Section 4

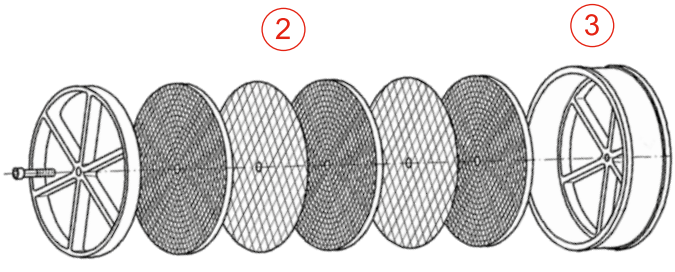
PROTEGO
for safety and environment

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

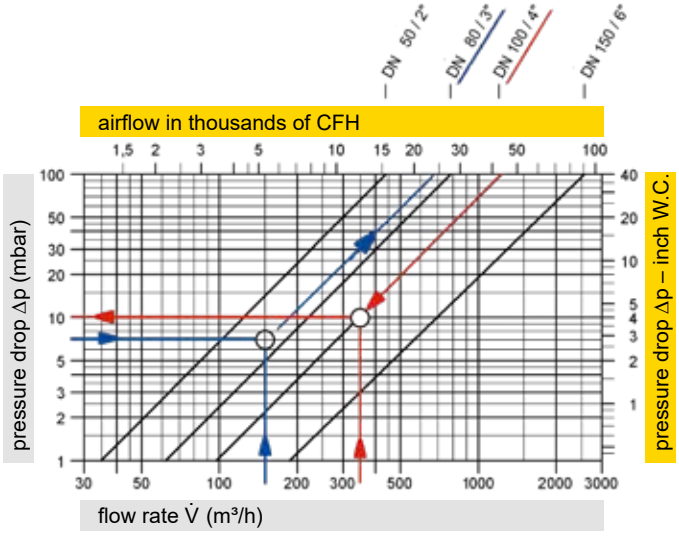
or

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

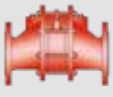
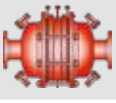
Instructions on how to calculate the volumetric flow or influence of density are found in Sec. 1 “Technical Fundamentals.”

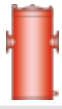
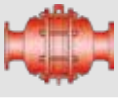
After all the steps are completed, the device can be specified and ordered.



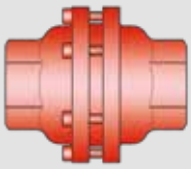
PROTEGO® Detonation Flame Arrester

Catalog

	Type	Size	Design cc = concentric ec = eccentric	Explosion Group ATEX	Explosion Group NEC	Approvals		○ = dry type x = liquid type	○ = for non-standard operating parameter	○ = for critical substances (polymerization, corrosion, crystallization)	○ = heating jacket, heating coil	○ = uni-directional, x = bi-directional	Page
for stable detonation													
	DA-G	G ½ - G 2	straigth through, cc	IIA, IIB3, IIC	D, C, B	ATEX		○	○			x	118 - 121
	DR/SV	G ½ - G ¾	straight through, cc	IIA	D	ATEX		○				○	
	DA-E	25-300 1" - 12"	straight through, ec	IIA, IIB3	D, C	ATEX		○	○			x	122 - 124
	DA-SB	50-600 2" - 24"	straight through, cc	IIA, IIB3, IIC	D, C, B	ATEX		○	○		○	x	126 - 131
	DA-SB-PTFE	50-100 2" - 4"	straight through, cc	IIA	D	ATEX		○		○		x	
	DR/ES	G ¼ -G ¾	90-degree	IIA, IIB3, IIC	D, C, B	ATEX		○	○			○	132 - 134
	DR/ES	25-200 1" - 8"	90-degree	IIA, IIB3	D, C	ATEX		○/x	○		○	○	136 - 140
	DR/ES-V	40-200 1 ½" - 8"	90-degree	IIA, IIB3	D, C	ATEX		○	○		○	○	142 - 145
	DR/ES-PTFE	40-150 1 ½" - 6"	90-degree	IIA	D	ATEX		○		○		○	
	DR/SBW	50-400 2" - 16"	straight through, cc	IIA, IIB3	D, C	ATEX		○	○		○	x	
	BR/TS	80 3"	90-degree	IIB3, IIB	C, B	ATEX		○				○	-IIB -IIB3

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

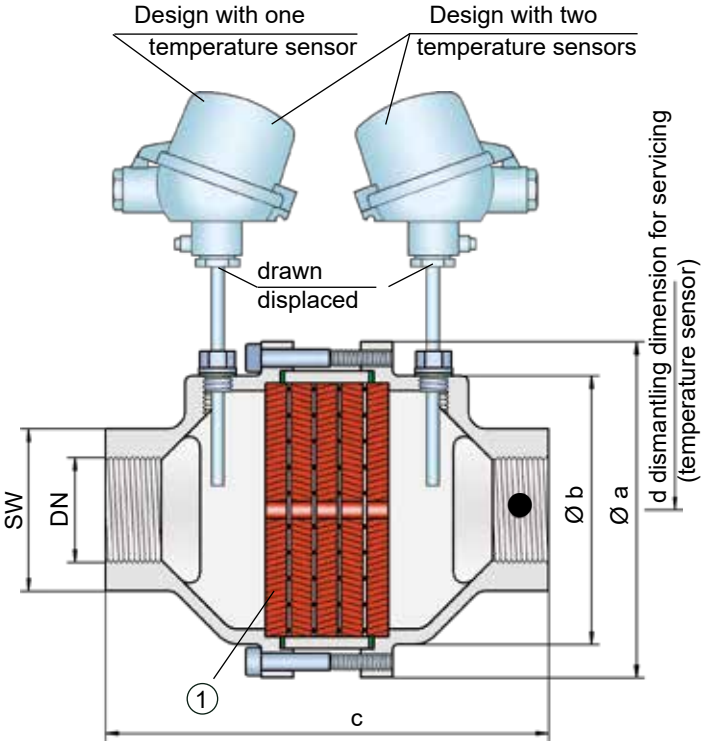
Larger sizes upon request.



In-Line Detonation Flame Arrester

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

PROTEGO® DA-G



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

Function and Description

The PROTEGO® DA-G series is a compact in-line detonation flame arrester for installation in pipes with diameters up to 2“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**.

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

Design Types and Specifications

There are three different designs available:

Basic design of the DA-G in-line detonation flame arrester, size ½“ to 2“	**DA-G-** **–**
In-line detonation flame arrester with integrated temperature sensor* as additional protection against short burning from one side, size 1½“ to 2“	**DA-G-** **T**
In-line detonation flame arrester with two integrated temperature sensors* as additional protection against short-time burning from both sides, size 1½“ to 2“	**DA-G-** **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
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)	112 / 4.41	112 / 4.41	122 / 4.80	122 / 4.80	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
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
≥ 0,65 mm	IIB3	C
< 0,50 mm	IIC	B

Special approvals upon request.

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}	1.2/17.4	1.2/17.4	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
	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

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

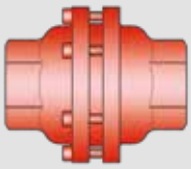
Design	B	C
Housing	Stainless Steel	Hastelloy
Gasket	PTFE	PTFE
FLAMEFILTER®*	Stainless Steel	Hastelloy

*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

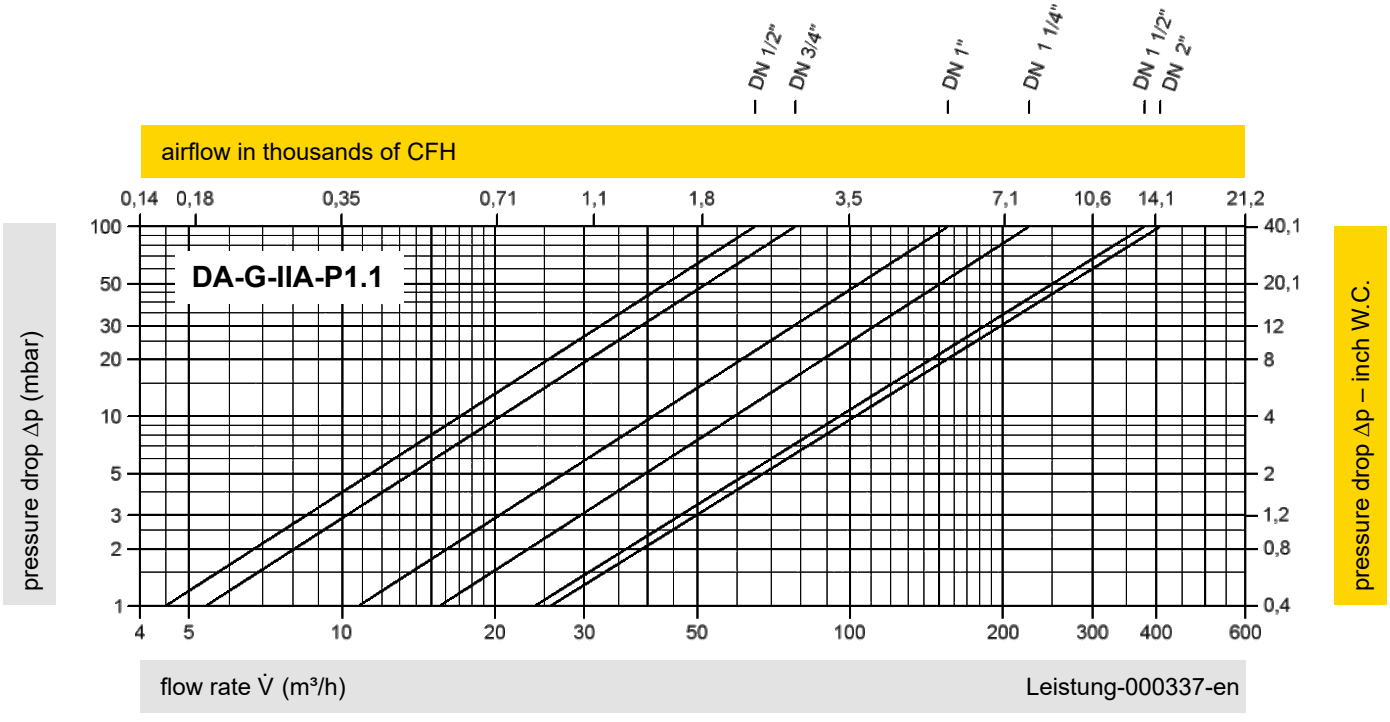
Pipe thread DIN ISO 228-1	DIN	Other types of thread upon request.



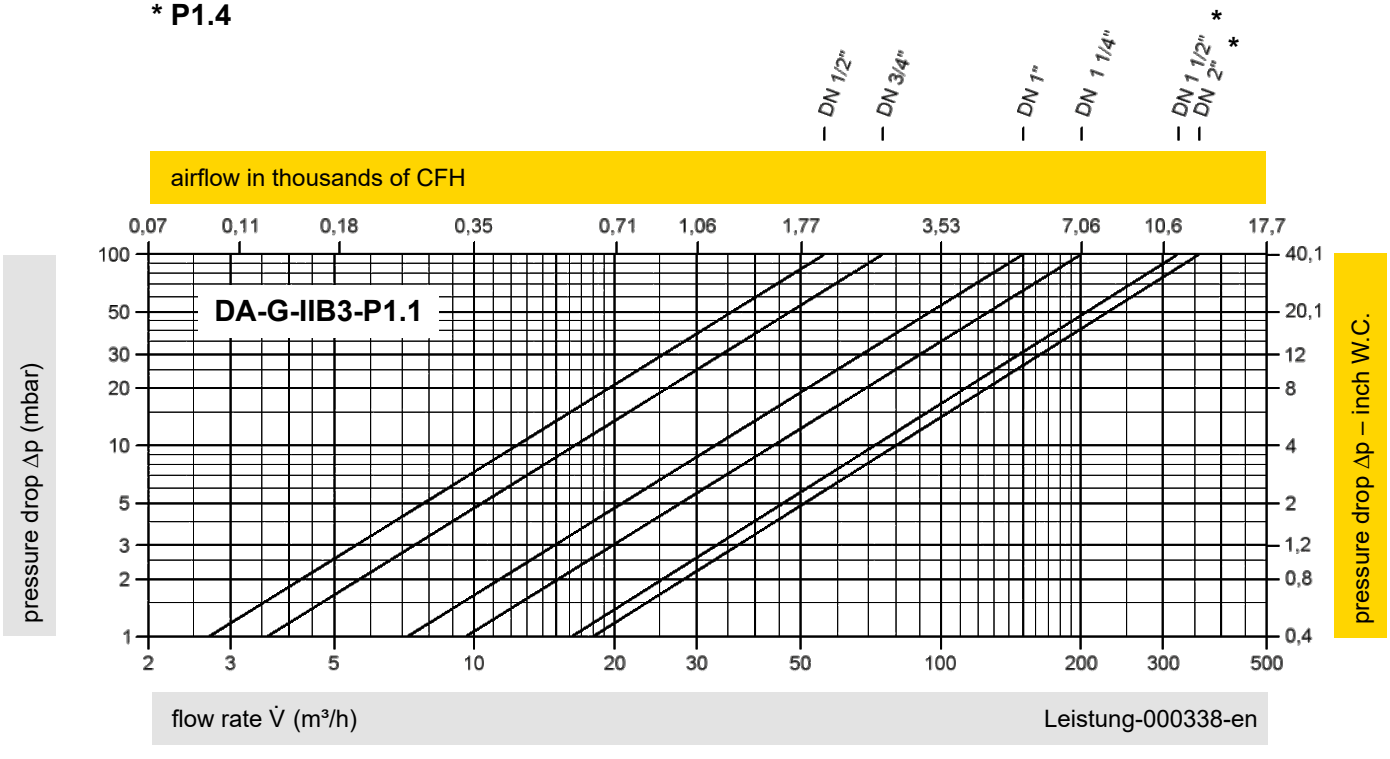
In-Line Detonation Flame Arrester

Flow Capacity Charts

PROTEGO® DA-G



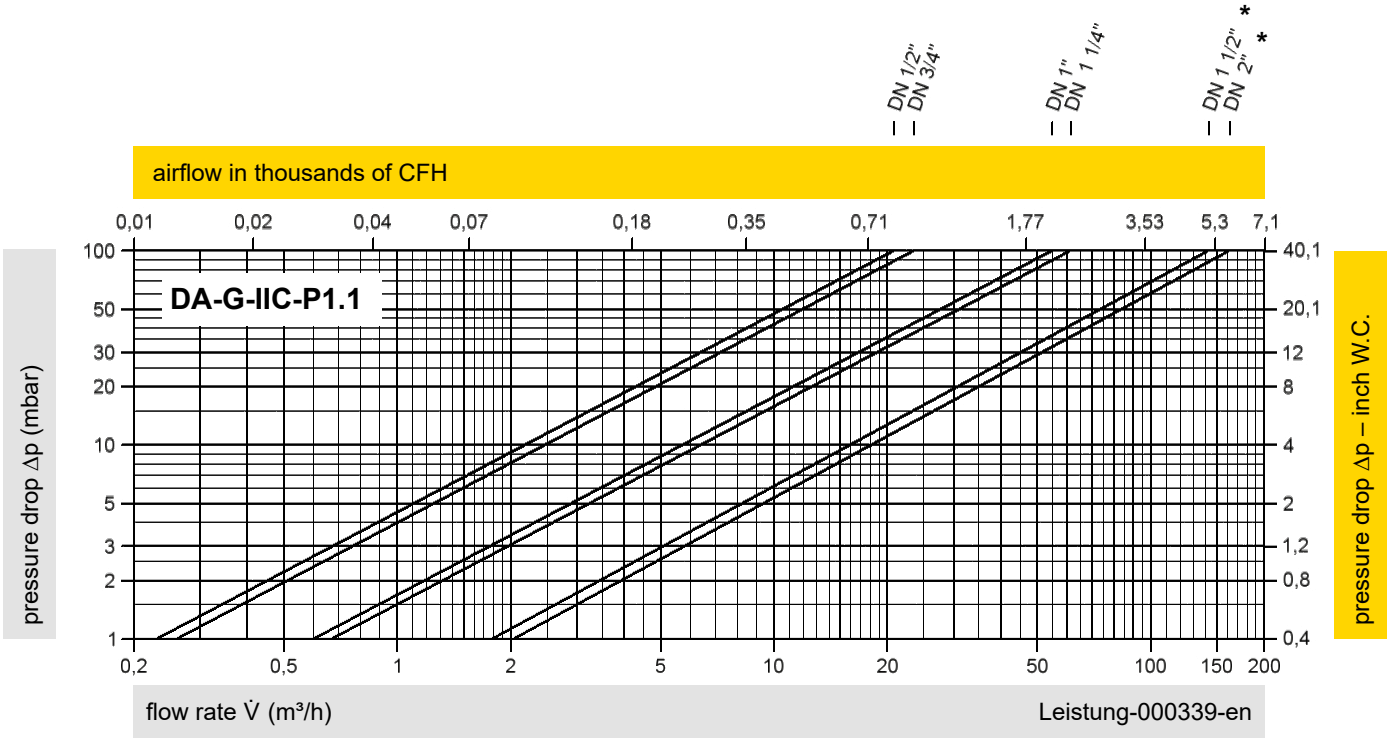
*** P1.4**

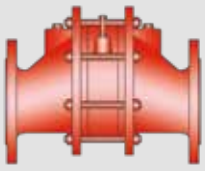


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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**

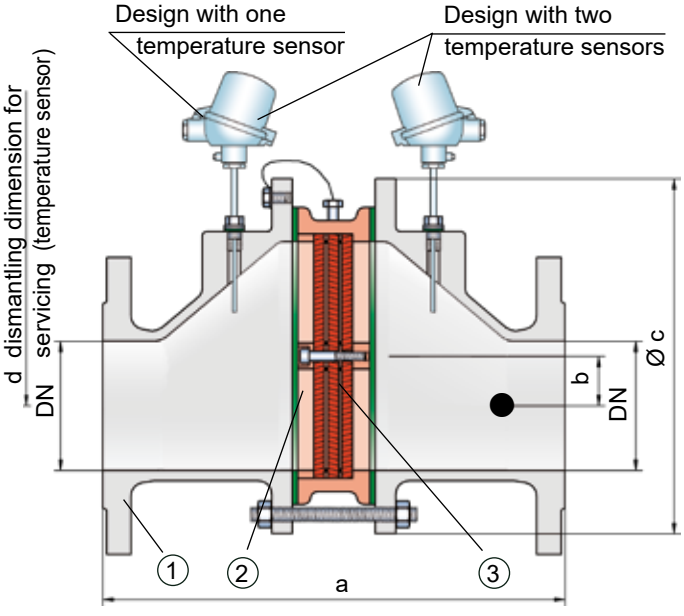

DN 1/2"
DN 3/4"
DN 1"
DN 1 1/4"
DN 1 1/2"
DN 2"
*
*
airflow in thousands of CFH
0,01
0,02
0,04
0,07
0,18
0,35
0,71
1,77
3,53
5,3
7,1
DA-G-IIC-P1.1
100
50
30
20
10
5
3
2
1
40,1
20,1
12
8
4
2
1,2
0,8
0,4
pressure drop Δp (mbar)
pressure drop Δp – inch W.C.
0,2
0,5
1
2
5
10
20
50
100
150
200
flow rate V̇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

