	Gallons	SCFH Air	SCFH Air	SCFH Air
100	4.200	100	60	100
500	21.000	500	300	500
1.000	42.000	1.000	600	1.000
2.000	84.000	2.000	1.200	2.000
4.000	168.000	4.000	2.400	4.000
5.000	210.000	5.000	3.000	5.000
10.000	420.000	10.000	6.000	10.000
20.000	840.000	20.000	12.000	20.000
30.000	1.260.000	28.000	17.000	28.000
40.000	1.680.000	34.000	21.000	34.000
50.000	2.100.000	40.000	24.000	40.000
100.000	4.200.000	60.000	36.000	60.000
140.000	5.880.000	75.000	45.000	75.000
160.000	6.720.000	82.000	50.000	82.000
180.000	7.560.000	90.000	54.000	90.000

Excerpt from API 2000, 5th Ed.

Figure 2A

Requirements for Thermal Venting Capacity (Metric Units)

Tank Capacity	In-breathing *thermal $_{in}$*	Out-breathing *thermal $_{Out}$*	
		Flashpoint ≥ 37,8°C	Flashpoint < 37,8°C
m³	Nm³/h	Nm³/h	Nm³/h
10	1,69	1,01	1,69
20	3,37	2,02	3,37
100	16,90	10,10	16,90
200	33,70	20,20	33,70
300	50,60	30,30	50,60
500	84,30	50,60	84,30
1.000	169,00	101,00	169,00
2.000	337,00	202,00	337,00
3.000	506,00	303,00	506,00
4.000	647,00	472,00	647,00
5.000	787,00	537,00	787,00
10.000	1.210,00	807,00	1.210,00
20.000	1.877,00	1.307,00	1.877,00
25.000	2.179,00	1.378,00	2.179,00
30.000	2.495,00	1.497,00	2.495,00

Excerpt from API 2000, 5th Ed.

Figure 2B

Emergency Venting required for Fire Exposure Versus Wetted Surface Area (English Units)

Wetted Area A square feet	Venting Requirement $\dot{V}$ SCFH
20	21.100
40	42.100
60	63.200
80	84.200
100	105.000
140	147.000
180	190.000
250	239.000
350	288.000
500	354.000
700	428.000
1400	587.000
2800	742.000

Excerpt from API 2000, 5th Ed.

Figure 3A

Emergency Venting required for Fire Exposure Versus Wetted Surface Area (Metric Units)

Wetted Area A m^2	Venting Requirement $\dot{V}$ Nm^3/h
2	608
4	1.217
6	1.825
8	2.434
15	4.563
25	6.684
30	7.411
35	8.086
45	9.322
60	10.971
80	12.911
150	16.532
260	19.910

Excerpt from API 2000, 5th Ed.

Figure 3B

Environmental Factors for non-refrigerated Above-ground Tanks (English Units)

Tank-configuration	Insulation Thickness inch	F- Factor
Bare metal tank	0	1.0
insulated tank	1	0.3
insulated tank	2	0.15
insulated tank	4	0.075
insulated tank	6	0.05
underground storage		0
earth covered storage		0.03
impoundment away from tank		0.5

Excerpt from API 2000, 5th Ed.

Figure 4A

Environmental Factors for non-refrigerated Above-ground Tanks (Metric Units)

Tank-configuration	Insulation Thickness cm	F- Factor
Bare metal tank	0	1,0
insulated tank	2,5	0,3
insulated tank	5	0,15
insulated tank	10	0,075
insulated tank	15	0,05
underground storage		0
earth covered storage		0,03
impoundment away from tank		0,5

Excerpt from API 2000, 5th Ed.

Figure 4B

Conversion of operational flow into equivalent diagram flow for use of flow charts

To use the flow charts (pressure vs. flow diagram) by considering the operational and product data, it is necessary to convert the given operational flow $\dot{V}_{B,Gas}$ into the equivalent diagram flow $\dot{V}_{Dia}$. This $\dot{V}_{Dia}$ then creates the same pressure loss as the actual operational flow.

1) Conversion of the operational flow $\dot{V}_{B,Gas}$ into the standard flow $\dot{V}_{N,Gas}$:

$$\dot{V}_{N,\,Gas} = \dot{V}_{B,\,Gas} * \frac{T_N * p_B}{T_B * p_N} = \dot{V}_{B,\,Gas} * \frac{p_B * 273{,}15K}{T_B * 1{,}013\ bar_{abs.}}$$

2) Conversion of the standard flow $\dot{V}_{N,Gas}$ into the equivalent diagram flow $\dot{V}_{Dia}$:

$$\dot{V}_{Dia} = \dot{V}_{N,\,Gas} * \sqrt{\frac{\rho_{N,\,Gas} * p_N * T_B}{\rho_{Dia} * p_G * T_N}}$$

$$= \dot{V}_{N,\,Gas} * \sqrt{\frac{\rho_{N,\,Gas} * T_B * 1{,}013\ bar_{abs.}}{p_G * 1{,}2\,\frac{kg}{m^3} * 273{,}15\ K}}$$

3) Calculation of the average density $\rho_{N,Gas}$ of a gas-mixture

$$\rho_{N,\,Gas} = (v_1 * \rho_{N,\,Gas\,1} + v_2 * \rho_{N,\,Gas\,2} + \ldots + v_x * \rho_{N,\,Gas\,x})$$

Terms

$\dot{V}$ = Flow m³/h (CFH)

p = Pressure bar abs (psi abs)

T = Temperature K

ρ = Specific density kg/m³ (lb / cu ft)

v = Volume fraction

Indexes

N = Standard condition (at 1,013 bar abs and 273,15 K)

B = Operational condition (pressure and temperature acc. to operation)

Gas = Actual product

Dia = Refers to the diagram when using the flow chart for sizing (ρ_{Dia}=1,189 kg/m³ related density of air at 20 °C and 1 bar abs.)

G = Refers to the outlet of the device (p_G back pressure) for operating conditions

Safety Procedures for Protecting Hazardous Explosive Areas in Third Party audited processing plants

Step 1

Assessment of the possible combustion process based on Standards, e.g., EN 1127-1 General Explosion Protection Methods and EN ISO 16852, or EN 12874 Flame Arresters

- Deflagration in the atmosphere, in the pre-volume or in a pipeline
- Detonation in a pipeline, stable or unstable
- Endurance burning due to continous flow of vapors/gases in the pipeline or at the opening of a tank

Step 2

Classification of the products based on literature and international standards EN ISO 16852, VbF, NFPA, British Standard for liquids, gases, vapors and multiple component mixtures

- Liquids: subdivided into flammable, highly flammable, and extremely flammable due to the flash point of the liquid and verifying the ignition temperature.

The classification is following the VbF (previous) and the Ordinance on Hazardous Substances (Gef. Stoff VO - current):

Non-water soluble		
previous	current	
(A I FP< 21 °C)	FP < 0 °C (32°F)	Extremely flammable
	FP < 21 °C (70°F)	Highly flammable
(A II FP 21–55 °C)	FP 21-55°C (70-131°F)	Flammable
(A III FP 55–100 °C)		-

Water soluble		
previous	current	
(B < FP 21 °C)	FP < 0 °C (32°F)	Extremely flammable
	FP < 21 °C (70°F)	Highly flammable
	FP 21–55 °C (70-131°F)	Flammable

FP = Flashpoint

Products with a flashpoint FP>55°C (>131°F) become flammable when being heated close to the flashpoint (ΔT = 5 degree safety margin as a rule of thumb for hydrocarbons and 15 degrees for mixtures).

Vapors: classification of the gas/vapor-air-mixtures according to the MESG of the substances or the mixture into the Explosion Groups IIA1, IIA, IIB1, IIB2, IIB3, IIB, and IIC (NEC Group D, C, and B).

Step 3

Consideration of the operational process parameters of the unburned mixtures and the impact on the combustion behavior:

- OperatingTemperature
  ≤ 60°C (≤ 140°F) Standard, no particular requirements
  > 60°C (> 140°F) Special approvals necessary
- Operating pressure
  ≤ 1,1 bar abs (≤ 15.95 psi) Standard, no particular requirements
  > 1,1 bar abs (> 15.95 psi) Special approvals necessary

Step 4

Assessment of the overall system and classification into hazardous zones according to frequency and duration of explosive atmosphere based on national and international regulations, e.g., TRBS, IEC, or NFPA/NEC.

- Zone 0

  Constant or frequent explosive atmosphere.
- Zone 1

  Occasional explosive atmosphere.
- Zone 2

  No or rare explosive atmosphere.

For risk assessment, the possible ignition sources must be evaluated under normal operating conditions as well as under special operating conditions, such as cleaning and maintenance work (see EN 1127-1):

Effective ignition source:

- Steady and continuous under normal operation
- Solely as a result of malfunctions
- Solely as a result of rare malfunctions

Effective ignition sources are chemical reactions, flames and hot gases, hot surfaces, mechanical generated sparks, static electricity, lightning, electromagnetic waves, ultrasonic sparks, adiabatic compression, shock waves, etc.

Effectiveness of the ignition source must be compared with the flammability of the flammable substance.

Step 5

Selection, number and location of the suitable equipment, protective system, and component must follow the requirements of national and international regulations (ATEX Directive).

For equipment (blowers, agitators, containers, etc.)

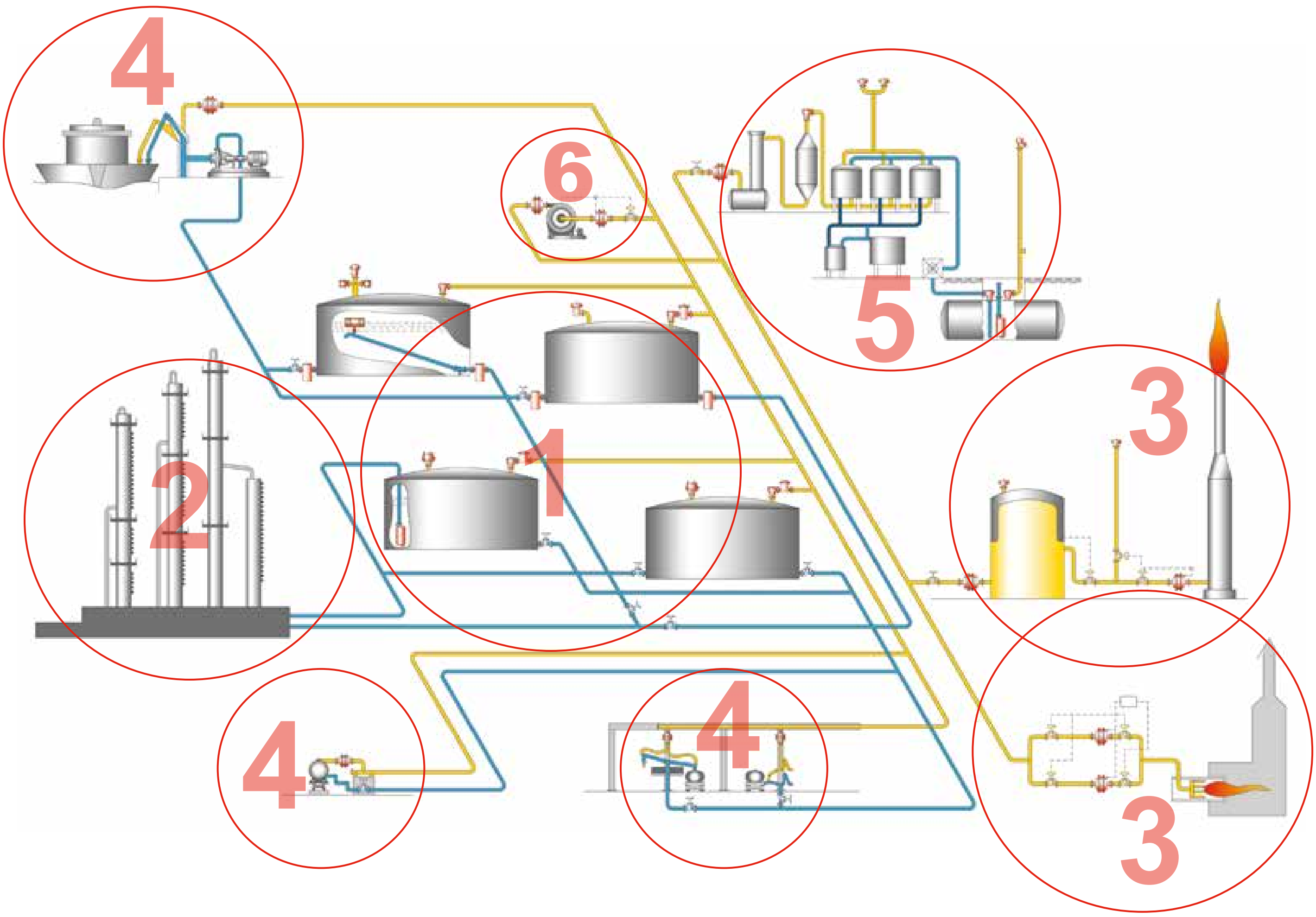
- In Zone 0 equipment categorized in group II, cat. 1
- In Zone 1 equipment categorized in group II, cat. 2
- In Zone 2 equipment categorized in group II, cat. 3

Flame arresters tested in accordance with EN ISO 16852 or EN 12874 fullfil the health and safety requirements of current ATEX regulations.

Flame arresters are protective systems and are not categorized. They must be type examination tested and approved by a Notified Body. They can be installed in all zones (zone 0, 1, or 2) and are marked with CE to show conformity with all applicable requirements.

The procedure and the results of the risk assessment must be verified in the "Explosion Protection Document". The plant operator (employer) must confirm that equipment has the latest technology and that the equipment, protective systems, and components for intended operation in potentially explosive atmospheres are in compliance with ATEX or other international regulations. Process engineering, plant-layout, material data, zoning, risk assessment, etc. are part of the protection document, as well as oganizational measures and the definition of responsibilities.

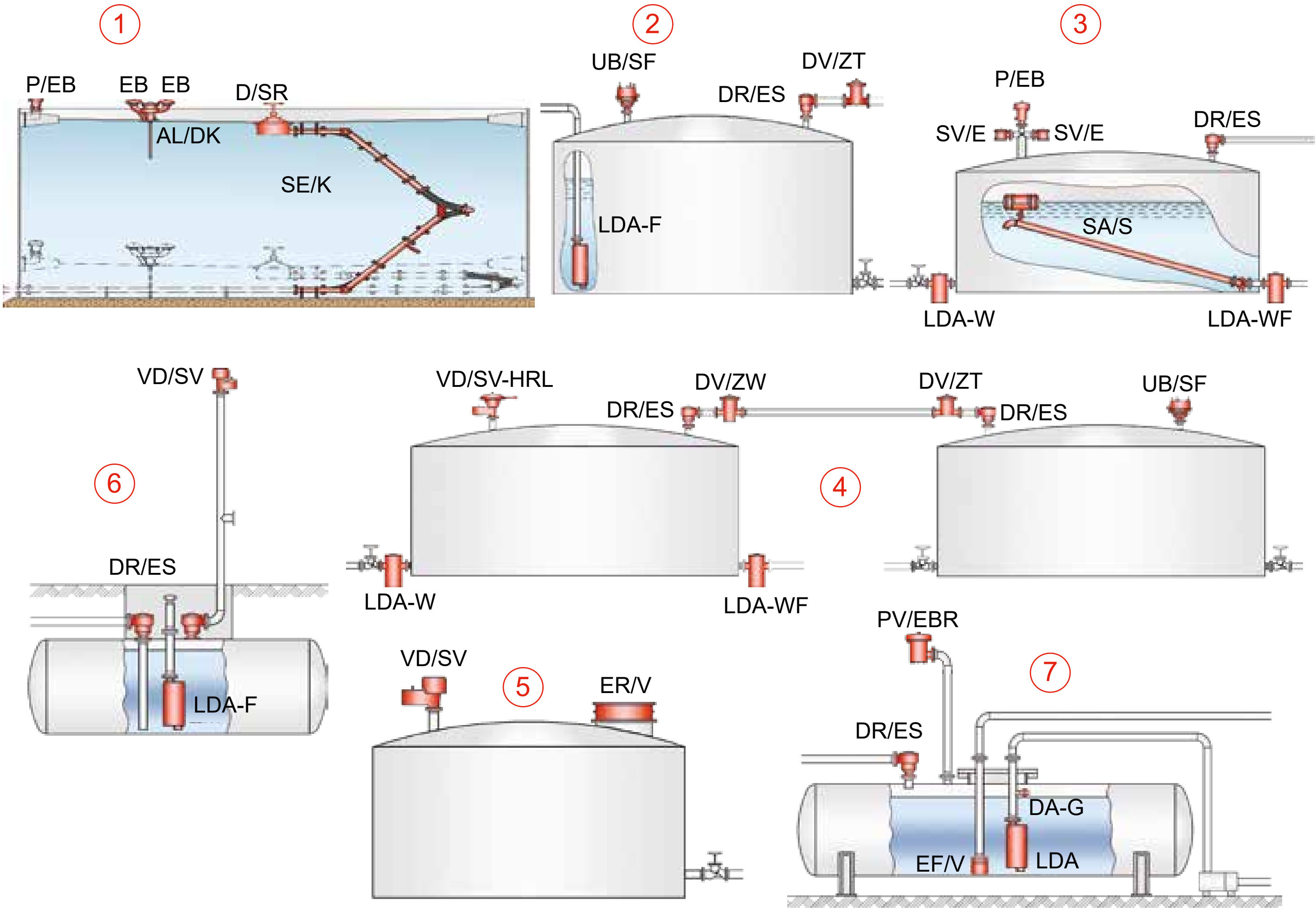
PROTEGO® safety devices are used in a wide range of industrial applications. A safe process requires reliable protection for every conceivable operating parameter. Practical examples show how systems can be made safe and how PROTEGO® devices can be incorporated into control loops. Engineers are responsible for the proper organization of the overall system.



PROTEGO® devices offer safety and environmental protection

1. In Storage Tank Farms for Refineries and Chemical Plants
2. In Processing Systems for Chemical and Pharmaceutical Industries
3. In Vapor Combustion Systems and Flares
4. In Ship Building and Loading Systems
5. In Vapor Recovery Units
6. As integrated Component of Equipment, Machines, and Vessels

Applications of PROTEGO® devices are used in other areas such as in biogas and landfill gas systems, medical technology, food processing, aircraft construction, automotive engineering, IT clean room technology, thin-film technology, etc.



1. Floating roof storage tank with floating-roof drainage system SE/K (→ Sec. 8), roof valve D/SR (→ Sec. 8) stem-actuated valve AL/DK (→ Sec. 8) with deflagration flame arresters EB (→ Sec. 2)

2. Fixed roof storage tank for flammable liquids with pressure and vacuum diaphragm valve UB/SF (→ Sec. 7), liquid detonation flame arrester LDA-F (→ Sec. 4), in the protective gas blanket line DR/ES (→ Sec. 4) with DV/ZT (→ Sec. 6)

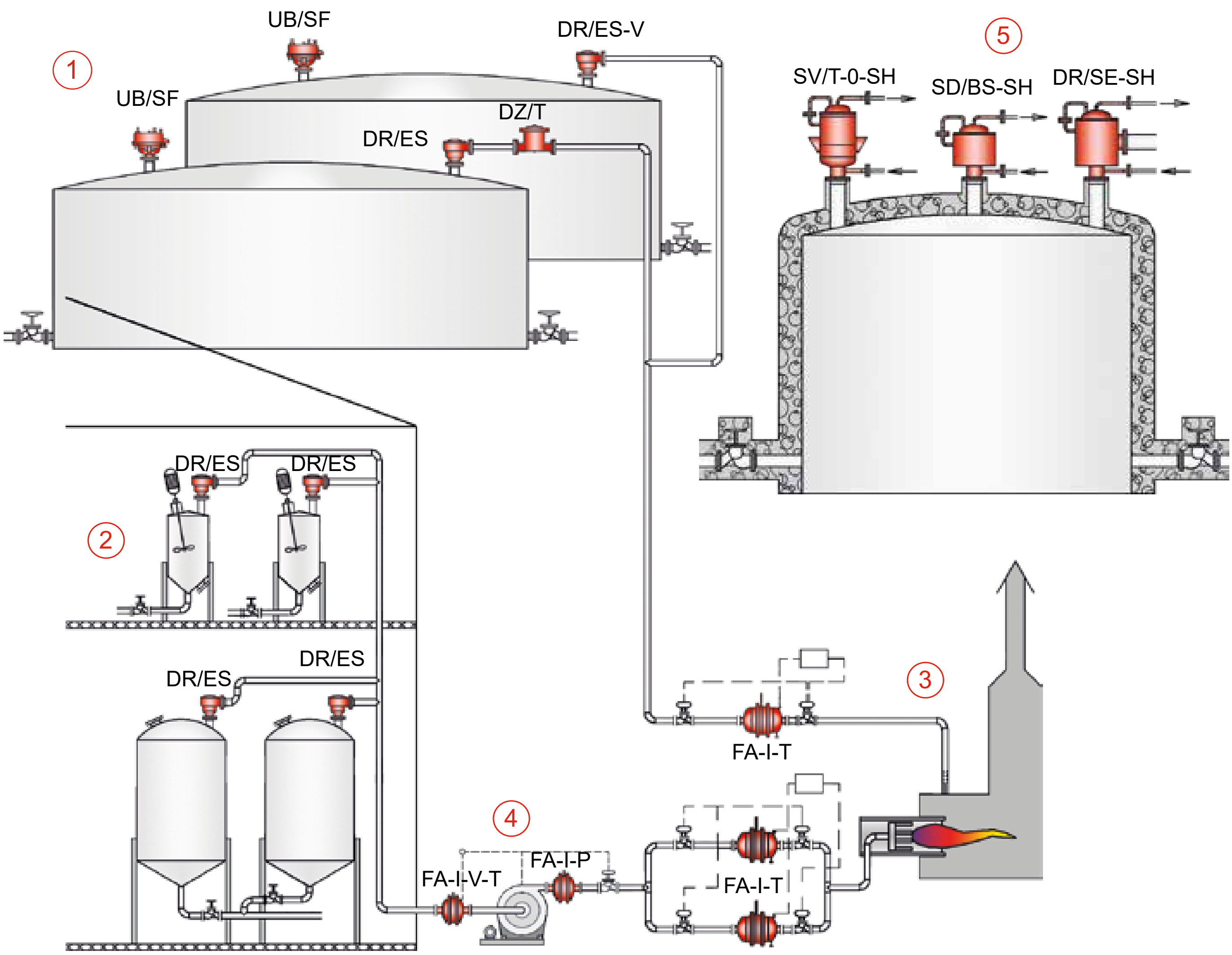
3. Fixed roof storage tank for flammable liquids with pressure safety relief valve P/EB (→ Sec. 7) and vacuum safety relief valve SV/E (→ Sec. 7), liquid detonation flame arrester LDA-W (→ Sec. 4) and/or LDA-W-F (→ Sec. 4) in the filling and emptying line, float-controlled swing pipe system SA/S (→ Sec. 8), detonation-proof gas displacement connection DR/ES (→ Sec. 4)

4. Fixed roof storage tank for flammable liquids with pressure and vacuum relief valve VD/SV-HRL (→ Sec. 7), pressure and vacuum relief diaphragm valve UB/SF (→ Sec. 7), connection to gas vent header system with detonation flame arrester DR/ES (→ Sec. 4) and in-line pressure and vacuum safety relief valve DV/ZT or DV/ZW (→ Sec. 6), liquid detonation arrester in the filling line LDA-W and emptying line LDA-WF (→ Sec. 4)

5. Fixed roof storage tank for non-flammable liquids with pressure and vacuum conservation valve VD/SV (→ Sec. 5) and emergency pressure relief valve ER/V (→ Sec. 5) instead of frangible seam.

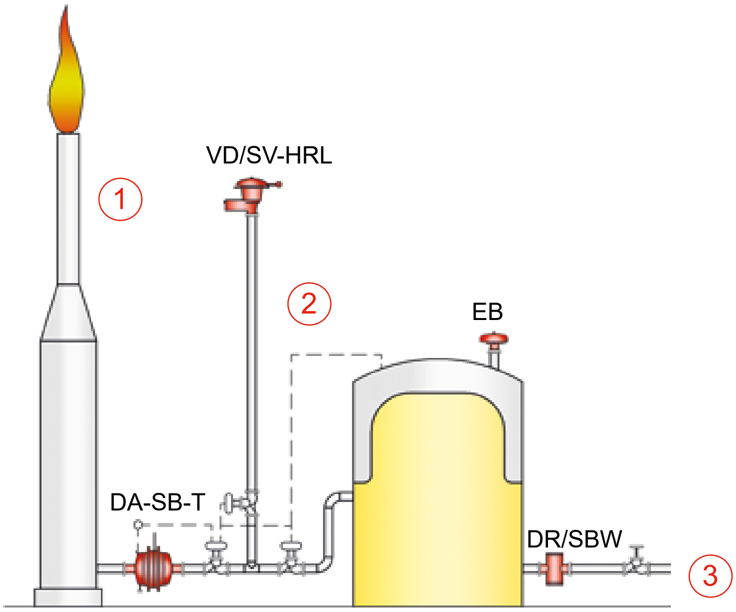
6. Underground storage tank with safety devices in the filling line LDA-F (→ Sec. 4), detonation flame arrester in the drain line DR/ES (→ Sec. 4), and in the vent line DR/ES (→ Sec. 4) and VD/SV (→ Sec. 5)

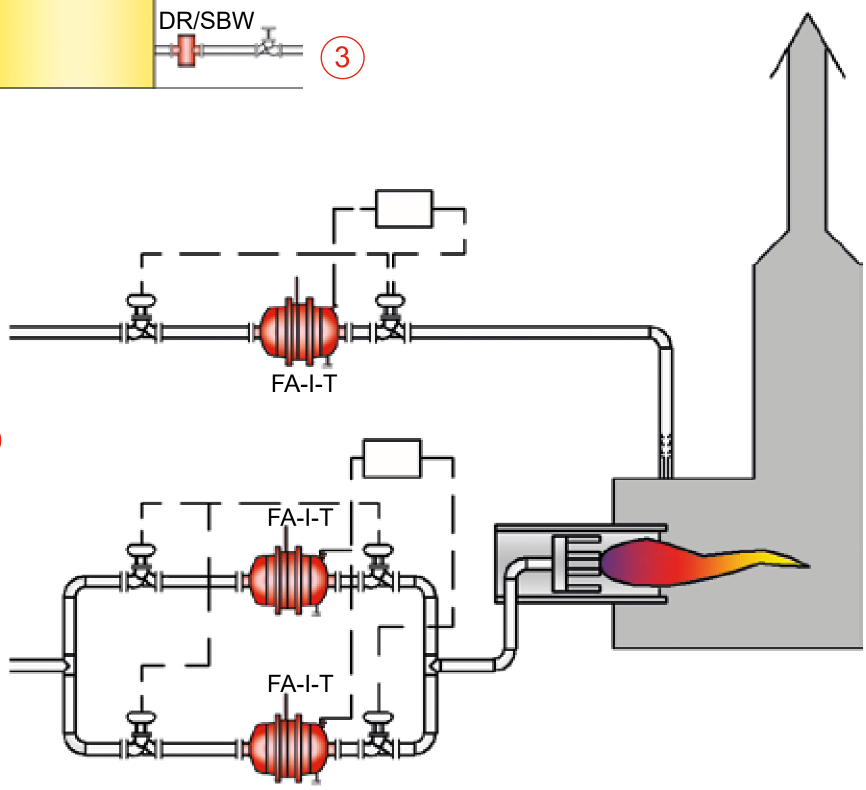
7. Aboveground tank for flammable liquids with pressure and vacuum safety relief valve PV/EBR (→ Sec. 7), liquid detonation flame arrester LDA (→ Sec. 4) in the filling line and an additional detonation flame arrester DA-G (→ Sec. 4) ensures that the tank is not emptied, detonation-proof foot valve for drain line EF/V (→ Sec. 4), detonation flame arrester DR/ES (→ Sec. 4) in vapor return pipeline.



1. Tank farms for flammable liquids with pressure and vacuum relief diaphragm valve UB/SF (→ Sec. 7), connection to gas vent header system with detonation flame arrester DR/ES-V or DR/ES (→ Sec. 4), and pressure or vacuum relief valve DZ/T (→ Sec. 6).
2. Ventilation of industrial mixers and process vessels in a common vapor vent header via detonation flame arresters DR/ES (→ Sec. 4).
3. Temperature monitored deflagration flame arresters FA-I-T (→ Sec. 3) in the inlet line for vapor combustion at the maximum allowable distance from the ignition source and installation location of the flame arrester (L/D ratio) an in parallel for the availability of maintenance or emergency switchover in case of an endurance burning on the arrester. Vapor pipeline from plant to vapor combustion unit with deflagration flame arrester FA-I-T (→ Sec. 3) to protect the vent header collection line and the operating locations in the plant.
4. Protection of pressure-resistant radial blowers as type-approved zone-0 blowers with integrated PROTEGO® flame arresters FA-I-V-T and FA-I-P (→ Sec. 3).
5. Protection of storage tanks for substances that can only be pumped with assistance of heating systems. These applications, e.g., bitumen storage, need continually heated devices, such as the pressure relief valve SD / BS - H (→ Sec. 5), vacuum relief valve SV / T - 0 - H (→ Sec. 5), and heated detonation flame arrester DR / SE – SH for venting up to 320 ° C at 6 bar.

Vapor Combustion Systems and Flares





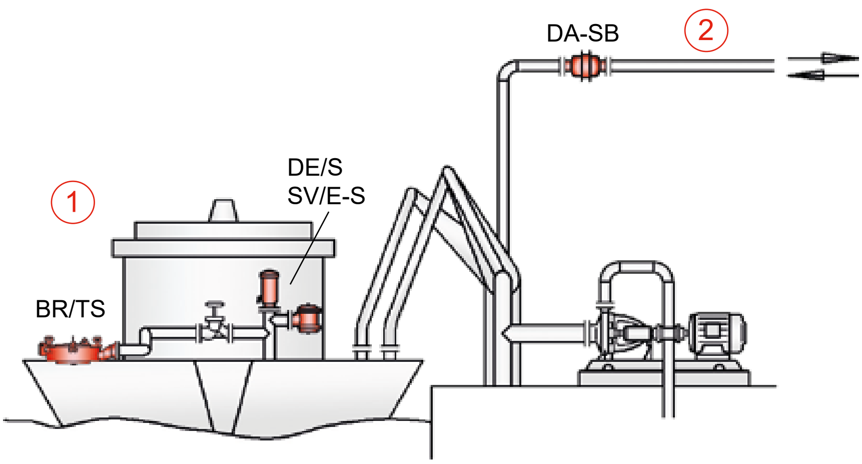
1. Flare pipes or ground flares with detonation flame arresters DA-SB-T (→ Sec. 4).

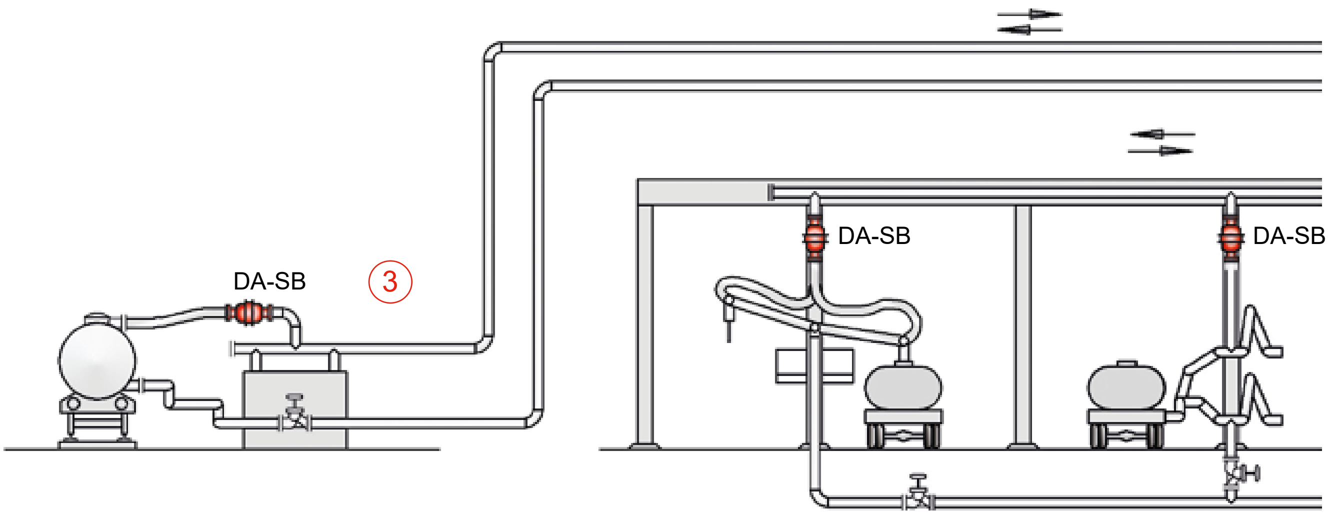
2. Emergency pressure relief stack with endurance burning-proof pressure and vacuum relief valve VD/SV-HRL (→ Sec. 7).

3. Protection of the gasometers with detonation flame arrester DR/SBW (→ Sec. 4) in the gas supply and end-of-line deflagration flame arrester EB (→ Sec. 2), which protects against endurance burning above the diaphragm.

4. Temperature-monitored deflagration flame arresters FA-I-T (→ Sec. 3) in the inlet line for vapor combustion, arranged without falling below the maximum allowable distance from the ignition source and installation location of the flame arrester (L/D ratio), and in parallel for the availability of maintenance or emergency switchover in case of an endurance burning on the arrester.

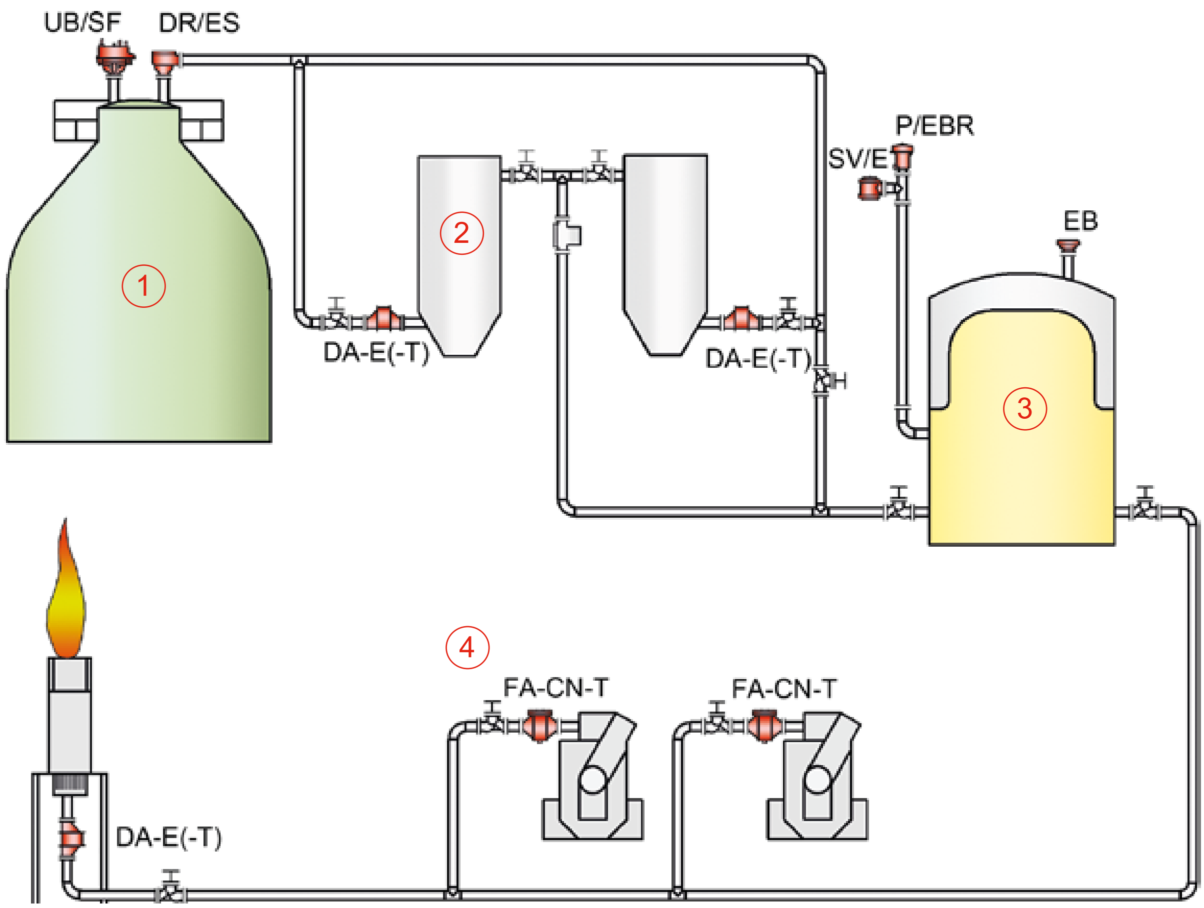
   Vapor pipeline from plant to vapour combustion unit with deflagration flame arrester FA-I-T (→ Sec. 3) to protect the vent header collection line and the operating locations in the plant.



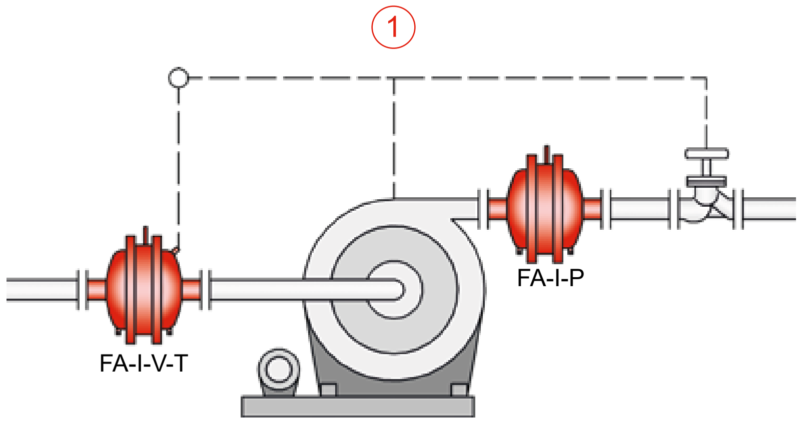


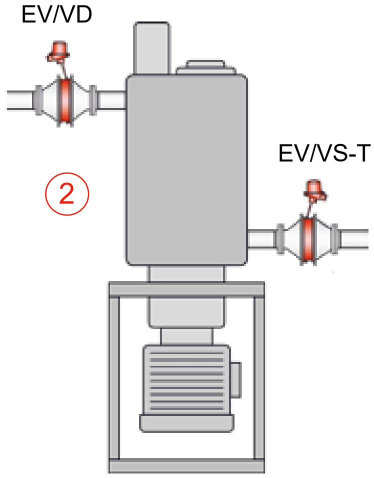
1. Tankers for flammable products/chemical tankers with detonation flame arresters BR/TS (→ Sec. 4) on the individual tank, endurance burning-proof high-velocity vent valves DE/S (→ Sec. 7), and explosion-proof vacuum flame arrester SV/E-S (→ Sec. 7).
2. Detonation-proof connection of the gas return line at the loading terminal for flammable liquids with a detonation flame arrester DA-SB (→ Sec. 4).
3. Detonation flame arresters DA-SB (→ Sec. 4) in the gas displacement/gas return line from the loading stations for tank wagons and tank trucks.

Not shown: Offshore platforms/drilling platforms with detonation flame arresters DA-SB (→ Sec. 4) and deflagration flame arresters FA-CN (→ Sec. 3), FPSOs (Floating Production Storage and Offloading) with IMO-approved detonation flame arresters DA-SB (→ Sec. 4) and pressure and vacuum relief valves VD/TS (→ Sec. 7), hydraulic control boxes with deflagration flame arresters BE-AD (→ Sec. 2).



1. Protection the digester or the collectiong with a UB/SF (→ Sec.7) frost-proof pressure and vacuum relief valve and with DR/ES (→ Sec. 4) detonation flame arresters in the gas or vapour manifold.
2. Protection the desulfurisation unit (e.g. activated carbon filter) with detonation flame arresters DA-E or DA-E-T (→ Sec. 4).
3. Protection the in-line gasholder in the pressure and vacuum relief line with an EB (→ Sec. 2) endurance burning-proof deflagration flame arrester; equipping the emergency vent stack with P/EBR (→ Sec. 7) deflagration-proof and endurance burning-proof pressure relief valve and SV/E (→ Sec. 7) deflagration-proof vacuum relief valve.
4. Ground flares and gas engines (combined heat and power generation in the cogeneration plant) are potential ignition sources for biogas (methane) air mixture. Suitable flame arresters that consider temperature and pressure need to be installed in the piping toward the equipment. Use needs to be made of either FA-CN-T or FA-E-T (→ Sec. 3) temperature-monitored deflagration flame arresters or- at a great distance from the potential ignition source DA-SB(-T), DA-E(-T) or DR/ES(-T) (→ Sec. 4) detonation flame arresters are used.





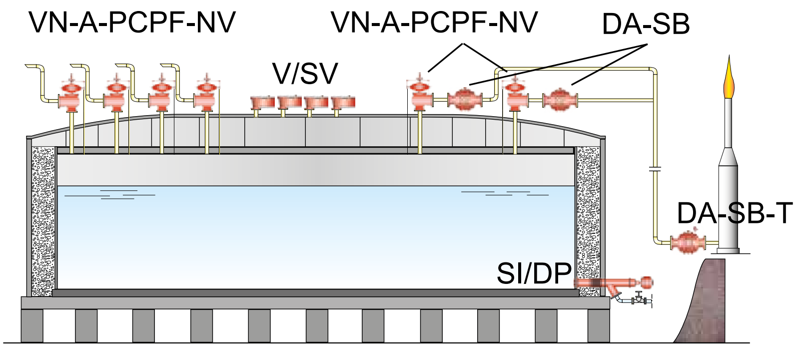
FLAMEFILTER®, or PROTEGO® flame arresters as OEM components, are product varieties that are integrated by equipment manufacturers in their brand-name products.

1 Protection of pressure-resistant radial blowers as type-examined zone-0 blowers with integrated PROTEGO® flame arresters FA-I-V-T and FA-I-P (→ Sec. 3).

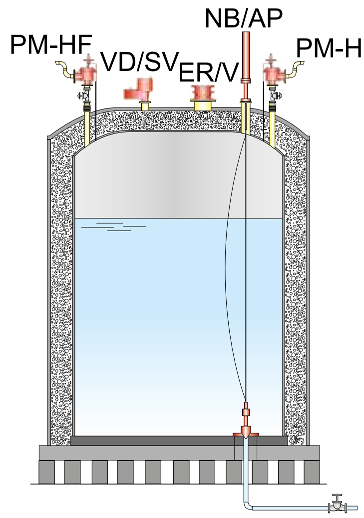
2 Protection of dry-running vacuum pumps with PROTEGO® flame arresters EV/VS-T and EV/VD (→ Sec. 3) at both the inlet and outlet which are tested and certified together with the vacuum pump. Other forms of protection with DR/ES and DR/ES-T (→ Sec. 4) are possible.

Not shown: FLAMEFILTER® used in gas analyzers to protect the explosive environment from explosions arising in the device from the ignition of the gases or vapors to be measured or analyzed. PROTEGO® flame arresters are installed in the pressure and vacuum relief openings of airplane fuel tanks to protect from external explosions.

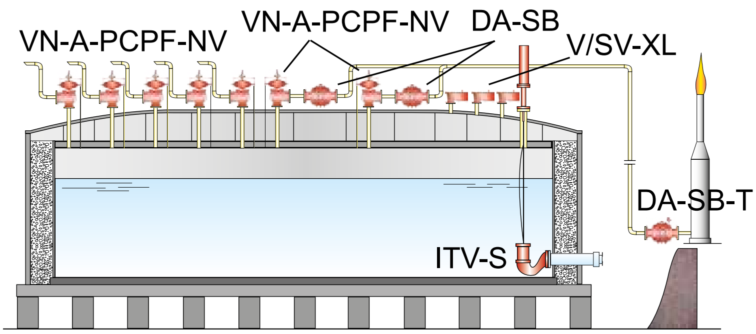
Cryogenic Tanks



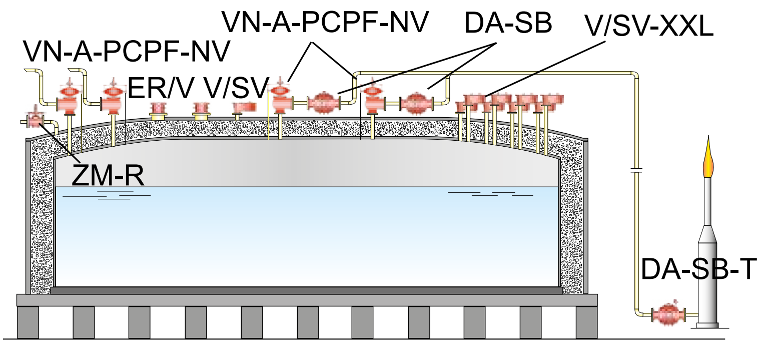
Ammonia Storage Tank



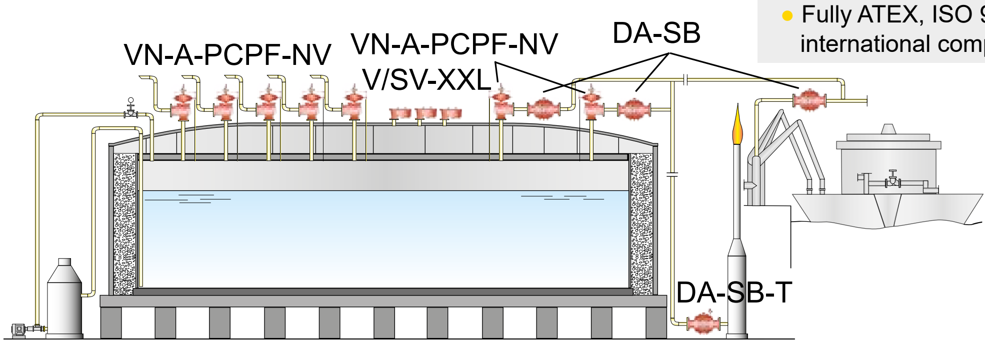
LIN-LOX-LAR Storage Tank



Ethylene Storage Tank



Propylene Storage Tank



LNG Storage Tank

- Pilot operated valves that solve instability problems, such as fluttering and chattering, during operation
- Cleaning for oxygen service available upon request
- Cryogenic functional test available upon request
- Low pressure and vacuum conservation vents
  - Full lift technology available (fully open with only 10% overpressure/pressure accumulation)
  - Weight-loaded or spring-loaded
- Extremely low leakage rates on breather valves (much lower than ISO 28300 and API 2000, 7th Ed.)
- Low pressure reducing valves

- Quick-release bottom outlet valve with pneumatic actuator, in-tank valves
- Internal safety valves with pneumatic and manual actuator

- ATEX approved Flame Arresters
  - End-of-line applications
    - Deflagration Flame Arresters
    - Endurance burning-proof Flame Arresters
  - In-line applications
    - Deflagration Flame Arresters
    - Detonation Flame Arresters

- Sold globally, serviced locally (PARC)
- Fully ATEX, ISO 9001, and ISO 14001 certified international company

Products

VN-A-PCPF-NV, V/SV, ITV-S (→)
NB/AP, SI/DP, PM-HF (→ Sec. 9)
V/SV-XL, V/SV-XXL (→ Sec. 9)
DA-SB, DA-SB-T (→ Sec. 4)
VD/SV, ER/V (→ Sec. 5)
ZM-R (→ Sec. 6)

PROTEGO
for safety and environment

Catalog

Flame Arresters

Deflagration flame arresters, deflagration-proof, short time burning-proof, endurance burning-proof

Vent caps without flame arresters

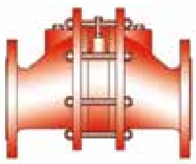
Explosion groups: IIA1, IIA, IIB1, IIB2, IIB3, IIB, IIC

Nominal sizes: 15 to 800 mm (½“ to 32“)

Materials: carbon steel, stainless steel, Hastelloy, ECTFE coated

Special designs according to customer specifications

Service and spare parts



Deflagration flame arresters, in-line deflagration flame arrester units on equipment

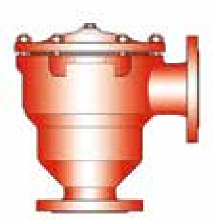
Explosion groups: IIA1, IIA, IIB1, IIB2, IIB3, IIB, IIC

Nominal sizes: 10 to 1000 mm (¼“ to 40“)

Materials: carbon steel, stainless steel, Hastelloy, ECTFE coated

Special designs according to customer specifications

Service and spare parts



Detonation flame arresters for stable and unstable detonations

Explosion groups: IIA1, IIA, IIB1, IIB2, IIB3, IIB, IIC

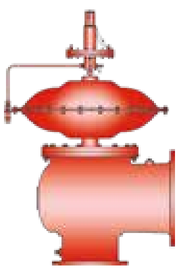
Nominal sizes: 15 to 800 mm (½“ to 32“)

Materials: carbon steel, stainless steel, Hastelloy, ECTFE coated

Special designs according to customer specifications

Service and spare parts

Equipment for Cryogenic Storage Tanks



Pressure and Vacuum Relief Valves – pilot-operated, Vacuum Relief Valves, Change-Over Valve, In-Tank Valves

Pressure settings: 10 to 1034 mbar (4 to 415.1 inch W.C.)

Nominal sizes: 40 (1 ½“) to 300 (12“)

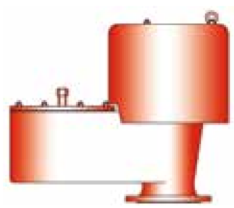
Materials: carbon steel, stainless steel, aluminum

Special designs according to customer specifications

Service and spare parts

Valves

Pressure and Vacuum Relief Valves, end-of-line ....Section 5



Pressure relief valves, vacuum relief valves, pressure and vacuum relief valves,

pressure relief and vacuum valves

Pressure settings: 2 to 200 mbar (0.08 to 8 inch W.C.)

Nominal sizes: 50 to 700 mm (2“ to 28“)

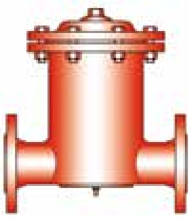
Materials: carbon steel, stainless steel, Hastelloy, aluminum, PP, PE, PVDF, PTFE,

ECTFE coated

Special designs according to customer specifications

Service and spare parts

Pressure and Vacuum Relief Valves, in-line..Section 6



Pressure or vacuum relief valves, pressure and vacuum relief valves, blanketing valves

Pressure settings: 2 to 500 mbar (0.08 to 20 inch W.C.)

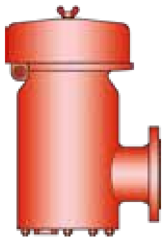
Nominal sizes: 25 to 300 mm (1“ to 12“)

Materials: carbon steel, stainless steel, Hastelloy, PP, PE, PVDF, ECTFE coated

Special designs according to customer specifications

Service and spare parts

Pressure and Vacuum Relief Valves with Flame Arresters, end-of-line..Section 7



Pressure relief valves, vacuum relief valves, pressure and vacuum relief valves,

pressure-/vacuum relief diaphragm valves, pressure relief valves, high velocity valves

Deflagration-proof and endurance burning-proof or deflagration-proof only

Explosion groups: IIA1, IIA, IIB1, IIB2, IIB3, IIB, IIC

Pressure settings: 2 to 200 mbar (0.08 to 8 inch W.C.)

Nominal sizes: 50 to 300 mm (2“ to 12“)

Materials: carbon steel, stainless steel, Hastelloy, ECTFE coated

Special designs according to customer specifications

Service and spare parts

Tank Accessories and Special Equipment

Level-gauging and sampling equipment...Section 8

Floating suction unit, floating roof drainage system

Floating roof vacuum relief valves, skimming system

Air drying aggregates, sampling and draining valves

Service and spare parts

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Regulations and Laws

2014/34/EU Directive of the European Parliament and the Council of February 21, 2014 on the approximate of the laws of the Member States concerning equipment and Protective Systems intended for use in potentially explosive atmospheres (replaces 94/9/EC since April 20, 2016)

94/9/EC Directive of the European Parliament and the Council of March 23, 1994, on the approximate of the laws of the Member States concerning equipment and Protective Systems intended for use in potentially explosive atmospheres (replaced by 2014/34/EU)

1999/92/EC Directive of the Council on minimum requirements for improving the safety and health of workers potentially at risk from explosive atmospheres (individual directive according to article 16 of Directive 89/391/EEC)

1999/13/EC Directive on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations (replaced by Directive 2010/75/EU) 2010/75/EU Directive of the European Parliament and of the Council of 24. November 2010 on industrial emissions (integrated pollution prevention and control)

97/23/EC Pressure equipment directive of the European Parliament and the European Council (replaced by Directive 2014/68/EU)

2014/68/EU (PED) Pressure equipment directive of the EuropeanParliament and the European Council (replaces 97/23/EC since 17.7.2015 with transitional regulation until 18.7.2016)

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EN ISO 28300: Petroleum, petrochemical and natural gas industries - Venting of atmospheric and low-pressure storage tanks, 2008

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Appendix L: Requirements for Pressure and Vacuum Relief Systems, 2005

EN ISO 16852 Flame Arresters - Performance requirements, test methods and limits for use, 2016

EN 12874 Flame Arresters: Performance Requirements, Test Methods, and Limits for Use, 2001 (replaced by EN ISO 16852 since 01.09.2010)

EN 1127-1 Explosive Atmospheres. Explosion Prevention and Protection.
Part 1: Basic Concepts and Methodology, 2019

EN 1012-2 Compressors and Vacuum Pumps. Part 2: Vacuum pumps, 2011

EN 746-2 Industrial thermoprocessing equipment - Part 2: Safety requirements for combustion and fuel handling systems, 2010
EN 12255-10 Wastewater Treatment Plants - Part 10: Safety and Construction Principles, 2001

EN 13463-1 Non-Electrical Equipment Intended for Use in Potentially Explosive Atmospheres - Part 1: Basic Methods and Requirements, 2009 (replaced by EN ISO 80079-36)

EN 13463-5 Non-electrical equipment intended for use in potentially explosive atmospheres - Part 5: Protection by constructional safety ‘c’, 2012 (replaced by EN ISO 80079-37)

EN ISO/IEC 80079-34 Explosive atmospheres - Part 34: Application of quality systems for equipment manufacture, 2012

EN ISO 80079-36: 2016 Explosive atmospheres - Part 36: Non-electrical equipment for explosive atmospheres - Basic method and requirements (ISO 80079-36:2016)

EN ISO 80079-37:2016 Explosive atmospheres - Part 37: Non-electrical type of protection constructional safety „c“, control of ignition sources „b“, liquid immersion „k“ (ISO 80079-37: 2016) (Endorsed by AENOR in September of 2016)

EN IEC 60079-0 Explosive atmospheres - Part 0: Equipment - General requirements, 2018

EN IEC 60079-10-1 Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres, 2021

33 CFR Part 154 Facilities Transferring Oil or Hazardous Material in Bulk (USCG-Rule)

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API Publ. 2028 3rd Ed. Flame Arresters in Piping, 2002 (2015)

UL 525 Ed. 8, Flame Arresters, 2023

ASTM F1273-21 Standard Specification for Tank Vent Flame Arresters, 2021
NFPA 30 Flammable and Combustible Liquids Code, 2021
NFPA 36 Standard for Solvent Extraction Plants, 2021
NFPA 59A Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG), 2023

NFPA 67 Guide on Explosion Protection for Gaseous Mixtures in Pipe Systems, 2019

NFPA 68 Standard on Explosion Protection by Deflagration Venting, 2023

NFPA 69 Standard on Explosion Prevention Systems, 2019

NFPA 497 Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, 2021

HSG176 The Storage of Flammable Liquids in Tanks, 2015
EN 60079-20-1 Explosive atmospheres - Part 20-1: Material characteristics for gas and vapour classification - Test methods and data (IEC 60079-20-1), 2010

CEN/TR 16793:2016 Guide for the selection, application and use of flame arrester)

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TRGS 723 Gefährliche explosionsfähige Gemische – Vermeidung der Entzündung gefährlicher explosionsfähiger Gemische, 2020

TRBS 3151/TRGS 751 Vermeidung von Brand-, Explosions- und Druckgefährdungen an Tankstellen und Füllanlagen zur Befüllung von Landfahrzeugen, 2022

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New ISO standard for flame arresters to increase explosion isolation efficiency; Dr. M. Davies/Dr. T. Heidermann/Dr. P. Bosse; HYDROCARBON ENGINEERING

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Testing and applying flame arresters to prevent large terminal fires; Dr. M. Davies, D. Long; Tank Storage Magazine, 2017

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Storage Instability, discuss how to solve pilot valve instability oncryogenic storage tanks - Dr Michael Davies, Dr Davide Moncalvo, Thorsten Schaper, Braunschweiger Flammenfilter GmbH

Term	Description	Source
accumulation	pressure increase over the MAWP of the vessel allowed during discharge through the pressure-relief device	ISO 28300
adjusted set pressure	inlet static pressure at which a pressure-relief valve is adjusted to open on the test stand	ISO 28300-3.2
ambient air	normal atmosphere surrounding the equipment and protection system	EN 13237 - 3.1
ambient temperature	temperature of the air or other medium where the equipment is to be used (IEV 826-01-04) (IEC 60204-32:1998) Note: For the application of the Directive 94/9/EC, only air is considered	EN 13237 - 3.2
atmospheric conditions	atmospheric conditions are pressures from 80 kPa till 110 kPa and temperatures from -20°C up to +60°C	ISO 16852 - 3.25
atmospheric discharge	release of vapors from pressure-relieving and depressuring devices to the atmosphere	ISO 23251 – 3.4
back pressure	pressure that exists at the outlet of a safety valve as a result of pressure in the discharge system	ISO 4126-3.11
bi-directional flame arrester	a flame arrester which prevents flame transmission from both sides	ISO 16852 - 3.13
blow down	difference between set pressure and reseating pressures; normally stated as a percentage of set pressure except for pressures of less then 3 bar when the blowdown is expressed in bar	ISO 4126 – 3.15
check valve	valve that prevents backflow against flow direction	-
coating	protective painting with defined layer-thickness	-
coefficient of discharge	value of actual flowing capacity divided by theoretical flowing capacity (from calculation)	ISO 4126-3.20
component	a component that is required for the safe operation of equipment and protective systems without performing an autonomous function itself	EN 13237-A.7
condensate drain screw	screw to drain the condensate	-
conventional pressure-relief valve	spring-loaded pressure-relief valve whose operational characteristics are directly affected by changes in the back pressure	ISO 23251 - 3.20
deflagration	explosion propagating at subsonic velocity (EN 1127-1:1997)	EN 13237 - 3.6
deflagration flame arrester	flame arrester designed to prevent the transmission of a deflagration. It can be an end-of-line flame arrester or an in-line flame arrester	ISO 16852 - 3.14
design pressure (tank)	max. permissible over-pressure of a tank in the space above the stored liquid	DIN EN 14015
design pressure / design temperature (general design)	pressure, together with the design temperature, used to determine the minimum permissible thickness or physical characteristic of each vessel component, as determined by the vessel design rules	ISO 23251 - 3.23
design vacuum (negative gauge pressure)	max. permissible vacuum (negative gauge pressure) in the space above the stored liquid	-
detonation	explosion propagating at supersonic velocity and characterized by a shock wave (EN 1127-1: 1997)	EN 13237 - 3.8
detonation flame arrester	flame arrester designed to prevent the transmission of a detonation. It can be an end-of-line flame arrester or an in-line flame arrester	ISO 16852 3.15

Term	Description	Source
diaphragm valve	valve where the moving valve part consists of a diaphragm	-
emergency venting	venting required when an abnormal condition, such as ruptured internal heating coils or an external fire, exists either inside or outside a tank	ISO 28300 - 3.4
emergency venting valves	pressure relief valves for emergency venting	-
empty lift safety device	safety device which prevents the emptying of a liquid detonation safety device up to a maximum suction power	-
end-of-line flame arrester	flame arrester that is fitted with one pipe connection only	ISO 16852 - 3.21
endurance burning	stabilized burning for an unlimited time	ISO 16852 - 3.6
endurance burning flame arrester	flame arrester that prevents flame transmission during and after endurance burning	ISO 16852 - 3.16
equipment	machines, appliances, fixed or mobile devices, control parts and accessories, and warning and prevention systems, whether separate or combined, intended for the generation, transfer, storage, measurement, control, and conversion of energy, and for the processing of materials, which have their own potential source of ignition and may cause an explosion	EN 13237 - 3.13
equipment category	within an equipment group, a category is the classification according to the required level of protection	EN 13237 – 3.26
explosion	abrupt oxidation or decomposition reaction producing an increase in temperature, pressure, or in both simultaneously	ISO 16852 - 3.7
explosion limits	limits of explosion range	EN 13237 - 3.19
explosive atmosphere	a mixture of air and flammable substance in the form of gases, vapors, mists or dusts under atmospheric conditions in which, after ignition, spreads to the entire unburned mixture	EN 13237 - 3.28
explosion pressure resistant	characteristic of vessels and equipment designed to withstand the expected explosion pressure without permanent deformation	EN 13237 - 3.23.1
explosion shock proof	characteristic of vessels and equipment designed to withstand the expected explosion pressure without bursting, but which may sustain permanent deformation	EN 13237 - 3.23.2
flame arrester	device fitted to the opening of an enclosure, or to the connecting pipe work of a system of enclosures, and whose intended function is to allow flow but prevent the transmission flame	ISO 16852 - 3.1
flame arrester housing	portion of a flame arrester whose principal function is to provide a suitable enclosure for the flame arrester element and allow mechanical connections to other systems	ISO 16852 - 3.2
flame arrester unit	flame arrester casing with FLAMEFILTER® set	-
flame transmission-proof	characteristic of a device to avoid flashback	-
FLAMEFILTER®	internationally registered trademark of Braunschweiger Flammenfilter GmbH for flame arrester element made of crimped ribbon	-
FLAMEFILTER® casing	enclosure for FLAMEFILTER® including insert rings	-
FLAMEFILTER® gap width	the triangular height of a FLAMEFILTER®	-

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Term	Description	Source
FLAMEFILTER® set	combination of FLAMEFILTER® with spacers	-
flammable gas or vapor	gas or vapor which, when mixed with air in certain proportions, will form an explosive gas atmosphere (EN 60079-10:1996)	EN 13237 - 3.36.1
flammable liquid	liquid capable of producing a flammable vapor under any foreseeable operating condition (EN 60079-10:1996)	EN 13237-3.36.2
flammable material	material which is flammable of itself, or is capable of producing a flammable gas, vapor or mist (EN 60079-10-3.20)	EN 13237 - 3.37
flammable substances	substance in the form of gas, vapor, liquid, solid, or mixtures of these, able to undergo an exothermic reaction with air when ignited (EN 1127-1:1997)	EN 13237 - 3.37
flashback	phenomenon occurring in a flammable mixture of air and gas when the local velocity of the combustible mixture becomes less than the flame velocity, causing the flame to travel back to the point of mixture	ISO 23251 - 3.34
flashpoint	lowest temperature at which, under certain standardized conditions, vapors develop from the liquid in such quantity that they are capable of forming a flammable vapor/air mixture	EN 13237 - 3.38
floating cover	structure which floats on the surface of a liquid inside a fixed roof tank, primarily to reduce vapor loss	EN 14015 - 3.1.22
floating exhaust system	movable pipeline, with or without float gauge, within a storage tank for filling and emptying	-
floating roof	metallic structure which floats on the surface of a liquid inside an open top tank shell, and in complete contact with this surface	EN 14015 - 3.1.21
floating suction devices	mechanical device, sometimes articulated, installed in some tanks, which floats on the liquid surface and only permits product to be withdrawn from this point; commonly adopted for aviation fuel storage tanks	EN 14015 - 3.1.28
foot valve flame arrester	flame arrester designed to use the liquid product combined with a non-return valve to form a barrier to flame transmission	ISO 16852 - 3.19.2
free vents	open vents	EN 14015 - 3.1.40
gauging and sampling device	equipment for stating the liquid level within storage tanks as well as for sampling from any height within the stored substance	-
gauging nozzle	opening at a storage tank for gauging or sampling	-
gauging pipe	pipe within the storage tank for determining the liquid level and for sampling - in flashback-proof or regular design	-
gauging probe	device for determining the liquid levels in storage tanks	-
guide pipe	pipe for guiding the guide spindle of a valve pallet	-
guide rod	component (rod) for guiding the valve pallet	-
guide sleeve	component for guiding, e.g., the guide spindle of a valve pallet	-
guide spindle	orthogonal to valve pallet section, centrically arranged pipe for guiding the valve pallet	-
hazardous area	atmosphere which may become explosive due to local and operational conditions	EN 13237 - 3.28.2
hazardous explosive atmosphere	explosive atmosphere which, in the event of an explosion, causes damage	EN 13237 – 3.28.1

Term	Description	Source
heat release	total heat liberated by combustion of the relief gases based on the lower heating value	ISO 23251 - 3.36
heating jacket	enclosed space for heating a device which encloses all or part of the device	-
high velocity vent valve (dynamic flame arrester)	pressure relief valve designed to have nominal flow velocities that exceed the flame velocity of the explosive mixture, resulting in prevention of flame transmission	ISO 16852 - 3.18
housing	enclosure of a product or component	-
hydraulic flame arrester	flame arrester designed to break the flow of an explosive mixture into discrete bubbles in a water column, thus preventing flame transmission	ISO 16852 - 3.20
ignition source	any source with enough energy to initiate combustion	-
ignition temperature (of a combustible gas or of a combustible liquid)	the lowest temperature (a hot surface) at which, under specified test conditions, ignition of a combustible gas or vapor occurs in a mixture with air or air/inert gas	EN 13237 - 3.45
inert gas	non-flammable gas which will not support combustion and does not react to produce a flammable gas	EN 13237 - 3.46
inerting	replacing atmospheric oxygen in a plant with a non-reactive, non-flammable gas to prevent flame propagation in the atmosphere of a plant	EN 13237 - 3.47
in-line flame arrester	flame arrester that is fitted with two pipe connections, one on each side of the flame arrester	ISO 16852 - 3.22
in-tank valve	emergency valve in the tank bottom which closes immediately in case of downstream piping rupture	-
integrated temperature sensor	temperature sensor integrated into the flame arrester, as specified by the manufacturer of the flame arrester, in order to provide a signal suitable to activate counter measures	ISO 16852 - 3.24
leak rate	measure of the amount of substance (liter per second) flowing through a leak in the fitting	-
left-wound	orientation (angle) of gaps of crimped ribbon element	-
lift	actual travel of the valve disc away from the closed position	ISO 4126 - 3.16
limiting oxygen concentration (LOC)	maximum oxygen concentration in a mixture of a flammable substance with air and inert gas in which an explosion does not occur, determined under specified test conditions	EN 13237 - 3.49
lining	protective plastic lining with a defined minimum/maximum thickness to protect against aggressive mixtures (e.g., acid)	-
liquid seal flame arrester	flame arrester designed to use the liquid product to form a barrier to flame transmission	ISO 16852 - 3.19.1
liquid seal (water seal)	device that directs the flow of relief gases through a liquid (normally water) on the path to the flare burner, used to protect the flare header from air infiltration or flashback, to divert flow, or to create back pressure for the flare header	ISO 23251-3.43
lower flammable limit (LFL)	the lowest concentration of a combustible substance in an oxidizing medium that will propagate a flame.	NFPA 69-2019

Term	Description	Source
maintenance	combination of all technical and administrative actions, including supervision actions, intended to maintain or restore a unit in working order	EN 13237 - 3.78
malfunction	devices, protective system, and components do not fulfill their intended function	EN 13237 - 3.50
manifold	piping system for the collection and/or distribution of a fluid to or from multiple flow paths	ISO 23251 - 3.45
maximum allowable explosion pressure	maximum explosion pressure measured during the explosion pressure test when the proportion of combustible substances in the mixture is varied	EN 13237 - 3.21.1
maximum allowable pressure (pressure equipment)	maximum pressure for which the equipment is designed as specified by the manufacturer	97/23/EC (PED)
maximum allowable temperature (pressure equipment)	maximum temperature for which the equipment is designed as specified by the manufacturer	97/23/EC (PED)
maximum allowable working pressure (MAWP)	maximum gauge pressure permissible at the top of a completed vessel in its normal operating position at the designated coincident temperature specified for that pressure	ISO 23251 - 3.47
maximum experimental safe gap (MESG)	the maximum gap width between the two parts of the interior chamber of the test equipment which, when the internal gas mixture is ignited and under specified conditions, prevents ignition of the external gas mixture through a 25 mm long joint for all concentrations of the tested gas or vapor in air. The MESG is a property of the respective gas mixture (EN 1127-1: 1997) Note: IEC 60079-1 A standardizes the test equipment and the test method	-
maximum operating temperature	maximum temperature reached when a piece of equipment or protective system is operating under its intended operating conditions	-
measurable type (static flame arrester)	flame arrester where the quenching gaps of the flame arrester element can be technically drawn, measured and controlled	ISO 16852 - 3.17.1
melting element	component which melts at a defined temperature and triggers an action (opening of hood, closing of valve)	-
most inflammable explosive atmosphere	explosive atmosphere with a concentration of flammable substances which, under specified conditions, requires the smallest amount of energy to ignite	-
nominal size	(DN) alphanumeric designation of size that is common for components used in a piping system, used for reference purposes, compromising the letters DN followed by a dimensionless number having an indirect correspondence to the physical size of the bore or outside diameter of the component end connection	ISO 4126-1.3.22
non-measurable type (static flame arrester)	flame arrester where the quenching gaps of the flame arrester element cannot be technically drawn, measured or controlled (e.g. random structures such as knitted mesh, sintered materials and gravel beds)	ISO 16852 - 3.17.2
normal pressure venting	outbreathing under normal operating conditions (pumping product into the tank and thermal outbreathing)	EN 14015 - 3.1.35
normal vacuum venting	inbreathing under normal operating conditions (pumping product out of the tank and thermal in-breathing)	EN 14015 - 3.1.36

Term	Description	Source
normal venting	venting required because of operational requirements or atmospheric changes	ISO 28300 – 3.7
opening pressure	the vacuum or gauge pressure at which the valve reaches the distance required for mass flow to be released; it is equal to the set pressure plus overpressure	DIN 3320 - 54
operating pressure	pressure existing at normal operating conditions within the system being protected	ISO 4126-2:2003(E) - 3.16
operating temperature	temperature reached when the equipment is operating under design conditions	-
overpressure	pressure increase over the set pressure. Overpressure is usually expressed as a percentage of the set pressure	ISO 4126 - 3.7
pallet type valve (disc valve)	valve with disc-shaped seal and axial guide	-
pilot-operated pressure relief valve	pressure relief valve in which the major relieving device or main valve is combined with and controlled by a self-actuated auxiliary pressure-relief valve (pilot)	ISO 23251 - 3.52
pilot-operated valve	valve controlled by a control device (pilot)	-
pipe away valve	pressure or vacuum valve to which a vent pipe may be connected	EN 14015 - 3.1.44
pressure (gauge pressure)	Pressure for which the value is equal to the algebraic difference between the absolute pressure and the atmospheric pressure	ISO 21013-2:2007
pressure-relief valve	valve designed to open and relieve excess pressure and to reclose and prevent the further flow of fluid after normal conditions have been restored	ISO 23251 - 3.56
pressure/vacuum valve (PV valve)	weight-loaded, pilot-operated, or spring-loaded valve used to relieve excess pressure and/or vacuum that has developed in a tank	EN 14015 - 3.1.41
pre-volume flame arrester	flame arrester that, after ignition by an internal ignition source, prevents flame transmission from inside an explosion-pressure-resistant containment (e.g. a vessel or closed pipe work) to the outside, or into the connecting pipe work	ISO 16852 - 3.23
product	includes equipment, protective systems, devices, components and combinations of these	-
protective screen	component which allows free flow but prevents the passage of foreign matter, e.g., animals	-
protective system	all devices, with the exception of components (see A.6) of the equipment, intended to immediately stop explosions and/or to limit the area affected by an explosion and separately placed on the market as autonomous systems	EN 13237 – A.5
quenching	cooling of a fluid by mixing it with another fluid of a lower temperature	ISO 23251 - 3.59
relieving pressure	pressure at the inlet of a relief device when the fluid is flowing at the required relieving capacity	ISO 28300 - 3.15
reseating pressure	value of the inlet static pressure at which the disc re-establishes contact with the seat or at which the lift becomes zero	ISO 4126 - 3.8
right-wound	orientation (angle) of gaps of crimped ribbon element	-

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Term	Description	Source
ring-shaped flame arresting unit	flame arrester consisting of ring-shaped crimped ribbons	-
safety shut-off valve	a safety shut-off valve is a valve which closes automatically to prevent a predetermined gauge pressure from being exceeded	DIN 3320-2
safety valve	valve which automatically, without the assistance of any energy other than that of the fluid concerned, discharges a quantity of the fluid so as to prevent a predetermined safe pressure being exceeded, and which is designed to re-close and prevent further flow of fluid after normal pressure conditions of service have been restored	ISO 4126 - 3.1
sampling and air bleed valve	flashback-proof and non-flashback-proof taps or valves for out-breathing and in-breathing plant components	-
set pressure	gauge pressure at the device inlet at which the relief device is set to start opening under service conditions	ISO 28300 - 3.19
set vacuum	internal negative gauge pressure at which a vacuum valve first opens	EN 14015 – 3.1.4
shock absorber	component to reduce the kinetic energy of a detonation	-
Shock-Wave-Guide-Tube (SWGT)	component for decoupling of shock wave and flame front: PROTEGO® patent	-
short time burning	stabilized burning for a specific time	ISO 16852 - 3.5
spacer	component that is installed on and between the crimped ribbon elements of a flame arrester	-
sparge pipe	inlet pipe into the stored substances of a hydraulic flame arrester	-
stabilized burning	steady burning of a flame stabilized at, or close to the flame arrester element	ISO 16852 - 3.4
stable detonation	a detonation is stable when it progresses through a confined system without significant variation of velocity and pressure characteristics	ISO 16852 - 3.10
static electricity	build-up of an electrical difference of potential or charge, through friction of dissimilar materials or substances e.g. product flow through a pipe	EN 14015 - 3.1.18
static flame arrester	flame arrester designed to prevent flame transmission by quenching gaps	ISO 16852 - 3.17
stoichiometric air	chemically correct ratio of fuel to air capable of perfect combustion with no infused fuel or air	ISO 23251 - 3.73
storage tank/vessel	fixed tank or vessel that is not part of the processing unit in petrochemical facilities, refineries, gas plants, oil and gas production facilities, and other facilities	ISO 23251 - 3.74
swivel joint	part of a swing pipe system	-
temperature class	classification of equipment, protective systems, or components for explosive atmospheres based on their maximum surface temperature, or to classify flammable gases and vapors according to their ignition temperature	EN 13237 - 3.63
temperature sensor	temperature sensor for monitoring the temperature	-
test pressure	pressure to test the static strength and/or tightness of a device	-
theoretical discharge capacity	calculated capacity expressed in mass or volumetric units of a theoretically perfect nozzle having a cross-sectional flow area equal to the flow area of a safety valve	ISO 4126-1:3.19

Term	Description	Source
thermal inbreathing	movement of air or blanketing gas into a tank, when vapours in the tank contract or condense as a result of weather changes (e.g. decrease in atmospheric temperature)	ISO 28300 - 3.20
thermal outbreathing	movement of air or blanketing gas out of a tank, when vapors in the tank expand and liquid in the tank vapourizes as a result of weather changes (e.g. increase in atmospheric temperature)	ISO 28300 - 3.21
unstable detonation	detonation during the transition of a combustion process from a deflagration into a stable detonation. The transition occurs in a limited spatial zone where the velocity of the combustion wave is not constant and where the explosion pressure is significantly higher than in a stable detonation	ISO 16852 - 3.11
upper flammable limit (UFL)	highest concentration of a combustible substance in a gaseous oxidizer that will propagate a flame	NFPA 69-2019
valve disc guide	valve element for guiding a valve pallet	-
valve lift	actual travel of the valve pallet away from the closed position when a valve is relieving	-
valve pallet gasket	sealing element between valve pallet and valve seat	-
vent cap	end-of-line device for free out-breathing and in-breathing of plant components. This device can be flame transmission-proof	-
vent header	piping system that collects and delivers the relief gases to the vent stack	ISO 23251 - 3.78
vent pipes	pipes for valves with pipeline connection	EN 14015 - 3.1.45
venting system	system which consists of pipeline and devices for free out-breathing and in-breathing of plant components	-
venting system with flame arresting capability	vent and vent hood or pressure/vacuum valves combined with a flame arrester or with integrated flame arresting elements	DIN EN 14015 - 3.1.42
vessel	container or structural envelope in which materials are processed, treated or stored	ISO 23251 - 3.80
zone 0	a place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapor or mist is present continuously or for long periods or frequently	1999/92/EC – appx. 1
zone 1	a place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapor or mist is likely to occur in normal operation occasionally	1999/92/EC – appx. 1
zone 2	a place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapor or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only	1999/92/EC – appx. 1
zones for gases/vapors	hazardous areas are classified into zones based on the frequency and duration of the occurrence of an explosive gas atmosphere; the definitions are only applicable to equipment group II	1999/92/EC – appx. 1

Materials, Terms, and Conversion Tables

Pressure

1 bar	= 14.504 psi	1 lb/ft^2	=	47,88 N/m^2
	= 29.530 inch Hg		=	0,4788 mbar
	= 0.987 atm		=	4,882 mm WC
	= 401.46 inch W.C.			
1 mbar	= 0.0145 psi	1 inch W.C.	=	249,09 N/m^2
	= 0.0295 inch Hg		=	2,4909 mbar
	= 0.4015 inch W.C.		=	25,4 mm WC
	= 2.089 lb/ft^2	1 inch Hg	=	33,864 mbar
1 kPa	= 10 mbar	1 psi	=	68,94757 mbar
1 inch H_2O	= 2,49089 mbar	1 inch Hg	=	33,8639 mbar
1 Pa	= 1 N/m^2	1 psi	=	1 lb/in^2

Temperature

To convert ºC in ºF use	T_F	= $32 + 1{,}8\ T_C$
	0ºC	= 32ºF
	100ºC	= 212ºF
To convert ºF in ºC use	T_C	= $\frac{5}{9}(T_F - 32)$
	0ºF	= -17,8ºC
	100ºF	= 37,8ºC

Material

DIN Material Number	DIN-Material	ASTM-Material	
0.6020	GG 20	A 278-30	C.I.
0.7040	GGG 40	A 536-77	C.I.
1.0619	GS-C 25	A 216 Gr. WCB	C.S.
1.4301	X5 CrNi 18 10	A 240 Gr. 304	S.S.
1.4408	G-X6 CrNiMo 18 10	A 351 Gr. CF 8 M	S.S.
1.0425	P 265 GH	A 515 Gr. 60	C.S.
1.4541	X6 CrNiTi 18 10	A 240 Gr. 321	S.S.
1.4571	X10 CrNiMoTi 18 10	A 240 Gr. 316 Ti	S.S.
3.2581	AC 44200	A 413	Alu
Ta	Tantal	UNS R05200	
2.4610	NiMo 16 Cr 16 Ti	UNS N06455	C-4
2.4686	G-NiMo 17 Cr	UNS N30107	Casting
2.4602	NiCr 21 Mo 14 W	UNS N06022	C-22
2.4819	NiMo 16 Cr 15 W	UNS N10276	C-276

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

Important differences: US decimals in accordance with SI-System

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

Sealings and Coatings

PTFE	= polytetrafluoroethylene
PVDF	= polyvinylidenfluoride
PFA	= perfluoralkoxy polymer
FPM 70	= fluoropolimer elastomer
WS 3822	= aramide and anorganic fibers as well as mineral reinforcement materials bonded with NBR rubber
ECTFE	= ethylene chlorotrifluorethylene
FEP	= perfluoroethylene propylene

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

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

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

Length

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

Area

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

Volume

1 cm^3	= 0.06102	cu inch	1 cu inch	=	16,3870 cm^3
1 liter	= 0.03531	cu ft	1 cu ft	=	28,317 liter
	= 0.21997	gal (UK)	1 gal (UK)	=	4,5461 liter
	= 0.26417	gal (US)	1 gal (US)	=	3,785 liter
1 m^3	= 35.315	cu ft	1 cu ft	=	0,028317 m^3
	= 6.290	petr. barrels	1 petr. barrel	=	0,15899 m^3

Mass

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

Velocity and Volume Flow

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

Torsion

1 Nm = 0.738 lb ft   1 lb ft = 1,36 Nm

Density

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

Project Data Sheet

Quotation-No. **Order-No.**
Project-No. **Project Reference**
Valve / Flame Arrester Tag No. **Tank / Vessel No.**

Storage Tank / Vessel

□ aboveground	diameter m/ft	design pressure	mbar/inch W.C.
□ underground	height m/ft	design vacuum	mbar/inch W.C.
□ insulated	wall height m/ft	pumping-in-rate	m³/h cu ft/min
ins. thickness mm / inch	blanketing level m/ft	pumping-out-rate	m³/h cu ft/min
□ inert gas	inert gas blanketing level	tank design standard	

Stored Product Offgas/Vapor-Composition

Components Name Formula Vol.%	Flashpoint °C/°F	CAS	MESG mm/inch	Ex.- Group

Processing Plant

design temperature °C/°F	design pressure bar/psi	
operating temperature °C/°F	operating pressure bar/psi	back pressure mbar/inch W.C.

Installation

□ in-line	□ horizontal	distance to source of ignition m/ft
□ end-of-line	□ vertical	

Function

□ pressure	□ endurance burning proof	□ temperature monitored on side
□ vacuum	□ short-time burning proof	□ temperature monitored both side
□ pressure/vacuum combined	□ deflagration proof	□ pressure monitored
	□ detonation proof	□ bidirectional flame arrester

Valve and Flame Arrester Data

size nominal DN	flow $\dot{V}$ m³/h cu ft/min	density	kg/m³ lb/cu ft
pressure nominal PN	inlet flange DN	PN	form
set pressure mbar/inch W.C.	outlet flange DN	PN	form
set vacuum mbar/inch W.C.	pressure drop Δp mbar/inch W.C.		

Material

pressure carrying parts	internals	lining

Inspection/Documentation

material certificate	works certificate	performance certificate

Piping Flow Diagram (excerpt) / Additional Remarks / Miscellaneous → refer to separate sheet

Fill in and □ check, if applicable

signed: date: approved: released:

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Notes:

PROTEGO® Deflagration Flame Arresters
End-of-Line
and Vent Caps

Section 2

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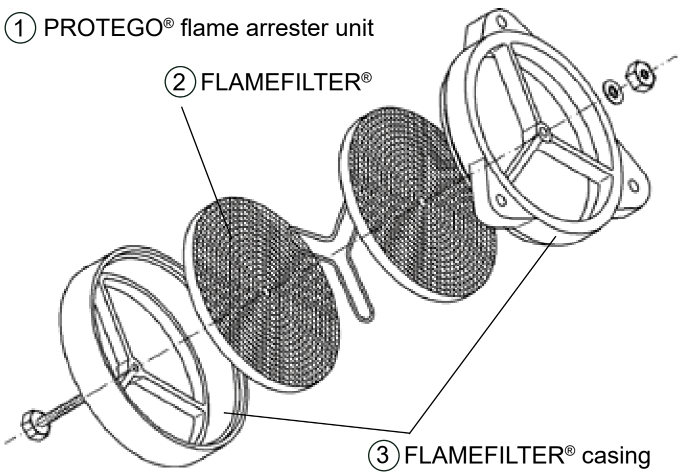
Function and description

The different combustion processes and installation locations of flame arresters are discussed in “Technical Fundamentals“ (Sec. 1). This section discusses the PROTEGO® product range for end-of-line deflagration flame arresters and vent caps. These devices protect against atmospheric deflagration, atmospheric deflagration and short time burning, or atmospheric deflagration and endurance burning, which also includes short time burning. Vent caps without flame arrester elements complete our range of end-of-line devices.

PROTEGO® end-of-line deflagration flame arresters are state-of-the-art safety devices which are installed on storage tanks, vessels, or in process plants. They provide safe protection against atmospheric deflagration, short time burning or endurance burning if potentially explosive vapors are released. They reduce the impact of atmospheric deflagration and prevent flame transmission to protect equipment which is not designed to be explosion pressure-proof.

The main component is the PROTEGO® flame arrester unit (1) which stops the propagation of flames. The PROTEGO® flame arrester unit consists of one or two FLAMEFILTER® discs which are secured in a FLAMEFILTER® casing (3). The gap size and number of FLAMEFILTER® discs depend on the operating parameters of the mixture that is flowing through (i.e., explosion group, pressure, temperature, composition of the product).



Deflagration and short time burning proof end-of-line flame arresters are equipped with a temperature sensor which detects a stabilized flame on the flame arrester element. If a flame is detected, measures have to be taken to extinguish the flame and prevent endurance burning.

Should venting of an explosive mixture over a long period of time be unavoidable, and no secondary measure is implemented to extinguish a flame, devices which provide endurance burning protection shall be installed. **Deflagration and endurance burning proof end-of-line flame arresters** from PROTEGO® are equipped with a melting element which melts if a flame stabilizes on the flame arrester element and then allows the weather hood to open. This allows the flame to transfer most of its heat directly to the environment, and a flashback is prevented by the FLAMEFILTER®.

Vent caps without flame arrester elements protect against environmental impact (harsh weather conditions, foreign bodies, and nesting animals) complete our product range.

In close cooperation with scientific institutions, PROTEGO® has developed safety devices which can be applied to all explosion hazardous locations and provide protection against atmospheric deflagration, short time burning, and endurance burning. Our devices are subjected to and certified by type examination according to ATEX and other international standards (CE, Gost-R, GL, etc.).

A wide range of types, designs, sizes, and materials can be provided. Most importantly, we have the capability to custom design and develop solutions at our test facility, which is the most technologically advanced in the world.

Special features and advantages

The following factors should be considered for selecting a device: **Deflagration protection, deflagration and short time burning protection,** including temperature control, or **deflagration and endurance burning protection. Vent caps** do not have a FLAMEFILTER®.

Regarding operating conditions, **higher temperatures** have to be considered if standard values for atmospheric operation are exceeded.

For selecting a suitable device, the components should be classified into **explosion groups** according to their MESG value.

The suitable **approval** must be chosen.

The system specification needs to be considered when selecting the appropriate connection and **size**.

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

We provide special designs for critical substances and product properties (e.g., viscosity, density, crystallization, and polymerization).

Preferred applications

PROTEGO® end-of-line deflagration flame arresters and vent caps are typically installed on storage tanks and vessels of the chemical, petrochemical, and pharmaceutical industries for protection.

Installation and maintenance

The modular design of the end-of-line deflagration flame arresters assures the easiest possible maintenance. For onsite maintenance purposes, the device has to be installed in a location where it can easily be accessed. For larger sizes, it may be necessary to provide lifting equipment. Maintenance is trouble-free for trained personnel.

PROTEGO® end-of-line deflagration flame arresters are installed in areas subject to explosion hazards. It is important to select the correct device for the specific application. The manufacturer´s statement of conformity confirms the tasks for which the deflagration flame arrester is suitable. The user documents proper use in accordance with the applicable safety regulations.

Selection

Based on main process data, the different types of devices can be selected from our product range:

- **Atmospheric deflagration-proof, short time burning-proof, endurance burning-proof,** or **vent caps**
- **Explosion group** of the processed mixture
- Standard or special operating conditions with **higher temperatures**

Subsequently, the following criteria has to be verified or selected:

- **Size** and type of connection
- **Approvals** according to ATEX, etc.
- **Heating jacket** or heating coil

Other details, such as material, coating etc., can be selected or defined on the data sheet after pre-selection.

If no suitable device can be found, please contact us. Special designs and approvals are available.

Sizing

The volume flow/pressure drop diagram shows the determined or checked nominal size of the device. If it is likely that the FLAMEFILTER® can become clogged, a safety factor should be considered for sizing.

Given: Flow rate $\dot{V}$ — m³/h or CFH
max. all. pressure drop — Δ p in mbar or inch W.C.

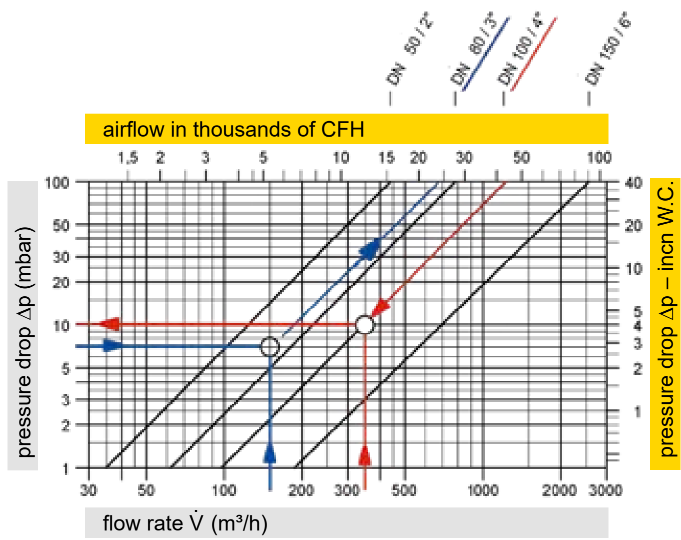
Desired: Size of the device — DN

Procedure: Intersection point of straight lines through the flow rate and maximum allowable pressure drop is above or at the size curve

Given: Flow rate $\dot{V}$ — m³/h or CFH
size of nozzle connection — DN

Desired: Pressure drop (flow resistance)
Δ p in mbar or inch W.C.

Procedure: Intersection point of the straight line through the flow rate and size curve, horizontal straight line provides the pressure drop



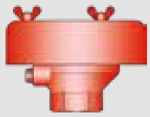
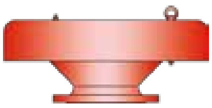
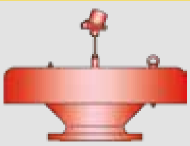
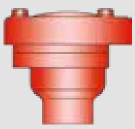
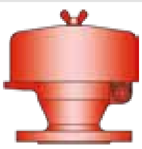
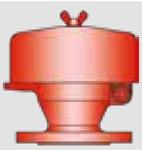
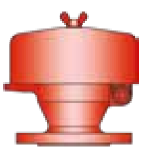
Instructions for calculating the volume flow or influence of density is covered in the “Technical Fundamentals” (see Sec. 1).

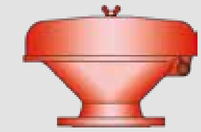
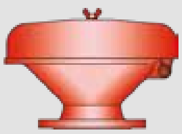
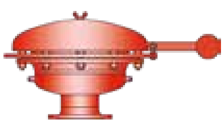
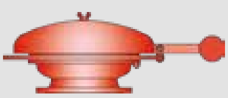
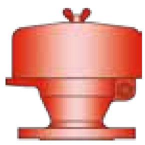
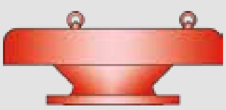
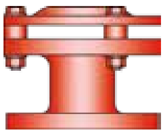
After all the steps are completed, the device can be specified and ordered.

For special applications, please complete the data sheet from Section 1 and provide the necessary information for a quotation.

PROTEGO® Deflagration Flame Arresters, End-of-Line, and Vent Caps

Catalog

	Type	Size DN	Explosion group ATEX	Explosion group NEC	Approvals	X = Special design for higher temperatures	X = Heating jacket / heating coil	Page
Deflagration flame arrester, end-of-line								
	BE/AD	15 - 50 ½" - 2"	IIB3, IIC	C B	ATEX			64 - 66
	LH/AD	50 - 800 2" - 32"	IIB3, IIC	C B	ATEX	X		68 - 70
Deflagration flame arrester, short time burning-proof, end-of-line								
	LH/AD-T	50 - 800 2" - 32"	IIB3, IIC	C B	ATEX	X		72 - 74
Deflagration flame arrester, endurance burning-proof, end-of-line								
	EB	25 - 800 1“ - 32“	IIA, IIB	D B	ATEX			76 - 79
	EB-DN/DN2	20 - 700 ¾“ - 28“	IIA, IIB	D B	ATEX	X	X	76 - 79
	EB-Z	15 - 32 ½" - 1¼"	IIA	D	ATEX			
	BE/HK	20 - 80 ¾" - 3" 20 - 32 ¾" - 1¼"	IIA, IIB3	D C	ATEX		X	
	BE/HK-E	20 - 80 ¾" - 3"	IIB1	–	ATEX		X	80 - 81
	BE-HK-E	80 3"	IIB3	C	ATEX IMO		X	

	Type	Size DN	Explosion group ATEX	Explosion group NEC	Approvals	X = Special design for higher temperatures	X = Heating jacket / heating coil	Page
Deflagration flame arrester, endurance burning-proof, end-of-line (Continuation)								
	BE/HR	80 - 100 3" - 4"	IIA, IIB3	D C	ATEX		X	
	BE/HR-E	80 - 100 3“ - 4“	IIB1	–	ATEX		X	82 - 83
	BE/HR-E	80 - 100 3“ - 4“	IIB3, IIB	C B	ATEX IMO		X	
	BE/HR 400	150 - 200 6" - 8"	IIA	D	ATEX		X	
	LH/EB	150 - 400 6" - 16"	IIA1 (I)	-	ATEX			
Vent caps, end-of-line, without flame arrester unit								
	EH/0	20 - 80 ¾" - 3"						
	EH/0S	100 - 600 4" - 24"						
	E/KS	50 - 200 2" - 8"						

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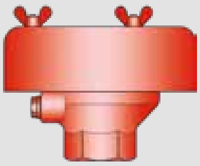
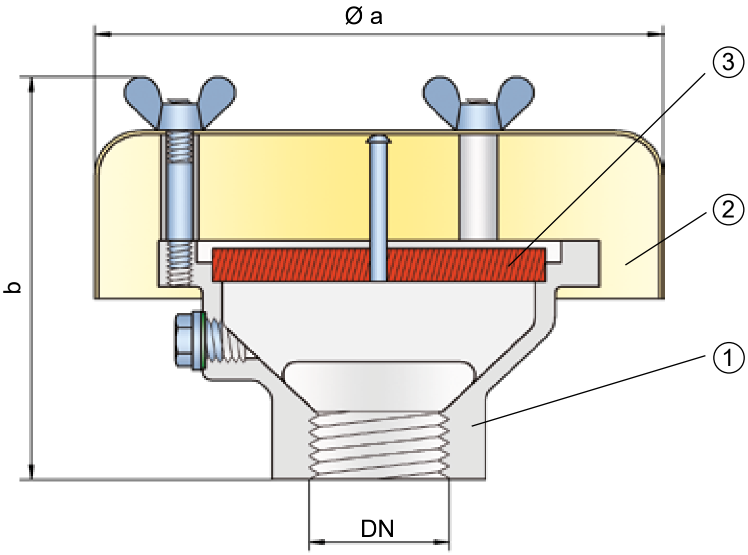


Deflagration Flame Arrester, End-of-Line

PROTEGO® BE/AD



Function and Description

The PROTEGO® BE/AD end-of-line deflagration flame arrester provides protection against atmospheric deflagrations. The device is usually installed on vent lines of small vessels and plant equipment which are not pressurized. For safe application, it is important that an endurance burning situation can be excluded. So typically, it is installed on vents lines which discharge vapor for a short time period. The device is the ideal solution for preventing flame transmission from atmospheric deflagration into the vessel or plant.

The PROTEGO® BE/AD consists of the housing (1), a weather hood (2), and the PROTEGO® flame arrester unit (3). The device is equipped with a metal weather hood. The FLAMEFILTER® gap size will depend on the device's intended use. Specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, enables PROTEGO® to select the best end-of-line deflagration flame arrester for your application. The PROTEGO® BE/AD series end-of-line deflagration flame arrester is available for substances from explosion groups IIA to IIC (NEC groups D to B).

The standard design can be used with an operating temperature of up to +60°C / 140°F.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- Weather hood provides protection against environmental impact (harsh weather conditions, foreign bodies, and nesting animals.)
- easy maintenance
- quick removal and installation of FLAMEFILTER®
- threaded connection
- provides protection against atmospheric deflagrations
- low operating and lifecycle costs
- cost-effective Flame arrester
- cost-effective spare parts

Design Type and Specification

Deflagration flame arrester, end-of-line, basic design **BE/AD**

Special designs 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	15 / G ½"	20 / G ¾"	25 / G 1"	32 / G 1¼"	40 / G 1½"	50 / G 2"
a	116 / 4.57	116 / 4.57	116 / 4.57	116 / 4.57	200 / 7.87	200 / 7.87
b	80 / 3.15	80 / 3.15	85 / 3.35	85 / 3.35	150 / 5.91	150 / 5.91

Table 2: Selection of explosion group			
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	Special approvals upon request.
≥ 0,65 mm	IIB3	C	
< 0,5 mm	IIC	B	

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			
Design	B	C	Special materials upon request.
Housing	Stainless Steel	Hastelloy	
Weather hood	Stainless Steel	Stainless Steel	
FLAMEFILTER®	Stainless Steel	Hastelloy	

Table 5: Type of connection		
Pipe thread DIN ISO 228-1	DIN	Other types of thread upon request.

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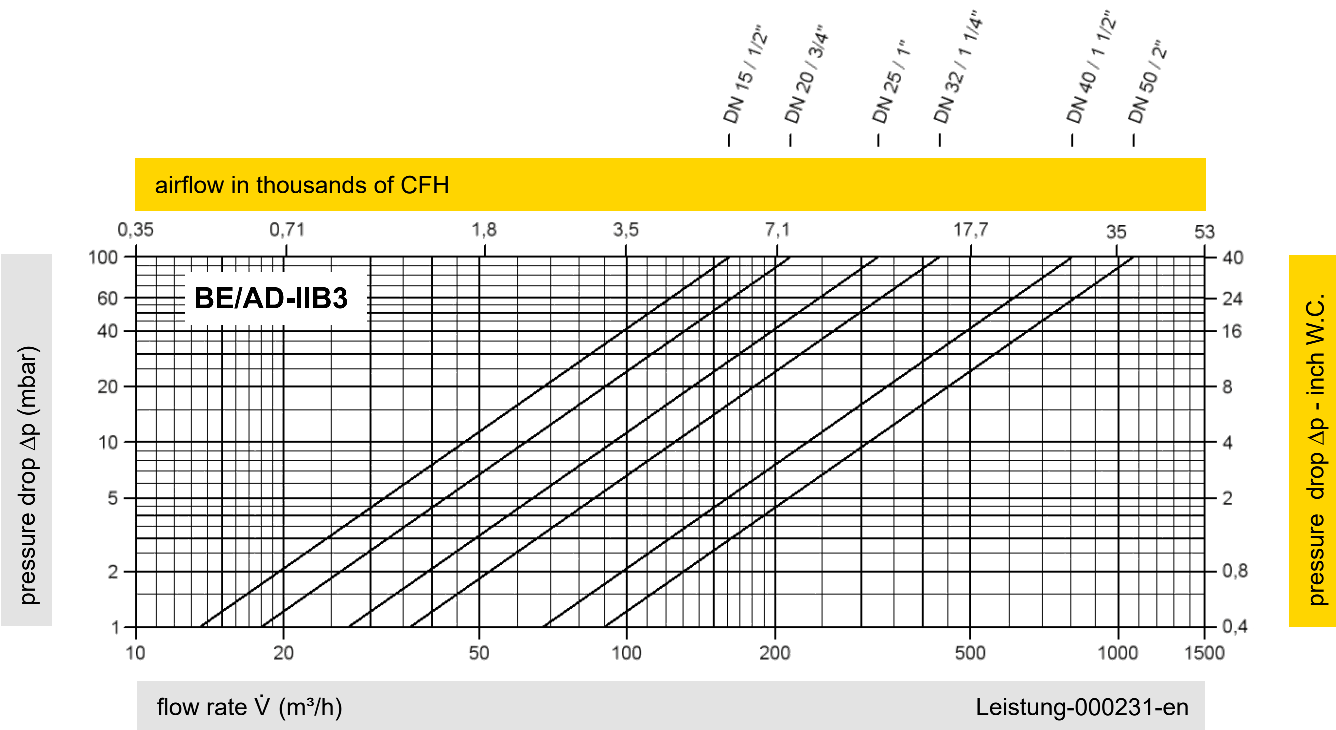
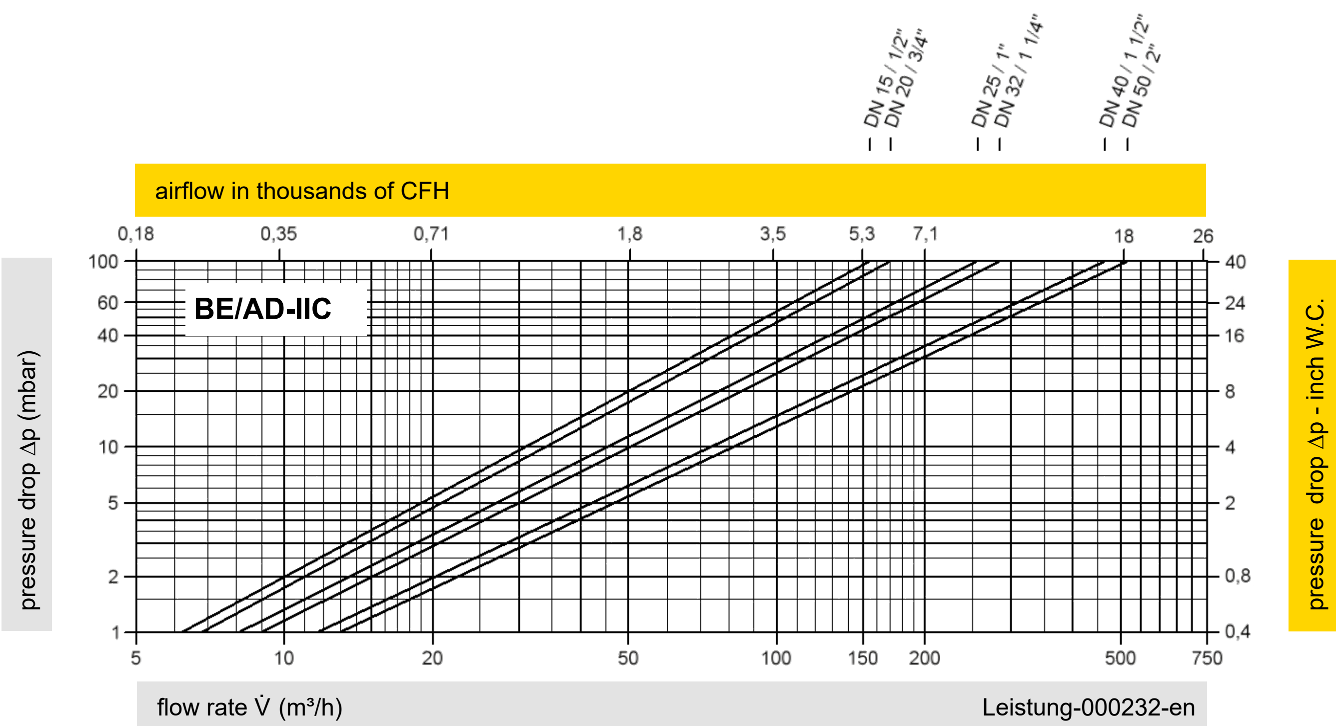
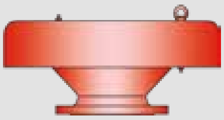




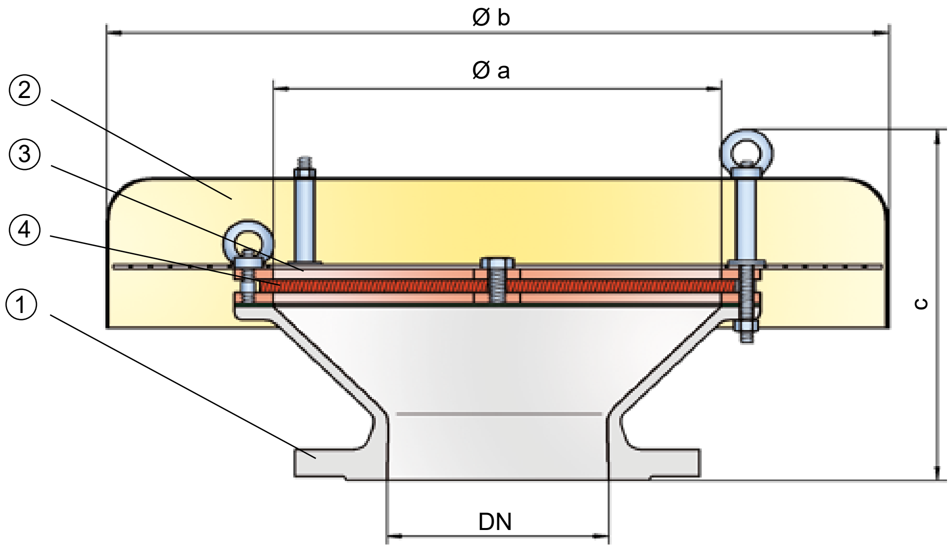
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:



Deflagration Flame Arrester, End-of-Line

PROTEGO® LH/AD



Function and Description

The PROTEGO® LH/AD end-of-line deflagration flame arrester provides protection against flame transmission through atmospheric deflagration. The device is typically installed on vent lines of vessels and plant equipment which are not pressurized. For safe application, it is important that an endurance burning situation can be excluded. So typically, it is installed on vent lines which discharge vapor for a short time period. The device prevents flame transmission from atmospheric deflagration into the vessel or plant.

The PROTEGO® LH/AD consists of the housing (1), a weather hood (2), and the PROTEGO® flame arrester unit (3). The device is equipped with a metal weather hood. A protection screen is installed between the weather hood and the housing to keep out animals and foreign bodies. The FLAMEFILTER® (4) gap size depends on the device's intended use. Specifying the operating conditions, such as the temperature, explosion group and the composition of the fluid, enables PROTEGO® to select the best end-of-line deflagration flame arrester for your application.

The PROTEGO® LH/AD series end-of-line deflagration flame arrester is available for substances from explosion groups IIA to IIC (NEC groups D to B). Special certifications for carbon disulfide are available.

The standard design can be used with an operating temperature of up to +60°C / 140°F. Devices with special approval for higher temperatures are available upon request.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- weather hood with protection screen protects the PROTEGO® flame arrester unit against environmental impact, such as nesting animals and weather conditions
- available for DN 50/2"- bis DN 800/32"- pipes
- trouble-free maintenance
- advanced design for higher operating temperatures
- provides protection against atmospheric deflagrations
- low operating and lifecycle costs
- cost-effective Flame arrester
- cost-effective spare parts

Design Type and Specification

End-of-line deflagration flame arrester, basic design	**LH/AD**
End-of-line deflagration flame arrester for carbon disulfide	**LH/AD-CS2**

Special designs 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	a	b	IIB3	IIC
			c*	c*
50 / 2"	100 / 3.94	200 / 7.87	175 / 6.89	185 / 7.28
80 / 3"	150 / 5.91	240 / 9.45	180 / 7.09	195 / 7.68
100 / 4"	200 / 7.87	295 / 11.61	220 / 8.66	235 / 9.25
125 / 5"	250 / 9.84	350 / 13.78	240 / 9.45	-
150 / 6"	300 / 11.81	550 / 21.65	260 / 10.24	270 / 10.63
200 / 8"	300 / 11.81	550 / 21.65	260 / 10.24	270 / 10.63
250 / 10"	400 / 15.75	600 / 23.62	355 / 13.98	365 / 14.37
300 / 12"	400 / 15.75	600 / 23.62	340 / 13.39	350 / 13.78
350 / 14"	600 / 23.62	800 / 31.50	390 / 15.35	400 / 15.75
400 / 16"	600 / 23.62	800 / 31.50	380 / 14.96	390 / 15.35
500 / 20"	700 / 27.56	1000 / 39.37	400 / 15.75	410 / 16.14
600 / 24"	800 / 31.50	1200 / 47.24	475 / 18.70	485 / 19.09
700 / 28"	1000 / 39.37	1400 / 55.12	505 / 19.88	515 / 20.28
800 / 32"	1200 / 47.24	1600 / 62.99	550 / 21.65	560 / 22.05

* "c" is reference values. Exact measures depend on the flange connection.

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,65 mm	IIB3	C	Special approvals upon request.
< 0,5 mm	IIC	B	

Table 3: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 4: Material selection for housing

Design	A	B	
Housing	Steel	Stainless Steel	Special materials upon request.
Weather hood	Stainless Steel	Stainless Steel	
Protection screen	Stainless Steel	Stainless Steel	
Flame arrester unit	A, B	B	

Table 5: Material combinations of flame arrester unit

Design	A	B	
FLAMEFILTER® casing	Steel	Stainless Steel	Special materials upon request.
FLAMEFILTER®	Stainless Steel	Stainless Steel	

Table 6: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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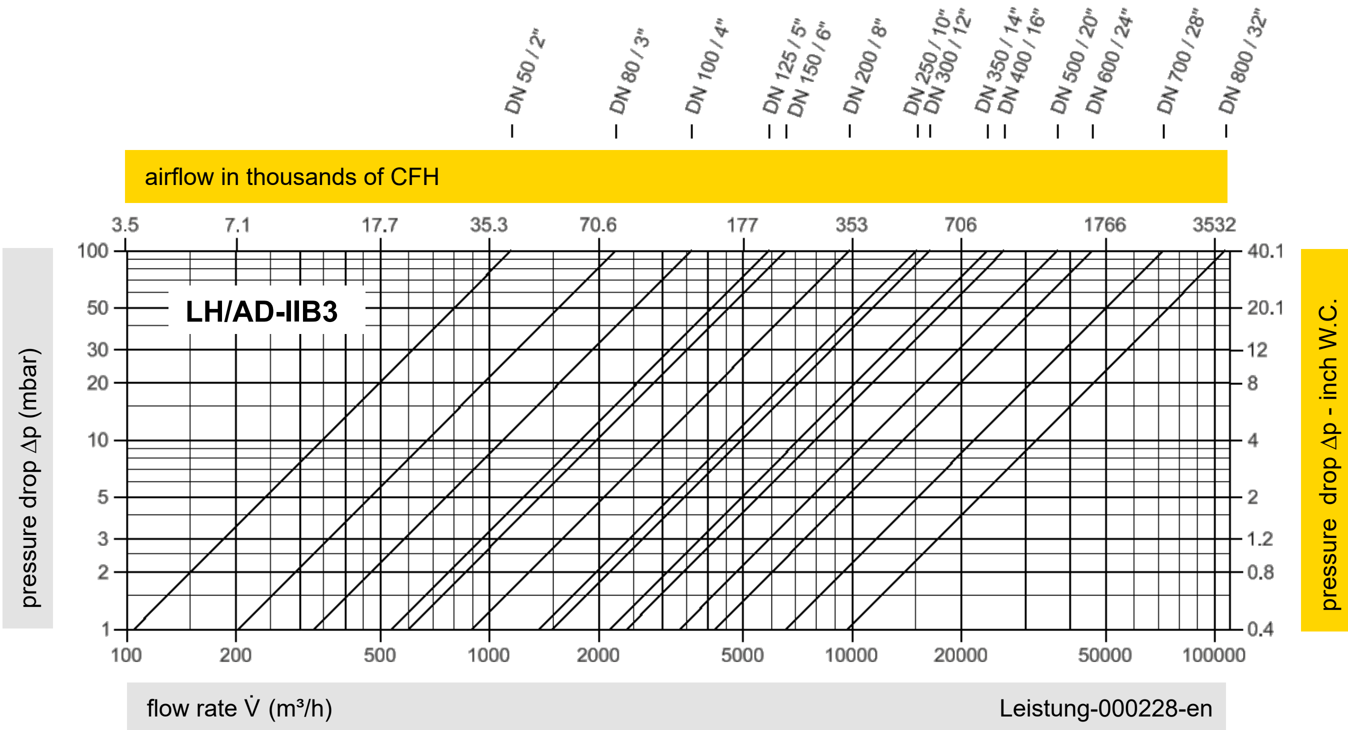
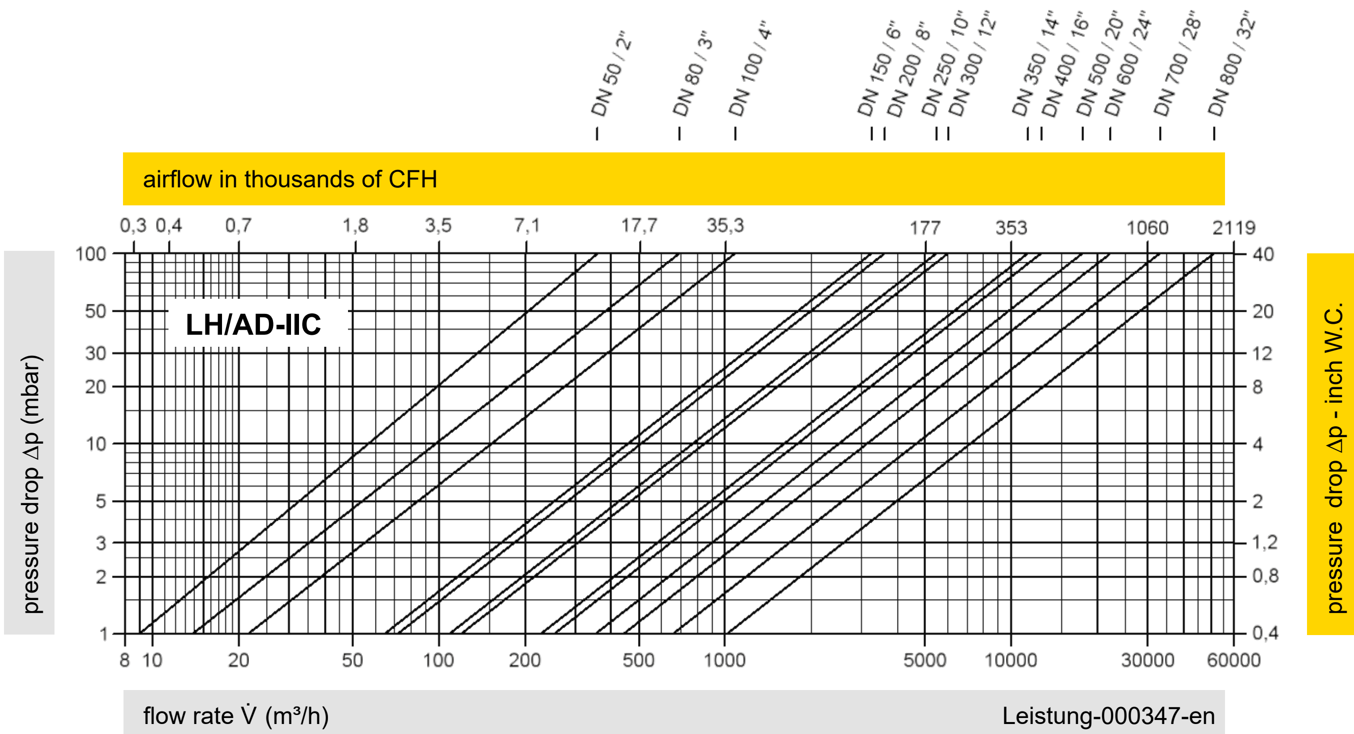
PROTEGO® LH/AD

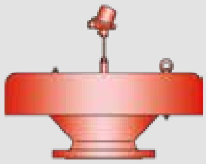




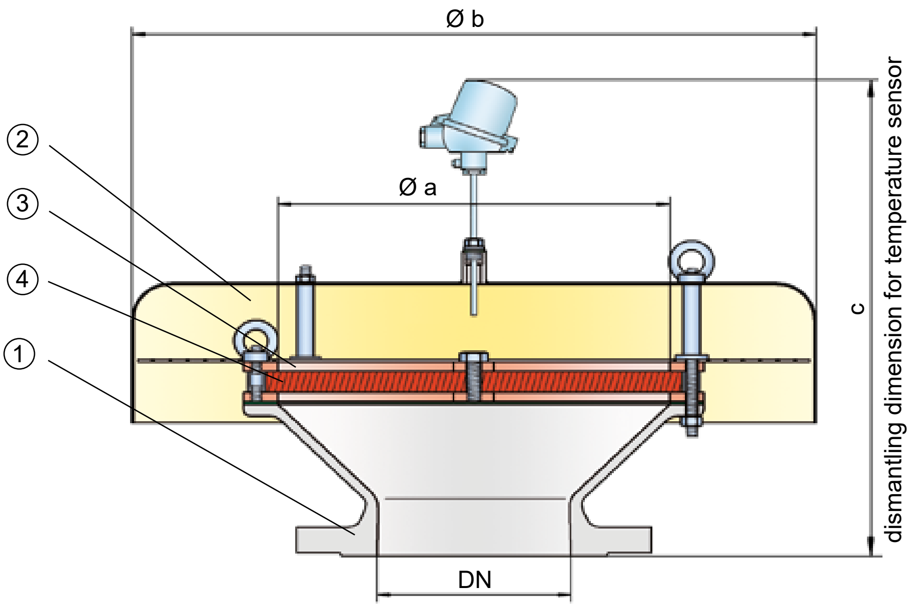
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

Notes:



PROTEGO® LH/AD-T



Function and Description

The PROTEGO® LH/AD-T end-of-line deflagration flame arrester provides protection against flame transmission through atmospheric deflagration and short time burning on the flame arrester element. The device is typically installed on vent lines of vessels and plant equipment which are not pressurized. The device is equipped with a temperature sensor which immediately detects a flame on the FLAMEFILTER® sur- face. After the flame is detected, a secondary measure, such as inerting or closing of a shut-off valve to block the vapor flow to the device, should activate within 60 seconds and extinguish the flame so that the system can operate safely. The device prevents flame transmission from short time burning and atmospheric deflagration into the vessel or plant.

The PROTEGO® LH/AD-T consists of the housing (1), a weather hood (2), and the PROTEGO® flame arrester unit (3). The device is equipped with a metal weather hood. The FLAMEFILTER® (4) gap size depends on the device's intended use. Specifying the operating conditions, such as the temperature, explosion group, and the composition of the fluid, enables PROTEGO® to select the best end-of-line deflagration flame arrester for your application. The PROTEGO® LH/AD-T series end-of-line deflagration flame arrester is available for substances from explosion groups IIA to IIC (NEC groups D to B).

The standard design can be used with an operating temperature of up to +60°C / 140°F. Devices with special approval for higher temperatures are available upon request.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- weather hood with protection screen protects the PROTEGO® flame arrester unit against environmental impact, such as nesting animals and weather conditions
- available for DN 50/2"- bis DN 800/32"- pipes
- trouble-free maintenance
- advanced design for higher operating temperatures
- provides protection against atmospheric deflagrations and short-time burning
- low operating and lifecycle costs
- cost-effective Flame arrester
- cost effective spare parts

Design Type and Specification

End-of-line deflagration flame arrester, basic design **LH/AD-T**

Special designs 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	a	b	IIB3	IIC
			c*	c*
50 / 2"	100 / 3.94	240 / 9.45	530 / 20.87	550 / 21.65
80 / 3"	150 / 5.91	295 / 11.61	560 / 22.05	580 / 22.83
100 / 4"	200 / 7.87	350 / 13.78	585 / 23.03	605 / 23.82
150 / 6"	300 / 11.81	600 / 23.62	630 / 24.80	655 / 25.79
200 / 8"	300 / 11.81	600 / 23.62	630 / 24.80	655 / 25.79
250 / 10"	400 / 15.75	800 / 31.50	750 / 29.53	770 / 30.31
300 / 12"	400 / 15.75	800 / 31.50	740 / 29.13	760 / 29.92
350 / 14"	600 / 23.62	1000 / 39.37	800 / 31.50	820 / 32.28
400 / 16"	600 / 23.62	1000 / 39.37	790 / 31.10	815 / 32.09
500 / 20"	700 / 27.56	1200 / 47.24	810 / 31.89	835 / 32.87
600 / 24"	800 / 31.50	1200 / 47.24	935 / 36.81	960 / 37.80
700 / 28"	1000 / 39.37	1500 / 59.06	975 / 38.39	995 / 39.17
800 / 32"	1200 / 47.24	1700 / 66.93	1015 / 39.96	1035 / 40.75

* 'c' is reference values. Exact measures depend on the flange connection.

Table 2: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,65 mm	IIB3	C	Special approvals upon request.
< 0,5 mm	IIC	B	

Table 3: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 4: Material selection for housing

Design	A	B	Special materials upon request.
Housing	Steel	Stainless Steel	
Weather hood	Stainless Steel	Stainless Steel	
Protection screen	Stainless Steel	Stainless Steel	
Flame arrester unit	A, B	B	

Table 5: Material combinations of flame arrester unit

Design	A	B	Special materials upon request.
FLAMEFILTER® casing	Steel	Stainless Steel	
FLAMEFILTER®	Stainless Steel	Stainless Steel	

Table 6: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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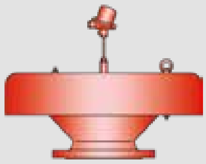
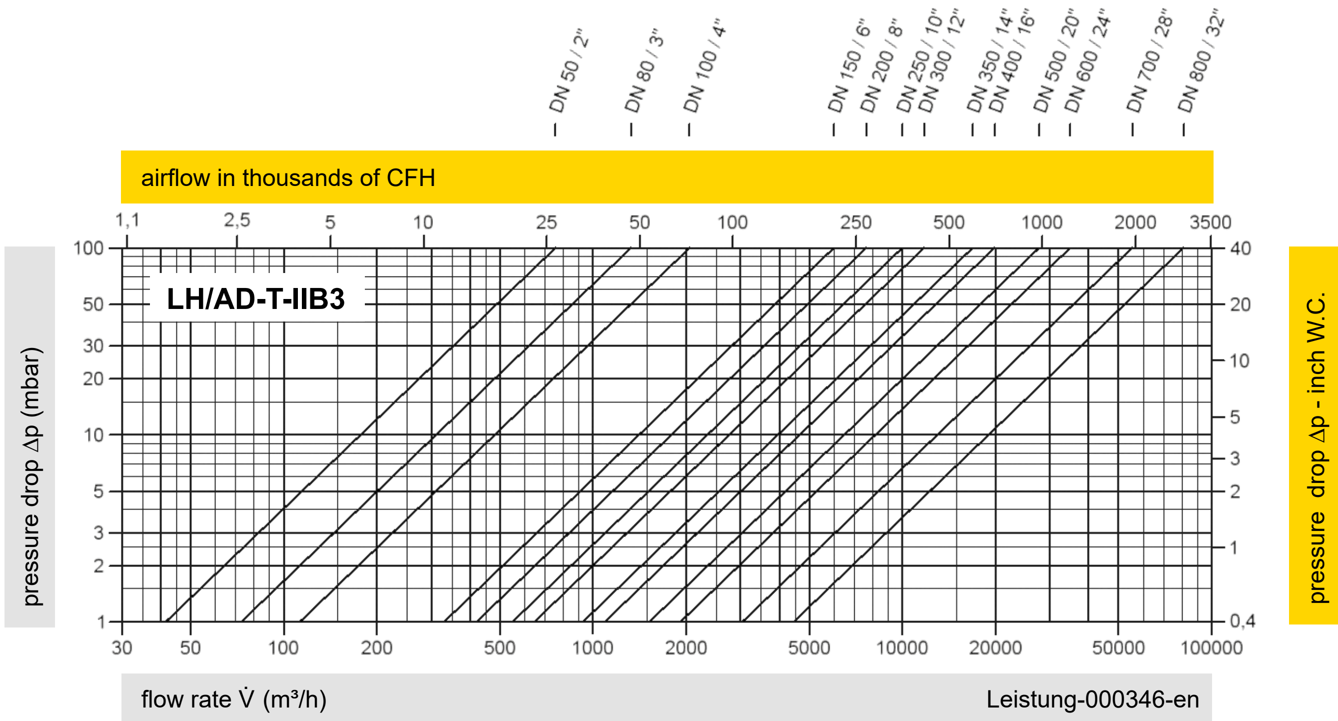
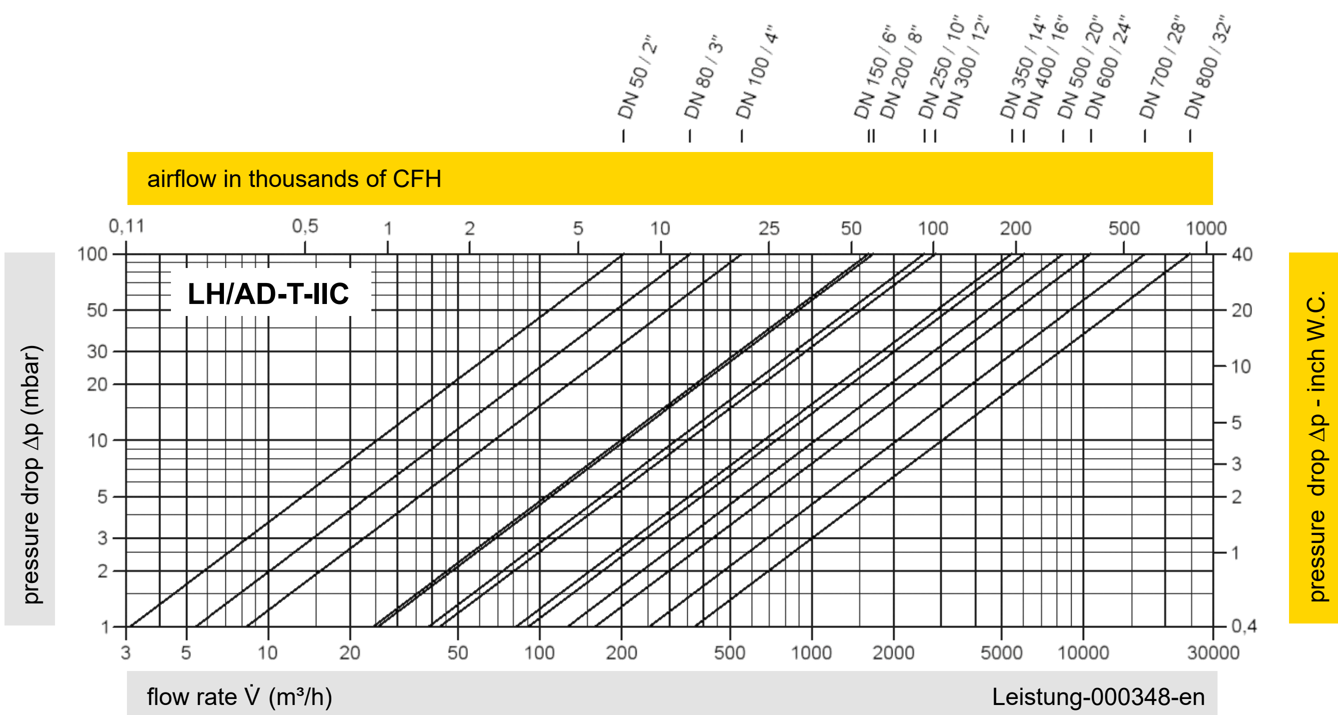


Deflagration Flame Arrester- Short-time burning-proof, End-of-Line

Flow Capacity Charts

PROTEGO® LH/AD-T





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

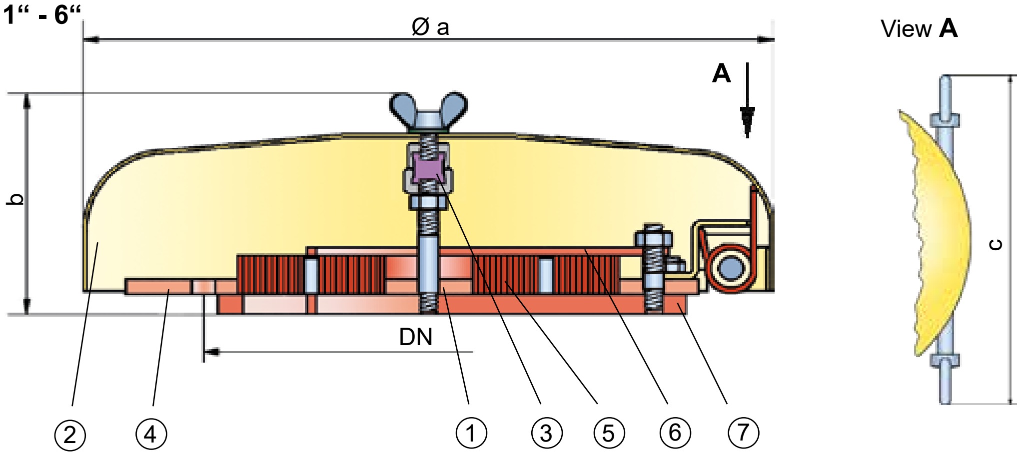
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

Notes:

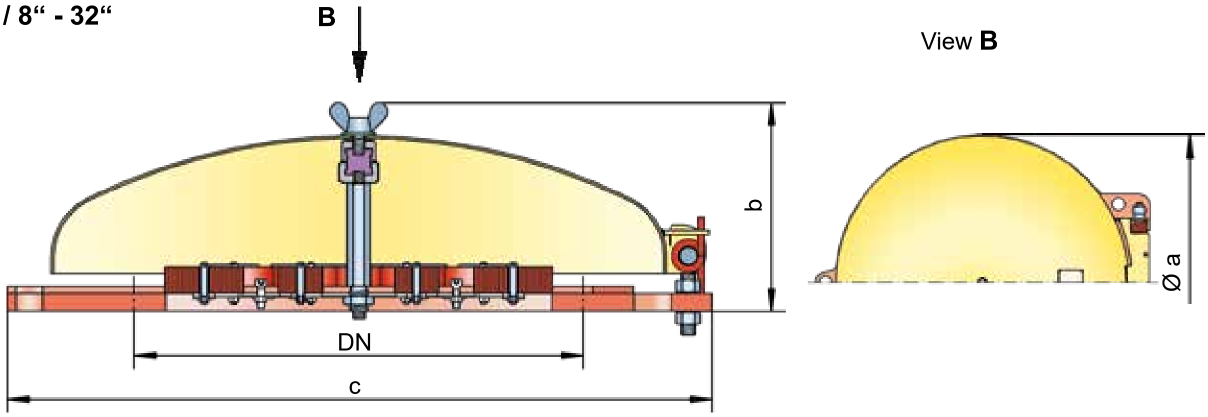
Deflagration Flame Arrester- Endurance burning-proof, End-of-Line

PROTEGO® EB-IIA and IIB

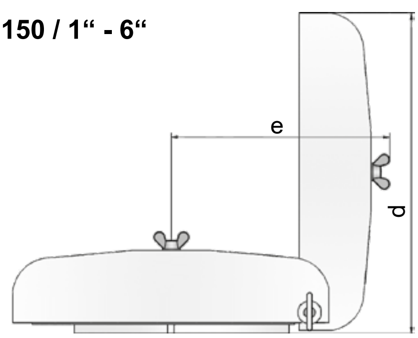
DN 25 - 150 / 1“ - 6“



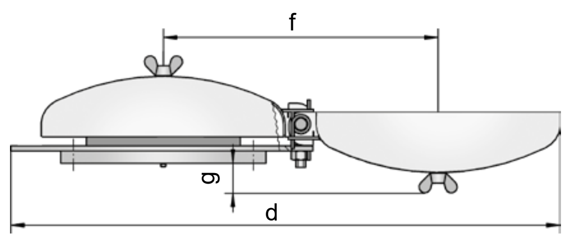
DN 200 - 800 / 8“ - 32“



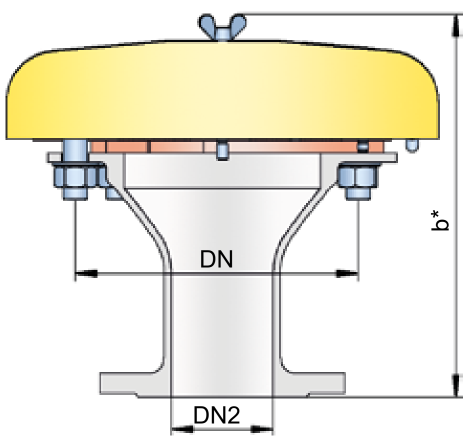
DN 25 - 150 / 1“ - 6“



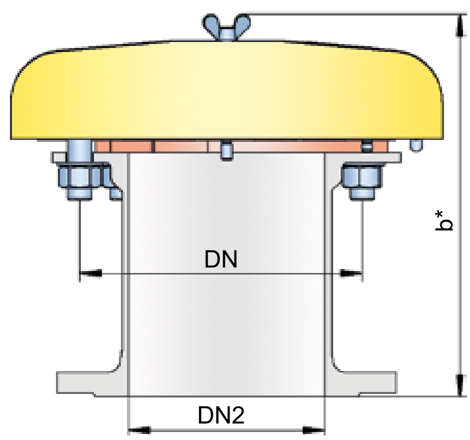
DN 200 - 800 / 8“ - 32“



EB with cone (example)



EB with nozzle (example)



PROTEGO® EB
(Flyer pdf)

Demonstration of endurance burning
Video

Function and Description

The PROTEGO® EB end-of-line deflagration flame arrester provides protection against atmospheric deflagration and long-lasting stabilized flames, called endurance burning. The device is typically installed on vent lines of vessels and plant equipment which is not pressurized. The device prevents flame transmission from endurance burning or atmospheric deflagration into the vessel or plant.

The PROTEGO® EB-IIA consists of the PROTEGO® flame arrester unit (1) and the metal weather hood (2). During normal operation, the metal weather hood is in a closed position. If a stabilized flame burns on the flame arrester element surface, the melting element (3), located in a center position, will melt and let the spring-loaded weather hood move into the open position. The PROTEGO® flame arrester unit consists of one or more FLAMEFILTER® (5), which are installed in a FLAMEFILTER® casing (4), a fixation element (6) and an insert ring (7). The FLAMEFILTER® gap size, height, and quantity depend on the device's intended use.

The PROTEGO® EB series end-of-line deflagration flame arrester is available for substances from explosion group IIA and IIB (NEC group D and B).

The standard design can be used with an operating temperature of up to +60°C / 140°F. Devices with special approval for higher temperatures are available upon request.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- weather hood protects the PROTEGO® flame arrester unit against environmental impact, such as nesting animals and weather conditions
- in case of fire, the weather hood opens, allowing the flame to be seen from a far distance
- provides protection against atmospheric deflagrations and endurance burning of pure hydrocarbons
- centrally aligned melting element is resistant to chemicals
- modular design enables replacement of individual FLAMEFILTER® discs
- easy maintenance without disassembling of the FLAMEFILTER®
- cost-effective spare parts

Design Types and Specifications

End-of-line deflagration flame arrester, basic design	**EB**
End-of-line deflagration flame arrester, with cone	**EB - DN/DN2**
End-of-line deflagration flame arrester, with cone and heating jacket	**EB - H - DN/DN2**

Special designs available upon request.

Table 1: Dimensions DN 25 - 150 / 1"- 6"
EB-IIA and EB-IIB

Dimensions in mm / inches

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

DN	25 / 1"	32 / 1¼"	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"
a	218 / 8.58	218 / 8.58	218 / 8.58	218 / 8.58	218 / 8.58	353 / 13.90	353 / 13.90	353 / 13.90	353 / 13.90
b	113 / 4.45	113 / 4.45	113 / 4.45	113 / 4.45	113 / 4.45	113 / 4.45	113 / 4.45	113 / 4.45	113 / 4.45
c	232 / 9.13	232 / 9.13	232 / 9.13	232 / 9.13	232 / 9.13	306 / 12.05	306 / 12.05	306 / 12.05	306 / 12.05
d	222 / 8.74	222 / 8.74	222 / 8.74	222 / 8.74	222 / 8.74	355 / 13.98	355 / 13.98	355 / 13.98	355 / 13.98
e	217 / 8.54	217 / 8.54	217 / 8.54	217 / 8.54	217 / 8.54	322 / 12.68	322 / 12.68	322 / 12.68	322 / 12.68

EB-IIA und IIB with cone/nozzle**

DN				50 / 2"		80 / 3"	100 / 4"		150 / 6"
DN2				≤ 50 / 2"		≤ 80 / 3"	≤ 100 / 4		≤ 150 / 6"
b*				238 / 9.37		263 / 10.35	383 / 15.08		313 / 12.32

Dimensions DN 200 - 800 / 8"- 32"
EB-IIA

DN	200 / 8"	300 / 12"	400 / 16"	500 / 20"	600 / 24"	800 / 32"
a	405 / 15.94	555 / 21.85	705 / 27.75	855 /33.66	1005 / 39.57	1210 / 47.64
b	177 / 6.97	206 / 8.11	235 / 9.25	265 / 10.43	294 / 11.57	330 / 12.99
c	496 / 19.53	650 / 25.59	802 / 31.57	987 / 38.86	1137 / 44.76	1336 / 52.60
d	900 / 35.43	1200 / 47.24	1500 / 59.06	1820 / 71.65	2120 / 83.46	2525 / 99.41
f	450 / 17.72	600 / 23.62	750 / 29.53	920 / 36.22	1070 / 42.13	1270 / 50.00
g	51 / 2.01	80 / 3.15	109 / 4.29	138 / 5.43	167 / 6.57	204 / 8.03

EB-IIA with cone/nozzle**

DN	200 / 8"	300 / 12"	400 / 16"	500 / 20"	600 / 24"	800 / 32"
DN2	≤ 200 / 8"	≤ 300 / 12"	≤ 400 / 16"	≤ 500 / 20"	≤ 600 / 24"	≤ 800 / 32"
b*	401 / 15.94	456 / 17.95	535 / 21.06	614 / 24.17	693 / 27.28	830 / 32.68

** For combinations (DN/DN2), please use the table on the following page.

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Deflagration Flame Arrester- Endurance burning-proof, End-of-Line

PROTEGO® EB-IIA and IIB

Table 2: Combination (DN/DN2) for EB with cone

Remarks: Flow capacity charts for EB-DN/DN2-IIA/IIB with cone upon request.

DN	50/2“	80/3“	100/4“	150/6“	200/8“	300/12“	400/16“	500/20“	600/24“	800/32“
DN2										
20/¾“	IIA/IIB	IIA/IIB	IIA/IIB	IIA/IIB						
25/1“	IIA/IIB	IIA/IIB	IIA/IIB	IIA/IIB						
32/1¼	IIA/IIB	IIA/IIB	IIA/IIB	IIA/IIB						
40/1½	IIA/IIB	IIA/IIB	IIA/IIB	IIA/IIB						
50/2“	IIA/IIB	IIA/IIB	IIA/IIB	IIA/IIB	IIA					
65/2½“		IIA/IIB	IIA/IIB	IIA/IIB						
80/3“		IIA/ IIB	IIA/ IIB	IIA/ IIB	IIA	IIA				
100/4“			IIA/ IIB	IIA/ IIB	IIA	IIA				
125/5“				IIA/ IIB	IIA					
150/6“				IIA/ IIB	IIA	IIA	IIA			
200/8“					IIA	IIA	IIA	IIA	IIA	
250/10“						IIA	IIA	IIA		
300/12“							IIA	IIA	IIA	
350/14“								IIA	IIA	
400/16“								IIA	IIA	IIA
450/18“								IIA	IIA	IIA
500/20“									IIA	IIA
600/24“										IIA
700/28“										IIA

Table 3: Selection of explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request.
≥ 0,50 mm	IIB	B	

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 5: Material selection for housing

Design	A	B	
Flange ring	Steel	Stainless Steel	Special materials upon request.
Weather hood	Steel	Stainless Steel	
Cone/nozzle	Steel	Stainless Steel	
Flame arrester unit	A, B, C	B, C	

Table 6: Material combinations of flame arrester unit

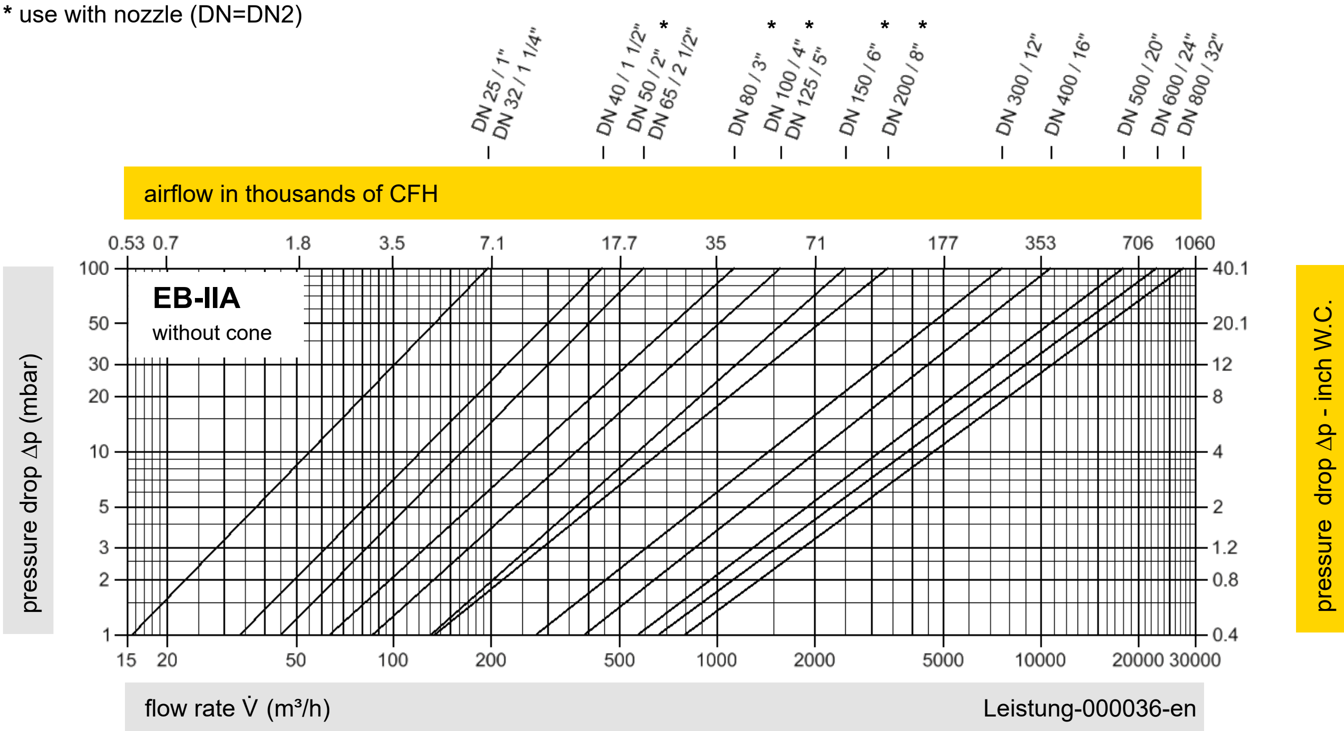
Design	A	B	C	
FLAMEFILTER® casing	Steel	Stainless Steel	Stainless Steel/Hastelloy	Special materials upon request.
FLAMEFILTER®	Stainless Steel	Stainless Steel	Hastelloy	
Insert ring/safety bar	Stainless Steel	Stainless Steel	Stainless Steel/Hastelloy	

Table 7: Flange connection type

EN 1092-1 (without cone); EN 1092-1; Form B1 (with cone/nozzle)	Other types upon request.
ASME B16.5 (without cone); ASME B16.5 CL 150 R.F. (with cone/nozzle)	

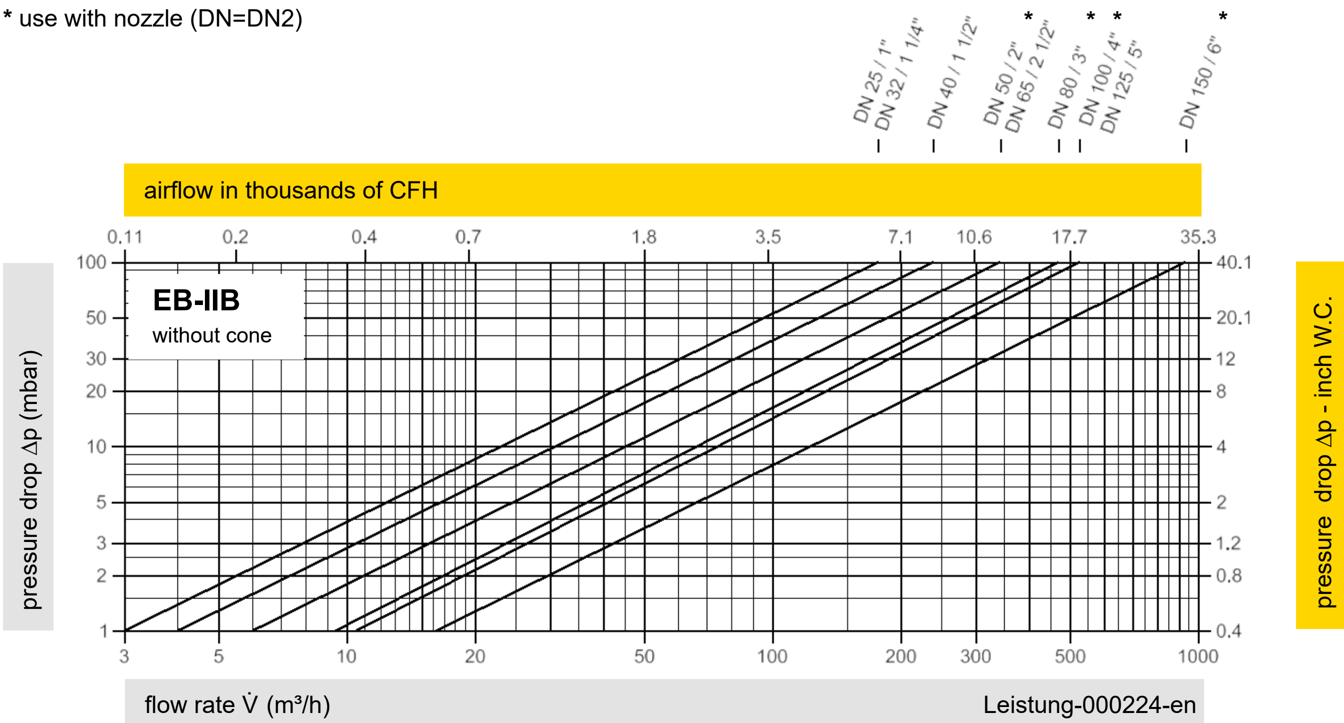
PROTEGO® EB-IIA and IIB without cone

* use with nozzle (DN=DN2)



Remark: Flow capacity charts for EB-DN/DN2-IIA/IIB with cone upon request.

* use with nozzle (DN=DN2)



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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

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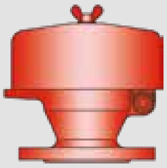
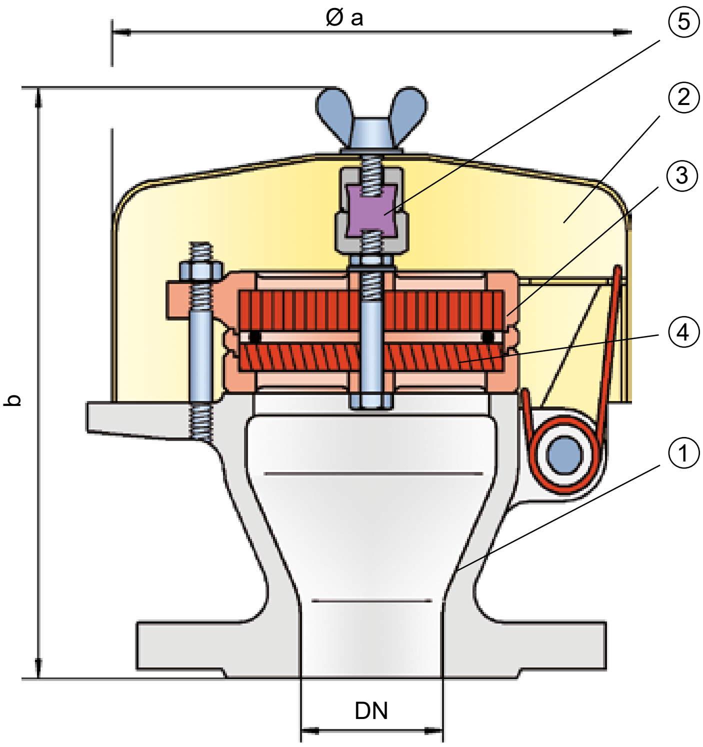


PROTEGO® BE/HK-E



Function and Description

The PROTEGO® BE/HK-E end-of-line deflagration flame arrester was specifically developed for vessels which are not pressurized and store Ethanol or other alcohols. The combustion of alcohol requires a modified flame arrester element design to provide protection against endurance burning. In addition, the device provides protection against atmospheric deflagration. It is typically installed on in - breathing and out-breathing vent lines to prevent flame transmission into the vessel or plant caused by endurance burning or atmospheric deflagration.

The PROTEGO® BE/HK-E consists of the housing (1), a weather hood (2), and the PROTEGO® flame arrester unit (3). During normal operation, the metal weather hood is in a closed position. If a stabilized flame burns on the flame arrester element surface, the melting element (5), located in a center position, will melt, and the spring-loaded weather hood will open. The PROTEGO® flame arrester unit consists of two FLAMEFILTER® discs (4) which are installed in a FLAMEFILTER® casing. The PROTEGO® BE/HK-E end-of-line deflagration flame arrester is available for alcohols and other substances with MESG ≥ 0,85mm.

The standard design can be used for operating temperatures up to +60°C / 140°F.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- endurance burning protection for alcohols and hydrocarbons with MESG ≥ 0,85mm
- weather hood protects the PROTEGO® flame arrester unit against environmental impact, such as nesting animals and weather conditions
- in case of fire, the weather hood opens, allowing the flame to be seen from a far distance
- centrally aligned melting element is resistant to chemicals
- modular design enables replacement of individual FLAME-FILTER® discs
- trouble-free maintenance
- provides protection against atmospheric deflagrations and endurance burning
- cost-effective spare parts

Design Types and Specifications

There are two different designs:

End-of-line deflagration flame arrester, basic design	**BE/HK-E - –**
End-of-line deflagration flame arrester with heating jacket	**BE/HK-E - H**

Special designs 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	20 / ¾"	25 / 1"	32 / 1¼"	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"
a	163 / 6.42	163 / 6.42	163 / 6.42	183 / 7.20	183 / 7.20	218 / 8.58	218 / 8.58
b	180 / 7.09	177 / 6.97	177 / 6.97	190 / 7.48	190 / 7.48	200 / 7.87	200 / 7.87

Dimensions for deflagration flame arrester with heating jacket upon request.

