

PROTEGO® Deflagration Flame Arresters



Section 3

Section 3



for safety and environment

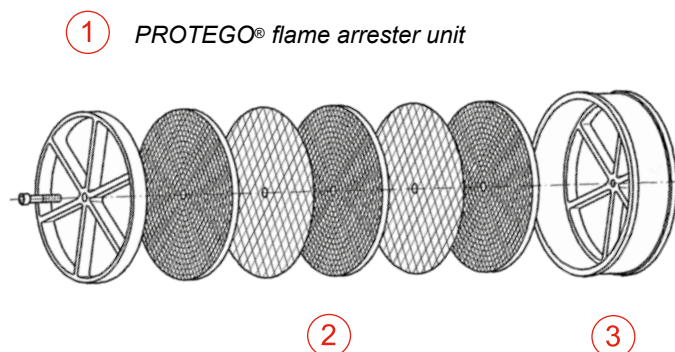


Function and description

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

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

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



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

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

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

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

Special features and advantages

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

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

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

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

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

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

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

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

Preferred applications

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



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



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

Installation and servicing

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

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

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

Selection

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

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

Lastly, the following criteria are reviewed and considered:

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

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

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

Sizing

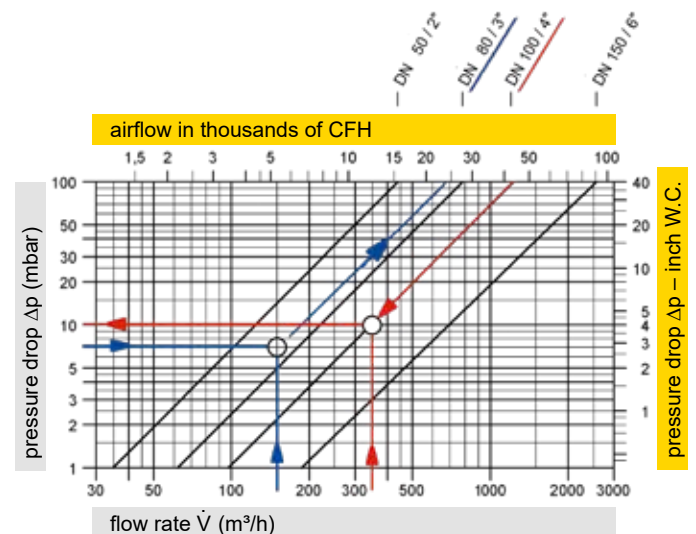
The nominal diameter of the device is determined or checked in the p/\dot{V} performance diagram. A safety factor must be considered when the fluid tends to clog the flame arrester element

- Given:** Volume flow m^3/h or CFH
- Given:** Max. all. pressure drop Δp mbar or inch W.C.
- Desired:** Nominal diameter of the deflagration flame arrester DN

Procedure: Intersection of the lines with volume flow and maximum allowable pressure drop lies above or on the desired nominal diameter curve of the device

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

Procedure: Intersection of the lines with the volume flow and nominal diameter curve of the device, the horizontal straight line leads to the desired flow resistance



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

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

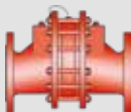

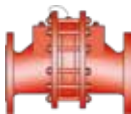



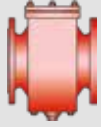
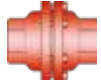
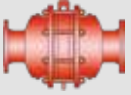


For special applications, please complete the data sheet from Section 1 and provide the necessary information for a quotation.

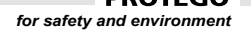


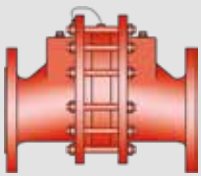
for safety and environment



PROTEGO® Deflagration Flame Arrester

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

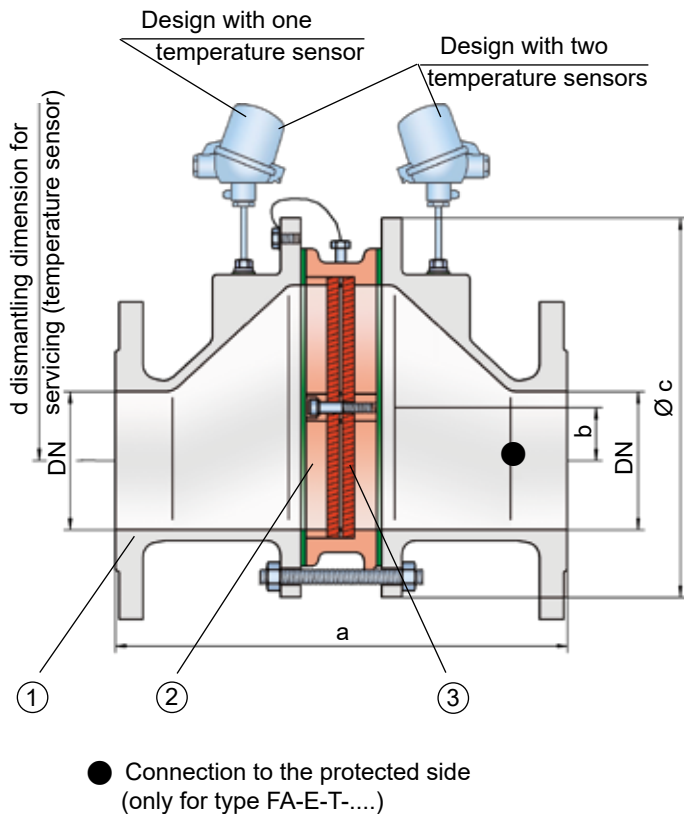




In-Line Deflagration Flame Arrester

eccentric design,
bi-directional

PROTEGO® FA-E



Function and Description

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

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

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

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

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

Special Features and Advantages

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

Design and Specifications

There are three different designs:

Basic in-line deflagration flame arrester	FA-E - <input type="checkbox"/>
In-line deflagration flame arrester with integrated temperature sensor* as additional protection against short-time burning from one side	FA-E - <input type="checkbox"/> T
In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides	FA-E - <input type="checkbox"/> TB

Additional special devices available upon request

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



Stabilized FLAMEFILTER®
Discs (Flyer pdf)



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



L/D ratio (Flyer pdf)

Table 1: Dimensions

Dimensions in mm / inches

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

Expl. Gr.	DN	25 / 1"	32 / 1¼"	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
IIA	a	304 / 11.97	304 / 11.97	310 / 12.20	314 / 12.36	360 / 14.17	364 / 14.33	370 / 14.57	434 / 17.09	440 / 17.32	450 / 17.72	480 / 18.90	500 / 19.69
IIB3	a	304 / 11.97	304 / 11.97	310 / 12.20	314 / 12.36	360 / 14.17	364 / 14.33	370 / 14.57	434 / 17.09	440 / 17.32	450 / 17.72	480 / 18.90	500 / 19.69
IIC	a	304 / 11.97	304 / 11.97	321 / 12.64	325 / 12.80	371 / 14.61	375 / 14.76	381 / 15.00	445 / 17.52	451 / 17.76	461 / 18.15	491 / 19.33	511 / 20.12
	b	29 / 1.14	29 / 1.14	29 / 1.14	29 / 1.14	38 / 1.49	38 / 1.49	39 / 1.53	65 / 2.56	65 / 2.56	55 / 2.17	58 / 2.28	60 / 2.36
	c	185 / 7.28	185 / 7.28	210 / 8.27	210 / 8.27	250 / 9.84	250 / 9.84	275 / 10.83	385 / 15.16	385 / 15.16	450 / 17.72	500 / 19.69	575 / 22.64
	d	400 / 15.75	400 / 15.75	410 / 16.14	410 / 16.14	440 / 17.32	440 / 17.32	460 / 18.11	520 / 20.47	520 / 20.47	540 / 21.26	570 / 22.44	600 / 23.62

Table 2: Selection of the explosion group

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

Table 3: Selection of max. operating pressure

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

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

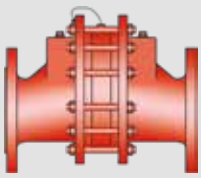
Table 4: Specification of max. operating temperature

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

Table 5: Material selection for housing

Design	B	C	D	The housing can also be delivered in carbon steel with an ECTFE coating. Special materials upon request.
Housing	Steel	Stainless Steel	Hastelloy	
Gasket	PTFE	PTFE	PTFE	
Flame arrester unit	A,C	C	D	