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	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	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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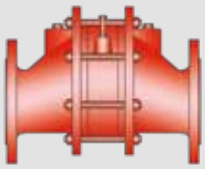
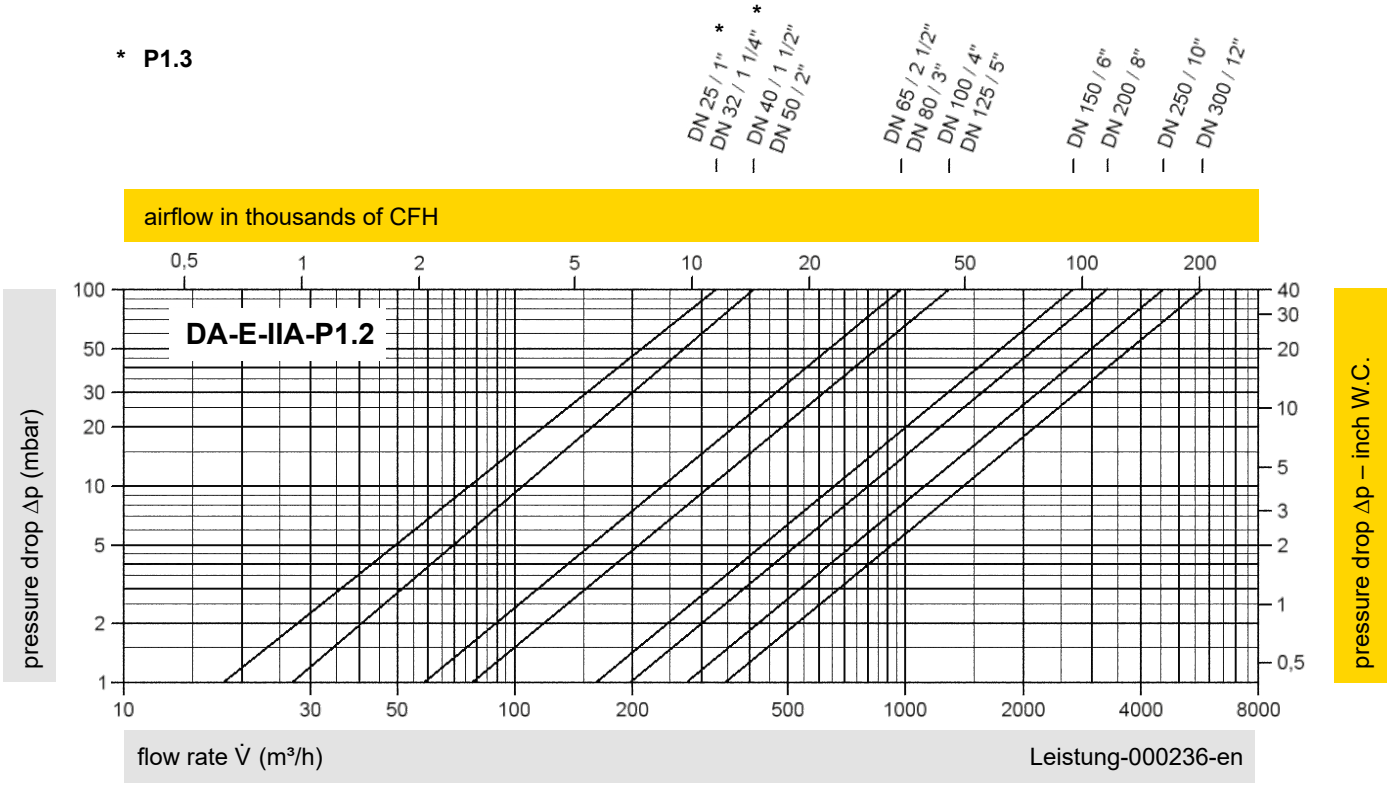


Eccentric In-Line Detonation Flame Arrester

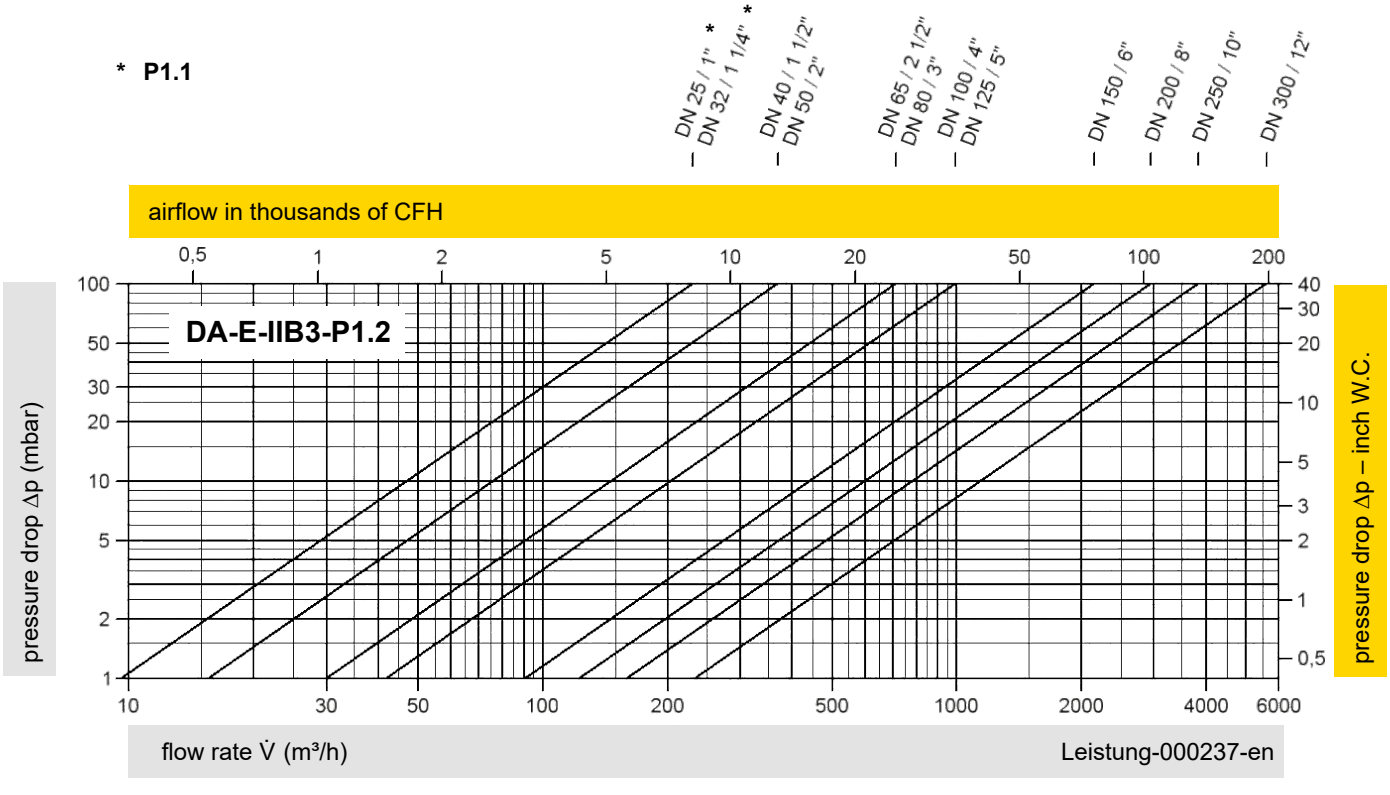
Flow Capacity Charts

PROTEGO® DA-E

* P1.3



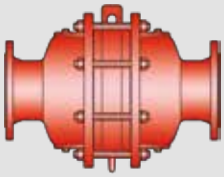
* P1.1



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.”

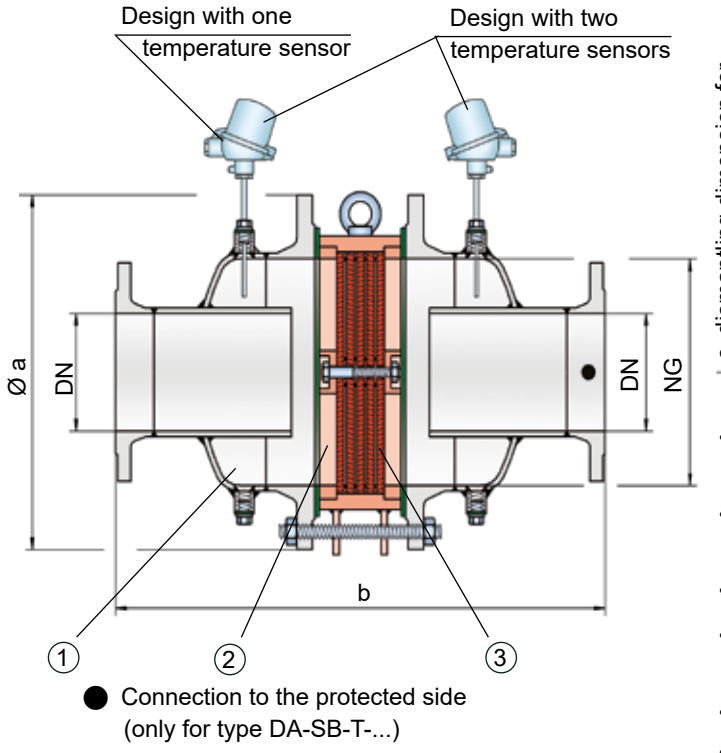
Notes:



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)

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 (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	

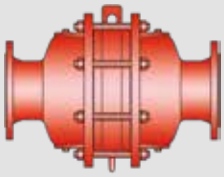
Table 3: Selection of max. operating pressure

			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.



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	The housing is also available in Steel with ECTFE coating.
Housing Heating jacket (DA-SB-(T)-H-...)	Steel Steel	Stainless Steel Stainless Steel	Hastelloy Stainless Steel	
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

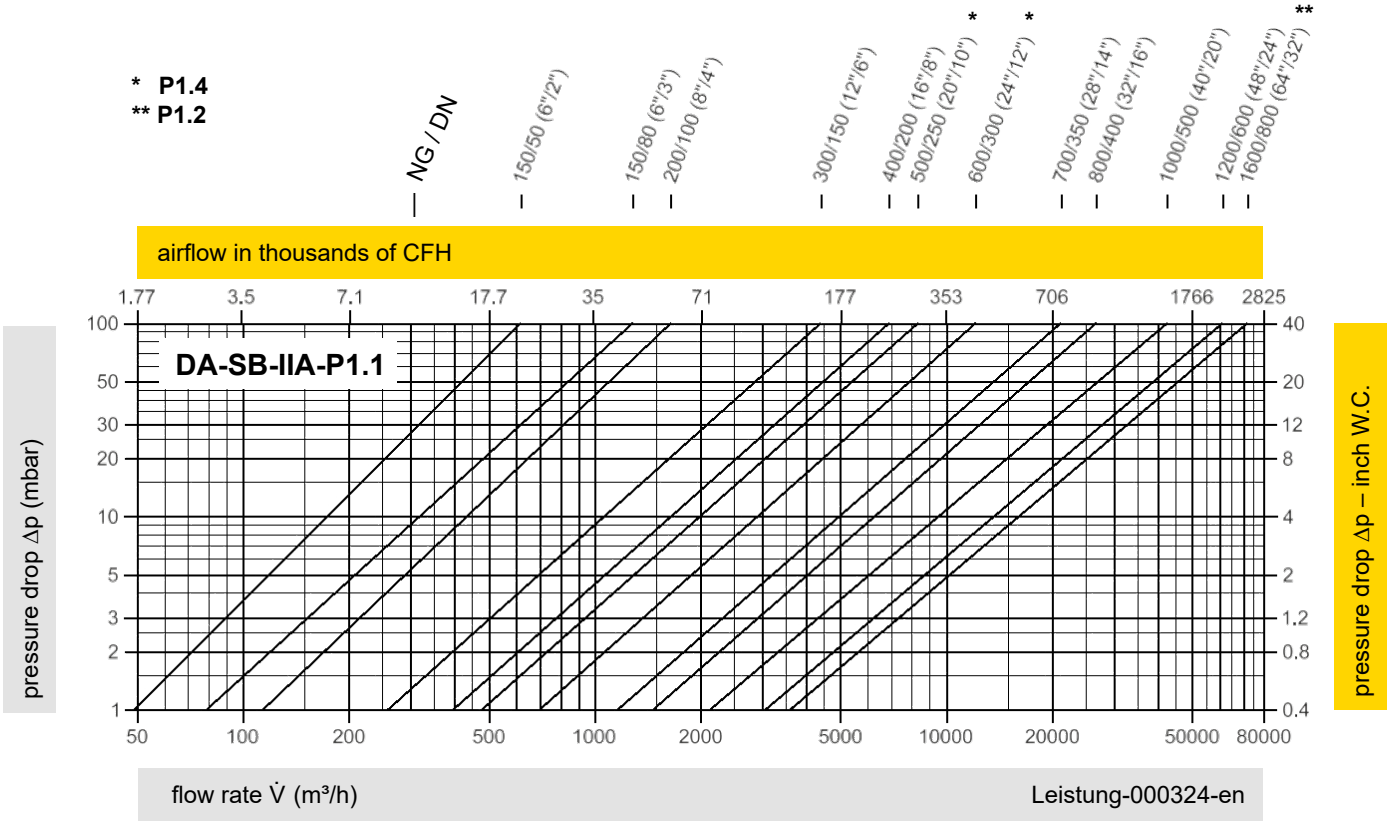
Design	A	B	C	D	*The FLAMEFILTER® are also available in Tantalum, Inconel, Copper, etc., when the listed housing and cage materials are used.
FLAMEFILTER® cage	Steel	Stainless Steel	Stainless Steel	Hastelloy	
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy	
Spacer	Stainless Steel	Stainless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

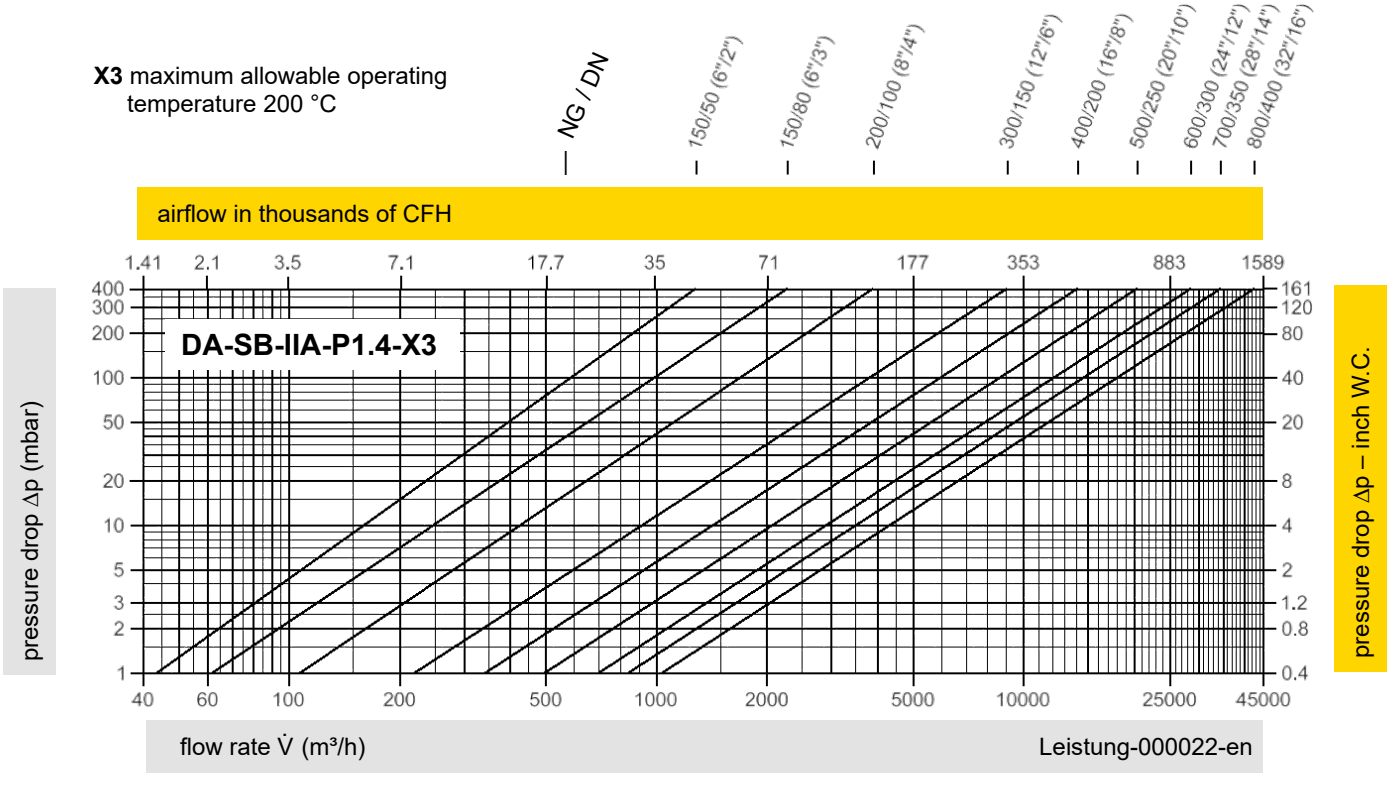
Special materials upon request.

