PROTEGO® Equipment for Cryogenic Storage Tanks

Section 9

PROTEGO
for safety and environment

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.

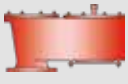
Using shuttle valves allows the operation of valves in AND/ OR mode and to carry out maintenance at the point of use.

Safety & In-Tank Valves

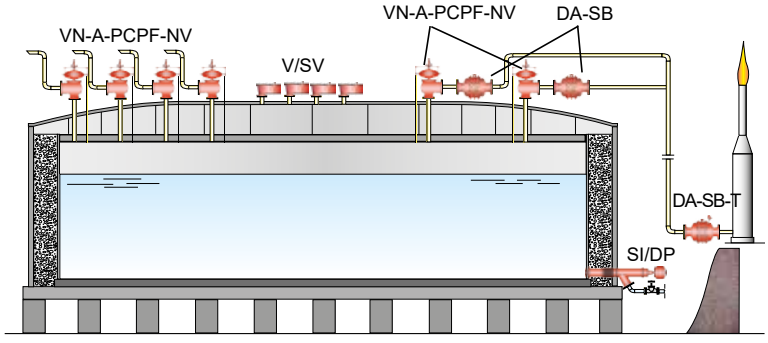
So-called in-tank valves (actuator operated shut-off valve with "fail close" function) are used mainly in cryogenic tanks where the tank wall or the bottom is penetrated by the discharge pipe. In the event of malfunctions, in-tank valves are used as a shut-off valve to minimize the spread of hazards due to product spills.

PROTEGO® Equipment for Cryogenic Storage Tanks

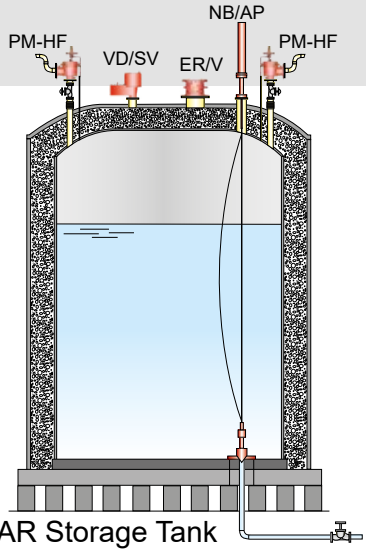
Catalog

	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	100 - 300 4“ - 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	100 - 300 4“ - 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“		In-Tank Valve with side						426 - 428
	SI/DP	150 - 300 6" - 12"		In-Tank Valve Internal Safety Valve						430 - 431

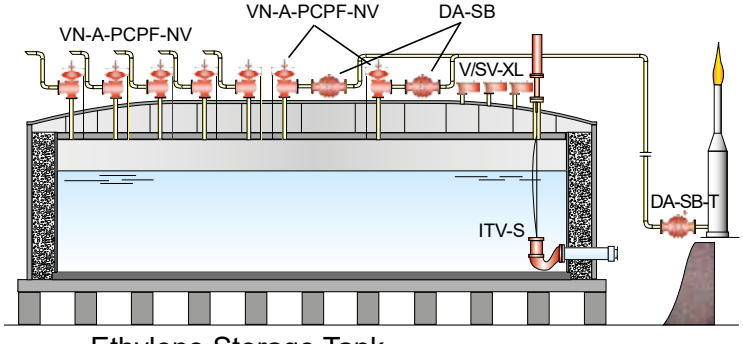
Cryogenic Tank Applications
(Flyer pdf)



Ammonia Storage Tank

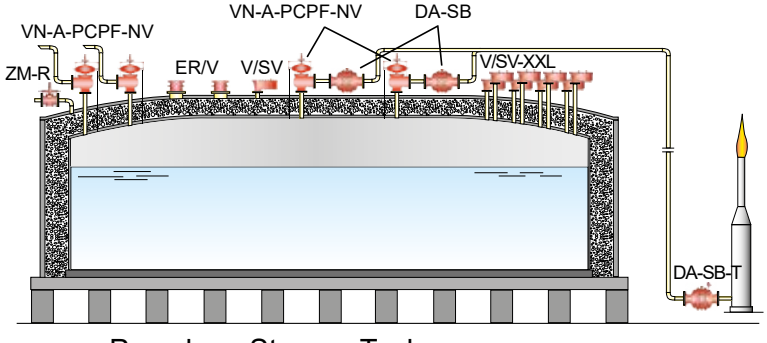


LIN-LOX-LAR Storage Tank



Ethylene 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

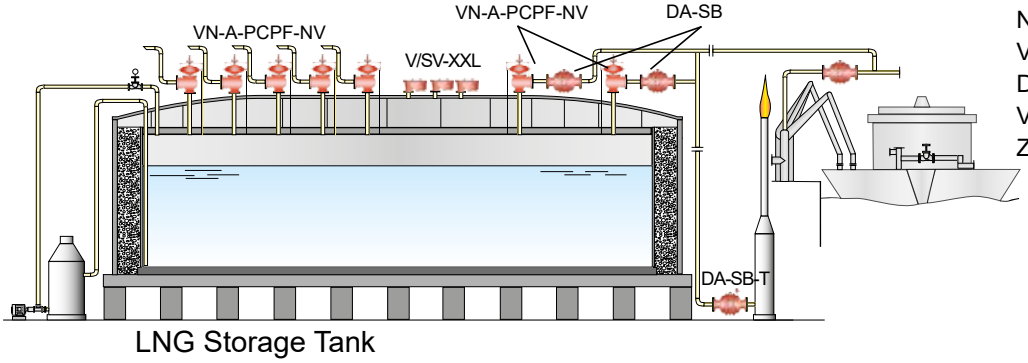


Propylene Storage Tank

- Pneumatic and fast-acting In-Tank Valves.
- Pneumatic and manual Internal Safety Valves.

- 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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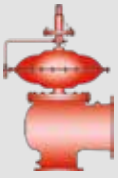
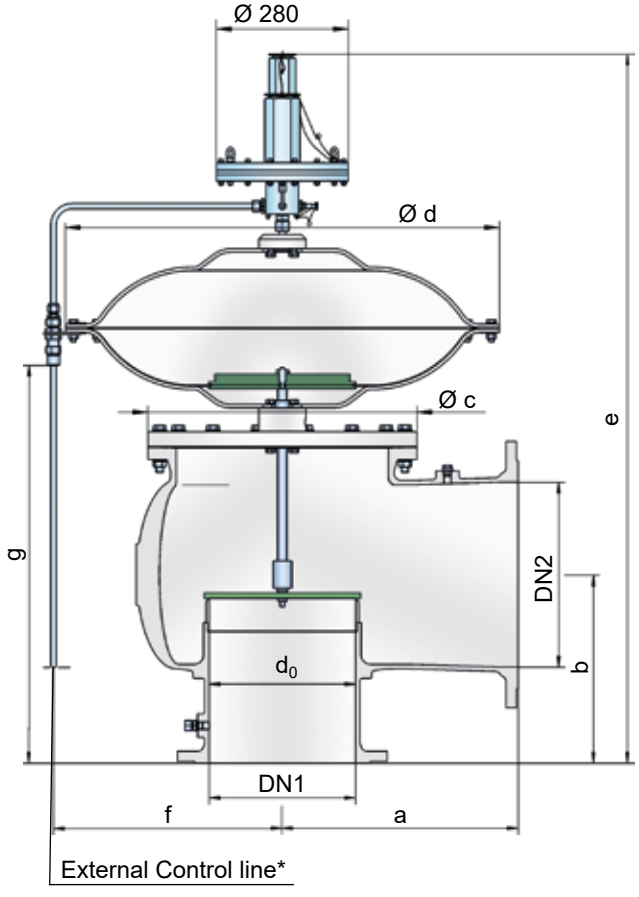


Pressure/Vacuum Relief Valve

Pilot-operated diaphragm valve

PROTEGO® VN-A-PCPF



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.

