

# PROTEGO® Deflagration Flame Arresters



Volume 3

## Volume 3



for safety and environment

# Deflagration Flame Arrester

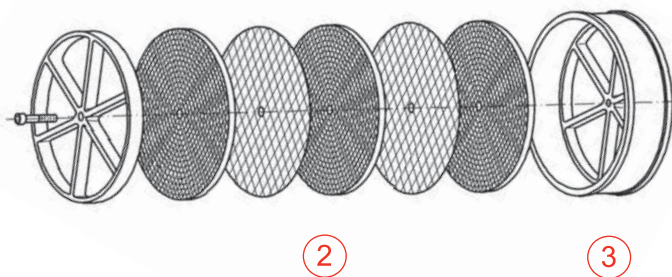
## Function and description

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

With the goal of protecting process units PROTEGO® deflagration flame arresters are state-of-the-art safety devices that are used in systems handling explosive mixtures to mitigate 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 cases where a stable flame can continue on the flame arrester element, in-line deflagration flame arresters only provide protection for a limited time. If this time can be exceeded, an additional measure has to be provided 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® cage (3). The number of FLAMEFILTER® discs and their gap size depend on the devices intended use and depend on process parameters such as temperature, pressure, vapour group of the handled gases.

① PROTEGO® flame arrester unit



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 time period, 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.

A broad variety of types, designs, nominal diameters and materials are available. In addition, we are able to develop customized solutions for our clients at our state-of-the-art test facility, which is the largest privately owned research center in flame arrester business worldwide.

## 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 vapour. Special operating conditions (e.g. **elevated operating pressures or temperatures**) that go beyond classified values of different test standards 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 a "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 bidirectional** protection can be provided as well as versions for **critical fluids (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 systems; loading systems; gas collection systems; exhaust combustion systems; flare systems; landfills and biogas systems and sewage treatment plants.

## 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 taken into account for designs with temperature sensors. No pipes with a nominal diameter greater than the nominal diameter of the device shall 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 planned to be very accessible; a hoist must be provided if the flame arrester is heavy. Servicing is easy for trained personnel.

PROTEGO® deflagration flame arresters are used in areas subject to explosion hazards. Devices have to be selected that match the intended use. The manufacturer's certificate of conformity provides the boundary conditions for which the device is suitable. The user has to document proper use in accordance with applicable safety guidelines or standards.

## 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**)

Finally, the following criteria are reviewed and considered

- **Nominal diameter** and type of connection
- **Approvals** according to ATEX, FM, Gost-R, GL, etc..
- **Concentric or eccentric design** or designed with an easy access cover
- **Heating jacket or heating coil**
- **Critical fluids**
- **Unidirectional or bidirectional** protection

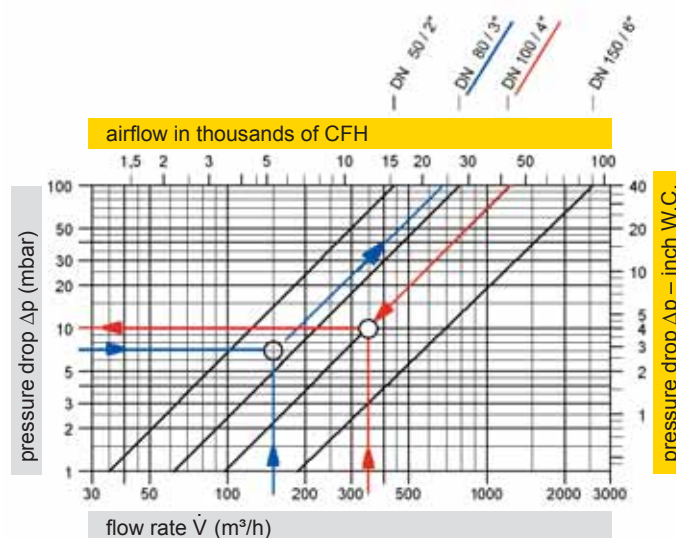
Based on this initial selection, the additional details such as materials, coatings, etc. can be requested or specified.

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

## 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 has a tendency to clog the flame arrester element.

- Given:** Volume flow  $\dot{V}$   $\text{m}^3/\text{h}$  or CFH
- Given:** Max. all. pressure drop  $\Delta p$  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  $\dot{V}$   $\text{m}^3/\text{h}$  or CFH
- Given:** Nominal diameter of pipe DN
- Desired:** Pressure drop  $\Delta p$  mbar or inch W.C.
- Procedure:** Intersection of the lines with the volume flow and nominal diameter curve of the device, horizontal straight line leads to the desired flow resistance



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

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






For special cases, please fill out the questionnaire with the process data in Vol. 1, that will serve as information for providing a quote.



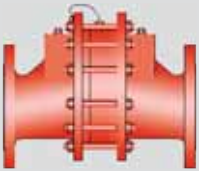
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## Selection Guide

### PROTEGO® Deflagration Flame Arrester

	Type	Size DN	Design cc = concentric ec = eccentric	Explosion- group		Approvals	Special designs for higher temperatures and pressures ○ =	for critical medium (polymerisation, corrosion, crystallisation) ○ =	unidirectional bidirectional ○ = X =	Page
				ATEX	NEC					
In-line deflagration flame arrester										
	FA-E	25 - 300 1" - 12"	straight through, ec	IIA, IIB3, IIC	D, C, B	ATEX	○	○	X	90 - 95
	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

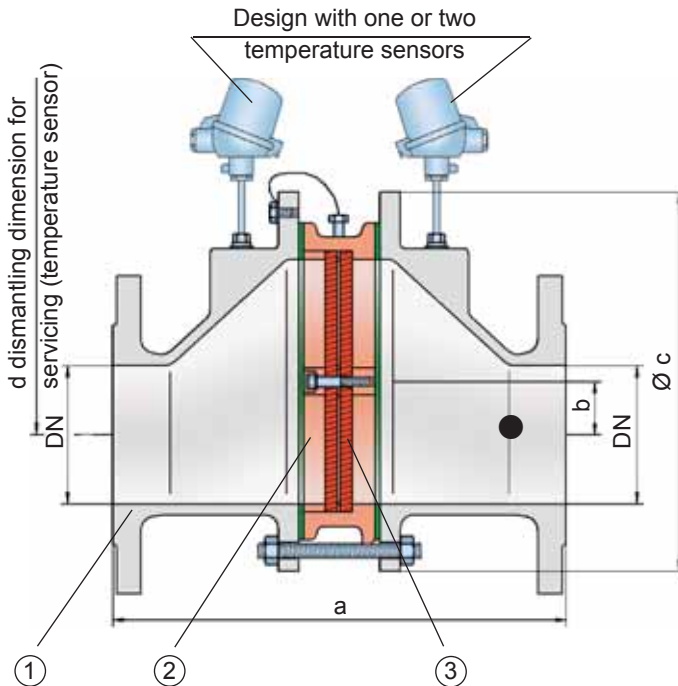




## In-Line Deflagration Flame Arrester

eccentric design,  
bidirectional

PROTEGO® FA-E



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

### Function and Description

The PROTEGO® FA-E series of in-line deflagration flame arresters is designed with an eccentric housing to automatically drain condensate build up in the housing. Due to its eccentric design the device can be installed in pipelines that run close to floors or walls and low points, where condensate can collect within the piping system, can be avoided. 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 bidirectional 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® cage. The number of FLAMEFILTER® and their gap size depends arrester's conditions of use.

By indicating the operating parameters such as temperature, pressure, explosion group and the composition of the fluid, the optimum deflagration flame arrester can be selected from a series of approved devices. 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 up to an operating temperature of +60°C / 140°F and an absolute operating pressure up to 1.1 bar / 15.9 psi. Devices with special approval can be obtained for higher pressures (see table 3) and higher temperatures upon request.

Type-approved according to ATEX Directive 94/9/EC and EN ISO 16852 as well as other international standards.