Table 7: Flange connection type

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

PROTEGO® DA-SB





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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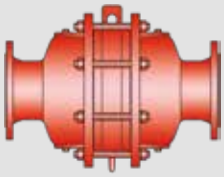
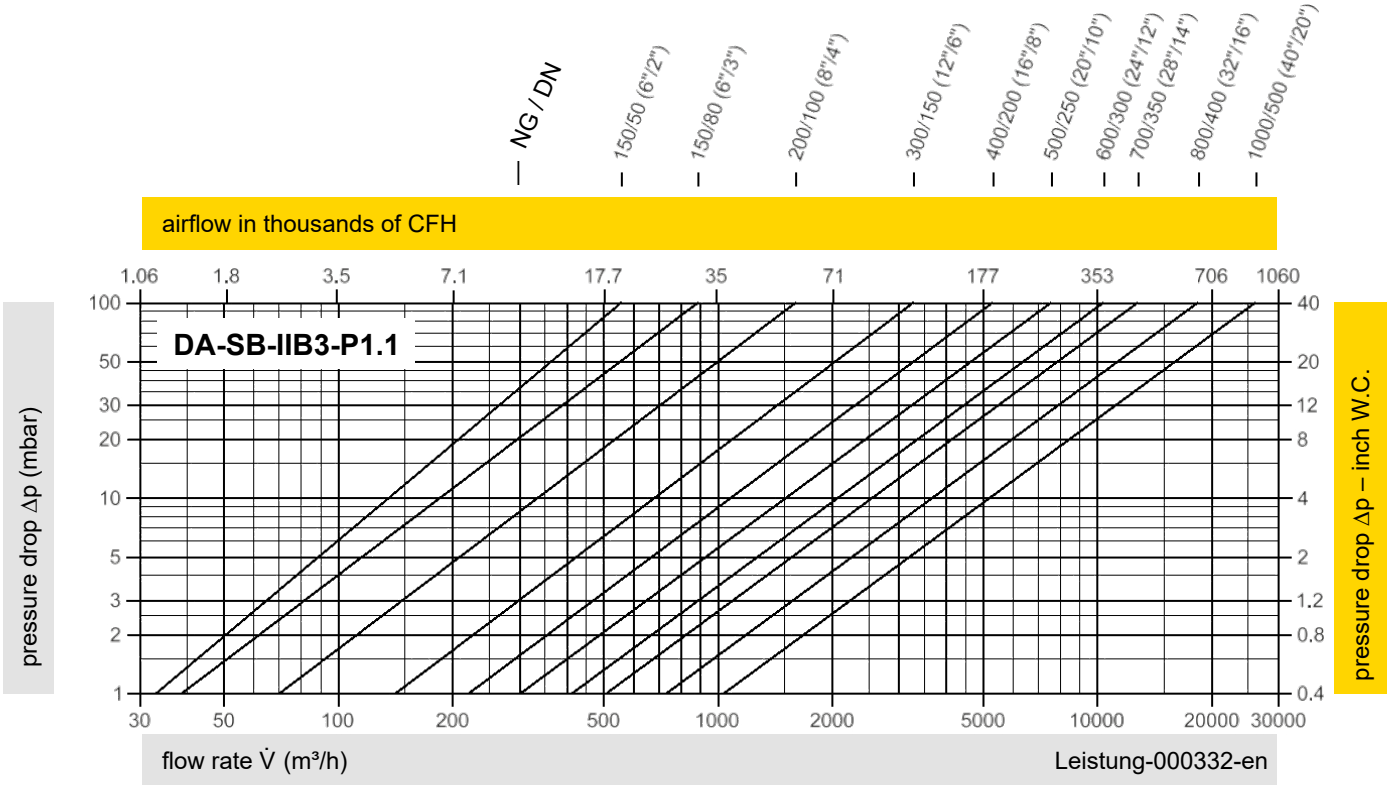


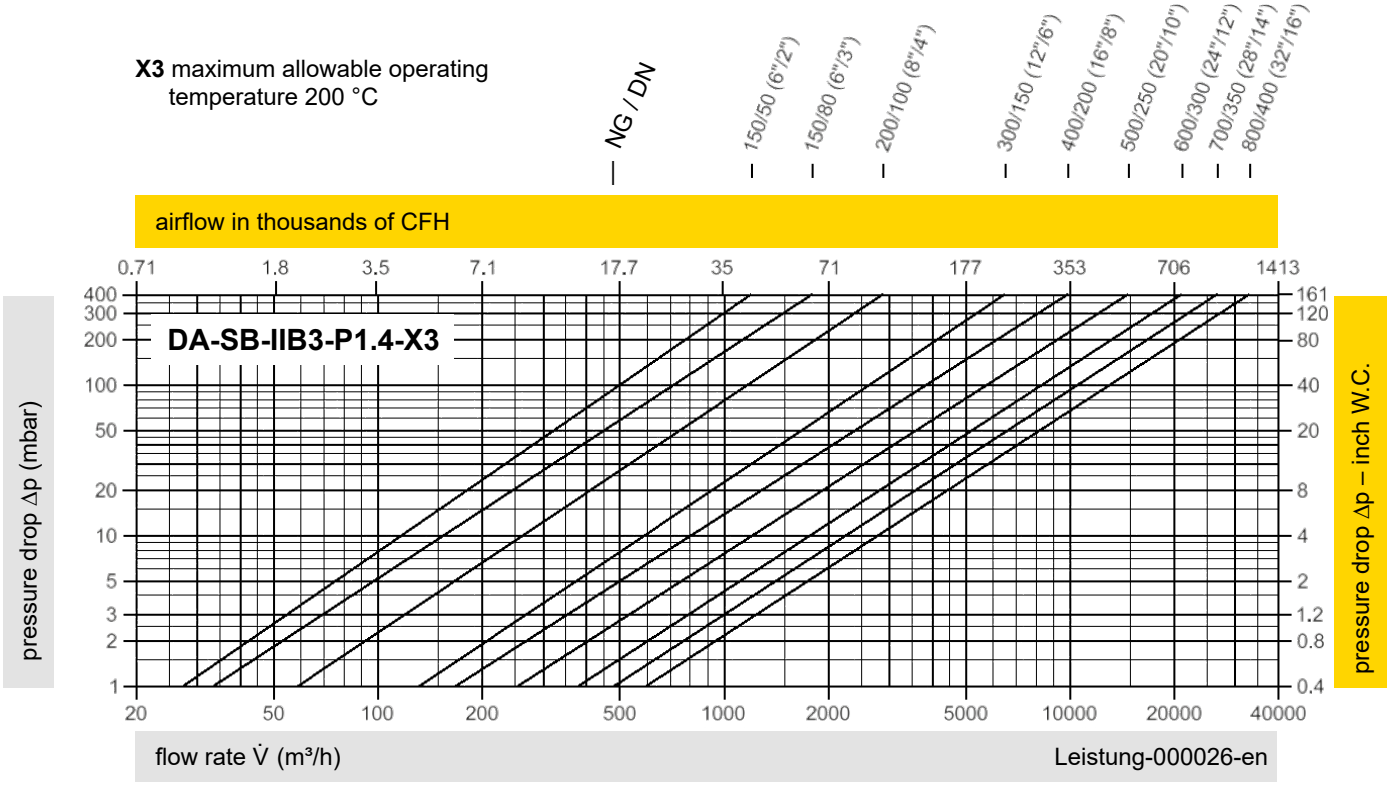
In-Line Detonation Flame Arrester

Flow Capacity Charts

PROTEGO® DA-SB

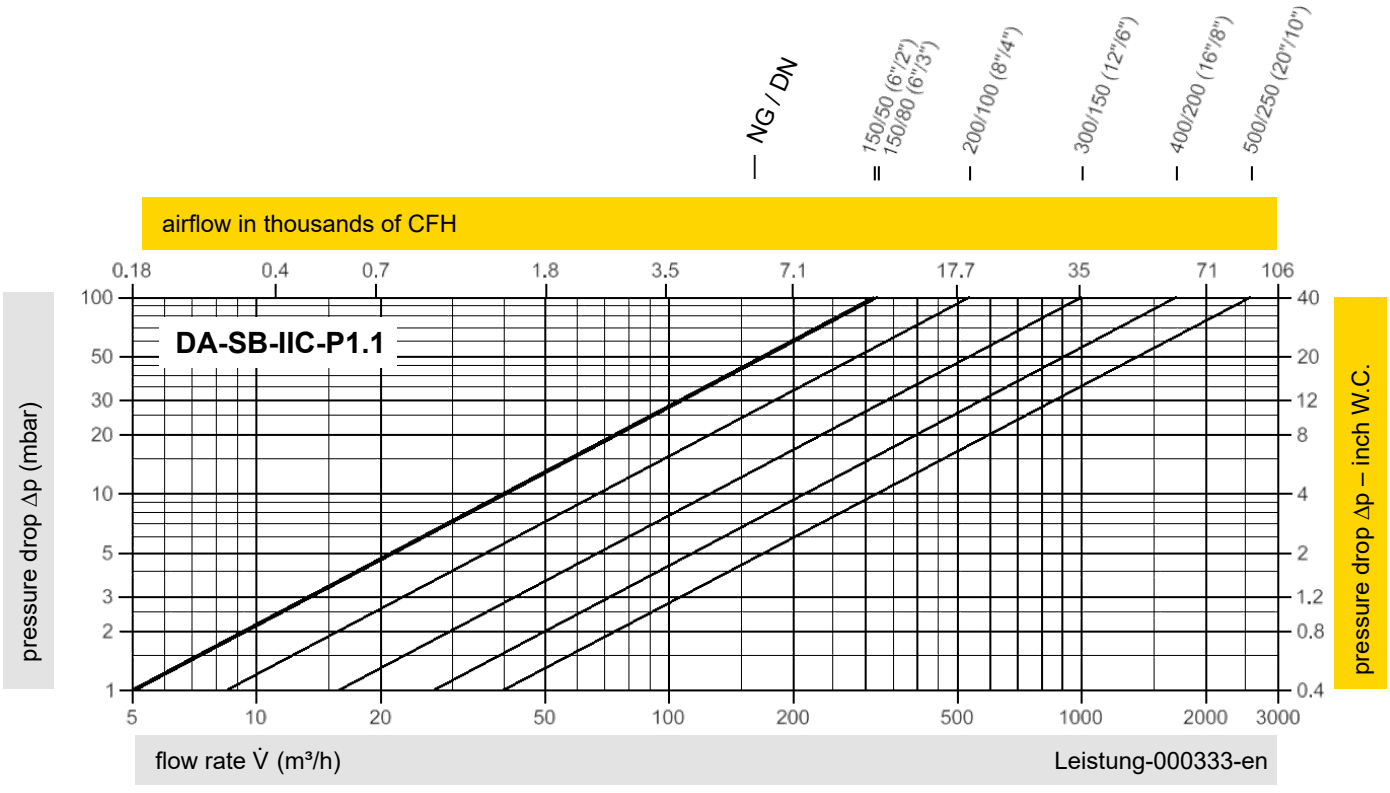


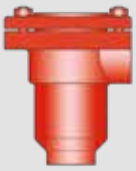
X3 maximum allowable operating temperature 200 °C



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.”

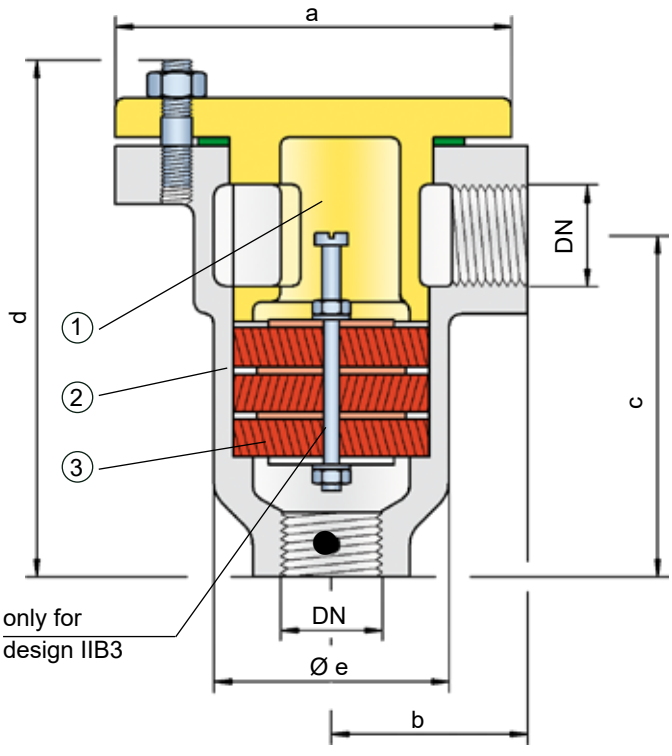

NG / DN
150/50 (6"/2")
150/80 (6"/3")
200/100 (8"/4")
300/150 (12"/6")
400/200 (16"/8")
500/250 (20"/10")
airflow in thousands of CFH
0.18
0.4
0.7
1.8
3.5
7.1
17.7
35
71
106
DA-SB-IIC-P1.1
pressure drop Δp (mbar)
pressure drop Δp – inch W.C.
flow rate V̇ (m³/h)
Leistung-000333-en



In-Line Detonation Flame Arrester

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

PROTEGO® DR/ES



● 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
-	Classification

Higher operating temperatures upon request.

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

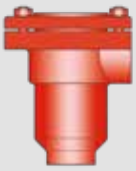
Design	A	B
FLAMEFILTER® *	Stainless Steel	Hastelloy
Spacer	Stainless Steel	Hastelloy

* 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

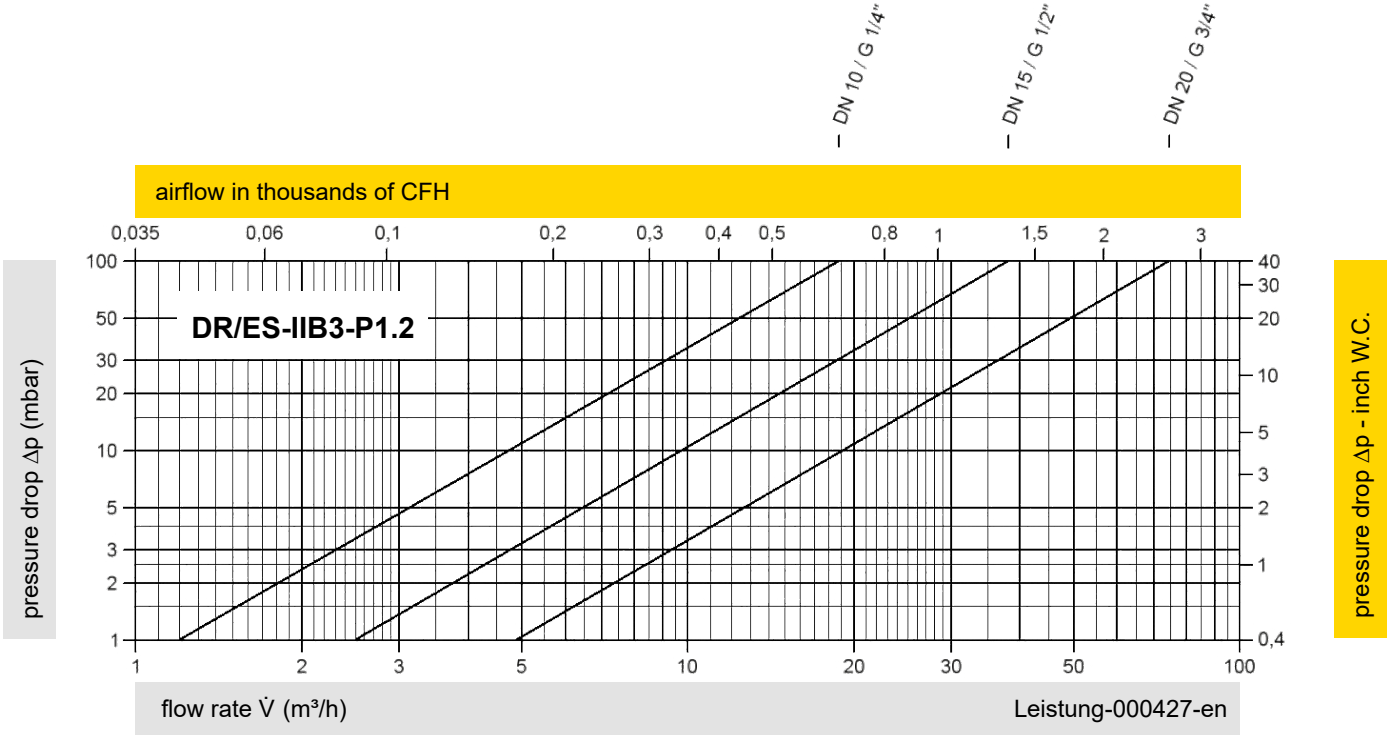
Pipe thread DIN ISO 228-1	DIN	Other types of thread upon request.

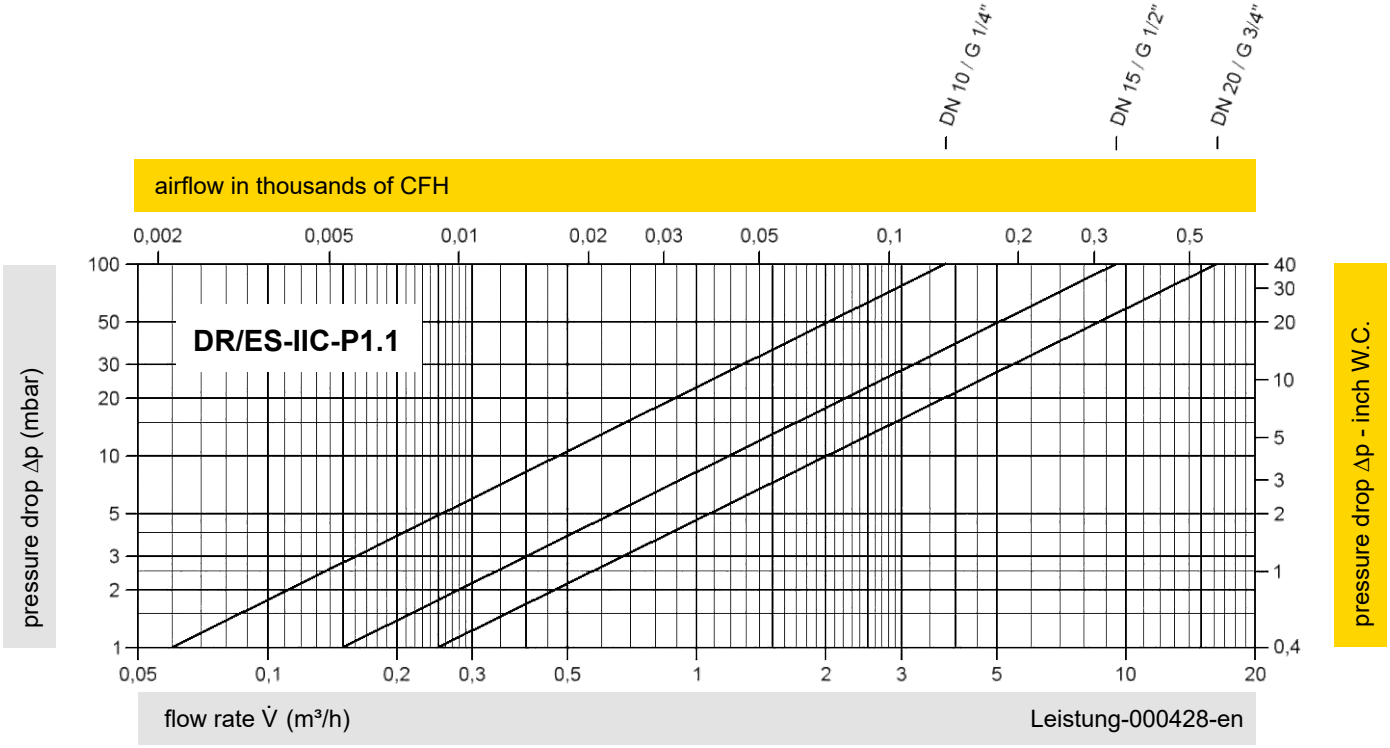


In-Line Detonation Flame Arrester

Flow Capacity Charts

PROTEGO® DR/ES

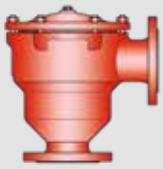




The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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.”