In-Line Deflagration Flame Arrester

eccentric design,
bi-directional

PROTEGO® FA-E

Table 6: Material combinations of the flame arrester unit

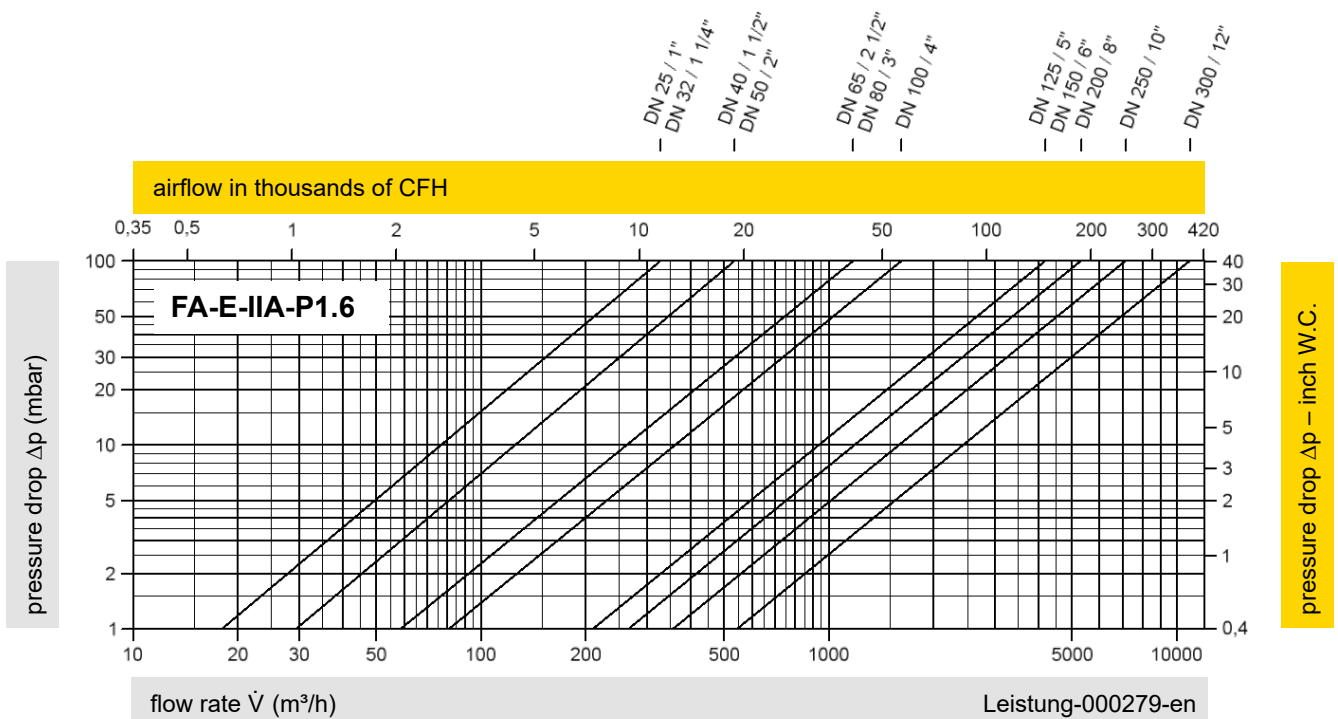
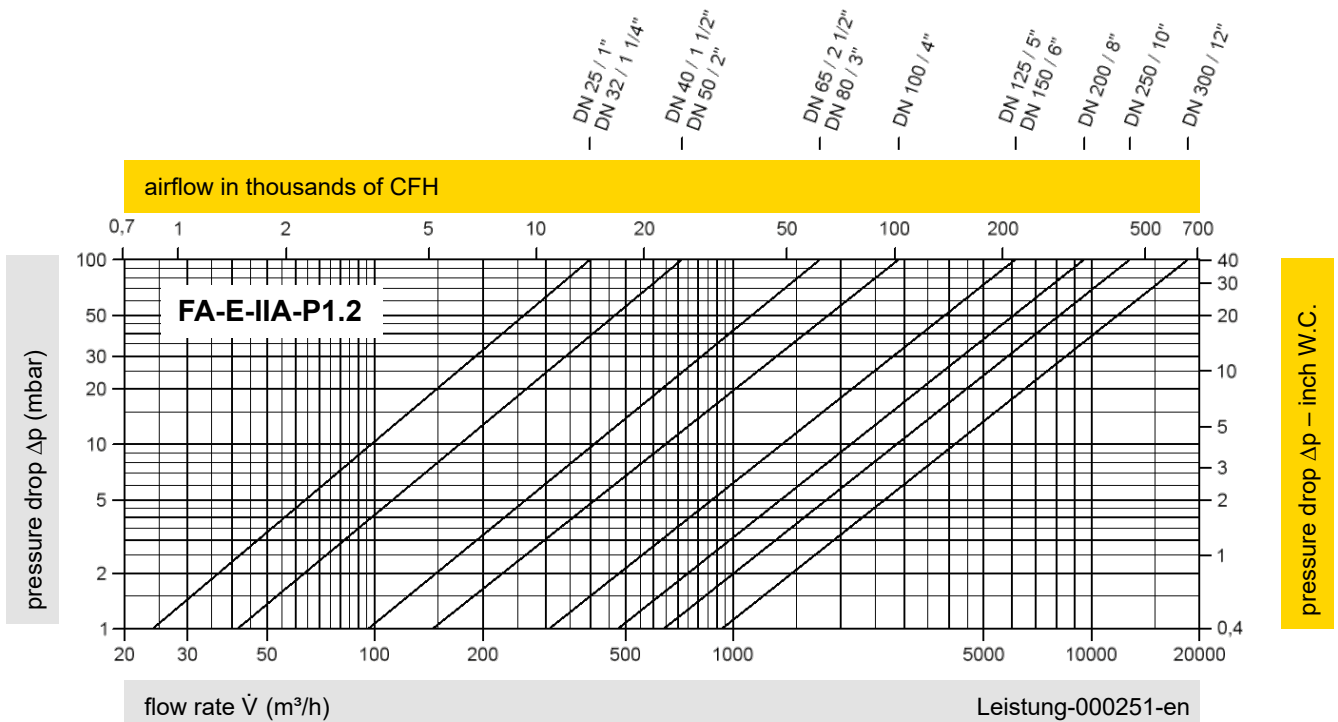
Design	A	C	D
FLAMEFILTER® casing	Steel	Stainless Steel	Hastelloy
FLAMEFILTER® *	Stainless Steel	Stainless Steel	Hastelloy
Spacers	Stainless Steel	Stainless Steel	Hastelloy

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

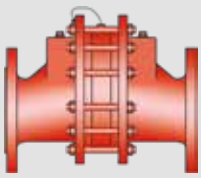
Table 7: Flange connection type

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

Other types upon request.



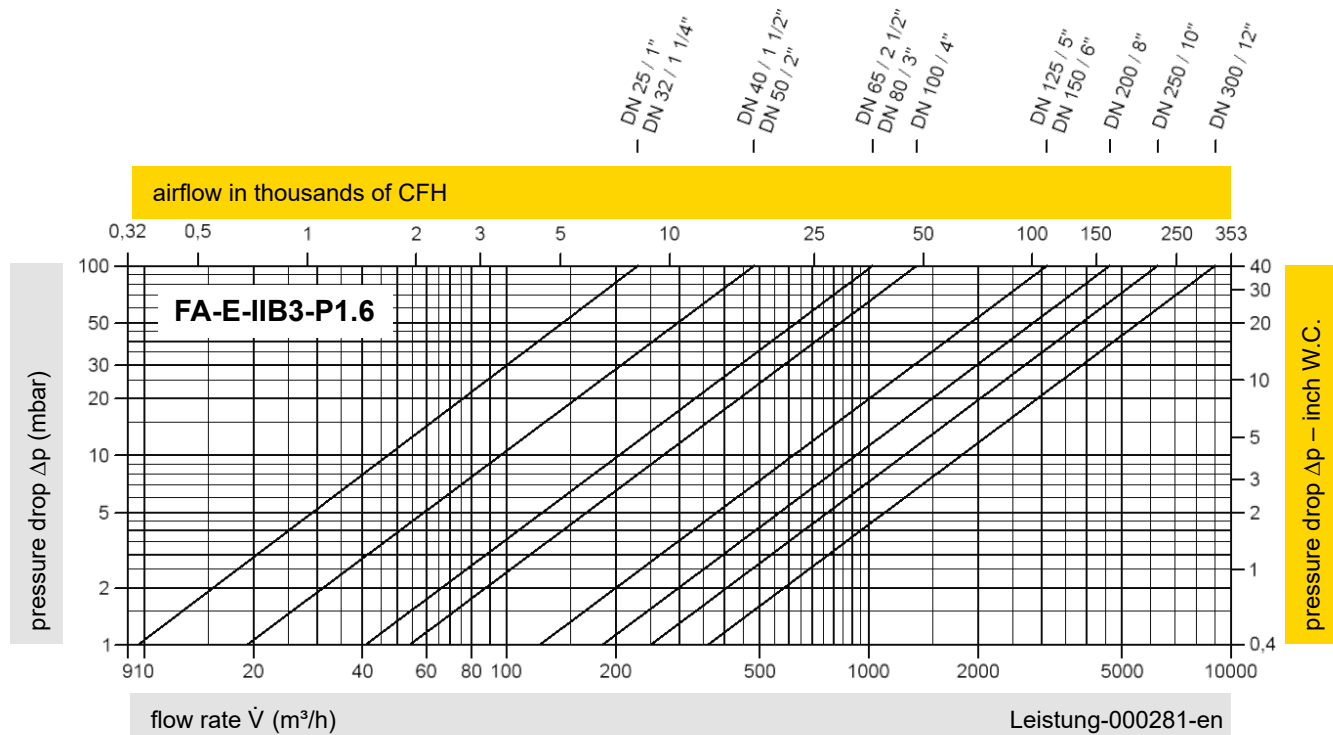
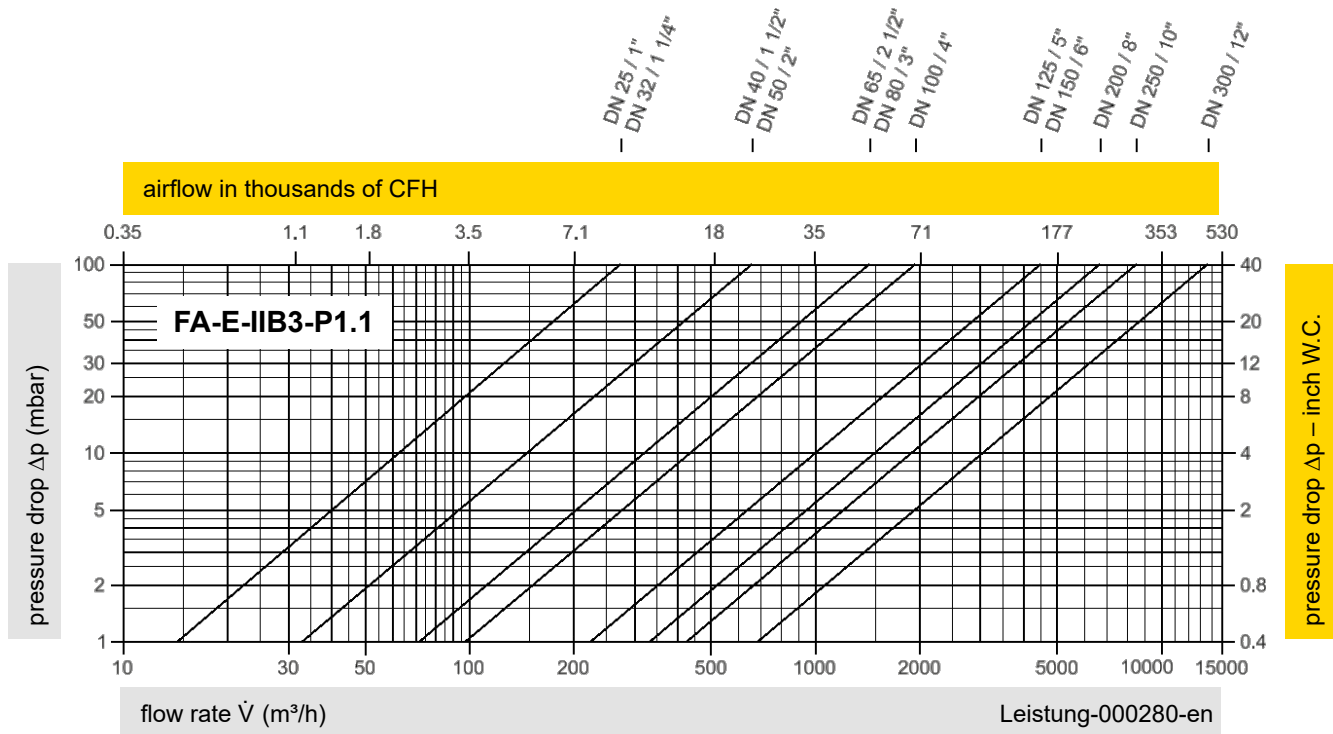
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.
 Volume flow \dot{V} in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).
 For conversion to other densities and temperatures, refer to Sec. 1: "Technical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