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

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
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	100 / 4"	100 / 4"	150 / 6"	150 / 6"	200 / 8"	200 / 8"	250 / 10"	250 / 10"	300 / 12"	300 / 12"	300 / 12"
DN2	100 / 4"	150 / 6"	150 / 6"	200 / 8"	200 / 8"	250 / 10"	250 / 10"	300 / 12"	300 / 12"	350 / 14"	400 / 16"
d_0	108/4.25	108/4.25	160/6.30	160/6.30	208/8.19	208/8.19	262/10.31	262/10.31	310/12.2	310/12.2	310/12.2
K	0.69	0.85	0.7	0.8	0.65	0.8	0.68	0.76	0.62	0.72	0.8

DN1 = size inlet
DN2 = size outlet
d_0 = orifice diameter (mm/inches)
K = coefficient of discharge

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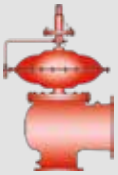
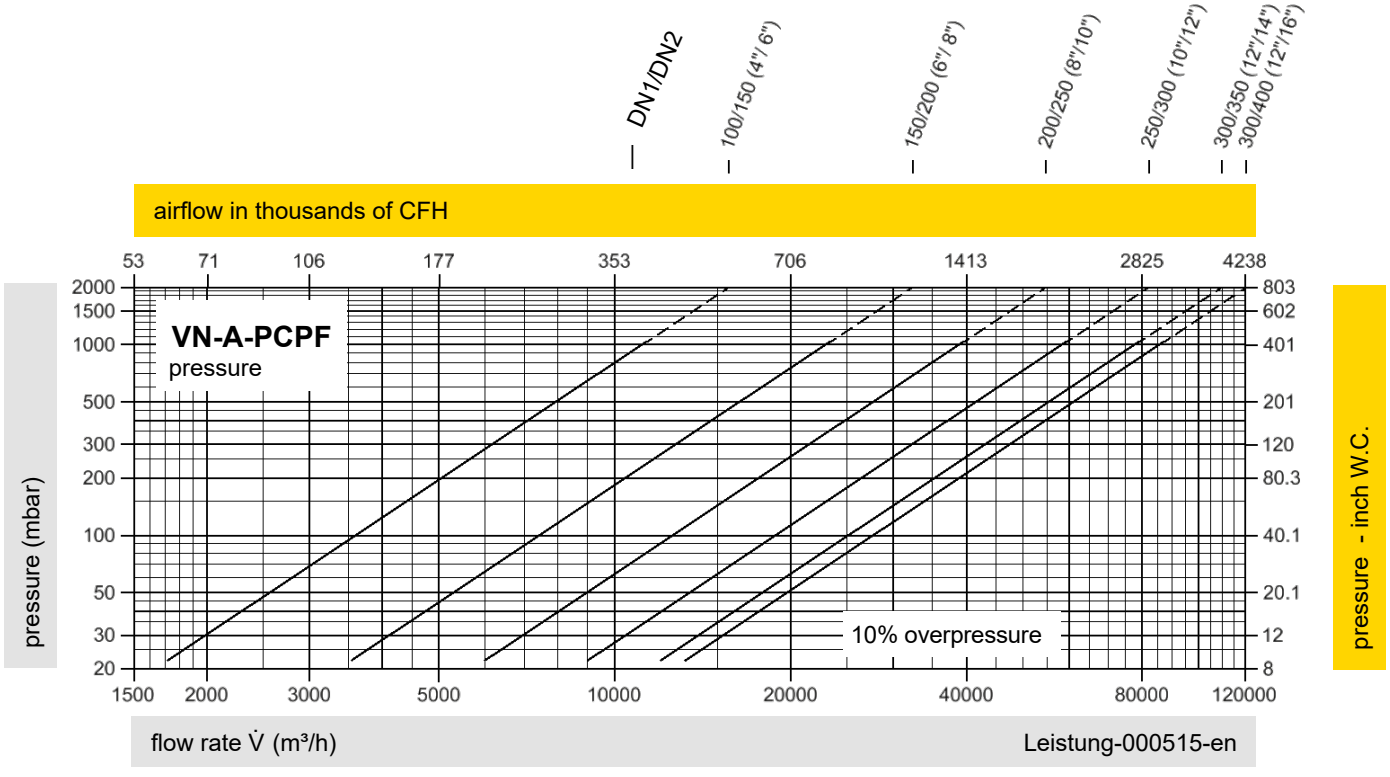
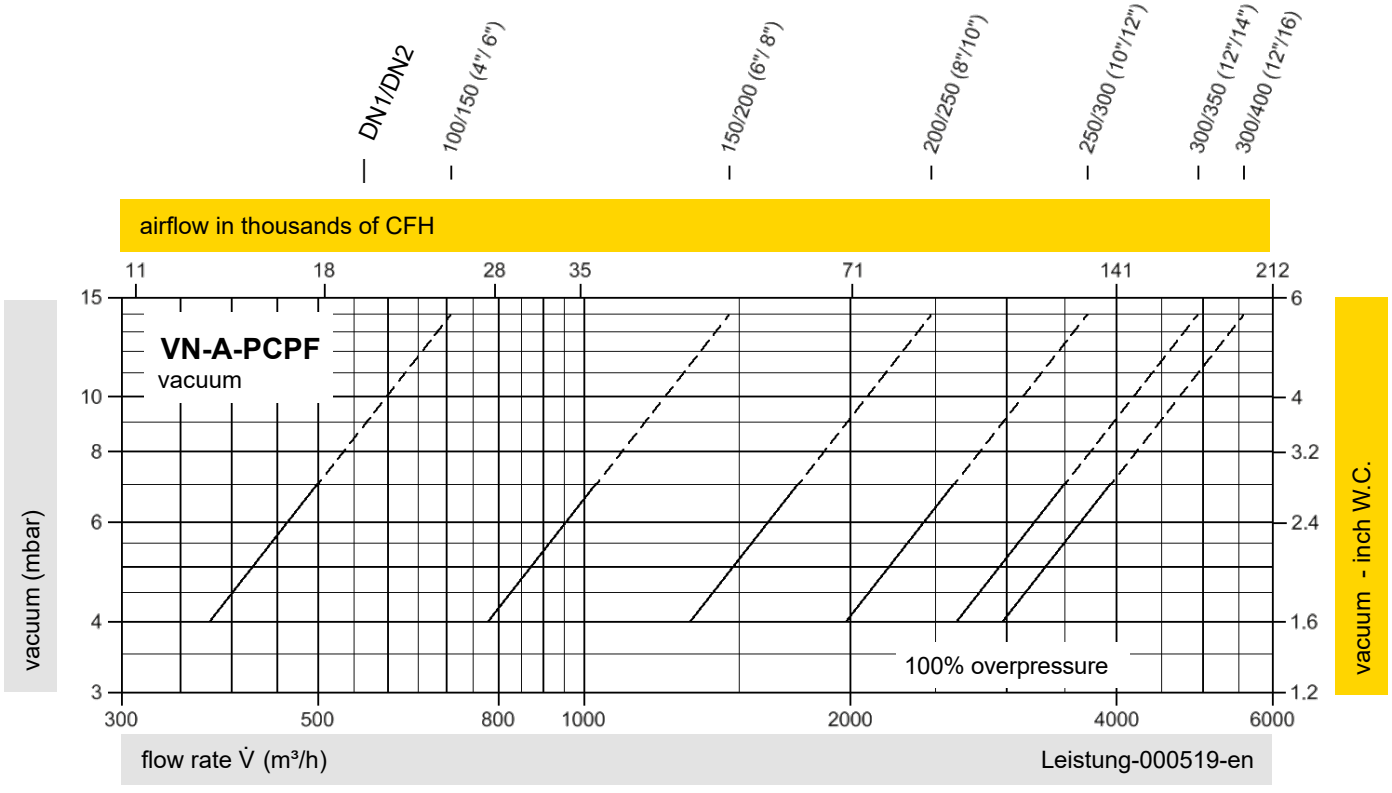