### 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
- bidirectional 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 - [ ]**

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

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

Additional special devices available upon request

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

**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 <sub>max</sub>	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 <sub>max</sub>	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 <sub>max</sub>	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<sub>max</sub> = maximum allowable operating pressure in bar / psi absolute, higher operating pressure upon request

**Table 4: Specification of max. operating temperature**

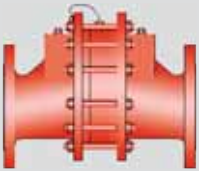
≤ 60°C / 140°F	higher operating temperatures upon request
T60	T <sub>maximum allowable operating temperature in °C</sub>

**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	



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## In-Line Deflagration Flame Arrester

eccentric design,  
bidirectional

**PROTEGO® FA-E**

**Table 6: Material combinations of the flame arrester unit**

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

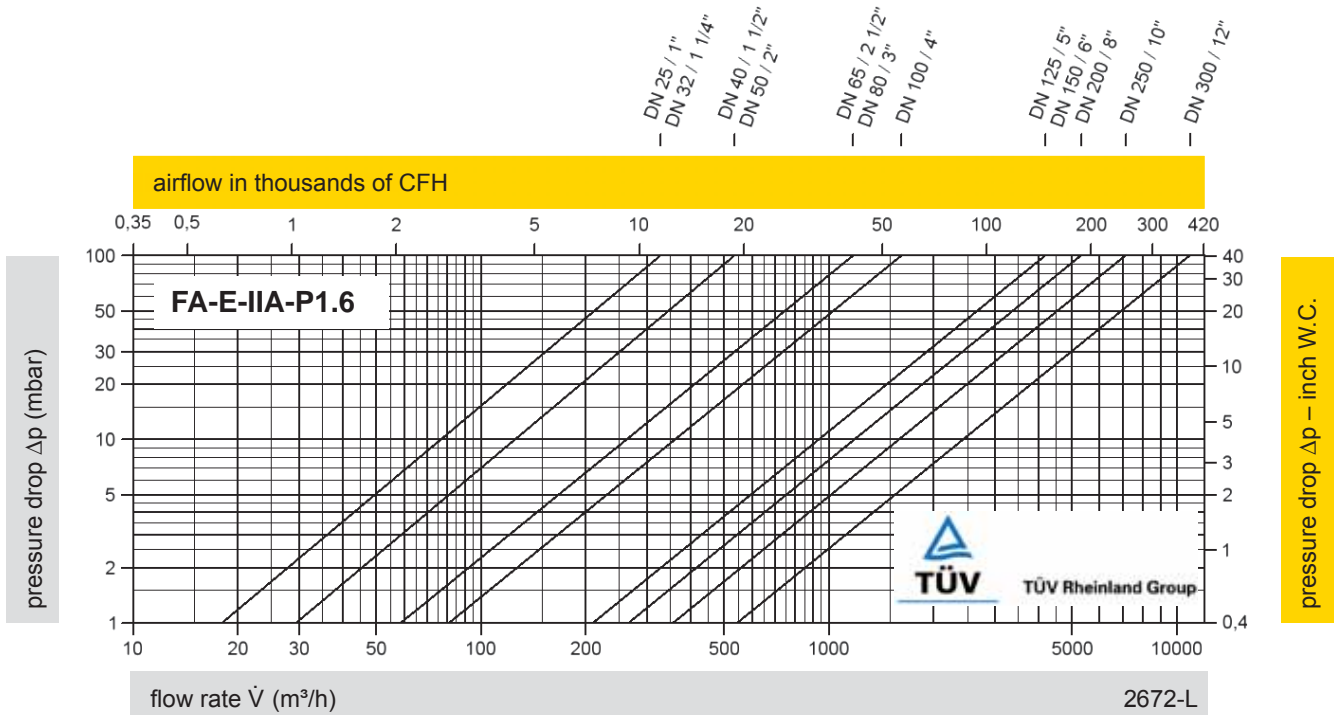
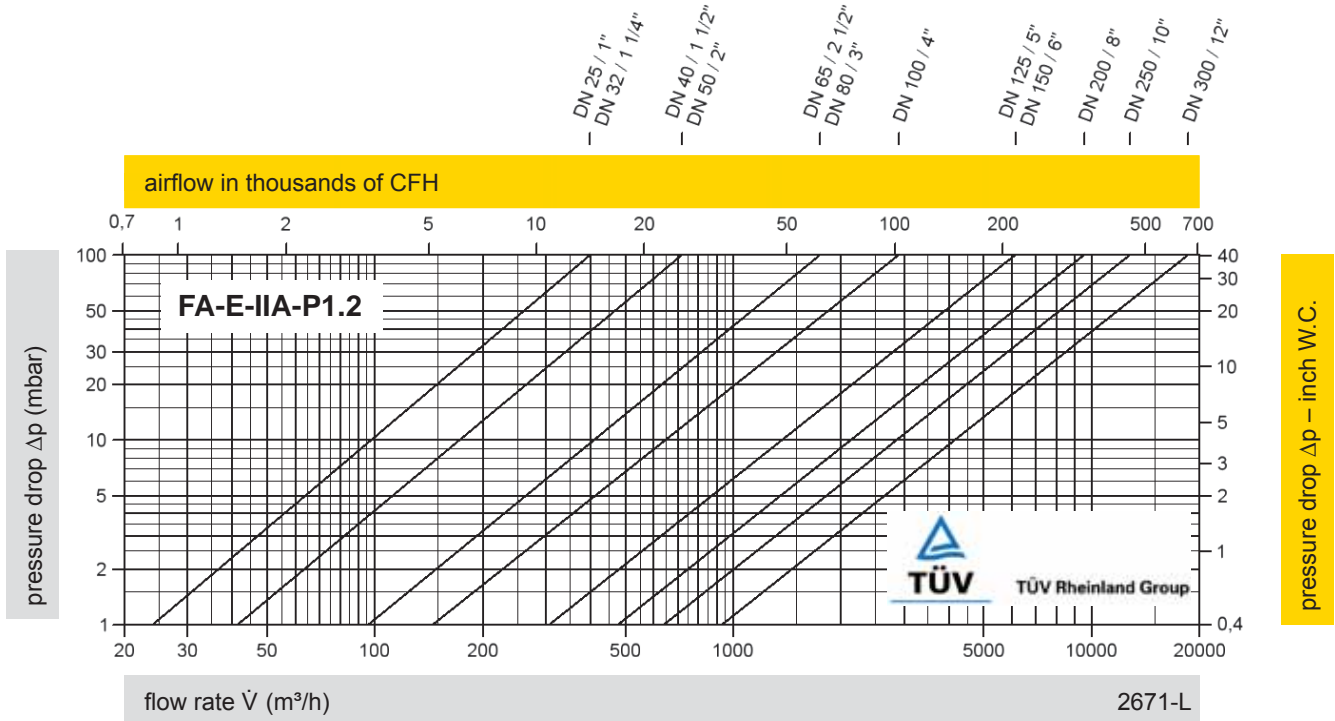
\*the FLAMEFILTER® is also available in the materials Tantalum, Inconel, Copper, etc. when the listed housing and cage materials are used.  
Special materials upon request.

**Table 7: Flange connection type**

EN 1092-1, Form B1 or DIN 2501, Form C, PN 16; from DN 200 PN 10	EN or DIN
ANSI 150 lbs RFSF	ANSI

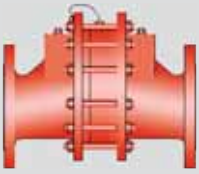
other types upon request





The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig. Volume flow  $\dot{V}$  in (m<sup>3</sup>/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar). Conversion to other densities and temperatures refer to Vol. 1: "Technical Fundamentals".