In-Line Deflagration Flame Arrester

Flow Capacity Charts

PROTEGO® FA-E

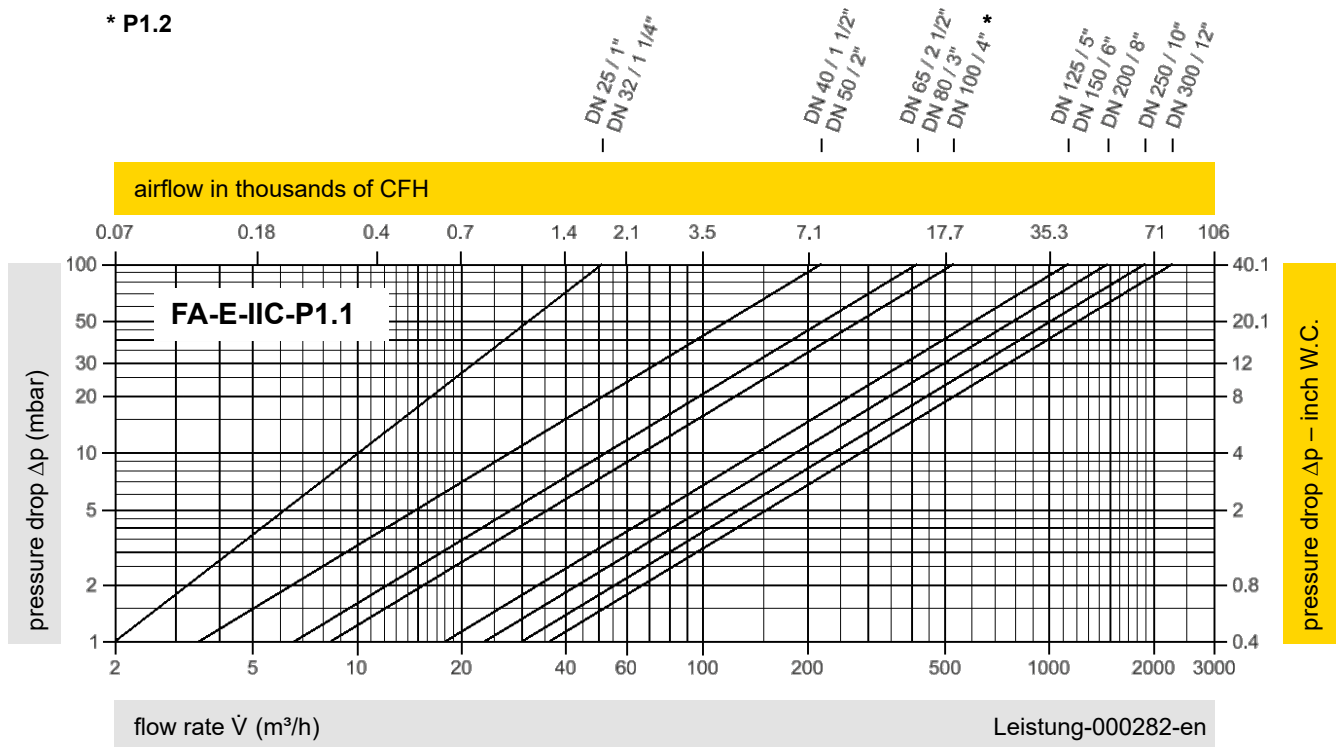


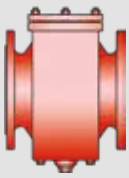
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Volume flow \dot{V} in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).

For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

* P1.2

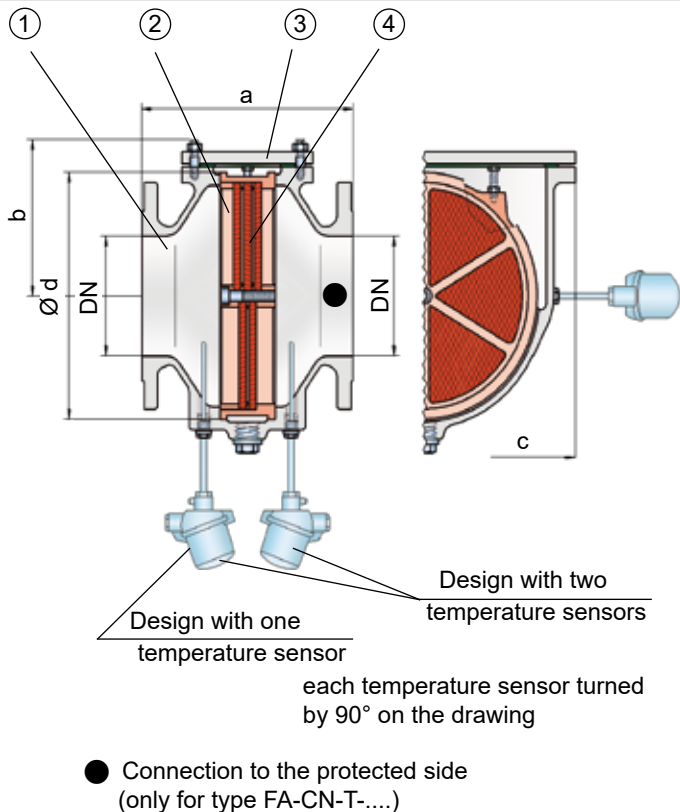




In-Line Deflagration Flame Arrester

concentric design,
bi-directional

PROTEGO® FA-CN-IIA and IIB3



Function and Description

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

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

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

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

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

Special Features and Advantages

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

Design and Specifications

There are three different designs:

Basic in-line deflagration flame arrester **FA-CN - -**

In-line deflagration flame arrester with integrated temperature sensor* as additional protection against short time burning from one side **FA-CN - T**

In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides **FA-CN - TB**

Additional special devices available upon request

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



Stabilized FLAMEFILTER®
Discs (Flyer pdf)



L/D ratio (Flyer pdf)

Table 1: Dimensions

Dimensions in mm / inches

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

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

Table 2: Selection of the explosion group

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

Table 3: Selection of max. operating pressure

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

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

n = number of FLAMEFILTER®

Table 4: Specification of max. operating temperature

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

Table 5: Material selection

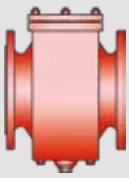
Design	A	B	Special materials upon request.
Housing	Steel	Stainless Steel	
Cover	Steel	Stainless Steel	
Gasket	PTFE	PTFE	
Flame arrester unit	Stainless Steel	Stainless Steel	