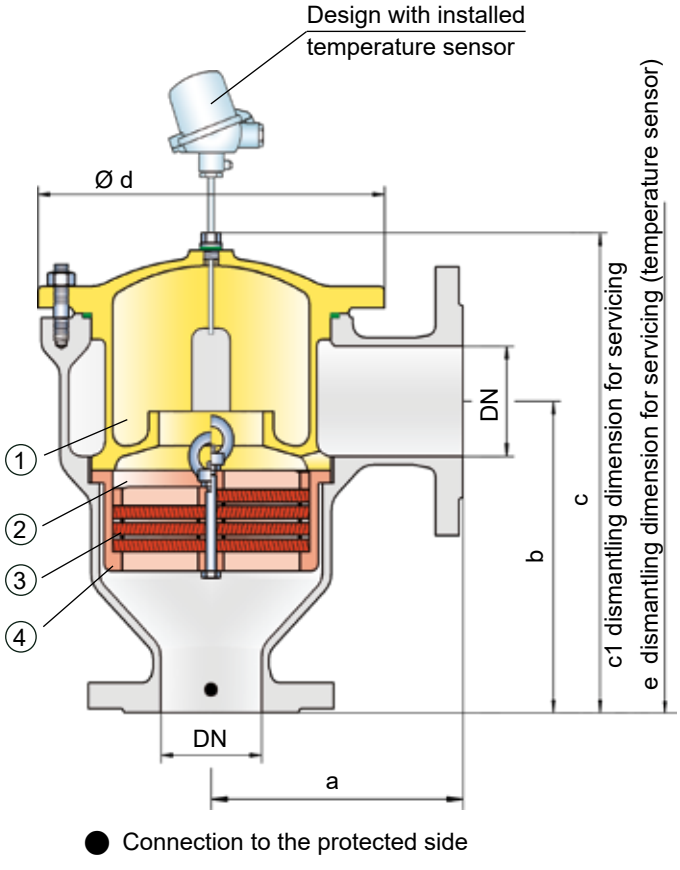
Notes:



In-Line Detonation Flame Arrester

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

PROTEGO® DR/ES



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 FLAMEFILTER® 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	440/17.32	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
Expl. Gr. 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

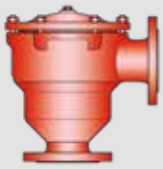
Design	A	C	D	E
FLAMEFILTER® cage	Steel	Stainless Steel	Stainless Steel	Hastelloy
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy
Spacer	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy

* 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

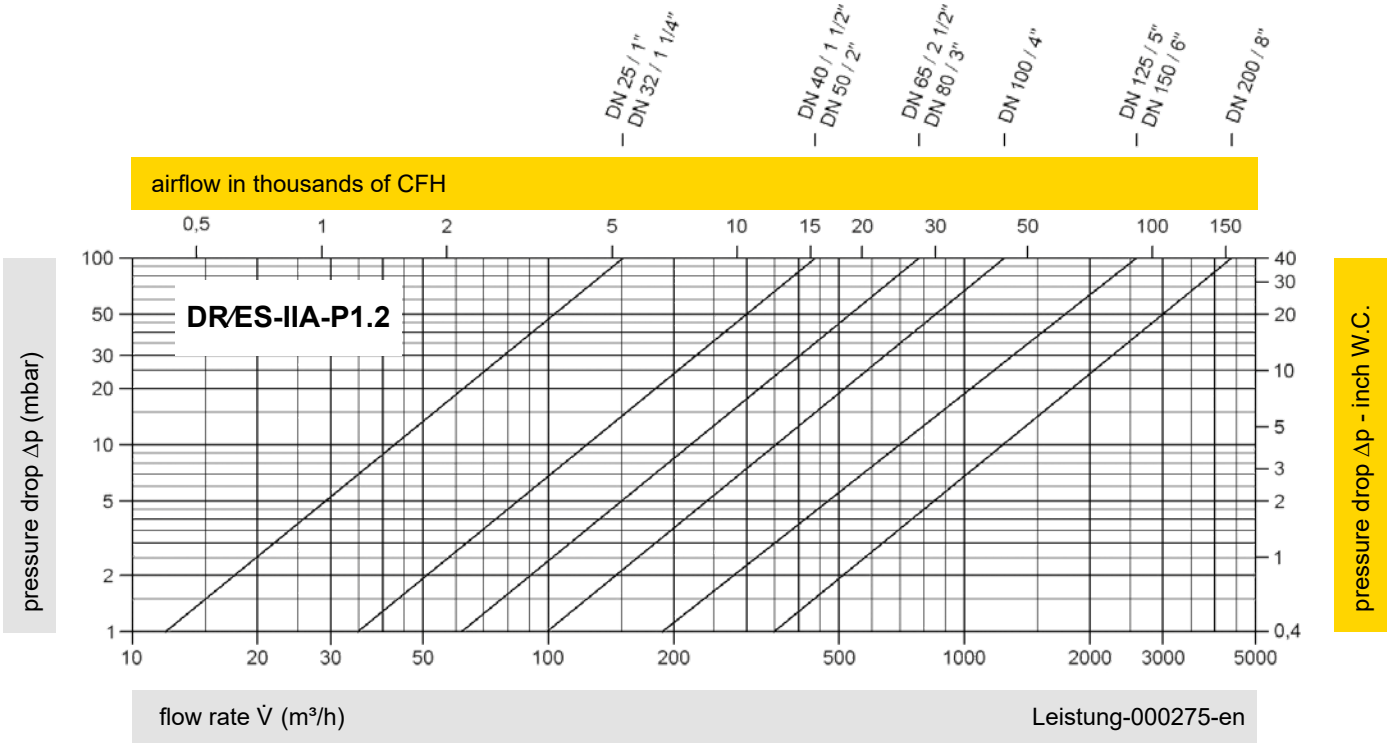
EN 1092-1; Form B1	Other types upon request.
ASME B16.5 CL 150 R.F.	

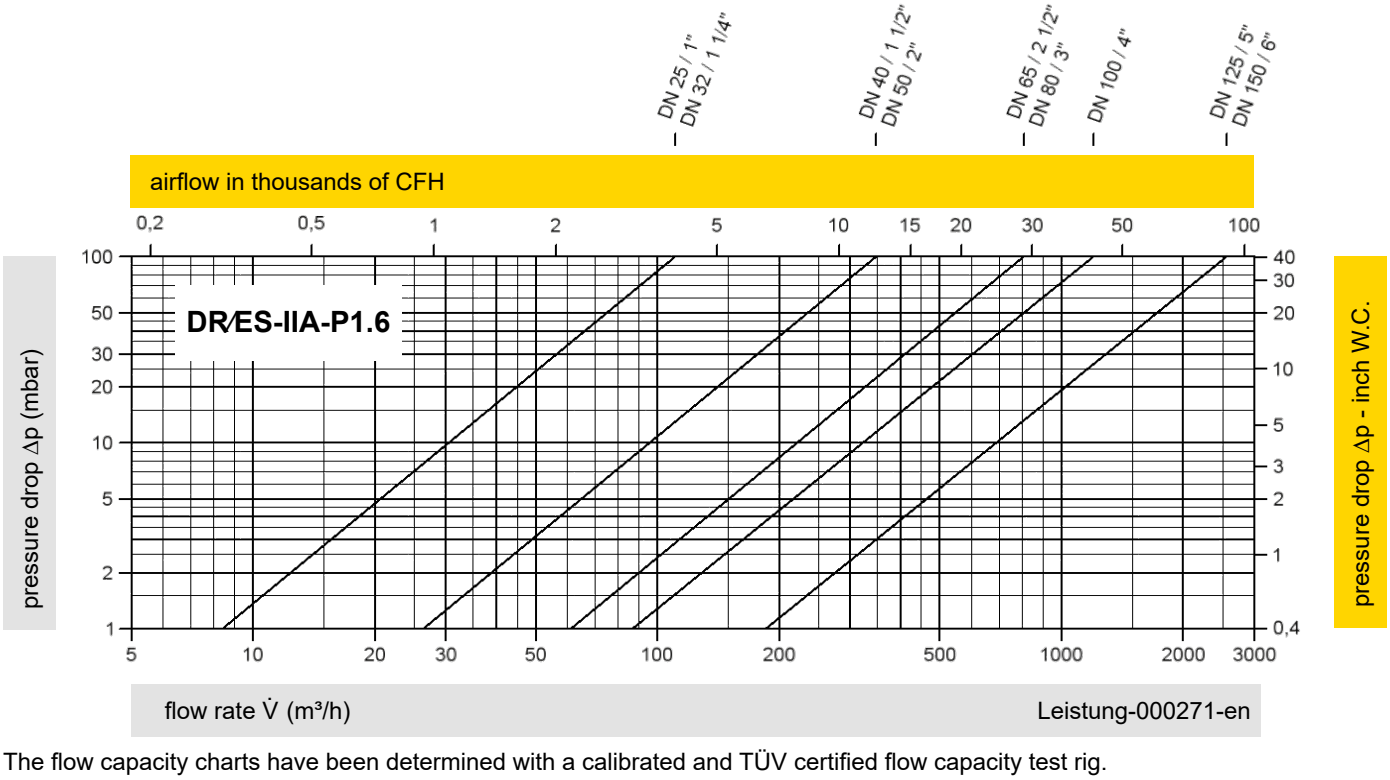


In-Line Detonation Flame Arrester

Flow Capacity Charts

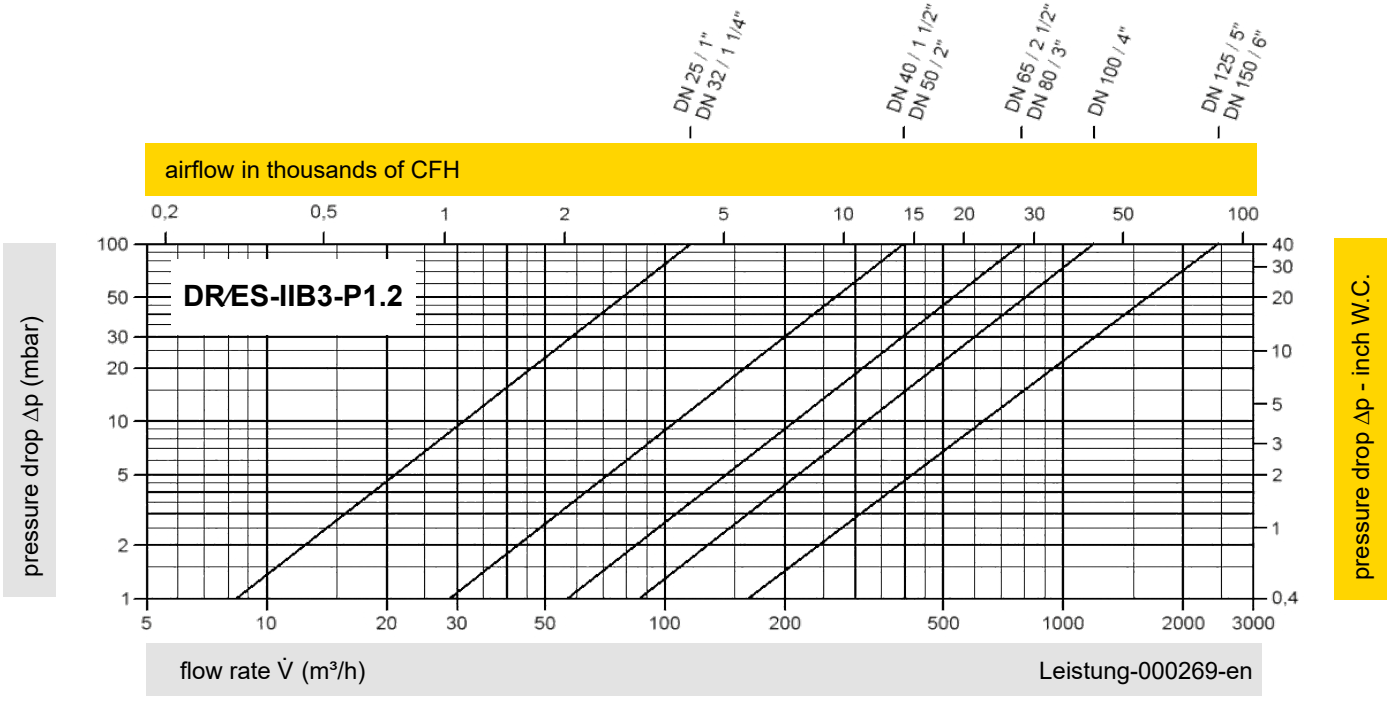
PROTEGO® DR/ES



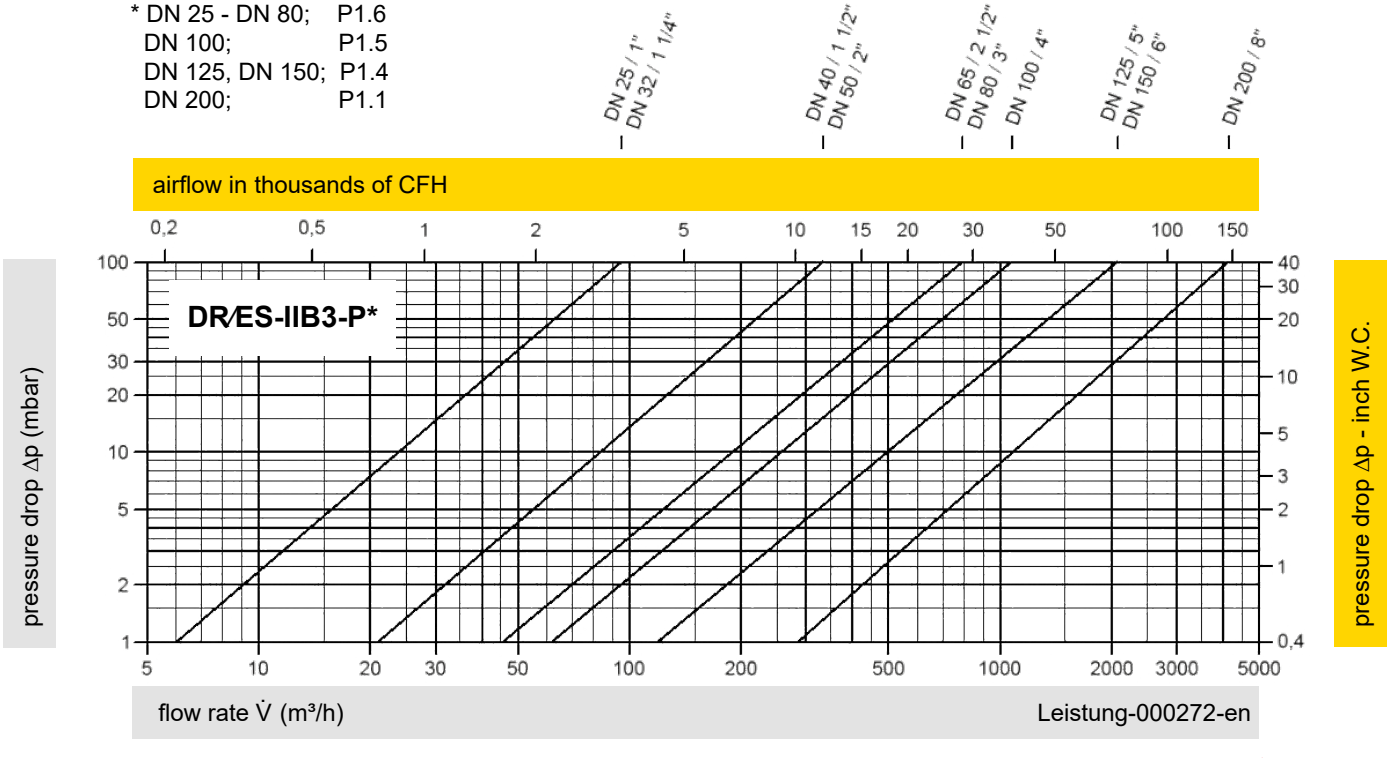


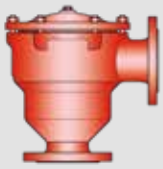
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

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

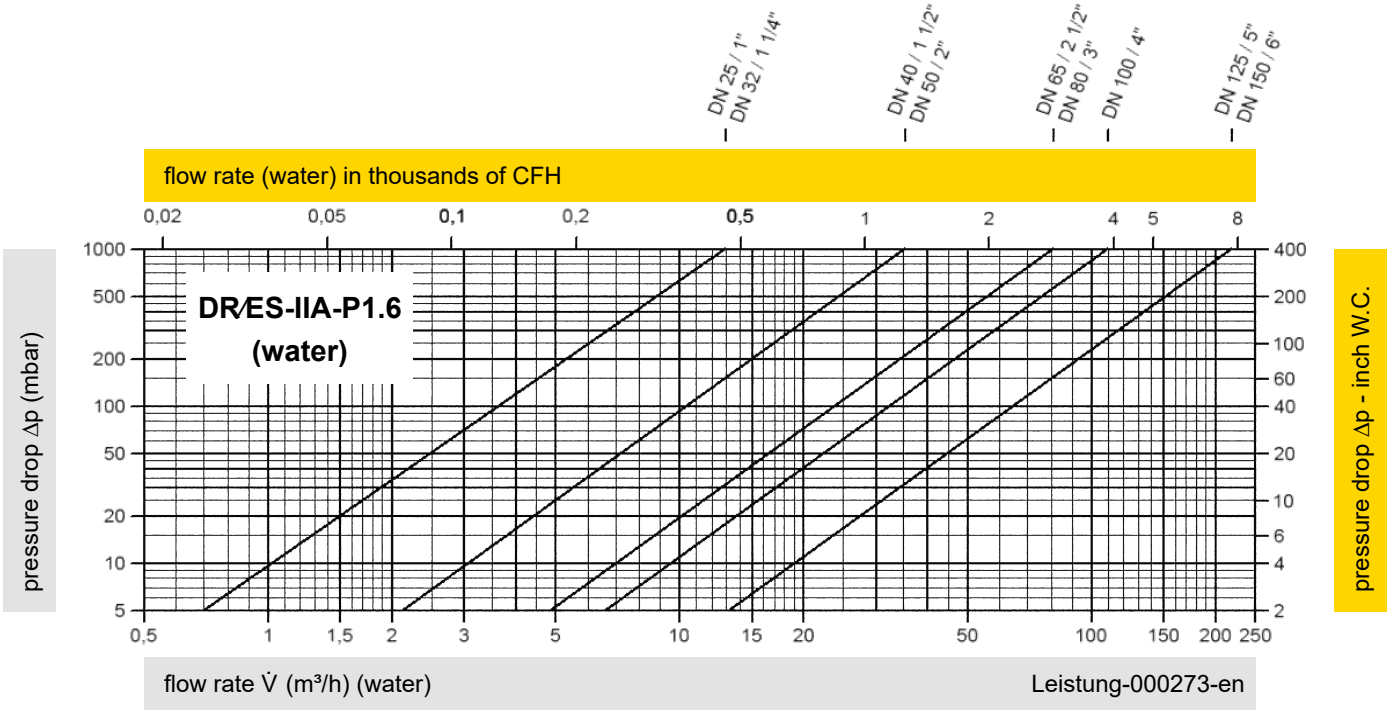




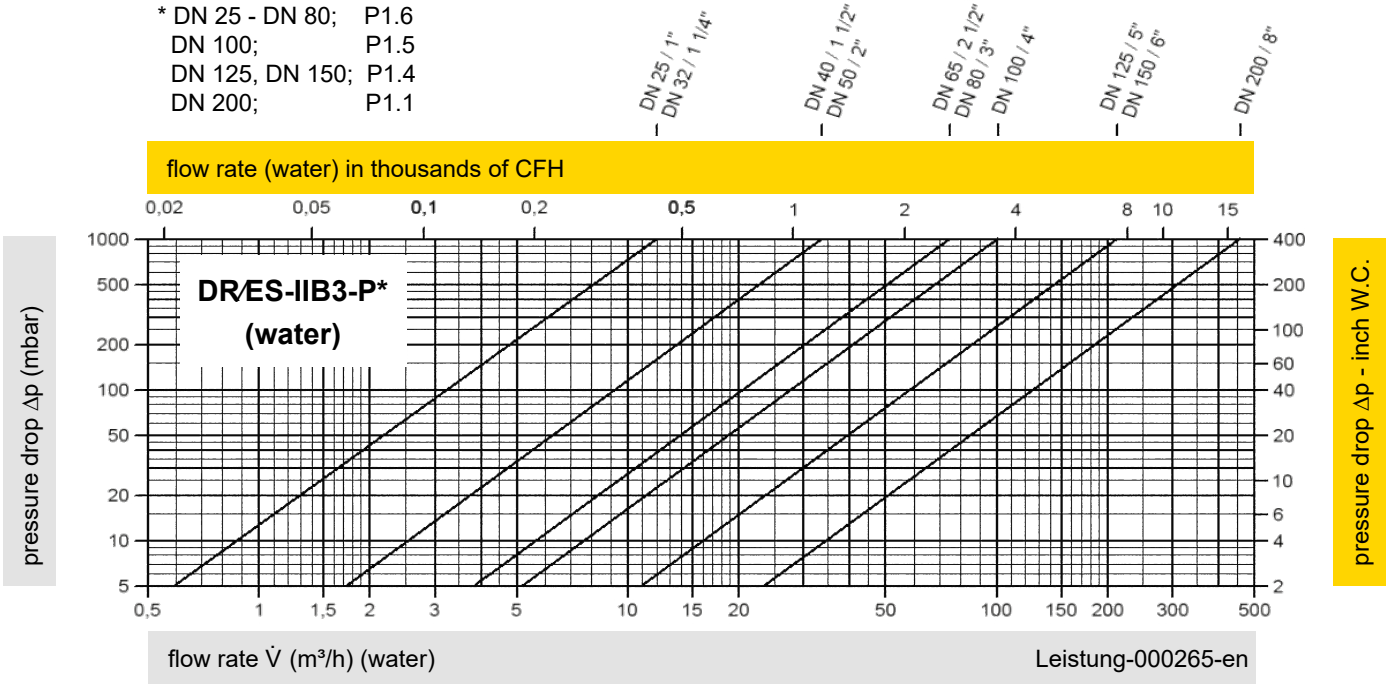
In-Line Detonation Flame Arrester

Flow Capacity Charts (water)