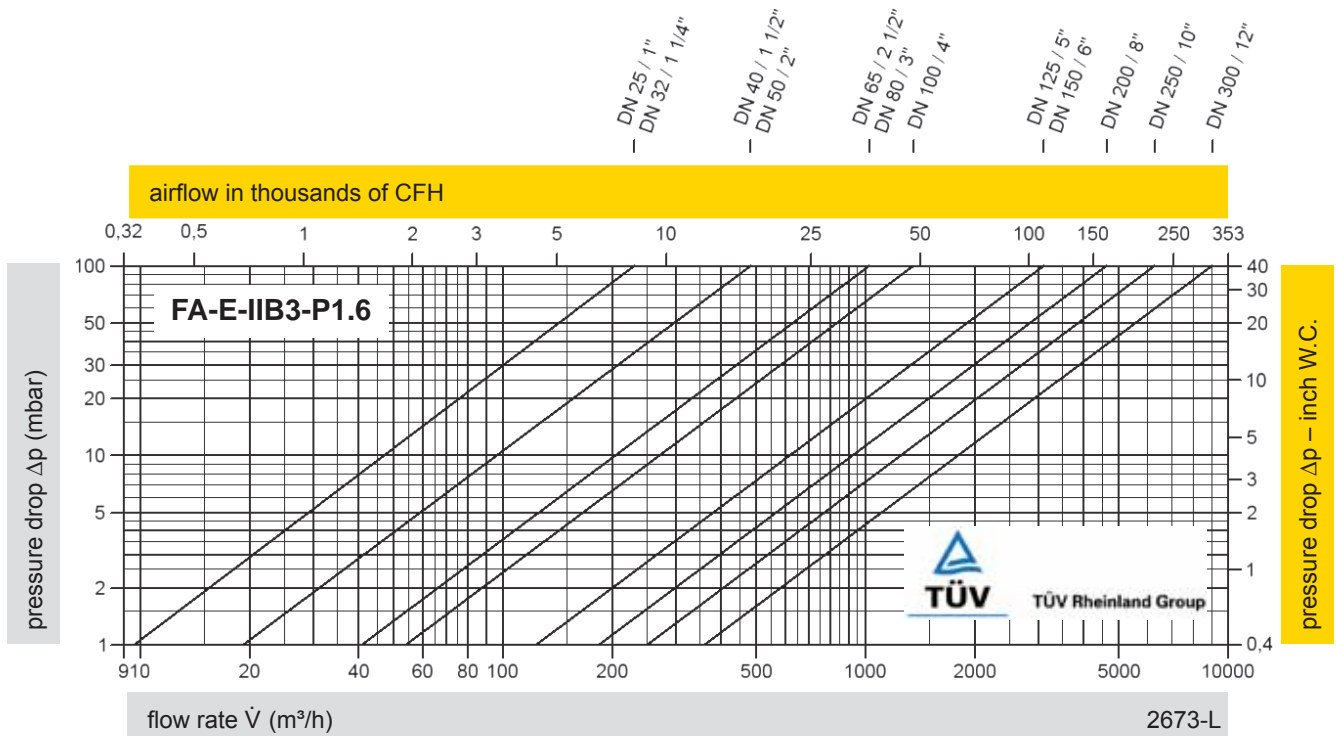
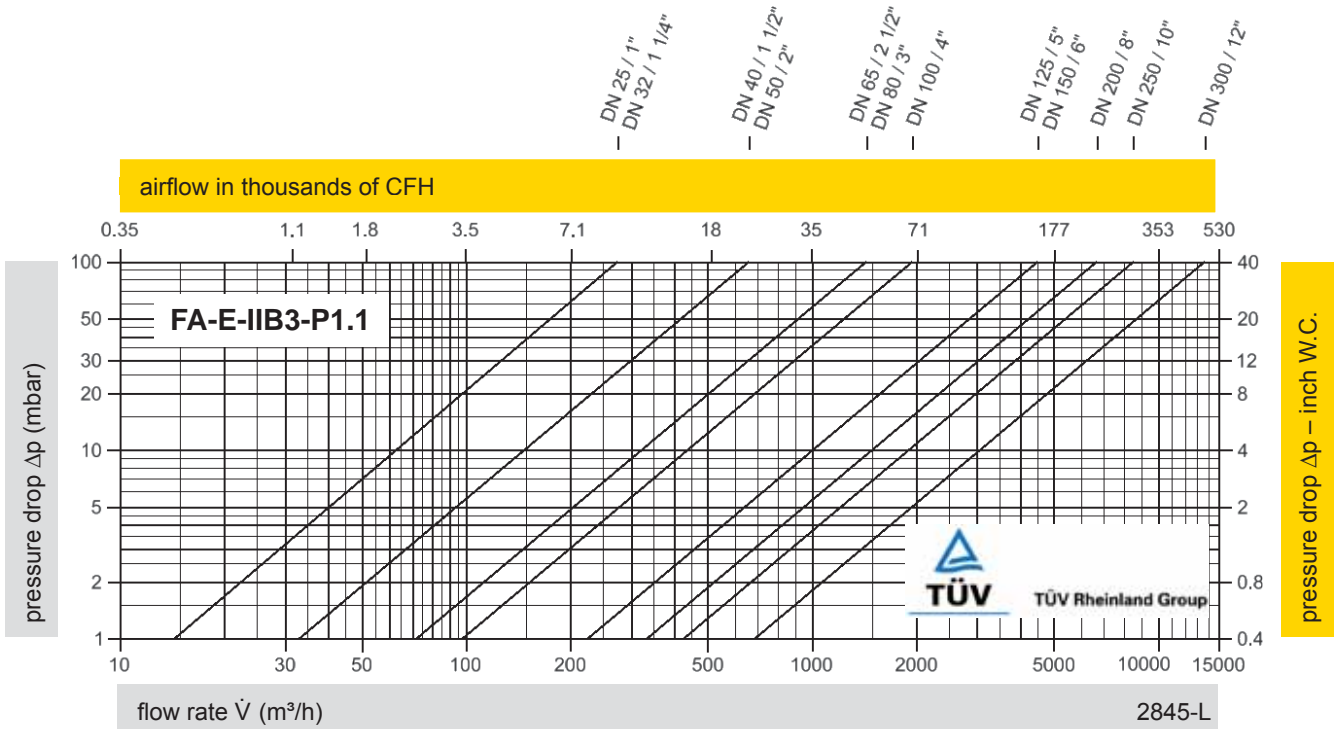




# In-Line Deflagration Flame Arrester

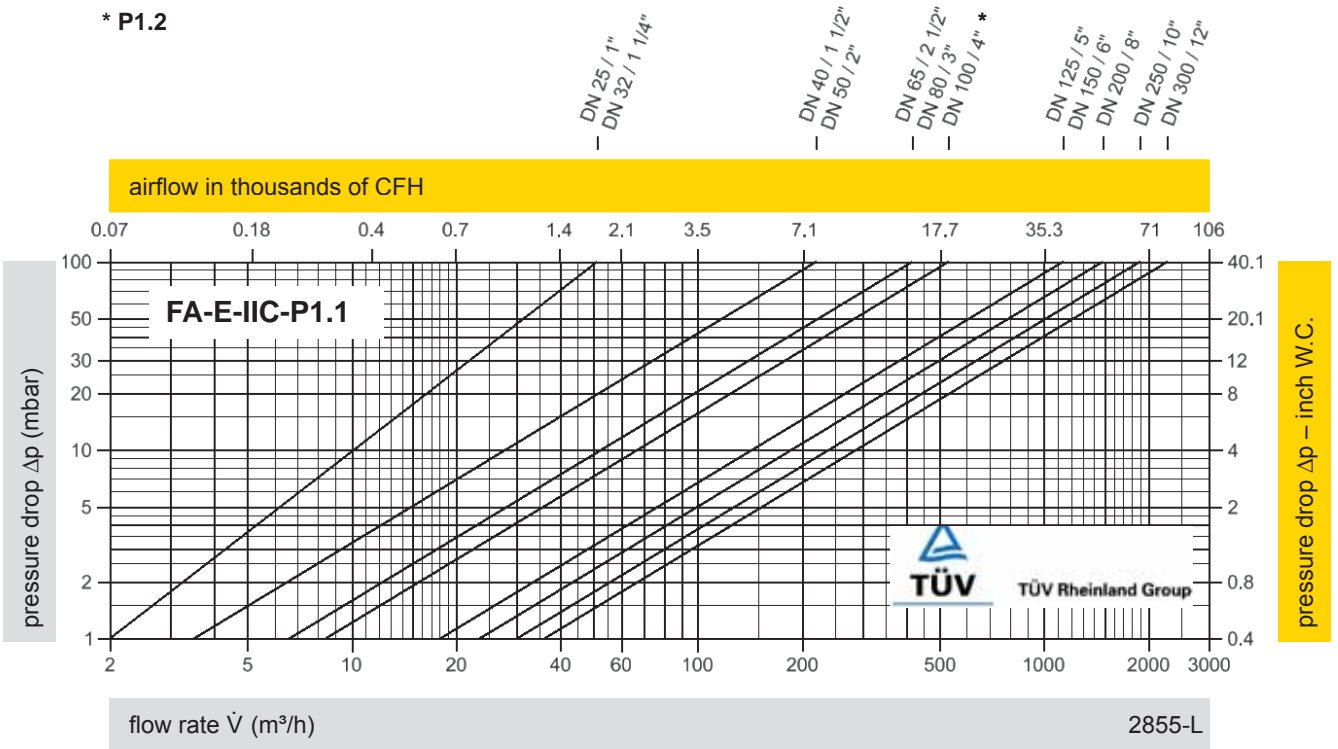
## Flow Capacity Charts

PROTEGO® FA-E



The flow capacity charts have been determined with a calibrated and TÜV certified flow capacity test rig. Volume flow  $\dot{V}$  in (m<sup>3</sup>/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar). Conversion to other densities and temperatures refer to Vol. 1: "Technical Fundamentals".

\* P1.2

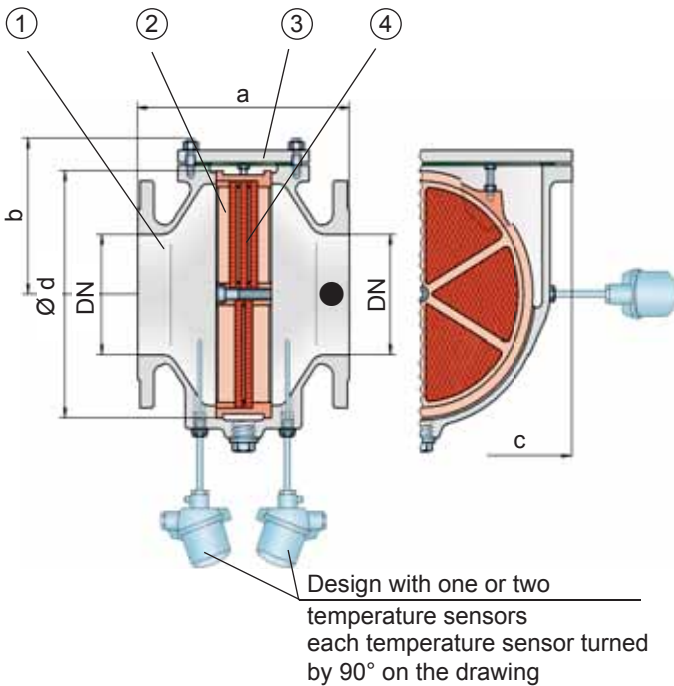




## In-Line Deflagration Flame Arrester

concentric design,  
bidirectional

PROTEGO® FA-CN-IIA and IIB3



- 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 maintainability. The PROTEGO® flame arrester unit can be removed and cleaned within moments 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)<sub>max</sub> ratio of 50.