Pressure/Vacuum relief valve

Flow Capacity Charts

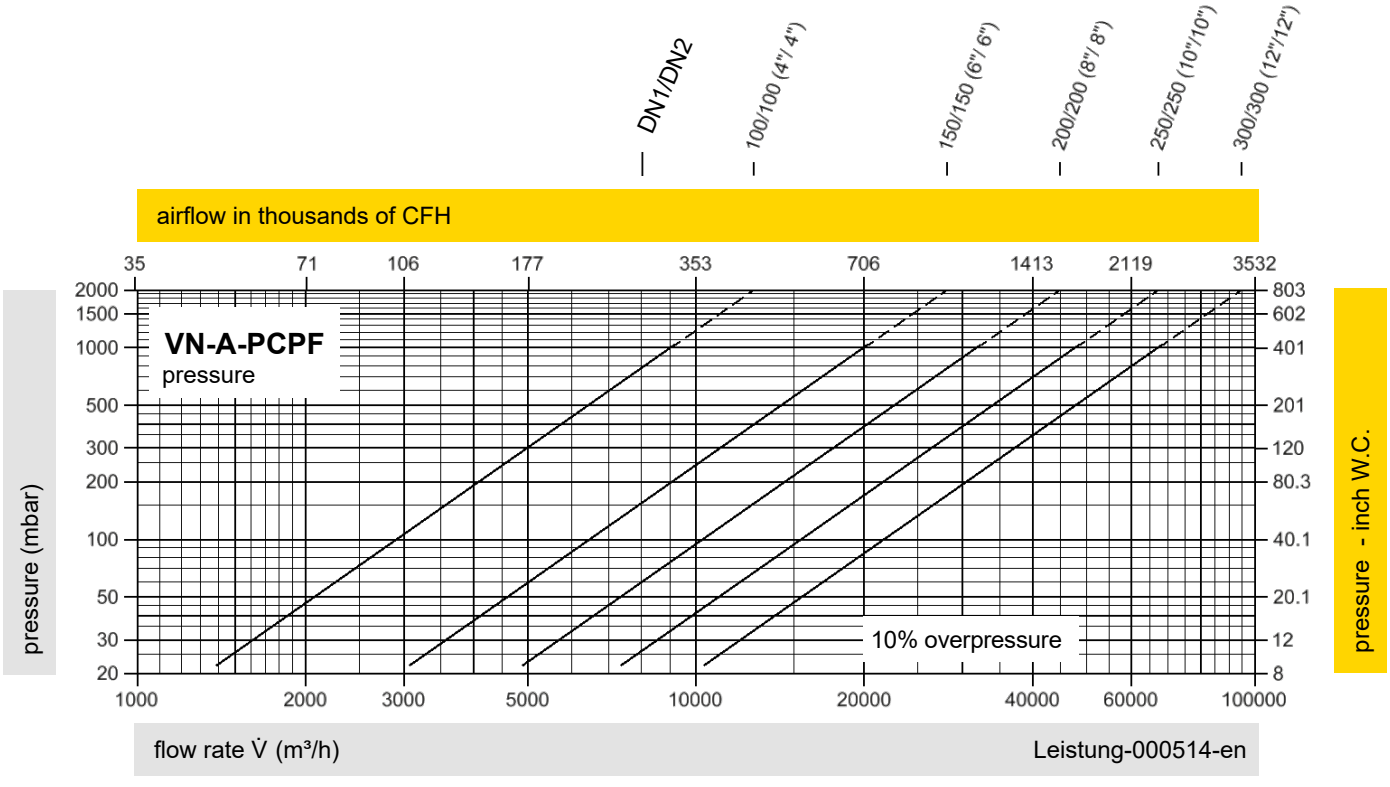
PROTEGO® VN-A-PCPF

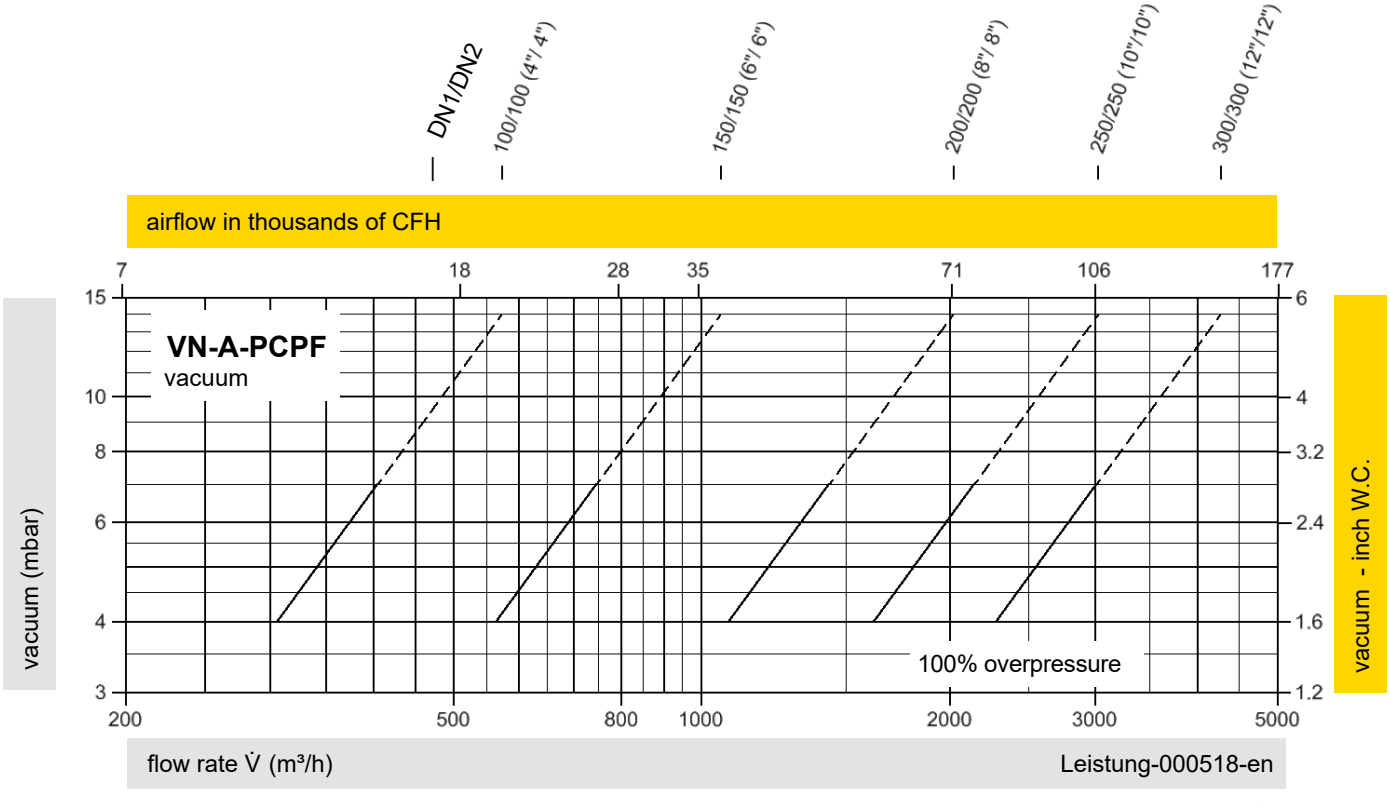




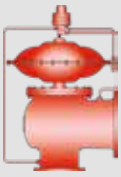
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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.”





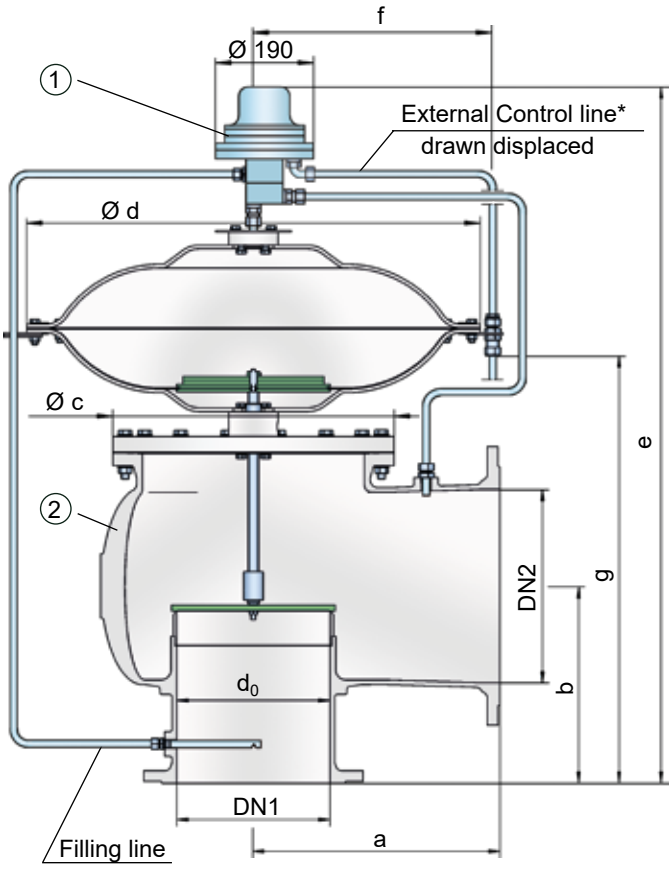
Remark: Technical Data Sheet see on page 416.