Table 6: Flange connection type

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



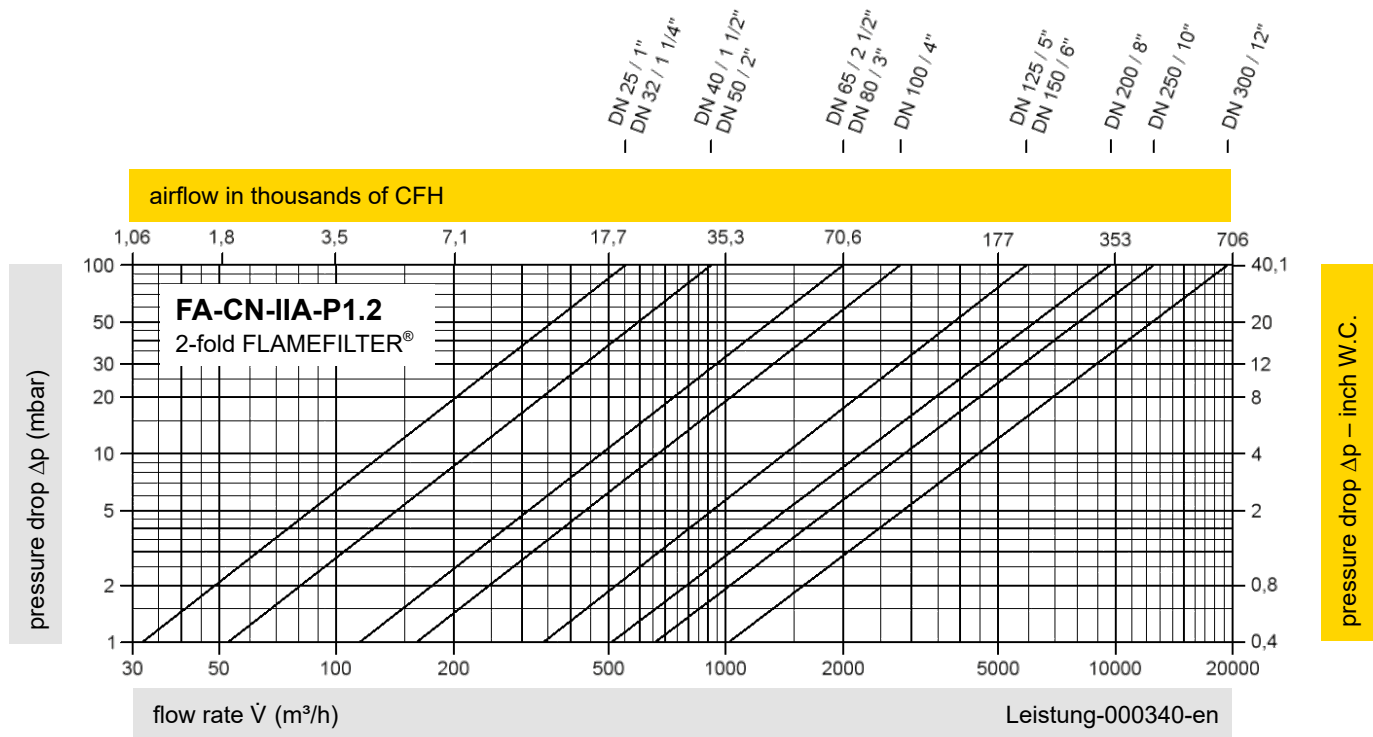
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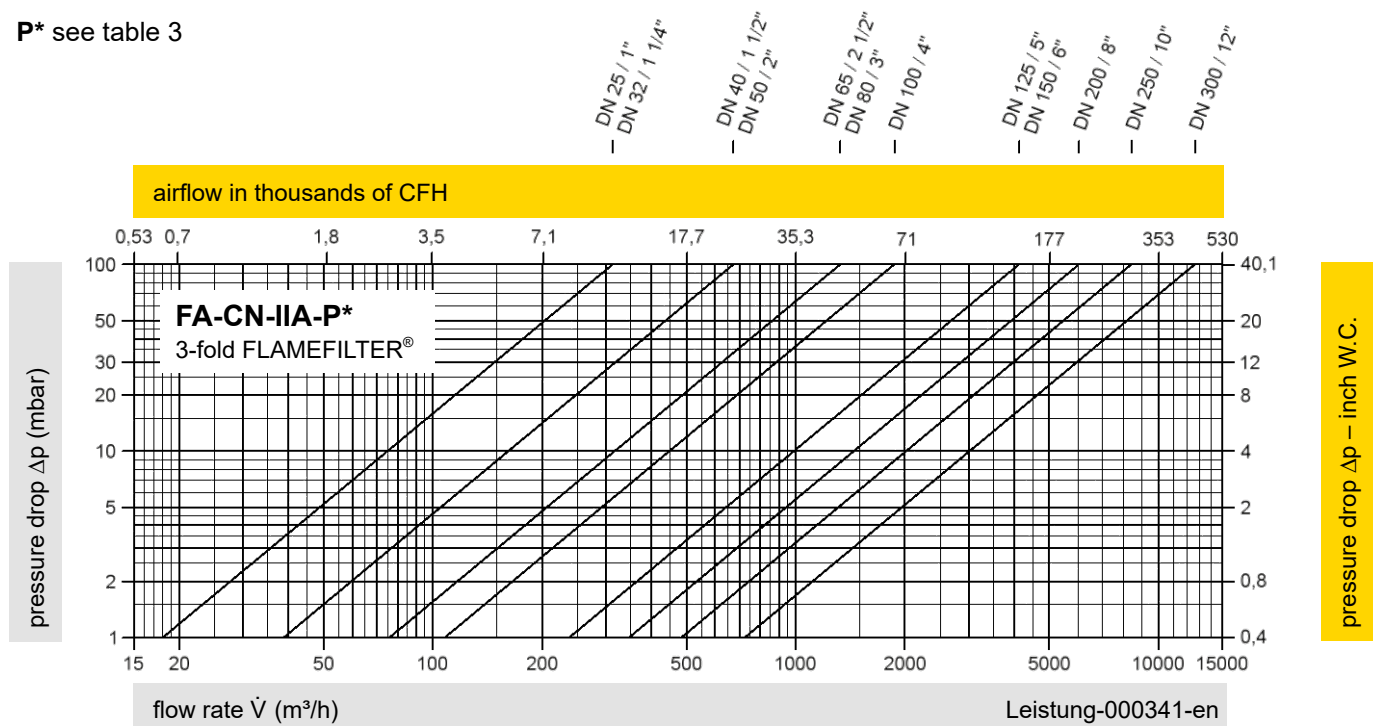
In-Line Deflagration Flame Arrester