The deflagration flame arrester is symmetrical and offers bidirectional flame transmission protection. The device consists of a 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® cage. The number of FLAMEFILTER® discs and their gap size depend on the devices intended use.

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

Type-approved according to ATEX Directive 94/9/EC and EN ISO 16852 as well as other international standards.

### 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
- bidirectional 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)

**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 <sub>max</sub>	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 <sub>max</sub>	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<sub>max</sub> = 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	higher operating temperatures upon request
T60	T <sub>maximum allowable operating temperature in °C</sub>

**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 or DIN 2501, Form C, PN 16; from DN 200 PN 10	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	



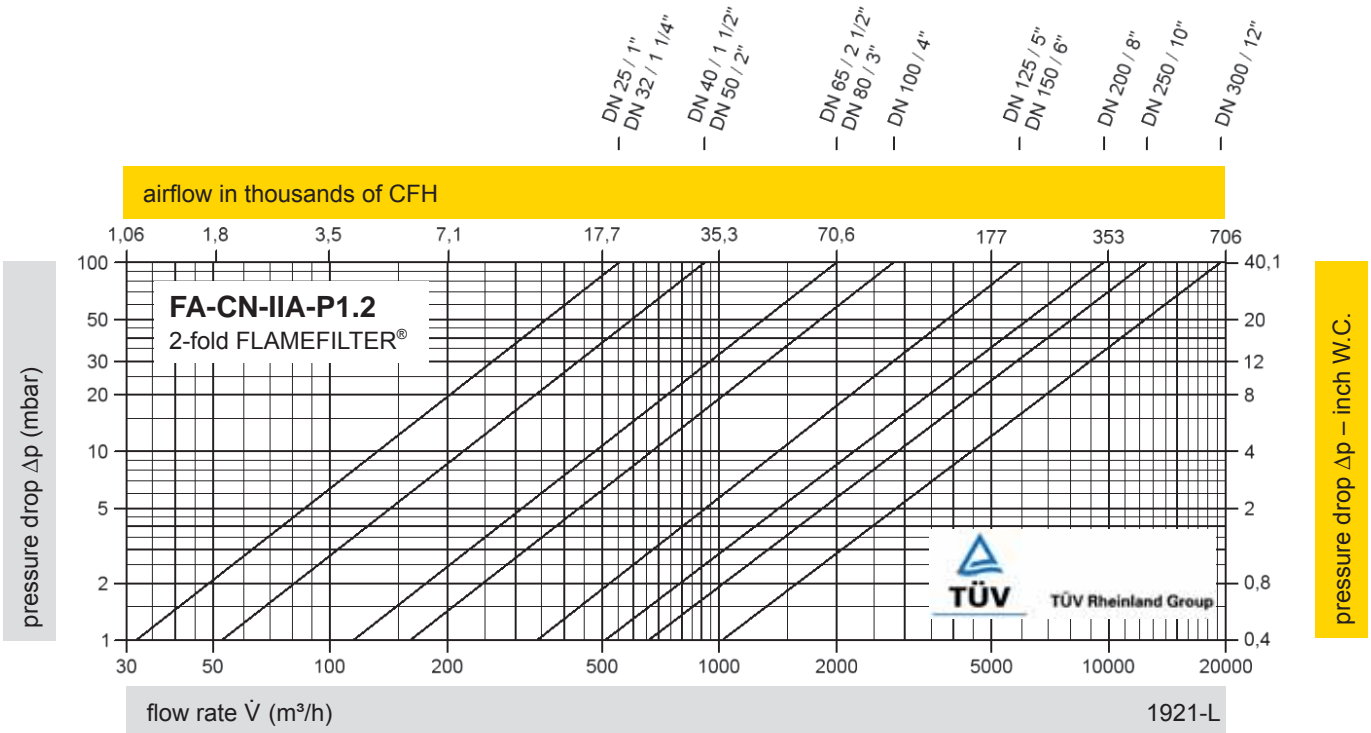
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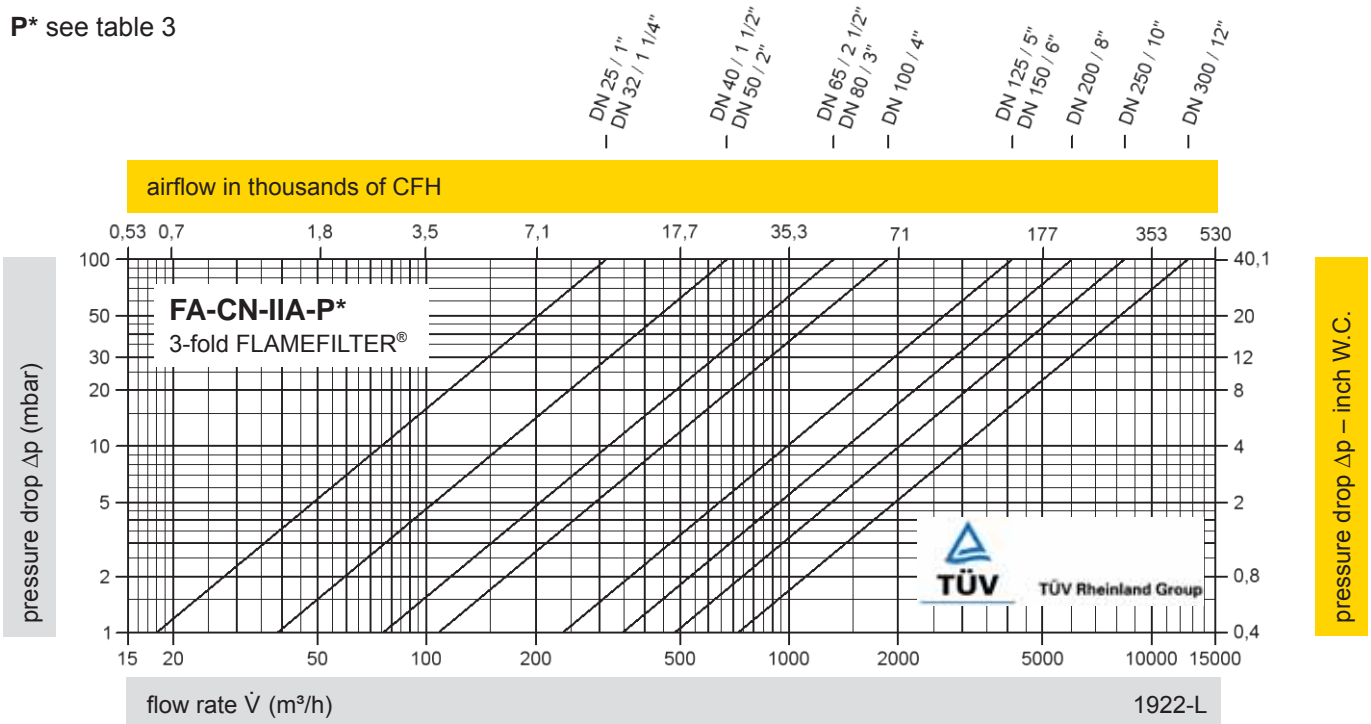
# In-Line Deflagration Flame Arrester