Pressure/Vacuum Relief Valve

Pilot-operated diaphragm Valve

PROTEGO® VN-A-PCPM



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
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

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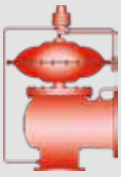
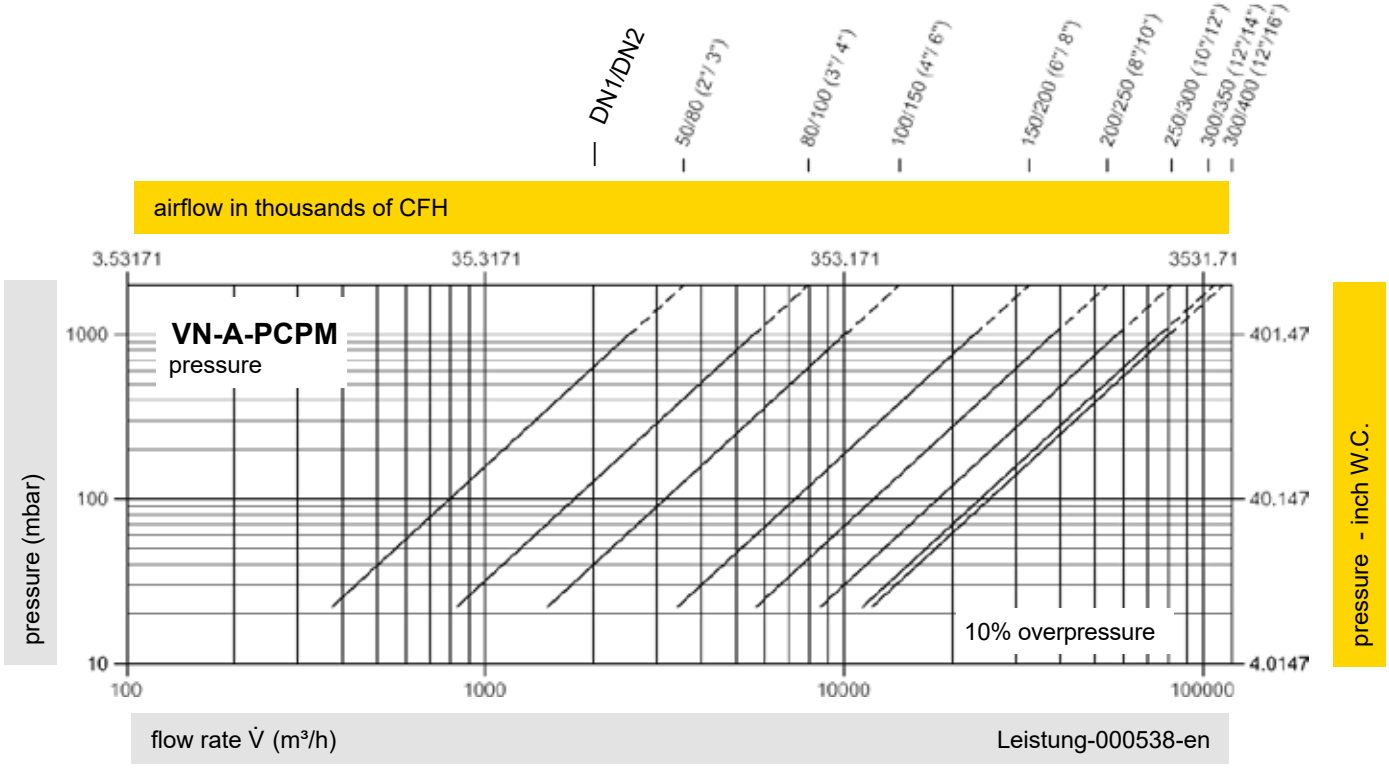
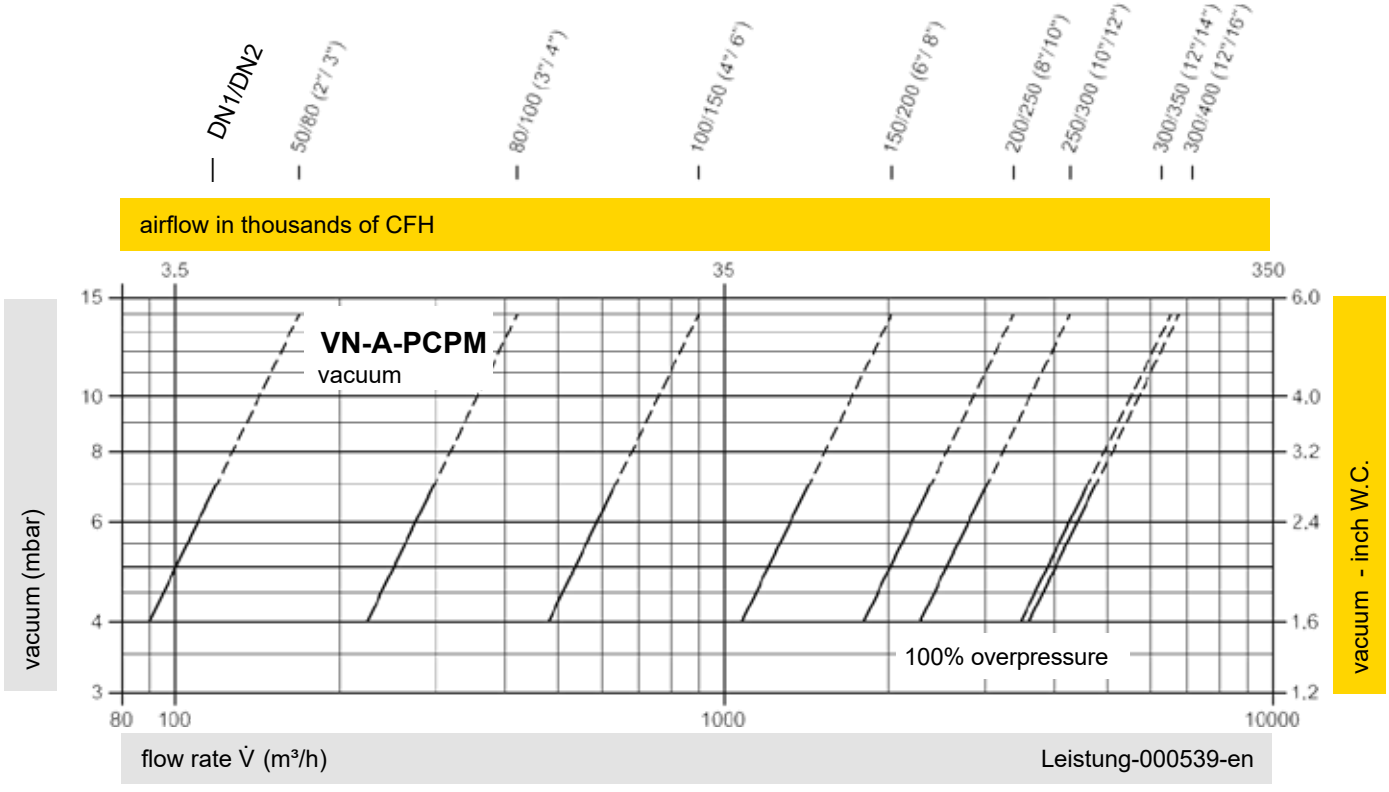


Pressure/Vacuum Relief Valve

Flow Capacity Charts

PROTEGO® VN-A-PCPM

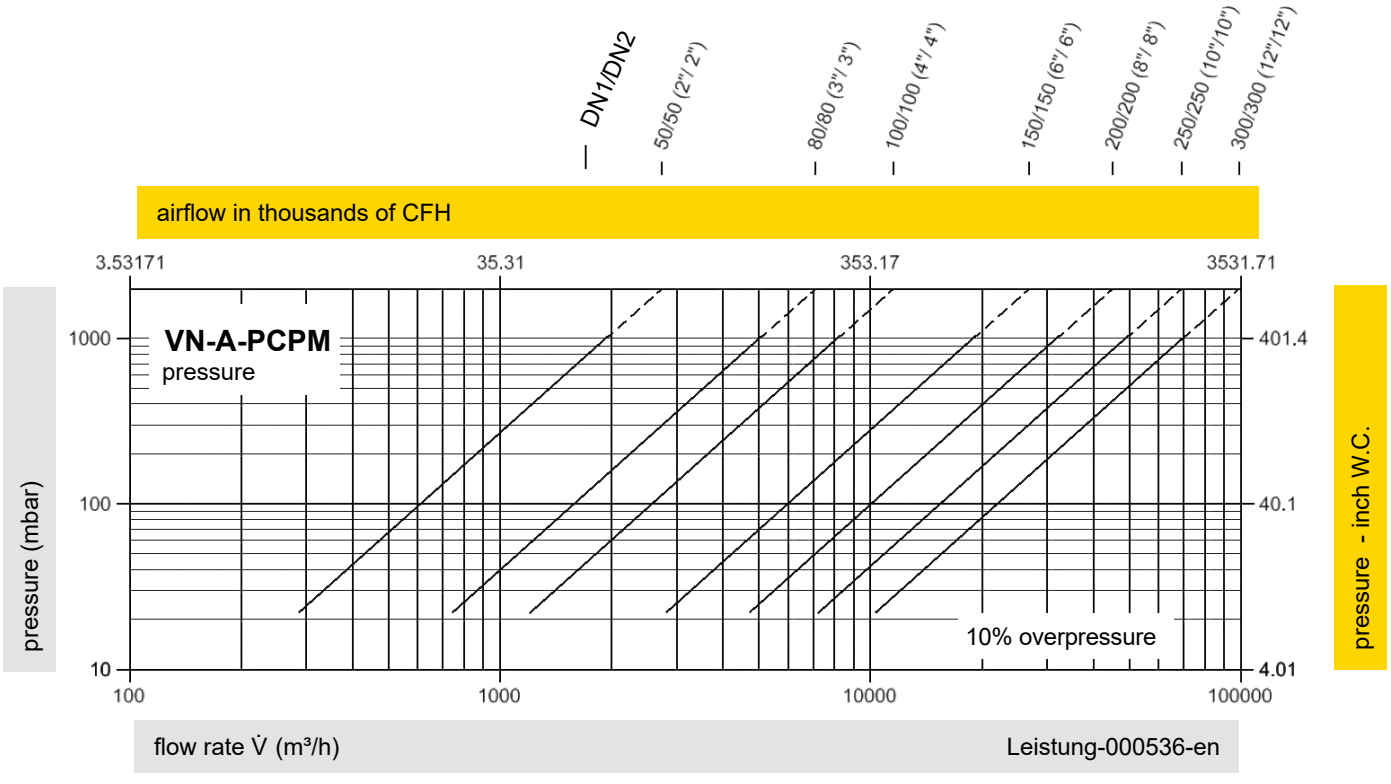


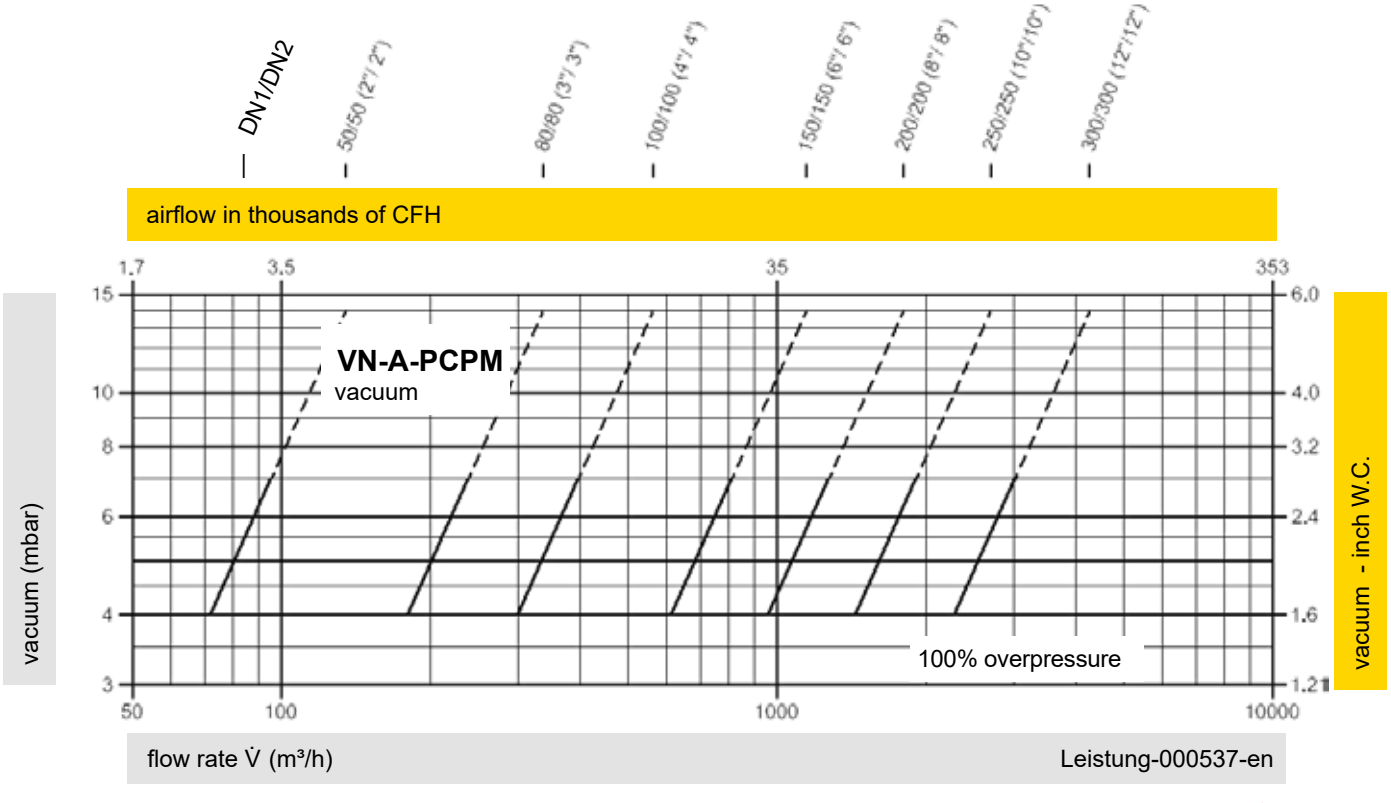


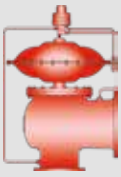
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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”.

PROTEGO® VN-A-PCPM







Pressure/Vacuum Relief Valve

Technical Data Sheet

PROTEGO® VN-A-PCPF and PROTEGO® VN-A-PCPM

Project Data Sheet

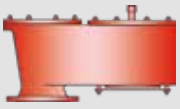
Project:	
Engineering:	
End-user:	

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:			m³/h or SCFH			
flange connection:	ASME	☐	EN 1092-1	☐	JIS	☐

Fill in and ☐ check, if applicable.

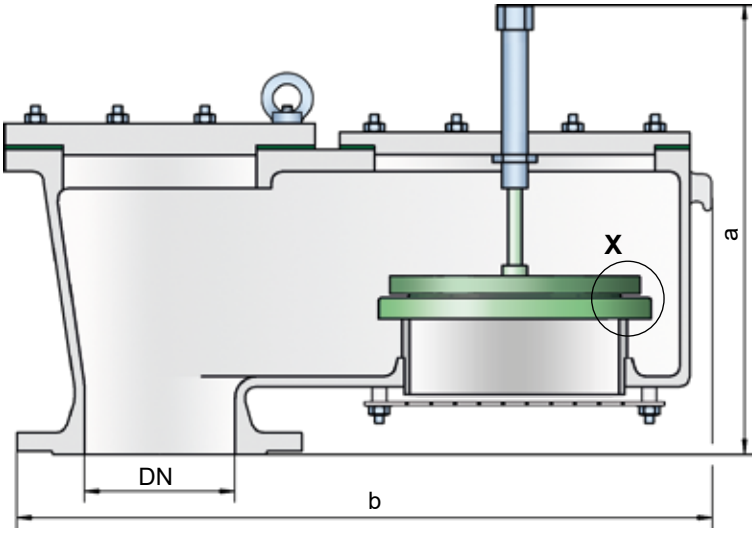
signature:	date:

Notes:

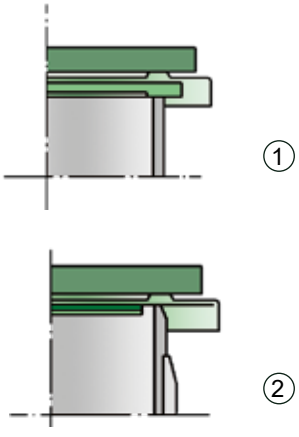


Vacuum Relief Valve

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 - –**

Pressure/vacuum relief valve with heating jacket **V/SV-XL - 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

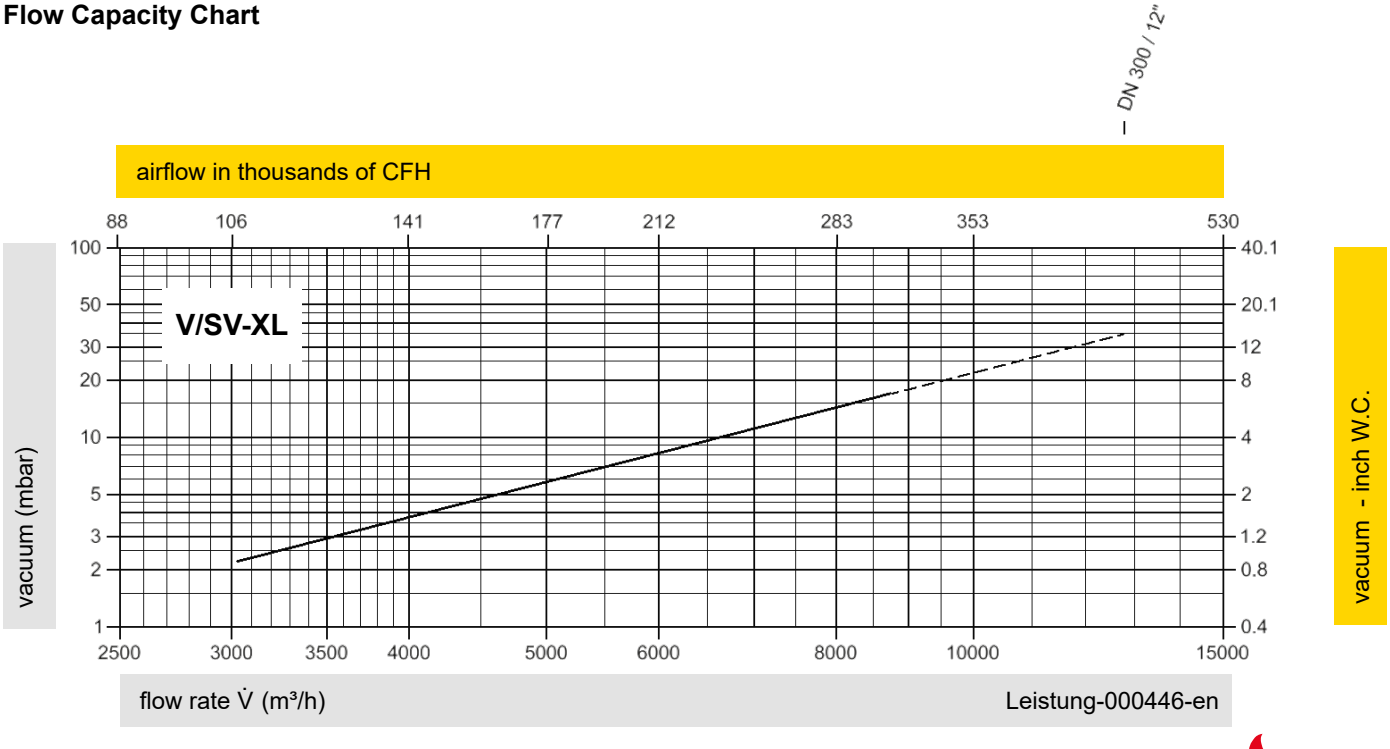
Special material and higher vacuum upon request.

Table 4 Flange connection type

EN 1092-1; Form B1
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.”

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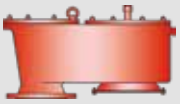
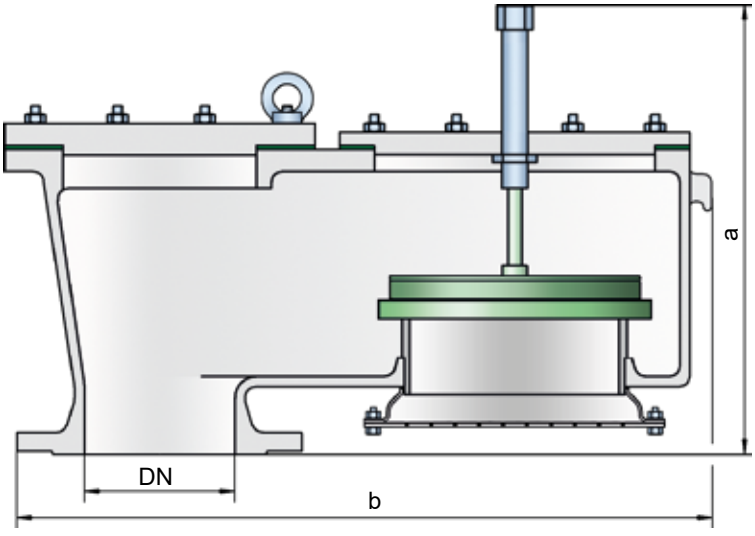


Vacuum Relief Valve

PROTEGO® V/SV-XXL



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	Aluminum	Steel	Stainless Steel
Heating jacket (V/SV-XXL-H-...)	–	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	C
Vacuum range (mbar)	-2.0 up to -9.0	<-9.0 up to -16
(inch W.C.)	-0.8 up to -3.6	<-3.6 up to -6.4
Valve pallet	Aluminum	Stainless Steel
Sealing	Metal to Metal	Metal to Metal