Demonstration of endurance burning
Video

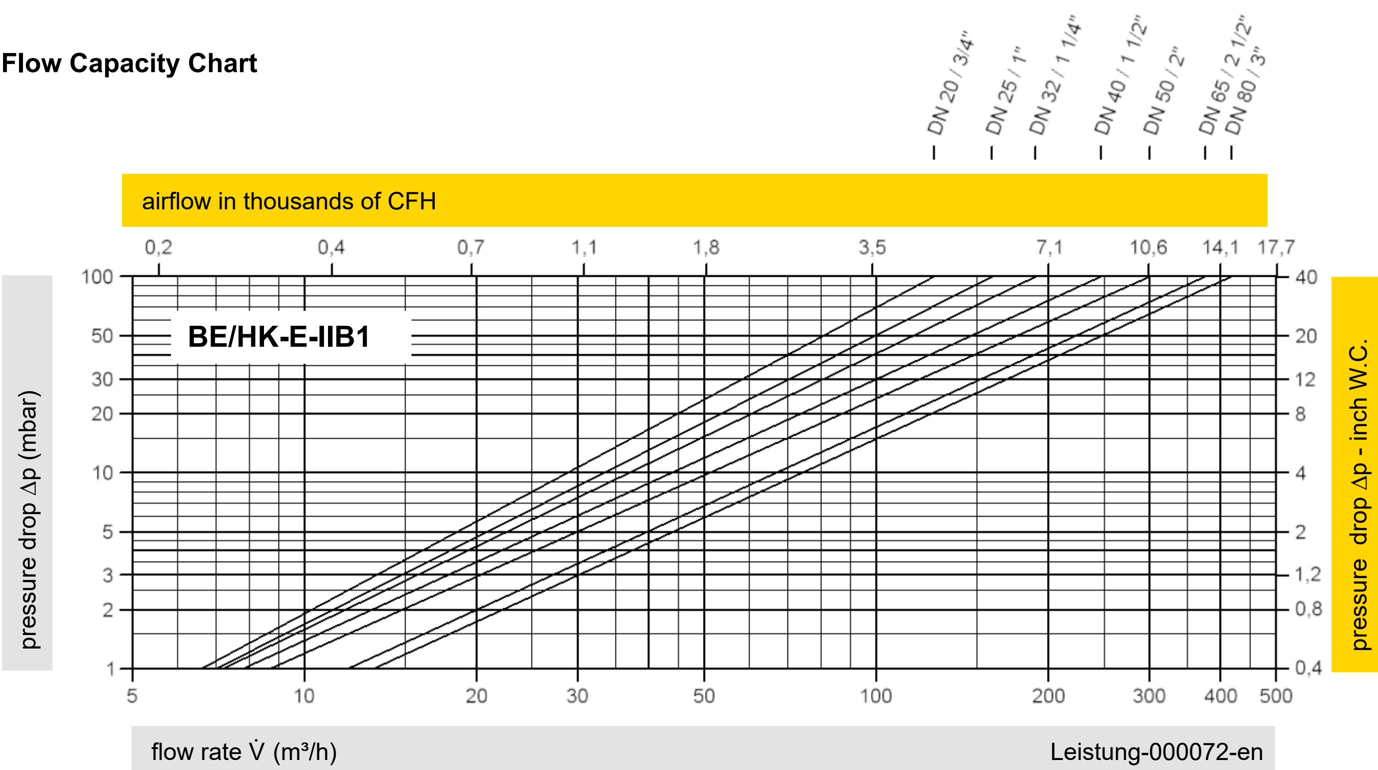
Table 2: Selection of explosion group			
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	Special approvals upon request.
≥ 0,85 mm	IIB1	–	

Table 3: Material selection for housing			
Design	B	C	Special materials upon request.
Housing	Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	
Flame arrester unit	A	A, B	

Table 4: Material combinations of flame arrester unit			
Design	A	B	Special materials upon request.
FLAMEFILTER® casing	Stainless Steel	Stainless Steel	
FLAMEFILTER®	Stainless Steel	Hastelloy	
Spacer	Stainless Steel	Hastelloy	

Table 5: Flange connection type	
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



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

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

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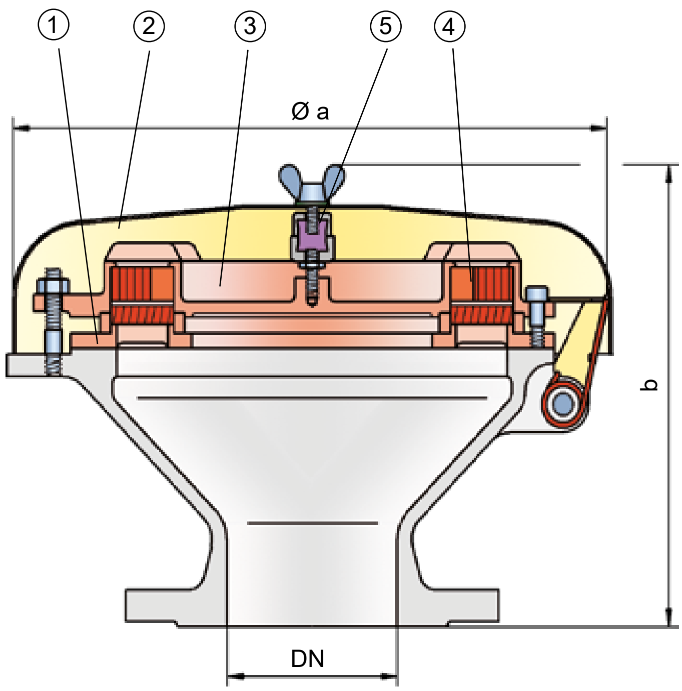
PROTEGO® BE/HR-E



The PROTEGO® BE/HR-E end-of-line deflagration flame arrester is available for alcohols and other substances with a MESG ≥ 0,85 mm.

The standard design can be used for operating temperatures up to +60°C / 140°F.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

.Special Features and Advantages

- endurance burning protection for alcohols and hydrocarbons with MESG ≥ 0,85mm
- weather hood protects the PROTEGO® flame arrester unit against environmental impact, such as nesting animals and weather conditions
- in case of fire, the weather hood opens, allowing the flame to be seen from a far distance
- centrally aligned melting element is resistant to chemicals
- modular design enables replacement of individual FLAME-FILTER® discs
- trouble-free maintenance
- provides protection against atmospheric deflagrations and endurance burning
- cost-effective spare parts

Function and Description

The PROTEGO® BE/HR-E end-of-line deflagration flame arrester was specifically developed for vessels which are not pressurized and store Ethanol or other alcohols with a MESG ≥ 0,85 mm. The combustion of alcohol requires a modified flame arrester element design to provide protection against endurance burning. In addition, the device provides protection against atmospheric deflagration. It is typically installed on in-breathing and out-breathing vent lines to prevent flame transmission into the vessel or plant caused by endurance burning or atmospheric deflagration.

The PROTEGO® BE/HR-E consists of the housing (1), a weather hood (2), and the PROTEGO® flame arrester unit (3). During normal operation, the metal weather hood is in a closed position. If a flame burns on the flame arrester element surface, the melting element (5), located in a center position, will melt, and the spring-loaded weather hood will open. The PROTEGO® flame arrester unit consists of two FLAMEFILTER® discs (4) which are installed in a FLAMEFILTER® casing.

Design Types and Specifications

There are two different designs:

End-of-line deflagration flame arrester, basic design	**BE/HR - E - $\boxed{-}$**
End-of-line deflagration flame arrester with heating jacket	**BE/HR - E - $\boxed{H}$**

Special designs 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	353 / 13.90	353 / 13.90	Dimensions for deflagration flame arrester with heating jacket upon request.
b	250 / 9.84	250 / 9.84	

Demonstration of endurance burning
Video

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	Steel	Stainless Steel	Special materials upon request.
Weather hood	Steel	Stainless Steel	
Flame arrester unit	A	A, B	

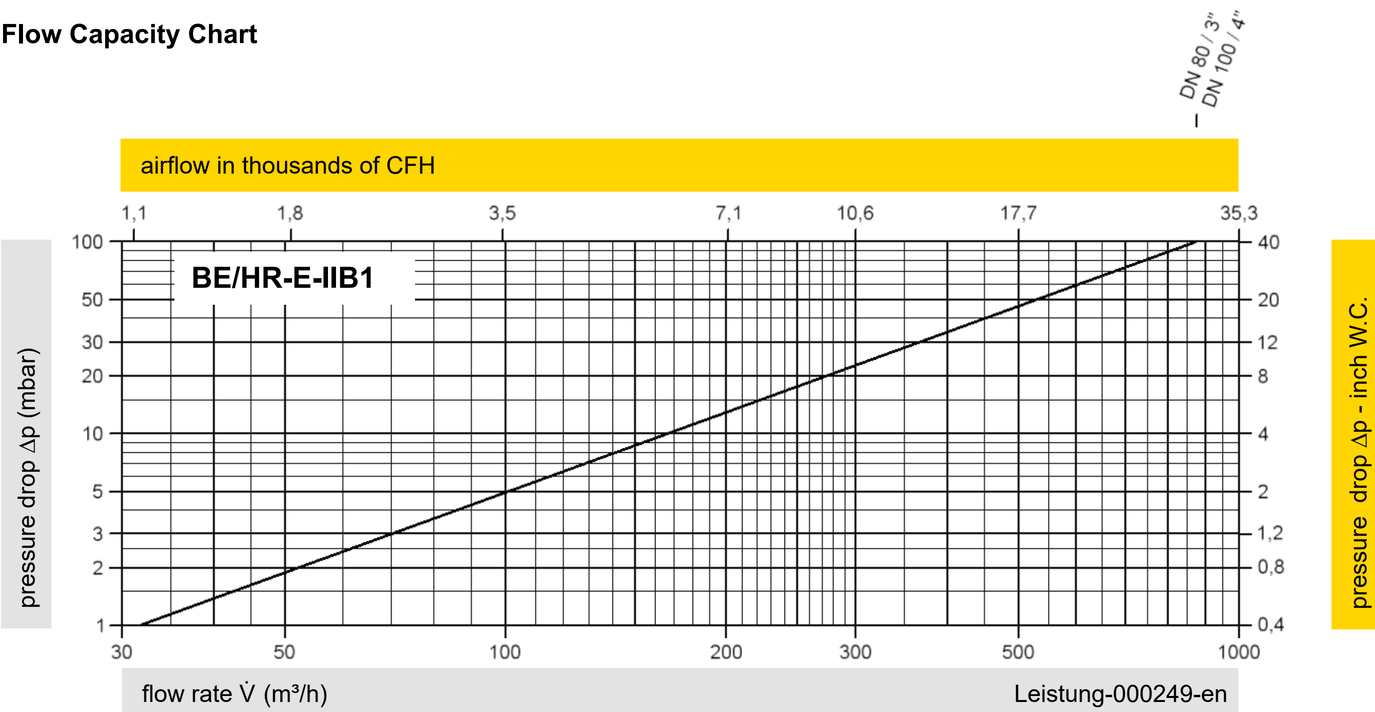
Table 4: Material combinations of flame arrester unit

Design	A	B	
FLAMEFILTER® casing	Stainless Steel	Stainless Steel	Special materials upon request.
FLAMEFILTER®	Stainless Steel	Hastelloy	
Spacer	Stainless Steel	Hastelloy	

Table 5: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



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

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PROTEGO® Deflagration Flame Arresters

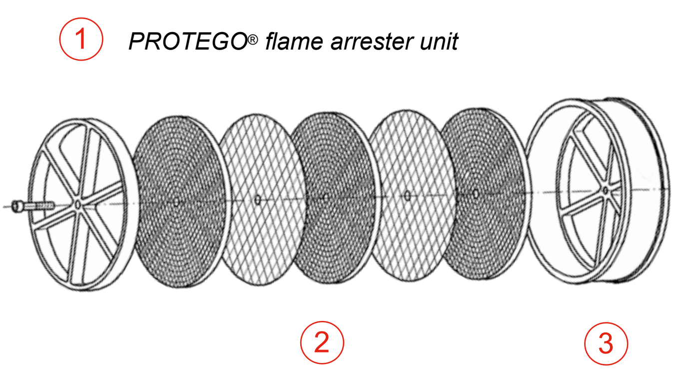
Section 3

Function and description

The function of flame arresters in the various combustion processes and the location of their installation is discussed in “Technical Fundamentals” (see Sec. 1). This section discusses PROTEGO® in-line **deflagration flame arresters which are installed in pipelines and as components on equipment (e.g. blowers, vacuum pumps)**.

PROTEGO® deflagration flame arresters are state-of-the-art safety devices that are used in systems handling explosive mixtures to protect process equipment from deflagrations. They reliably suppress the effect of a deflagration in the pipelines near a potential ignition source, extinguish the flame, and protect systems that cannot withstand the pressure of an explosion. In-line deflagration flame arresters only provide protection for a limited time. For this reason, additional measures need to be considered for mixtures that continue to flow continuously.

The main component is the PROTEGO® flame arrester unit (1), which takes the energy from the deflagration and extinguishes the flame in narrow gaps. The flame arrester unit is modular, consisting of several FLAMEFILTER® discs (2) installed within the FLAMEFILTER® casing (3). The number of FLAMEFILTER® discs and their gap size depend on the device’s intended use and the operating parameters of the mixture that is flowing through (i.e., explosion group, pressure, temperature, composition of the product).



Deflagration flame arresters in pipelines for protection of process units can only be used if approved for such application. The distance from the potential ignition source is limited and is expressed by (L/D) max for the individual device. A fire may result on the flame arrester unit if the mixture continues to flow. As the deflagration flame arrester is only approved for a specific amount of time, the device should be equipped with a temperature sensor to detect temperature increase caused by a flame. Should the temperature increase over a certain level, a suitable measure, such as nitrogen purging, should be used.

As a component of equipment, deflagration flame arresters are type-tested and approved along with the equipment (OEM part, e.g. vacuum pumps, blowers). They are not available separately as independent deflagration flame arresters.

In close cooperation with scientific institutions, PROTEGO® has developed safety devices which can be applied to all explosion hazardous locations and provide protection against atmospheric deflagration, short time burning, and endurance burning. Our devices are subjected to and certified by type examination according to ATEX and other international standards (CE, etc.).

A wide range of types, designs, sizes, and materials can be provided. Most importantly, we have the capability to custom design and develop solutions at our test facility, which is the most technologically advanced in the world.

Special features and advantages

The devices can be distinguished and selected based on the following main criteria: **components for equipment** (e.g., blowers, vacuum pumps) or **devices to be installed in pipelines** hand- ling gas or vapor. Special operating conditions (e.g. **high operating pressures or temperatures**) that exceed the standard values may have to be considered.

It is important to categorize the products or components into **explosion groups**, depending on their MESG, to select the suitable type of protection from the various designs.

The suitable or required **approved device** must be selected from the great variety of devices that have been tested and approved.

The basic **designs** of the housing are **concentric, eccentric** and with an “easy access cover” for simple disassembly of the flame arrester unit.

The system specification must be considered when choosing the required **nominal diameters** and types of connection.

A **heating jacket** may be necessary for problematic applications.

Special designs offering **unidirectional or bi-directional** protection can be provided as well as versions for **critical substance (such as products that tend to polymerize or crystallize)** and special product properties.

Deflagration arresters as specific components for OEM equipment (e.g., blowers or vacuum pumps) are specifically optimized and tested along with the equipment.

Preferred applications

Protection of pipelines; containers in chemical, petrochemical, and pharmaceutical processing plants; loading systems; gas collection systems; exhaust combustion systems; flare systems; landfills and biogas plants and sewage treatment plants.

In-line deflagration test
The Flame Arrester reliably stops
the explosion (Video)

In-line deflagration test without
working Flame Arrester
(Video)

Installation and servicing

PROTEGO® deflagration flame arresters are preferably installed as close as possible to the potential ignition source. Typically, any orientation of installation can be chosen, but the direction of flow needs to be considered for designs with temperature sensors. Pipes with a nominal diameter greater than the nominal diameter of the device must not be connected to the deflagration flame arrester.

Given the modular design of the PROTEGO® flame arrester unit, any type of deflagration flame arrester is extremely easy to service. For servicing reasons, the location of the flame arrester must be easily accessible; and a hoist must be provided if the flame arrester is heavy. Servicing is problem-free for trained personnel.

PROTEGO® deflagration flame arresters are installed in areas subject to explosion hazards. It is important to select the correct device for the specific application. The manufacturer´s statement of conformity confirms the tasks for which the deflagration flame arrester is suitable. The user documents proper use in accordance with the applicable safety regulations.

Selection

The following main points should be considered for choosing the correct device for your application:

- **In-line flame arrester or component on equipment** (e.g., vacuum pump or blower)
- **Explosion group** of gas mixture
- Standard or special operating conditions **(pressure and temperature)**

Lastly, the following criteria are reviewed and considered:

- **Nominal diameter** and type of connection
- **Approvals** according to ATEX, GOST-R, GL, etc..
- **Concentric or eccentric design,** or designed with an easy access cover
- **Heating jacket or heating coil**
- **Critical substances**
- **Uni-directional or bi-directional** protection

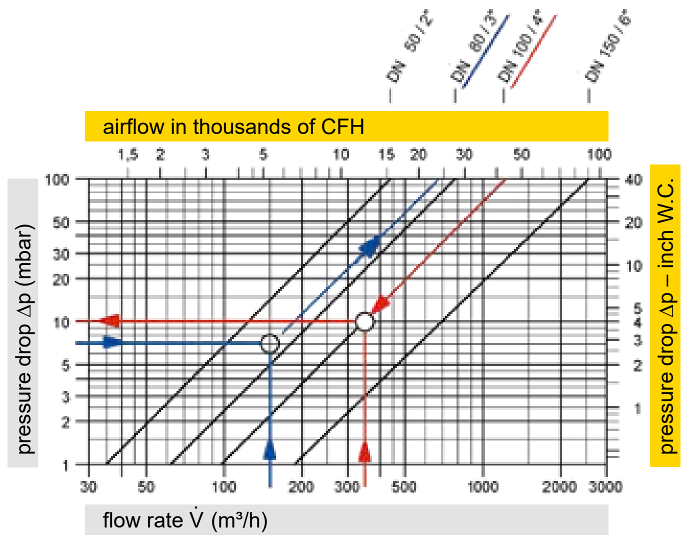
Based on this initial selection, additional details such as materials, coatings, etc. can be requested or defined in the data sheet.

If no suitable device can be found, please contact us. Special designs and approvals are available.

Sizing

The nominal diameter of the device is determined or checked in the p/$\dot{V}$ performance diagram. A safety factor must be considered when the fluid tends to clog the flame arrester element

Given:	Volume flow	m^3/h or CFH
Given:	Max. all. pressure drop	Δp mbar or inch W.C.
Desired:	Nominal diameter of the deflagration flame arrester	DN
Procedure:	Intersection of the lines with volume flow and maximum allowable pressure drop lies above or on the desired nominal diameter curve of the device	
Given:	Volume flow	m^3/h or CFH
Given:	Nominal diameter of pipe	DN
Desired:	Pressure drop	Δp mbar or inch W.C.
Procedure:	Intersection of the lines with the volume flow and nominal diameter curve of the device, the horizontal straight line leads to the desired flow resistance	



Instructions on calculating the volume flow or influence of density are found in “Technical Fundamentals” (Sec. 1).

After all the steps are completed, the device can be specified and ordered.

For special applications, please complete the data sheet from Section 1 and provide the necessary information for a quotation.

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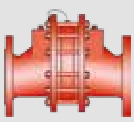
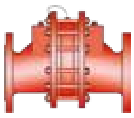
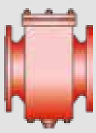
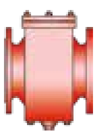
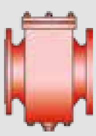
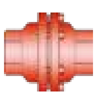
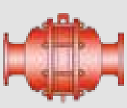
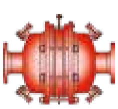
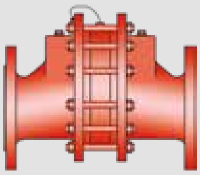
PROTEGO® Deflagration Flame Arrester

Catalog

	Type	Size DN	Design cc = concentric ec = eccentric	Explosion-group ATEX	Explosion-group NEC	Approvals	○ = Special designs for higher temperatures and pressures	○ = for critical substances (polymerization, corrosion, crystallization)	○ = uni-directional X = bi-directional	Page
In-line deflagration flame arrester										
	FA-E	25 - 300 1" - 12"	straight through, ec	IIA1 (I)	-	ATEX	○	○	X	
	FA-E	25 - 300 1" - 12"	straight through, ec	IIA, IIB3, IIC	D, C, B	ATEX	○	○	X	90 - 95
	FA-CN	40 - 300 1½" - 12"	straight through, cc	IIA1 (I)	-	ATEX	○		X	
	FA-CN	25 - 300 1" - 12"	straight through, cc	IIA, IIB3	D, C	ATEX	○		X	96 - 99
	FA-CN	40 - 300 1½" - 12"	straight through, cc	IIC	B	ATEX			X	100 - 102
	FA-G	G ½ - G 2	straight through, cc	IIA, IIB3, IIC	D, C, B	ATEX	○		X	104 - 107
	FA-I	50 - 1000 2" - 40"	straight through, cc	IIA, IIB3	D, C	ATEX	○	○	X	108 - 111
	FA-I-PTFE	50 - 150 2" - 6"	straight through, cc	IIA	D	ATEX		○	X	

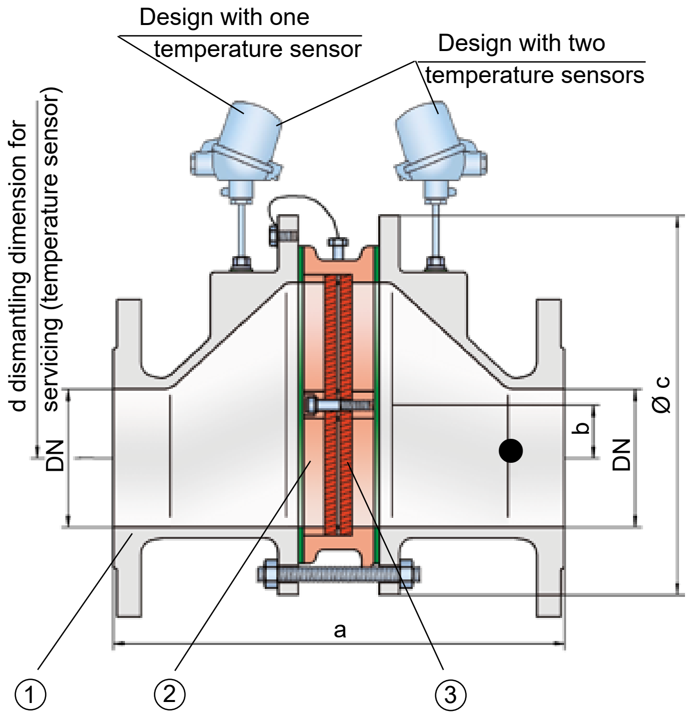
Notes:



In-Line Deflagration Flame Arrester

eccentric design,
bi-directional

PROTEGO® FA-E



● Connection to the protected side
(only for type FA-E-T-....)

Function and Description

The PROTEGO® FA-E series of in-line deflagration flame arresters is designed with an eccentric housing to automatically drain condensate build up in the housing. Due to its eccentric design, the device can be installed in pipelines that run close to floors or walls and low points to prevent the build-up of condensate. When installing the deflagration flame arrester, make sure that the distance between potential ignition sources and the location of the installed device does not exceed the L/D ratio (pipe length/pipe diameter) for which the device was approved. According to EN ISO 16852, the installation limits are (L/D) max ≤ 50 for deflagration flame arresters of explosion groups IIA and IIB3 (NEC groups D to C) and (L/D)max ≤ 30 for explosion group IIC (NEC group B).

The devices are symmetrical and offer bi-directional flame transmission protection. The arrester essentially consists of two housing parts (1) and a PROTEGO® flame arrester unit (2) in the center. The PROTEGO® flame arrester unit is modular and consists of several FLAMEFILTER® discs (3) and spacers firmly held in a FLAMEFILTER® casing. The number of FLAMEFILTER® and their gap size depends on the device's intended use.

Specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, enables PROTEGO® to select the best deflagration flame arrester for your application. The PROTEGO® FA-E series of deflagration flame arresters is available for substances from explosion groups IIA to IIC (NEC groups D to B).

The standard design can be used at an operating temperature of up to +60°C / 140°F and an absolute operating pressure up to 1.1 bar / 15.9 psi. **Devices with special approval for higher pressures (see table 3) and higher temperatures are available upon request.**

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- eccentric design prevents condensate build up
- special design for elevated operating temperatures and pressures available
- modular design enables each individual FLAMEFILTER® to be replaced
- service friendly: FLAMEFILTER® can be cleaned easily
- eccentric design eases installation close to floors and walls
- bi-directional flame transmission proof design
- protects against deflagrations for all explosion groups IIA, IIB3 and IIC (NEC groups D, C and B)
- modular design reduces spare parts cost

Design and Specifications

There are three different designs:

Basic in-line deflagration flame arrester	**FA-E - $\boxed{-}$**
In-line deflagration flame arrester with integrated temperature sensor* as additional protection against short-time burning from one side	**FA-E - $\boxed{T}$**
In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides	**FA-E - $\boxed{TB}$**

Additional special devices available upon request

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Stabilized FLAMEFILTER® Discs (Flyer pdf)

New PROTEGO® Flame Arrester Unit with unique maintenance friendly design (Flyer pdf)

L/D ratio (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

Expl. Gr.	DN	25 / 1"	32 / 1¼"	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
IIA	a	304 / 11.97	304 / 11.97	310 / 12.20	314 / 12.36	360 / 14.17	364 / 14,33	370 / 14.57	434 / 17.09	440 / 17.32	450 / 17.72	480 / 18.90	500 / 19.69
IIB3	a	304 / 11.97	304 / 11.97	310 / 12.20	314 / 12.36	360 / 14.17	364 / 14,33	370 / 14.57	434 / 17.09	440 / 17.32	450 / 17.72	480 / 18.90	500 / 19.69
IIC	a	304 / 11.97	304 / 11.97	321 / 12.64	325 / 12.80	371 / 14.61	375 / 14.76	381 / 15.00	445 / 17.52	451 / 17.76	461 / 18.15	491 / 19.33	511 / 20.12
	b	29 / 1.14	29 / 1.14	29 / 1.14	29 / 1.14	38 / 1.49	38 / 1.49	39 / 1.53	65 / 2.56	65 / 2.56	55 / 2.17	58 / 2.28	60 / 2.36
	c	185 / 7.28	185 / 7.28	210 / 8.27	210 / 8.27	250 / 9.84	250 / 9.84	275 / 10.83	385 / 15.16	385 / 15.16	450 / 17.72	500 / 19.69	575 / 22.64
	d	400 / 15.75	400 / 15.75	410 / 16.14	410 / 16.14	440 / 17.32	440 / 17.32	460 / 18.11	520 / 20.47	520 / 20.47	540 / 21.26	570 / 22.44	600 / 23.62

Table 2: Selection of the explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)
> 0.90 mm	IIA	D
≥ 0.65 mm	IIB3	C
< 0.50 mm (> 0.50 mm)	IIC (IIB)	B

Special approvals upon request.

Table 3: Selection of max. operating pressure

Expl. Gr.	DN	25 / 1"	32 / 1¼"	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
IIA	P_{max}	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2
IIB3	P_{max}	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2
IIC	P_{max}	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.2 / 17.4	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9

P_{max} = maximum allowable operating pressure in bar / psi absolute, higher operating pressure upon request.

Table 4: Specification of max. operating temperature

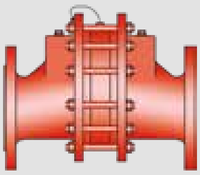
≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C
-	Classification

Higher operating temperatures upon request.

Table 5: Material selection for housing

Design	B	C	D
Housing	Steel	Stainless Steel	Hastelloy
Gasket	PTFE	PTFE	PTFE
Flame arrester unit	A,C	C	D

The housing can also be delivered in carbon steel with an ECTFE coating.
Special materials upon request.



In-Line Deflagration Flame Arrester

eccentric design, bi-directional

PROTEGO® FA-E

Table 6: Material combinations of the flame arrester unit

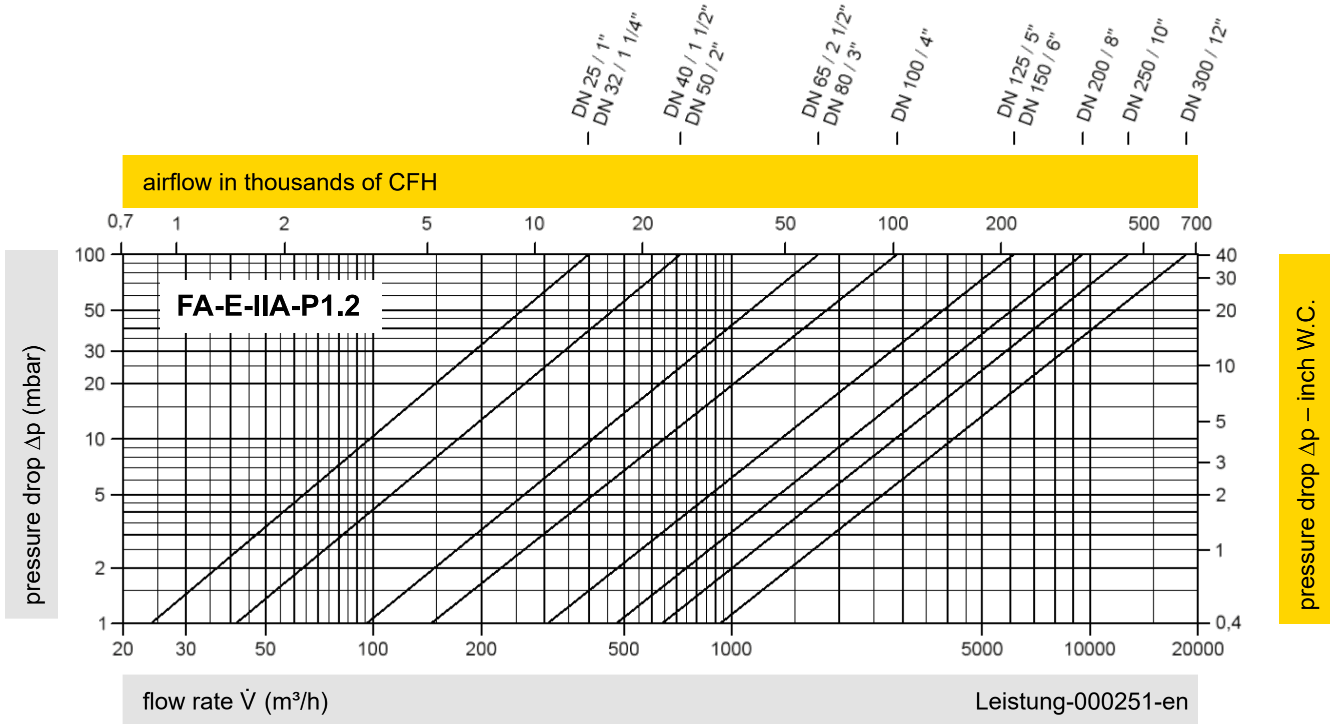
Design	A	C	D
FLAMEFILTER® casing	Steel	Stainless Steel	Hastelloy
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy
Spacers	Stainless Steel	Stainless Steel	Hastelloy

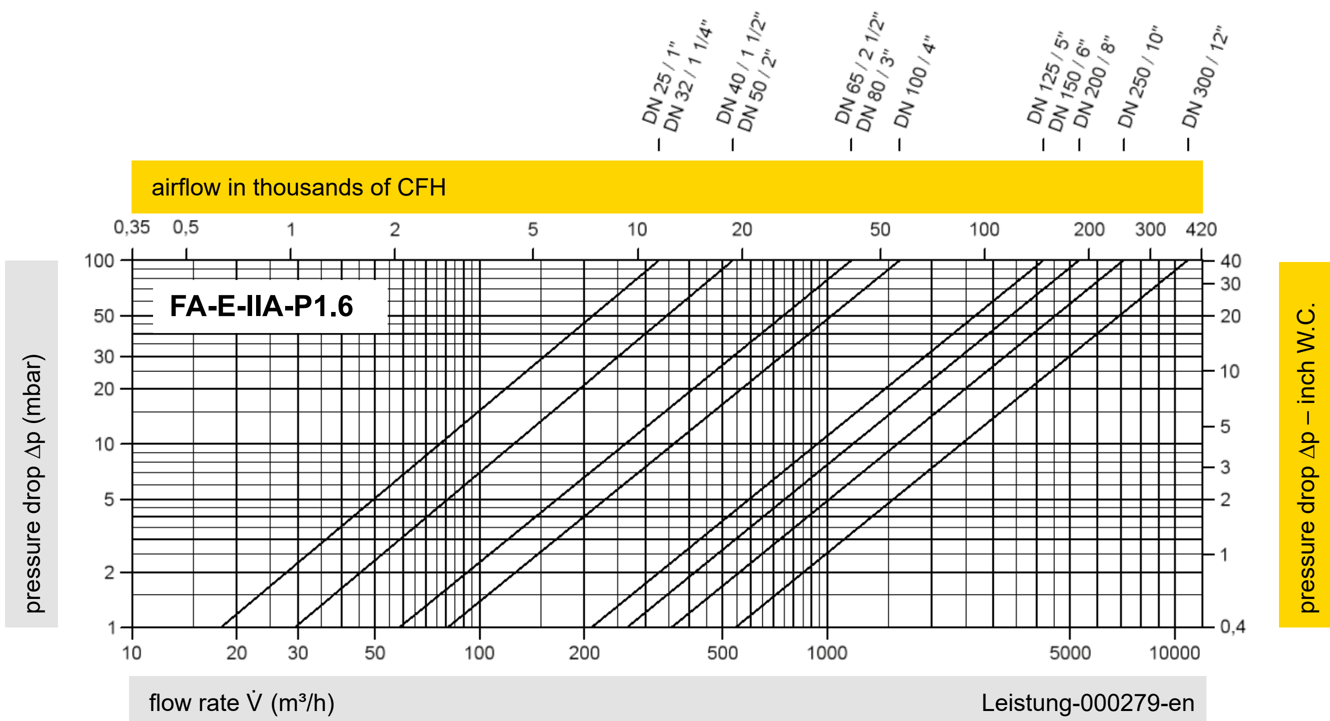
*the FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and casing materials are used.

Special materials upon request.

Table 7: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	





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

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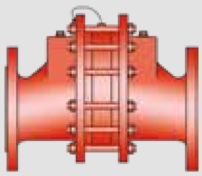
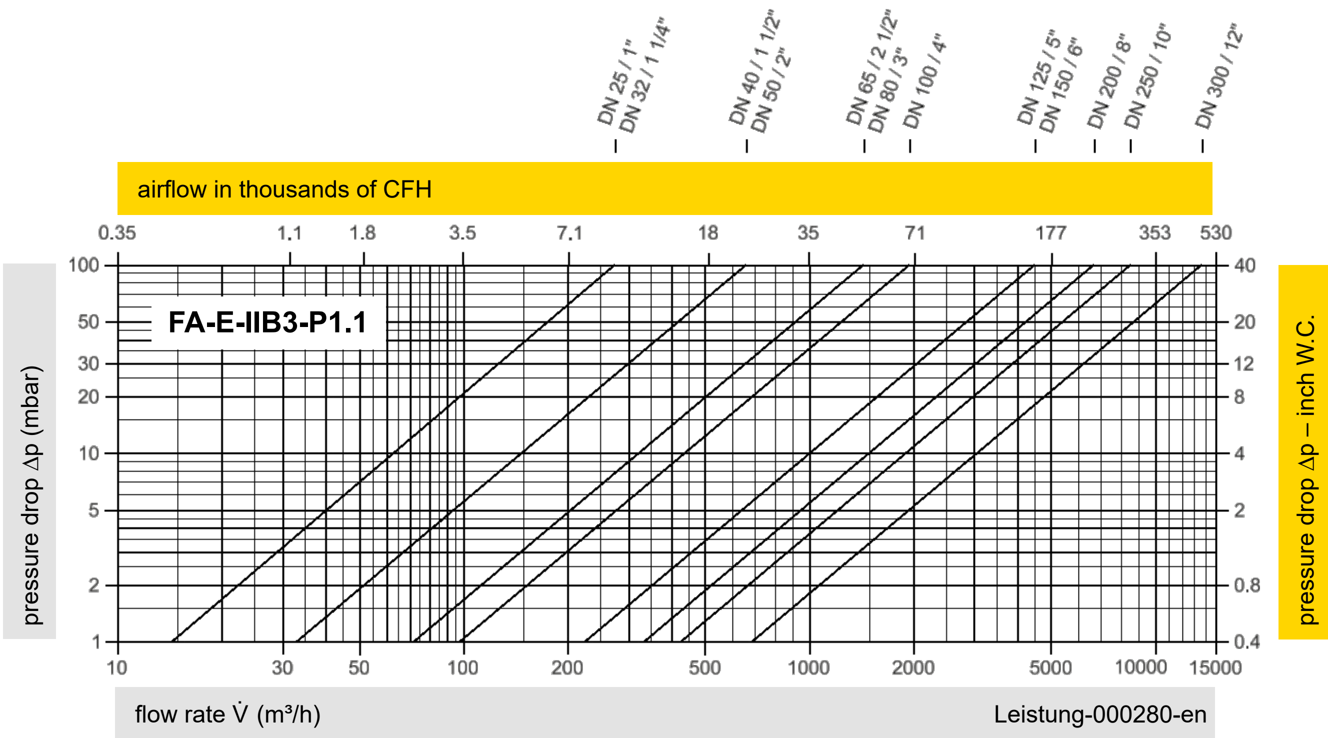
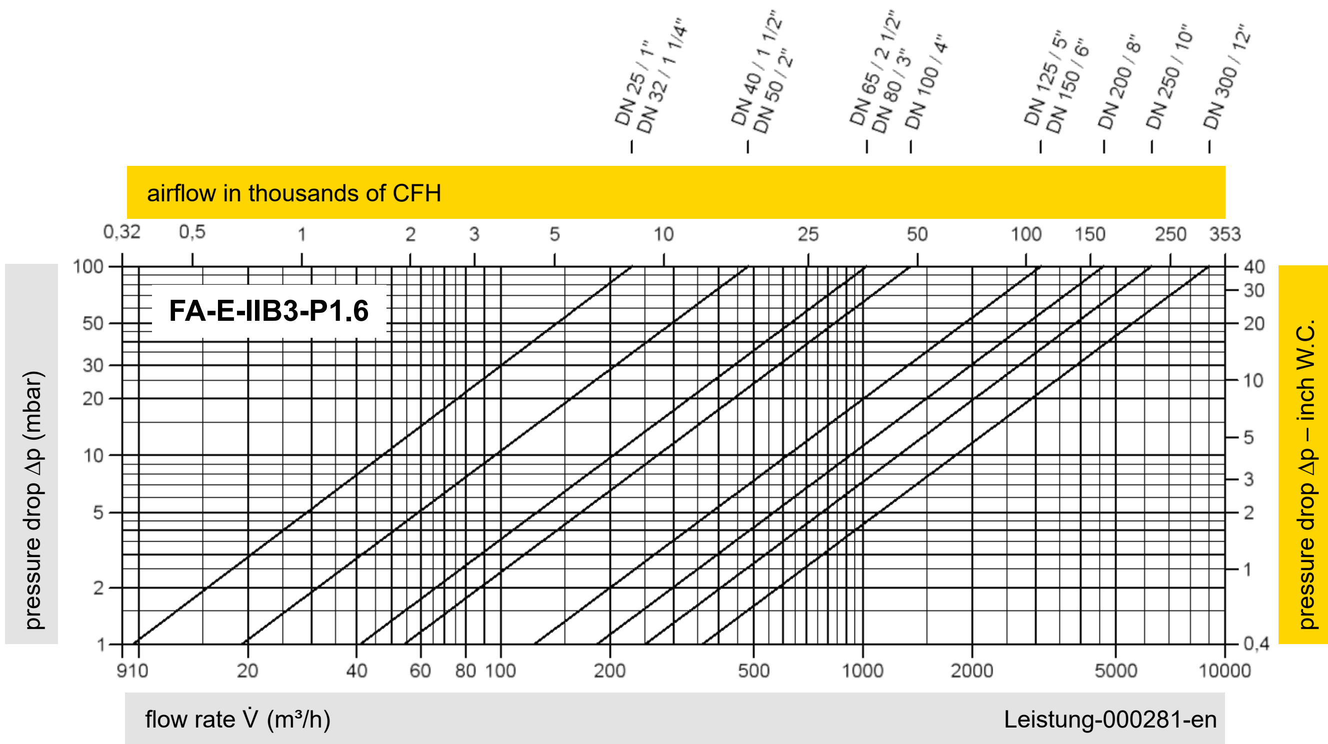


In-Line Deflagration Flame Arrester

Flow Capacity Charts

PROTEGO® FA-E

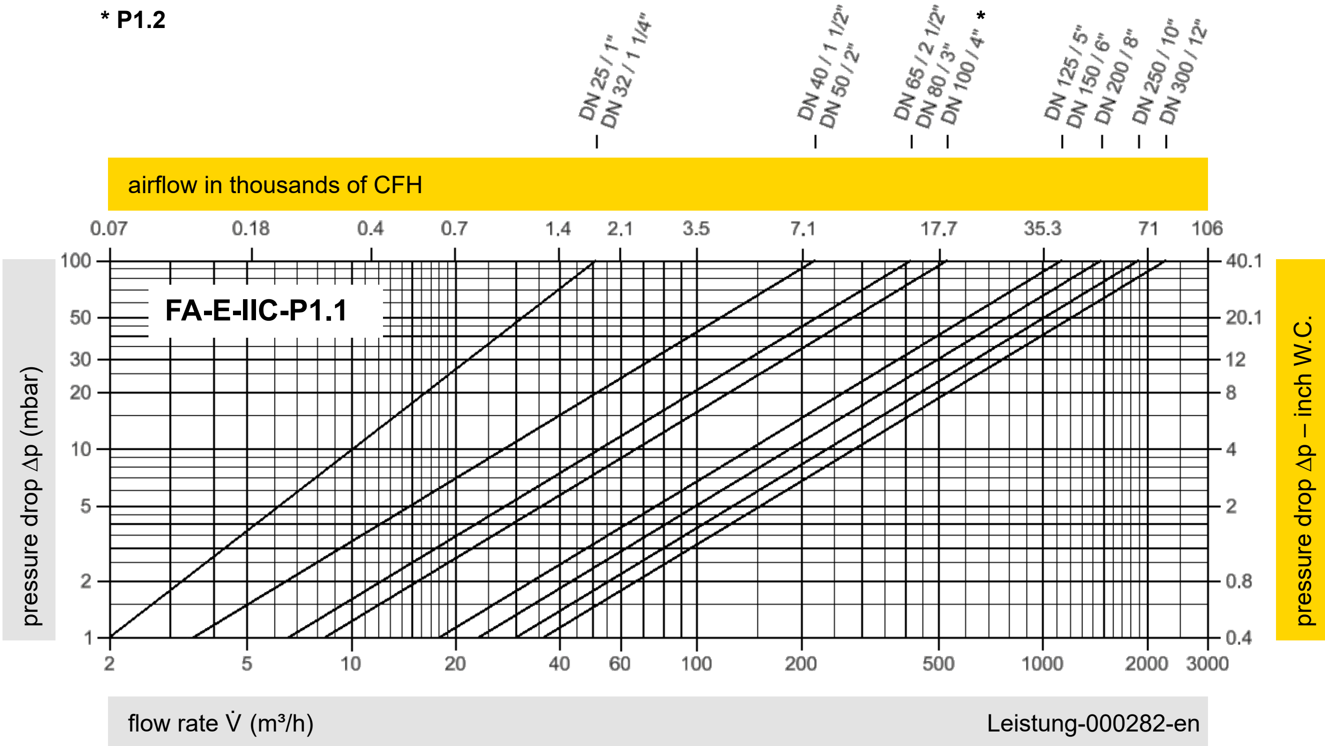




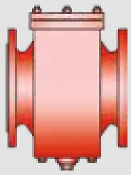
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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

* P1.2



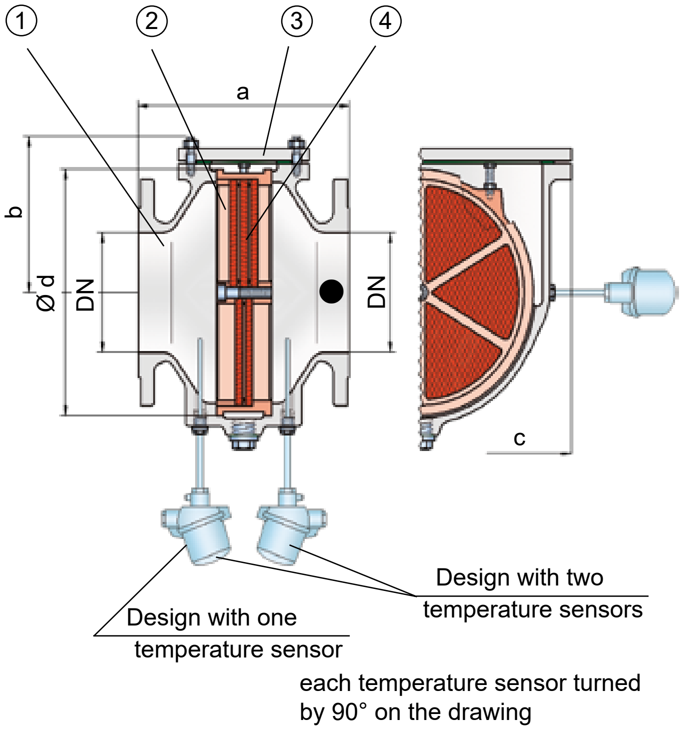
DN 25 / 1"
DN 32 / 1 1/4"
DN 40 / 1 1/2"
DN 50 / 2"
DN 65 / 2 1/2"
DN 80 / 3"
DN 100 / 4" *
DN 125 / 5"
DN 150 / 6"
DN 200 / 8"
DN 250 / 10"
DN 300 / 12"
airflow in thousands of CFH
0.07
0.18
0.4
0.7
1.4
2.1
3.5
7.1
17.7
35.3
71
106
FA-E-IIC-P1.1
pressure drop Δp (mbar)
100
50
30
20
10
5
2
1
pressure drop Δp – inch W.C.
40.1
20.1
12
8
4
2
0.8
0.4
2
5
10
20
40
60
100
200
500
1000
2000
3000
flow rate V̇ (m³/h)
Leistung-000282-en



In-Line Deflagration Flame Arrester

concentric design,
bi-directional

PROTEGO® FA-CN-IIA and IIB3



● Connection to the protected side (only for type FA-CN-T-....)

The standard design can be used with an operating temperature of up to +60°C / 140°F and an absolute operating pressure up to 1.1 bar / 15.9 psi. **Devices with special approval for higher pressures (see table 3) and higher temperatures are available upon request.**

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Function and Description

The PROTEGO® FA-CN in-line deflagration flame arrester is a compact design utilizing an easy access cover for easy maintenance. The PROTEGO® flame arrester unit can easily be removed and cleaned in just a few simple steps without having to disassemble the pipe. When installing the deflagration flame arrester, make sure that the distance between potential ignition sources and the location of the installed device does not exceed the L/D ratio (pipe length/pipe diameter) for which the device was tested. According to EN ISO 16852, this device is approved for a (L/D)max ratio of 50.

The deflagration flame arrester is symmetrical and offers bi-directional flame transmission protection. The device consists of the housing (1) with an easy access cover (3) and the PROTEGO® flame arrester unit (2) in the center. The PROTEGO® flame arrester unit is modular and consists of several FLAMEFILTER® discs (3) and spacers firmly held in a FLAMEFILTER® casing. The number of FLAMEFILTER® discs and their gap size depend on the device's intended use.

Specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, enables PROTEGO® to select the best deflagration flame arrester for your application. This version of PROTEGO® FA-CN-IIA and IIB3 flame arrester protects against deflagrations of fuel/air mixtures of explosion groups IIA and IIB 3 (NEC D and C {MESG ≥0.65 mm}). PROTEGO® FA-CN devices for substances of explosion groups IIA1 and IIC (NEC group B) are shown on separate pages.

Special Features and Advantages

- design available for elevated operating temperatures and pressures
- compact design with easy access cover
- easy maintenance without disassembling of the pipeline
- modular flame arrester unit enables individual FLAMEFILTER® to be replaced and cleaned
- bi-directional flame transmission proof design
- provides protection against deflagrations for group IIA and IIB3 vapours (NEC group D and C)
- lowest pressure drop results in low operating and lifecycle costs
- modular design reduces spare parts cost

Design and Specifications

There are three different designs:

Basic in-line deflagration flame arrester	**FA-CN - $\boxed{-}$**
In-line deflagration flame arrester with integrated temperature sensor* as additional protection against short time burning from one side	**FA-CN - $\boxed{T}$**
In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides	**FA-CN - $\boxed{TB}$**

Additional special devices available upon request

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Stabilized FLAMEFILTER® Discs (Flyer pdf)

L/D ratio (Flyer pdf)

Table 1: Dimensions Dimensions in mm / inches

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

DN	25 / 1"	32 / 1¼"	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	200 / 7.87	200 / 7.87	210 / 8.27	215 / 8.46	235 / 9.25	240 / 9.45	265 / 10.43	305 / 12.01	310 / 12.20	300 / 11.81	320 / 12.60	350 / 13.78
b	92 / 3.62	92 / 3.62	105 / 4.13	105 / 4.13	132 / 5.2	132 / 5.2	150 / 5.91	197 / 7.75	197 / 7.75	220 / 8.66	260 / 10.24	295 / 11.61
c	175 / 6.89	175 / 6.89	200 / 7.87	200 / 7.87	260 / 10.24	260 / 10.24	308 / 12.13	415 / 16.34	415 / 16.34	446 / 17.56	520 / 20.47	600 / 23.62
d	105 / 4.13	105 / 4.13	130 / 5.12	130 / 5.12	185 / 7.28	185 / 7.28	220 / 8.66	310 / 12.20	310 / 12.20	355 / 13.98	420 / 16.54	490 / 19.29

Table 2: Selection of the 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: Selection of max. operating pressure

Expl. Gr.	DN	25 / 1"	32 / 1¼"	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"	n
IIA	P_{max}	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.5 / 21.8	1.5 / 21.8	1.5 / 21.8	1.3 / 18.9	1.3 / 18.9	1.3 / 18.9	3
IIB3	P_{max}	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	3

P_{max} = maximum allowable operating pressure in bar / psi absolute, higher operating pressure upon request.
n = number of FLAMEFILTER®

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 5: Material selection

Design	A	B	
Housing	Steel	Stainless Steel	Special materials upon request.
Cover	Steel	Stainless Steel	
Gasket	PTFE	PTFE	
Flame arrester unit	Stainless Steel	Stainless Steel	

Table 6: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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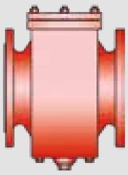
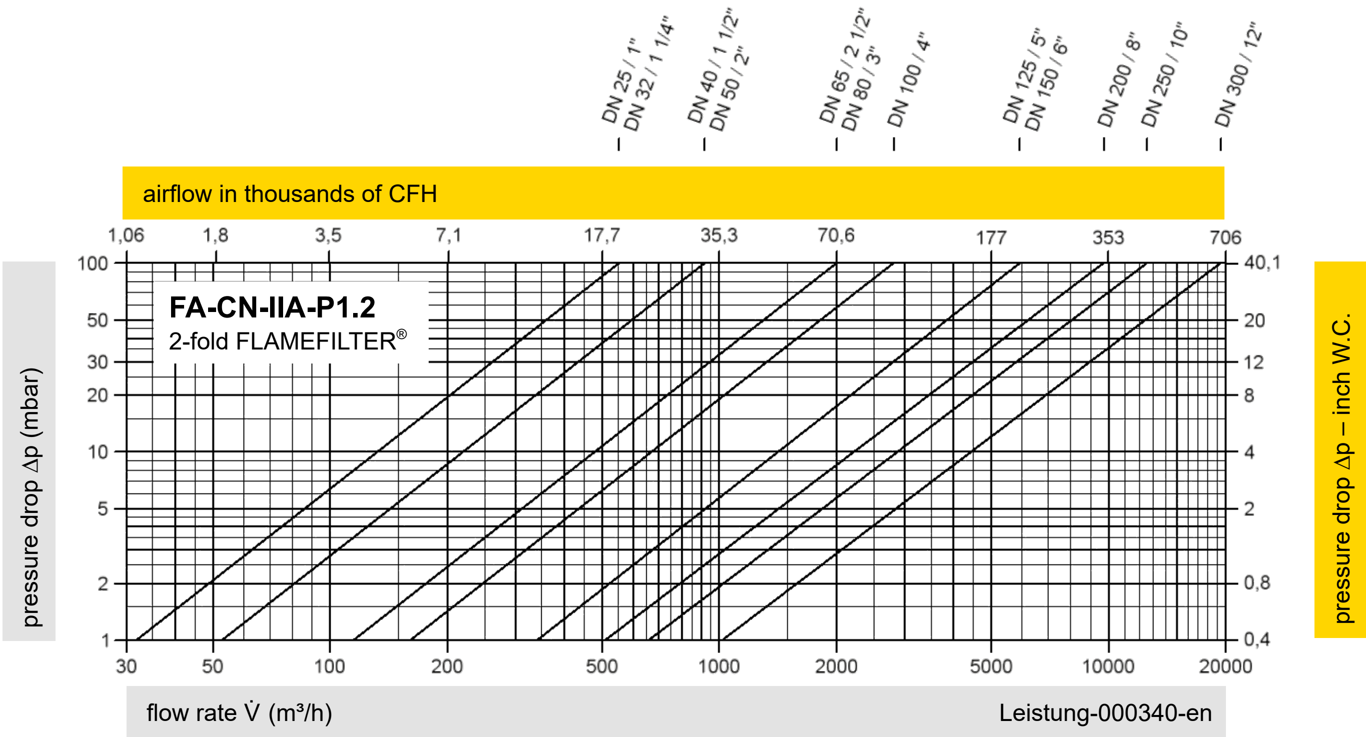


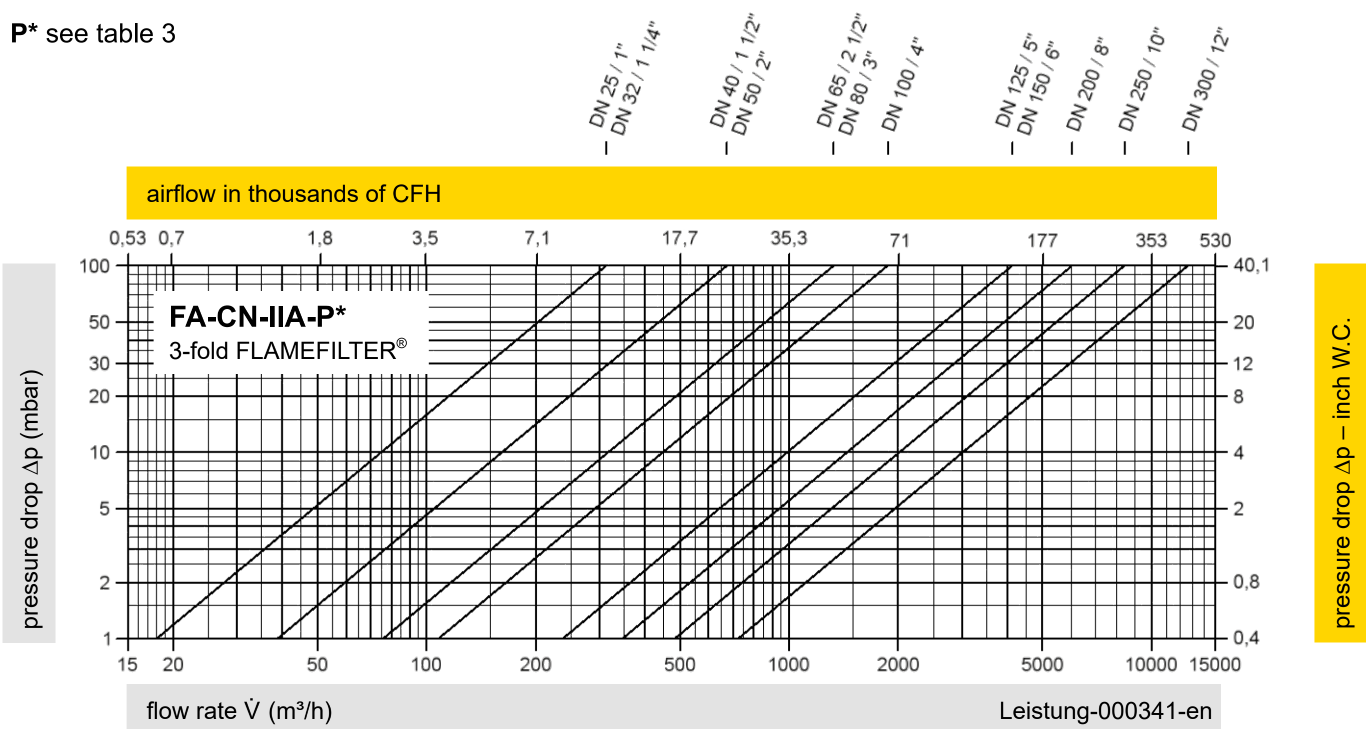
In-Line Deflagration Flame Arrester

Flow Capacity Charts

PROTEGO® FA-CN-IIA and IIB3

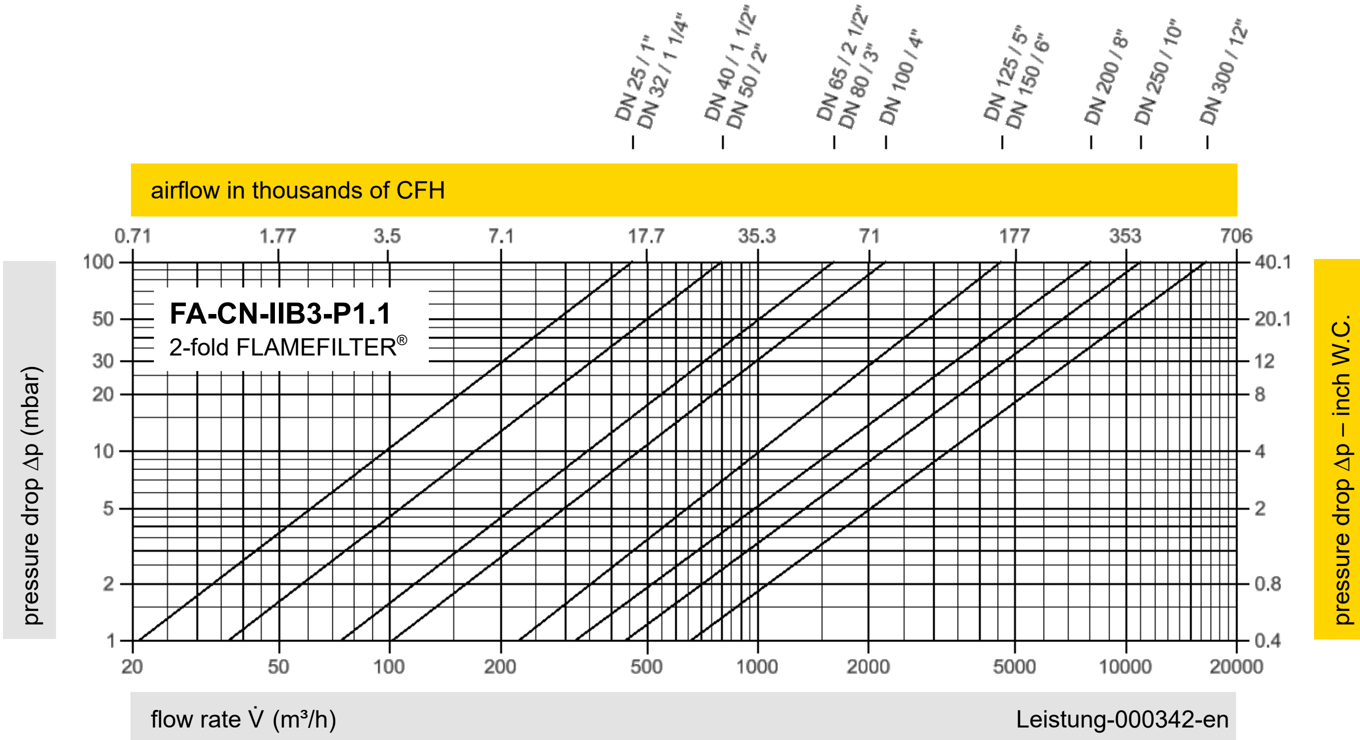


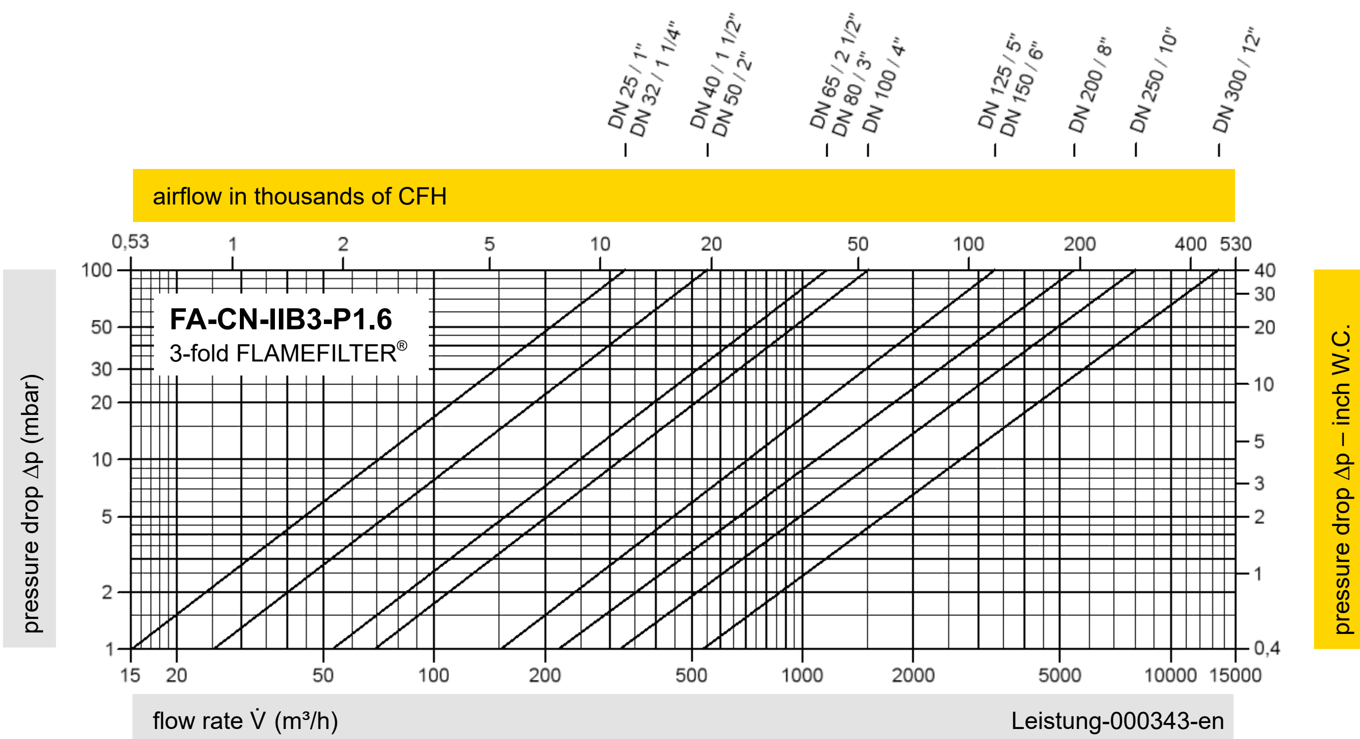
P* see table 3

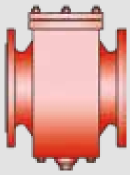


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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


DN 25 / 1"
DN 32 / 1 1/4"
DN 40 / 1 1/2"
DN 50 / 2"
DN 65 / 2 1/2"
DN 80 / 3"
DN 100 / 4"
DN 125 / 5"
DN 150 / 6"
DN 200 / 8"
DN 250 / 10"
DN 300 / 12"
airflow in thousands of CFH
0.71 1.77 3.5 7.1 17.7 35.3 71 177 353 706
FA-CN-IIB3-P1.1
2-fold FLAMEFILTER®
pressure drop Δp (mbar)
100 50 30 20 10 5 2 1
pressure drop Δp – inch W.C.
40.1 20.1 12 8 4 2 0.8 0.4
20 50 100 200 500 1000 2000 5000 10000 20000
flow rate V̇ (m³/h)
Leistung-000342-en

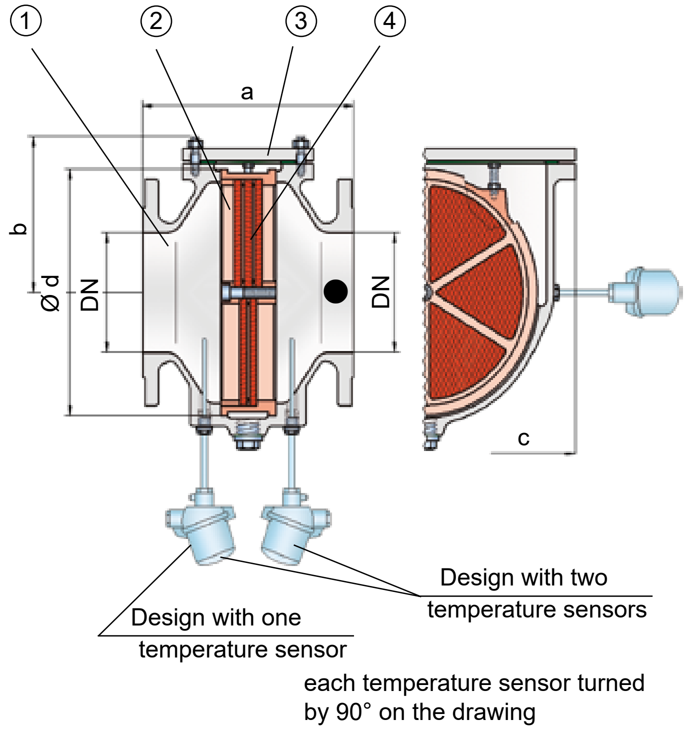

DN 25 / 1"
DN 32 / 1 1/4"
DN 40 / 1 1/2"
DN 50 / 2"
DN 65 / 2 1/2"
DN 80 / 3"
DN 100 / 4"
DN 125 / 5"
DN 150 / 6"
DN 200 / 8"
DN 250 / 10"
DN 300 / 12"
airflow in thousands of CFH
0,53 1 2 5 10 20 50 100 200 400 530
FA-CN-IIB3-P1.6
3-fold FLAMEFILTER®
pressure drop Δp (mbar)
100 50 30 20 10 5 2 1
pressure drop Δp – inch W.C.
40 30 20 10 5 3 2 1 0,4
15 20 50 100 200 500 1000 2000 5000 10000 15000
flow rate V̇ (m³/h)
Leistung-000343-en



In-Line Deflagration Flame Arrester

for hydrogen/air-mixtures, concentric design, bi-directional

PROTEGO® FA-CN-IIC



● Connection to the protected side (only for type FA-CN-T-....)

Function and Description

The PROTEGO® FA-CN in-line deflagration flame arrester is a compact design utilizing an easy access cover for easy maintenance. The special PROTEGO® FA-CN-IIC version was developed for hydrogen applications (group IIC vapors – NEC group B). The device is designed with relatively large gap widths – related to IIC – which causes minimum pressure loss and allows for permeation of small liquid droplets or particles. The PROTEGO® flame arrester unit can be removed and cleaned in just a few simple steps having to disassemble the pipe. When installing the deflagration flame arrester, make sure that the distance between potential ignition sources and thelocation of the installed device does not exceed the L/D ratio (pipe length/ pipe diameter) for which the device was approved (see table 4).

The deflagration flame arrester is symmetrical and offers bi-directional flame transmission protection. The device consists of the housing (1) with an easy access cover (3) and the PROTEGO® flame arrester unit (2) in the center. The PROTEGO® flame arrester unit is modular and consists of several FLAMEFILTER® discs (3) and spacers firmly held in a FLAMEFILTER® casing. The number of FLAMEFILTER® discs and their gap size depend on the device's intended use.

Specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, enables PROTEGO® to select the best deflagration flame arrester for your application. The versions of PROTEGO® FA-CN-IIC flame arrester protect against deflagrations of fuel/air mixtures of explosion group IIC (NEC B). FA-CN devices for substances of explosion groups IIA1, IIA, and IIB3 (NEC D and C (MESG ≥ 0.65 mm) are shown on separate pages.

The standard design can be used with an operating temperature of up to +60°C / 140°F and an absolute operating pressure up to 1.1 bar / 15.9 psi.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- state of the art protection for any hydrogen/air mixture
- can be applied to process flows with small liquid or particle load
- compact design with easy access cover
- easy maintenance without disassembling of the pipeline
- modular flame arrester unit enables individual FLAMEFILTER® to be replaced and cleaned
- bi-directional flame transmission proof design
- protects against deflagrations for all explosion groups
- lowest pressure drop results in low operating and lifecycle costs
- modular design reduces spare parts cost

Design and Specifications

There are three different designs:

Basic in-line deflagration flame arrester	**FA-CN -** $\boxed{-}$
In-line deflagration flame arrester with integrated temperature sensor* as additional protection against short time burning from one side	**FA-CN -** $\boxed{T}$
In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides	**FA-CN -** $\boxed{TB}$

Additional special devices available upon request

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Stabilized FLAMEFILTER® Discs (Flyer pdf)

L/D ratio (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	210 / 8.27	215 / 8.46	235 / 9.25	240 / 9.45	265 / 10.43	305 / 12.01	310 / 12.20	300 / 11.81	320 / 12.60	350 / 13.78
b	105 / 4.13	105 / 4.13	132 / 5.2	132 / 5.2	150 / 5.91	197/ 7.75	197 / 7.75	220 / 8.66	260 / 10.24	295 / 11.61
c	200 / 7.87	200 / 7.87	260 / 10.24	260 / 10.24	308 / 12.13	415 / 16.34	415 / 16.34	446 / 17.56	520 / 20.47	600 / 23.62
d	130 / 5.12	130 / 5.12	185 / 7.28	185 / 7.28	220 / 8.66	310 / 12.20	310 / 12.20	355 / 13.98	420 / 16.54	490 / 19.29

Table 2: Selection of the explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
< 0.50 mm	IIC	B	Special approvals upon request.

Table 3: Selection of max. operation pressure

DN	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
P_{max}	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9

P_{max} = maximum allowable operating pressure in bar / psi absolute; higher operating pressure upon request.

Table 4: Max. allowable L/D-ratio

DN	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
(L/D) max	30	30	10	10	10	20	20	10	10	5
Designation	–	–	X12	X12	X12	X10	X10	X12	X12	X13

Table 5: Material selection

Design	A	B	
Housing	Steel	Stainless Steel	Special materials upon request.
Cover	Steel	Stainless Steel	
Gasket	PTFE	PTFE	
Flame arrester unit	Stainless Steel	Stainless Steel	

Table 6: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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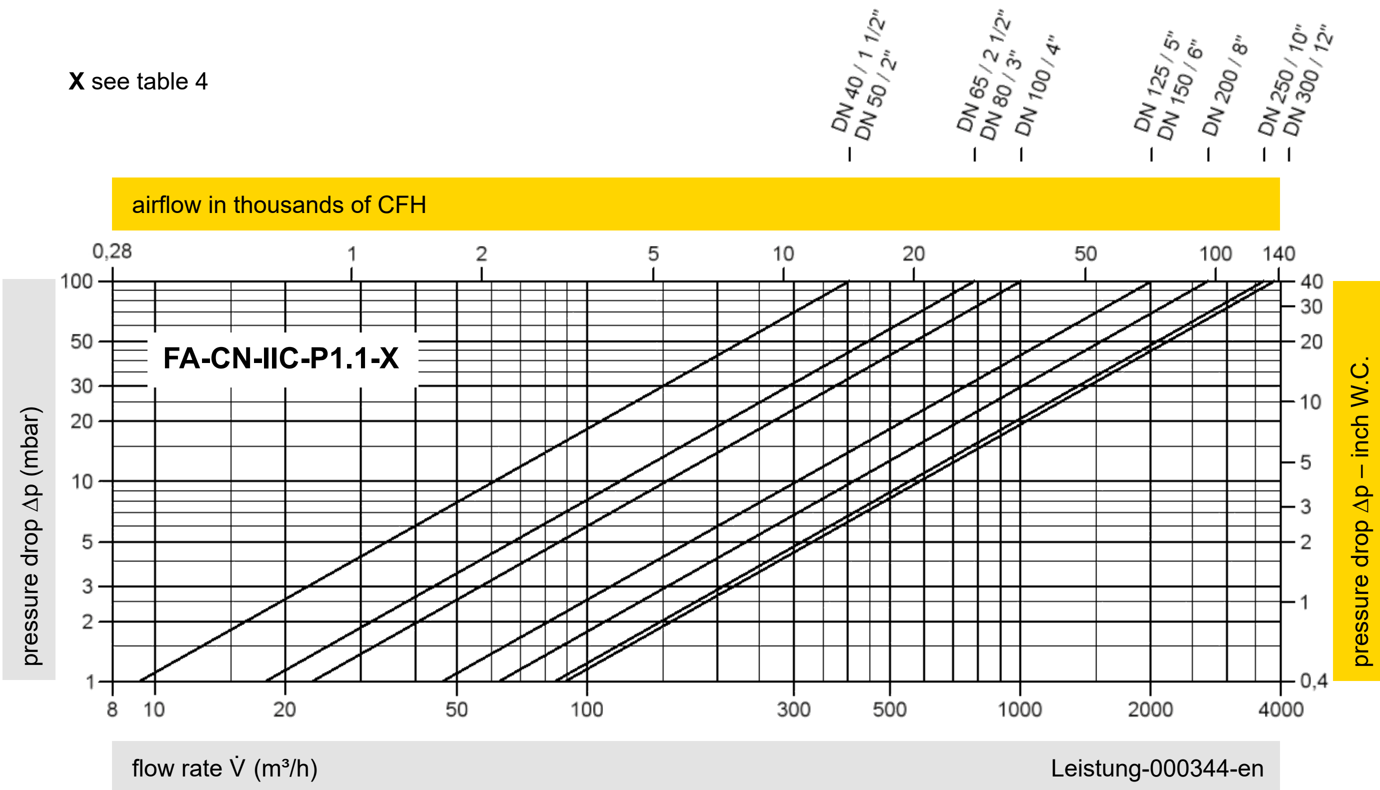
PROTEGO® FA-CN-IIC

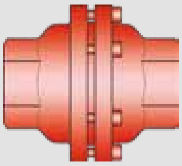
X see table 4



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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

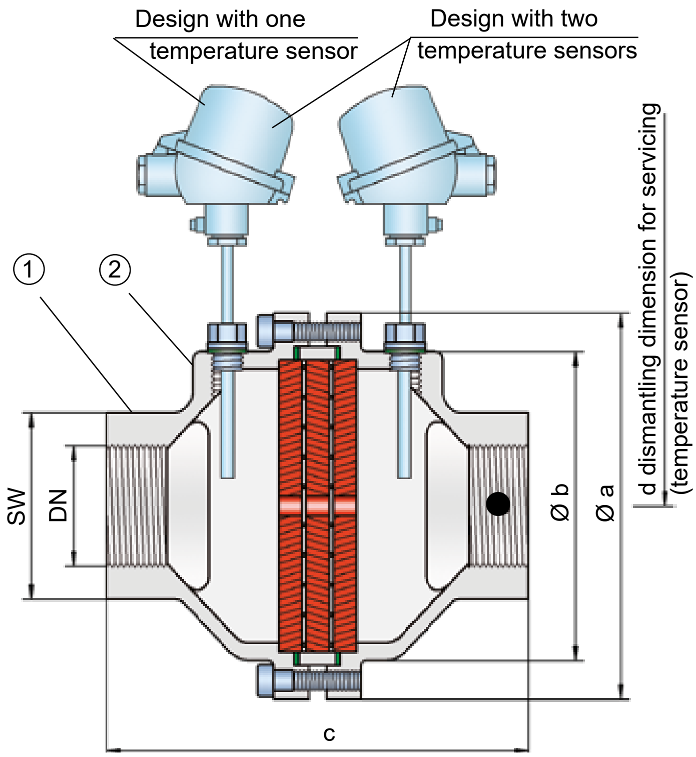
Notes:



In-Line Deflagration Flame Arrester

concentric design,
bi-directional

PROTEGO® FA-G



● Connection to the protected side (only for type FA-G-T-...)

Function and Description

The compact design of the PROTEGO® FA-G in-line deflagration flame arrester makes it the state-of-the-art technology for installation in pipes with diameters of up to 2”. The devices are installed with minimal distance to the burner to prevent flash-back into the fuel feed lines. When installing the deflagration flame arrester, make sure that the distance between potential ignition sources and the location of the installed device does not exceed the L/D ratio (pipe length/pipe diameter) for which the device was approved. As per EN ISO 16852, the L/D ratio is limited to (L/D)max ≤ 50 for deflagration flame arresters of explosion groups IIA and IIB3 (NEC groups D and C {MESG ≥ 0.65 mm}) and to (L/D)max ≤ 30 for explosion group IIC (NEC group B).

The in-line deflagration flame arrester is symmetrical and offers bi-directional flame transmission protection. The device consists of two housing parts (1) and a PROTEGO® flame arrester unit or a FLAMEFILTER® (2) and spacers in the center. The number of FLAMEFILTER® discs and their gap size depend on the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid. The PROTEGO® FA-G series in-line deflagration flame arresters is available for explosion groups IIA, IIB3, and IIC (NEC groups D, C {MESG ≥ 0.65 mm} and B).

The standard design can be used with an operating temperature of up to+60°C / 140°F and an absolute operating pressure acc. to table 3. Devices with special approval for higher pressures and higher temperatures are available upon request.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- different application possibilities
- modular design
- the individual FLAMEFILTER® can be quickly removed and installed
- threaded connection for direct mounting into pipeline
- bi-directional flame transmission proof design
- protects against deflagrations for all explosion groups
- use of temperature sensors for G 1½ and G 2 is possible
- cost efficient spare parts

Design and Specifications

There are three different designs:

Basic in-line deflagration flame arrester (size ½“ to 2“)	**FA-G-** $\boxed{–}$
In-line deflagration flame arrester with integrated temperature sensor* for additional protection against short-time burning from one side (size 1½“ to 2“)	**FA-G-** $\boxed{T}$
In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides (size 1½“ to 2“)	**FA-G-** $\boxed{TB}$

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Flange connection available upon request

Stabilized FLAMEFILTER® Discs (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches, SW = width across flats

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

DN	G ½	G ¾	G 1	G 1 ¼	G 1 ½	G 2
a	80 / 3.15	80 / 3.15	100 / 3.94	100 / 3.94	155 / 6.10	155 / 6.10
b	55 / 2.17	55 / 2.17	76 / 2.99	76 / 2.99	124 / 4.88	124 / 4.88
c (IIA up to IIB3)	100 / 3.94	100 / 3.94	110 / 4.33	110 / 4.33	170 / 6.69	170 / 6.69
c (IIB and IIC)	112 / 4.41	112 / 4.41	122 / 4.80	122 / 4.80	170 / 6.69	170 / 6.69
d	—	—	—	—	400 / 15.75	400 / 15.75
SW	32 / 1.26	32 / 1.26	50 / 1.97	50 / 1.97	75 / 2.95	75 / 2.95

Table 2: Selection of the explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0.90 mm	IIA	D	Special approvals upon request.
≥ 0.65 mm	IIB3	C	
< 0.50 mm	IIC	B	

Table 3: Selection of max. operating pressure

		DN	G ½	G ¾	G 1	G 1 ¼	G 1 ½	G 2	
Expl. Gr.	IIA	P_{max}	1.4/20.3	1.4/20.3	1.4/20.3	1.4/20.3	1.5/21.7	1.5/21.7	P_{max} = maximum allowable operating pressure in bar / psi absolute, higher operating pressure upon request.
	IIB3	P_{max}	1.2/17.4	1.2/17.4	1.2/17.4	1.2/17.4	1.2/17.4	1.2/17.4	
	IIC	P_{max}	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9	

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 5: Material selection

Design	B	C	* the FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc. when the listed housing materials are used.
Housing	Stainless Steel	Hastelloy	
Gasket	PTFE	PTFE	
FLAMEFILTER®*	Stainless Steel	Hastelloy	

Special materials upon request.

Table 6: Type of connection

Pipe thread DIN ISO 228-1	DIN	Other types of thread upon request.

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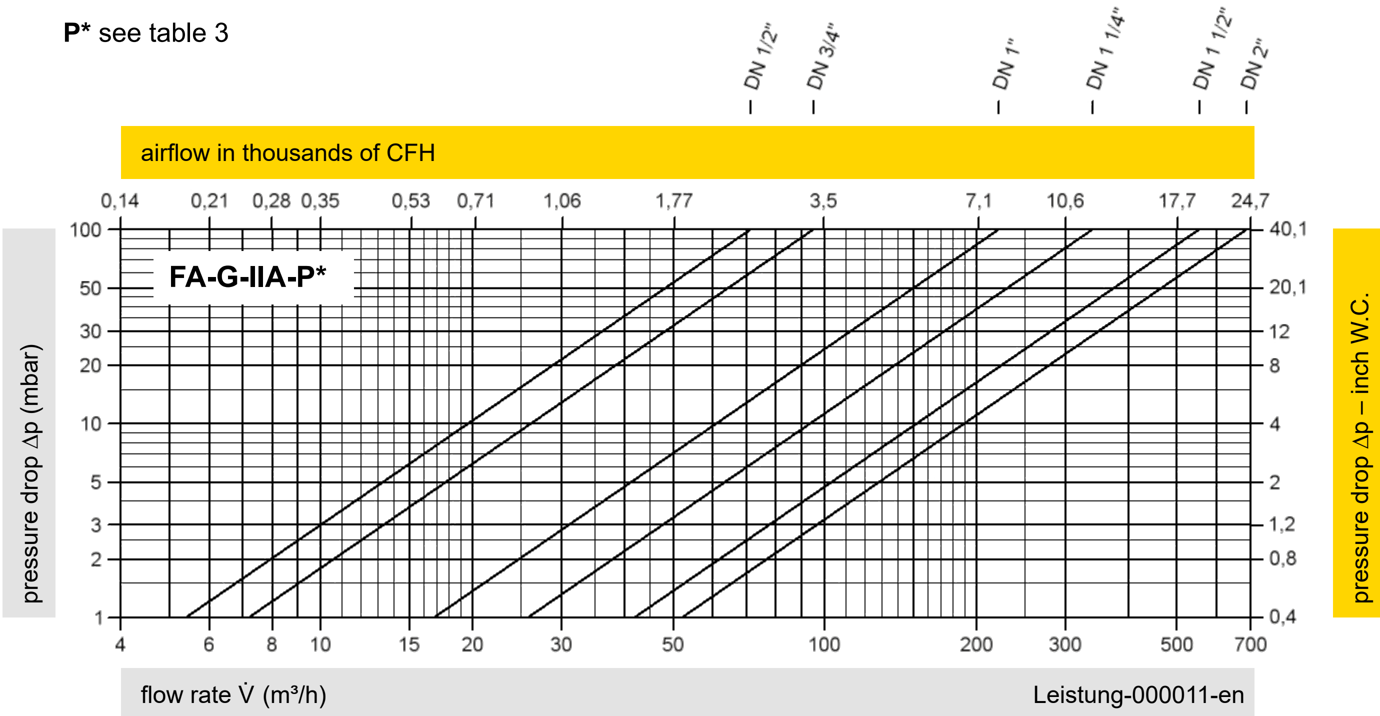
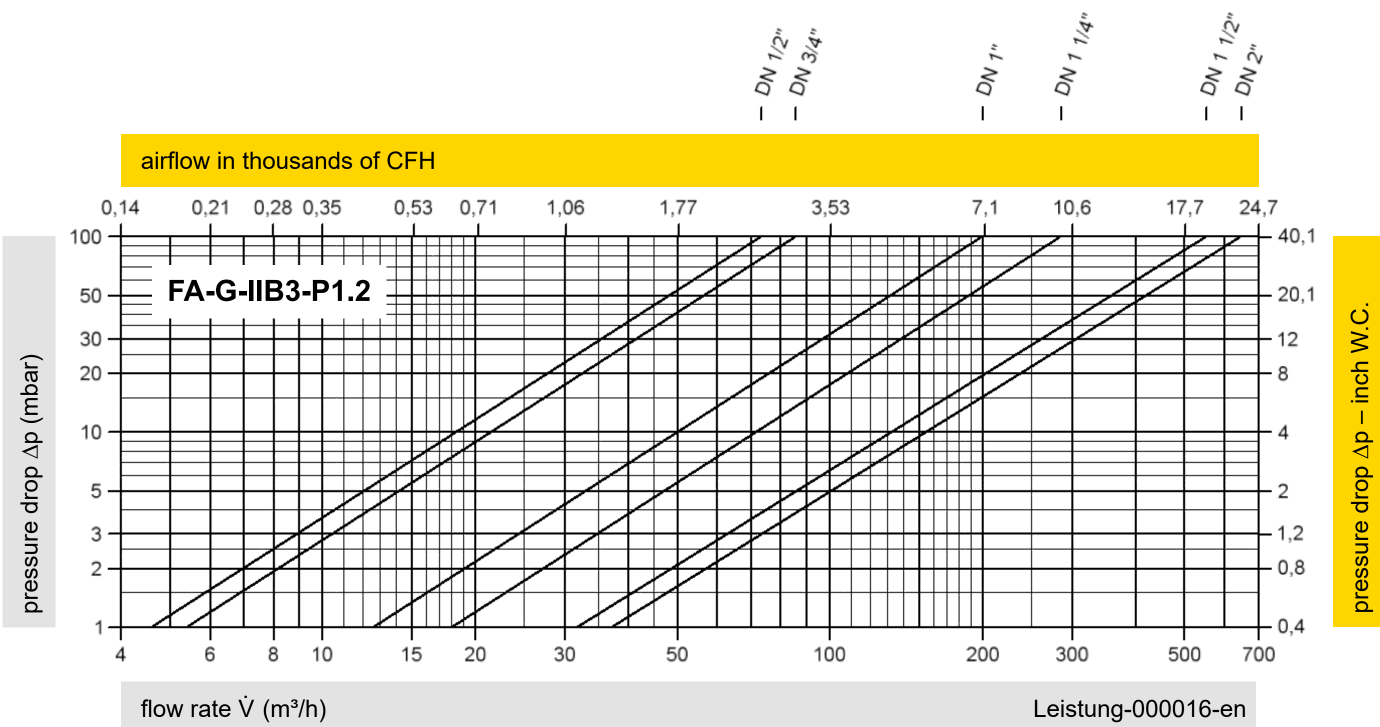
PROTEGO® FA-G-IIA, IIB3 and IIC

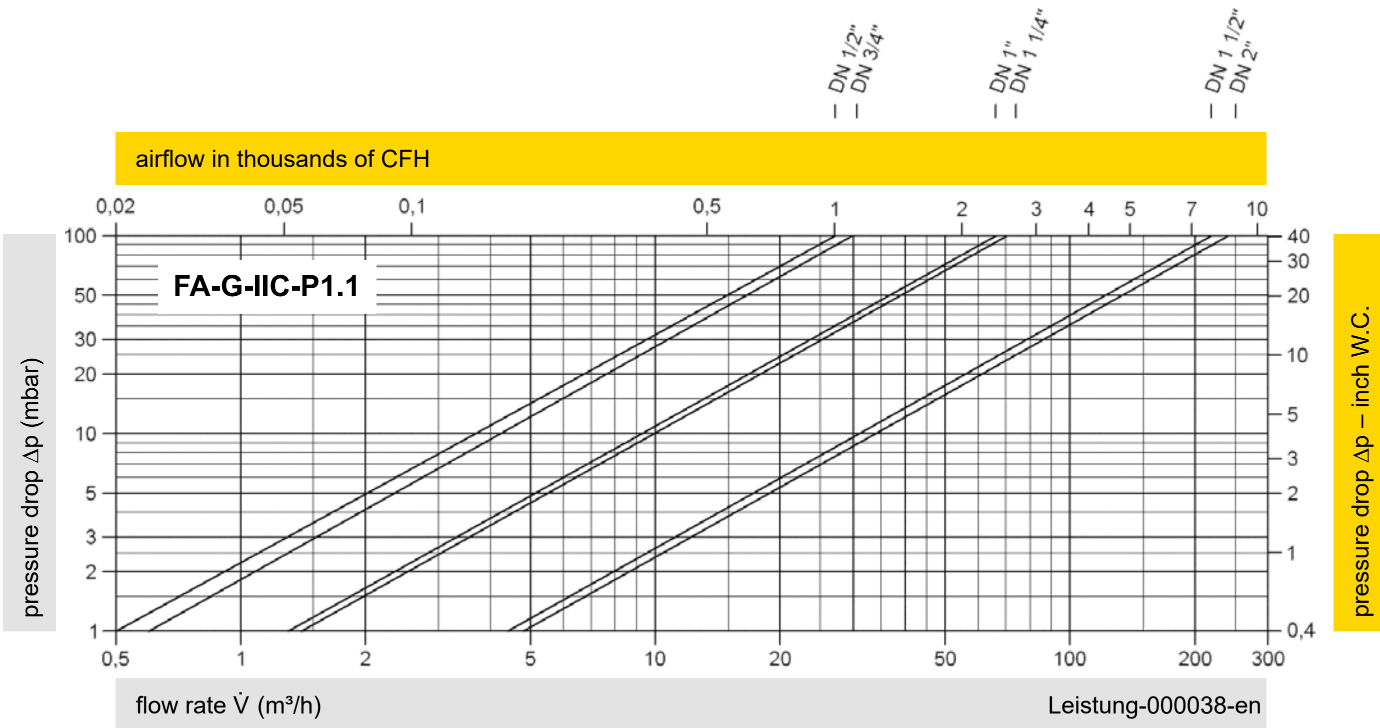
P* see table 3



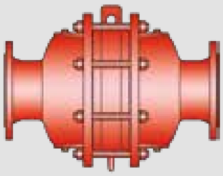


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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



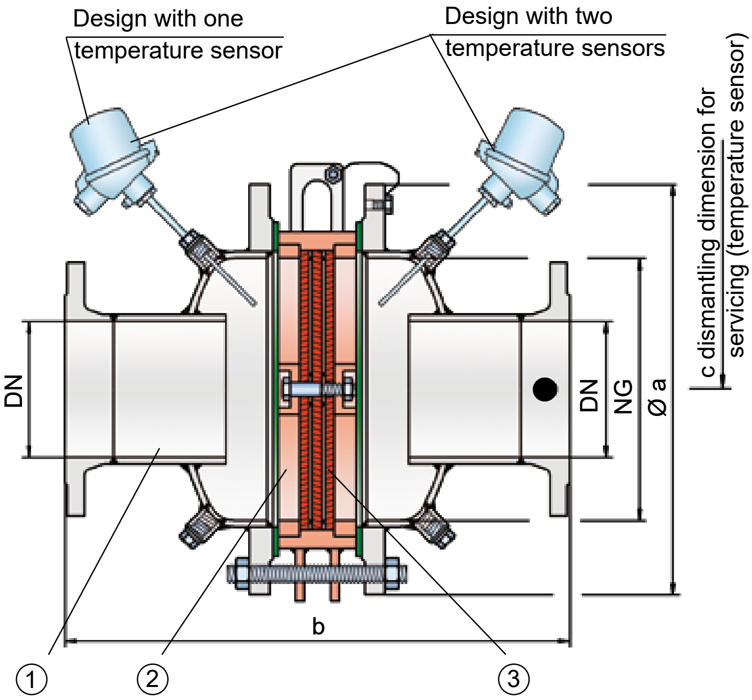
DN 1/2"
DN 3/4"
DN 1"
DN 1 1/4"
DN 1 1/2"
DN 2"
airflow in thousands of CFH
0,02
0,05
0,1
0,5
1
2
3
4
5
7
10
FA-G-IIC-P1.1
pressure drop ∆p (mbar)
100
50
30
20
10
5
3
2
1
pressure drop ∆p – inch W.C.
40
30
20
10
5
3
2
1
0,4
0,5
1
2
5
10
20
50
100
200
300
flow rate V̇ (m³/h)
Leistung-000038-en



In-Line Deflagration Flame Arrester

concentric design,
bi-directional

PROTEGO® FA-I



● Connection to the protected side (only for type FA-I-T-....)

Function and Description

In the development of the PROTEGO® FA-I in-line deflagration flame arrester, special effort was made to optimize the fluid dynamic flow characteristics. For a given flange connection size of the flame arrester, the FLAMEFILTER® size can be chosen for the most adequate flow capacity. When installing the deflagration flame arrester, make sure that the distance between potential ignition sources and location of the installed device does not exceed the L/D ratio (pipe length/pipe diameter) for which the device was tested (see table 4).

The deflagration flame arrester is symmetrical and offers bi-directional flame transmission protection. The device essentially consists of two housing parts (1) and the PROTEGO® flame arrester unit (2) in the center. The PROTEGO® flame arrester unit is modular and consists of several FLAMEFILTER® discs (3) and spacers firmly held in a FLAMEFILTER® casing. The number of FLAMEFILTER® discs and their gap size depends on the arrester´s intended use.

Specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, enables PROTEGO® to select the best deflagration flame arrester for your application. The PROTEGO® FA-I series of deflagration flame arresters is available for substances of explosion groups IIA and IIB3 (NEC groups D and C ((MESG ≥ 0.65 mm)).

The standard design can be used with an operating temperature of up to +60°C/ 140°F and an absolute operating pressure up to 1.1 bar / 15.9 psi. Devices with special approvals for higher pressures (see table 3) and higher temperatures are available upon request.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- optimized flow capacity
- different series allow increase of FLAMEFILTER® size for given flange connection resulting in lower pressure drop across the device
- option for integrated cleaning nozzles can be provided
- modular flame arrester unit enables each individual FLAMEFILTER® to be replaced and cleaned
- bi-directional flame transmission proof design
- protects with deflagrations for explosion groups IIA and IIB3 (NEC groups D and C)
- design available for elevated operating temperatures and pressures
- available sizes from DN 50 / 2” to DN 1000 / 40”
- lowest pressure drop results in low operating and lifecycle costs
- modular design reduces spare parts cost
- use of stabilized FLAMEFILTER® discs is possible
- use of PROTEGO® flame arrester unit in unique maintenance friendly design reduces service cost

Design and Specifications

There are three different designs:

Basic deflagration flame arrester design	**FA-I-** $\boxed{–}$
In-line deflagration flame arrester with integrated temperature sensor* for additional protection against short-time burning from one side	**FA-I-** $\boxed{T}$
In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides	**FA-I-** $\boxed{TB}$

Additional special devices available upon request

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Stabilized FLAMEFILTER®
Discs (Flyer pdf)

New PROTEGO® Flame Arrester Unit with
unique maintenance friendly design (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

To select nominal width/nominal size (NG/DN) combination, please use the flow capacity charts on the following pages.

Additional nominal width/nominal size (NG/DN) combinations with improved flow capacity upon request.

standard

NG	150 6“	150 6“	200 8“	300 12“	400 16“	500 20“	600 24“	800 32“	1000 40“	1200 48“	1400 56“	1600 64“
DN	≤ 50 2"	80 3"	≤ 100 4"	≤ 150 6"	≤ 200 8"	≤ 250 10"	≤ 300 12"	≤ 400 16"	≤ 500 20"	≤ 600 24"	≤ 800 32"	≤ 800 32"
a	285 / 11.22	285 / 11.22	340 / 13.39	445 / 17.52	565 / 22.24	670 / 26.38	780 / 30.71	975 / 38.39	1175 / 46.26	1405 / 55.31	1630 / 64.17	1830 / 72.05
Expl. Gr. IIA b*	364 / 14.33	364 / 14.33	452 / 17.79	584 / 22.99	638 / 25.12	688 / 27.09	800 / 31.50	900 / 35.43	1000 / 39.37	1100 / 43.31	1350 / 53.15	1450 / 57.09
Expl. Gr. IIB3 b*	364 / 14.33	364 / 14.33	464 / 18.27	596 / 23.46	650 / 25.59	700 / 27.56	800 / 31.50	900 / 35.43	1000 / 39.37	1100 / 43.31	1350 / 53.15	1450 / 57.09
c	500 / 19.69	500 / 19.69	520 / 20.47	570 / 22.44	620 / 24.41	670 / 26.38	700 / 31.50	900 / 35.43	1000 / 39.37	1100 / 43.31	1350 / 53.15	1450 / 57.09

*Dimension b only for P1.2 (IIA) and P1.1 (IIB3).

Table 2: Selection of the 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: Selection of max. operating pressure

	NG	150 6“	150 6“	200 8“	300 12“	400 16“	500 20“	600 24“	800 32“	1000 40“	1200 48“	1400 56“	1600 64“
	DN	≤ 50 2"	80 3"	≤ 100 4"	≤ 150 6"	≤ 200 8"	≤ 250 10"	≤ 300 12"	≤ 400 16"	≤ 500 20"	≤ 600 24"	≤ 800 32"	≤ 800 32"
Expl. Gr. IIA	P_{max}	1.8 / 26.1	1.8 / 26.1	1.5 / 21.7	1.5 / 21.7	1.5 / 21.7	1.5 / 21.7	1.5 / 21.7	1.4 / 20.3	1.3 / 18.8	1.3 / 18.8	1.2 / 17.4	1.1 / 15.9
Expl. Gr. IIB3	P_{max}	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9

P_{max} = maximum allowable operating pressure in bar / psi absolut, higher operating pressure upon request.

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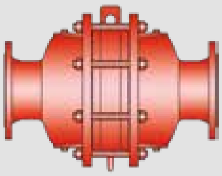


Table 4: Max. allowable L/D-ratio

standard

	NG	150 6“	150 6“	200 8“	300 12“	400 16“	500 20“	600 24“	800 32“	1000 40“	1200 48“	1400 56“	1600 64“
	DN	≤ 50 2"	80 3"	≤ 100 4"	≤ 150 6"	≤ 200 8"	≤ 250 10"	≤ 300 12"	≤ 400 16"	≤ 500 20"	≤ 600 24"	≤ 800 32"	≤ 800 32"
IIA	$(L/D)_{max}$	50	50	50	50	50	50	50	50	50	50	50	50
IIA	P_{max}	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.3 / 18.8	1.3 / 18.8	1.2 / 17.4	1.1 / 15.9
IIA	Classification	-	-	-	-	-	-	-	-	-	-	-	-
IIB3	$(L/D)_{max}$	50	50	40	40	35	35	35	30	30	30	25	25
IIB3	P_{max} (bar /psi)	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9
IIB3	Classification	-	-	X6	X6	X7	X7	X7	X8	X8	X8	X9	X9

Table 5: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 6: Material selection for housing

Design	A	B	C
Housing	Steel	Stainless Steel	Hastelloy
Gasket	PTFE	PTFE	PTFE
Flame arrester unit	A, B	C	D

The housing can also be delivered in carbon steel with an ECTFE coating.

Special materials upon request.

Table 7: Material combinations of the flame arrester unit

Design	A	C	D
FLAMEFILTER® casing	Steel	Stainless Steel	Hastelloy
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy
Spacers	Stainless Steel	Stainless Steel	Hastelloy

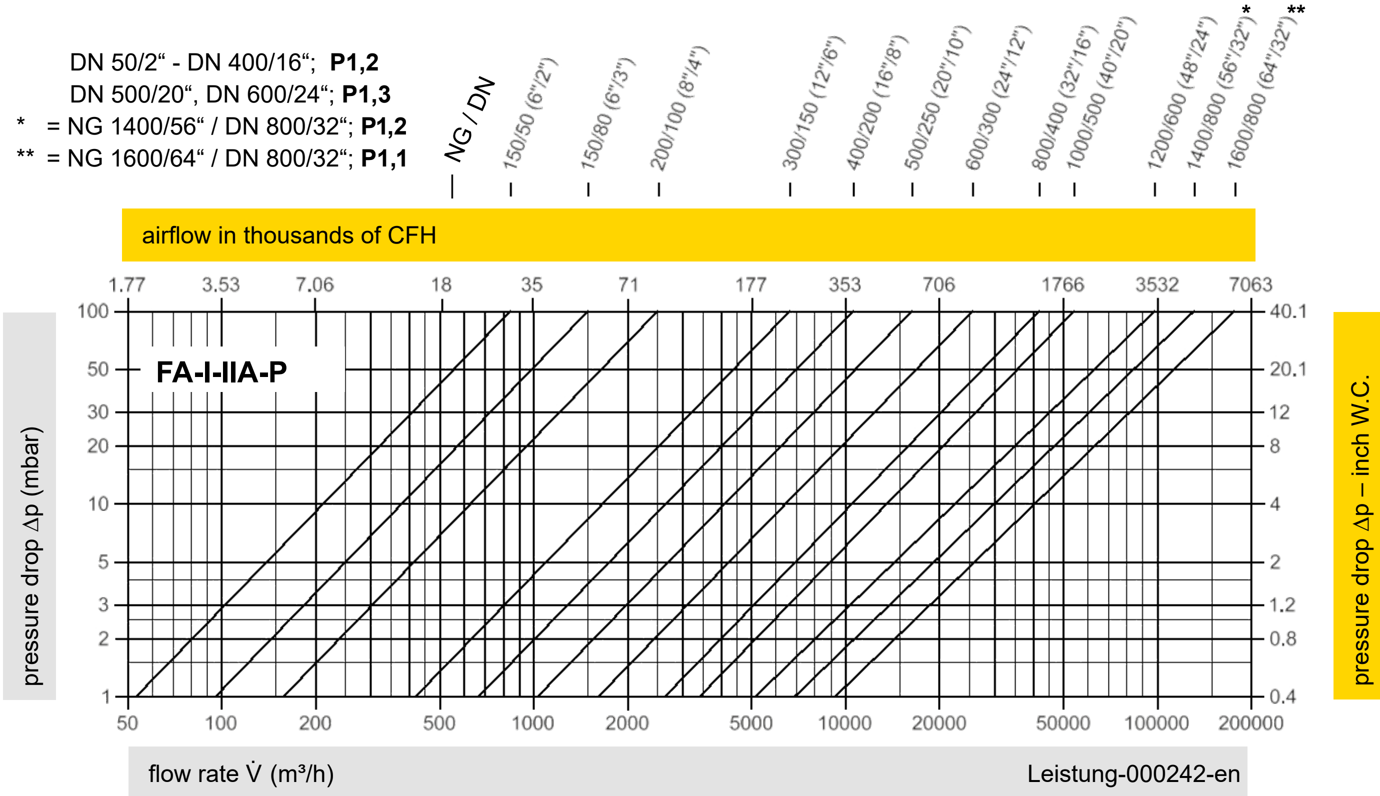
* the FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and casing materials are used.

Special materials upon request.

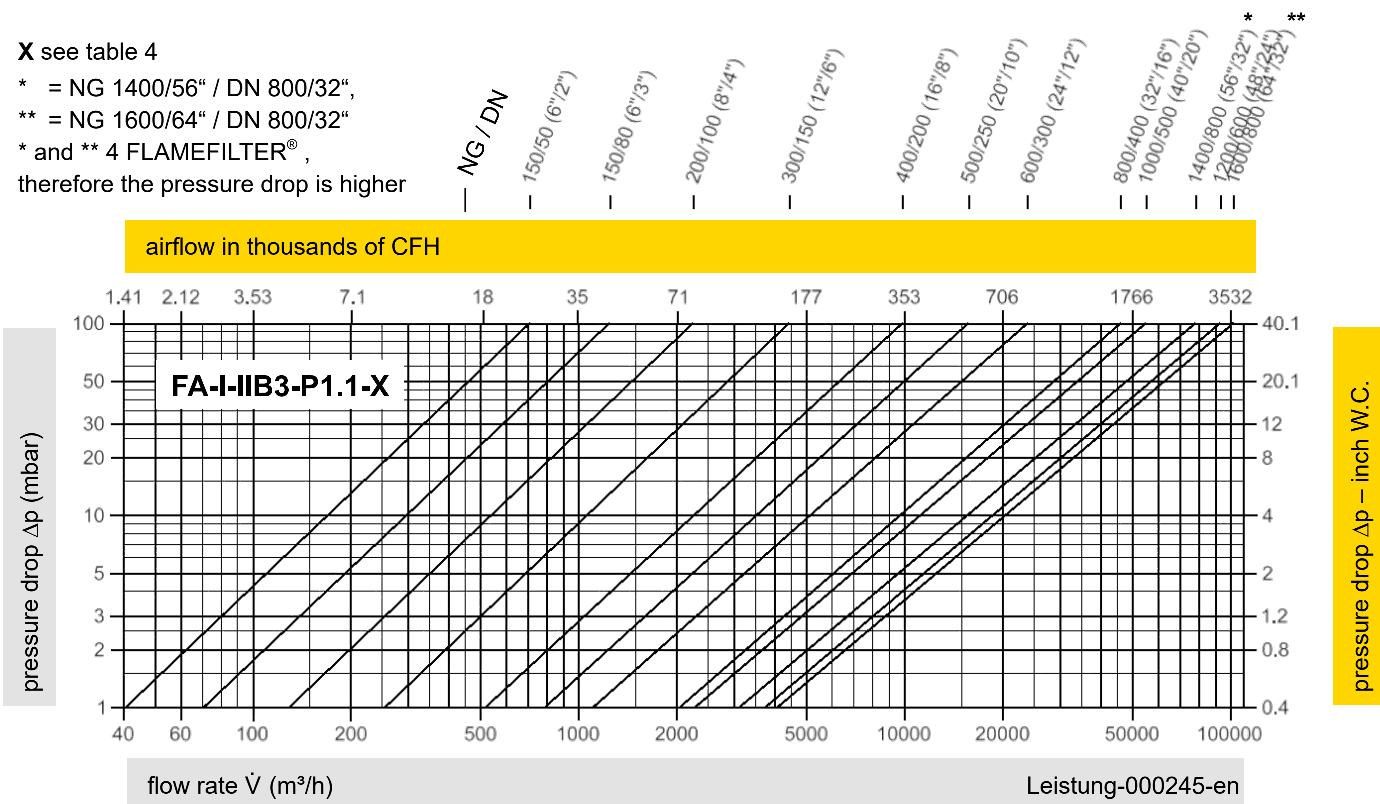
Table 8: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

DN 50/2" - DN 400/16"; **P1,2**
DN 500/20", DN 600/24"; **P1,3**
* = NG 1400/56" / DN 800/32"; **P1,2**
** = NG 1600/64" / DN 800/32"; **P1,1**



X see table 4
* = NG 1400/56" / DN 800/32",
** = NG 1600/64" / DN 800/32"
* and ** 4 FLAMEFILTER® ,
therefore the pressure drop is higher



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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

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PROTEGO® Detonation Flame Arresters

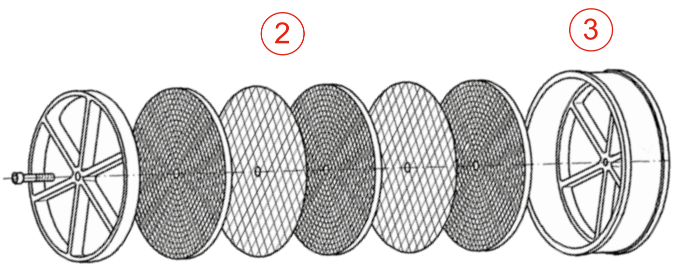
Section 4

Function and description

The function of flame arresters in the various combustion processes and applications is discussed in “Technical Fundamentals” (→ Sec. 1). This section discusses PROTEGO® **detonation arresters** for **stable** and **unstable detonations**.

PROTEGO® detonation flame arresters are state-of-the-art safety devices that are used in pipe systems where detonations can occur. They reliably suppress the effect of a detonation, extinguish the flame, and protect non-explosion-proof components and vessels.

The main component is generally the original PROTEGO® flame arrester unit (1), which takes the energy from the detonation and extinguishes the flame in narrow gaps. The PROTEGO® flame arrester unit consists of several FLAMEFILTER® discs (2) and spacers firmly held in the FLAMEFILTER® cage (3). The number of FLAMEFILTER® discs and their gap size depends on the device’s intended use and process parameters such as temperature, pressure, and vapor group of the handled gases.



1 *PROTEGO® flame arrester unit*

All dry detonation flame arrester types have a modular design. For larger nominal diameters, the patented shock absorber (SWGTE {Shock Wave Guide Tube Effect}) and other innovative technical solutions remove energy from the detonation shock wave before the detonation reaches the FLAMEFILTER®.

Dry PROTEGO® detonation flame arresters are also tested for and provide protection against deflagrations. Equipped with an additional temperature sensor, they also provide protection from short-time stabilized burning on the FLAMEFILTER®.

In close cooperation with scientific institutions, PROTEGO® has developed safety devices which can be applied to all explosion hazardous locations and provide protection against stable and unstable detonations, on one or both sides. Our devices are subjected to and certified by type examination in accordance with ATEX, PED, and other international standards (CE, etc.).

A wide range of types, designs, sizes, and materials can be provided. Most importantly, we have the capability to custom design and develop solutions at our test facility, which is the most technologically advanced in the world.

A special safety device is the hydraulic flame arrester. It is a collection device for large volume flows in vent headers, collecting exhaust air from various areas of the plant. It also functions as a backflow prevention device. With extremely low pressure losses, thanks to its relatively large drill holes in the sparge pipes, the hydraulic flame arrester is unsusceptible to clogging, preventing potential downtime in plant operation. It can be used as flame arrester with substances of all explosion groups and provides protection against all types of combustion. The hydraulic flame arrester has to be monitored and controlled by instrumentation. Early involvement of our engineers during the design stage is necessary to make the right selection.

Special features and advantages

The most important distinctive features are the selection criteria: **Stable or unstable** detonations; **dry detonation arresters** for installation in gas or vapor conducting pipes; or **liquid detonation arresters**, i.e., flame arresters with a liquid barrier for pipes in which liquids are transported. For the parameters of pressure and temperature, **special operating conditions** beyond standard values may have to be considered.

It is important to categorize the products or the components of the mixture into **explosion groups**, according to their MESG, to select the suitable flame arrester from the various designs for all explosion groups.

The designs differ according to their **concentric, eccentric, and 90-degree design**.

The respective system specification must be considered when choosing the required **nominal diameters and types of connection**.

A **heating jacket** may be necessary, but not every device can be provided with a heating jacket.

There are designs for **critical substances**, special **product properties** (such as viscosity, density, crystallization, and polymerization), and for **uni-directional or bi-directional protection**.

Preferred applications

Protection of

- Piping systems
- Tanks and vessels in chemical, petrochemical, and pharmaceutical processing plants
- Loading systems
- Gas collection systems
- Exhaust gas combustion systems
- Flare systems
- Landfills and biogas systems
- Waste-water treatment plants

Installation and maintenance

PROTEGO® detonation flame arresters are also tested for and provide protections against deflagrations so that they can be used at any distance from a potential ignition source. However, they are preferably installed as close as possible to the part of the system to be protected. Pipes with a nominal diameter larger than the nominal diameter of the devices must not be connected to detonation arresters.

Due to the modular design of the PROTEGO® flame arrester unit, any type of detonation flame arrester is extremely easy to service. For maintenance reasons, the location of the flame arrester must be easily accessible, and a hoist must be provided if the flame arrester is heavy. Maintenance is problem-free for trained personnel.

PROTEGO® detonation flame arresters are installed in areas subject to explosion hazards. It is important to select the correct device for the specific application. The manufacturer´s statement of conformity confirms the tasks for which the deflagration flame arrester is suitable. The user documents proper use in accordance with the applicable safety regulations.

Selection

The possible types are pre-selected from the product line based on the most important process data:

- **Stable** detonations or **unstable detonations**
- Lines that conduct **dry gas/vapors** or **liquids**
- Standard or **non-standard operating conditions** (pressure and temperature)
- **Explosion group** of the flowing mixture

Lastly, the following criteria is reviewed and selected:

- Approvals in accordance with ATEX, USCG, CSA, GOST-R, GL, IMO, etc.
- Concentric, excentric, or 90-degree design
- Nominal diameter and type of connection
- Heating jacket or custom supplied electrical heat tracing
- Critical substances
- Uni-directional or bi-directional

Based on this initial selection, additional details such as materials, coatings, etc. can be requested or defined in the data sheet.

If no suitable device can be found, please contact us. Special designs and approvals are available.

Sizing

The nominal diameter of the device is determined or checked in the p/V flow chart. A safety margin must be provided when the processed fluid is highly contaminated.

Given:	Volume flow	m^3/h or CFH
Given:	Max. all. pressure drop	Δp mbar or inch W.C.
Desired:	Nominal diameter of the detonation flame arrester	DN
Procedure:	Intersection of the lines with the volume flow and maximum allowable pressure drop lies above or on the desired nominal diameter curve	

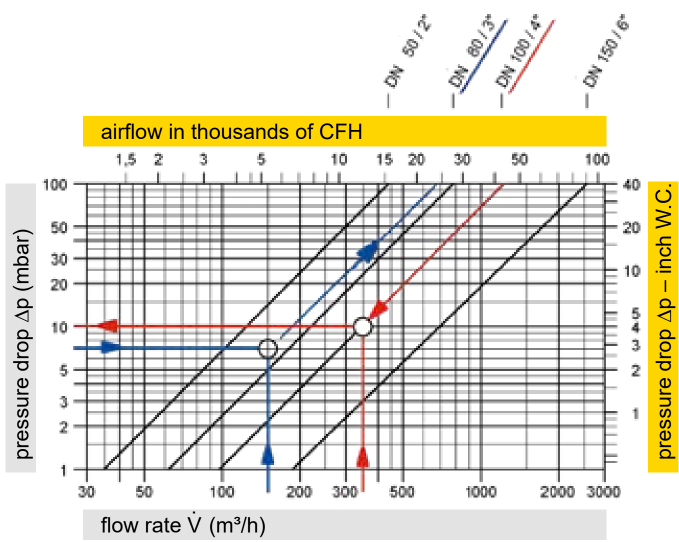
or

Given:	Volume flow	m^3/h or CFH
Given:	Nominal diameter of pipe	DN
Desired:	Pressure drop	Δp mbar or inch W.C.

Procedure: Intersection of the lines with the volume flow and nominal diameter curve, horizontal straight lines lead to the desired pressure drop

Instructions on how to calculate the volumetric flow or influence of density are found in Sec. 1 “Technical Fundamentals.”

After all the steps are completed, the device can be specified and ordered.



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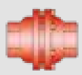
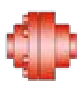
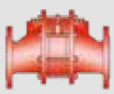
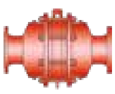
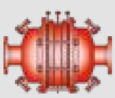
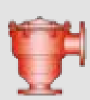
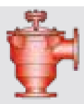
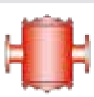
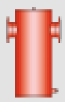
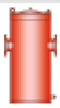
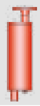
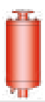
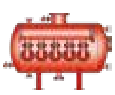
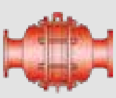
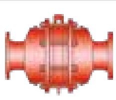
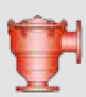
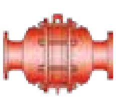
Catalog

PROTEGO® Detonation Flame Arrester

	Type	Size	Design cc = concentric ec = eccentric	Explosion Group ATEX	Explosion Group NEC	Approvals		O = dry type x = liquid type	O = for non-standard operating parameter	O = for critical substances (polymerization, corrosion, crystallization)	O = heating jacket, heating coil	O = uni-directional, x = bi-directional	Page
for stable detonation													
	DA-G	G ½ - G 3	straigth through, cc	IIA, IIB3, IIC	D, C, B	ATEX		O	O			x	118 - 121
	DR/SV	G ½ - G ¾	straight through, cc	IIA	D	ATEX		O				O	
	DA-E	25-300 1" - 12"	straight through, ec	IIA, IIB3	D, C	ATEX		O	O			x	122 - 124
	DA-SB	50-1000 2" - 40"	straight through, cc	IIA, IIB3, IIC	D, C, B	ATEX		O	O		O	x	126 - 131
	DA-SB-PTFE	50-100 2" - 4"	straight through, cc	IIA	D	ATEX		O		O		x	
	DR/ES	G ¼ -G ¾	90-degree	IIA, IIB3, IIC	D, C, B	ATEX		O	O			O	132 - 134
	DR/ES	25-200 1" - 8"	90-degree	IIA, IIB3	D, C	ATEX		O/x	O		O	O	136 - 140
	DR/ES-V	40-200 1 ½" - 8"	90-degree	IIA, IIB3	D, C	ATEX		O	O		O	O	142 - 145
	DR/ES-PTFE	40-150 1 ½" - 6"	90-degree	IIA	D	ATEX		O		O		O	
	DR/SBW	50-400 2" - 16"	straight through, cc	IIA, IIB3	D, C	ATEX		O	O		O	x	
	BR/TS	80 3"	90-degree	IIB3, IIB	C, B	ATEX		O				O	-IIB -IIB3

	Type	Size	Design cc = concentric ec = eccentric	Explosion Group ATEX	 NEC	Approvals		O = dry type x = liquid type	O = for non-standard operating parameter	O = for critical substances (polymerization, corrosion, crystallization)	O = heating jacket, heating coil	O = uni-directional, x = bi-directional	**Page**
for stable detonation / for liquid detonation													
	LDA-W	25-300 1" - 12"	straight through	IIA, IIB3	D, C	ATEX		x		O		O	146 - 147
	LDA-WF(W)	25-250 1" - 10"	straight through	IIA, IIB3	D, C	ATEX		x		O		O	148 - 149
	LDA	25-250 1" - 10"	vertical	IIA, IIB3	D, C	ATEX		x				O	150 - 151
	LDA-F	25-250 1" - 10"	vertical	IIA, IIB3	D, C	ATEX		x				O	152 - 153
	EF/V	25-250 1" - 10"	vertical	IIB3	C	ATEX		x				O	154 - 155
	TS/P TS/E TS/W			IIA, IIB3, IIC	D, C, B	ATEX		x		O		O	156 - 157
for unstable detonation													
	DA-UB	50-600 2" - 24"	straight through, cc	IIA, IIB3	D, C	ATEX		O	O		O	x	158 - 161
	DA-CG	50-600 2" - 24"	straight through, cc	IIA, IIB3	D, C	USCG		O	O		O	x	162 - 165
	DR/EU	25-150 1" - 6"	90-degree	IIA, IIB2, IIB3	D, C, C	ATEX		O	O		O	O	166 - 168
	DA-UCG	50-400 2“ - 16“	straight through, cc	IIA	D	ATEX USCG		O	O		O	x	

Larger sizes upon request.

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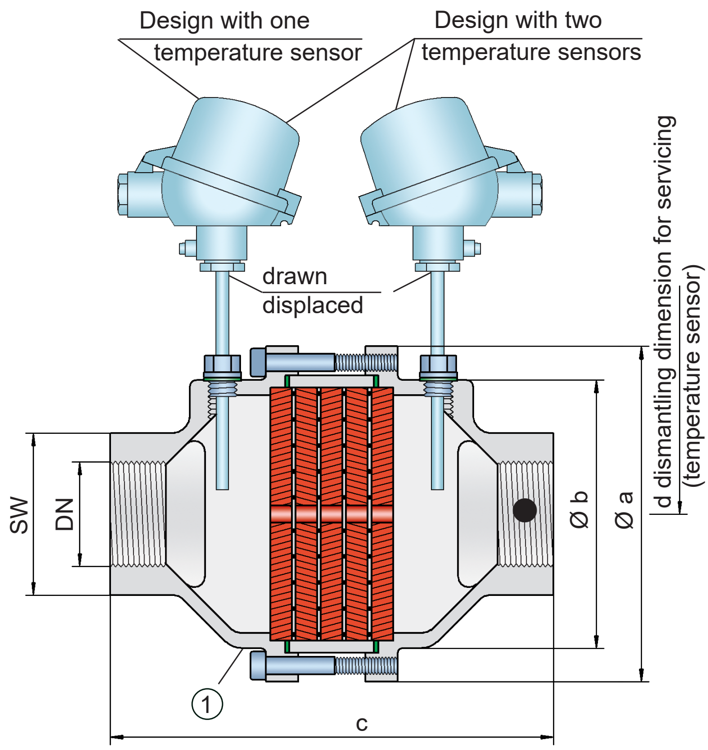

● Connection to the protected side (only for type DA-G-T-...)

The device is bi-directional and equipped with a threaded connection. This can be adapted to international standards. The detonation arrester can be used at any location in the pipe, regardless of the location of the ignition source.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- bi-directional
- modular design
- quick removal and installation of the individual FLAMEFILTER®
- easy maintenance and replacement of the individual FLAMEFILTER®
- Various uses possible
- Installation of temperature sensors for G 1½ and G 2 possible
- cost-effective spare parts

Function and Description

The PROTEGO® DA-G series is a compact in-line detonation flame arrester for installation in pipes with diameters up to 3“and is used, for example, in industrial applications such as gas analysis lines.

Once a detonation enters the flame arrester, energy is absorbed from the shock wave, and the flame is extinguished in the narrow gaps of the FLAMEFILTER® (1).

The PROTEGO® flame arrester unit consists of several FLAMEFILTER® discs firmly held in a housing. The gap size and number of FLAMEFILTER® discs are determined by the operating data and parameters of the mixture flowing in the line (explosion group, pressure, temperature).

To provide an optimum result between the housing size, number of FLAMEFILTER® discs and their gap size, a device was developed that can be used for all explosion groups - IIA, IIB3 and IIC (NEC Group D, C MESG ≥ 0.65 mm and B). The standard design can be used with an operating temperature of up to +60°C / 140°F and an absolute operating pressure up to 1.1 bar / 15.9 psi. **Devices with special approvals for higher pressures (see table 4) and higher temperatures are available upon request**.

Design Types and Specifications

There are three different designs available:

Basic design of the DA-G in-line detonation flame arrester, size ½“ to 3“	**DA-G- $\boxed{–}$**
In-line detonation flame arrester with integrated temperature sensor* as additional protection against short burning from one side, size 1½“ to 3“	**DA-G- $\boxed{T}$**
In-line detonation flame arrester with two integrated temperature sensors* as additional protection against short-time burning from both sides, size 1½“ to 3“	**DA-G- $\boxed{TB}$**

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Flange connection available upon request.

Table 1: Dimensions Dimensions in mm / inches, SW = width across flats

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

DN	G ½	G ¾	G 1	G 1 ¼	G 1 ½	G 2	G 3
a	80 / 3.15	80 / 3.15	100 / 3.94	100 / 3.94	155 / 6.10	155 / 6.10	155 / 6.10
b	55 / 2.17	55 / 2.17	76 / 2.99	76 / 2.99	124 / 4.88	124 / 4.88	124 / 4.88
c (IIA)	112 / 4.41	112 / 4.41	122 / 4.80	122 / 4.80	205 / 8.07	205 / 8.07	205 / 8.07
c (IIB3 and IIC)	135 / 5.31	135 / 5.31	145 / 5.71	145 / 5.71	205 / 8.07	205 / 8.07	205 / 8.07
d	—	—	—	—	400 / 15.75	400 / 15.75	400 / 15.75
SW	32 / 1.26	32 / 1.26	50 / 1.97	50 / 1.97	75 / 2.95	75 / 2.95	95 / 3.74

Table 2: Selection of the explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request.
≥ 0,65 mm	IIB3	C	
< 0,50 mm	IIC	B	

Table 3: Selection of max. operating pressure

		DN	G ½	G ¾	G 1	G 1 ¼	G 1 ½	G 2	G 3
Expl. Gr.	IIA	P_{max}	1.2/17.4	1.2/17.4	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9
	IIB3	P_{max}	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9	1.4/20.3	1.4/20.3	1.4/20.3
	IIC	P_{max}	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9	1.6/23.2	1.6/23.2	1.6/23.2

P_{max} = maximum allowable operating pressure in bar / psi (absolute); higher operating pressure upon request.

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 5: Material selection

Design	B	C
Housing	Stainless Steel	Hastelloy
Gasket	PTFE	PTFE
FLAMEFILTER®*	Stainless Steel	Hastelloy

*The FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing materials are used.

Special materials upon request.

Table 6: Type of connection

Pipe thread DIN ISO 228-1	DIN	Other types of thread upon request.

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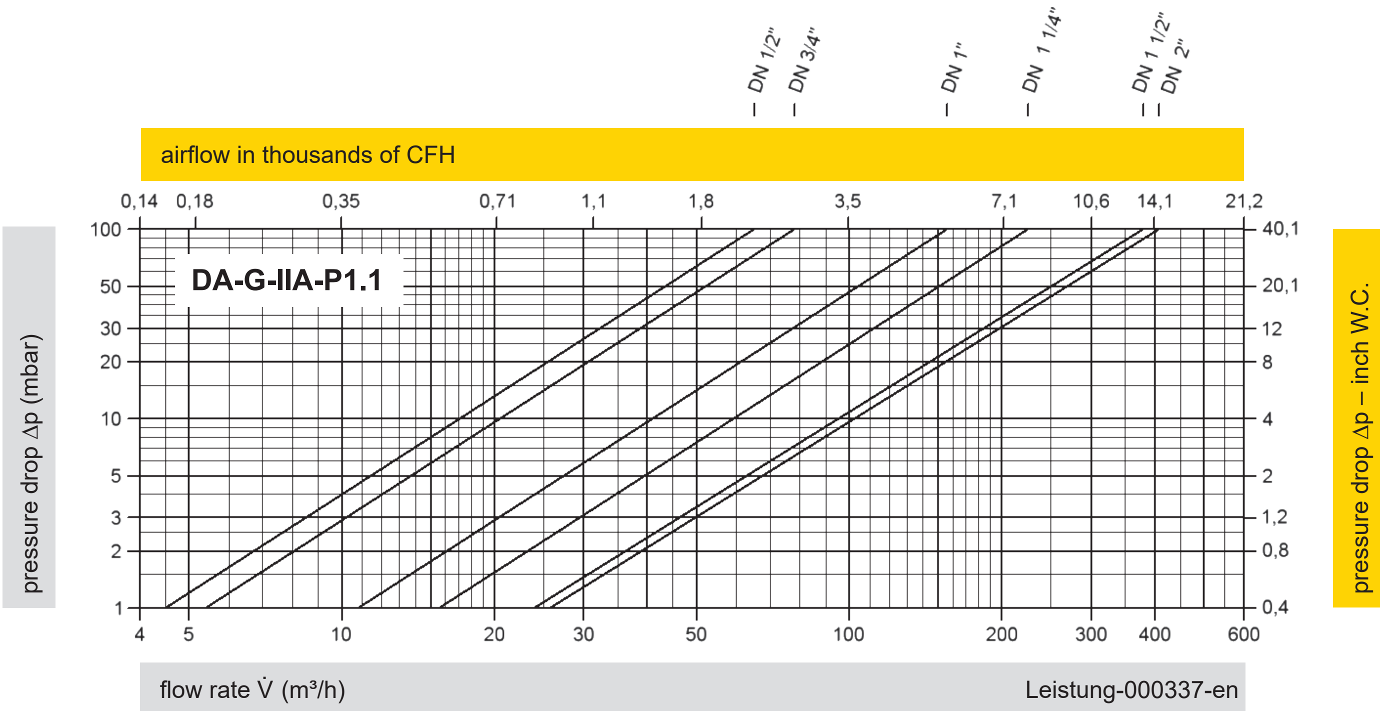
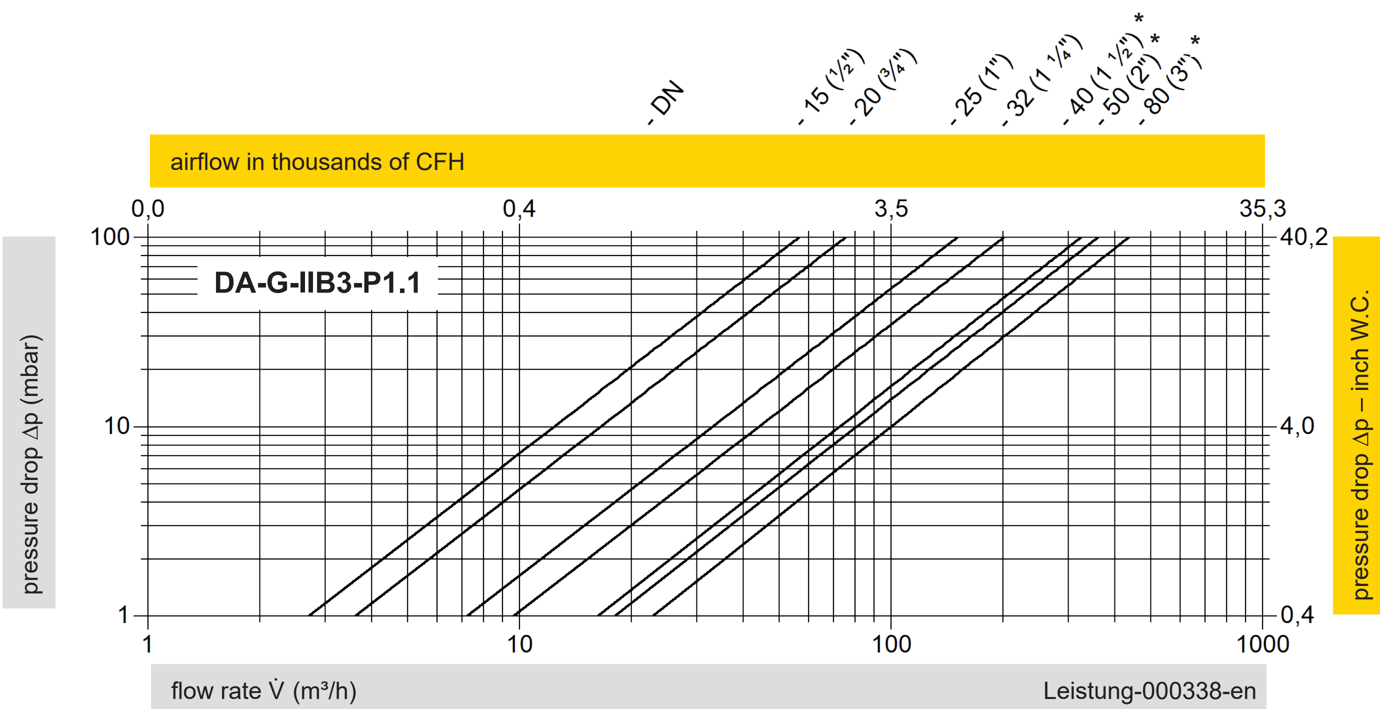
PROTEGO® DA-G



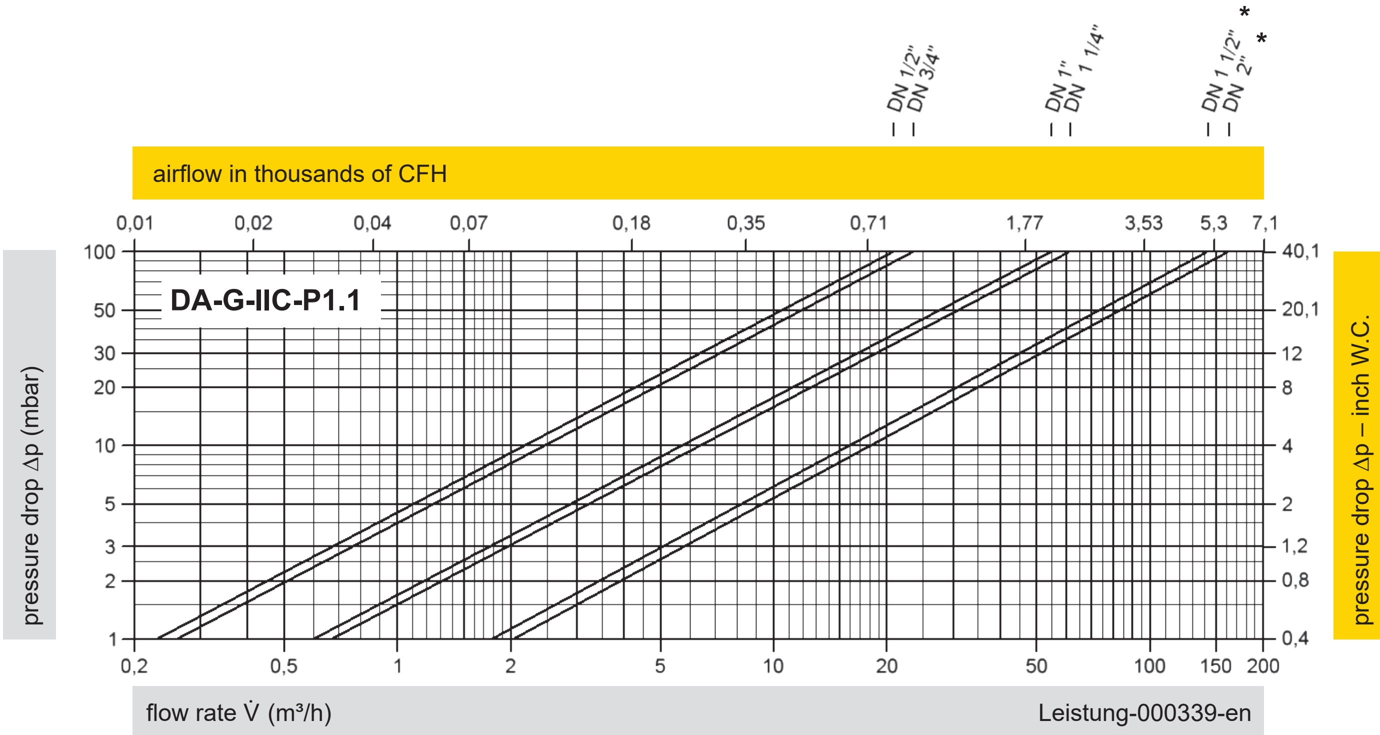
*** P1.4**



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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

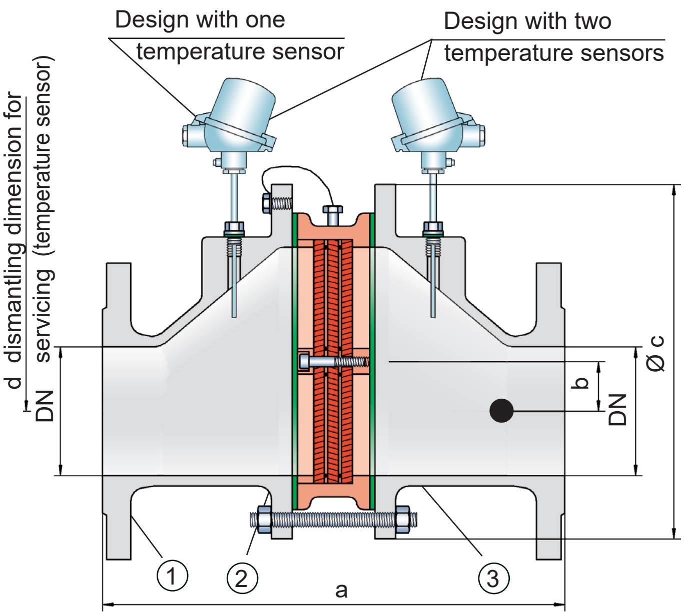
* P1.6


DN 1/2"
DN 3/4"
DN 1"
DN 1 1/4"
DN 1 1/2" *
DN 2" *
airflow in thousands of CFH
0,01
0,02
0,04
0,07
0,18
0,35
0,71
1,77
3,53
5,3
7,1
DA-G-IIC-P1.1
pressure drop Δp (mbar)
100
50
30
20
10
5
3
2
1
40,1
20,1
12
8
4
2
1,2
0,8
0,4
pressure drop Δp – inch W.C.
0,2
0,5
1
2
5
10
20
50
100
150
200
flow rate V̇ (m³/h)
Leistung-000339-en

Eccentric In-Line Detonation Flame Arrester

for stable detonations and deflagrations in a straight through design, bi-directional

PROTEGO® DA-E



● Connection to the protected side (only for type DA-E-T-...)

Function and Description

The PROTEGO® DA-E series of detonation arresters are distinguished by its eccentric housing shape. When condensate accumulates within the PROTEGO® flame arrester unit, the design allows the liquid to drain without collecting large amounts in the housing. The eccentric design of the device has distinctive advantages over the classic flame arresters when installed at lower depths.

The detonation arrester is symmetrical and offers bi-directional flame arresting. The arrester essentially consists of two housing parts (1) and the PROTEGO® flame arrester unit (2) in the center. The PROTEGO® flame arrester unit consists of several FLAMEFILTER® discs (3) and spacers firmly held in a FLAMEFILTER® cage. The number of FLAMEFILTER® discs and their gap size depends on the arrester's intended use. By specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, the optimum detonation arrester can be selected. The PROTEGO® DA-E series of flame arresters are available for explosion groups IIA to IIB3 (NEC Group D to C MESG ≥ 0.65 mm).

The standard design can be used with an operating temperature of up to +60°C / 140°F and an absolute operating pressure acc. to table 3. Devices with special approval for higher pressures and higher temperatures are available upon request.

The standard design can be used with an operating temperature of up to +60°C / 140°F and an absolute operating pressure acc. to table 3. **Devices with special approval for higher pressures and higher temperatures are available upon request.**

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- eccentric design prevents condensate build-up
- modular design enables replacement of the individual FLAMEFILTER® discs
- easy maintenance with fast assembly and disassembly of the FLAMEFILTER®
- advanced design allows for installation close to ground level
- bi-directional operation, as well as any flow direction and installation position
- provides protection against deflagration and stable detonation
- installation of temperature sensors possible
- cost-effective spare parts

Design Types and Specifications

There are three different designs available:

Basic design of the detonation arrester	**DA-E- –**
In-line detonation flame arrester with integrated temperature sensor* as additional protection against short-time burning of one side	**DA-E- T**
Detonation arrester with two integrated temperature sensors* as additional protection against short-time burning from both sides	**DA-E- TB**

Additional special arresters upon request.

*Resistance thermometer (Ex i II 1/2 G Ex ia IIC T1…T6 Ga/Gb)

Stabilized FLAMEFILTER®
Discs (Flyer pdf)

Table 1: Dimensions Dimensions in mm / inches

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

Expl. Gr.		DN	25 1"	32 1 ¼"	40 1 ½"	50 2"	65 2 ½"	80 3"	100 4"	125 5"	150 6"	200 8"	250 10"	300 12"
	IIA	a	304/315* / 11.97/12.4*	304/315* / 11.97/12.4*	320/ 12.60	325/ 12.80	370/ 14.57	375/ 14.76	380/ 14.96	481/ 18.94	487/ 19.17	510/ 20.08	540/ 21.26	560/ 22.05
	IIB3	a	304/ 11.97	304/ 11.97	357/ 14.06	361/ 14.21	408/ 16.06	412/ 16.22	428/ 16.85	493/ 19.41	499/ 19.65	522/ 20.55	552/ 21.73	572/ 22.52
		b	29/ 1.14	29/ 1.14	29/ 1.14	29/ 1.14	38/ 1.50	38/ 1.50	39/ 1.53	65/ 2.56	65/ 2.56	55/ 2.17	58/ 2.28	60/ 2.36
		c	185/ 7.28	185/ 7.28	210/ 8.27	210/ 8.27	250/ 9.84	250/ 9.84	275/ 10.83	385/ 15.16	385/ 15.16	450/ 17.72	500/ 19.69	575/ 22.64
		d	400/ 15.75	400/ 15.75	410/ 16.14	410/ 16.14	440/ 17.32	440/ 17.32	460/ 18.11	520/ 20.47	520/ 20.47	540/ 21.26	570/ 22.44	600/ 23.62

* for IIA-P2.0

Table 2: Selection of the 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: Selection of max. operating pressure

Expl. Gr.		DN	25 1"	32 1 ¼"	40 1 ½"	50 2"	65 2 ½"	80 3"	100 4"	125 5"	150 6"	200 8"	250 10"	300 12"
	IIA	P_{max}	2.0 / 29.0	2.0 / 29.0	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4
	IIB3	P_{max}	1.1 / 15.9	1.1 / 15.9	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4

P_{max} = maximum allowable operating pressure in bar / psi (absolute); higher operating pressure upon request.

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	T maximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 5: Material selection for housing

Design	B	C	D	
Housing	Steel	Stainless Steel	Hastelloy	The housing is also available in carbon steel with an ECTFE coating.
Gasket	PTFE	PTFE	PTFE	
Flame arrester unit	A, C	C	D	

Special materials upon request.

Table 6: Material combinations of the flame arrester unit

Design	A	C	D	
FLAMEFILTER® cage	Steel	Stainless Steel	Hastelloy	*The FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy	
Spacer	Stainless Steel	Stainless Steel	Hastelloy	

Special materials upon request.

Table 7: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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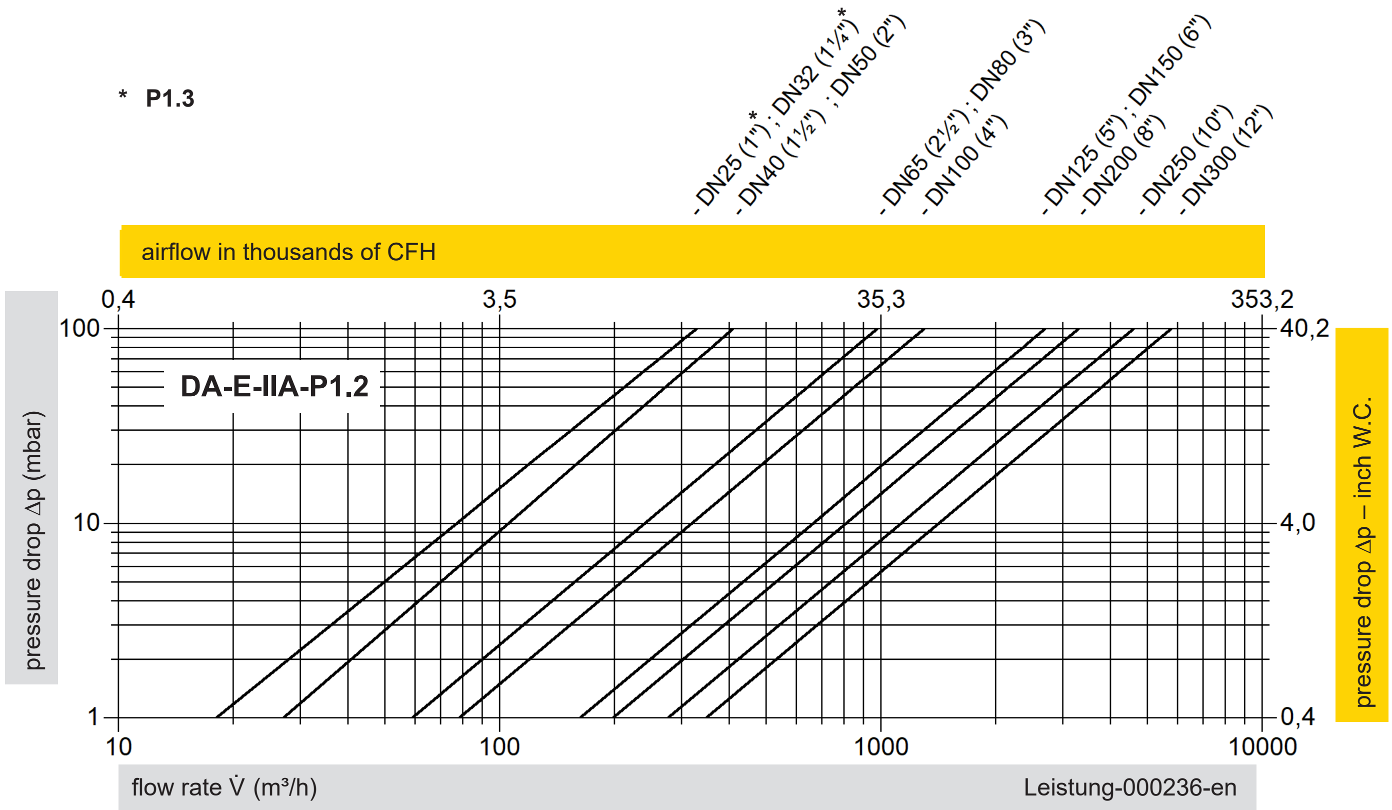
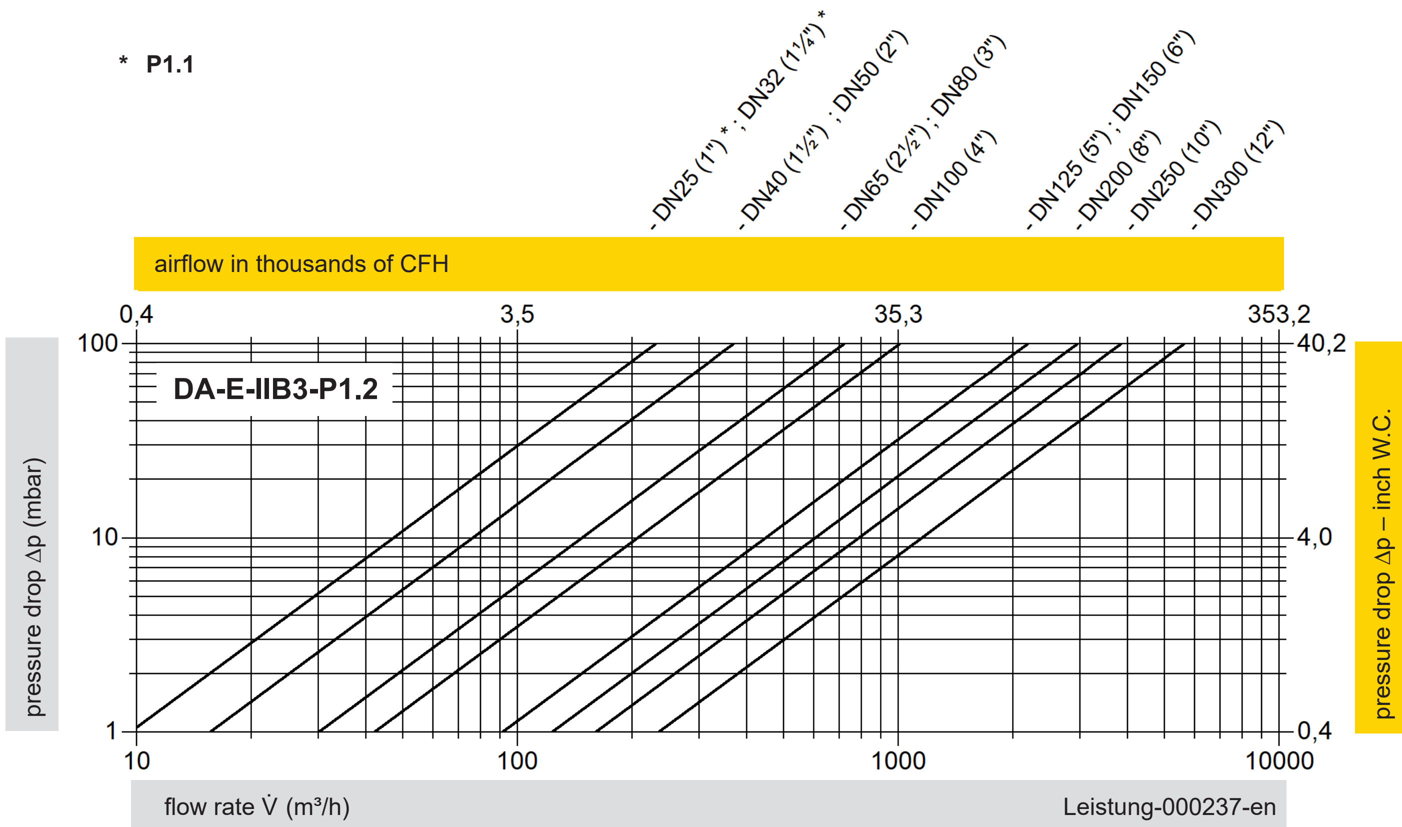
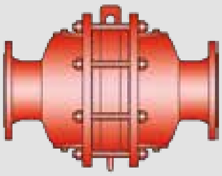




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

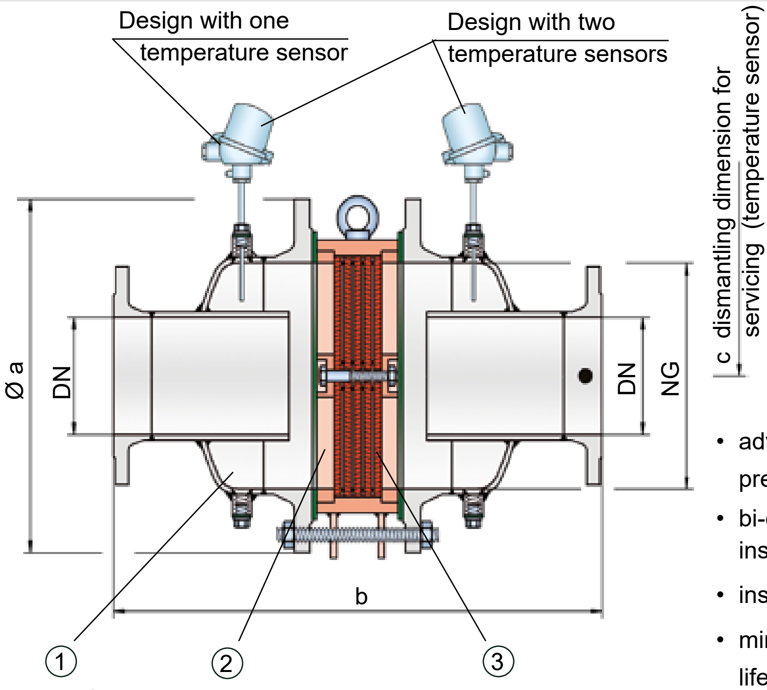
Notes:



In-Line Detonation Flame Arrester

for stable detonations and deflagrations in a straight through design with shock tube, bi-directional

PROTEGO® DA-SB



● Connection to the protected side (only for type DA-SB-T-...)

Function and Description

The in-line detonation flame arresters type PROTEGO® DA-SB are the newest generation of flame arresters. Based on flow and explosion dynamic calculations as well as decades of field tests, a product line was developed that offers minimum pressure losses with maximum safety. The flame arrester uses the Shock Wave Guide Tube Effect (SWGTE) to separate the flame front and shock wave. The result is an in-line detonation arrester without a classic shock absorber, which minimizes the use of FLAMEFILTER® discs.

The devices are symmetrical and offer bi-directional flame arresting for deflagrations and stable detonations. The arrester essentially consists of two housing parts with an integrated shock tube (1) and the PROTEGO® flame arrester unit (2) in the center. The PROTEGO® flame arrester unit is modular and consists of several FLAMEFILTER® discs (3) and spacers firmly held in a FLAMEFILTER® cage. The number of FLAMEFILTER® discs and their gap size depends on the arrester's intended use. By specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, the optimum detonation arrester can be selected from a series of approved devices. The PROTEGO® DA-SB flame arresters are available for all explosion groups.

The standard design can be used with an operating temperature of up to +60°C / 140°F and an absolute operating pressure up to bar / 15.9 psi. Numerous devices with special approval for higher pressures (see table 3) and higher temperatures are available upon request. EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- *optimized performance due to the patented Shock Wave Guide Tube Effect (SWGTE)*
- low number of FLAMEFILTER® discs due to the patented Shock Wave Guide Tube Effect (SWGTE)
- modular design enables replacement of the individual FLAMEFILTER® discs
- different designs allow scalable pressure loss over the area of the FLAMEFILTER®
- maintenance-friendly design
- advanced design for higher operating temperatures and pressures
- bi-directional operation, as well as any flow direction and installation position
- installation of temperature sensors possible
- minimal pressure loss resulting in low operating and lifecycle costs
- Cost-effective spare parts
- installation of stabilized FLAMEFILTER® possible
- use of maintenance-friendly PROTEGO® flame arrester unit possible

Design Types and Specifications

There are four different designs available:

Basic in-line detonation flame arrester	**DA-SB - – - –**
In-line detonation flame arrester with integrated temperature sensor* as additional protection against short-time burning from one side	**DA-SB - T - –**
In-line detonation flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides	**DA-SB-TB - –**
In-line detonation flame arrester with heating jacket	**DA-SB - H -**

Additional special flame arresters upon request.