PROTEGO® DR/ES



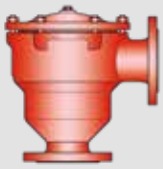
* DN 25 - DN 80; P1.6
DN 100; P1.5
DN 125, DN 150; P1.4
DN 200; P1.1



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 V̇ 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} m^2/s

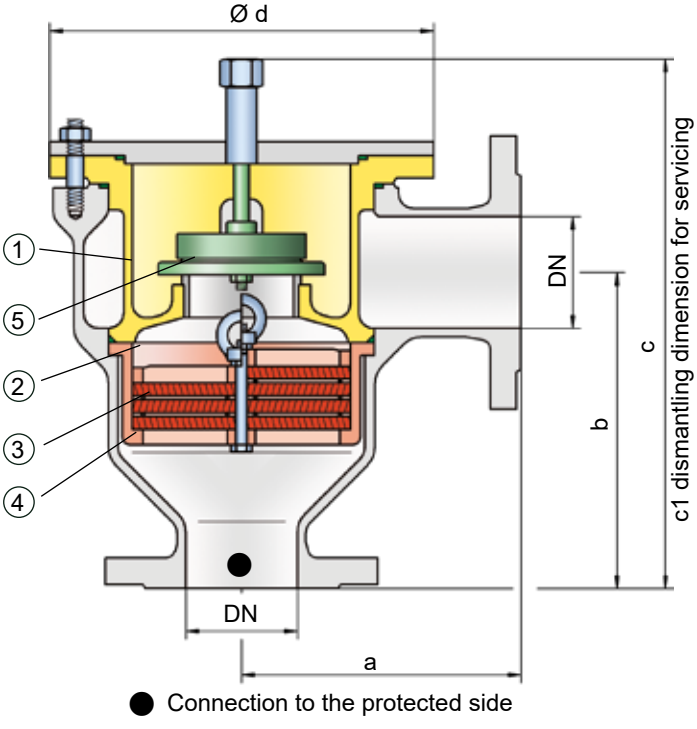
Notes:



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



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	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“
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	
Design Heating jacket (DR/ES-V-H-...)	Steel Steel	Stainless Steel Stainless Steel	Hastelloy Stainless Steel	The housing and the cover with shock absorber can also be delivered in steel with an ECTFE coating.
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	

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	*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	Hastelloy	
Spacer	Stainless Steel	Stainless Steel	Hastelloy	Hastelloy	

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	Other types upon request.
ASME B16.5 CL 150 R.F.	

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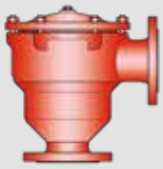
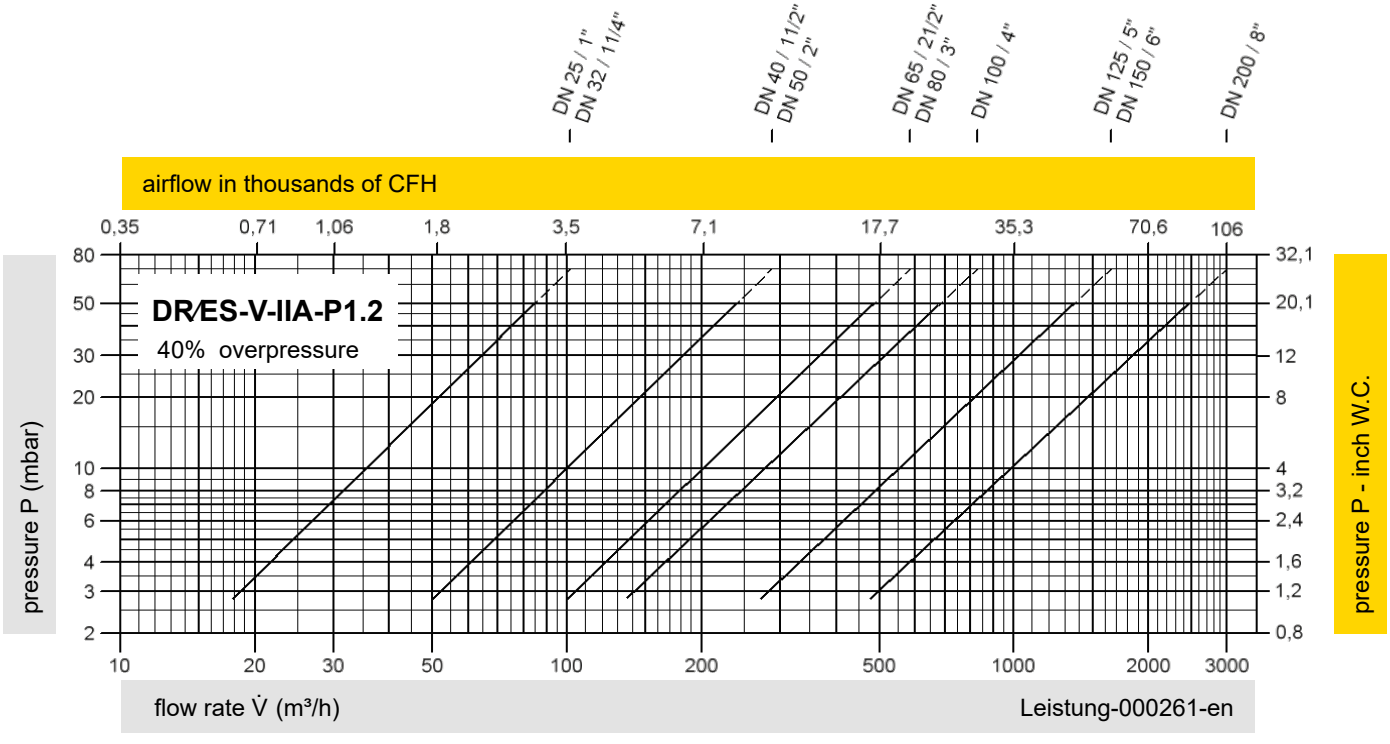
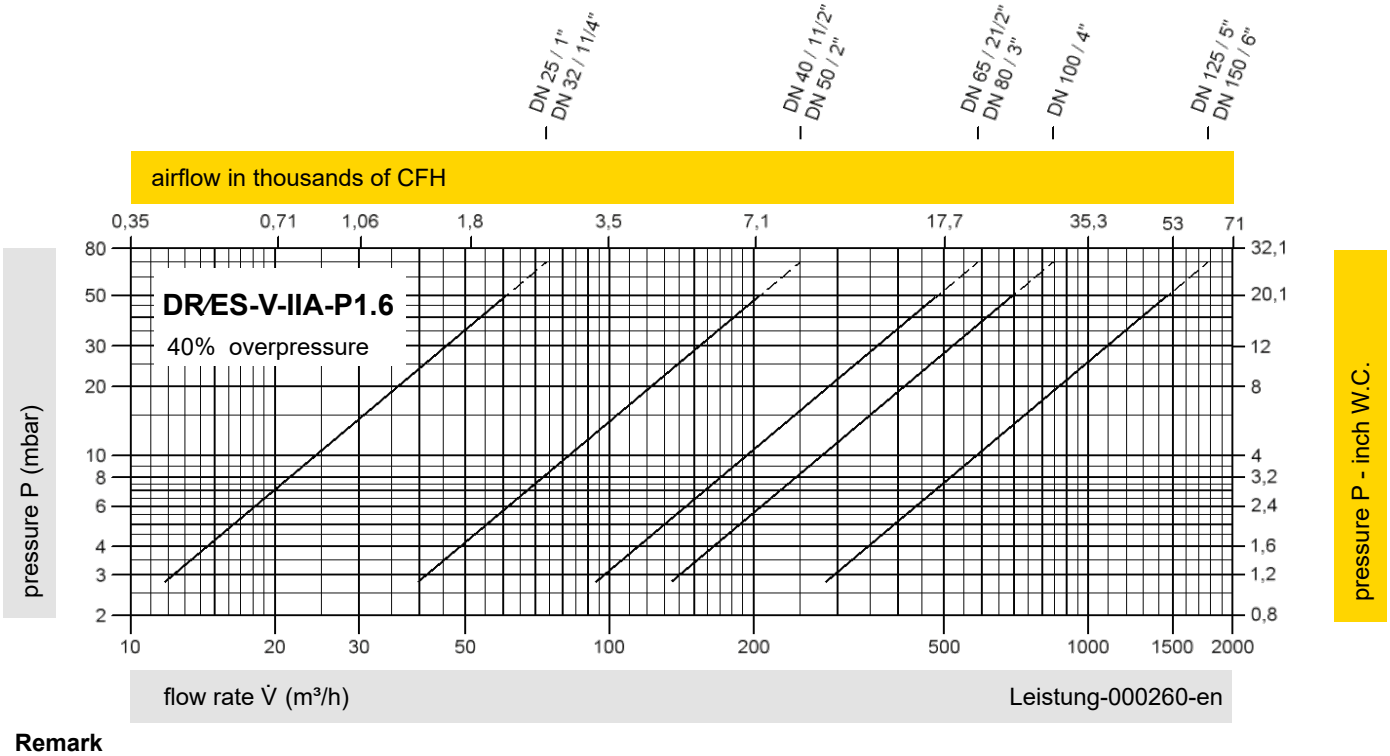


In-Line Detonation Flame Arrester

Flow Capacity Charts

PROTEGO® DR/ES-V





Remark

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

Set pressure = the valve starts to open

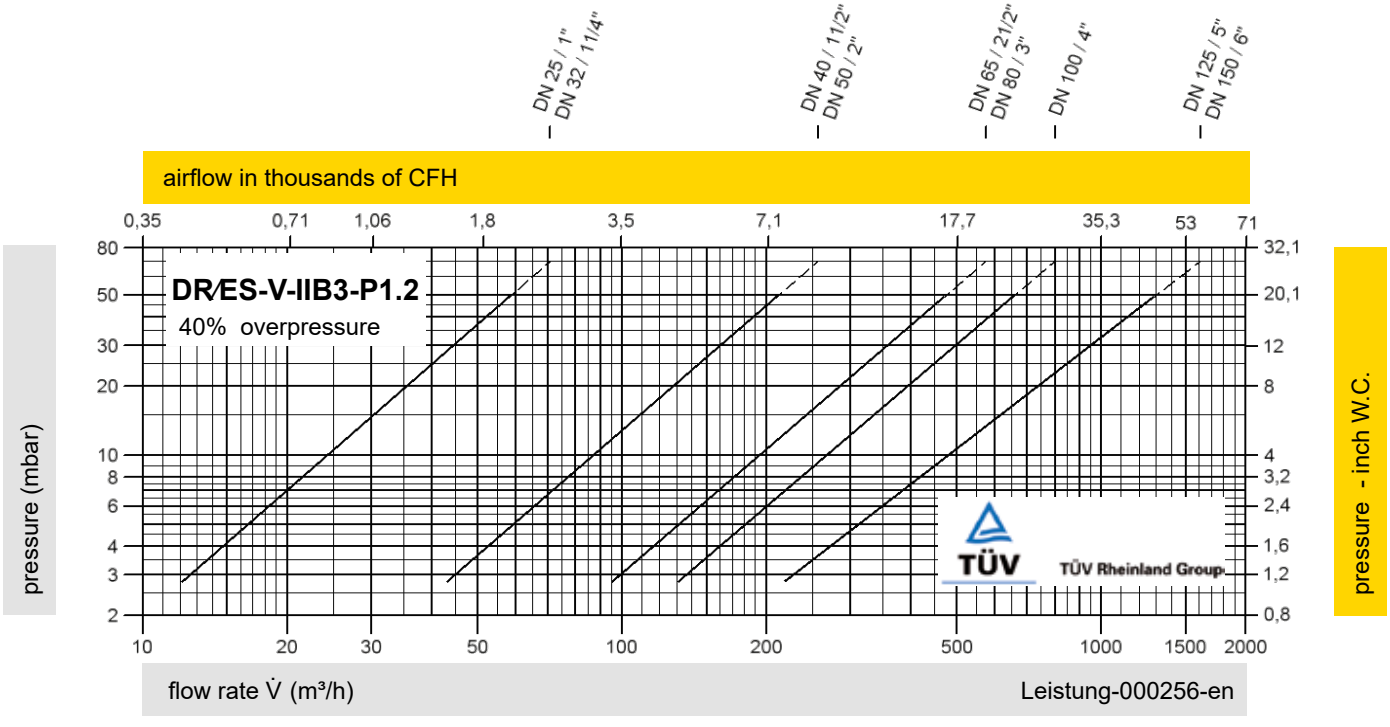
Opening pressure = set pressure plus overpressure

Overpressure = pressure increase over the set pressure

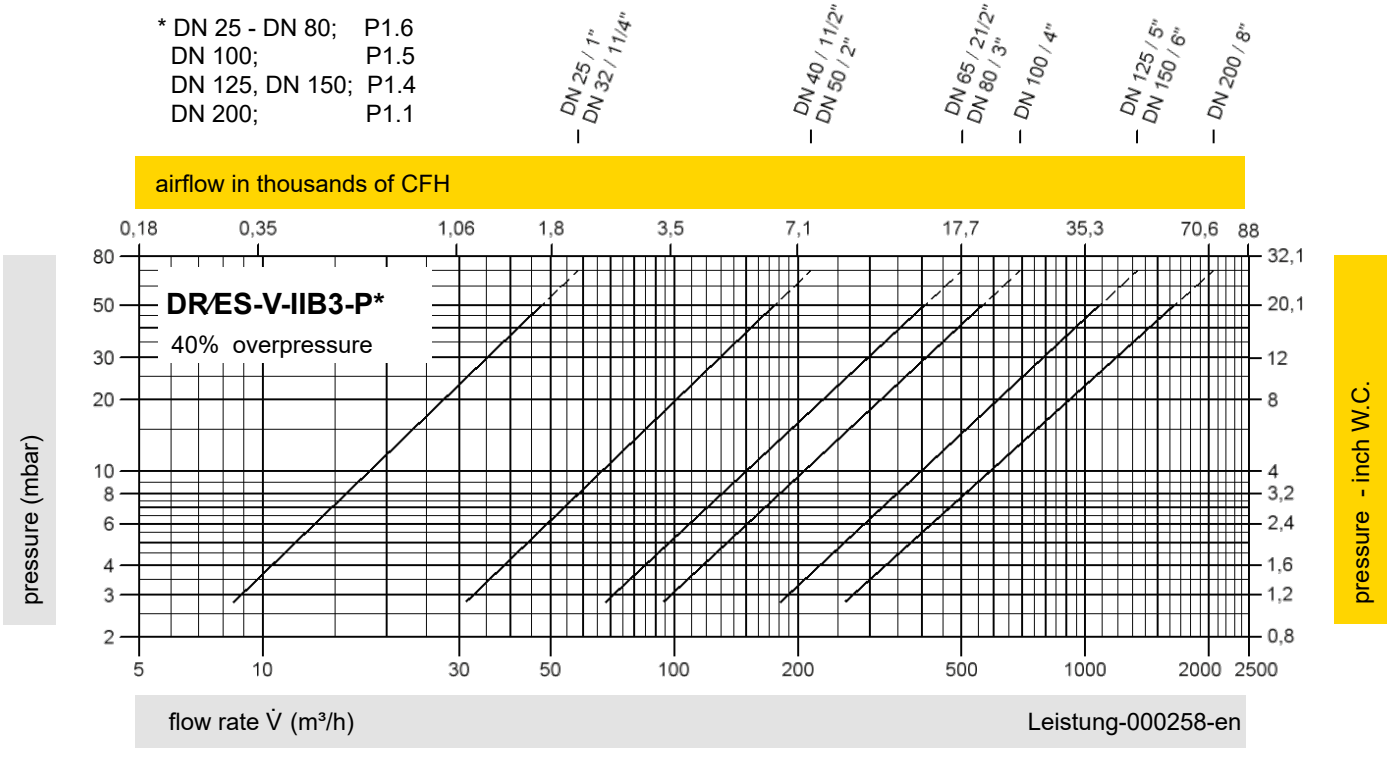
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

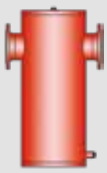
Volume flow V̇ in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
For conversion to other densities and temperatures, refer to Sec. 1: “Technical Fundamentals.”