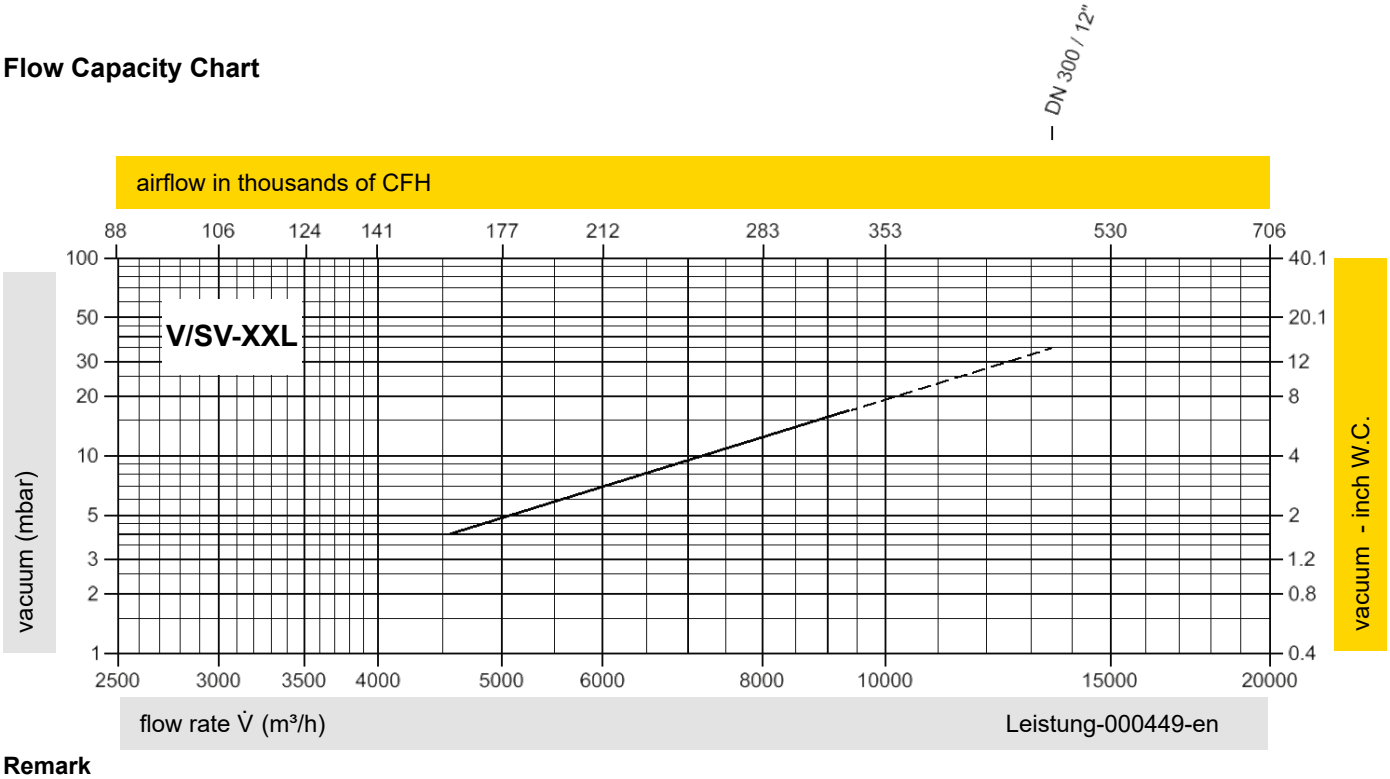
Special material and higher vacuum upon request.

Table 4 Flange connection type

EN 1092-1; Form B1
ASME B16.5 CL 150 R.F.

Other types upon request.

Flow Capacity Chart



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.”

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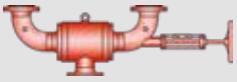
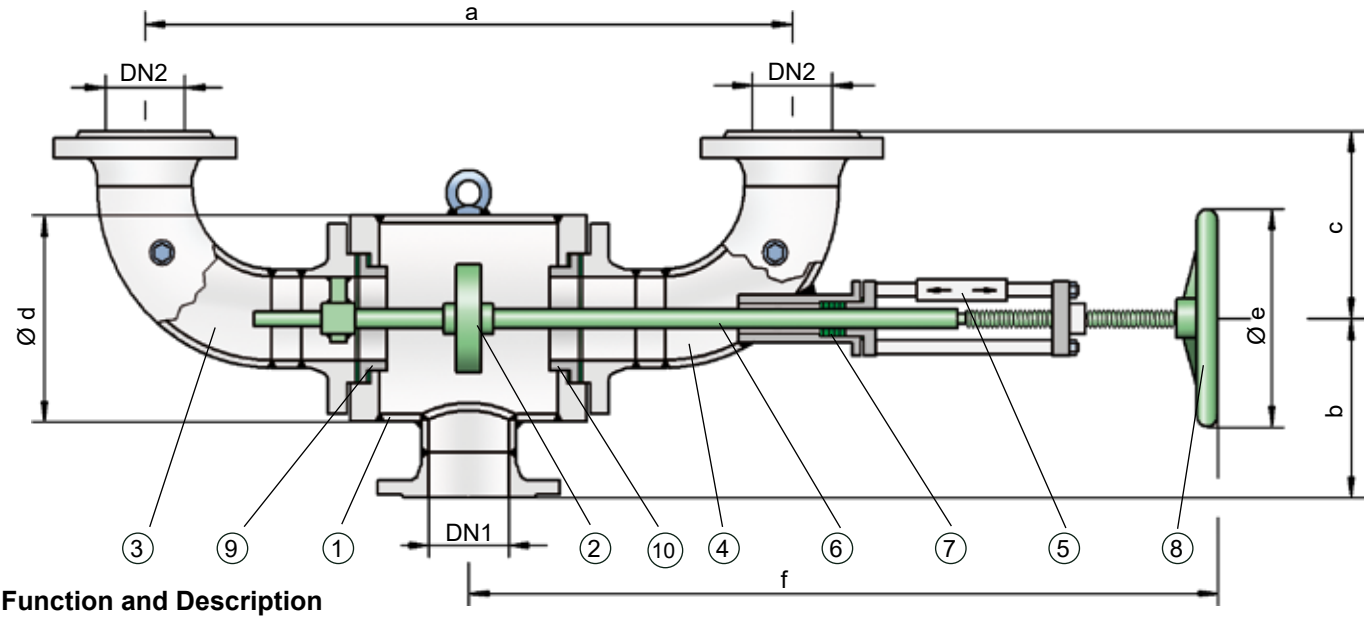
Change-over Valve



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 $\zeta = 1,2$ if valve is in the middle position
$\zeta = 2,6$ 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	1080 / 42.52	1515 / 59.65	1655 / 59.65
f_{min}	810 / 31.89	810 / 31.89	950 / 37.40	950 / 37.40	1170 / 47.76	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 6 bar/87 psi. 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)

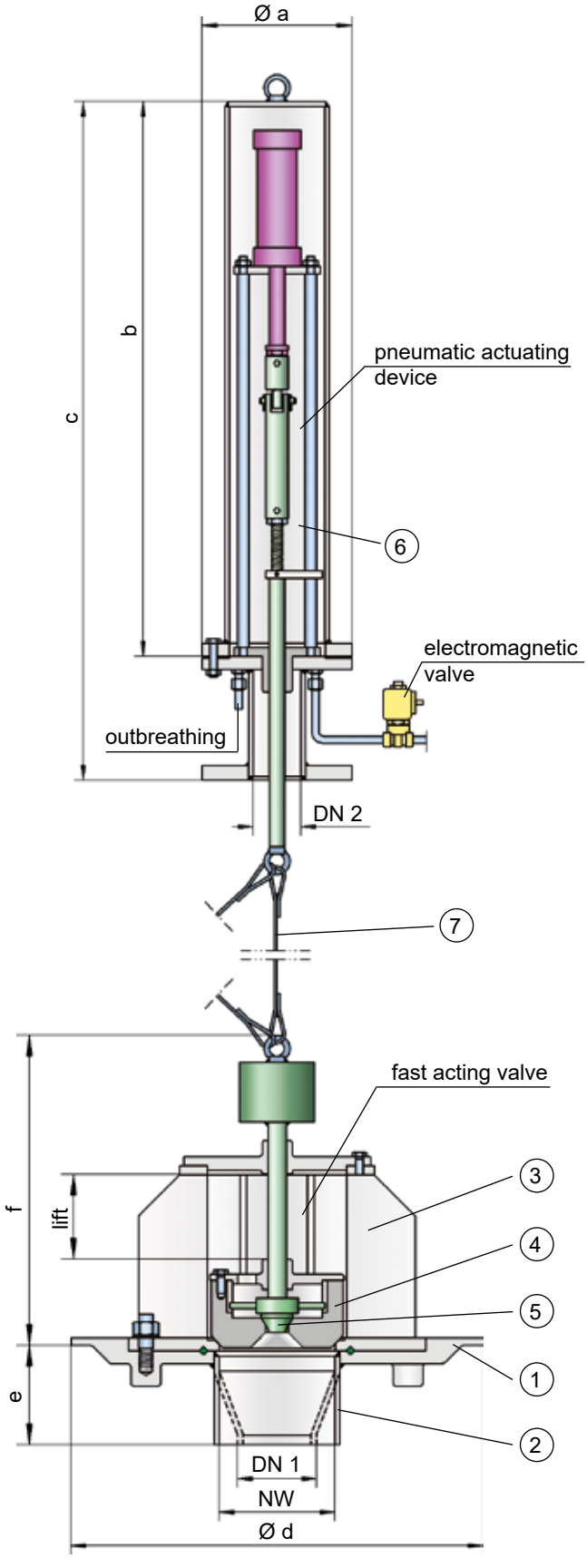
Tank nozzle DN2 (mm or inches)