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Table 1: Dimensions — Dimensions in mm / inches

To select nominal width/nominal size (NG/DN) combination, please use the flow capacity charts on the following pages.

Additional nominal width/nominal size (NG/DN) combinations for improved flow capacity upon request.

standard (special sizes up to NG 2000/80“, DN 1000/40“ available)

NG		150 6"	150 6"	200 8"	300 12"	400 16"	500 20"	600 24"	700 28"	800 32"	1000 40"	1200 48"	1600 64"
DN		≤ 50 2“	65, 80 2 ½“, 3“	≤ 100 4“	≤ 150 6“	≤ 200 8“	≤ 250 10“	≤ 300 12“	≤ 350 14“	≤ 400 16“	≤ 500 20“	≤ 600 24“	800 32“
a		285 / 11.22	285 / 11.22	340 / 13.39	445 / 17.52	565 / 22.24	670 / 26.38	780 / 30.71	895 / 35.24	1015 / 39.96	1230 / 48.43	1455 / 57.28	1915 / 75.39
b	IIA-P1,1	388 / 15.28	388 / 15.28	476 / 18.74	626 / 24.65	700 / 27.56	800 / 31.50*	1000 / 39.37*	1200 / 47.24	1400 / 55.12	1600 / 62.99	1800 / 70.87	2200/ 86.61**
b	IIA-P1,4-X3	400 / 15.75	400 / 15.75	488 / 19.21	626 / 24.65	724 / 28.50	800 / 31.50	1000 / 39.37	1200 / 47.24	1400 / 55.12			
b	IIB3-P1,1	400 / 15.75	412 / 16.22	500 / 19.69	650 / 25.59	724 / 28.50	824 / 32.44	1000 / 39.37	1200 / 47.24	1400 / 55.12	1600 / 62.99	1800 / 70.87	
b	IIB3-P1,4-X3	412 / 16.22	412 / 16.22	512 / 20.16	650 / 25.59	724 / 28.50	824 / 32.44	1000 / 39.37	1200 / 47.24	1400 / 55.12			
b	IIC-P1,1	400 / 15.75	400 / 15.75	500 / 19.69	638 / 25.12	700 / 27.56	788 / 31.02	1000 / 39.37***	1200 / 47.24***	1400 / 55.12***			
c		500 / 19.69	500 / 19.69	520 / 20.47	570 / 22.44	620 / 24.41	670 / 26.38	720 / 28.35	770 / 30.31	820 / 32.28	950 / 37.40	1050 / 41.34	1250 / 49.21

* dimension b only for P1.4 / 20.3

** dimension b only for P1.2 / 17.4

*** EN 12874

Table 2: Selection of the explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request.
≥ 0,65 mm	IIB3	C	
< 0,50 mm	IIC	B	

Table 3: Selection of max. operating pressure

		NG	150 6“	150 6“	200 8“	300 12“	400 16“	500 20“	600 24“	700 28“	800 32“	1000 40“	1200 48“	1600 64“
		DN	≤ 50 2“	65, 80 2 ½“, 3“	≤ 100 4“	≤ 150 6“	≤ 200 8“	≤ 250 10“	≤ 300 12“	≤ 350 14“	≤ 400 6“	≤ 500 20“	≤ 600 24“	800 32“
Expl. Gr.	IIA	P_{max}	2.1 / 30.5	2.1 / 30.5	2.1 / 30.5	2.1 / 30.5	2.1 / 30.5	2.1 / 30.5	1.4 / 20.3	1.4 / 20.3	1.4 / 20.3	1.1 / 15.9	1.1 / 15.9	1.2 / 17.4
Expl. Gr.	IIB3	P_{max}	1.4 / 20.3	1.4 / 20.3	1.4 / 20.3	1.8 / 26.1	1.8 / 26.1	1.8 / 26.1	1.8 / 26.1	1.4 / 20.3	1.4 / 20.3	1.1 / 15.9	1.1 / 15.9	
Expl. Gr.	IIC	P_{max}	2.2 / 31.9	2.2 / 31.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / * 15.9	1.1 / * 15.9	1.1 / * 15.9			

P_{max} = maximum allowable operating pressure in bar / psi absolut; higher operating pressure upon request.

In-between size up to P_{max} upon request.

* Capacity charts upon request.

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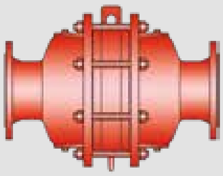


In-Line Detonation Flame Arrester

for stable detonations and deflagrations in a straight through design with shock tube, bi-directional

PROTEGO® DA-SB

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	≤ 200°C / 392°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	X3	Classification	

Table 5: Material selection for housing

Design	A	B	C	
Housing Heating jacket (DA-SB-(T)-H-...)	Steel Steel	Stainless Steel Stainless Steel	Hastelloy Stainless Steel	The housing is also available in Steel with ECTFE coating.
Gasket	PTFE	PTFE	PTFE	
Flame arrester unit	A, B	B, C, D	D	

Special materials upon request.

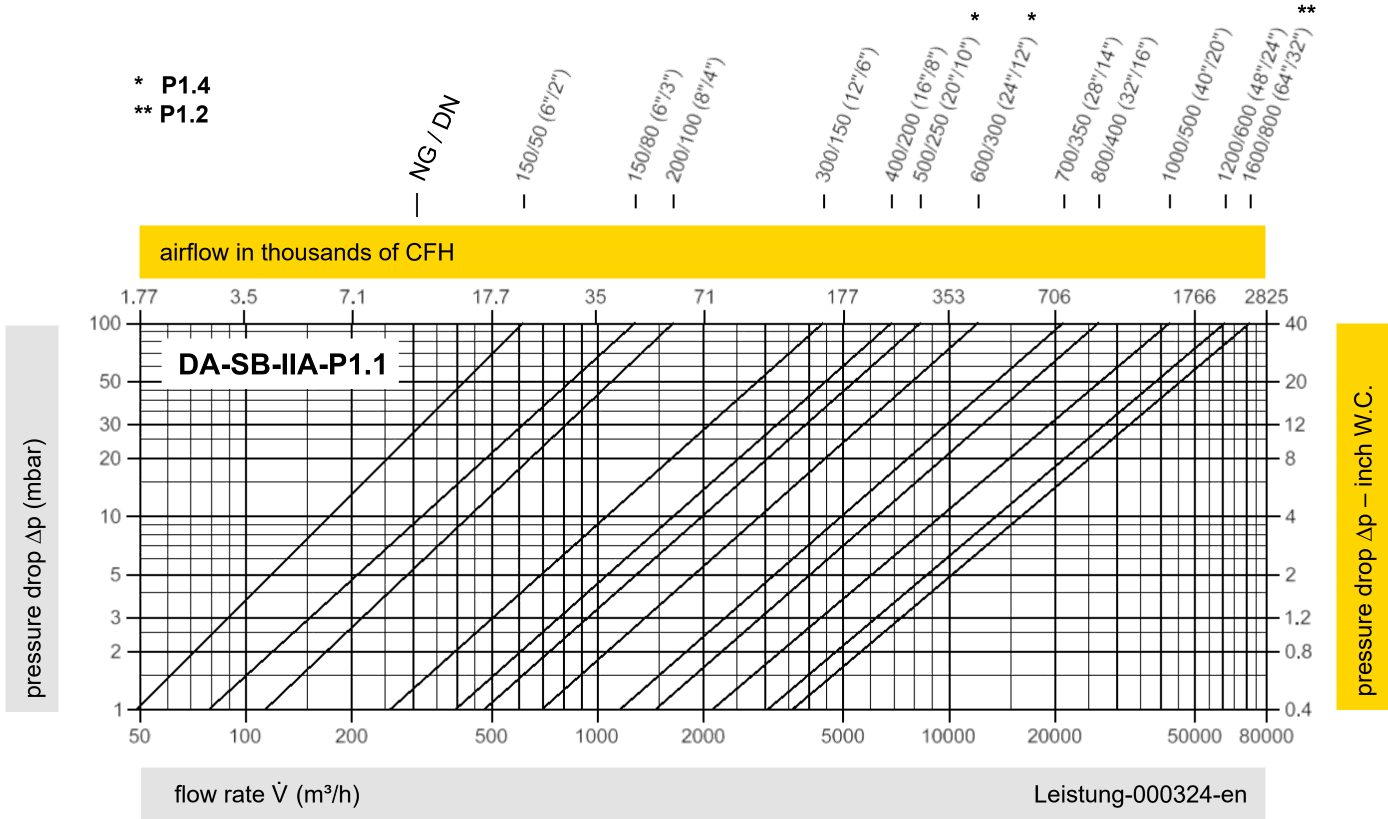
Table 6: Material combinations of the flame arrester unit

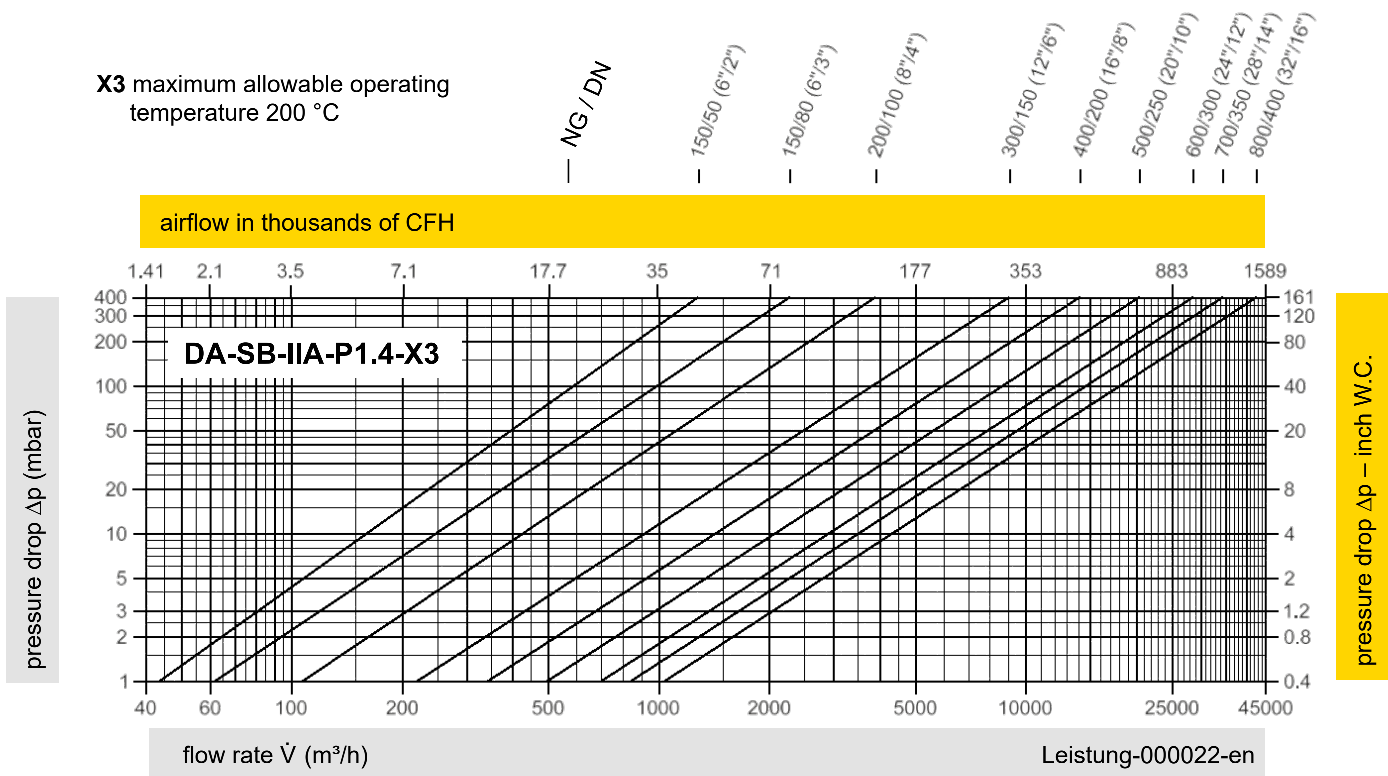
Design	A	B	C	D	
FLAMEFILTER® cage	Steel	Stainless Steel	Stainless Steel	Hastelloy	*The FLAMEFILTER® are also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy	
Spacer	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy	

Special materials upon request.

Table 7: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	





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

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

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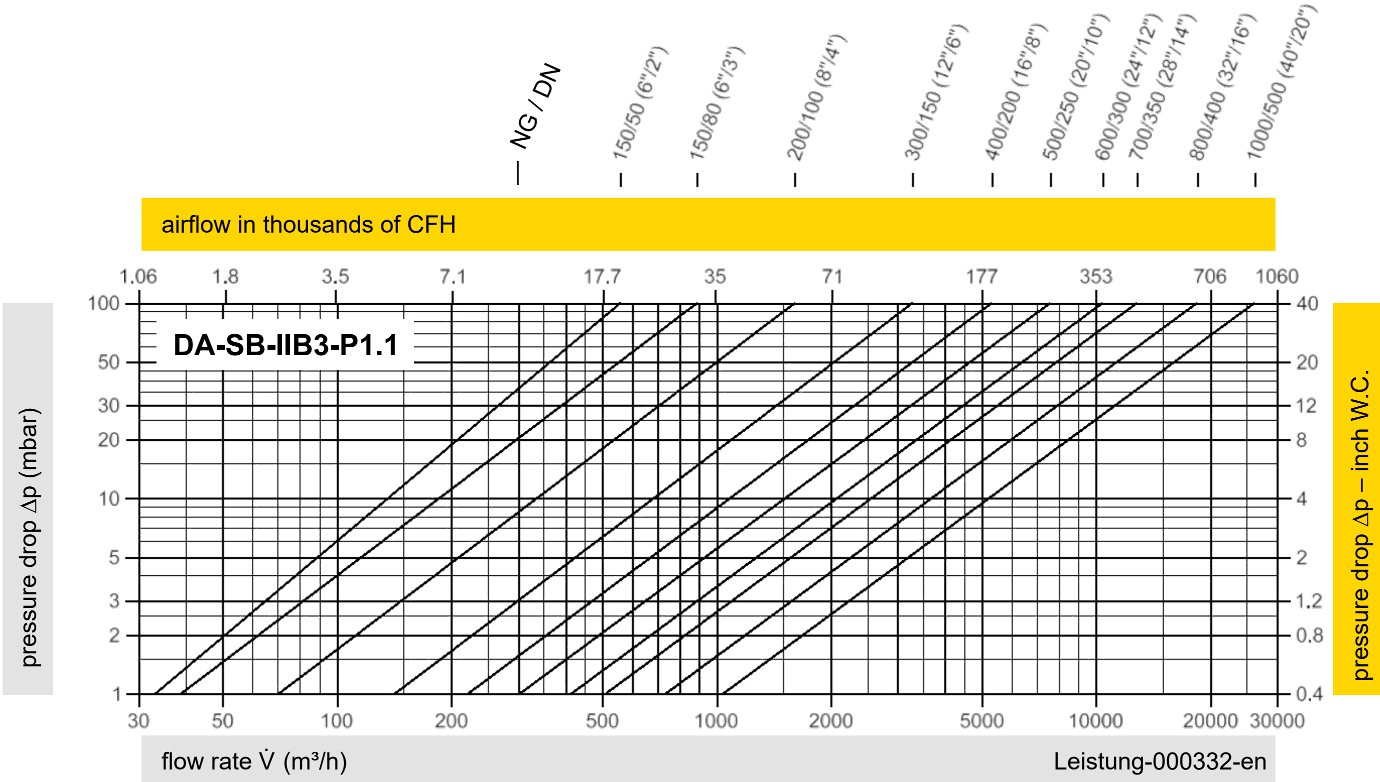
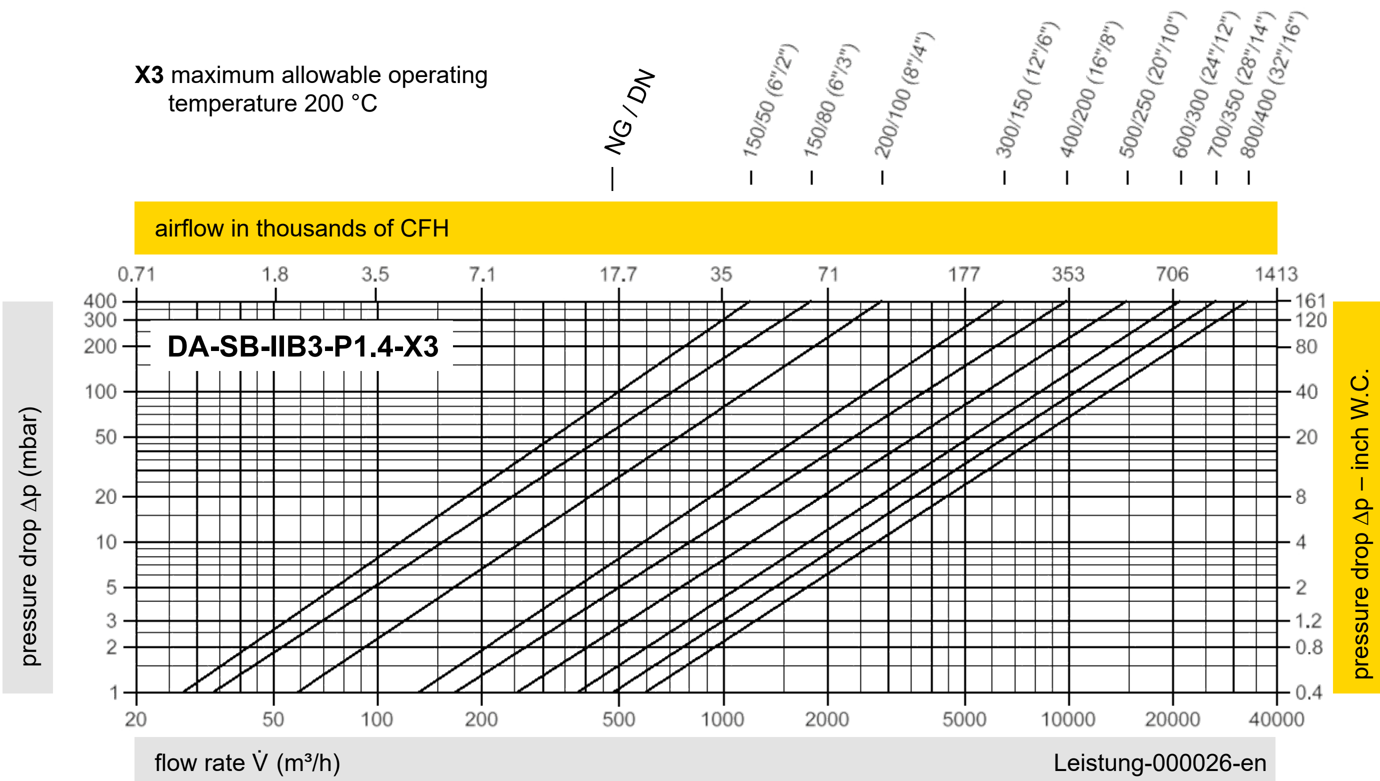
PROTEGO® DA-SB

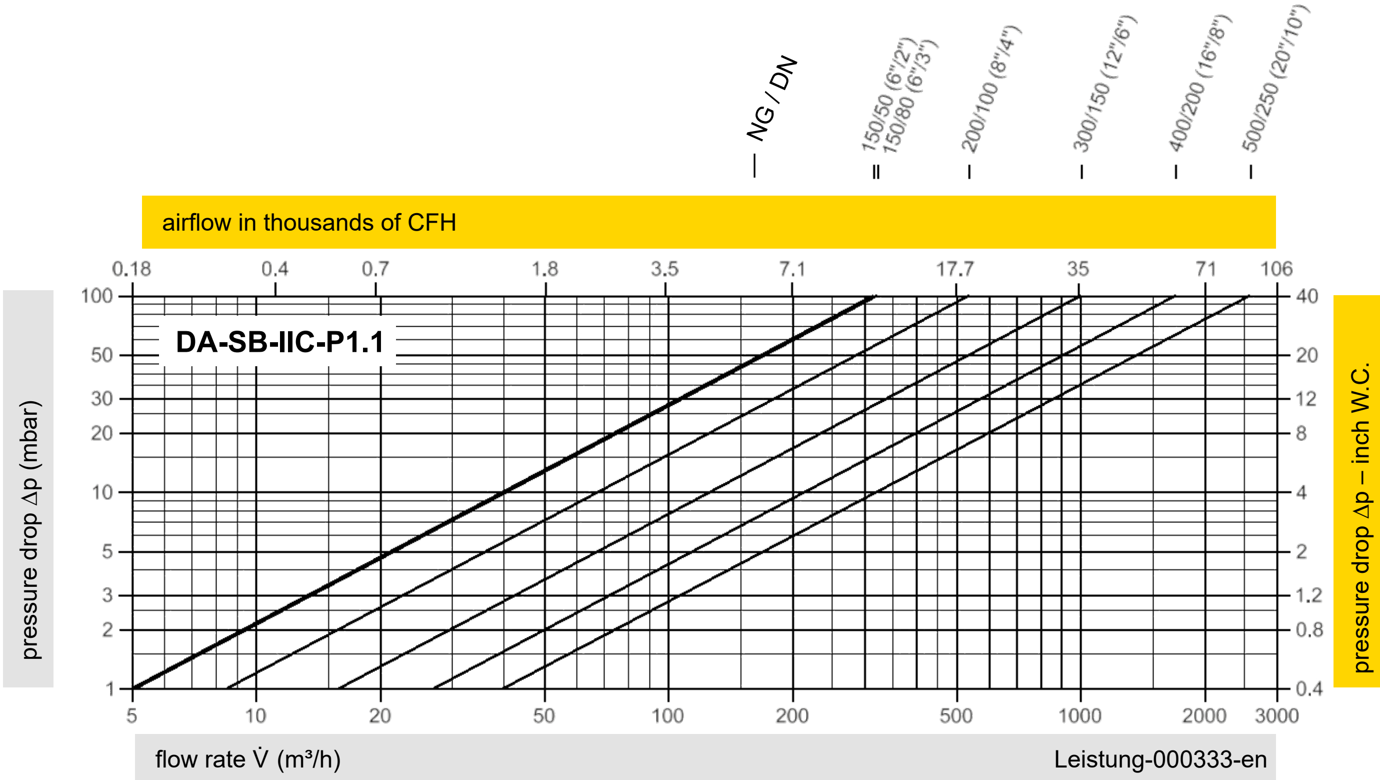


X3 maximum allowable operating temperature 200 °C

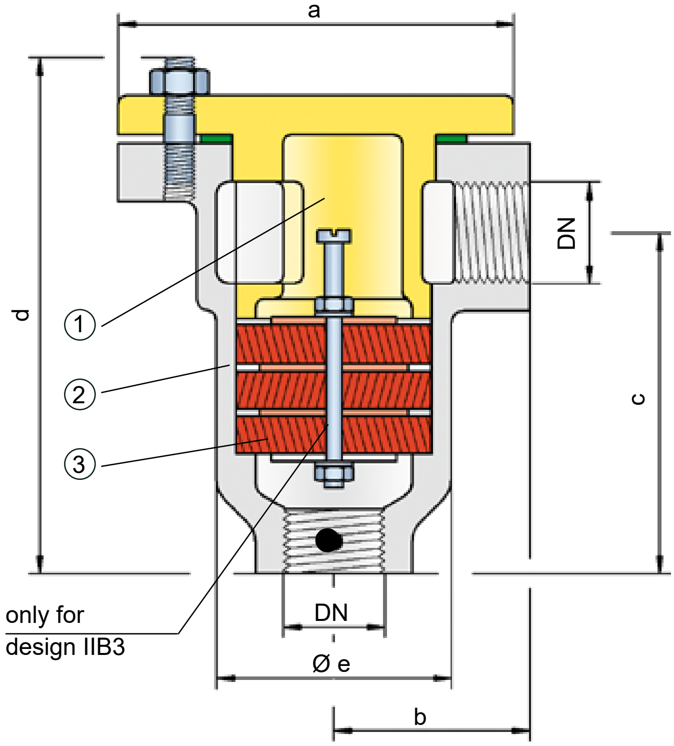


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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



NG / DN
150/50 (6"/2")
150/80 (6"/3")
200/100 (8"/4")
300/150 (12"/6")
400/200 (16"/8")
500/250 (20"/10")
airflow in thousands of CFH
0.18
0.4
0.7
1.8
3.5
7.1
17.7
35
71
106
DA-SB-IIC-P1.1
pressure drop Δp (mbar)
100
50
30
20
10
5
3
2
1
pressure drop Δp – inch W.C.
40
20
12
8
4
2
1.2
0.8
0.4
5
10
20
50
100
200
500
1000
2000
3000
flow rate V̇ (m³/h)
Leistung-000333-en



● Connection to the protected side

Function and Description

The PROTEGO® DR/ES series in-line detonation flame arrester with connection size up to ¾" is ideal for installation in small pipes to protect equipment such as gas analysis devices. The de- vice protects against deflagrations and stable detonations. It can be installed anywhere in the pipe no matter what the distance is from the potential ignition source. The small and compact flame arrester has a right-angle design.

Once a detonation enters the flame arrester, energy is absorbed from the detonation shock by diversion of by the shock absorber (1) before the flame is extinguished in the narrow gaps of the FLAMEFILTER® (3).

The PROTEGO® flame arrester unit (2) consists of several FLAMEFILTER® discs and spacers (for explosion group IIC) whose gap size and number is determined by the operating conditions.

By specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, the optimal arrester for your application can be determined. This device can be used for all explosion groups from IIB3 to IIC (NEC group C MESG ≥ 0.65 mm and B).

This in-line detonation flame arrester is unidirectional and equipped with a threaded connection. The thread can be adapted to international standards. The standard design is approved at an operating temperature of up to +60°C / 140°F and an absolute operating pressure acc. to table 3. **Devices with special approvals for higher pressures and higher temperatures are available upon request.**

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- compact design
- low number of FLAMEFILTER® discs due to shock absorber technology or optimized geometry

Design for IIB3:
- maintenance is possible without disconnecting the pipe
- quick removal and installation of the individual FLAMEFILTER®

- provides protection against deflagration and stable detonation
- right-angle design eliminates need for pipe elbows
- useable for nearly all flammable gas and gas mixtures
- low lifecycle costs
- cost-effective spare parts

Table 1: Dimensions — Dimensions in mm / inches

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

DN	G ¼	G ½	G¾
a	48 / 1.89	70 / 2.76	80 / 3.15
b	35 / 1.38	40 / 1.57	47 / 1.85
c	70 / 2.76	75 / 2.95	87 / 3.43
d	108 / 4.25	115 / 4.53	135 / 5.31
e	34 / 1.34	50 / 1.97	60 / 2.36

Table 2: Selection of the explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,65 mm	IIB3	C	Special approvals upon request.
< 0,50 mm	IIC	B	

Table 3: Selection of max. operating pressure

Expl. Gr.	DN	G¼	G ½	G ¾
IIB3	P_{max}	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4
IIC	P_{max}	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9

P_{max} = maximum allowable operating pressure in bar / psi (absolute); higher operating pressure upon request.
Expl. Gr. IIB3 covers Expl. Gr. IIA.

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 5: Material selection for housing

Design	B	C	D
Housing	Steel	Stainless Steel	Hastelloy
Cover with shock absorber*	Steel	Stainless Steel	Hastelloy
Gasket	PTFE	PTFE	PTFE
Flame arrester unit	A	A	B

G ¼ only comes in design C and D.

* G ¼ without shock absorber.

Special materials upon request.

Table 6: Material combinations of the flame arrester unit

Design	A	B
FLAMEFILTER® *	Stainless Steel	Hastelloy
Spacer	Stainless Steel	Hastelloy

* The FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.

Special materials upon request.

Table 7: Type of connection

Pipe thread DIN ISO 228-1	DIN	Other types of thread upon request.

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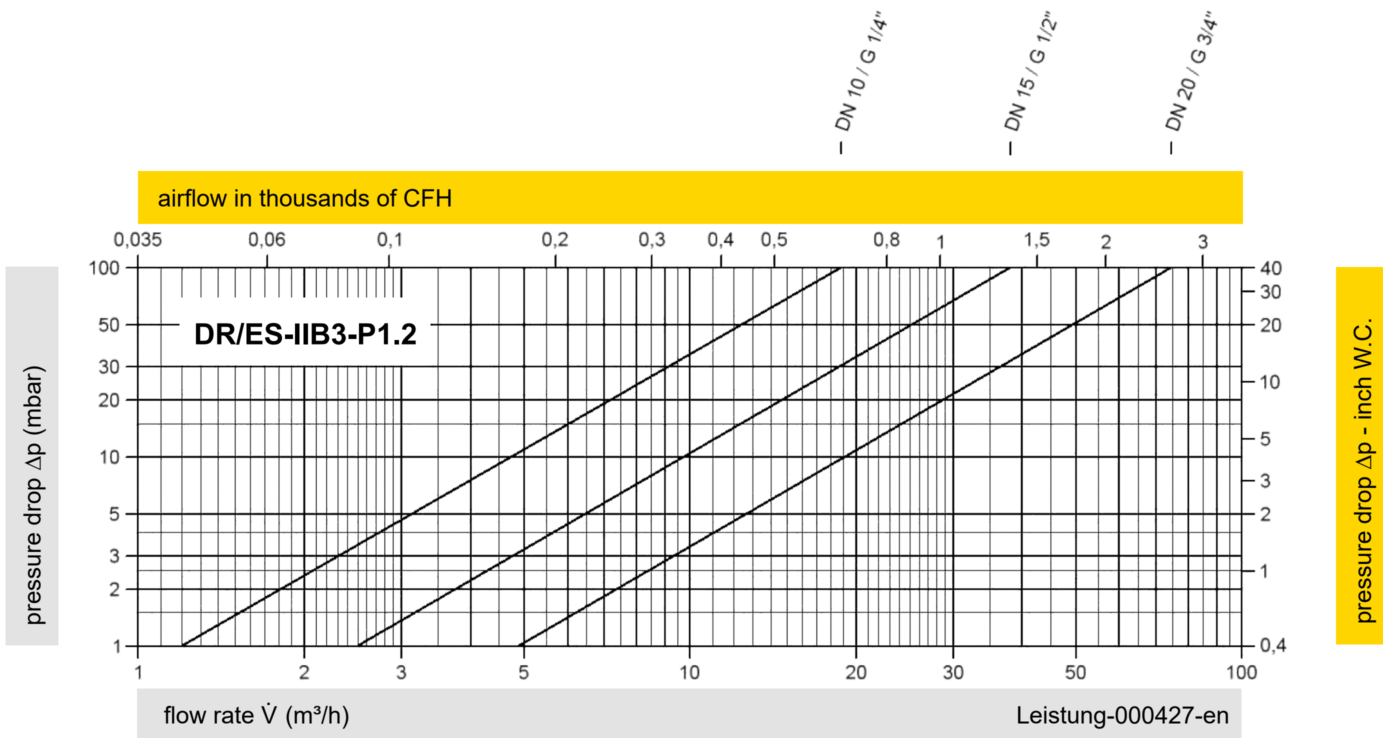
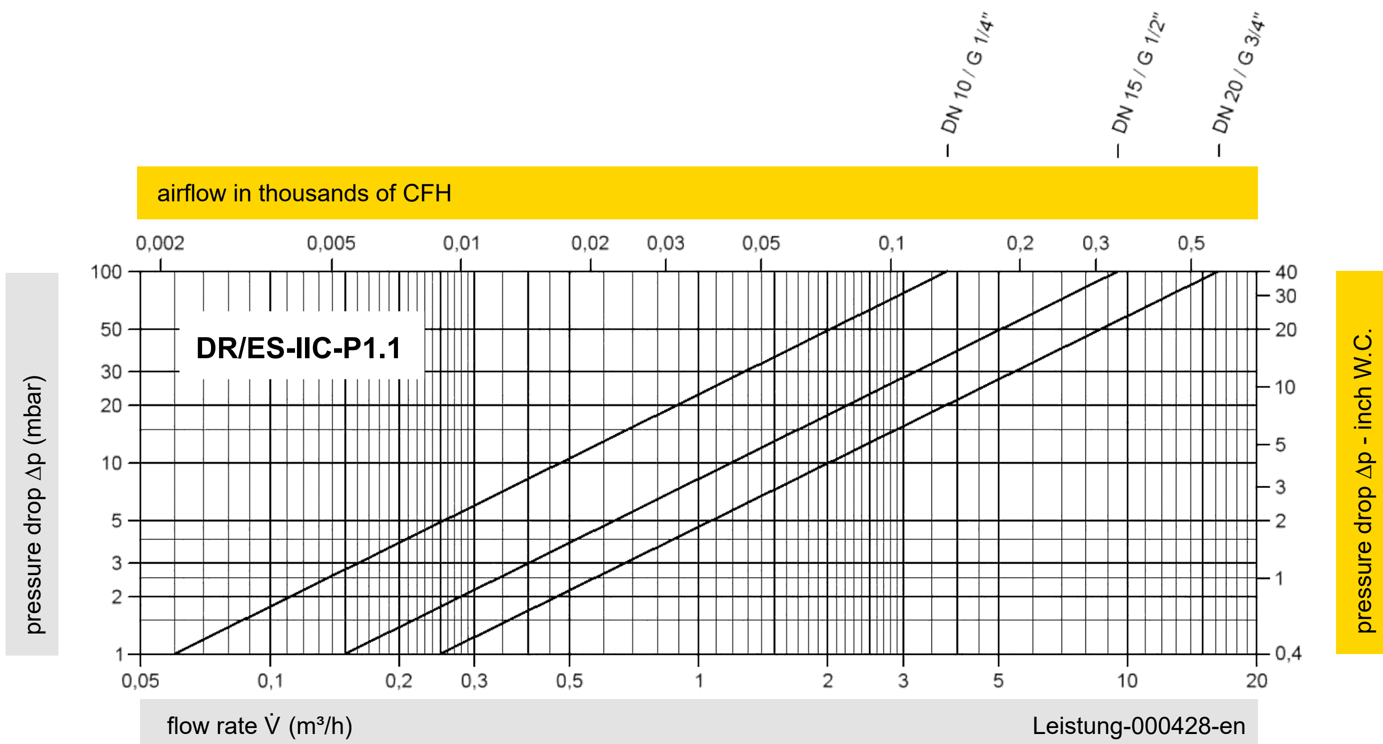
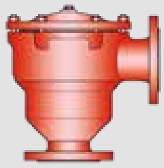




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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

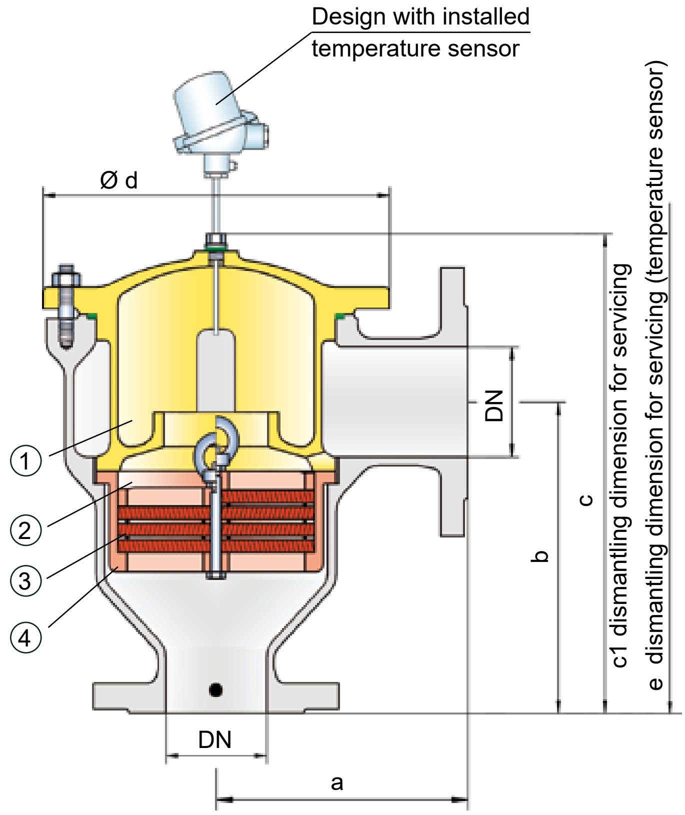
Notes:



In-Line Detonation Flame Arrester

for stable detonations and deflagrations in right-angle design with shock absorber, uni-directional

PROTEGO® DR/ES



● Connection to the protected side

The standard design is approved at an operating temperature of up to +60°C / 140°F and an absolute operating pressure up to 1.2bar/17.4psi. **Devices with special approvals for higher pressures and higher temperatures are available upon request.**

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- low number of FLAMEFILTER® discs due to shock absorber technology
- quick removal and installation of the complete PROTEGO® flame arrester unit and the individual FLAMEFILTER® in the cage
- modular design enables replacement of the individual FLAMEFILTER® discs
- right-angle design eliminates need for pipe elbows
- advanced design for higher operating temperatures and pressures
- low pressure loss results in low operating and lifecycle costs
- cost-effective spare parts

Function and Description

The PROTEGO® DR/ES in-line detonation flame arrester has been used for decades in industrial plant construction as its right-angle design offers maintenance and costs advantages in comparison with most straight designs.

Once a detonation enters the device, energy is absorbed from the detonation shock wave by the integrated shock absorber (1) before the flame is extinguished in the narrow gaps of the FLAMEFILTER® (3).

The PROTEGO® flame arrester unit (2) consists of several FLAMEFILTER® discs and spacers firmly held in the FLAME-FILTER® cage (4). The gap size and number of FLAMEFILTER® discs are determined by the operating conditions of the flowing mixture (explosion group, pressure, temperature). This device is approved for explosion groups from IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

Design Types and Specifications

There are four different designs available:

Basic in-line detonation flame arrester	**DR/ES-** – - –
In-line detonation flame arrester with integrated temperature sensor* as additional protection against short-time burning	**DR/ES-** T - –
In-line detonation flame arrester with heating jacket	**DR/ES-** H - –
In-line detonation flame arrester with integrated temperature sensor* against short-time burning and heating jacket	**DR/ES-** H - T

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Stabilized FLAMEFILTER®
Discs (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	65 / 2 ½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8“
a	125/4.92	125/4.92	153/6.02	155/6.10	198/7.80	200/7.87	250/9.84	332/13.07	335/13.19	425/16.73
b	140/5.51	140/5.51	183/7.20	185/7.28	223/8.78	225/8.86	290/11.42	357/14.06	360/14.07	505/19.88
c	210/8.27	210/8.27	290/11.42	290/11.42	365/14.37	365/14.37	415/16.34	535/21.06	535/21.06	810/31.89
c1	285/11.22	285/11.22	395/15.55	395/15.55	500/19.69	500/19.69	595/23.43	750/29.53	750/29.53	1230/48.43
d	150/5.91	150/5.91	210/8.27	210/8.27	275/10.83	275/10.83	325/12.80	460/18.11	460/18.11	620/24.41
e	495/19.49	495/19.49	600/23.62	600/23.62	705/27.76	705/27.76	795/31.30	950/37.40	950/37.40	1435/56.50

Table 2: Selection of the 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: Selection of max. operating pressure

		DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	65 / 2 ½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8“
Expl. Gr.	IIA	P_{max}	4.0/58.0	4.0/58.0	4.0/58.0	4.0/58.0	2.9/42.1	2.9/42.1	2.0/29.0	2.0/29.0	2.0/29.0	1.2/17.4
	IIB3	P_{max}	3.0/43.5	3.0/43.5	2.0/29.0	2.0/29.0	2.0/29.0	2.0/29.0	1.5/21.7	1.4/20.3	1.4/20.3	1.1/15.9

P_{max} = maximum allowable operating pressure in bar / psi (absolute); higher operating pressure upon request.

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 5: Material selection for housing

Design	B	C	D
Housing Heating jacket (DR/ES-H-(T)-...)	Steel Steel	Stainless Steel Stainless Steel	Hastelloy Stainless Steel
Cover with shock absorber	Steel	Stainless Steel	Hastelloy
O-Ring	FPM*	PTFE	PTFE
Flame arrester unit	A	C, D	E

* For devices exposed to elevated temperatures above 150°C / 302°F, gaskets are made of PTFE. The housing and cover with the shock absorber can also be delivered in steel with an ECTFE coating.

Special materials upon request.

Table 6: Material combinations of the flame arrester unit

Design	A	C	D	E
FLAMEFILTER® cage	Steel	Stainless Steel	Stainless Steel	Hastelloy
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy
Spacer	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy

* The FLAMEFILTER® are also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.

Special materials upon request.

Table 7: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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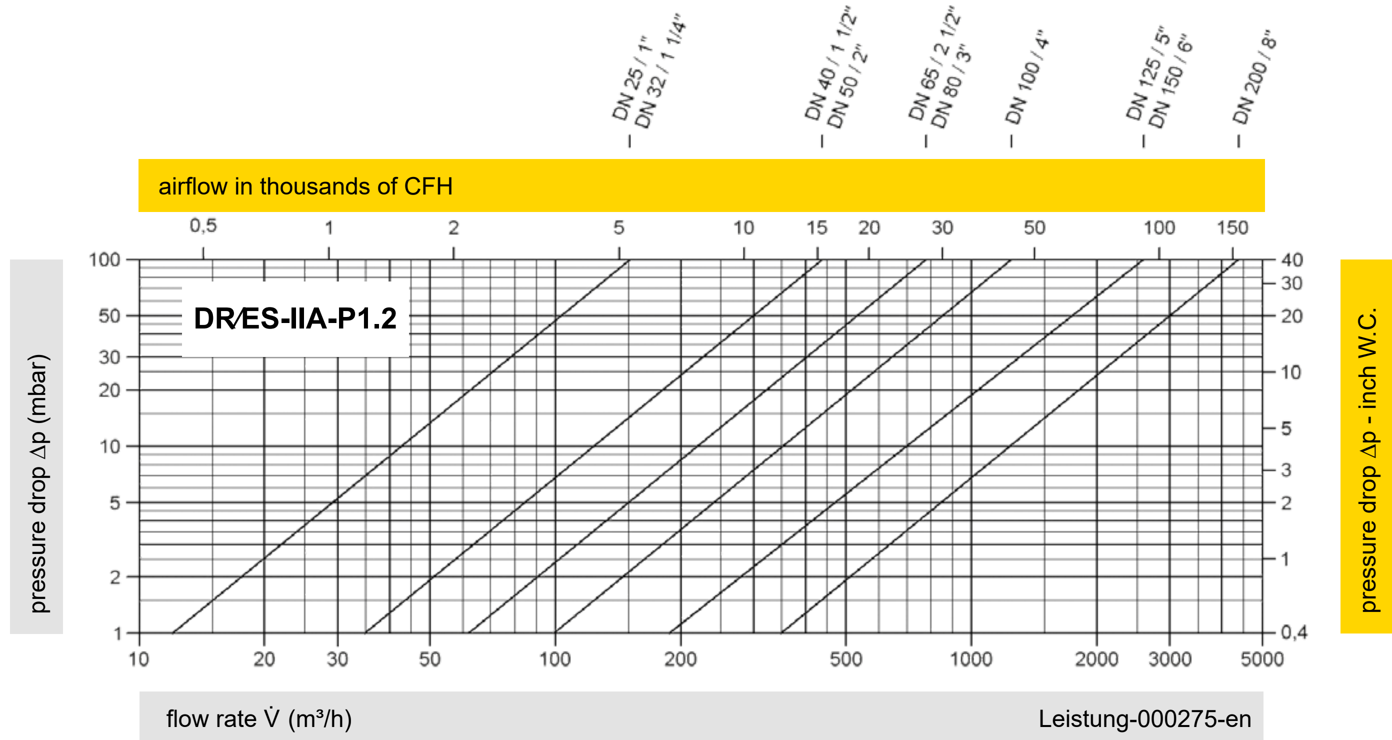
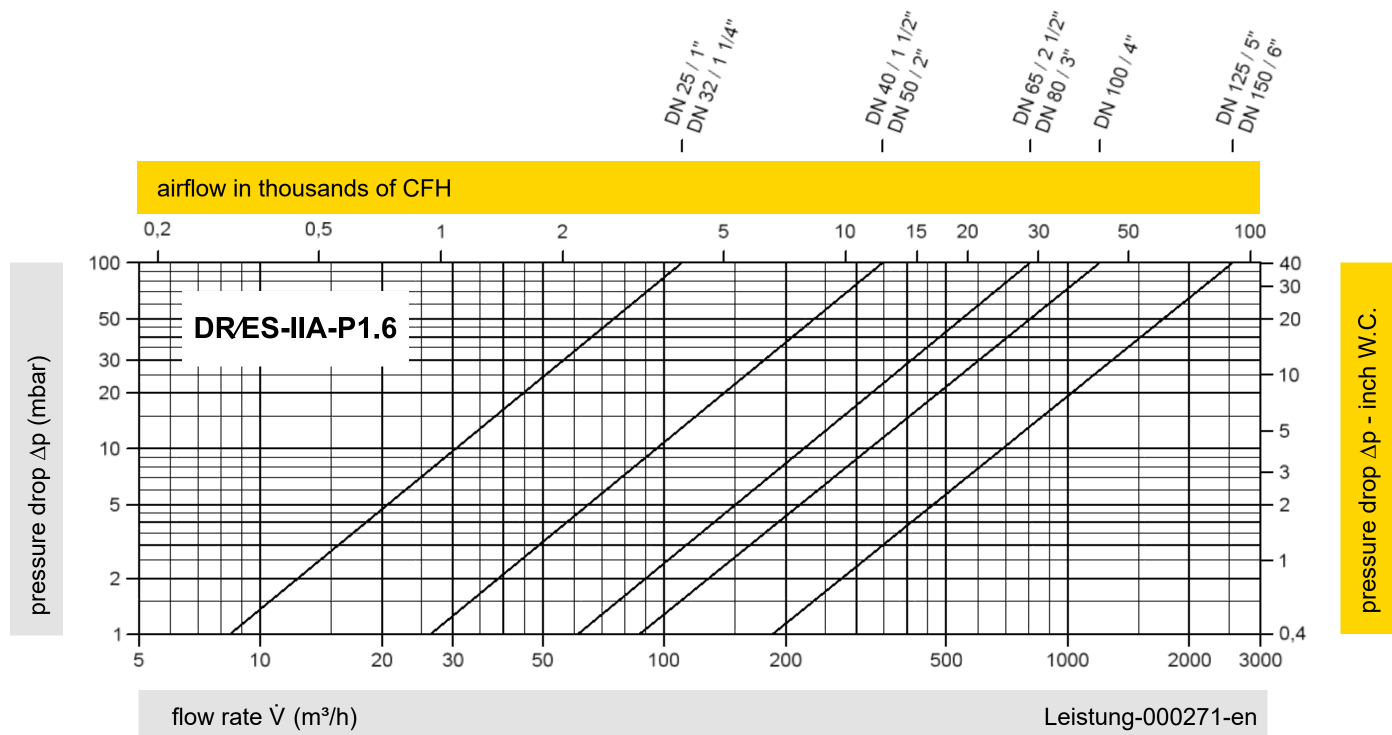
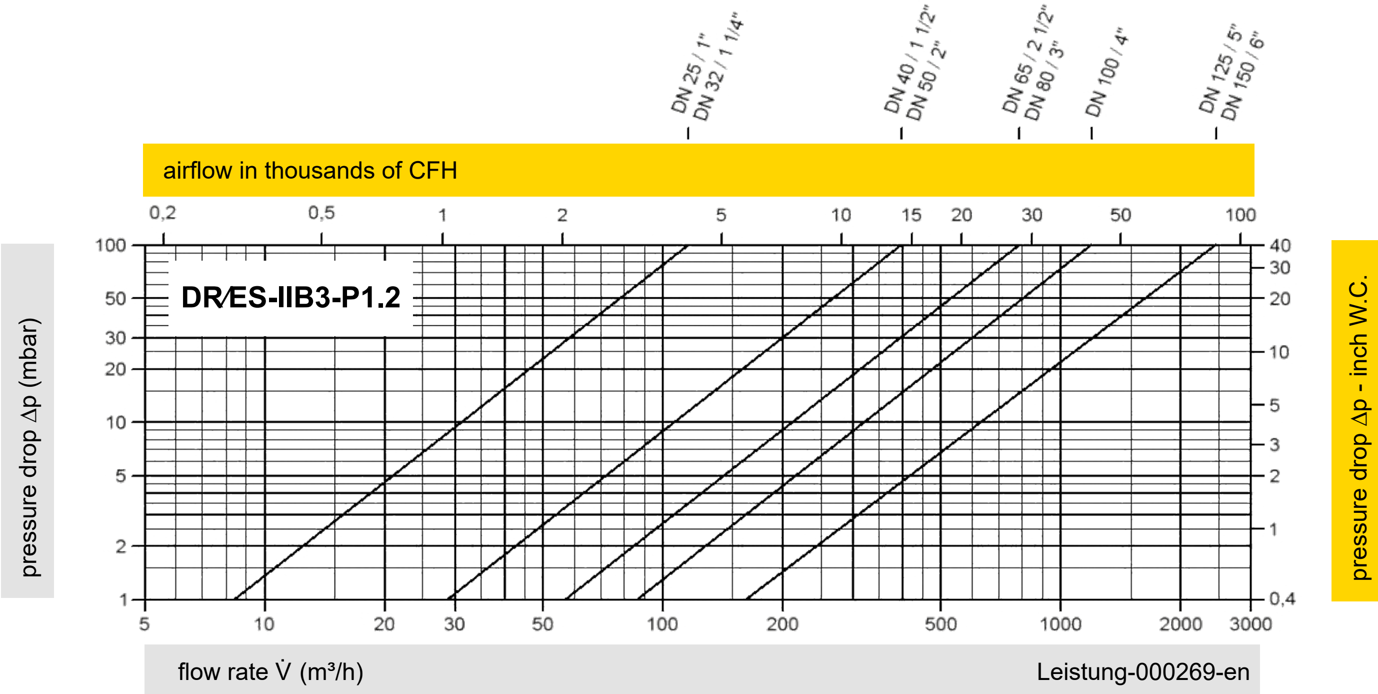
for safety and environment



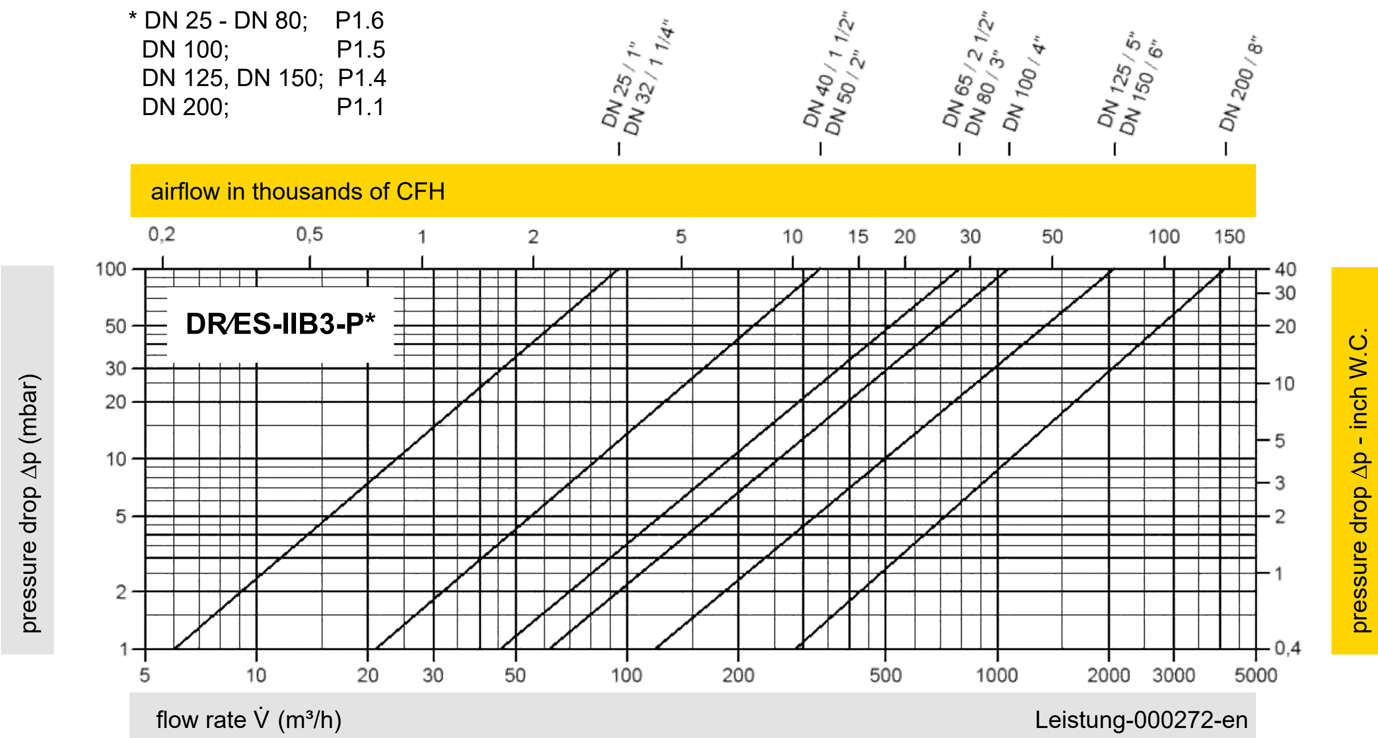


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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



* DN 25 - DN 80; P1.6
DN 100; P1.5
DN 125, DN 150; P1.4
DN 200; P1.1



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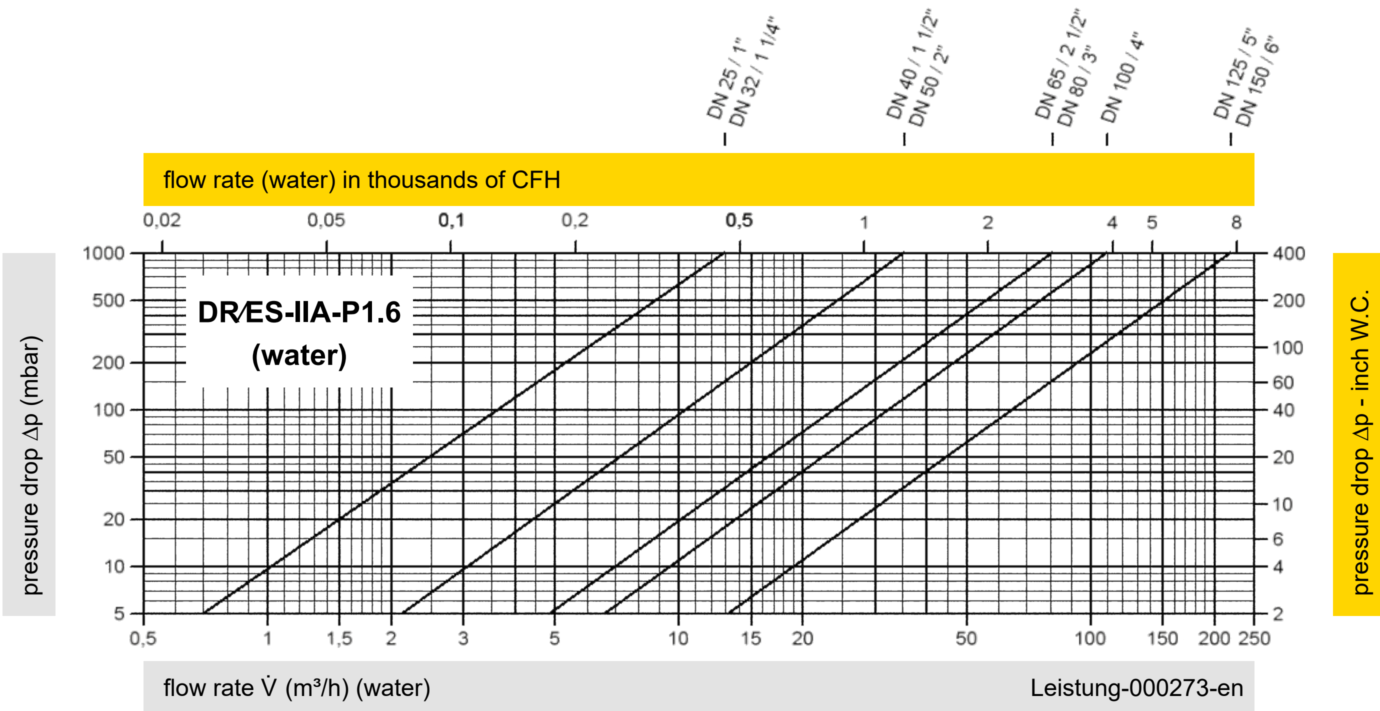
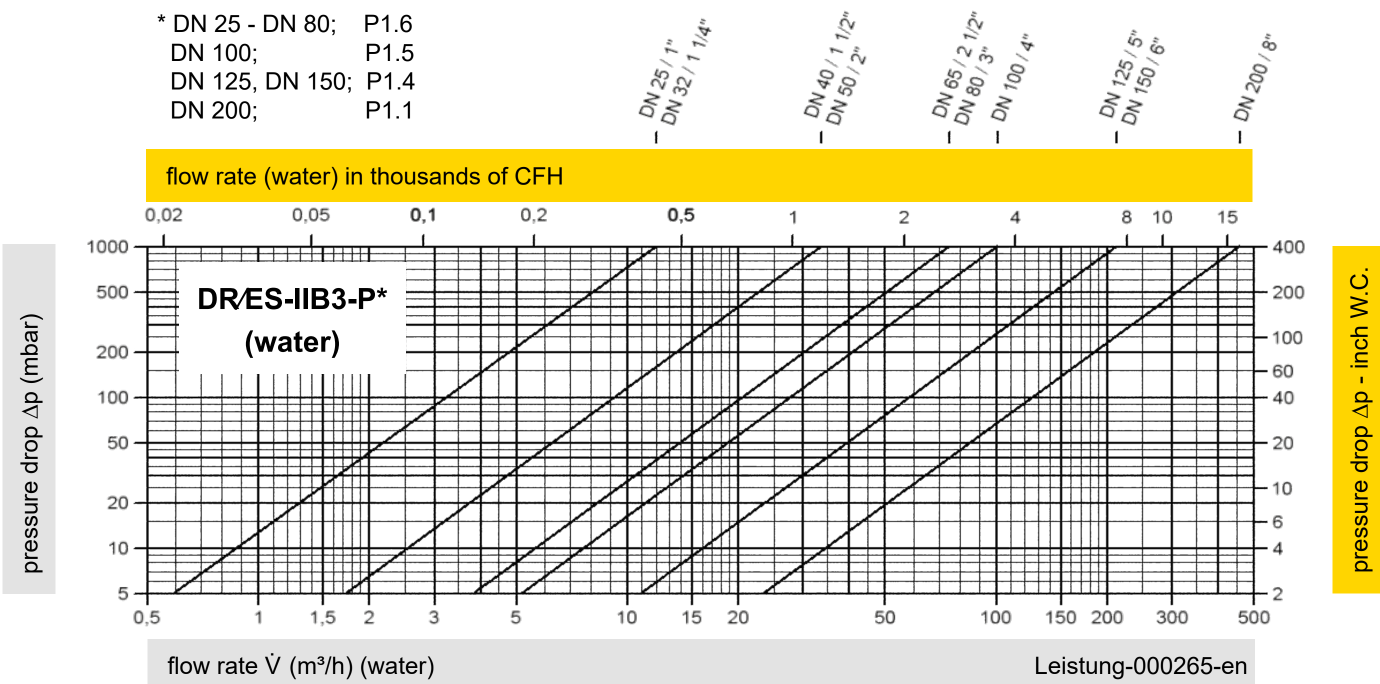
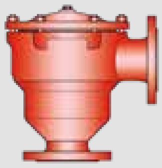




Conversion: $\dot{V}_{water} = \dot{V}_{liquid} * \sqrt{\dfrac{\rho_{liquid}}{\rho_{water}}}$ $\qquad \dot{V}_{liquid} = \dot{V}_{water} * \sqrt{\dfrac{\rho_{water}}{\rho_{liquid}}}$

The volume flow $\dot{V}$ in m³/h was determined with water, in accordance with DIN EN 60534, at a temperature T_n = 20°C, and an atmospheric pressure p_n = 1,013 bar, kinematic viscosity $v = 10^{-6}$ m²/s

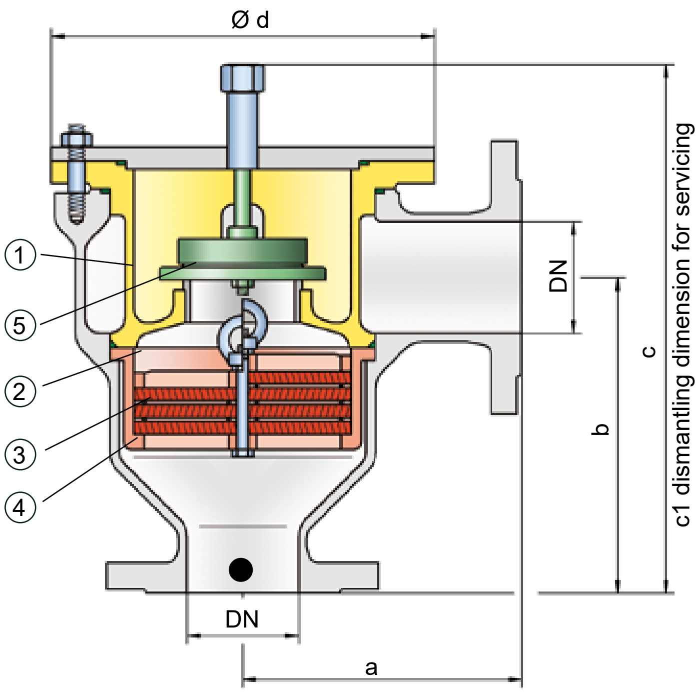
Notes:



In-Line Detonation Flame Arrester

with integrated pressure relief valve for stable detonations and deflagrations in right-angle design with shock absorber, uni-directional

PROTEGO® DR/ES-V



● Connection to the protected side

Set pressure: from +2.0 mbar up to +35 mbar
from +0.8 inch W.C. up to +14 inch W.C.

Higher or lower settings upon request.

Function and Description

PROTEGO® DR/ES-V series uniquely combines the function of an in-line detonation flame arrester with the function of a pressure relief valve in one device. The device protects against deflagration and stable detonation. The weight-loaded pallet type valve (5) integrated in the shock absorber (1) of the in-line detonation flame arrester is designed as a pressure relief valve. The set pressure of the valve is adjusted in the factory and can range from 2 to 35 mbar (0.8 to 14 inch W.C.). After the pressure increases 40% from its set pressure, the valve completely opens to yield the maximum volumetric flow. If installed in vent headers connected to storage tanks, the valve pallet works as a check valve. This means that the product cannot flow back from the suction line into the tank. Although several functions are integrated in a single housing, the device is extremely easy to service, which is primarily due to the right-angle design.

Once a detonation enters the flame arrester, energy is absorbed from the detonation shock wave by the integrated shock absorber, before the flame is extinguished in the narrow gaps of the FLAMEFILTER® (3). The flame suppression is guaranteed, regardless of the valve pallet position.

The PROTEGO® flame arrester unit (2) consists of several FLAMEFILTER® discs and spacers firmly held in the FLAMEFILTER® cage (4). The gap size and number of FLAMEFILTER® discs depend on the operating conditions of the flowing mixture (explosion group, pressure, temperature). This device is available for explosion groups from IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

The standard design is approved for an operating temperature of up to +60°C / 140°F and absolute operating pressure up to 1.2 bar / 17.4 psi. **Devices with special approval for higher pressures and temperatures are available upon request.** EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- integration of in-line detonation flame arrester and pressure relief valve in one device
- excellent tightness of the valve
- can be used as a detonation-proof valve in suction lines of storage tanks
- optimal use as an overflow valve in venting and gas supply lines
- low number of FLAMEFILTER® discs due to shock absorber technology
- quick removal and installation of the complete PROTEGO® flame arrester unit and the individual FLAMEFILTER® in the cage
- provides protection against deflagration and stable detonation
- advanced design for higher operating temperatures and pressures
- cost-effective spare parts

Design Types and Specifications

There are two different designs available:

Basic version of the detonation arrester with check valve **DR/ES- V - –**

Detonation arrester with check valve and heating jacket **DR/ES- V - H**

Table 1: Dimensions Dimensions in mm / inches

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

DN	25 / 1 / 32 / 1 ¼"	40 / 1 ½"	50 / 2"	65 / 2 ½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"
a	125 / 4.92	153 / 6.02	155 / 6.10	198 / 7.80	200 / 7.87	250 / 9.84	332 / 13.07	335 / 13.19	425 / 16.73
b	140 / 5.51	183 / 7.20	185 / 7.28	223 / 8.78	225 / 8.86	290 / 11.42	357 / 14.06	360 / 14.17	505 / 19.88
c	237 / 9.33	305 / 12.01	305 / 12.01	395 / 15.55	395 / 15.55	460 / 18.11	575 / 22.64	575 / 22.64	863 / 33.98
c1	345 / 13.58	410 / 16.14	410 / 16.14	530 / 20.87	530 / 20.87	615 / 24.21	790 / 31.10	790 / 31.10	1295 / 50.98
d	149 / 5.87	210 / 8.27	210 / 8.27	275 / 10.83	275 / 10.83	325 / 12.80	460 / 18.11	460 / 18.11	620 / 24.41

Stabilized FLAMEFILTER® Discs (Flyer pdf)

Table 2: Selection of the explosion group

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

Special approvals upon request.

Table 3: Selection of max. operating pressure

Expl. Gr.	DN	25 / 1	32 / 1 ¼"	40 / 1 ½"	50 / 2"	65 / 2 ½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"
IIA	P_{max}	4.0/58.0	4.0/58.0	4.0/58.0	4.0/58.0	2.9/42.1	2.9/42.1	2.0/29.0	2.0/29.0	2.0/29.0	1.2/17.4
IIB3	P_{max}	3.0/43.5	3.0/43.5	2.0/29.0	2.0/29.0	2.0/29.0	2.0/29.0	1.5/21.7	1.4/20.3	1.4/20.3	1.1/15.9

P_{max} = maximum allowable operating pressure in bar / psi (absolute); higher operating pressure upon request.

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C
-	Classification

Higher operating temperatures upon request.

Table 5: Material selection for housing

Design	B	C	D
Design Heating jacket (DR/ES-V-H-...)	Steel Steel	Stainless Steel Stainless Steel	Hastelloy Stainless Steel
Cover with shock absorber	Steel	Stainless Steel	Hastelloy
Gaskets	PTFE	PTFE	PTFE
Valve seat	Stainless Steel	Stainless Steel	Stainless Steel
Flame arrester unit	A	C, D	E

The housing and the cover with shock absorber can also be delivered in steel with an ECTFE coating.

Special materials upon request.

Table 6: Material combinations of the flame arrester unit

Design	A	C	D	E
FLAMEFILTER® cage	Steel	Stainless Steel	Stainless Steel	Hastelloy
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy
Spacer	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy

*The FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.

Special materials upon request.

Table 7: Material selection for valve pallet

Design	A	B	C
Pressure range	I	II	III
Set pressure (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	Aluminum	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal

Table 8: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

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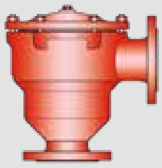
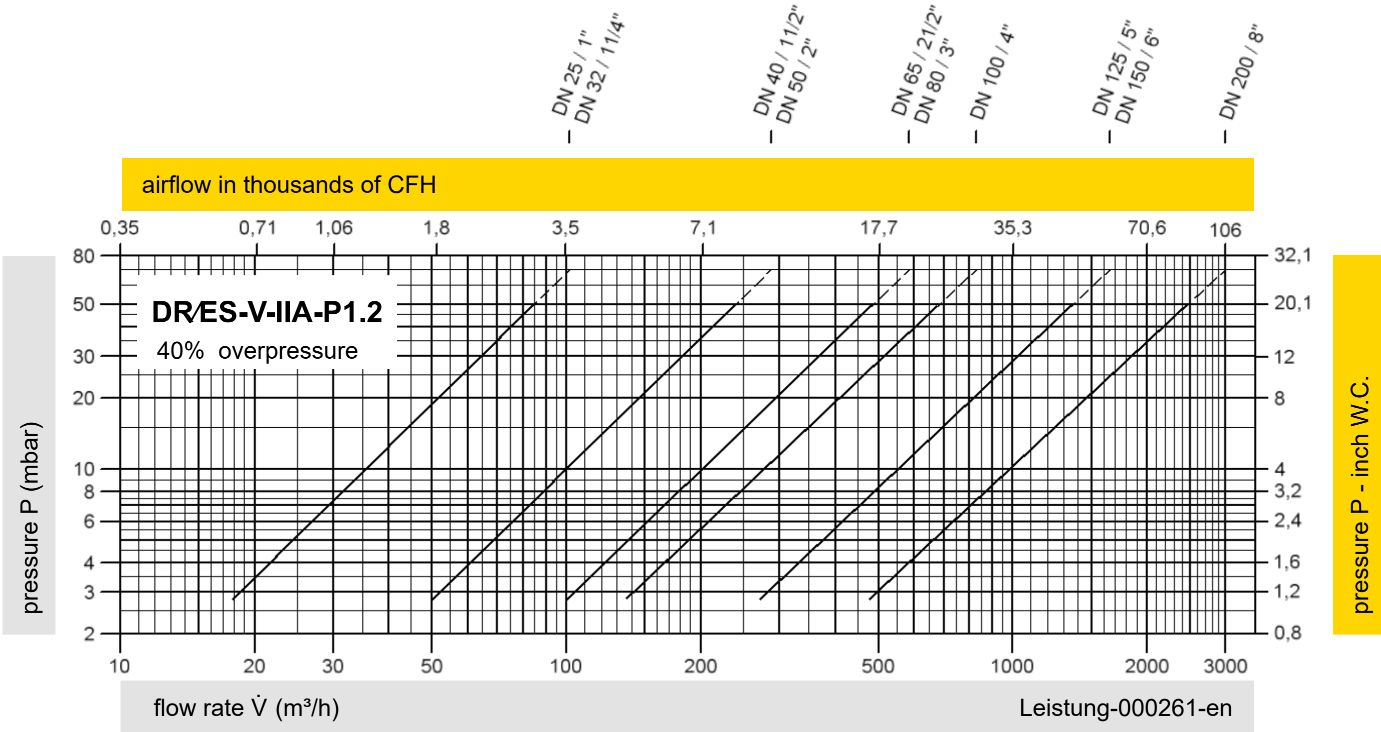
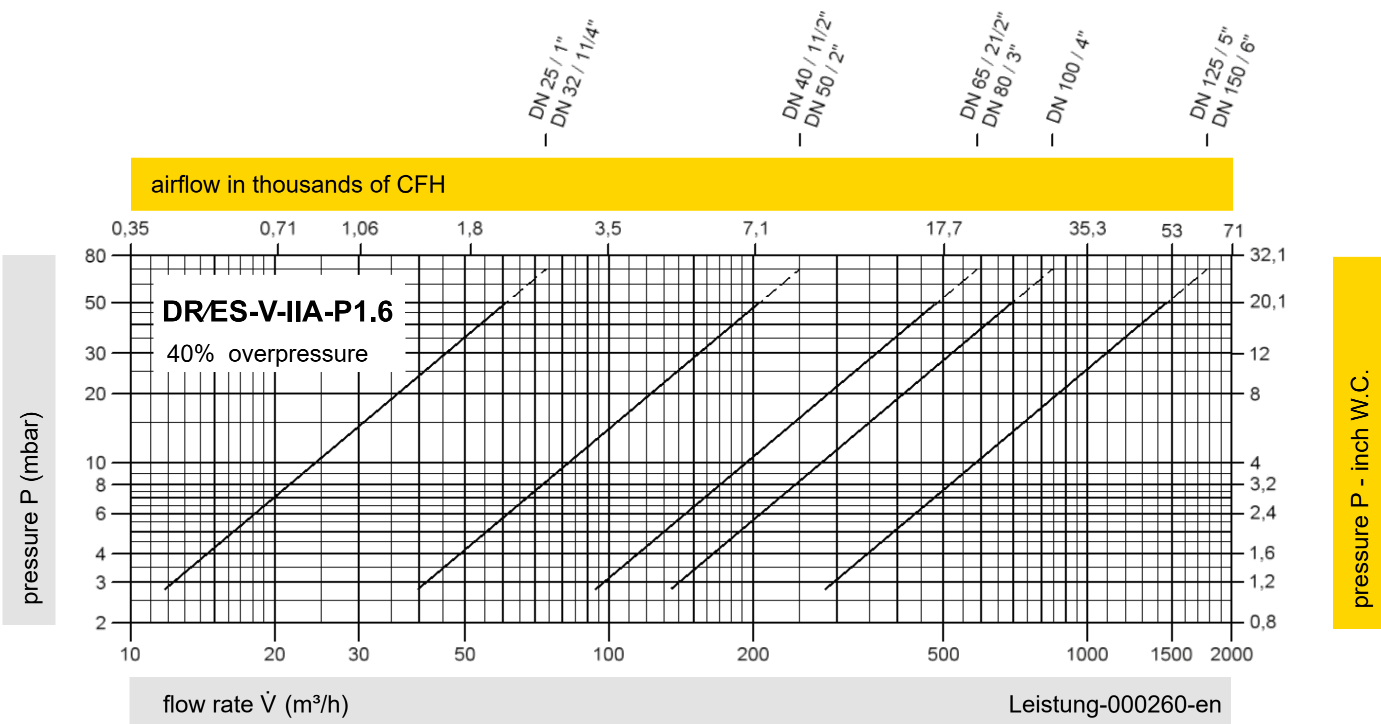


In-Line Detonation Flame Arrester

Flow Capacity Charts

PROTEGO® DR/ES-V





Remark

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

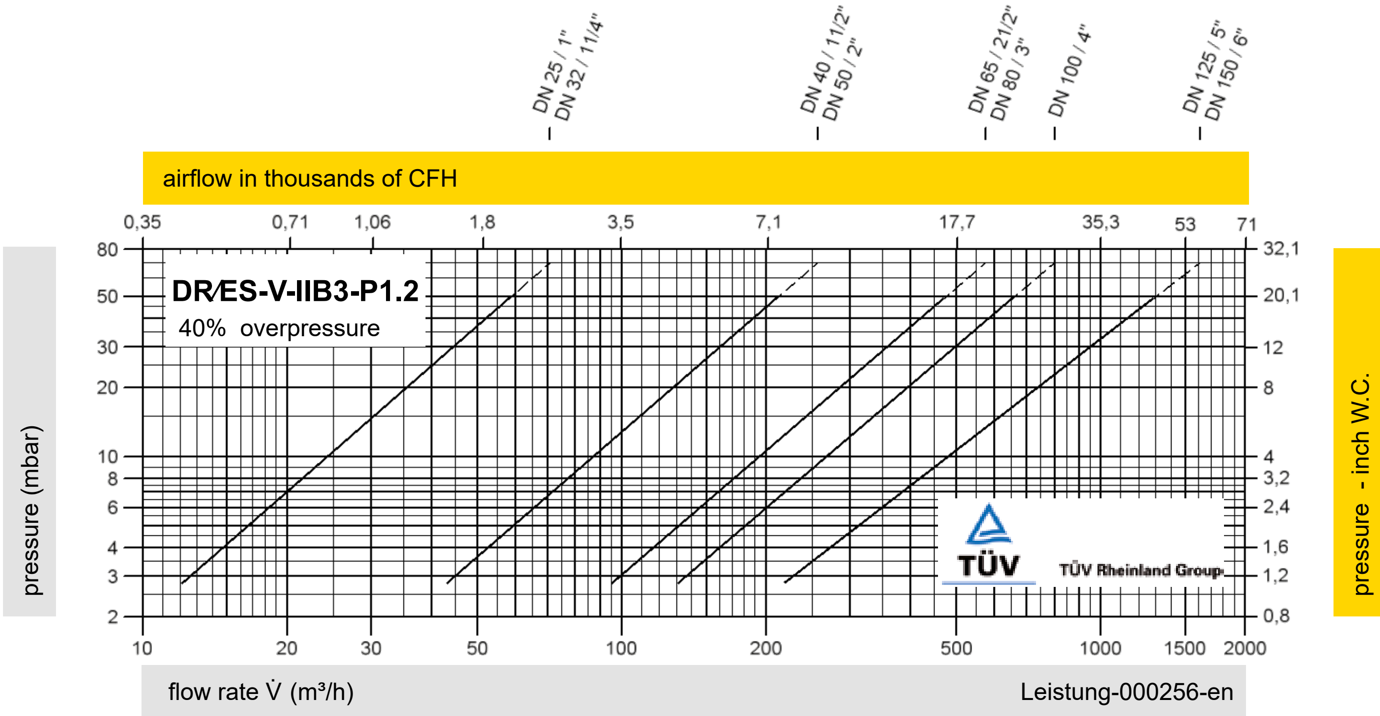
Set pressure = the valve starts to open

Opening pressure = set pressure plus overpressure

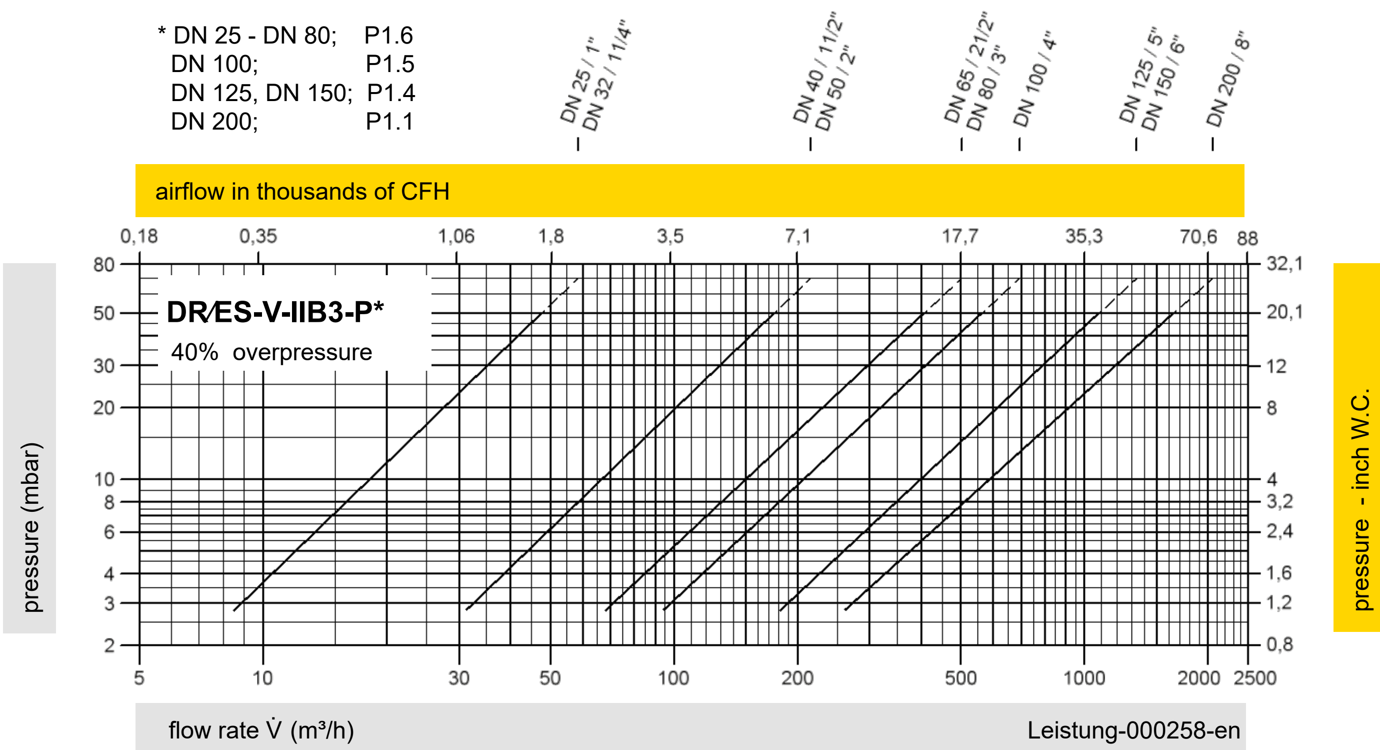
Overpressure = pressure increase over the set pressure

The 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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."



* DN 25 - DN 80; P1.6
DN 100; P1.5
DN 125, DN 150; P1.4
DN 200; P1.1



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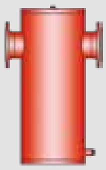
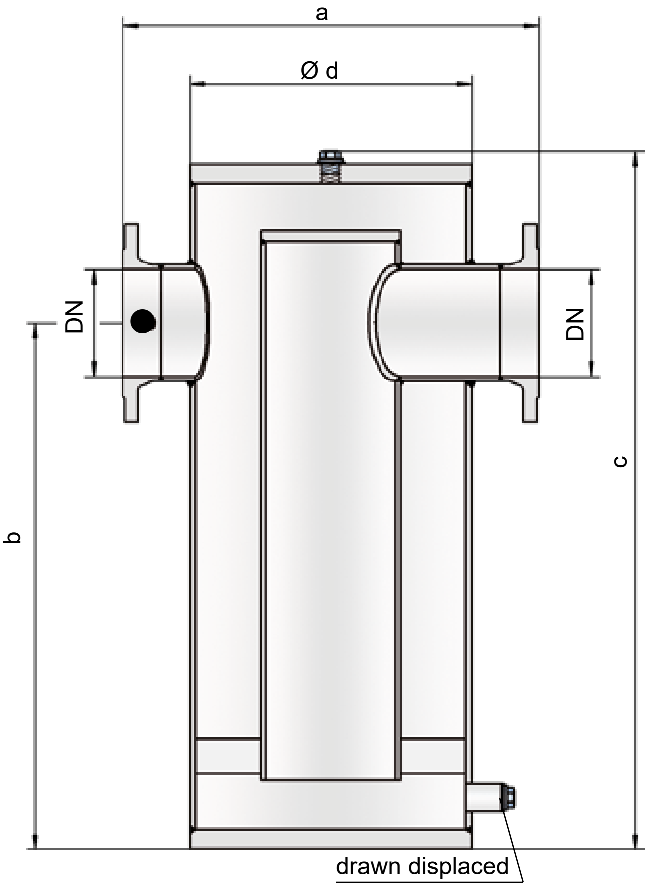
for safety and environment



In-Line Liquid Detonation Flame Arrester

for filling lines - external installation

PROTEGO® LDA-W



● Tank connection / protected side

When a highly accelerated pipe deflagration or detonation occurs, the combustion pressure and flame propagation speed are substantially reduced by the design and converted into a low-energy deflagration that is then stopped by the remaining immersion liquid.

The application range for the device is a product vapor / air mixture temperature of up to +60°C / 140°F and an absolute pressure of up to 1.1 bar / 15.9 psi. This covers all possible operating conditions of empty lines for flammable liquids. The liquid detonation arrester is designed for pressures of up to 10 bar / 145 psi, resists explosion pressure, and provides protection for almost all flammable liquids. The device is approved for explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm). **Special designs with a cleaning cover for highly viscous and contaminated liquids are available.**

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Function and Description

The PROTEGO® LDA-W liquid detonation flame arrester was developed for storage container filling lines that are not continuously filled with product and sometimes contain a combustible mixture. The device is installed outside the container in the filling line. If the explosive atmosphere is ignited, the device prevents the combustion from transferring into the tank. The PROTEGO® LDA-W series of liquid detonation flame arresters function according to the siphon principle in which the liquid product serves as a barrier against flame propagation.

Special Features and Advantages

- easily accessible due to external installation
- low risk of contamination
- low pressure loss
- provides protection against deflagrations and stable detonations
- useable for nearly all flammable liquids
- meets TRGS* requirements
- can also be used as a dirt catcher in a maintenance friendly design

* TRGS = technical regulations for hazardous substances

Table 1: Dimensions — Dimensions in mm / inches

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

DN	25 1"	32 1 ¼"	40 1 ½"	50 2"	65 2 ½"	80 3"	100 4"	125 5"	150 6"	200 8"	250 10"	300 12"
a	250 / 9.84	275 / 10.83	350 / 13.78	350 / 13.78	450 / 17.72	450 / 17.72	500 / 19.69	600 / 23.62	600 / 23.62	700 / 27.56	850 / 33.46	1000 / 39.37
b	325 / 12.80	360 / 14.17	420 / 16.54	420 / 16.54	540 / 21.26	540 / 21.26	595 / 23.43	915 / 36.02	915 / 36.02	1100 / 43.31	1325 / 52.17	1480 / 58.27
c	445 / 17.52	480 / 18.90	565 / 22.24	565 / 22.24	720 / 28.35	720 / 28.35	800 / 31.50	1265 / 49.80	1265 / 49.80	1520 / 59.84	1830 / 72.05	2050 / 80.71
d	140 / 5.51	140 / 5.51	195 / 7.68	195 / 7.68	275 / 10.83	275 / 10.83	325 / 12.80	460 / 18.11	460 / 18.11	510 / 20.08	610 / 24.02	700 / 27.56

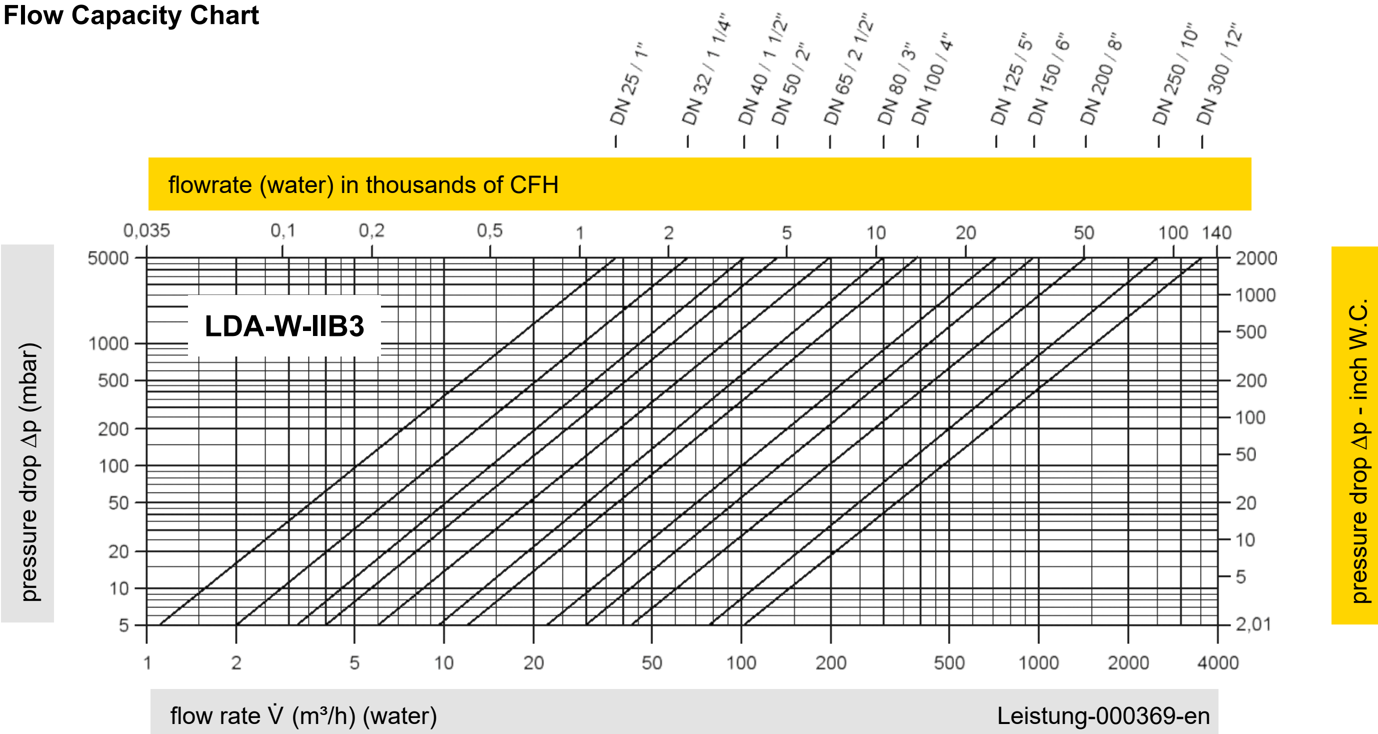
Table 2: Selection of the explosion group			
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	Special approvals upon request.
≥ 0,65 mm	IIB3	C	

Table 3: Specification of max. operating temperature		
≤ 60°C / 140°F	T maximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 4: Material selection for housing				
Design	A	B	C	Special materials upon request.
Housing	Steel	Stainless Steel	Hastelloy	
Gasket	PTFE	PTFE	PTFE	

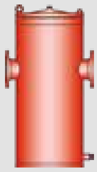
Table 5: Flange connection type	
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



Conversion: $\dot{V}_{water} = \dot{V}_{liquid} * \sqrt{\dfrac{\rho_{liquid}}{\rho_{water}}}$ $\qquad \dot{V}_{liquid} = \dot{V}_{water} * \sqrt{\dfrac{\rho_{water}}{\rho_{liquid}}}$

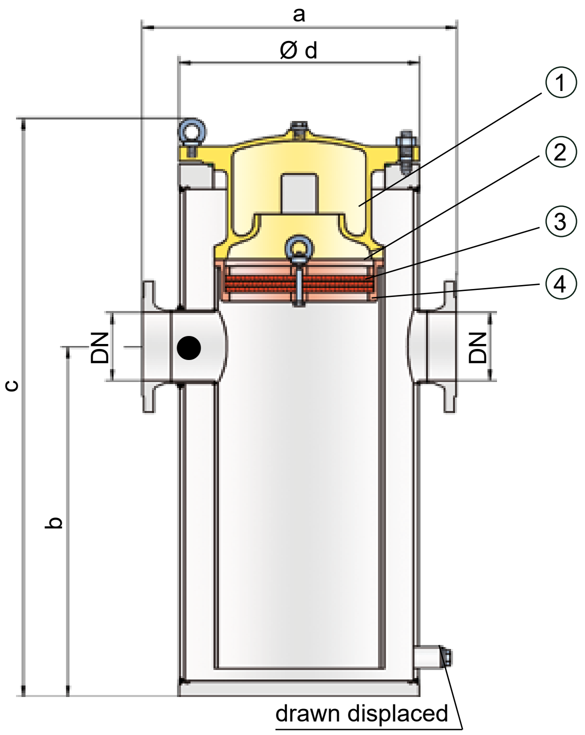
The volume flow $\dot{V}$ in m³/h was determined with water, in accordance with DIN EN 60534, at a temperature $T_n = 20°C$ and an atmospheric pressure p_n = 1,013 bar, kinematic viscosity $\nu = 10^{-6}$ m²/s.
To avoid electrostatic charge of flammable liquids, the maximum flow is limited (refer to TRGS 727, CENELEC-Report CLC/TR 60079-32-1).



In-Line Liquid Detonation Flame Arrester

for filling and drain lines - external installation

PROTEGO® LDA-WF(W)



● Tank connection / protected side

Function and Description

The PROTEGO® LDA-WF(W) series of liquid detonation flame arresters was developed for storage container filling lines that are not continuously filled with product and sometimes contain a combustible mixture. The integrated siphon protection (1) with PROTEGO® flame arrester unit (2) additionally prevents the liquid, in which the lines are immersed, from being siphoned off while the container is being drained. The PROTEGO® flame arrester unit consists of several FLAMEFILTER® discs (3) and spacers firmly held in a FLAMEFILTER® cage (4). The number of FLAMEFILTER® discs and their gap size depends on the arrester's intended use. The device is installed outside the container in the filling and drain lines. If the explosive atmosphere is ignited, the device prevents the combustion from traveling into the tank. The PROTEGO® LDA-WF(W) series of liquid detonation flame arresters combines the classic PROTEGO® flame arrester design with the siphon principle in which the liquid product serves as a barrier to flame propagation.

When a highly accelerated pipe deflagration or detonation occurs, the combustion pressure and flame propagation speed are substantially reduced, converted into a low-energy deflagration, and then stopped by the remaining immersion liquid and the PROTEGO® flame arrester.

The application range for the device is a product vapor/air mixture temperature of up to +60°C / 140°F and an absolute pressure up to 1.1 bar / 15.9 psi. **Devices with special approval for higher temperatures are available upon request.** This covers all possible operating conditions of empty lines for flammable liquids. The liquid detonation arrester is designed for pressures of up to 10 bar / 145 psi, resists explosion pressure, and provides protection for almost all flammable liquids. The device is approved for explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm). **Special designs with a cleaning cover for highly viscous liquids can be provided.**

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- easily accessible due to external installation
- siphon protection offers increased safety
- low risk of contamination
- low pressure loss
- provides protection against deflagrations and stable detonations
- useable for nearly all flammable liquids
- meets TRGS* requirements

* TRGS = technical regulations for hazardous substances

Table 1: Dimensions — Dimensions in mm / inches

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

DN	25 1"	32 1 ¼"	40 1 ½"	50 2"	65 2 ½"	80 3"	100 4"	125 5"	150 6"	200 8"	250 10"
a	250 / 9.84	250 / 9.84	346 / 13.62	350 / 13.78	446 / 17.56	450 / 17.72	500 / 19.69	600 / 23.62	600 / 23.62	700 / 27.56	900 / 35.43
b	325 / 12.80	325 / 12.80	415 / 16.34	415 / 16.34	535 / 21.06	535 / 21.06	600 / 23.62	915 / 36.02	915 / 36.02	1090 / 42.91	1300 / 51.18
c	475 / 18.70	475 / 18.70	605 / 23.82	605 / 23.82	831 / 32.72	831 / 32.72	936 / 36.58	1340 / 52.76	1340 / 52.76	1520 / 59.84	1750 / 68.90
d	150 / 5.91	150 / 5.91	210 / 8.27	210 / 8.27	275 / 10.83	275 / 10.83	325 / 12.80	460 / 18.11	460 / 18.11	510 / 20.08	610 / 24.02

Table 2: Selection of the explosion group

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

Stabilized FLAMEFILTER® Discs (Flyer pdf)

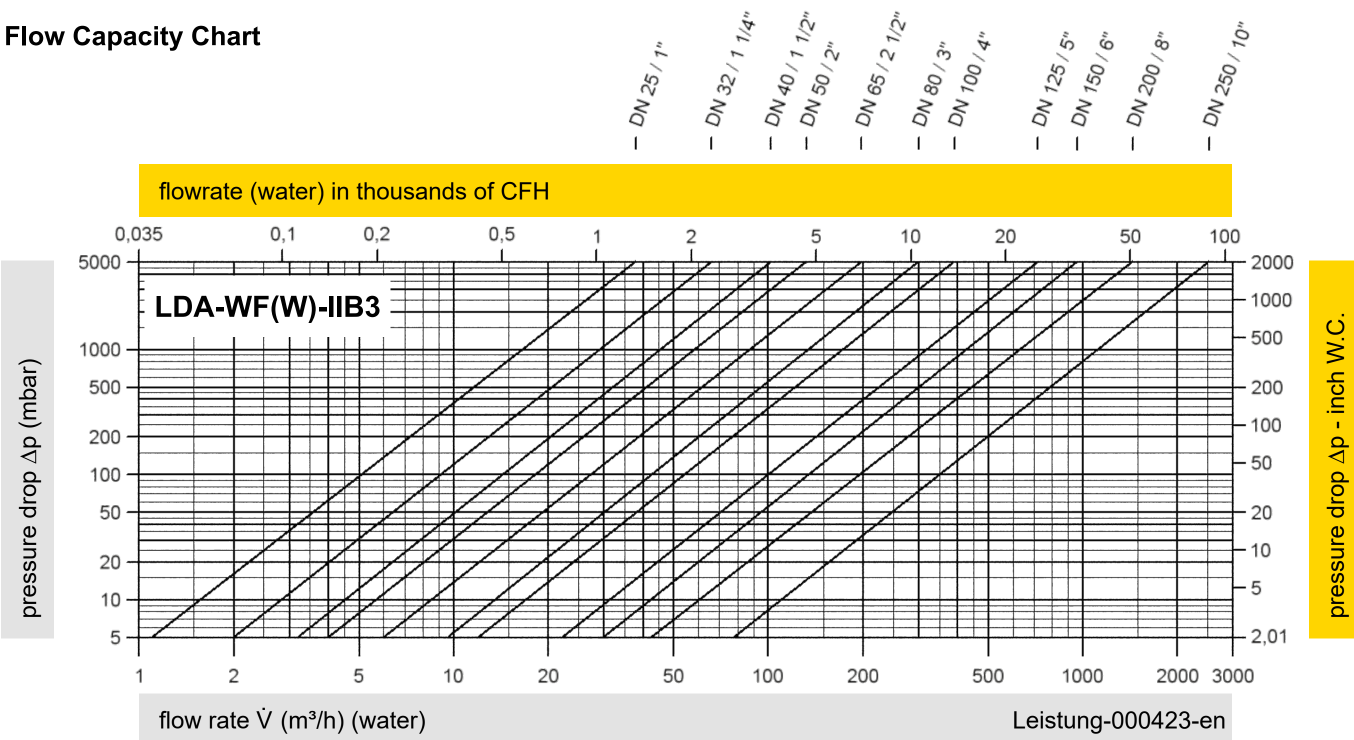
Table 3: Specification of max. operating temperature		
≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 4: Material selection for housing			
Design	A	B	Special materials upon request.
Housing	Steel	Stainless Steel	
Shock absorber	Steel	Stainless Steel	
Gasket (shock absorber)	FPM	PTFE	
Gasket (locking screw)	PTFE	PTFE	
Flame arrester unit	A	A	

Table 5: Material for flame arrester unit		
Design	A	* The FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used. Special materials upon request.
FLAMEFILTER® cage	Stainless Steel	
FLAMEFILTER® *	Stainless Steel	
Spacer	Stainless Steel	

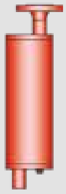
Table 6: Flange connection type	
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



Conversion: $\dot{V}_{water} = \dot{V}_{liquid} * \sqrt{\frac{\rho_{liquid}}{\rho_{water}}}$ $\dot{V}_{liquid} = \dot{V}_{water} * \sqrt{\frac{\rho_{water}}{\rho_{liquid}}}$

The volume flow $\dot{V}$ in m³/h was determined with water, in accordance with DIN EN 60534, at a temperature $T_n = 20°C$ and an atmospheric pressure p_n = 1,013 bar, kinematic viscosity $v = 10^{-6}$ m²/s.
To avoid electrostatic charge of flammable liquids, the maximum flow is limited (refer to TRGS 727, CENELEC-Report CLC/TR 60079-32-1).

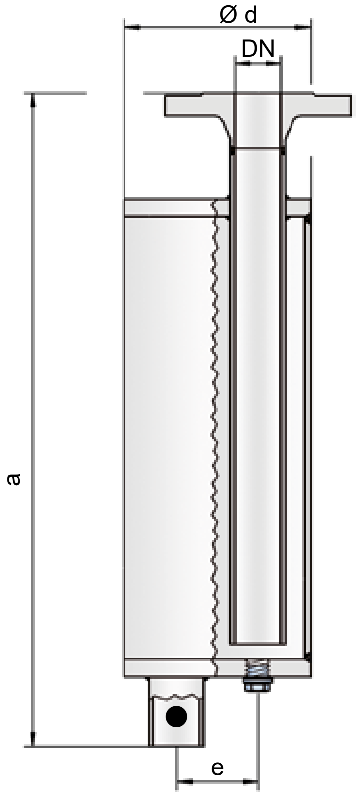


Liquid Detonation Flame Arrester

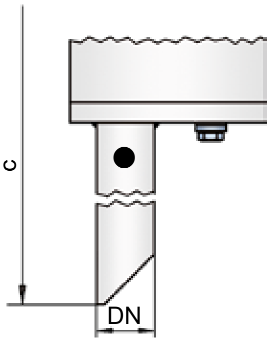
for filling lines - internal installation

PROTEGO® LDA

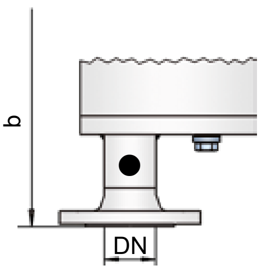
LDA



Outlet type I



Outlet type II



Outlet type III

● Tank connection / protected side

Function and Description

The PROTEGO® LDA series of liquid detonation arresters was developed for storage tank filling lines that are not continuously filled with product and sometimes contain a combustible mixture.

The device is installed inside the tank at the end of the line and prevents the combustion from being transferred into the tank if the explosive atmosphere ignites. The liquid detonation arresters function according to the siphon principle in which the liquid product serves as a liquid barrier to flame propagation.

When a highly accelerated pipe deflagration or detonation occurs, the combustion pressure and flame propagation speed is substantially reduced by the design, converted into a low-energy deflagration, and then stopped by the remaining immersion liquid.

The application range for the device is a product vapor/air mixture temperature of up to + 60°C / 140°F and an absolute pressure up to 1.1 bar / 15.9 psi. This covers all possible operating conditions of empty lines for flammable liquids. The liquid detonation arrester is pressure-resistant up to 10 bar / 145 psi. The device protects against nearly all flammable liquids and is approved for explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- simple construction provides low risk of contamination
- low pressure loss
- provides protection against deflagrations and stable detonations
- useable for nearly all flammable liquids
- meets TRGS* requirements
- available with different connections

* TRGS = technical regulations for hazardous substances

Table 1: Dimensions — Dimensions in mm / inches

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

DN	25 1"	32 1 ¼"	40 1 ½"	50 2"	65 2 ½"	80 3"	100 4"	125 5"	150 6"	200 8"	250 10"
a	500 / 19.69	580 / 22.83	700 / 27.56	700 / 27.56	825 / 32.48	925 / 36.42	1050 / 41.34	1150 / 45.28	1350 / 53.15	1650 / 64.96	2000 / 78.74
b	538 / 21.18	620 / 24.41	745 / 29.33	745 / 29.33	870 / 34.25	975 / 38.39	1102 / 43.39	1205 / 47.44	1405 / 55.31	1712 / 67.40	2068 / 81.42
c	725 / 28.54	805 / 31.69	925 / 36.42	925 / 36.42	1050 / 41.34	1145 / 45.08	1270 / 50.00	1380 / 54.33	1580 / 62.20	1880 / 74.02	2300 / 90.55
d	115 / 4.53	140 / 5.51	168 / 6.61	168 / 6.61	220 / 8.66	245 / 9.65	325 / 12.80	356 / 14.02	500 / 19.69	600 / 23.62	700 / 27.56
e	50 / 1.97	58 / 2.28	65 / 2.56	65 / 2.56	95 / 3.74	105 / 4.13	135 / 5.31	155 / 6.10	200 / 7.87	250 / 9.84	300 / 11.81

Table 2: Selection of the explosion group			
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	Special approvals upon request.
≥ 0,65 mm	IIB3	C	

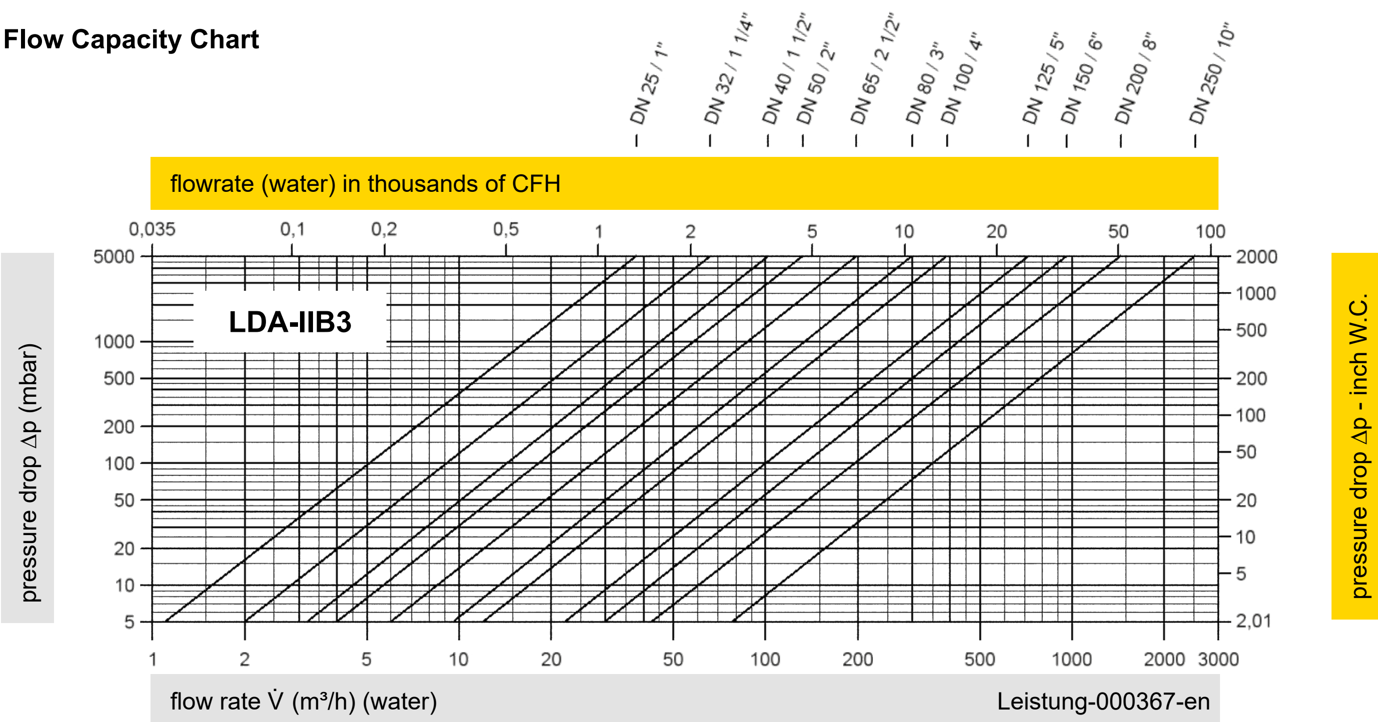
Table 3: Specification of max. operating temperature		
≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 4: Material selection for housing			
Design	A	B	Special materials upon request.
Housing	Steel	Stainless Steel	
Gasket	PTFE	PTFE	

Table 5: Flange connection type	
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

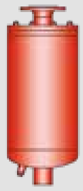
Table 6: Outlet type		
Straight pipe	I	Other types upon request.
Beveled pipe	II	
EN 1092-1; Form B1	III	
ASME B16.5 CL 150 R.F.	III	

Flow Capacity Chart



Conversion: $\dot{V}_{water} = \dot{V}_{liquid} * \sqrt{\frac{\rho_{liquid}}{\rho_{water}}}$ $\quad$ $\dot{V}_{liquid} = \dot{V}_{water} * \sqrt{\frac{\rho_{water}}{\rho_{liquid}}}$

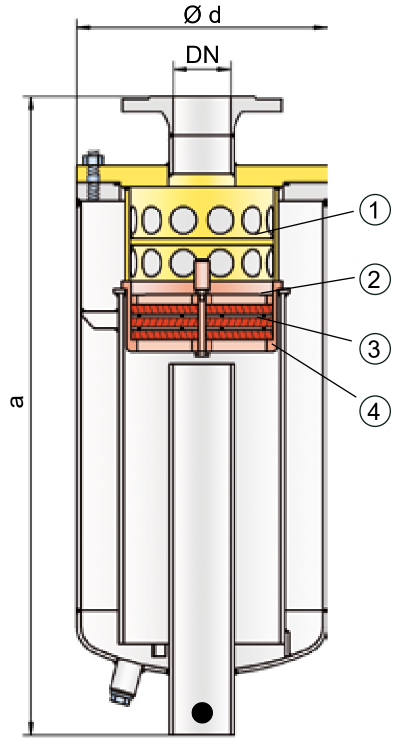
The volume flow $\dot{V}$ in m³/h was determined with water, in accordance with DIN EN 60534, at a temperature $T_n = 20°C$ and an atmospheric pressure p_n = 1,013 bar, kinematic viscosity $\nu = 10^{-6}$ m²/s.
To avoid electrostatic charge of flammable liquids, the maximum flow is limited (refer to TRGS 727, CENELEC-Report CLC/TR 60079-32-1).



Liquid Detonation Flame Arrester

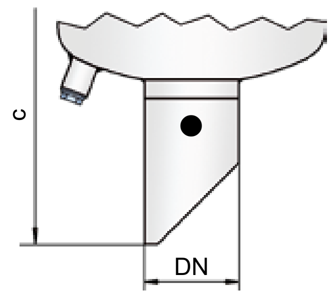
for filling and drain lines - internal installation

PROTEGO® LDA-F

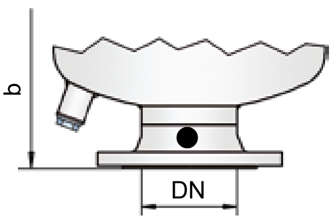


Outlet type I

● Tank connection / protected side



Outlet type II



Outlet type III

The device is installed inside the container at the end of the line and prevents the combustion from being transferred into the tank if the explosive atmosphere ignites. The PROTEGO® LDA-F series of liquid detonation arresters combine the classic PROTEGO® flame arrester design with the siphon principle in which the liquid product serves as a barrier to flame propagation.

When a highly accelerated pipe deflagration or detonation occurs, the combustion pressure and flame propagation speed are substantially reduced by the design, converted into a low-energy deflagration, and then stopped by the remaining immersion liquid and the PROTEGO® flame arrester.

The application limits for the device is product vapor/air mixture temperatures up to +60°C / 140°F and an absolute pressure up to 1.1 bar / 15.9 psi. This covers all possible operating conditions of empty lines for flammable liquids. The liquid detonation arrester in standard design is pressure-resistant up to 10 bar / 145 psi. The device protects against nearly all flammable liquids and is approved for explosion groups IIA to IIB3 (NEC group D and C MESG ≥ 0.65 mm).

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Function and Description

The PROTEGO® LDA-F series of liquid detonation arresters was developed for storage tanks filling and drain lines that are not continuously filled with product and sometimes contain a combustible mixture. The integrated siphon protection (1) with PROTEGO® flame arrester unit (2) additionally prevents the liquid, in which the lines are immersed, from being siphoned off while the container is being drained. The PROTEGO® flame arrester unit consists of several FLAMEFILTER® discs (3) and spacers firmly held in a FLAMEFILTER® cage (4). The number of FLAMEFILTER® discs and their gap size depends on the arrester's intended use.

Special Features and Advantages

- siphon protection offers increased safety
- low risk of contamination
- low pressure loss
- provides protection against deflagrations and stable detonations
- useable for nearly all flammable liquids
- meets TRGS* requirements
- available with different connections

* TRGS = technical regulations for hazardous substances

Table 1: Dimensions — Dimensions in mm / inches

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

DN	25 1"	32 1 ¼"	40 1 ½"	50 2"	65 2 ½"	80 3"	100 4"	125 5"	150 6"	200 8"	250 10"
a	550 / 21.65	550 / 21.65	650 / 25.59	650 / 25.59	850 / 33.46	875 / 34.45	1050 / 41.34	1250 / 49.21	1450 / 57.09	1600 / 62.99	1975 / 77.76
b	588 / 23.15	590 / 23.23	692 / 27.24	695 / 27.36	895 / 35.24	925 / 36.42	1102 / 43.39	1305 / 51.38	1505 / 59.25	1662 / 65.43	2043 / 80.43
c	775 / 30.51	775 / 30.51	875 / 34.45	875 / 34.45	1075 / 42.32	1095 / 43.11	1270 / 50.00	1480 / 58.27	1680 / 66.14	1830 / 72.05	2275 / 89.57
d	140 / 5.51	140 / 5.51	220 / 8.66	220 / 8.66	275 / 10.83	275 / 10.83	356 / 14.07	457 / 17.99	508 / 20.00	600 / 23.62	711 / 27.99

Table 2: Selection of the explosion group

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

Stabilized FLAMEFILTER®
Discs (Flyer pdf)

Table 3: Specification of max. operating temperature		
≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

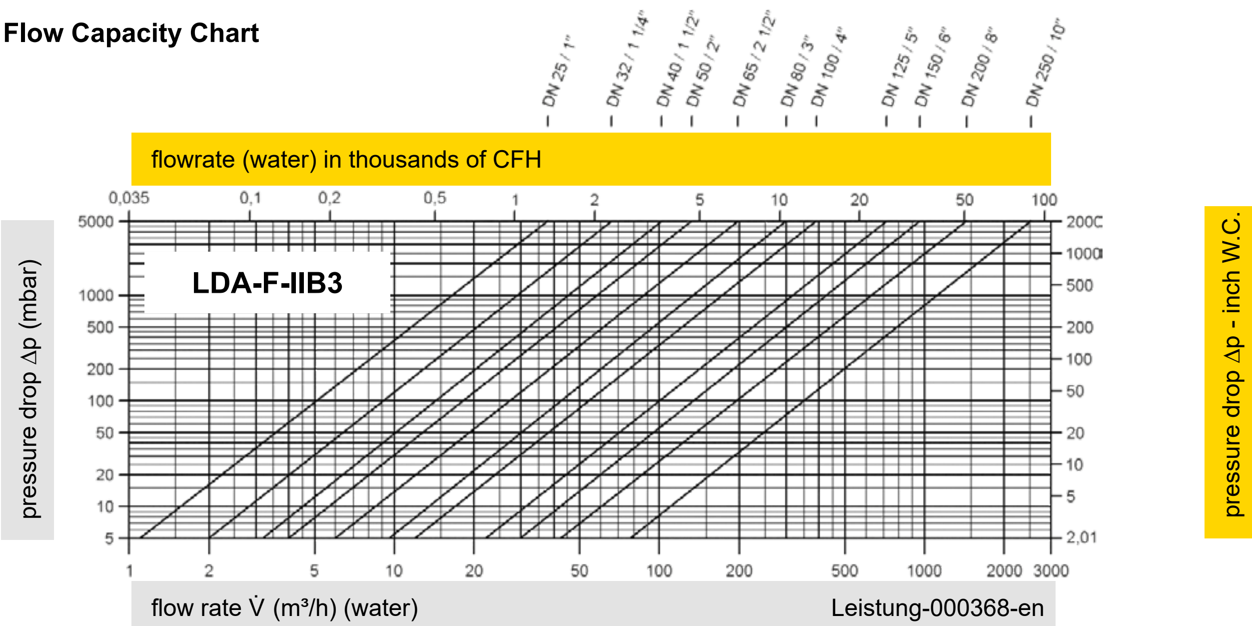
Table 4: Material selection for housing			
Design	A	B	Special materials upon request.
Housing	Steel	Stainless Steel	
Shock absorber	Steel	Stainless Steel	
Gasket	FPM	PTFE	
Flame arrester unit	A	A	

Table 5: Material for flame arrester unit		
Design	A	*The FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.
FLAMEFILTER® cage	Stainless Steel	
FLAMEFILTER® *	Stainless Steel	Special materials upon request.
Spacer	Stainless Steel	

Table 6: Flange connection type	
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Table 7: Outlet type		
Straight pipe	I	Other types upon request.
Beveled pipe	II	
EN 1092-1; Form B1	III	
ASME B16.5 CL 150 R.F.	III	

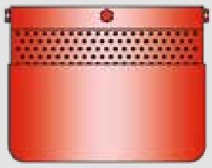
Flow Capacity Chart



Conversion: $\dot{V}_{water} = \dot{V}_{liquid} * \sqrt{\frac{\rho_{liquid}}{\rho_{water}}}$ $\dot{V}_{liquid} = \dot{V}_{water} * \sqrt{\frac{\rho_{water}}{\rho_{liquid}}}$

The volume flow $\dot{V}$ in m³/h was determined with water, in accordance with DIN EN 60534, at a temperature T_n = 20°C and an atmospheric pressure p_n = 1,013 bar, kinematic viscosity $v = 10^{-6}$ m²/s.
To avoid electrostatic charge of flammable liquids, the maximum flow is limited (refer to TRGS 727, CENELEC-Report CLC/TR 60079-32-1).

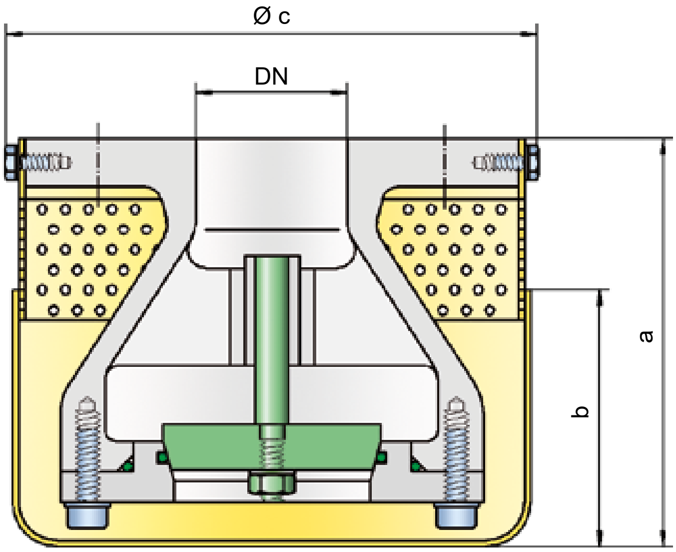
PROTEGO
for safety and environment



Detonation Flame Arrester

Detonation-proof foot valve for suction lines

PROTEGO® EF/V-IIB3



Combustible mixtures can form in filling and drain lines of storage containers that are not always filled with product. Ignition of explosive atmospheres can lead to highly accelerated pipe deflagration or detonations. The detonation-proof foot valve prevents the combustion from being transmitted into the tank and destroying it. The design of the foot valve ensures that the strainer is always filled with residual product. Together with the special valve design, this combination prevents flame flash back from the inside out.

The application limits for the device are a product vapor/air mixture temperature of up to +60°C / 140°F and an absolute pressure up to 1.1 bar / 15.9 psi. This covers all the possible operating conditions of empty lines for flammable liquids.

The device protects against nearly all flammable liquids and is permitted for explosion group IIB3 (C MESG ≥ 0.65 mm).

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Function and Description

The PROTEGO® EF/V-IIB3 detonation-safe foot valve protects the suction line in a storage tank. The virtually maintenance-free device is installed at the end of the emptying line within the tank. During suction, the valve opens at an approximate under-pressure of 30 mbar / 12 inch W.C. When the pump is turned off, the device functions as a check valve and prevents the line from emptying. This is very helpful when the pump is restarted.

Special Features and Advantages

- virtually maintenance-free
- check valve makes starting the pump easier
- provides protection against deflagrations and stable detonations
- useable for nearly all flammable liquids
- meets TRGS* requirements
- special strainer prevents solid particles from entering

* TRGS = technical regulations for hazardous substances

Table 1: Dimensions — Dimensions in mm / inches

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

DN	25 1"	32 1 ¼"	40 1 ½"	50 2"	65 2 ½"	80 3"	100 4"	125 5"	150 6"	200 8"	250 10"
a	125 / 4.92	125 / 4.92	135 / 5.31	135 / 5.31	160 / 6.29	160 / 6.29	200 / 7.87	235 / 9.25	260 / 10.24	400 / 15.75	450 / 17.72
b	85 / 3.35	85 / 3.35	85 / 3.35	85 / 3.35	95 / 3.74	95 / 3.74	125 / 4.92	130 / 5.12	135 / 5.31	175 / 6.89	200 / 7.81
c	155 / 6.10	155 / 6.10	180 / 7.09	180 / 7.09	210 / 8.27	210 / 8.27	250 / 9.84	310 / 12.20	365 / 14.37	480 / 18.90	565 / 22.24

Table 2: Selection of the explosion group

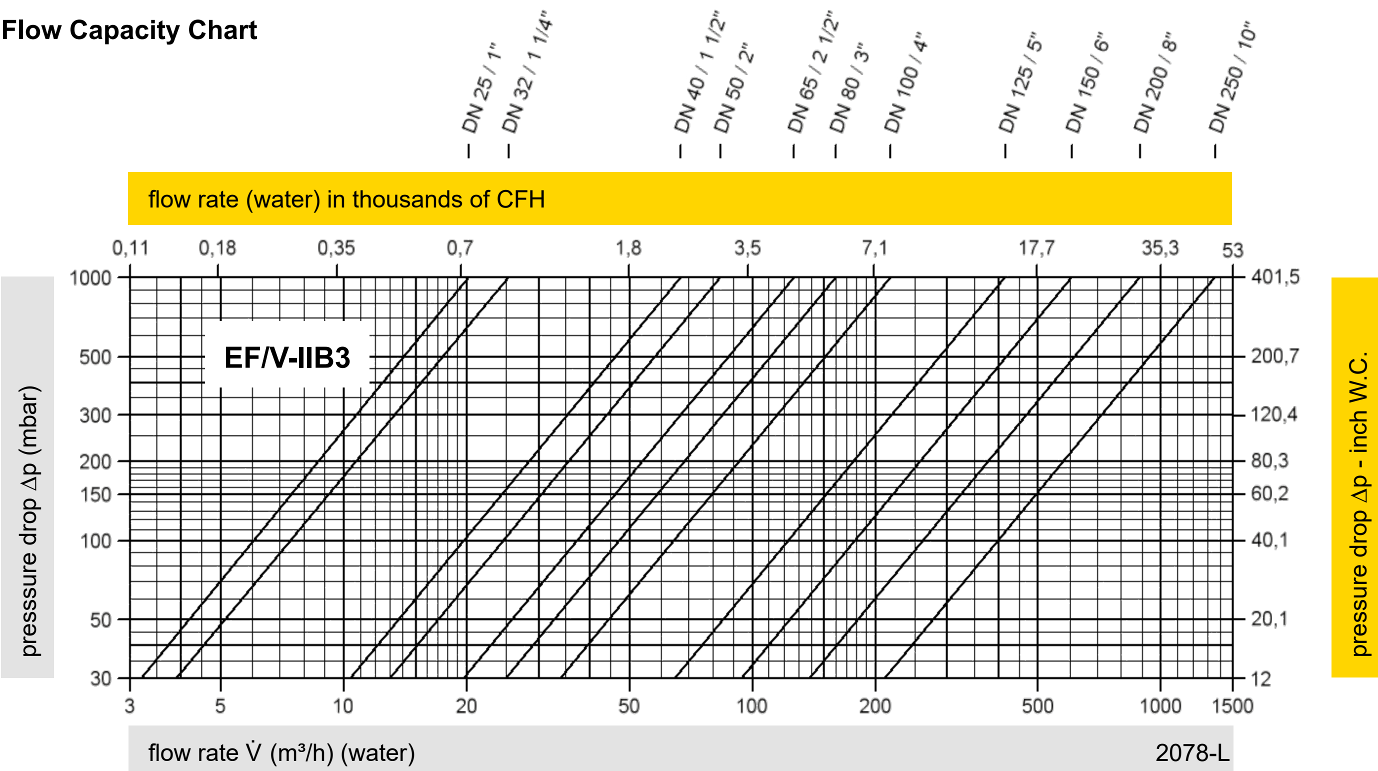
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
≥ 0,65 mm	IIB3	C	Special approvals upon request.

Table 3: Specification of max. operating temperature		
≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 4: Material selection for housing					
Design	A	B	C	D	Special materials upon request.
Housing	Steel	Stainless Steel	Steel	Stainless Steel	
Valve	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	
Gasket (Valve)	PTFE	PTFE	PTFE	PTFE	
Gasket (Housing)	FPM	FPM	PTFE	PTFE	
Strainer	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	

Table 5: Flange connection type	
EN 1092-1; Form A	Other types upon request.
ASME B16.5 CL 150 F.F.	

Flow Capacity Chart



Conversion: $\dot{V}_{water} = \dot{V}_{liquid} * \sqrt{\frac{\rho_{liquid}}{\rho_{water}}}$ $\qquad \dot{V}_{liquid} = \dot{V}_{water} * \sqrt{\frac{\rho_{water}}{\rho_{liquid}}}$

The volume flow $\dot{V}$ in m³/h was determined with water, in accordance with DIN EN 60534, at a temperature $T_n = 20°C$ and an atmospheric pressure p_n = 1,013 bar, kinematic viscosity $v = 10^{-6}$ m²/s.
To avoid electrostatic charge of flammable liquids, the maximum flow is limited (refer to TRGS 727, CENELEC-Report CLC/TR 60079-32-1).

PROTEGO
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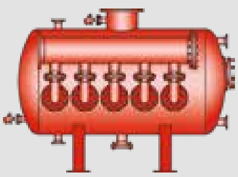
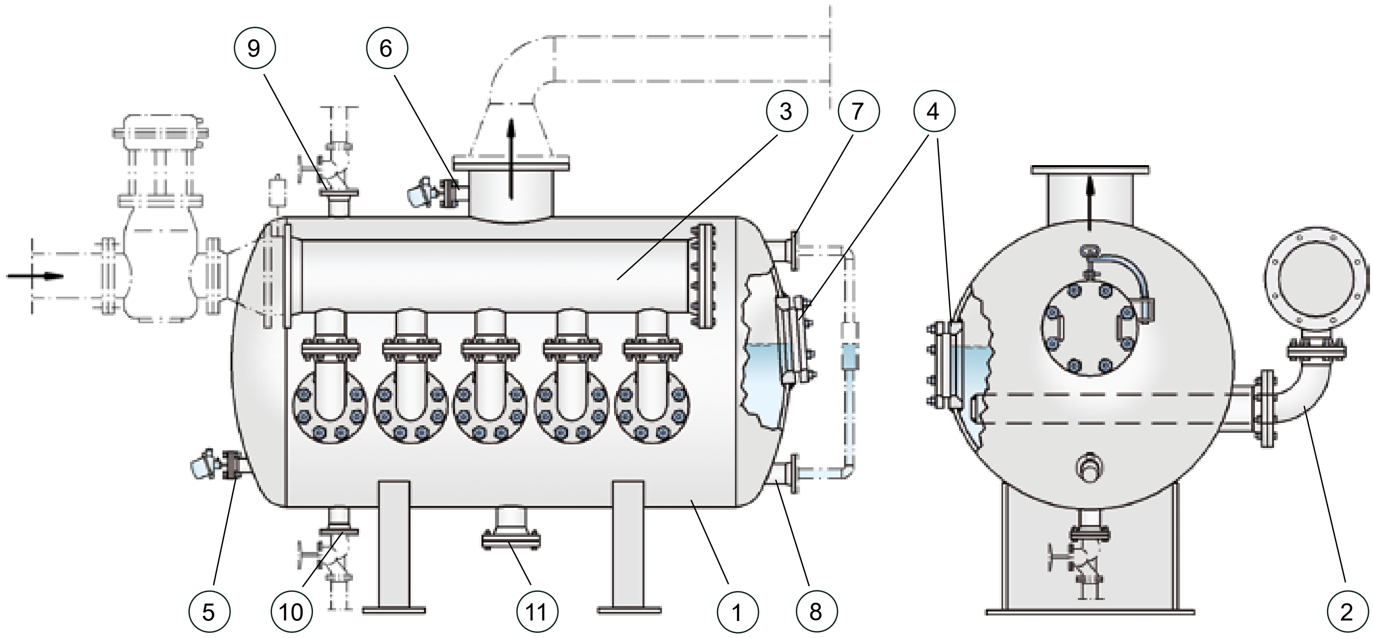


Hydraulic Flame Arresters

Deflagration-proof, detonation-proof and short-time burning-proof

PROTEGO® TS/P, TS/E and TS/W



Function and Description

The PROTEGO® type TS/… series of hydraulic flame arresters are mainly designed to protect process plants which are connected to waste thermal combustion units. Hydraulic flame arresters of the TS/… series are particularly suitable to protect plants which supply heavily contaminated, sticking, polymerizing or even foaming substances into thermal combustion units. Generally, it is necessary to protect the plant against in-line deflagration, stable detonation, and endurance burning hazards, and consider the plant's operating conditions.

The PROTEGO® TS/… series of hydraulic flame arresters guarantees flame transmission protection during short-time burning, deflagration, and stable detonation of gas/air mixtures or product vapor/air mixtures of the relevant explosion groups in all ranges of flammable concentrations with a service temperature of up to +60 °C / 140 °F and an operating pressure up to 1.1 bar / 15 psi (absolute).

Flame arresters of type TS/… are the only hydraulic flame arresters which have been tested and certified for substances of all explosion groups.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Hydraulic flame arresters of series TS/… mainly consist of the immersion tank (1) with exhaust air nozzle and connection nozzles for the sparge pipes, the sparge pipes (2) with elbows and connection flanges as well as the manifolds (3) with connection flanges. To allow measurement of the immersion liquid temperature, the tank (1) has a minimum of one nozzle (5) and, for measuring the temperature of the exhaust gas, there is a minimum of one connection for each exhaust air nozzle (6) for inserting temperature sensors. Additionally, the tank has two nozzles (7, 8) for level measurement, two nozzles (9, 10) for level control, and one nozzle (11) for draining. Inspection glasses (4) are included for inspection of the immersion liquid and gas space. The sparge pipes can be pulled out of the hydraulic flame arrester to allow cleaning of the drill holes and pipes. They contain the appropriate flange connections for the supply of exhaust air and, depending on the distribution of the exhaust air flow, the number of nozzles for distribution to the sparge pipes.

In PROTEGO® type TS/… hydraulic flame arresters. the flammable mixtures are passed through a water seal with a defined immersion depth. The mixture flow is divided and supplied evenly to the individual sparge pipes. The sparge pipes have small drill holes, which produce defined bubble columns. In case of an ignition in the flowing gas mixture, the flame is prevented from returning into the inlet line. The following parameters have a significant effect on the flame arresting efficiency of the device in case of deflagrations, detonations, or short-time burning:

- Mixture volume flow
- Immersion depth from the water seal's surface to the upper edges of the drill holes in the sparge pipes,
- Water temperature in the hydraulic flame arrester
- Precise drill hole diameter in the sparge pipes due to size, form, and density of the bubbles

If the mixture ignites under certain operating conditions within the hydraulic flame arrester and burns directly on the liquid surface, prevention of flame transmission can only be guaranteed for a limited amount of time. So, several temperature sensors are installed in the gas space, and, when reaching a specified temperature, they trigger appropriate emergency functions upstream in the connected system (shut down, inerting, etc.).

A high accuracy volume flow meter must be installed as an essential technical safety element. It has to guarantee that the maximum allowable volume flow, on which the design of the hydraulic flame arrester has been based, is recorded and limited so that emergency functions are triggered if the exhaust air volumes exceed the safe level. In addition, a minimum flame transmission-proof immersion height is necessary, i.e. an adequate water level must be guaranteed by suitable measuring equipment.

The pressure loss of a hydraulic flame arrester at maximum volume flow results from the inlet and outlet losses of approximately 12 to 18 mbar / 4.8 to 7.2 inch W.C. plus the immersion depth, e.g. 350 mm = 35 mbar / 13.8 In = 14.1 inch W.C., so the total is between 47 and 53 mbar / 18.9 and 21.3 inch W.C.

Instrumentation

The efficiency and function of the PROTEGO® TS/… series hydraulic flame arrester requires measurement and control equipment for the filling level, volume flow, and temperature of the system. It is necessary to maintain the minimum operating immersion depth and measure the maximum mixture volume flow, maximum gas temperature, and minimum water temperature. If necessary, automatic emergency functions must be quickly initiated by the MSR technology. The safety devices of the MSR technology must be explosion-protected and approved for zone 0.

MSR technology is not part of the scope of supply.

Maximum Volume Flow

The maximum allowable operating volume flow is calculated by multiplying the number of sparge pipes by the maximum allowable operating volume flow for each sparge pipe at its immersion depth.

In special cases, it may not be necessary to measure the volume flow provided that the volume flow limitation is guaranteed by other components in the system, such as a conveying element and throttle.

Level Measurement and Level Control

The operating immersion depth should be kept constant by a controlled automatic water supply so that the level does not fall below the minimum immersion depth.

Temperature Measurement and Limitation

To prevent endurance burning in the arrester, the exhaust air supply must be stopped automatically when the temperature exceeds T = 80°C / 176 °F at the exhaust air nozzle. Temperature sensors monitor the mixture temperature.

If the water temperature falls below T < 10°C / 50 °F (danger of freezing) or rises above the limiting temperature in the gas space, a quick-acting closing device must close automatically and stop the exhaust air supply.

As an option, temperature sensors can be supplied.

Design Types and Specifications

The hydraulic flame arresters are designated by explosion groups, diameters, and numbers of sparge pipes. They are designed in modules and type tested for the corresponding explosion groups.

For explosion group IIA (NEC group D)
Types TS/P 1000 / 40” or TS/P 2000 / 80”

For explosion group IIB3 (NEC group C)
Types TS/E 1000 / 40” or TS/E 2000 / 80”

For explosion group IIC (NEC group B)
Types TS/W 1000 / 40” or TS/W 2000 / 80”

The number of sparge pipes depends on the design volume flow.

Example: TS/E-1000-5 is a hydraulic flame arrester for substances of explosion group IIB3 (NEC group C) with a diameter of 1000 mm / 40” and 5 sparge pipes.

Dimensions

Standard diameters of TS/… series hydraulic flame arresters are 1000 mm / 40” and 2000 mm / 80”. Alternatively, diameters from 600 mm / 24” to 3000 mm / 120” are available depending on the exhaust air volume flow. Hydraulic flame arresters with diameters from 2000 mm / 80” and larger have a restriction plate to prevent wave motions in the sparging zone. All outlet and inlet collectors, as well as internal components, are safety-relevant components and, as also with the hydraulic flame arrester, must not be modified in design nor function!

Material Selection

The material selection is determined by the exhaust air process data. Tank designs of steel, stainless steel, coated steel, or steel lined with ECTFE or resin are available depending on the application. The sparge pipes are made of stainless, hastelloy, or plastic.

Flange Connection Type

The standard flange connections are made in accordance with EN 1092-1; Form B1. Alternatively, the connecting flanges can be made in accordance with any international standard.

Selection and Design

The total pressure loss is a result of the static immersion depth and the dynamic flow resistance in the sparge pipes, as well as in the exhaust air supply lines. In any case, the manufacturer’s advice about technical safety is required!

For particularly corrosive mixtures, the hydraulic flame arrester may be coated. The materials of tank, installations, and sparge pipes have to be selected according to the corrosive properties of the mixture.

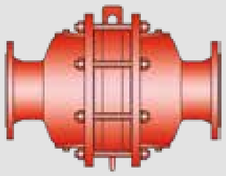
Data Necessary for Specification

The following operational data is required for the technical safety of the hydraulic flame arrester design:

Exhaust air volume flow, considering the maximum possible volume flow (m³/h or CFH)

Exhaust air composition (vol.%)

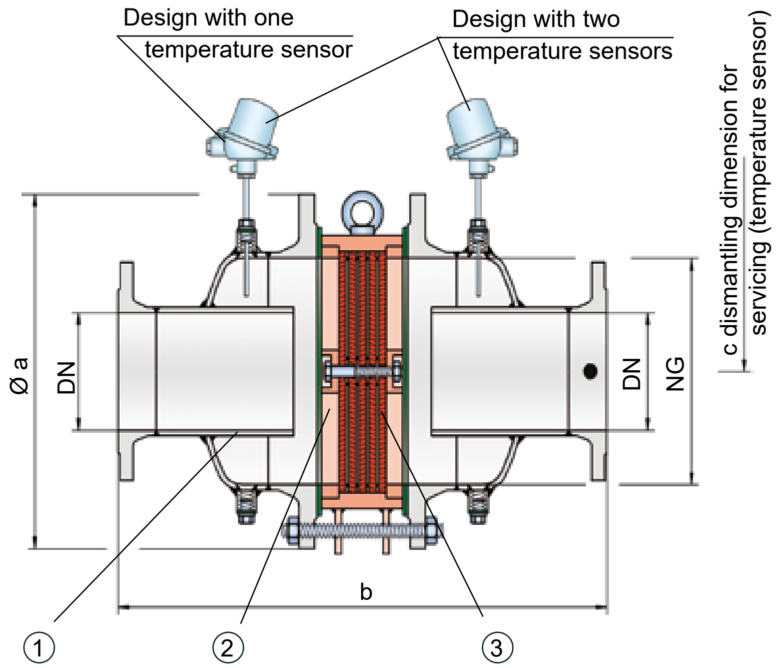
Operating temperature (°C or °F)



In-Line Detonation Flame Arrester

for unstable and stable detonations, and deflagrations in a straight-through design with a shock tube, bi-directional

PROTEGO® DA-UB



● Connection to the protected side (only for type DA-UB-T-....)

The standard design can be used at an operating temperature of up to +60°C / 140°F and an absolute operating pressure up to 1.1 bar / 15.9 psi. **Devices with special approval for higher temperatures and pressures (see table 3) are available upon request.** EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- optimized performance due to the patented *Shock Wave Guide Tube Effect (SWGTE)*
- low number of FLAMEFILTER® discs due to the patented shock tube *(SWGTE)*
- modular design enables replacement of the individual FLAMEFILTER® discs
- different designs allow scalable pressure loss over the area of the FLAMEFILTER®
- maintenance-friendly design
- advanced design for higher operating temperatures and pressures
- bi-directional operation, as well as any flow direction and installation position
- installation of temperature sensors possible
- minimal pressure loss resulting in low operating and lifecycle costs
- cost-effective spare parts

Function and Description

The type PROTEGO® DA-UB in-line detonation flame arresters are the newest generation of flame arresters. Based on fluid dynamic and explosion-dynamic calculations, as well as decades of field tests, a line was developed that offers minimum pressure loss and maximum safety. The device uses the Shock Wave Guide Tube Effect (SWGTE) to separate the flame front and shock wave. The result is an in-line detonation flame arrester without a classic shock absorber, and the use of flame-extinguishing elements is minimized.

The devices are symmetrical and offer bi-directional flame arresting for deflagrations and stable and unstable detonations. The arrester essentially consists of two housing parts with an integrated shock tube (1) and the PROTEGO® flame arrester unit (2) in the center. The PROTEGO® flame arrester unit is modular and consists of several FLAMEFILTER® discs (3) and spacers firmly held in a FLAMEFILTER® cage. The number of FLAMEFILTER® discs and their gap size depends on the arrester's intended use.

By specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, the optimum detonation arrester can be selected from a series of approved devices. PROTEGO® DA-UB flame arresters are available for explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

Design Types and Specifications

There are four different designs available:

Basic in-line detonation flame arrester	**DA-UB - [–] - [–]**
In-line detonation flame arrester with integrated temperature sensor* as additional protection against short-time burning	**DA-UB - [T] - [–]**
In-line detonation flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides	**DA-UB-[TB] - [–]**
In-line detonation flame arrester with heating jacket	**DA-UB - [H] - [ ]**

Additional special flame arresters upon request.

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Stabilized FLAMEFILTER® Discs (Flyer pdf)

New PROTEGO® Flame Arrester Unit with unique maintenance friendly design (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

To select nominal width/nominal size (NG/DN) - combination, please use the flow capacity charts on the following pages.

Additional nominal width/nominal size (NG/DN) - combinations for improved flow capacity upon request.

standard

NG		150 6“	150 6“	200 8“	300 12“	400 16“	500 20“	600 24“	700 28“	800 32“	1400 56“
DN		≤ 50 2"	80 3"	≤ 100 4"	≤ 150 6"	≤ 200 8"	≤ 250 10"	≤ 300 12"	≤ 350 14"	≤ 400 16"	≤ 600 24“
a		285 / 11.22	285 / 11.22	340 / 13.39	445 / 17.52	565 / 22.24	670 / 26.38	780 / 30.71	895 / 35.24	1015 / 39.96	1675 / 65.94
b	IIA -P1.1					700 / 27.56	800 / 31.50	1000 / 39.37	1200 / 47.24	1400 / 55.12	2200 / 86.61
	IIA-P1.2	388 / 15.28	388 / 15.28	488 / 19.21	626 / 24.65						
	IIB3-P1.1			500 / 19.69	638 / 25.12	724 / 28.50	824 / 32.44	1000 / 39.37	1200 / 47.24	1400 / 55.12	
	IIB3-P1.2	388 / 15.28	388 / 15.28								
c		500 / 19.69	500 / 19.69	520 / 20.47	570 / 22.44	620 / 24.41	670 / 26.38	720 / 28.35	770 / 30.31	820 / 32.28	1060 / 41.73

Table 2: Selection of the 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: Selection of max. operating pressure

		NG	150 6“	150 6“	200 8“	300 12“	400 16“	500 20“	600 24“	700 28“	800 32“	1400 56“
		DN	≤ 50 2“	80 3“	≤ 100 4“	≤ 150 6“	≤ 200 8“	≤ 250 10“	≤ 300 12“	≤ 350 14“	≤ 400 6“	≤ 600 24“
Expl. Gr.	IIA	P_{max}	1.8 / 26.1	1.8 / 26.1	1.6 / 23.2	1.6 / 23.2	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.6/ 23.2
	IIB3	P_{max}	1.5 / 21.7	1.5 / 21.7	1.5 / 21.7	1.5 / 21.7	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	

P_{max} = maximum allowable operating pressure in bar / psi (absolute); higher operating pressure upon request.

In-between size up to P_{max} upon request.

Table 4: Specification of max. operating temperature

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

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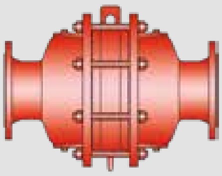


In-Line Detonation Flame Arrester

for unstable and stable detonations, and deflagrations in a straight-through design with a shock tube, bi-directional

PROTEGO® DA-UB

Table 5: Material selection for housing

Design	A	B	C
Housing Heating jacket (DA-UB-(T)-H-...)	Steel Steel	Stainless Steel Stainless Steel	Hastelloy Stainless Steel
Gasket	PTFE	PTFE	PTFE
Flame arrester unit	A	B, C	D

The housing is also available in Steel with an ECTFE coating.

Special materials upon request.

Table 6: Material combinations of the flame arrester unit

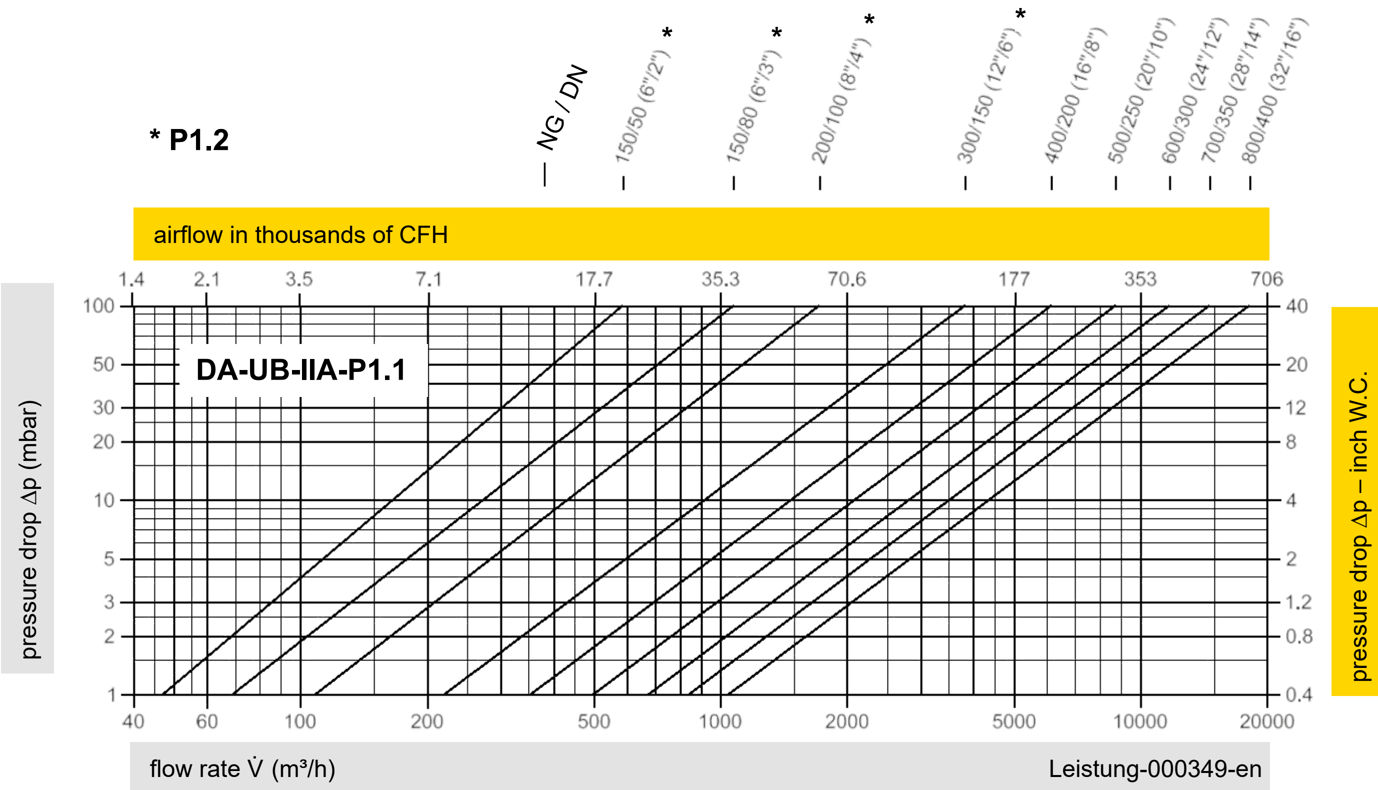
Design	A	B	C	D
FLAMEFILTER® cage	Steel	Stainless Steel	Stainless Steel	Hastelloy
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy
Spacer	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy

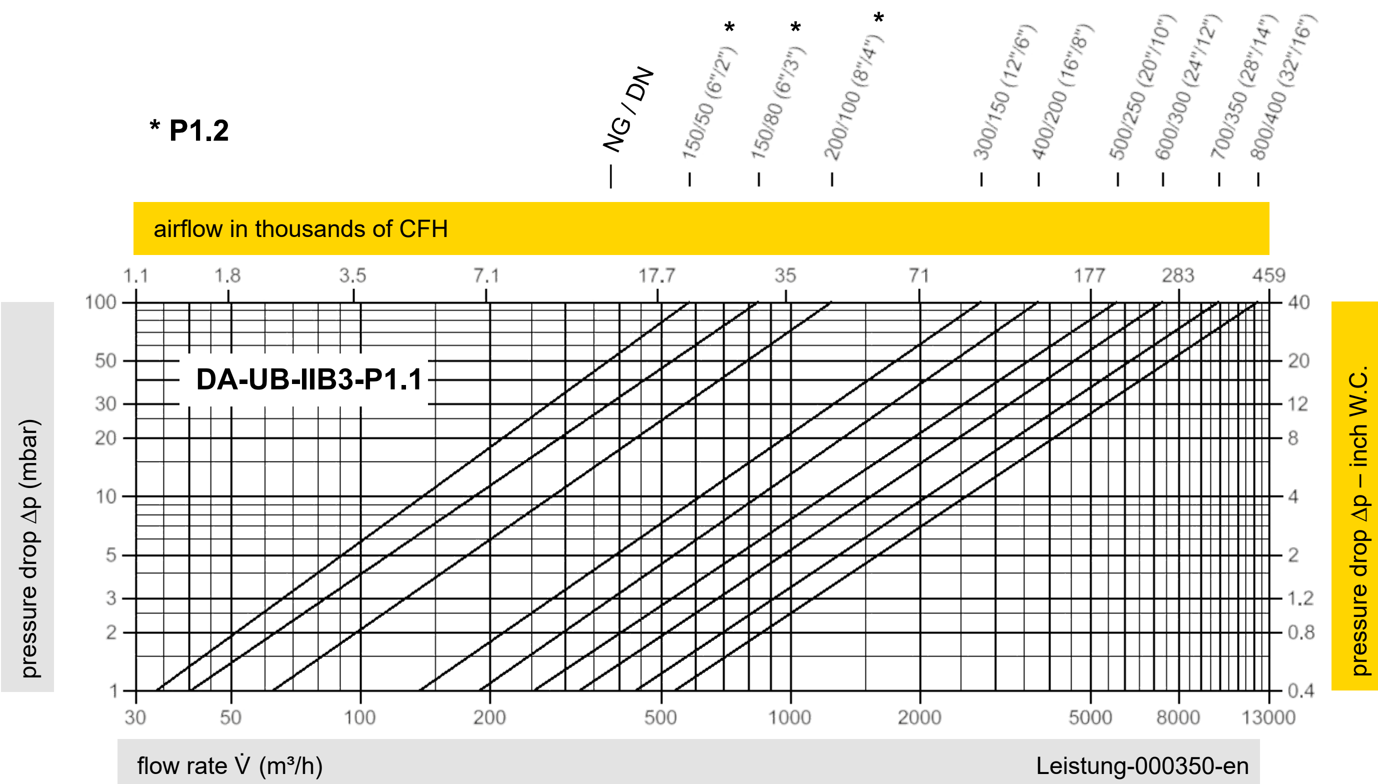
*The FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.

Special materials upon request.

Table 7: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	





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

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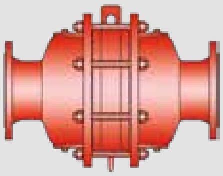
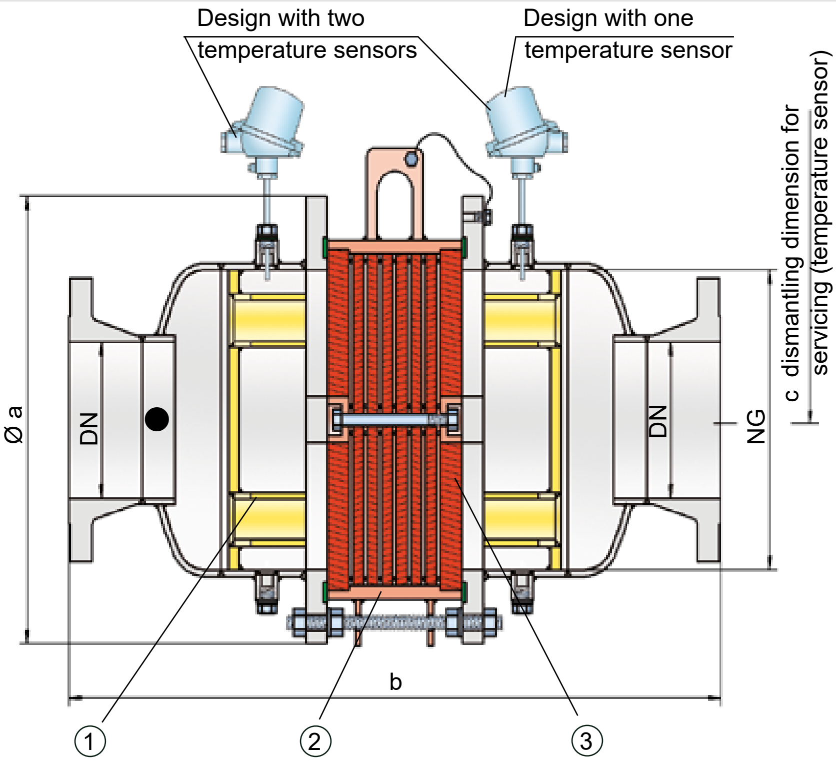


In-Line Detonation Flame Arrester

for unstable and stable detonations, and deflagrations in a straight-through design with shock absorber, bi-directional

PROTEGO® DA-CG



● Connection to the protected side (only for type DA-CG-T-....)