PROTEGO® DR/ES-V



* DN 25 - DN 80; P1.6
DN 100; P1.5
DN 125, DN 150; P1.4
DN 200; P1.1

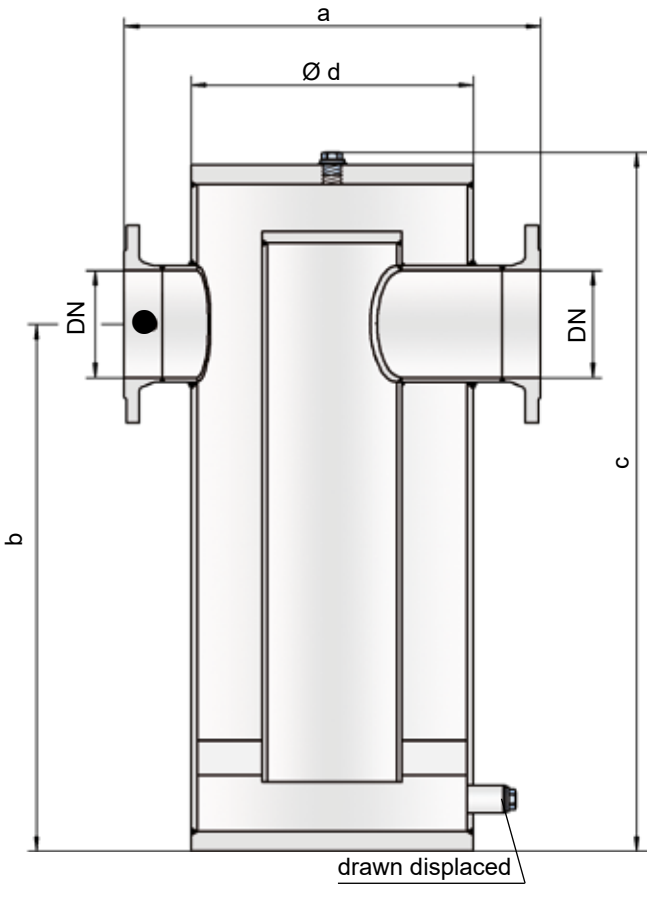




In-Line Liquid Detonation Flame Arrester

for filling lines - external installation

PROTEGO® LDA-W



● Tank connection / protected side

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.

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.

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

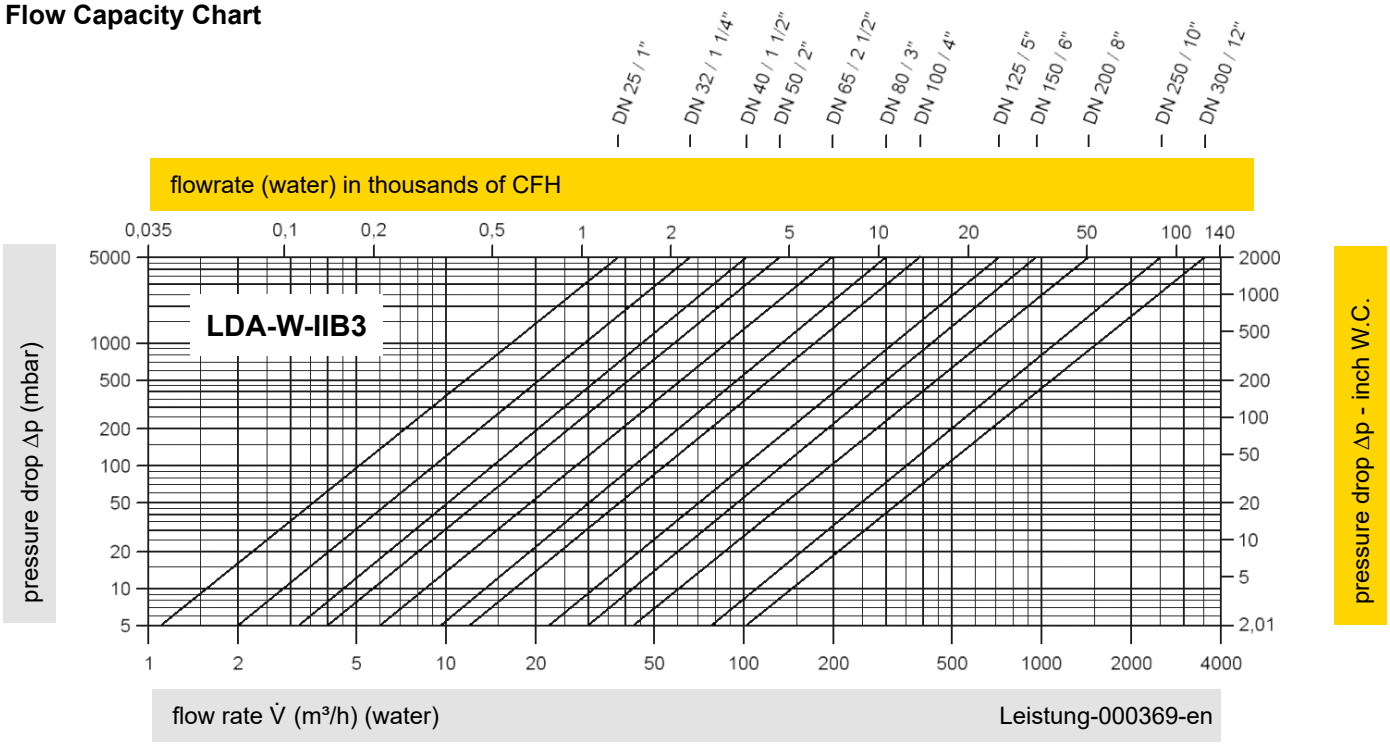
Table 2: Selection of the explosion group			
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	Special approvals upon request.
≥ 0,65 mm	IIB3	C	

Table 3: Specification of max. operating temperature		
≤ 60°C / 140°F	Tmaximum 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: $\dot{V}_{water} = \dot{V}_{liquid} * \sqrt{\frac{\rho_{liquid}}{\rho_{water}}}$ $\dot{V}_{liquid} = \dot{V}_{water} * \sqrt{\frac{\rho_{water}}{\rho_{liquid}}}$

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).

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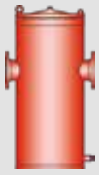
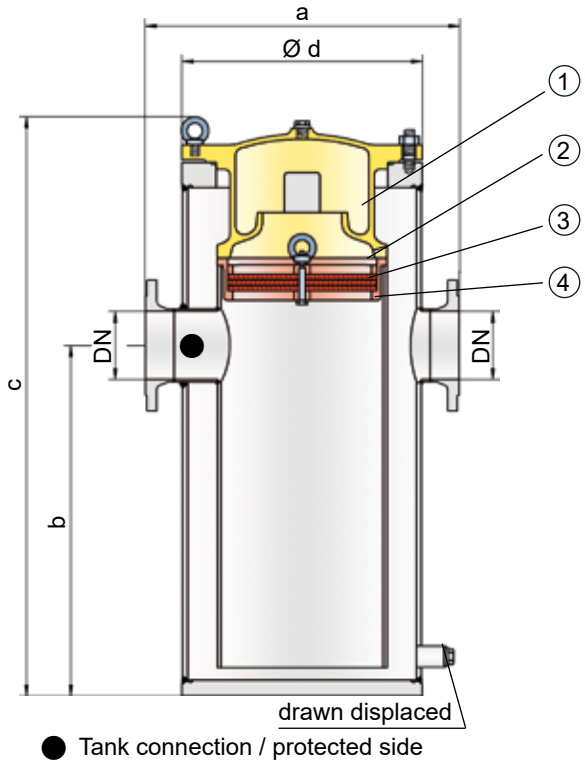


In-Line Liquid Detonation Flame Arrester

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
-	Classification

Higher operating temperatures upon request.

Table 4: Material selection for housing

Design	A	B
Housing	Steel	Stainless Steel
Shock absorber	Steel	Stainless Steel
Gasket (shock absorber)	FPM	PTFE
Gasket (locking screw)	PTFE	PTFE
Flame arrester unit	A	A

Special materials upon request.

Table 5: Material for flame arrester unit

Design	A
FLAMEFILTER® cage	Stainless Steel
FLAMEFILTER® *	Stainless Steel
Spacer	Stainless Steel

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

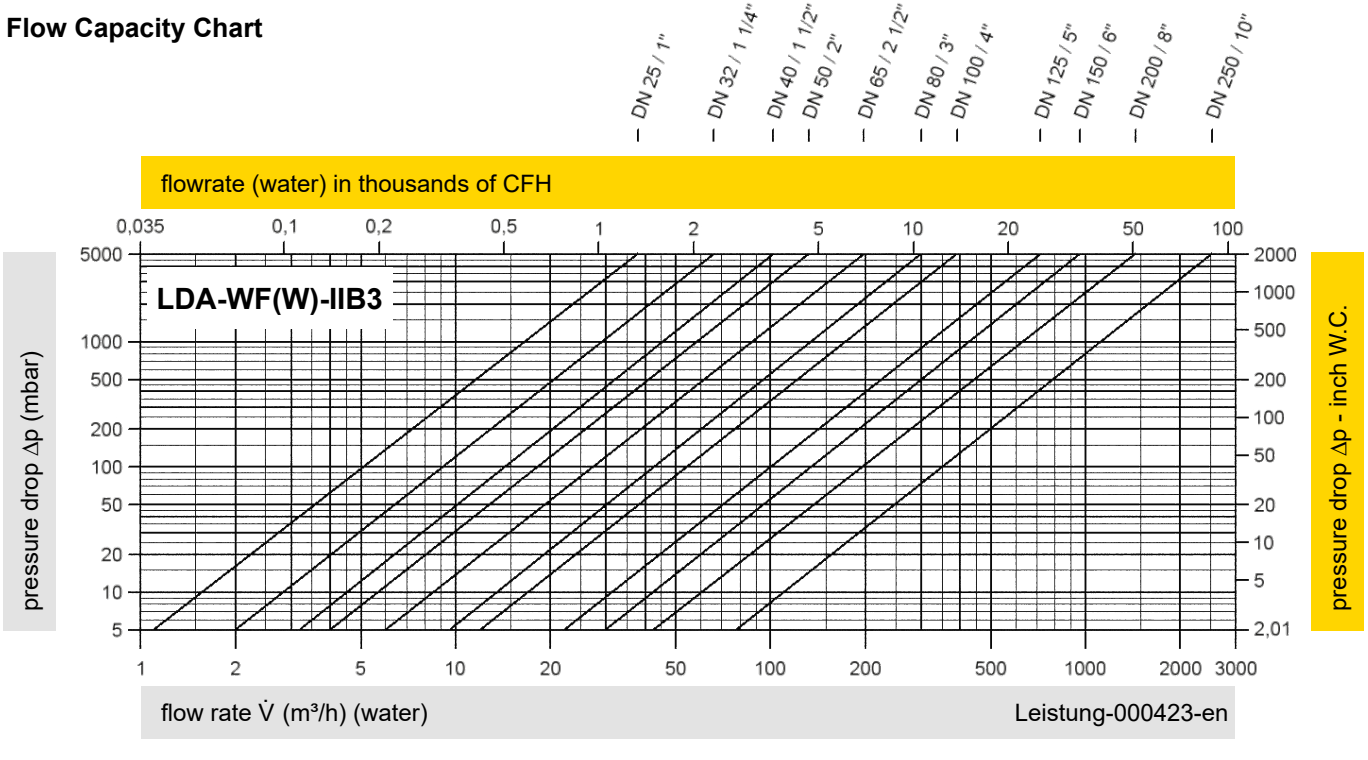
Special materials upon request.

Table 6: Flange connection type

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

Other types upon request.

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 V̇ 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).

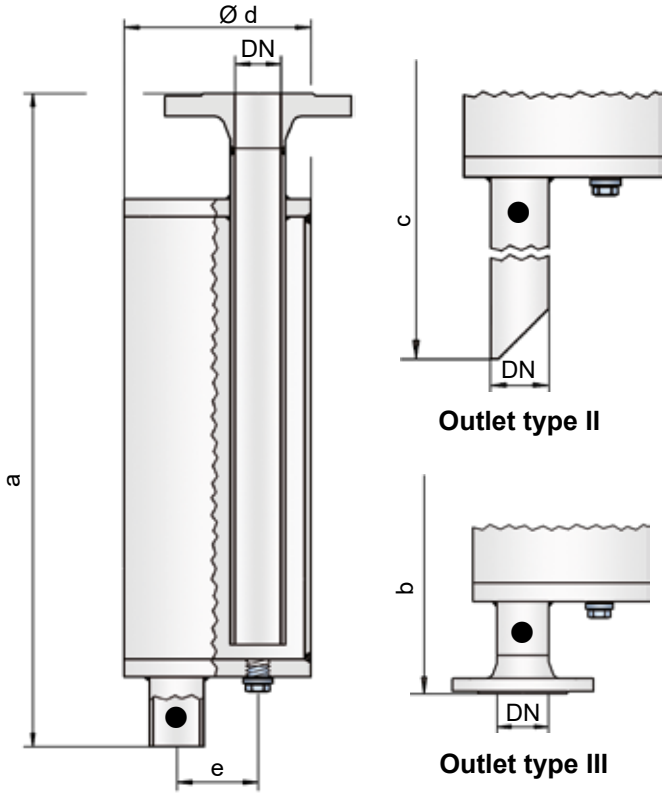
PROTEGO
for safety and environment

Liquid Detonation Flame Arrester

for filling lines - internal installation

PROTEGO® LDA

LDA



● 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)	
≥ 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	Special materials upon request.
Housing	Steel	Stainless Steel	
Gasket	PTFE	PTFE	

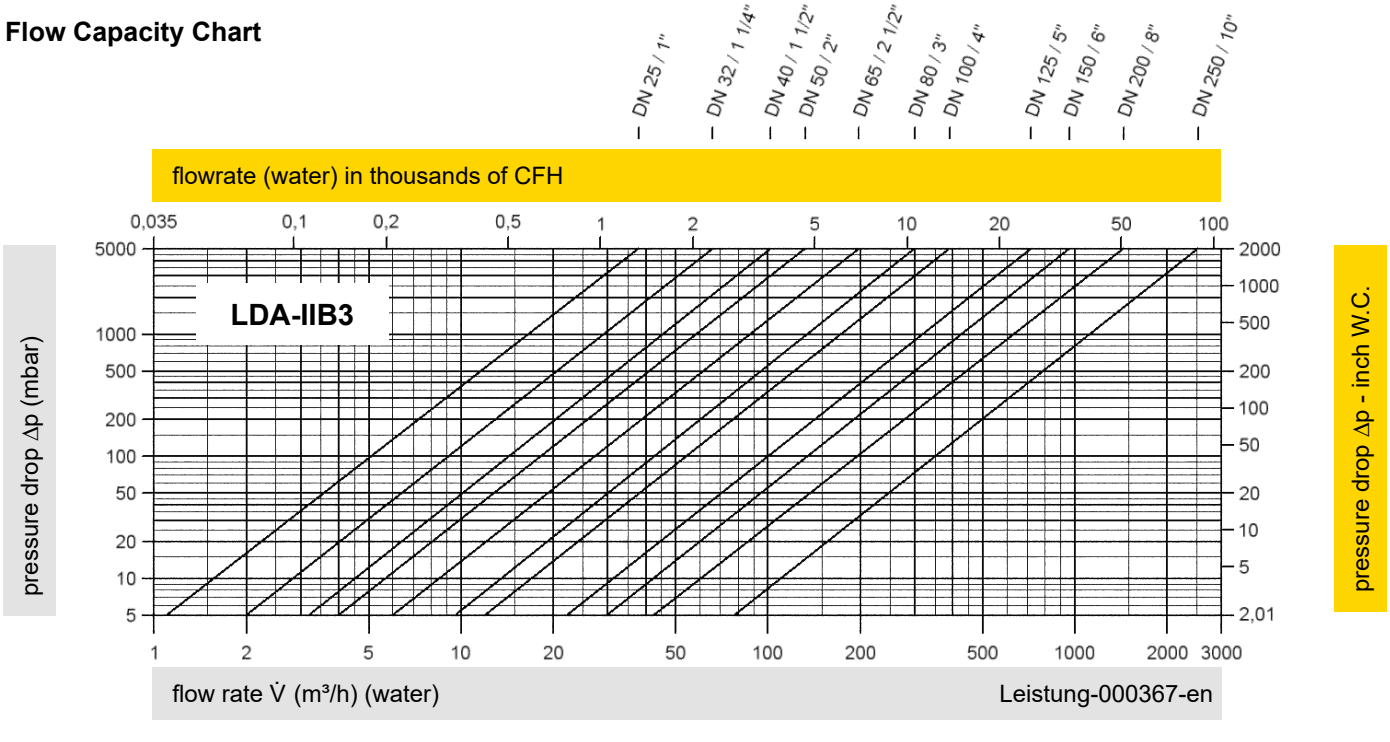
Table 5: Flange connection type

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: $\dot{V}_{water} = \dot{V}_{liquid} * \sqrt{\frac{\rho_{liquid}}{\rho_{water}}}$ $\dot{V}_{liquid} = \dot{V}_{water} * \sqrt{\frac{\rho_{water}}{\rho_{liquid}}}$

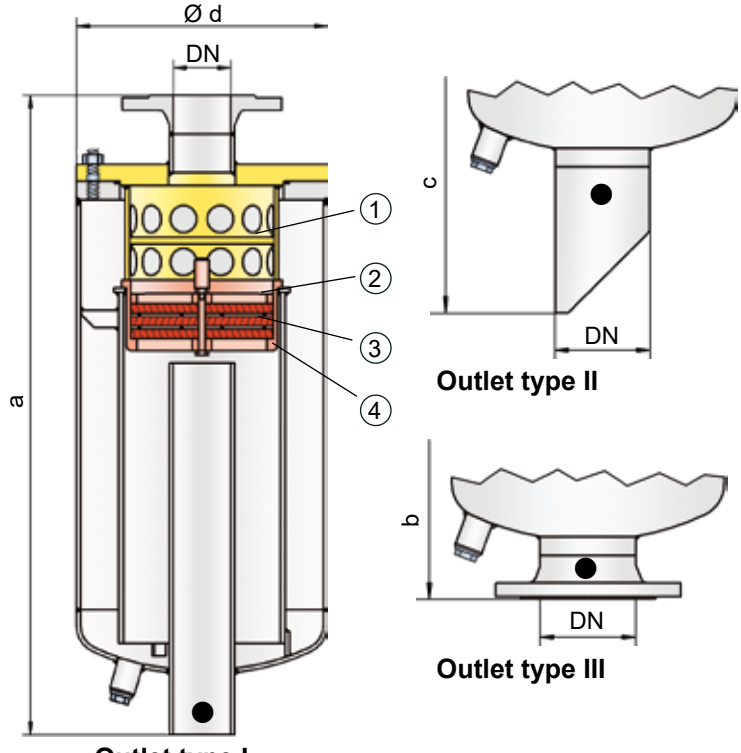
The volume flow V̇ in m³/h was determined with water, in accordance with DIN EN 60534, at a temperature T_n = 20°C and an atmospheric pressure p_n = 1,013 bar, kinematic viscosity v = 10^{-6} m²/s.
To avoid electrostatic charge of flammable liquids, the maximum flow is limited (refer to TRGS 727, CENELEC-Report CLC/TR 60079-32-1).