## Flow Capacity Charts

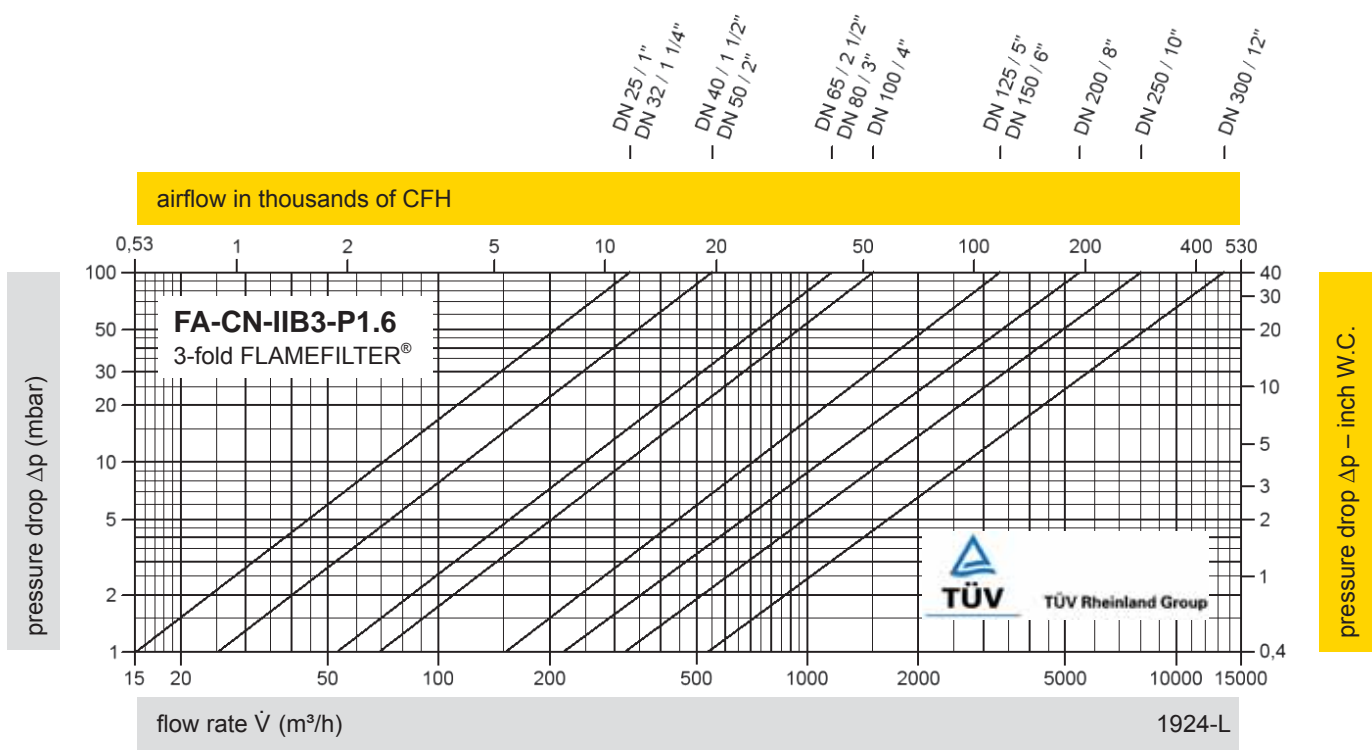
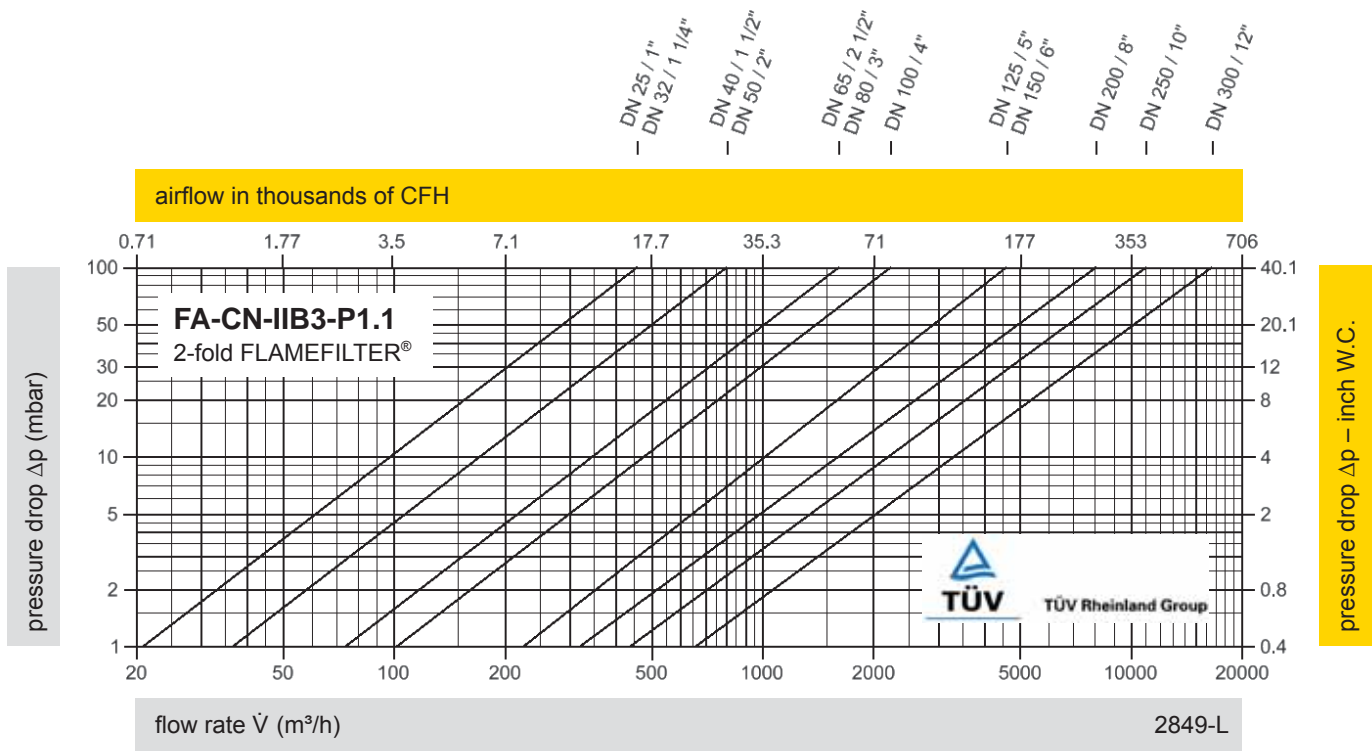
### PROTEGO® FA-CN-IIA and IIB3



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 (m<sup>3</sup>/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar). Conversion to other densities and temperatures refer to Vol. 1: "Technical Fundamentals".

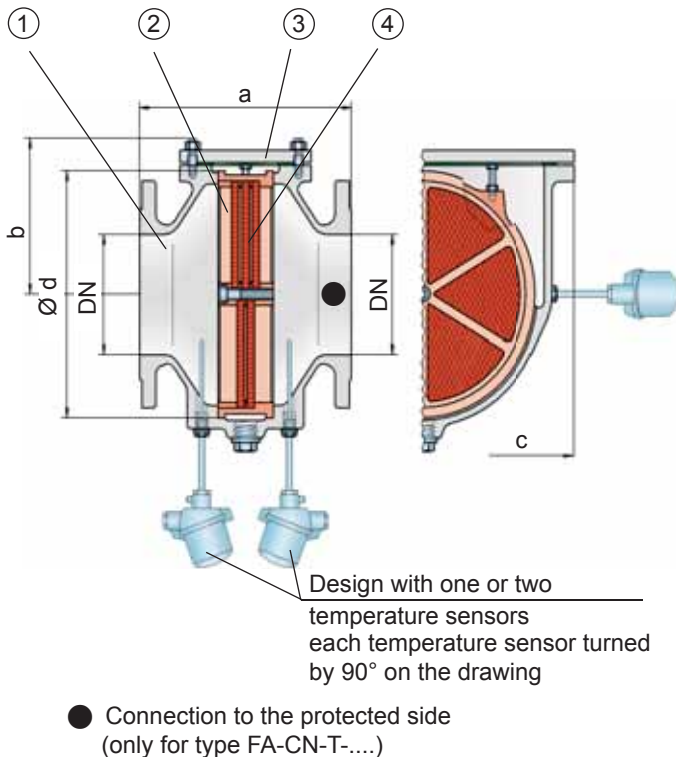




## In-Line Deflagration Flame Arrester

for hydrogen/air-mixtures, concentric design,  
bidirectional

**PROTEGO® FA-CN-IIC**



### Function and Description

The PROTEGO® FA-CN in-line deflagration flame arrester is a compact design utilizing an easy access cover for easy maintainability. The special PROTEGO® FA-CN-IIC version was developed for hydrogen applications (group IIC vapours – NEC group B). The device is designed to have comparatively large gaps, in relation to other flame arresters for the same explosion group. This allows to apply it to processes having small fluid droplets or particles. The PROTEGO® flame arrester unit can be removed and cleaned within moments 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 approved (see table 4).

The deflagration flame arrester is symmetrical and offers bidirectional flame transmission protection. The device consists of a 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® cage. The number of FLAMEFILTER® discs and their gap size depend on the devices intended use.

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

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

Type-approved according to ATEX Directive 94/9/EC and EN ISO 16852 as well as other international standards.

### 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
- bidirectional 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 -

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

FA-CN -

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

FA-CN -

Additional special devices available upon request

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



**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 <sub>max</sub>	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<sub>max</sub> = 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 or DIN 2501, Form C, PN 16; from DN 200 PN 10	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	



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# In-Line Deflagration Flame Arrester

## Flow Capacity Chart

### PROTEGO® FA-CN-IIC

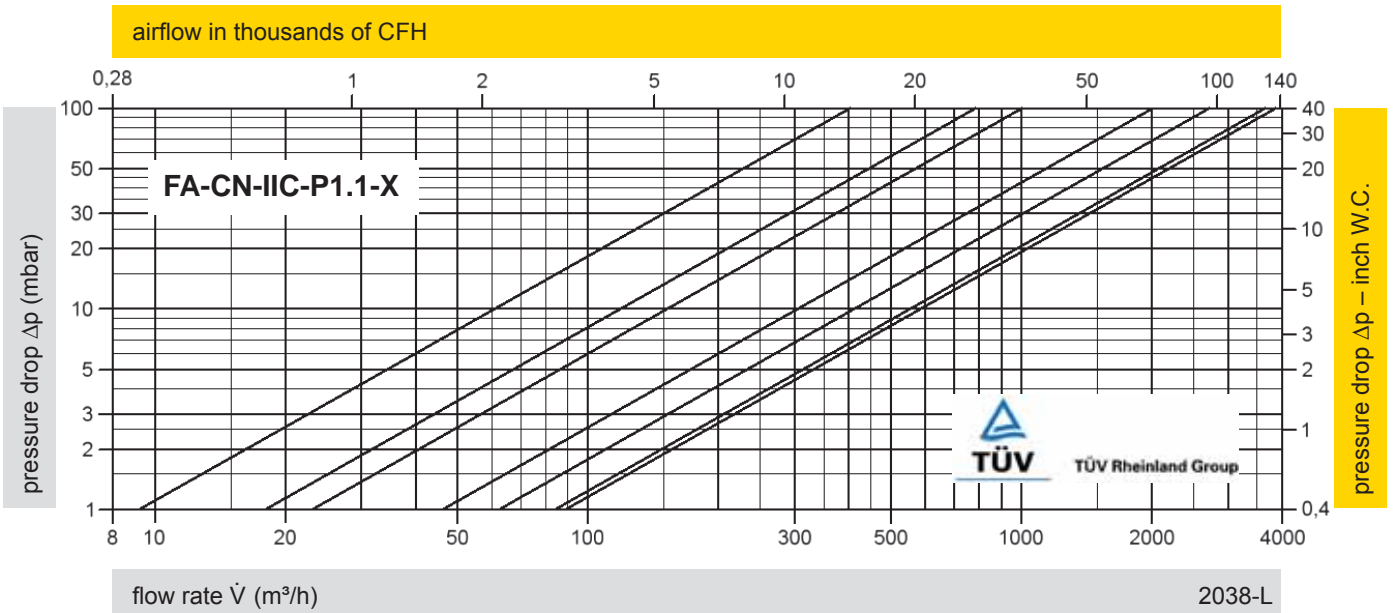
X see table 4

DN 40 / 1 1/2"  
DN 50 / 2"

DN 65 / 2 1/2"  
DN 80 / 3"  
DN 100 / 4"

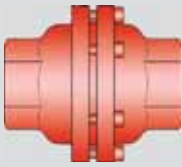
DN 125 / 5"  
DN 150 / 6"  
DN 200 / 8"

DN 250 / 10"  
DN 300 / 12"



The flow capacity chart has 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 ISO 6358 (20°C, 1bar). Conversion to other densities and temperatures refer to Vol. 1: "Technical Fundamentals".



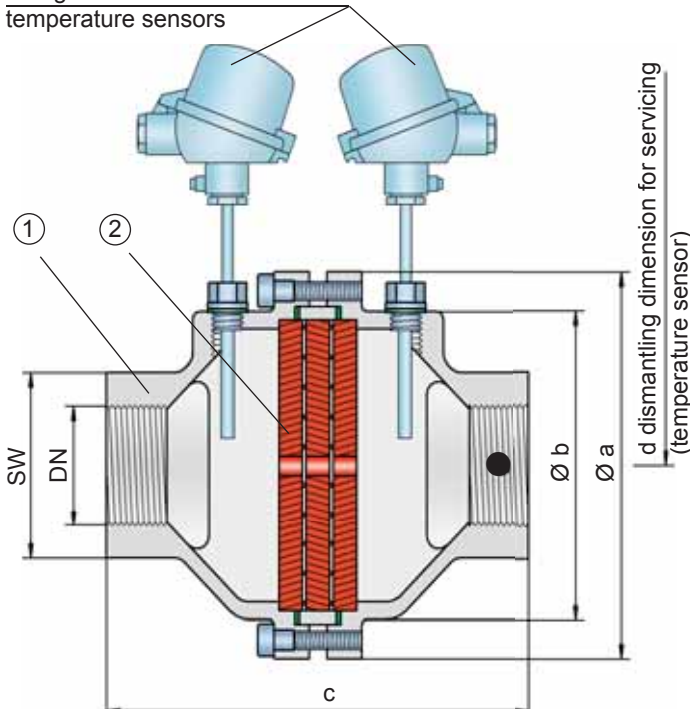


## In-Line Deflagration Flame Arrester

concentric design,  
bidirectional

PROTEGO® FA-G

Design with one or two  
temperature sensors



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

terminated by the operating data and parameters of the mixture flowing in the line (explosion group, pressure, temperature). The PROTEGO® FA-G series in-line deflagration flame arrester is available for explosion groups IIA, IIB3 and IIC (NEC groups D, C (MESG  $\geq 0.65$  mm) and B).

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

Type-approved according to ATEX Directive 94/9/EC and EN ISO 16852 as well as other international standards.

### 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
- bidirectional flame transmission proof design
- protects against deflagrations for all explosion groups
- use of temperature sensors for G 1½" and 2" is possible
- cost efficient spare parts

### 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 in to 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  $(L/D)_{max} \leq 50$  for deflagration flame arresters of explosion groups IIA and IIB3 (NEC groups D and C (MESG  $\geq 0.65$  mm)) and to  $(L/D)_{max} \leq 30$  for explosion group IIC (NEC group B).

The in-line deflagration flame arrester is symmetrical and offers bidirectional 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 are de-

### Design and Specifications

There are three different designs:

Basic in-line deflagration flame arrester  
(G ½" to 2")

FA-G-

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

FA-G-

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

FA-G-

\*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), 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**

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

**Table 4: Specification of max. operating temperature**

≤ 60°C / 140°F	higher operating temperatures upon request
T60	Tmaximum allowable operating temperature in °C

**Table 5: Material selection**

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

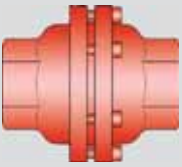
Special materials upon request.

**Table 6: Type of connection**

Pipe thread DIN ISO 228-1	DIN	other types of thread upon request
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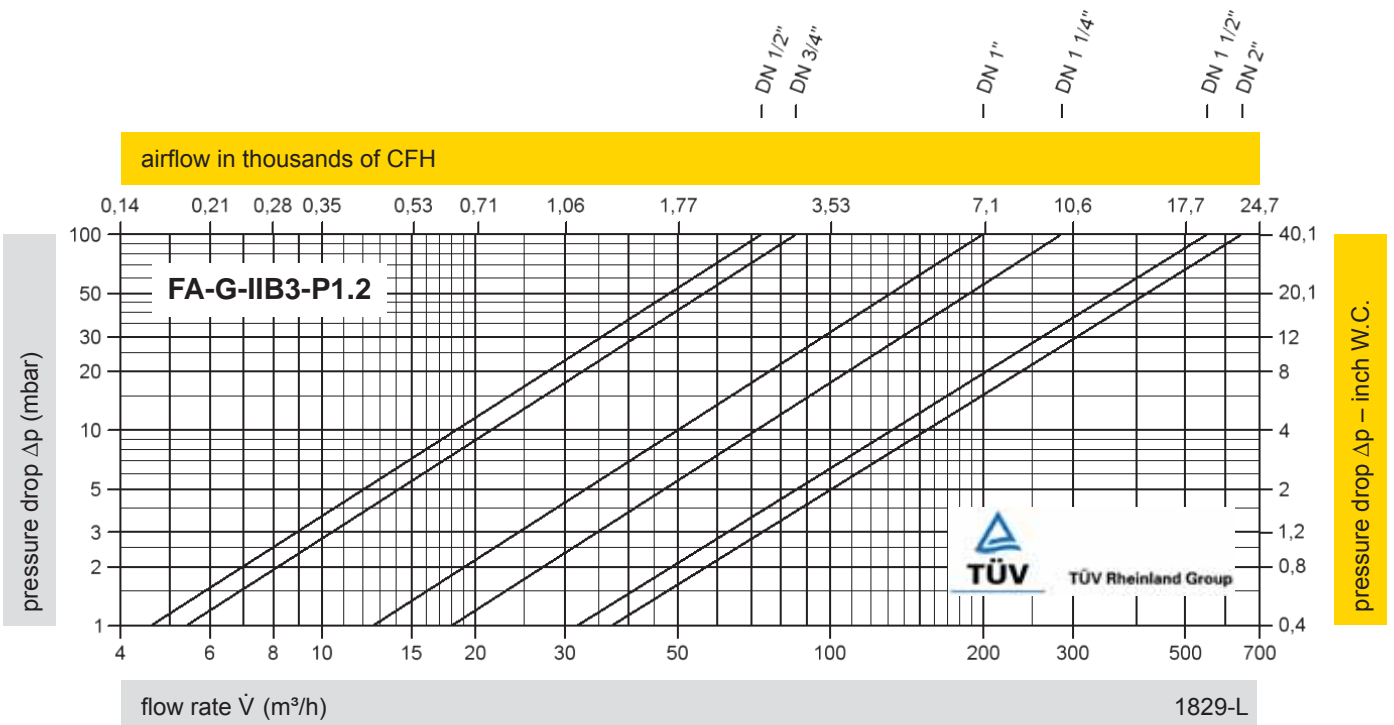
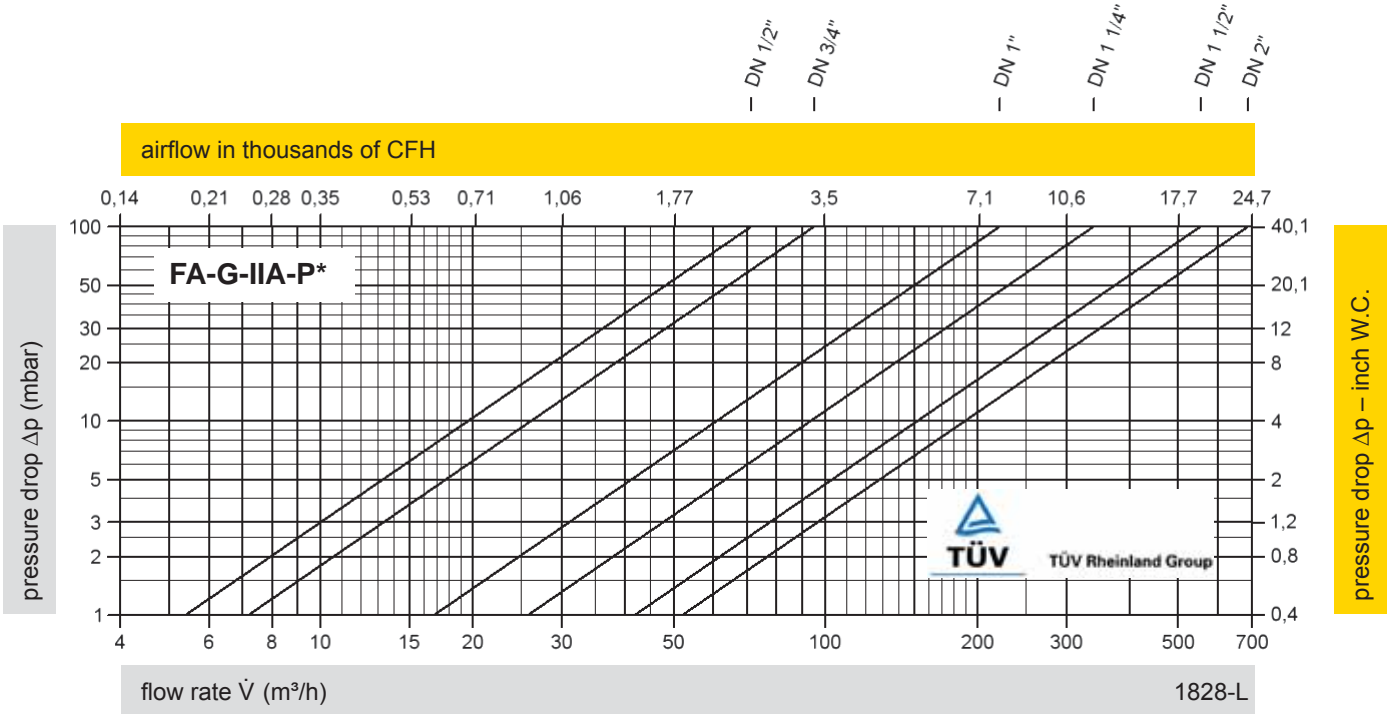


# In-Line Deflagration Flame Arrester

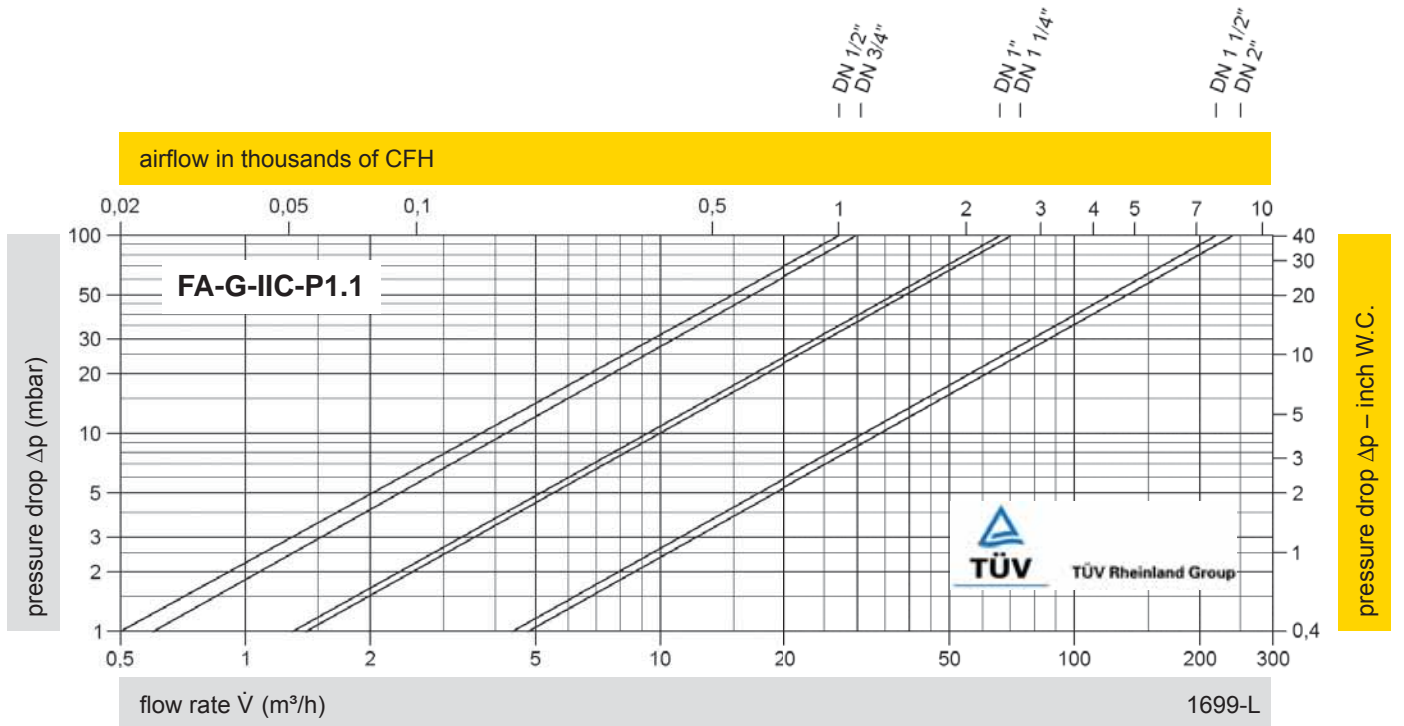
## Flow Capacity Charts

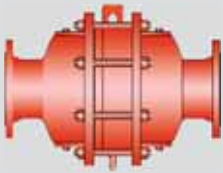
### PROTEGO® FA-G-IIA, IIB3 and IIC

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 (m<sup>3</sup>/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar). Conversion to other densities and temperatures refer to Vol. 1: "Technical Fundamentals".

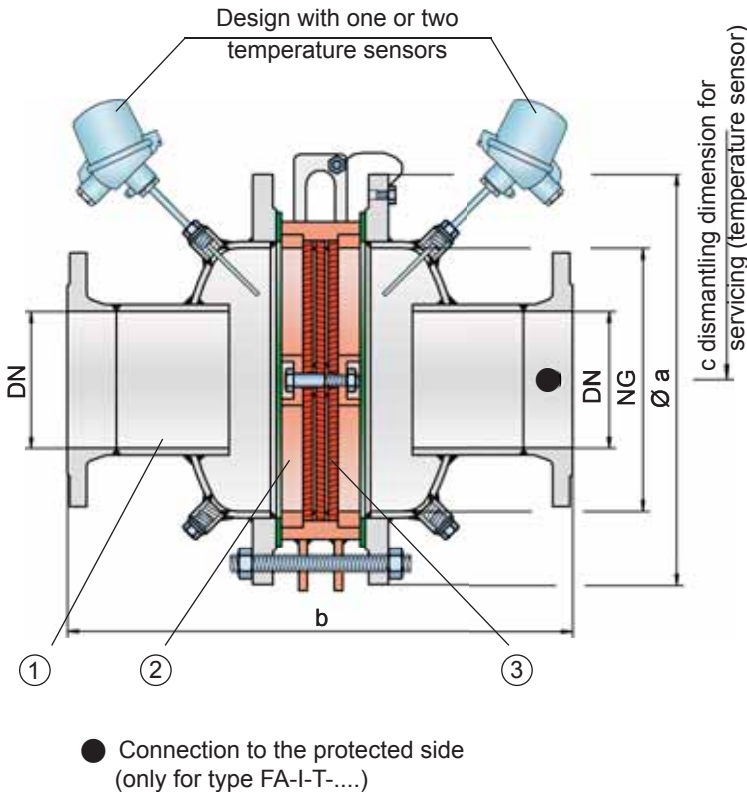




## In-Line Deflagration Flame Arrester

concentric design,  
bidirectional

PROTEGO® FA-I



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

Type-approved according to ATEX Directive 94/9/EC and EN ISO 16852 as well as other international standards.

### 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
- bidirectional 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

### 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 from series 1, 2 and 3 (see table 1) for the most adequate flow capacity. 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 (see table 4).

The deflagration flame arrester is symmetrical and offers bidirectional 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® cage. The number of FLAMEFILTER® discs and their gap size depends on the arrester's conditions of use.

Providing 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)).

### 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)



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

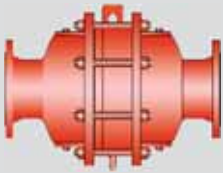
\*Dimension b only for P1.2 (IIA) and P1.1 (IIB3).

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 <sub>max</sub>	1.8 / 26.1	1.8 / 26.1	1.5 / 21.7	1.5 / 21.7	1.5 / 21.7	1.5 / 21.7	1.5 / 21.7	1.4 / 20.3	1.3 / 18.8	1.3 / 18.8	1.2 / 17.4	1.1 / 15.9
	IIB3	P <sub>max</sub>	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.2 / 17.4	1.1 / 15.9	1.1 / 15.9	1.1 / 15.9

P<sub>max</sub> = maximum allowable operating pressure in bar / psi absolut, higher operating pressure upon request





## In-Line Deflagration Flame Arrester

concentric design,  
bidirectional

PROTEGO® FA-I

**Table 4: Table 4: Max. allowable L/D-ratio**

standard													
NG	150 6"	150 6"	200 8"	300 12"	400 16"	500 20"	600 24"	800 32"	1000 40"	1200 48"	1400 56"	1600 64"	
DN	≤ 50 2"	80 3"	≤ 100 4"	≤ 150 6"	≤ 200 8"	≤ 250 10"	≤ 300 12"	≤ 400 16"	≤ 500 20"	≤ 600 24"	≤ 800 32"	≤ 800 32"	
IIA	(L/D) <sub>max</sub>	50	50	50	50	50	50	50	50	50	50	50	
	P <sub>max</sub>	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
	Designation	-	-	-	-	-	-	-	-	-	-	-	-
IIB3	(L/D) <sub>max</sub>	50	50	40	40	35	35	35	30	30	30	25	25
	P <sub>max</sub> (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
	Designation	-	-	X6	X6	X7	X7	X7	X8	X8	X8	X9	X9

**Table 5: Specification of max. operating temperature**

≤ 60°C / 140°F	higher operating temperatures upon request
T60	Tmaximum allowable operating temperature in °C

**Table 6: Material selection for housing**

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

Special materials upon request.

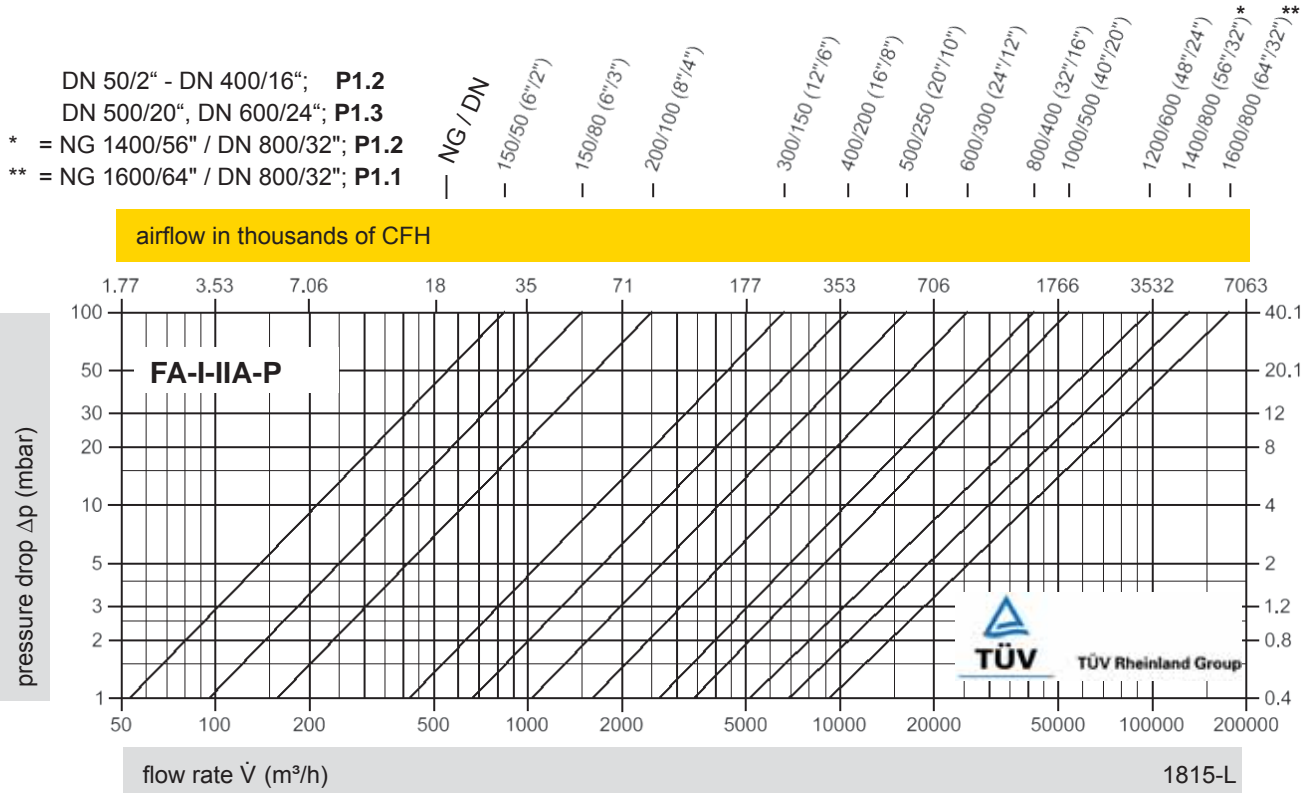
**Table 7: Material combinations of the flame arrester unit**

Design	A	C	D	
FLAMEFILTER® cage	Steel	Stainless Steel	Hastelloy	* the FLAMEFILTER® is also available in the materials Tantalum, Inconel, Copper, etc. when the listed housing and cage materials are used
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 or DIN 2501, Form C, PN 16; from DN 200 PN 10	EN or DIN	other types upon request
ANSI 150 lbs RFSF	ANSI	

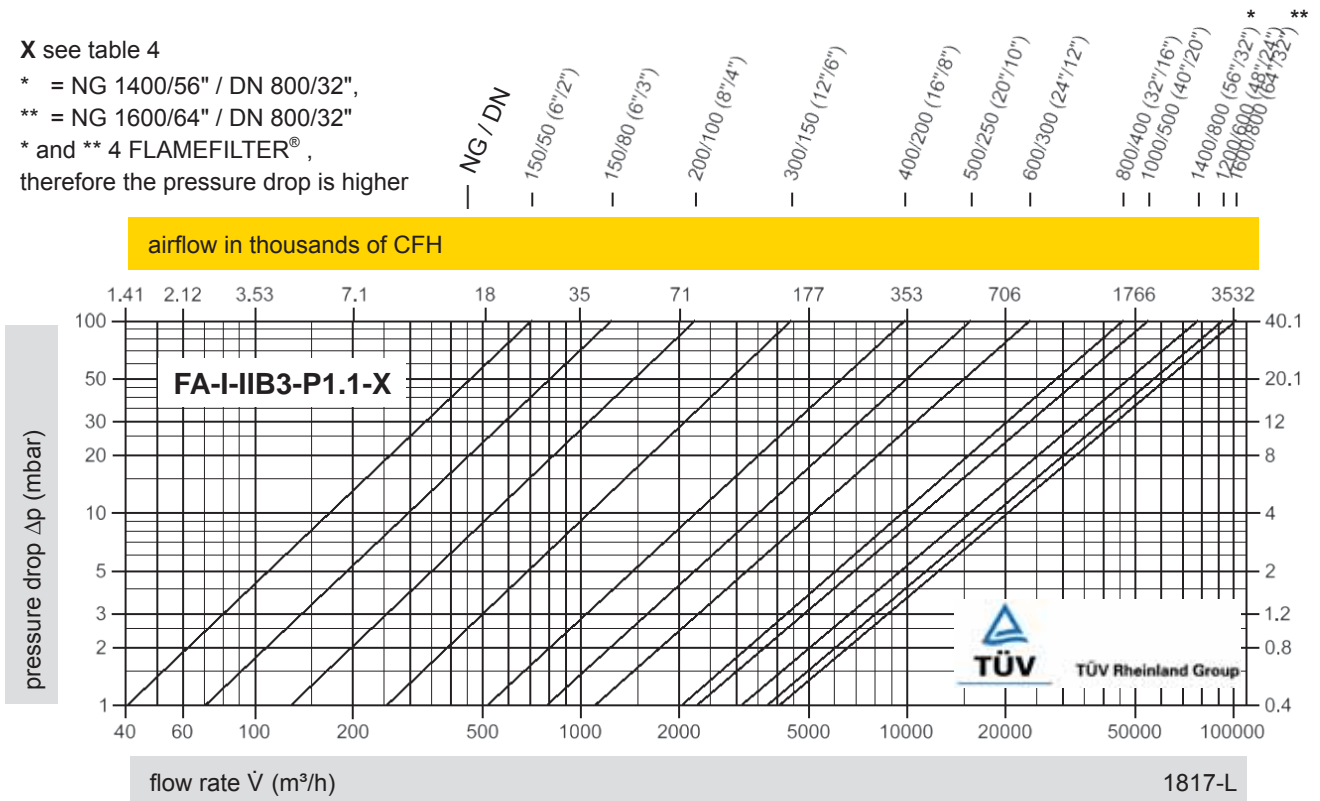


X see table 4

\* = 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 (m<sup>3</sup>/h) and CFH refer to the standard reference conditions of air ISO 6358 (20°C, 1bar).  
 Conversion to other densities and temperatures refer to Vol. 1: "Technical Fundamentals".



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