Function and Description

The PROTEGO® DA-CG series of detonation arresters was mainly developed for the North American market and optimized to meet the demands of the US Coast Guard. The devices are symmetrical and offer bi-directional flame arresting for deflagrations and stable and unstable detonations.

The effective shock absorber (1) greatly reduces the speed of incoming detonations. This leads to improved flame extinguishing in the narrow gaps of the FLAMEFILTER® (3).

The flame arrester essentially consists of two housing parts with an integrated shock absorber and the PROTEGO® flame arrester unit (2) in the center. The PROTEGO® flame arrester unit is modular and consists of several FLAMEFILTER® discs and spacers firmly held in a FLAMEFILTER® cage. The number of FLAMEFILTER® discs and their gap size depends on the arrester‘s intended use.

By specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, the optimum in-line detonation flame arrester can be selected. Type PROTEGO® DA-CG flame arresters are available for explosion groups IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

The standard design can be used at an operating temperature of up to +60°C / 140°F and an absolute operating pressure acc. to table 3. **Devices with special approvals for higher pressures and higher temperatures are available upon request.**

The flame arresters have been approved in accordance with the American Standard 33 CFR part 154 and are accepted by the US Coast Guard.

Special Features and Advantages

- provides protection against deflagrations and stable and unstable detonations
- low number of FLAMEFILTER® discs due to shock absorber technology
- modular design enables individual cleaning and replacement of the FLAMEFILTER® discs
- different design allow scalable pressure loss over the area of the FLAMEFILTER®
- maintenance-friendly design
- available in large nominal widths
- advanced design for higher operating temperatures and pressures
- bi-directional operation, as well as any flow direction and installation position
- installation of temperature sensors possible
- minimal pressure loss resulting in low operating and lifecycle costs
- cost-effective spare parts

Design Types and Specifications

There are three different designs available:

Basic in-line detonation flame arrester	**DA-CG- $\boxed{-}$**
In-line detonation flame arrester with integrated temperature sensor* as additional protection against short-time burning from one side	**DA-CG- $\boxed{T}$**
Detonation arrester with two integrated temperature sensors* as additional protection against short-time burning from both sides	**DA-CG- $\boxed{TB}$**

Additional special flame arresters upon request.

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Stabilized FLAMEFILTER® Discs (Flyer pdf)

Table 1: Dimensions Dimensions in mm / inches

To select nominal width/nominal size (NG/DN) - combination, please use the flow capacity charts on the following pages.	Additional nominal width/nominal size (NG/DN) - combinations for improved flow capacity upon request.

standard

NG	150 6”	150 6”	200 8”	300 12”	400 16”	500 20”	600 24”	700 28”	800 32”	1000 40”	1200 48”
DN	≤ 50 2"	80 3"	≤ 100 4"	≤ 150 6"	≤ 200 8"	≤ 250 10"	≤ 300 12"	≤ 350 14"	≤ 400 16"	≤ 500 20"	≤ 600 24"
a	285 / 11.22	285 / 11.22	340 / 13.39	460 / 18.11	580 / 22.83	715 / 28.15	840 / 33.07		1025 / 40.35	1255 / 49.41	1485 / 58.46
b (D)	594 / 23.39	570 / 22.44	620 / 24.41	720 / 28.35	852 / 33.54	1052 / 41.42	1202 / 47.32		1500 / 59.06	1700 / 66.93	2000 / 78.74
b (C)	650 / 25.59	650 / 25.59	700 / 27.56	800 / 31.50	900 / 35.43	1100 / 43.31	1250 / 49.21		1548 / 60.94	-	-
c	300 / 11.81	300 / 11.81	330 / 12.99	380 / 14.96	490 / 19.29	540 / 21.26	590 / 23.23		690 / 27.17	790 / 31.10	880 / 34.65

Table 2: Selection of the 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: Selection of max. operating pressure

		NG	150 6“	150 6“	200 8“	300 12“	400 16“	500 20“	600 24“	700 28“	800 32“	1000 40“	1200 48“
		DN	≤ 50 2“	80 3“	≤ 100 4“	≤ 150 6“	≤ 200 8“	≤ 250 10“	≤ 300 12“	≤ 350 14“	≤ 400 16“	≤ 500 20“	≤ 600 24“
Expl. Gr.	IIA	P_{max}	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4
	IIB3	P_{max}	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.26	1.6 / 23.2	1.6 / 23.2

P_{max} = maximum allowable operating pressure in bar / psi (absolute); higher operating pressure upon request.

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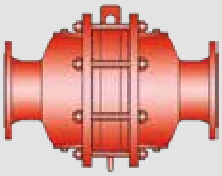


In-Line Detonation Flame Arrester

for unstable and stable detonations and deflagrations in a straight through design with shock absorber, bi-directional

PROTEGO® DA-CG

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 5: Material selection for housing

Design	A	B	Special materials upon request.
Housing	Steel	Stainless Steel	
Gasket	PTFE	PTFE	
Flame arrester unit	A	B	

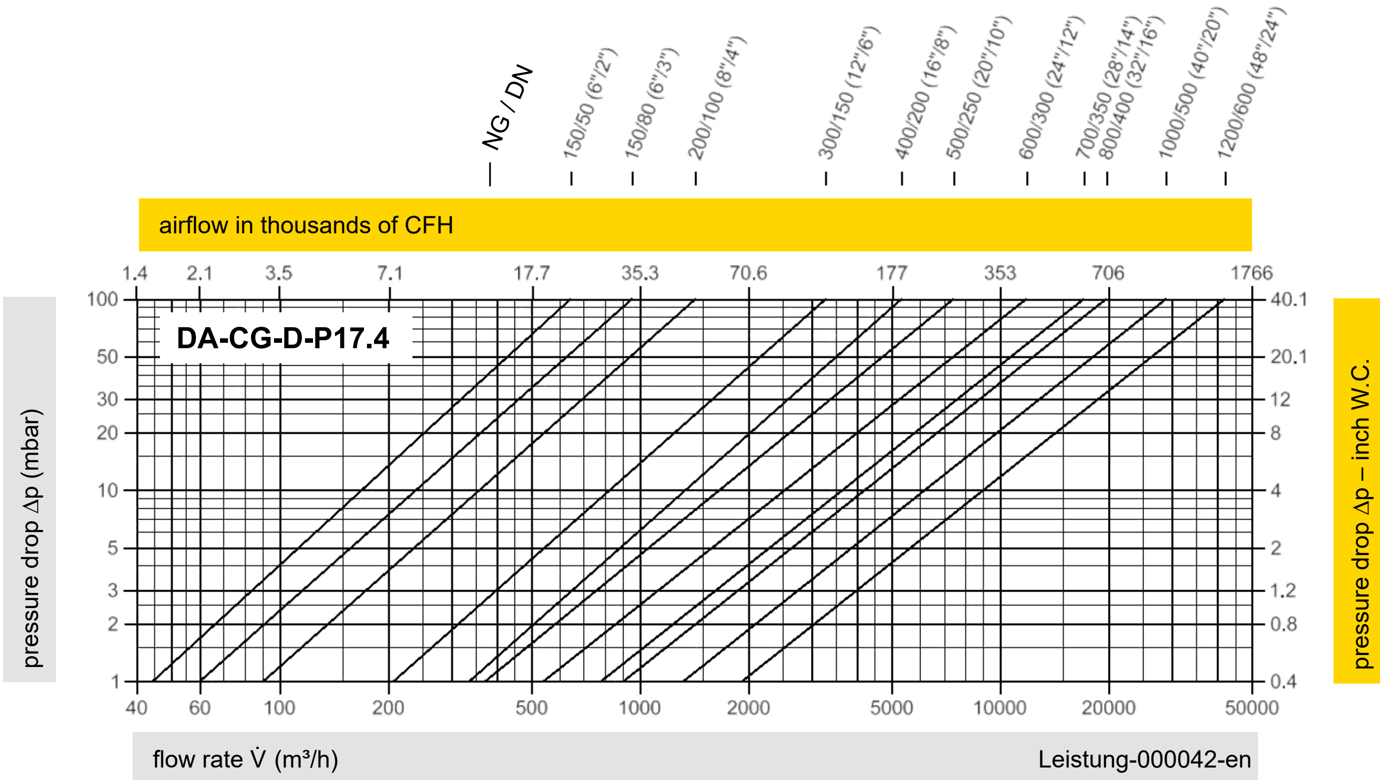
Table 6: Material combinations of the flame arrester unit

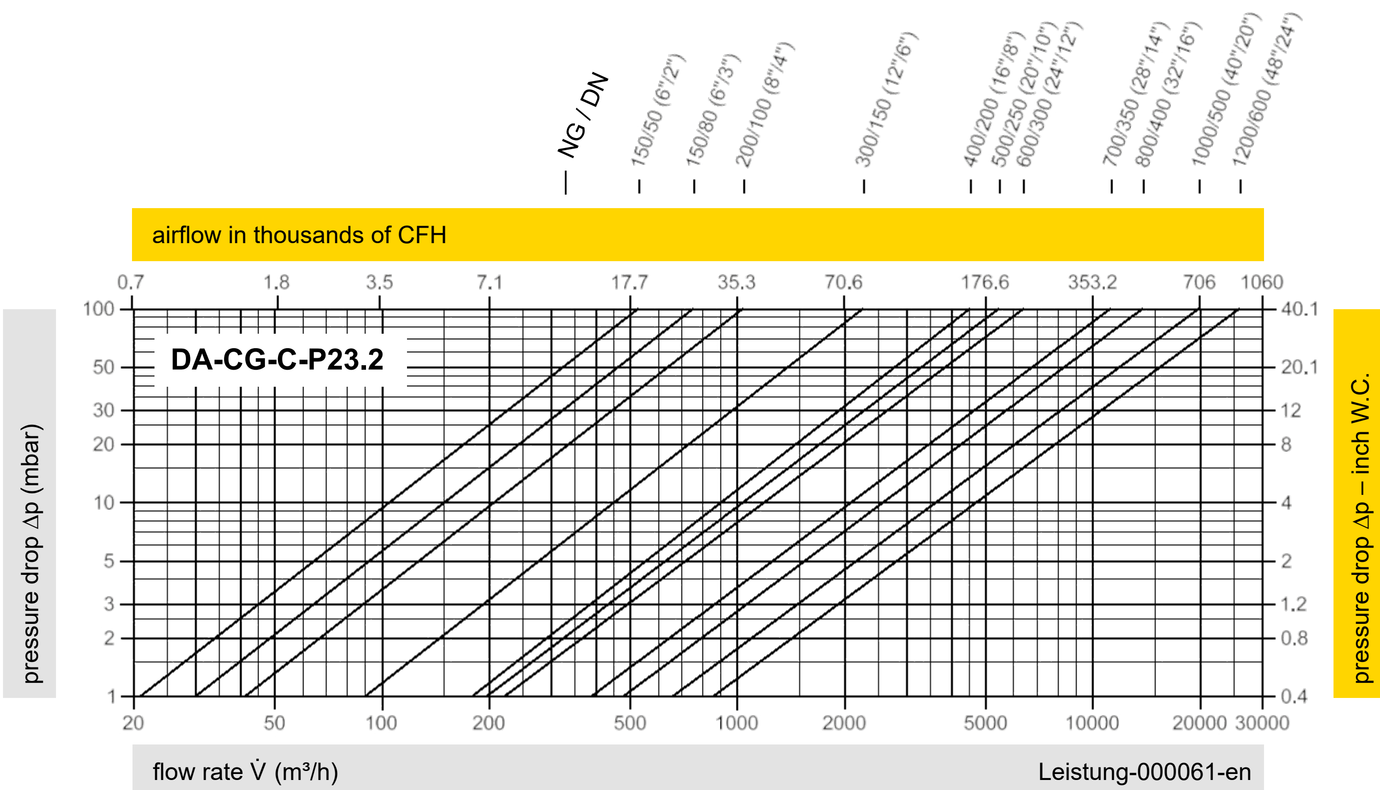
Design	A	B	*The FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.
FLAMEFILTER® cage	Steel	Stainless Steel	
FLAMEFILTER® *	Stainless Steel	Stainless Steel	
Spacer	Stainless Steel	Stainless Steel	

Special materials upon request.

Table 7: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	





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

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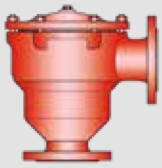
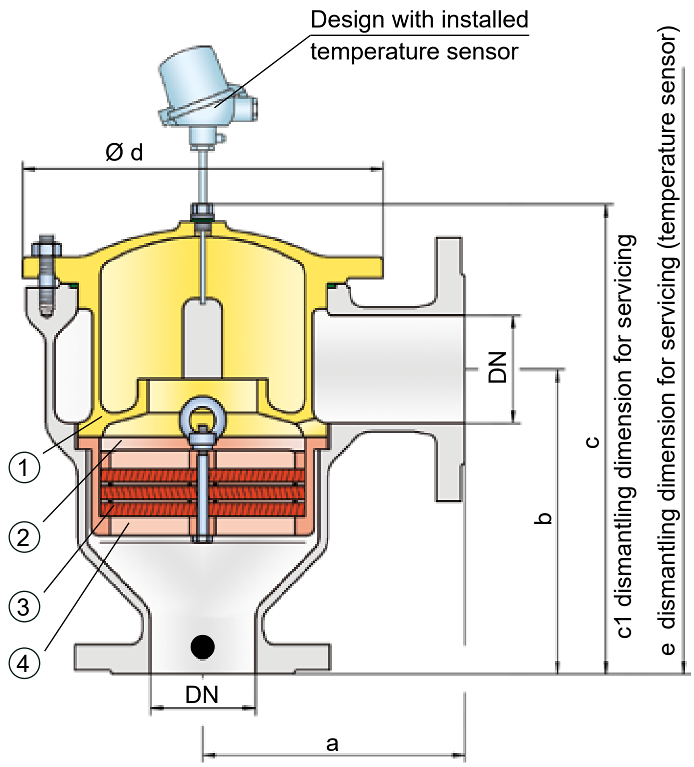


In-Line Detonation Flame Arrester

for unstable and stable detonations, and deflagrations in right angle design with a shock absorber, uni-directional

PROTEGO® DR/EU



● Connection to the protected side

Function and Description

The PROTEGO® DR/EU series of in-line detonation flame arresters represents further development of PROTEGO® flame arrester series DR/ES, which has been successfully used in industry for decades.

The device protects against deflagrations and stable and unstable detonations. The classic right-angle design offers considerable costs and maintenance advantages over the straight-through design.

Once a detonation enters the flame arrester, energy is absorbed from the detonation shock wave by the integrated shock absorber (1) before the flame is extinguished in the narrow gaps of the FLAMEFILTER® (3).

The PROTEGO® flame arrester unit (2) consists of several FLAMEFILTER® discs and spacers firmly held in the FLAMEFILTER® cage (4). The gap size and number of FLAMEFILTER® discs are by the operating conditions of the flowing mixture (explosion group, pressure, temperature). This device is can be used for explosion groups from IIA to IIB3 (NEC group D to C MESG ≥ 0.65 mm).

The standard design can be used with an operating temperature of up to +60°C / 140°F and an absolute operating pressure acc. to table 3. **Devices with special approval for higher pressures and temperatures are available upon request.**

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- low number of FLAMEFILTER® discs due to shock absorber technology
- quick removal and installation of the complete PROTEGO® flame arrester and the individual FLAMEFILTER® in the cage
- modular design enables replacement of the individual FLAMEFILTER® discs
- provides protection against deflagrations and stable and unstable detonations
- right-angle design eliminates need for pipe elbows
- advanced design for higher operating temperatures and pressures
- low pressure loss results in low operating and lifecycle costs
- cost-effective spare part

Design Types and Specifications

There are four different designs available:

Basic in-line detonation flame arrester	**DR/EU-** $\boxed{-}$ $\boxed{-}$
In-line detonation flame arrester with integrated temperature sensor* as additional protection against short-time burning	**DR/EU-** $\boxed{T}$ $\boxed{-}$
In-line detonation flame arrester with heating jacket	**DR/EU-** $\boxed{H}$ $\boxed{-}$
in-line detonation flame arrester with integrated temperature sensor* and heating jacket	**DR/EU-** $\boxed{H}$ - $\boxed{T}$

*Resistance thermometer for device group II, category (1) 2 (GII cat. (1) 2)

Stabilized FLAMEFILTER®
Discs (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	65 / 2 ½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"
a	125/4.92	125/4.92	153/6.02	155/6.10	198/7.80	200/7.87	250/9.84	332/13.07	335/13.19
b	140/5.51	140/5.51	183/7.20	185/7.28	223/8.78	225/8.86	290/11.42	357/14.06	360/14.17
c	210/8.27	210/8.27	290/11.42	290/11.42	365/14.37	365/14.37	440/17.32	535/21.06	535/21.06
c1	285/11.22	285/11.22	395/15.55	395/15.55	500/19.69	500/19.69	595/23.43	750/29.53	750/29.53
d	150/5.91	150/5.91	210/8.27	210/8.27	275/10.83	275/10.83	325/12.80	460/18.11	460/18.11
e	495/19.49	495/19.49	600/23.62	600/23.62	705/27.76	705/27.76	795/31.30	950/37.40	950/37.40

Table 2: Selection of the explosion group

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Special approvals upon request.
≥ 0,75 mm	IIB2	C	
≥ 0,65 mm	IIB3	C	

Table 3: Selection of max. operating pressure

		DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	65 / 2 ½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"
Expl. Gr.	IIA	P_{max}	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.5 / 21.7	1.2 / 17.4	1.2 / 17.4
	IIB2	P_{max}								1.4 / 20.3	1.4 / 20.3
	IIB3	P_{max}	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.6 / 23.2	1.4 / 20.3	1.2 / 17.4*	1.2 / 17.4*

P_{max} = maximum allowable operating pressure in bar / psi (absolute); higher operating pressure upon request.
* special flame arrester unit

Table 4: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 5: Material selection for housing

Design	B	C	D
Housing Heating jacket (DR/EU-H-(T)-...)	Carbon Steel Steel	Stainless Steel Stainless Steel	Hastelloy Stainless Steel
Cover with shock absorber	Steel	Stainless Steel	Hastelloy
O-Ring	FPM *	PTFE	PTFE
Flame arrester unit	A	C, D	E

*For devices exposed to elevated temperatures above 150°C / 302°F, gaskets are made of PTFE.

The housing and cover with the shock absorber can also be delivered in steel with an ECTFE coating.

Special materials upon request.

Table 6: Material combinations of the flame arrester unit

Design	A	C	D	E
FLAMEFILTER® cage	Steel	Stainless Steel	Stainless Steel	Hastelloy
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy
Spacer	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy

*The FLAMEFILTER® is also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.

Special materials upon request.

Table 7: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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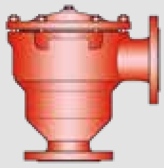
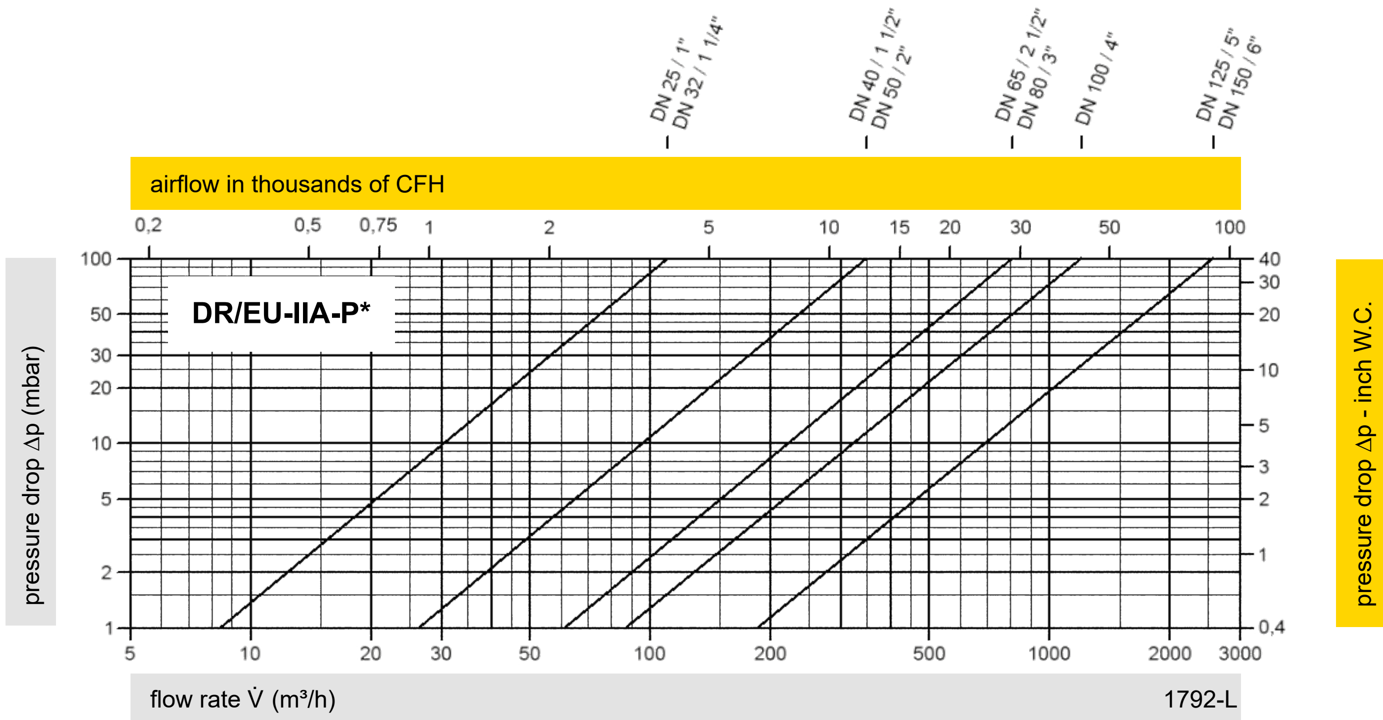


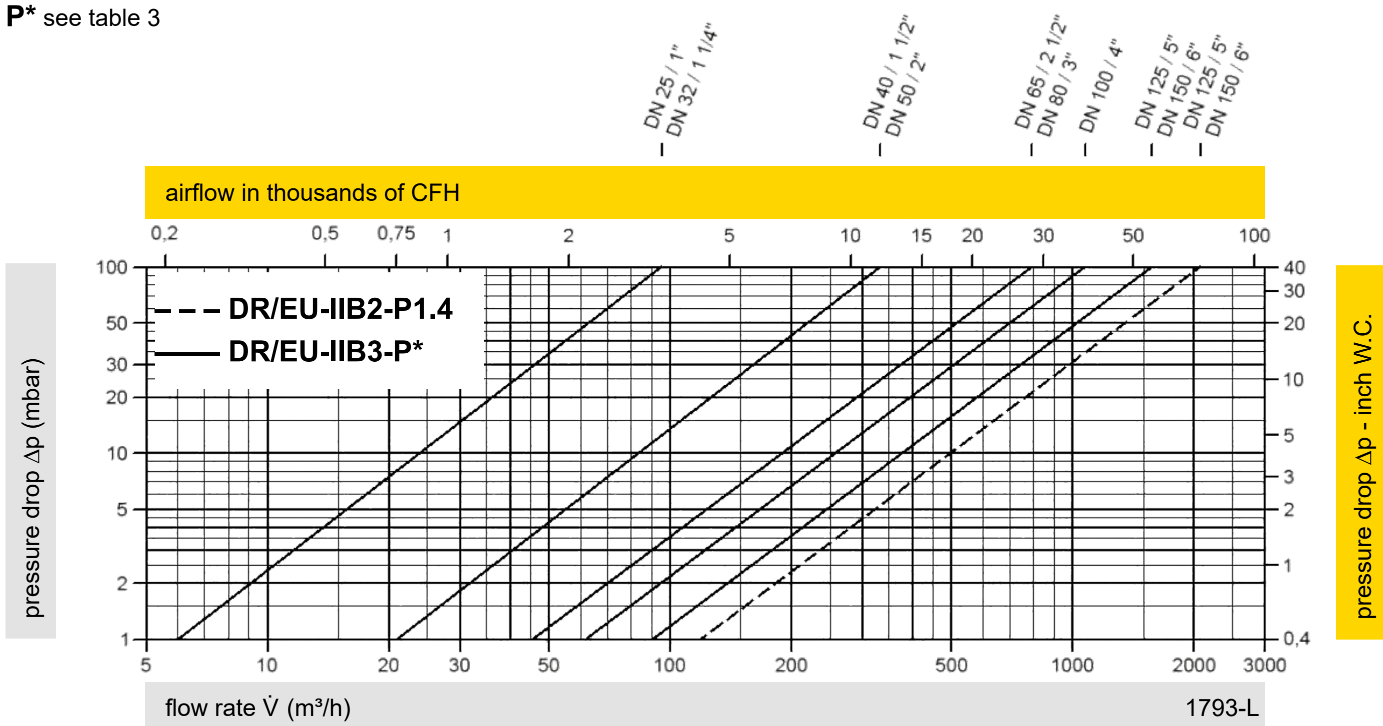
In-Line Detonation Flame Arrester

Flow Capacity Charts

PROTEGO® DR/EU



P* see table 3



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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:

PROTEGO® Pressure/Vacuum Relief Valves

End-of-Line

Section 5

Function and Description

The function of pressure/vacuum valves for relief and conservation and the corresponding applications is discussed in "Technical Fundamentals" (→Sec. 1). This section discusses the PROTEGO® product line of pressure/vacuum relief valves in end-of-line applications.

These are special devices that function as an **end-of-line valve** to protect against unacceptable over-pressure and under-pressure. If necessary, the valves are fitted with an attachment with flange connection so that a pipeline can be connected for releasing product vapors.

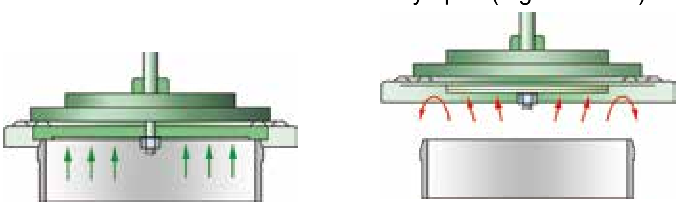
Pressure relief valves prevent vapor loss up to the adjusted set pressure and offer reliable protection against excess pressure.

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

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

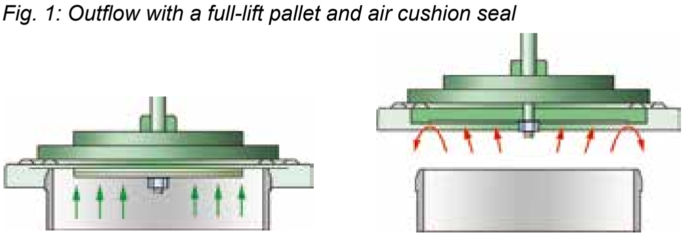
PROTEGO® pressure/vacuum relief valves have weight- loaded or spring-loaded valve pallets.

PROTEGO® pressure/vacuum relief valves with a full-lift pallet achieve full lift within 10% of the set pressure and then released the flow when the valve is fully open (Figs. 1 and 2).



closed *outflow with full lift*

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



closed *outflow with full lift*

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

This is achieved by precise coordination between the diameter and height of the valve pallet rim with the adapted, lapped valve seat. In addition, a flow-enhancing design reinforces the overall effect on the outflow side. These valve pallets are used in end-of-line valves and in-line valves.

Given the right size, the unique **10% technology** of the valves enables a set pressure that is just 10% below the maximum allowable tank pressure. Through continuous investments in and commitment to research and development, PROTEGO® has succeeded in transferring this opening behavior, which is typical for safety valves, to low pressure ranges. This feature is ensured by valve seats made of high-quality stainless steel and with individually lapped valve pallets or valve seats with an air cushion seal in conjunction with high-quality FEP film. Up to the set pressure, the pressure in the tank is maintained with a tightness that is far above the usual standards due to the highly developed production technology.

When extremely high venting rates are required due to fire on the outside surface of the tank or malfunctions in special tank equipment , additional **emergency pressure relief valves** must be used. Even in the low pressure range, the vent has the opening characteristic comparable to a typical high pressure safety relief valve. For tanks with emergency relief valves, the opening pressure of the relief valve needs to be below the set pressure of the emergency relief valves. The valve immediately opens to a full lift under a full load, like a classic safety valve, but in response to minimum changes in pressure. The full-lift pallets are the result of years of development, and the innovation engineering enables reliable valve pallet operation under a full load.

Diaphragm valves are pressure/vacuum relief valves with a flexible diaphragm. Due to their special design, they have proven to successfully operate in problematic products and at extremely low temperatures below freezing.

Special features and advantages

- large volume flows with only a small pressure difference
- set pressure close to opening pressure (10% technology) for optimum pressure maintenance in the system
- seal superior to normal standards, resulting in minimal product loss
- valve pallet is guided inside the housing to protect against harsh weather conditions

Preferred Applications

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

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

Pilot valves are advantageous for special control responses or when a tight seal is required up to the point at which the valve starts to open (-> Section 9).

High-velocity-vent valves are used on tanker ships and for special land uses (-> Section 7).

Installation and maintenance

The valves come with detailed installation and maintenance instructions.
Safety devices are installed for safe transportation. Make sure that the transportation locks are removed before installing the valves. Checklists help to ensure proper installation for optimal valve operation.

Selection

Selection of the correct valve is critical to the safe operation of the system.

Consider the following to select the appropriate valve:

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

Design – a combined end-of-line valve or separate pressure relief and vacuum relief valves with a perpendicular connection or horizontal connection. Since they are weight-loaded, they must be installed vertically.

The adjusted set pressure – the standard maximum allowable (tank) pressure minus 10% overpressure. This determines the combination of materials for the valve pallet.

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

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

The **nominal diameter** is usually determined by the flow rate which must be released to avoid an unallowable over-pressure and under-pressure. Certified flow rate diagrams are available. For correct sizing, the operating conditions, pressure loss in the pipelines (incl. other installed devices), and any possible backpressure must be considered.

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

Sizing

The **valve size** is such that the allowable pressures are not exceeded when releasing the required flow rate (Sec. 1). When determining the opening pressure of the valve, pressure losses in the connected pipes may also have to be considered.

Example 1

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

Requested: Valve size DN

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

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

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

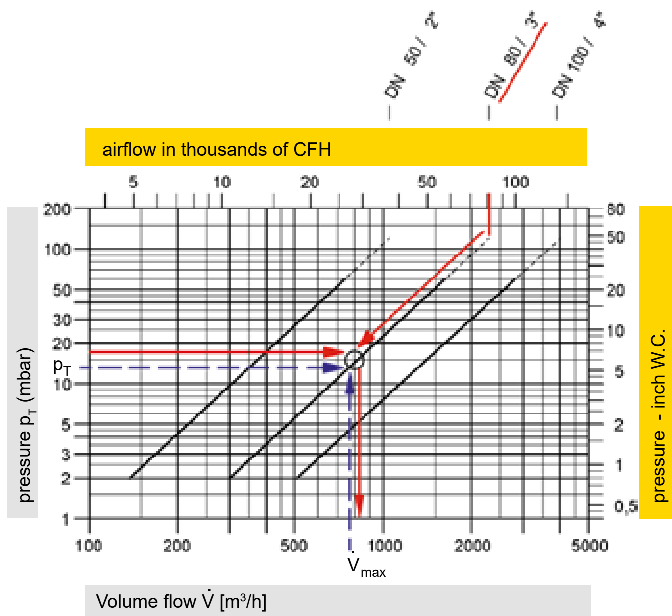
Example 2

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

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

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

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



The required set pressure (= start of opening) is the opening pressure (valve fully open) minus the characteristic overpressure.
For PROTEGO® valves and end of line devices, the overpressure characteristic is 10% unless otherwise stated. Within 10% overpressure, the valve pallet will reach full lift. A further increase in performance is possible according to the pressure loss curve shown in the diagram.

Material selection is based on plant and engineering specifications.

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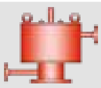
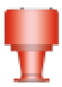
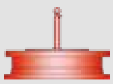
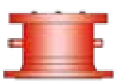
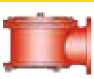
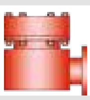
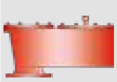
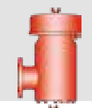
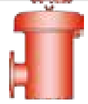
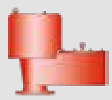
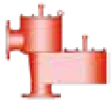
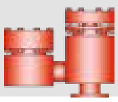
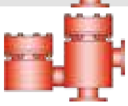
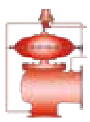
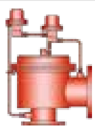
PROTEGO® Pressure/Vacuum Relief Valves - End-of-Line

Catalog

	Type	Size	pressure setting positive setting range mbar / inch W.C.	pressure setting negative setting range mbar / inch W.C.	Design O = horizontal connection X = vertical connection	O = soft sealing X = metallic sealing	O = for non-standard operating parameters	O = for critical medium (polimerization, corrosion, crystallization)	O = Heating jacket, Heating coil	Page
Pressure Relief Valves, weight pallet type										
	P/EL	50 - 80 2" - 3"	+3.5 up to +210/ +1.4 up to +84		X	O / X			O	176 - 177
	P/ELR	80 - 100 3" - 4"	+3.5 up to +210/ +1.4 up to +84		X	O / X			O	178 - 179
	SD/BS-H	80-200 3" - 8"	+5 up to +210/ +2 up to +84		X	X	O		O	180 - 181
	D/SVL	50-300 2" - 12"	+2.0 up to +60/ +0.8 up to +24		X	O / X				182 - 183
	ER-V-LP	200-700 8" - 28"	+3.4 up to +15/ +1.36 up to +6		X	O			O	184 - 185
	ER/V	200-700 8" - 28"	DN 200-350: +5 up to +40/ +2 up to +16 DN 400-700: +5 up to +25/ +2 up to +10		X	O			O	
	ER/VH	200-700 8" - 28"	DN 200-350: >+40 up to +60/ >+16 up to +24 DN 400-700: >+25 up to +60/ >+10 up to +24		X	O				186 - 187
	ER/V-F	200-700 8" - 28"	>+60 up to +500/ >+24 up to +200		X	O				188 - 189
	D/KSM	50-200 2" - 8"	+5.0 up to +100/ +2.0 up to +40		X	O	O	O		190 - 191
Vacuum Relief Valves, weight pallet type										
	SV/E-1-0	50 - 300 2" - 12"		-2.0 up to -60 / -0.8 up to -24	O	O / X			O	192 - 193
	SV/T-0-H	80 - 250 3" - 10"		-7.0 up to -50 / -2.8 up to -20	X	X	O		O	194 - 196
	V/KSM	50-200 2" - 8"		-5.0 up to -100 / -2.0 up to -40	O	O	O	O		198 - 199
	V/SV	40 - 300 1½" - 12"		-2.0 up to -60 / -0.8 up to -24	X	O / X			O	

	Type	Size	pressure setting positive setting range mbar / inch W.C.	pressure setting negative setting range mbar / inch W.C.	Design O = horizontal connection X = vertical connection	O = soft sealing X = metallic sealing	O = for non-standard operating parameters	O = for critical medium (polimerization, corrosion, crystallization)	O = Heating jacket, Heating coil	Page
Pressure and Vacuum Relief Valves, weight pallet type										
	PV/EL	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	O / X			O	200 - 202
	PV/ELR	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	O / X			O	204 - 206
	VD/SV	40 - 300 1½" - 12"	+2.0 up to +60 / +0.8 up to +24	-2.0 up to -60 / -0.8 up to -24	X	O / X			O	208 - 210
	VD/SV-PA(L)	50 - 300 2" - 12"	+2.0 up to +60 / +0.8 up to +24	-2.0 up to -60 / -0.8 up to -24	X	O / X			O	212 - 215
	VD/KSM	50 - 200 2" - 8"	+5.0 up to +100 / +2.0 up to +40	-5.0 up to -100 / -2.0 up to -40	X	O	O	O		216 - 218
	VD/KSM-PA	50 - 200 2" - 8"	+5.0 up to +100 / +2.0 up to +40	-5.0 up to -100 / -2.0 up to -40	X	O	O	O		220 - 222
Pressure and Vacuum Relief Valves, pilot-operated										
	VN-A-PCPF		→ Section 9							408 - 411 416
	VN-A-PCPM		→ Section 9 **NEW**							412 - 416
	PM-HF		→ Section 9							
	PM/(D)S		→ Section 9							**NEW**

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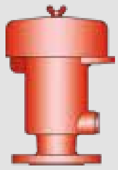
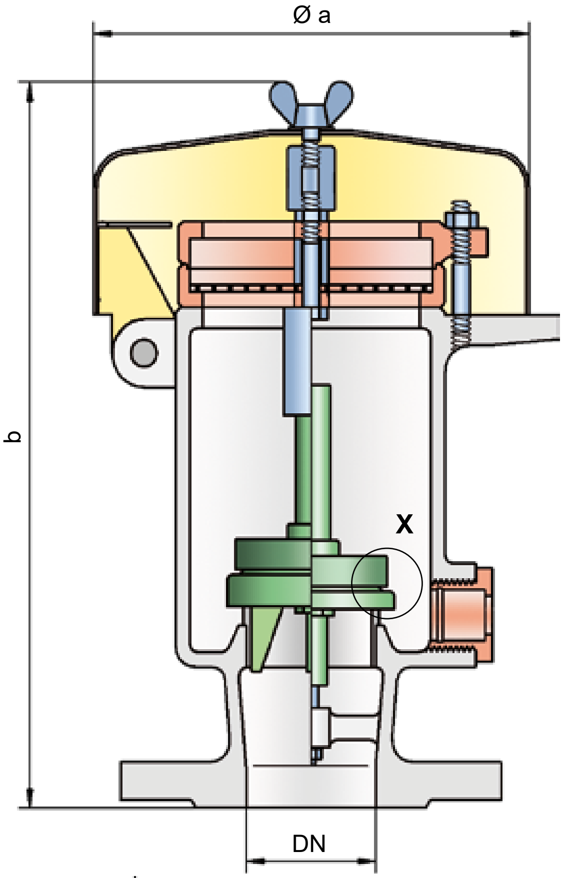


Pressure Relief Valve

PROTEGO® P/EL



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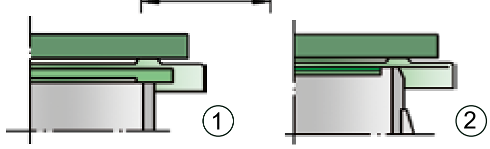


Pressure settings:

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

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low-pressure valve which has the same opening characteristic as a high-pressure safety relief valve.

With this “full lift type” technology, the valve can be set at just 10% below the maximum allowable working pressure of the tank and still safely vent the required flow.

Due to our highly developed manufacturing technology, the tank pressure is maintained up to the set pressure with a tightness that is far above the usual standards. This feature is achieved by valve seats made of high-quality stainless steel with precisely lapped valve pallets (1) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm.

The valve pallets are also available with a PTFE seal to prevent the valve pallets from sticking when sticky products are used, and they enable the use of corrosive substances. After the overpressure is released, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- automatic condensate drain

Design Types and Specifications

The valve pallet is weight-loaded. At set pressures greater than 80 mbar (32.1 inch W.C.), an extended model is used.

There are two different designs:

Pressure valve in basic design	**P/EL - $\boxed{–}$**
Pressure valve with heating jacket	**P/EL - $\boxed{H}$**

Additional special devices available upon request.

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Table 1: Dimensions				Dimensions in mm / inches
To select the nominal size (DN), use the flow capacity chart on the following page.				
DN	50 / 2"	50 / 2"	80 / 3"	80 / 3"
Set pressure	≤ +80 mbar ≤ +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

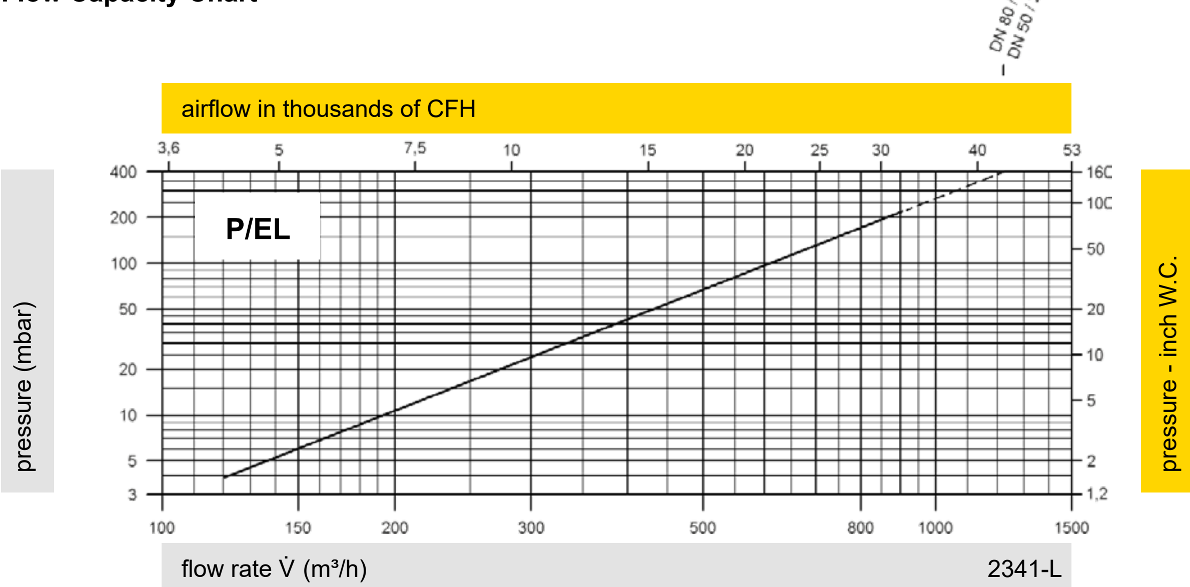
Dimensions for pressure valves with heating jacket upon request.

Table 2: Material selection for housing			
Design	B	C	Special materials upon request.
Housing Heating jacket (P/EL-H-...)	Steel Steel	Stainless Steel Stainless Steel	
Valve seat	Stainless Steel	Stainless Steel	
Weather hood	Steel	Stainless Steel	
Protective mesh screen	Stainless Steel	Stainless Steel	

Table 3: Material selection for pressure valve pallet					
Design	A	B	C	D	Special materials (Aluminum-coated, Titanium, Hastelloy) and higher pressure settings upon request.
Pressure range (mbar) (inch W.C.)	+3.5 up to +5.0 +1.4 up to +2.0	>+5.0 up to +14 >+1.4 up to +5.6	>+14 up to +210 >+5.6 up to +84	>+14 up to +210 >+5.6 up to +84	
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 4: Flange connection type	
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

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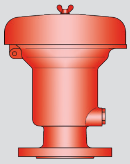

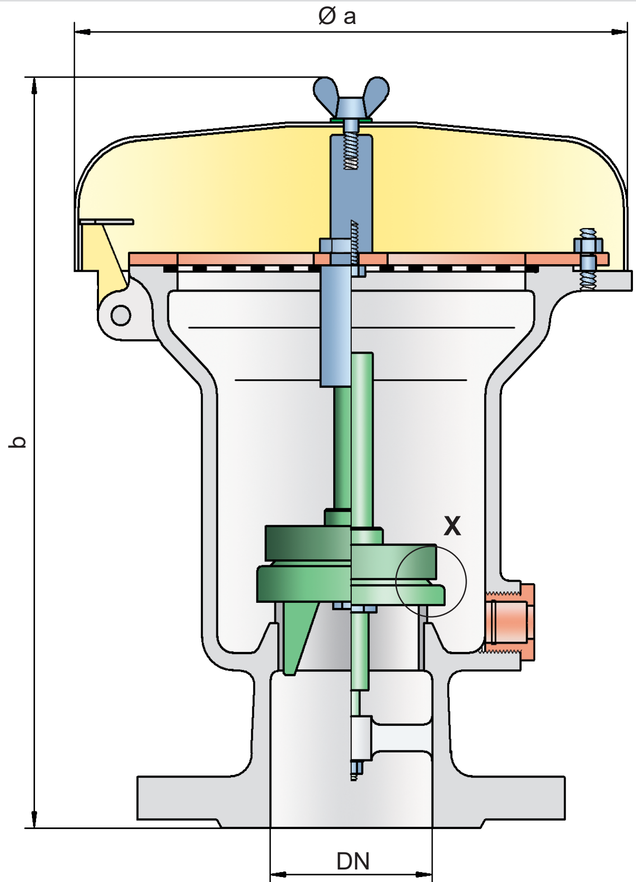

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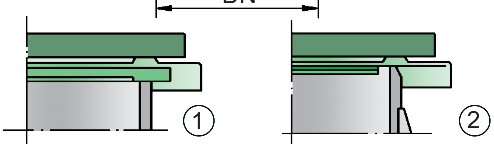

Pressure settings:

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

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve.

With this "full lift type" technology, valve can be set at just 10% below the maximum allowable working pressure of the tank and still safely vent the required mass flow.

Due to our highly developed manufacturing technology, the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is achieved by valve seats made of high quality stainless steel and with precisely 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 substance. After the overpressure is released, the valve re-seats and provides a tight seal.

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There are two different designs:

Pressure valve in basic design	**P/ELR -** $\boxed{-}$
Pressure valve with heating jacket	**P/ELR -** $\boxed{H}$

Additional special devices available upon request.

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

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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	350 / 13.78	510 / 20.08	350 / 13.78	510 / 20.08

Dimensions for pressure valves with heating jacket upon request.

Table 2: Material selection for housing

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

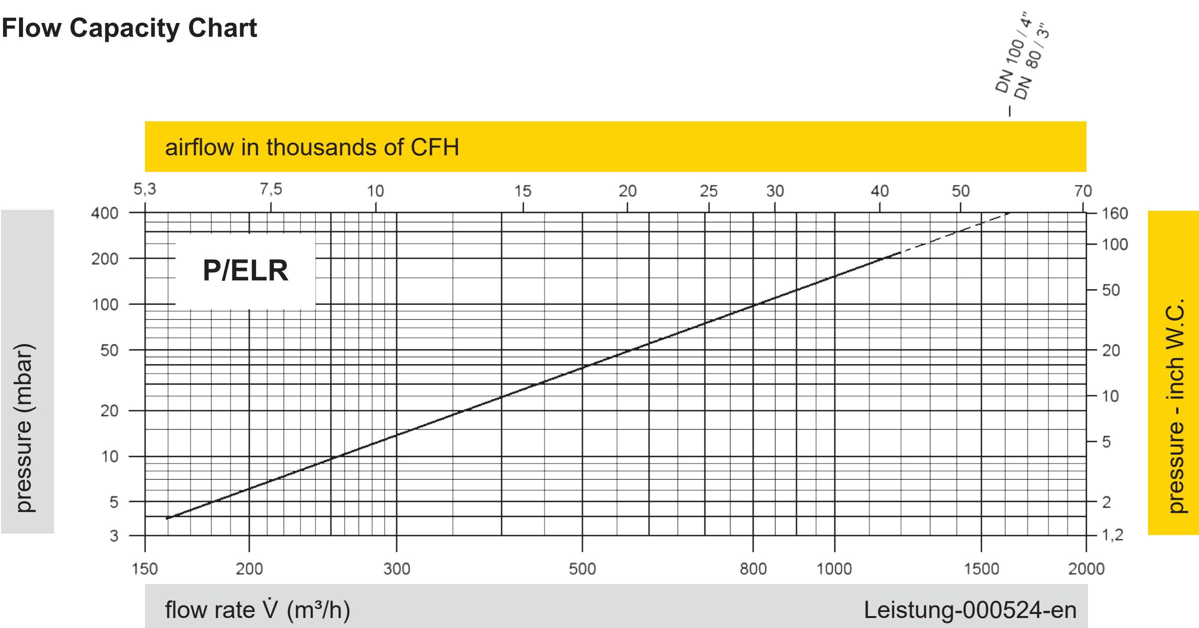
Table 3: Material selection for pressure valve pallet

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

Table 4: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



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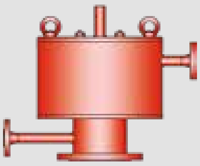
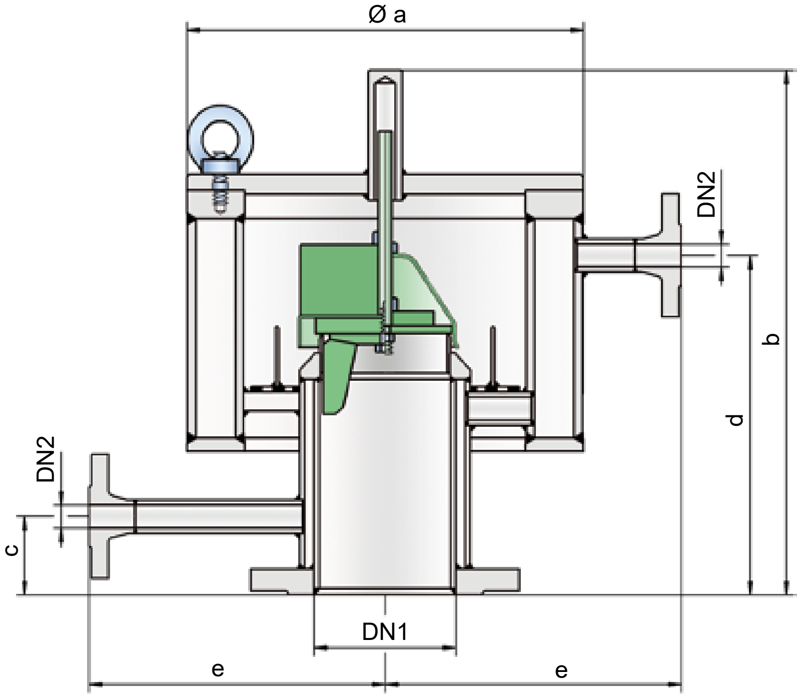


Pressure Relief Valve

in heat jacketed design

PROTEGO® SD/BS-H



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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in areas subject to an explosion hazard
- complete heating jacket up to the flange to avoid ice build-up
- maximum allowable heating medium temperature of 320°C / 608°F (at 6 bar / 87 psi)
- available in a special design with a heatable valve cover
- for low pressure settings, an optimized valve pallet cover prevents the set pressure from being adjusted due to dust deposits or condensate
- sturdy housing design
- available in a special design with lifting device

Pressure Settings:

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

Function and Description

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

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. With this “full lift type” technology, the valve can be set at just 10% below the maximum allowable working pressure of the tank and still safely vent the required mass flow.

Design Types and Specifications

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

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

Additional special devices available upon request.

Table 1: Dimensions Dimensions in mm / inches

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

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

* also available with special flange DN 50 / 2"

Vents - 10% Technology (Flyer pdf)

Leak Rate/10% Technology (Flyer pdf)

Table 2: Material selection for housing

Design	A	B
Housing Heating Jacket	Steel Steel	Stainless Steel Stainless Steel
Valve Seat	Stainless Steel	Stainless Steel

Special materials upon request.

Table 3: Material selection for pressure valve pallet

Design	A	B	C
Pressure range (mbar) (inch W.C.)	+5 up to +25 +2 up to +10	>+10 up to +30 >+4 up to +12	>+30 up to +210 >+12 up to +84
Valve pallet	Aluminum	Stainless Steel	Stainless Steel
Valve pallet hood	Stainless Steel	Stainless Steel	-
Sealing	Metal to Metal	Metal to Metal	Metal to Metal

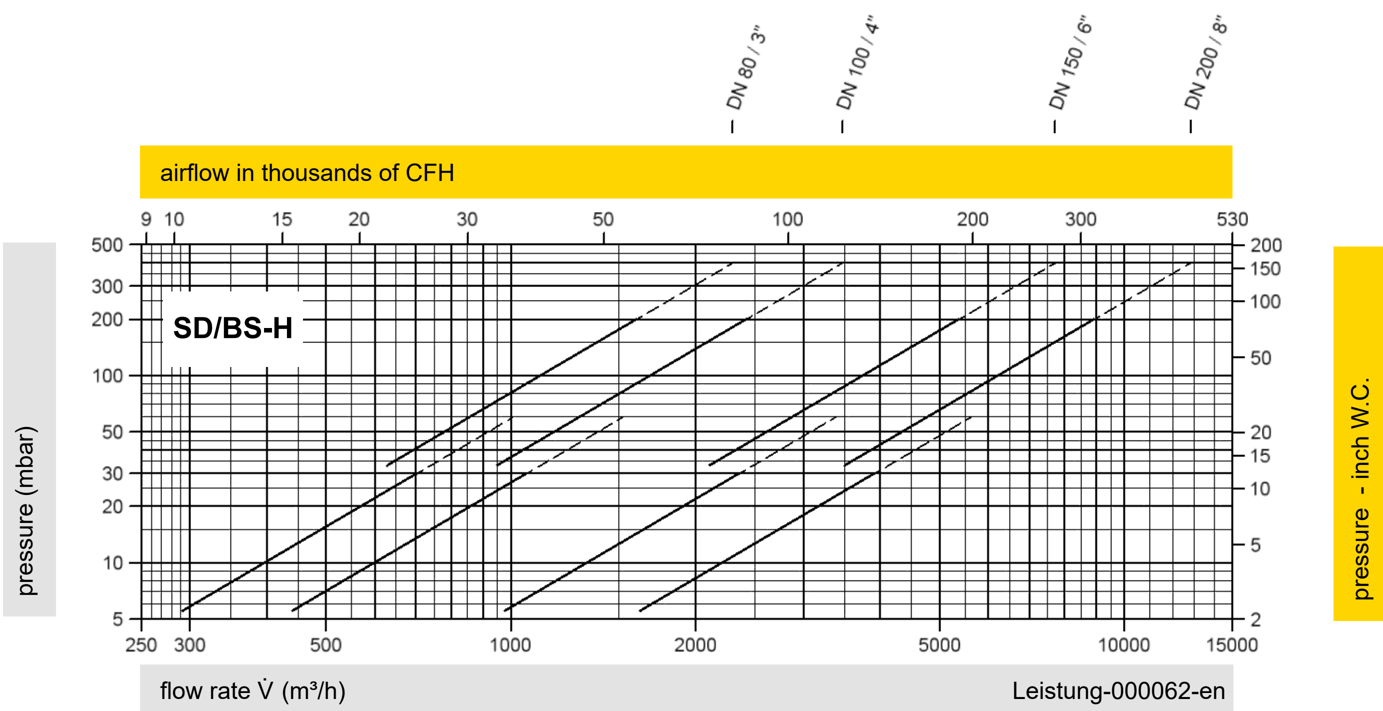
Special materials and higher pressure settings upon request.

Table 4: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

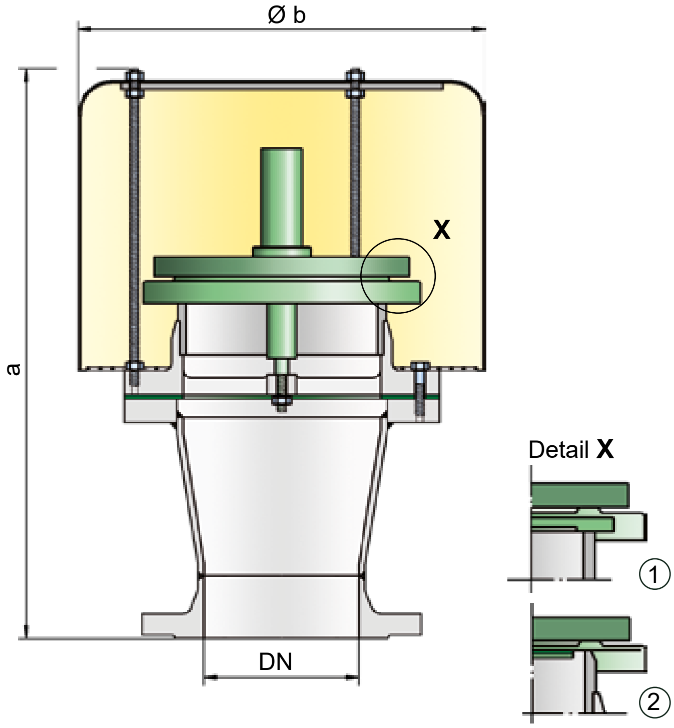
Flow Capacity Chart



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

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

PROTEGO for safety and environment



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

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve.

With this "full lift type" technology, the valve can be set at just 10% below the maximum allowable working pressure of the tank and still safely vent the required mass flow.

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard. This feature is achieved by valve seats made of high quality stainless steel and with precisely 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 pallet from sticking when sticky products are used, and they enable the use of corrosive substances. After the overpressure is released, the valve re-seats and provides a tight seal again. The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research, resulting in a stable operation of the valve pallet, optimized performance, and reduced product losses.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- particularly high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- best technology for API tanks

Design Types and Specifications

The valve pallet is weight-loaded. Higher pressures with a special spring-loaded design are available upon request.

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

Additional special devices available upon request.

Table 1: Dimensions Dimensions in mm / inches

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

DN	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	336 / 13.23	412 / 16.22	444 / 17.48	564 / 22.20	664 / 26.20	687 / 27.05	687 / 27.05
b	200 / 7.87	295 / 11.61	295 / 11.61	465 / 18.31	550 / 21.65	650 / 25.59	650 / 25.59

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

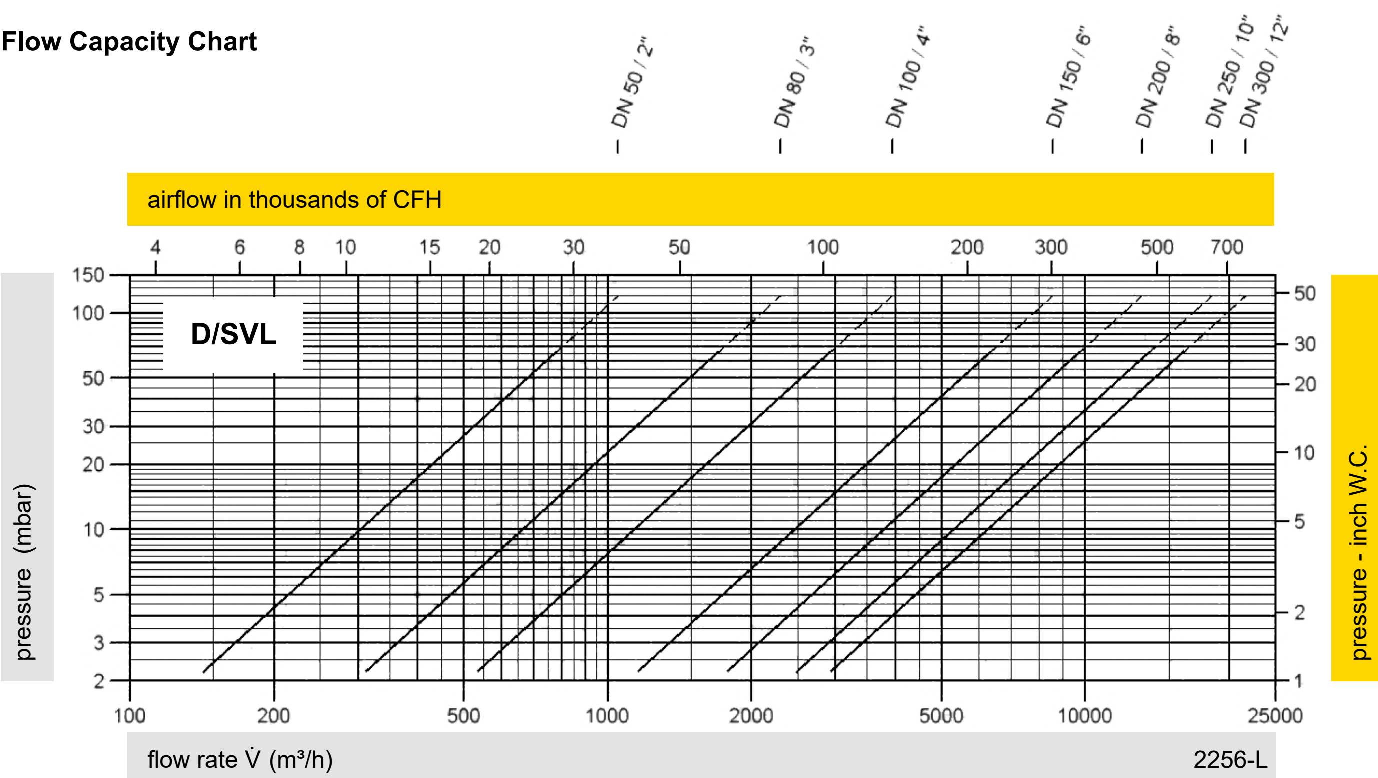
Table 2: Material selection for housing			
Design	A	B	
Housing	Steel	Stainless Steel	
Valve seat	Stainless Steel	Stainless Steel	Special materials upon request.
Sealing	PTFE	PTFE	
Weather hood	Stainless Steel	Stainless Steel	

Table 3: Material selection for pressure valve pallet						
Design	A	B	C	D	E	F
Pressure (mbar) range (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	Aluminum	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 4: Flange connection type	
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



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

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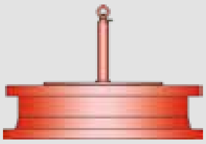
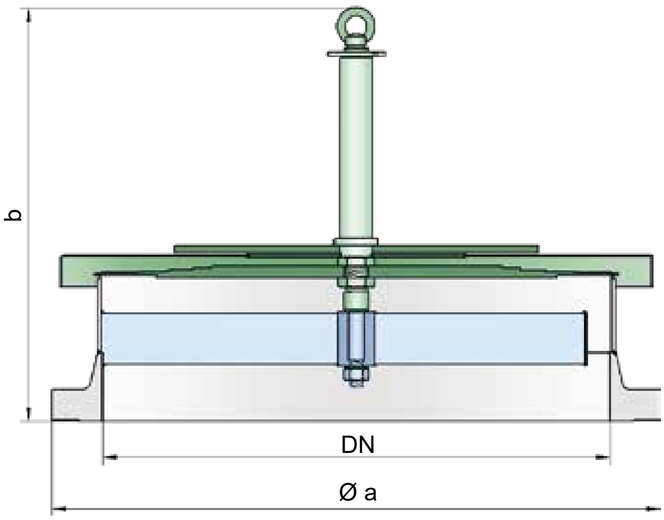


PROTEGO® ER-V-LP



Pressure settings:

DN 200/8" to DN 300/12" :	+3.4 mbar	up to +40 mbar
	+1.4 inch W.C.	up to +16 inch W.C.
DN 350/14" to DN 700/28":	+3.4 mbar	up to +25 mbar
	+1.4 inch W.C.	up to +10 inch W.C.

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

Function and Description

The PROTEGO® type ER-V-LP valve is a sophisticated pressure relief valve for applications in which a high flow efficiency is of the essence. It is primarily used as an emergency pressure relief valve on storage tanks, vessels, silos, and process engineering equipment. It offers reliable protection against excessive overpressure and prevents excessive product loss at pressures as high as close to the set pressure. It is designed to release particularly large quantities to prevent the vessel from rupturing in an emergency case.

The valve will start to open as soon as the set pressure is reached and only requires a 10% pressure increase or opening pressure differential until full lift. Continuous investments in and a commitment to research and development have enabled PROTEGO® to develop a new *valve pallet technology* for which a patent has been granted. This patented *valve pallet technology* enables the typical safety valve characteristics to be applied to low pressure ranges while also maintaining a low leakage rate.

Adopting this new patented *valve pallet technology* permits the valve to be set to just 10% below the maximum allowable working pressure of the tank and still vent the required flow.

Due to the sophisticated manufacturing technology, the tank pressure is maintained up to the set pressure, with a tightness that is far above the common standards. Once the excess pressure is released, the valve re-seats and seals tight again.

Special Features and Advantages

- patented *valve pallet technology* guarantees excellent tightness resulting in the lowest possible product losses and reduced environmental impact
- 10% technology for minimum pressure increase until full lift
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow efficiency
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- sturdy housing design
- secured movable components
- best technology for API tanks

Design Types and Specifications

The valve pallet is weight-loaded. Higher set pressures are achieved with types ER/V and ER/VH (lever-operated) valves or Type ER/V-F (spring-loaded) valves.

Pressure valve in basic design	**ER-V-LP**

Additional special devices available upon request.

Emergency Relief Valve
(Flyer pdf)

Vents - 10% Technology
(Flyer pdf)

Table 1: Dimensions Dimensions in mm / inches

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

DN	200 / 8"	250 / 10"	300 / 12"	350 / 14"	400 / 16"	450 / 18"	500 / 20"	600 / 24"	700 / 28"
a	343 / 13.50	406 / 15.98	483 / 19.02	533 / 20.98	597 / 23.50	635 / 25.00	699 / 27.52	813 / 32.01	837 / 32.95
b	378 / 14.88	399 / 15.71	409 / 16.10	440 / 17.32	455 / 17.91	464 / 18.27	481 / 18.94	556 / 21.89	571 / 22.48

Table 2: Material selection

Design	A	B
Housing	Steel	Stainless Steel
Valve seat	Stainless Steel	Stainless Steel
Valve pallet	Stainless Steel	Stainless Steel
Sealing	Stainless Steel	Stainless Steel

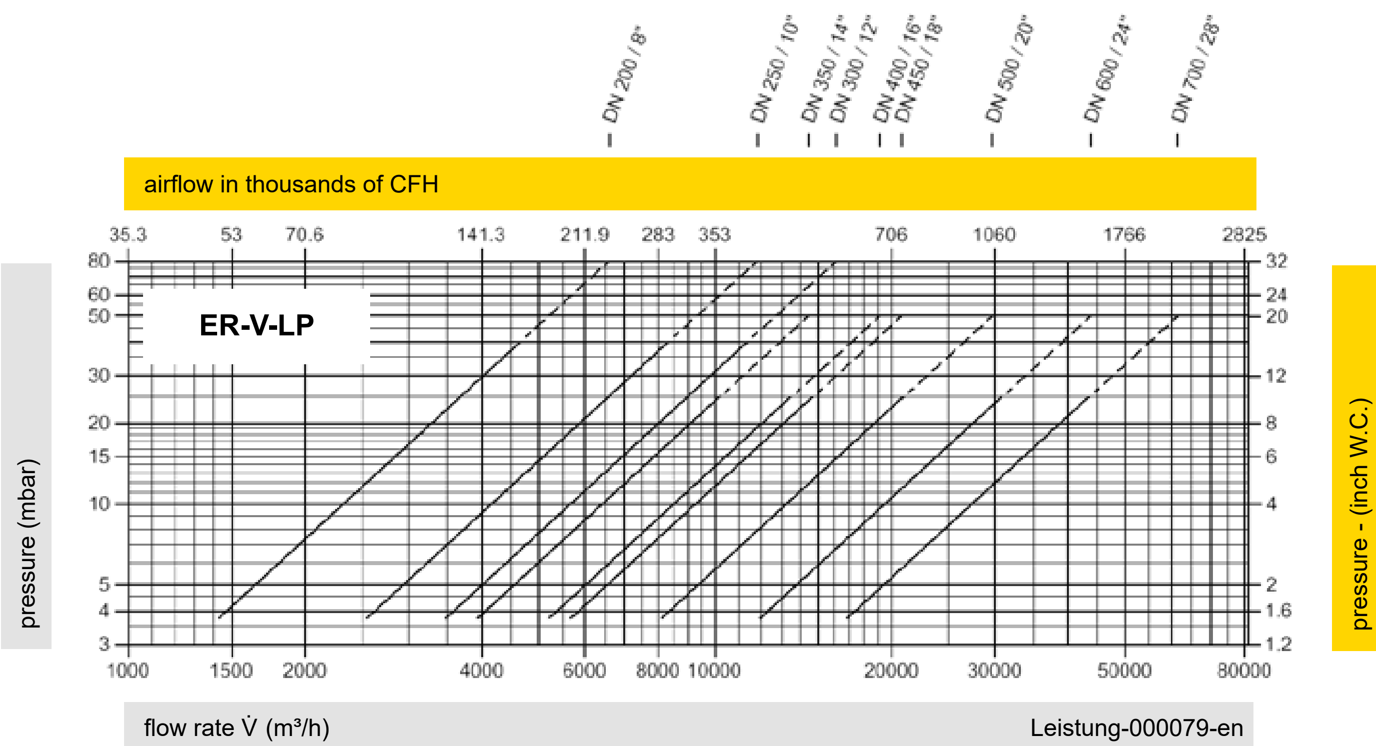
Special materials upon request.

Table 3: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

Flow Capacity Chart



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

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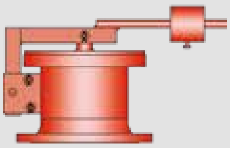
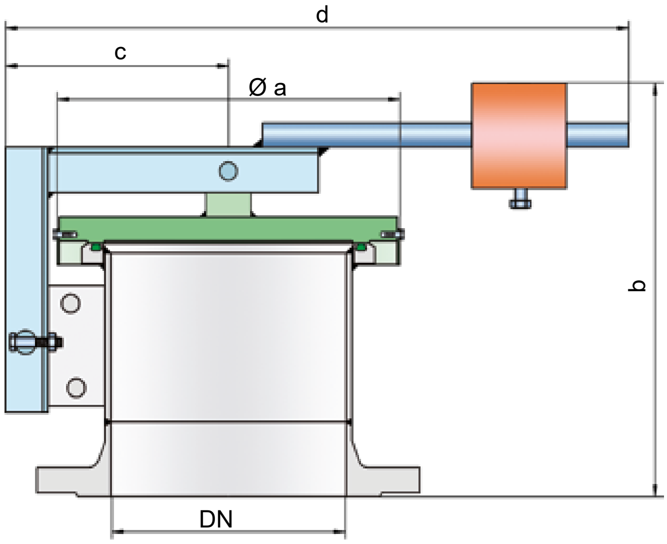


Pressure Relief Valve

PROTEGO® ER/VH



Pressure settings:

DN 200/8"	:>+35 mbar	up to +60 mbar
	>+14 inch W.C.	up to +24 inch W.C.
DN 250/10" to DN 350/14":	>+30 mbar	up to +60 mbar
	>+12 inch W.C.	up to +24 inch W.C.
DN 400/16" to DN 700/28":	>+25 mbar	up to +60 mbar
	>+10 inch W.C.	up to +24 inch W.C.

Higher and lower pressure settings upon request.

Function and Description

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

When the set pressure is reached, the valve starts to open and is fully open within 10% overpressure. This unique 10% "full lift type technology" enables a pressure setting that is only 10% below the maximum allowable working pressure or design pressure of the tank.

Even in the low pressure range, the vent has the opening characteristic comparable to a typical high pressure safety relief valve. The full lift type pallets are a result of many years of development. The valve pallet is mounted on one side.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- excellent tightness resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- can be used in explosion hazardous areas
- sturdy housing design
- secured housing cover with lever and lockable weight load
- best technology for API tanks

Design Types and Specifications

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

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

Additional special devices available upon request.

Vents - 10% Technology
(Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	200 / 8"	250 / 10"	300 / 12"	350 / 14"	400 / 16"	450 / 18"	500 / 20"	600 / 24"	700 / 28"
a	305 / 12.01	375 / 14.76	425 / 16.73	445 / 17.52	495 / 19.49	545 / 21.46	615 / 24.21	715 / 28.15	795 / 31.30
b EN	350 / 13.78	375 / 14.76	395 / 15.56	380 / 14.96	400 / 15.375	410 / 16.314	430 / 16.93	400 / 15.75	425 / 16.73
b ASME	390 / 15.36	409 / 16.10	442 / 17.40	439 / 17.28	455 / 17.91	478 / 18.82	500 / 19.69	471 / 18.54	420 / 16.54
c	200 / 7.87	240 / 9.45	265 / 10.43	285 / 11.22	310 / 12.20	330 / 12.99	360 / 14.17	410 / 16.14	450 / 17.72
d	590 / 23.23	735 / 28.94	780 / 30.71	845 / 33.27	890 / 35.04	1070 / 42.13	1090 / 42.91	1140 / 44.88	1380 / 54.33

Table 2: Material selection

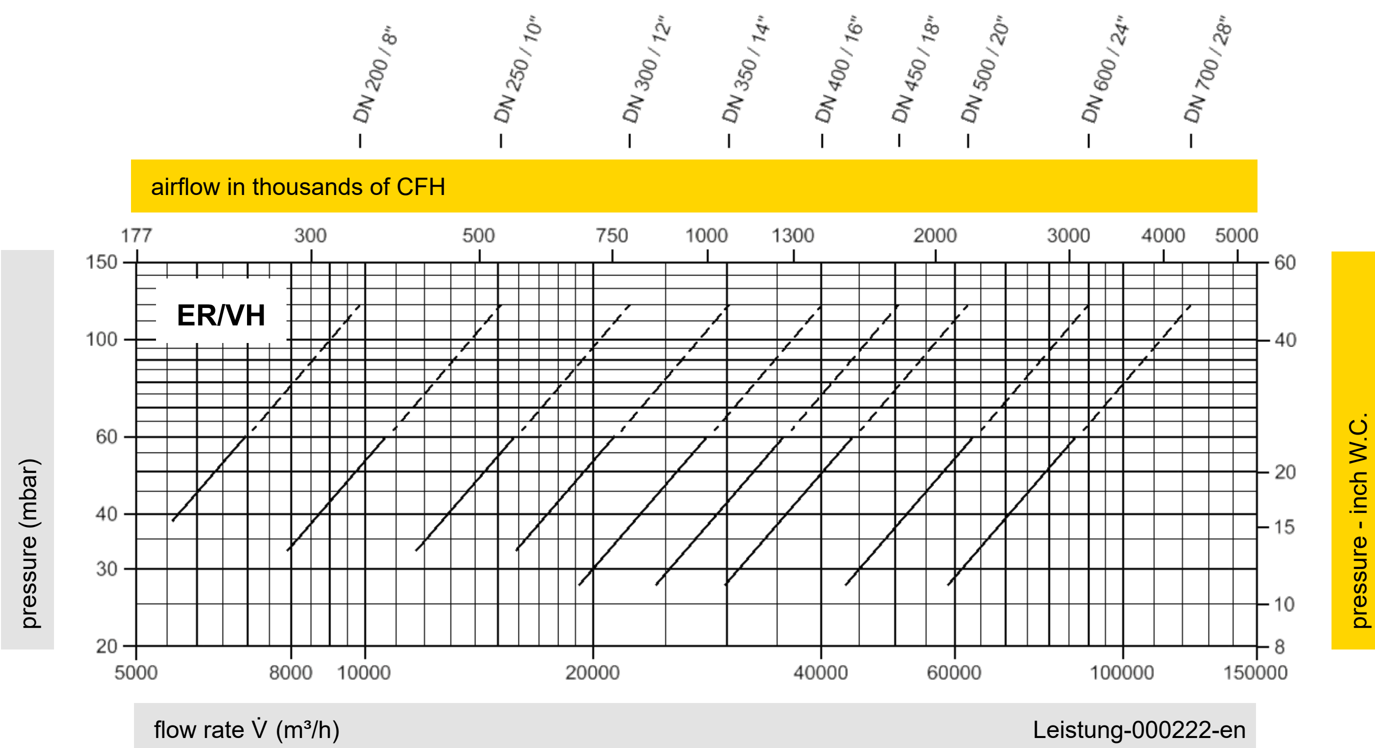
Design	A	B
Housing	Steel	Stainless Steel
Valve seat	Stainless Steel	Stainless Steel
Valve pallet	Stainless Steel or Steel-Stainless Steel	Stainless Steel
Sealing	FPM	FPM
Weight	Steel	Stainless Steel

Special materials upon request.

Table 3: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



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

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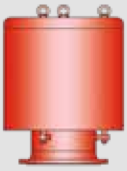
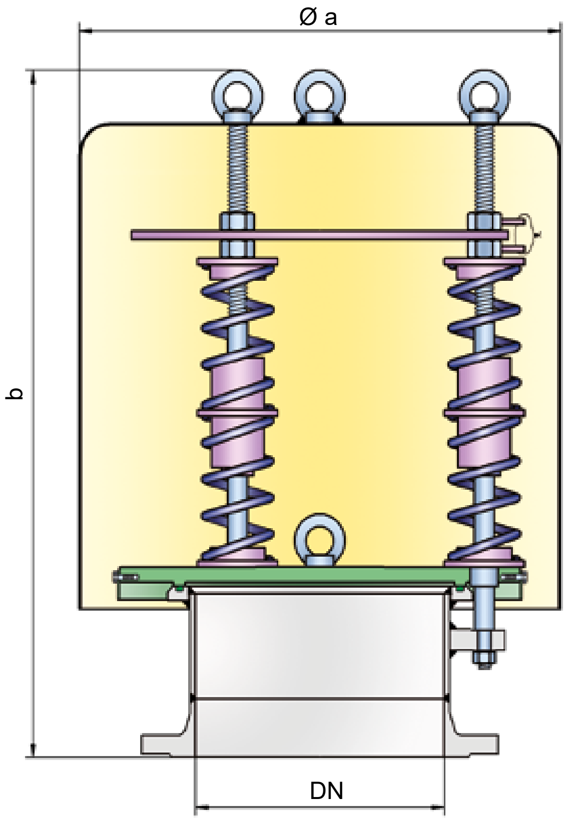




Pressure settings:

>+60 mbar up to +500 mbar
>+24 inch W.C. up to +200 inch W.C.
Higher pressure settings upon request.
For lower pressure settings, see types ER-V-LP, ER/V, and ER/VH.

Function and Description

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

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to reach full lift. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This "full lift type" technology allows the valve to be set at just 10% below the maximum allowable working pressure of the tank and still safely vent the required mass flow.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- excellent tightness resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- sturdy housing design
- spring-loaded for high set pressures
- best technology for API tanks

Design Types and Specifications

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

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

Additional special devices available upon request.

Vents - 10% Technology
(Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	200 / 8"	250 / 10"	300 / 12"	350 / 14"	400 / 16"	450 / 18"	500 / 20"	600 / 24"	700 / 28"
a	465 / 18.31	550 / 21.65	650 / 25.59	650 / 25.59	800 / 31.50	800 / 31.50	1000 / 39.37	1000 / 39.37	1200 / 47.24
b EN	860 / 33.86 (≤370 mbar ≤148 inchW.C.)	860 / 33.86 (≤240 mbar ≤96 inchW.C.)	1170 / 46.06 (≤240 mbar ≤96 inchW.C.)	1170 / 46.06 (≤270 mbar ≤108 inchW.C.)	1150 / 45.28 (≤220 mbar ≤88 inchW.C.)	1175 / 46.26 (≤170 mbar ≤68 inchW.C.)	1430 / 56.30 (≤130 mbar ≤52 inchW.C.)	1425 / 56.10 (≤140 mbar ≤56 inchW.C.)	1690 / 66.54 (≤140 mbar ≤56 inchW.C.)
b EN	980 / 38.58 (>370 mbar >148 inchW.C.)	980 / 38.58 (>240 mbar >96 inchW.C.)	1490 / 58.66 (>240 mbar >96 inchW.C.)	1490 / 58.66 (>270 mbar ≤108 inchW.C.)	1490 / 58.66 (>220 mbar ≤88 inchW.C.)	1515 / 59.65 (>170 mbar >68 inchW.C.)	1660 / 65.35 (>130 mbar >52 inchW.C.)	1655 / 65.16 (>140 mbar >56 inchW.C.)	1910 / 75.20 (>140 mbar >56 inchW.C.)
b ASME	900 / 35.43 (≤370 mbar ≤148 inchW.C.)	894 / 35.20 (≤240 mbar ≤96 inchW.C.)	1217 / 47.91 (≤240 mbar ≤96 inchW.C.)	1229 / 48.39 (≤270 mbar ≤108 inchW.C.)	1205 / 47.44 (≤220 mbar ≤88 inchW.C.)	1243 / 48.94 (≤170 mbar ≤68 inchW.C.)	1500 / 59.06 (≤130 mbar ≤52 inchW.C.)	1496 / 58.90 (≤140 mbar ≤56 inchW.C.)	
b ASME	1020 / 40.16 (>370 mbar >148 inchW.C.)	1014 / 39.92 (>240 mbar >96 inchW.C.)	1537 / 60.51 (>240 mbar >96 inchW.C.)	1549 / 60.98 (>270 mbar ≤108 inchW.C.)	1545 / 60.83 (>220 mbar ≤88 inchW.C.)	1583 / 62.32 (>170 mbar >68 inchW.C.)	1730 / 68.11 (>130 mbar >52 inchW.C.)	1726 / 67.95 (>140 mbar >56 inchW.C.)	

Table 2: Material selection

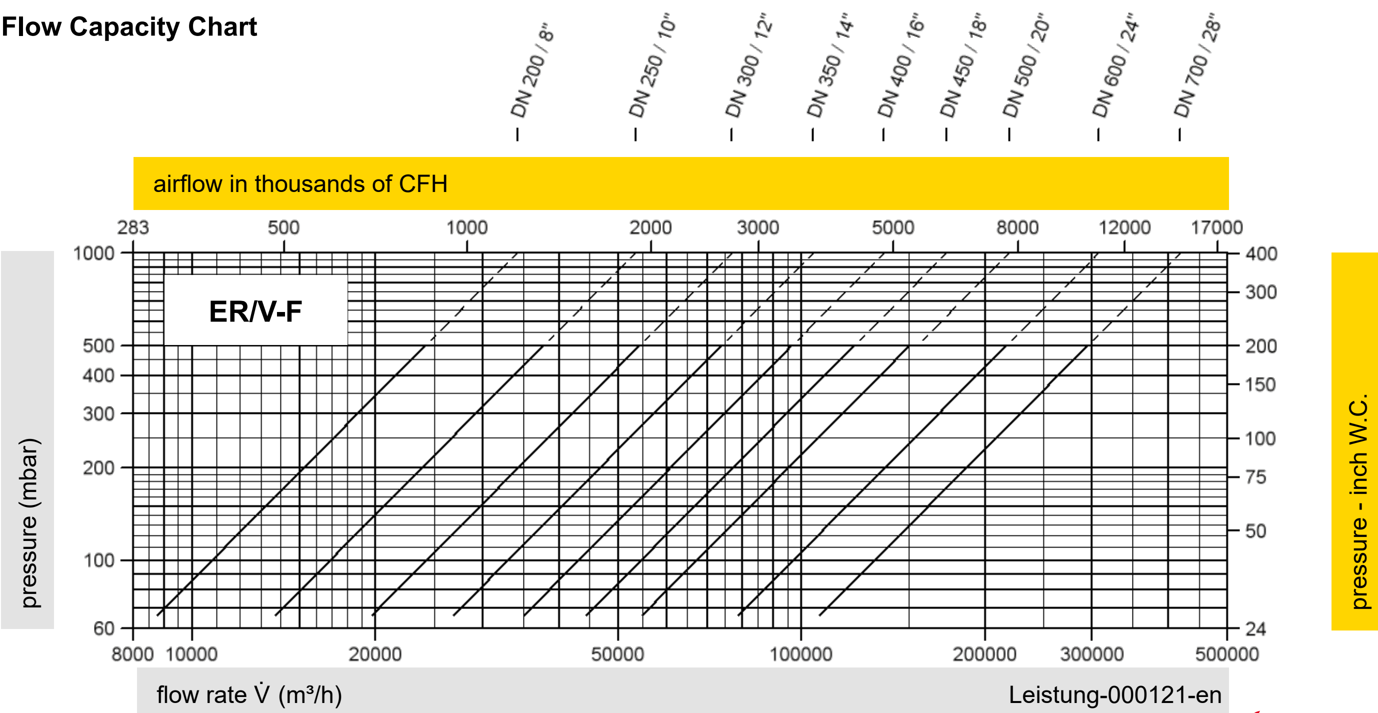
Design	A	B
Housing	Steel	Stainless Steel
Valve seat	Stainless Steel	Stainless Steel
Valve pallet	Stainless Steel or Steel-Stainless Steel	Stainless Steel
Sealing	FPM	FPM
Pressure spring	Stainless Steel	Stainless Steel
Weather hood	Steel	Stainless Steel

Special materials upon request.

Table 3: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



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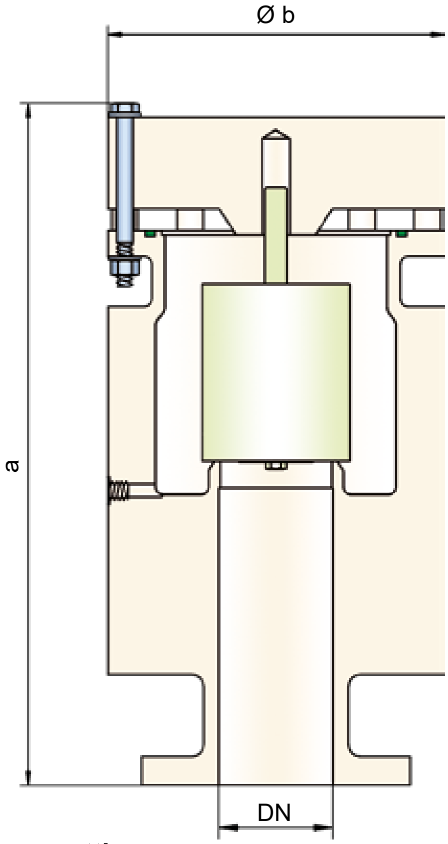
Pressure Relief Valve

made of plastic

PROTEGO® D/KSM



Pressure settings:

+6.0 mbar up to +100 mbar (DN 50/2”)
+2.4 inch W.C. up to +40 inch W.C.

+4.0 mbar up to +100 mbar (DN 80/3”)
+1.6 inch W.C. up to +40 inch W.C.

+4.5 mbar up to +100 mbar (DN 100/4” - DN 200/8”)
+1.8 inch W.C. up to +40 inch W.C.

Higher pressure settings upon request.

Function and Description

The PROTEGO® valve D/KSM is a state-of-the-art pressure relief valve with excellent flow performance made out of high grade synthetic material. It is primarily used as a safety fitting for relieving pressure in tanks, containers, and process engineering equipment. The valve prevents emission losses almost up to the set pressure. The valve is a perfect solution for corrosive, polymerizing, or sticky substances. The device will start to open as soon as the set pressure is reached and only required 10% overpressure to reach full lift.

Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set at just 10% below the maximum allowable working pressure (MAWP) of the tank and still safely vent the required mass flow.
Due to our highly developed manufacturing technology, the tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard. This feature is achieved by special valve seats made of high quality synthetic material or PTFE. After the excess pressure is released, the valve re-seats and provides a tight seal.
The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research, resulting in a stable operation of the valve pallet, optimized performance, and reduced product losses.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- valve pallet is guided inside the housing to protect against harsh weather conditions
- non-corrosive
- especially suitable for aggressive, sticky, or polymerizing substances
- weight reduction in comparison to steel/stainless steel
- high surface quality
- automatic condensate drain
- different plastics can easily be combined
- maintenance-friendly design

Design Types and Specifications

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

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

Additional special devices available upon request.

Table 1: Dimensions Dimensions in mm / inches

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

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

* Dimensions in brackets only for PVDF.

Vents for corrosive vapor service (Flyer pdf)

Vents - 10% Technology (Flyer pdf)

Leak Rate/10% Technology (Flyer pdf)

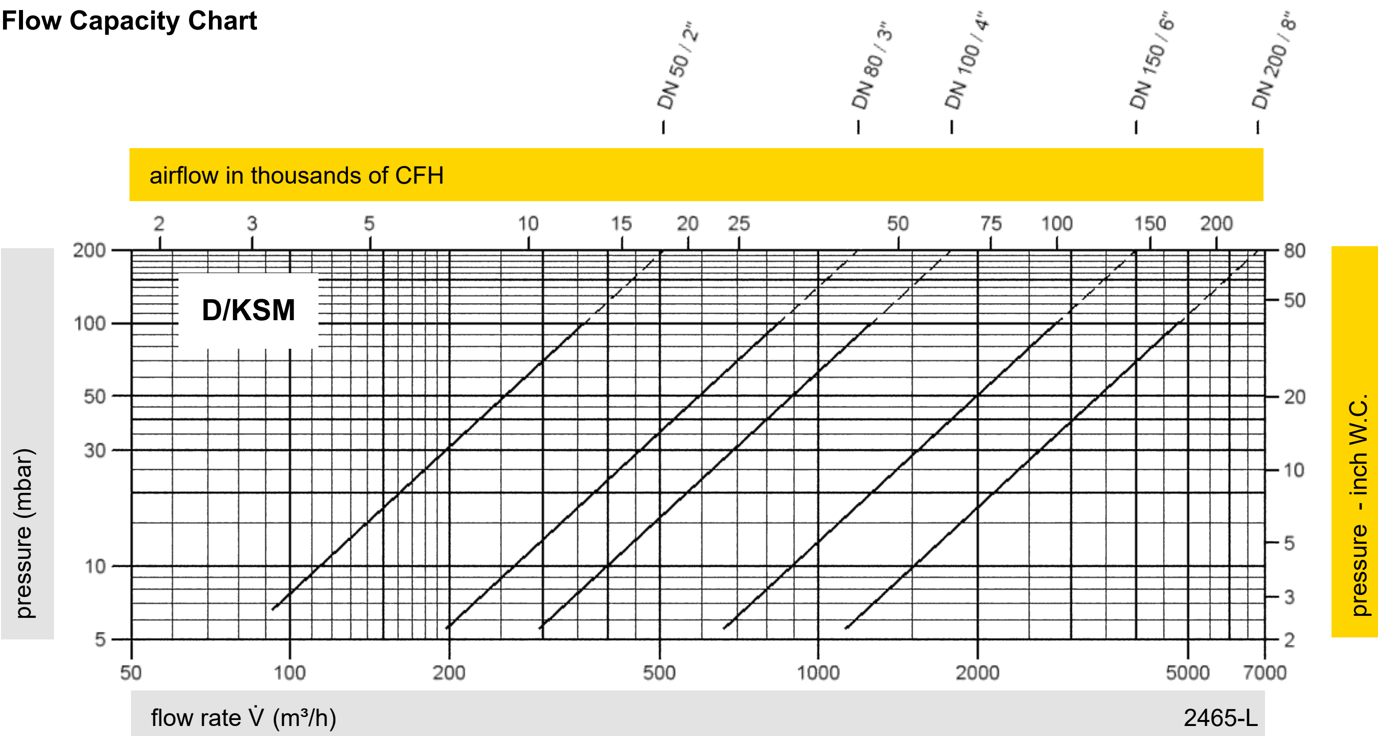
Tabelle 2: Material selection for housing				
Design	A	B	C	
Housing	PE	PP	PVDF	
Valve seats	PE	PP	PVDF	Special materials upon request.
Sealing	FPM	FPM	FPM	
Valve pallet	A, C, D	B, C, D	C, D	

Table 3: Material selection for pressure valve pallet				
Design	A	B	C	D
Pressure range (mbar) (inch W.C.)	+6.0 up to +16 +2.4 up to +6.4	+5.5 up to +16 +2.2 up to +6.4	+9.5 up to +30 +3.8 up to +12	+30 up to +100 +12 up to +40
Valve pallet	PE	PP	PVDF	Hastelloy
Sealing	PTFE	PTFE	PTFE	PTFE
Spindle guide	PE	PP	PVDF	Hastelloy
Weights	PE	PP	PVDF	Hastelloy

Special materials and other pressure settings are available upon request.

Table 4: Flange connection type	
EN 1092-1, Form A	Other types upon request.
ASME B16.5 CL 150 F.F.	

Flow Capacity Chart



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

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

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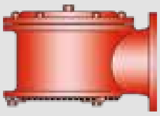
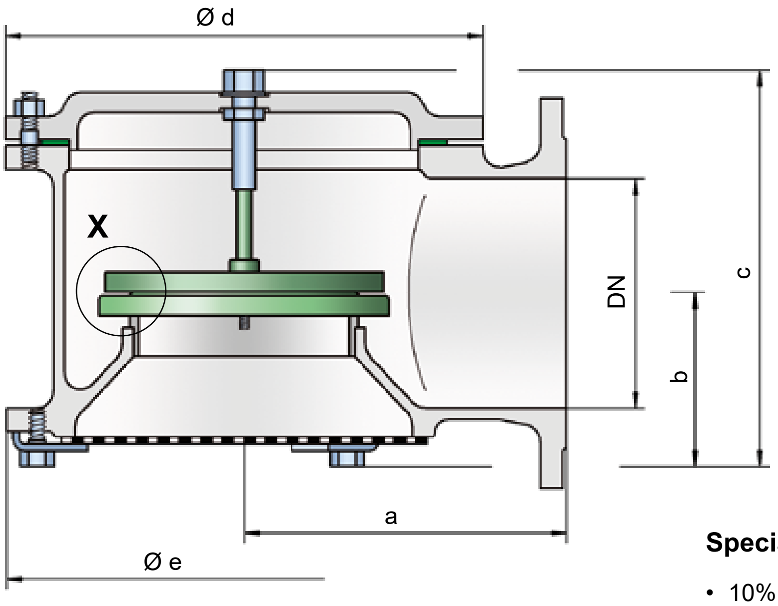
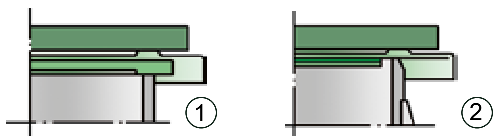


Vacuum Relief Valve

PROTEGO® SV/E-1-0



Detail **X**



Vacuum settings:
-2.0 mbar up to -60 mbar
-0.8 inch W.C. up to -24 inch W.C.
Higher vacuum settings upon request.

Function and Description

The SV/E-1-0 type PROTEGO® valve is a highly developed vacuum relief valve with excellent flow performance. It is primarily used as a safety device for relieving vacuum in tanks, containers, and process engineering equipment. The valve offers reliable protection against vacuum and prevents in-breathing of air close to the set pressure.
The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to reach full lift. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristics as a high pressure safety relief valve.

This "full lift type" technology allows the valve to be set at just 10% below the maximum allowable working pressure of the tank and still safely vent the required mass flow.
Due to our highly developed manufacturing technology, the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is achieved by valve seats made of high quality stainless steel and with precisely lapped valve pallets (1) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent the valve pallets from sticking when sticky products are used, and they enable the use of corrosive substances. After the vacuum is released, the valve re-seats and provides a tight seal again.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- automatic condensate drain
- best technology for API tanks

Design Types and Specifications

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

There are two different designs:

Vacuum valve in basic design **SV/E-1-0 - $\boxed{–}$**

Vacuum valve with heating jacket **SV/E-1-0 - $\boxed{H}$**

Additional special devices available upon request.

Table 1: Dimensions — Dimensions in mm / inches

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

DN	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	140 / 5.51	170 / 6.69	190 / 7.48	230 / 9.06	300 / 11.81	325 / 12.80	425 / 16.73
b	75 / 2.95	85 / 3.35	95 / 3.74	120 / 4.72	140 / 5.51	165 / 6.50	205 / 8.07
c	205 / 8.07	205 / 8.07	285 / 11.22	360 / 14.17	405 / 15.94	460 / 18.11	500 / 19.69
d	170 / 6.69	235 / 9.25	280 / 11.02	335 /13.19	445 / 17.52	505 / 19.88	505 / 19.88
e	215 / 8.46	215 / 8.46	255 / 10.04	335 / 13.19	425 / 16.73	460 / 18.11	625 / 24.61

Dimensions for vacuum relief valve with heating jacket upon request.

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Table 2: Material selection for housing

Design	B	C	D*
Housing Heating jacket (SV/E-1-0-H-...)	Steel Steel	Stainless Steel Stainless Steel	Aluminum –
Valve seat	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	PTFE	PTFE	PTFE

The housings are also available with an ECTFE-coating.

Special materials upon request.

*Design D upon request.

Table 3: Material selection for vacuum valve pallet

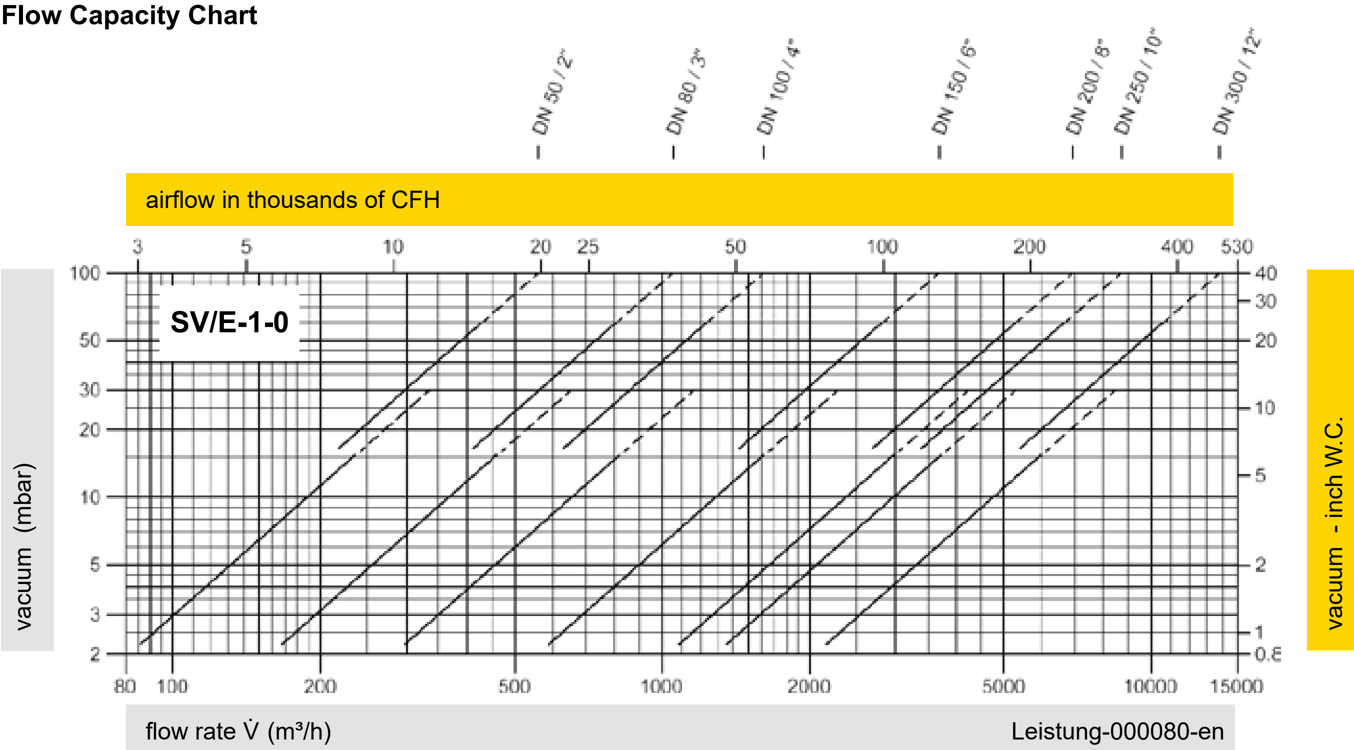
Design	A	B	C	D	E	F
vacuum range (mbar) (inch W.C.)	-2.0 up to -3.5 -0.8 up to -1.4	<-3.5 up to -14 <-1.4 up to 5.6	<-14 up to -35 <-5.6 up to -14	<-35 up to -60 <-14 up to -24	<-14 up to -35 <-5.6 up to -14	<-35 up to -60 <-14 up to -24
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless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

Special materials (Alu-coated, Titanium, Hastelloy) and higher vacuum settings are available upon request.

Table 4: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



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

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

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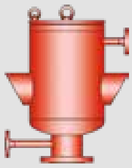
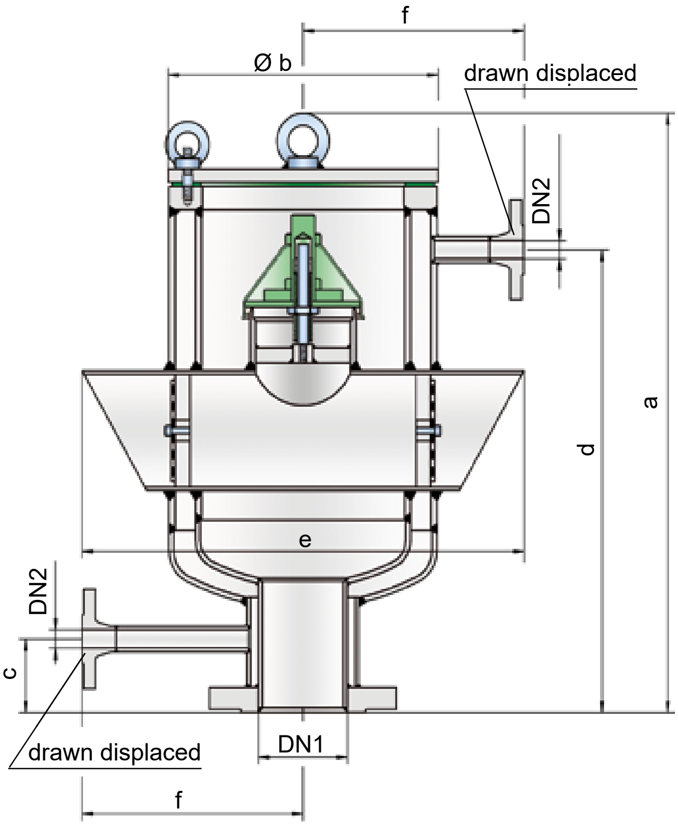


Vacuum Relief Valve

with a special heat jacketed design

PROTEGO® SV/T-0-H



Vacuum settings:

-7 mbar up to -50 mbar
-2.8 inch W.C. up to -20 inch W.C.
Higher and lower vacuum settings upon request.

Function and Description

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

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

Special Features and Advantages

- excellent tightness resulting in lowest possible product losses and reduced environmental pollution
- high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- complete heating jacket up to the flange to avoid ice build-up
- maximum allowable heating medium temperature of 320°C / 608°F (at 6 bar/87 psi)
- a special design that preheats incoming air is also available
- available in a special design with a heatable valve cover
- a valve pallet cover prevents the adjustment of the set pressure due to dust deposits or condensate
- sturdy housing design
- available in a special design with lifting device

Design Types and Specifications

The valve pallet is weight-loaded.

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

Additional special devices available upon request.

Table 1: Dimensions Dimensions in mm / inches

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

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

* Also available with special flange DN 50 / 2"

Table 2: Material selection for housing

Design	A	B	
Housing Heating jacket	Steel Steel	Stainless Steel Stainless Steel	Special materials upon request.
Valve seat	Stainless Steel	Stainless Steel	
Sealing	PTFE	PTFE	

Table 3: Material selection for vacuum valve pallet

Design	A	B	C	
Vacuum range (mbar) (inch W.C.)	-7.0 up to -25 -2.8 up to -10	-10 up to -30 -4.0 up to -12	-30 up to -50 -12 up to -20	Special materials and other vacuum settings are available upon request.
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	
Valve pallet hood	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	Metal to Metal	Metal to Metal	Metal to Metal	

Table 4: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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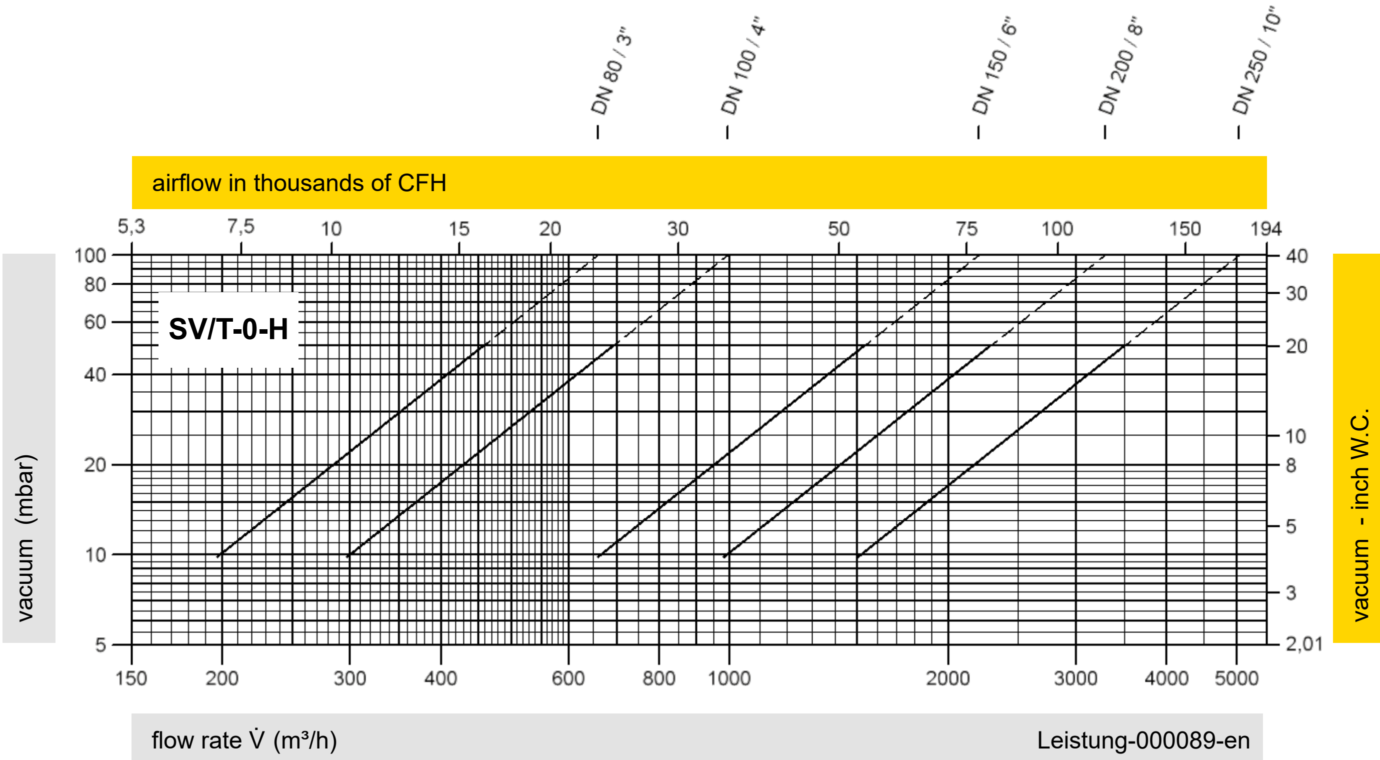
PROTEGO® SV/T-0-H



Remark

$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1.4}$$

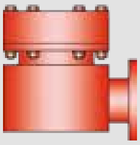
Set pressure = the valve starts to open

Opening pressure = set pressure plus overpressure

Overpressure = pressure increase over the set pressure

The 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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

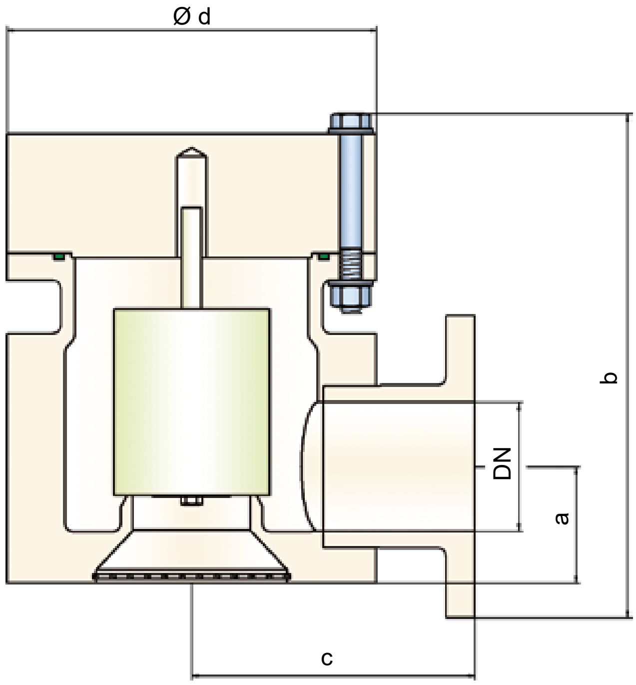
Notes:



Vacuum Relief Valve

made of plastic

PROTEGO® V/KSM



Vacuum settings:

-6.0 mbar up to -100 mbar (DN 50/2")
-2.4 inch W.C. up to -40 inch W.C.

-4.0 mbar up to -100 mbar (DN 80/3")
-1.6 inch W.C. up to -40 inch W.C.

-4.5 mbar up to -100 mbar (DN 100/4" - DN 200/8")
-1.8 inch W.C. up to -40 inch W.C.

Higher pressure settings upon request.

Function and Description

The PROTEGO® valve V/KSM is a state-of-the-art vacuum relief valve with excellent flow performance made of high-grade synthetic material. It is used as a safety device to relieve vacuum in tanks, containers, and process engineering equipment. It prevents the in-breathing of air until reaching the set pressure. The valve is a perfect solution for corrosive, polymerizing, or sticky substances.
The device will start to open as soon as the set pressure is reached and is fully open within 10% pressure increase. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This "full lift type" technology allows the valve to be set at just 10% below the maximum allowable working vacuum (MAWV) of the tank and still safely vent the required mass flow.

Due to our highly developed manufacturing technology, the tank pressure is maintained up to the set pressure with a seal that is far superior to the conventional standard. This feature is achieved by valve seats made of high-performance plastics and a high grade PTFE seal. After the vacuum is released, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- valve pallet is guided inside the housing to protect against harsh weather conditions
- non-corrosive
- especially suitable for aggressive, sticky, or polymerizing substances
- weight reduction in comparison to steel/stainless steel
- high surface quality
- automatic condensate drain
- different plastics can easily be combined
- maintenance-friendly design

Design Types and Specifications

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

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

Additional special devices available upon request.

Table 1: Dimensions — Dimensions in mm / inches

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

DN	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"
a	57 / 2.24	77 / 3.03	87 / 3.43 (115 / 4.53)*	126 / 4.96 (146 / 5.75)*	180 / 7.09 (175 / 6.89)*
b	259 / 10.20	376 / 14.80	373 / 14.69 (338 / 13.31)*	460 / 18.11 (427 / 16.81)*	469 / 18.46 (437 / 17.20)*
c	150 / 5.91	200 / 7.87	225 / 8.86	280 / 11.02	350 / 13.78
d	180 / 7.09	250 / 9.84	300 / 11.81	350 / 13.78 (405 / 15.94)*	560 / 22.05 (500 / 19.68)*

* Dimensions in parentheses are for devices made of PVDF.

Table 2: Material selection for housing

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

Table 3: Material selection for vacuum valve pallet

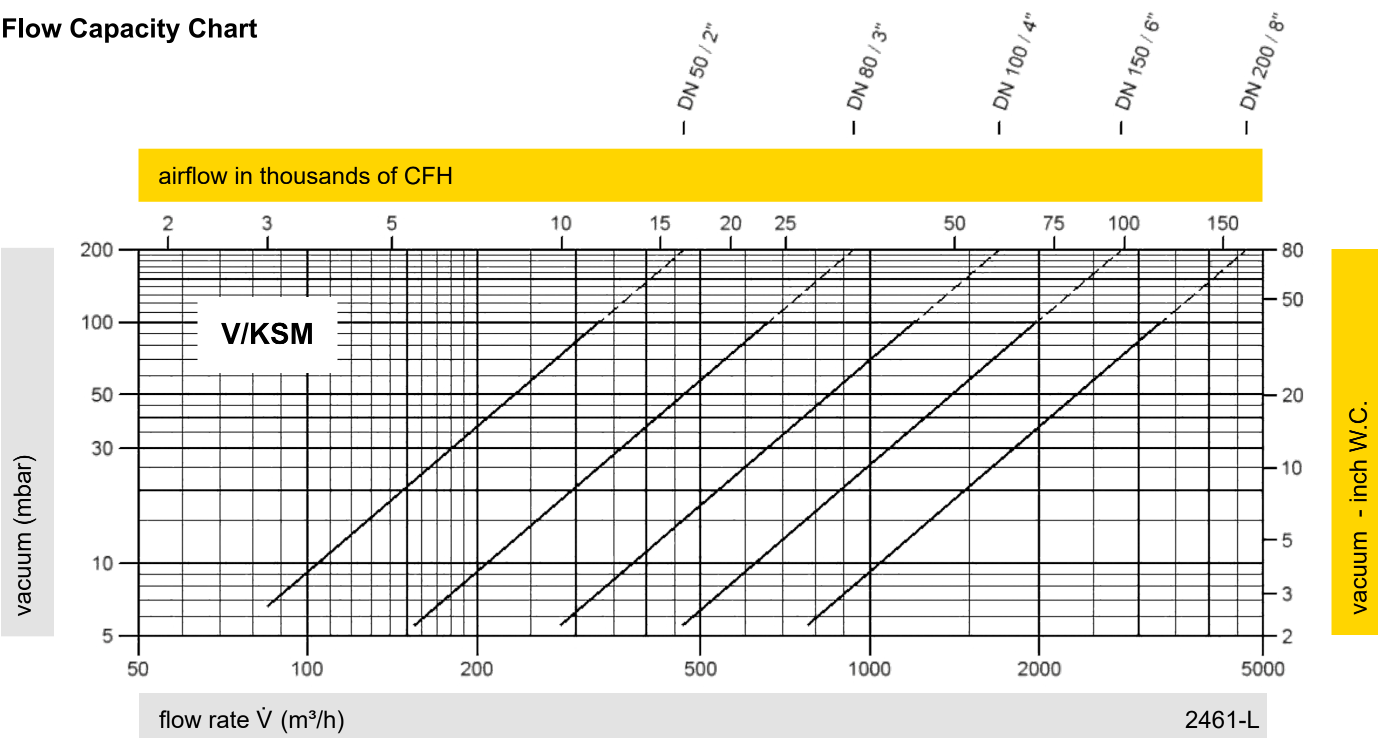
Design	A	B	C	D
Vacuum range (mbar) (inch W.C.)	-6.0 up to -16 -2.4 up to -6.4	-5.5 up to -16 -2.2 up to -6.4	-9.5 up to -30 -3.8 up to -12	-30 up to -100 -12 up to -40
Valve pallet	PE	PP	PVDF	Hastelloy
Sealing	PTFE	PTFE	PTFE	PTFE
Spindle guide	PE	PP	PVDF	Hastelloy
Weight	PE	PP	PVDF	Hastelloy

Special materials and other vacuum settings are available upon request.

Table 4: Flange connection type

EN 1092-1; Form A	Other types upon request.
ASME B16.5 CL 150 F.F.	

Flow Capacity Chart



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

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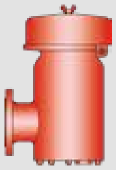
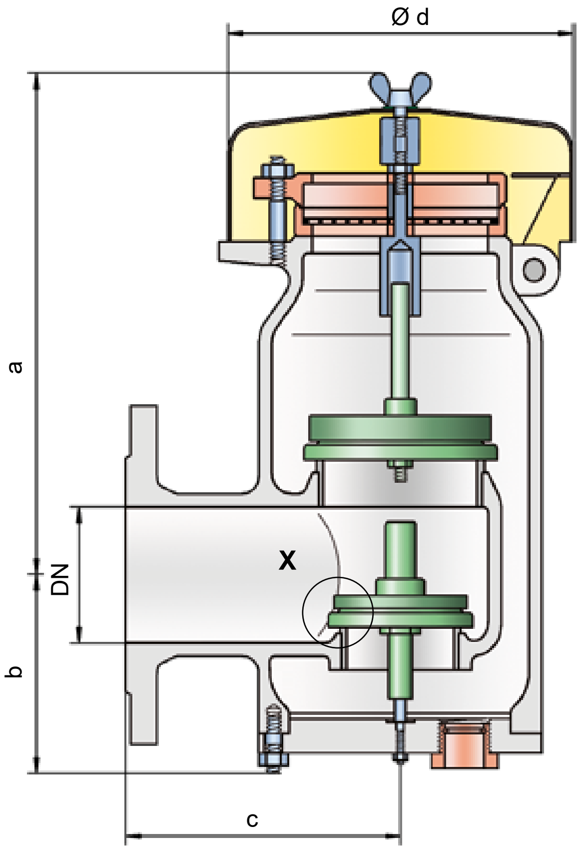
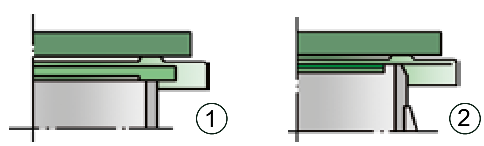


Pressure and Vacuum Relief Valve

PROTEGO® PV/EL



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	-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 PV/EL type PROTEGO® valve is a highly developed combined pressure and vacuum relief valve. It is primarily used as a safety device for relieving pressure and vacuum in tanks, containers, and process engineering equipment. The valve offers reliable protection against unallowable overpressure and underpressure. Product loss close to the set pressure is avoided and unallowable product entry is prevented.

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

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set pressure with a tightness that is far superior to the conventional standard. This feature is achieved by valve seats made of high quality stainless steel and with precisely 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 pallet from sticking when sticky products are used, and they enable the use of corrosive substances. After the overpressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- automatic condensate drain
- available in a special design with lifting device
- maintenance-friendly design

Design Types and Specifications

The valve pallets are weight-loaded. At set pressures greater than 60 mbar (24.1 inch W.C.), an extended design is used.

There are two different designs

Pressure/vacuum relief valve in basic design	**PV/EL -** $\boxed{-}$
Pressure/vacuum relief valve with heating jacket	**PV/EL -** $\boxed{H}$

Additional special devices available upon request.

Any combination of vacuum and pressure levels is possible. When the difference between the pressure and vacuum exceeds 150 mbar / 60.2 inch W.C., special valve pallets are used.

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

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: Material selection for housing

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

Table 3: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (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	>+14 up to +210 >+5.6 up to +84	Special material and higher set pressure upon request.
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 4: Material selection for vacuum valve pallet

Design	A	B	C	D	
Vacuum range (mbar) (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 and higher set vacuum upon request.
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 5: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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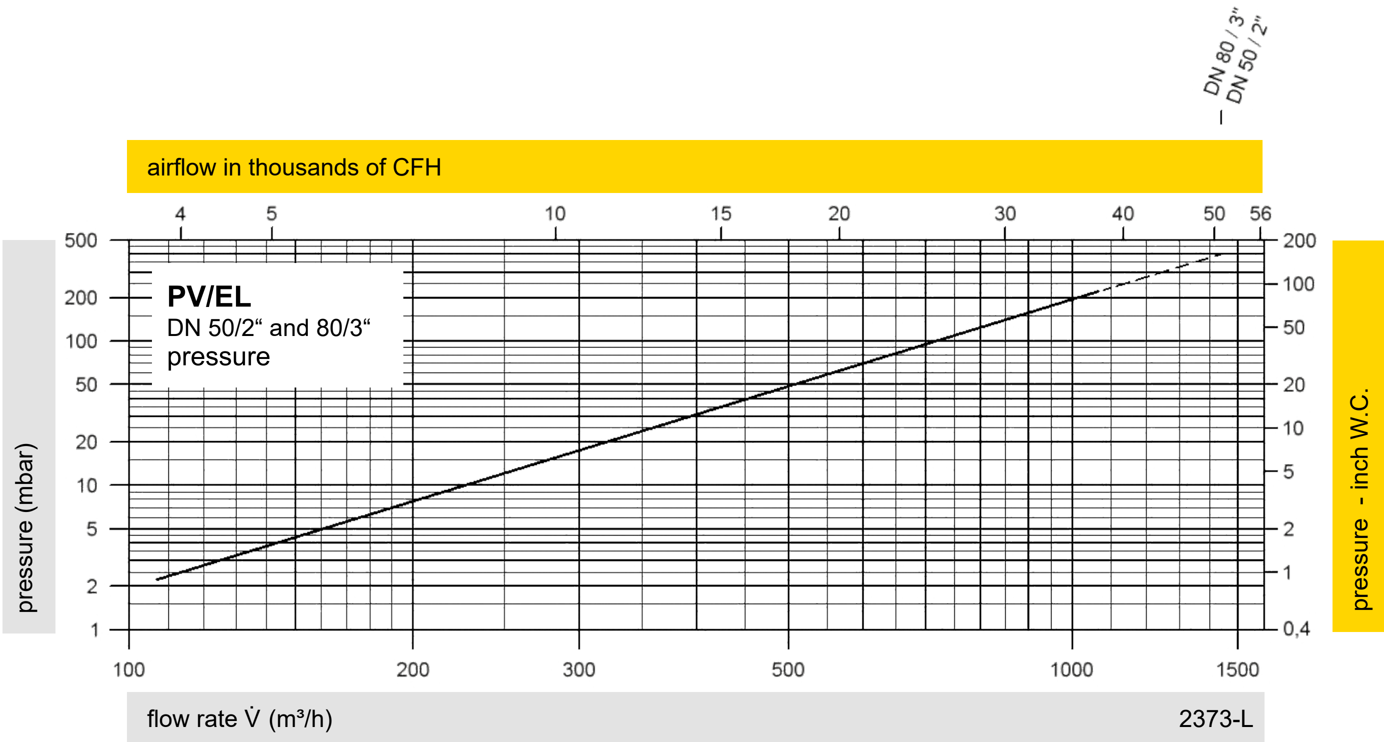
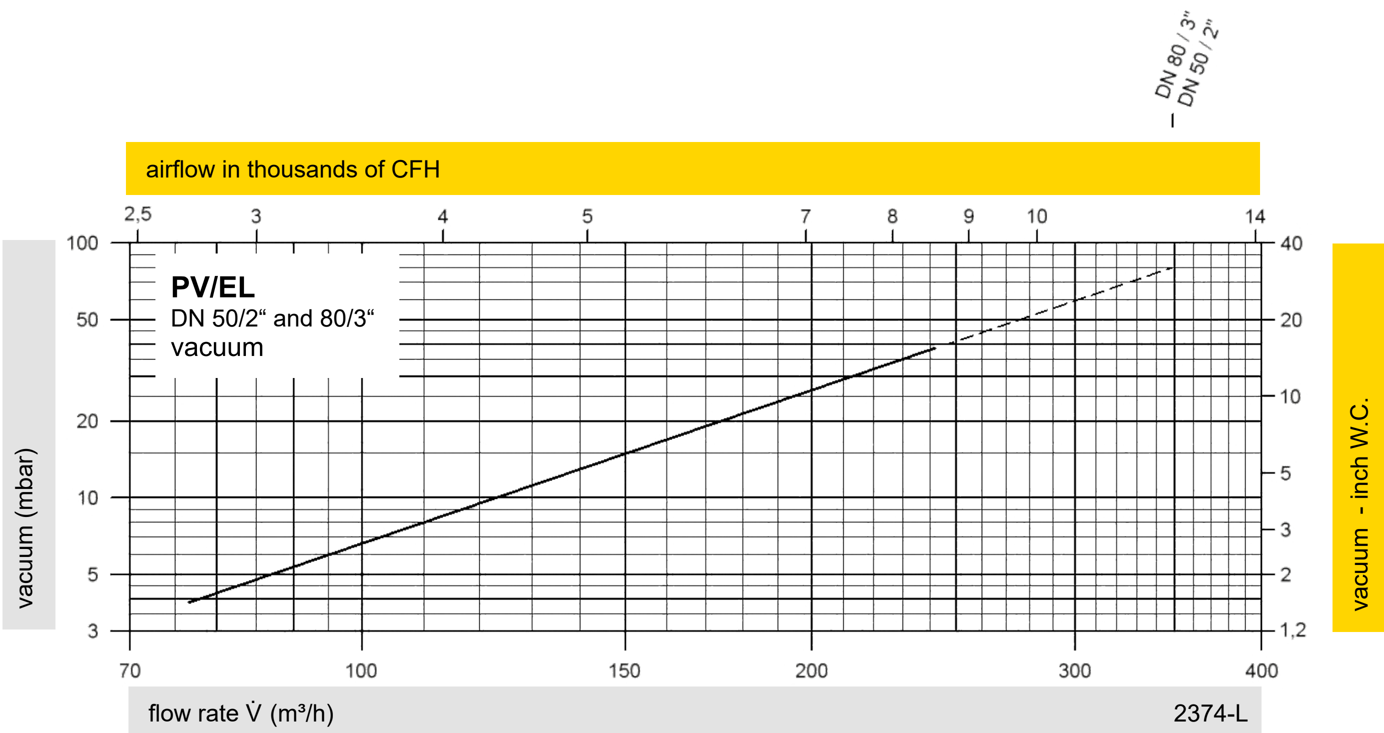
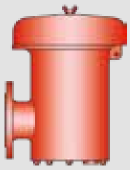
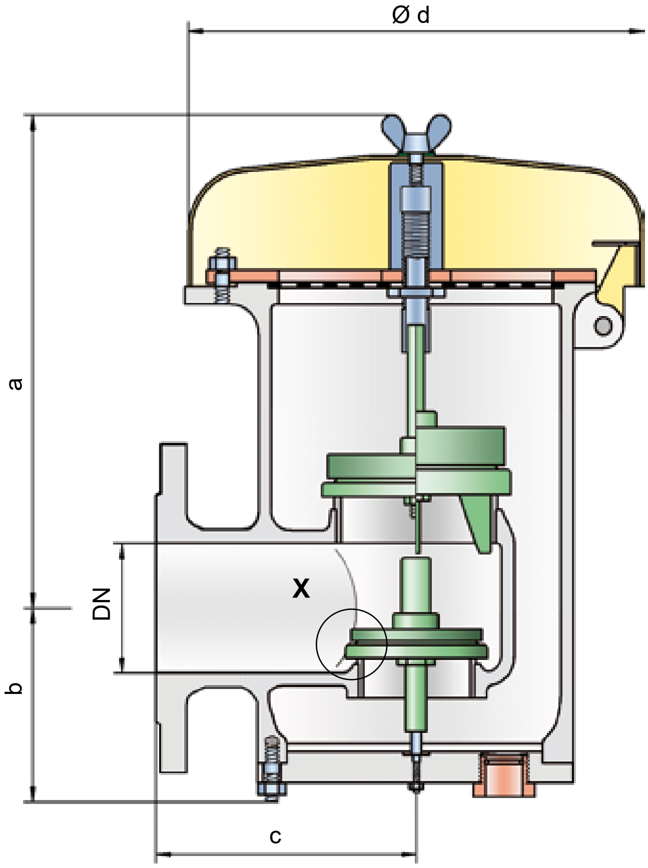




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:





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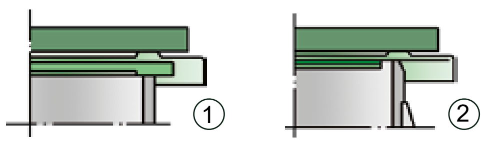

Settings:

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 PV/ELR type PROTEGO® valve is a highly developed combined pressure and vacuum relief valve with excellent flow performance. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure and underpressure. The valve prevents emission losses almost up to the set pressure and air intake almost up to the set vacuum.

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

Due to the highly developed manufacturing technology, the tank pressure is maintained up to the set pressure, with a tightness that is far superior to the conventional standard. This feature is achieved by valve seats made of high quality stainless steel and with precisely 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 pallet from sticking when sticky products are used, and they enable the use of corrosive substances. After the overpressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- automatic condensate drain
- compact, space-saving design
- available in a special design with lifting device
- maintenance-friendly design

Design Types and Specifications

The valve pallets are weight-loaded. At set pressures greater than 35 mbar (14 inch W.C.), an extended design is used.

There are two different designs:

Pressure/vacuum relief valve in basic design	**PV/ELR - –**
Pressure/vacuum relief valve with heating jacket	**PV/ELR - H**

Additional special devices available upon request.

Any combination of vacuum and pressure levels is possible. When the difference between the pressure and vacuum exceeds 150 mbar / 60.2 inch W.C., special valve pallets are used.

Vents - 10% Technology (Flyer pdf)

Leak Rate/10% Technology (Flyer pdf)

The optimized valve pallet (Flyer pdf)

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	146 / 5.75	146 / 5.75	146 / 5.75	146 / 5.75	
c	218 / 8.58	218 / 8.58	218 / 8.58	218 / 8.58	
d	353 / 13.90	353 / 13.90	353 / 13.90	353 / 13.90	

Table 2: Material selection for housing

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

Table 3: Material selection for pressure valve pallet

Design	A	B	C	D	
Pressure range (mbar) (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	>+14 up to +210 >+5.6 up to +84	Special material and higher set pressure upon request.
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 4: Material selection for vacuum valve pallet

Design	A	B	C	D	
Vacuum range (mbar) (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 and higher set vacuum upon request.
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	FEP	FEP	Metal to Metal	PTFE	

Table 5: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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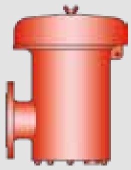
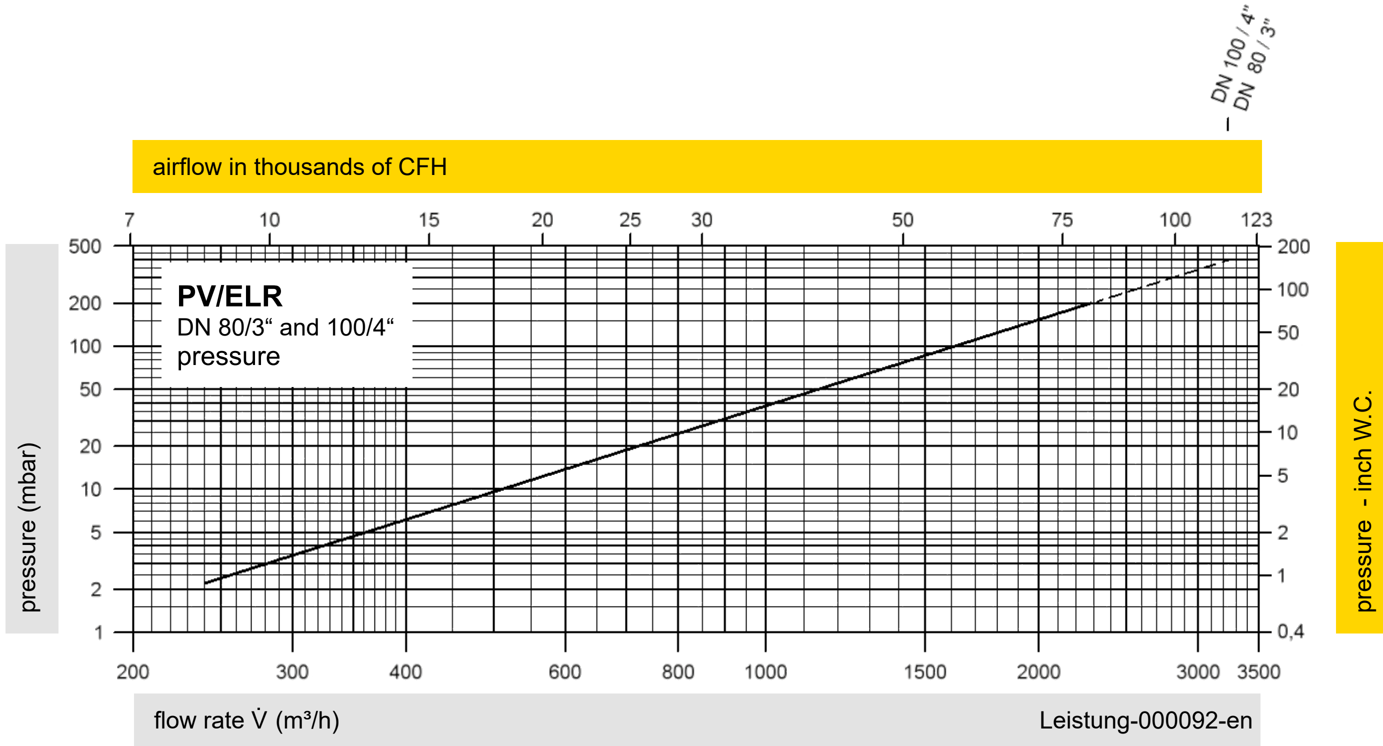
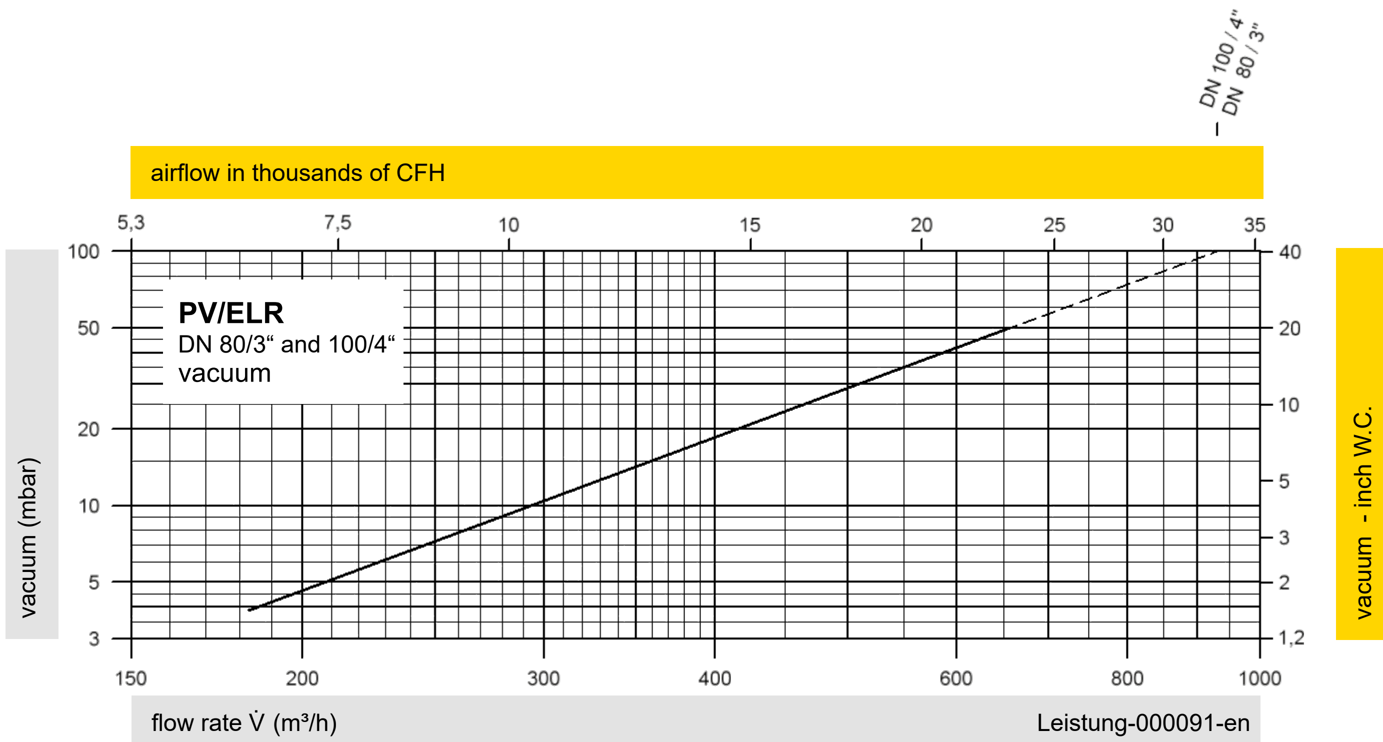


Pressure and Vacuum Relief Valve

Flow Capacity Charts

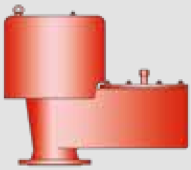
PROTEGO® PV/ELR





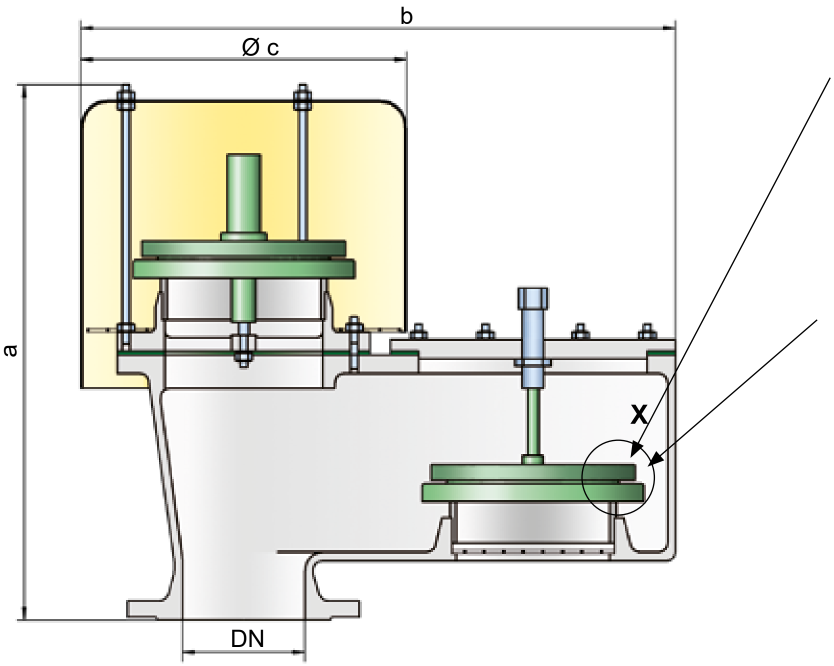
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

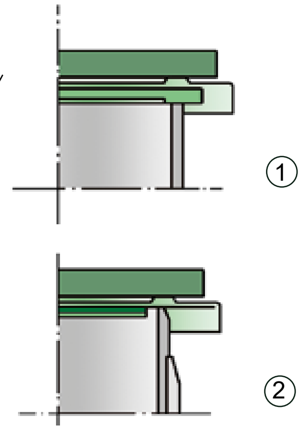
Notes:



Pressure and Vacuum Relief Valve

PROTEGO® VD/SV





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 or lower settings upon request.

Function and Description

The VD/SV type PROTEGO® valve is a highly developed pressure and vacuum relief valve with excellent flow performance. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure and underpressure. The valve prevents emission losses almost up to the set pressure and prevents air intake almost up to the set vacuum.

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

Due to our highly developed manufacturing technology, the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is achieved by valve seats made of high quality stainless steel and with precisely 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 them from sticking when sticky products are used and to enable the use of corrosive substances. After the overpressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- very high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- automatic condensate drain
- maintenance-friendly design
- best technology for API tanks

Design Types and Specifications

The valve pallets are weight-loaded. Higher pressures with a special spring-loaded design upon request.

There are two different designs:

Pressure/vacuum valve in basic design	**VD/SV-** $\boxed{-}$
Pressure/vacuum relief valve with heating jacket	**VD/SV-** $\boxed{H}$

Additional special devices available upon request.

Any combination of vacuum and pressure levels is possible. When the difference between the pressure and vacuum exceeds 150 mbar / 60.2 inch W.C., special valve pallets are used.

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Coated Devices
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	396 / 15.59	396 / 15.59	497 / 19.57	519 / 20.43	654 / 25.75	757 / 29.80	802 / 31.57	802 / 31.57
b	355 / 13.98	355 / 13.98	448 / 17.64	548 / 21.57	788 / 31.02	900 / 35.43	1030 / 40.55	1030 / 40.55
c	200 / 7.87	200 / 7.87	295 / 11.61	295 / 11.61	465 / 18.31	550 / 21.65	650 / 25.59	650 / 25.59

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

Table 2: Material selection for housing

Design	A	B	C
Housing Heating jacket (VD/SV-H-...)	Aluminum –	Steel Steel	Stainless Steel Stainless Steel
Valve seat	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	PTFE	PTFE	PTFE
Weather hood	Stainless Steel	Stainless Steel	Stainless Steel

The housings are also available with an ECTFE-coating.

Special materials upon request.

Table 3: 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	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	PTFE	PTFE

Special material and higher set pressure upon request.

Table 4: 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	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE	Metal to Metal	PTFE

Special material and higher vacuum upon request.

Table 5: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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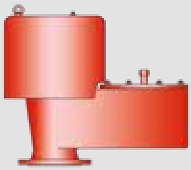
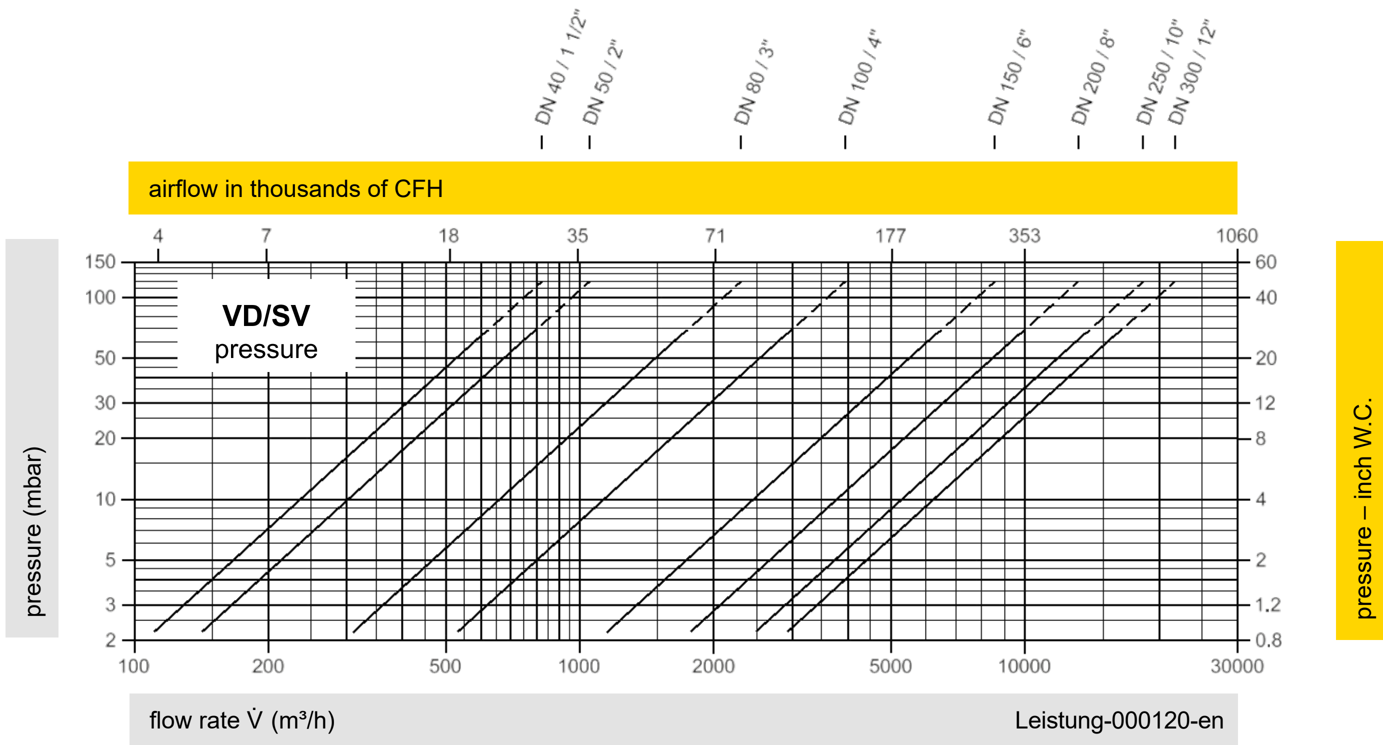
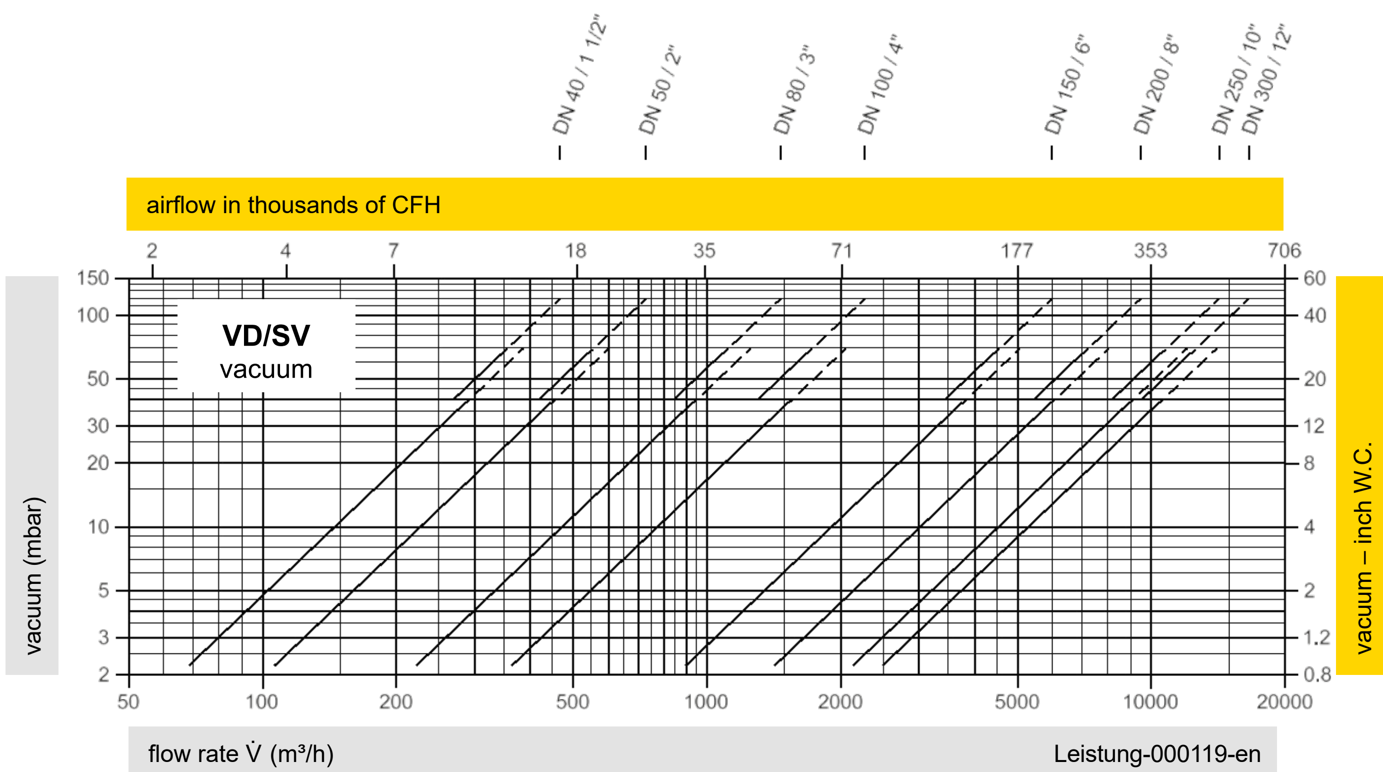


Pressure and Vacuum Relief Valve

Flow Capacity Charts

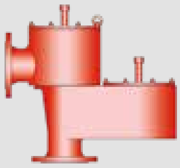
PROTEGO® VD/SV





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

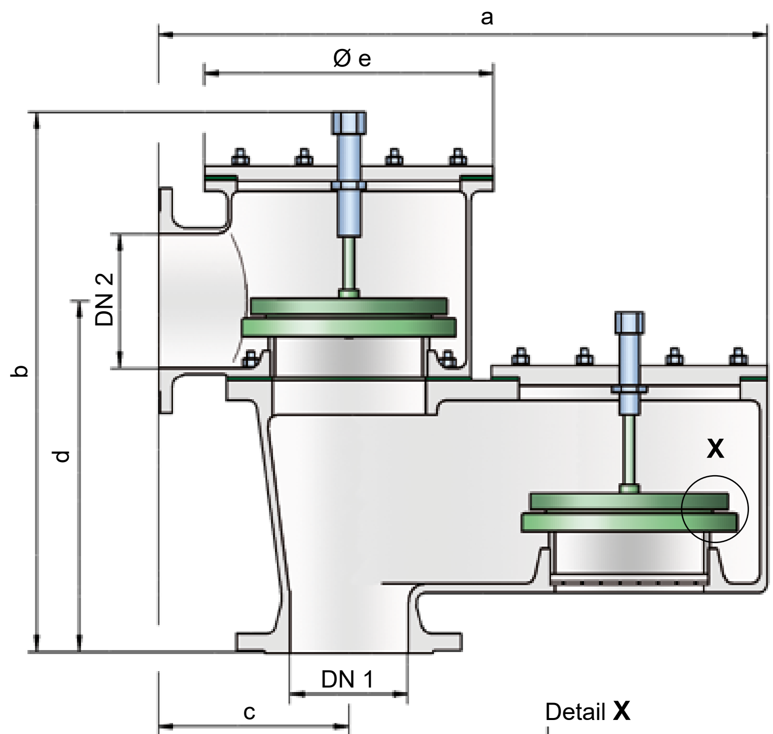
Notes:



Pressure and Vacuum Relief Valve

with Pipe-Away Connection

PROTEGO® VD/SV-PA(L)



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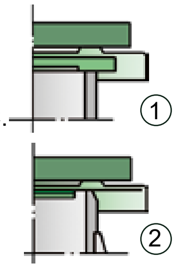

Settings:

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 or lower settings upon request.

Function and Description

The VD/SV-PA(L) type PROTEGO® valve is a highly developed pressure and vacuum relief valve with excellent flow performance. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure and underpressure. The valve prevents emission losses almost up to the set pressure and prevents air intake almost up to the set vacuum. The product vapors can be released through a collective line connected to the line flange on the pressure side.

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

Due to our highly developed manufacturing technology, the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is valve seats made of high quality stainless steel and achieved by valve seats made of high quality stainless steel and with precisely 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 substances. After the excess pressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- very high flow capacity
- can be used in explosion hazardous areas
- automatic condensate drain
- maintenance-friendly design
- best technology for API tanks

Design Types and Specifications

The valve pallets are weight-loaded. Higher pressures with a special spring-loaded design are available. Choose the model (L) if the discharge nozzle has a nominal diameter that is greater than the nominal diameter of the tank filler neck.

There are four different designs:

Pressure/vacuum valve in basic design	**VD/SV-PA -** $\boxed{-}$
Pressure/vacuum valve with heating jacket	**VD/SV-PA -** $\boxed{H}$
Pressure/vacuum relief valve with DN2 > DN1	**VD/SV-PAL-** $\boxed{-}$
Pressure/vacuum relief valve with DN2 > DN1 with heating jacket	**VD/SV-PAL-** $\boxed{H}$

Additional special devices available upon request.

Any combination of vacuum and pressure is possible. When the difference between the pressure and vacuum exceeds 150 mbar (60.2 inch W.C.), special valve pallets are used.

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Coated Devices
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Table 1: Dimensions Dimensions in mm / inches

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

VD/SV-PA

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

VD/SV-PAL

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

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

Table 2: Material selection for housing

Desing	A	B	C
Housing Heating jacket (VD/SV-PA(L)-H-...)	Aluminum –	Steel Steel	Stainless Steel Stainless Steel
Valve seat	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	PTFE	PTFE	PTFE

The housings are also available with an ECTFE-coating.

Special materials upon request.

Table 3: 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	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	PTFE	PTFE

Special material (Alu coated, Titan, Hastelloy) and higher set pressure upon request.

Table 4: 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	<-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	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	PTFE	PTFE

Special material (Alu coated, Titan, Hastelloy) and higher set vacuum upon request.

Table 5: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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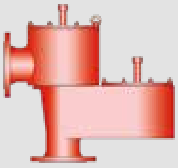
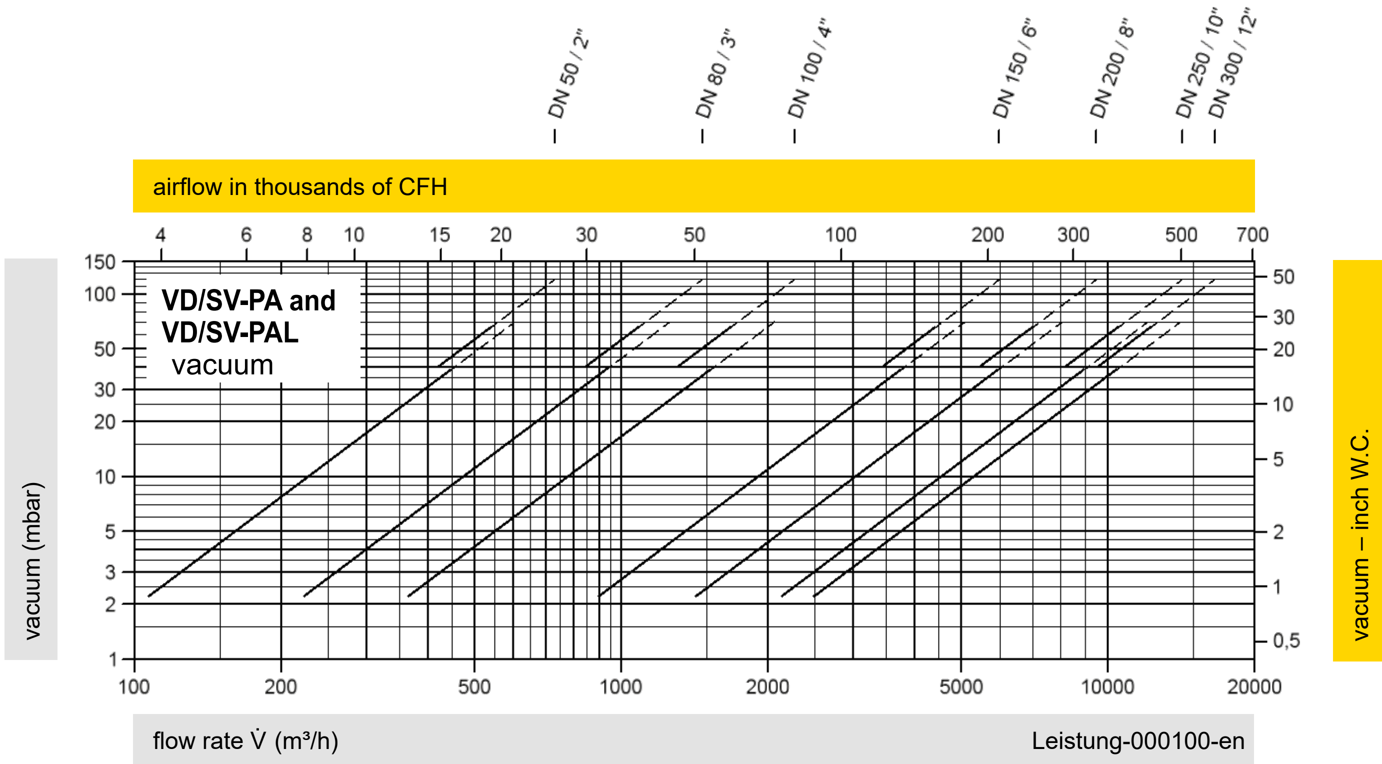
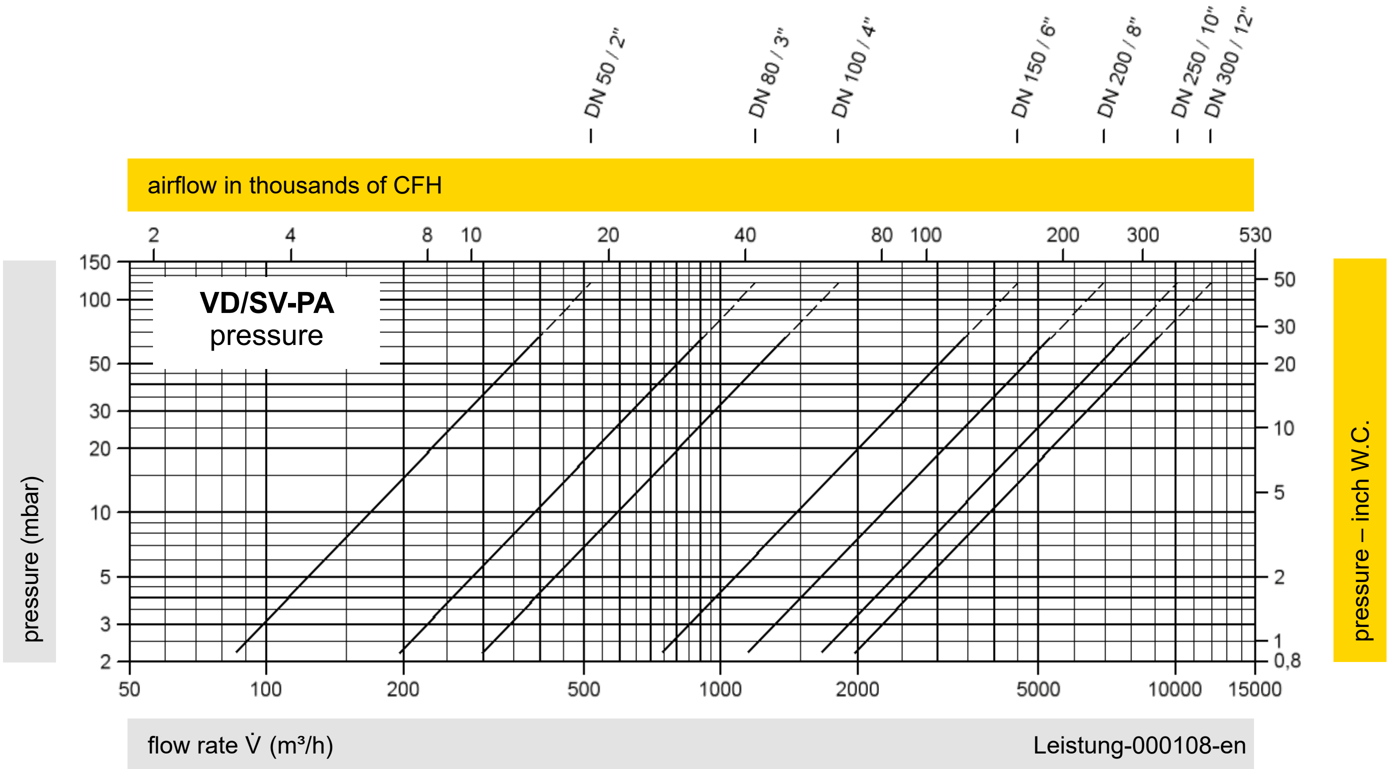


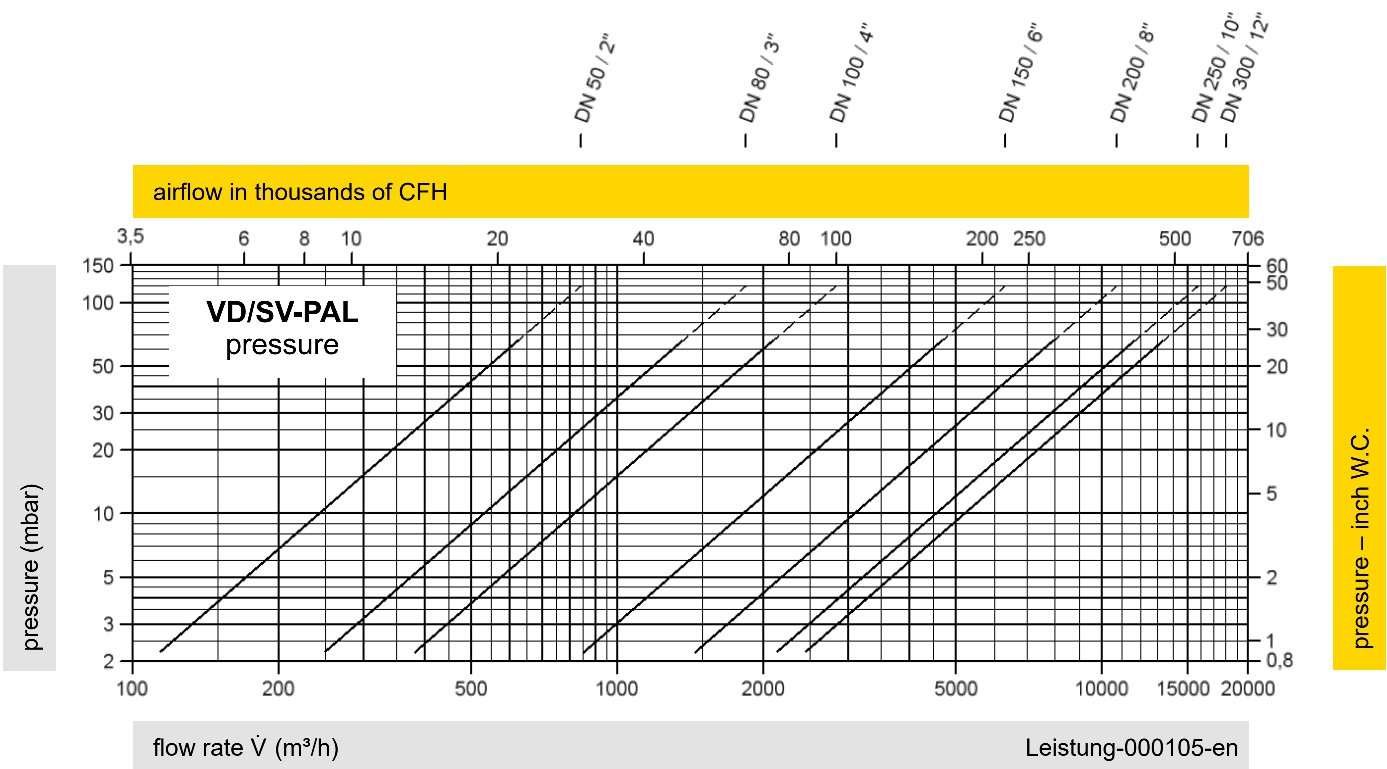
PROTEGO® VD/SV-PA(L)



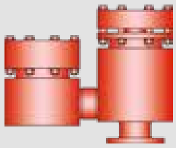
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

PROTEGO® VD/SV-PA(L)





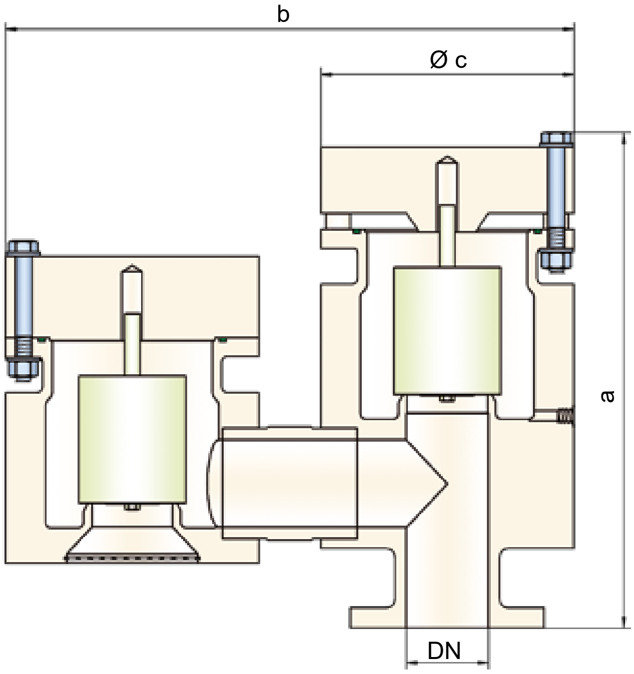
for safety and environment



Pressure and Vacuum Relief Valve

made of plastic

PROTEGO® VD/KSM



Settings:

Pressure:

+6.0 mbar up to +100 mbar (DN 50/2")
+2.4 inch W.C. up to +40 inch W.C.

+4.0 mbar up to +100 mbar (DN 80/3")
+1.6 inch W.C. up to +40 inch W.C.

+4.5 mbar up to +100 mbar (DN 100/4" - DN 200/8")
+1.8 inch W.C. up to +40 inch W.C.

Vacuum:

-6.0 mbar up to -100 mbar (DN 50/2")
-2.4 inch W.C. up to -40 inch W.C.

-4.0 mbar up to -100 mbar (DN 80/3")
-1.6 inch W.C. up to -40 inch W.C.

-4.5 mbar up to -100 mbar (DN 100/4" - DN 200/8")
-1.8 inch W.C. up to -40 inch W.C.

Higher and lower settings upon request.

Function and Description

The PROTEGO® valve VD/KSM is a state-of-the-art pressure and vacuum relief valve with excellent flow performance made of high-grade synthetic material. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process apparatus to protect against unallowable overpressure or underpressure. The valve prevents emission losses almost up to the set pressure. The valve is a perfect solution for corrosive, polymerizing, or sticky substances. The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This "full lift type" technology allows the valve to be set at just 10% below the maximum allowable working pressure and vacuum (MAWP and MAWV) of the tank and still safely vent the required mass flow. The opening characteristic for pressure and vacuum side is the same.

Due to our highly developed manufacturing technology, the tank pressure is maintained up to set pressure with a tightness that is far superior to the conventional standard. This feature is achieved by special valve seats made of high quality synthetic material or PTFE. After the excess pressure is released or vacuum is balanced, the valve re-seats and provides a tight seal. The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research, resulting in a stable operation of the valve pallet, optimized performance, and reduced product losses.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- valve pallet is guided inside the housing to protect against harsh weather conditions
- non-corrosive
- especially suitable for aggressive, sticky, or polymerizing substances
- weight reduction in comparison to steel/stainless steel
- automatic condensate drain
- high surface quality
- different plastics can easily be combined
- maintenance-friendly design

Design Types and Specifications

The valve pallets are weight-loaded, and the highest pressure levels are only achieved with metal discs.

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

Additional special devices available upon request.

Vents for corrosive vapor service (Flyer pdf)

Vents - 10% Technology (Flyer pdf)

Leak Rate/10% Technology (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"
a	376 / 14.80	521 / 20.51	563 / 22.17 (542 / 21.34)*	670 / 26.38 (681 / 26.81)*	917 / 36.10 (952 / 37.48)*
b	430 / 16.93	575 / 22.64	700 / 27.56 (675 / 26.57)*	825 / 32.48 (880 / 34.65)*	1190 / 46.85 (1100 / 43.31)*
c	180 / 7.09	250 / 9.84	300 / 11.81	350 / 13.78 (405 / 15.94)*	560 / 22.05 (500 / 19.68)*

* Dimensions in parentheses are for devices made of PVDF.

Table 2: Material selection for the housing

Design	A	B	C
Housing	PE	PP	PVDF
Valve seat	PE	PP	PVDF
Sealing	FPM	FPM	FPM
Pressure valve pallet	A, C, D	B, C, D	C, D
Vacuum valve pallet	A, C, D	B, C, D	C, D

Special materials upon request.

Table 3: Material selection for pressure valve pallet

Design	A	B	C	D
Pressure range (mbar) (inch W.C.)	+6.0 up to +16 +2.4 up to +6.4	+5.5 up to +16 +2.2 up to +6.4	+9.5 up to +30 +3.8 up to +12	+30 up to +100 +12 up to +40
Valve pallet	PE	PP	PVDF	Hastelloy
Sealing	PTFE	PTFE	PTFE	PTFE
Spindle guide	PE	PP	PVDF	Hastelloy
Weight	PE	PP	PVDF	Hastelloy

Special materials and other pressure settings are available upon request.

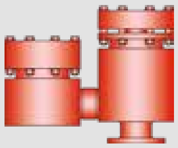
Table 4: Material selection for vacuum valve pallet

Design	A	B	C	D
Vacuum range (mbar) (inch W.C.)	-6.0 up to -16 -2.4 up to -6.4	-5.5 up to -16 -2.2 up to -6.4	-9.5 up to -30 -3.8 up to -12	-30 up to -100 -12 up to -40
Valve pallet	PE	PP	PVDF	Hastelloy
Sealing	PTFE	PTFE	PTFE	PTFE
Spindle guide	PE	PP	PVDF	Hastelloy
Weight	PE	PP	PVDF	Hastelloy

Special materials and other vacuum settings are available upon request.

Table 5: Flange connection type

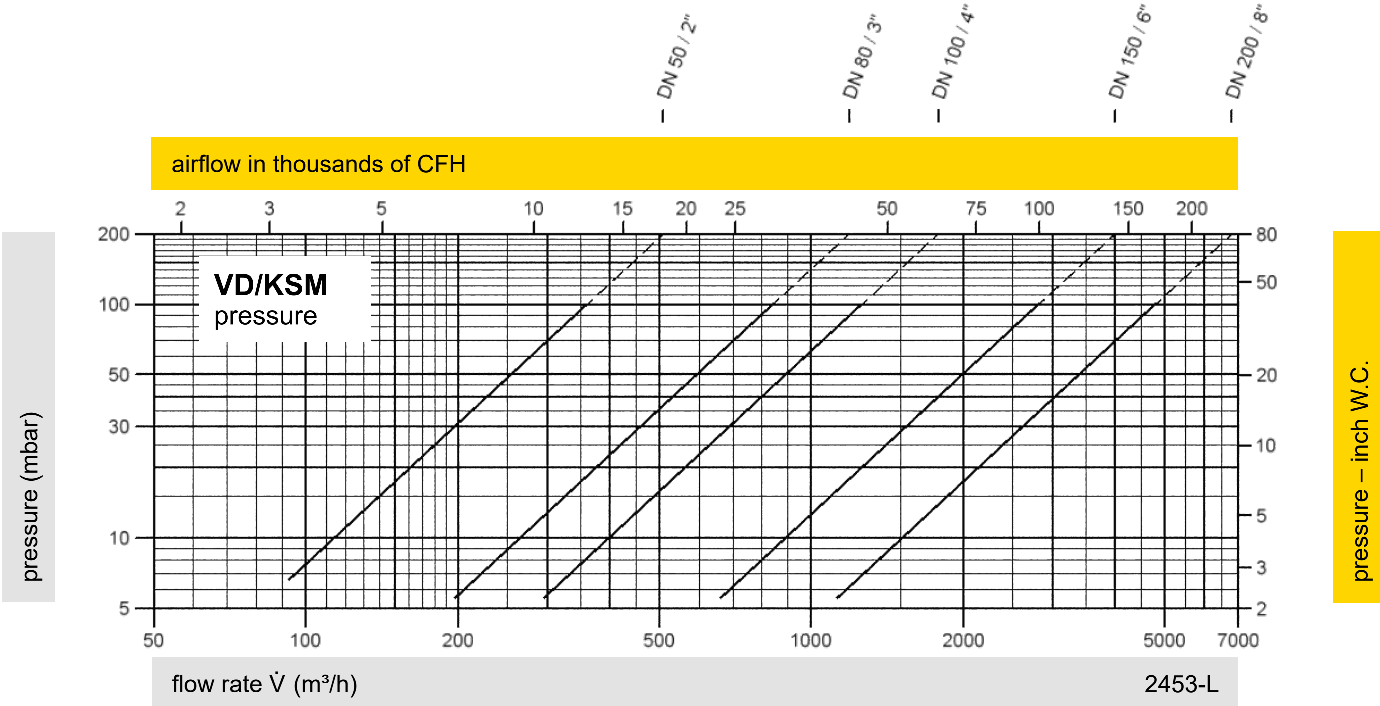
EN 1092-1; Form A	Other types upon request.
ASME B16.5 CL 150 F.F.	

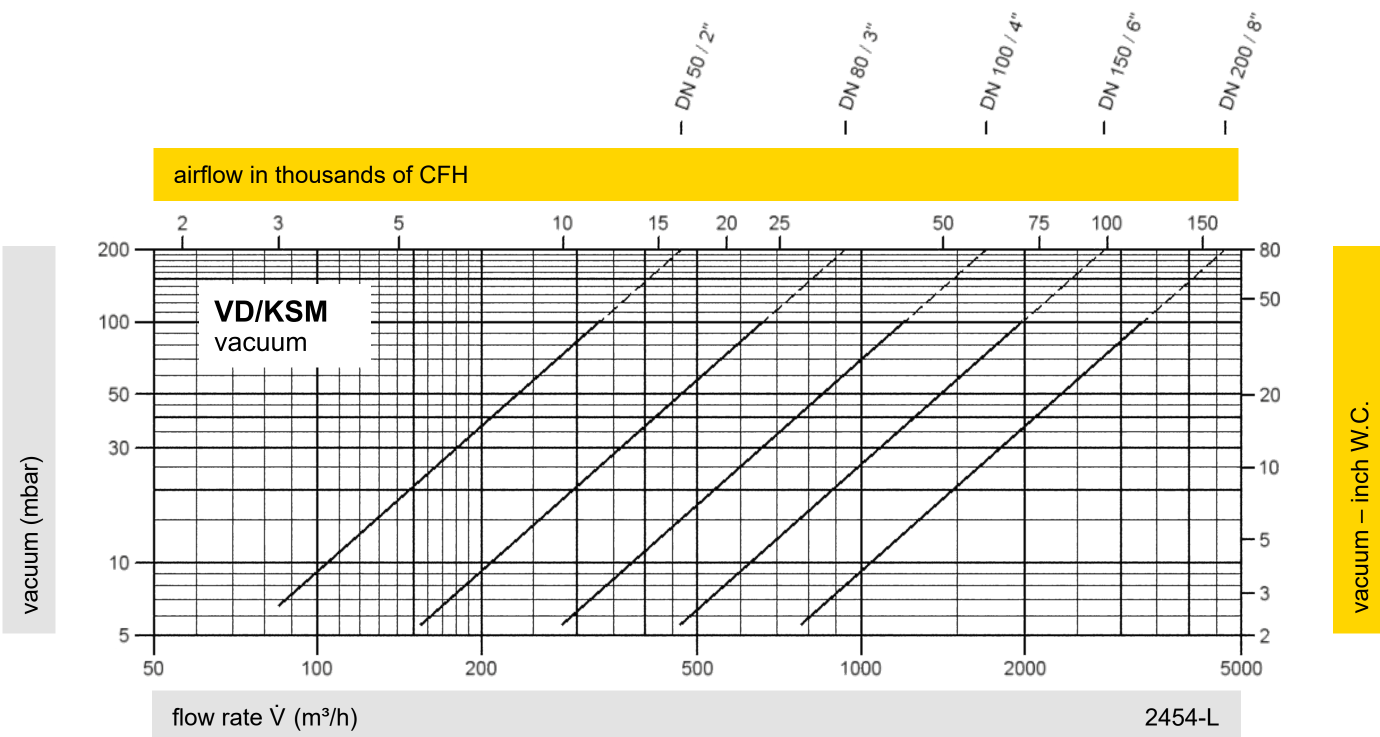


Pressure and Vacuum Relief Valve

Flow Capacity Charts

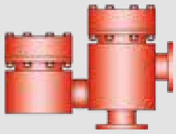
PROTEGO® VD/KSM





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

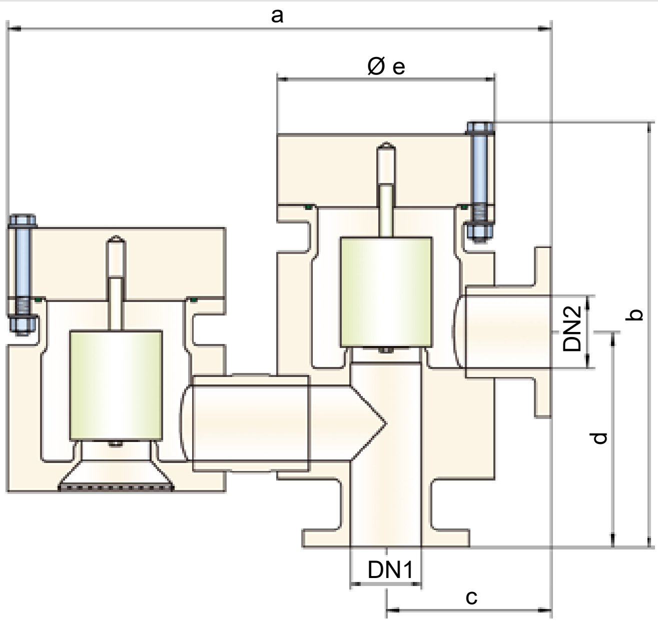
Notes:



Pressure and Vacuum Relief Valve

made of plastic

PROTEGO® VD/KSM-PA



Settings:

Pressure:

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

Vacuum:

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

Higher and lower settings upon request.

Function and Description

The PROTEGO® valve VD/KSM-PA is a state-of-the-art pressure and vacuum relief valve with excellent flow performance made of high-grade synthetic material. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure and under pressure.

The valve prevents emission losses almost up to the set pressure. The valve is a perfect solution for corrosive, polymerizing, or sticky substances.

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

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

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- valve pallet is guided inside the housing to protect against harsh weather conditions
- non-corrosive
- especially suitable for aggressive, sticky, or polymerizing substances
- weight reduction in comparison to steel/stainless steel
- automatic condensate drain
- high surface quality
- different plastics can easily be combined
- maintenance-friendly design

Design Types and Specifications

The valve pallets are weight-loaded, and the highest pressure levels are only achieved with metal discs.

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

Additional special devices available upon request.

Vents for corrosive vapor service
(Flyer pdf)

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Table 1: Dimensions Dimensions in mm / inches

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

DN1	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"
DN2	50 / 2"	80 / 3"	100 / 4"	150 / 6"	200 / 8"
a	490 / 19.29	650 / 25.59	775 / 30.51 (750 / 29.53)*	930 / 36.61 (958 / 37.72)*	1260 / 49.61 (1200 / 47.24)*
b	376 / 14.80	521 / 20.51	563 / 22.17 (523 / 20.59)*	670 / 26.38 (651 / 25.63)*	879 / 34.61 (912 / 35.91)*
c	150 / 5.91	200 / 7.87	225 / 8.86	280 / 11.02	350 / 13.78
d	200 / 7.87	245 / 9.65	300 / 11.81	370 / 14.57	590 / 23.23 (650 / 25.59)*
e	180 / 7.09	250 / 9.84	300 / 11.81	350 / 13.78 (405 / 15.94)*	560 / 22.05 (500 / 19.68)*

* Dimensions in parentheses are for devices made of PVDF.

Table 2: Material selection for the housing

Design	A	B	C
Housing	PE	PP	PVDF
Valve seat	PE	PP	PVDF
Sealing	FPM	FPM	FPM
Pressure valve pallet	A, C, D	B, C, D	C, D
Vacuum valve pallet	A, C, D	B, C, D	C, D

Special materials upon request.

Table 3: Material selection for pressure valve pallet

Design	A	B	C	D
Pressure range (mbar) (inch W.C.)	+6.0 up to +16 +2.4 up to +6.4	+5.5 up to +16 +2.2 up to +6.4	+9.5 up to +30 +3.8 up to +12	+30 up to +100 +12 up to +40
Valve pallet	PE	PP	PVDF	Hastelloy
Sealing	PTFE	PTFE	PTFE	PTFE
Spindle guide	PE	PP	PVDF	Hastelloy
Weight	PE	PP	PVDF	Hastelloy

Special materials and other pressure settings are available upon request.

Table 4: Material selection for vacuum valve pallet

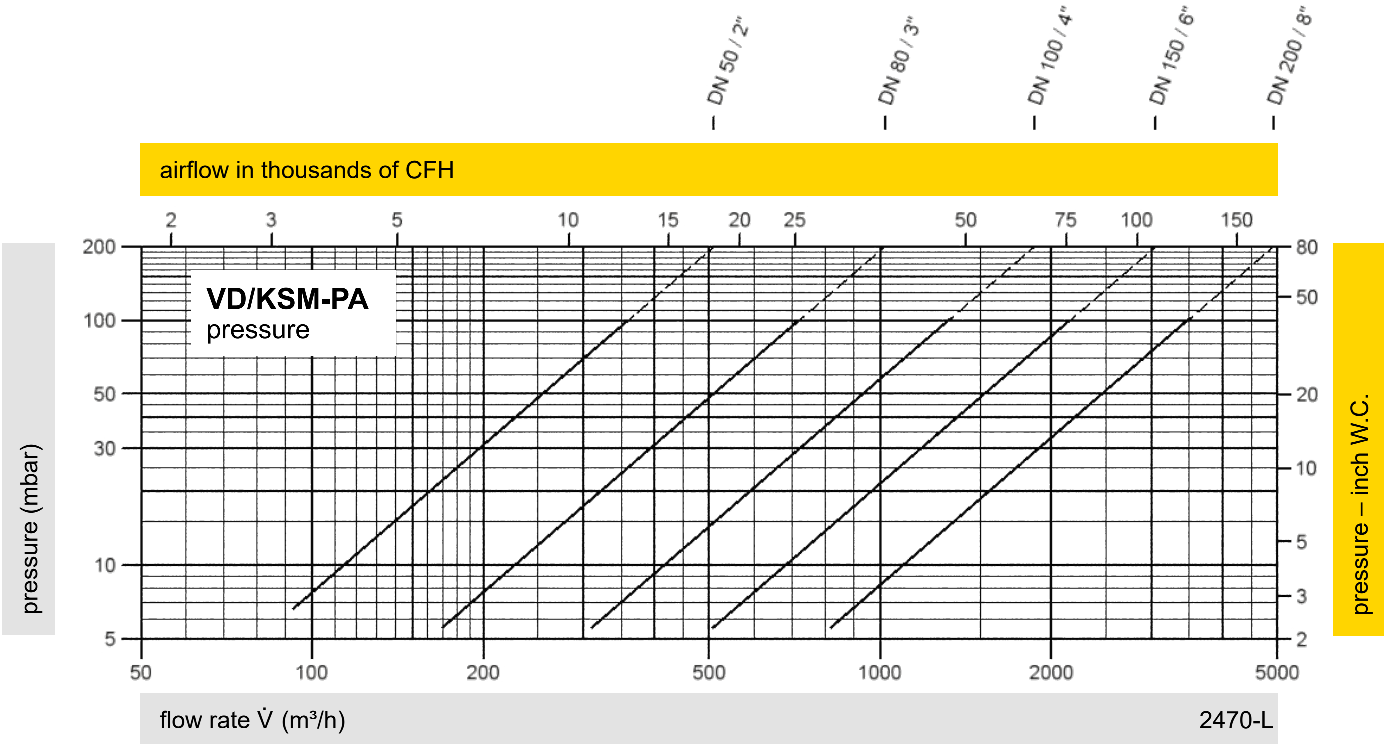
Design	A	B	C	D
Vacuum range (mbar) (inch W.C.)	-6.0 up to -16 -2.4 up to -6.4	-5.5 up to -16 -2.2 up to -6.4	-9.5 up to -30 -3.8 up to -12	-30 up to -100 -12 up to -40
Valve pallet	PE	PP	PVDF	Hastelloy
Sealing	PTFE	PTFE	PTFE	PTFE
Spindle guide	PE	PP	PVDF	Hastelloy
Weight	PE	PP	PVDF	Hastelloy

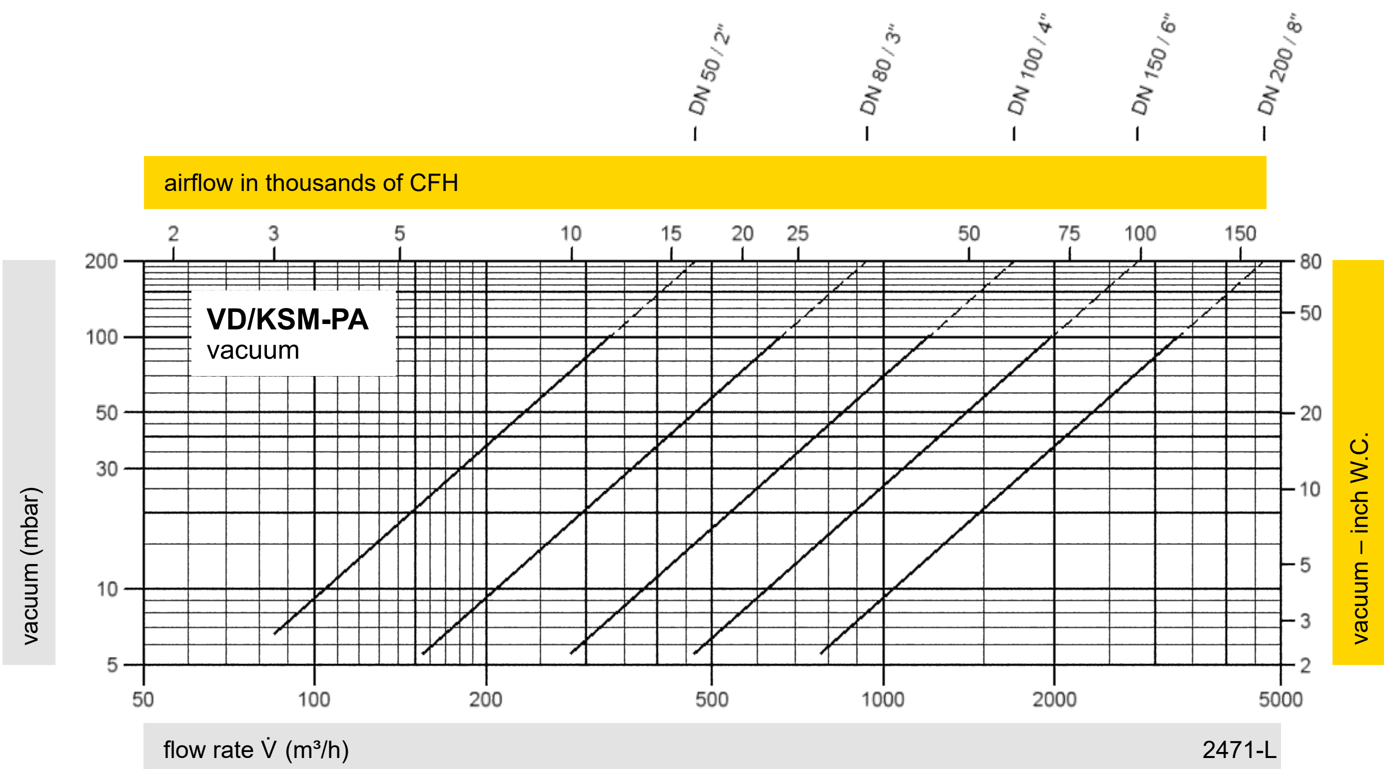
Special materials and other vacuum settings are available upon request.

Table 5: Flange connection type

EN 1092-1; Form A	Other types upon request.
ASME B16.5 CL 150 F.F.	

PROTEGO
for safety and environment



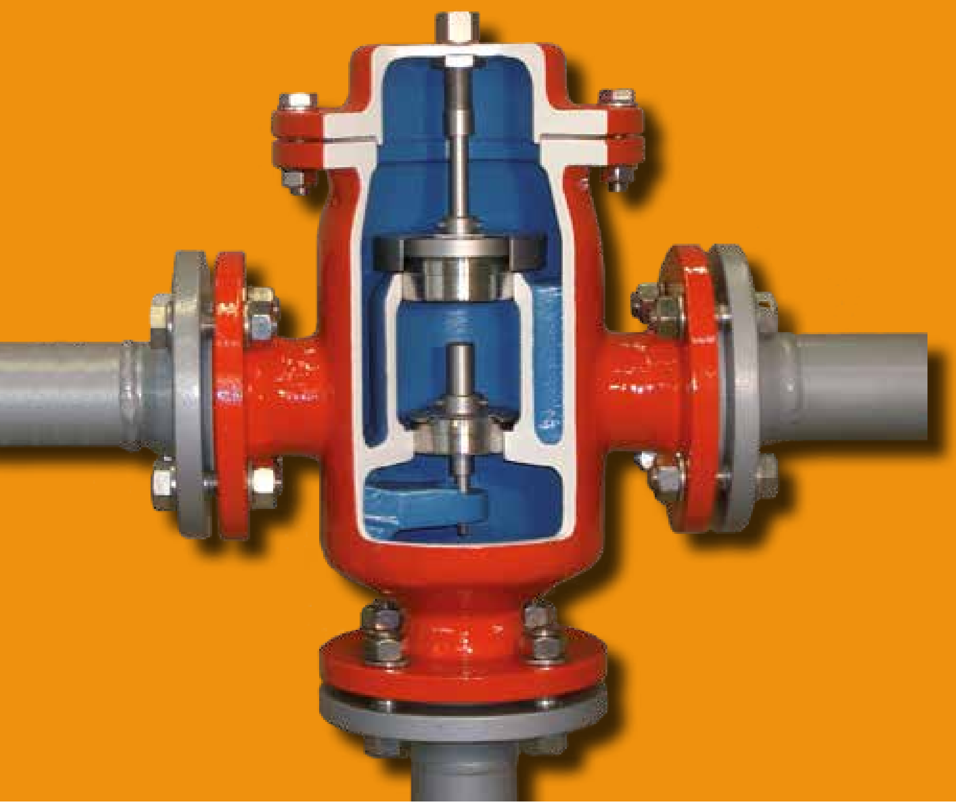


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:

PROTEGO® Pressure and Vacuum Relief Valves

In-line



Section 6

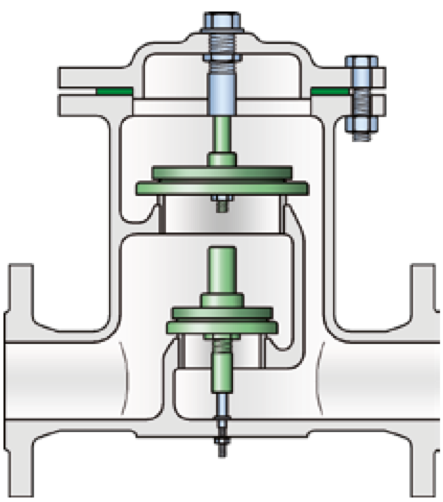
for safety and environment

The working principle and application of pressure and vacuum relief valves on tanks and process equipment is discussed in "Technical Fundamentals" (Section 1). This section introduces in-line pressure and vacuum relief valves which can act in a pressure containing, relief, or back flow protection function if installed on a tank or other process equipment.

Function and Description

These devices are direct acting weight-loaded or spring-loaded in-line valves, pallet type, used to protect plant equipment (tanks, vessels, process equipment, piping etc.) against excessive overpressure or underpressure. In-line valves may also be installed as end-of-line valves. In these cases, the opening to the atmosphere has to be protected against weather influences, dirt particles or foreign bodies/animals (Figure 1).

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



PROTEGO® pressure relief valves provide protection against unallowable overpressure and prevent emission losses until shortly before the set pressure is reached.

PROTEGO® vacuum relief valves provide safety against unallowable low vacuum and prevent the intake of air until shortly before the set pressure is reached.

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

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

Special features and advantages

Continuous investment in and a commitment to research and development has allowed PROTEGO® to design valves with the following advantages:

- 10% full-lift technology results in product savings (reduction of product losses greater than 30% possible)
- PROTEGO® valves open later and re-seat earlier than conventional valves, resulting in optimized pressure management and conservation of inert gases
- high flow capacity reduces costs through the use of smaller valves
- seal significantly above the normal standards
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- maintenance-friendly design

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

Preferred applications

- as pressure maintaining valve, e.g. for inert gas blanketing
- as pressure reducing valve, e.g. for connection to inert gas supply systems
- for controlled venting of plant or storage tanks in vapor collection systems
- as backflow protection for connection to exhaust air systems or inert gas systems

Installation and servicing

All PROTEGO® valves are supplied with detailed installation and maintenance instructions. Please take note of the separate instructions for removing transportation protection if they have been installed to protect the PROTEGO® valves. We have developed special checklists for the correct installation of PROTEGO® valves.

Selection

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

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

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

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

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

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

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

Based on this initial selection, additional details such as materials, coatings, etc. can be requested or defined in the data sheet.

If no suitable device can be found, please contact us. Special designs and approvals are available.

The **valve size** results from the volume flow which has to be vented to avoid an increase above the maximum allowable overpressure or underpressure. Certified volume flow diagrams are available for the design of the valves. In addition to operating conditions, the correct design must consider the pressure losses in the pipelines (including other installed devices) as well as external backpressures that may influence the set pressure and opening behavior. Detailed procedures and examples for the design are described in "Technical Fundamentals" (see Section 1).

Design

The valve must be dimensioned so that the permissible pressures are not exceeded when releasing the required flow (Section 1). When determining the opening pressure of the valve, pressure losses in the connected pipelines also have to be considered.

Example 1

Given: Volume flow $\dot{V}_{max}$ in m^3/h / CFH (e.g. for in-breathing or out-breathing of a storage tank as the sum of the pump capacity and the thermal breathing requirement) and maximum allowable opening pressure (e.g., tank pressure) p in mbar / inch W.C

Required: Valve size DN

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

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

Many conventional valves need 100% overpressure to reach full lift. In these cases, the set pressure may be just half of the maximum allowable opening pressure. Consequently, these valves open earlier and cause unnecessary product loss.

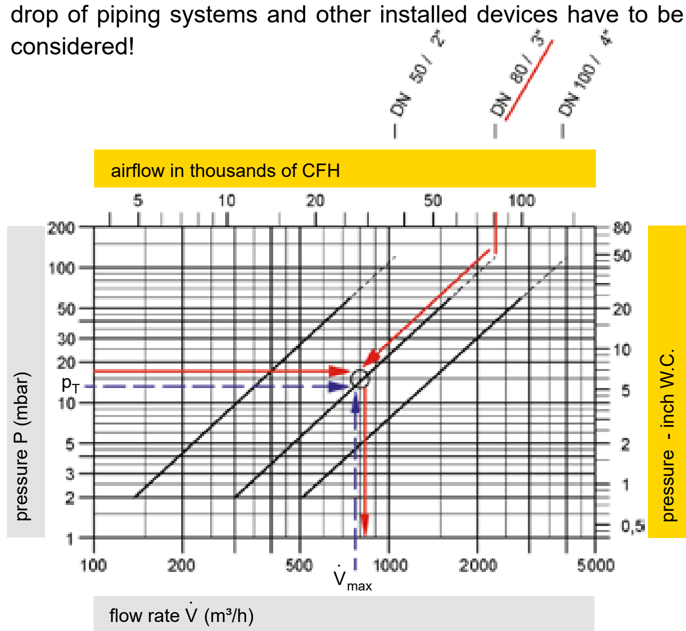
Example 2

Alternatively, the valve performance should be checked if the nominal size and maximum allowable pressure are specified.

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

Required: Volume flow in m^3/h / CFH; set pressure p_A in mbar / inch W.C.

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



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

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

Material selection is based on plant and engineering specifications.

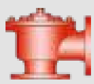
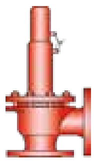
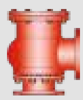
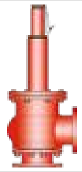
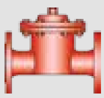
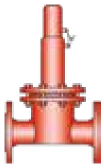
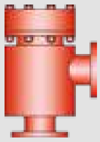
Guidelines for calculating the volume flow and considering the density influence are given in "Technical Fundamentals" (see Section 1).

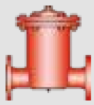
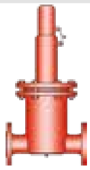
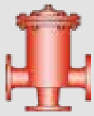
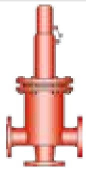
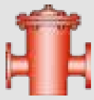
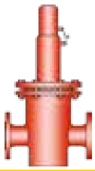
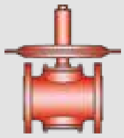
After completing all steps, the device can be completely specified and ordered.

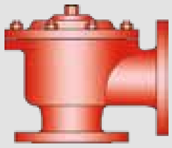
For special cases, the data sheet from Section 1 must be completed so we can provide an accurate quotation.

PROTEGO® Pressure and Vacuum Relief Valves – In-Line

Catalog

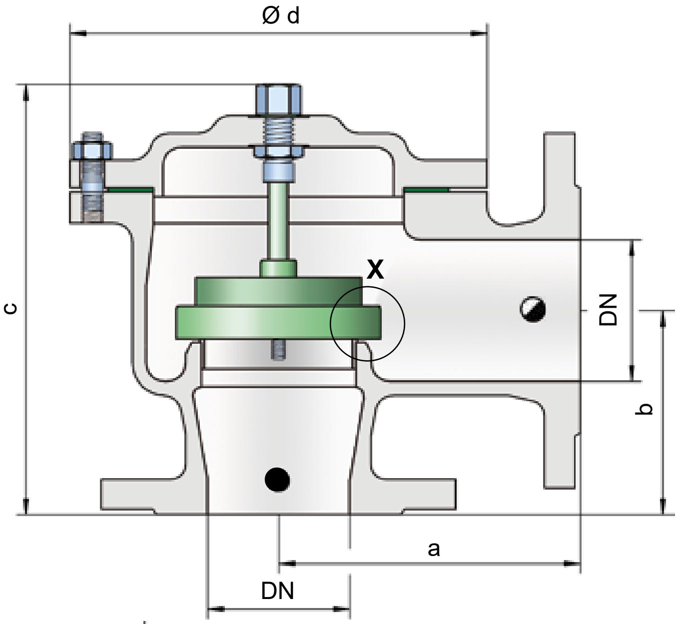
	Type	Size	Pressure setting positive or negative setting range mbar / inch W.C.	O = weight-loaded X = spring-loaded	Design O = straight through design X = right angle design	O = soft sealing X = metallic sealing	O= for critical substances (polymerization, corrosion, crystallization)	O = heating jacket	Page
Pressure or Vacuum Relief Valves									
	DZ/E	25 - 300 1" - 12"	±2.0 up to ±60 ±0.8 up to ±24	O	X	O / X		O	230 - 232
	DZ/E-F	25 - 300 1" - 12"	±60 up to ±500 ±24 up to ±200	X	X	X		O	234 - 236
	DZ/EA	50 - 150 2" - 6"	±5 up to ±50 ±2 up to ±20	O	X	X	O		238- 239
	DZ/EA-F	50 - 150 2" - 6"	±60 up to ±500 ±24 up to ±200	X	X	X	O		240 - 242
	DZ/T	25 - 300 1" - 12"	±2.0 up to ±60 ±0.8 up to ±24	O	O	O / X		O	244 - 246
	DZ/T-F	25 - 300 1" - 12"	±60 up to ±500 ±24 up to ±200	X	O	X		O	248 - 250
	R/KSM	50 - 200 2" - 8"	±5 up to ±100 ±2 up to ±40	O	X	O			252 - 253

	Type	Size	Pressure setting positive setting range mbar / inch W.C.	Pressure setting negative setting range mbar / inch W.C.	O = weight-loaded X = spring-loaded	Design O = straight through design X = right angle design	O = soft sealing X = metallic sealing	O= for critical substances (polymerization, corrosion, crystallization)	O = heating jacket	Page
Pressure and Vacuum Relief Valves										
	DV/ZT	40 - 150 1½" - 6"	upper valve pallet ±2.0 up to ±60 ±0.8 up to ±24	lower valve pallet ±3.5 up to ±50 ±1.4 up to ±20	O	O	O / X		O	254 - 256
	DV/ZT-F	40 - 150 1½" - 6"	+60 up to +500 +24 up to +200	-3.5 up to -50 -1.4 up to -20	X	O	X		O	258 - 260
	DV/ZU	40 - 150 1½" - 6"	+2.0 up to +60 +0.8 up to +24	-3.5 up to -50 -1.4 up to -20	O	O / X	O / X		O	262 - 264
	DV/ZU-F	40 - 150 1½" - 6"	+60 up to +500 +24 up to +200	-3.5 up to -50 -1.4 up to -20	X	O / X	X		O	266 - 268
	DV/ZW	40 - 150 1½" - 6"	+2.0 up to +60 +0.8 up to +24	-3.5 up to -50 -1.4 up to -20	O	O	O / X		O	270 - 272
	DV/ZW-F	40 - 150 1½" - 6"	+60 up to +500 +24 up to +200	-3.5 up to -50 -1.4 up to -20	X	O	X		O	274 - 276
Blanketing Valve										
	ZM-R	15 - 100 ½" - 4"	up to +500 up to +200	up to -200 up to -80	X	O	O			278 - 283

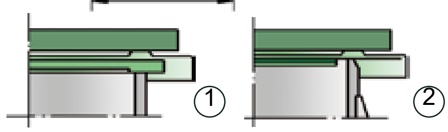


Pressure or Vacuum Relief Valve, In-Line

PROTEGO® DZ/E



Detail **X**



● = Tank connection for pressure relief function

◐ = Tank connection for vacuum relief function

Flow direction marked at the housing by →

Pressure or vacuum settings:

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

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

Function and Description

The PROTEGO® in-line valve DZ/E is a state-of-the-art pressure or vacuum relief valve with a right angle design. Typically, the valve is installed in the in-breathing or out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure or underpressure. The valve prevents emission losses almost up to the set pressure and prevents unacceptable product entry.

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

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity reduces costs through the use of smaller valves
- can be used as pressure or vacuum relief valve
- compact, space-saving right-angle design
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- maintenance-friendly design

Designs and Specifications

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

Two different right angle designs are available:

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

Additional special devices available upon request.

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

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Coated Devices
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

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

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

Table 2: Material selection for housing

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

The housings are also available with an ECTFE-coating.

Special materials upon request.

Table 3: Material selection for valve pallet

DN 40 - 300 / 1 ½" - 12"

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

DN 25 - 32 / 1" - 1 ¼"

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

Special materials upon request.

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

Table 4: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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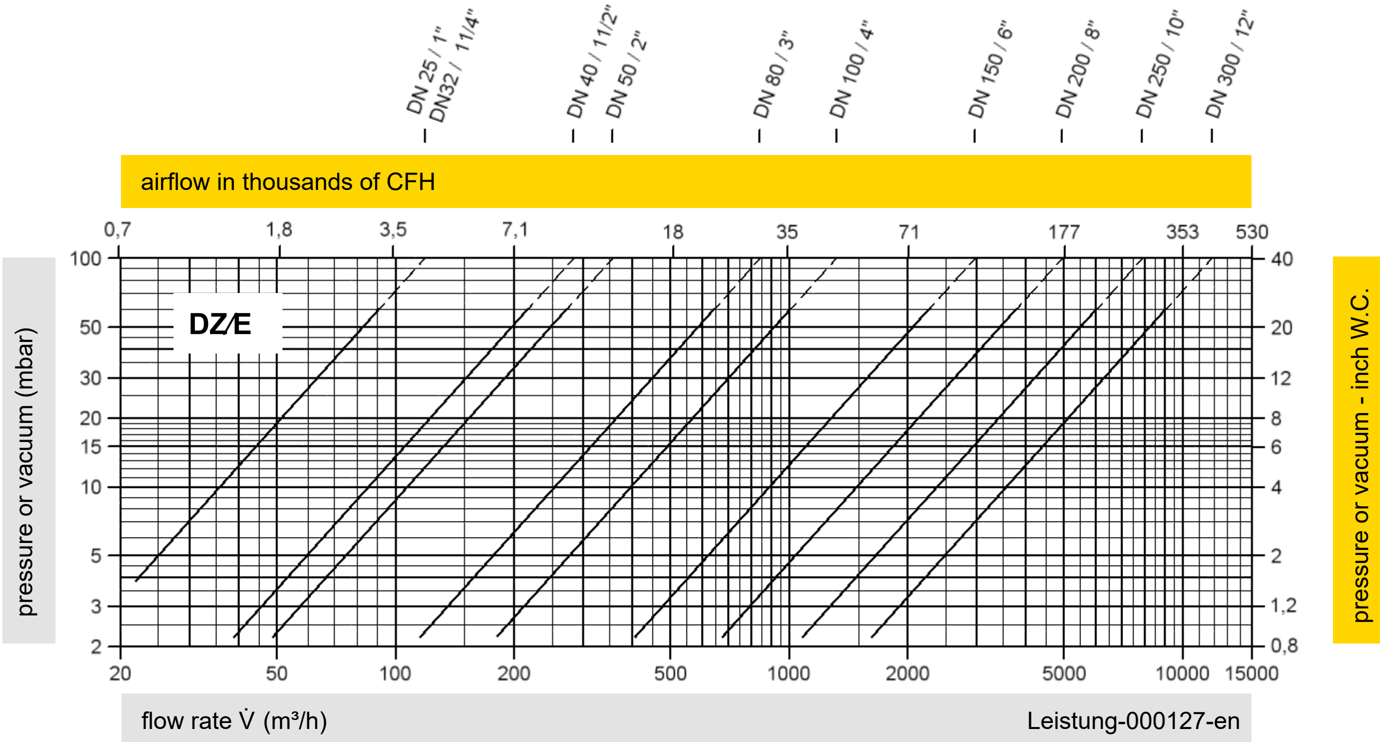
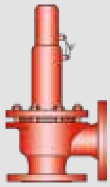


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

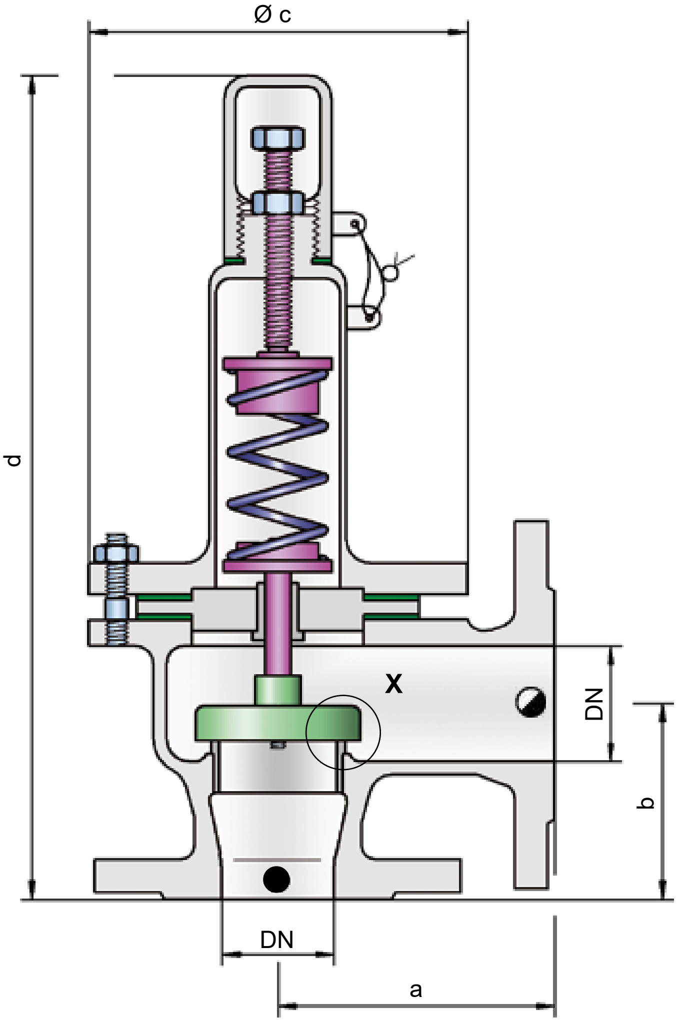
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:



Pressure or Vacuum Relief Valve, In-Line

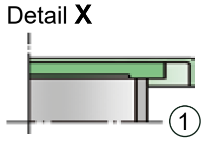
PROTEGO® DZ/E-F



● = Tank connection for pressure relief function

◐ = Tank connection for vacuum relief function

Detail **X**



Flow direction marked at the housing by ➝

Pressure or vacuum settings:

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

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

Function and Description

The PROTEGO® in-line valve DZ/E-F is a state-of-the-art pressure or vacuum relief valve in a right angle design for higher system pressures. Typically, the valve is installed in the in-breathing or out-breathing lines of tanks, vessels, and opening pressure which results in best possible process equipment to protect against unallowable overpressure or underpressure. The valve prevents emission losses almost up to the set pressure and prevents unacceptable product entry. As this device is equipped with a spring, higher set pressures are achieved than with the DZ/E.

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

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity reduces costs through the use of smaller valves
- can be used as pressure or vacuum relief valve
- compact, space-saving right-angle design
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- spring-loaded for high set pressures
- maintenance-friendly design

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Coated Devices
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Designs and Specifications

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

Two different right angle designs are available:

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

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

Additional special devices available upon request.

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

Spring-loaded PV-Valves
Maintenance-friendly design (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	65 / 2 ½“ 80 / 3“	100 / 4"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	110 / 4.33	110 / 4.33	125 / 4.92	125 / 4.92	170 / 6.69	190 / 7.48	230 / 9.06	275 / 10.83	325 / 12.80	350* / 13.78
b	75 / 2.95	75 / 2.95	90 / 3.54	90 / 3.54	115 / 4.53	120 / 4.72	160 / 6.30	225 / 8.86	275 / 10.83	300 / 11.81
c	150 / 5.91	150 / 5.91	170 / 6.69	170 / 6.69	235 / 9.25	280 / 11.02	335 / 13.19	420 / 16.54	505 / 19.88	565 / 22.24
d	435 / 17.13	435 / 17.13	445 / 17.52	445 / 17.52	620 / 24.41	700 / 27.56	970 / 38.19	1205 / 47.44	1275 / 52.36	1330 / 52.36

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

* for ANSI 12" = 400 mm / 15.75 inches

Table 2: Material selection for housing

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

The housings are also available with an ECTFE coating.

Special materials upon request.

Table 3: Material of valve pallet

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

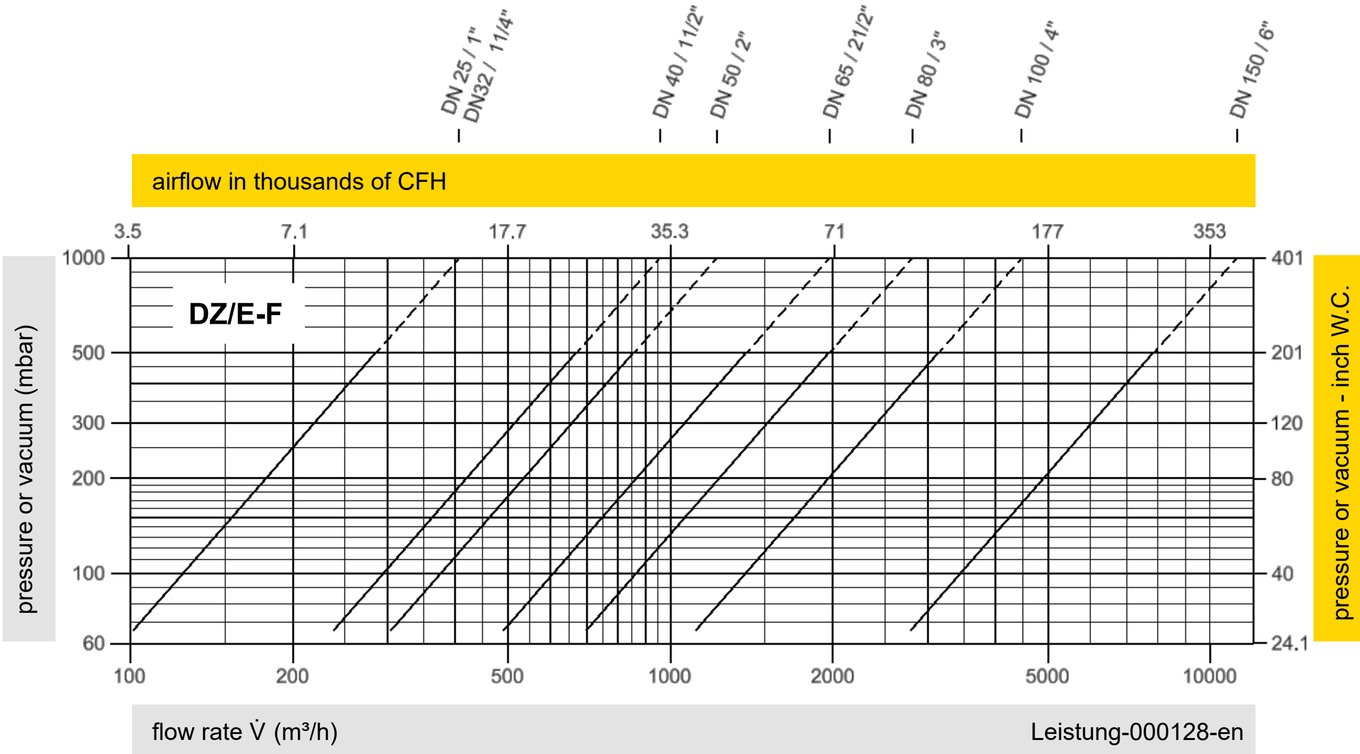
Special materials upon request.

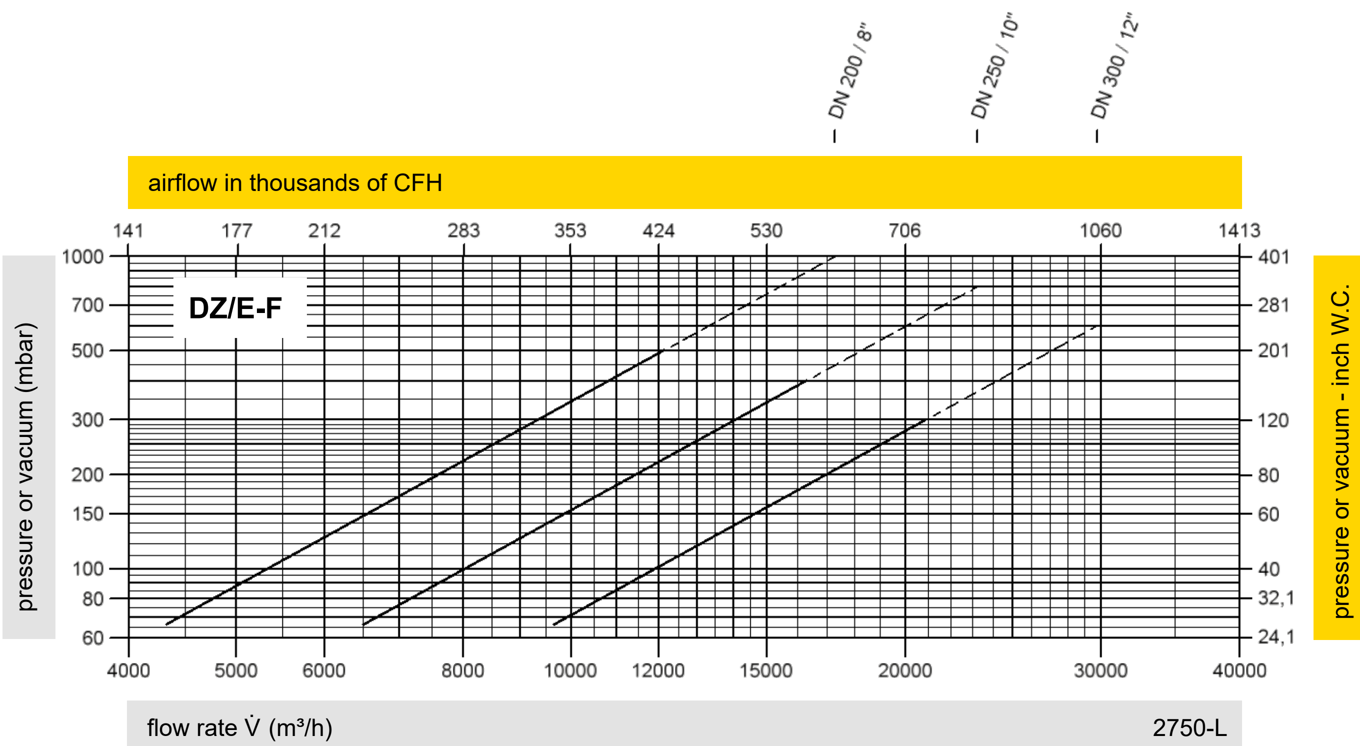
Devices with higher set pressure or vacuum are available upon request.
For lower set pressures or vacuum, refer to type DZ/E.

Table 4: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

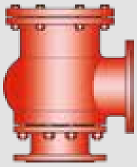
Other types upon request.





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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

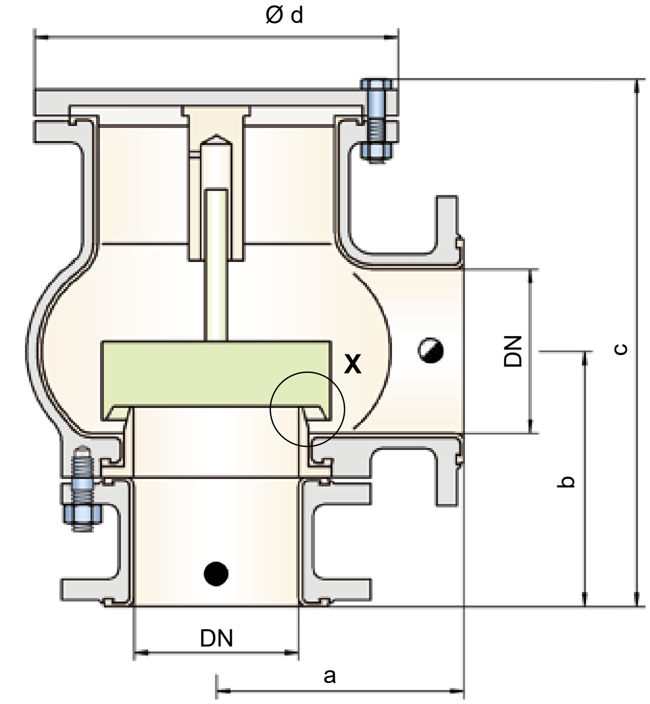
Notes:



Pressure or Vacuum Relief Valve, In-Line

with ETFE Lining

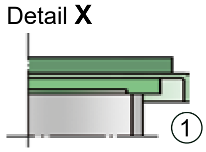
PROTEGO® DZ/EA



● = Tank connection for pressure relief function

◐ = Tank connection for vacuum relief function

Detail **X**



Flow direction marked at the housing by ➝

Pressure or vacuum settings:

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

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

Function and Description

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

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

The opening characteristic is the same for pressure and vacuum relief. Due to our highly developed manufacturing technology, the tank pressure is maintained up to the set pressure with a tightness that is far above to the conventional standard. This feature is ensured by specially finished PTFE valve seats, or by the use of Hastelloy valve seats, and with individually lapped valve pallets (1). After the overpressure is released or the vacuum is balances, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- inner lining and material selection makes this type suitable for highly corrosive, polymerizing, or sticky substances
- high flow capacity reduces costs through the use of smaller valves
- can be used as pressure or vacuum relief valve
- compact, space-saving right-angle design
- sturdy housing design (PN 10)
- maintenance-friendly design

Design and Specification

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

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

Additional special devices available upon request.

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

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Coated Devices
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

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

Table 2: Material selection for housing

Design	C	D
Housing	Steel	Steel
Lining	ETFE	ETFE
Cover	Steel	Steel
Valve seat	PTFE	Hastelloy
Valve pallet	A	A, B

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

Special materials upon request.

Table 3: Material selection for valve pallet

Design	A	B
Pressure range (mbar) (inch W.C.)	±5 up to ±50 ±2 up to ±20	±5 up to ±50 ±2 up to ±20
Valve pallet	PTFE	Hastelloy
Sealing	PTFE	Metal to Metal

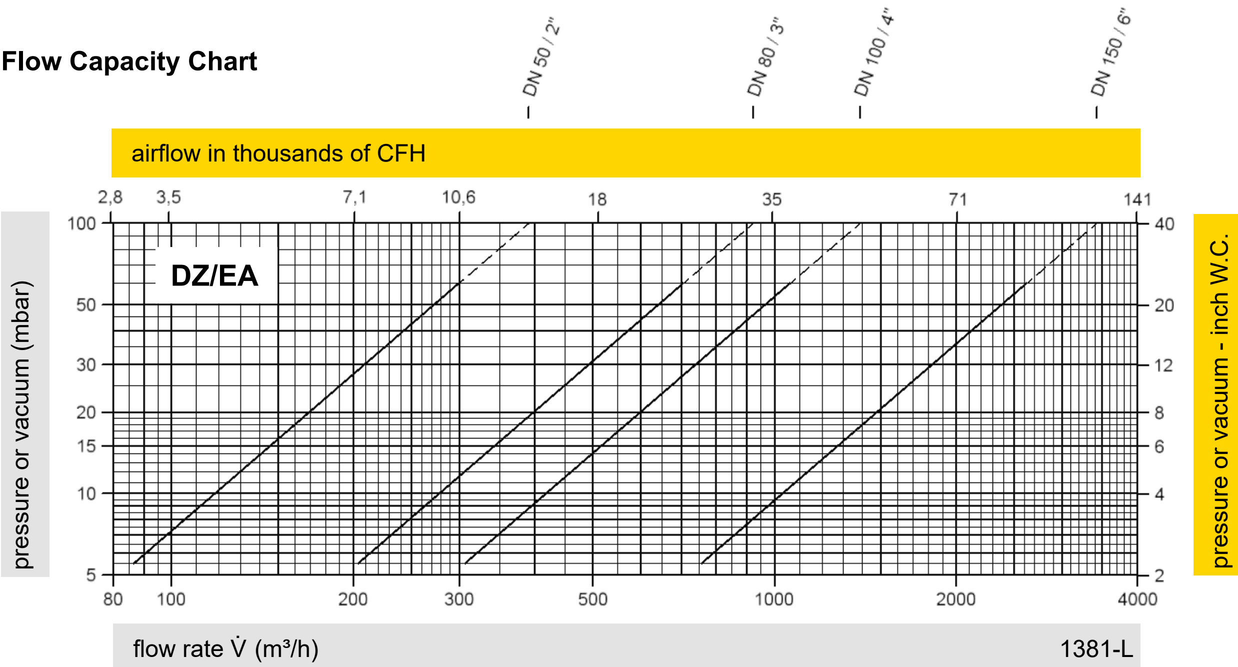
Special materials upon request.
For higher set pressure or vacuum, refer to type DZ/EA-F.

Table 4: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

Flow Capacity Chart



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
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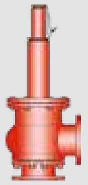
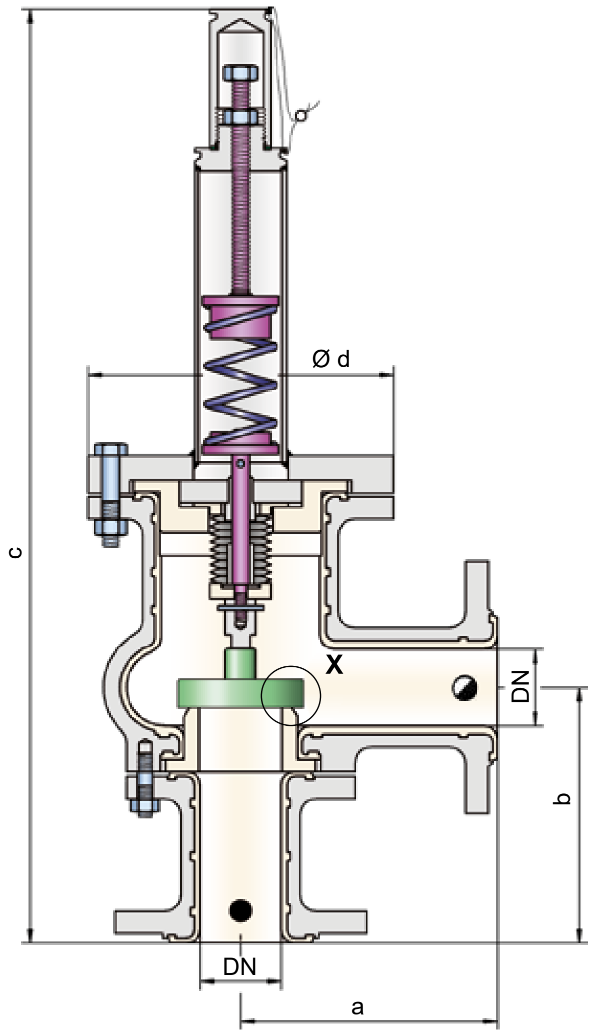


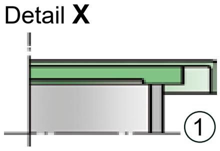
PROTEGO® DZ/EA-F



● = Tank connection for pressure relief function

◐ = Tank connection for vacuum relief function

Detail **X**



Flow direction marked at the housing by →

Pressure or vacuum settings:

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

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

Function and Description

The lined PROTEGO® in-line valve DZ/EA-F is a state-of-the-art pressure or vacuum relief valve in a right angle design for higher set pressures. The lining makes this model a perfect solution for corrosive, polymerizing, or sticky substances. All inner parts are manufactured from PTFE or other highly corrosion resistant materials. Typically, the valve is installed in the in-breathing or out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure or underpressure.

The valve prevents emission losses almost up to the set pressure and prevents unacceptable product entry. This spring-loaded model allows higher set pressures than the DZ/EA.

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

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- inner lining and material selection makes this type suitable for highly corrosive, polymerizing, or sticky substances
- high flow capacity reduces costs through the use of smaller valves
- can be used as pressure or vacuum relief valve
- compact, space-saving right-angle design
- sturdy housing design (PN 10)
- spring-loaded for high set pressures
- maintenance-friendly design

Vents - 10% Technology (Flyer pdf)

Leak Rate/10% Technology (Flyer pdf)

Coated Devices (Flyer pdf)

The optimized valve pallet (Flyer pdf)

Designs and Specifications

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

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

Additional special devices available upon request.

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

Table 1: Dimensions — Dimensions in mm / inches

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

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

Table 2: Material for housing

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

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

Table 3: Material for valve pallet

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

Special materials upon request.

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

Table 4: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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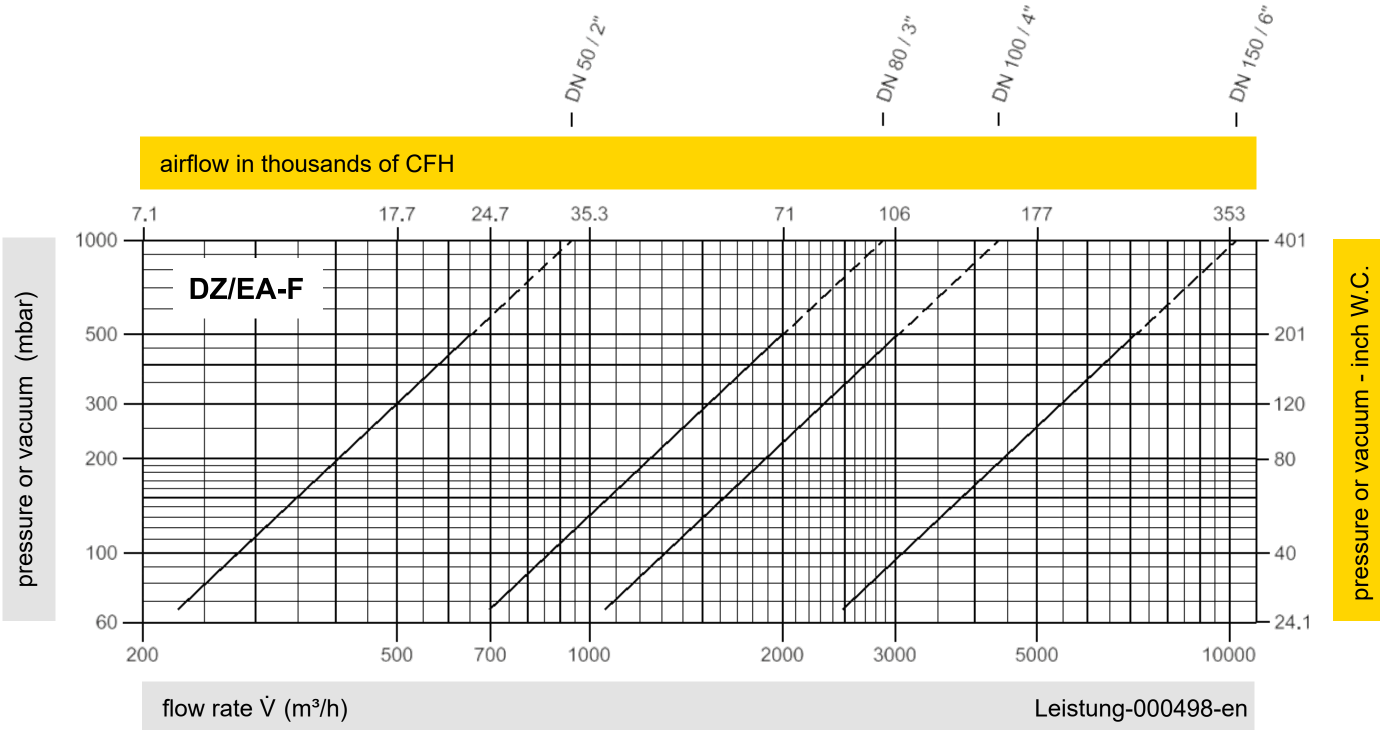
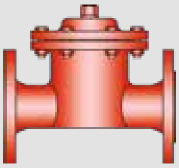
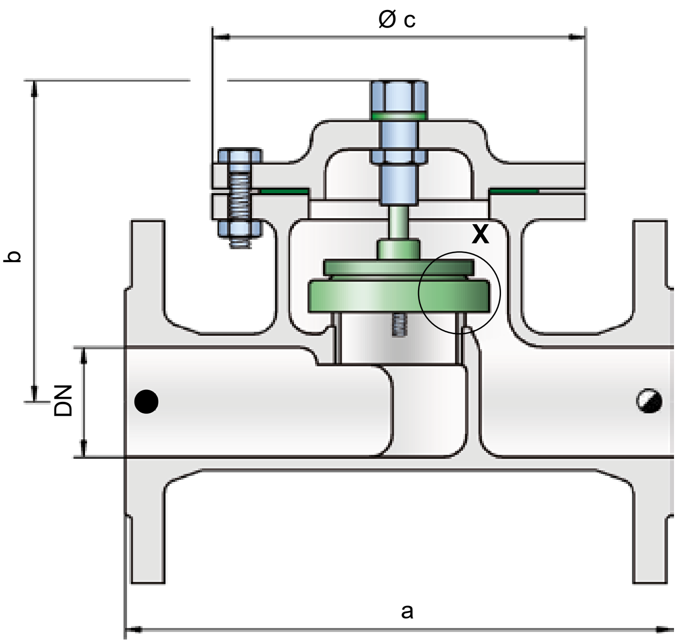
PROTEGO® DZ/EA-F



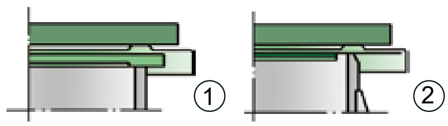
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:





Detail **X**



● = Tank connection for pressure relief function

◑ = Tank connection for vacuum relief function

Flow direction marked at the housing by ➝

Pressure or vacuum settings:

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

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

Function and Description

The PROTEGO® in-line valve DZ/T is a state-of-the-art pressure or vacuum relief valve. Typically, the valve is installed in the in-breathing or out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure or underpressure. The valve prevents emission losses almost up to the set pressure and prevents unacceptable product entry. The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set at just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. Due to our highly developed manufacturing technology, the tank pressure is maintained up to set pressure with a tightness that is far above the conventional standard. This feature is ensured by valve seats made of high quality stainless steel and with individually lapped valve pallets (1) or with an air cushion seal (2) in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent the valve pallets from sticking when sticky products are used and to enable the use of corrosive fluids. After the overpressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity reduces costs through the use of smaller valves
- can be used as pressure or vacuum relief valve
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- maintenance-friendly design

Designs and Specifications

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

Two different designs are available:

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

Additional special devices available upon request.

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

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Coated Devices
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	25 / 1"	32 / 1 ¼"	40 / 1 ½"	50 / 2"	65 / 2 ½"	80 / 3"	100 / 4"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	220/8.66	220/8.66	250/9.84	250/9.84	340/13.39	340/13.39	380/14.96	460/18.11	550/21.65	650/25.59	700/27.56
b	140/5.51	140/5.51	190/7.48	190/7.48	210/8.27	210/8.27	240/9.45	305/12.01	460/18.11	515/20.28	555/21.85
c	150/5.91	150/5.91	170/6.69	170/6.69	235/9.25	235/9.25	280/11.02	335/13.19	420/16.54	505/19.88	565/22.24

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

Table 2: Material selection for housing

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

The housings are also available with an ECTFE coating.

Special materials upon request.

Table 3: Material selection for valve pallet

DN 40 - 300 / 1 ½" - 12"

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

DN 25 - 32 / 1" - 1 ¼"

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

Special materials upon request.

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

Table 3: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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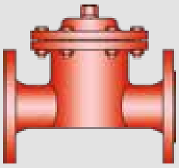
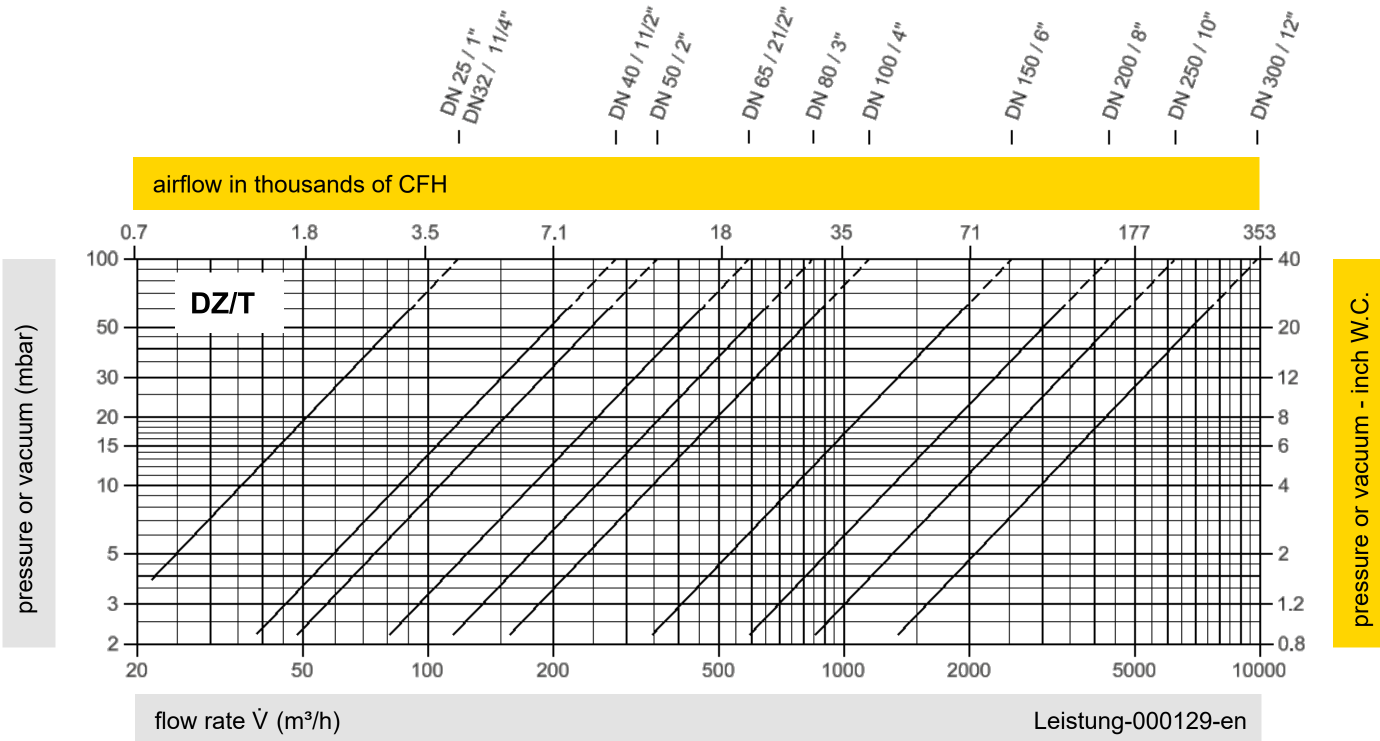


Pressure or Vacuum Relief Valve, In-Line

Flow Capacity Chart

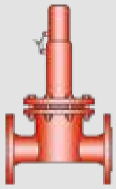
PROTEGO® DZ/T



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

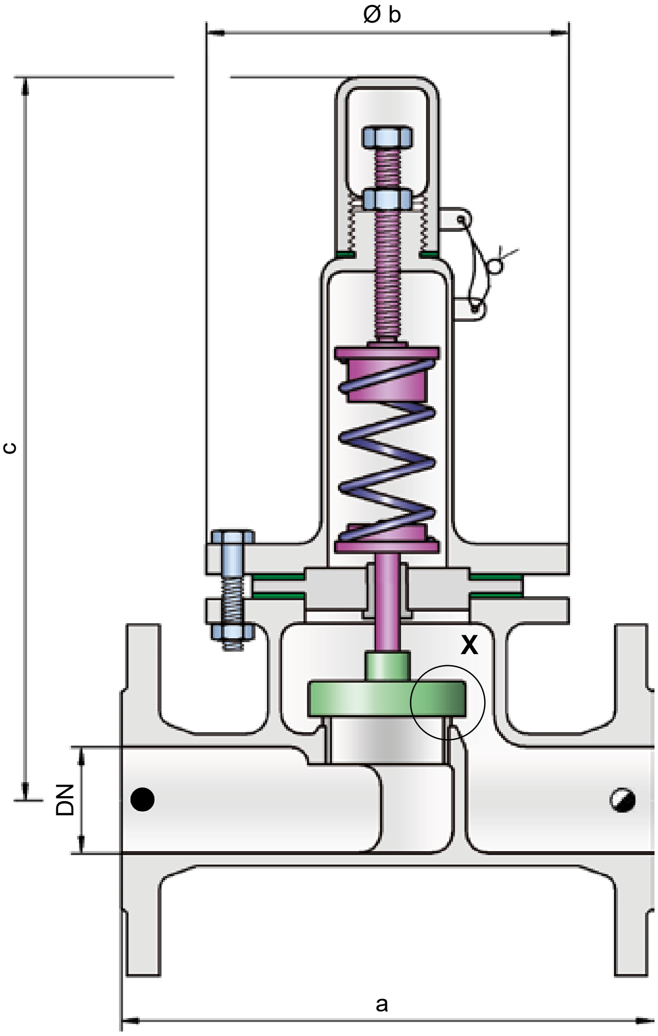
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:



Pressure or Vacuum Relief Valve, In-Line

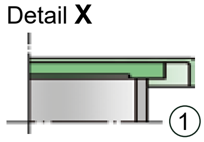
PROTEGO® DZ/T-F



● = Tank connection for pressure relief function

◐ = Tank connection for vacuum relief function

Detail **X**



Flow direction marked at the housing by ➝

Pressure or vacuum settings:

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

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

Function and Description

The PROTEGO® in-line valve DZ/T-F is a state-of-the-art pressure or vacuum relief valve for higher system pressures. Typically, the valve is installed in the in-breathing or out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure or underpressure. The valve prevents emission losses almost up to the set pressure and prevents unacceptable product. This spring-loaded model allows higher set pressures than the DZ/T.

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

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity reduces costs through the use of smaller valves
- can be used as pressure or vacuum relief valve
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- spring-loaded for high set pressures
- maintenance-friendly design

Vents - 10% Technology (Flyer pdf)

Leak Rate/10% Technology (Flyer pdf)

Coated Devices (Flyer pdf)

The optimized valve pallet (Flyer pdf)

Designs and Specifications

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

Two different designs are available:

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

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

Additional special devices available upon request.

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

Spring-loaded PV-Valves
Maintenance-friendly design (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

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

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

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

Table 2: Material selection for housing

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

The housings are also available with an ECTFE coating. Special materials upon request.

Table 3: Material of valve pallet

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

Special materials upon request.

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

Table 4: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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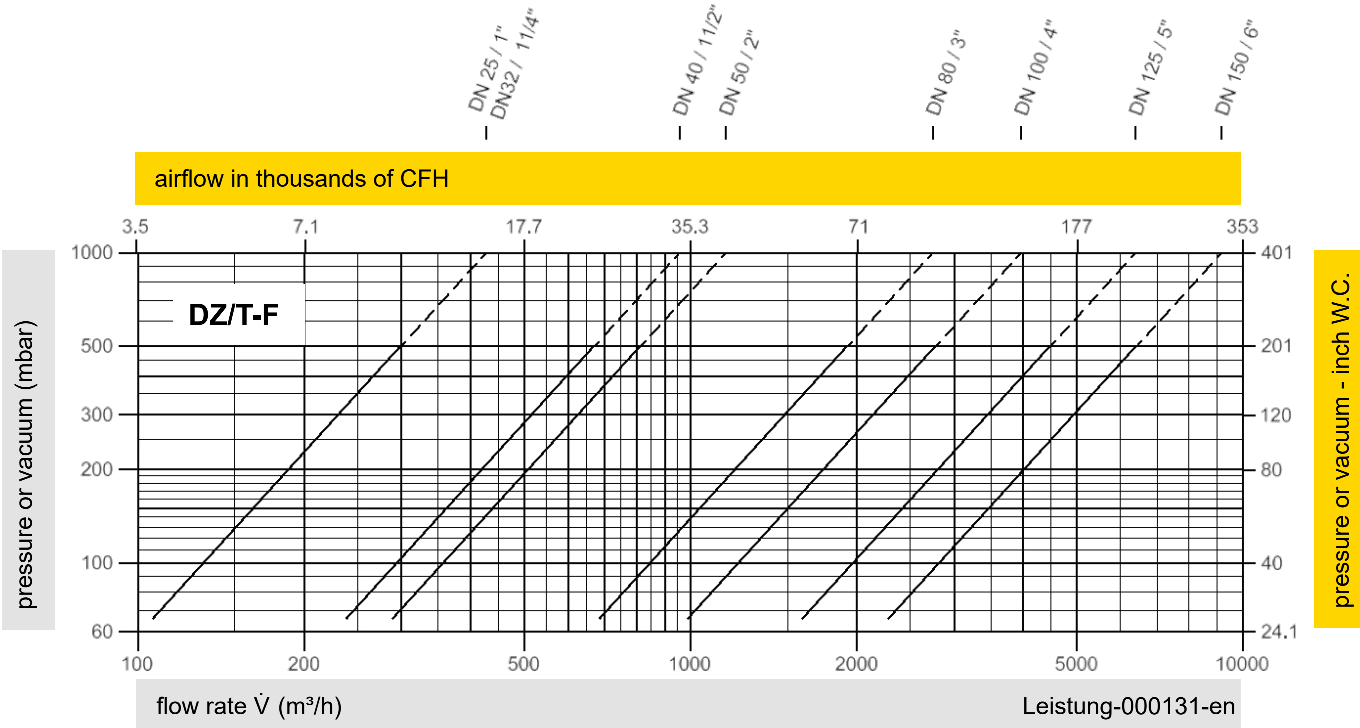
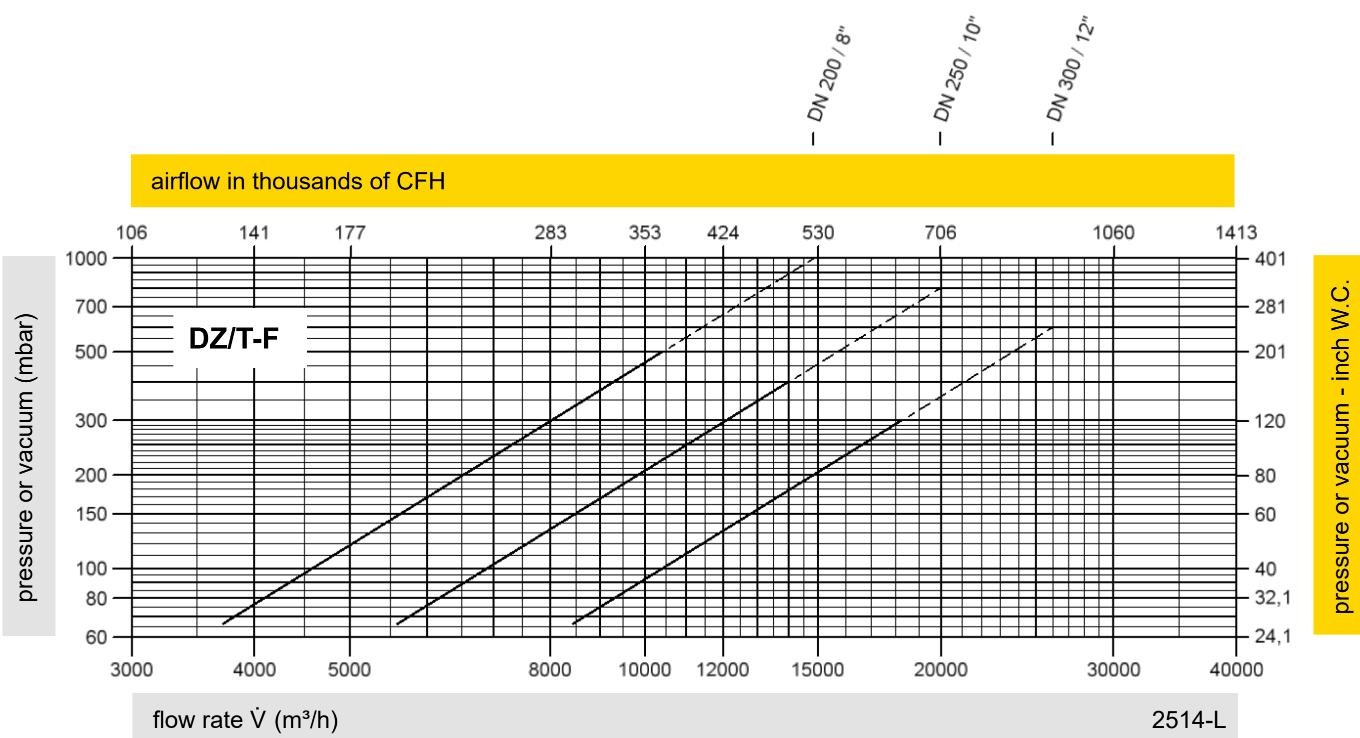
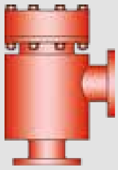




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

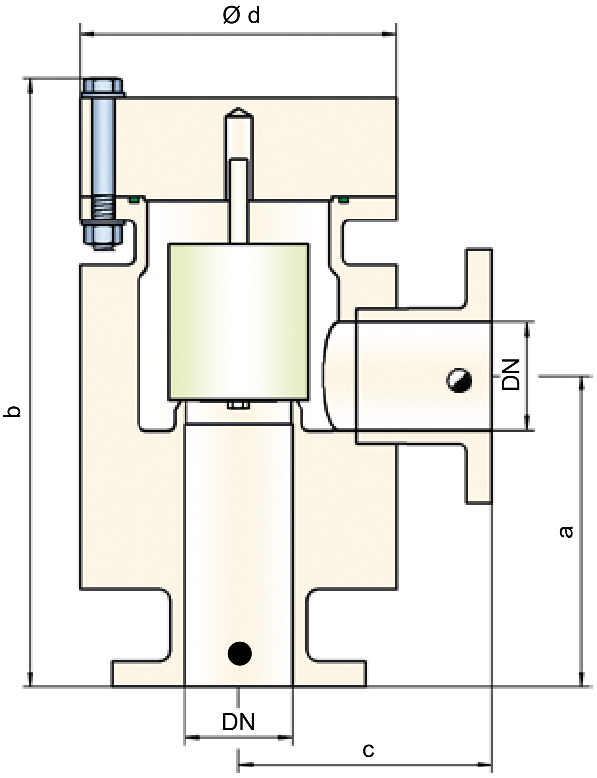
Notes:



Pressure or Vacuum Relief Valve, In-Line

made of plastic

PROTEGO® R/KSM



● = Tank connection for pressure relief function

◑ = Tank connection for vacuum relief function

Flow direction marked at the housing by ➝

Pressure or vacuum settings:

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

Function and Description

The PROTEGO® in-line valve R/KSM is a state-of-the-art pressure or vacuum relief valve in a right angle design made out of high-grade synthetic material. Typically, the valve is installed in the in-breathing or out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure or underpressure. The valve prevents emission losses almost up to the set pressure and prevents unacceptable product entry. The valve is a perfect solution for corrosive, polymerizing, or sticky substances.

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

The opening characteristic for pressure and vacuum side is the same. Due to our highly developed manufacturing technology, the tank pressure is maintained up to the set pressure with a tightness that is far above to the conventional standard. This feature is ensured by special valve seats made of high quality synthetic material or PTFE. After the overpressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- can be used as pressure or vacuum relief valve
- compact, space-saving right-angle design
- high flow capacity reduces costs through the use of smaller valves
- non-corrosive
- weight reduction in comparison to steel/stainless steel
- high surface quality
- different plastics can easily be combined
- maintenance-friendly design

Design and Specification

The valve pallet is weight-loaded. Higher set pressures are achieved with metal valve pallets.

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

Additional special devices available upon request.

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

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Vents for corrosive vapor service
(Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

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

* Dimensions in parentheses only for PVDF

Table 2: Material selection for housing

Design	A	B	C
Housing	PE	PP	PVDF
Valve seat	PE	PP	PVDF
Gasket	FPM	FPM	FPM
Valve pallet	A, C, D	B, C, D	C, D

Special materials upon request.

Table 3: Material selection for valve pallet

Design	A	B	C	D
Pressure range (mbar) (inch W.C.)	±6.0 up to ±16 ±2.4 up to ±6.4	±5.5 up to ±16 ±2.2 up to ±6.4	±9.5 up to ±30 ±3.8 up to ±12	±30 up to ±100 ±12 up to ± 40
Valve pallet	PE	PP	PVDF	Hastelloy
Sealing	PTFE	PTFE	PTFE	PTFE
Spindle guide	PE	PP	PVDF	Hastelloy

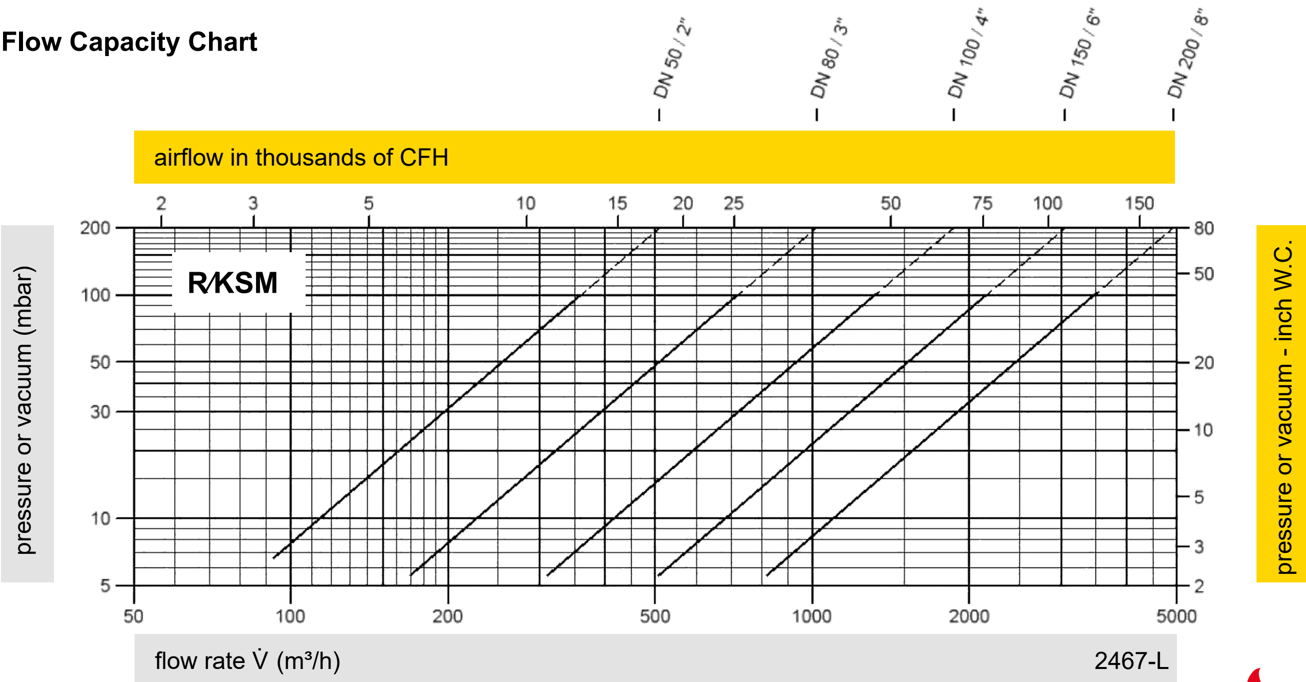
Special materials and devices with higher set pressure or vacuum are available upon request.

Table 4: Flange connection type

EN 1092-1; Form A
ASME B16.5 CL 150 F.F.

Other types upon request.

Flow Capacity Chart



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

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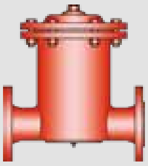
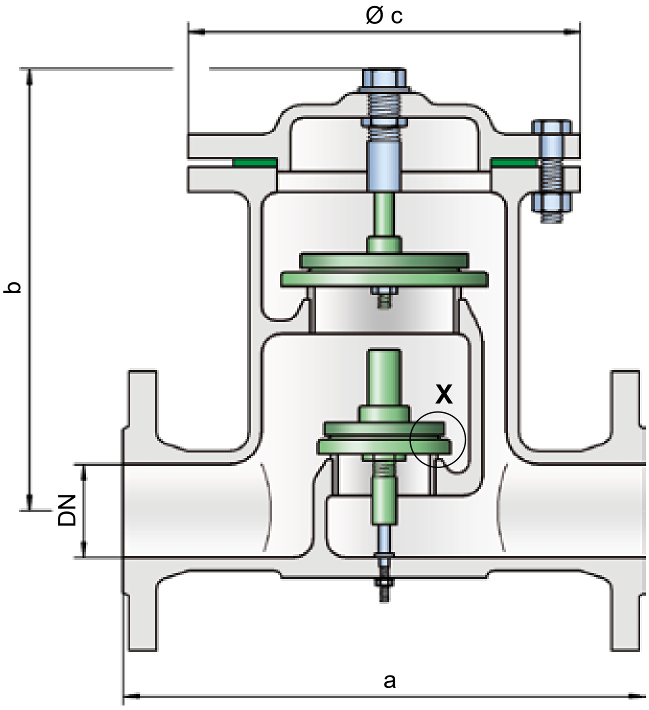


Pressure and Vacuum Relief Valve, In-Line

PROTEGO® DV/ZT



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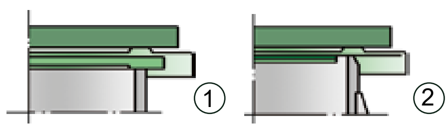


Tank connection depends upon flow capacity, set pressure, and set vacuum for in-breathing and out-breathing.

Pressure or vacuum settings:

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

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

Function and Description

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

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

Due to our highly developed manufacturing technology, the tank pressure is maintained up to set pressure with a tightness that is far above the conventional standard. This feature is ensured by valve seats made of high quality stainless steel and with individually lapped valve pallets (1), or with an air cushion seal (2), in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent the valve pallets from sticking when sticky products are used and to enable the use of corrosive fluids. After the overpressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity reduces costs through the use of smaller valves
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- maintenance-friendly design

Designs and Specifications

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

Two different designs are available:

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

Additional special devices available upon request.

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

Vents - 10% Technology (Flyer pdf)

Leak Rate/10% Technology (Flyer pdf)

Coated Devices (Flyer pdf)

The optimized valve pallet (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

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

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

Table 2: Material selection for housing

Design	A	B	
Housing Heating jacket (DV/ZT-H-...)	Steel Steel	Stainless Steel Stainless Steel	The housings are also available with an ECTFE coating. Special materials upon request.
Valve seat	Stainless Steel	Stainless Steel	
Gasket	PTFE	PTFE	

Table 3: Material selection for upper valve pallet

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

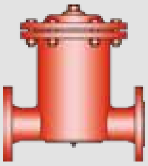
Table 4: Material selection for lower valve pallet

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

Special materials and lower set vacuum upon request.

Table 5: Flange connection type

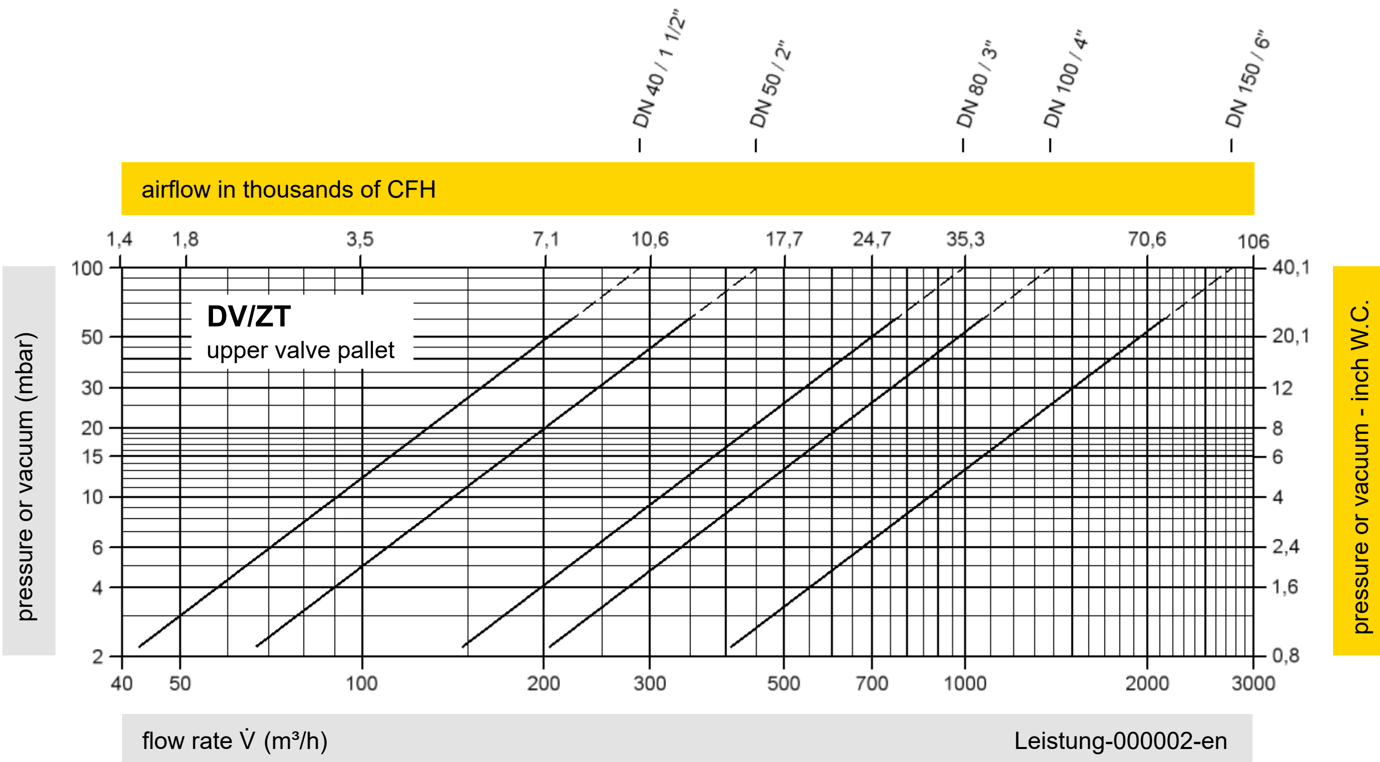
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

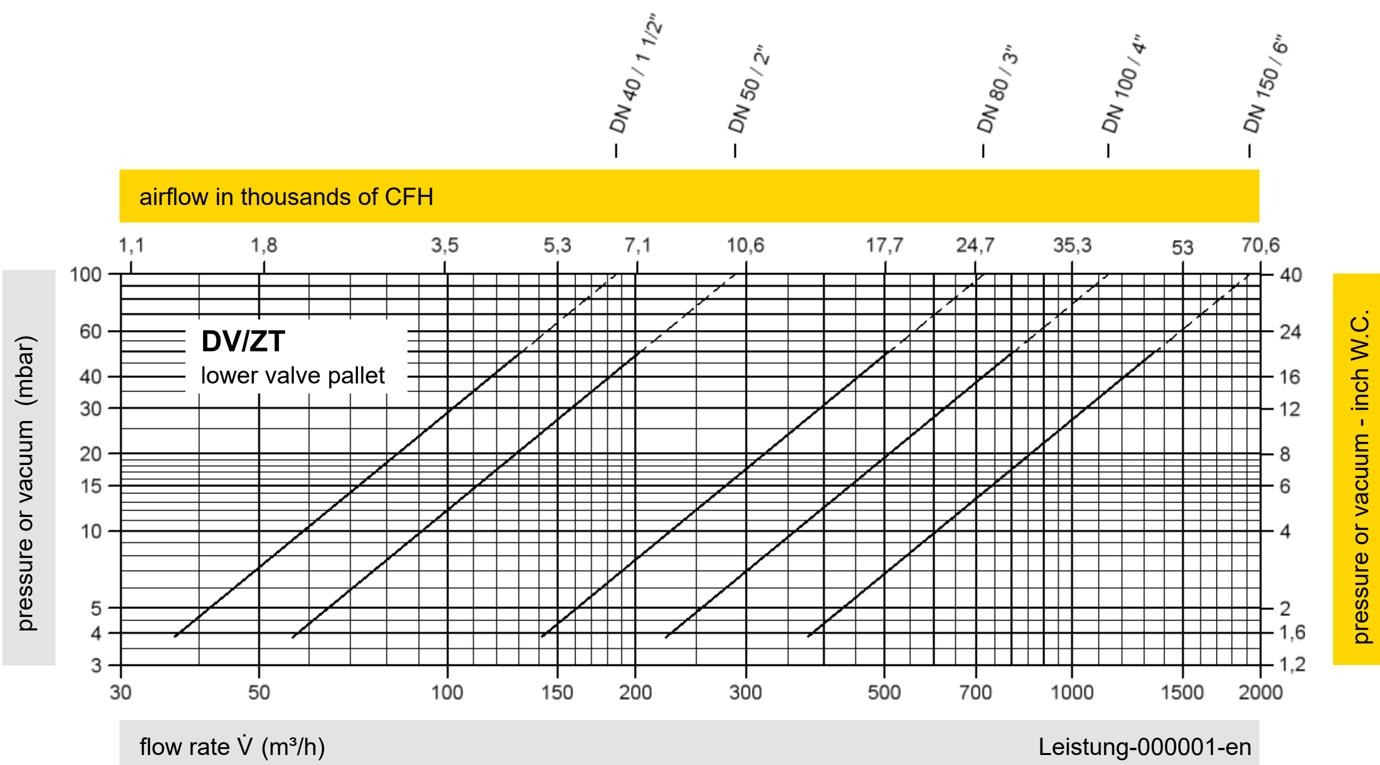


Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

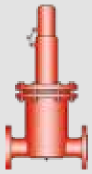
PROTEGO® DV/ZT





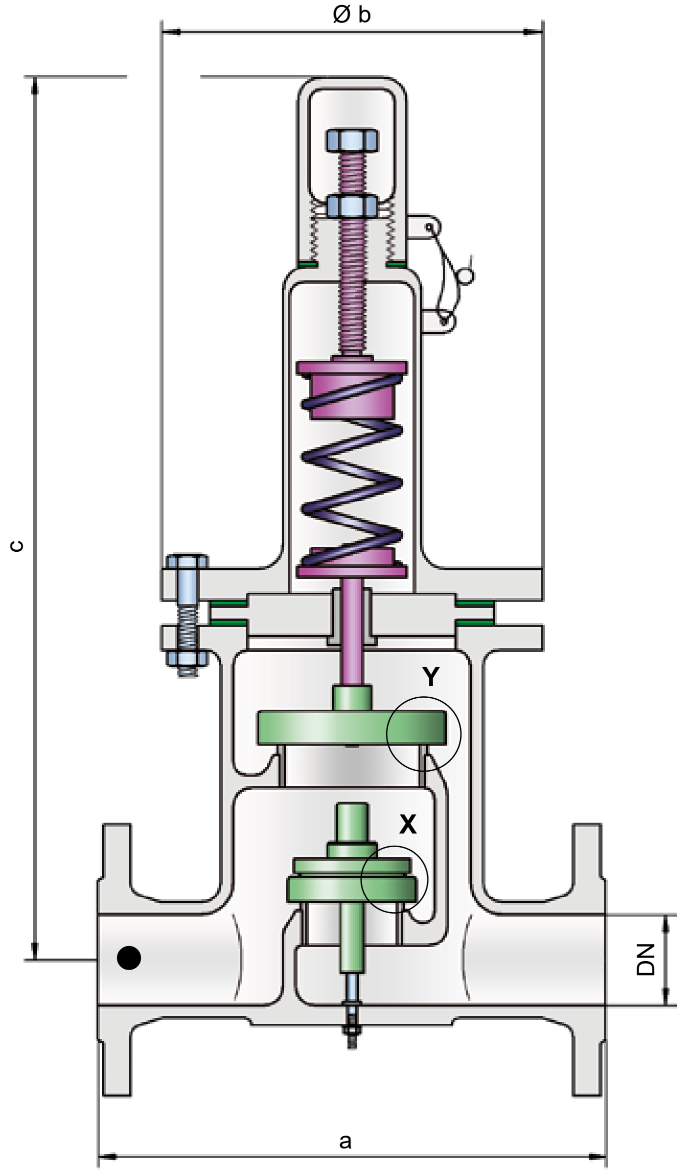
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:



Pressure and Vacuum Relief Valve, In-Line

PROTEGO® DV/ZT-F



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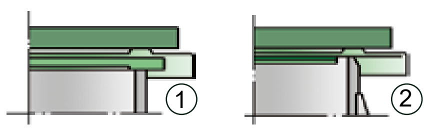

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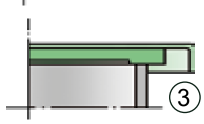

● = Tank connection

Settings:

Pressure:

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

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

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

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

Function and Description

The PROTEGO® in-line valve DV/ZT-F is a state-of-the-art pressure and vacuum relief valve. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure and underpressure. The valve prevents emission losses almost up to the set pressure and prevents unacceptable product entry system. For structural reasons, the vacuum valve pallet is one size smaller than the pressure valve pallet. Due to the spring-loaded design, higher set pressures can be achieved.

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

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity reduces costs through the use of smaller valves
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- spring-loaded on overpressure side for higher set pressures
- maintenance-friendly design

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Coated Devices
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Designs and Specifications

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

Two different designs are available:

In-line pressure and vacuum relief valve, standard design **DV/ZT-F** $\boxed{-}$

In-line pressure and vacuum relief valve with heating jacket **DV/ZT-F -** $\boxed{H}$

Additional special devices available upon request.

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

Spring-loaded PV-Valves
Maintenance-friendly design (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

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

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

Table 2: Material selection for housing

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

The housings are also available with an ECTFE coating.
Special materials upon request.

Table 3: Material of pressure valve pallet

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

Special materials upon request.

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

Table 4: Material selection for vacuum valve pallet

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

Special materials and lower set vacuum upon request.

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

Table 5: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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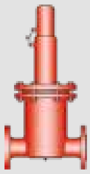
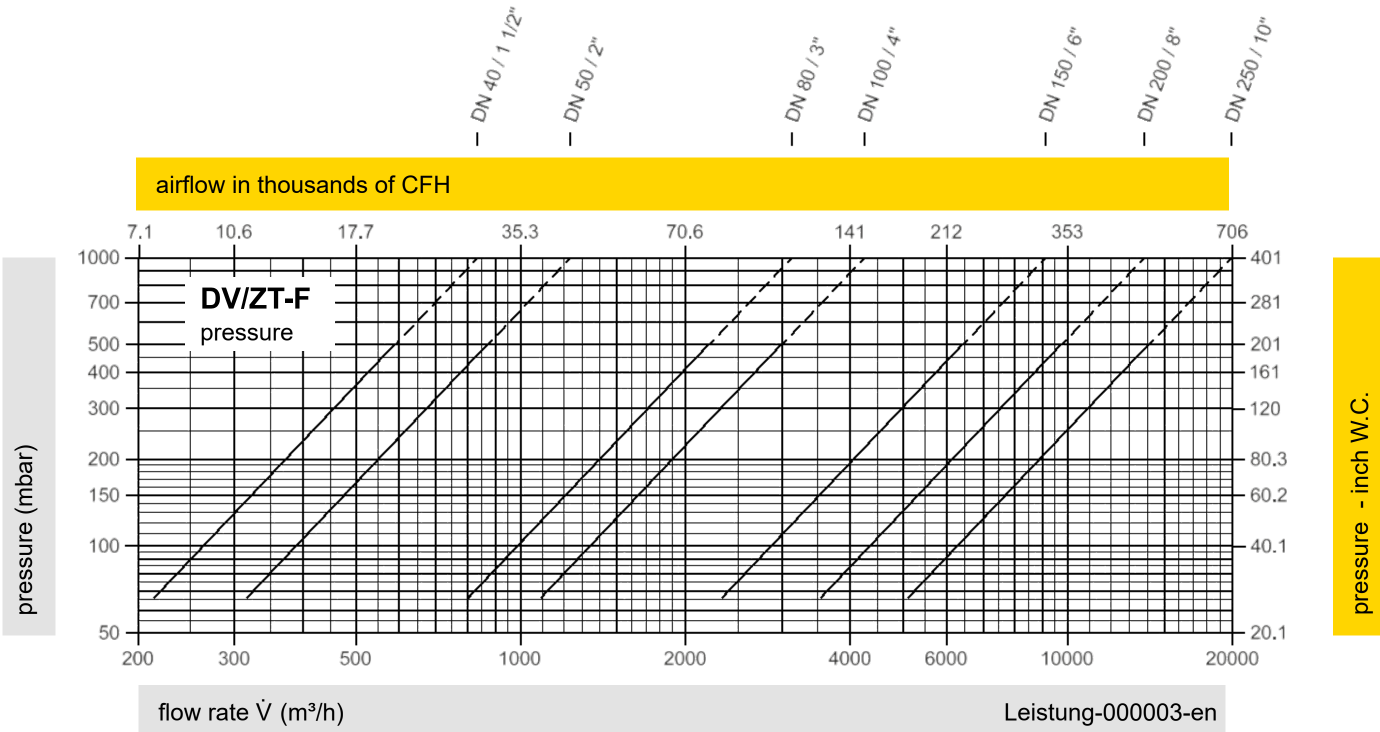
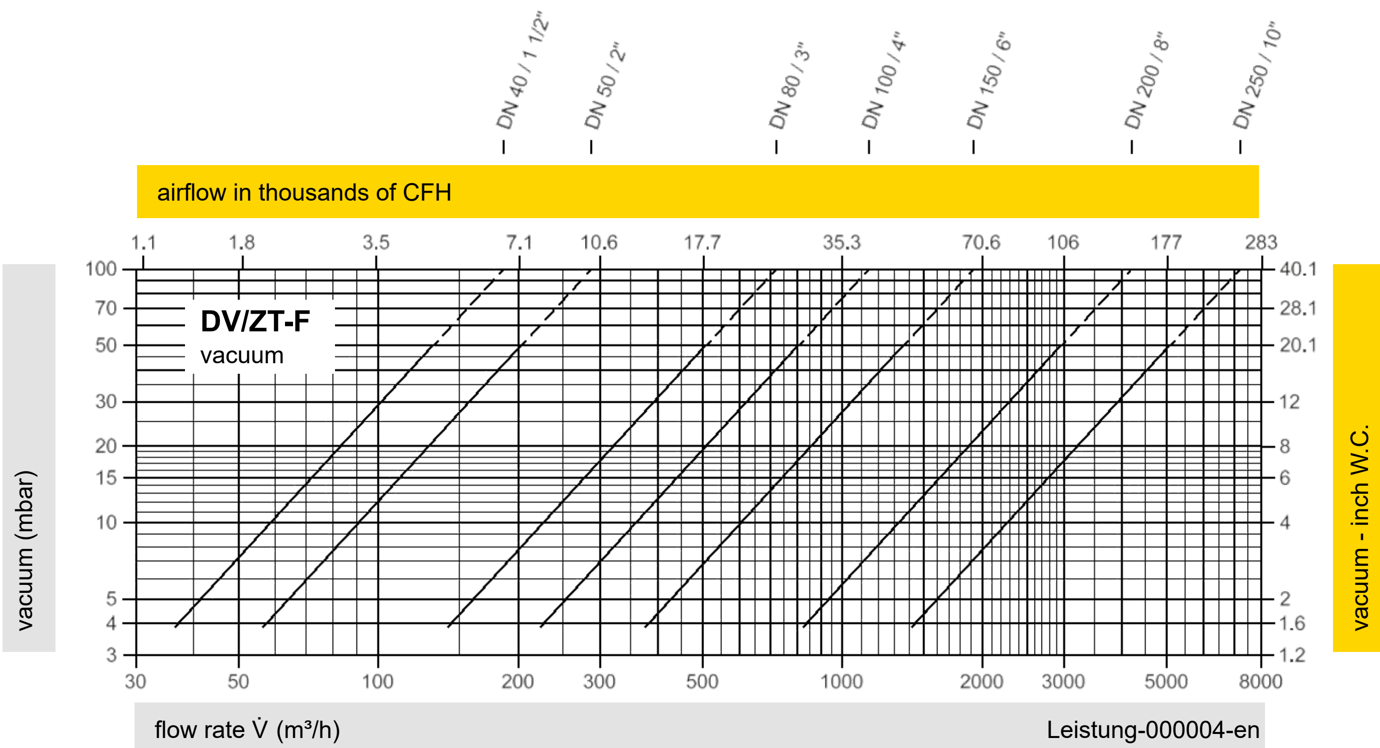


Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

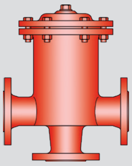
PROTEGO® DV/ZT-F



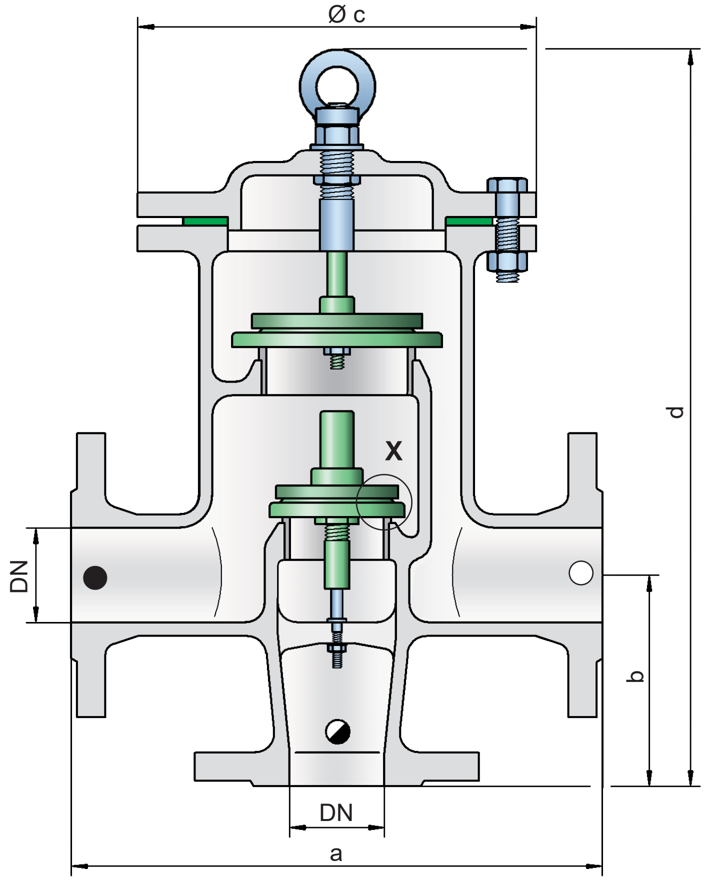


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

Notes:



PROTEGO® DV/ZU



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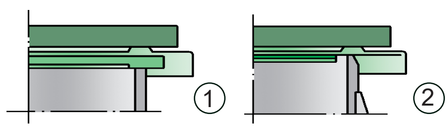

● = Tank connection

◐ = In-breathing

○ = Out-breathing

Settings:

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

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

Function and Description

The PROTEGO® in-line valve DV/ZU is a state-of-the-art pressure and vacuum relief valve with separate flange connections for pressure and vacuum breathing. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure and underpressure. The valve prevents emission losses almost up to the set pressure and prevents unacceptable product entry. It is designed in a way that if the set pressure is exceeded, the vapors are released into an exhaust pipe (e.g., vent header). If the set vacuum is exceeded, atmospheric air is pulled into the system. For structural reasons, the vacuum valve pallet is one size smaller than the pressure valve pallet.

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

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity reduces costs through the use of smaller valves
- separate connections for in-breathing and out-breathing pipes
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- maintenance-friendly design

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Coated Devices
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Designs and Specifications

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

Two different designs are available:

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

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

Additional special devices available upon request.

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

Table 1: Dimensions Dimensions in mm / inches

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

DN	40 / 1 ½"	50 / 2"	65 / 2 ½"	80 / 3"	100 / 4"	150 / 6"
a	280 / 11.02	280 / 11.02	340 / 13.39	340 / 13.39	390 / 15.35	520 / 20.47
b	165 / 6.50	165 / 6.50	200 / 7.84	200 / 7.84	240 / 9.45	300 /11.81
c	210 / 8.27	210 / 8.27	280 / 11.02	280 / 11.02	310 / 12.20	390 / 15.35
d	440 / 17.32	440 / 17.32	495 / 19.49	495 / 19.49	590 / 23.23	715 / 28.15

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

Table 2: Material selection for housing

Design	A	B	
Housing Heating jacket (DV/ZU-H-...)	Steel Steel	Stainless Steel Stainless Steel	The housings are also available with an ECTFE coating. Special materials upon request.
Valve seat	Stainless Steel	Stainless Steel	
Gasket	PTFE	PTFE	

Table 3: Material selection for pressure valve pallet

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

Table 4: Material selection for vacuum valve pallet

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

Special materials and lower set vacuum upon request.

Table 5: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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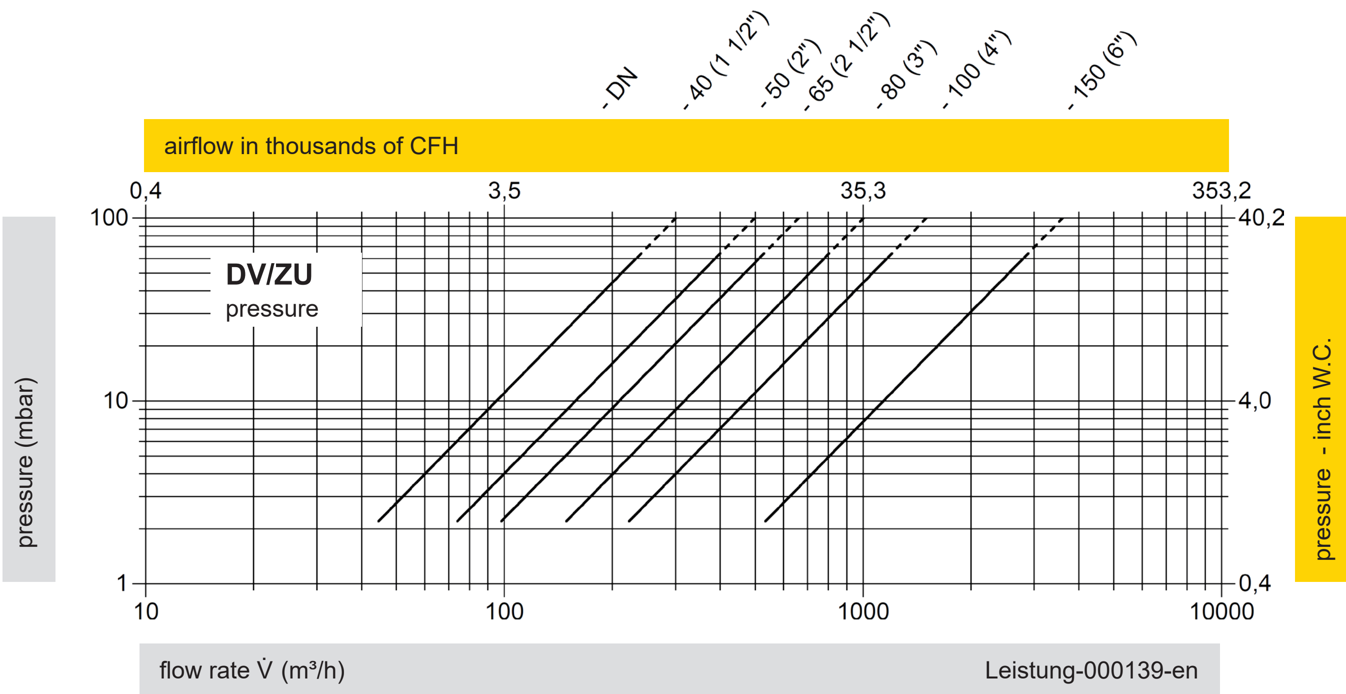

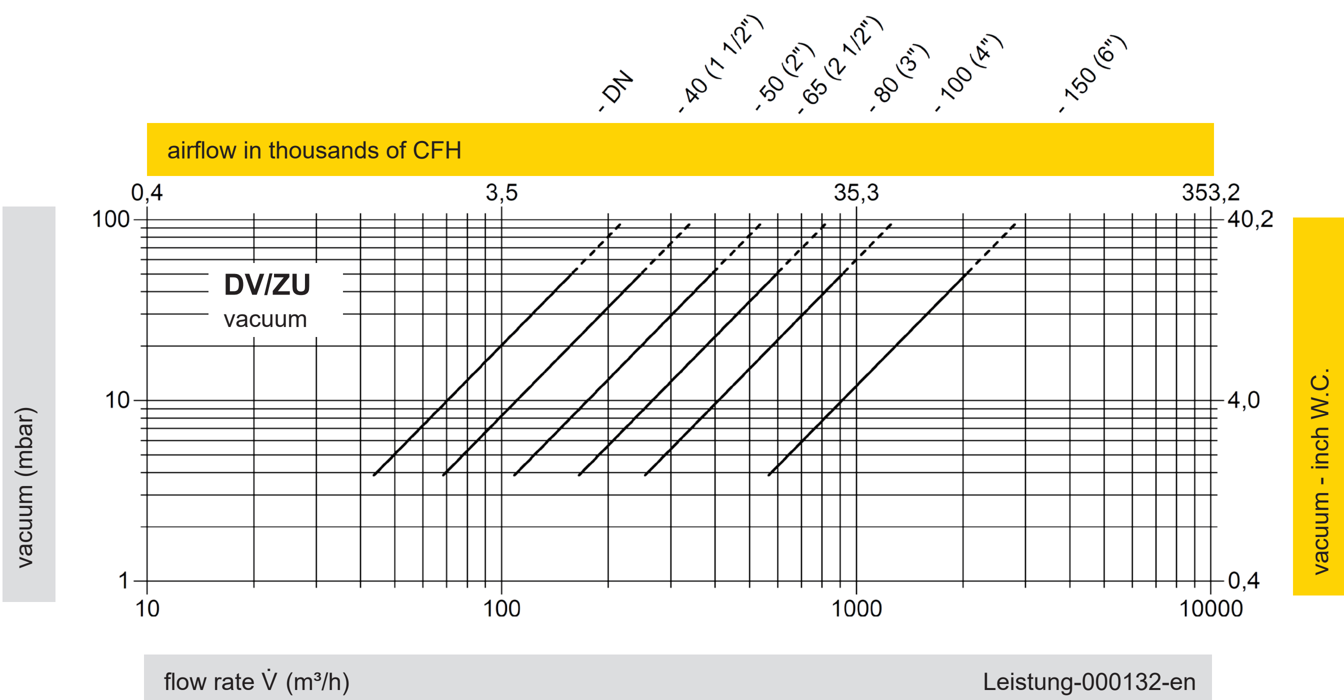

The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar). For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:

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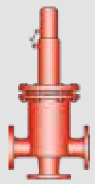
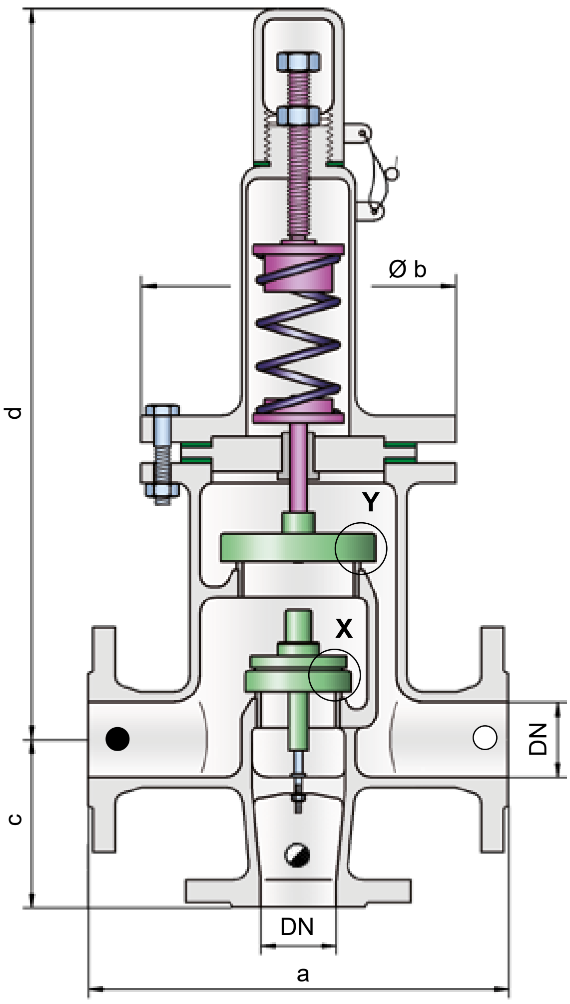


PROTEGO® DV/ZU-F



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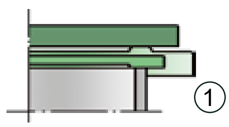

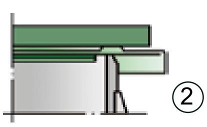

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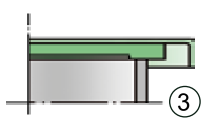

● = Tank connection

◐ = In-breathing

○ = Out-breathing

Settings:

Pressure:	+60 mbar	up to	+500 mbar
	+24 inch W.C.	up to	+200 inch W.C.
Vacuum:	-3.5 mbar	up to	-50 mbar
	-1.4 inch W.C.	up to	-20 inch W.C.
Vacuum:	-3.5 mbar	up to	-14 mbar
	-1.4 inch W.C.	up to	-5.6 inch W.C.
	by set pressure up to +150 mbar / +60 inch W.C.		

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

Function and Description

The PROTEGO® in-line valve DV/ZU is a state-of-the-art pressure and vacuum relief valve with separate flange connections for pressure and vacuum breathing. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure and underpressure. The valve prevents emission losses almost up to the pressure and prevents air intake almost up to set vacuum. The valve is designed in a way that if the set pressure is exceeded, the vapors are released into an exhaust pipe (e.g., vent header). If the set vacuum is exceeded, atmospheric air is pulled into the system. For structural reasons, the vacuum valve pallet is one size smaller than the pressure valve pallet. Due to the spring-loaded design, higher set pressures can be achieved.

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

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity reduces costs through the use of smaller valves
- separate connections for in-breathing and out-breathing pipes
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- spring-loaded on overpressure side for higher set pressures
- maintenance-friendly design

Vents - 10% Technology (Flyer pdf)

Leak Rate/10% Technology (Flyer pdf)

Coated Devices (Flyer pdf)

The optimized valve pallet (Flyer pdf)

Designs and Specifications

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

Two different designs are available:

In-line pressure and vacuum relief valve, standard design **DV/ZU-F** $\boxed{-}$

In-line pressure and vacuum relief valve with heating jacket **DV/ZU-F -** $\boxed{H}$

Additional special devices available upon request.

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

Spring-loaded PV-Valves
Maintenance-friendly design (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

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

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

Table 2: Material selection for housing

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

The housings are also available with an ECTFE coating.

Special materials upon request.

Table 3: Material of pressure valve pallet

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

Special materials upon request.

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

Table 4: Material selection for vacuum valve pallet

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

Special materials and lower set vacuum upon request.

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

Table 5: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

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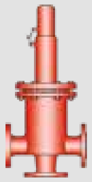
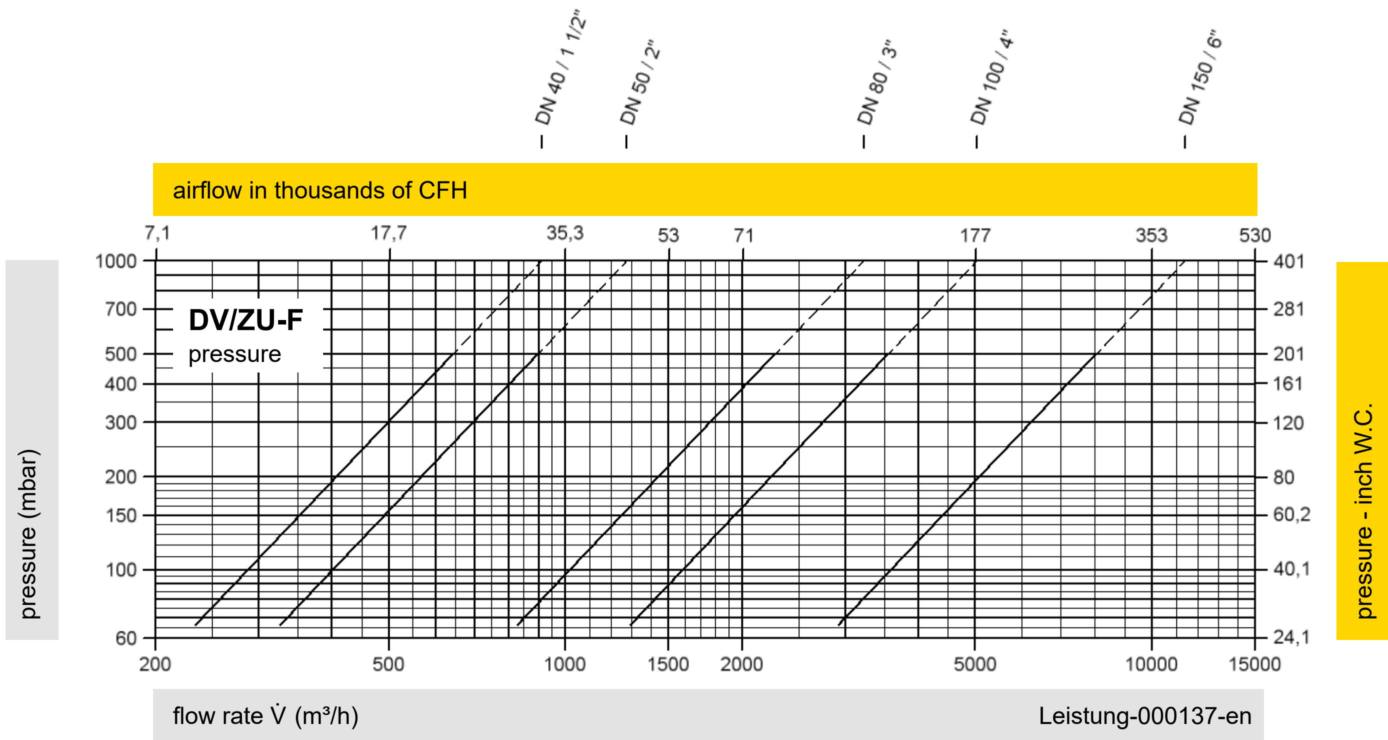
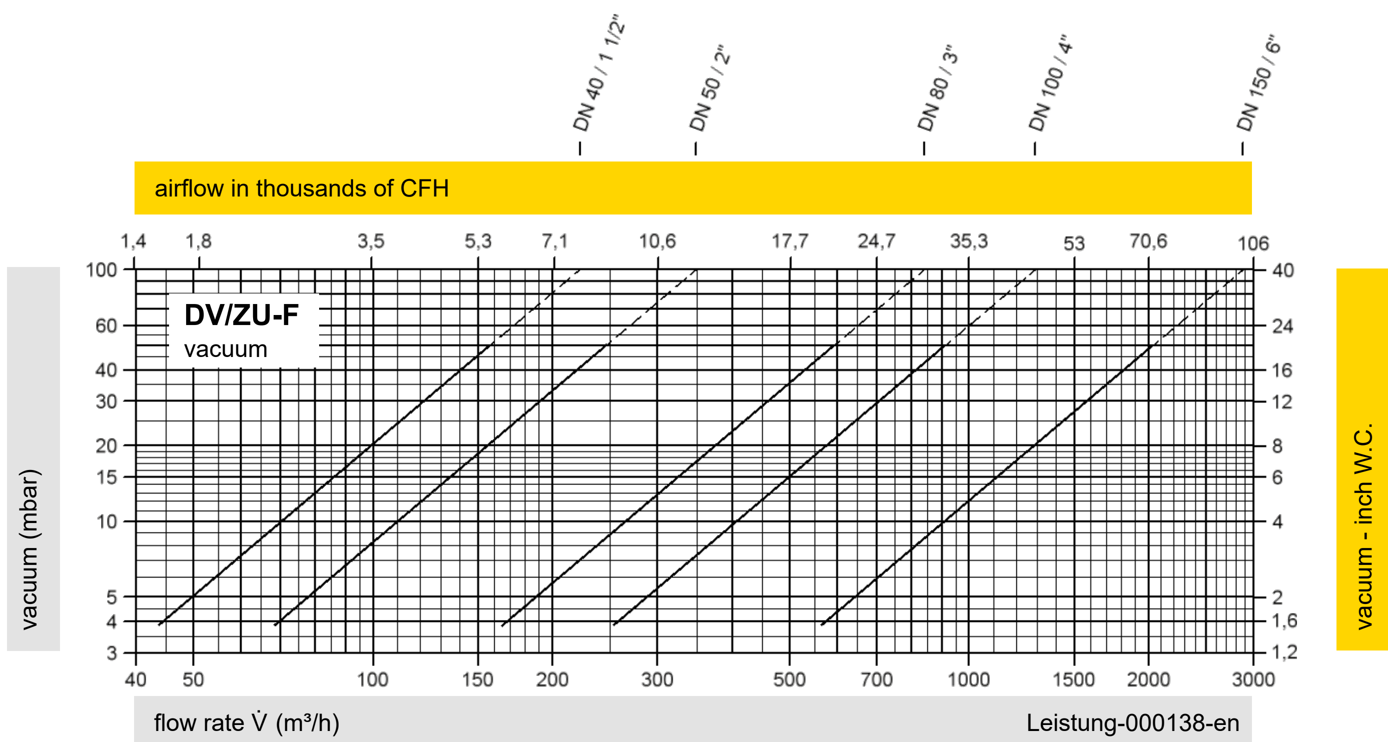


Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

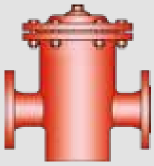
PROTEGO® DV/ZU-F





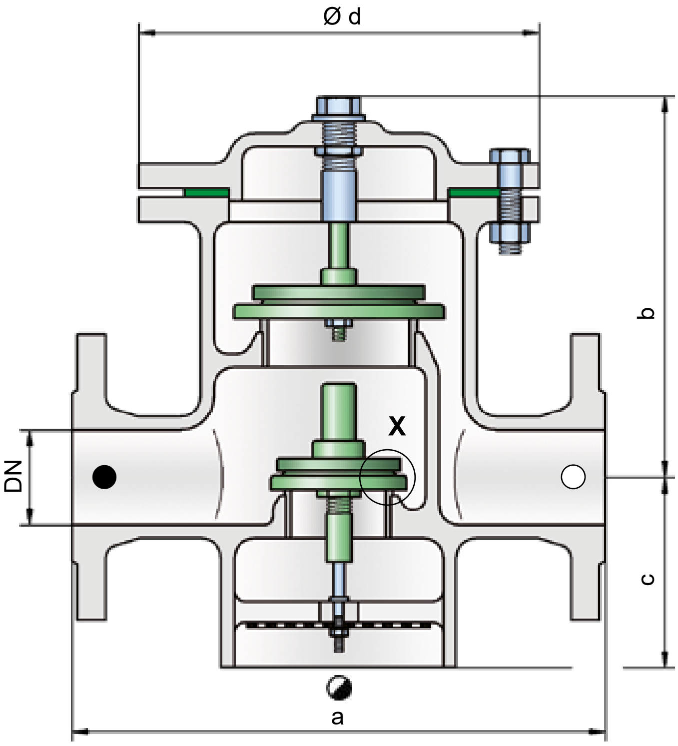
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

Notes:



Pressure and Vacuum Relief Valve, In-Line

PROTEGO® DV/ZW



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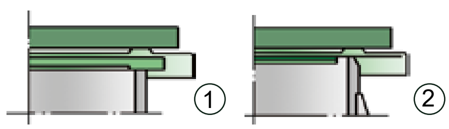

● = Tank connection

◒ = In-breathing

○ = Out-breathing

Settings:

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

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

Function and Description

The PROTEGO® in-line valve DV/ZW is a state-of-the-art pressure and vacuum relief valve with separate flange connections for use in a vent line. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure and underpressure. The valve prevents emission losses almost up to the set pressure and prevents air intake almost up to set vacuum. It is designed in a way that if the set pressure is exceeded, the vapors are released into an exhaust pipe (e.g., vent header). If the set vacuum is exceeded, atmospheric air is pulled into the system. For structural reasons, the vacuum valve pallet is one size smaller than the pressure valve pallet.

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

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity reduces costs through the use of smaller valves
- connection for vent line
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- maintenance-friendly design

Vents - 10% Technology (Flyer pdf)

Leak Rate/10% Technology (Flyer pdf)

Coated Devices (Flyer pdf)

The optimized valve pallet (Flyer pdf)

Designs and Specifications

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

Two different designs are available:

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

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

Additional special devices available upon request.

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

Table 1: Dimensions — Dimensions in mm / inches

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

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

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

Table 2: Material selection for housing

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

The housings are also available with an ECTFE coating.

Special materials upon request.

Table 3: Material selection for pressure valve pallet

Design	A	B	C	D
Pressure range (mbar) (inch W.C.)	+2.0 up to +3.5 +0.8 up to +1.4	>+3.5 up to +14 >+1.4 up to +5.6	>+14 up to +60 >+5.6 up to +24	>+14 up to +60 >+5.6 up to +24
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE

Special materials upon request.

For higher set pressures, refer to type DV/ZW-F.

Table 4: Material selection for vacuum valve pallet

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

Special materials and lower set vacuum upon request.

Table 5: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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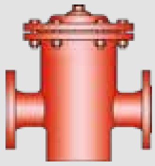
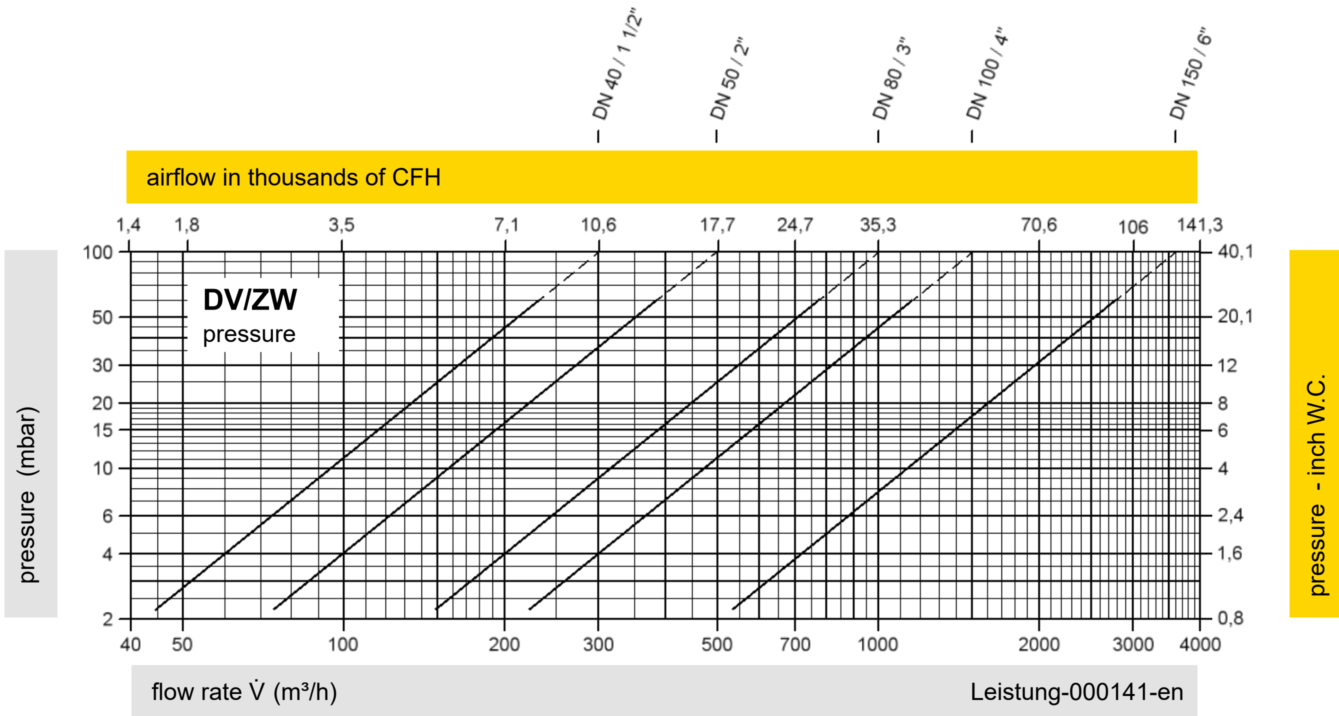
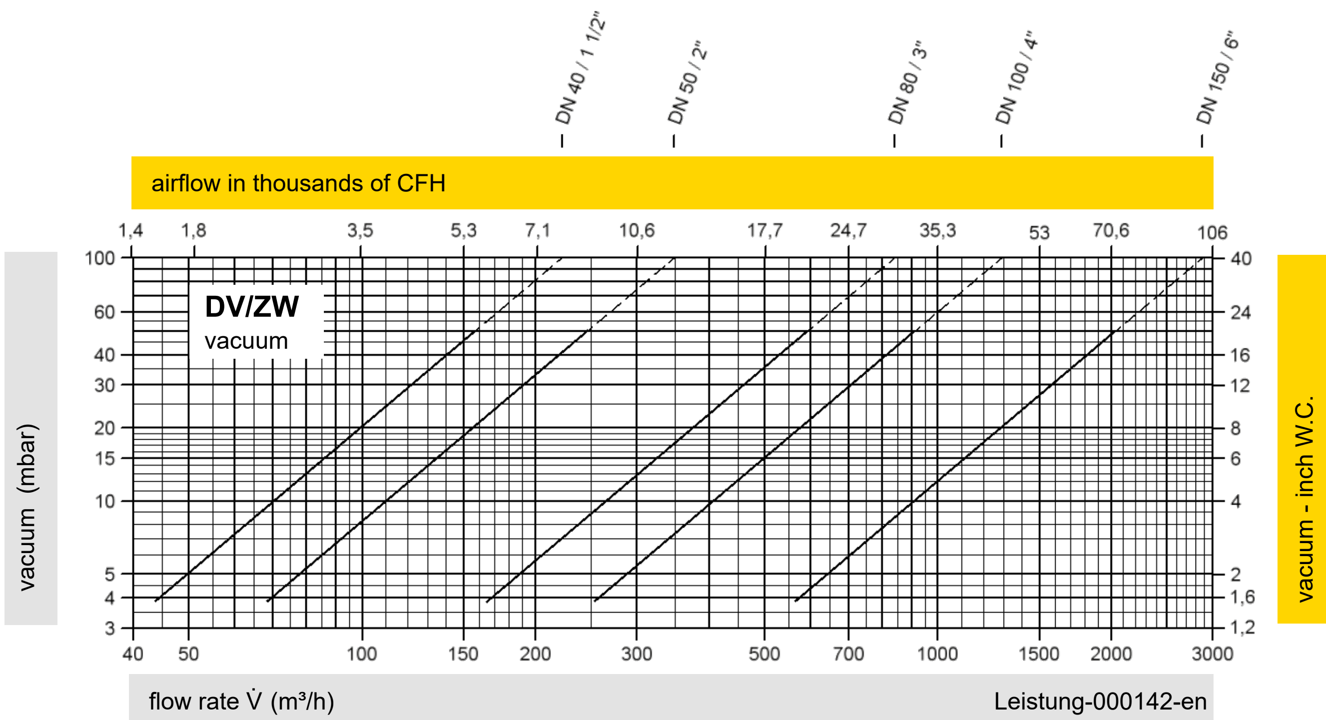


Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

PROTEGO® DV/ZW

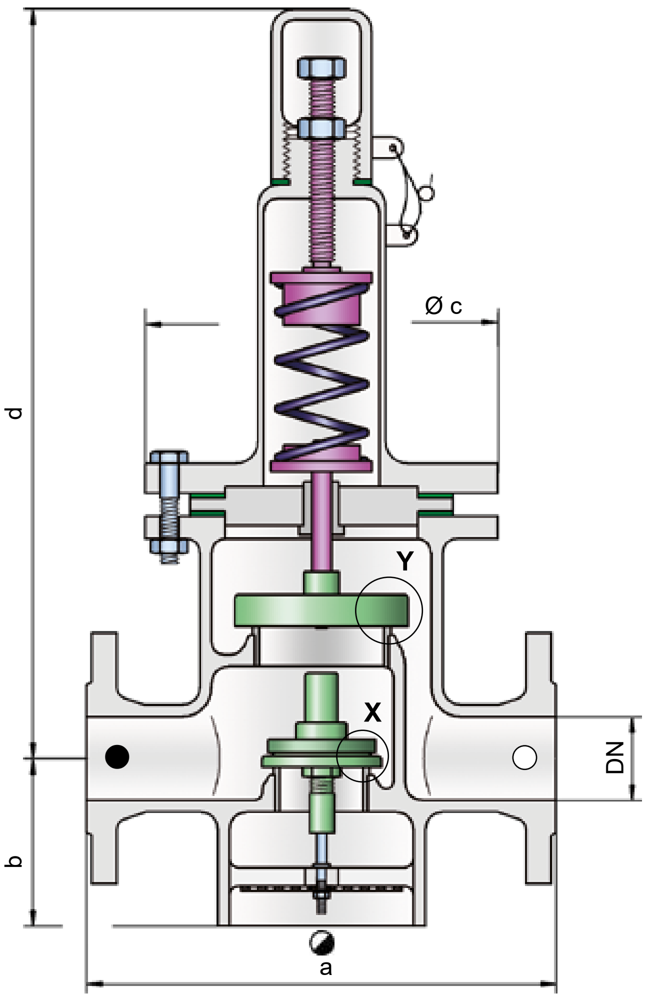




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

Notes:

PROTEGO® DV/ZW-F



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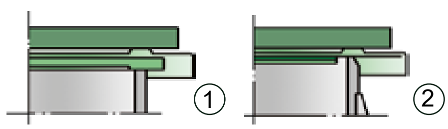

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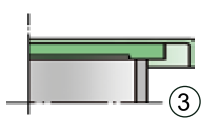

● = Tank connection

◐ = In-breathing

○ = Out-breathing

Settings:

Pressure:	+60 mbar	up to	+500 mbar
	+24 inch W.C.	up to	+200 inch W.C.
Vacuum:	-3.5 mbar	up to	-50 mbar
	-1.4 inch W.C.	up to	-20 inch W.C.
Vacuum:	-3.5 mbar	up to	-14 mbar
	-1.4 inch W.C.	up to	-5.6 inch W.C.
	by set pressure up to +150 mbar / +60 inch W.C.		

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

Function and Description

The PROTEGO® in-line valve DV/ZW-F is a state-of-the-art pressure and vacuum relief valve with flanged connections for use in a vent line. Typically, the valve is installed in the in-breathing and out-breathing lines of tanks, vessels, and process equipment to protect against unallowable overpressure and underpressure.

The valve prevents emission losses almost up to the set pressure and pre- vents air intake almost up to set vacuum. It is designed in a way that if the set pressure is exceeded, the vapors are released into an exhaust pipe (e.g., vent header). If the set vacuum is exceeded, atmospheric air is pulled into the system. For structural reasons, the vacuum valve pallet is one size smaller than the pressure valve pallet. Due to the spring-loaded design, higher set pressures can be achieved.

The device will start to open as soon as the set pressure is reached and only requires 10% overpressure to full lift. Continuous investments in and a commitment to research and development have allowed PROTEGO® to develop a low pressure valve which has the same opening characteristic as a high pressure safety relief valve. This “full lift type” technology allows the valve to be set at just 10% below the maximum allowable working pressure or vacuum (MAWP or MAWV) of the tank and still safely vent the required mass flow. The in-breathing will start as soon as the differential pressure between the atmospheric pressure and the tank is greater than the set pressure of the vacuum valve pallet. The tank pressure is maintained up to set pressure with a tightness that is above the normal standards due to our highly developed manufacturing technology. This feature is ensured by valve seats made of high quality stainless steel and with individually lapped valve pallets (1), (3), or with an air cushion seal (2), in conjunction with a high quality FEP diaphragm and a sturdy housing design. After the overpressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal. The optimized fluid dynamic design of the valve body and valve pallet is a result of many years of research, resulting in stable operation of the valve pallet, optimized performance, and reduced product losses.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- based on 10% technology the set pressure is close to the opening pressure which results in best possible pressure management of the system compared to conventional 40%- or 100%- technology valves
- high flow capacity reduces costs through the use of smaller valves
- connection for vent line
- can be used in explosion hazardous areas
- sturdy housing design (PN 10)
- spring-loaded on overpressure side for higher set pressures
- maintenance-friendly design

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Coated Devices
(Flyer pdf)

The optimized valve pallet
(Flyer pdf)

Designs and Specifications

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

Two different designs are available:

In-line pressure and vacuum relief valve, standard design **DV/ZW-F** $\boxed{-}$

In-line pressure and vacuum relief valve with heating jacket **DV/ZW-F -** $\boxed{H}$

Additional special devices available upon request.

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

Spring-loaded PV-Valves
Maintenance-friendly design (Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

DN	40 / 1 ½"	50 / 2"	80 / 3"	100 / 4"	150 / 6"
a	280 / 11.02	280 / 11.02	340 / 13.39	390 / 15.35	520 / 20.47
b	85 / 3.35	85 / 3.35	125 / 4.92	140 / 5.51	185 / 7.28
c	210 / 8.27	210 / 8.27	280 / 11.02	310 / 12.20	390 / 15.35
d	565 / 22.24	565 / 22.24	675 / 26.57	805 / 31.69	1070 / 42.13

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

Table 2: Material selection for housing

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

The housings are also available with an ECTFE coating.

Special materials upon request.

Table 3: Material of pressure valve pallet

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

Special materials upon request.

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

Table 4: Material selection for vacuum valve pallet

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

Special materials and lower set vacuum upon request.

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

Table 5: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

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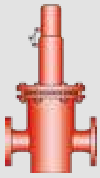
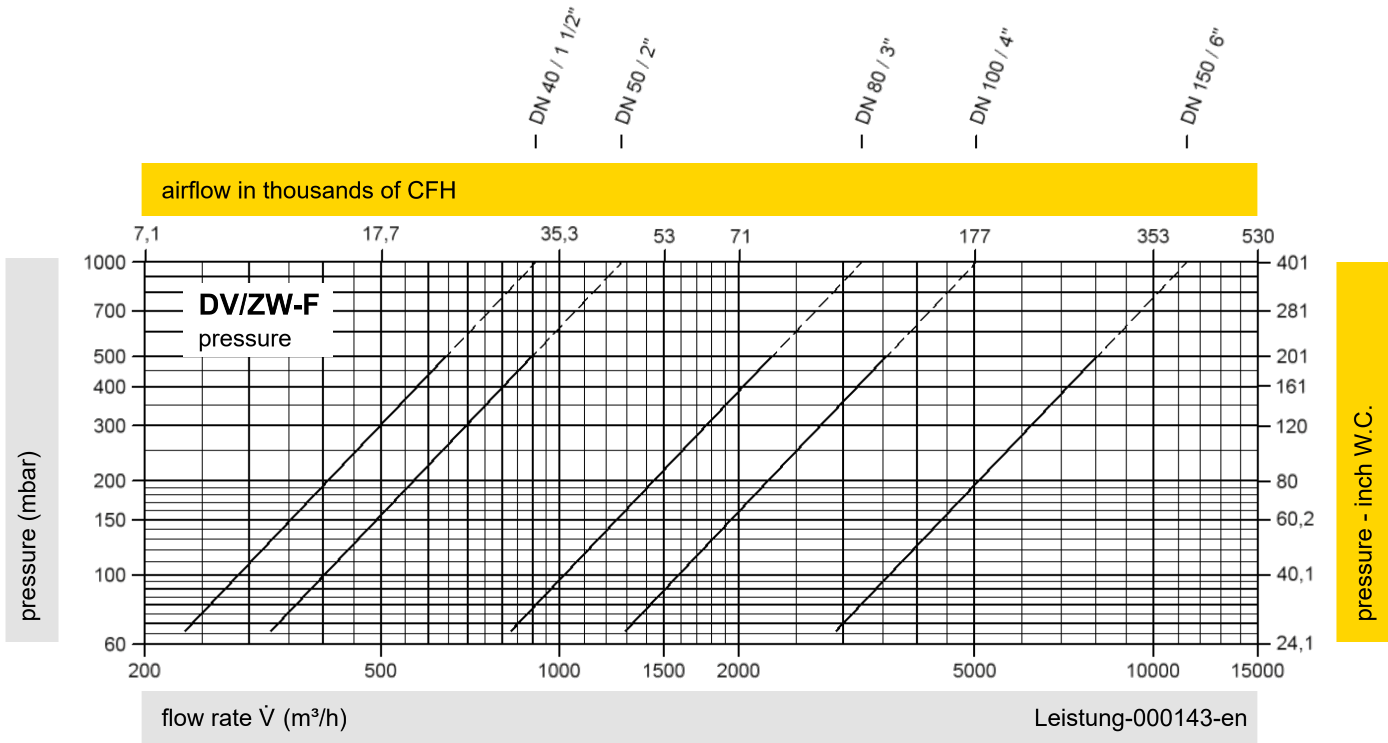
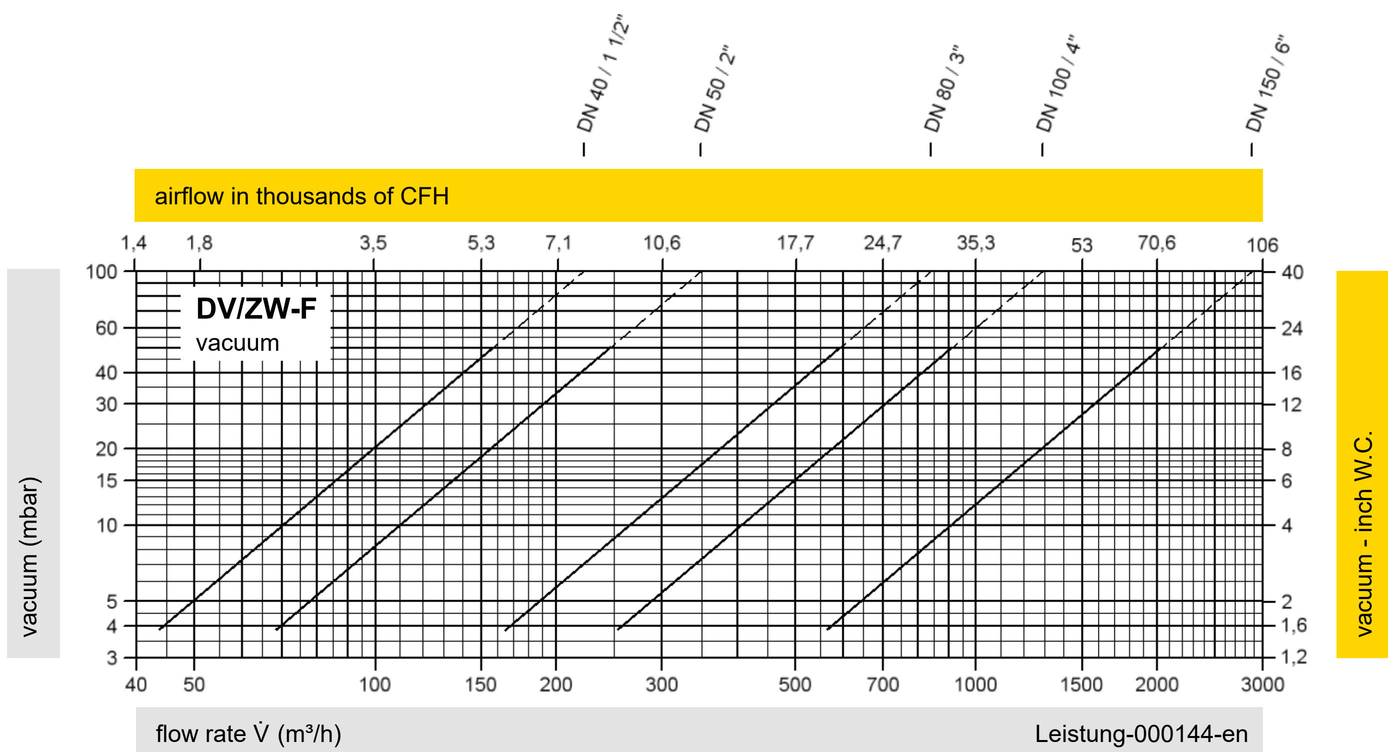


Pressure and Vacuum Relief Valve, In-Line

Flow Capacity Charts

PROTEGO® DV/ZW-F

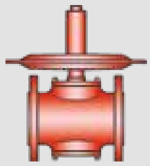




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

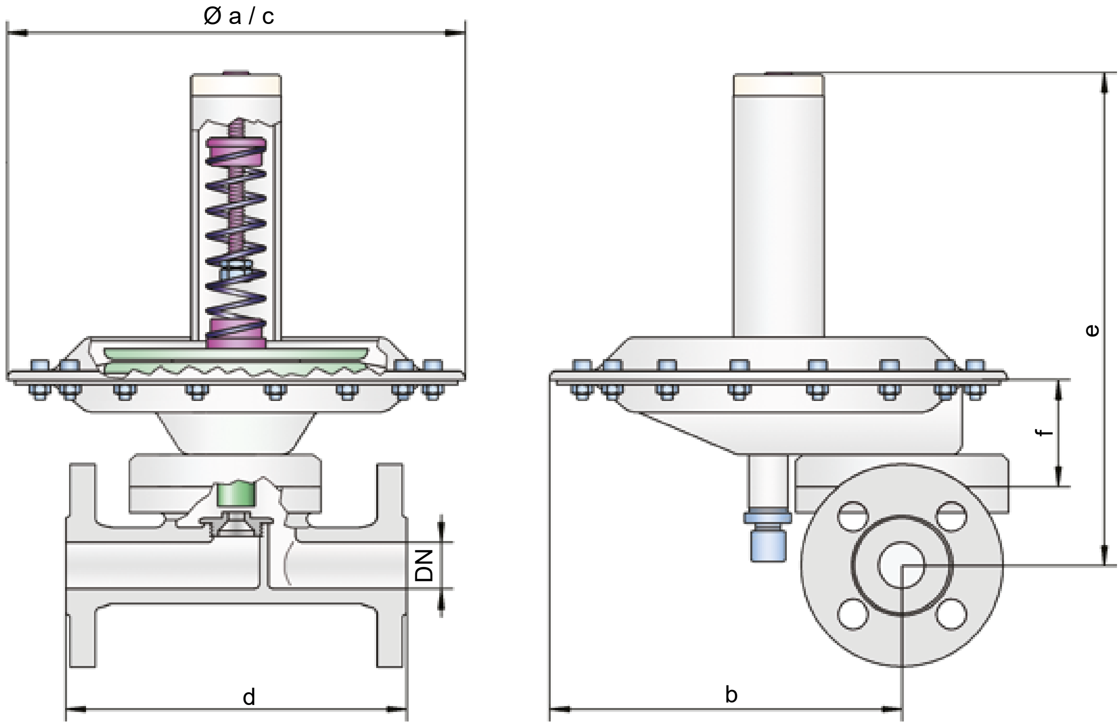
Notes:



Blanketing Valve

Low pressure reducing valve

ZM-R



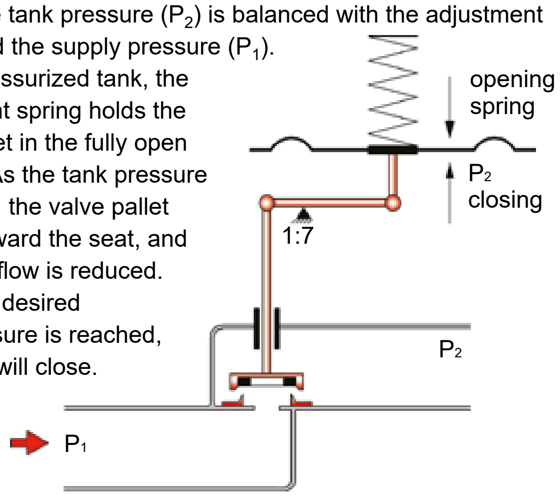
Pressure range:
Supply pressure:
up to +16 bar / +6424 inch W.C.
Set pressure for overpressure function:
up to +500 mbar / +200 inch W.C.
Set pressure for vacuum function:
up to -200 mbar / -80 inch W.C.

Function and Description

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

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

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



If the tank pressure decreases, the valve will open. If the system is operated in a vacuum mode, vacuum pressures down to -200 mbar /-80 inch W.C. (relative pressure) can be achieved.

Special features and advantages

- single-stage pressure reduction possible within a high-pressure range
- large diaphragm area to increase the closing force
- all function-relevant and product-contacting parts are made of stainless steel or Hastelloy
- simple adjustment of set pressure (within the spring range)
- any mounting position (taking the set pressure into account)
- no external energy supply needed
- high flow capacity reduces costs through the use of smaller valves
- valve pallet is guided inside the housing to protect against harsh weather conditions, e.g., freezing of the valve pallet in extreme cold
- reduction within the vacuum range is possible
- high precision
- can be used in explosion hazardous areas
- sturdy housing design (PN 16)
- maintenance-friendly design

Design and Specification

Two different designs are available:

Blanketing valve for overpressure, standard design — **ZM-R** $\boxed{-}$

Blanketing valve for vacuum, standard design — **ZM-R /** $\boxed{N}$

Other special devices can be supplied on request.

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

Table 1: Dimensions — Dimensions in mm | Dimensions in inches

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

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

* depends on size of diaphragm.

Table 2: Material selection for housing

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

Housings can also be electropolished.

Special materials upon request.

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

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

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

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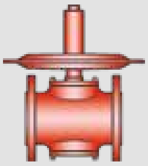


In-Line Pressure Reducing Valve

low pressure reducing valve

ZM-R

Table 4: Connection type			
FD	EN 1092-1; Form B1	EN	Other types upon request.
FA	ASME B16.5 CL 150 R.F.	ASME	
G	Thread	G or NPT	

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

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

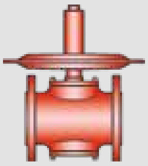
ZM-R 50: flow rate (air, 0°C) at ΔP = P1 - P2 and valve fully open

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

ZM-R 100: flow rate (air, 0°C) at ΔP = P1 - P2 and valve fully open

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

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



In-Line Pressure Reducing Valve

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

ZM-R

ZM-R 15 / ZM-R 25: flow rate (air, 32°F) at ΔP = P1 - P2 and valve fully open

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

ZM-R 50: flow rate (air, 32°F) at ΔP = P1 - P2 and valve fully open

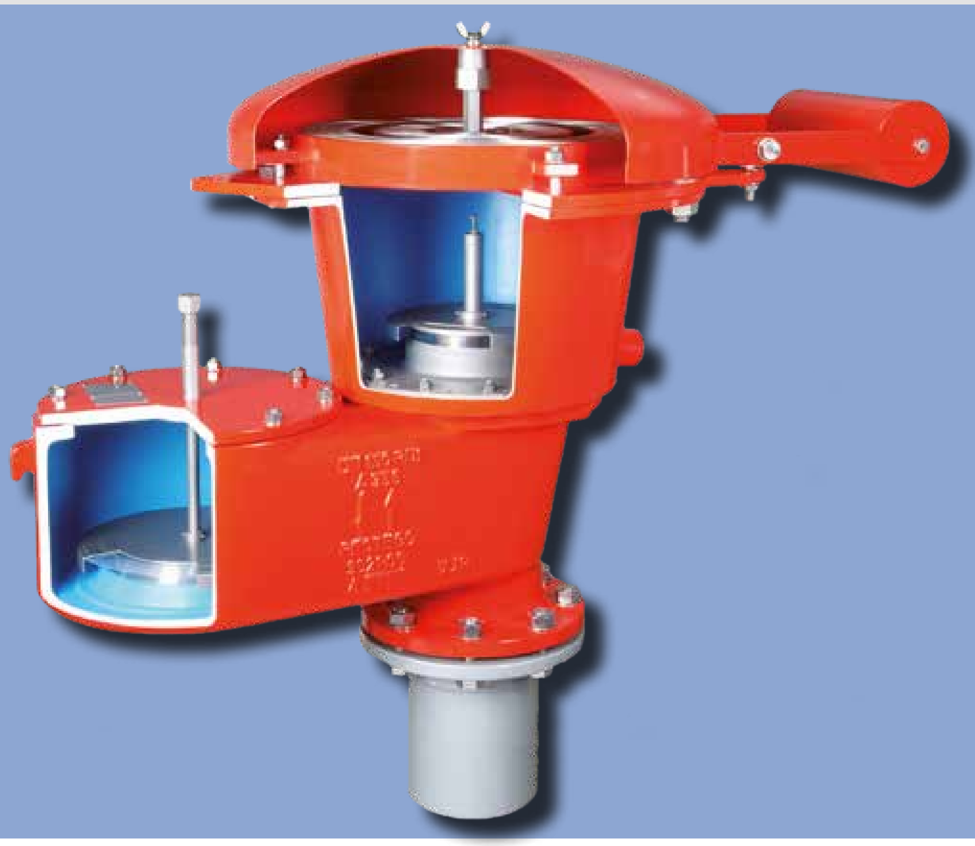
overpressure P1 (psi) / P2 ("wc)	2.18 [SCFH]	3.63 [SCFH]	5.80 [SCFH]	9.43 [SCFH]	14.50 [SCFH]	21.76 [SCFH]	36.26 [SCFH]	58.02 [SCFH]	87.02 [SCFH]	145.04 [SCFH]	Seat-Ø [inch]
3.94	1023	1340	1708	2188	2722	3398	4750	6779	9483	14892	Ø 0.55
	2486	3254	4149	5314	6610	8253	11536	16462	23030	36166	Ø 0.71
	5300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

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

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

PROTEGO® Pressure/Vacuum Relief Valves

with Flame Arrester - End-of-Line



Section 7

The working principle and installation location of valves on tanks and equipment is discussed in “Technical Fundamentals“ (Sec. 1). This section discusses end-of-line pressure/vacuum relief valves with integrated flame arrester units.

Function and Description

These valves are used to protect plant components (e.g., tanks, pipelines) from exceeding maximum allowable operating pressures and vacuum. They offer additional protection against atmospheric deflagration, and some valves also protect against endurance burning (Figure 1).

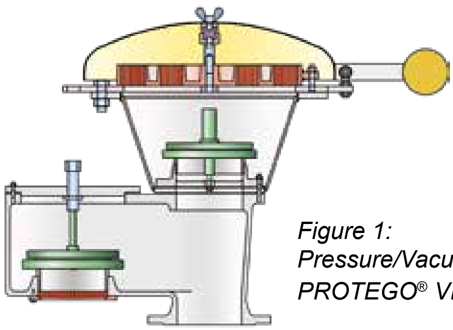


Figure 1: Pressure/Vacuum Relief Valve PROTEGO® VD/SV-HRL

PROTEGO® Pressure relief valves with an integrated flame arrester unit provide protection against unallowable overpressure, atmospheric deflagration and endurance burning. Additionally, they reduce emissions almost up to the set pressure.

PROTEGO® Vacuum Relief Valves with an integrated flame arrester unit provide protection against unallowable vacuum and atmospheric deflagration. Additionally, they prevent air intake almost up to the set pressure.

PROTEGO® Pressure Vacuum Relief Valves with an integrated flame arrester unit perform all of the above-mentioned functions for pressure and vacuum relief, and they 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 at 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

Continuous investments in and a commitment to research and development have PROTEGO® to design a valve for low pressure applications, providing you with the following advantages:

- 10% full-lift technology results in product savings (possible reduction of product losses greater than 30%)
- PROTEGO® valves open later and re-seat earlier than conventional valves, resulting in optimized pressure management and conservation of inert gases
- high flow capacity reduces costs through the use of smaller valves
- seal above the normal standards
- flame arrester for almost all chemical mixture
- valve pallet is guided inside the housing to protect against harsh weather conditions
- flame arrester not in contact with product during operation with closed valve pallets, reducing maintenance intervals
- endurance burning protection against alcohols

In order to meet the highest demands of the industry and to reduce leakage rates, our valve pallets and seats are manufactured from high-quality stainless steel and are hand lapped using highly developed manufacturing processes. Valve pallets with air-cushioned diaphragms are used for low set pressures.

Valves with integrated flame arresters are approved for substances in explosion groups IIA and IIB3 and, with special approvals, 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 tend to polymerize (e.g., Styrene, Acrylate). A specially designed valve seat, combined with the flexible diaphragm, prevents the diaphragm from freezing on the valve seat due to, e.g., condensed and frozen product vapors at low temperatures. Any build-up ice is blown off by the deformation of the diaphragm when the pressure increases.

This valve does not have any guiding elements which are likely to stick and/or clog.

Main areas of application: same as above for storage of flammable liquids, especially when storing monomers.

PROTEGO® High Velocity Pressure Relief Valves (Jet Valves) open and close almost immediately due to an integrated magnet. As a result, the required pressure increase from set pressure to full lift is almost 0%, which significantly contributes to the reduction of emissions. All PROTEGO® high velocity relief valves are tested and designed to resist oscillating flow and are equipped with a specially designed valve cone and seat so that a free jet is created vertically during pressure relief. As a result, the product vapors are quickly and effective released, and the gas concentration in the immediate vicinity (e.g., ship deck) is reduced. This valve, which works on the principal of a dynamic flame arrester, is approved for substances in explosion groups IIA, IIB3 and IIC (NEC D, C and B).

Main areas of application: transportation of flammable liquids on tankers and special onshore tasks.

Installation and servicing

All PROTEGO® valves are delivered with detailed installation and maintenance instructions. Please pay special attention to the separate instructions for removing transportation protection if they have been installed to protect the PROTEGO® valves. We have devised special checklists to ensure correct installation and operation of PROTEGO® valves.

Selection and sizing

Selection and sizing of the correct PROTEGO® valve is critical for the safe operation of the system. Consider the following to select the appropriate valve:

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 a vertical direction. The maximum possible pressure setting depends on the design of the valve. Metallic 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 that can cause the FLAMEFILTER® to clog; operating temperatures; operating pressures oxygen content; volume flows.

The **valve size** has to be determined so that the volume flow to be released does not exceed the allowable pressure of the protected vessel. Certified opening pressure/volume flow rate diagrams are available for the design of the valves. The operating conditions have to be known for correct sizing. Sometimes, vessels may already be equipped with pre-existing nozzles (e.g., older vessels). In such cases, it might be necessary to adjust the volume flow rate to be released over several valves. For correct sizing, each possible system back-pressure or additional pressure losses have to be considered.

Valve sizing:

The valve size is dimensioned for the calculated required flow rate (→ Section 1) or given.

Given: Volume flow (e.g., in-breathing or outbreathing of a storage tank as the 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 performance as the opening pressure in function of the flow rate with the valve fully open.

The set pressure of the valve has to be selected so that the calculated volume flow can be safely released. A valve with a 10% overpressure characteristic has to be set at 10% below the maximum allowable tank pressure.

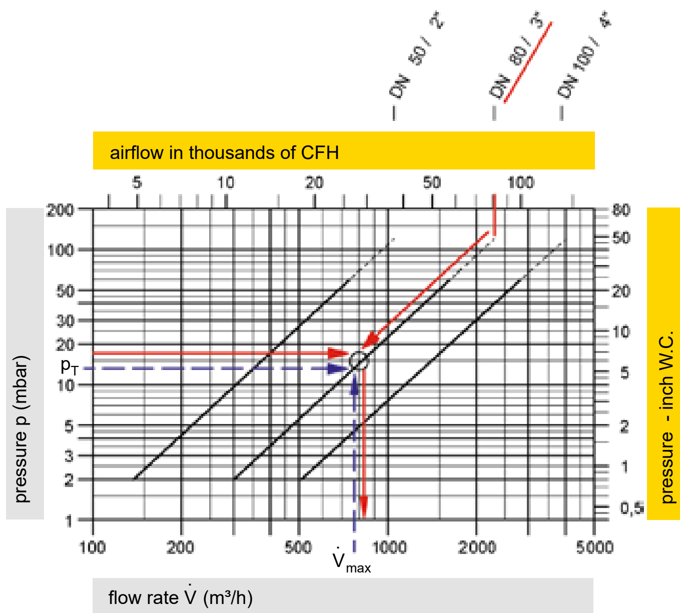
Many conventional valves require 100% overpressure to reach full lift, i.e., the set pressure must be set to half the maximum allowable tank pressure. These conventional valves open earlier and cause unnecessary product losses.

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 m^3/h (CFH) and set pressure p_{set}

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



The set pressure of the valve (= valve starts to open) is 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 otherwise specified. Within 10% overpressure, the valve will reach its performance at full lift. A further performance increase will follow the curve according to the pressure volume flow diagram.

When selecting materials, the plant and engineering specifications have to be considered.

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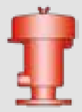
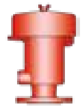
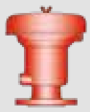
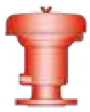
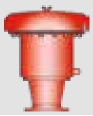
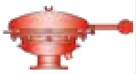
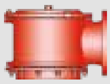
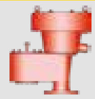
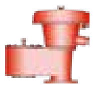
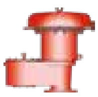
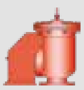
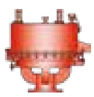
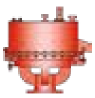
PROTEGO® Pressure/Vacuum Relief Valves with Flame Arrester – End-of-Line

Catalog

	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 substances (polymerization, corrosion, crystallization)	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	290 - 292
	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	294 - 296
	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	298 - 300
	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	302 - 304
	D-SVL-EB	150 -200 6" - 8"	+2.0 up to +60/ +0.8 up to +24		O / X	IIA	D	ATEX		X	O / X		O	306 - 308
	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			310 - 312
Vacuum Relief Valves, Pallet Type														
	SV/E	50 - 300 2" - 12"		-2.0 up to -60/ -0.8 up to -24	X	IIB3, IIB IIC	C, B, B	ATEX IMO		O	O / X		O	314 - 317
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	318 - 320
	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	322 - 324
	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	326 - 329
	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	330 - 332

	Type	Size	Pressure setting positive setting range mbar / inch W.C.	Pressure setting negative setting range mbar / inch W.C	○ = endurance burning proof X = prevent flashback in case of atmospheric deflagrations	Explosion group ATEX	Explosion group NEC	Approvals		Design ○ = horizontal connection X = vertical connection	○ = soft sealing X = metallic sealing	○ = for critical substances (polymerization, corrosion, crystallization)	○ = 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	○ / X			334 - 336
	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	○ / X	IIA, IIB3	D, C	ATEX		X	○ / X			338 - 341
	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	○ / X	IIA	D	ATEX		X	○ / X			342 - 344
	VD-SV-EB	150 -200 6" - 8"	+2.0 up to +60/ +0.8 up to +24	-2.0 up to -60/ -0.8 up to -24	○ / X	IIA	D	ATEX		X	○ / X		○	346 - 348
	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	○ / X			350 - 353
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	○ / X	IIB3	C	ATEX		X	○	○	○	354 - 361
	UB/DF	80 - 150 3" - 6"	+3.5 up to +140/ +1.4 up to +56		○ / X	IIB3	C	ATEX		X	○	○	○	362 - 367
	UB/VF	80 - 150 3" - 6"		-3.5 up to -35/ -1.4 up to -16	X	IIB3	C	ATEX		X	○	○	○	368 - 371
Pressure Relief Valves, High Velocity Valve														
	DE/S	80 - 150 3" - 6"	+100 up to +500/ +40 up to +200		○ / X	IIB3, IIB	C, B	ATEX		X	X			-IIB -IIB3
	DE/S-MK VI	80 - 150 3" - 6"	+60 up to +350/ +24 up to +140		○ / X	IIB3, IIC	C, B	ATEX IMO		X	X			-IIB3 -IIC

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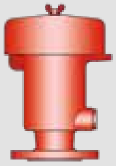
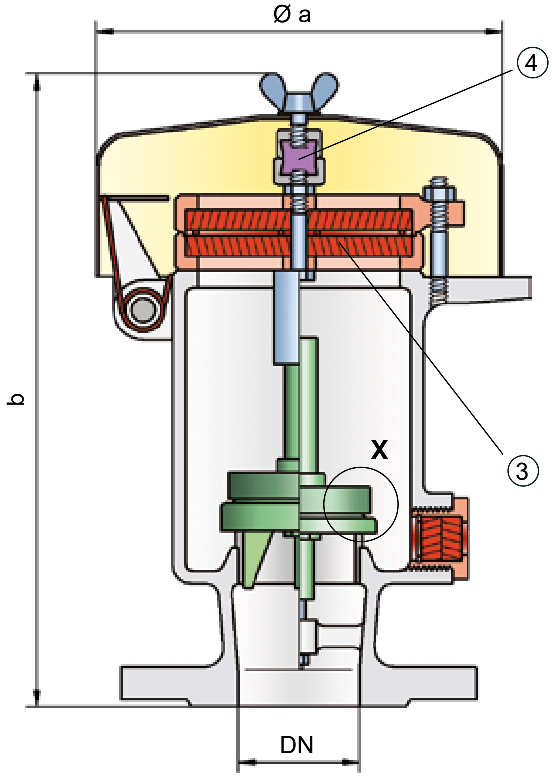


Pressure Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® P/EB



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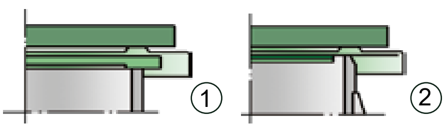

Pressure settings:

+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 out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and prevents product losses almost up to the set pressure, while at the same time protecting against atmospheric deflagration as well as endurance burning. The PROTEGO® flame arrester unit is designed to achieve minimum pressure losses with maximum safety. The PROTEGO® P/EB valve is available for substances in 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 above the normal standards 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 them from sticking when sticky substances are used and to enable the use in corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 in and stabilized burning occurs, the integrated flame arrester unit prevents flashback as a result of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmosphere in accordance with ATEX
- PROTEGO® flame arrester unit provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Demonstration of endurance burning
Video

Design Types and Specifications

The valve pallet is weight-loaded. At set pressure >80 mbar (32.1 inch W.C.), an extended 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)	Special approvals upon request.
> 0,90 mm	IIA	D	

Table 3: Material selection for housing

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

Table 4: Material combination of flame arrester unit

Design	A	Special materials upon request.
FLAMEFILTER® casing	Stainless Steel	
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

Table 5: Material selection for valve pallet

Design	A	B	C	D	Special materials and higher pressure settings upon request.
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	
Valve pallet	Aluminum	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 CL 150 R.F.	

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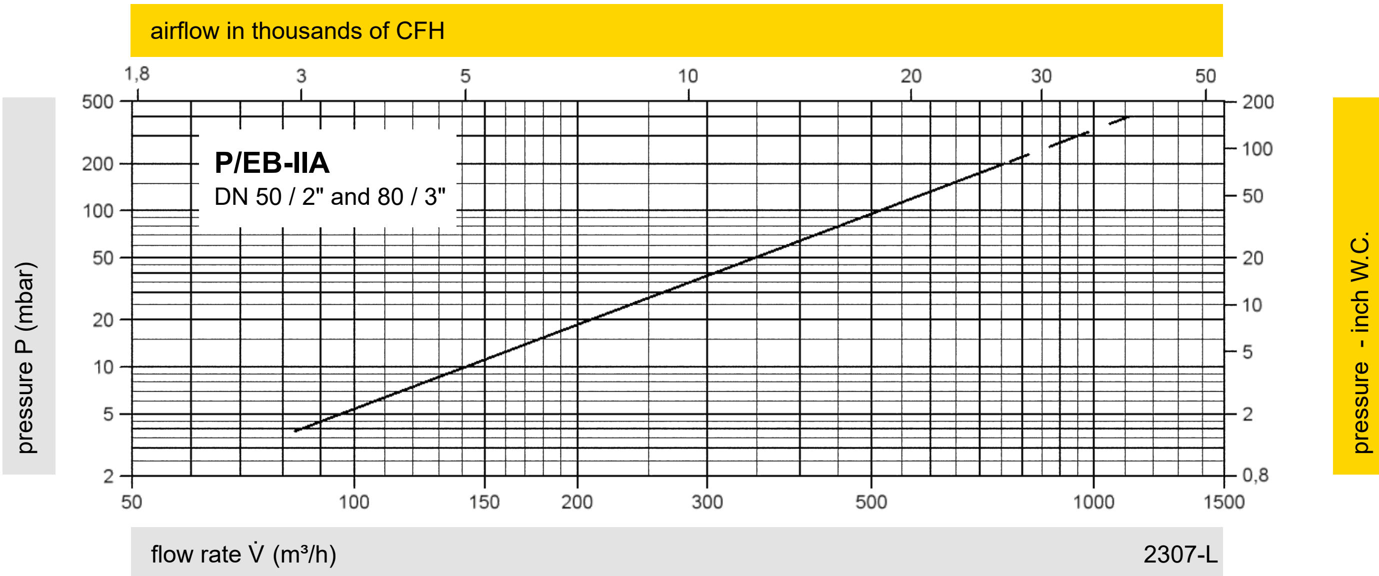
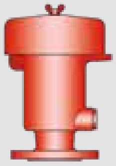
PROTEGO® P/EB



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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

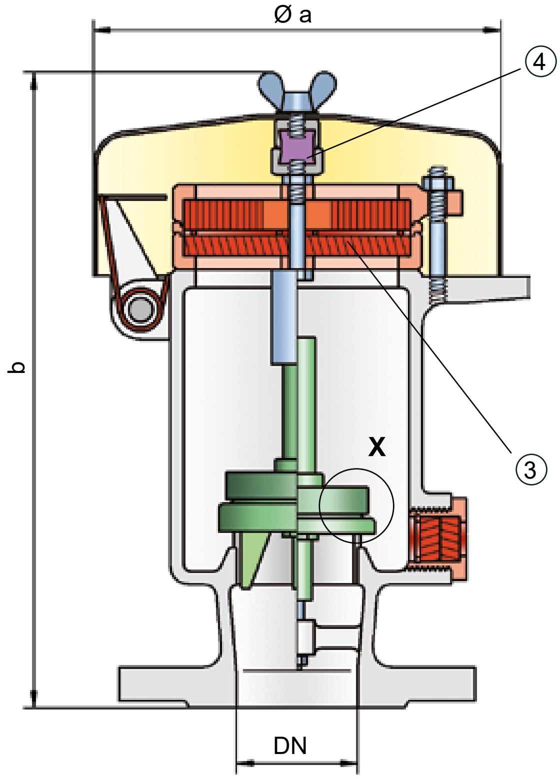
Notes:



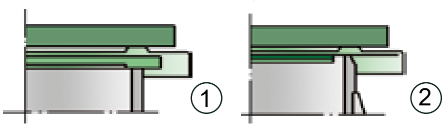
Pressure Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® P/EB-E



Detail **X**



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 specifically designed for use in ethanol production, processing, and storage. It is primarily used as a safety device for flame transmission-proof out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and prevents product losses almost up to the set pressure, while at the same time protecting 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 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 behavior (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 above the usual standards 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 substances are used and to enable the use of corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as protective system according in areas with potentially explosive atmospheres in accordance with ATEX
- protected against deflagration and endurance burning of alcohol/air mixtures from explosion group IIB1
- PROTEGO® flame arrester unit provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- flame arrester unit is protected from clogging and sticky sub-stances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet

Demonstration of endurance burning
Video

Design Types and Specifications

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

There are two different designs:

Pressure relief valve, basic design	**P/EB - E - –**
Pressure relief valve with heating jacket (max. heating fluid temperature +85°C / 185°F)	**P/EB - 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 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	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® casing	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	Aluminum	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 CL 150 R.F.	

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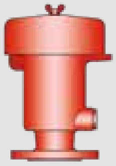
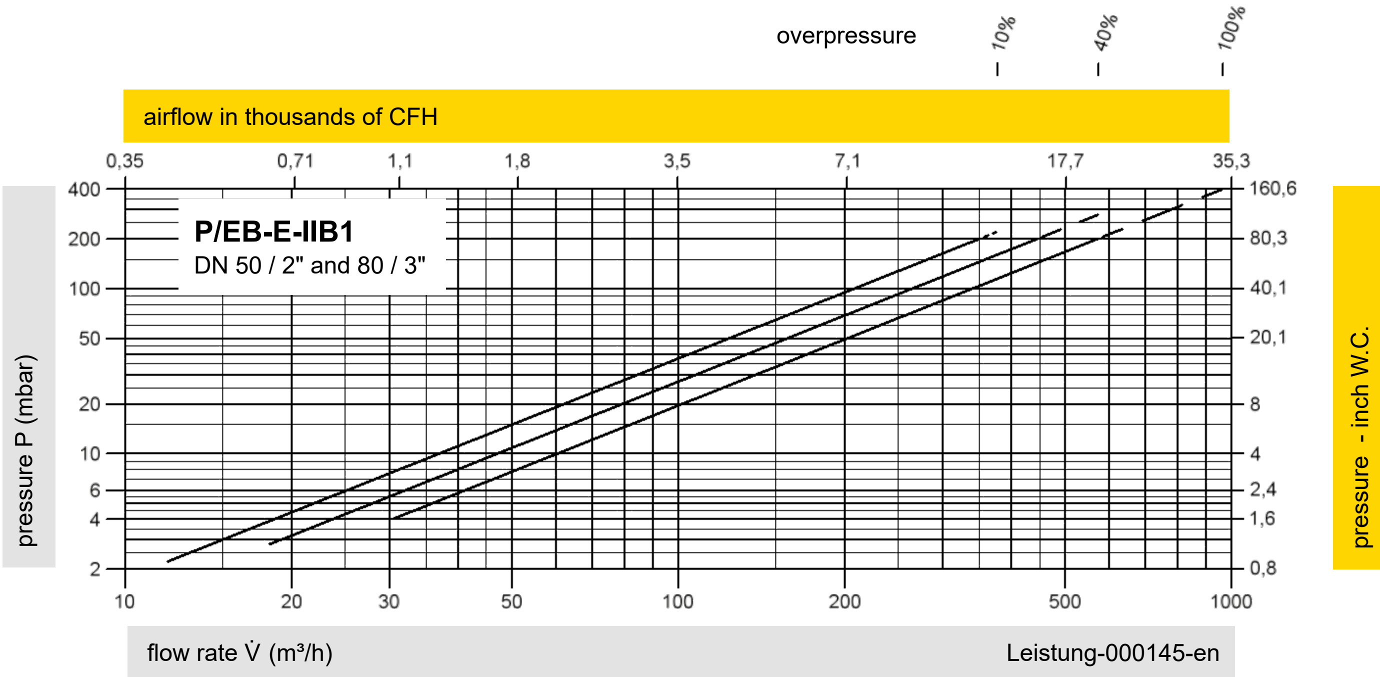


Pressure Relief Valve

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

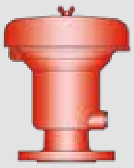
Opening pressure = set pressure plus overpressure

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 $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

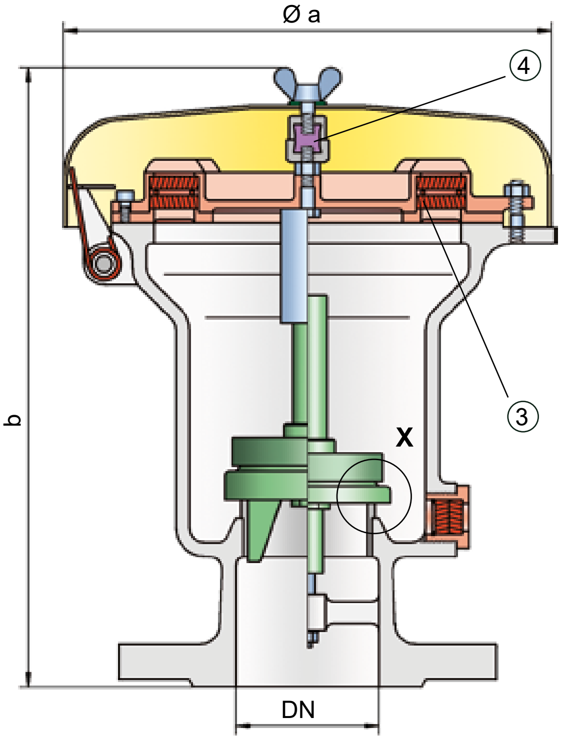
Notes:



Pressure Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® P/EBR



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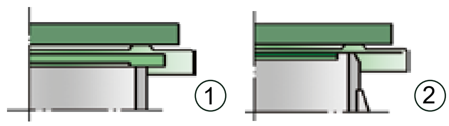

Pressure settings:

+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 out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and prevents product losses almost up to the set pressure, while at the same time protecting 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. 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 behavior (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 above the normal standards 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 substances are used and to enable the use of corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift (applies to explosion group IIA)
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as protective system in areas with potentially explosive atmospheres in accordance with ATEX
- FLAMEFILTER® provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Demonstration of endurance burning
Video

Design Types and Specifications

The valve pallet is weight-loaded. At set pressures >80 mbar (32.1 inch W.C.), an extended 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 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)	
> 0,90 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® casing	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	Aluminum	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 CL 150 R.F.	

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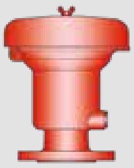
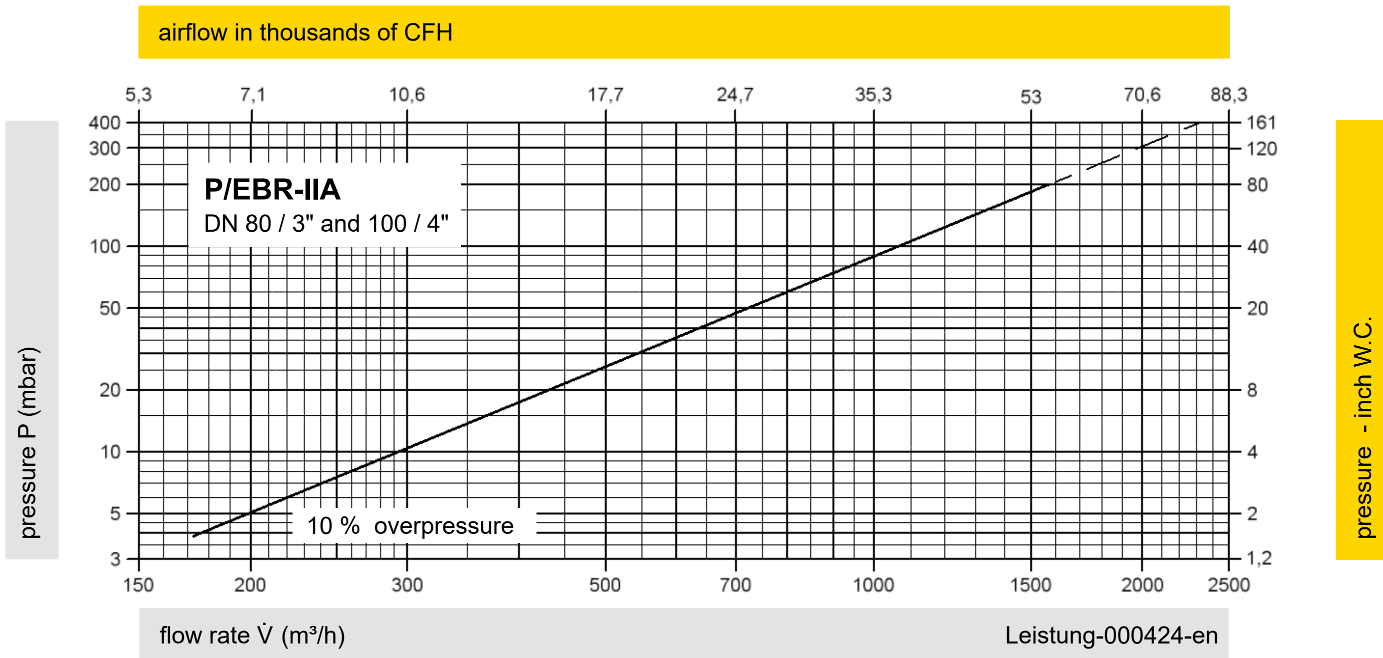
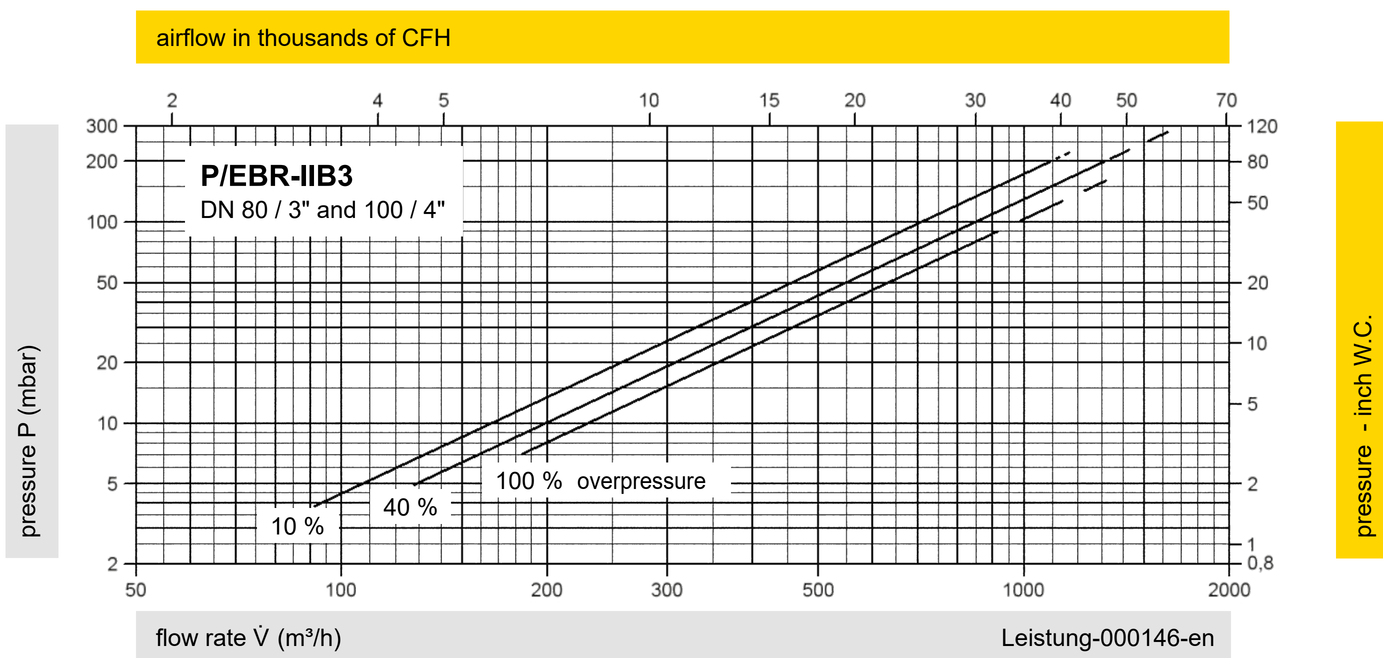


Pressure Relief Valve

Flow Capacity Charts

PROTEGO® P/EBR





Remark

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

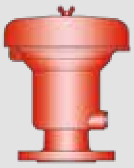
Set pressure = the valve starts to open

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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

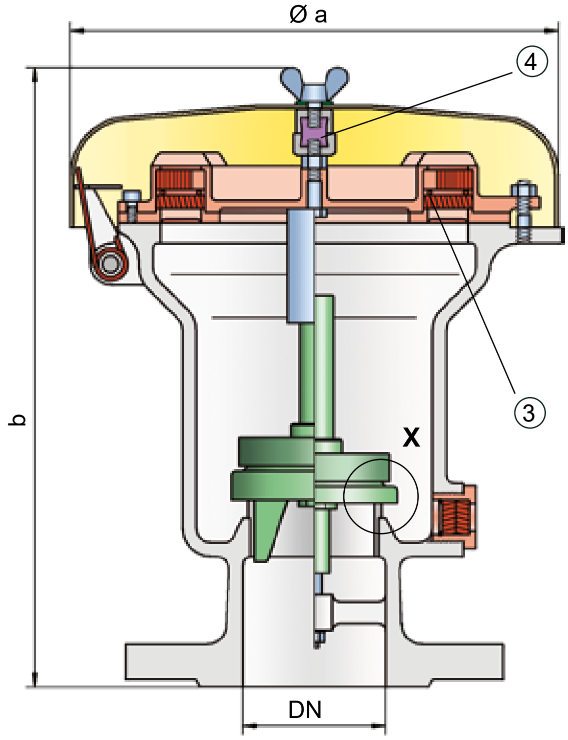
Notes:



Pressure Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® P/EBR-E



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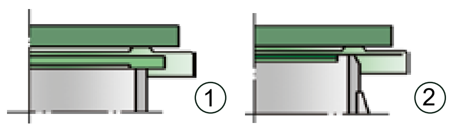

Pressure settings:

+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 specifically designed for use in ethanol production, processing, and storage. It is primarily used as a safety device for flame transmission-proof out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and prevents product losses almost up to the set pressure, while at the same time protecting 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 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 behavior (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 above the normal standards 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 substances are used and to enable the use corrosive fluids. After the over pressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- protected against deflagration and endurance burning of alcohol/air mixtures from explosion group IIB1
- high flow capacity due to larger FLAMEFILTER® cross section
- PROTEGO® flame arrester unit provides protection against atmospheric deflagration and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet

Demonstration of endurance burning
Video

Design Types and Specifications

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

There are two different designs:

Pressure relief valve, basic design	**P/EBR - E - –**
Pressure relief valve with heating jacket (max. heating fluid temperature +85°C / 185°F)	**P/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 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® casing	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	Aluminum	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 CL 150 R.F.	

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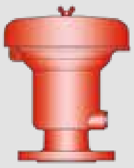
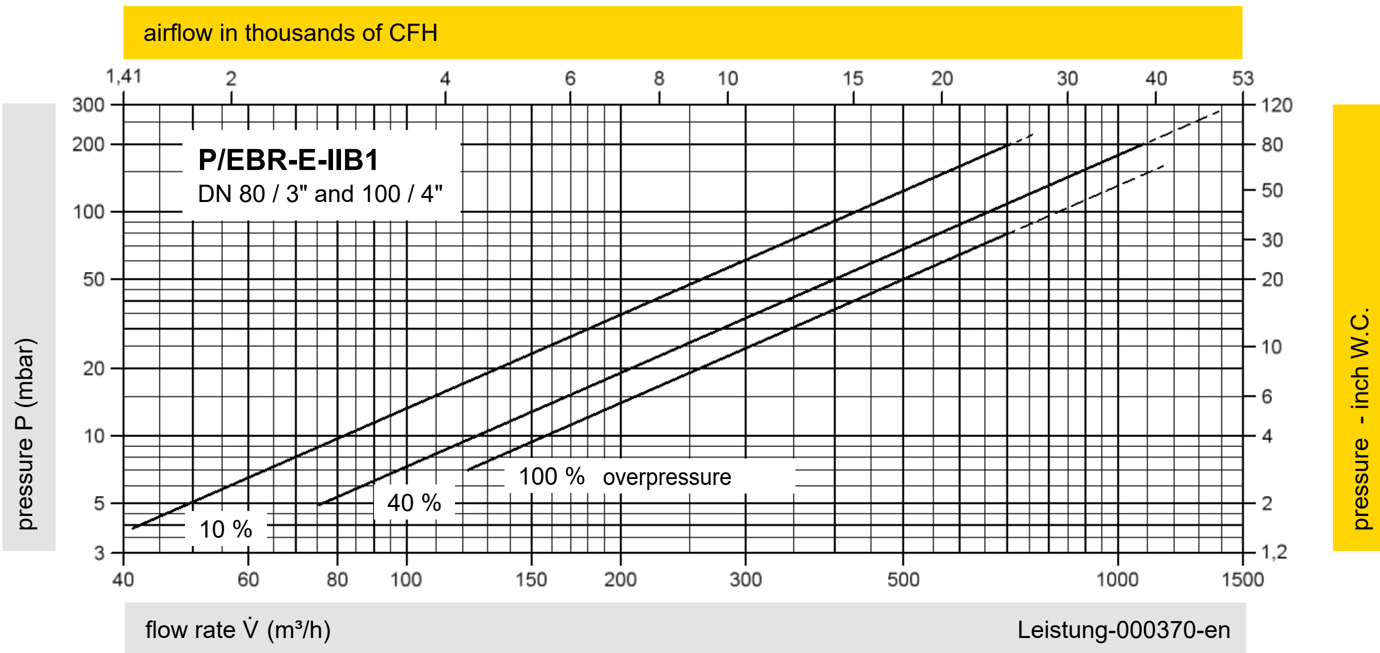


Pressure Relief Valve

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

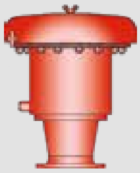
Opening pressure = set pressure plus overpressure

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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

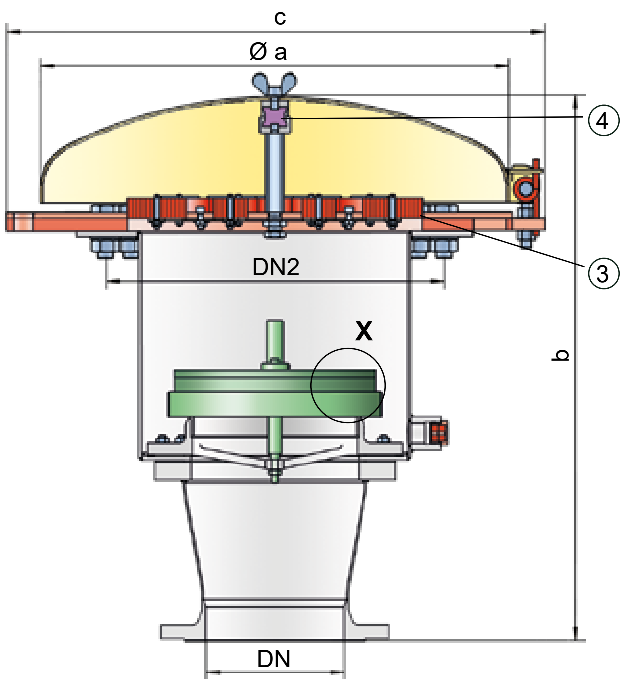
Notes:

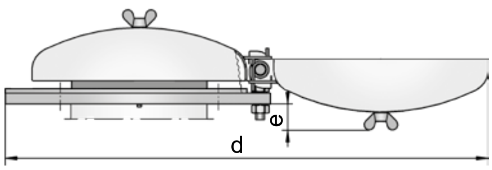


Pressure Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® D-SVL-EB-IIA





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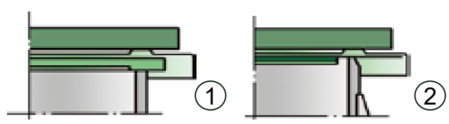

Pressure settings:

+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 deflagration-proof and endurance burning-proof D-SVL-EB type PROTEGO® valve is a highly developed pressure relief valve for large flows with an integrated flame arrester PROTEGO® EB. It is primarily used as a safety device for flame transmission-proof out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against excess pressure and prevents product losses almost up to the set pressure; while at the same time protecting 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. 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 (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 above the conventional standards 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 substances are used and to enable the use in corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.
If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- set pressure close to opening pressure for optimum pressure maintenance in the system
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- PROTEGO® flame arrester unit provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Demonstration of endurance burning
Video

Design Types and Specifications

The valve pallet is weight-loaded.

There are two different designs:

Pressure relief valve, basic design	**D-SVL-EB -** $\boxed{-}$
Pressure relief valve with heating jacket	**D-SVL-EB -** $\boxed{H}$

Additional special devices available upon request.

Table 1: Dimensions — Dimensions in mm / inches

DN	DN2	a	b	c	d	e
150 / 6“	400 / 16“	705 / 27.76	754 / 29.68	802 / 31.57	1500 / 59.06	109 / 4.29
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® casing	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	Aluminum	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 CL 150 R.F.	

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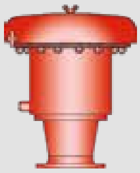
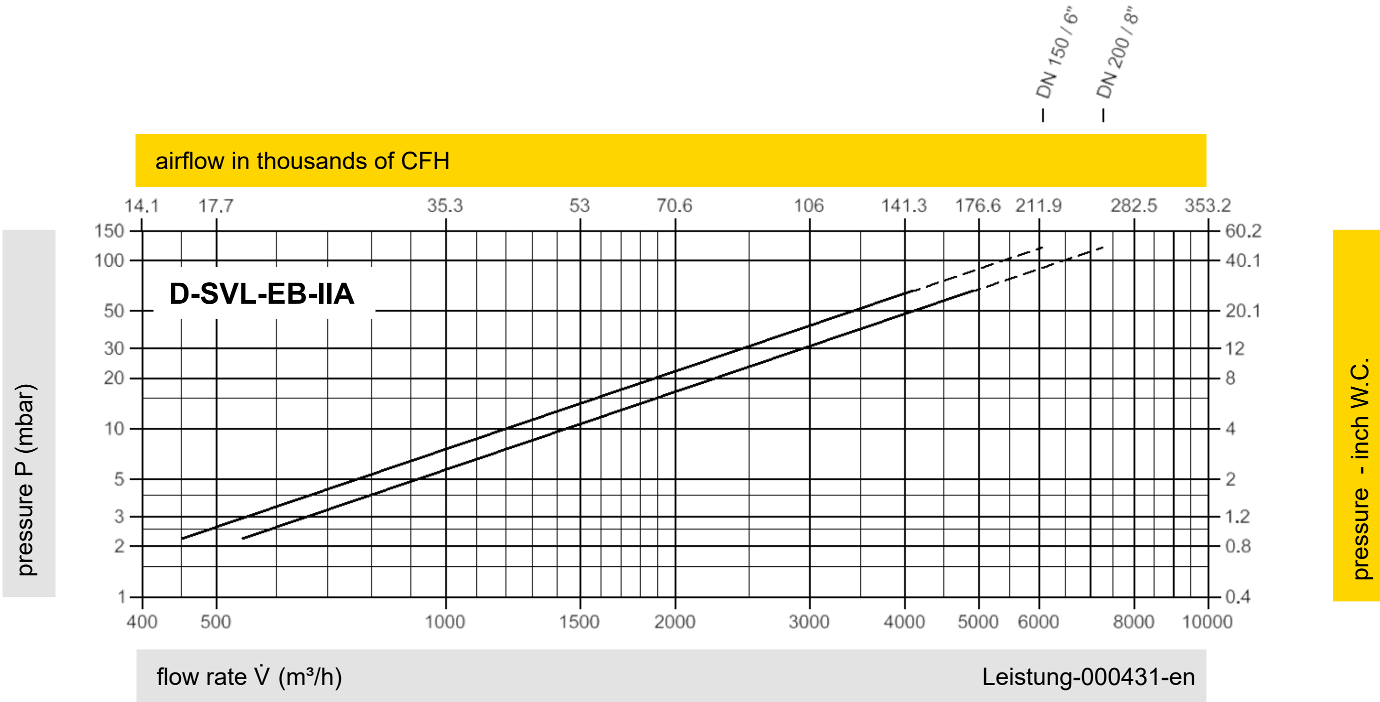


Pressure Relief Valve

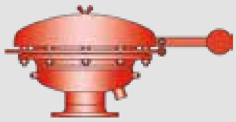
Flow Capacity Chart

PROTEGO® D-SVL-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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

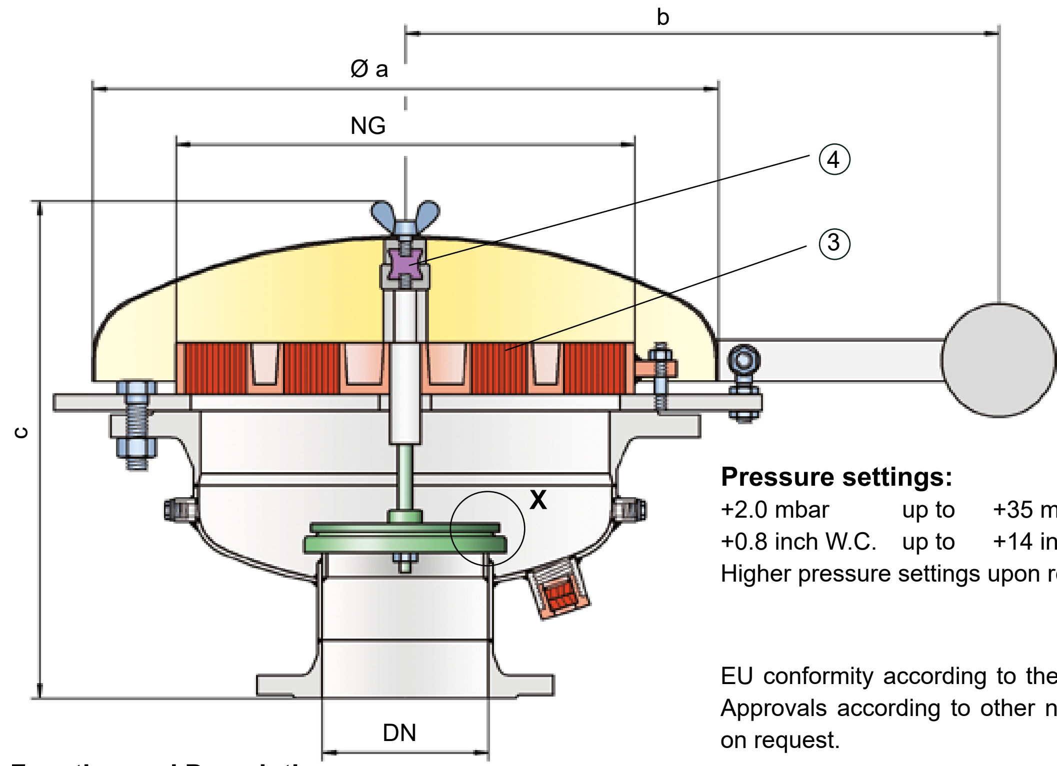
Notes:

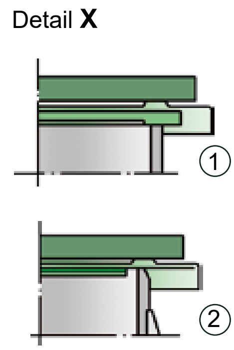


Pressure Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® BE/HR-D





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.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Function and Description

The deflagration-proof and endurance burning-proof BE/HR-D 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 out-breathing on tanks, containers. and process equipment. The valve offers reliable protection against overpressure and prevents product losses almost up to the set pressure, while at the same time protecting 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 BE/HR-D valve is available for substances from 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 above conventional standards 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 overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/ air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

The valve can be used at an operating temperature of up to +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 reach full lift
- due to 40% technology, higher set pressures can be used, resulting in reduced product loss, as compared to conventional 100% technology (compare API 2000)
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- high flow capacity due to large FLAMEFILTER® cross section
- PROTEGO® flame arrester unit provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design

Design and Specifications

The valve pallet is weight-loaded.

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

Additional special devices available upon request.

Demonstration of endurance burning
Video

Table 1: Dimensions			Dimensions in mm / inches
To select the nominal size (DN), please use the flow 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® casing	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	Aluminum	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 CL 150 R.F.	

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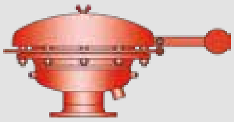
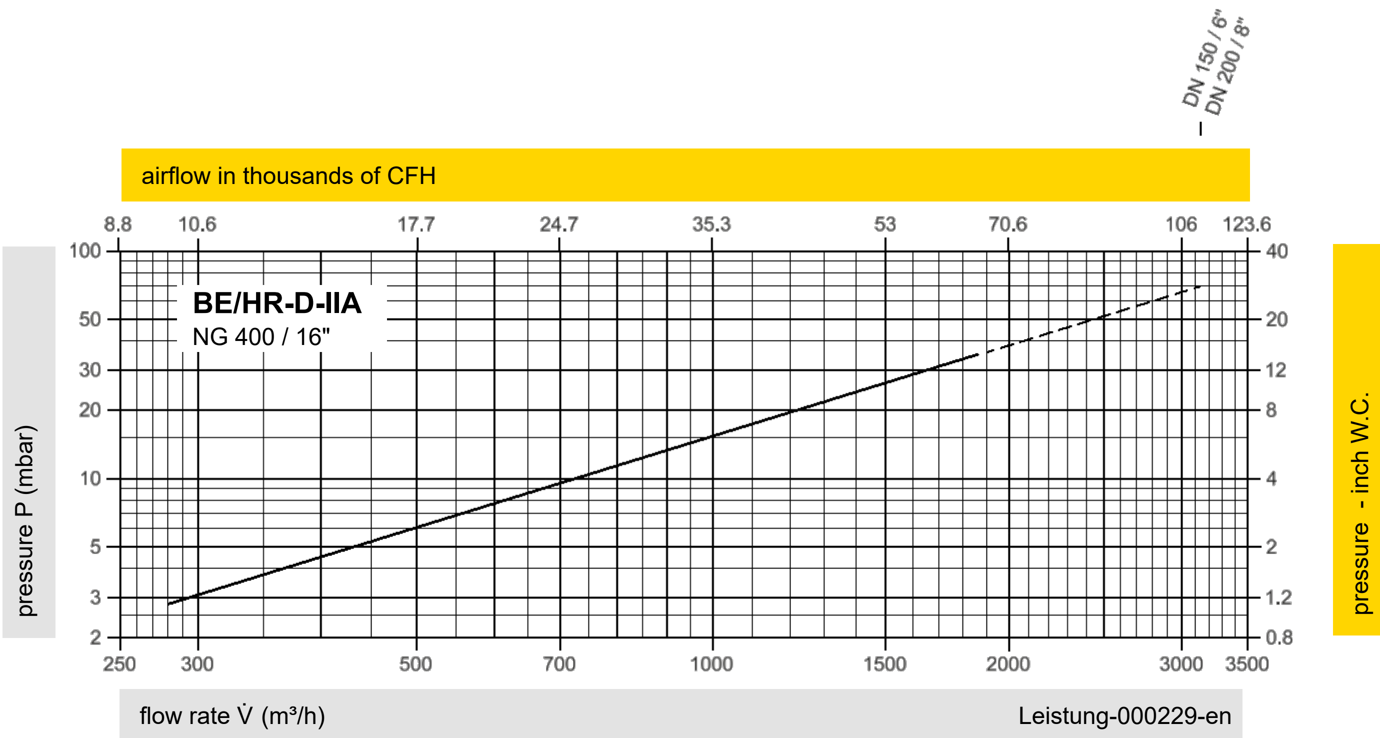


Pressure Relief Valve

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

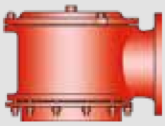
Opening pressure = set pressure plus overpressure

Overpressure = pressure increase over the set pressure

The 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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

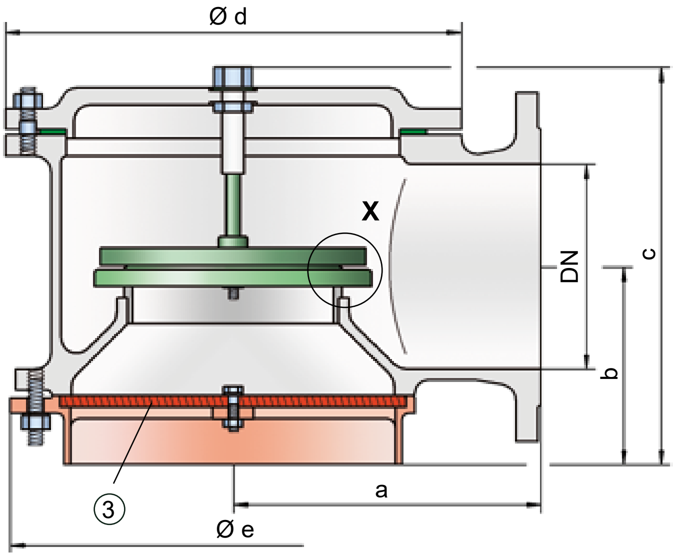
Notes:



Vacuum Relief Valve

Deflagration-proof

PROTEGO® SV/E



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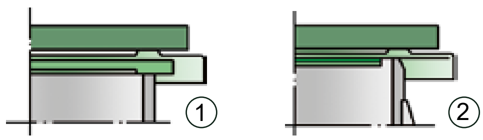

Vacuum settings:

-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 in-breathing on tanks, containers, and process equipment. The valve offers reliable protection against vacuum and prevents in-breathing of air almost up to the set pressure; while at the same time protecting 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 IIC.

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 above the normal standards 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 them from sticking when sticky substances are used and to enable the use corrosive fluids. After the vacuum is balanced, the valve re-seats 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 of 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.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request. Additional certificates from classification organizations for use on ships are also available.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- excellent tightness, resulting in lowest possible product losses and reduced environmental pollution
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- FLAMEFILTER® provides protection against atmospheric deflagrations
- integrated FLAMEFILTER® saves space and weight and reduces costs
- FLAMEFILTER® is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet
- available in a special design with lifting device (for ships)

Design Types and Specifications

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

There are four different designs:

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

Additional special devices available upon request.

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

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.
≥ 0,5 mm	IIB	B	
< 0,5 mm	IIC	B	

Table 3: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

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® casing	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	Aluminum	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 CL 150 R.F.	

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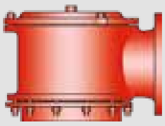
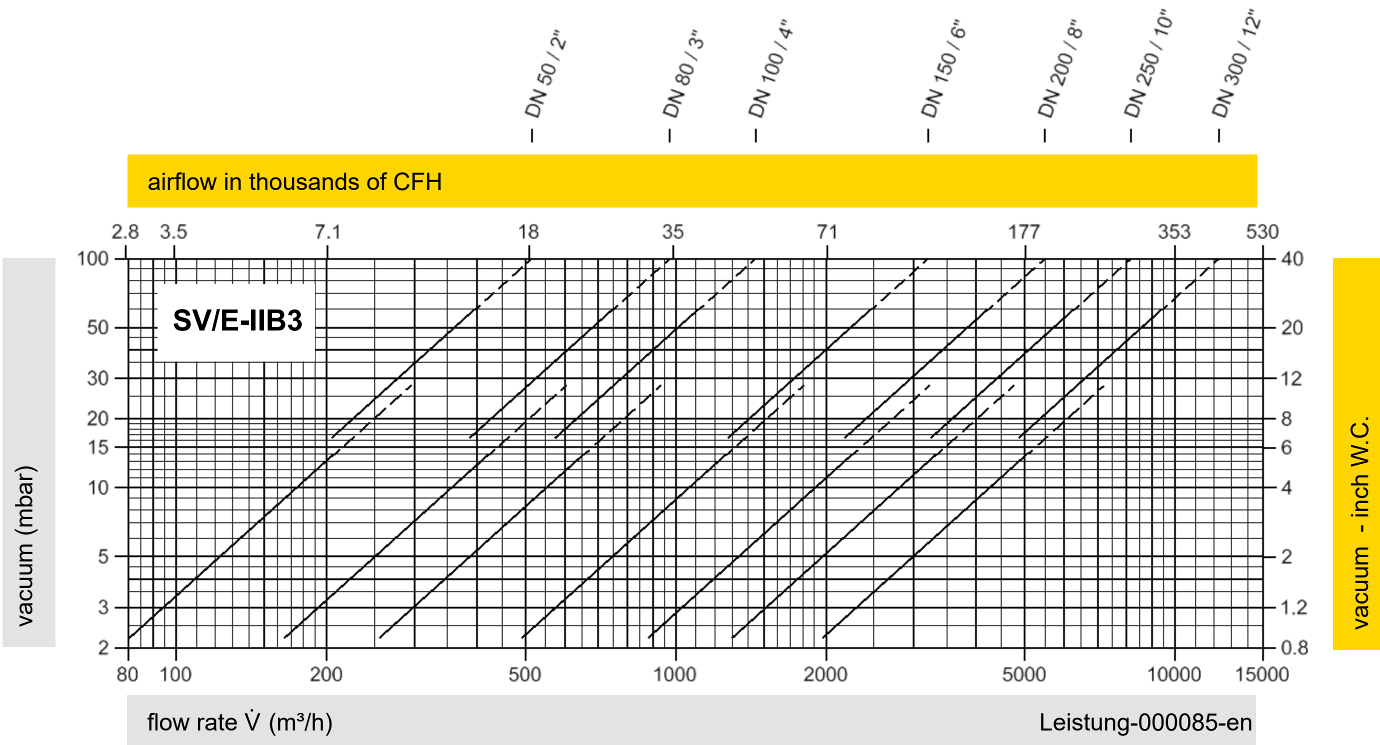
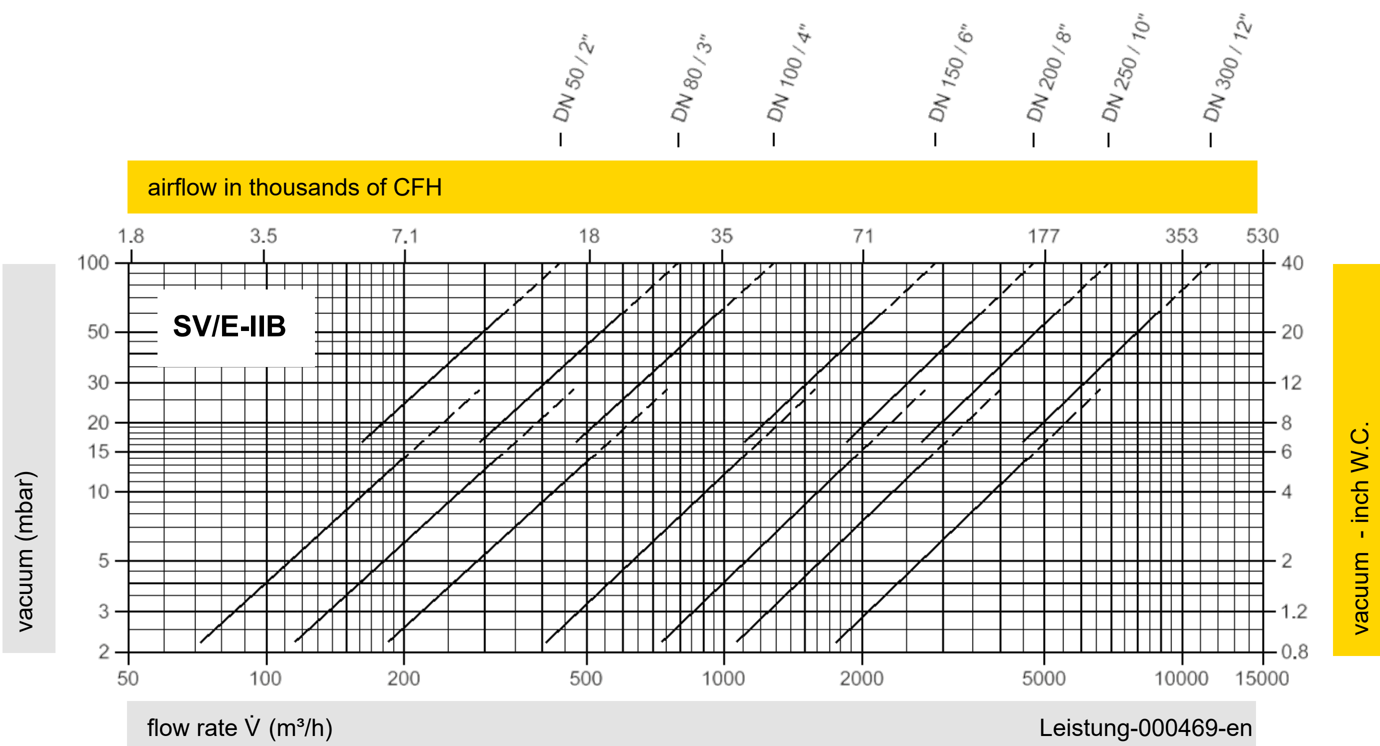


Vacuum Relief Valve

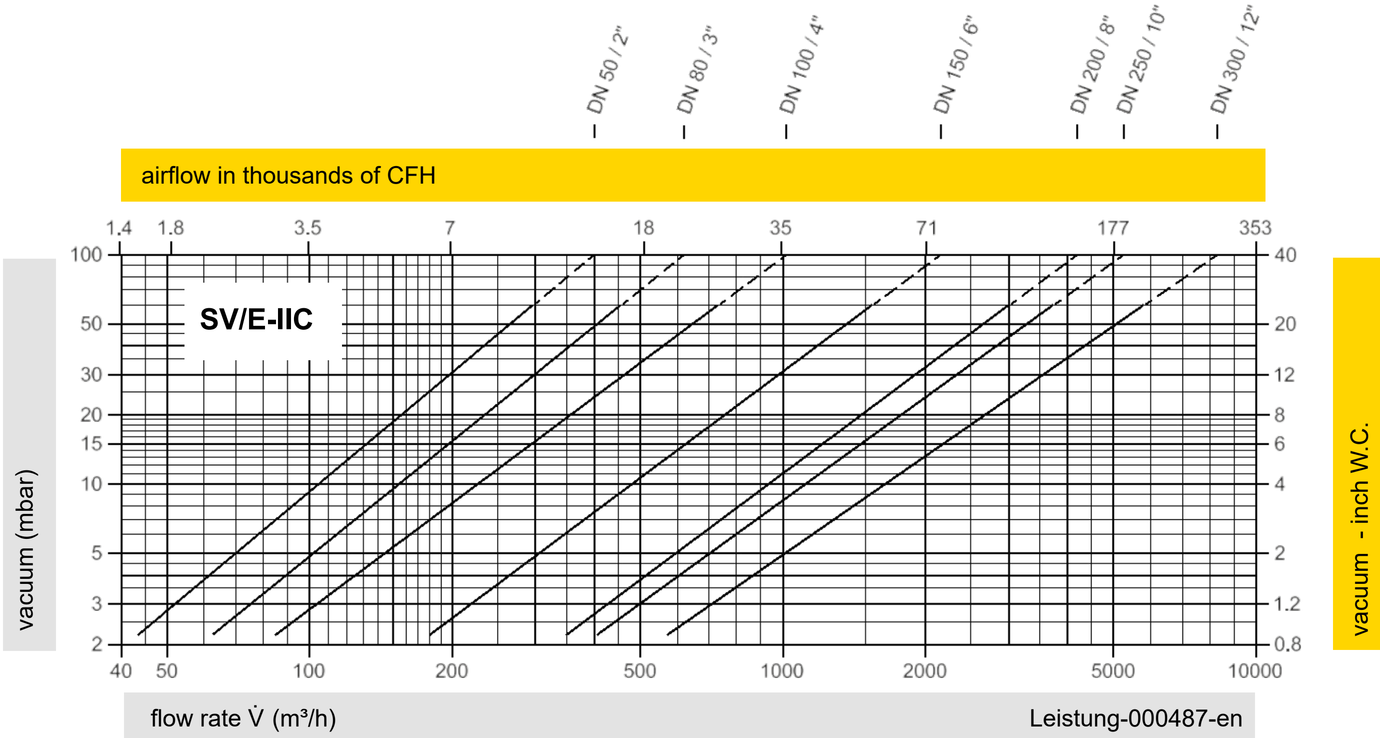
Flow Capacity Chart

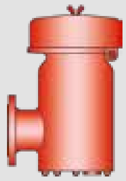
PROTEGO® SV/E





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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

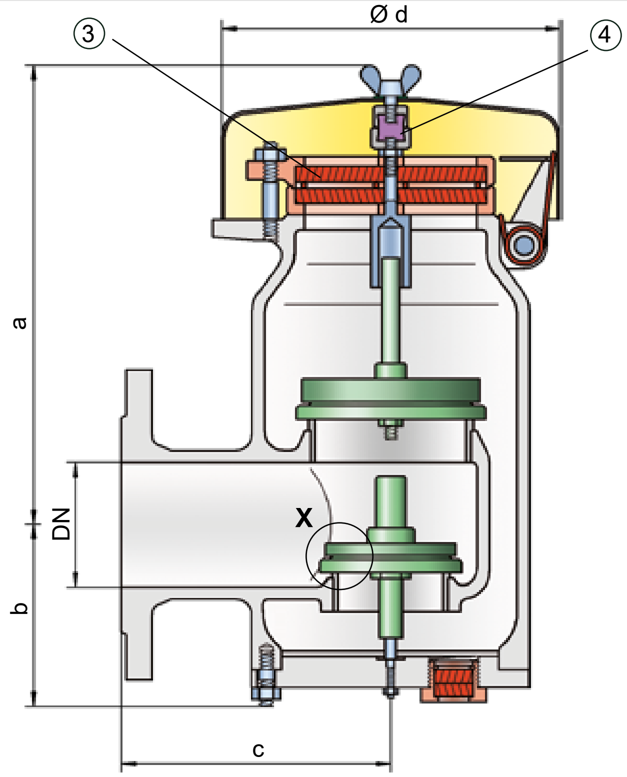

DN 50 / 2"
DN 80 / 3"
DN 100 / 4"
DN 150 / 6"
DN 200 / 8"
DN 250 / 10"
DN 300 / 12"
airflow in thousands of CFH
1.4
1.8
3.5
7
18
35
71
177
353
SV/E-IIC
vacuum (mbar)
100
50
30
20
15
10
5
3
2
vacuum - inch W.C.
40
20
12
8
6
4
2
1.2
0.8
40
50
100
200
500
1000
2000
5000
10000
flow rate V̇ (m³/h)
Leistung-000487-en



Pressure/Vacuum Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® PV/EB



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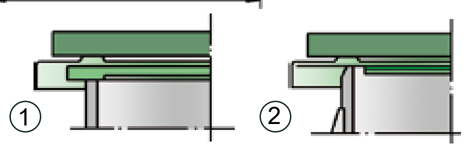

Settings:

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-proof 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-breathing and out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and vacuum, prevents the in-breathing 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® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The PROTEGO® PV/EB valve is available for substances from 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) 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 above the normal standards 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 substances are used and to enable the use of corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.
If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 PROTEGO® flame arrester unit prevents flashback as a result of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.
The valve can be used at an operating temperature of up to +60°C / 140°F and meets the requirements of European tank design standard EN 14015 (Appendix L) and ISO 28300 (API 2000).
EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% and 100% technology
- valve opens later and closes earlier than conventional valves
- excellent tightness, resulting in lowest possible product losses and environmental pollution
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- PROTEGO® flame arrester unit provides protection against atmospheric deflagration and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapor
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet
- available in a special design with lifting device

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Demonstration of endurance burning
Video

Design Types and Specifications

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

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.
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

Dimensions for pressure/vacuum 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 (PV/EB-H-...)	Steel Steel	Stainless Steel Stainless Steel
Valve seats	Stainless Steel	Stainless Steel
Weather hood	Steel	Stainless Steel

Special materials upon request.

Table 4: Material combination of flame arrester unit

Design	A
FLAMEFILTER® casing	Stainless Steel
FLAMEFILTER®	Stainless Steel
Spacer	Stainless Steel

Special materials upon request.

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
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE

Special materials and higher set pressures upon request.

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
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE

Special materials and higher set vacuum upon request.

Table 7: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

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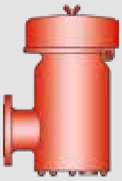
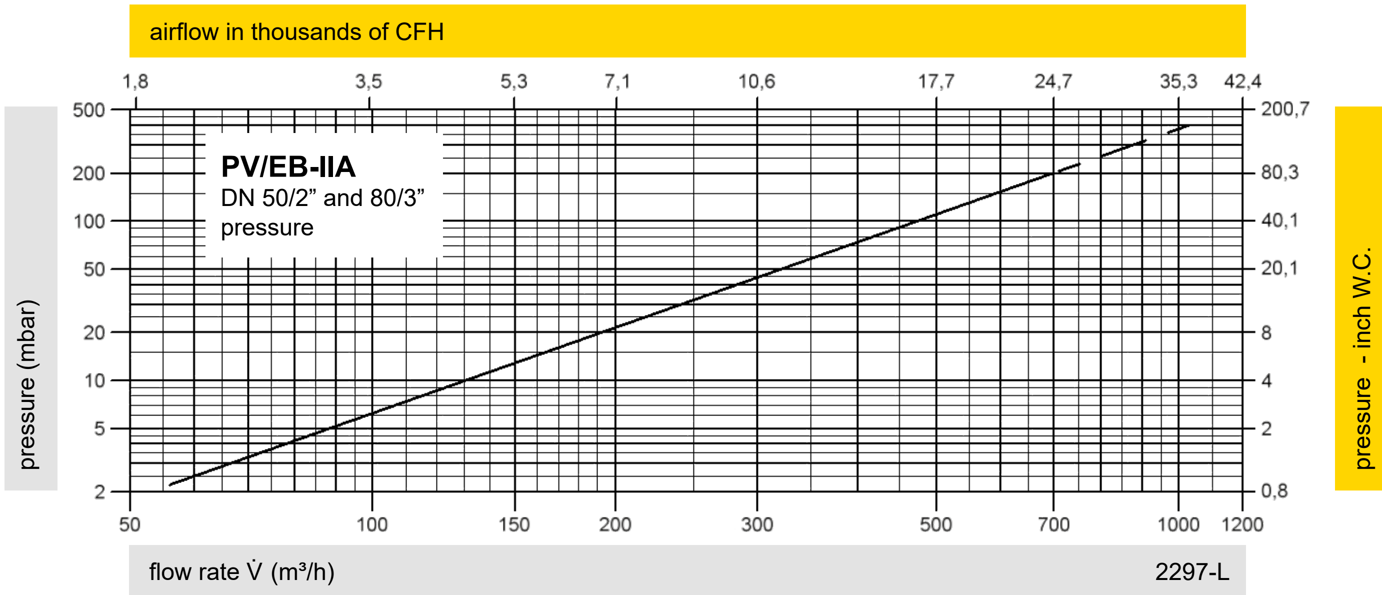
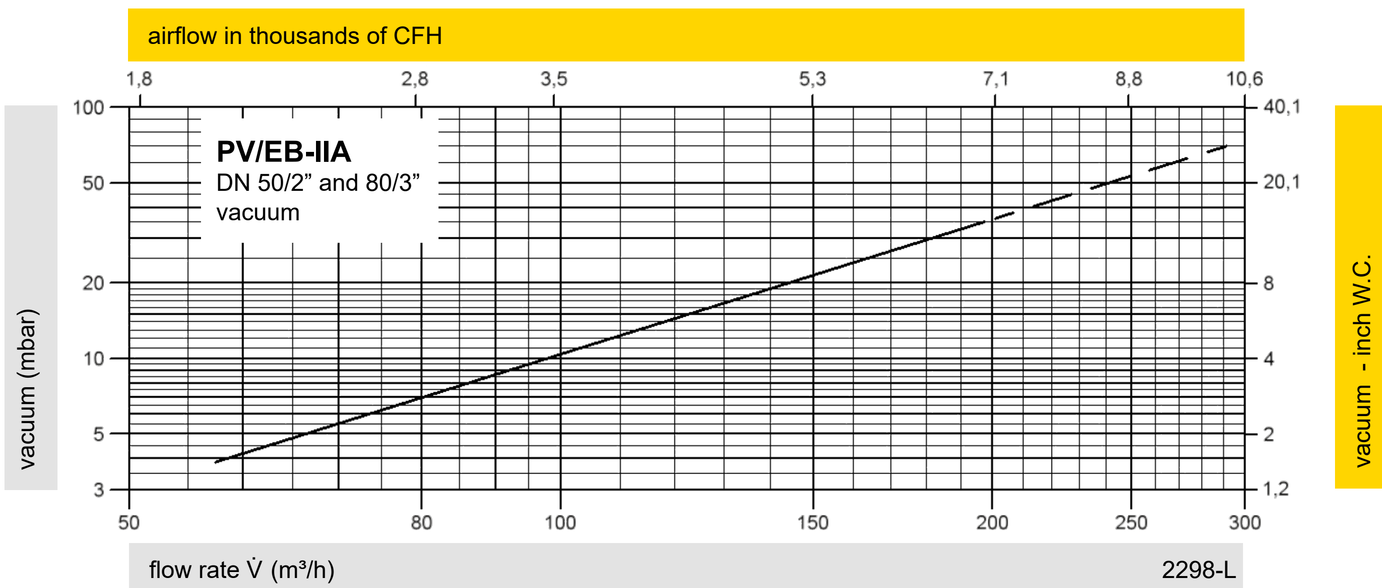


Pressure/Vacuum Relief Valve

Flow Capacity Charts

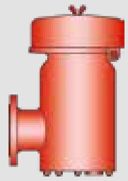
PROTEGO® PV/EB





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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

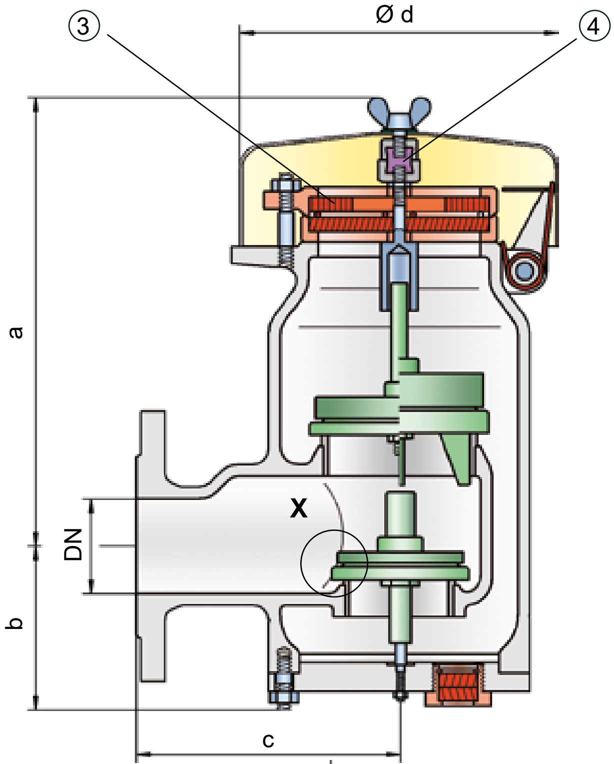
Notes:



Pressure/Vacuum Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® PV/EB-E



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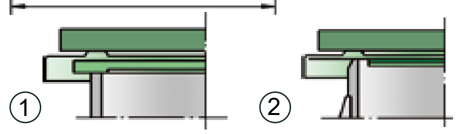

Settings:

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 specifically designed for use in ethanol production, processing, and storage. It is primarily used as a safety device for flame transmission-proof in-breathing and out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and vacuum, prevents the in-breathing of air and product losses almost up to the set pressure, and protects against atmospheric deflagration and 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 from 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 behavior (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 above the normal standards 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 them from sticking when sticky substances are used and to enable the use of corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, gas/product vapor/air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- excellent tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- protected against deflagration and endurance burning of alcohol/air mixtures from explosion group IIB1
- PROTEGO® flame arrester unit provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit is saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallets
- available in a special design with lifting device

Demonstration of endurance burning
Video

Design Types and Specifications

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

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
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

Dimensions for pressure/ vacuum 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 (PV/EB-E-H-...)	Steel Steel	Stainless Steel Stainless Steel
Valve seats	Stainless Steel	Stainless Steel
Weather hood	Steel	Stainless Steel

Special materials upon request.

Table 4: Material combination of flame arrester unit

Design	A
FLAMEFILTER® casing	Stainless Steel
FLAMEFILTER®	Stainless Steel
Spacer	Stainless Steel

Special materials upon request.

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
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE

Special materials and higher set pressures upon request.

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
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE

Special materials and higher set vacuum upon request.

Table 7: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

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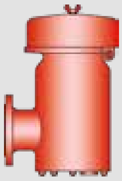
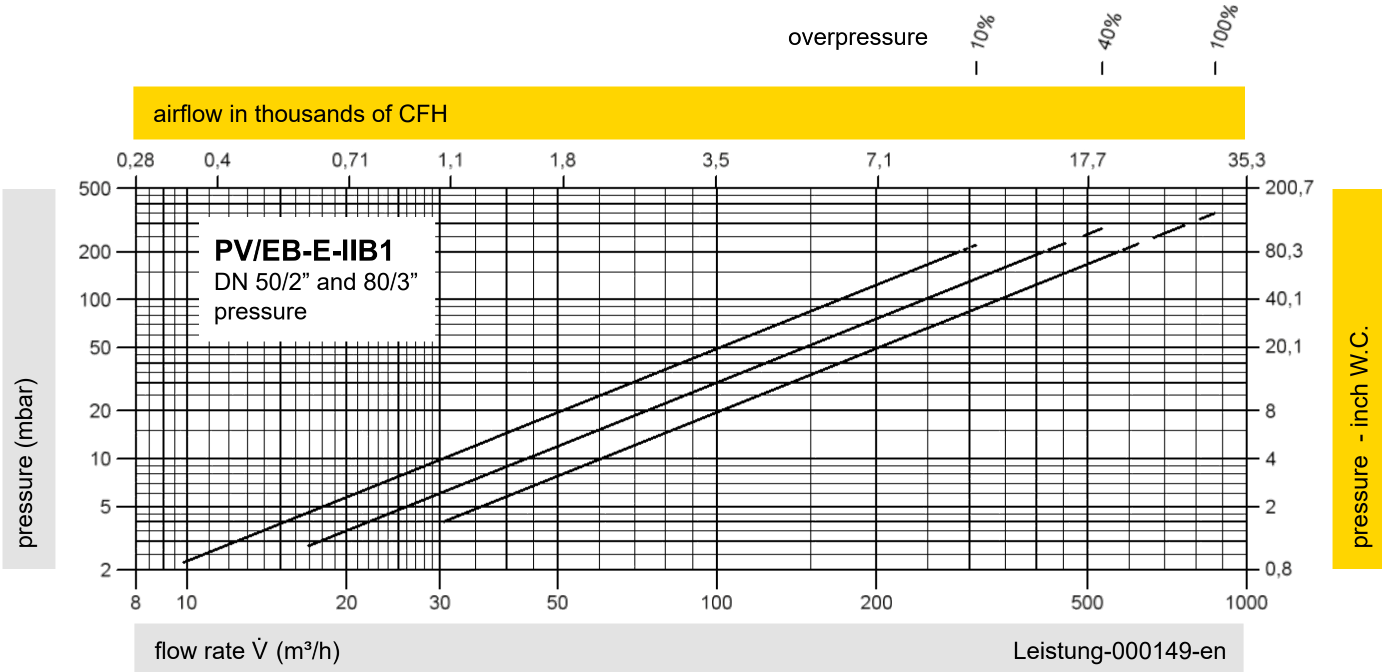
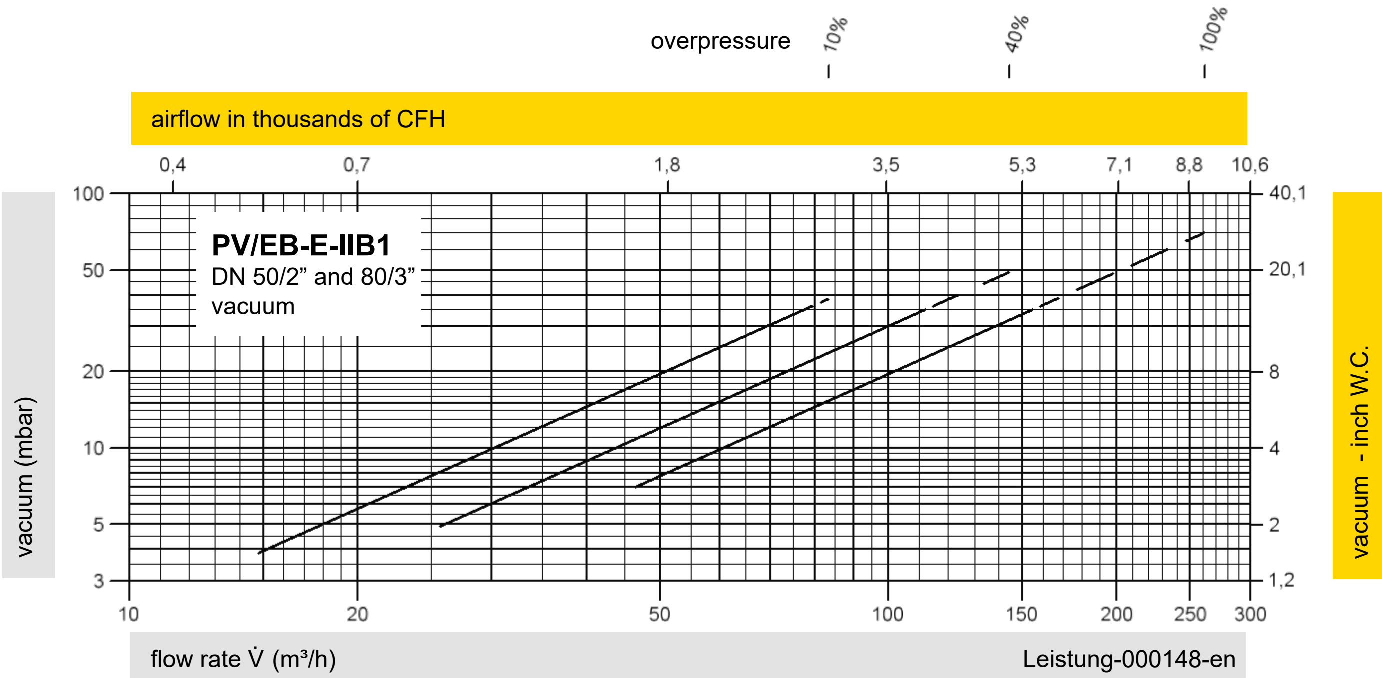


Pressure/Vacuum Relief Valve

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

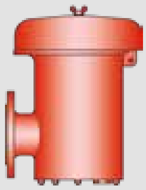
Opening pressure = set pressure plus overpressure

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 $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

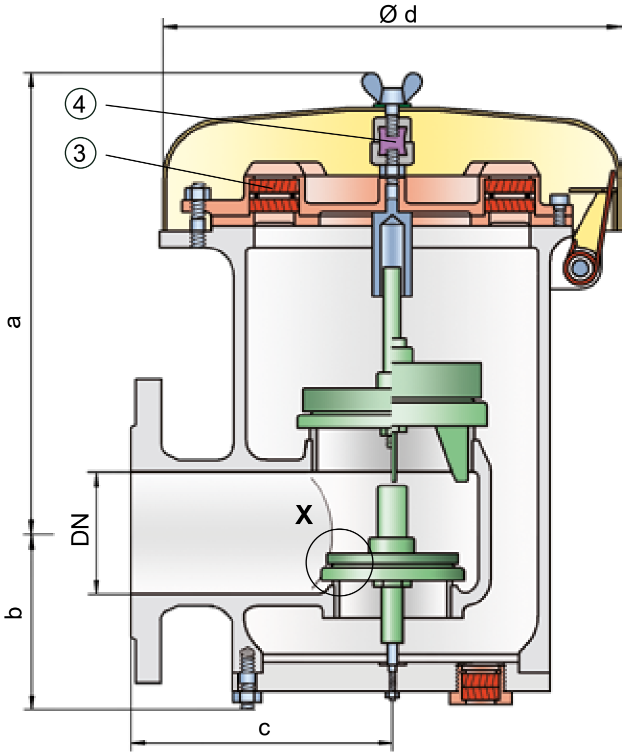
Notes:



Pressure/Vacuum Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® PV/EBR



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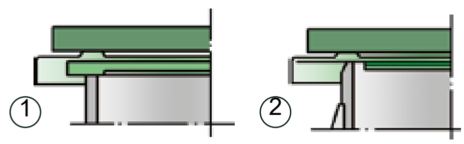

Settings:

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-breathing and out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and vacuum, prevents the in-breathing 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® 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 behavior (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 above the normal standards 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 substances are used and to enable the use of corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- excellent tightness, resulting in lowest possible product losses and environmental pollution
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- high flow capacity due to larger FLAMEFILTER® cross section
- PROTEGO® flame arrester unit provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet
- available in a special design with lifting device

Demonstration of endurance burning
Video

Design Types and Specifications

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

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® casing	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 materials and higher set pressures upon request.
Valve pallet	Aluminum	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 materials and higher set vacuum upon request.
Valve pallet	Aluminum	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 CL 150 R.F.	

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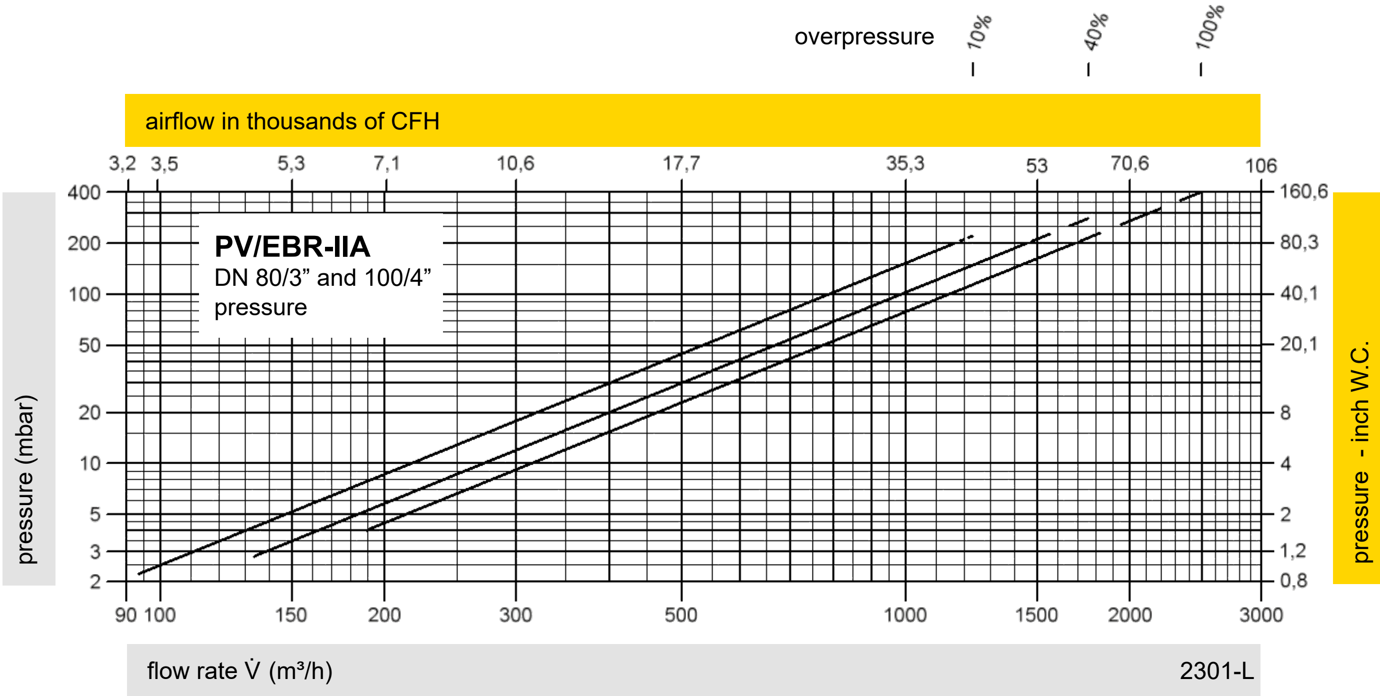
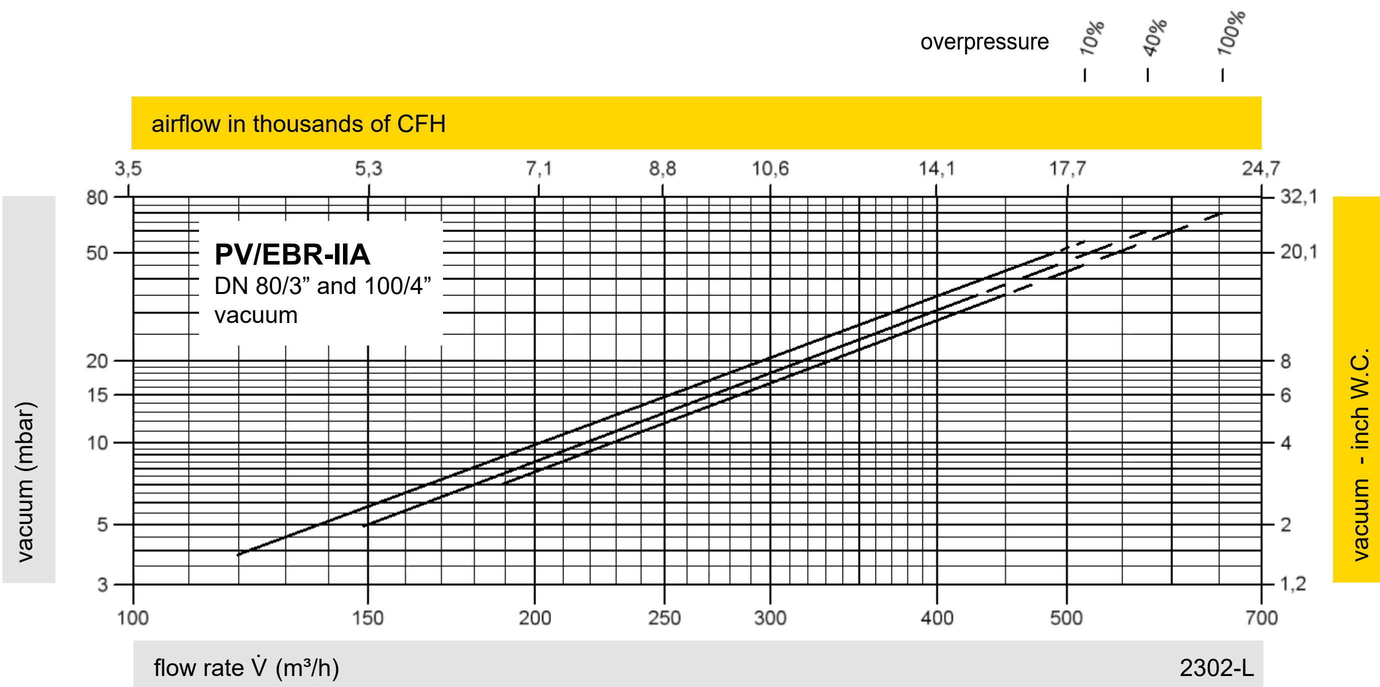
Pressure/Vacuum Relief Valve

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

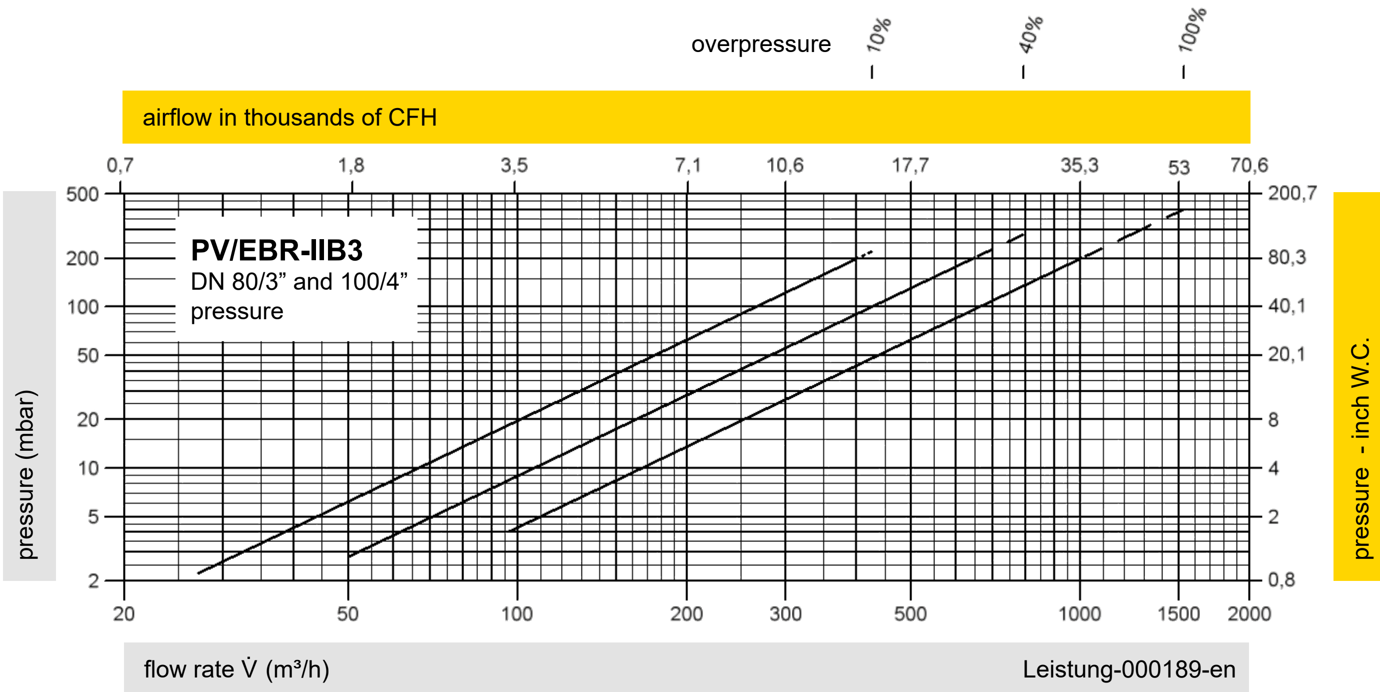
Opening pressure = set pressure plus overpressure

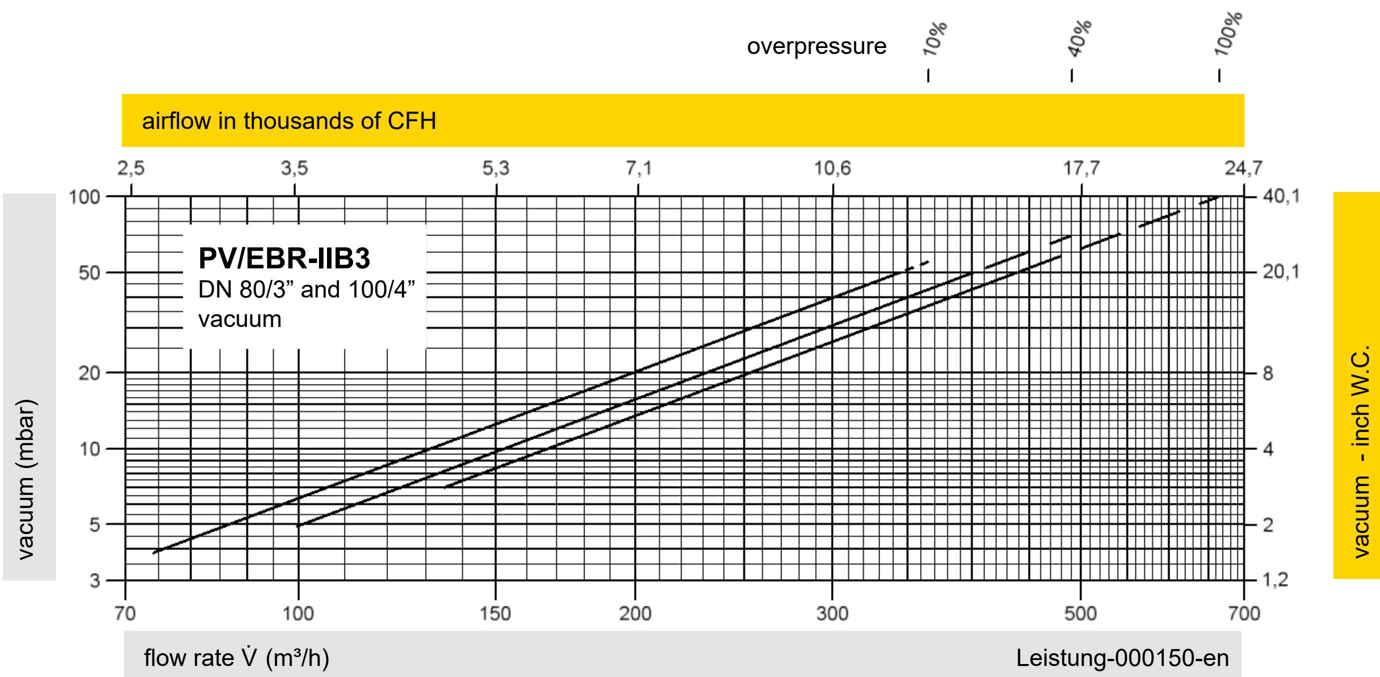
Overpressure % = percentage pressure increase over the set pressure

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

Volume flow $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

PROTEGO® PV/EBR





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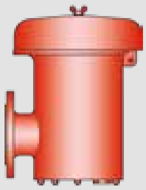
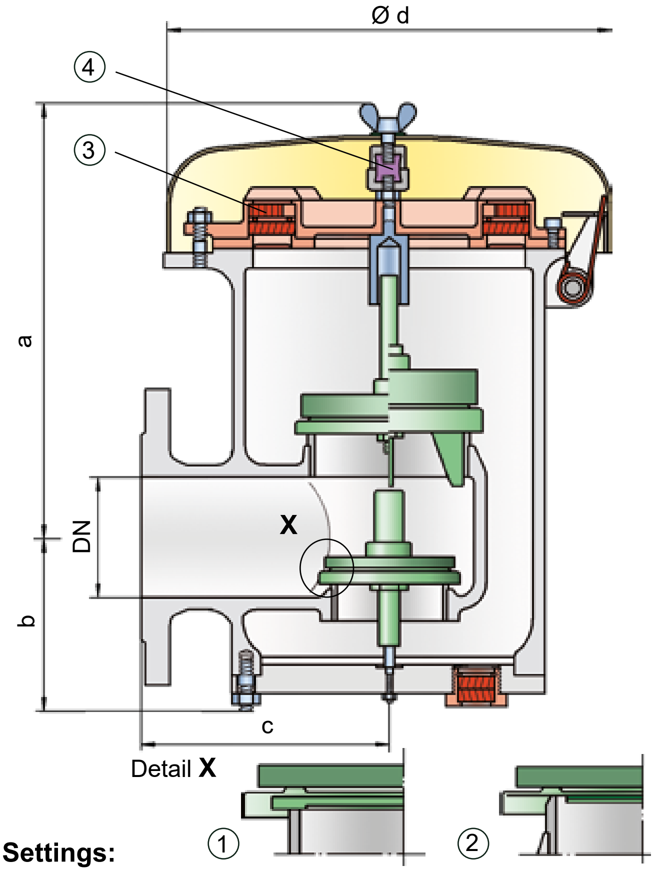


Pressure/Vacuum Relief Valve

Deflagration-proof 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 specifically designed for use in ethanol production, processing, and storage. It is primarily used as a safety device for flame transmission-proof out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and vacuum, prevents the in-breathing 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® flame arrester unit is designed to achieve minimum pressure drop with maximum safety. The PROTEGO® PV/EBR-E valve is available for substances from 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 behavior (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 above the normal standards due to our state-of-the-art manufacturing technology. This feature is e nsured 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 substances are used and to enable the use corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- excellent tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX in areas
- protected against deflagration and endurance burning of alcohol/air mixtures and substances from explosion group IIB1
- high flow capacity due to larger FLAMEFILTER® cross section
- PROTEGO® flame arrester unit provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet
- available in a special design with lifting device

Demonstration of endurance burning
Video

Design Types and Specifications

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

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® casing	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 materials and higher set pressures upon request.
Valve pallet	Aluminum	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 materials and higher set vacuum upon request.
Valve pallet	Aluminum	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 CL 150 R.F.	

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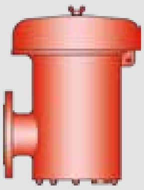
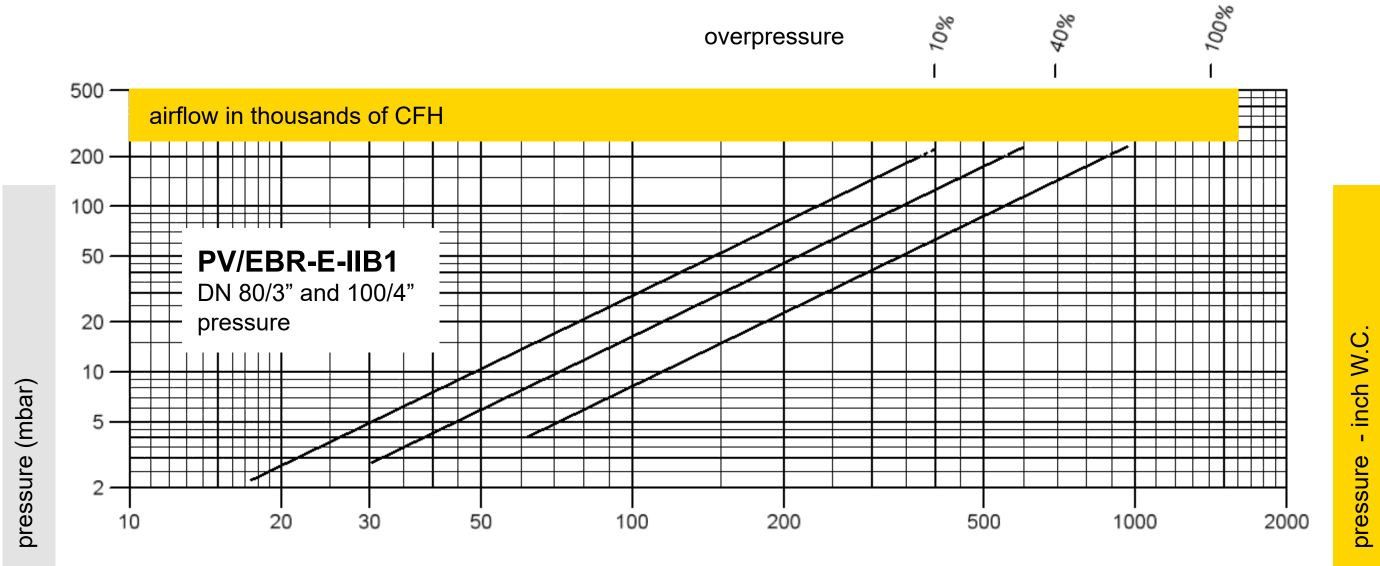


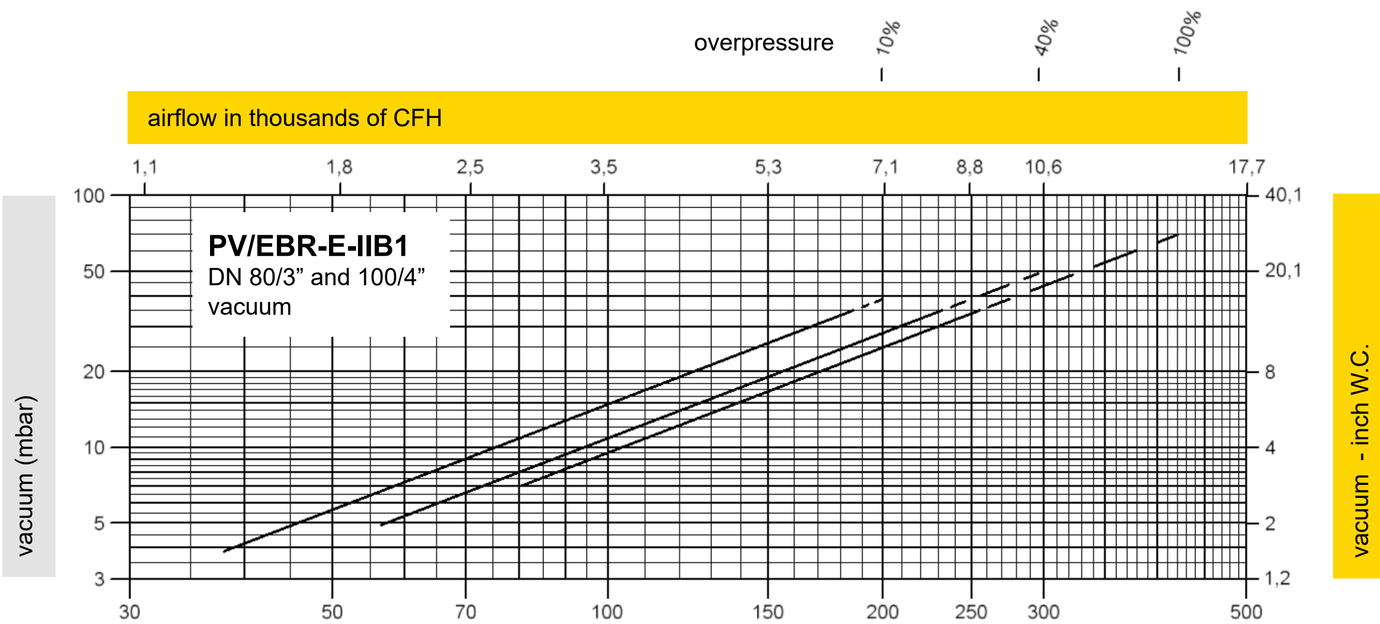
Pressure/Vacuum Relief Valve

Flow Capacity Charts

PROTEGO® PV/EBR-E



flow rate $\dot{V}$ (m³/h) Leistung-000491-en



flow rate $\dot{V}$ (m³/h) Leistung-000492-en

Remark

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

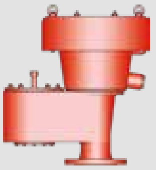
Set pressure = the valve starts to open

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 $\dot{V}$ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

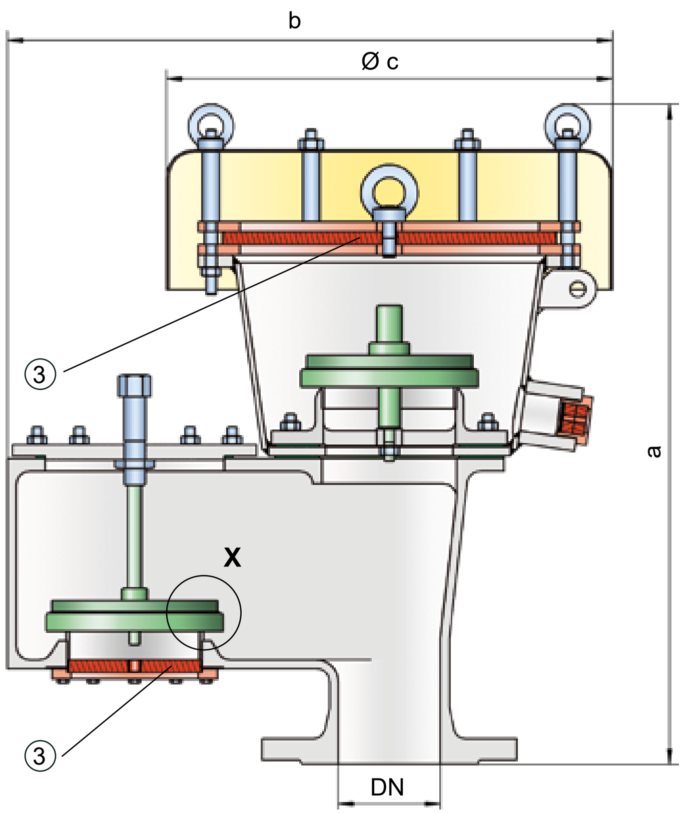
Notes:



Pressure/Vacuum Relief Valve

Atmospheric Deflagration-proof

PROTEGO® VD/SV-AD and VD/SV-ADL



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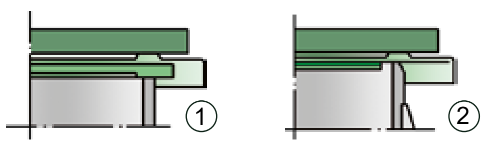

Settings:

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-breathing and out-breathing in tanks, containers, and process equipment. The valve offers reliable protection against overpressure and vacuum, prevents out-breathing of product vapor and in-breathing of air almost up to the set pressure, and 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 ofdevelopment, 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 above to the normal standards 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 them from sticking when sticky substances are used and to enable the use of corrosive fluids. After the over-pressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 at an operating temperature of up to +60°C / 140°F and meets the requirements of European tank design standard EN 14015 (Appendix L) and ISO 28300 (API 2000).

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- FLAMEFILTER® provides protection against atmospheric deflagrations
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- higher flow capacity
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet
- best possible technology for API tanks

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Design Types and Specifications

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

The valve pallets 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 page.

	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
Valve seats	Stainless Steel	Stainless Steel
Gasket	PTFE	PTFE
Weather hood	Stainless Steel	Stainless Steel
Flame arrester unit	A, B	B

The housings are also available with an ECTFE coating.

Special materials upon request.

Table 4: Material combinations of flame arrester units

Design	A	B
FLAMEFILTER® casing	Steel	Stainless Steel
FLAMEFILTER®	Stainless Steel	Stainless Steel

Special materials upon request.

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
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE

Special materials and higher set pressures upon request.

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
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE

Special material and higher set vacuum upon request.

Table 7: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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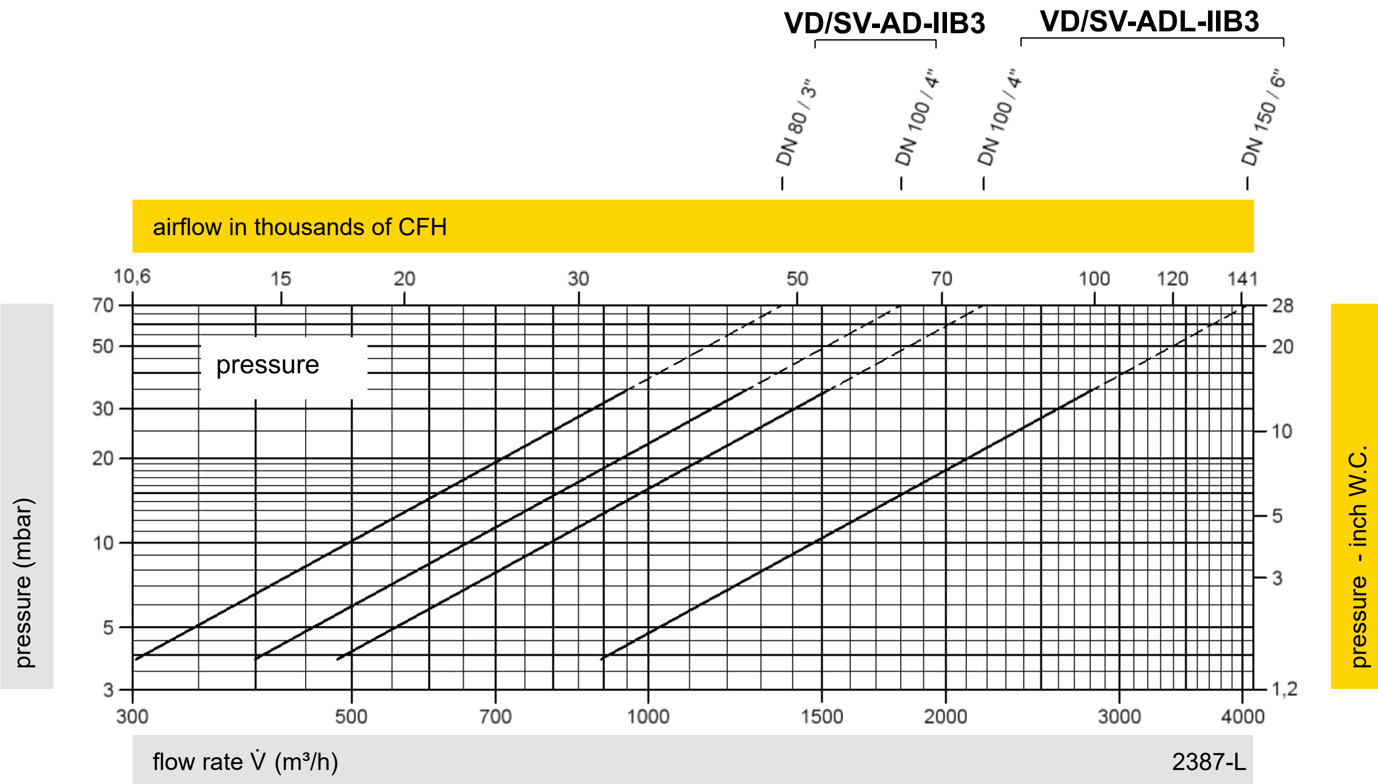
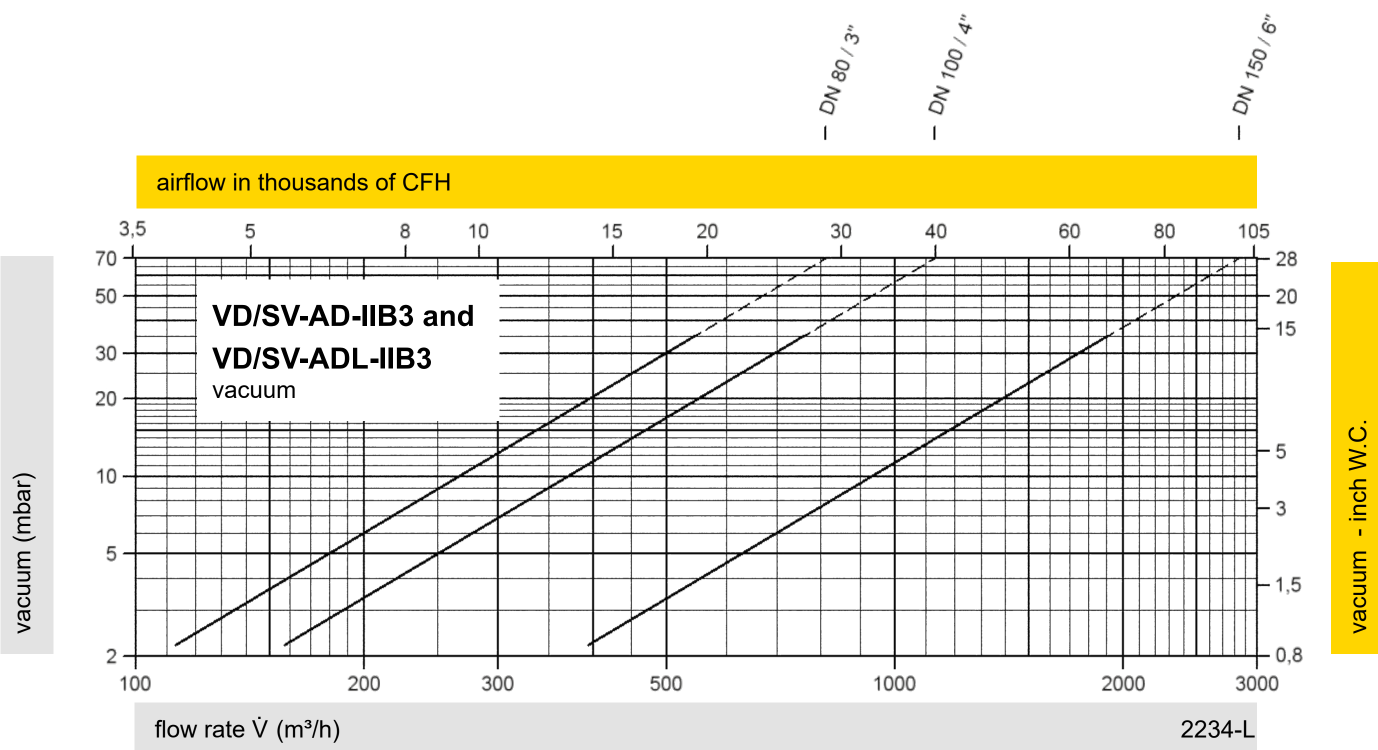
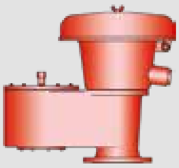




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

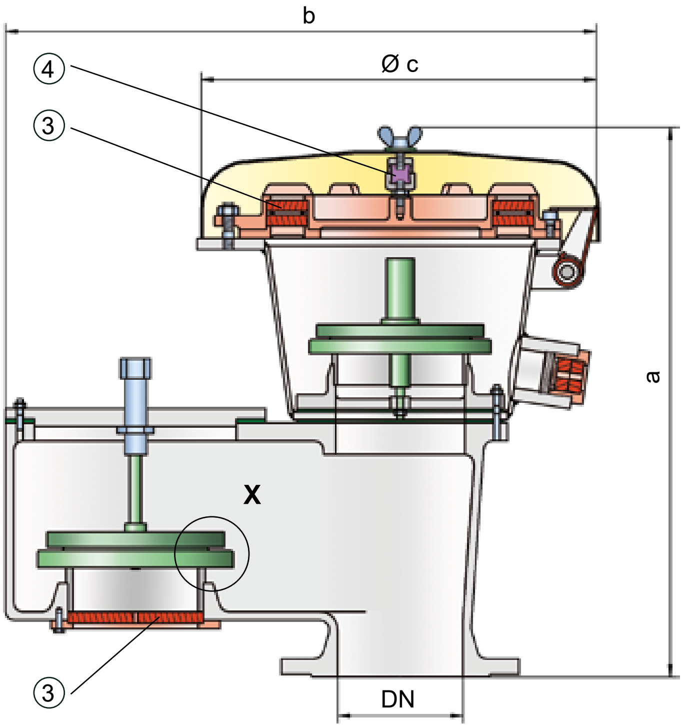
Notes:



Pressure/Vacuum Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® VD/SV-HR



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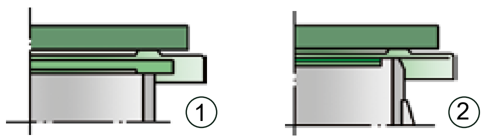

Settings:

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-breathing and out-breathing in tanks, containers, and process equipment. The valve offers reliable protection against overpressure and vacuum, prevents out-breathing of product vapor and in-breathing of air almost up to the set pressure, and 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 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 behavior (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 above the normal standards 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 them from sticking when sticky substances are used and to enable the use of corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- PROTEGO® flame arrester unit provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- high flow capacity due to larger FLAMEFILTER® cross section
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Design and Specifications

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

The valve pallets 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 page.

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
≥ 0,65 mm	IIB3	C

Special approvals upon request.

Table 3: Material selection for housing

Design	A	B
Housing	Steel	Stainless Steel
Valve seats	Stainless Steel	Stainless Steel
Gasket	PTFE	PTFE
Weather hood	Steel	Stainless Steel
Flame arrester unit	A	A

Special materials upon request.

Table 4: Material combination of flame arrester unit

Design	A
FLAMEFILTER® casing	Stainless Steel
FLAMEFILTER®	Stainless Steel

Special materials upon request.

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
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE

Special materials and higher set pressures upon request.

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
Valve pallet	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE

Special material and higher set vacuum upon request.

Table 7: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

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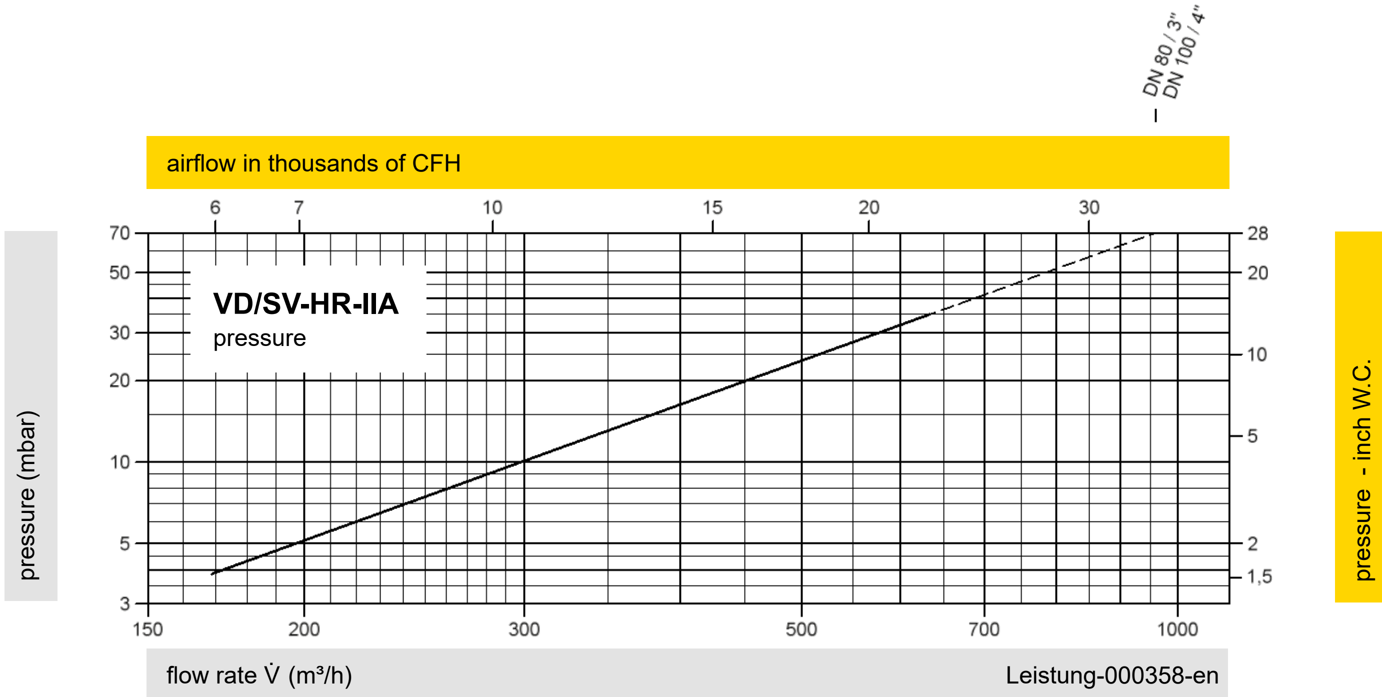
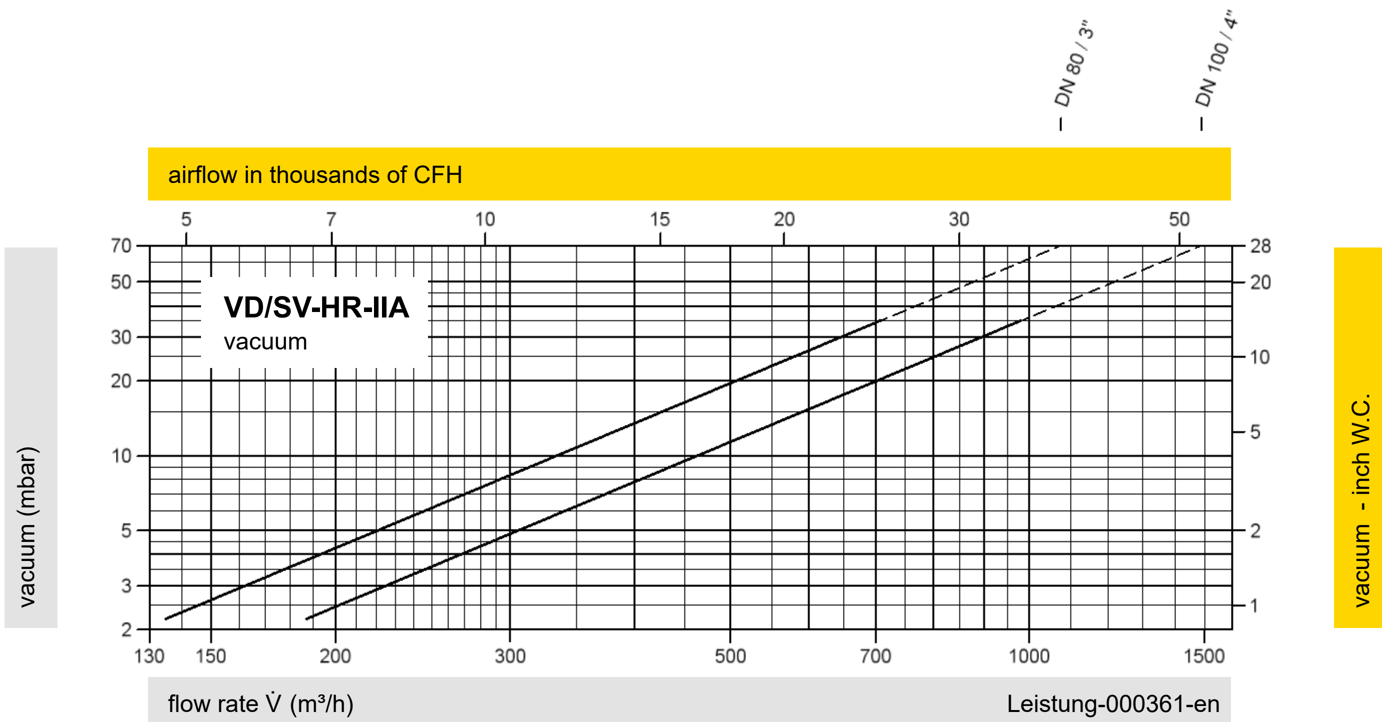
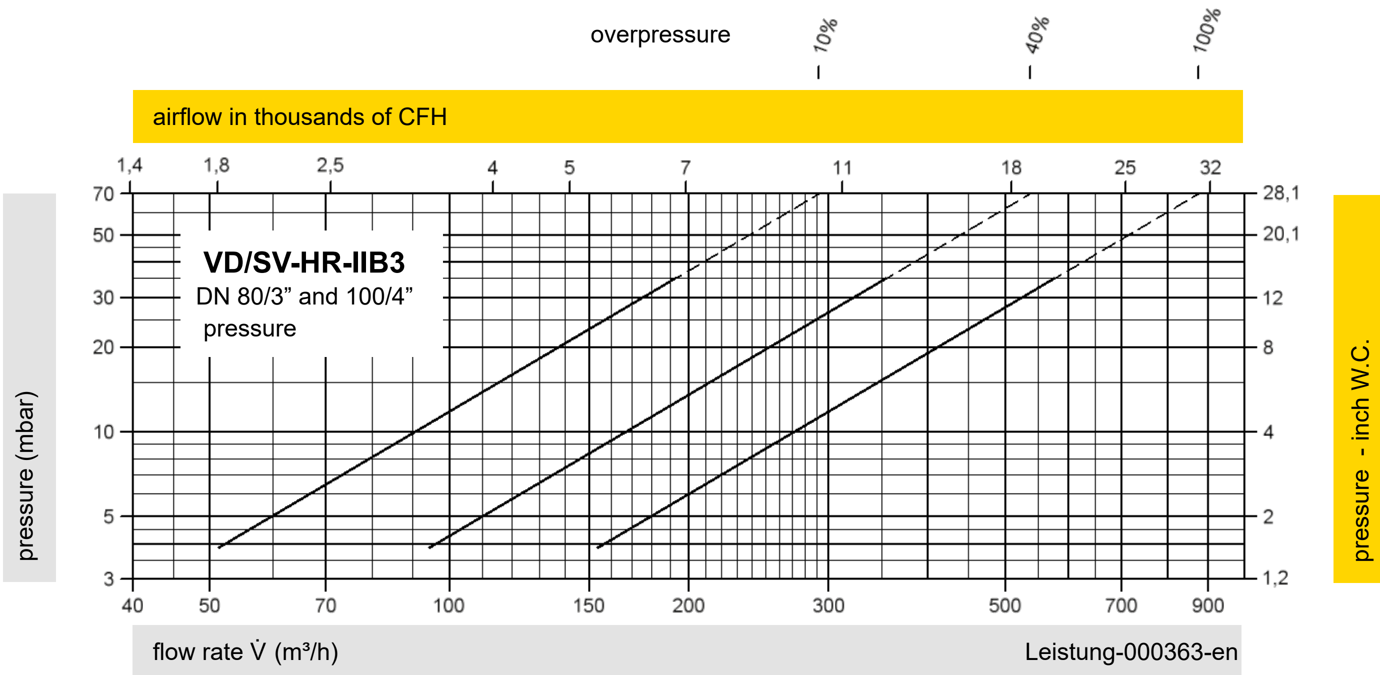




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."



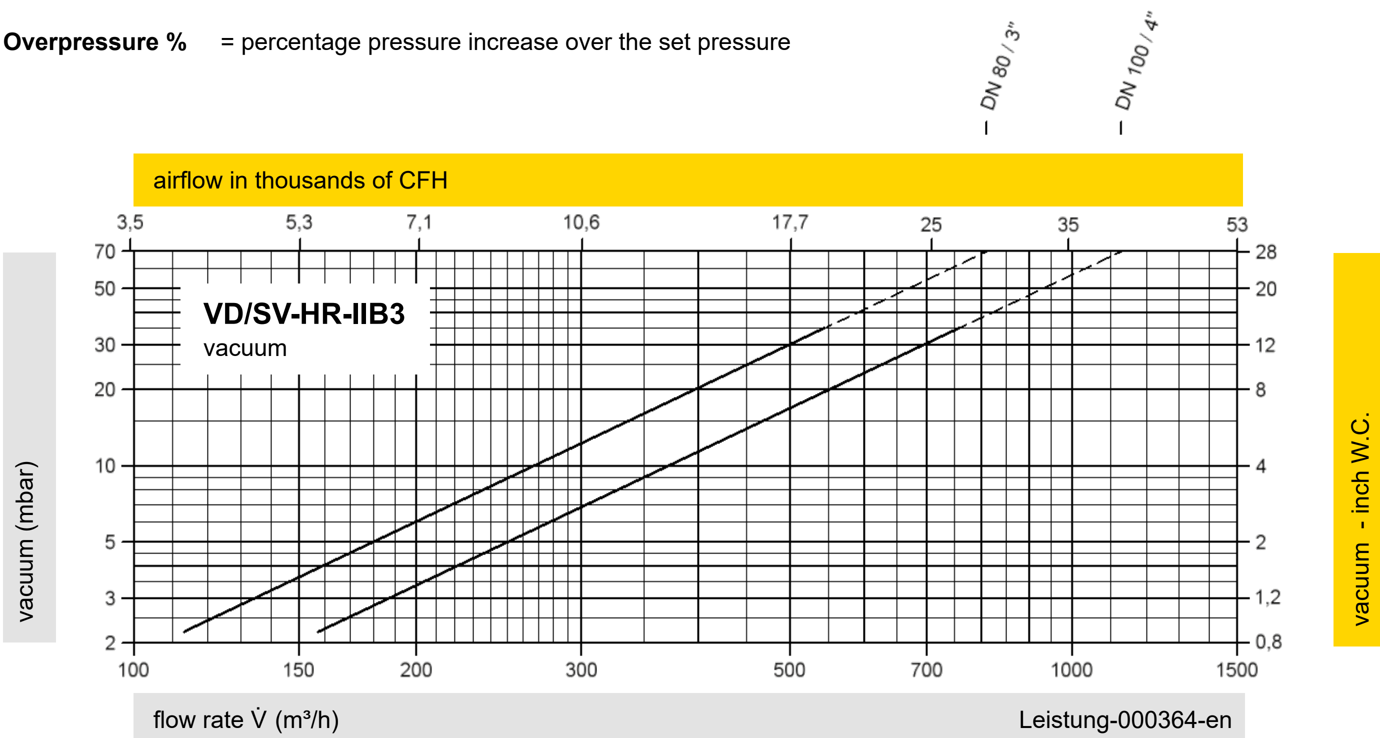
Remark

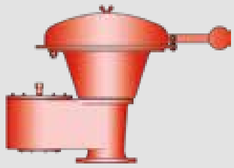
$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{1 + \frac{\text{overpressure }\%}{100\%}}$$

Set pressure = the valve starts to open

Opening pressure = set pressure plus overpressure

Overpressure % = percentage pressure increase over the set pressure

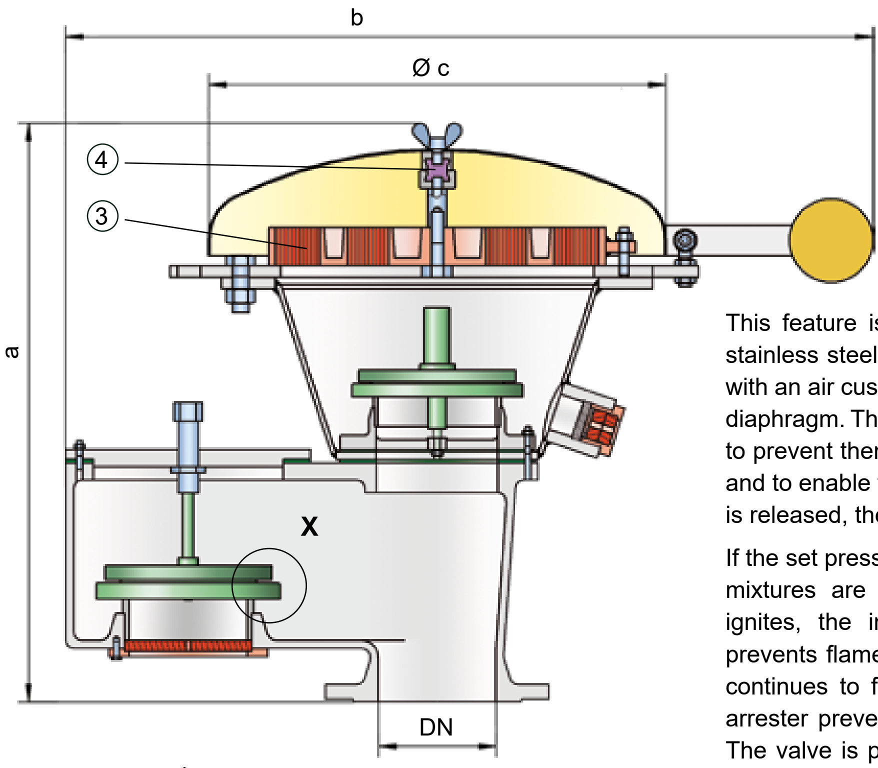




Pressure/Vacuum Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® VD/SV-HRL



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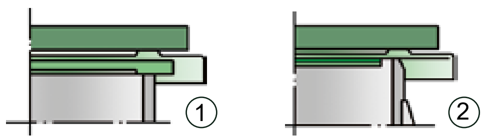

Settings:

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 atmospheric deflagration and endurance burning-proof VD/SV-HRL 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-breathing and out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and vacuum, prevents the in-breathing 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® flame 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 (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 above The normal standards due to our state-of-the-art manufacturing technology. This feature is ensured by valve seats made of high quality stainless steel and with individually lapped valve pallets (1), or with an air cushion seal (2), in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent them from sticking when sticky substances are used and to enable the use of corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 occurs, the integrated flame arrester prevents flashback as a result of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts. The valve can be used at an operating temperature of up to +60°C /140°F and meets the requirements of European tank design standard EN 14015 (Appendix L) and ISO 28300 (API 2000).

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- FLAMEFILTER® provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- high flow capacity due to large FLAMEFILTER® cross section

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet
- best technology for API tanks

Design and Specifications

Any combination of vacuum and pressure levels can be set for the valve. The valve pallets 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 flow capacity charts on the following page.

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	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® casing	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 materials and higher set pressures upon request.
Valve pallet	Aluminum	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 and higher set vacuum upon request.
Valve pallet	Aluminum	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 CL 150 R.F.	

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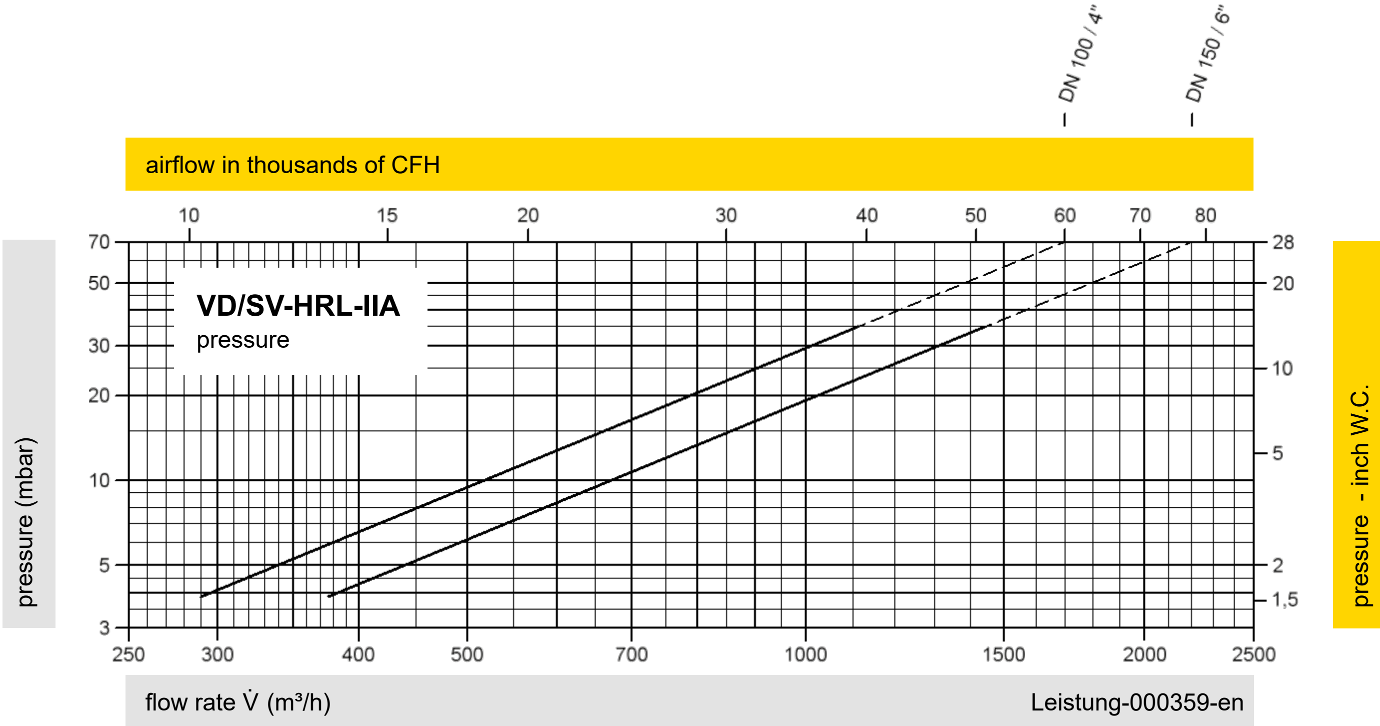
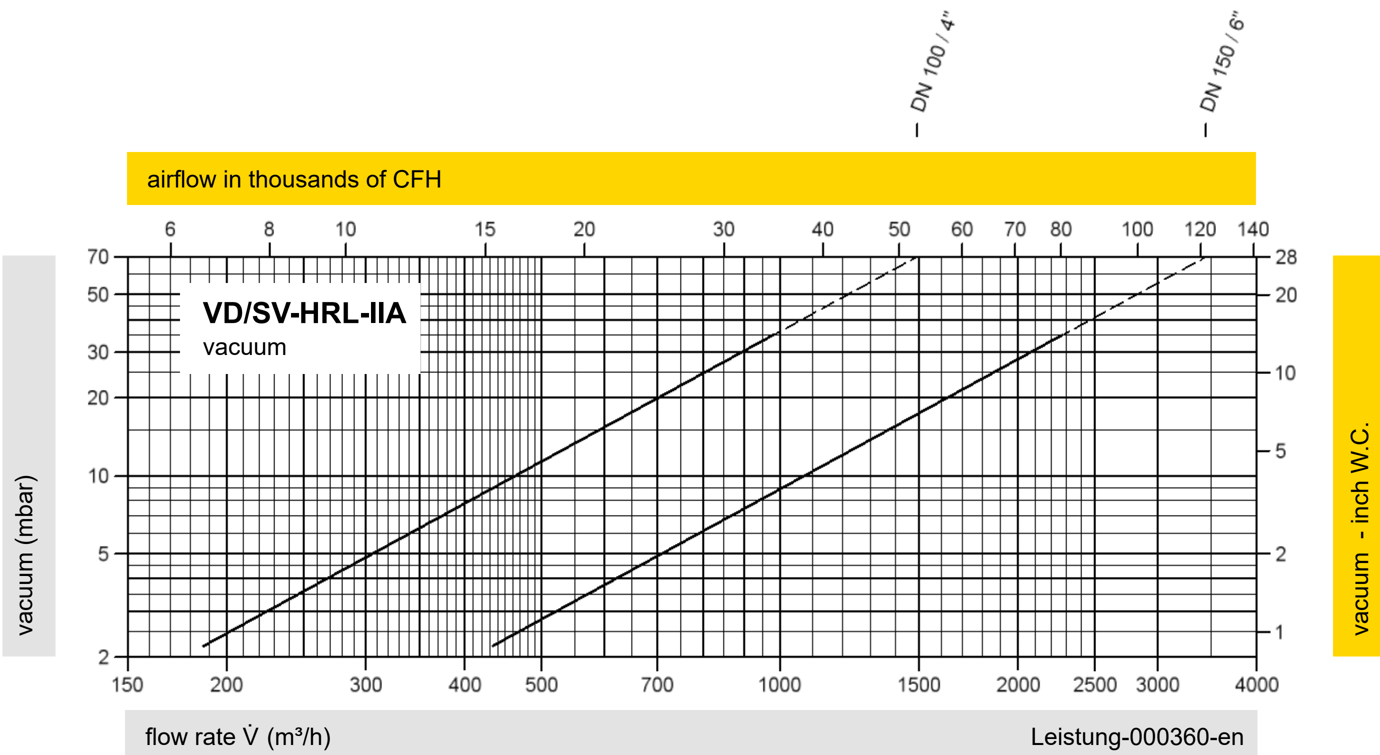
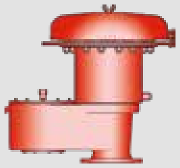
PROTEGO® VD/SV-HRL





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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

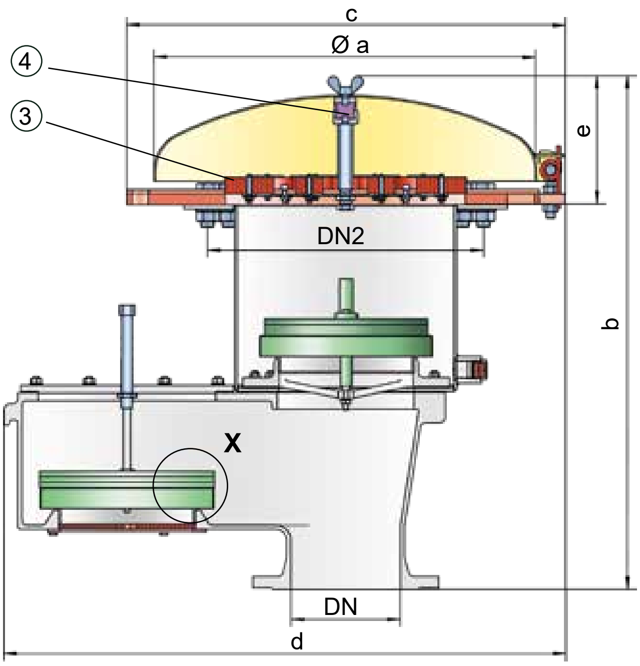
Notes:

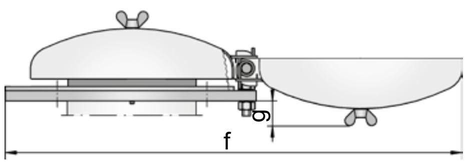


Pressure/Vacuum Relief Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® VD-SV-EB





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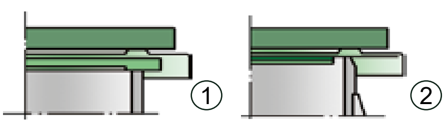

Settings:

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-breathing and out-breathing in tanks, containers, and process equipment. The valve offers reliable protection against over pressure and vacuum, prevents out-breathing of product vapor and in-breathing of air almost up to the set pressure, and 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 deflagration-proof and endurance burning-proof PROTEGO® VD-SV-EB device is available for substances from 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 above the normal standards due to our state-of-the-art manufacturing technology. This feature is ensured by valve seats made of high quality stainless steel and with individually lapped valve pallets (1), or with an air cushion seal (2), in conjunction with a high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent them from sticking when sticky substances are used and to enable the use in corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.
If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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 of endurance burning. The valve is protected and also fulfils its function under these severe conditions. The spring-loaded weather hood opens as soon as the melting element (4) melts.
The valve can be used at an operating temperature of up to +60°C / 140°F and meets the requirements of European tank design standard EN 14015 (Appendix L) and ISO 28300 (API 2000).

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift for explosion group IIA (NEC group D) vapours
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- valve opens later and closes earlier than conventional valves
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- FLAMEFILTER® provides protection against atmospheric deflagrations and endurance burning
- integrated PROTEGO® flame arrester unit saves space and weight and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky substances caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- high flow capacity due to large FLAMEFILTER® cross section
- flameproof condensate drain
- maintenance-friendly design
- modular design enables replacement of individual FLAMEFILTER® discs and valve pallet

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Demonstration of endurance burning
Video

Design and Specifications

Any combination of vacuum and pressure levels can be set for the valve.
The valve pallets 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	Special materials upon request.
Valve seats	Stainless Steel	Stainless Steel	
Gasket	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® casing	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	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	Metal to Metal	PTFE	PTFE

Special material and 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	Aluminum	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal	PTFE	Metal to Metal	PTFE

Special material and higher set vacuum upon request.

Table 7: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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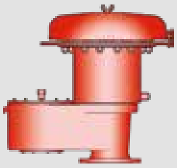
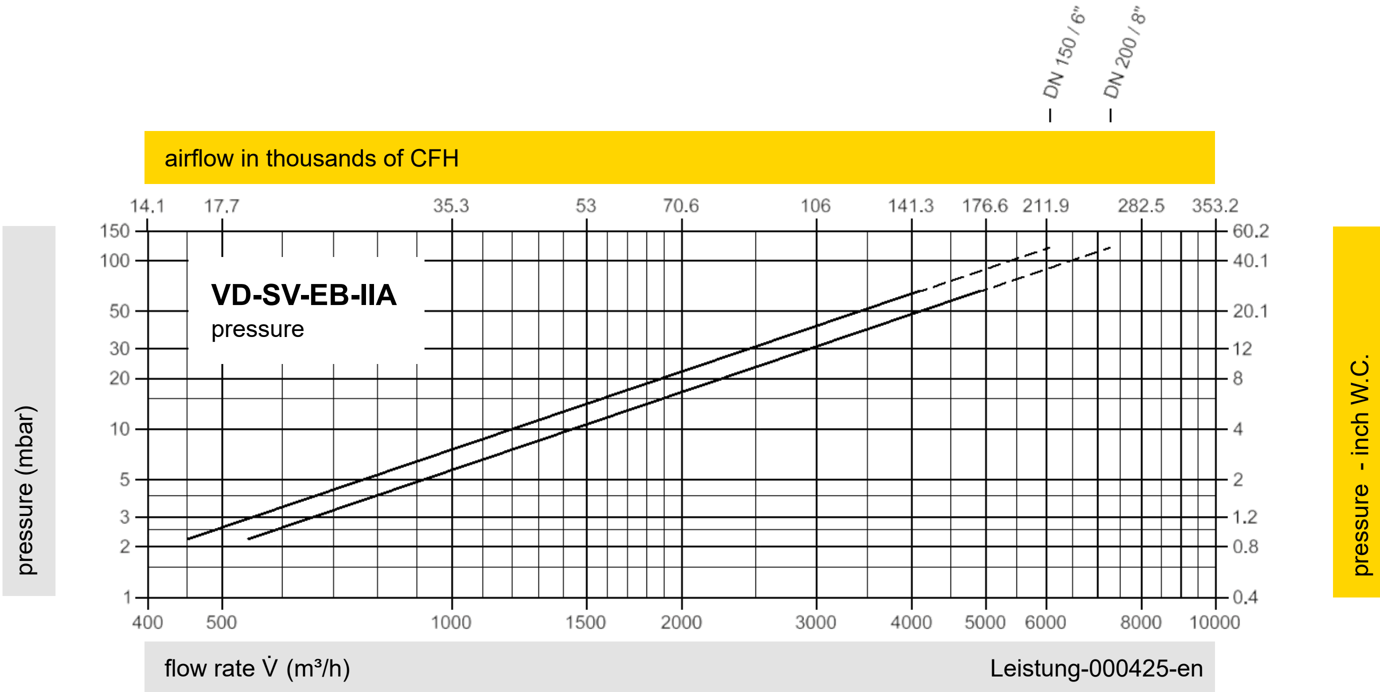
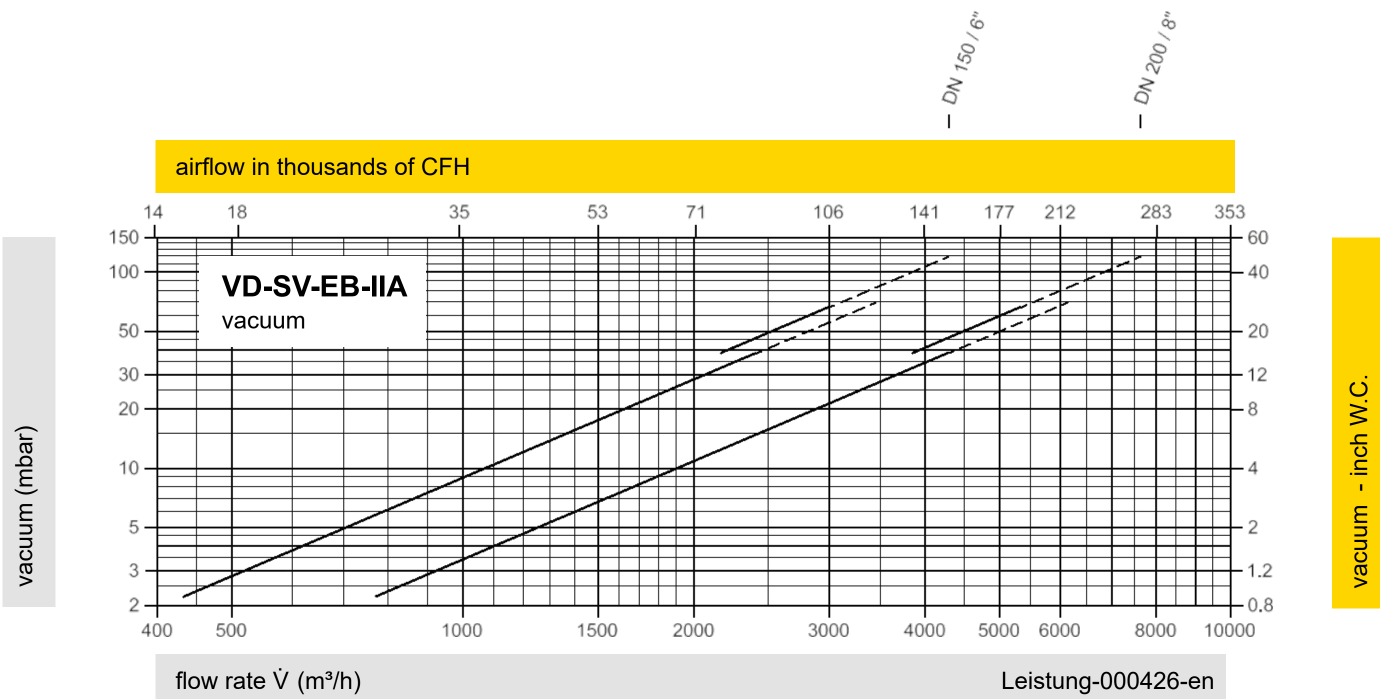


PROTEGO® VD-SV-EB-IIA

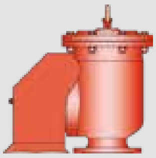




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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

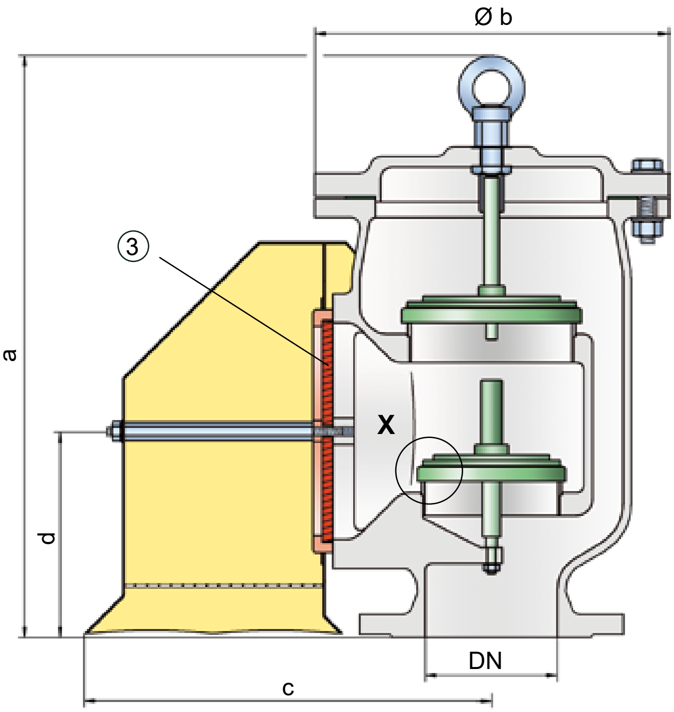
Notes:



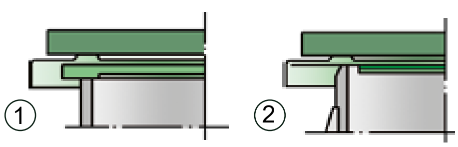
Pressure/Vacuum Relief Valve

Atmospheric Deflagration-proof

PROTEGO® VD/TS



Detail **X**



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-breathing and out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure and vacuum, prevents the in-breathing of air and product losses almost up to the set pressure, and 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 above the normal standards due to our state-of-the-art manufacturing technology. This feature is ensured by valve seats made of high quality stainless steel and with individually lapped valve pallets (1), or with an air cushion seal (2), in conjunction with high quality FEP diaphragm. The valve pallets are also available with a PTFE seal to prevent them from sticking when sticky substances are used and to enable the use of corrosive fluids. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into 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.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- due to 10% technology, set pressure is close to opening pressure for optimum pressure maintenance in the system as compared to conventional 40% or 100% technology
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- FLAMEFILTER® provides protection against atmospheric deflagrations
- integrated flame arrester unit saves space and reduces costs
- PROTEGO® flame arrester unit is protected from clogging and sticky products caused by product vapors
- minimum pressure loss of the PROTEGO® flame arrester unit
- high flow capacity
- maintenance-friendly design
- sturdy housing design
- best possible technology for API tanks

Design and Specifications

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

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

Additional special devices available upon request.

P/V-Valve with integrated Flame Arrester
Many traditional configurations are a safety risk. (Flyer pdf)

Safety Risk
(Video)

P/V-Valve with integrated Flame Arrester (Video)

Vents - 10% Technology
(Flyer pdf)

Leak Rate/10% Technology
(Flyer pdf)

Table 1: Dimensions — Dimensions in mm / inches

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

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)	Special approvals upon request.
≥ 0,65 mm	IIB3	C	

Table 3: Specification of max. operating temperature

≤ 60°C / 140°F	Tmaximum allowable operating temperature in °C	Higher operating temperatures upon request.
-	Classification	

Table 4: Material selection for housing

Design	A	C	D	E
Housing	Aluminum	Steel	Stainless Steel	Hastelloy
Valve seats	Stainless Steel	Stainless Steel	Stainless Steel	Hastelloy
Gasket	PTFE	PTFE	PTFE	PTFE
Weather hood	Stainless Steel	Stainless Steel	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	Special materials upon request.
FLAMEFILTER® casing	Stainless Steel	Hastelloy	
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	Aluminum	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 and higher set pressure upon request.

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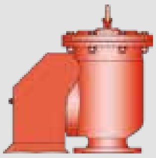


Pressure/Vacuum Relief Valve

Atmospheric Deflagration-proof

PROTEGO® VD/TS

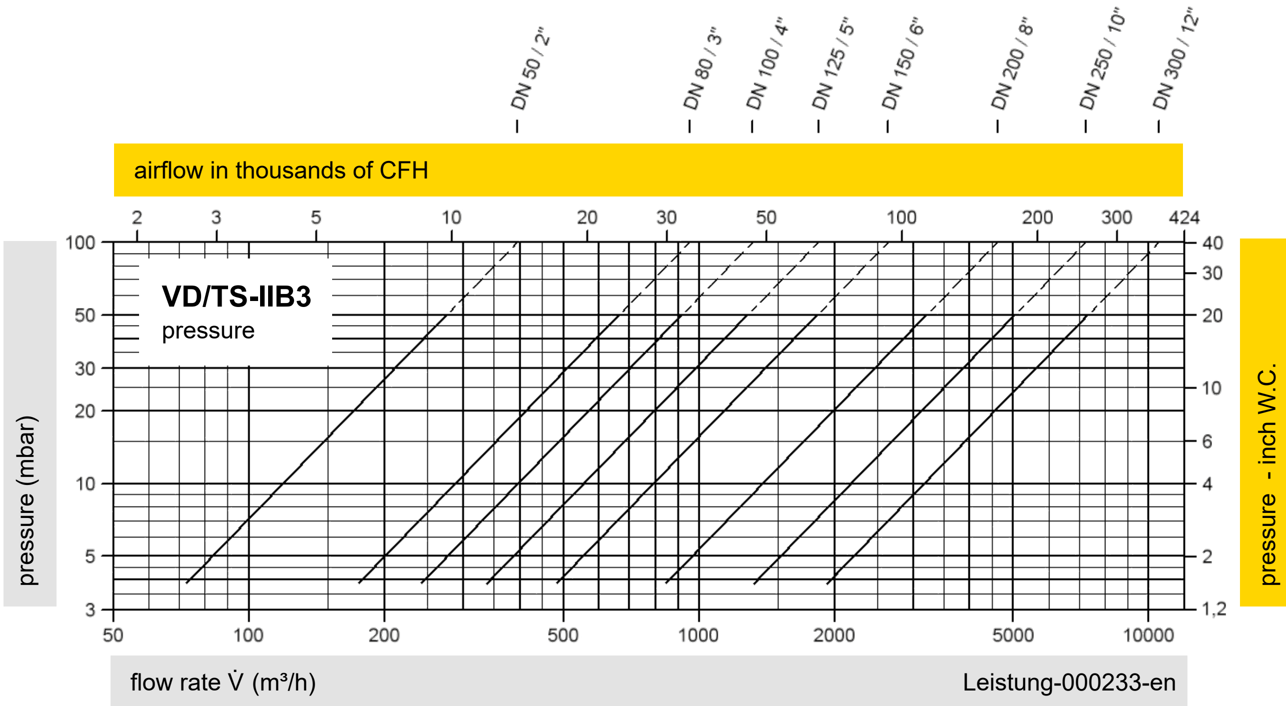
Table 7: Material selection for vacuum pallet

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	Aluminum	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

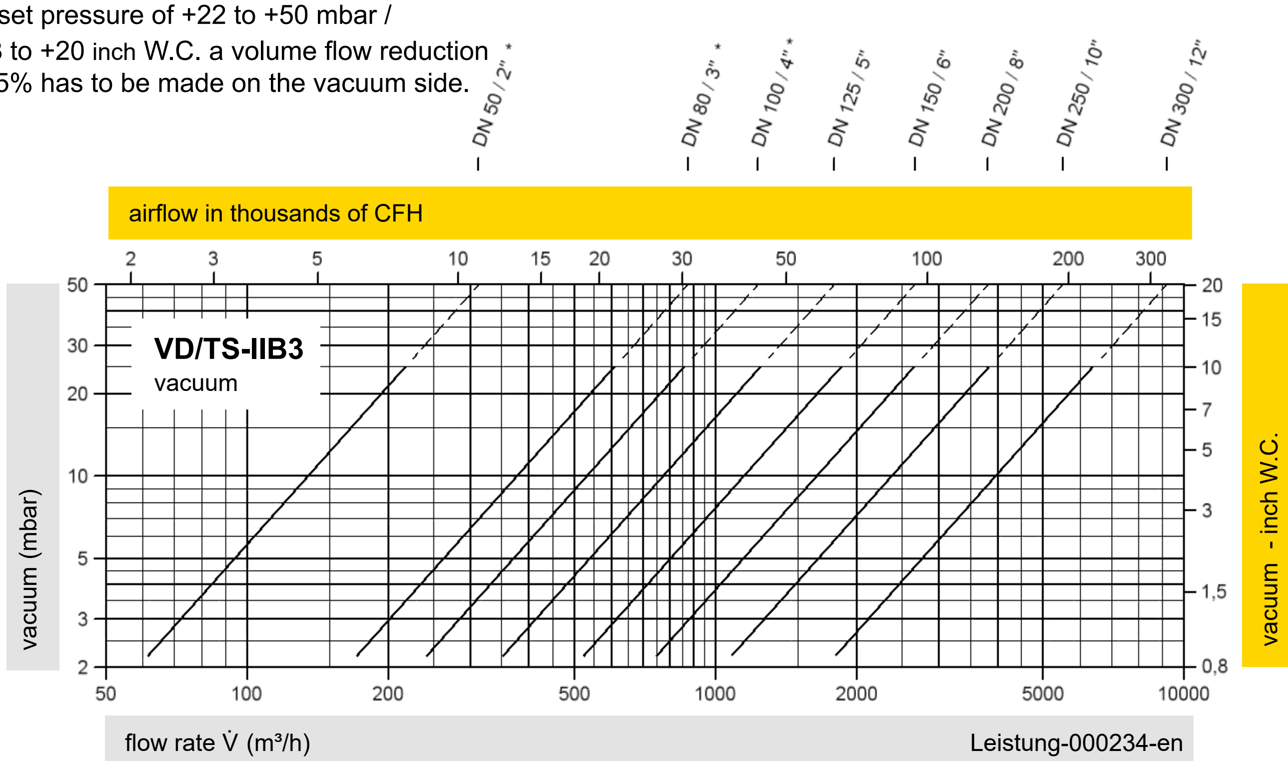
Design	G	H	
Vacuum range (mbar) (inch W.C.)	<-3.5 up to -14 <-1.4 up to -5.6	<-14 up to -25 <-5.6 up to -10	Special material and higher set vacuum upon request.
Valve pallet	Hastelloy	Hastelloy	
Sealing	FEP	Metal to Metal	
Weight	Hastelloy	Hastelloy	

Table 8: Flange connection type

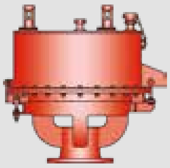
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	



* 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.



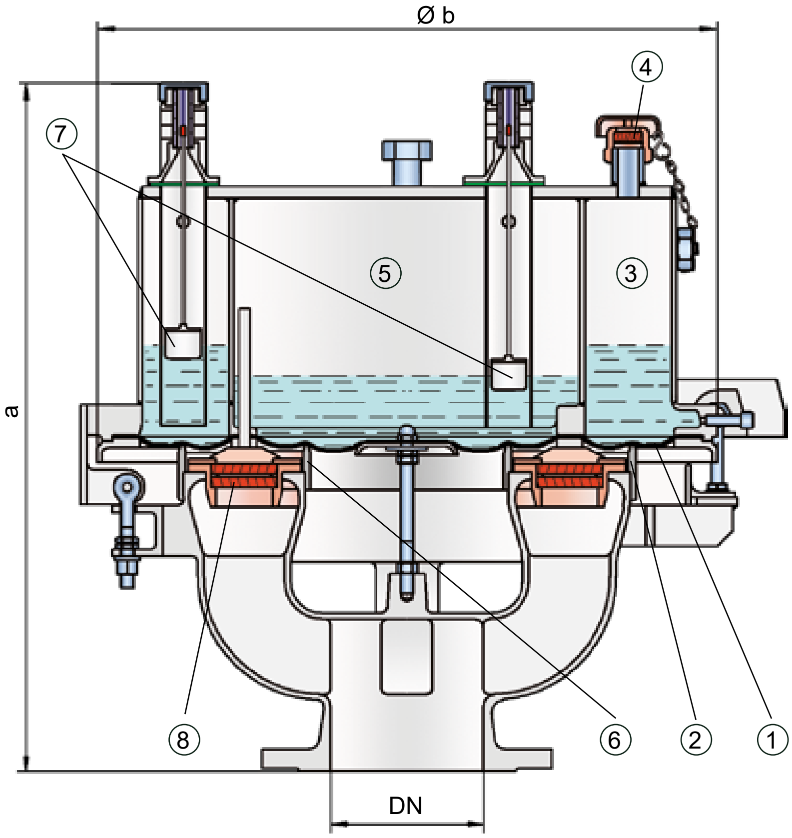
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."



Pressure/Vacuum Diaphragm Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® UB/SF



The set pressure is adjusted with a freeze resistant water-glycol mixture which ensures safe operation under extreme cold weather conditions. The PROTEGO® UB/SF valve is available for substances from explosion group IIB3. When the pressure in the tank reaches the set pressure, the diaphragm (1) on the outer valve seat ring (2) is lifted and vapors are released into environment. The set pressure is adjusted by weight of the liquid load (water-glycol mixture) in the outer ring chamber (3). The overpressure chamber is equipped with an opening (4) to keep the pressure in balance. The opening is equipped with a FLAMEFILTER® to prevent flame transmission into the overpressure chamber. If a vacuum builds up in the tank, it is transferred to the vacuum chamber (5) (inner chamber) through pressure balancing tubes. If the set vacuum is reached, the atmospheric pressure lifts the diaphragm of the inner valve seat ring (6), resulting in ventilation of the tank. Both the overpressure and underpressure are adjusted via the filling level of the load liquid in the various chambers and can be checked by floating level indicators (7).

The tank pressure is maintained up to the set pressure with a tightness that is above the normal standards due to our highly developed manufacturing technology. This is achieved by the liquid loaded diaphragm pressing tightly around the special designed valve seat surface area even when the operating pressure increases, which reduces surface pressure and unnecessary leakage. After the overpressure is released, the valve re-seats and provides a tight seal.

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 vacuum settings upon request.

Function and Description

The PROTEGO® UB/SF diaphragm valve is the only deflagration-proof and endurance burning-proof valve of its kind in the world. It is a highly developed combined pressure and vacuum valve with dynamic and static flame arrester. It is primarily used as a safety device for flame transmission-proof in-breathing and out-breathing on tanks, containers, and process equipment. The valve provides reliable protection against overpressure and vacuum, prevents the in-breathing 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 itself over many years under a wide variety of operating conditions in the mineral oil and chemical industries. Worldwide, it is the only vent which works reliably with problem products such as Styrene or Acrylates.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into the atmosphere. The speed at which these mixtures exit the annular gap between the diaphragm and the outer valve seat ring is considerably greater 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 a flashback, even in the case of endurance burning. Even at relatively low flow rates, e.g., during thermal out-breathing, the gap formed by the volumetric flow is so narrow, that flames in the gap are extinguished and a 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. The ignition into the tank can be prevented by installing the PROTEGO® flame arrester unit (8). This PROTEGO® flame arrester unit provides additional protection against atmospheric deflagration when the valve is open for maintenance and inspection.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

UB/SF-IIB3
(Flyer pdf)

Frost-Proof P/V Diaphragm
Valve (Video)

Special Features and Advantages

- excellent tightness, resulting in lowest possible product losses and environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- protection against atmospheric deflagrations and endurance burning for products up to explosion group IIB3 (NEC group C MESG ≥ 0.65 mm)
- minimum pressure loss of the PROTEGO® flame arrester unit
- flame arrester venting and ventilation of the pressurized chamber
- optimal frost protection
- automatic condensate drain
- monitoring of the load liquid by level indicator
- easy operation monitoring and maintenance by simply opening the hinged valve cap
- modular design enables replacement of individual FLAMEFILTER® discs and diaphragm
- particularly suitable for problematic products such as styrene, acrylates, etc.

Design Types and Specifications

The valve can be combined with almost any combination of vacuum and pressure settings. The diaphragm is pressurized by liquid. Higher pressures are available upon request in a special version with an additional attachment. 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 -** $\boxed{-}$

Pressure/vacuum diaphragm valve with heating coil **UB/SF -** $\boxed{\mathbf{H}}$
(max. heating fluid temperature +85°C / 185°F)

In addition to the standard design, a series of specially developed designs (e.g., for acrylate or styrene storage tanks, etc.) can be provided upon request.

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 page.

DN	pressure	80 / 3"	pressure	100 / 4"	pressure	150 / 6"
a	up to +28 mbar / +11.2 inch W.C.	615 / 24.21	up to +28 mbar / +11.2 inch W.C.	645 / 25.39	up to +25 mbar / +10 inch W.C.	680 / 26.77
a	> +28 mbar / +11.2 inch W.C.	765 / 30.12	> +28 mbar / +11.2 inch W.C.	795 / 31.30	> +25 mbar / +10 inch W.C.	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)	
≥ 0,65 mm	IIB3	C	Special approvals upon request.

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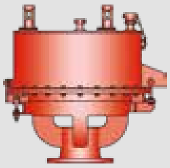


Pressure/Vacuum Diaphragm Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® UB/SF

Table 3: Material selection for housing

Design	C	D
Housing	Steel	Stainless Steel
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

The housings are also available with an ECTFE coating.

Special materials upon request.

Coated Devices
(Flyer pdf)

Table 4: Material selection for diaphragm

Design	A	B
Diaphragm	FPM	FEP

Special materials upon request.

Table 5: Material combinations of flame arrester unit

Design	C
FLAMEFILTER® casing	Stainless Steel
FLAMEFILTER®	Stainless Steel
Spacer	Stainless Steel

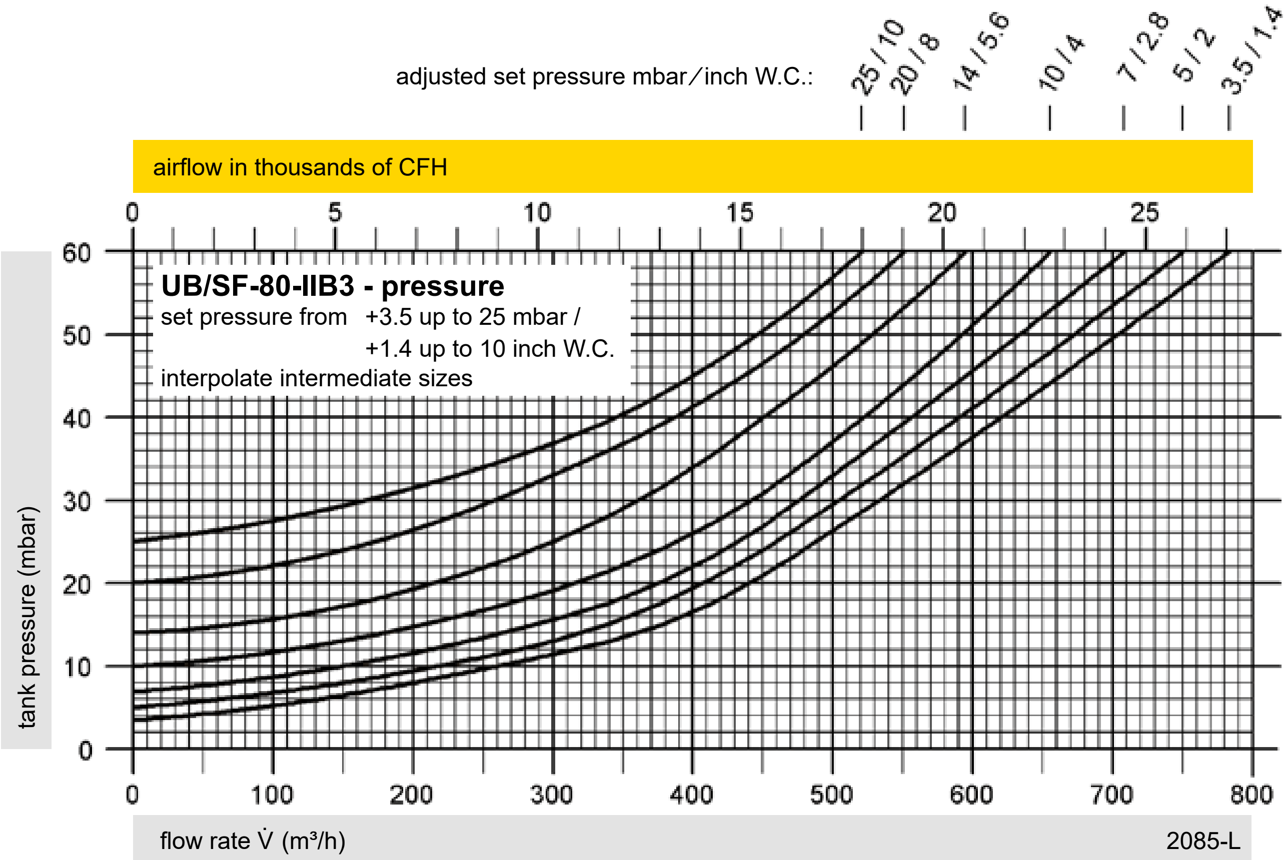
Special materials upon request.

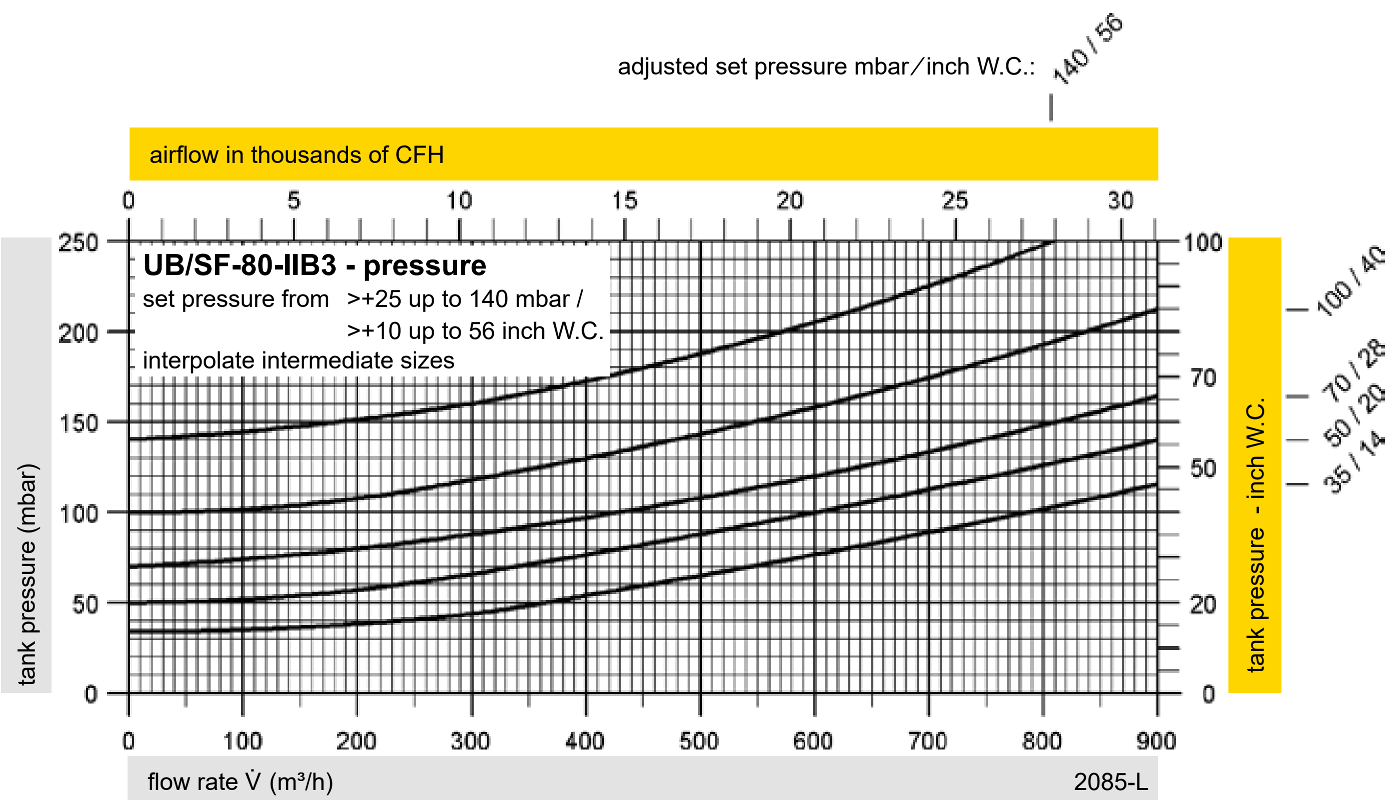
Table 6: Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

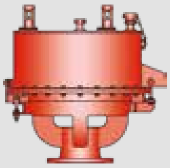
PROTEGO® UB/SF-80





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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

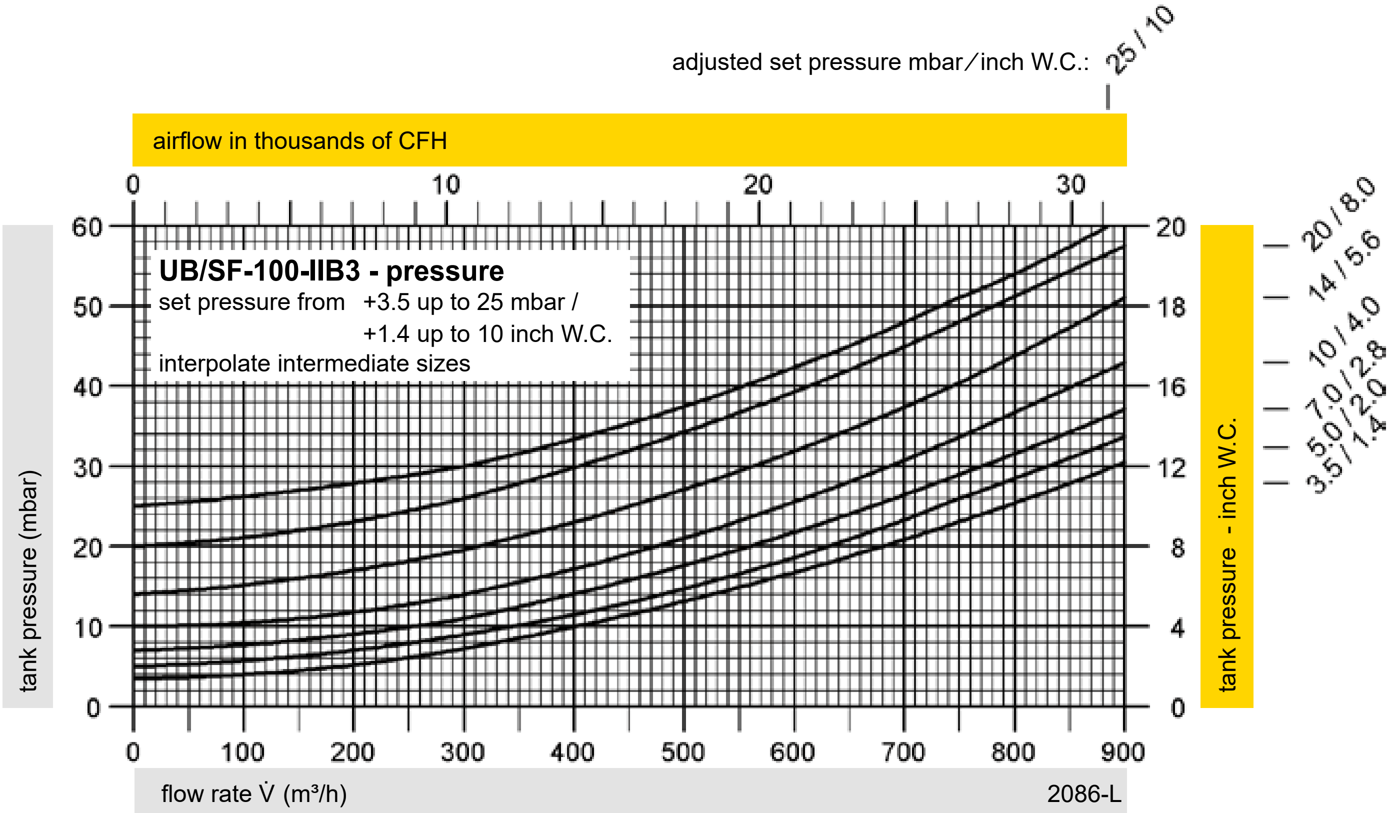
PROTEGO
for safety and environment

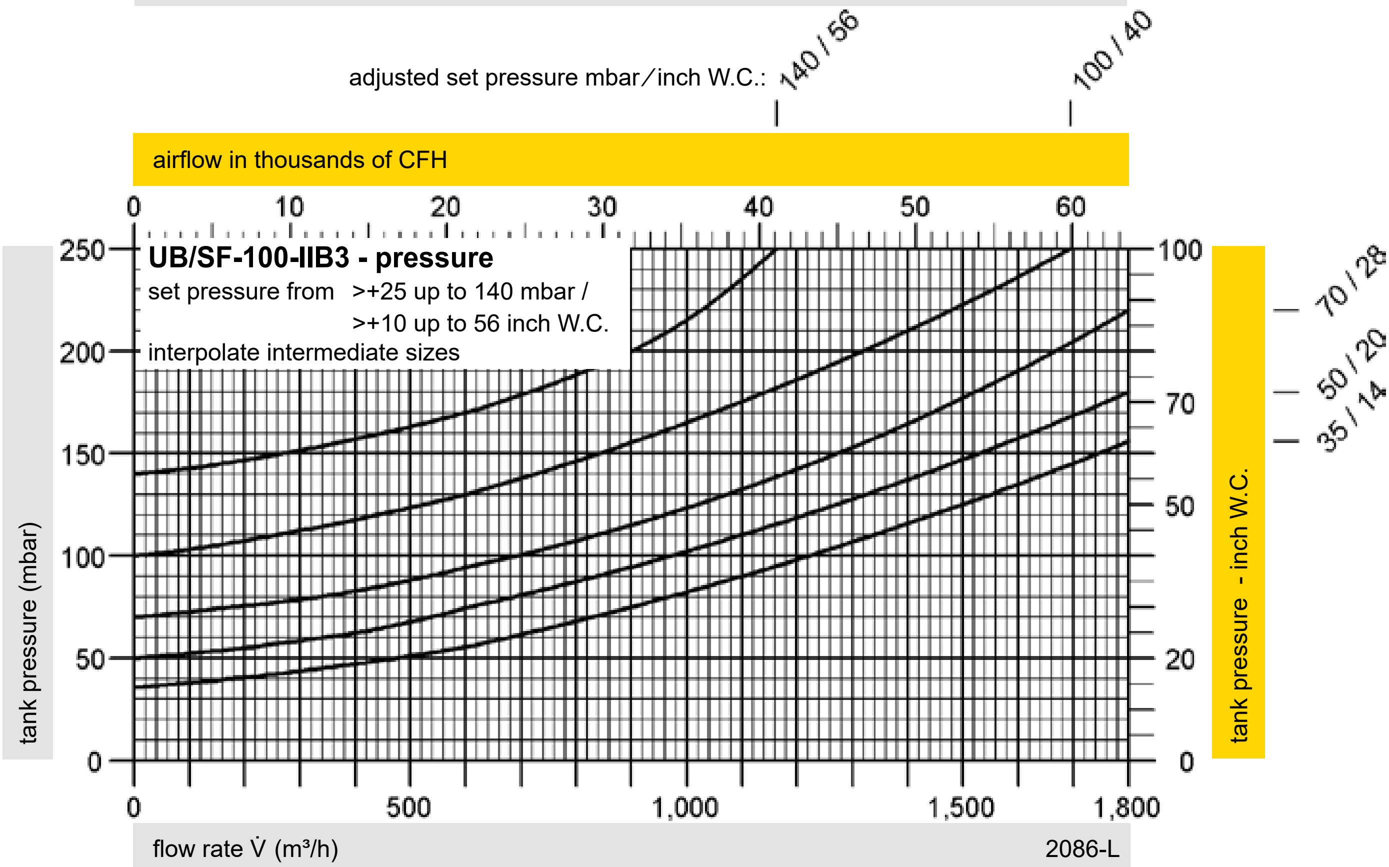


Pressure/Vacuum Diaphragm Valve

Flow Capacity Charts - Pressure

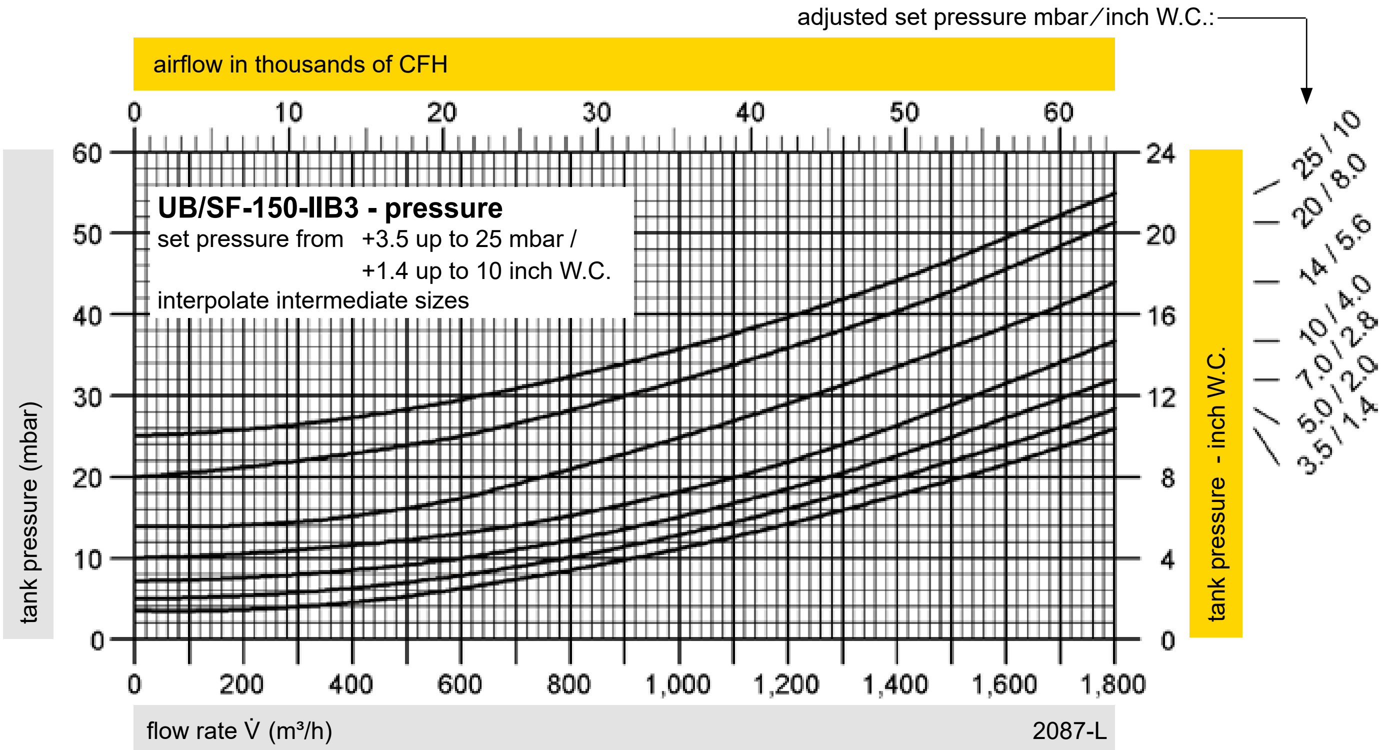
PROTEGO® UB/SF-100

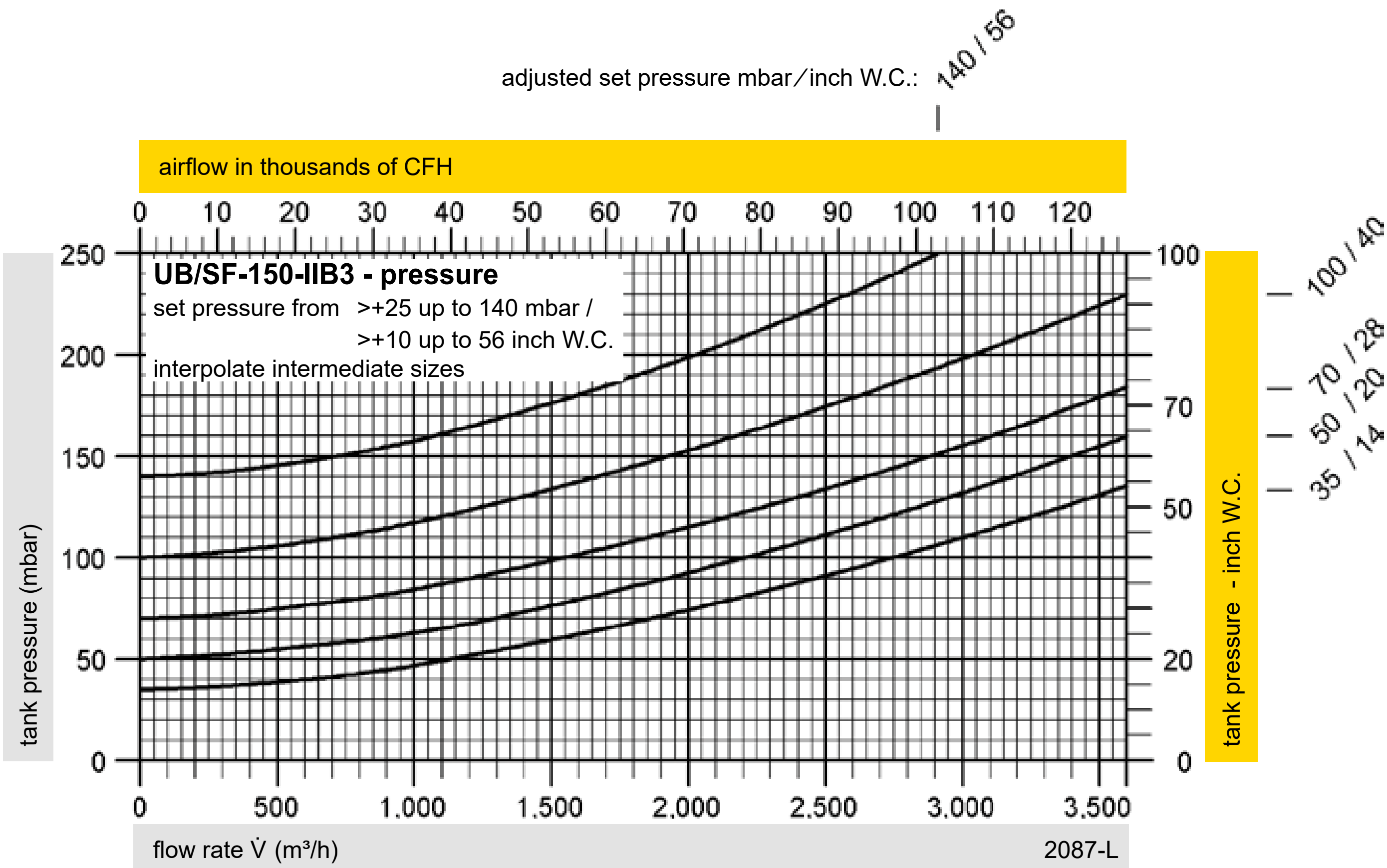


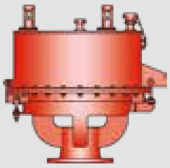


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

PROTEGO® UB/SF-150



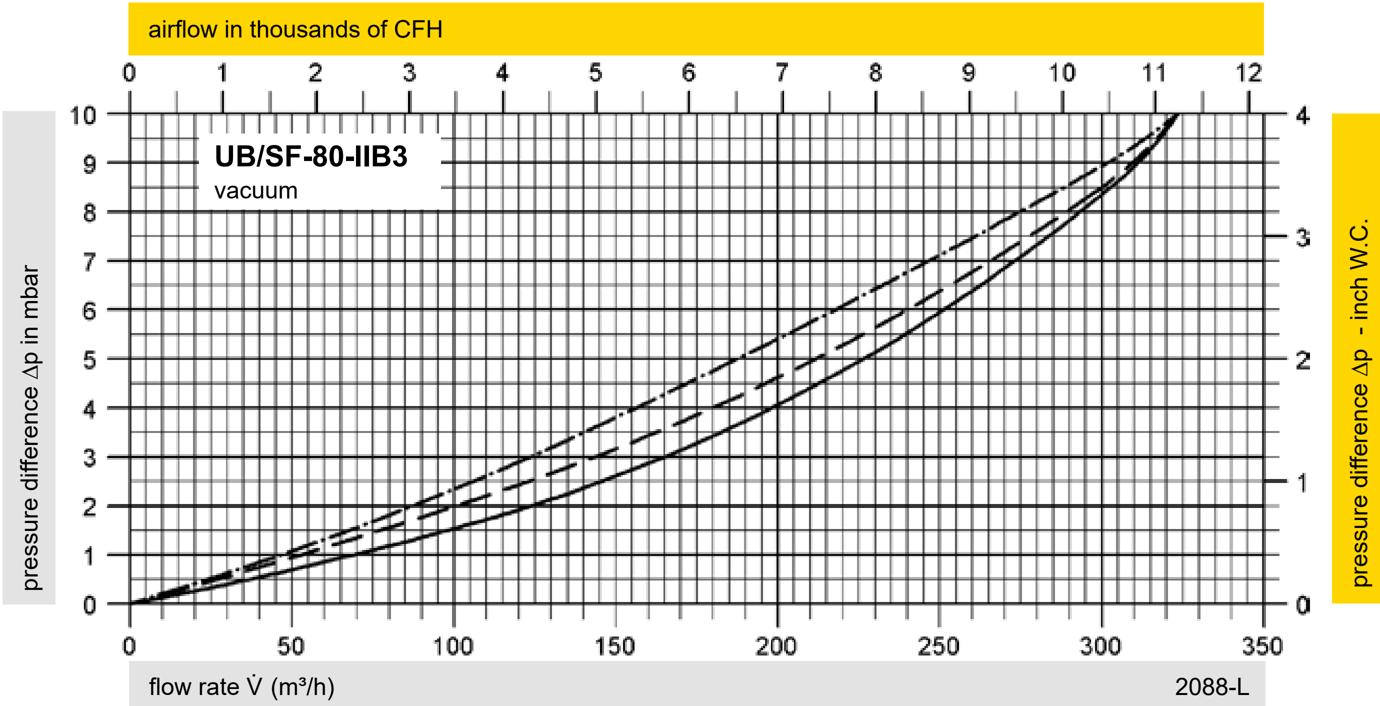




Pressure/Vacuum Diaphragm Valve

Flow Capacity Charts - Vacuum

PROTEGO® UB/SF-80 and 100



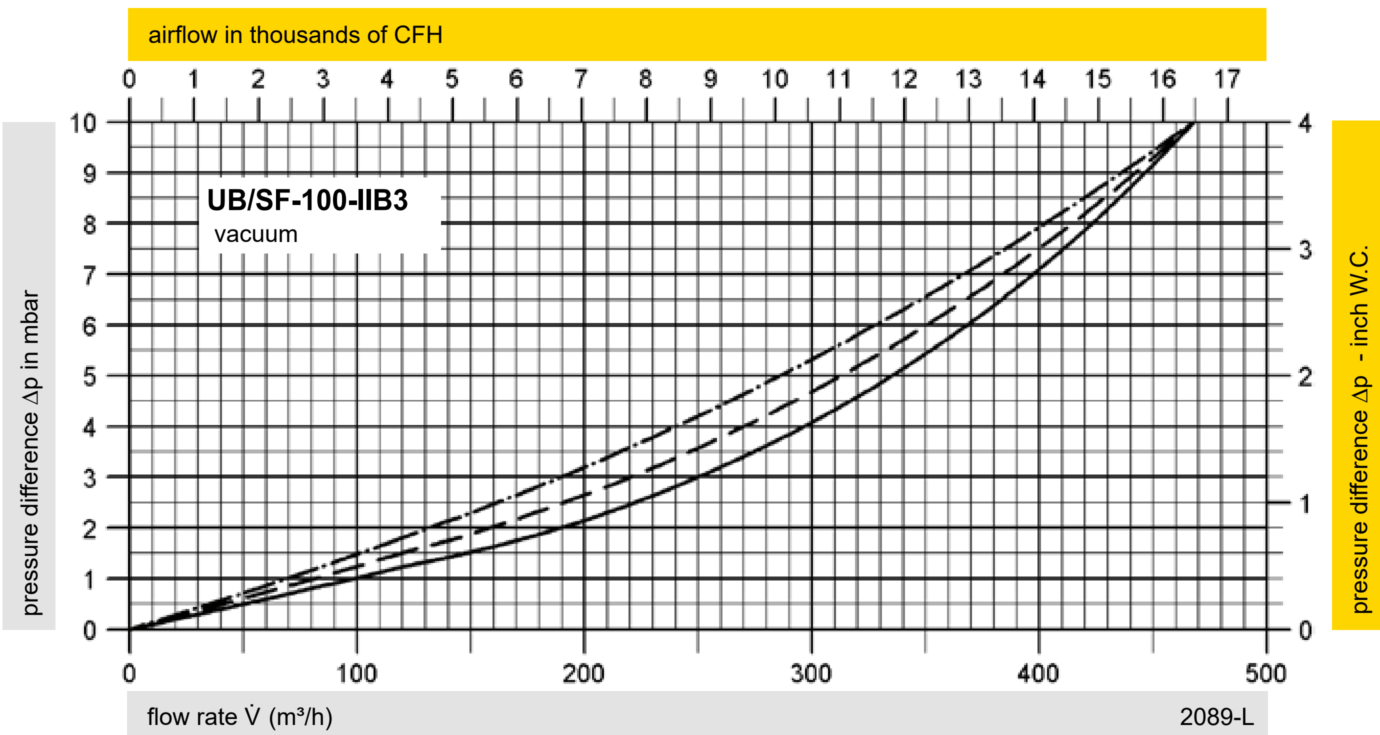
pressure difference = max. allowable tank design vacuum - valve set vacuum

adjusted set vacuum:

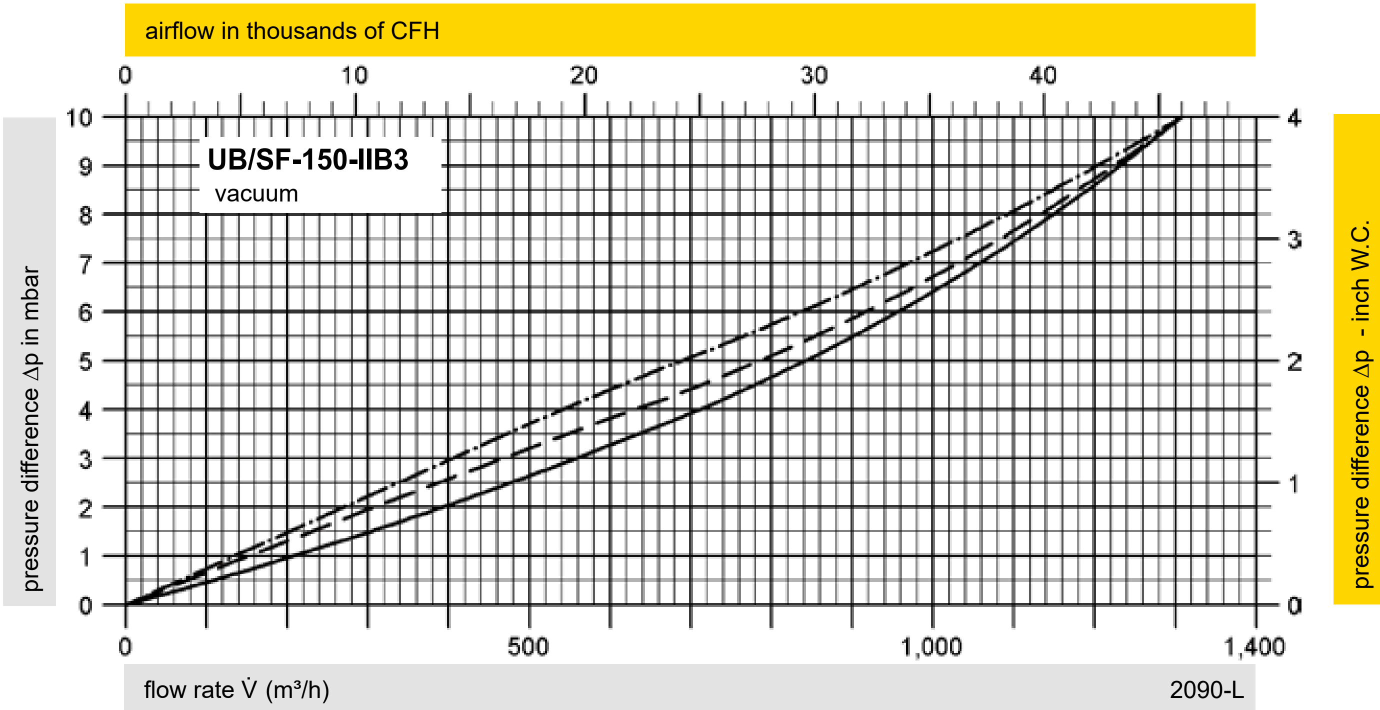
≤ -5 mbar / ≤ -2 inch W.C.

> -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.



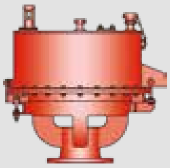
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”



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

adjusted set vacuum:

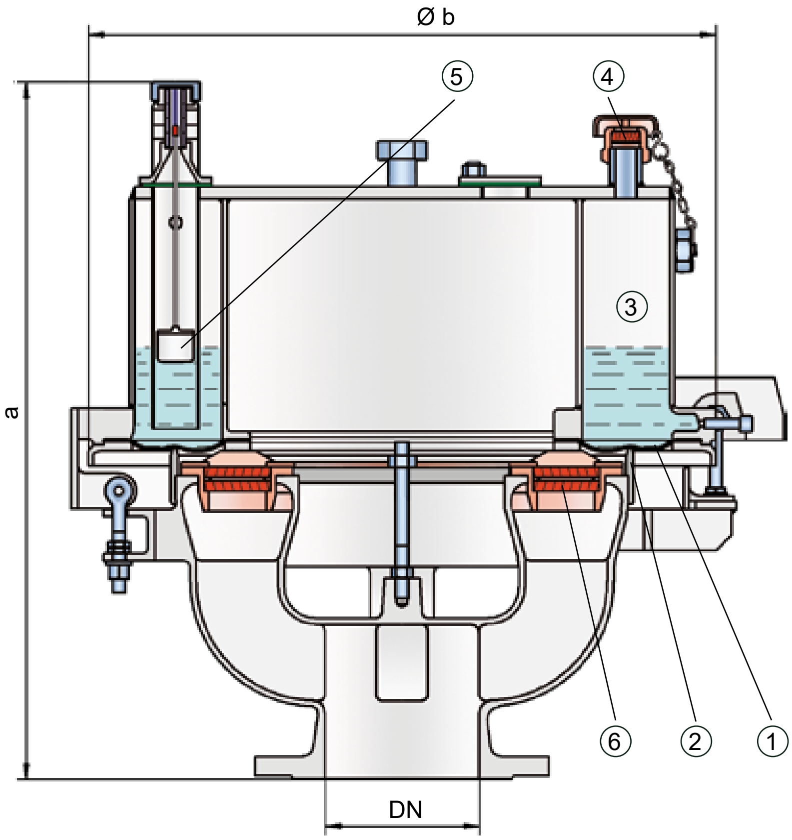
- ≤ -5 mbar / ≤ -2 inch W.C.
- > -5 mbar up to ≤ -7 mbar / > -2 inch W.C. up to ≤ -2.8 inch W.C.
- > -7 mbar up to ≤ -35 mbar / > -2.8 inch W.C. up to ≤ -14 inch W.C.



Pressure Diaphragm Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® UB/DF



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 attachment and lower pressure settings upon request.

Function and Description

The PROTEGO® UB/DF diaphragm valve is a worldwide unique deflagration-proof and endurance burning-proof pressure relief valve combining the function of a dynamic and static flame arrester. It is primarily used as a safety device for flame transmission-proof out-breathing on tanks, containers, and process equipment. The valve offers reliable protection against overpressure, prevents the in-breathing 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 itself over many years under a wide variety of operating conditions in the mineral oil and chemical industries. The set pressure is adjusted with a freeze resistant water-glycol mixture which ensures safe operation under extreme cold weather conditions. The PROTEGO® UB/DF valve is available for substances from 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 vapors are released into the environment. The set pressure is adjusted by the weight of the liquid load (water-glycol mixture) in the outer ring chamber (3). The overpressure chamber is equipped with an opening (4) to keep the pressure in balance. The opening is equipped with a FLAMEFILTER® to prevent flame transmission into the overpressure chamber. The overpressure setting is determined by the filling level of the loading liquid and can be adjusted by a floating level indicator (5).

The tank pressure is maintained up to the set pressure with a tightness that is above the normal standards due to our highly developed manufacturing technology. This is achieved by the liquid loaded diaphragm pressing tightly around the special designed valve seat surface area even when the operating pressure increases, which reduces surface pressure and unnecessary leakage. After the overpressure is released, the valve re-seats and provides a tight seal.

If the set pressure is exceeded, explosive gas/product vapor/air mixtures are released into the atmosphere. The speed at which these mixtures exit the annular gap between the diaphragm and the outer valve seat ring is considerably greater 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, even in the case of endurance burning. Even at relatively low flow rates, e.g., during thermal out-breathing, the gap formed by the volumetric flow is so narrow, that flames in the gap are extinguished, and a 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. The ignition into the tank can be prevented by installing the PROTEGO® flame arrester unit (8). This PROTEGO® flame arrester unit provides additional protection against atmospheric deflagration when the valve is open for maintenance and inspection.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Frost-Proof P/V Diaphragm
Valve (Video)

Special Features and Advantages

- excellent tightness, resulting in lowest possible product losses and environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- protection against atmospheric deflagrations and endurance burning for products up to explosion group IIB3 (NEC group C MESG ≥ 0.65 mm)
- minimum pressure loss of the PROTEGO® flame arrester unit
- flame arrester venting and ventilation of the pressurized chamber
- optimal frost protection
- automatic condensate drain
- monitoring of the load liquid by level indicator
- easy operation monitoring and maintenance by simply opening the hinged valve cap
- modular design enables replacement of individual FLAMEFILTER® discs and diaphragm
- particularly suitable for problematic products such as styrene, acrylates, etc.

Design Types and Specifications

The diaphragm is pressurized by liquid. Higher pressures are available upon request in a special version with an additional attachment.

There are two different designs:

Pressure diaphragm valve, basic design **UB/DF -** $\boxed{-}$

Pressure diaphragm valve with heating coil **UB/DF -** $\boxed{H}$
(max. heating fluid temperature +85°C / 185°F)

In addition to the standard design, a series of specially developed designs (e.g., for acrylate or styrene storage tanks, etc.) can be provided upon request.

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 page.

DN	pressure	80 / 3"	pressure	100 / 4"	pressure	150 / 6"
a	up to +28 mbar / +11.2 inch W.C.	615 / 24.21	up to +28 mbar / +11.2 inch W.C.	645 / 25.39	up to +25 mbar / +10 inch W.C.	680 / 26.77
a	> +28 mbar / +11.2 inch W.C.	765 / 30.12	> +28 mbar / +11.2 inch W.C.	795 / 31.30	> +25 mbar / +10 inch W.C.	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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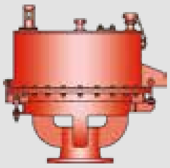


Pressure Diaphragm Valve

Deflagration-proof and Endurance Burning-proof

PROTEGO® UB/DF

Table 3: Material selection for housing

Design	C	D	
Housing	Steel	Stainless Steel	The housings are also available with an ECTFE coating. 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	Coated Devices (Flyer pdf)
Flame arrester unit	C	C	

Table 4: Material selection for diaphragm

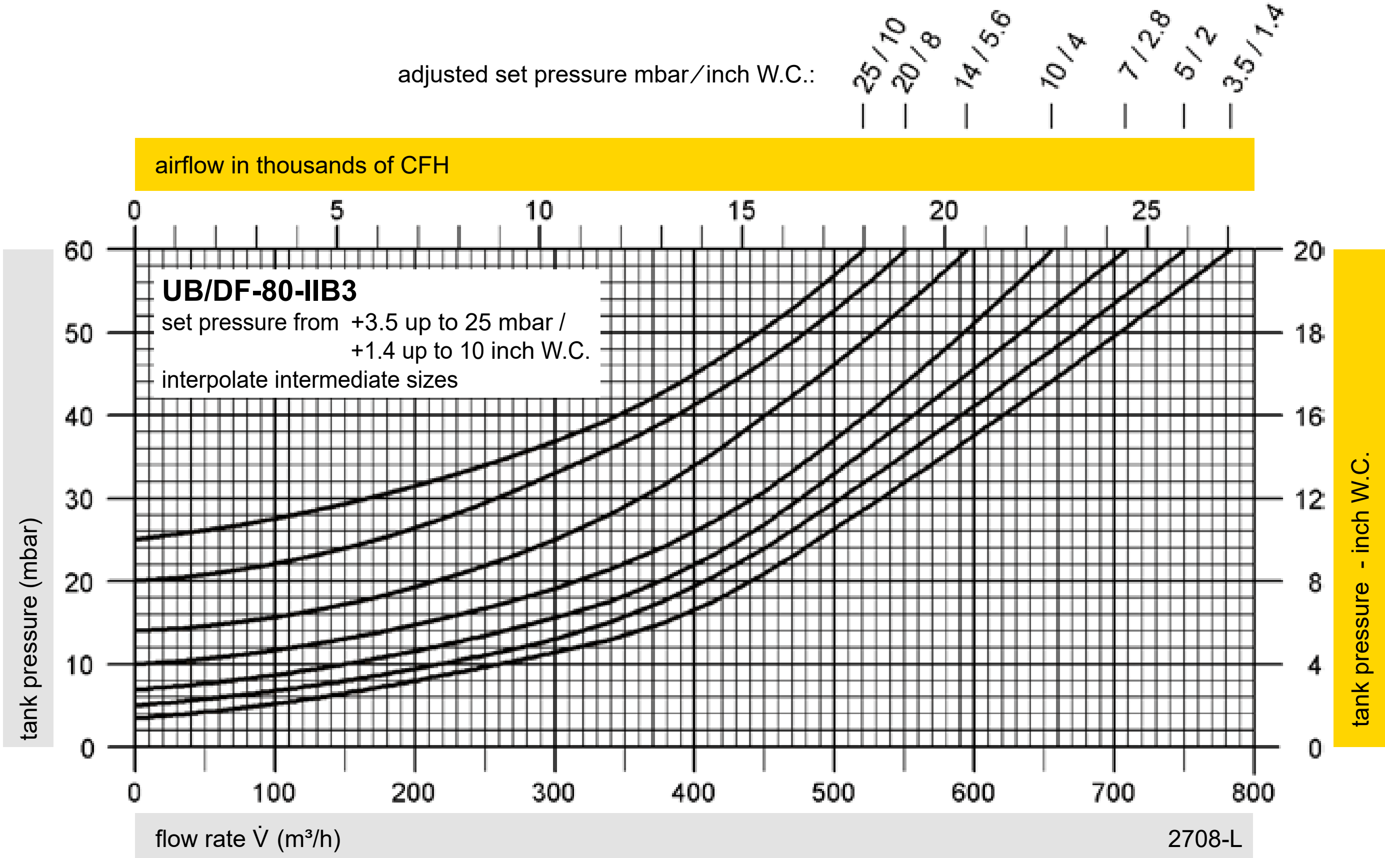
Design	A	B	
Diaphragm	FPM	FEP	Special materials upon request.

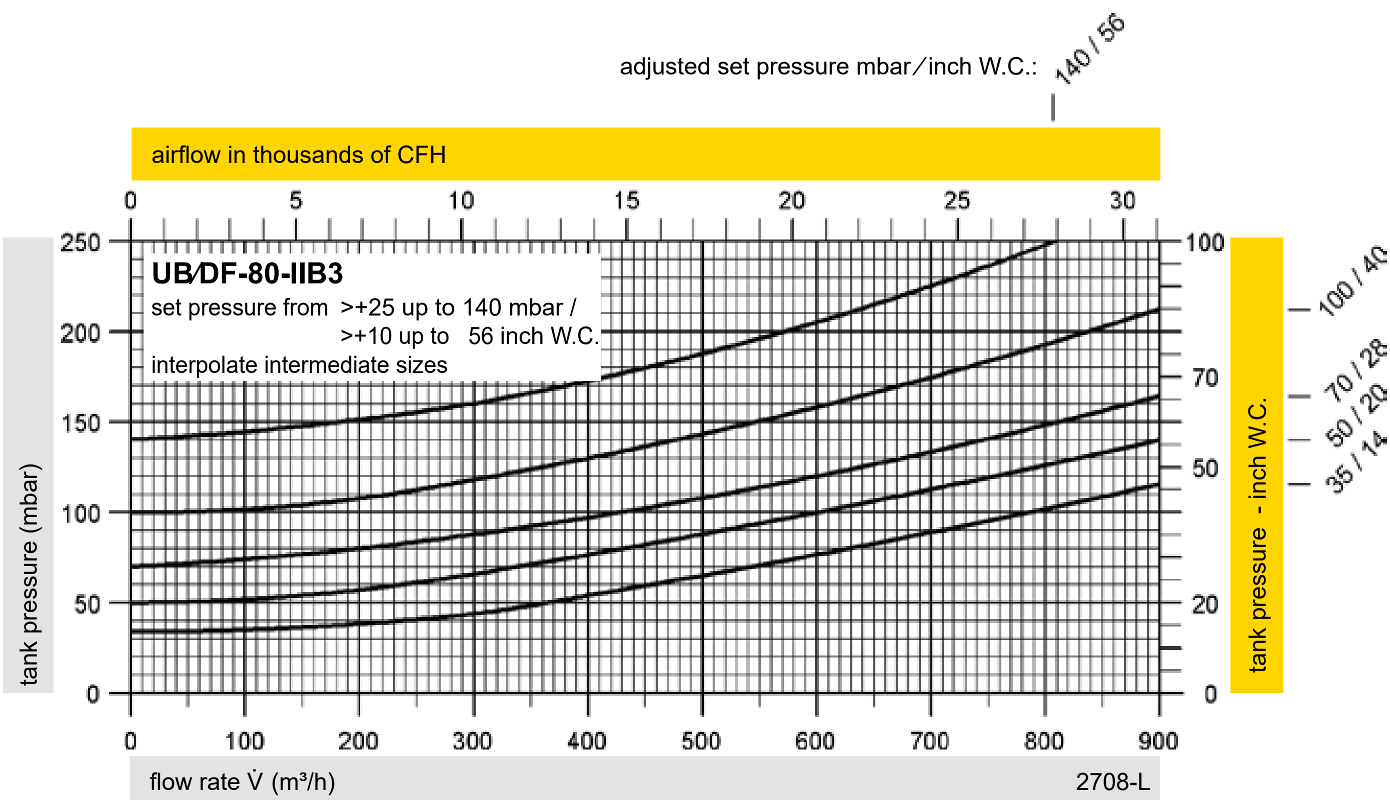
Table 5: Material combinations of flame arrester unit

Design	C	
FLAMEFILTER® casing	Stainless Steel	Special materials upon request.
FLAMEFILTER®	Stainless Steel	
Spacer	Stainless Steel	

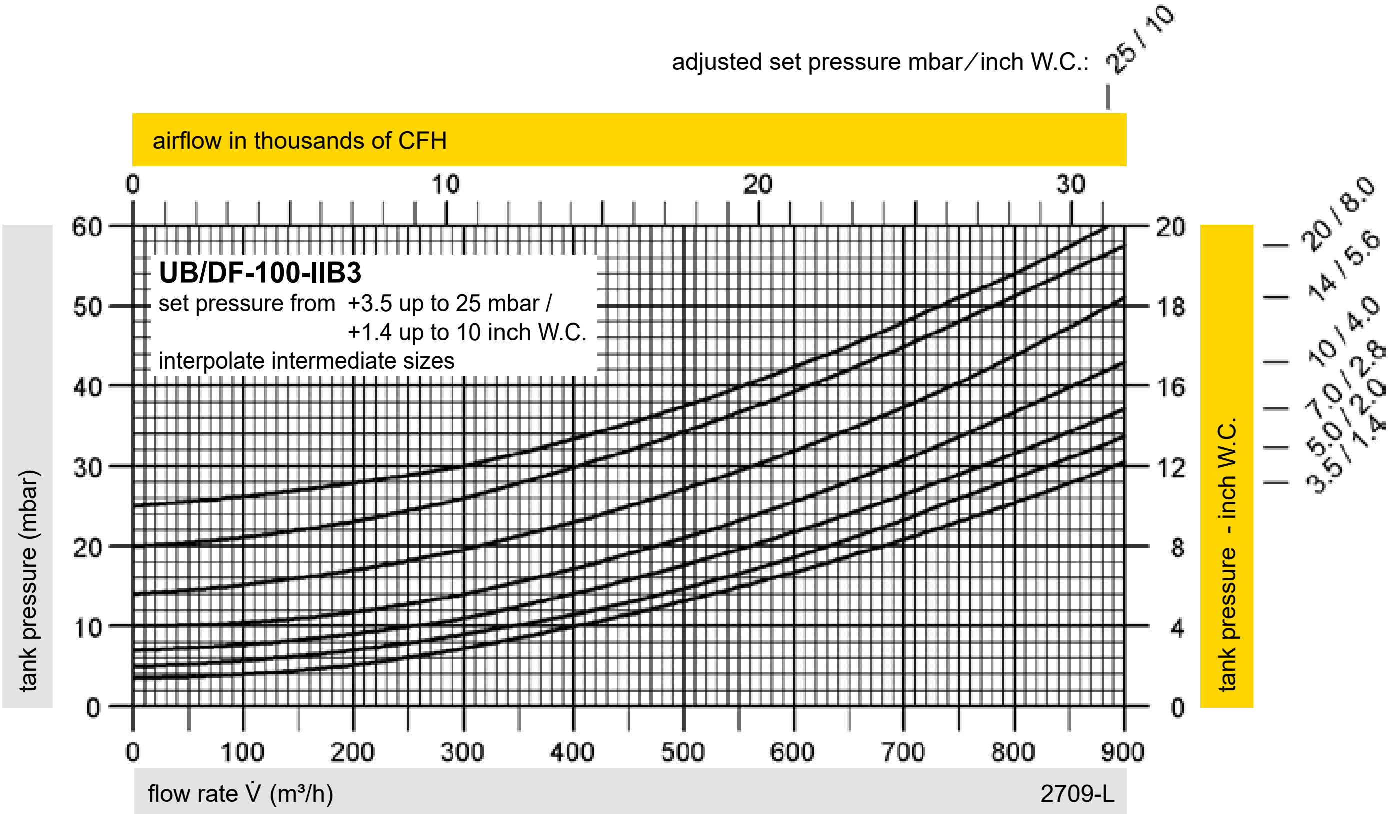
Table 6: Flange connection type

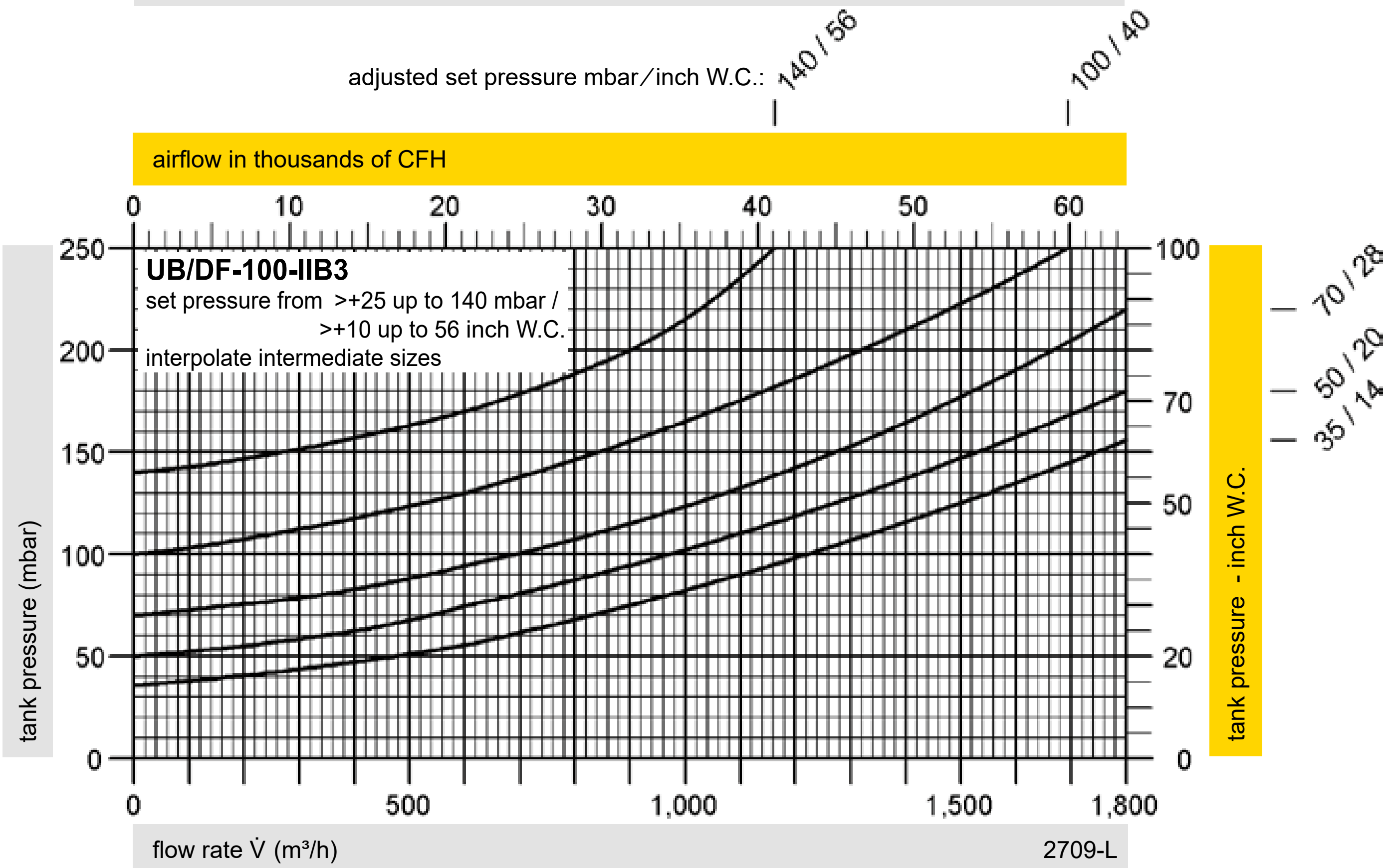
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	



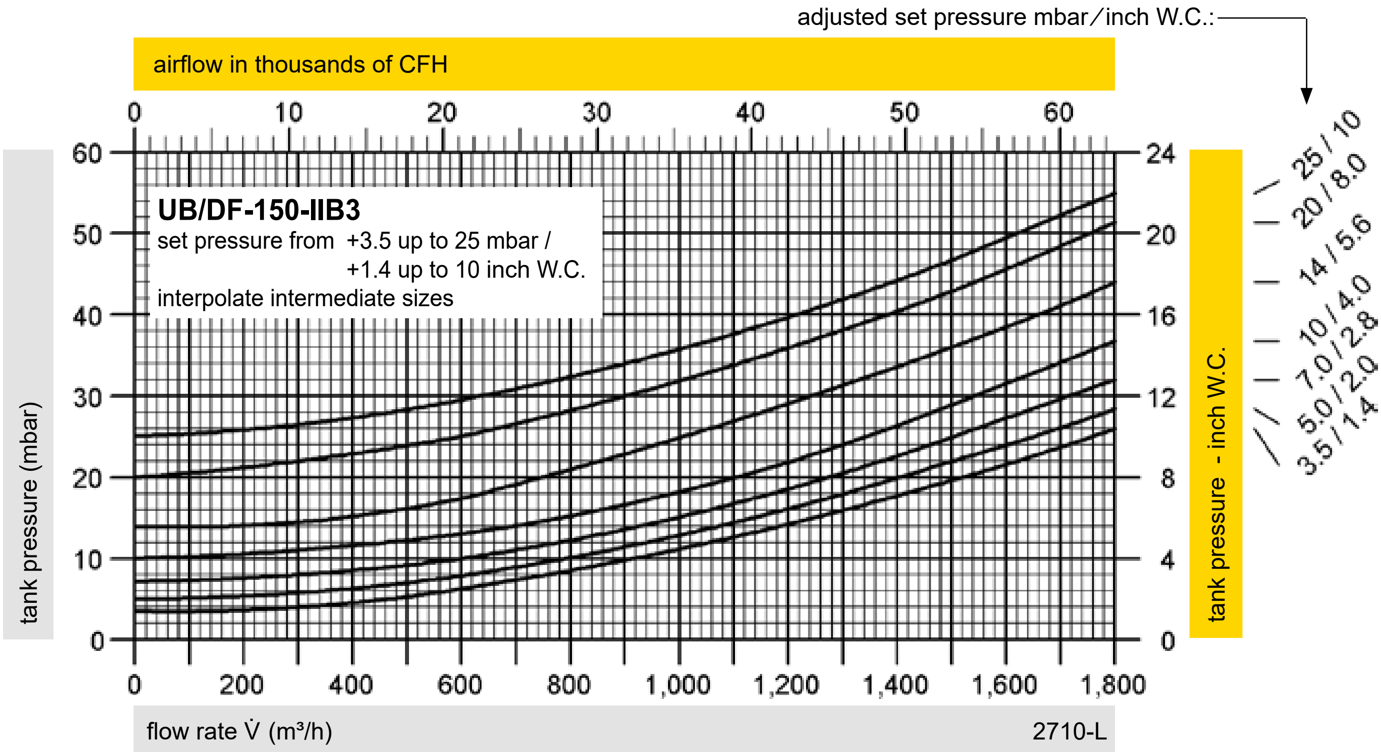


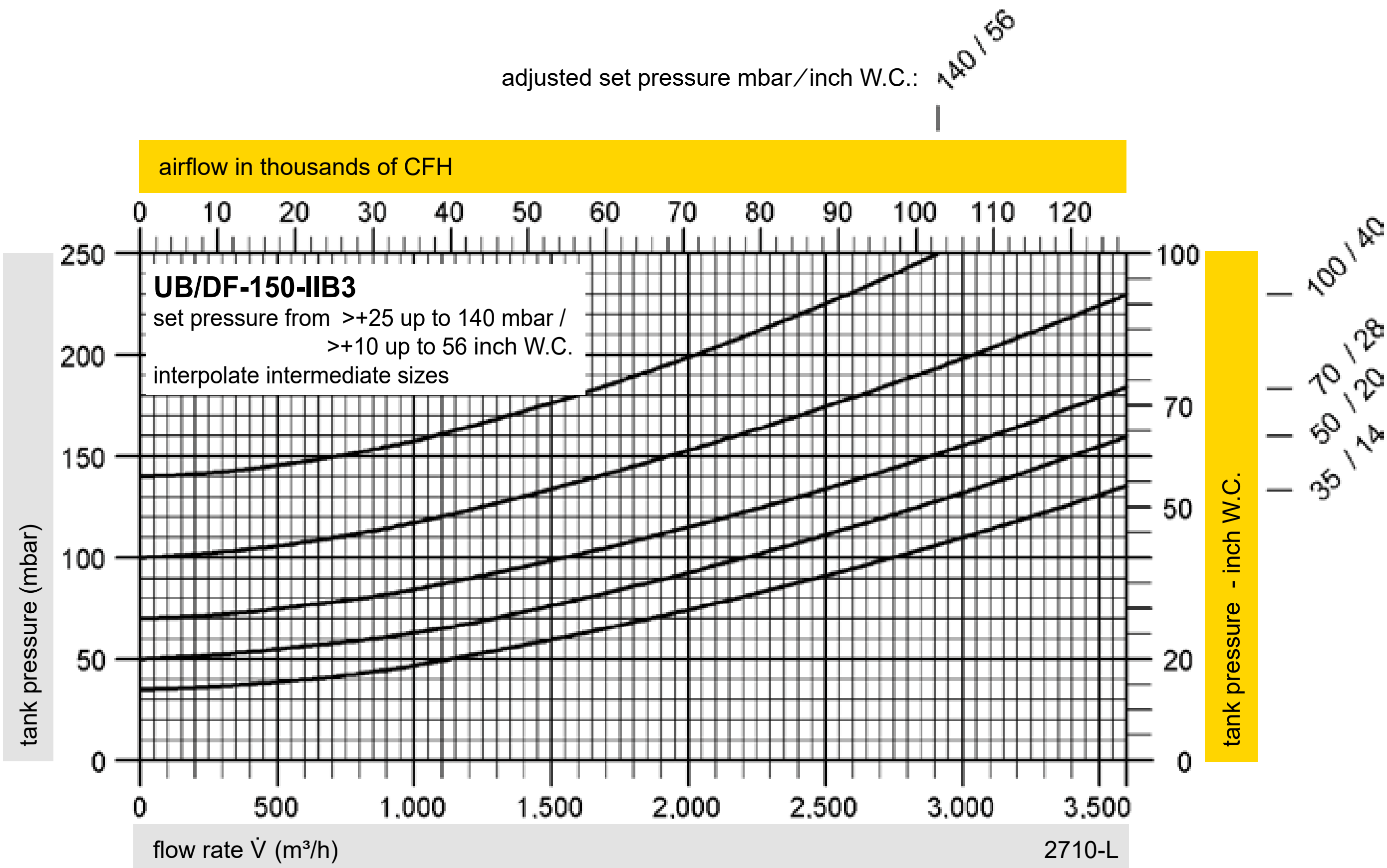
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

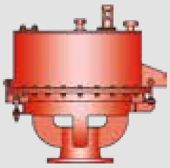




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”


adjusted set pressure mbar ⁄ inch W.C.:
airflow in thousands of CFH
UB/DF-150-IIB3
set pressure from +3.5 up to 25 mbar /
+1.4 up to 10 inch W.C.
interpolate intermediate sizes
tank pressure (mbar)
tank pressure - inch W.C.
25 / 10
20 / 8.0
14 / 5.6
10 / 4.0
7.0 / 2.8
5.0 / 2.0
3.5 / 1.4
flow rate V̇ (m³/h)
2710-L

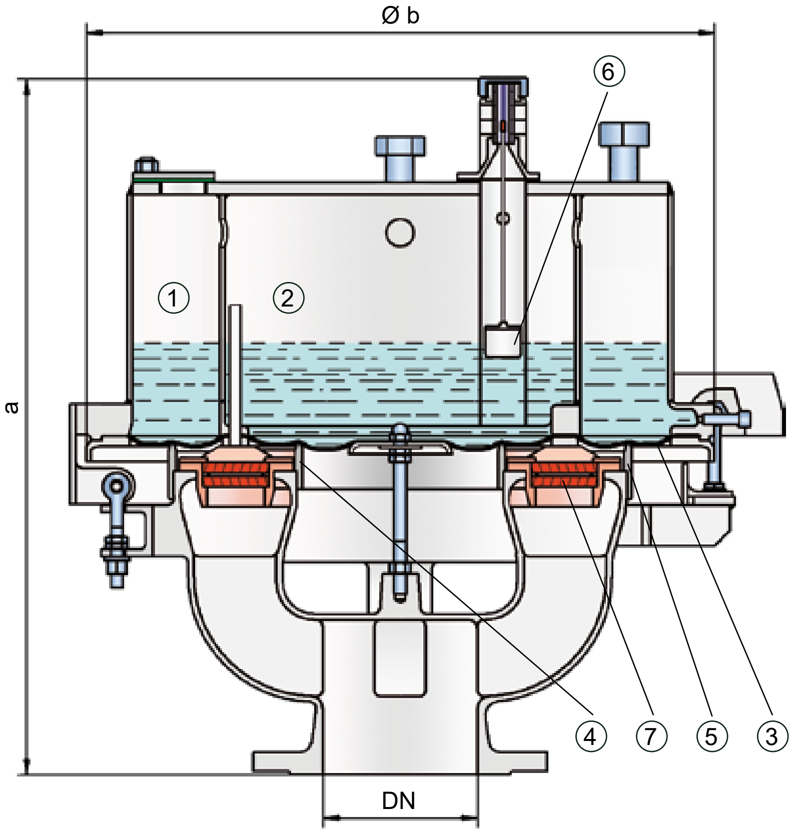

adjusted set pressure mbar ⁄ inch W.C.:
140 / 56
airflow in thousands of CFH
UB/DF-150-IIB3
set pressure from >+25 up to 140 mbar /
>+10 up to 56 inch W.C.
interpolate intermediate sizes
tank pressure (mbar)
tank pressure - inch W.C.
100 / 40
70 / 28
50 / 20
35 / 14
flow rate V̇ (m³/h)
2710-L



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 vacuum settings upon request.

Function and Description

The PROTEGO® UB/VF diaphragm valve is a worldwide unique vacuum relief valve combining the function of a dynamic and static flame arrester. It is primarily used as a safety device for flame transmission-proof in-breathing on tanks, containers, and process equipment. The valve offers reliable protection against vacuum build up, prevents the in-breathing of air and product losses almost up to the set vacuum, and protects against atmospheric deflagration. The PROTEGO® UB/VF diaphragm valve has proven itself over many years under a wide variety of operating conditions in the mineral oil and chemical industries. Worldwide, it is the only vent which works reliably with problem products such as styrene or acrylates. The set vacuum is adjusted with a freeze resistant water-glycol mixture which ensures safe operation under extreme cold weather conditions. The PROTEGO® UB/VF valve is available for substances from explosion group IIB3.

If a vacuum builds up in the tank, it is transmitted through pressure balancing tubes into the vacuum chambers (1), (2), which are connected to each other. This will remove the weight of the load liquid, and the atmospheric pressure will lift the diaphragm (3) off the inner and outer valve seat rings (4, 5), resulting in ventilation of the tank. The vacuum setting is adjusted via the filling level of the load liquid and can be checked by a floating level indicator (6).

The tank vacuum is maintained up to the set vacuum with a tightness that is above the normal standards due to our highly developed manufacturing technology. This is achieved by the liquid loaded diaphragm pressing tightly around the special designed valve seat surface area even when the operating vacuum increases, which reduces surface pressure and unnecessary leakage. After the vacuum is balanced, the valve re-seats 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. The ignition into the tank can be prevented by installing the PROTEGO® flame arrester unit (7). This PROTEGO® flame arrester unit provides additional protection against atmospheric deflagration when the valve is open for maintenance and inspection.

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

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Special Features and Advantages

- excellent tightness, resulting in lowest possible product losses and environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- can be used as a protective system in areas with potentially explosive atmospheres in accordance with ATEX
- protection against atmospheric deflagrations for products up to explosion group IIB3 (NEC group C MESG ≥ 0.65 mm)
- minimum pressure loss of the PROTEGO® flame arrester unit
- optimal frost protection
- automatic condensate drain
- monitoring of the load liquid by level indicator
- easy operation monitoring and maintenance by simply opening the hinged valve cap

Frost-Proof P/V Diaphragm
Valve (Video)

- modular design enables replacement of individual FLAMEFILTER® discs and diaphragm
- particularly suitable for problematic products such as styrene, acrylates, 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 (max. heating fluid temperature +85°C / 185°F)	**UB/VF -** **H**

In addition to the standard design, a series of specially developed designs (e.g., for acrylate or styrene storage tanks, etc.) can be provided upon request.

Table 1: Dimensions — Dimensions in mm / inches

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

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
Valve seat	Stainless Steel	Stainless Steel
Gasket	FPM	PTFE
Diaphragm	A, B	A, B
Flame arrester unit	C	C

The housings are also available with an ECTFE coating.
Special materials upon request.

Coated Devices
(Flyer pdf)

Table 4: Material selection for diaphragm

Design	A	B
Diaphragm	FPM	FEP

Special materials upon request.

Table 5: Material combinations of flame arrester unit

Design	C
FLAMEFILTER® casing	Stainless Steel
FLAMEFILTER®	Stainless Steel
Spacer	Stainless Steel

Special materials upon request.

Table 6: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

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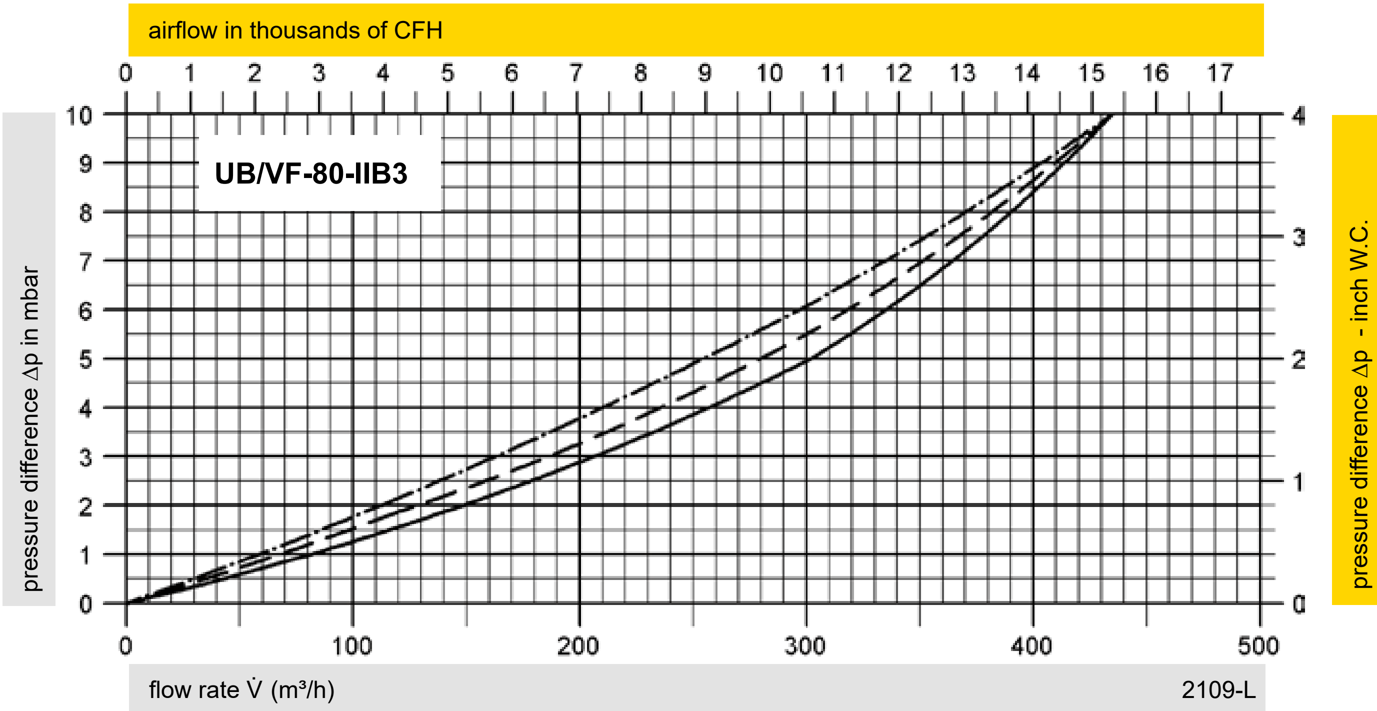
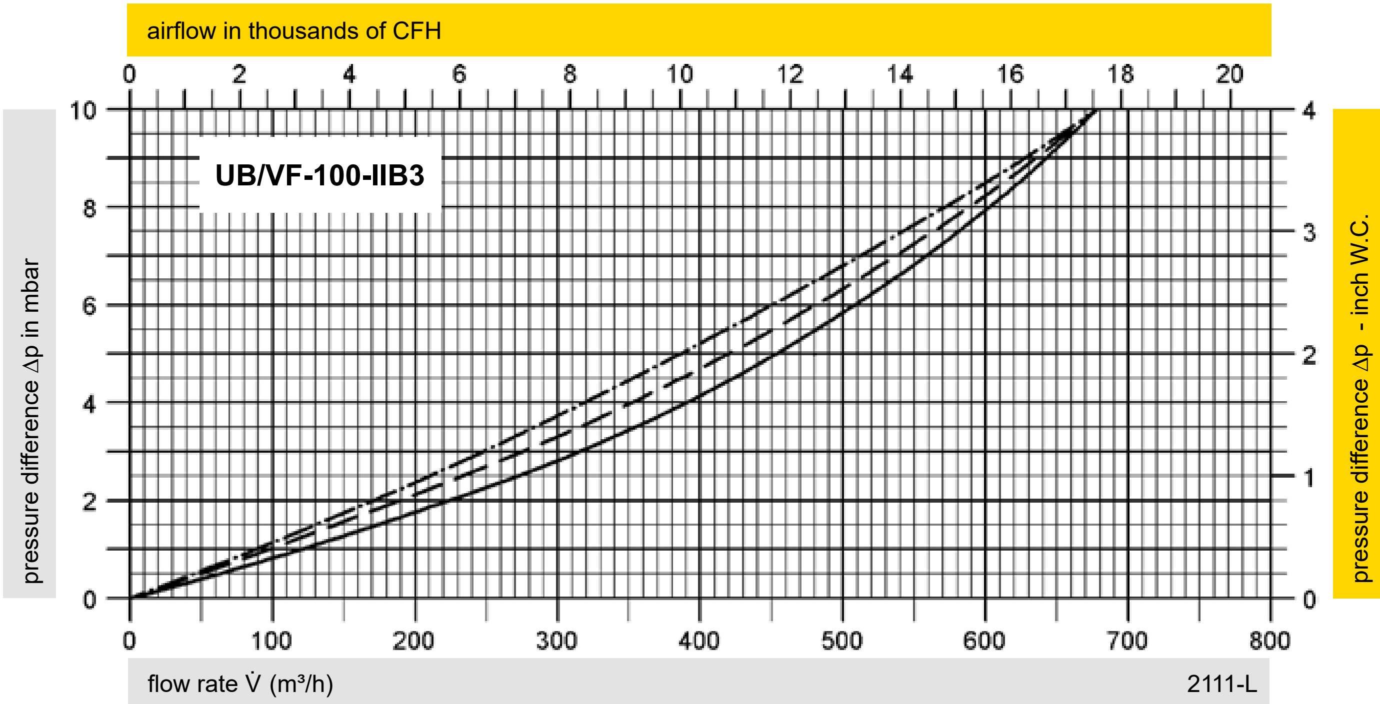


pressure difference = max. allowable tank design vacuum - valve set vacuum

adjusted set vacuum:

- (solid line) ≤ -5 mbar / ≤ -2 inch W.C.
- (dashed line) > -5 mbar up to ≤ -7 mbar / > -2 inch W.C. up to ≤ -2.8 inch W.C.
- (dash-dot line) > -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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."



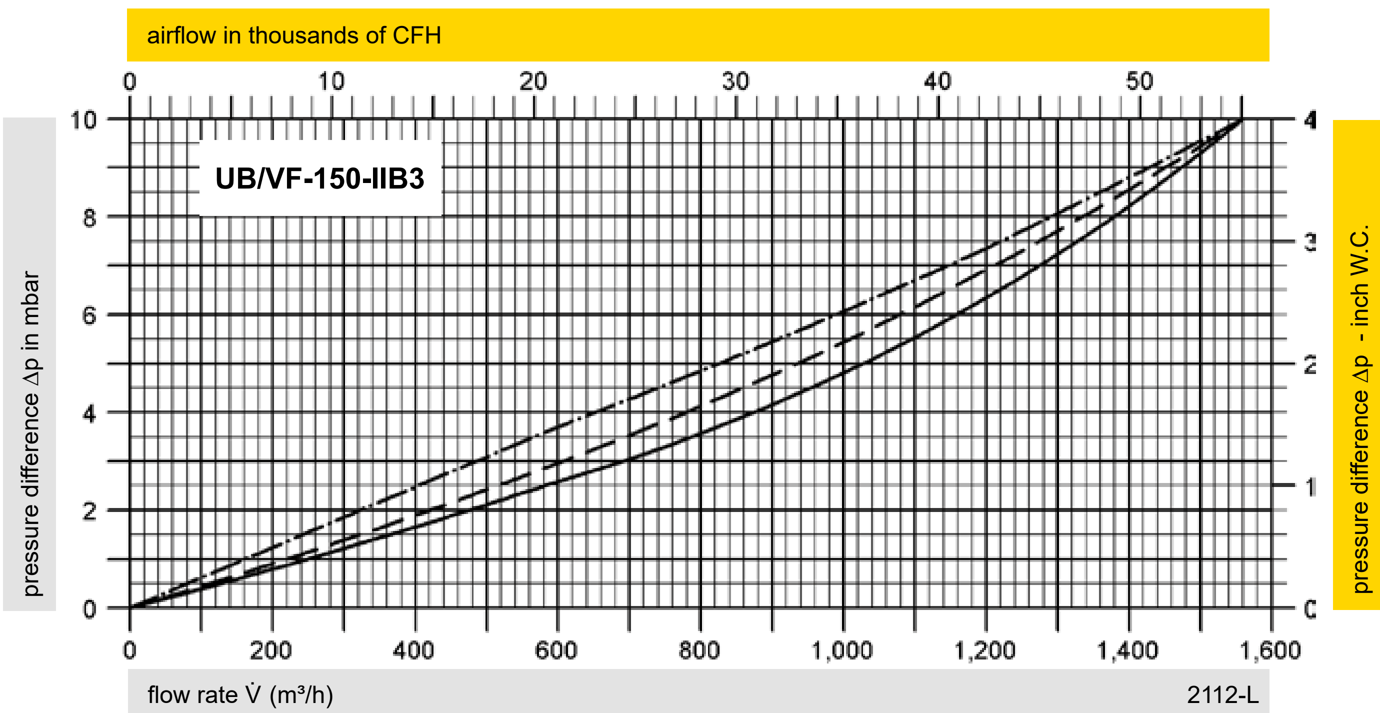
pressure difference = max. allowable tank design vacuum - valve set vacuum

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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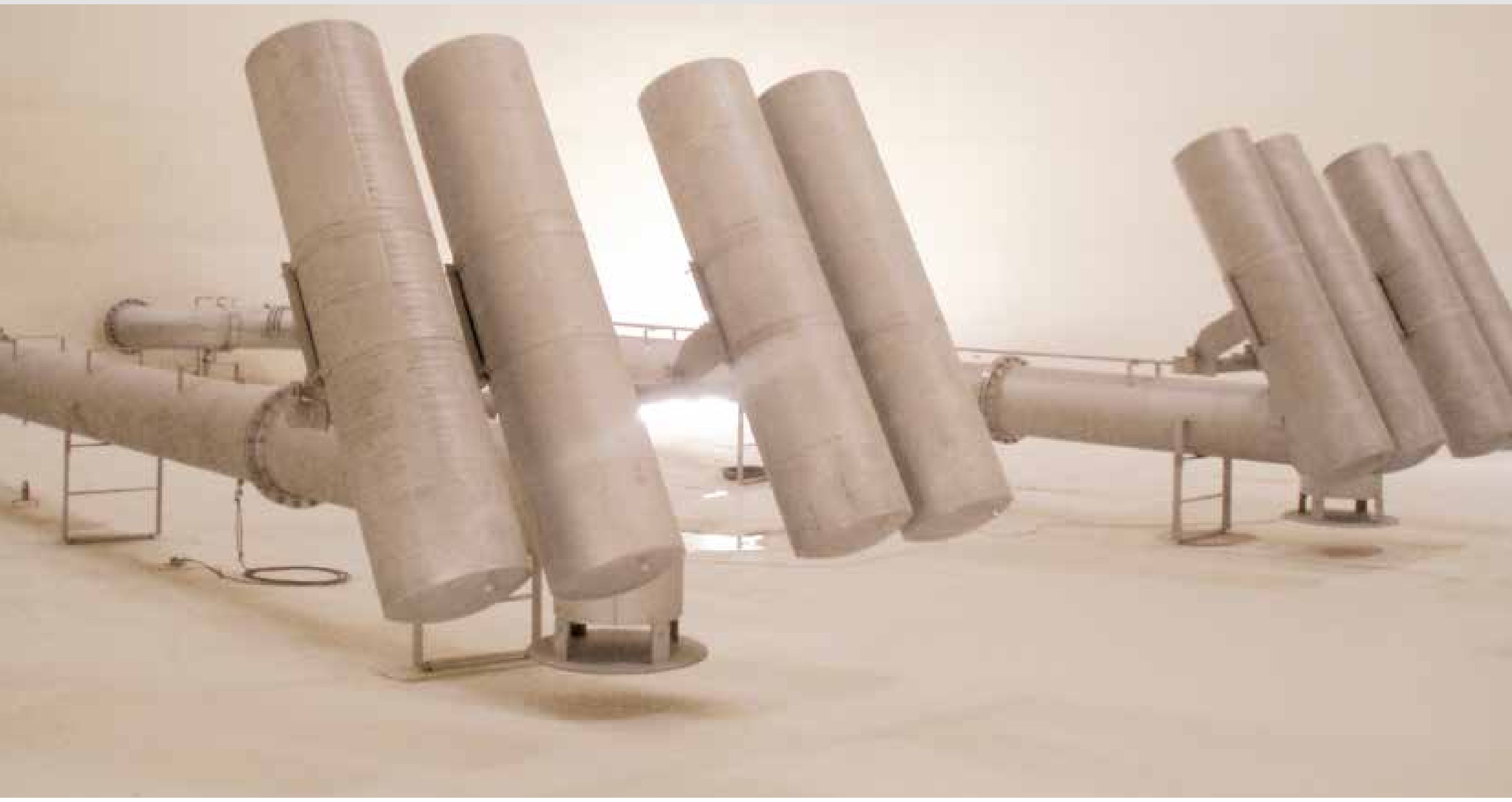
PROTEGO® Tank Accessories and Special Equipment



Section 8

for safety and environment

Tanks in tank farms and large vessels not only need to be equipped with flame arresters or pressure and vacuum valves, but they also need special equipment that meets the same high requirements to operate safely.

Special Valves with Safety Functions

For emergency shut-off or extraordinary operating conditions, it is necessary to provide internal safety valves to quickly prevent product leakage after a pipe burst.

Gauging and Sampling Equipment

Gauge and sampling hatches allow the use of gauging and sampling devices in the tank. For horizontal tanks, deflagration-proof gauging pipes are available.

For sampling and local venting of tanks that store flammable liquids, PROTEGO® has designed special sampling and air bleed valves with flame arrester elements.

Explosion-proof floor drains for helicopter landing pads safely release flammable liquids (e.g., kerosene) into collecting containers. There is no flame transmission if an outside ignition source ignites the potentially explosive atmosphere.

Floating Suction Units and Skimming Systems

PROTEGO® SA/S floating suction units are used in storage tanks with very high purity requirements of the substances, e.g., aviation or fossil fuels.

Fixed roof tanks that store liquids with different densities, so-called slop tanks, are fitted with the Floating Skimmer System PROTEGO® SA/DA for separating the phases.

Together with the tank operator or tank builder, we develop the best way to ensure both economical and safe operation.

Floating Roof Tank Equipment

For floating roof tanks, the **drainage system for the floating roof** must be very precisely designed. Every movement of the floating roof must be considered, and the load on the joints must not affect the free moving space. If there is restricted movement, the system will crack, the pipes will bend, and the joints will be stuck. In order to prevent the water in the system from standing still and freezing, ensure sufficient drain to the lateral tank nozzle. Decades of experience have been incorporated into the trouble-free systems – from the **roof drain valves** to the systems with ball bearing joints or metal hose joints. When the floating roofs are in maintenance position, the completely drained space below the floating roof must be vented through a **lift-actuated vent valve**. When storing flammable liquids in the tank, venting is to be done through flame arresters.

Special Equipment

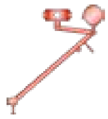
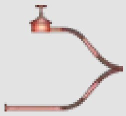
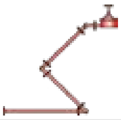
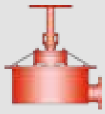
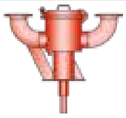
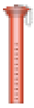
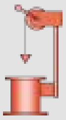
Hygroscopic products must be vented with dry air when stored. **Air-drying devices** with dry beads extract moisture from the air.

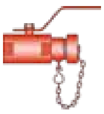
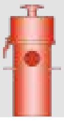
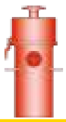
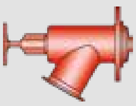
Selection

The special valves, systems, and devices are designed together with the operator, engineering company, and tank builder. PROTEGO® prepares a quotation based on the detailed system specifications.

PROTEGO® Tank Accessories and Special Equipment

Catalog

	Type	Size	Description	Page
Floating Suction Unit				
	SA/S		Floating Suction Unit	378 - 379
	SA/DA		Floating Skimmer System	380 - 381
Floating Roof Tank Equipment				
	SE/K	80 - 100 3" - 4"	Floating Roof Drainage System with Metal Hose Joint	382 - 383
	SE/CK	80 - 150 3" - 6"	Floating Roof Drainage System with Swivel Joints	384 - 385
	D/SR D/SR-W	80 - 150 3" - 6"	Roof Drain Valves	386 - 387
	AL-DK	200 8"	Vent Valve, Lift-actuated	388 - 390
Gauging and Sampling Equipment				
	PF/K PF/TK PS/KF	100 - 200 4" - 8"	Gauge Hatch with flange	392 - 393
	PS/K PS/TK	100 - 200 4" - 8"	Gauge Hatch with welded nozzle	394 - 395
	PU-IIA	25 - 50 1" - 2"	Gauging Pipe, deflagration-proof	
	PR/0	25 - 150 1" - 6"	Gauging and Sampling Pipe, verifiable	
	VP/HK with PS/E und PG/H	100 - 150 4" - 6"	Gauging and Sampling Device with accessories	

	Type	Size	Description	Page
Deflagration proof Special Valves				
	ZE/WU	15 - 25 G½" - G1"	Sampling and Air Bleed Valve, deflagration-proof	396 - 397
	ZE/TK	15 - 25 G½" - G1"	Condensate Drain Valve, deflagration-proof	398 - 399
Air-Drying Devices				
	LA	50 - 150 2" - 6"	Air-Drying Device	
	LA/V	50 - 150 2" - 6"	Air-Drying Device with Check Valve	
In-Tank Valve				
	SI/F	50 - 200 2“ - 8“	Internal Safety Valve	400 - 401
	NB/AP	→ Section 9		424 - 425
	ITV-S	→ Section 9		426 - 428
	SI/DP	→ Section 9		430 - 431
Change-Over Valve				
	WV/T	→ Section 9		422 - 423

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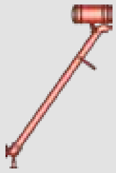
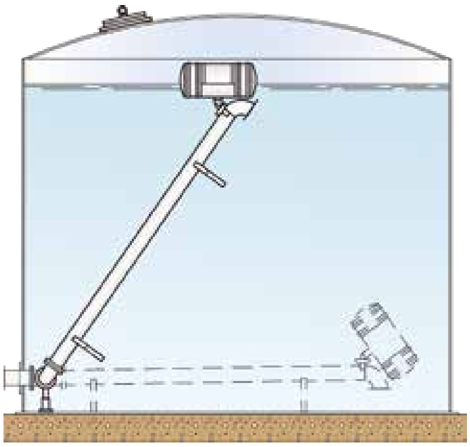
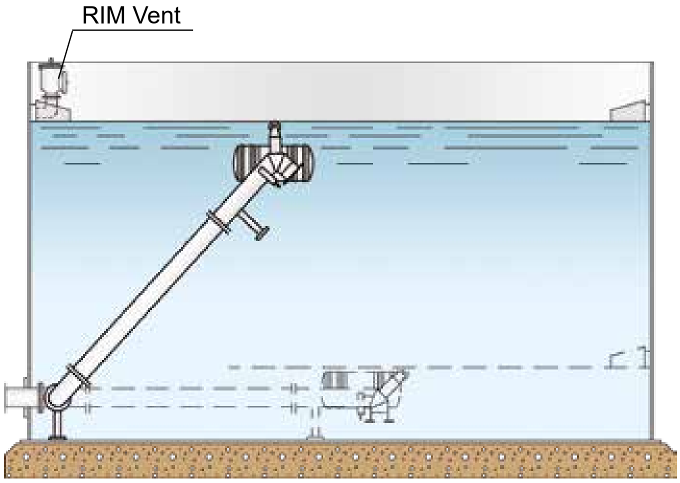






PROTEGO® SA/S for fixed roof tanks

PROTEGO® SA/S for floating roof tanks

Function and Description

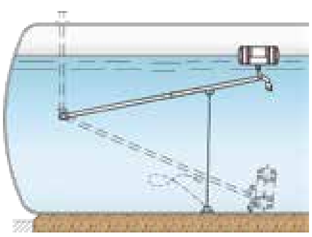
PROTEGO® Floating Suction Units, FSU, are used in storage tanks with very high purity requirements of the substances, e.g., aviation or fossil fuels. They are designed to ensure that product in a storage tank is drawn off just below the surface of the liquid where it is cleanest. This prevents the settled water and residuals at the bottom of the tank from being sucked in.

Design Types and Specifications

PROTEGO® Floating Suction Units are designed and sized to suit the individual tank specifications and customer requirements.

PROTEGO® Floating Suction Units are designed for long-term operation in full contact with the substances used. We use stainless steel for highly loaded components or aggressive substances.

Sizes are available from 1" to 36" for horizontal or vertical tanks with fixed or floating roofs. Custom designs for unusual stored products are available.



PROTEGO® SA/S for horizontal tanks

Selection and Design

PROTEGO® Floating Suction Units are the result of extensive experience and are well-conceived solutions for the end-user. This includes easy installation, assembly, and full project documentation with design drawings taking into account tank installations.

Essential for the design of the PROTEGO® Floating Suction Unit is the Heavy Duty Swivel Joint, which is designed to work maintenance-free for many years in full contact with the substances used. This design provides the tank operator with operational reliability, and unforeseen and expensive repairs are prevented.

The Swivel Joints are:

- made of stainless steel;
- lubricated with a maintenance-free lifetime lubrication system; and
- equipped with a double row ball bearing with larger sizes to optimize reliability.

PROTEGO® Floating Suction Units are equipped with a suction opening which prevents a vortex from forming and the suction of air.

Floats are all made exclusively of high-quality stainless steel and are 100 % pressure tested.

Options upon request:

- Sampling pipes
- Function indicator
- Stress calculation due to liquid movement
- On-site support

PROTEGO® Floating Suction Units are „Made in Germany“ and will provide many years of trouble free tank operation.

*Project:
Location:
Customer:
*End user:
*Engineering:

Tank Main Details

*Fixed roof tank ☐	*Fixed roof tank with internal floating roof ☐	
*Floating roof tank ☐		
*Horizontal tank ☐		
Tank-No.:	*Tank height: mm	*Tank diameter: mm
*Maximum filling height: mm		
*Material design of floating suction unit:		

Product details

*Stored product:	
*Product specific density:	
Maximum product temperature: °C	

Tank details

*Suction line size: DN		
**Height of connection flange / length of connection piece (inside): mm		
*Manhole size: DN		
Bottom slope: ☐	Slope direction:	
*Are there any obstructions? (supports, heating pipes, etc.) ☐		if ☒ - please specify
*Tank drawing / sketch? ☐		if ☒ - specify request

*This information must be provided upon request.
Fill in and ☐ check, if applicable.

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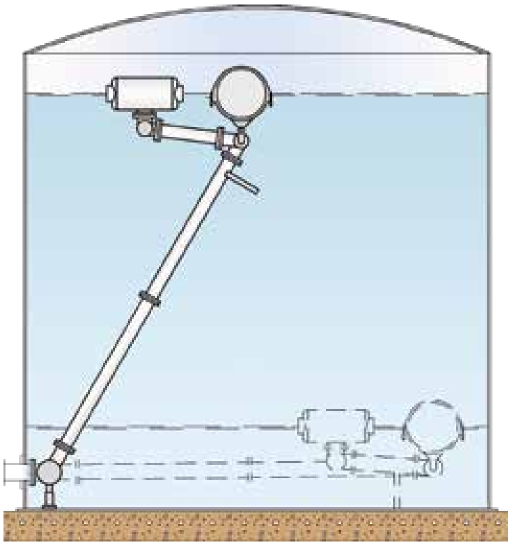
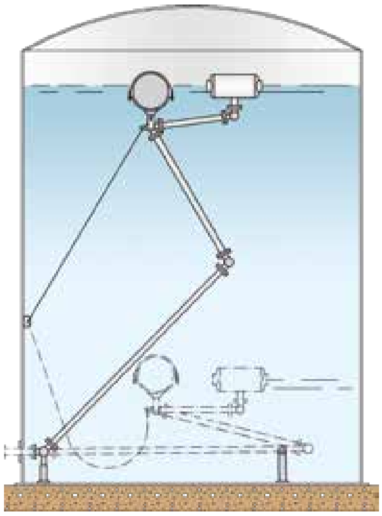


PROTEGO® SA/DA for fixed roof tanks



PROTEGO® SA/DA with double-bend for fixed roof tanks

Function and Description

Fixed roof tanks (e.g. slop tanks) are equipped with Floating Skimmer System PROTEGO® SA/DA to discharge the liquid at the liquid surface. In this process, the inlet opening is always moved with the liquid surface using one or more floats, depending on the liquid level. This ensures that medium can always be discharged.

Design Types and Specifications

Floating Skimmer System PROTEGO® SA/DA are engineered, constructed and manufactured according to customer requirements and taking the stored medium and customers tank parameters into account. They are designed for many years of operation in full medium contact. We use stainless steel for highly loaded components or aggressive substances.

Sizes are available from 2” to 6” for fixed roof tanks.

Other nominal diameters, materials and special solutions are possible, but must be checked in each individual case.

Selection and Design

PROTEGO® Floating Skimmer Systems are the result of extensive experience and are well-conceived solutions for the end-user. This includes full project documentation with design drawings taking tank installations (optional arrangement check) and, if required, an inspection of the installed equipment before commissioning into account.

Essential for the design of the PROTEGO® Floating Skimmer Systems is the Heavy Duty Swivel Joints, which are designed to work maintenance-free for many years in full medium contact. This design provides the tank operator with operational reliability, and unforeseen and expensive repairs are prevented.

The Swivel Joints are:

- made of stainless steel;
- lubricated with a maintenance-free lifetime lubrication system; and
- equipped with a double row ball bearing with larger sizes to optimize reliability.

PROTEGO® Floating Skimmer Systems SA/DA are equipped with a skimmer float, which discharges the stored medium at the liquid surface. The design of this float depends on several factors, but the density of the medium is primarily decisive.

The buoyancy to move the system is also generated by the skimmer-float, if possible. If necessary, an additional buoyancy float is used, which carries the main weight of the plant.

Floats are exclusively manufactured from high-quality stainless steel and are 100 % pressure tested.

PROTEGO® Floating Skimmer Systems are „Made in Germany“ and will provide many years of trouble free tank operation.

PROTEGO® SA/DA

*Project:
Location:
Customer:
*End user:
*Engineering:

Tank Main Details

*Fixed roof tank ☐		
Tank No.:	*Tank height: : mm	*Tank diameter: mm
*Maximum filling height: mm		
*Material design of Skimming Systems:		

Product Details

*Stored liquid:	Specific density:
*Sucked in liquid:	Specific density:
Maximum product temperature: °C	

Tank Details

*Skimming System size: DN	
*Height of connection flange / length of connection piece (inside) mm	
*Manhole size: DN	
Bottom slope: ☐	Slope direction:
*Are there any obstructions? (supports, heating pipes, etc.) ☐	if ☒ - please specify
*Tank drawing / sketch ☐	if ☒ - specify request

* This information must be provided upon request.
Fill in and ☐ check, if applicable.

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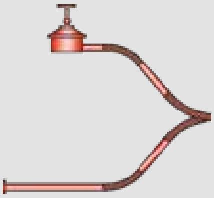
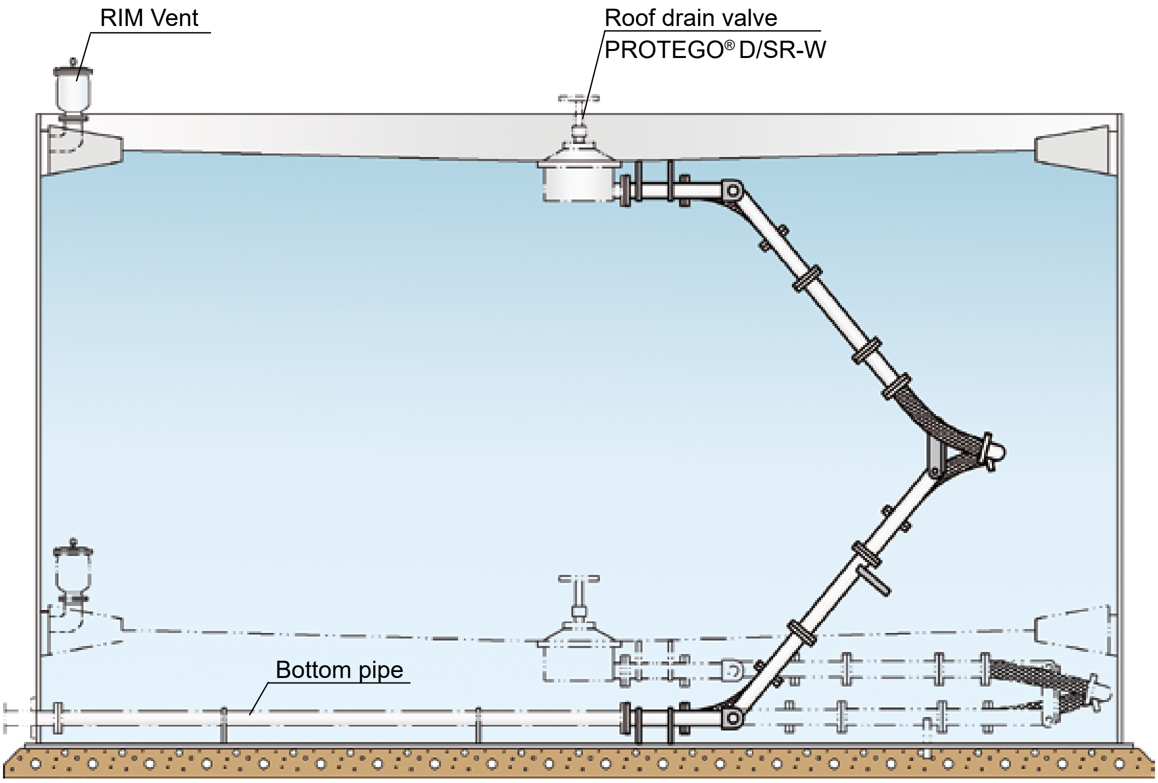


PROTEGO® SE/K



Function and Description

Floating roof tanks require a drainage system that automatically drains the accumulating rainwater from the floating roof. PROTEGO® SE/K is a single-scissor pipe system that works with sturdy shackle joints. The water is drained by pressure-resistant metal hoses installed without tension.

The upper scissor pipe is connected to the roof drain valve, and the lower scissor pipe is connected to the bottom pipe. The water is drained from the tank through the drainage system via the opened roof drain valve.

Design Types and Specifications

PROTEGO® floating roof drainage systems are designed and sized to suit the individual tank specifications and customer requirements.

PROTEGO® floating roof drainage systems are designed for long-term operation in full contact with the substances used. a long life in service. We use carbon steel or stainless steel for highly loaded components or aggressive substances. For the carbon steel version, the joint bearings are made of stainless steel.

Sizes are available from 3” to 8” for floating roof tanks with an external floating roof.

Selection and Design

PROTEGO® Floating Roof Drainage Systems are the result of extensive experience and are well-conceived solutions for the end-user. This includes easy installation, assembly, and full project documentation with design drawings considering tank installations.

The flexibility of the metal hose is possible due to the shackle-bolted joint. Forces caused by torsion or uneven movements of the floating roof are absorbed through design and arrangement of the joints and have no negative effects on the system or metal hoses. The water is drained by metal hoses that are directly connected to the scissor pipes. The drain water does not pass through the actual joints, so sealing elements used for common swivel joint systems are not required.

For stability reasons, metal hose joints are made of steel or stainless steel.

Options upon request:

- Roof drain valve
- Bottom pipe
- On-site support

PROTEGO® Floating Roof Drainage Systems are „Made in Germany“ and will provide many years of trouble free tank operation.

Project Data Sheet

for Floating Roof Drainage System with Metal Hose Joints

PROTEGO® SE/K

*Project:
Location:
Customer:
*End user:
*Engineering:

Tank Main Details

*Floating roof tank ☐		
Tank No.:	*Tank height: : mm	*Tank diameter: mm
*Maximum filling height: mm		
* Material design of Floating Roof Drainage System:		

Product Details

*Product stored:	
*Specific density:	
Maximum product temperature: °C	

Tank Details

*Nominal diameter of drain line: DN	
*Height of connection flange / length of connection piece (inside): mm	
*Manhole size: DN	
Bottom slope: ☐	Slope direction:
*Are there any obstructions? (supports, heating pipes, etc.) ☐	if ☒ - please specify
*Tank drawing / sketch ☐	if ☒ - please specify

* This information must be provided upon request.
Fill in and ☐ check, if applicable.

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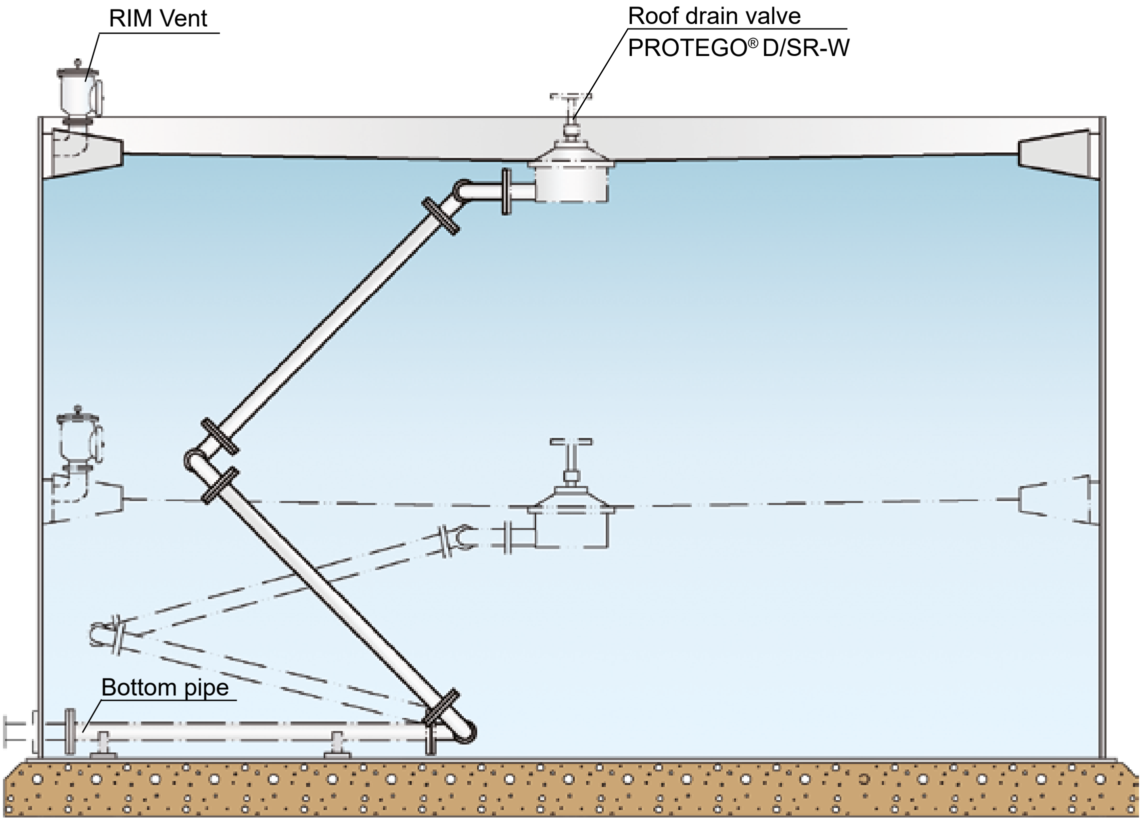
PROTEGO® SE/CK



Function and Description

Floating roof tanks require a drainage system that automatically drains the accumulating rainwater from the floating roof. PROTEGO® SE/CK is a single scissor pipe system that works with swivel joints.

The upper scissor pipe is connected to the roof drain valve, and the lower scissor pipe is connected to the bottom pipe. The water is drained from the tank through the drainage system via the opened roof drain valve.

Design Types and Specifications

PROTEGO® floating roof drainage systems are designed and sized to suit the individual tank specifications and customer requirements.

PROTEGO® floating roof drainage systems are designed for long-term operation in full contact with the substances used. We use carbon steel or stainless steel for highly loaded components or aggressive substances.

Sizes are available from DN 80/3” to DN 200/8” for floating roof tanks with external floating roof.

Selection and Design

PROTEGO® Floating Roof Drainage Systems are the result of extensive experience and are well-conceived solutions for the end-user. This includes easy installation, assembly, and full project documentation with drawings considering tank installations.

Essential for the design of the PROTEGO® Floating Roof Drainage System is the Heavy Duty Swivel Joint, which is designed to work maintenance-free for many years in full contact with the substances used. This design provides the tank operator with operational reliability, and unforeseen and expensive repairs are prevented.

The Swivel Joints are:

- made of carbon steel or stainless steel;
- lubricated with a maintenance-free lifetime lubrication system; and
- equipped with a double row ball bearing with larger sizes to optimize reliability.

Options upon request:

- Roof drain valve
- Bottom pipes
- On-site support

PROTEGO® Floating Roof Drainage Systems are „Made in Germany“ and will provide many years of trouble free tank operation.

Project Data Sheet

for Floating Roof Drainage System with Swivel Joints

PROTEGO® SE/CK

*Project:
Location:
Customer:
*End user:
*Engineering:

Tank Main Details

*Floating roof tank ☐		
Tank No.:	*Tank height: : mm	*Tank diameter: mm
*Maximum filling height: mm		
* Material design of Floating Roof Drainage System:		

Product Details

*Product stored:	
*Specific density:	
Maximum product temperature: °C	

Tank Details

*Nominal diameter of drain line: DN	
*Height of connection flange / length of connection piece (inside): mm	
*Manhole size: DN	
Bottom slope: ☐	Slope direction:
*Are there any obstructions? (supports, heating pipes, etc.) ☐	if ☒ - please specify
*Tank drawing / sketch ☐	if ☒ - please specify

* This information must be provided upon request.
Fill in and ☐ check, if applicable.

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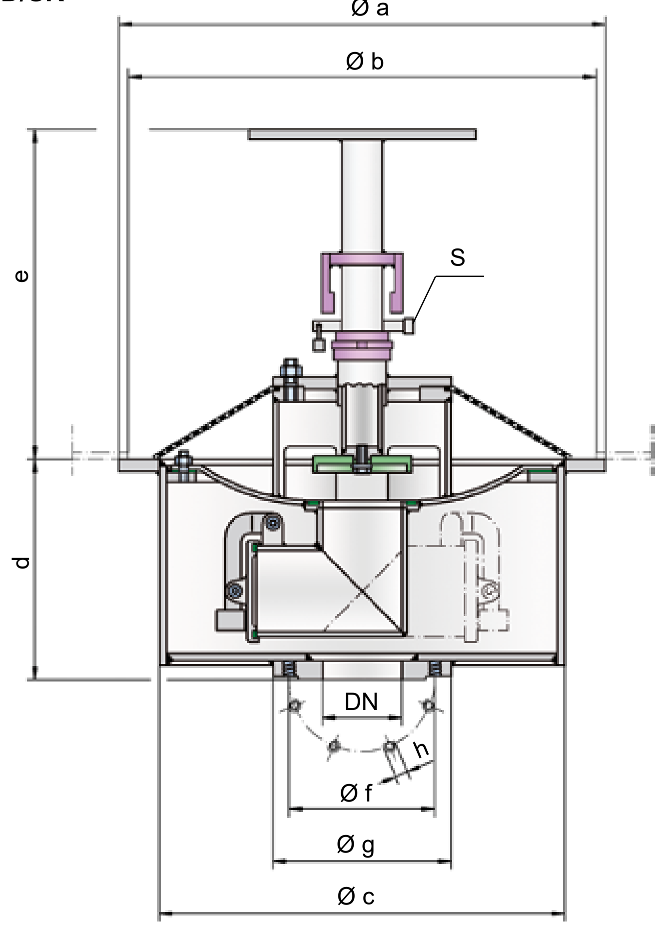
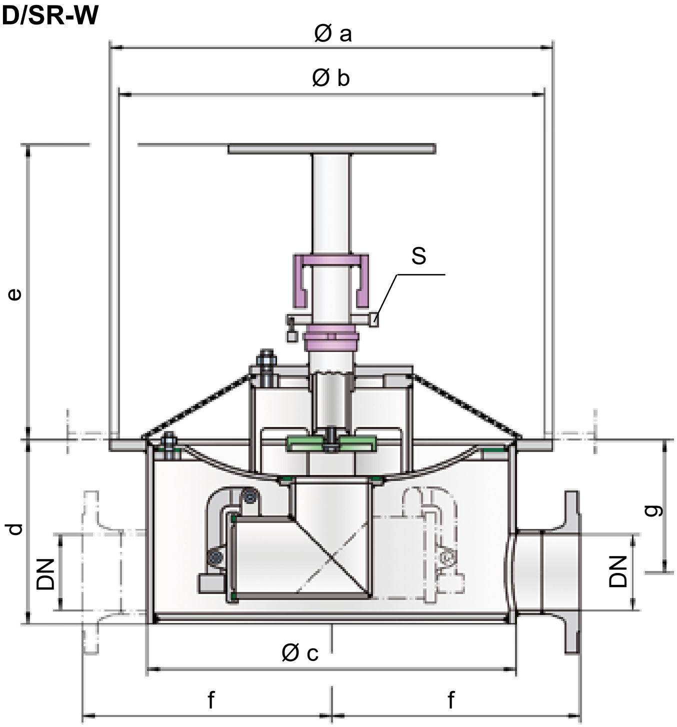
D/SR



D/SR-W



Function and Description

The PROTEGO® roof drain valves D/SR or D/SR-W have the function of an inlet cup, which collects the rainwater from the floating roof through the scissor pipes of a PROTEGO® floating roof drainage system, e.g., SE/K or SE/CK, into the sewage system.

Under normal operating conditions, the roof drain valve is open. In case of any leakage, the non-return valve prevents the stored substance from escaping to the floating roof. The inlet screen protects the roof drain valve from any dirt, leaves, or nesting animals.

Design Types and Specifications

Two designs are available:

Roof drain valve with vertical connection	**D/SR**
Roof drain valve with horizontal connection	**D/SR-W**

As an option, a special design of the roof drain valve is available with protection against unauthorized closing of the quick-action shut-off (S).

Table 1: Dimensions D/SR Dimensions in mm / inches

DN	80 / 3"	100 / 4"	150 / 6"
a	550 / 21.65	600 / 23.62	650 / 25.59
b	490 / 19.29	540 / 21.26	590 / 23.23
c	450 / 17.72	500 / 19.69	550 / 21.65
d	240 / 9.45	280 / 11.02	330 / 12.99
e	490 / 19.29	490 / 19.29	490 / 19.29
f	160 / 6.3	180 / 7.09	240 / 9.45
g	200 / 7.87	220 / 8.66	285 / 11.22
h	M 16	M 16	M 20

Table 2: Dimensions D/SR-W Dimensions in mm / inches

DN	80 / 3"	100 / 4"	150 / 6"
a	550 / 21.65	600 / 23.62	650 / 25.59
b	490 / 19.29	540 / 21.26	590 / 23.23
c	450 / 17.72	500 / 19.69	550 / 21.65
d	205 / 8.07	250 / 9.84	320 / 12.6
e	490 / 19.29	490 / 19.29	490 / 19.29
f	285 / 11.22	320 / 12.6	350 / 13.78
g	150 / 5.91	180 / 7.09	225 / 8.86

Table 3: Material selection		
Design	A	B
Housing	Steel	Stainless Steel
Non-return valve	Red Brass	Red Brass
Valve disc	Steel	Stainless Steel
Quick-action shut-off	Steel	Stainless Steel
Gasket	PUR	PUR

The device must have sufficient corrosion resistance to the stored substance. If necessary, designs in special stainless steel quality should be selected.

Flange Connection Type

In type PROTEGO® D/SR, the housing bottom is equipped with a loose flange on the underside with threaded holes in accordance with EN 1092-1 or, optionally, to any other international standard.

In the standard model of PROTEGO® D/SR-W, the housing is equipped with a lateral flange connection in accordance with EN 1092-1 or, optionally, to any other international standard. An additional flange connection is available

Selection and Design

The specified maximum rainfall is required to determine the required nominal size. Alternatively, the connection size of the roof drain valve corresponds with the existing nominal dimension of the floating roof drainage system. Roof drain valves with 2 or 3 non-return valves are available as an option.

Necessary Data for Specification

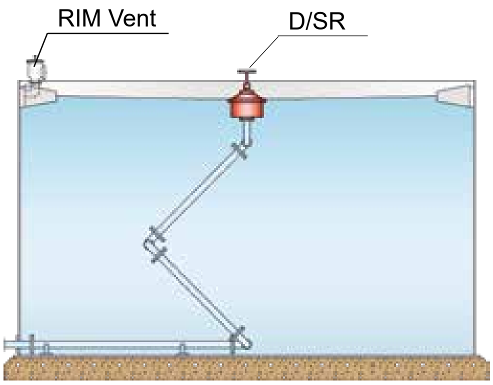
Maximum rainfall to be drained off (m³/h or CFH)

Material of floating roof

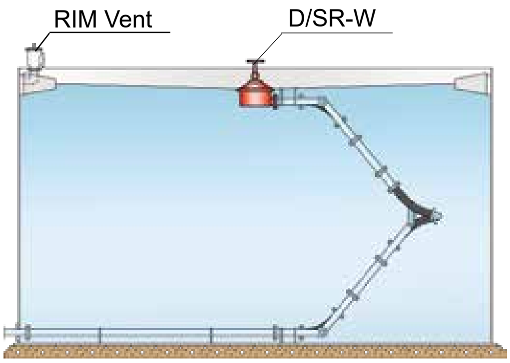
Connection size of the floating roof drainage system DN (mm or inches)

Design of floating roof drainage system

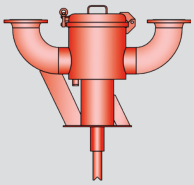
Application Examples



PROTEGO® roof drain valve type D/SR in combination with Floating roof drainage system PROTEGO® SE/CK

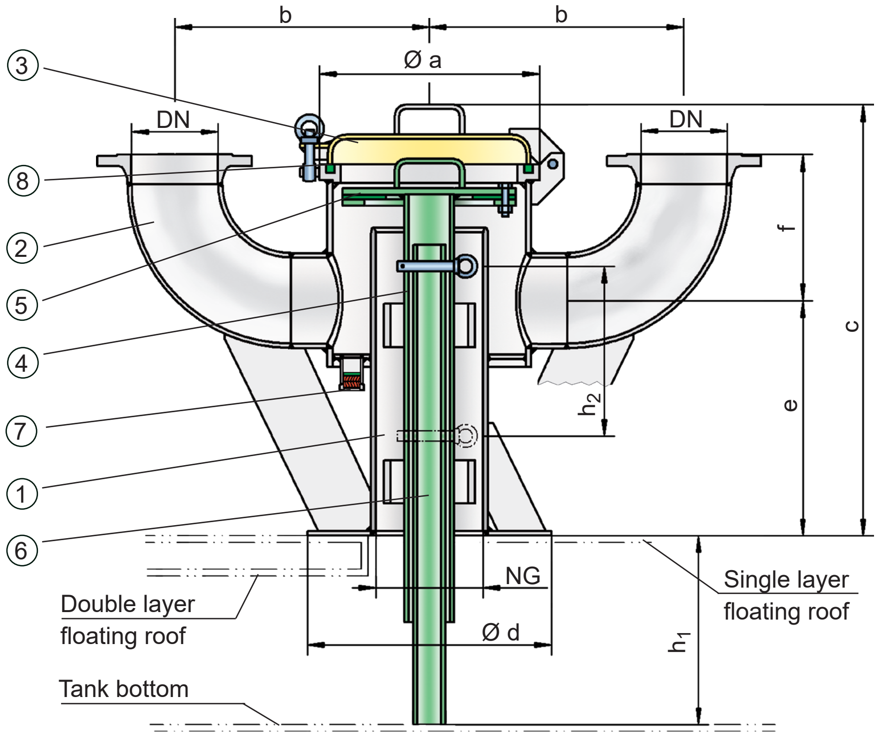


PROTEGO® roof drain valve type D/SR-W in combination with Floating roof drainage system PROTEGO® SE/K.

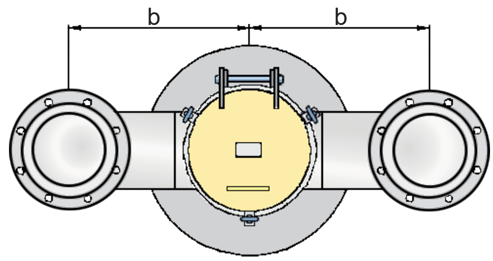


Vent Valve, Lift-actuated

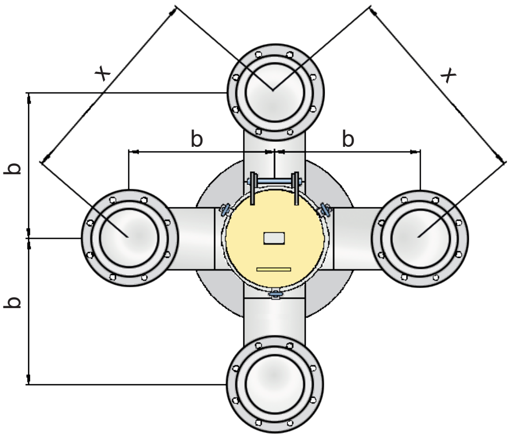
PROTEGO® AL/DK



Top view AL-DK



Top view AL-DK-4



Function and Description

PROTEGO® lift-actuated vent valves type AL-DK provide automatic venting of floating roof tanks when the floating roof is lowered onto its supports and the tank is either drained or refilled. When the floating roof is in its lowest position, the valve is forced to open through lift actuation, which prevents inadmissible vacuum during final draining or inadmissible pressure during refilling.

The PROTEGO® AL-DK valve consists of a housing (1) with a sheet metal panel to be welded onto the floating roof, two or four connection nozzles (2) for installation of vent caps, cover (3), lift (4) including valve disc (5), lift pipe (6), and the condensate drain valve (7) which can be designed to be flame transmission proof. The condensate drain is sealed by a flat gasket attached to the valve disk (5). The cover (3) is sealed by a sealing cord (8).

As the lowest position of the floating roof varies for operation and assembly, specify the dimensions h_1 and h_2:

h_1: Distance between the lower edge of sheet-metal panel (or mounting flange) and the tank bottom in lowest position of floating roof (operating position with an empty tank).

h_2: Distance between the floating roof in lifted maintenance position and the height of the floating roof in fully lowered operating position (operating position with an empty tank).

If the floating roof supports are changed from operating position to maintenance position, the lift has to be extended as well. This is done with an adjustable locking pin that is secured with a split pin.

The valve is not flame transmission proof.

Based on a hazard analysis with regard to material selection and function, the valves have no potential ignition sources. As a result, they are not subject to the European Explosion Protection Directive (ATEX) when used in explosive atmospheres.

Designs and Specifications

Two designs are available:

Vent valve with two connections	**AL-DK**
Vent valve with four connections	**AL-DK- 4**

Tabelle 1: Maßtabelle								
	AL-DK						AL-DK-4	
DN1	200 / 8“	200 / 8"	200 / 8"	200 / 8"	250 / 10“	250 / 10“	200 / 8“	200 / 8“
DN2	80 / 3“	100 / 4"	150 / 6"	200 / 8"	150 / 6“	200 / 8“	100 / 4“	200 / 8“
a	350 / 13.78	350 / 13.78	350 / 13.78	350 / 13.78	350 / 13.78	350 / 13.78	350 / 13.78	350 / 13.78
b	465 / 18.31	465 / 18.31	465 / 18.31	515 / 20.28	465 / 18.31	515 / 20.28	465 / 18.31	650 / 25.59
c	870 / 34.25	870 / 34.25	870 / 34.25	870 / 34.25	870 / 34.25	870 / 34.25	870 / 34.25	870 / 34.25
d	450 / 17.72	450 / 17.72	450 / 17.72	450 / 17.72	450 / 17.72	450 / 17.72	450 / 17.72	600 / 23.62
e	345 / 13.58	360 / 14.17	385 / 15.16	415 / 16.34	385 / 15.16	415 / 16.34	415 / 16.34	415 / 16.34
f	460 / 18.11	445 / 17.52	285 / 11.22	370 / 14.57	285 / 11.22	367 / 14.45	445 / 17.52	370 / 14.57
x							658 / 25.91	920 / 36.22

Dimensions in mm / inches

Table 2: Material		
Housing	Steel	Special materials upon request.
Valve guide	Stainless Steel	
Gasket	FPM	

Table 3: Flange connection type DN	
EN 1092-1, Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Selection and Design

The required amount and nominal size DN is determined based on the calculated flow rate from the thermal venting and pump rate in lowest floating roof position (Nm³/h or CFH) and on the maximum acceptable tank pressure p_T (mbar / inch W.C.) according to the flow capacity charts. Special designs are available upon request.

Flow rates and pressure losses of vent caps PROTEGO® EB or PROTEGO® LH/AD have to also considered according to the appropriate charts in the relevant data sheets.

Necessary Data for Specification

Stored product

Tank diameter (m or ft)

Tank height (m or ft)

Support height h_1 (operating position with empty tank)

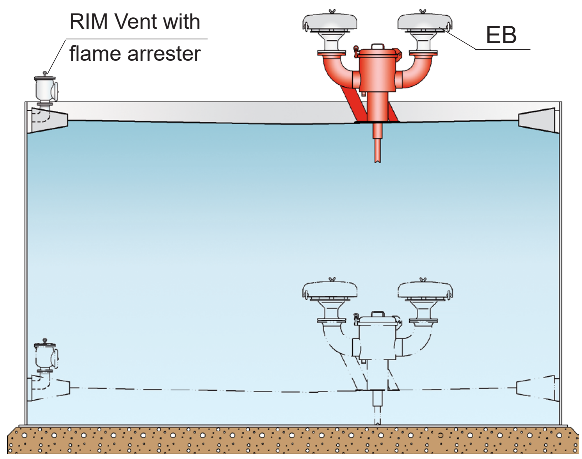
Support height h_2 (lifted assembly position)

Maximum allowable tank pressure p_T (mbar or inch W.C.)

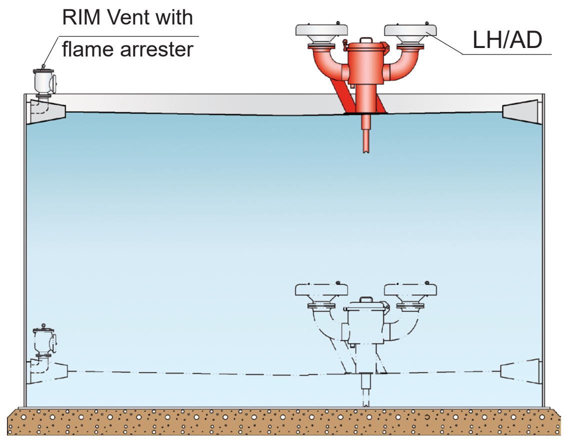
Pump rate (m³/h or CFH)

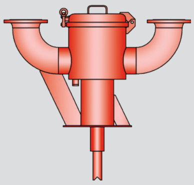
Application Examples

Lift-actuated vent valves PROTEGO® AL-DK can be combined with vent caps PROTEGO® EB which are deflagration-proof and endurance burning-proof. This ensures flame transmission- proof ventilation.



If endurance burning-proof is not required, the valves can be combined with deflagration-proof PROTEGO® LH/AD devices. The applicable data sheets are available in Sec. 2 “Deflagration Flame Arresters, End-of-Line and Vent Caps”.

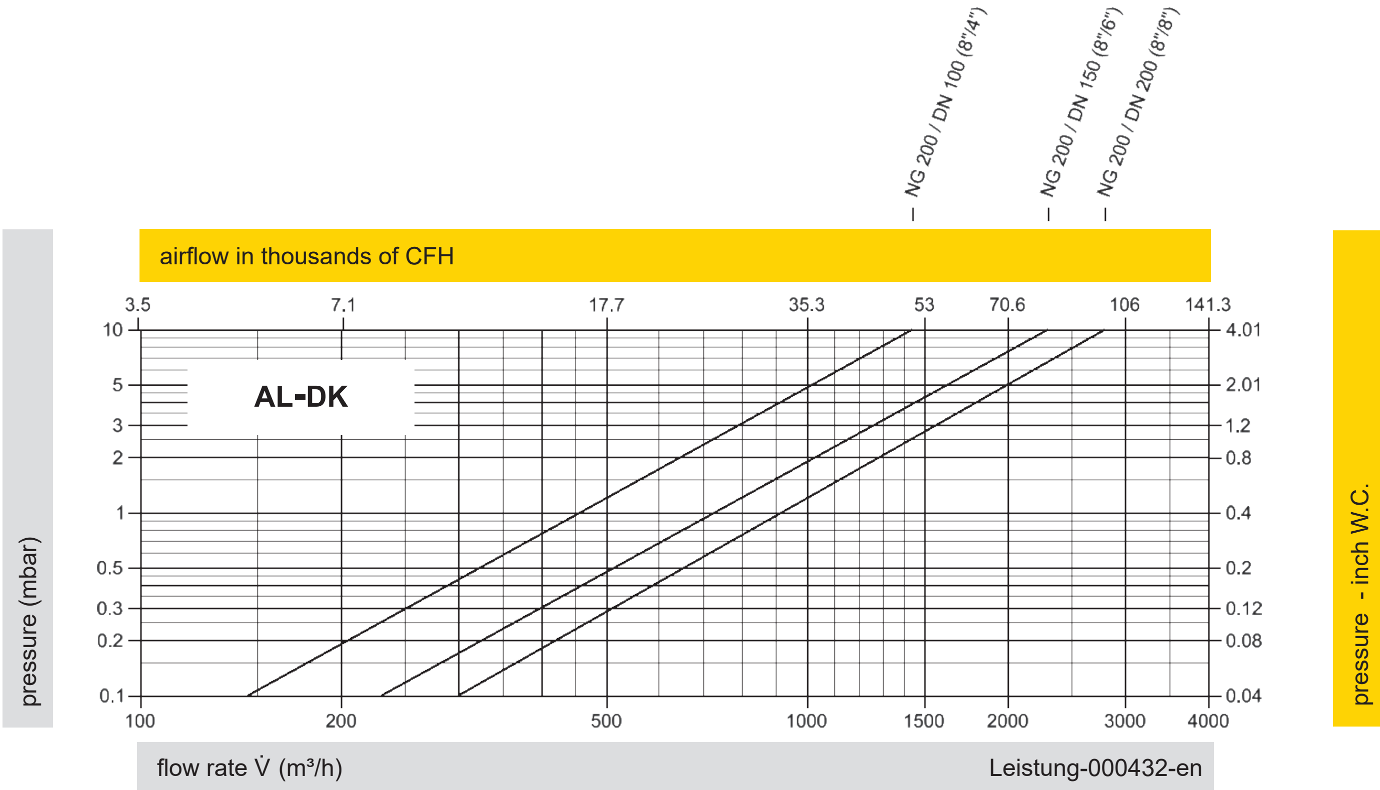




Vent Valve, Lift-actuated

Flow Capacity Chart

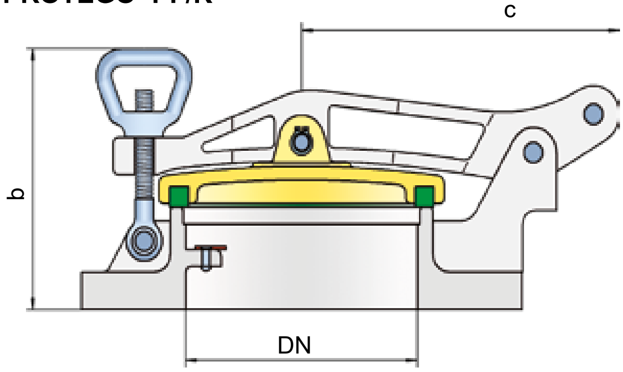
PROTEGO® AL-DK



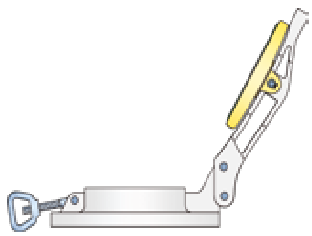
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

Notes:

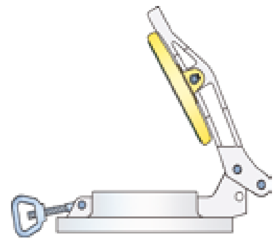
PROTEGO® PF/K



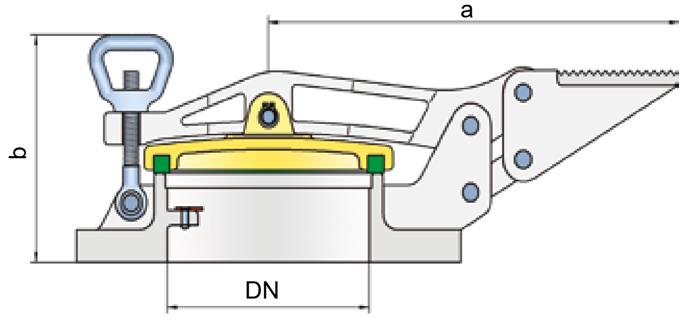
Design "I"
remaining open



Design "II"
automatic cover closing

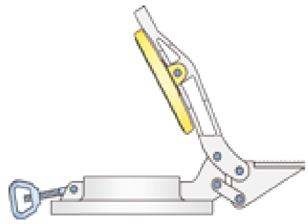


PROTEGO® PF/TK

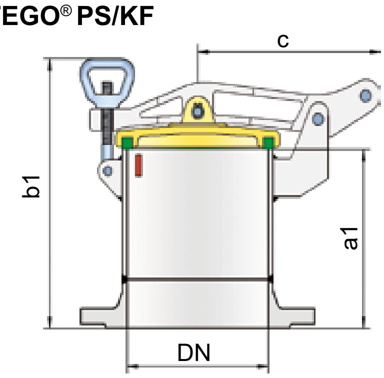


Pedal-operated version

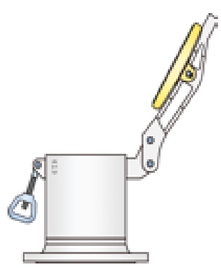
automatic cover closing



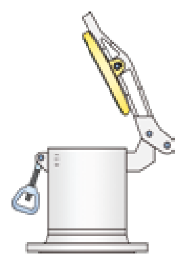
PROTEGO® PS/KF



Design "I"
remaining open



Design "II"
automatic cover closing



Function and Description

PROTEGO® gauge hatches types PF/K, PF/TK, and PS/KF are used as lockable gauge nozzles which are only opened for gauging or sampling. Otherwise, they are tightly closed.

The gauge hatches PROTEGO® PF/K, PF/TK, and PS/KF mainly consist of housing, cover, and bracket. The housing is equipped with stainless steel gauge marks as standard.

In the pedal-operated version PROTEGO® PF/TK, the gauging nozzle pedal is connected to both the housing and the bracket.

Design Types and Specifications

Depending on the intended use, the following designs are available:

Gauge hatch with flange	**PF/K** design I and II „I“ : remaining open „II“ : automatic cover closing
Gauge hatch with flange and pedal	**PF/TK** automatic cover closing
Gauge hatch with flange nozzle	**PS/KF** design I and II „I“ : remaining open „II“ : automatic cover closing

PROTEGO® PS/K and PS/TK are available for welding onto the tank. A separate data sheet is available.

Table 1: Dimensions			Dimensions in mm / inches
DN	100 / 4"	150 / 6"	200 / 8"
a	260 / 10.24	305 / 12.01	335 / 13.19
b	150 / 5.91	155 / 6.10	175 / 6.89
c	160 / 6.30	205 / 8.07	235 / 9.25
a1	225 / 8.86	265 / 10.43	300 / 11.81
b1	315 / 12.40	360 / 14.17	405 / 15.94

The nominal size depends on the dimensions of the gauging and sampling device.

Table 2: Material selection				
Design	A	B	C	D
Housing	Ductile Iron*	Stainless Steel	Aluminum	Steel
Cover	Ductile Iron*	Stainless Steel	Aluminum Stainless Steel**	Steel

The combination of steel and aluminum in explosive environments is prohibited due to risk of ignition.
* only for PF/K and PF/TK
** only for PF/TK-100

Flange Connection Type

The flange connection is in accordance with EN 1092-1, Form A. Optionally, the connecting flange can be made in accordance with any international standard.

Necessary Data for Specification

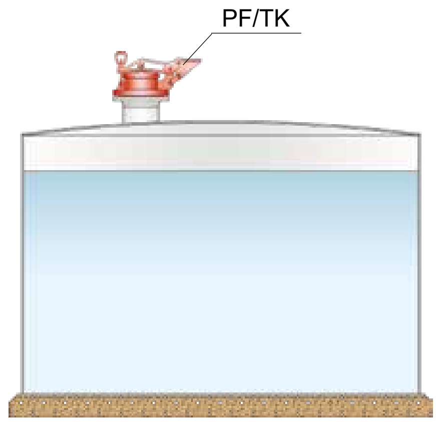
Stored product

Tank material

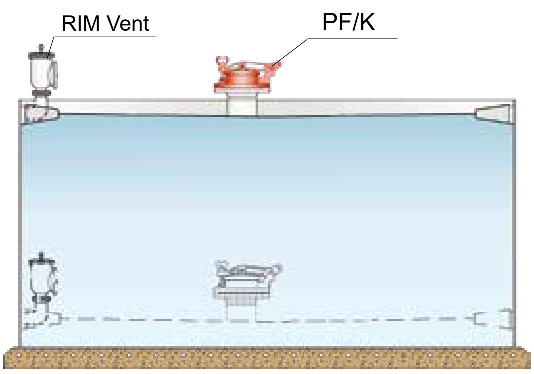
Tank nozzle DN (mm or inches)

Application Examples

Gauge hatches can, for example, be used in combination with the manual gauge devices PROTEGO® H/P or with the gauging and sampling device PROTEGO® VP/HK.



Gauge hatches can be installed on tanks with floating roofs.



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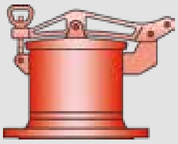
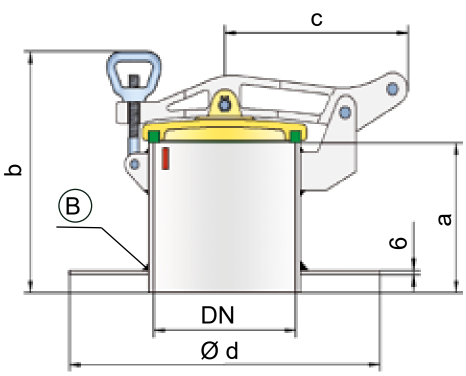


Gauge Hatch

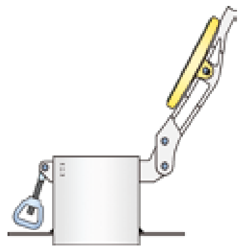
with Welded nozzle

PROTEGO® PS/K, PS/TK

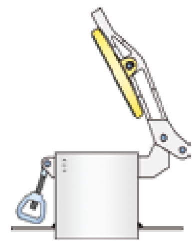
PROTEGO® PS/K



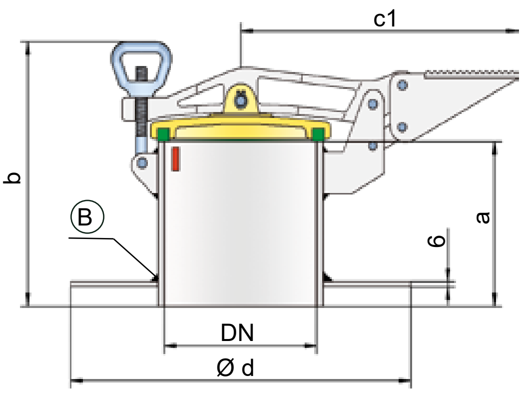
Design “I”
remaining open



Design “II”
automatic cover closing

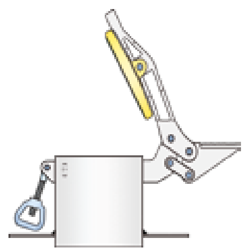


PROTEGO® PS/TK



Pedal-operated version

automatic cover closing



Ⓑ Welding on-site

Function and Description

PROTEGO® gauge hatches PS/K and PS/TK are used as lockable gauge nozzles which are only opened for gauging or sampling.

The gauge hatches PROTEGO® PS/K and PS/TK mainly consist of housing, cover, and bracket. As a standard, the housing has stainless steel gauge marks.

In the pedal-operated version PROTEGO® PS/TK, the gauging nozzle pedal is connected to both the housing and the bracket

Design Types and Specifications

Depending on the intended use, the following designs are available:

Gauge hatch with welding nozzle	**PS/K** design I and II „I“ : remaining open „II“ : automatic cover closing
Gauge hatch with welding nozzle and pedal	**PS/TK** automatic cover closing

Gauge hatches with flange are available as type PROTEGO® PF/K, PF/TK and PS/KF. A separate data sheet is available.

Table 1: Dimensions			Dimensions in mm / inches
DN	100 / 4"	150 / 6"	200 / 8"
a	175 / 6.89	225 / 8.86	250 / 9.84
b	265 / 10.43	320 / 12.60	355 / 13.98
c	160 / 6.30	205 / 8.07	235 / 9.25
c1	260 / 10.24	305 / 12.01	335 / 13.19
d	275 / 10.83	350 / 13.78	450 / 17.72

The nominal size depends on the dimensions of the gauging and sampling device.

Table 2: Material selection		
Design	A	B
Housing	Steel	Stainless Steel*
Cover	Ductile Iron	Stainless Steel*

* Only for PS/K

Flange Connection Type

The flange connection is in accordance to EN 1092-1, Form A. Optionally, the connecting flange can be made in accordance with any international standard.

Necessary Data for Specification

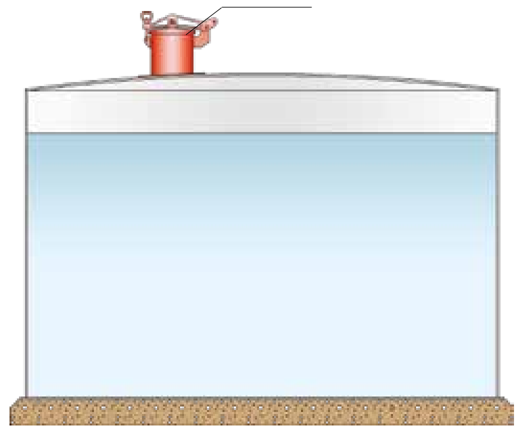
Stored product

Tank material

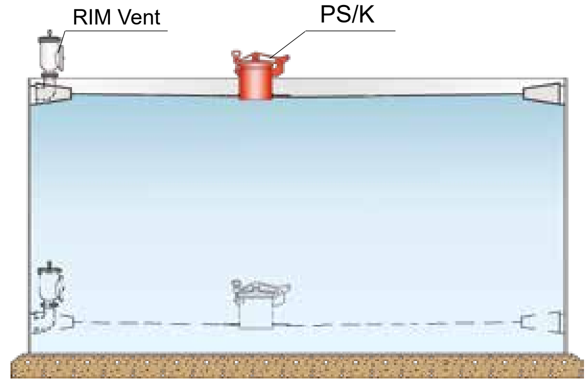
Tank nozzle DN (mm or inches)

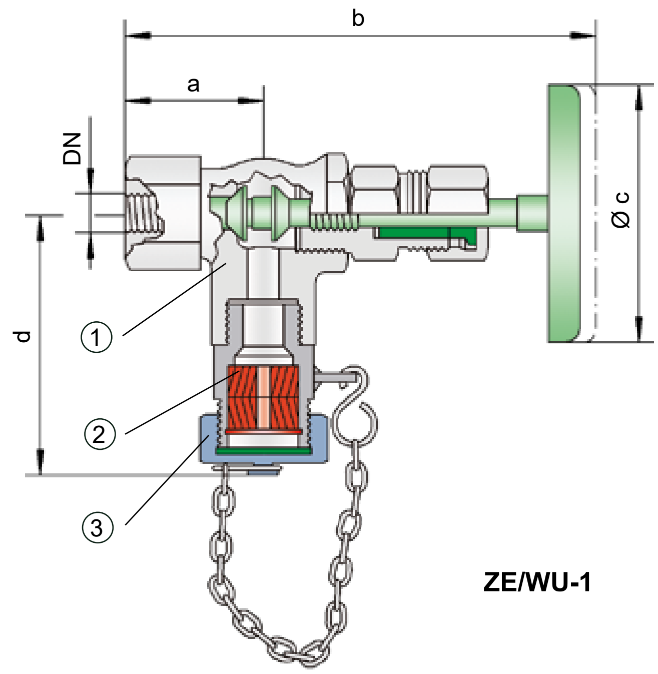
Application Examples

Gauge hatches can, for example, be used in combination with the manual gauge devices type PROTEGO® H/P or with the gauging and sampling device PROTEGO® VP/HK.



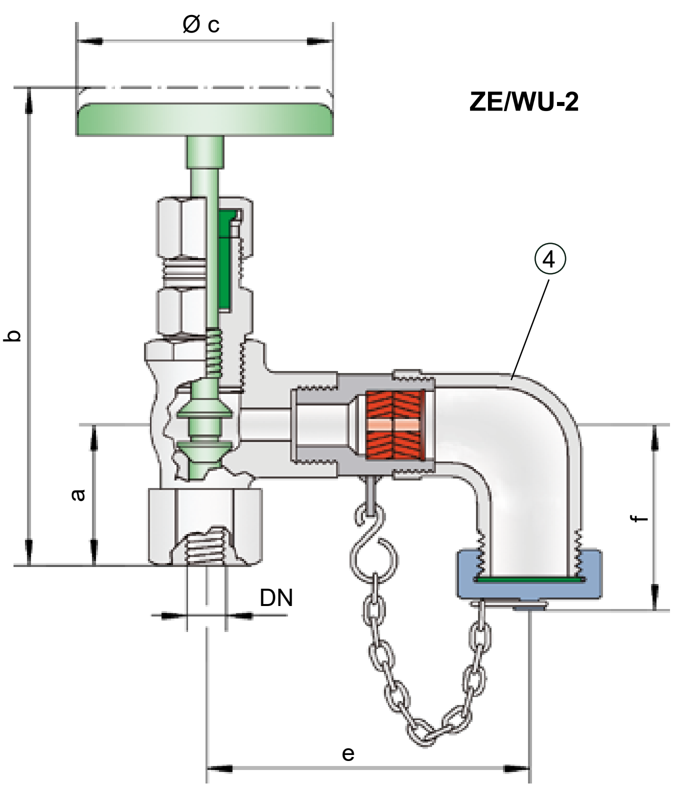
Gauge hatches can be welded onto tanks with floating roof.





ZE/WU-1

Standard design up to PN 25



ZE/WU-2

Function and Description

The PROTEGO® sampling and air bleed valve is used for flame transmission-proof venting of pipelines and equipment that transports or processes flammable liquids and for taking liquid samples. The valve incorporates an end-of-line deflagration flame arrester. Should the gas/air mixtures or product vapor/air mixtures ignite during venting, the valve prevents flash back into the protected system.

The sampling and air bleed valve PROTEGO® ZE/WU consists of the threaded angle valve in pressure stage PN25 (1) with hand wheel as standard design, a female threaded connection (pipe thread G½"up to G1"), and the flame arrester (2) with cover (3).

Optionally, an elbow fitting (4) is available as outlet for sampling. The PROTEGO® flame arrester (2) consists of the flame arrester casing with FLAMEFILTER®.

The valve opens manually with the hand wheel. For sampling, a suitable container is required.

The simple and sturdy design makes it suitable for nearly all flammable liquids. This device can be installed in any position.

Flame transmission protection is guaranteed against atmospheric deflagrations of gas/air mixtures or product vapor/air mixtures of explosion groups up to IIB IIB (NEC group D to C) up to an operating temperature of +60°C / 140°F and an absolute operating pressure of up to 1.1 bar / 15.9 psi.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Designs and Specifications

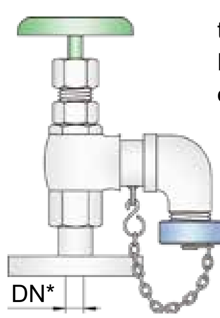
There are two designs available:

Sampling and air bleed valve, standard design **ZE/WU - 1**

Sampling and air bleed valve with elbow **ZE/WU - 2**

Special designs for higher pressures are available

Also available with flange connection (see figure).



* The flange is available in drilling pattern and thickness for DN15 / ½", DN20 / ¾", DN25 / 1", DN32 / 1¼", DN40 / 1½" , and for PN25/40 or PN100 upon request.

Table 1: Dimensions					Dimensions in mm / inches	
DN	a	b	Ø c	d	e	f
15 / G½"	40 / 1.57	140 / 5.51	70 / 2.76	80 / 3.15	96 / 3.78	67 / 2.64
20 / G¾"	50 / 1.97	165 / 6.50	85 / 3.35	80 / 3.15	89 / 3.50	67 / 2.64
25 / G1"	65 / 2.56	200 / 7.87	100 / 3.94	95 / 3.74	104 / 4.09	67 / 2.64

Table 2: Explosion group		
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)
≥ 0,50 mm	IIB	B

Table 3: Material	
Design	A
Threaded angle valve	Stainless Steel
Elbow	Stainless Steel
Cover	Stainless Steel
FLAMEFILTER®	Stainless Steel

The valve must be sufficiently resistant to corrosion through the gas/air mixtures or product vapor/air mixtures. This applies especially to the FLAMEFILTER®.

Table 4: Type of connection	
Pipe thread DIN ISO 228 T1	DIN

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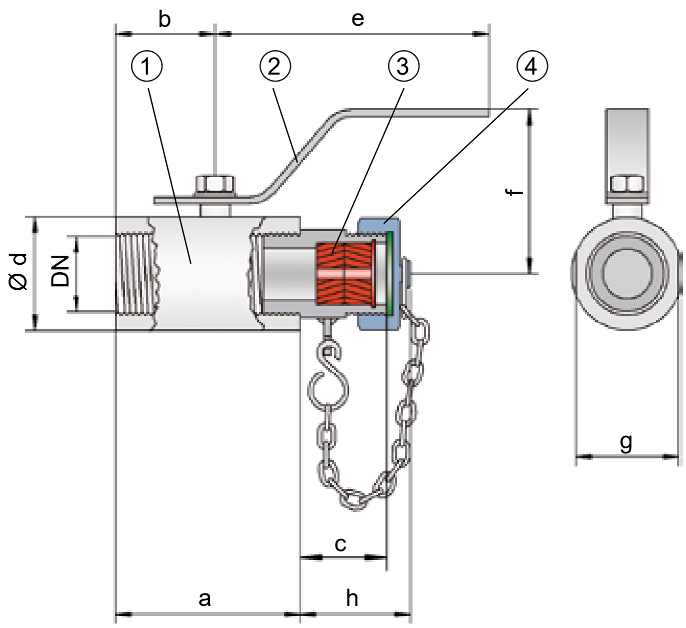
Condensate Drain Valve

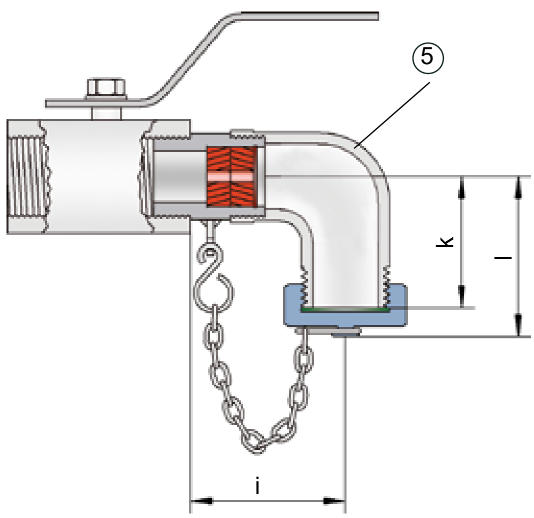
Deflagration-proof

PROTEGO® ZE/TK

ZE/TK-1



ZE/TK-2



Function and Description

The PROTEGO® ZE/TK condensate drain valve is used for flame transmission-proof condensate drainage of devices or plant equipment (e.g., tanks, pipelines, etc.) where flammable liquids can form condensate and flammable product vapor/ air mixtures could develop. They can also be used for the venting of tanks, plant components, and pipes that transport or process flammable liquids. The drain valve incorporates an end-of-line deflagration flame arrester.

The condensate drain valve PROTEGO® ZE/TK consists of the ball valve (1) with hand lever (2), a female threaded connection (e.g., pipe thread G½" up to G1"), and the flame arrester (3) with cover (4).

The elbow fitting (5) is also available as an optional outlet.

The flame arrester (3) consists of the flame arrester casing and FLAMEFILTER®.

The ball valve is opened with the hand lever. When draining condensate, a suitable container is required. When draining flammable and/or toxic products, observe the appropriate safety provisions.

The simple and sturdy design is suitable for nearly all flammable liquids and can be installed in any position.

Flame transmission protection is guaranteed against atmospheric deflagrations of product vapor/air mixtures of explosion groups up to IIB (NEC groups D to C) up to an operating temperature of +60°C/140°F and an operating pressure up to 1.1 bar/15.9 psi.

EU conformity according to the currently valid ATEX directive. Approvals according to other national/international regulations on request.

Designs and Specifications

There are two designs available:

Condensate drain valve, standard design	**ZE/TK -** $\boxed{1}$
Condensate drain valve with elbow	**ZE/TK -** $\boxed{2}$

Special designs are available upon request.

Table 1: Dimensions											Dimensions in mm / inches
DN	a	b	c	Ø d	e	f	g	h	i	k	l
15 / G½"	60 / 2.36	30 / 1.18	33 / 1.30	32 / 1.26	110 / 4.33	55 / 2.17	27 / 1.06	45 / 1.77	54 / 2.13	38 / 1.50	67 / 2.64
20 / G¾"	65 / 2.56	35 / 1.38	33 / 1.30	38 / 1.50	110 / 4.33	60 / 2.36	34 / 1.34	45 / 1.77	54 / 2.13	38 / 1.50	67 / 2.64
25 / G1"	73 / 2.87	40 / 1.57	33 / 1.30	45 / 1.77	110 / 4.33	65 / 2.56	41 / 1.61	45 / 1.77	54 / 2.13	38 / 1.50	67 / 2.64

Table 2: Explosion group		
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)
≥ 0,50 mm	IIB	B

Table 3: Material	
Ball valve	Stainless Steel
Elbow	Stainless Steel
Cover	Stainless Steel
FLAMEFILTER®	Stainless Steel

The valves must be sufficiently resistant to corrosion through the gas/air mixtures or product vapor/air mixtures. This applies especially to the FLAMEFILTER®. If necessary, designs in special stainless steel quality should be selected.

Table 4: Type of connection	
Pipe thread DIN ISO 228 T1	DIN

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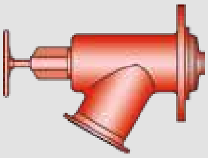
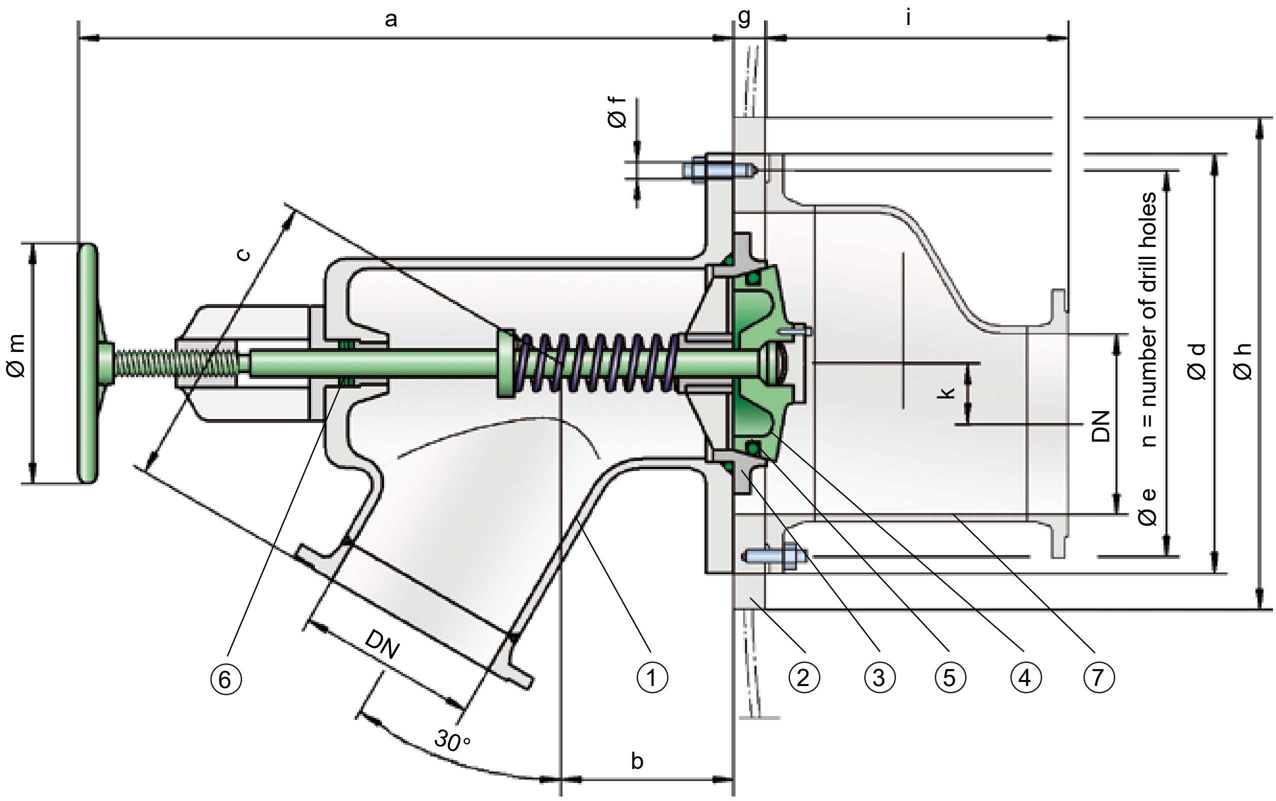


In-tank Valve

Internal Safety Valve

PROTEGO® SI/F



Function and Description

The PROTEGO® SI/F in-tank valve is a shut-off valve and protects the downstream liquid lines of storage tanks and containers in process plants in the chemical, petrochemical, and pharmaceutical industries. This valve also increases safety and operation of the equipment. These valves are also known as in-tank valves.

The in-tank valve SI/F (figure 1) consists of the housing (1), mounting flange (2), valve seat (3), valve disc (4), and sealing (5). The mounting flange is welded into the tank shell. The valve seat is replaceable. The valve seat and valve disc are lapped metallic surfaces and an additional O-ring is installed to ensure the required tightness. The spindle sealing (6) can be adjusted or replaced and is designed for a test pressure of 25 bar / 363 psi.

The external connection piece of the housing is fitted with an operating valve, which is supplied by the customer, and is used for normal operation. The internal safety valve is kept open during normal operation. It is only closed in the event of a longer operation interruption, in an emergency, or for necessary repairs.

It is closed by an “internal sealing“, i.e., the valve is closed inside of the tank. This prevents the tank from leaking even if external components or leaks in any connected pipelines are destroyed.

Due to the special design of PROTEGO® in-tank valves SI/F, in which only the mounting flange (2) is welded to the tank shell, almost all other parts can be replaced. Replacement of important external parts does not require draining the tank. This results in significant operational advantages.

The PROTEGO® SI/F is available in various nominal sizes and materials. As an option, the in-tank valve can be equipped with an internal nozzle (7) for mounting a suction and filling pipe or a swing pipe system (SI/FA).

Tank shut-off valves of this type are usually operated manually. Versions with an explosion-proof electric actuator for direct or remote control are also available.

For special tank designs (e.g., full containment tank system), special versions with pneumatic control (PROTEGO® SI/DP) can also be supplied.

Design Types and Specifications

Two designs are available:

In-tank valve, standard design	**SI/F**
In-tank valve with internal connection nozzle (7)	**SI/FA**

Table 1: Dimensions												Dimensions in mm / inches
DN	a	b	c	d	e	f	g	h	i	k	m	n
50 / 2"	371/14.61	75/2.95	170/6.69	240/9.45	205/8.07	14/0.55	30/1.18	305/12.01	250/9.84	54/2.13	200/7.87	8
65 / 2 ½"	400/15.75	85/3.35	190/7.48	305/12.01	205/8.07	14/0.55	30/1.18	305/12.01	240/9.45	45/1.77	200/7.87	8
80 / 3"	416/16.38	90/3.54	200/7.87	330/12.99	230/9.06	14/0.55	30/1.18	330/12.99	290/11.42	53/2.09	200/7.87	8
100 / 4"	434/17.09	100/3.94	225/8.86	270/10.63	230/9.06	14/0.55	30/1.18	330/12.99	270/10.63	40/1.57	200/7.87	8
150 / 6"	658/25.91	130/5.12	320/2.60	410/16.14	370/14.57	18/0.71	40/1.57	505/19.88	440/17.32	78/3.07	400/15.75	12
200 / 8"	725/28.54	145/5.71	365/14.37	540/21.26	405/15.94	18/0.71	45/1.77	540/21.26	450/17.72	68/2.68	400/15.75	12

Table 2: Material selection		
Design	A	B
Housing	Steel	Stainless Steel
Valve seat	Stainless Steel	Stainless Steel
Valve disc	Stainless Steel	Stainless Steel
Spring	Stainless Steel	Stainless Steel
Bushing	PTFE	PTFE
Hand wheel	Aluminum	Aluminum
Spindle sealing	PTFE	PTFE
Mounting flange	Steel	Stainless Steel

Table 3: Flange connection type DN	
EN 1092-1, Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Selection and Design

Together with our engineers, the valve is designed for each specific application. The relevant plant specifications are considered when defining the required nominal sizes and connection types. Regarding temperature, special operating conditions may require special materials. The mounting flange material must be compatible with the tank material. If there are special requirements for the valve or operating parameters, please contact us. Special designs may also be necessary.

Necessary Data for Specification

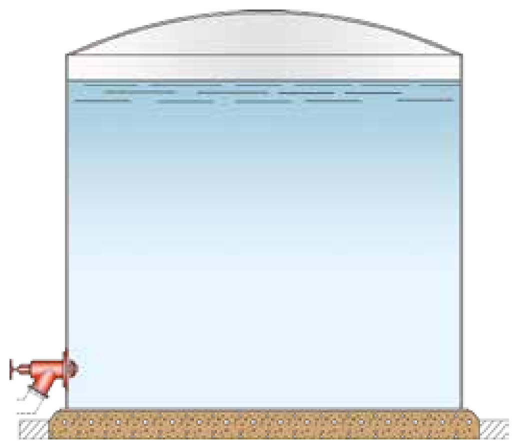
Stored medium

Tank height (m or ft)

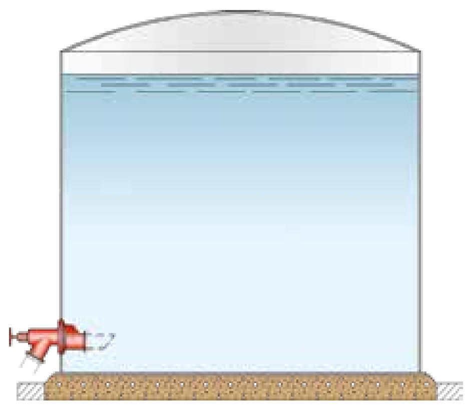
Tank material

Connection diameter of drain pipe, DN (mm or inch)

Application Examples



PROTEGO® SI/F



PROTEGO® SI/FA with internal connection nozzle www.protego.com

for safety and environment

PROTEGO® Equipment for Cryogenic Storage Tanks

Section 9

PROTEGO
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Pressure/vacuum relief valves

Decades of experience in manufacturing pilot-operated pressure/vacuum relief valves, our expertise in computer-optimized design, and our extensive test facilities form the basis for the development of the most powerful vent valves.

The storage of cryogenic liquified gases makes special demands on the venting devices required for tank equipment. These valves are designed in accordance with the applicable standards and the operating point of the various products in the process. Pilot-operated pressure and vacuum relief valves - if necessary, used in combination with separate pallet valves - ensure that maximum allowable operating pressures of the tank are not exceeded.

Pilot-operated pressure and vacuum relief valves achieve maximum tightness up to the set pressure. Spring-loaded and magnet-loaded pilots are the main valve’s reliable switching components.

Optional backflow preventers, test connections, and test equipment are available for functional inspections at the point of installation.

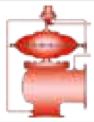
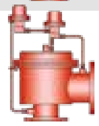
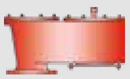
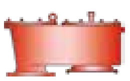
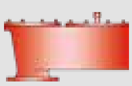
Using shuttle valves allows the operation of valves in AND/ OR mode and to carry out maintenance at the point of use.

Safety & In-Tank Valves

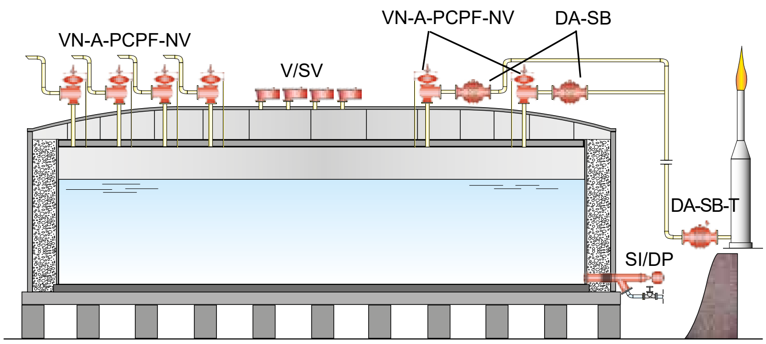
So-called in-tank valves (actuator operated shut-off valve with “fail close” function) are used mainly in cryogenic tanks where the tank wall or the bottom is penetrated by the discharge pipe. In the event of malfunctions, in-tank valves are used as a shut-off valve to minimize the spread of hazards due to product spills.

Catalog

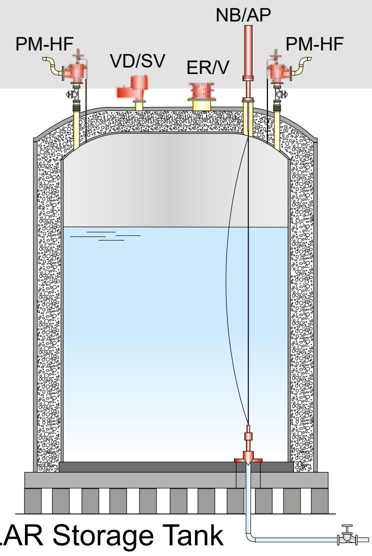
PROTEGO® Equipment for Cryogenic Storage Tanks

	Type	Size	positive setting range mbar / inch W.C.	negative setting range mbar / inch W.C.	Design O = horizontal connection X = vertical connection	O = soft sealing X = metallic sealing	O = for non-standard operating parameters	O = for critical substances (polymerization, corrosion, crystallization)	O = Heating jacket, Heating coil	Page
Pressure and Vacuum Relief Valves, pilot-operated										
	VN-A-PCPF	50 - 300 2“ - 12“	+20 up to +1034 +8.0 up to +415.1	-2.0 up to -7 / -0.8 up to -2.8	X	X	O			408 - 411 416
	VN-A-PCPM	50 - 300 2“ - 12“	+20 up to +1034 +8.0 up to +415.1	-2.0 up to -7 / -0.8 up to -2.8	X	X	O			*NEW* 412 - 416
	PM-HF	80 - 300 3" - 12"	+10 up to +1034 / +4.0 up to +415.1	-2.2 up to -7 / -0.88 up to -2.8	X	X	O			
	PM/(D)S	80 - 300 3“ - 12“	+10 up to +300 / +4.0 up to +120	-3.0 up to -7 / -1.2 up to -2.8	X	X	O			*NEW*
Vacuum Relief Valves, Pallet Type										
	V/SV-XL	300 12“		-2.0 up to -16 / -0.8 up to -6.4	X	O / X			O	418 - 419
	V/SV-XXL	300 12“		-2.0 up to -16 / -0.8 up to -6.4	X	O / X			O	420 - 421
	V/SV	40 - 300 1½“ - 12“		-2.0 up to -60 / -0.8 up to -24	X	O / X			O	
Change-Over Valve										
	WV/T	80 - 250 3“ - 10“								422 - 423
In-Tank Valves										
	NB/AP	150 - 200 6" - 8"	Description	In-Tank Valve Fast Action Bottom Drain Valve with pneumatic actuator						424 - 425
	ITV-S	150 - 600 6“ - 24“	Description	In-Tank Valve with side						426 - 428
	SI/DP	150 - 300 6" - 12"	Description	In-Tank Valve Internal Safety Valve						430 - 431

Cryogenic Tank Applications
(Flyer pdf)

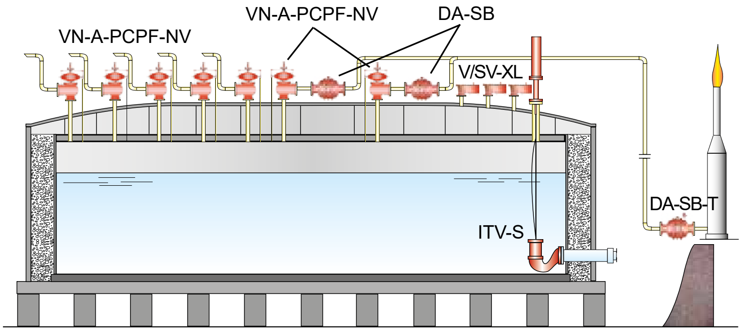


Ammonia Storage Tank



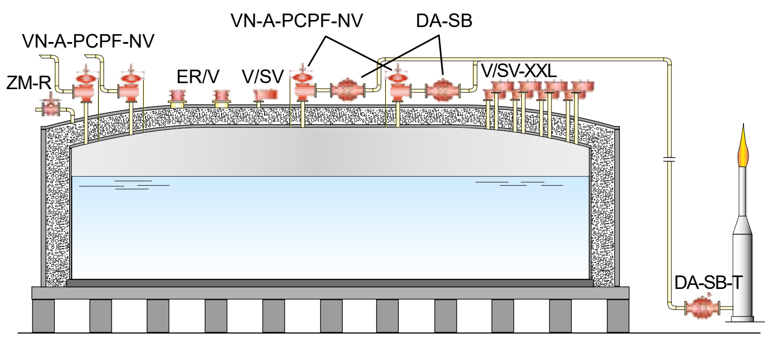
LIN-LOX-LAR Storage Tank

- Pilot-operated valves that solve instability problems during operation (fluttering and chattering).
- Cleaning for oxygen applications upon request.
- Cryogenic function test upon request.
- Pressure and Vacuum Valves.
  - 10% technology for lowest pressure increase up to full lift)
  - Spring-loaded or weight-loaded
- Extreme tightness of overpressure and vacuum valves (much lower than the requirements of ISO 28300 and API 2000, 7th Ed.)
- Pressure reducing valves



Ethylene Storage Tank

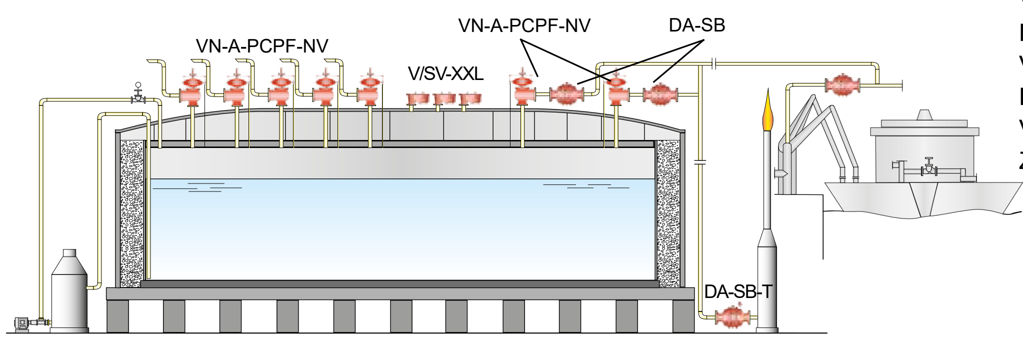
- Pneumatic and fast-acting In-Tank Valves.
- Pneumatic and manual Internal Safety Valves.



Propylene Storage Tank

- ATEX approved Flame Arresters
  - End-of-line
    - Deflagration Flame Arresters
    - Endurance burning-proof Flame Arresters
  - In-line
    - Deflagration Flame Arresters
    - Detonation Flame Arresters

- Sold globally, serviced locally (PARC).
- Fully ATEX, ISO 9001, and ISO 14001 certified international company.



LNG Storage Tank

Products

VN-A-PCPF-NV, V/SV, ITV-S (→)
NB/AP, SI/DP, PM-HF (→ Section 9)
V/SV-XL, V/SV-XXL(→ Section 9)
DA-SB, DA-SB-T (→ Section 4)
VD/SV, ER/V (→ Section 5)
ZM-R (→ Section 6)

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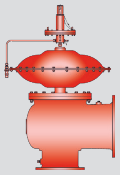
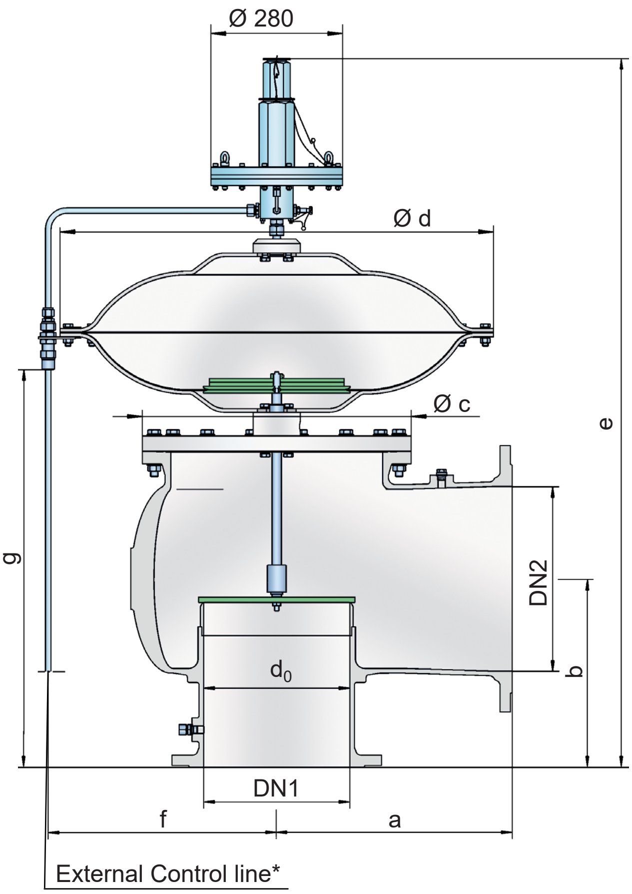


Pressure/Vacuum Relief Valve

Pilot-operated diaphragm valve

PROTEGO® VN-A-PCPF



The main valve is controlled by a pilot valve which is controlled by the tank pressure. A small amount of vapor is released into the atmosphere by the pilot valve when the valve opens. The set pressure is adjusted by increasing or decreasing the tension on the spring on the pilot valve.
As the pressure increases, the closing force on the main valve increases, i.e., the valve becomes tighter with increasing tank pressure until the set pressure is reached. Once the valve has started to lift, it opens fully within a 10% of the pressure increase or opening pressure difference, and the nominal volume flow is released through a fully open valve. If and when this level is exceeded, the pressure increase will follow the performance curve ($\Delta p/\dot{V}$ curve). From set pressure to full capacity (fully open valve), the pressure increase is 100% in case of vacuum venting/in-breathing function.
The tank pressure is maintained up to the set pressure with a tightness that is above the normal standards due to our highly developed manufacturing technology. This feature is ensured by valve seats made of high quality stainless steel with precisely lapped valve discs. After the overpressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

Special Features and Advantages

- controlled by corrosion-resistant control valve (pilot valve)
- small amounts of tank substance is released into the atmosphere when the valve is opened
- max. 10% pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- protection of the main valve control diaphragm from low temperatures – high durability
- high flow capacity
- can be used in explosion hazardous areas
- field test connection possible upon request
- field test kit upon request

Settings:
Pressure:
+20 mbar up to +1034 mbar
+8 inch W.C. up to +415.1 inch W.C.
Vacuum:
-2 mbar up to -7 mbar
-0.8 inch W.C. up to -2.8 inch W.C.
Higher or lower settings upon request.

Function and Description

The PROTEGO® Type VN-A-PCPF pilot-controlled diaphragm valve is a newly developed valve for pressure and vacuum relief. It is primarily used as a safety device for out-breathing in tanks, containers, and process equipment. It provides protection against vacuum and overpressure and prevents the intake of air and unallowable product vapor loss up to the set pressure.
The valve can also be used as an in-breathing valve where the main valve is directly controlled when it is exposed to a vacuum, i.e., it functions as a weight-loaded diaphragm valve.

Design Types and Specifications

Basic design of pressure/vacuum relief valve with a control pilot valve	**VN-A-PCPF**

Additional special devices available upon request.

* It is recommended that an external control line is to be provided with direct connection to the tank.

Table 1: Dimensions — Dimensions in mm / inches

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

DN1	DN2	a	b	c	d	e	f	g
50 / 2“	50 / 2“	175 / 6.89	175 / 6.89	170/ 6.69	360 / 14.17	916 / 36.06	205 / 8.07	343 / 13.53
50 / 2“	80 / 3“	175 / 6.89	175 / 6.89	170/ 6.69	360 / 14.17	931 / 36.65	205 / 8.07	358 / 14.09
80 / 3“	80 / 3“	200 / 7.87	200 / 7.87	205 / 8.07	360 / 14.17	957 / 37.68	205 / 8.07	383 / 15.08
80 / 3“	100 / 4“	200 / 7.87	200 / 7.87	205 / 8.07	360 / 14.17	967 / 38.07	205 / 8.07	393 / 15.47
100 / 4"	100 / 4"	225 / 8.86	225 / 8.86	250 / 9.84	360 / 14.17	991 / 39.02	205 / 8.07	418 / 16.46
100 / 4"	150 / 6"	225 / 8.86	225 / 8.86	250 / 9.84	360 / 14.17	1001/39.41	205 / 8.07	428 / 16.85
150 / 6"	150 / 6"	300 / 11,81	250 / 9.84	335 / 13.19	500 / 19.69	1104 / 43.46	275 / 10.83	503 / 19.80
150 / 6"	200 / 8"	300 / 11,81	250 / 9.84	335 / 13.19	500 / 19.69	1124 / 44.25	275 / 10.83	523 / 20.59
200 / 8"	200 / 8"	375 / 14.77	300 / 11,81	410 / 16.14	630 / 24.80	1237 / 48.70	340 / 13.39	610 / 24.02
200 / 8"	250 / 10"	375 / 14.77	300 / 11,81	410 / 16.14	630 / 24.80	1267 / 49.88	340 / 13.39	640 / 25.20
250 / 10"	250 / 10"	425 / 16.73	350 / 13.78	500 / 19.69	790 / 31.10	1357 / 53.43	420 / 16.54	710 / 27.96
250 / 10"	300 / 12"	425 / 16.73	350 / 13.78	500 / 19.69	790 / 31.10	1377 / 54.41	420 / 16.54	730 / 28.74
300 / 12"	300 / 12"	500 / 19.69	400 / 15.75	570 / 22.44	920 / 36.22	1468 / 57.80	485 / 19.09	803 / 31.61
300 / 12"	350 / 14"	500 / 19.69	400 / 15.75	570 / 22.44	920 / 36.22	1488 / 58.59	485 / 19.09	823 / 32.40
300 / 12"	400 / 16"	500 / 19.69	400 / 15.75	570 / 22.44	920 / 36.22	1508 / 59.37	485 / 19.09	843 / 33.19

Table 2: Material selection for housing

Design	A	B	C
Housing	Aluminum	Stainless Steel	LTCS * (Low Temperature Carbon Steel)
Valve seat	Stainless Steel	Stainless Steel	Stainless Steel
Sealing - housing	PTFE	PTFE	PTFE
Sealing - valve disc	Metal - to - Metal	Metal - to - Metal	Metal - to - Metal
Housing diaphragm	Stainless Steel	Stainless Steel	Stainless Steel
Pilot lines	Stainless Steel	Stainless Steel	Stainless Steel
Pilot housing	Aluminum	Aluminum / Stainless Steel	Aluminum / Stainless Steel
Pilot diaphragm	FEP	FEP	FEP

* Special materials upon request.

Table 3: Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Table 4: Coefficient of Discharge

DN1	DN2	d_0	K
50 / 2"	50 / 2"	54/2.13	0,57
50 / 2"	80 / 3"	54/2.13	0,83
80 / 3"	80 / 3"	83/3.27	0,75
80 / 3"	100 / 4"	83/3.27	0,74
100 / 4"	100 / 4"	108/4.25	0.69
100 / 4"	150 / 6"	108/4.25	0.85
150 / 6"	150 / 6"	160/6.30	0.7
150 / 6"	200 / 8"	160/6.30	0.8

DN1	DN2	d_0	K
200 / 8"	200 / 8"	208/8.19	0.65
200 / 8"	250 / 10"	208/8.19	0.8
250 / 10"	250 / 10"	262/10.31	0.62
250 / 10"	300 / 12"	262/10.31	0.76
300 / 12"	300 / 12"	310/12.2	0.62
300 / 12"	350 / 14"	310/12.2	0.72
300 / 12"	400 / 16"	310/12.2	0.8

DN1 = size inlet
DN2 = size outlet
d_0 = orifice diameter (mm/inches)
K = coefficient of discharge

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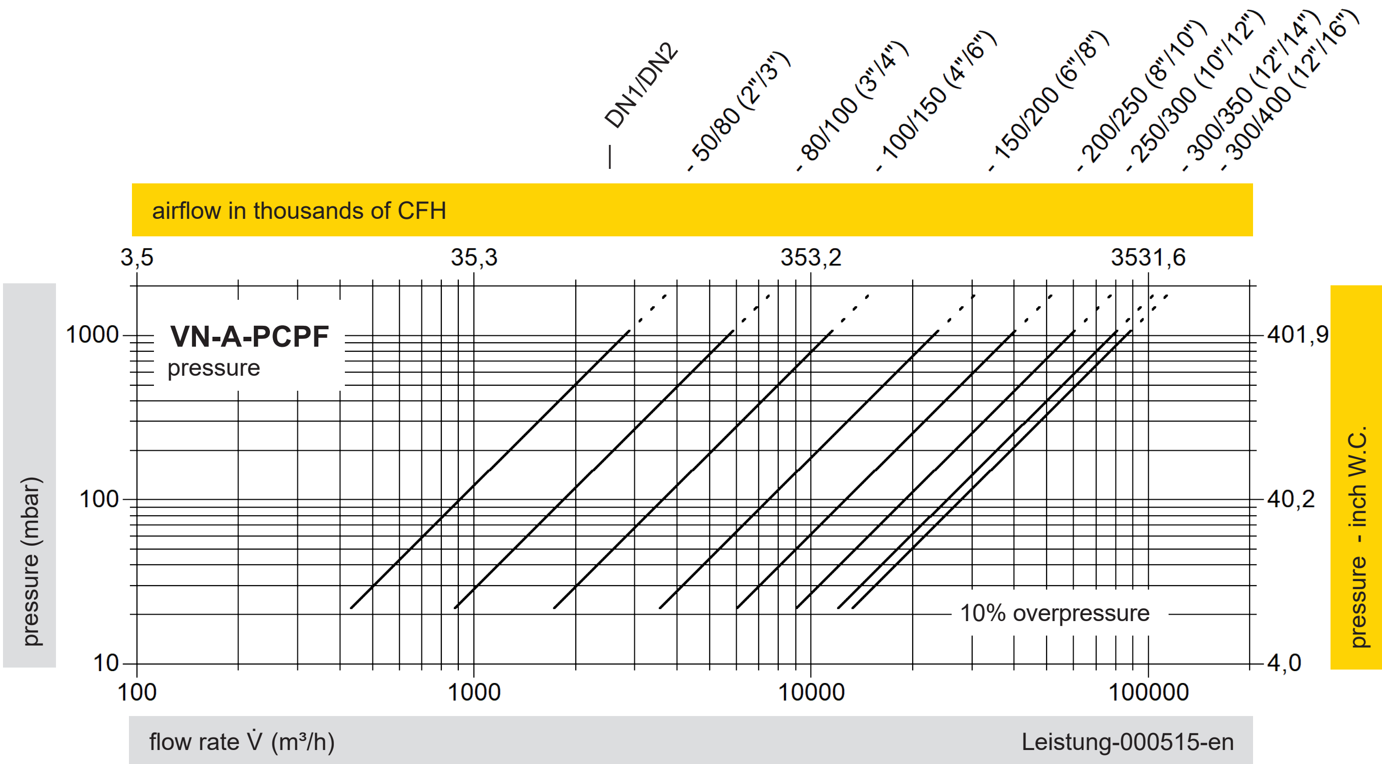
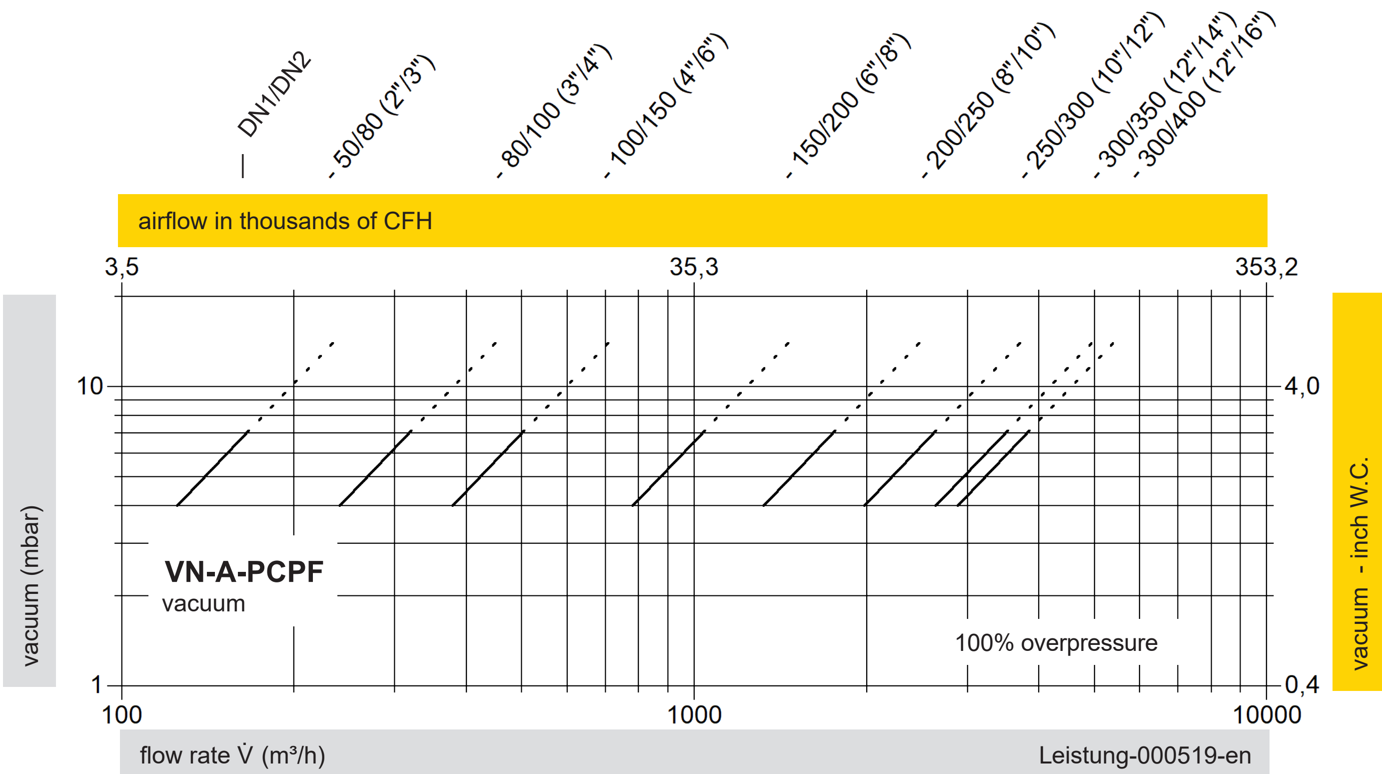
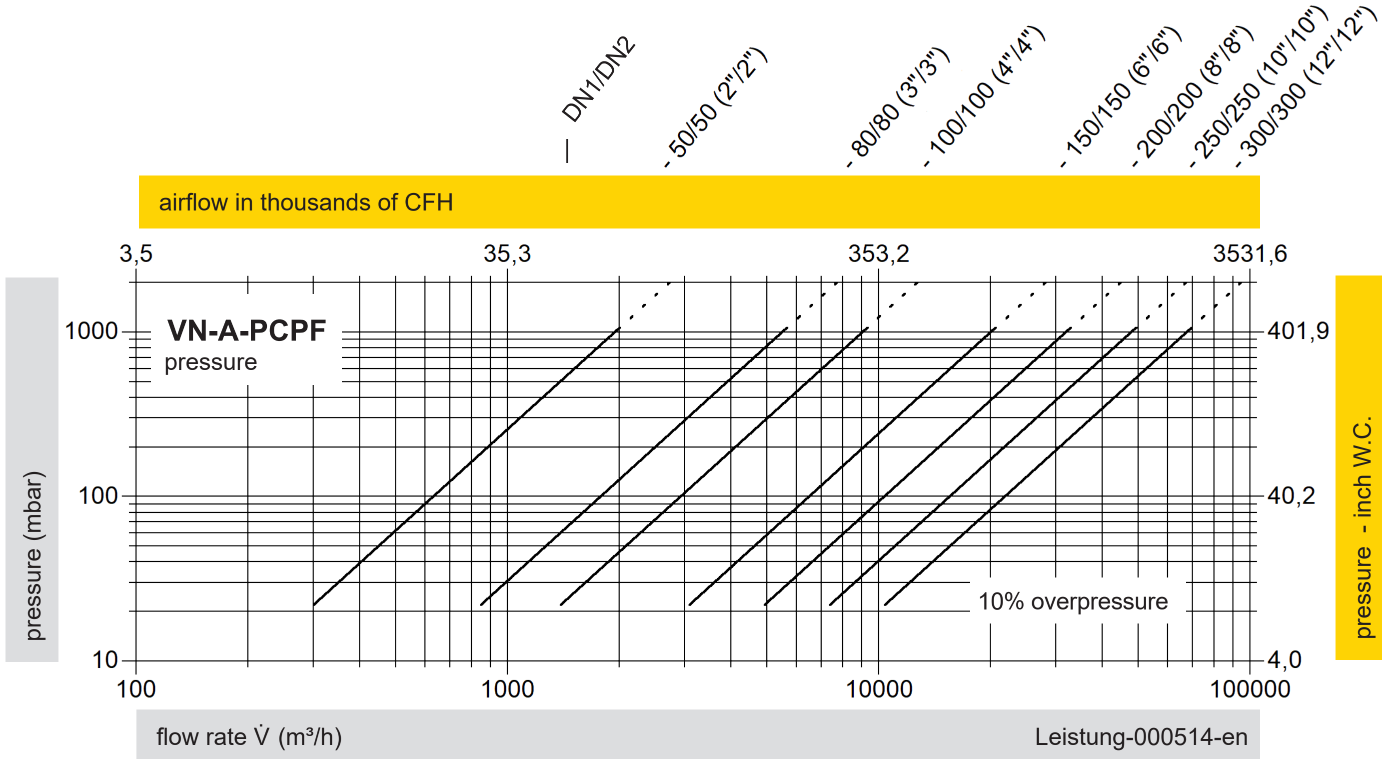
PROTEGO® VN-A-PCPF

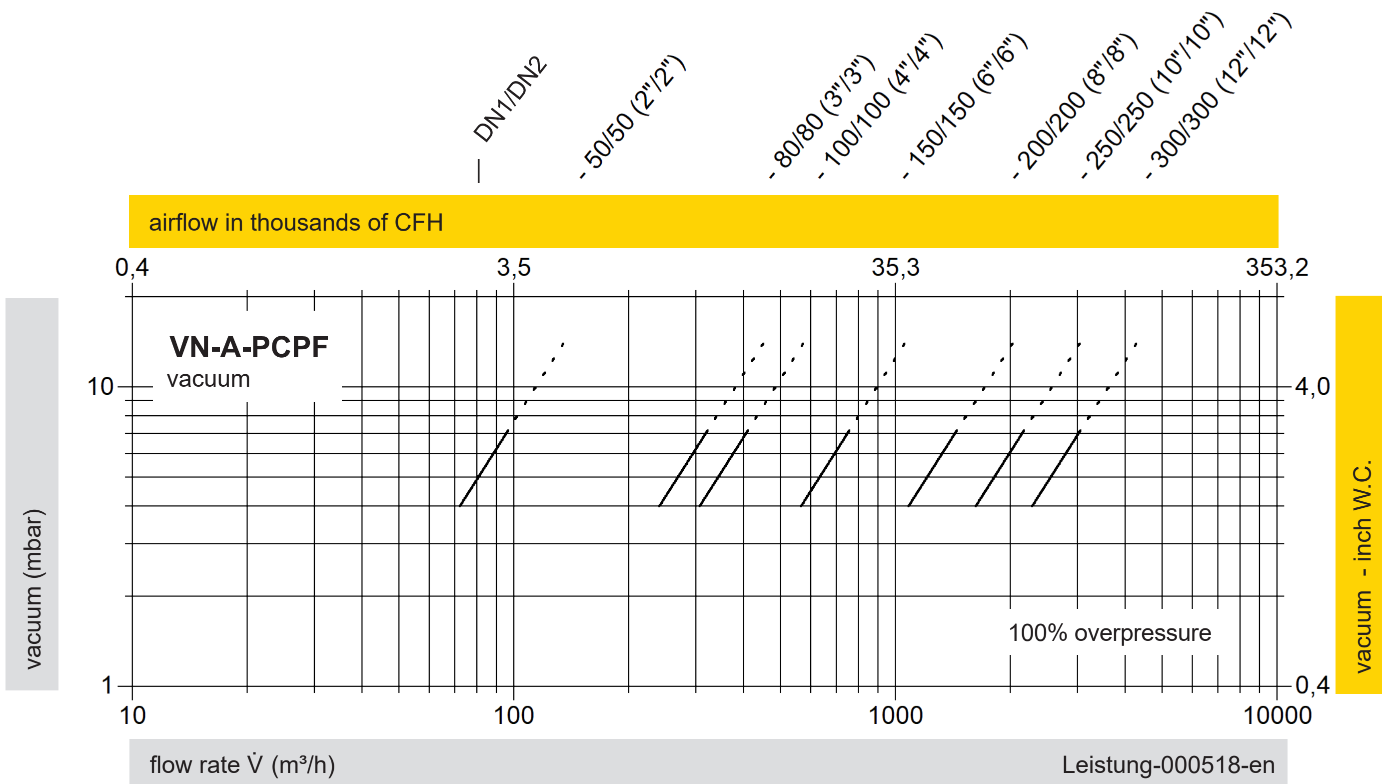




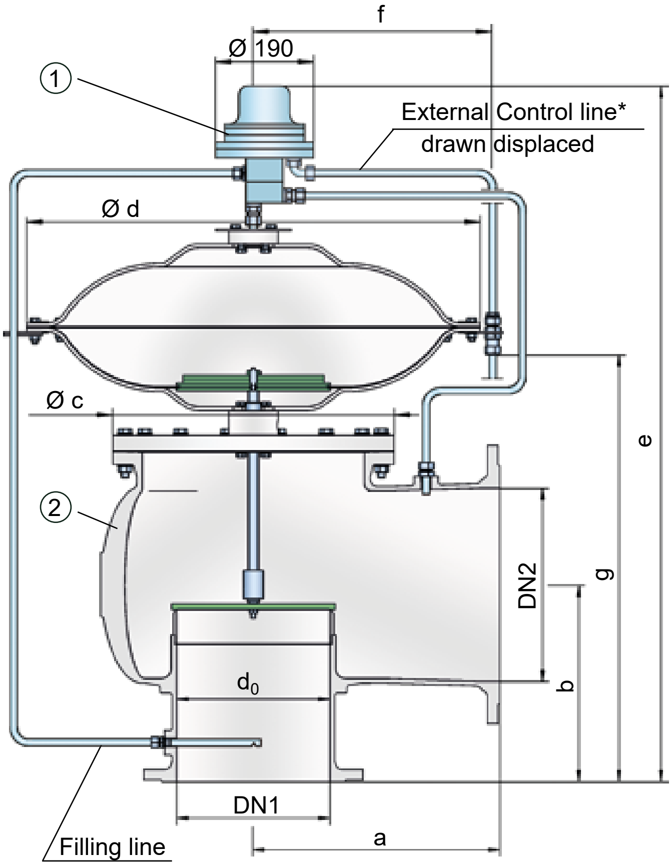
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

PROTEGO® VN-A-PCPF





Remark: Technical Data Sheet see on page 416.



Settings:

Pressure:

+20 mbar up to +1034 mbar
+8 inch W.C. up to +415.1 inch W.C.

Vacuum:

-2 mbar up to -7 mbar
-0.8 inch W.C. up to -2.8 inch W.C.

Higher or lower settings upon request.

Function and Description

The PROTEGO® VN-A-PCPM pilot-operated diaphragm valve is a highly developed valve for pressure and vacuum relief. It is primarily used as a safety device for out-breathing in tanks, containers, and process equipment. It provides protection against unallowable overpressure and prevents the intake of air and unallowable product vapor loss up to the set pressure.
The valve can also be used as an in-breathing valve where the main valve is directly controlled when it is exposed to a vacuum, i.e., it functions as a weight-loaded diaphragm valve. It is ideally suitable for both atmospheric conditions and for use in low temperatures.

The main valve (2) is controlled by a pilot valve (1). The pilot valve is controlled by the tank pressure. The tank substance does not continuously flow through the pilot. The set pressure is adjusted on the pilot valve by a corrosion-resistant and low-temperature- resistant permanent magnet.

As the operating pressure increases, the closing force at the main valve also increases; i.e., the valve tightness increases until the set pressure is reached to prevent leakage. After the valve responds, it immediately opens completely without any significant increase in pressure (pop-open characteristic), and the nominal volumetric flow is released through a fully open valve. If this is exceeded, the pressure increase follows the volume flow ($\Delta p/\dot{V}$ curve). From set pressure to full capacity (fully open valve), the pressure increase is 100% in case of vacuum venting/in-breathing function.

The tank pressure is maintained up to the set pressure with a tightness that is above the normal standards due to our state-of-the art manufacturing. This feature is ensured by valve seats made of high quality stainless steel with precisely lapped valve pallets. After the overpressure is released or the vacuum is balanced, the valve re-seats and provides a tight seal.

Special Features and Advantages

- controlled by corrosion-resistant, low-temperature-resistant permanent magnet
- no continuous flow of the tank substance through the pilot valve
- pop-open characteristic from the lowest pressure increase up to full lift
- max. 10% pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- protection of the main valve control diaphragm from low temperatures – high durability
- can be used in explosion hazardous areas
- designed for use at low temperatures
- automatic condensate drain
- Field test connection possible upon request
- Field test kit upon request

Design Types and Specifications

Basic design of pressure/vacuum relief valve with a pilot valve **VN-A-PCPM**

Additional special devices available upon request.

* It is recommended that an external control line is to be provided with direct connection to the tank.

Table 1: Dimensions								Dimensions in mm / inches
To select the nominal size (DN), use the flow capacity charts on the following pages								
DN1	DN2	a	b	c	d	e	f	g
50 / 2"	50 / 2"	175 / 6.89	175 / 6.89	170 / 6.69	360 / 14.17	838 / 32.99	205 / 8.07	371 / 14.61
50 / 2"	80 / 3"	175 / 6.89	175 / 6.89	170 / 6.69	360 / 14.17	853 / 33.58	205 / 8.07	386 / 15.20
80 / 3"	80 / 3"	200 / 7.87	200 / 7.87	205 / 8.07	360 / 14.17	878 / 34.57	205 / 8.07	411 / 16.18
80 / 3"	100 / 4"	200 / 7.87	200 / 7.87	205 / 8.07	360 / 14.17	888 / 34.96	205 / 8.07	421 / 16.57
100 / 4"	100 / 4"	225 / 8.86	225 / 8.86	250 / 9.84	360 / 14.17	913 / 35.94	205 / 8.07	446 / 17.56
100 / 4"	150 / 6"	225 / 8.86	225 / 8.86	250 / 9.84	360 / 14.17	923 /36.34	205 / 8.07	456 / 17.95
150 / 6"	150 / 6"	300 / 11,81	250 / 9.84	335 / 13.19	500 / 19.69	1025 / 40.35	275 / 10.83	531 / 20.91
150 / 6"	200 / 8"	300 / 11,81	250 / 9.84	335 / 13.19	500 / 19.69	1045 / 41.14	275 / 10.83	551 / 21.69
200 / 8"	200 / 8"	375 / 14.77	300 / 11,81	410 / 16.14	630 / 24.80	1237 / 48.70	340 / 13.39	638 / 25.12
200 / 8"	250 / 10"	375 / 14.77	300 / 11,81	410 / 16.14	630 / 24.80	1188 / 46.77	340 / 13.39	668 / 26.30
250 / 10"	250 / 10"	425 / 16.73	350 / 13.78	500 / 19.69	790 / 31.10	1278 / 50.31	420 / 16.54	738 / 29.05
250 / 10"	300 / 12"	425 / 16.73	350 / 13.78	500 / 19.69	790 / 31.10	1298 / 51.10	420 / 16.54	758 / 29.84
300 / 12"	300 / 12"	500 / 19.69	400 / 15.75	570 / 22.44	920 / 36.22	1389 / 54.58	485 / 19.09	831 / 32.72
300 / 12"	350 / 14"	500 / 19.69	400 / 15.75	570 / 22.44	920 / 36.22	1409 / 55.47	485 / 19.09	851 / 33.50
300 / 12"	400 / 16"	500 / 19.69	400 / 15.75	570 / 22.44	920 / 36.22	1429 / 56.26	485 / 19.09	871 / 34.29

Table 2: Material selection for housing

Design	A	B	C
Housing	Aluminum	Stainless Steel	LTCS * (Low Temperature Carbon Steel)
Valve seat	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	PTFE	PTFE	PTFE
Housing diaphragm	Stainless Steel	Stainless Steel	Stainless Steel
Pilot lines	Stainless Steel	Stainless Steel	Stainless Steel
Pilot housing	Aluminum	Aluminum / Stainless Steel	Aluminum / Stainless Steel
Pilot diaphragm	FEP	FEP	FEP

* Special materials upon request.

Table 3: Flange connection type

EN 1092-1; Form B1	Other types upon request
ASME B16.5 CL 150 R.F.	

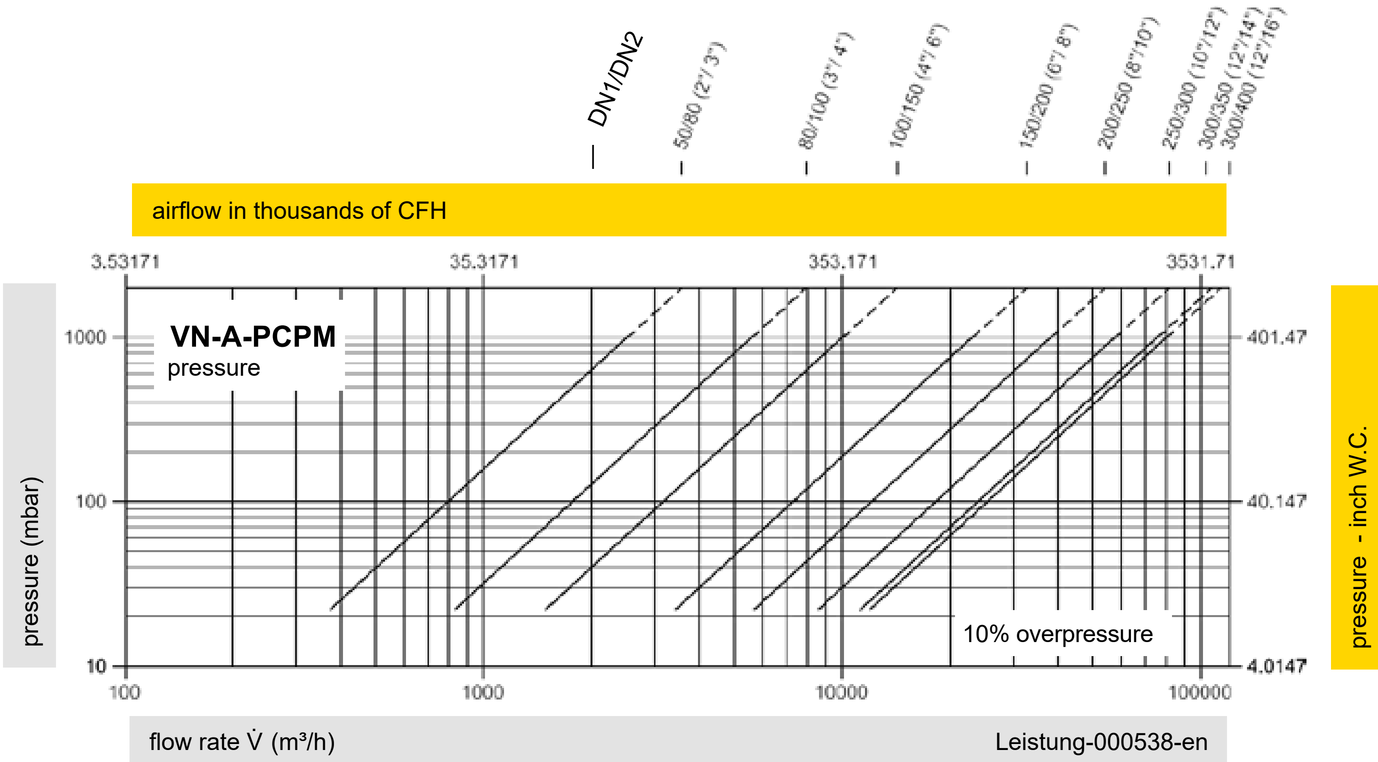
Table 4: Coefficient of Discharge

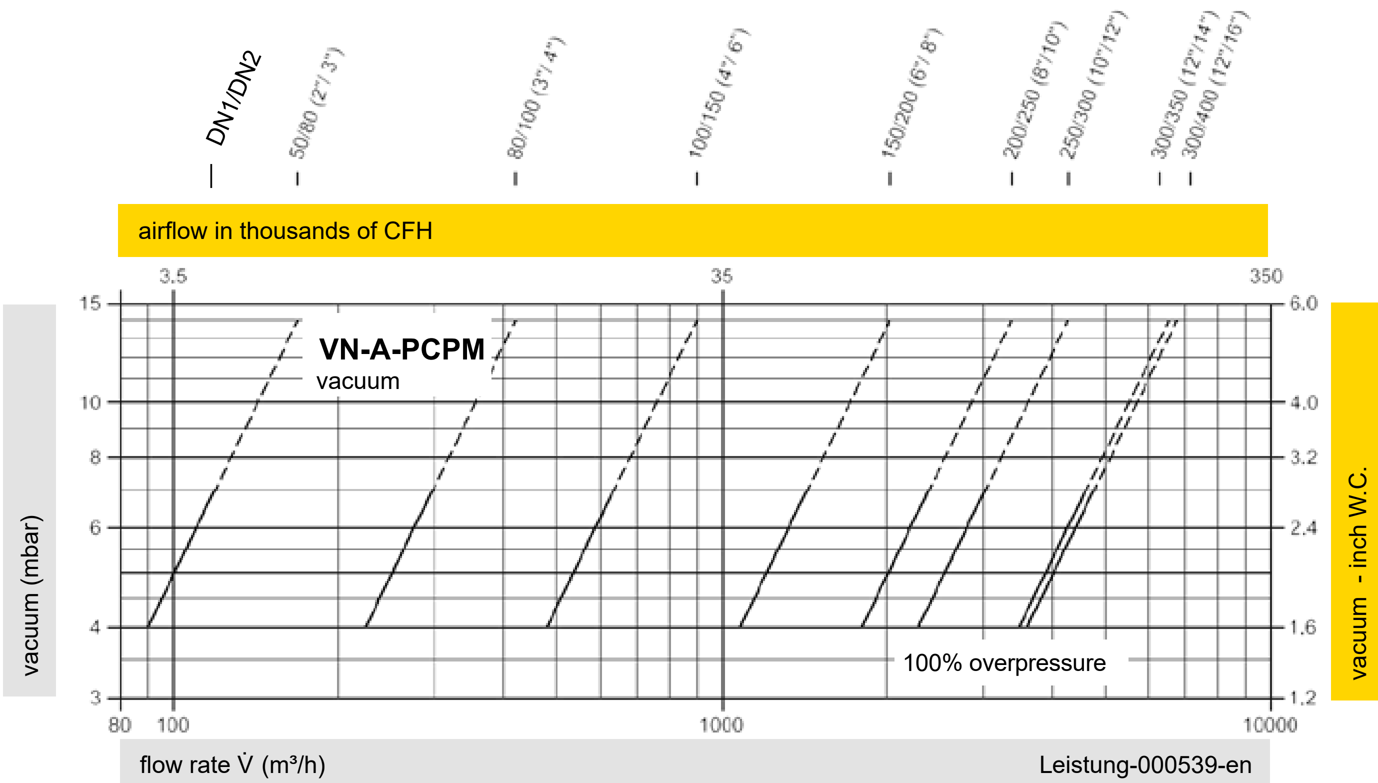
DN1	DN2	d_0	K
50 / 2"	50 / 2"	54/2.13	0,57
50 / 2"	80 / 3"	54/2.13	0,75
80 / 3"	80 / 3"	83/3.27	0,63
80 / 3"	100 / 4"	83/3.27	0,71
100 / 4"	100 / 4"	108/4.25	0.60
100 / 4"	150 / 6"	108/4.25	0.75
150 / 6"	150 / 6"	160/6.30	0.64
150 / 6"	200 / 8"	160/6.30	0.78

DN1	DN2	d_0	K
200 / 8"	200 / 8"	208/8.19	0.063
200 / 8"	250 / 10"	208/8.19	0.76
250 / 10"	250 / 10"	262/10.31	0.62
250 / 10"	300 / 12"	262/10.31	0.73
300 / 12"	300 / 12"	310/12.2	0.63
300 / 12"	350 / 14"	310/12.2	0.68
300 / 12"	400 / 16"	310/12.2	0.74

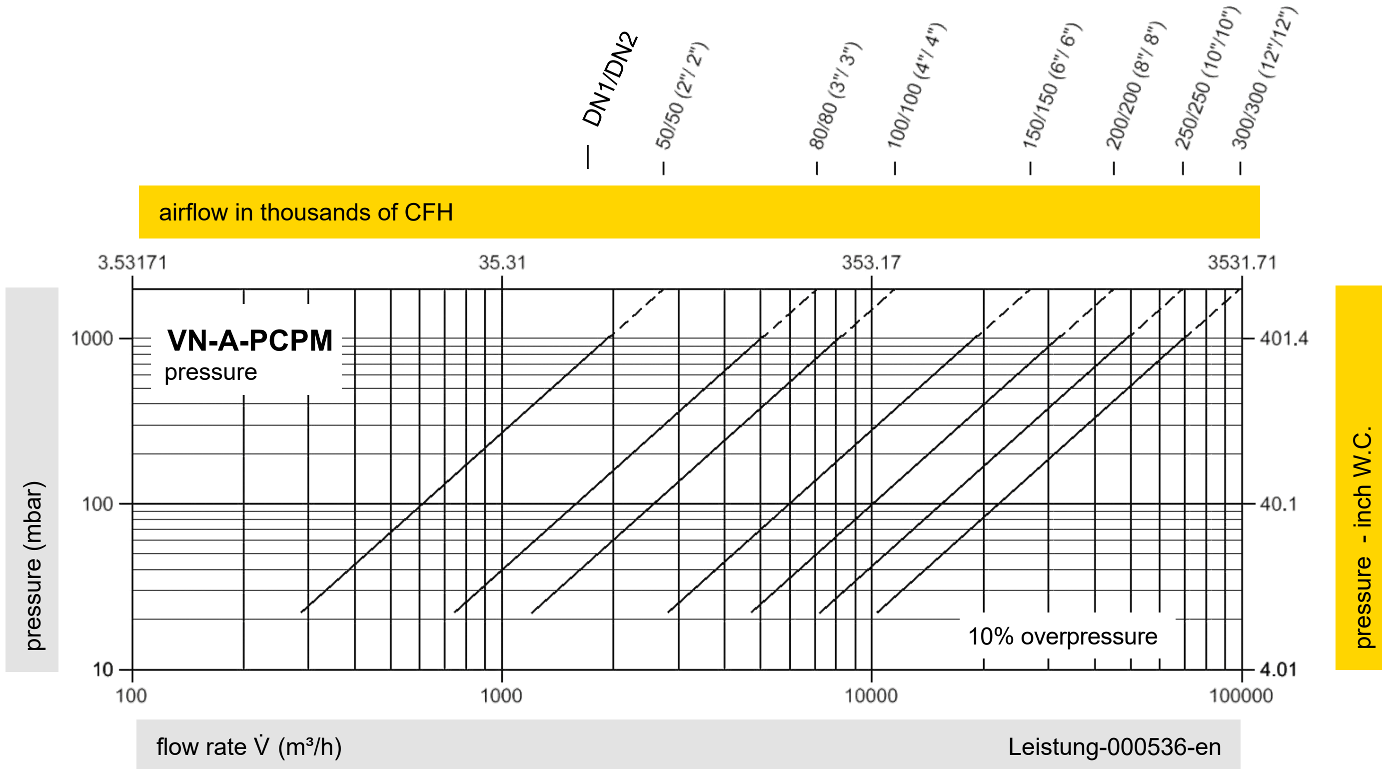
DN1 = size inlet
DN2 = size outlet
d_0 = orifice diameter (mm/inches)
K = coefficient of discharge

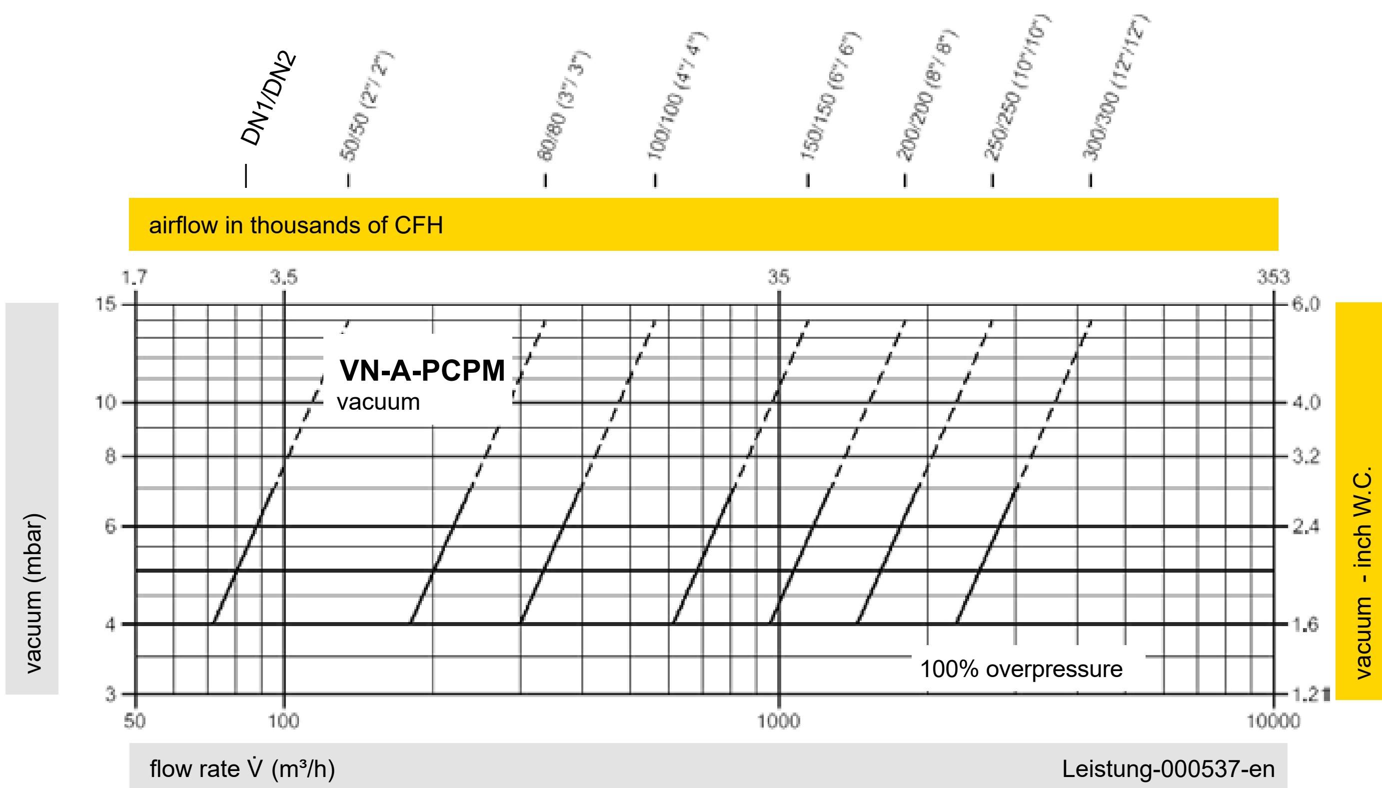
PROTEGO® VN-A-PCPM





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).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals”.


DN1/DN2
50/50 (2"/ 2")
80/80 (3"/ 3")
100/100 (4"/ 4")
150/150 (6"/ 6")
200/200 (8"/ 8")
250/250 (10"/10")
300/300 (12"/12")
airflow in thousands of CFH
3.53171
35.31
353.17
3531.71
VN-A-PCPM
pressure
pressure (mbar)
1000
100
10
401.4
40.1
4.01
pressure - inch W.C.
10% overpressure
100
1000
10000
100000
flow rate V̇ (m³/h)
Leistung-000536-en


DN1/DN2
50/50 (2"/ 2")
80/80 (3"/ 3")
100/100 (4"/ 4")
150/150 (6"/ 6")
200/200 (8"/ 8")
250/250 (10"/10")
300/300 (12"/12")
airflow in thousands of CFH
1.7
3.5
35
353
VN-A-PCPM
vacuum
vacuum (mbar)
15
10
8
6
4
3
6.0
4.0
3.2
2.4
1.6
1.21
vacuum - inch W.C.
100% overpressure
50
100
1000
10000
flow rate V̇ (m³/h)
Leistung-000537-en

PROTEGO® VN-A-PCPF and PROTEGO® VN-A-PCPM

Project Data Sheet

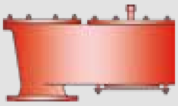
Project:	
Engineering:	
End-user:	

PROTEGO® VN-A-PCPF	☐					
PROTEGO® VN-A-PCPM	☐					
relief type:	pressure only	☐				
	pressure and vacuum	☐				
substance:						
boiling point:			°C			
molar mass:			g/mol			
total back pressure:			mbar or inch W.C.			
dynamic back pressure:			mbar or inch W.C.			
static (superimposed) back pressure:			mbar or inch W.C.			
inlet pressure drop:			mbar or inch W.C.			
set pressure:			mbar or inch W.C.			
set vacuum:			mbar or inch W.C.			
tank design code:	API 620	☐	API 650	☐	EN 14015	☐
tank design pressure:			mbar			
tank design vacuum:			mbar			
material:						
required discharge per valve:			kg/h or lb/hr			
required vacuum capacity per valve at +20°C:			m^3/h or SCFH			
flange connection:	ASME	☐	EN 1092-1	☐	JIS	☐

Fill in and ☐ check, if applicable.

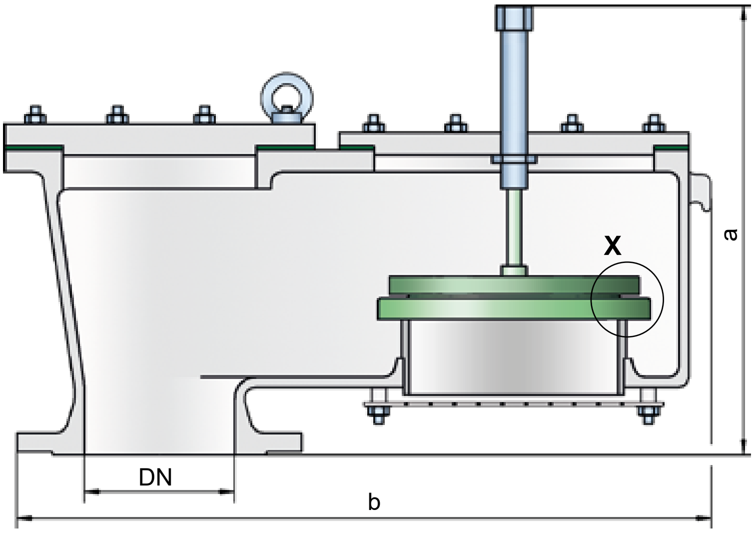
signature:	date:

Notes:

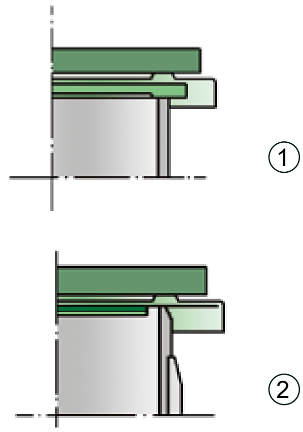


Vacuum Relief Valve

PROTEGO® V/SV-XL



Detail **X**



Settings:

Vacuum: -2.0 mbar up to -16 mbar
-0.8 inch W.C. up to -6.4 inch W.C.

Higher vacuum settings upon request.

Function and Description

The PROTEGO® V/SV-XL valve is a highly developed vacuum optimized relief valve with excellent flow performance. It is primarily used as a safety device for relieving vacuum in tanks, containers, and process equipment. The valve provides protection against vacuum and prevents in-breathing of air close to the set pressure.

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

The tank pressure is maintained up to set pressure with a tightness that is above the normal standards due to our highly developed manufacturing technology. This feature is achieved by valve seats made of high quality stainless steel and with precisely 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 them from sticking when sticky products are used and to enable the use of corrosive fluids. After the vacuum is balanced, the valve re-seats and provides a tight seal.

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

Special Features and Advantages

- 10% technology for minimum pressure increase up to full lift
- extreme tightness, resulting in lowest possible product losses and reduced environmental pollution
- set pressure close to opening pressure for optimum pressure maintenance in the system
- high flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- automatic condensate drain
- maintenance-friendly design
- best technology for API tanks

Design Types and Specifications

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

There are two different designs:

Pressure/vacuum valve in basic design **V/SV-XL - $\boxed{–}$**

Pressure/vacuum relief valve with heating jacket **V/SV-XL - $\boxed{H}$**

Additional special devices available
upon request.

Table 1: Dimensions	Dimensions in mm / inches
DN	300 / 12"
a	649 / 25.55
b	946 / 37.24

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

Table 2: Material selection for housing

Design	A	B	C
Housing Heating jacket (V/SV-XL-H-...)	Aluminum –	Steel Steel	Stainless Steel Stainless Steel
Valve seat	Stainless Steel	Stainless Steel	Stainless Steel
Sealing	PTFE	PTFE	PTFE
Cover	Aluminum	Steel	Stainless Steel

The housings are also available with an ECTFE coating.

Special materials upon request.

Table 3: Material selection for vacuum valve pallet

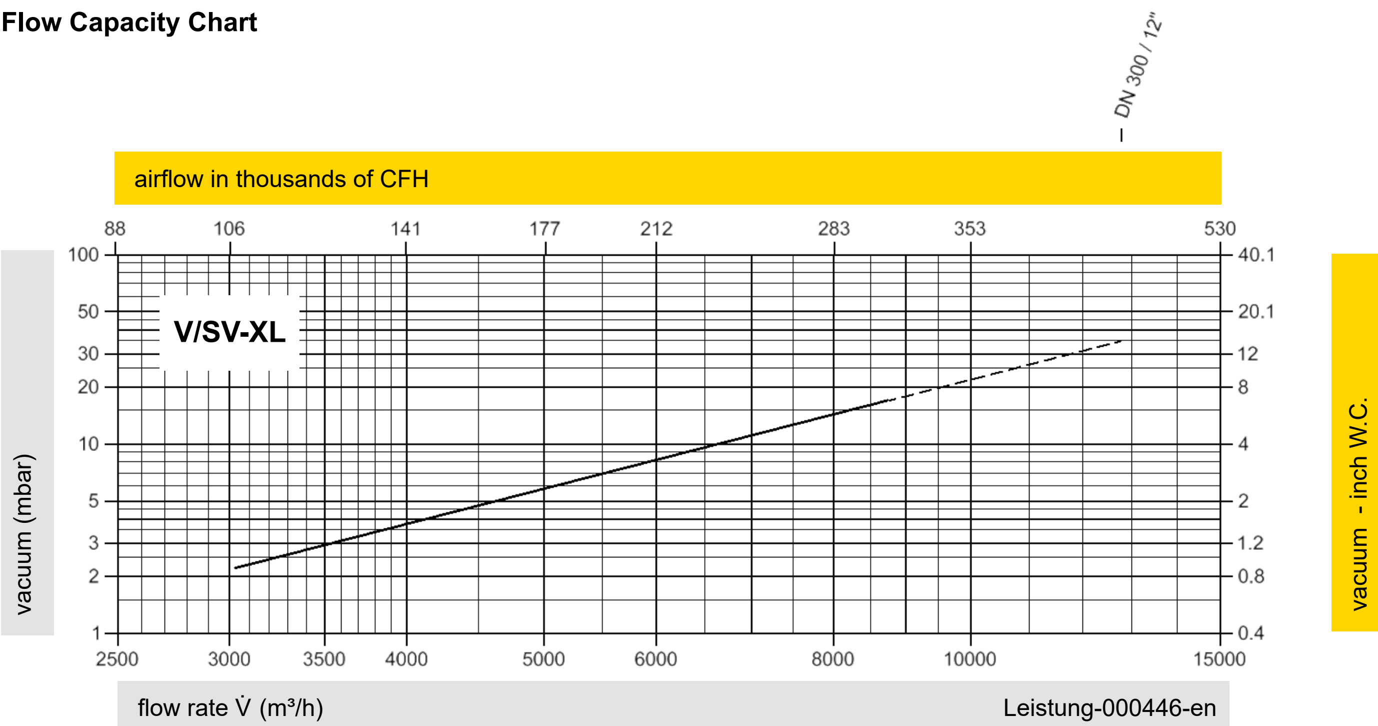
Design	A	B	C
Vacuum range (mbar) (inch W.C.)	-2.0 up to -3.0 -0.8 up to -1.2	<-3.0 up to -9.0 <-1.2 up to -3.6	<-9.0 up to -16 <-3.6 up to -6.4
Valve pallet	Aluminum	Stainless Steel	Stainless Steel
Sealing	FEP	FEP	Metal to Metal

Special material and higher vacuum upon request.

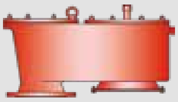
Table 4 Flange connection type

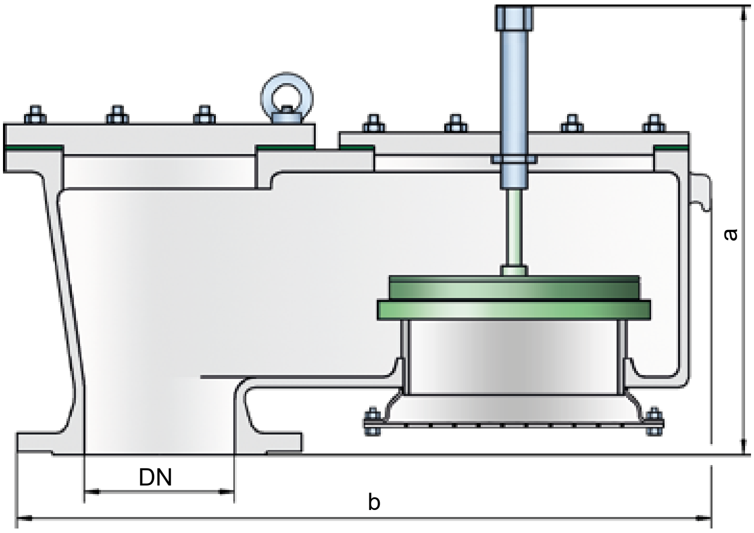
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



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





Settings:

Vacuum: -2.0 mbar up to -16 mbar
-0.8 inch W.C. up to -6.4 inch W.C.

Higher vacuum settings upon request.

Function and Description

The PROTEGO® V/SV-XXL valve is a highly developed optimized vacuum relief valve with excellent flow performance. It is primarily used as a safety device for relieving vacuum in tanks, containers, and process equipment.

When the set vacuum is reached, the valve starts to open and reaches full lift within 100% vacuum increase. The tank vacuum is maintained up to the set vacuum with a tightness that is above the normal standards due to our highly developed manufacturing technology. This feature is ensured by valve seats made of high quality stainless steel with precisely lapped valve pallets and a reinforced housing design. After the vacuum is balanced, the valve re-seats and provides a tight seal.

The optimized fluid dynamic design of the valve body and valve pallet is a result of extensive research and development, resulting in stable operation of the valve pallet, optimized performance, and reduced product losses.

Special Features and Advantages

- excellent tightness, resulting in lowest possible product losses and reduced environmental pollution
- very high optimized flow capacity
- valve pallet is guided inside the housing to protect against harsh weather conditions
- can be used in explosion hazardous areas
- automatic condensate drain
- maintenance-friendly design
- best technology for API tanks
- suitable for use on cold storage tanks

Design Types and Specifications

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

There are two different designs:

Pressure/vacuum valve in basic design **V/SV-XXL - –**

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

Additional special devices available upon request.

Table 1: Dimensions Dimensions in mm / inches

DN	300 / 12"
a	649 / 25.55
b	946 / 37.24

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

Table 2: Material selection for housing

Design	A	B	C	
Housing Heating jacket (V/SV-XXL-H-...)	Aluminum –	Steel Steel	Stainless Steel Stainless Steel	The housings are also available with an ECTFE coating. Special materials upon request.
Valve seat	Stainless Steel	Stainless Steel	Stainless Steel	
Sealing	PTFE	PTFE	PTFE	
Cover	Aluminum	Steel	Stainless Steel	

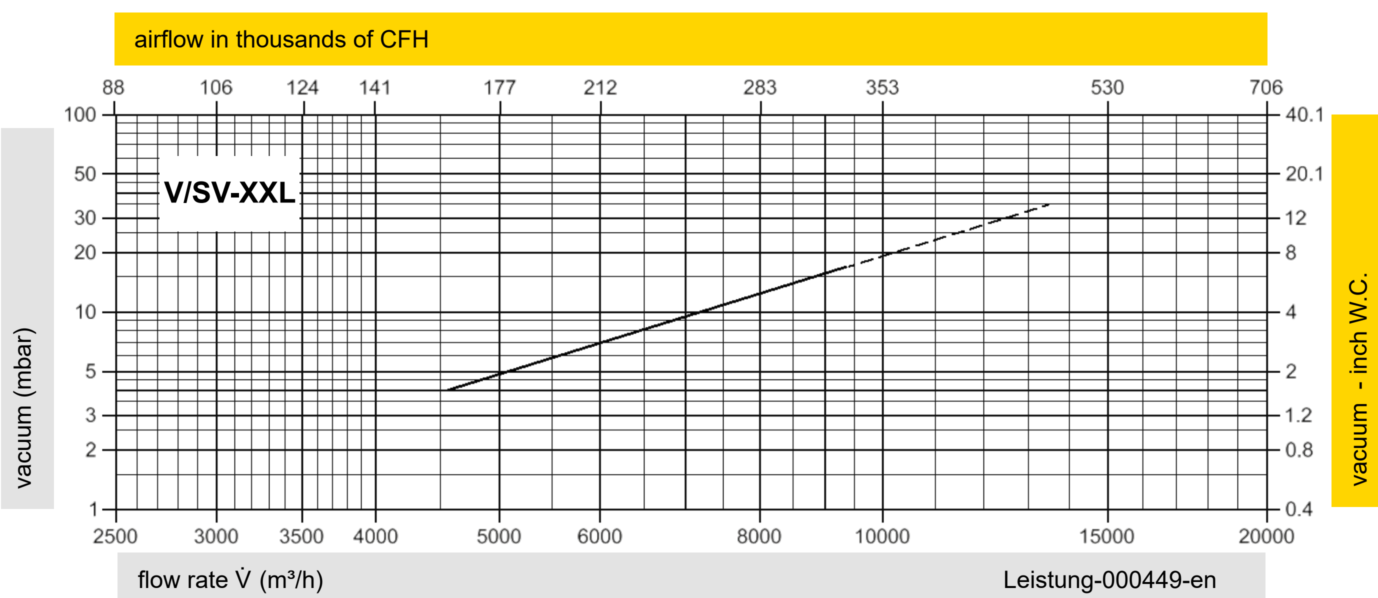
Table 3: Material selection for vacuum valve pallet

Design	A	C	
Vacuum range (mbar) (inch W.C.)	-2.0 up to -9.0 -0.8 up to -3.6	<-9.0 up to -16 <-3.6 up to -6.4	Special material and higher vacuum upon request.
Valve pallet	Aluminum	Stainless Steel	
Sealing	Metal to Metal	Metal to Metal	

Table 4 Flange connection type

EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Flow Capacity Chart



Remark

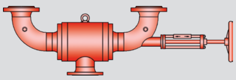
$$\text{set pressure} = \frac{\text{opening pressure resp. tank design pressure}}{2}$$

Set pressure = the valve starts to open

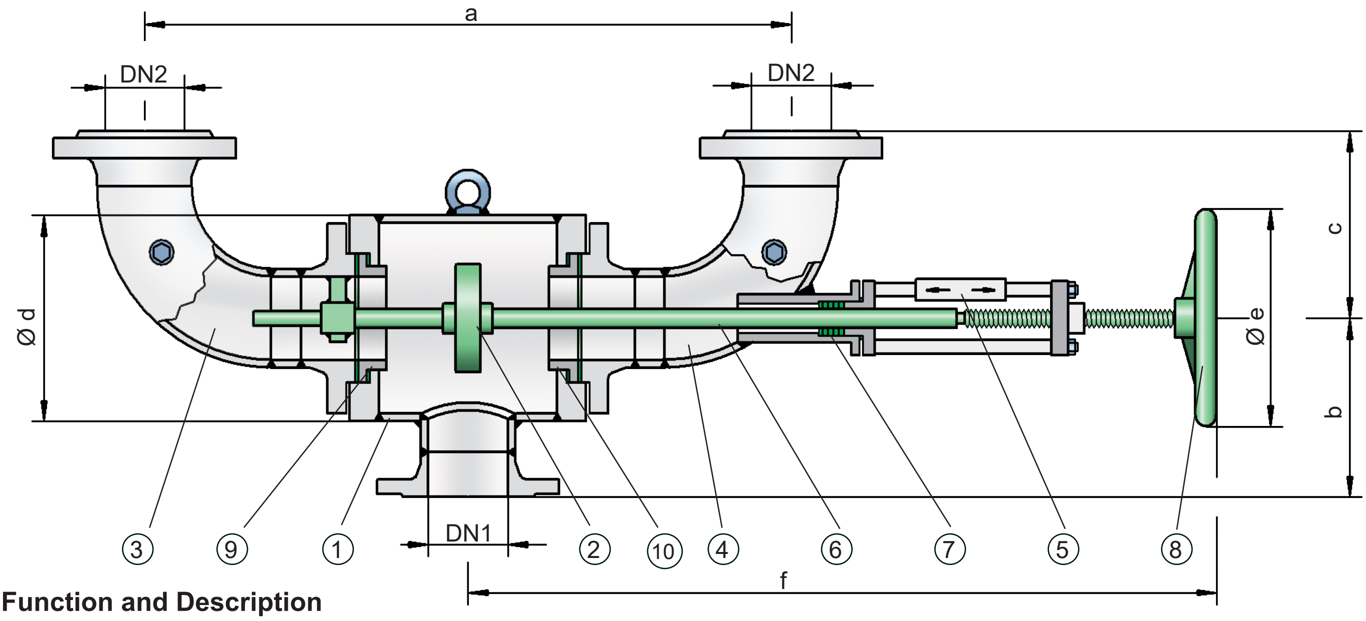
Opening pressure = set pressure plus overpressure

Overpressure = 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 in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."



PROTEGO® WV/T



Function and Description

PROTEGO® WV/T change-over valves are mainly used together with other valves or safety devices (e.g., PROTEGO® flame arresters) on cryogenic storage tanks and on tanks in process plants in the chemical, petrochemical, and pharmaceutical industries. They increase the operational safety of the equipment to be protected, as each valve or safety device can be checked, maintained, or repaired without interrupting plant operation.

The valves mainly consist of the housing (1) with flange connections DN 1 and two lateral connection elbows (3, 4) with flange connections DN 2 and the valve disc (2). If necessary, it is possible to off-set and turn the connection elbows. The valve seats (9, 10) are replaceable. The valve disc with metallic sealing surface is movable on the valve spindle (6). This ensures good contact pressure with the valve seats (9, 10) even with high temperature differences. The sealing between the valve disc and valve spindle is done by an O-ring. The valve spindle is guided by bushings and sealed to the outside by an adjustable sealing set (7).

The change-over valve allows the operator to block one valve or safety device at a time by operating the hand wheel (8). In normal operation, the valve disc (2) is in middle position and the gas/liquid flows through both connection elbows. By turning the hand wheel as far as it will go, one of the connecting elbows (3 or 4) is closed while the other one remains open. The actual position of the valve disc is indicated by the position indicator (5) on the valve spindle.

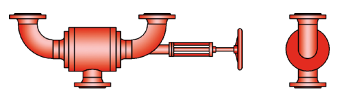
Depending on the requirements, the position of the change-over valve in normal operation can be in the middle or end position: Middle position, for example, is if a high capacity of relief is required through emergency relief valves controlled in parallel. End position, for example, is with flame arresters that are connected in parallel and can be used or cleaned alternately.

Due to their design and appropriately selected materials, the valves are characterized by their high functional reliability and very good flow rates. All elements are made of stainless steel.

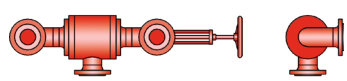
The design of the PROTEGO® WV/T change-over valves allows the following connections to be made in accordance with the variable valve position or other safety devices with both angle or straight connections without additional fittings

Positions of nozzles

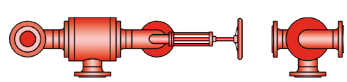
I.



II.



III.



resistance coefficient ζ = 1,2 if valve is in the middle position
ζ = 2,6 if valve closed on one side

PROTEGO® WV/T change-over valves are characterized by their simple design, easy handling, the option of quick replacement of components that affect the function, and by their excellent availability and operational reliability. The lapped metallic sealing surfaces ensure a high degree of tightness even in low temperature ranges.

These valves are not flame-proof and do not fall within the scope of the European Explosion Protection Directive 94/9/EC, even if installed in explosive atmospheres.

Based on a hazard analysis with regard to material selection and function, the valves have no potential ignition sources. This enables unrestricted use in potentially explosive areas.

Design Types and Specifications

For special operating conditions, special heatable designs must be used:

- for products which crystallize or tend to form deposits that negatively affect the function
- when used under extreme weather conditions in winter (frost), when there is the possibility that warm product vapors condensate and freeze in the supercooled valve and ice can build up, blocking the valve discs

Table 1: Dimensions							Dimensions in mm / inches
DN1	80 / 3"	100 / 4"	150 / 6"	200 / 8"	200 / 8"	250 / 10"	300 / 12"
DN2	80 / 3"	100 / 4"	150 / 6"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
a	780 / 30.71	780 / 30.71	960 / 37.80	960 / 37.80	1130 / 46.12	1450 / 57.09	1650 / 64.96
b	250 / 9.84	250 / 9.84	310 / 12.20	310 / 12.20	330 / 13.47	360 / 14.17	415 / 16.34
c *	303 / 11.93	205 / 8.07	285 / 11.22	285 / 11.22	367 / 14.98	450 / 17.72	525 / 20.67
c**	323 / 12.72	230 / 9.06	317 / 12.48	317 / 12.48	407 / 16.02	483 / 19.01	571 / 22.48
d	273 / 10.75	273 / 10.75	324 / 12.76	324 / 12.76	355 / 14.49	457 / 17.99	500 / 19.68
e	250 / 9.84	250 / 9.84	250 / 9.84	250 / 9.84	400 / 16.33	400 / 15.75	500 / 19.68
f	905 / 35.63	905 / 35.63	1070 / 42.13	1070 / 42.13	1200 / 47.24	1530 / 60.24	1655 / 59.65
f_{min}	810 / 31.89	810 / 31.89	950 / 37.40	950 / 37.40	1080 / 42.52	1360 / 53.54	1470 / 57.87
f_{max}	995 / 39.17	995 / 39.17	1190 / 46.85	1190 / 46.85	1310 / 53.47	1695 / 66.73	2015 / 79.33

* for connection flange DIN PN16 resp. from DN 200 to DIN PN 10
** for connection flange ANSI 150 lbs.

Table 2: Material selection		
Design	A	B
Housing and connection elbows	Steel	Stainless Steel
Valve disc	Hastelloy	Hastelloy
Packing	PTFE	PTFE
Spindle sealing	FPM	FPM
Handwheel	Steel	Steel

The connection flange material must be compatible with the material of the plant component. Special versions are available for special requirements.

Table 3: Flange connection type DN	
EN 1092-1, Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Selection and Design

Together with our engineers, the valve is designed for each specific application. The relevant plant specifications are considered when defining the required nominal sizes and connection types. The maximum allowable operating temperature for standard valves is +200°C/392°F at a maximum allowable operating pressure of 0,5 bar/7.25 psi (special version up to 6 bar/87 psi possible). The device must have sufficient corrosion resistance to the stored substance. If necessary, designs in special stainless steel quality should be selected.

Necessary Data for Specification

Stored substance

Service temperature (°C or °F)

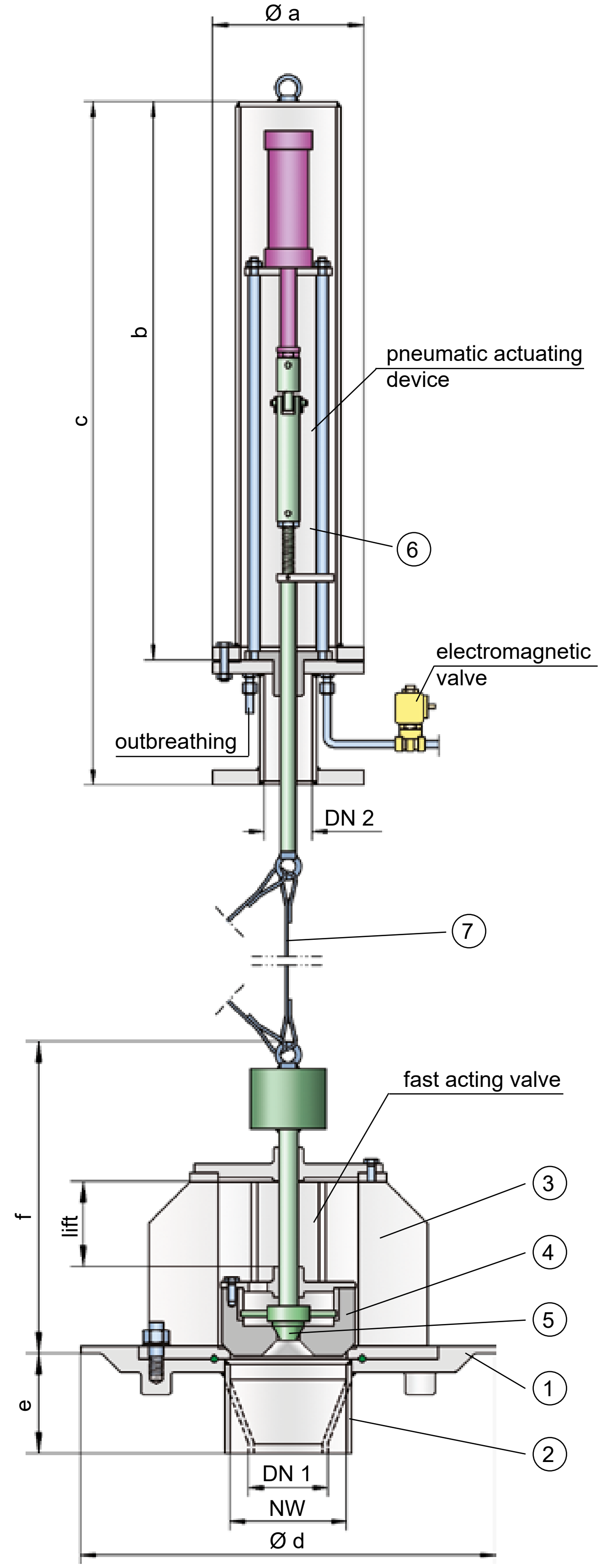
Operating pressure (bar or psi)

Tank material

Tank nozzle DN1 (mm or inches)

Tank nozzle DN2 (mm or inches)

Position of nozzle I, II or III



If fast acting valve is open, resistance coefficient is 1.5.

Function and Description

PROTEGO® NB/AP in-tank valves are used in storage tanks for cryogenic liquids in order to seal off discharge lines in the event of an accident or emergency (pipe bursting). These devices meet the requirements of API 625.

The device consists of the bottom plate (1) which has to be welded onto the vessel bottom; a nozzle (2) which has to be welded to the discharge line; the flanged fast-acting valve (3) with valve piston (4) and release valve cone (5); and the complete pneumatic actuating device (6) which is mounted onto the roof of the tank. The required tightness is ensured by a lapped metallic valve pallet and relief valve cone.

The quick-release valve (3) and the actuating system (6) are connected by an actuator cable (7). An additional emergency cable enables the quick-release valve to be opened if the main actuator rope is damaged.

During normal operation, a pneumatic cylinder holds the valves in the open position. The pneumatic cylinder is actuated by a control line to lift the valve piston. The bottom valve is only closed in an emergency. In the event of an energy drop, the valve piston, due to its own weight, falls onto the valve seat which closes the bottom valve.(fail safe concept).

The valve design is independent of the nominal size. The nominal size DN 1 is determined by the nominal size of discharge line.

Material selection depends on the substance and the operating temperature.

In-Tank Valves
(Flyer pdf)

Design Types and Specifications

Table 1: Dimensions — Dimensions in mm / inches

NW	DN 1	DN 2	a	b	c	d	e	f	Hub
150 / 6“	100 / 4“	80 / 3“	200 / 7.87	1130 / 44.49	1430 / 56.30	550 / 21.65	155 / 6.10	465 / 18.31	160 / 6.30
150 / 6"	150 / 6“	80 / 3"	200 / 7.87	1130 / 44.49	1430 / 56.30	550 / 21.65	175 / 6.89	465 / 18.31	160 / 6.30
200 / 8"	200 / 8“	80 / 3"	200 / 7.87	1130 / 44.49	1430 / 56.30	600 / 23.62	175 / 6.89	470 / 18.50	160 / 6.30
250 / 10“	250 / 10“	80 / 3“	200 / 7.87	1130 / 44.49	1430 / 56.30	740 / 29.13	175 / 6.89	485 / 19.09	160 / 6.30

Table 2: Material of fast action bottom drain valve

Bottom plate with nozzle	*
Valve housing with valve cone	Stainless Steel
Sealing ring	*
Actuator rope	Stainless Steel

* Upon request.

Table 3: Material of actuating device

Housing	Stainless Steel
Actuator spindle	Stainless Steel
Guide bushing	Brass
Seal	PTFE
Protective cap	Stainless Steel
Pneumatic cylinder	Aluminum

Table 4: Flange connection type DN 2

EN 1092-1, Form B, PN 40 or upon request.

Selection and Design

The main process data and product properties of the stored substance, as well as the temperature of the stored substance, determine the material for the specific valve. Subsequently, the **nominal diameter** and the **type of connection** are checked and selected.

The in-tank valve is available in nominal sizes of DN 100/4” to DN 250/10”, where the connection for the pneumatic actuating device has a nominal size of DN 80/3”.

The length of the actuator cable and of the emergency cable is determined by the tank height. The final adjustment is completed during installation.

The standard material of the bottom plate is stainless steel. Other materials are available upon request.

The position is indicated by inductive proximity switches. The control and regulating valves can be designed and provided upon customer request.

Necessary Data for Specification

Stored substance

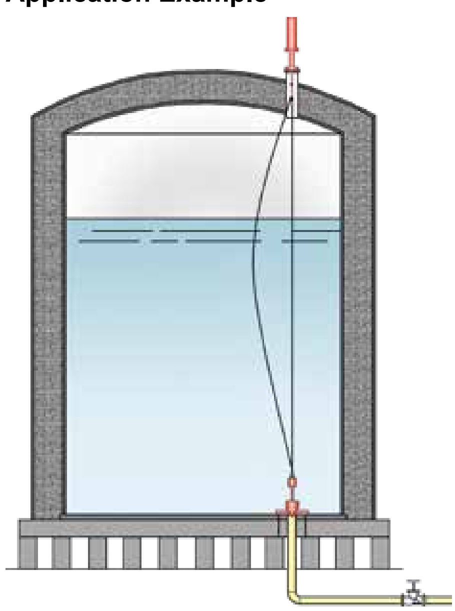
Operating temperature T (°C or °F)

Operating pressure p (bar or psi)

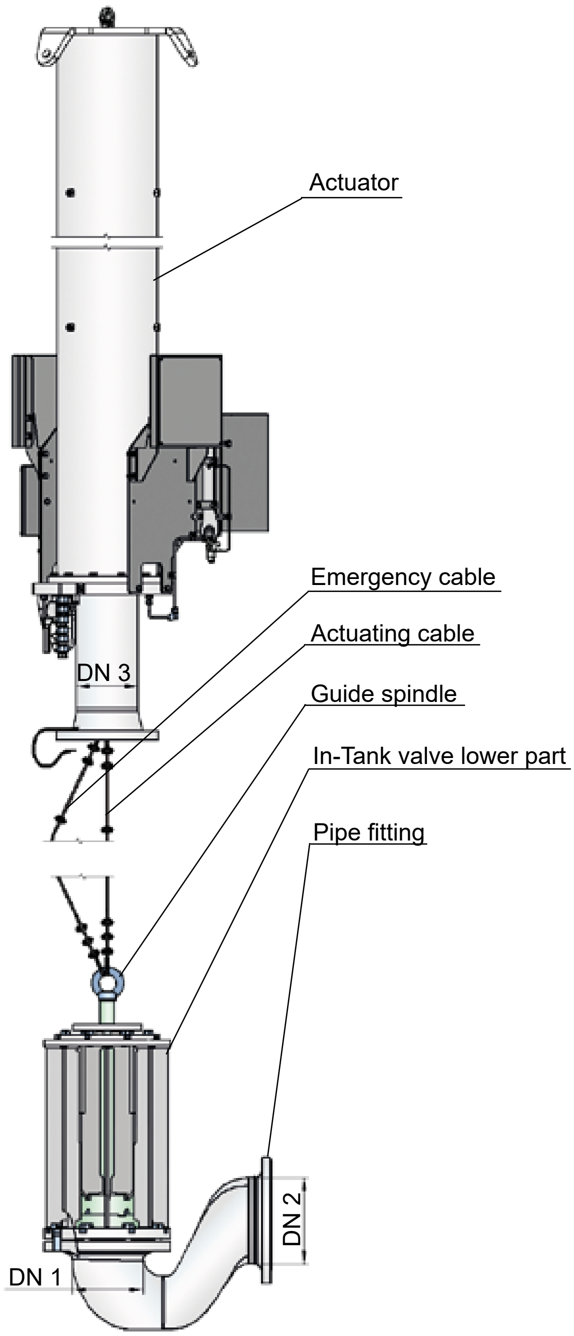
Connection size DN 1

Tank height (m or ft)

Application Example



PROTEGO
for safety and environment



Function and Description

PROTEGO® ITV-S and ITV in-tank valves are used in storage tanks for cryogenic liquids in order to seal off discharge lines in the event of an accident or emergency. These devices meet the requirements of API 625.

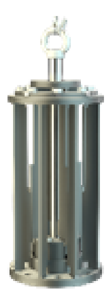
The PROTEGO® ITV-S and ITV consist of a valve guide unit with elbow and valve seat which is mounted on the inside of the tank wall. This unit accommodates the valve piston and guides it over the entire lift stroke. The seal between the valve seat and the valve disk is ensured by finely lapped surfaces and achieves maximum tightness.

The actuating unit, installed on the tank roof, is specifically designed for the requirements of the application and connected to the valve unit installed in the tank via suitable cables.

During normal operation, the valves are kept in the open position. The bottom valve is only closed in an emergency. In the event of an energy drop, the valve piston, due to its own weight, falls onto the valve seat which closes the bottom valve (fail safe concept).

The PROTEGO® ITV-S and ITV design provide the tank designer and the user with the following benefits:

- Very light and compact design
- Connection to the tank wall via flange connection
- No support or guidance required in the tank
- Low forces required for lifting the valve piston
- Extremely high tightness due to metallic sealing surfaces



In-Tank valve lower part from PROTEGO® ITV

In-Tank valve lower part from PROTEGO® ITV-S

In-Tank Valves ITV-S
(Flyer pdf)

In-Tank Valves
(Flyer pdf)

Design and Specification

The standard PROTEGO® ITV-S and PROTEGO® ITV versions are manufactured in stainless steel. Other materials are available upon request and depending on the operating data. The design is custom made for each project.

Available sizes: DN150/6” to DN600/24”.

Table 1: Nominal size ITV-S and ITV

DN1	DN2*	DN3
150 / 6“	100 / 4"	150 / 6“
150 / 6“	150 / 6"	150 / 6“
200 / 8“	200 / 8“	150 / 6“
250 / 10“	250 / 10“	150 / 6“
300 / 12“	300 / 12“	250 / 10“
400 / 16“	350 / 14“	250 / 10“
400 / 16“	400 / 16“	250 / 10“
500 / 20“	500 / 20“	250 / 10“
600 / 24“	600 / 24“	250 / 10“

*only for ITV-S

Table 2: Flange connection type DN

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

Application example:

PROTEGO
for safety and environment

Questionnaire

for In-Tank Valves

PROTEGO® ITV-S and ITV

Project:	
Engineering:	
End-user:	

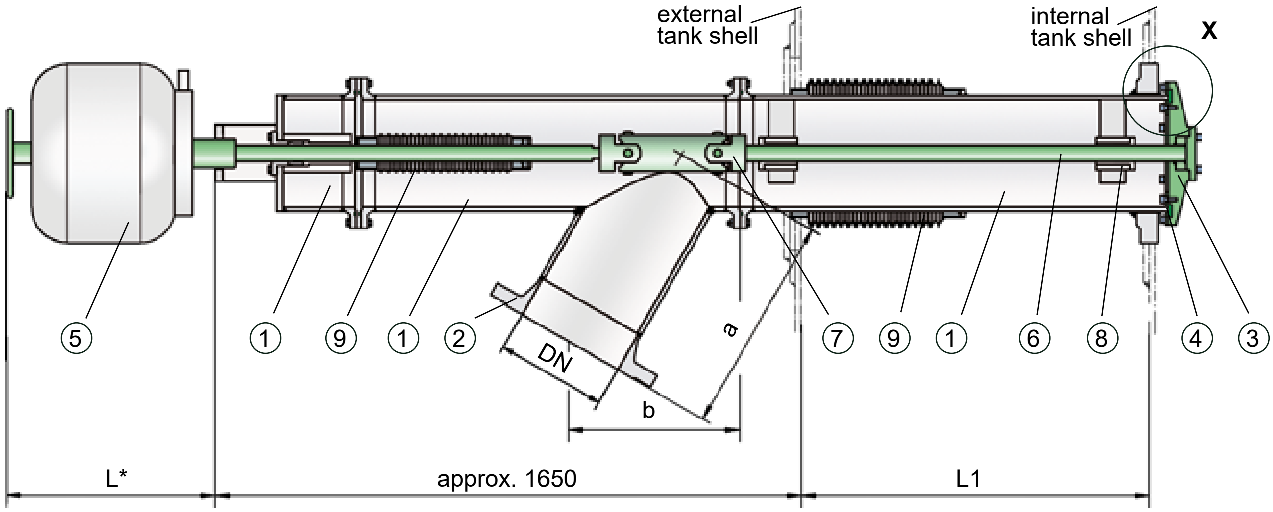
PROTEGO® ITV (bottom penetration)	☐		
PROTEGO® ITV-S (shell penetration)	☐		
Tank Standard:			
Storage Concept:			
Number of In-Tank Valves		TAG No:	
Nominal size:		Process connection:	
Process and design data			
Media			
Product density at storage temperature			
Tank design temperature			
Operating storage temperature			
Tank design pressure/vacuum			
Operating pressure/vacuum			
Design Pressure ITV / back pressure			
Ambient temperature			
Instrument air supply pressure			
Environmental condition			
Available project documents			
Tank General Arrangement Drawing	☐		
Nozzle elevation and orientation	☐		
P&ID Storage Tank Instruments	☐		
Process safety basis of design	☐		
Instrument Specification	☐		
Painting specification	☐		
Documentation requirement list	☐		
Further project specifications			

Fill in and ☐ check, if applicable.

signature:	Date:

Notes:

In-tank Valve
Internal Safety Valve
PROTEGO® SI/DP



*depends on actuator

Function and Description

PROTEGO® SI/DP in-tank valves are used as additional shut-off valves for double-walled containers, e.g., for storing liquefied gases, cryogenic gases, or other low temperature products or chemicals.

The external connection piece of the housing is usually fitted with a gate valve that is provided by the customer and aids the normal operating procedure. During normal operation, the valves are kept in the open position. It is only closed in case of emergency or for necessary repairs to the gate valve.

The key feature of these valves is the shut-off element inside the container.

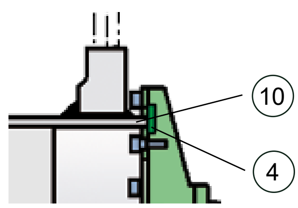
The internal safety valve consists of three housing parts (1) with lateral connecting nozzle (2) for installation of pipeline; a valve cone (3) with sealing (4); and a pneumatic actuator (5). The lapped valve seat (10) and the seal guarantee the desired tightness. Bushings (8) guide the split valve spindle (6), which is equipped with double universal joint (7). Two compensators (9) are provided to accommodate the change in length due to temperature variations.

The in-tank valve is operated/opened by a pneumatic actuator. The required closing force is provided by sufficiently dimensioned compression springs installed in the actuator. The controls must be designed in a way so that in the event of a malfunction, i.e., if the control substance (compressed air for the actuator and/or electrical power for the 3-way solenoid valve) fail, the internal safety valve automatically seals tightly.

By attaching an additional element, the in-tank valve can also be opened or closed manually. This attachment must be removed for the valve to operate automatically.

The PROTEGO® SI/DP is available in various nominal sizes. Optionally, the internal safety valve can be equipped with an internal nozzle to connect to a suction and filling pipe or a swing pipe system.

Detail **X**



Download Flyer
In-tank Valves

Designs and Specifications

Table 1: Dimensions		Dimensions in mm / inches
DN	a	b
150 / 6"	300 / 11.81	350 / 13.78
200 / 8"	400 / 15.75	400 / 15.75
250 / 10"	500 / 19.68	450 / 17.72
300 / 12"	600 / 23.62	500 / 19.68

Table 2: Materialselection	
Design	A
Housing	Stainless Steel
Valve disc	Stainless Steel
Valve spindle	Stainless Steel
Spindle sealing	PTFE
Bushing	PTFE
O-rings	PTFE

Table 3: Flange connection type DN	
EN 1092-1, Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

Selection and Design

Together with our engineers, the valve is designed for each specific application. The relevant plant specifications are considered when defining the required nominal sizes and connection types. The operating temperature and operating conditions may require special materials. The mounting flange material must be compatible with the tank material. If there are any special requirements, please contact us as special designs may also be necessary.

Necessary Data for Specification

Stored substance

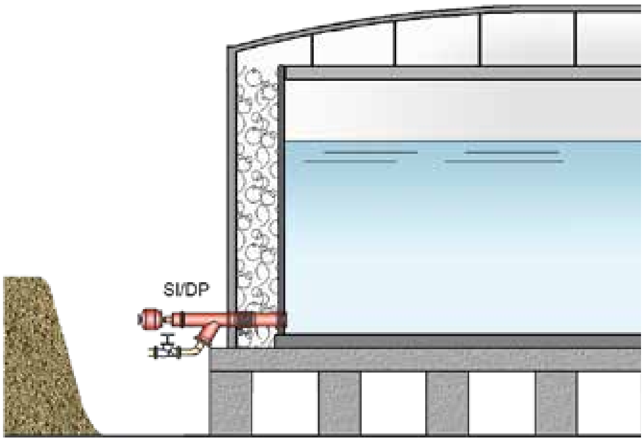
Tank height/Tank diameter (m or ft)

Jacket space L1

Tank material

Connection diameter of drain pipe, DN (mm or inch)

Application Example



In-tank valve PROTEGO® SI/DP for a double-walled tank system as per API 625.

Materials, Terms, and Conversion Tables

Pressure

1 bar	= 14.504 psi	1 lb/ft^2	=	47,88 N/m^2
	= 29.530 inch Hg		=	0,4788 mbar
	= 0.987 atm		=	4,882 mm WC
	= 401.46 inch W.C.			
1 mbar	= 0.0145 psi	1 inch W.C.	=	249,09 N/m^2
	= 0.0295 inch Hg		=	2,4909 mbar
	= 0.4015 inch W.C.		=	25,4 mm WC
	= 2.089 lb/ft^2	1 inch Hg	=	33,864 mbar
1 kPa	= 10 mbar	1 psi	=	68,94757 mbar
1 inch H_2O	= 2,49089 mbar	1 inch Hg	=	33,8639 mbar
1 Pa	= 1 N/m^2	1 psi	=	1 lb/in^2

Temperature

To convert ºC in ºF use	T_F	= 32 + 1,8 T_C
	0ºC	= 32ºF
	100ºC	= 212ºF
To convert ºF in ºC use	T_C	= 5/9 (T_F - 32)
	0ºF	= -17,8ºC
	100ºF	= 37,8ºC

Material

DIN Material Number	DIN-Material	ASTM-Material	
0.6020	GG 20	A 278-30	C.I.
0.7040	GGG 40	A 536-77	C.I.
1.0619	GS-C 25	A 216 Gr. WCB	C.S.
1.4301	X5 CrNi 18 10	A 240 Gr. 304	S.S.
1.4408	G-X6 CrNiMo 18 10	A 351 Gr. CF 8 M	S.S.
1.0425	P 265 GH	A 515 Gr. 60	C.S.
1.4541	X6 CrNiTi 18 10	A 240 Gr. 321	S.S.
1.4571	X10 CrNiMoTi 18 10	A 240 Gr. 316 Ti	S.S.
3.2581	AC 44200	A 413	Alu
Ta	Tantal	UNS R05200	
2.4610	NiMo 16 Cr 16 Ti	UNS N06455	C-4
2.4686	G-NiMo 17 Cr	UNS N30107	Casting
2.4602	NiCr 21 Mo 14 W	UNS N06022	C-22
2.4819	NiMo 16 Cr 15 W	UNS N10276	C-276

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

Important differences: US decimals in accordance with SI-System

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

Sealings and Coatings

PTFE	= polytetrafluoroethylene
PVDF	= polyvinylidenfluoride
PFA	= perfluoralkoxy polymer
FPM 70	= fluoropolimer elastomer
WS 3822	= aramide and anorganic fibers as well as mineral reinforcement materials bonded with NBR rubber
ECTFE	= ethylene chlorotrifluorethylene
FEP	= perfluoroethylene propylene

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

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

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

Length

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

Area

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

Volume

1 cm^3	= 0.06102	cu inch	1 cu inch	=	16,3870 cm^3
1 liter	= 0.03531	cu ft	1 cu ft	=	28,317 liter
	= 0.21997	gal (UK)	1 gal (UK)	=	4,5461 liter
	= 0.26417	gal (US)	1 gal (US)	=	3,785 liter
1 m^3	= 35.315	cu ft	1 cu ft	=	0,028317 m^3
	= 6.290	petr. barrels	1 petr. barrel	=	0,15899 m^3

Mass

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

Velocity and Volume Flow

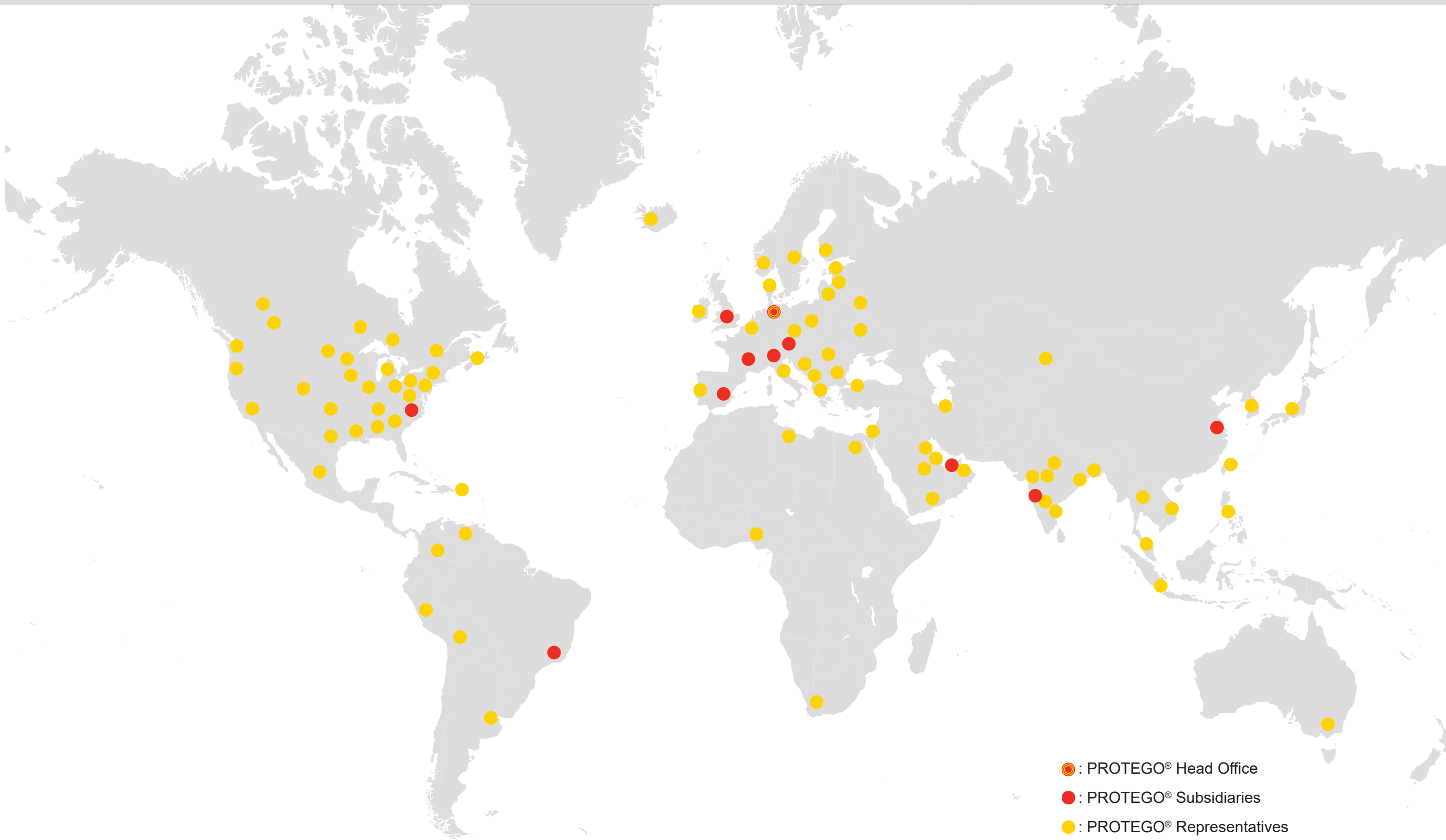
1 m/s	= 196.85	ft/min	1 ft/min	=	0,508 cm/s
1 km/h	= 0.6214	mph	1 mph	=	1,60934 km/h
1 m^3/h	= 4.403	gal/min (US)	1 gal/min (US)	=	0,227 m^3/h
	= 3.666	gal/min (UK)	1 gal/min (UK)	=	0,273 m^3/h
	= 0.5886	cu ft/min	1 cu ft/min	=	28,317 liter/min
1 kg/h	= 0.0367	lb/min	1 lb/min	=	27,216 kg/h
			1 cu ft/h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

Torsion

1 Nm	= 0.738 lb ft	1 lb ft	= 1,36 Nm

Density

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



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