PROTEGO
for safety and environment

Liquid Detonation Flame Arrester

for filling and drain lines - internal installation

PROTEGO® LDA-F



Outlet type I

Outlet type II

Outlet type III

● Tank connection / protected side

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. Special materials upon request.
FLAMEFILTER® cage	Stainless Steel	
FLAMEFILTER® *	Stainless Steel	
Spacer	Stainless Steel	

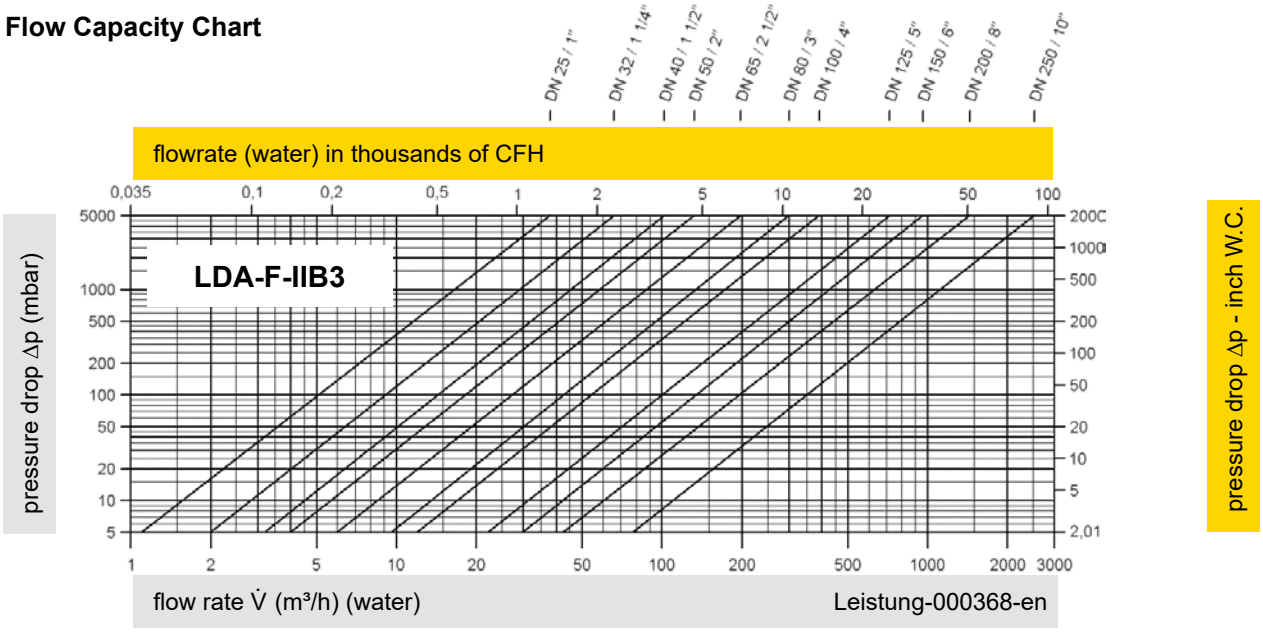
Table 6: Flange connection type

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

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 V̇ 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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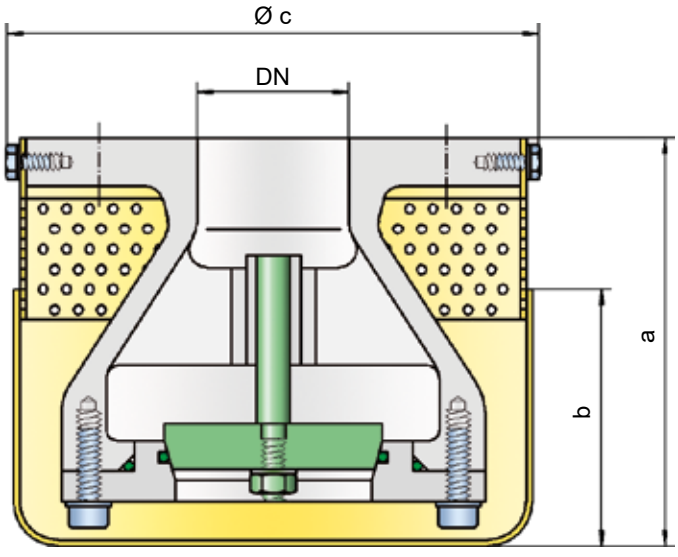
Detonation Flame Arrester

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
-	Classification

Higher operating temperatures upon request.

Table 4: Material selection for housing

Design	A	B	C	D
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

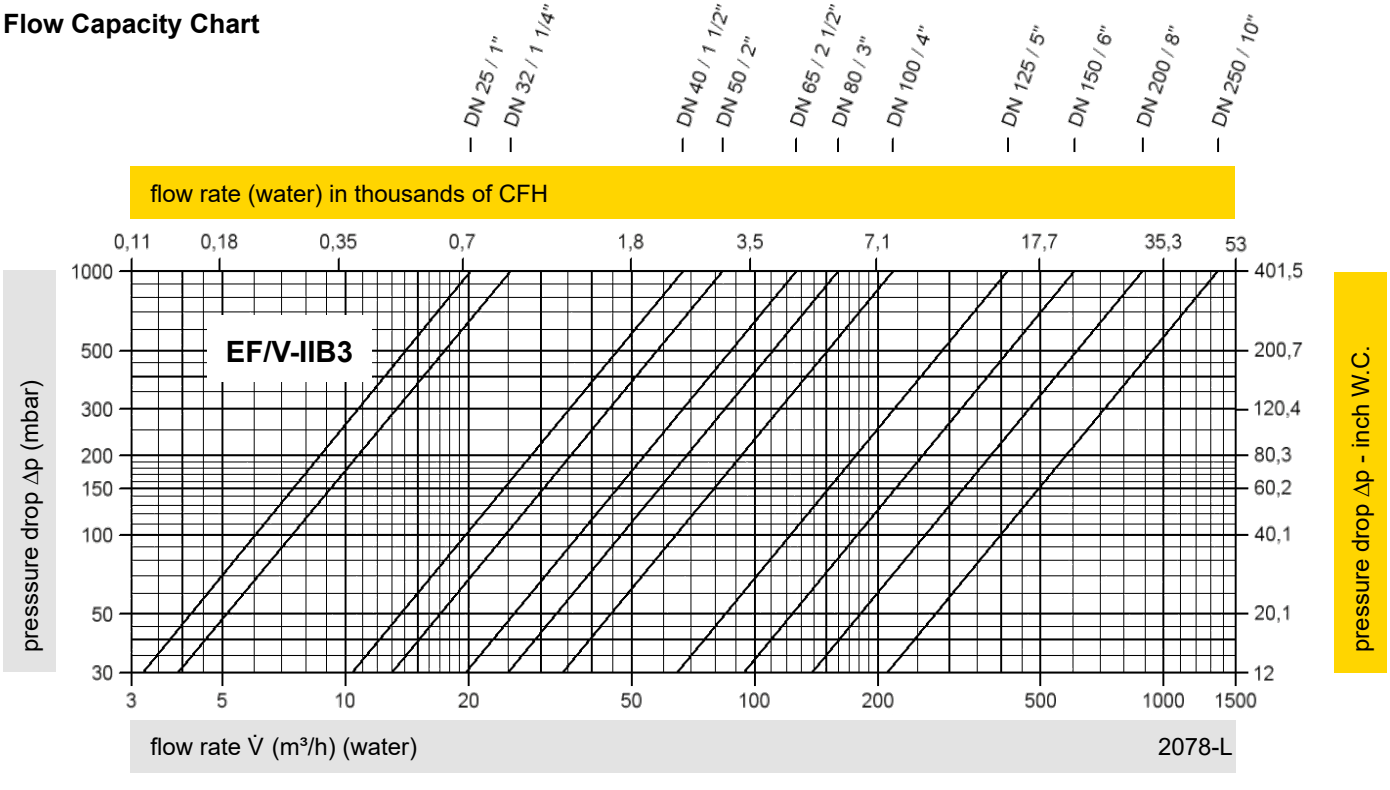
Special materials upon request.

Table 5: Flange connection type

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

Other types upon request.

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 V̇ 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).

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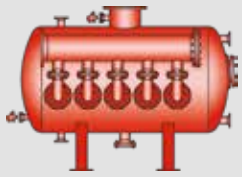
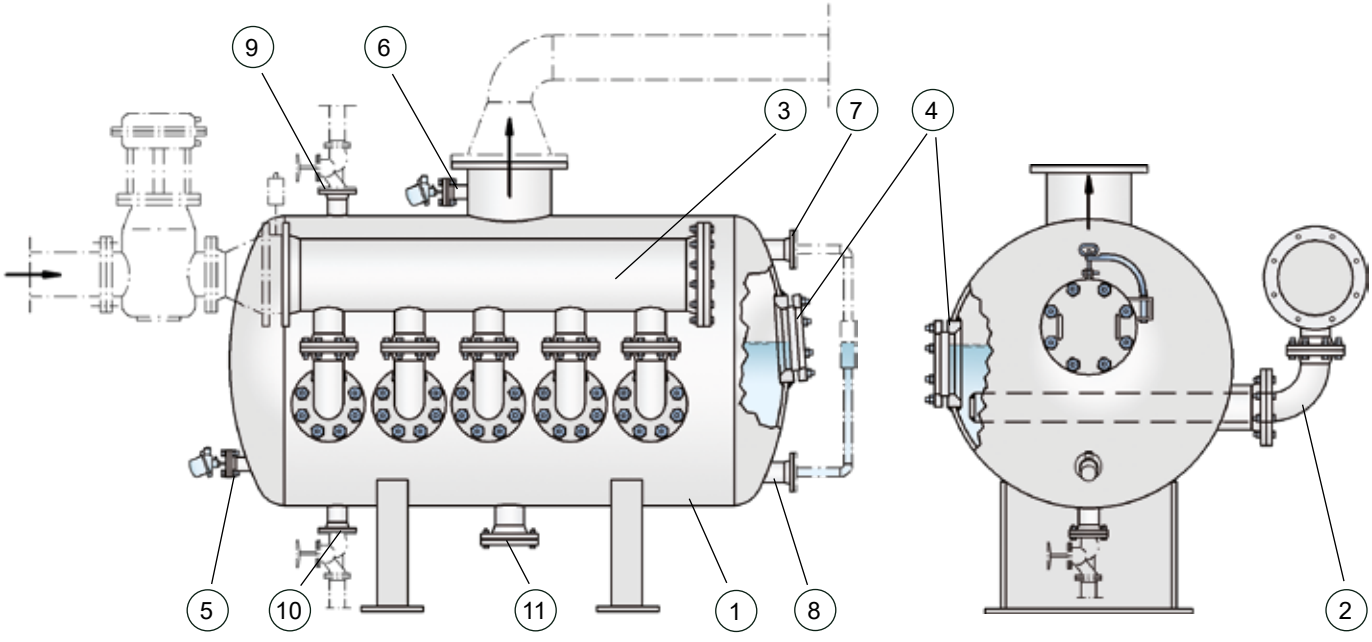


Hydraulic Flame Arresters

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.

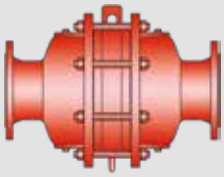
Data Necessary for Specification

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.%)

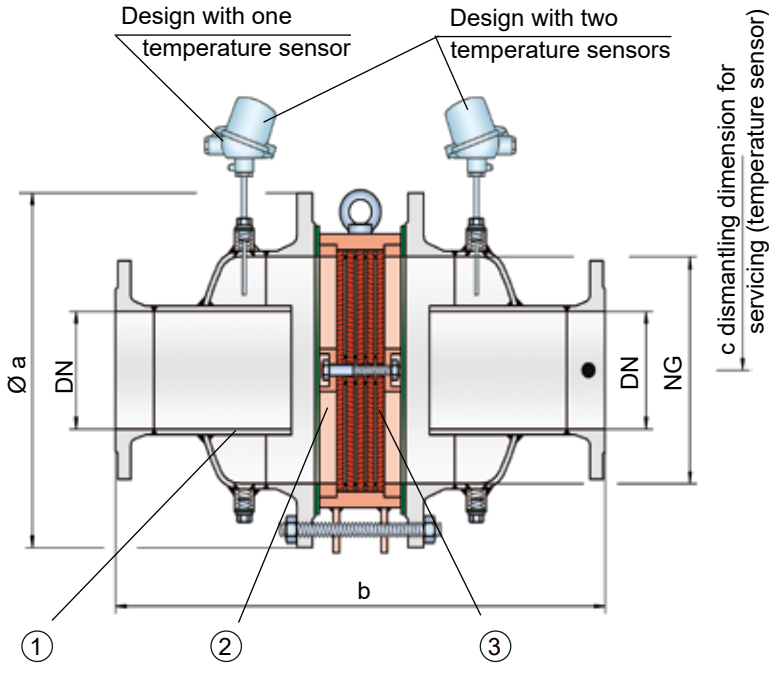
Operating temperature (°C or °F)



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-....)

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).

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

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 - –**
	DA-UB- TB - –
In-line detonation flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides	**DA-UB - H - ☐**
In-line detonation flame arrester with heating jacket	

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

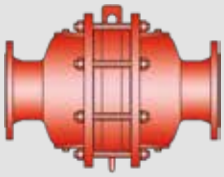
		NG	150 6“	150 6“	200 8“	300 12“	400 16“	500 20“	600 24“	700 28“	800 32“	1400 56“
		DN	≤ 50 2“	80 3“	≤ 100 4“	≤ 150 6“	≤ 200 8“	≤ 250 10“	≤ 300 12“	≤ 350 14“	≤ 400 6“	≤ 600 24“
Expl. Gr.	IIA	P_{max}	1.8 / 26.1	1.8 / 26.1	1.6 / 23.2	1.6 / 23.2	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.6/ 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	



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.

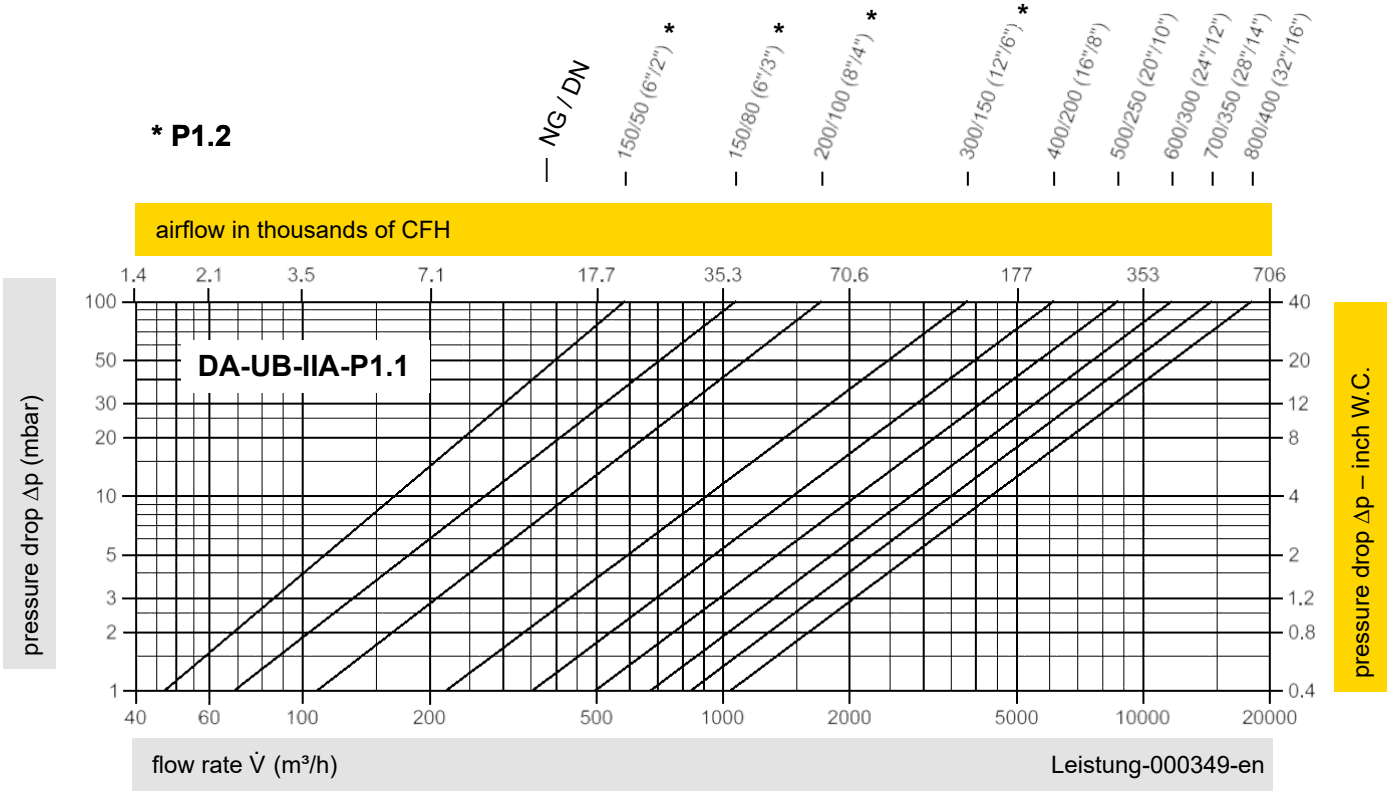
Special materials upon request.

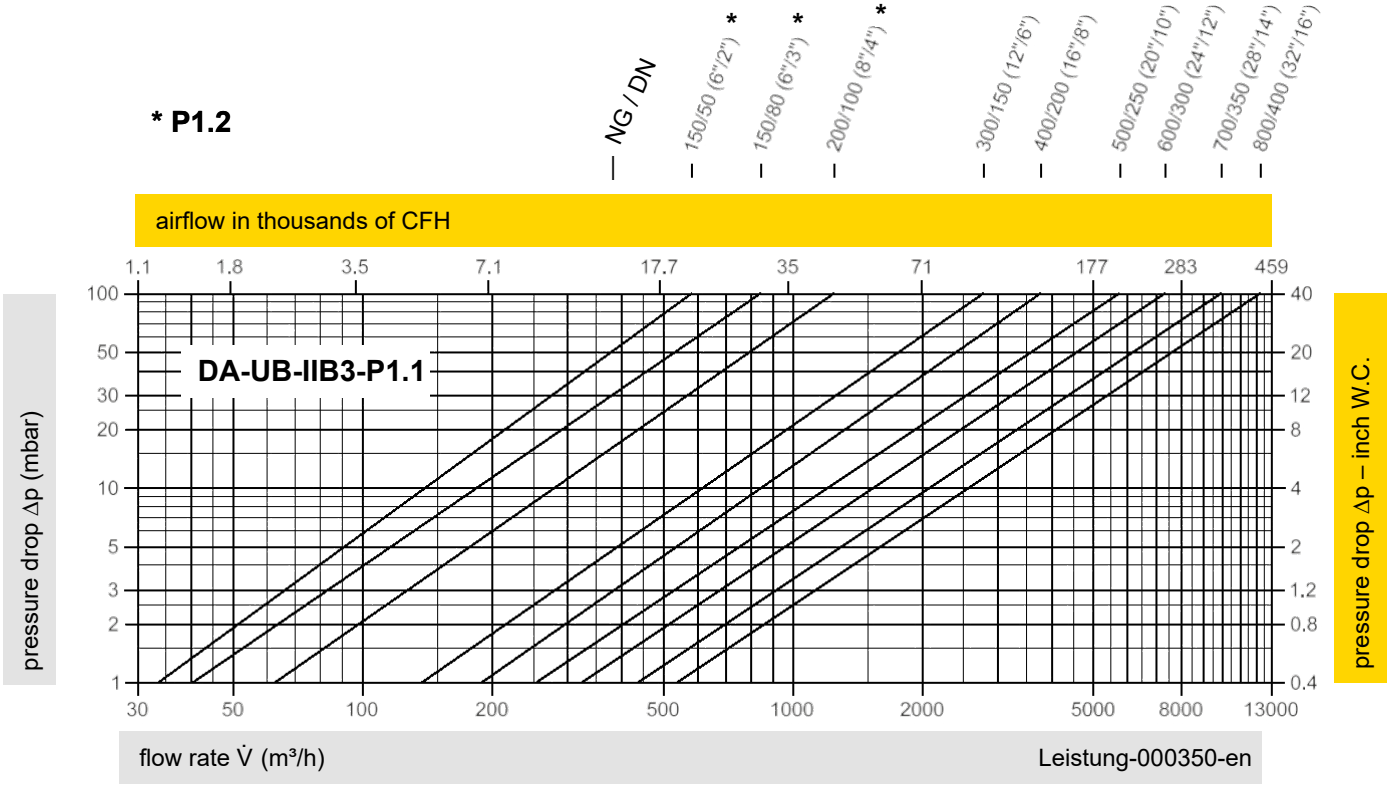
Table 7: Flange connection type

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

Other types upon request.