Position of nozzle I, II or III

In-tank Valve

with Pneumatic Actuator

PROTEGO® NB/AP



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

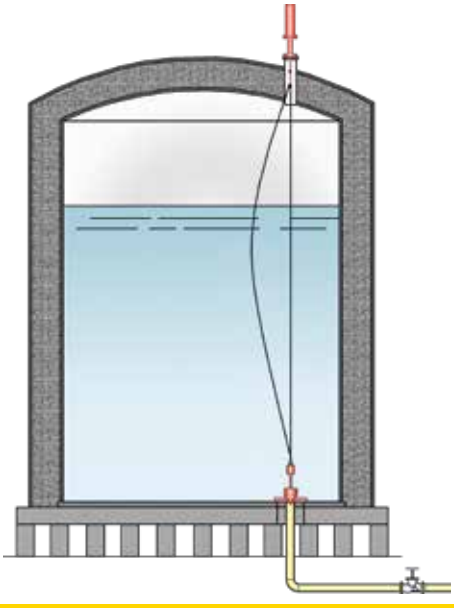
Operating temperature T (°C or °F)

Operating pressure p (bar or psi)

Connection size DN 1

Tank height (m or ft)

Application Example



PROTEGO
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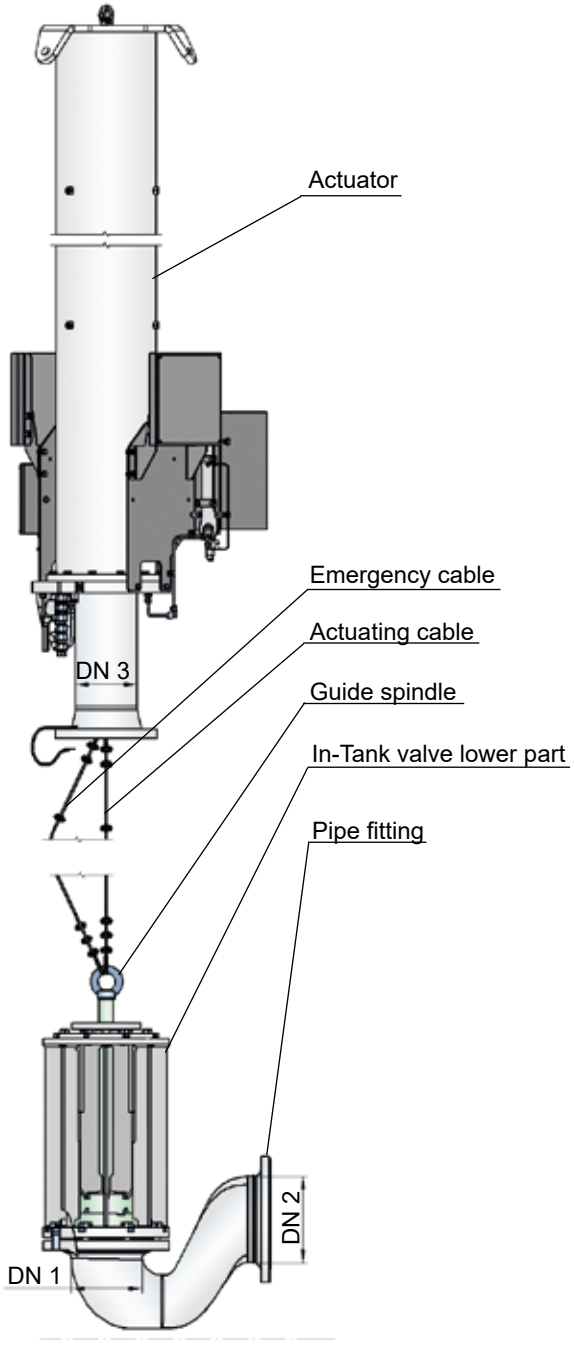
PROTEGO® ITV-S and ITV



In-Tank valve lower part from PROTEGO® ITV

In-Tank valve lower part from PROTEGO® ITV-S

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 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:

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.

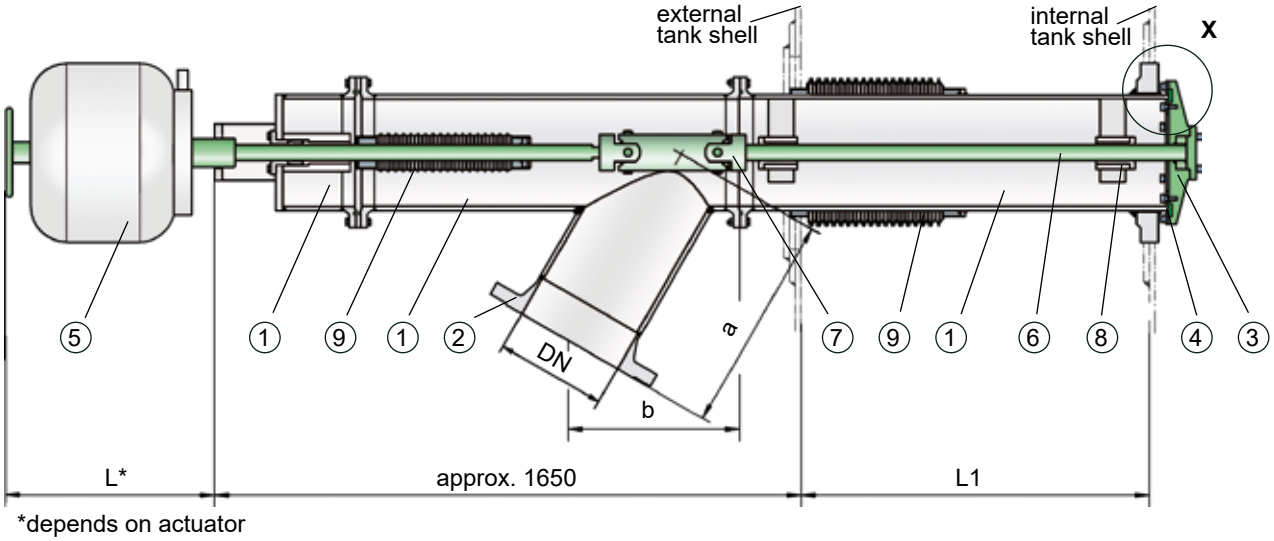
signature:	Date:

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.

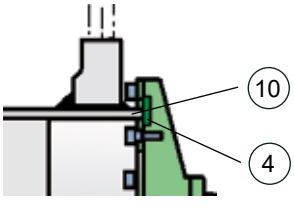
The internal safety valve consists of three housing parts (1) with lateral connecting nozzle (2) for installation of pipeline; a valve cone (3) with sealing (4); and a pneumatic actuator (5). The lapped valve seat (10) and the seal guarantee the desired tightness. Bushings (8) guide the split valve spindle (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**



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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

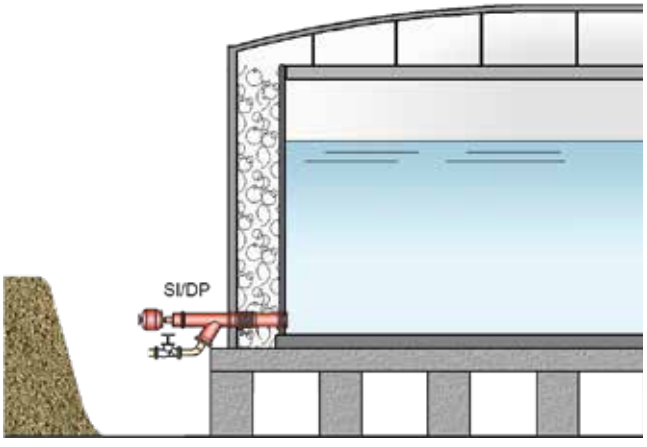
Tank height/Tank diameter (m or ft)

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.