Flow Capacity Charts

PROTEGO® FA-CN-IIA and IIB3



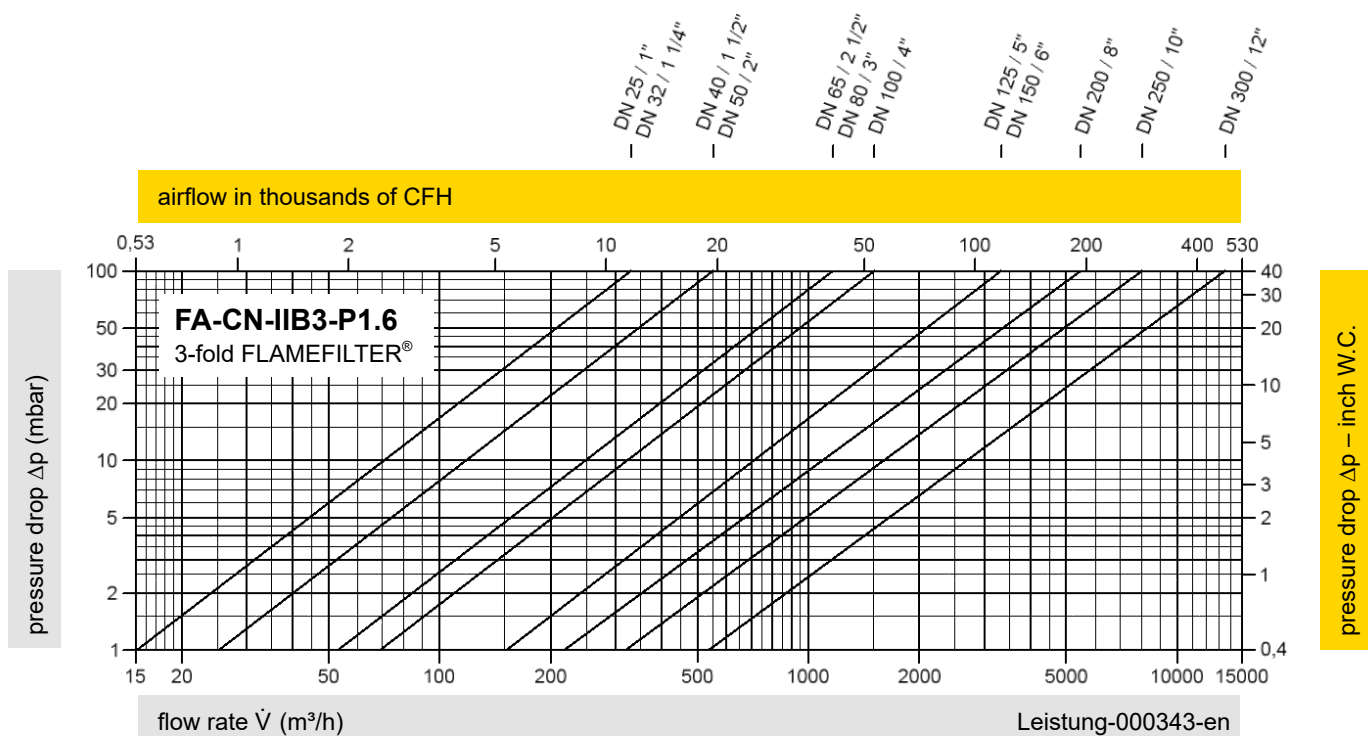
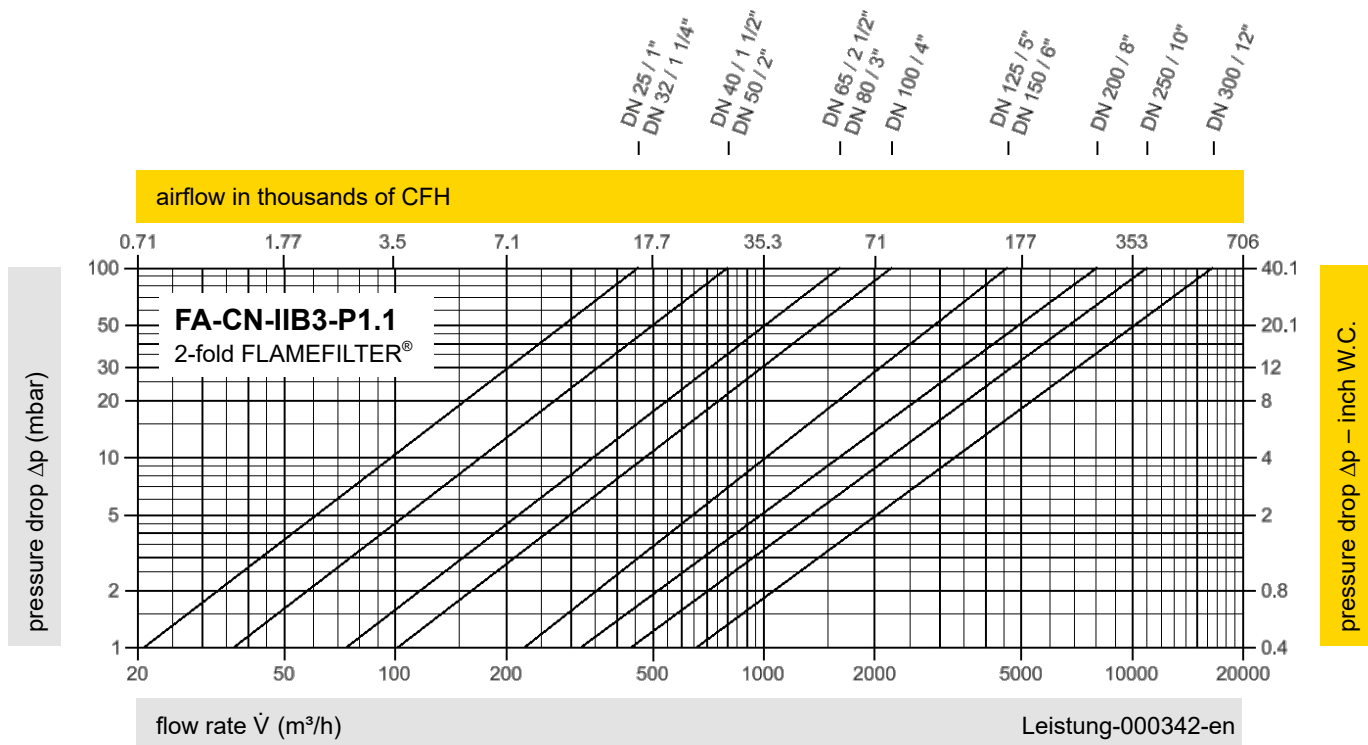
P* see table 3



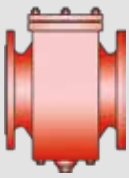
The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow \dot{V} in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).

For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."



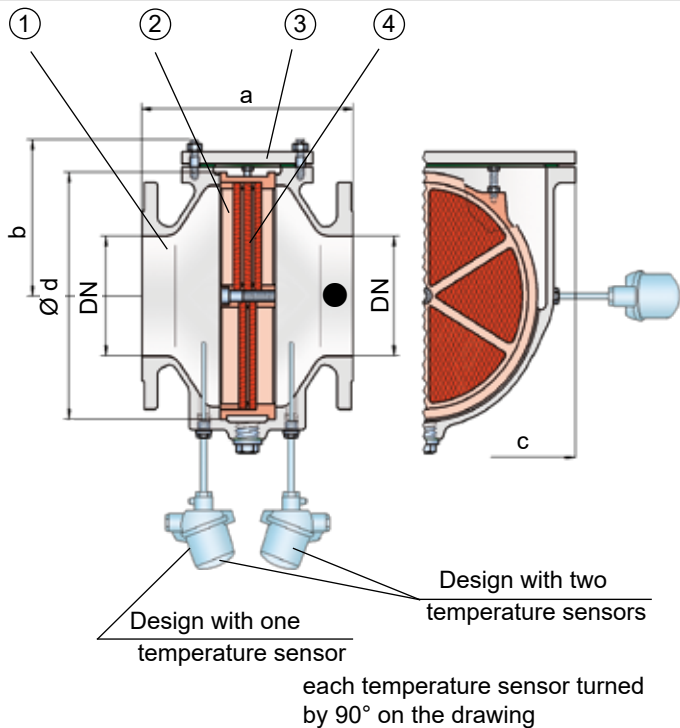
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In-Line Deflagration Flame Arrester

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

PROTEGO® FA-CN-IIC



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

Function and Description

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

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

Specifying the operating conditions, such as the temperature, pressure, explosion group, and the composition of the fluid, enables PROTEGO® to select the best deflagration flame arrester for your application. The versions of PROTEGO® FA-CN-IIC

flame arrester protect against deflagrations of fuel/air mixtures of explosion group IIC (NEC B). FA-CN devices for substances of explosion groups IIA1, IIA, and IIB3 (NEC D and C (MESG \geq 0.65 mm) are shown on separate pages.

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

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

Special Features and Advantages

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

Design and Specifications

There are three different designs:

Basic in-line deflagration flame arrester	FA-CN - <input type="checkbox"/>
In-line deflagration flame arrester with integrated temperature sensor* as additional protection against short time burning from one side	FA-CN - <input checked="" type="checkbox"/>
In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides	FA-CN - <input checked="" type="checkbox"/>

Additional special devices available upon request

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



Stabilized FLAMEFILTER®
Discs (Flyer pdf)



L/D ratio (Flyer pdf)

Table 1: Dimensions

Dimensions in mm / inches

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

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

Table 2: Selection of the explosion group

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

Table 3: Selection of max. operation pressure

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

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

Table 4: Max. allowable L/D-ratio

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

Table 5: Material selection

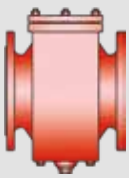
Design	A	B	Special materials upon request.
Housing	Steel	Stainless Steel	
Cover	Steel	Stainless Steel	
Gasket	PTFE	PTFE	
Flame arrester unit	Stainless Steel	Stainless Steel	

Table 6: Flange connection type

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



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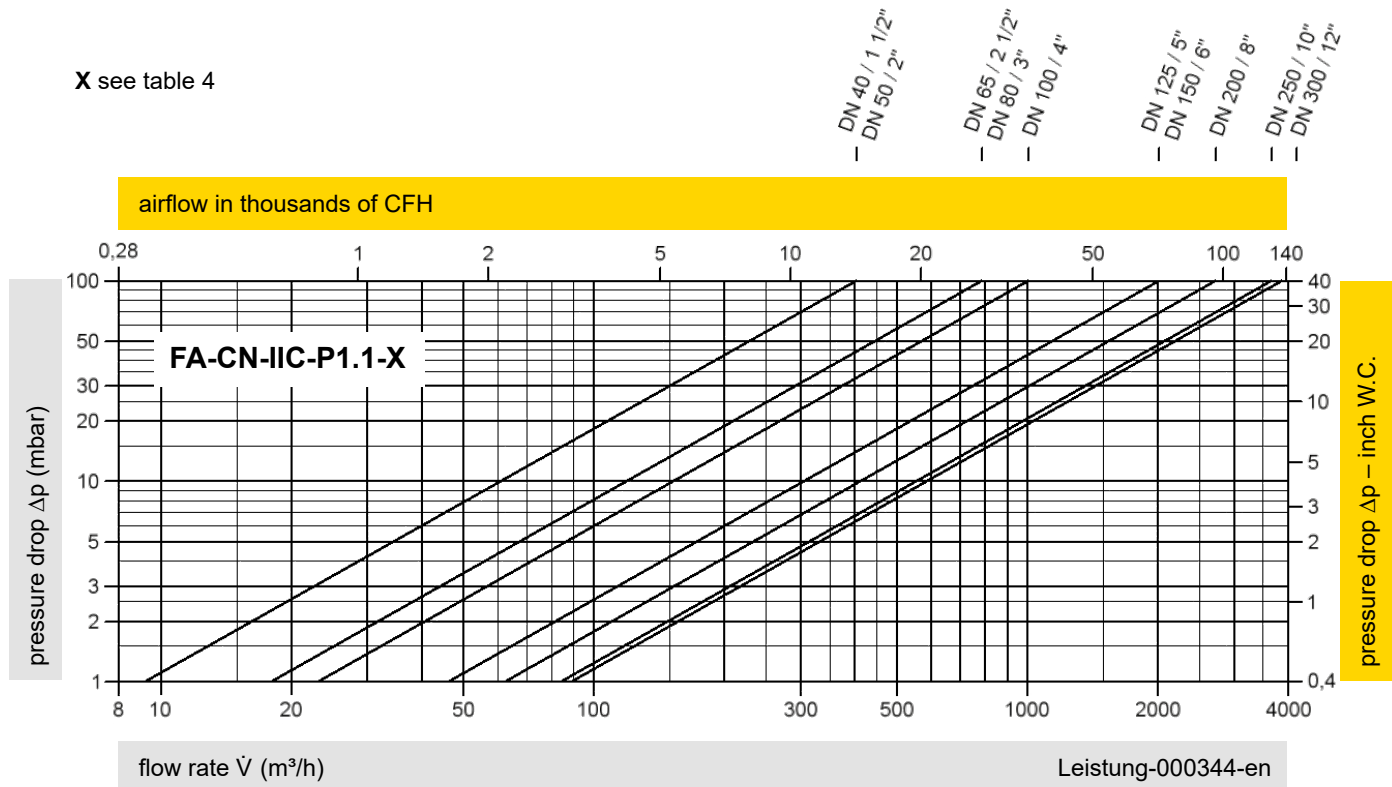


In-Line Deflagration Flame Arrester

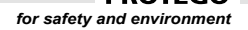
Flow Capacity Chart

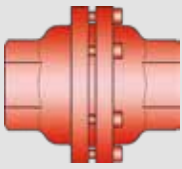
PROTEGO® FA-CN-IIC

X see table 4



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

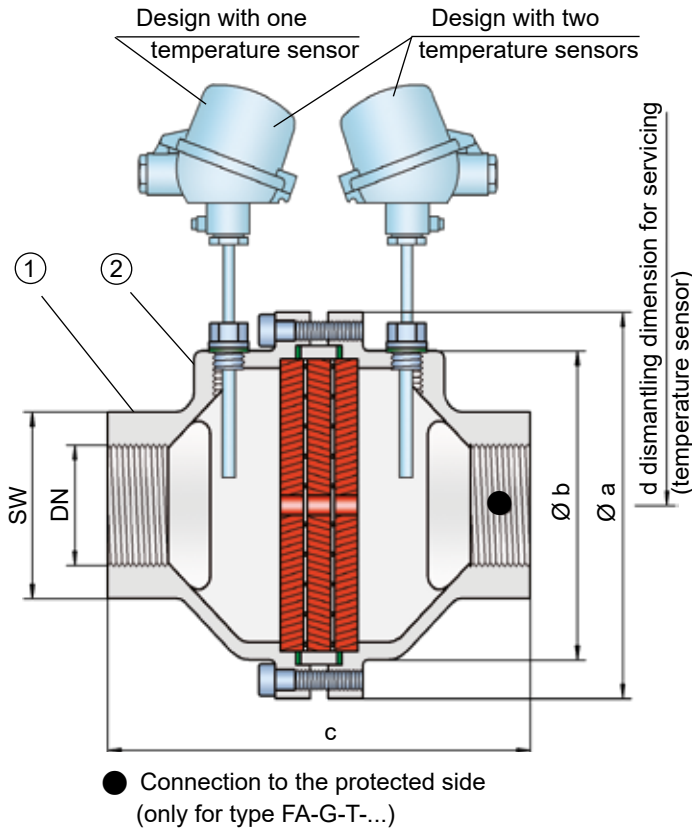




In-Line Deflagration Flame Arrester

concentric design,
bi-directional

PROTEGO® FA-G



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

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

Special Features and Advantages

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

Design and Specifications

There are three different designs:

Basic in-line deflagration flame arrester (size ½" to 2") **FA-G- []**

In-line deflagration flame arrester with integrated temperature sensor* for additional protection against short-time burning from one side (size 1½" to 2") **FA-G- [T]**

In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides (size 1½" to 2") **FA-G- [TB]**

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

Flange connection available upon request

Function and Description

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

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



Stabilized FLAMEFILTER®
Discs (Flyer pdf)

Table 1: Dimensions

Dimensions in mm / inches, SW = width across flats

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

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

Table 2: Selection of the explosion group

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

Table 3: Selection of max. operating pressure

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

Table 4: Specification of max. operating temperature

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

Table 5: Material selection

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

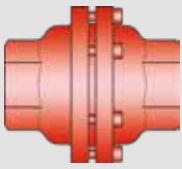
Special materials upon request.

Table 6: Type of connection

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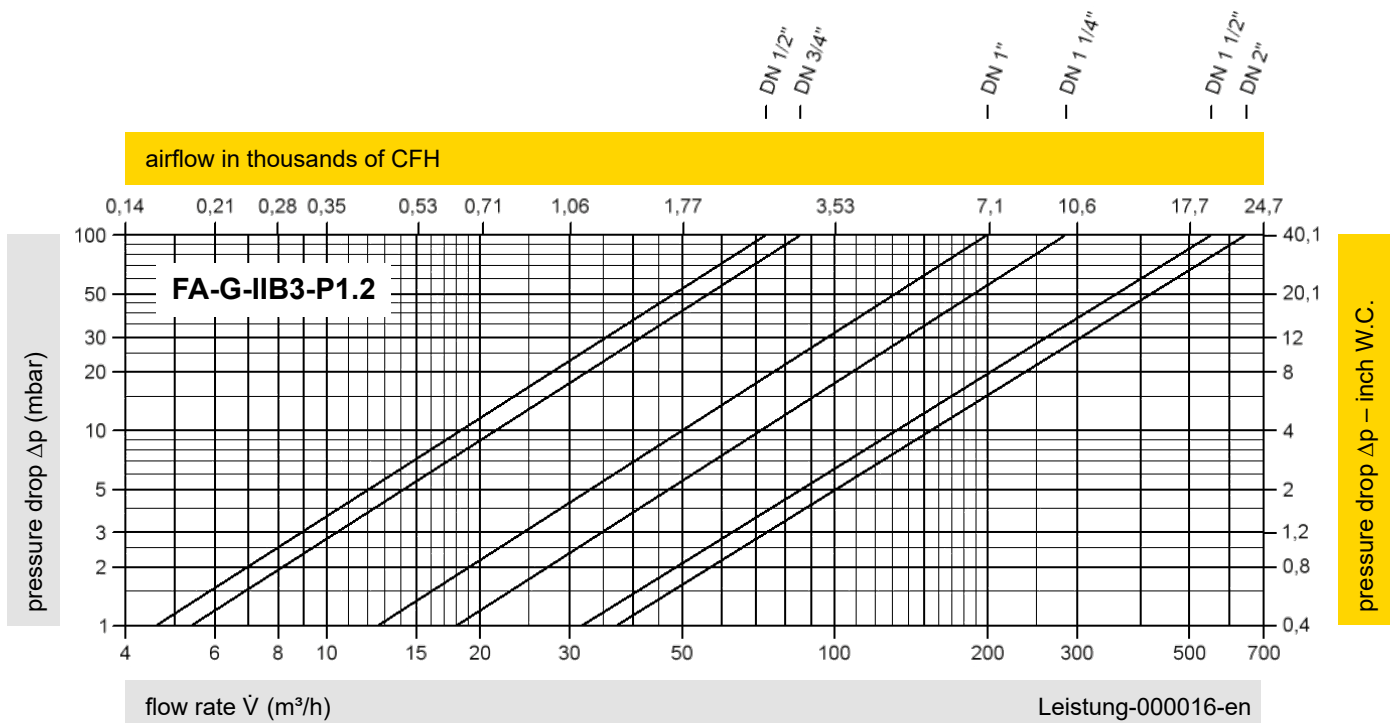
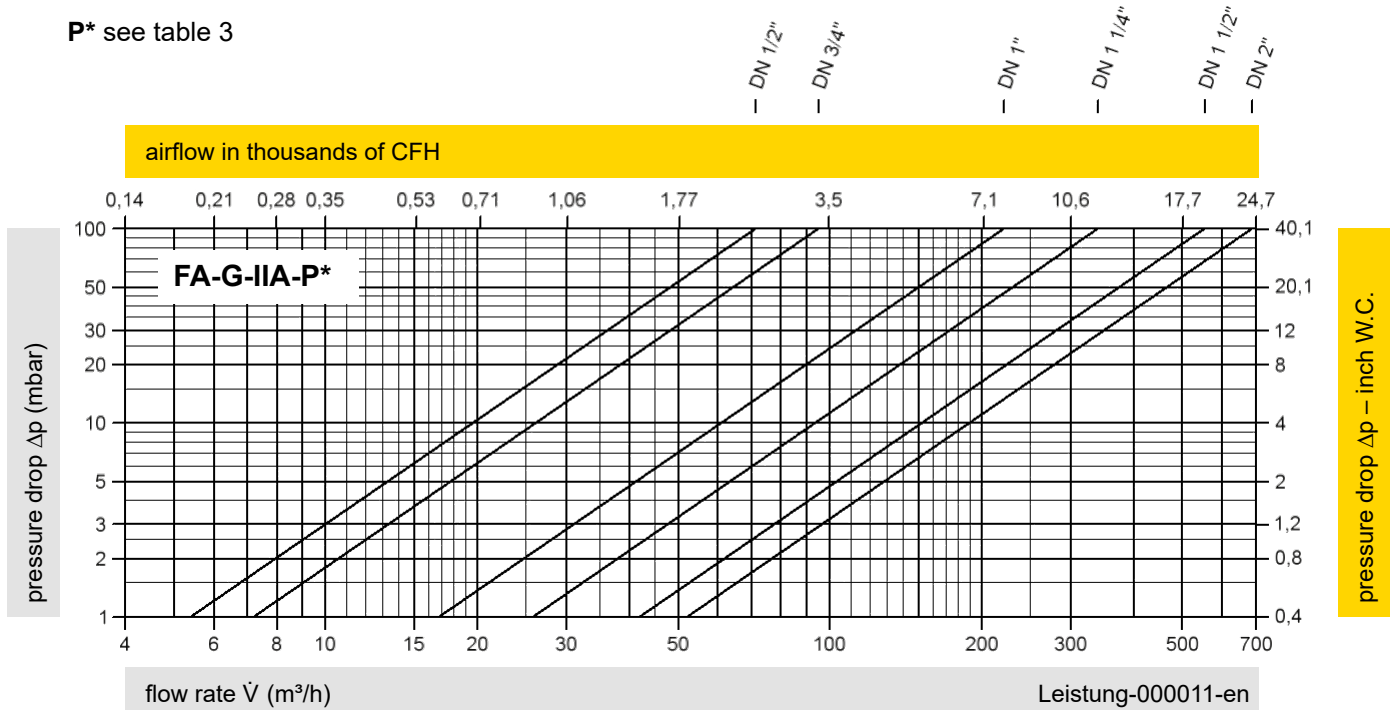


In-Line Deflagration Flame Arrester

Flow Capacity Charts

PROTEGO® FA-G-IIA, IIB3 and IIC

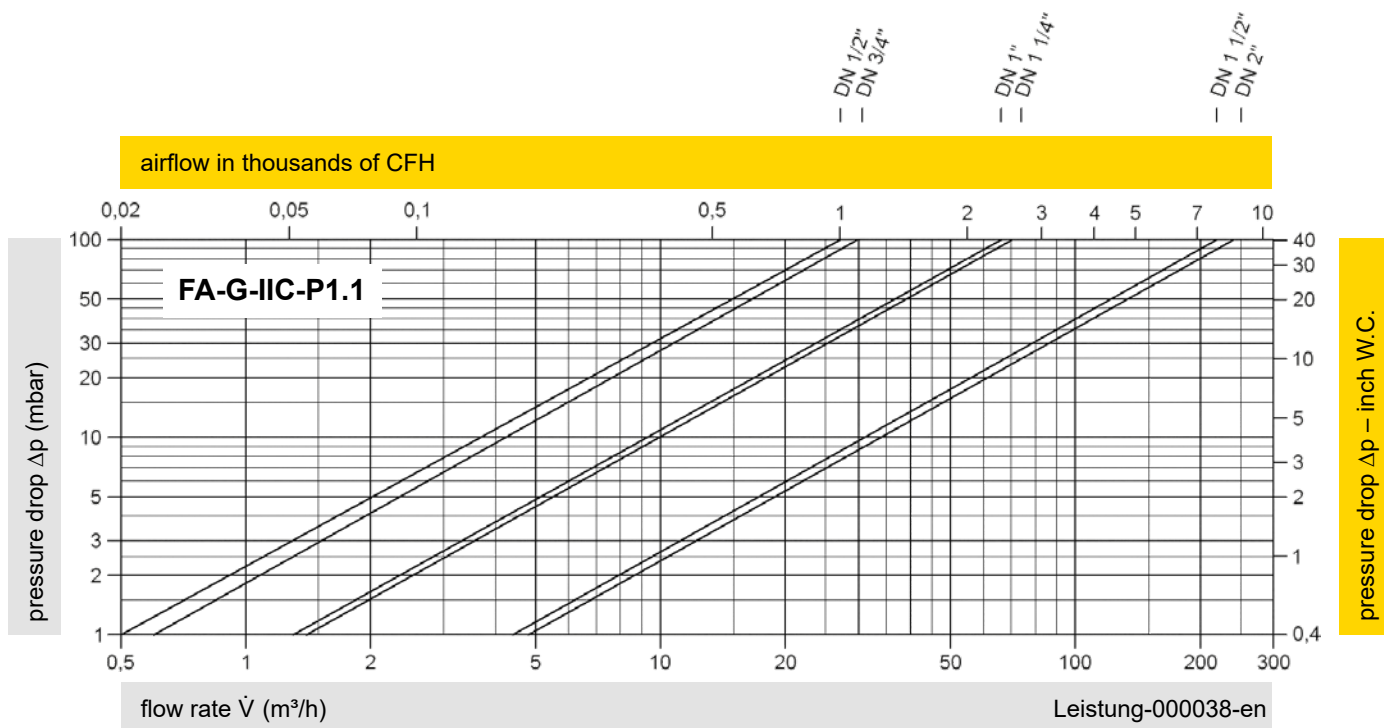
P* see table 3

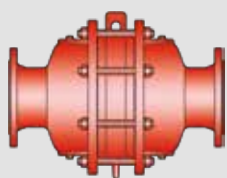


The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig.

Volume flow \dot{V} in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).

For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."

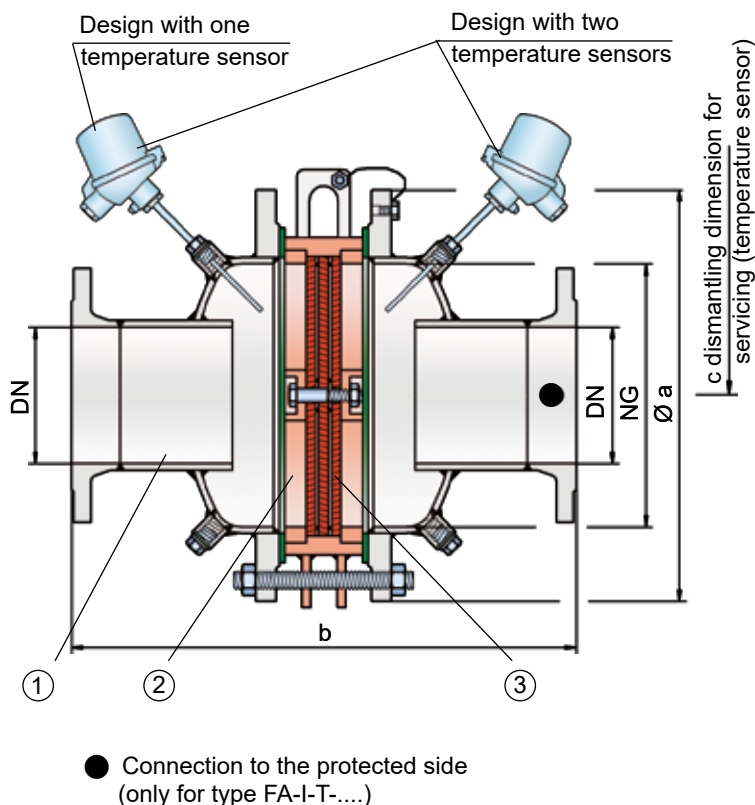




In-Line Deflagration Flame Arrester

concentric design,
bi-directional

PROTEGO® FA-I



Function and Description

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

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

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

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

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

Special Features and Advantages

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

Design and Specifications

There are three different designs:

Basic deflagration flame arrester design **FA-I- ☐**

In-line deflagration flame arrester with integrated temperature sensor* for additional protection against short-time burning from one side **FA-I- ☐**

In-line deflagration flame arrester with two integrated temperature sensors* for additional protection against short-time burning from both sides **FA-I- ☐**

Additional special devices available upon request

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



Stabilized FLAMEFILTER®
Discs (Flyer pdf)



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

Table 1: Dimensions

Dimensions in mm / inches

To select nominal width/nominal size (NG/DN) combination, please use the flow capacity charts on the following pages.						Additional nominal width/nominal size (NG/DN) combinations with improved flow capacity upon request.							
standard													
NG	150 6"	150 6"	200 8"	300 12"	400 16"	500 20"	600 24"	800 32"	1000 40"	1200 48"	1400 56"	1600 64"	
DN	≤ 50 2"	80 3"	≤ 100 4"	≤ 150 6"	≤ 200 8"	≤ 250 10"	≤ 300 12"	≤ 400 16"	≤ 500 20"	≤ 600 24"	≤ 800 32"	≤ 800 32"	
Expl. Gr.	a	285 / 11.22	285 / 11.22	340 / 13.39	445 / 17.52	565 / 22.24	670 / 26.38	780 / 30.71	975 / 38.39	1175 / 46.26	1405 / 55.31	1630 / 64.17	1830 / 72.05
	IIA b*	364 / 14.33	364 / 14.33	452 / 17.79	584 / 22.99	638 / 25.12	688 / 27.09	800 / 31.50	900 / 35.43	1000 / 39.37	1100 / 43.31	1350 / 53.15	1450 / 57.09
	IIB3 b*	364 / 14.33	364 / 14.33	464 / 18.27	596 / 23.46	650 / 25.59	700 / 27.56	800 / 31.50	900 / 35.43	1000 / 39.37	1100 / 43.31	1350 / 53.15	1450 / 57.09
	c	500 / 19.69	500 / 19.69	520 / 20.47	570 / 22.44	620 / 24.41	670 / 26.38	700 / 31.50	900 / 35.43	1000 / 39.37	1100 / 43.31	1350 / 53.15	1450 / 57.09

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

Table 2: Selection of the explosion group

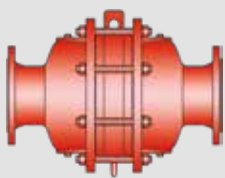
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	Special approvals upon request.
> 0.90 mm	IIA	D	
≥ 0.65 mm	IIB3	C	

Table 3: Selection of max. operating pressure

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

concentric design,
bi-directional

PROTEGO® FA-I

Table 4: Max. allowable L/D-ratio

standard												
NG	150 6"	150 6"	200 8"	300 12"	400 16"	500 20"	600 24"	800 32"	1000 40"	1200 48"	1400 56"	1600 64"
DN	≤ 50 2"	80 3"	≤ 100 4"	≤ 150 6"	≤ 200 8"	≤ 250 10"	≤ 300 12"	≤ 400 16"	≤ 500 20"	≤ 600 24"	≤ 800 32"	≤ 800 32"
(L/D) _{max}	50	50	50	50	50	50	50	50	50	50	50	50
I/A P _{max}	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.3 / 18.8	1.3 / 18.8	1.2 / 17.4	1.1 / 15.9
Classification	-	-	-	-	-	-	-	-	-	-	-	-
(L/D) _{max}	50	50	40	40	35	35	35	30	30	30	25	25
I/B3 P _{max} (bar /psi)	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9
Classification	-	-	X6	X6	X7	X7	X7	X8	X8	X8	X9	X9

Table 5: Specification of max. operating temperature

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

Table 6: Material selection for housing

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

Special materials upon request.

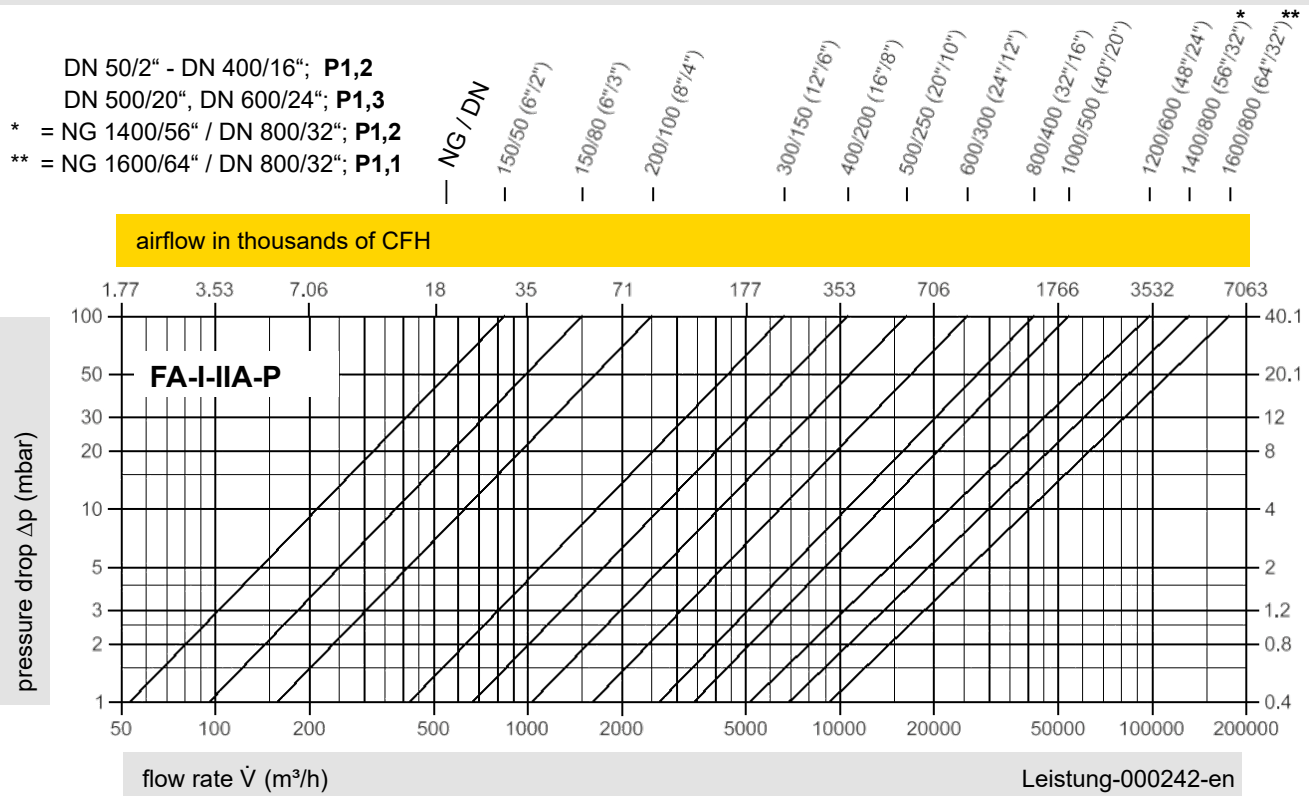
Table 7: Material combinations of the flame arrester unit

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

Special materials upon request.

Table 8: Flange connection type

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

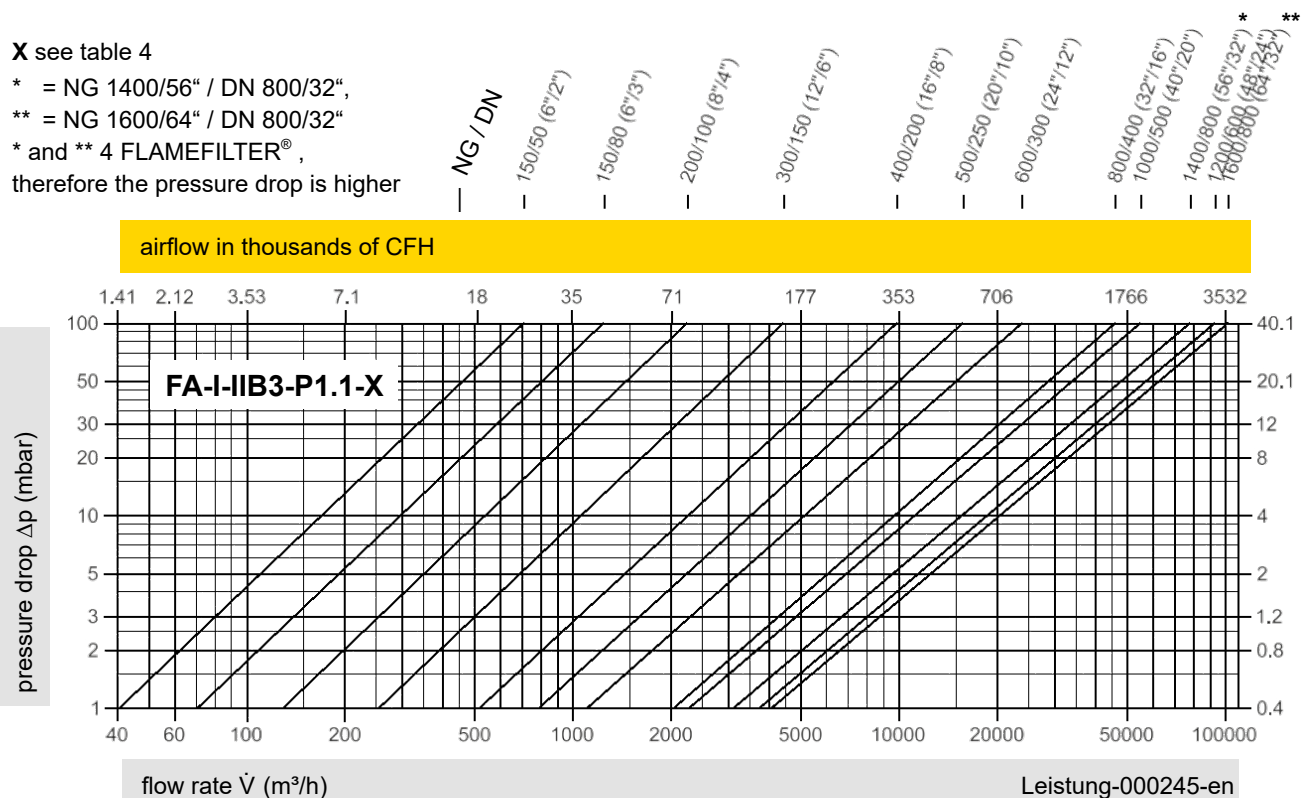


X see table 4

* = NG 1400/56" / DN 800/32",

** = NG 1600/64" / DN 800/32"

* and ** 4 FLAMEFILTER®,
 therefore the pressure drop is higher



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

Volume flow \dot{V} in (m³/h) and CFH refer to the standard reference conditions of air in ISO 6358 (20°C, 1bar).

For conversion to other densities and temperatures, refer to Sec. 1: "Technical Fundamentals."



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