PROTEGO® DA-UB





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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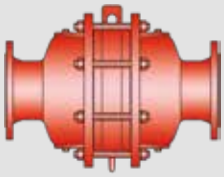
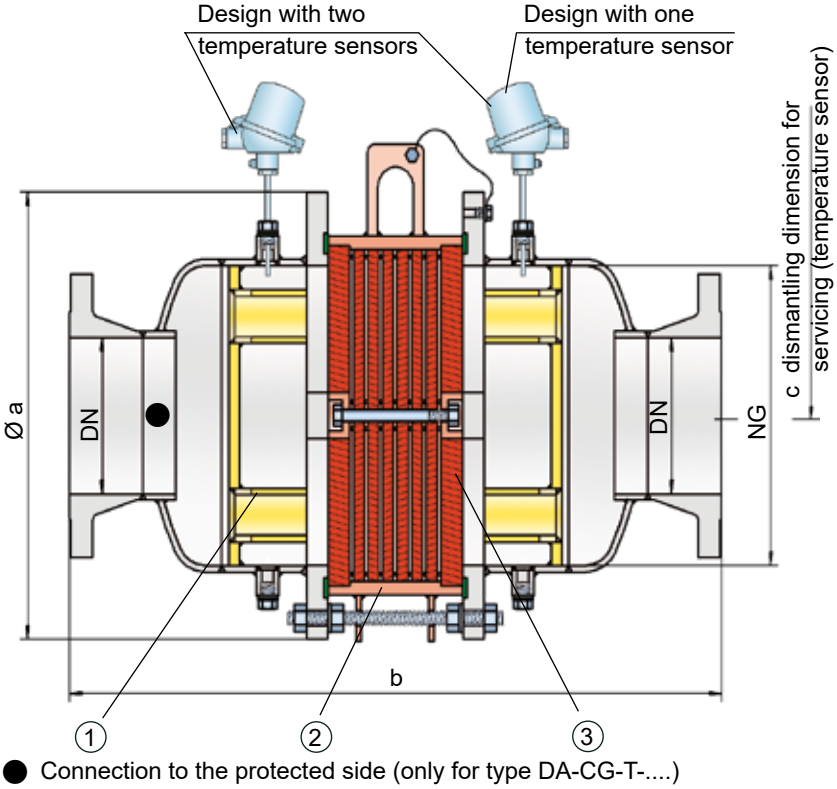


In-Line Detonation Flame Arrester

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

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

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

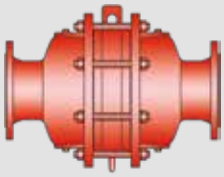
Table 2: Selection of the explosion group

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

Expl. Gr.		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“
	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.



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
-	Classification

Higher operating temperatures upon request.

Table 5: Material selection for housing

Design	A	B
Housing	Steel	Stainless Steel
Gasket	PTFE	PTFE
Flame arrester unit	A	B

Special materials upon request.

Table 6: Material combinations of the flame arrester unit

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

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

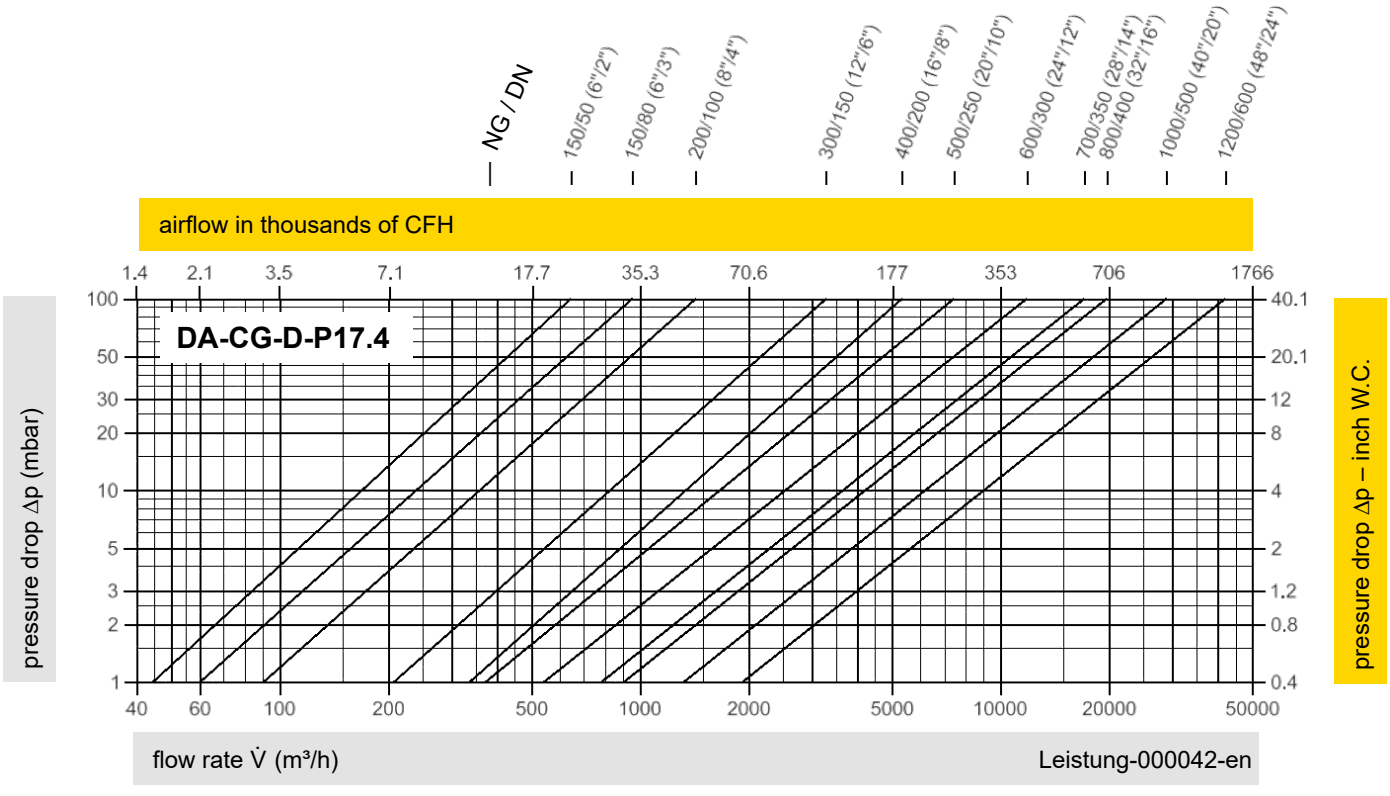
Special materials upon request.

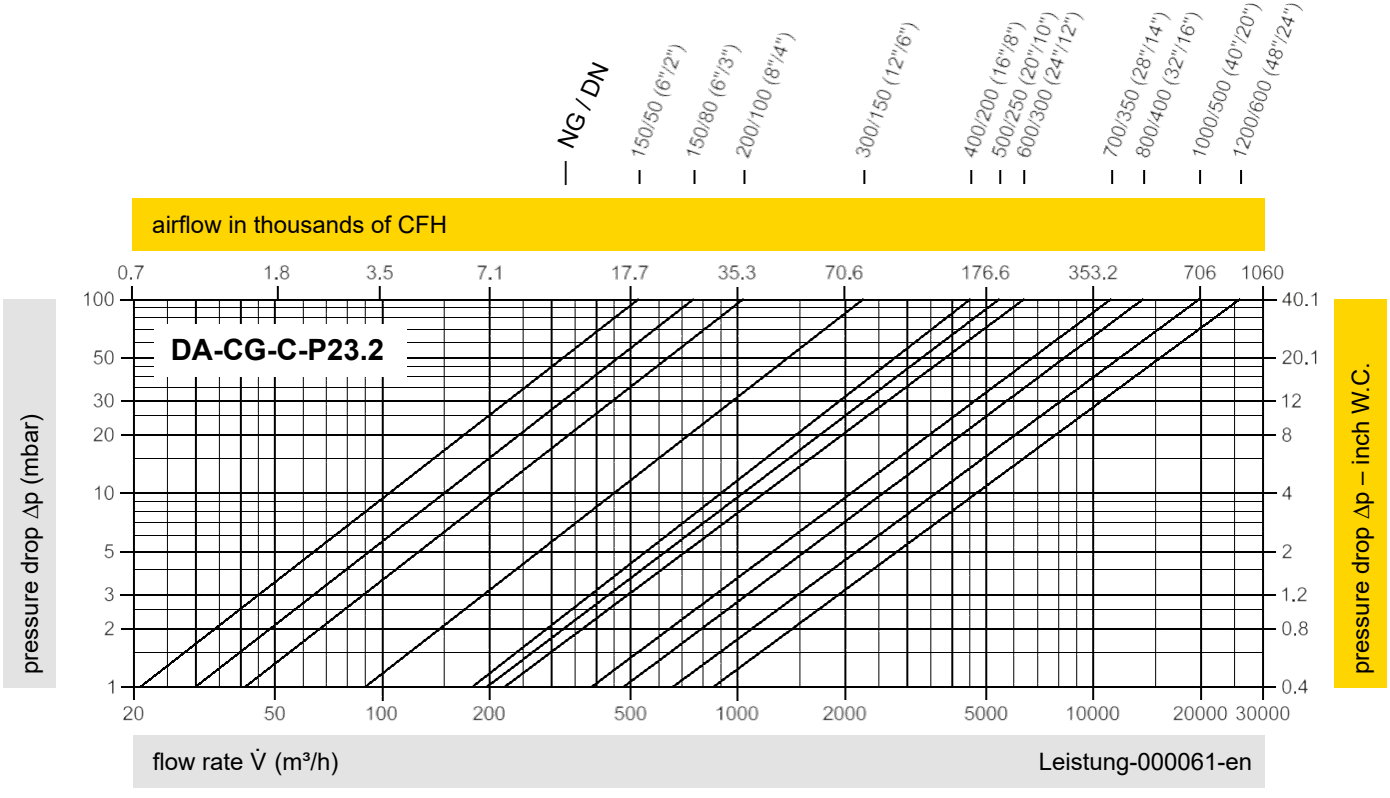
Table 7: Flange connection type

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

Other types upon request.

PROTEGO® DA-CG





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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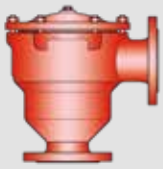
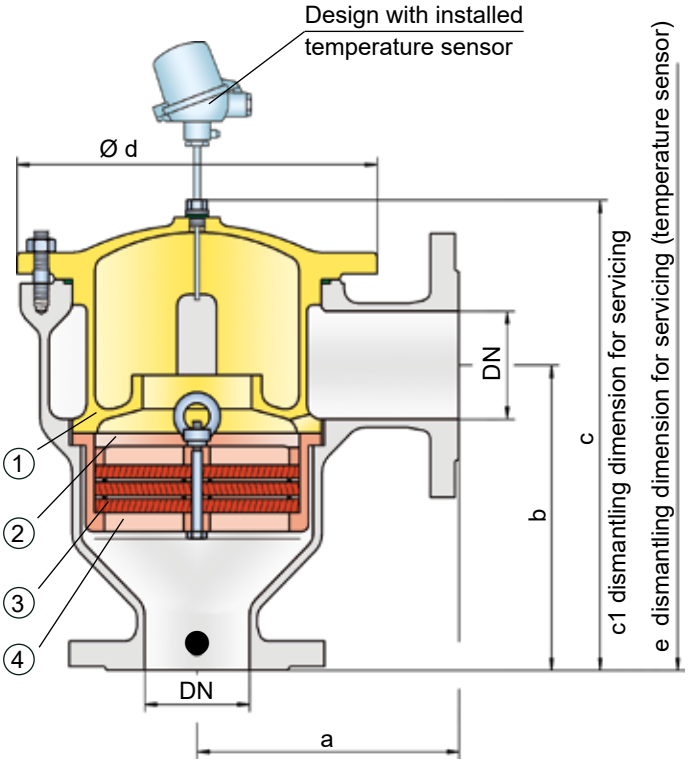


In-Line Detonation Flame Arrester

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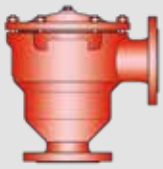
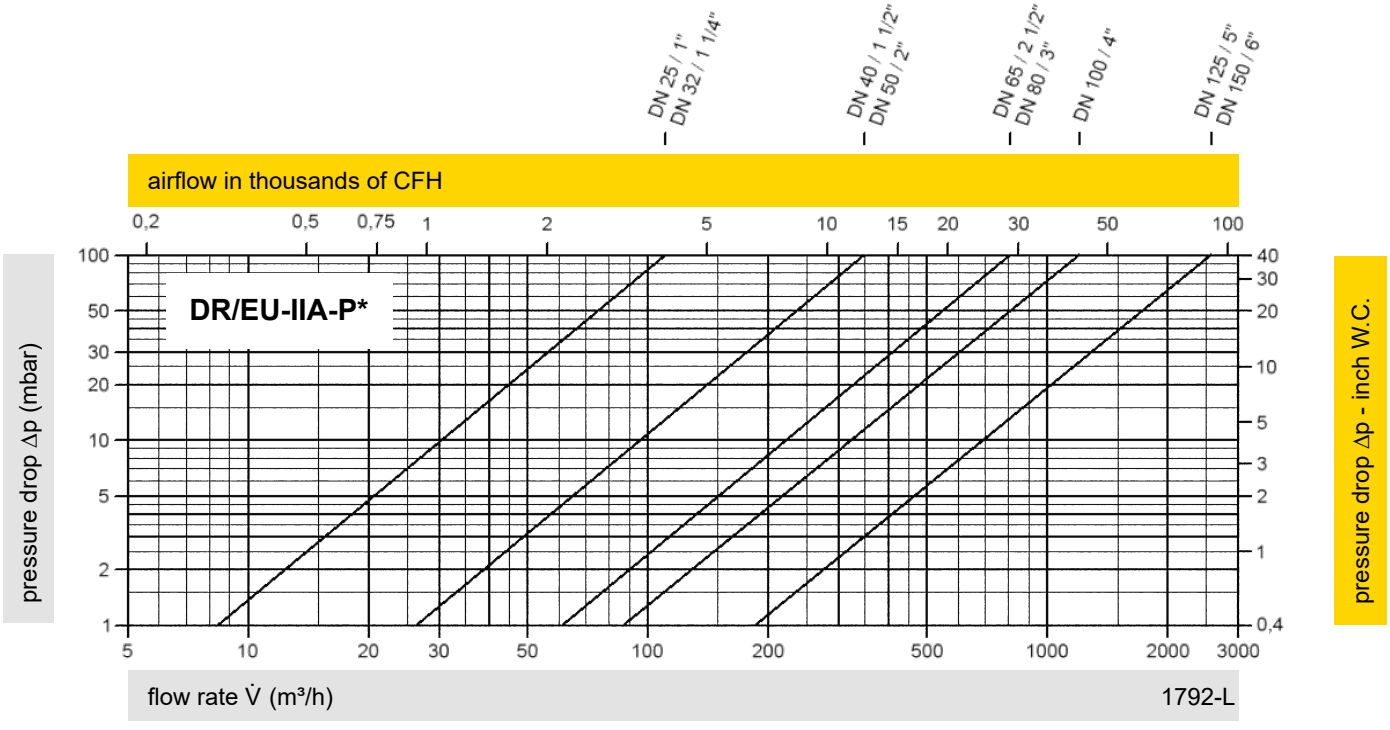


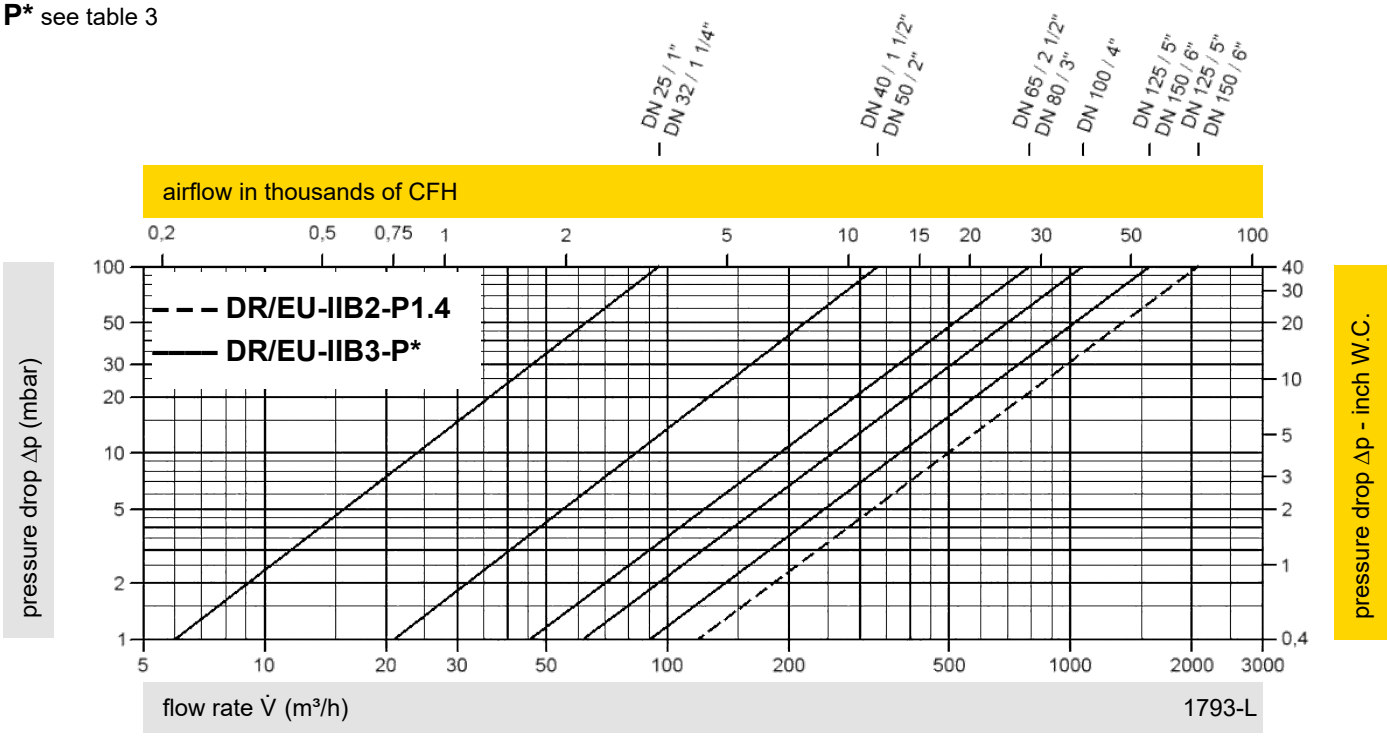
In-Line Detonation Flame Arrester

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: