

PROTEGO® Deflagration Flame Arresters



Volume 3

Volume 3

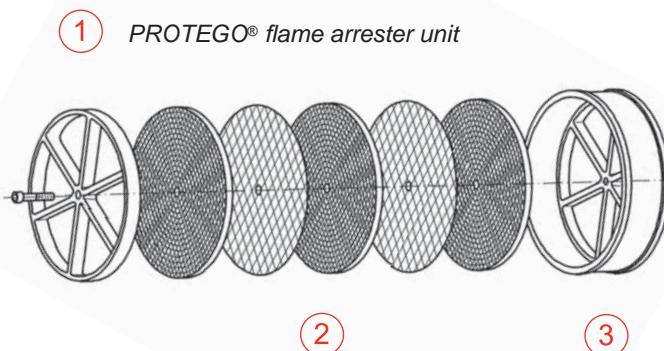
Deflagration Flame Arrester

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.



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 MESG, to select the suitable type of protection from the various designs.

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

The basic **designs** of the housing are **concentric**, **eccentric** and with 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, 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

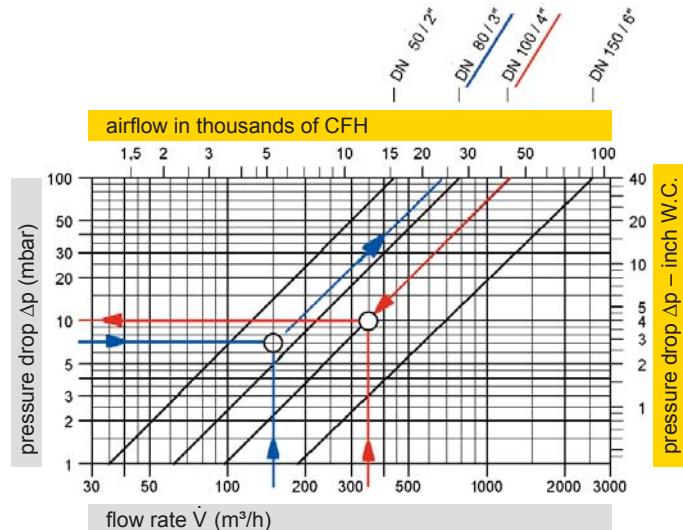
Based on this initial selection, the additional details such as materials, coatings, etc. can be requested or specified.

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/V performance diagram. A safety factor must be considered when the fluid has a tendency 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, 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.

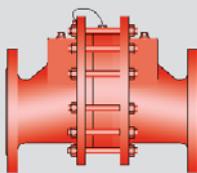


PROTEGO® Deflagration Flame Arrester

Type	Size DN	Design cc = concentric ec = eccentric	Explosion- group	Approvals	Special designs for higher temperatures and pressures	for critical medium (polymerisation, corro- sion, crystallisation)	unidirectional bidirectional	Page	
In-line deflagration flame arrester									
	FA-E	25 - 300 1" - 12"	straight through, ec	IIA1 (I)	-	ATEX	○	○ X	www.protego.com
	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	www.protego.com
	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	www.protego.com

Notes:

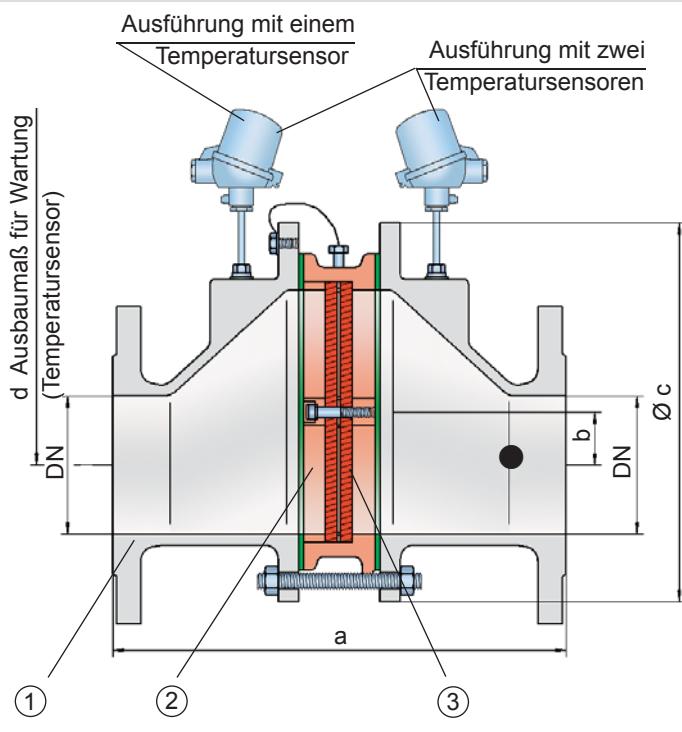




Deflagrationsrohrsicherung

exzentrische Bauform,
beidseitig wirkend

PROTEGO® FA-E



- Anschluss an die zu schützende Zone
(gilt nur für Typ FA-E-T-....)

Funktion und Beschreibung

Die Deflagrationsrohrsicherungen vom Typ PROTEGO® FA-E zeichnen sich durch ihre exzentrische Gehäuseform aus. Bei Kondensatanfall innerhalb der PROTEGO® Flammensicherung ermöglicht diese Bauform ein Abfließen der Flüssigkeit, ohne dass sich größere Mengen im Gehäuse ansammeln können. Die Exzentrizität der Armatur hat bei wandnaher Rohrinstallation durch die geringere Einbautiefe entscheidende Vorteile gegenüber den klassischen konzentrischen Flammendurchschlagsicherungen. Der Abstand zwischen potentieller Zündquelle und dem Einbauort der Deflagrationsrohrsicherung darf einen bestimmten Wert nicht überschreiten. Dieser Wert wird als so genanntes maximales L/D-Verhältnis $(L/D)_{max}$, d.h. Rohrlänge/Rohrdurchmesser beschrieben und ist nach EN ISO 16852 für Deflagrationsrohrsicherungen der Explosionsgruppe IIA bis IIB3 auf $(L/D)_{max} \leq 50$ bzw. für IIC-Sicherungen auf $(L/D)_{max} \leq 30$ begrenzt.

Die Armaturen sind symmetrisch aufgebaut und bieten bidirektionale Flammendurchschlagsicherheit. Im Wesentlichen besteht die Sicherung aus zwei Gehäusehälften (1) und der PROTEGO® Flammensicherung (2) in der Mitte. Mehrere FLAMMENFILTER® (3) und Zwischenlagen, die in einem FLAMMENFILTER® Käfig stabil eingefasst sind, kennzeichnen die PROTEGO® Flammensicherung. In Abhängigkeit von den Einsatzbedingungen der Armatur werden Anzahl und Spaltweite der FLAMMENFILTER® abgestimmt.

Durch Angabe der Betriebsparameter wie Temperatur, Druck und Explosionsgruppe bzw. Zusammensetzung des Mediums kann die optimale Deflagrationsrohrsicherung ausgewählt werden. Flammendurchschlagsicherungen vom Typ PROTEGO® FA-E sind für alle Explosionsgruppen von IIA bis IIC verfügbar.

Die Standardausführung ist bis zu einer Betriebstemperatur von +60°C und einem Betriebsdruck von 1,1 bar absolut einsetzbar. Davon abweichend sind Armaturen mit Sonderzulassungen für höhere Drücke (siehe Tabelle 3) und höhere Temperaturen auf Anfrage erhältlich.

Baumusterprüfung nach derzeit gültiger ATEX-Richtlinie und EN ISO 16852 sowie weiteren internationalen Standards.

Besondere Merkmale und Vorteile

- exzentrische Bauform verhindert die Ansammlung von Kondensat
- vielfältige Einsatzmöglichkeiten
- erweitertes Einsatzgebiet für höhere Betriebstemperaturen und -drücke
- modularer Aufbau ermöglicht Einzelerneuerung der FLAMMENFILTER®
- sehr wartungsfreundlich: Einzelreinigung der FLAMMENFILTER® möglich
- exzentrische Bauform verringert Einbautiefe
- doppelseitige Wirkungsweise sowie beliebige Durchströmungsrichtung und Einbaulage
- bietet Sicherheit bei Deflagrationen für alle Explosionsgruppen
- preiswerte Ersatzteile

Ausführungsarten und Spezifikationen

Es stehen drei Ausführungen zur Auswahl:

Deflagrationsrohrsicherung in der Grundausführung **FA-E -**

Deflagrationsrohrsicherung mit einem integrierten Temperatursensor* für zusätzliche Absicherung gegen kurzzeitiges Brennen von einer Seite **FA-E -**

Deflagrationsrohrsicherung mit zwei integrierten Temperatursensoren* für zusätzliche Absicherung gegen kurzzeitiges Brennen von beiden Seiten **FA-E -**

Weitere Sonderarmaturen auf Anfrage

*Widerstandsthermometer für Gerätekategorie II
Kategorie (1) 2 (GII Kat. (1) 2)

Tabelle 1: Maßtabelle

Abmessungen in mm

Zur Auswahl der Nennweite (DN) benutzen Sie bitte die Volumenstromdiagramme auf den folgenden Seiten

Expl. Gr.	DN	25 / 1"	32 / 1½"	40 / 1½"	50 / 2"	65 / 2½"	80 / 3"	100 / 4"	125 / 5"	150 / 6"	200 / 8"	250 / 10"	300 / 12"
IIA	a	304	304	310	314	360	364	370	434	440	450	480	500
IIB3	a	304	304	310	314	360	364	370	434	440	450	480	500
IIC	a	304	304	321	325	371	375	381	445	451	461	491	511
	b	29	29	29	29	38	38	39	65	65	55	58	60
	c	185	185	210	210	250	250	275	385	385	450	500	575
	d	400	400	410	410	440	440	460	520	520	540	570	600

Tabelle 2: Auswahl der Explosionsgruppe

MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0,90 mm	IIA	D	Sonderabnahmen auf Anfrage
≥ 0,65 mm	IIB3	C	
< 0,50 mm (> 0,50 mm)	IIC (IIB)	B	

Tabelle 3: Auswahl des max. Betriebsdrucks

Expl. Gr.	DN	25 / 1"	32 / 1½"	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	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6
IIB3	P _{max}	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6
IIC	P _{max}	1,1	1,1	1,1	1,1	1,1	1,1	1,2	1,1	1,1	1,1	1,1	1,1

P_{max} = maximaler zulässiger Betriebsdruck in bar absolut, höherer Betriebsdruck auf Anfrage**Tabelle 4: Angabe der max. Betriebstemperatur**

≤ 60°C	Tmaximal zulässige Betriebstemperatur in C°	höhere Betriebstemperaturen auf Anfrage
-	Kennzeichnung	

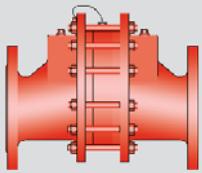
Tabelle 5: Materialauswahl für Gehäuse

Ausführung	B	C	D	
Gehäuse	Stahl	Edelstahl	Hastelloy	
Dichtung	PTFE	PTFE	PTFE	
Flammensicherung	A,C	C	D	

Das Gehäuse kann auch in Werkstoff Stahl mit ECTFE-Beschichtung geliefert werden.

Sonderwerkstoffe auf Anfrage





Deflagrationsrohrsicherung

exzentrische Bauform,
beidseitig wirkend

PROTEGO® FA-E

Tabelle 6: Materialkombinationen der Flammensicherung

Ausführung	A	C	D
FLAMMENFILTER® Käfig	Stahl	Edelstahl	Hastelloy
FLAMMENFILTER® *	Edelstahl	Edelstahl	Hastelloy
Zwischenlagen	Edelstahl	Edelstahl	Hastelloy

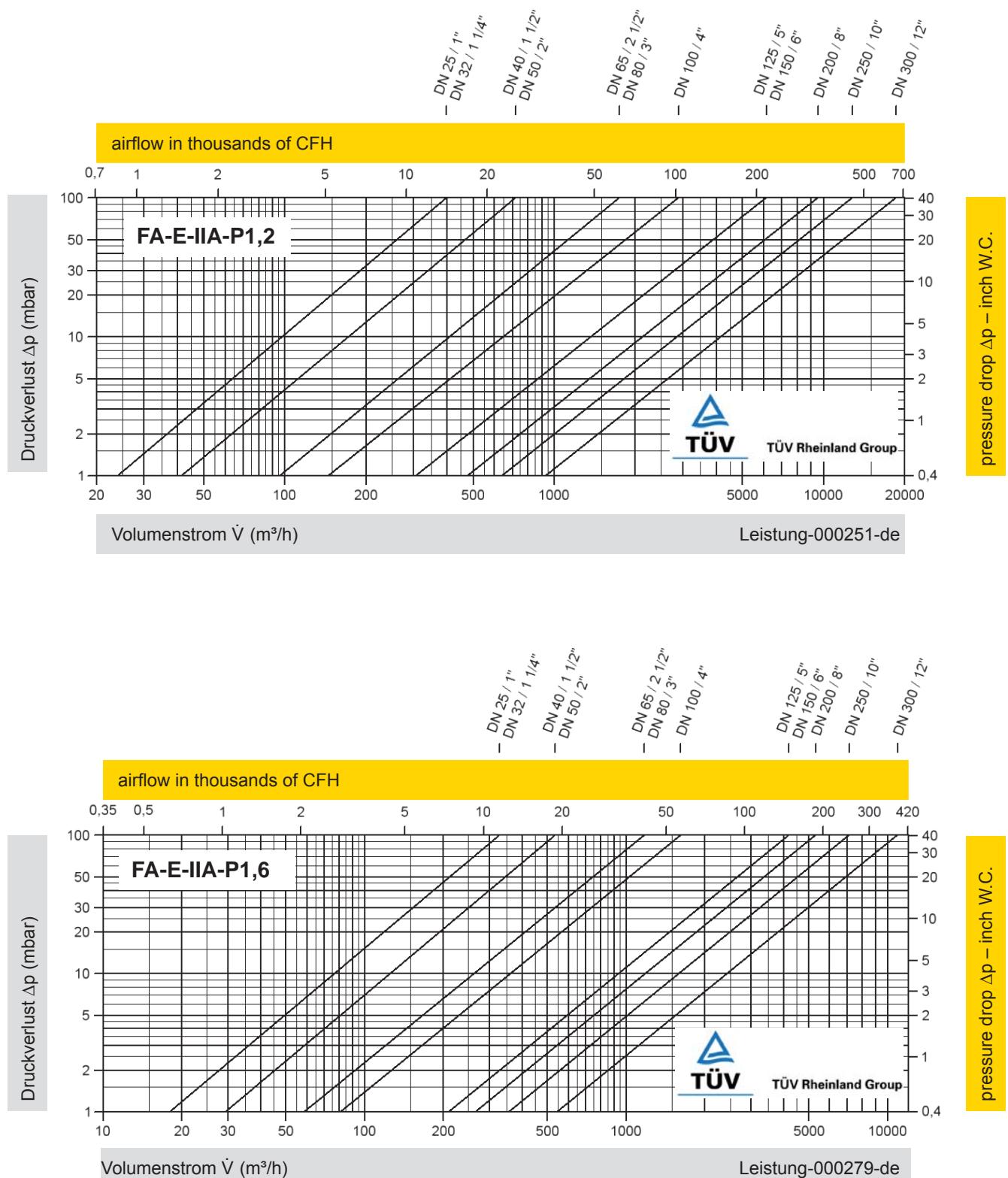
* die FLAMMENFILTER® sind auch in den Werkstoffen Tantal, Inconel, Kupfer usw. bei Verwendung der aufgeführten Gehäuse- bzw. Käfigwerkstoffe lieferbar.
Sonderwerkstoffe auf Anfrage.

Tabelle 7: Flanschanschlussart

EN 1092-1; Form B1

ASME B16.5; 150 lbs RFSF

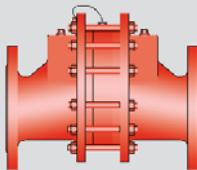
andere Anschlüsse auf Anfrage



Diese Volumenstromdiagramme sind mit einer kalibrierten und TÜV-zertifizierten Strömungsmessanlage ermittelt worden.

Der Volumenstrom \dot{V} in m^3/h bezieht sich auf den technischen Normzustand von Luft nach ISO 6358 (20°C, 1bar). Umrechnung auf andere Dichte und Temperatur siehe Kap. 1: Technische Grundlagen.

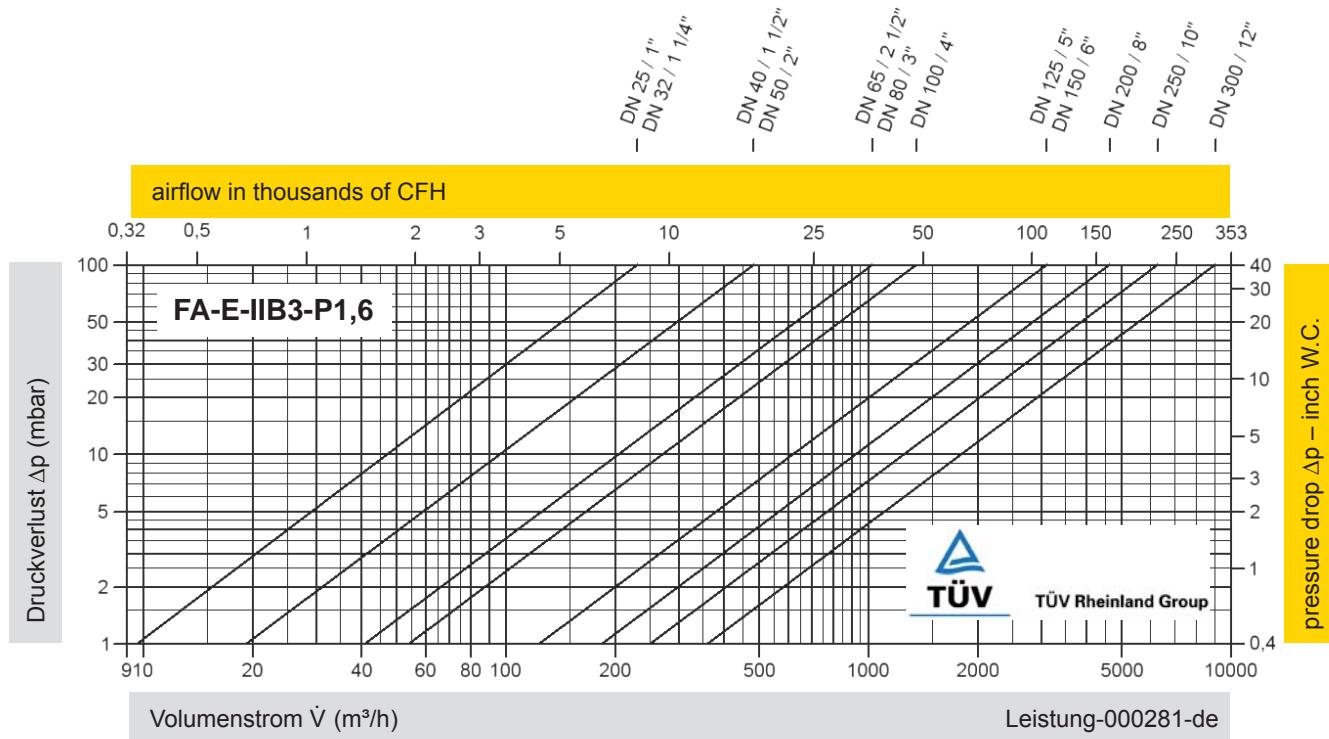
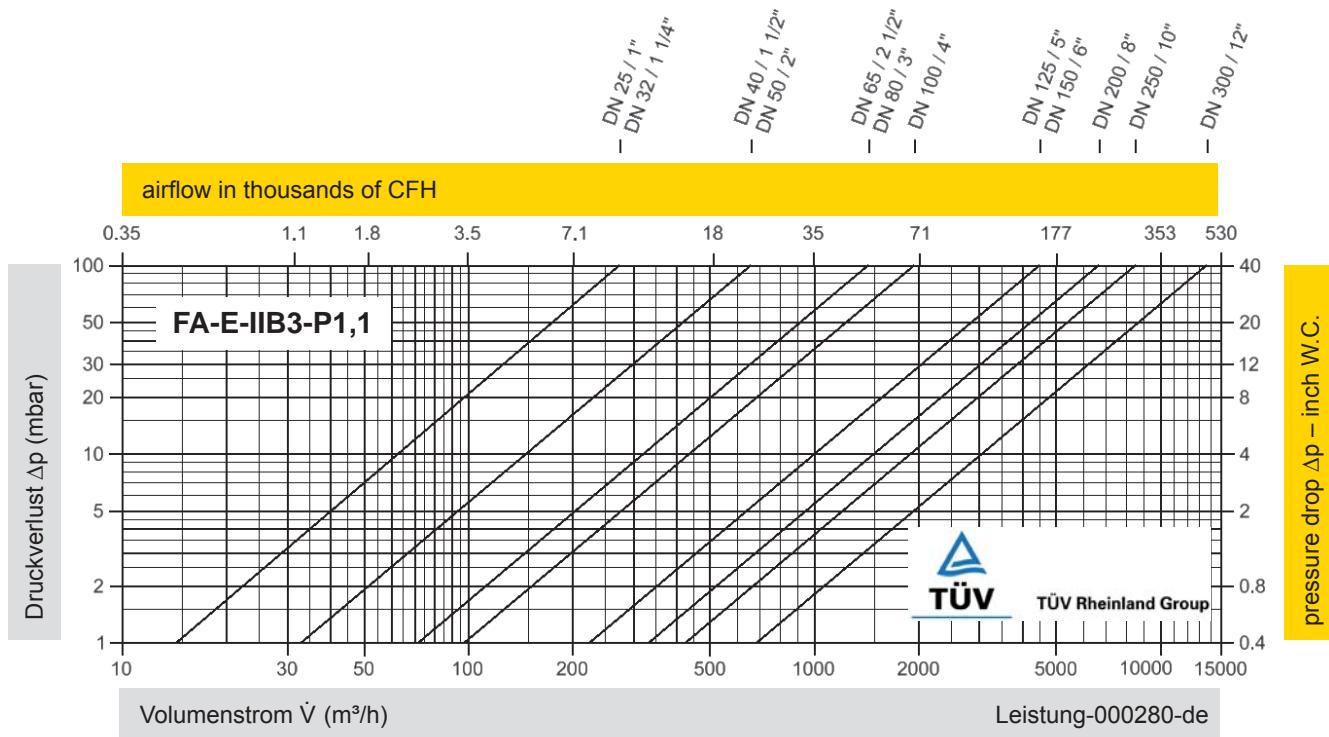




Deflagrationsrohrsicherung

Volumenstromdiagramme

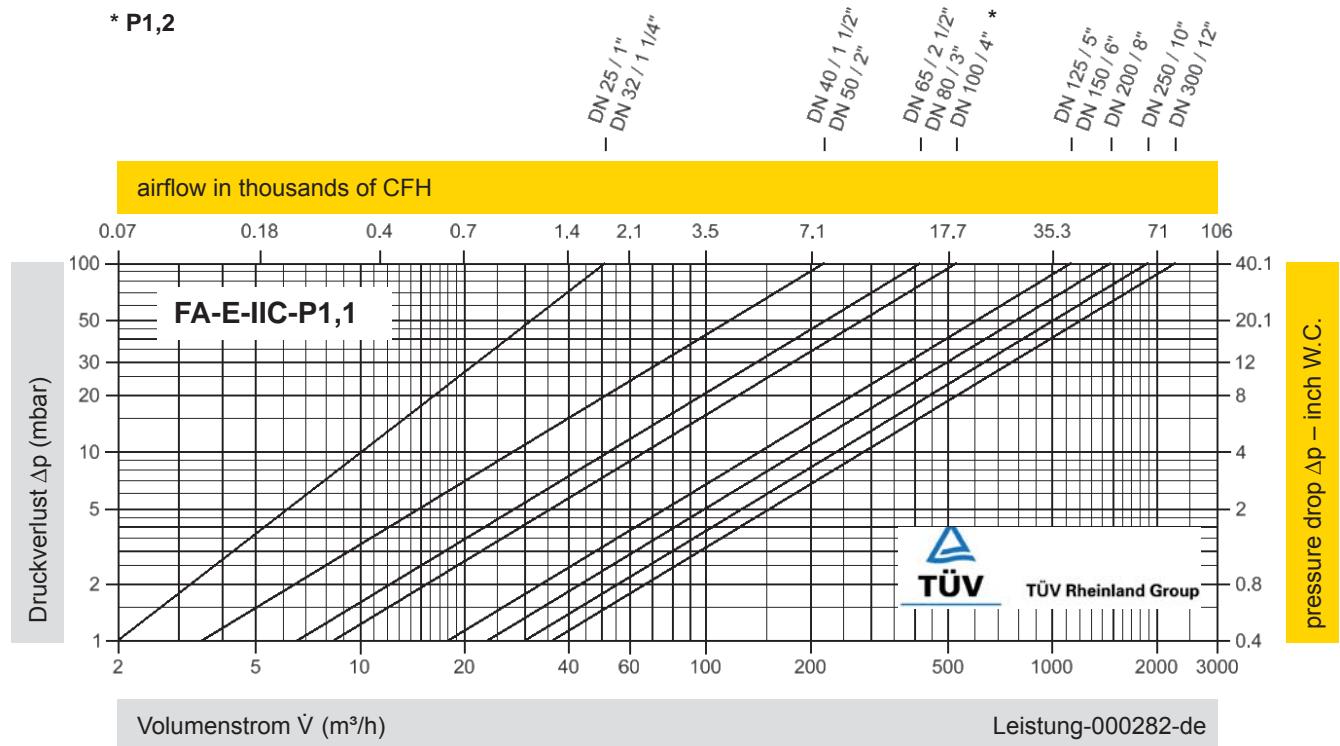
PROTEGO® FA-E



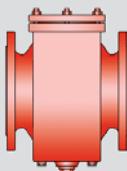
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* P1,2



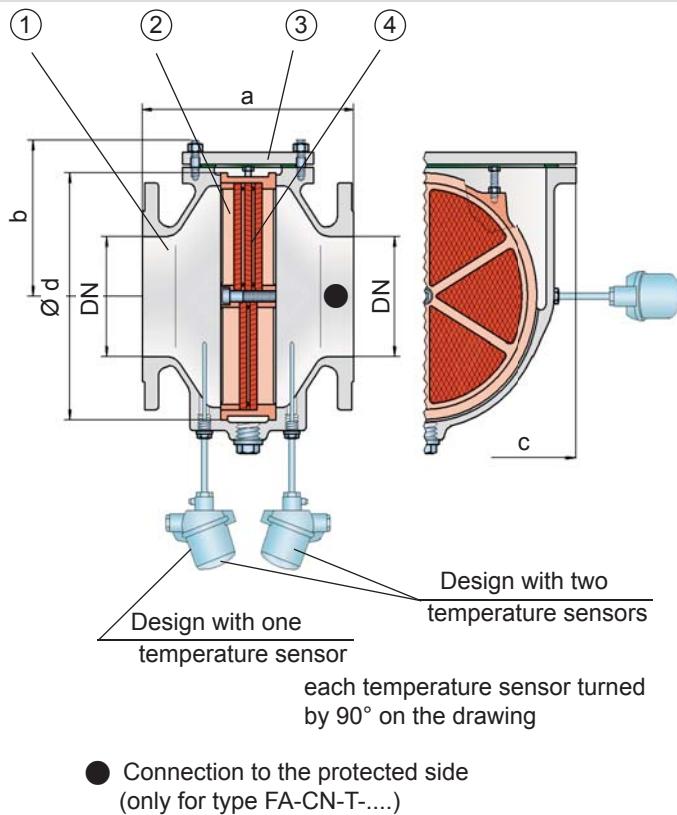
für Sicherheit und Umweltschutz



In-Line Deflagration Flame Arrester

concentric design,
bidirectional

PROTEGO® FA-CN-IIA and IIB3



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 in accordance with the current ATEX Directive 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 -

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)

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)_{max} 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 \geq 0.65 mm)). PROTEGO® FA-CN devices for substances of explosion groups IIA1 and IIC (NEC group B) are shown on separate pages.

Table 1: Dimensions

Dimensions in mm / inches

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

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

Table 2: Selection of the explosion group

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

Table 3: Selection of max. operating pressure

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

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

n = number of FLAMEFILTER®

Table 4: Specification of max. operating temperature

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

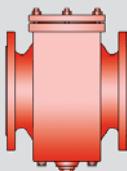
Table 5: Material selection

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

Table 6: Flange connection type

EN 1092-1; Form B1		
ASME B16.5; 150 lbs RFSF		other types upon request

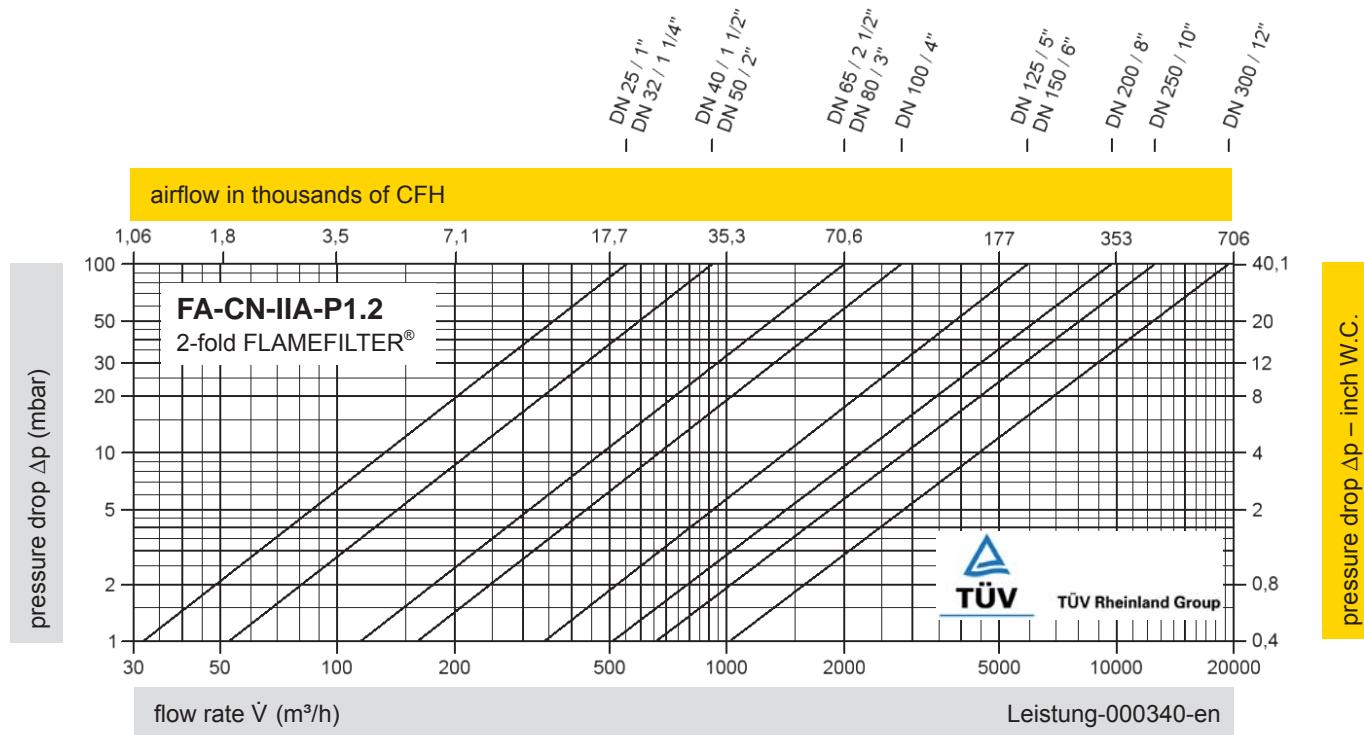




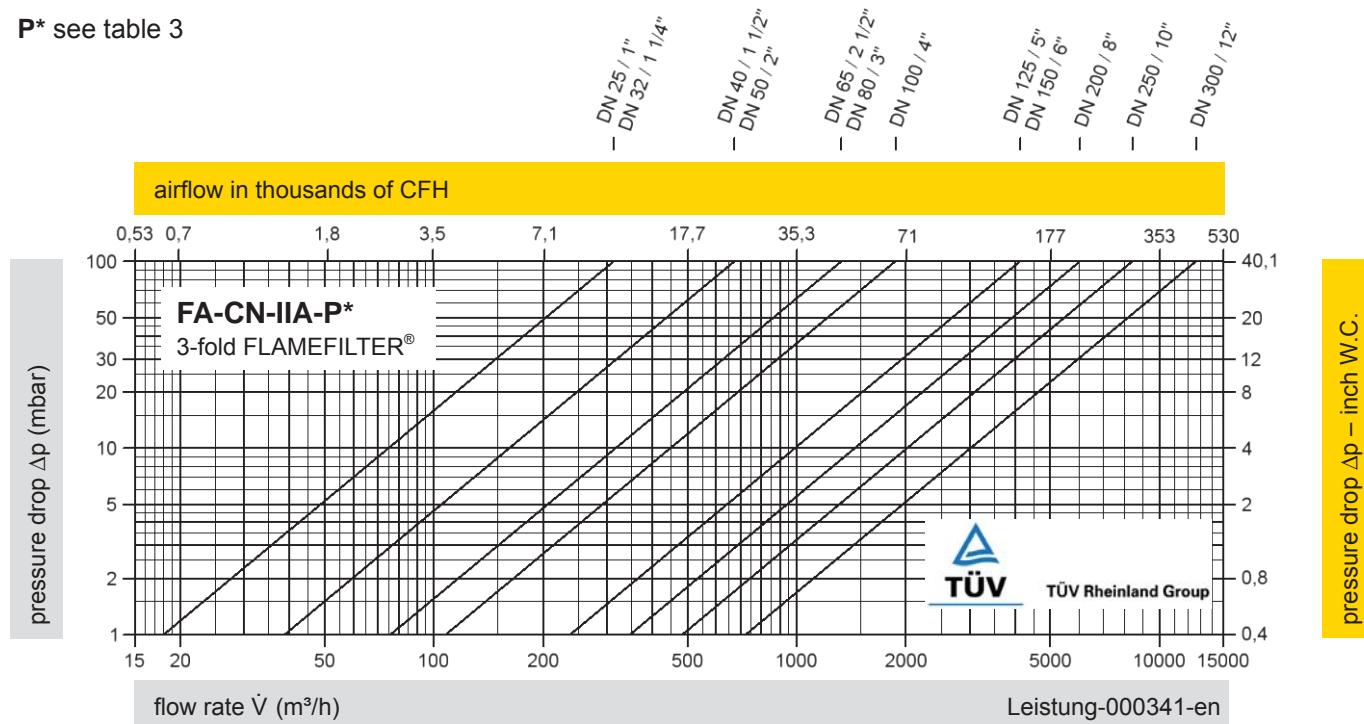
In-Line Deflagration Flame Arrester

Flow Capacity Charts

PROTEGO® FA-CN-IIA and IIB3

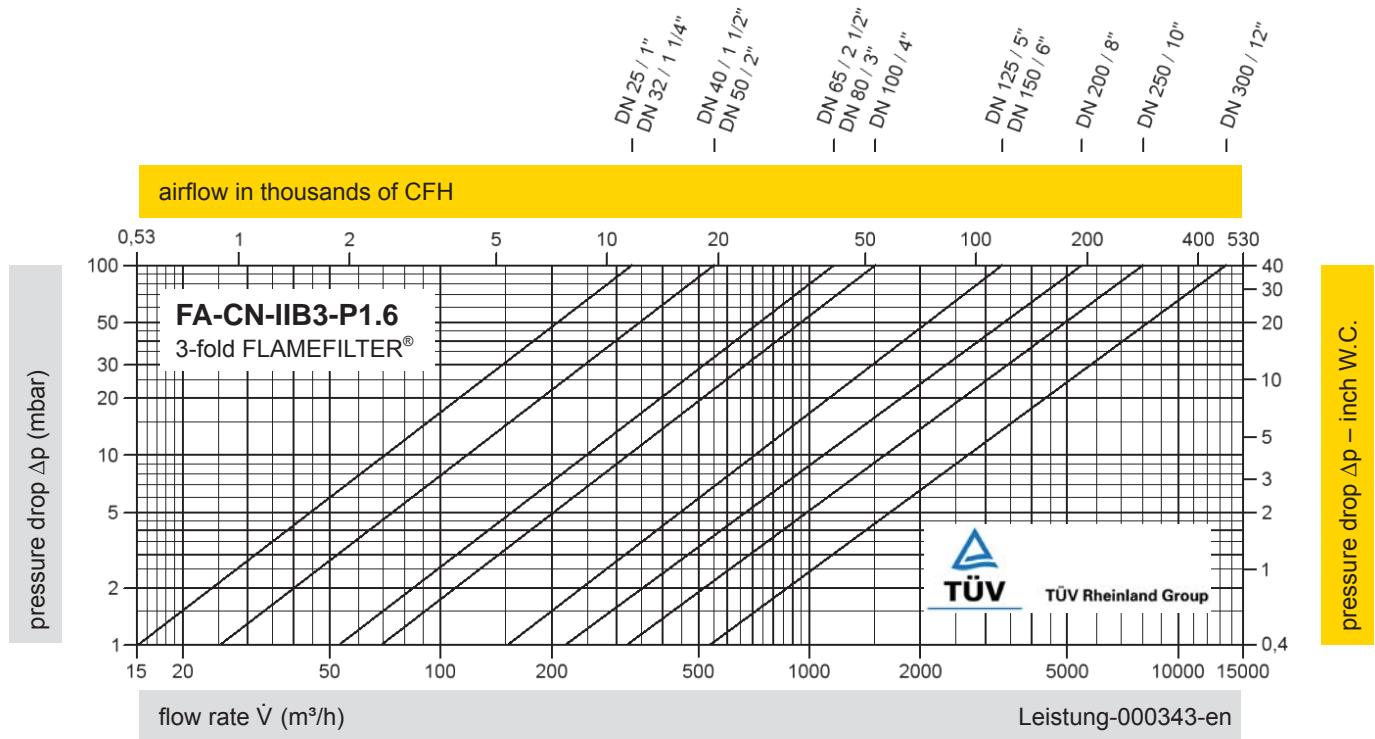
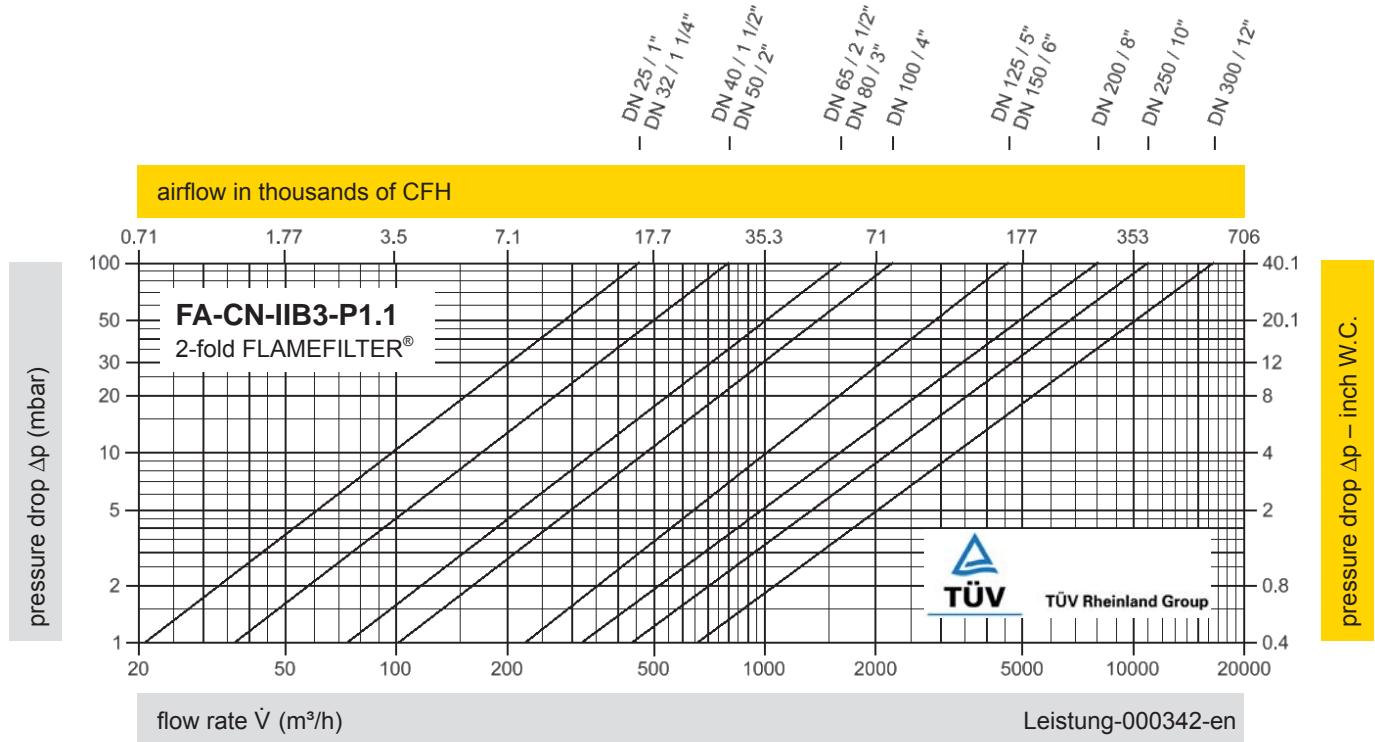


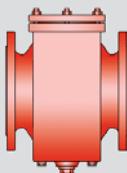
P* see table 3



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

Volume flow V in (m^3/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".

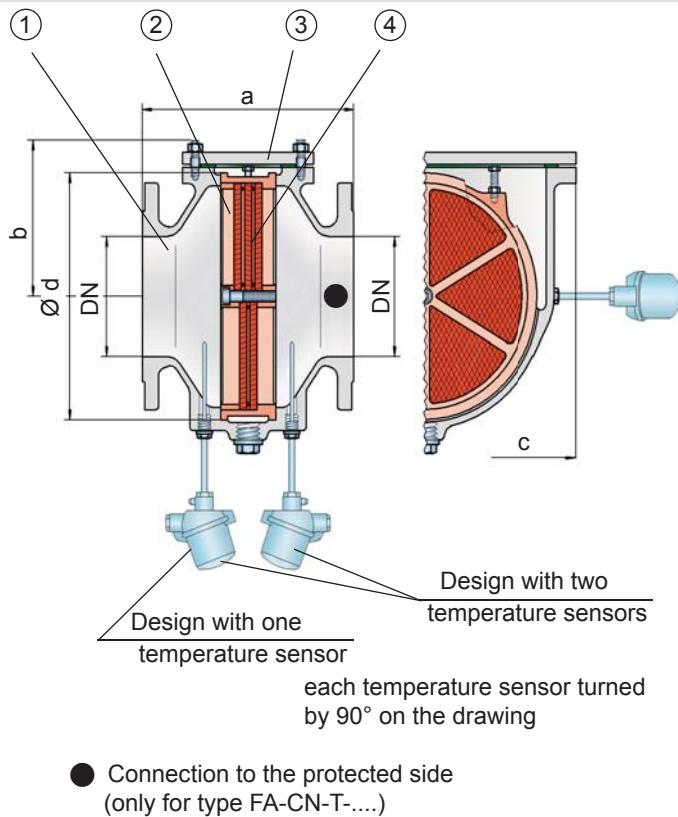




In-Line Deflagration Flame Arrester

for hydrogen/air-mixtures, concentric design, bidirectional

PROTEGO® FA-CN-IIC



- 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 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 \geq 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 in accordance with the current ATEX Directive 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

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

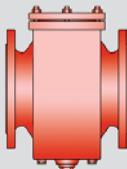
Table 5: Material selection

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; 150 lbs RFSF	



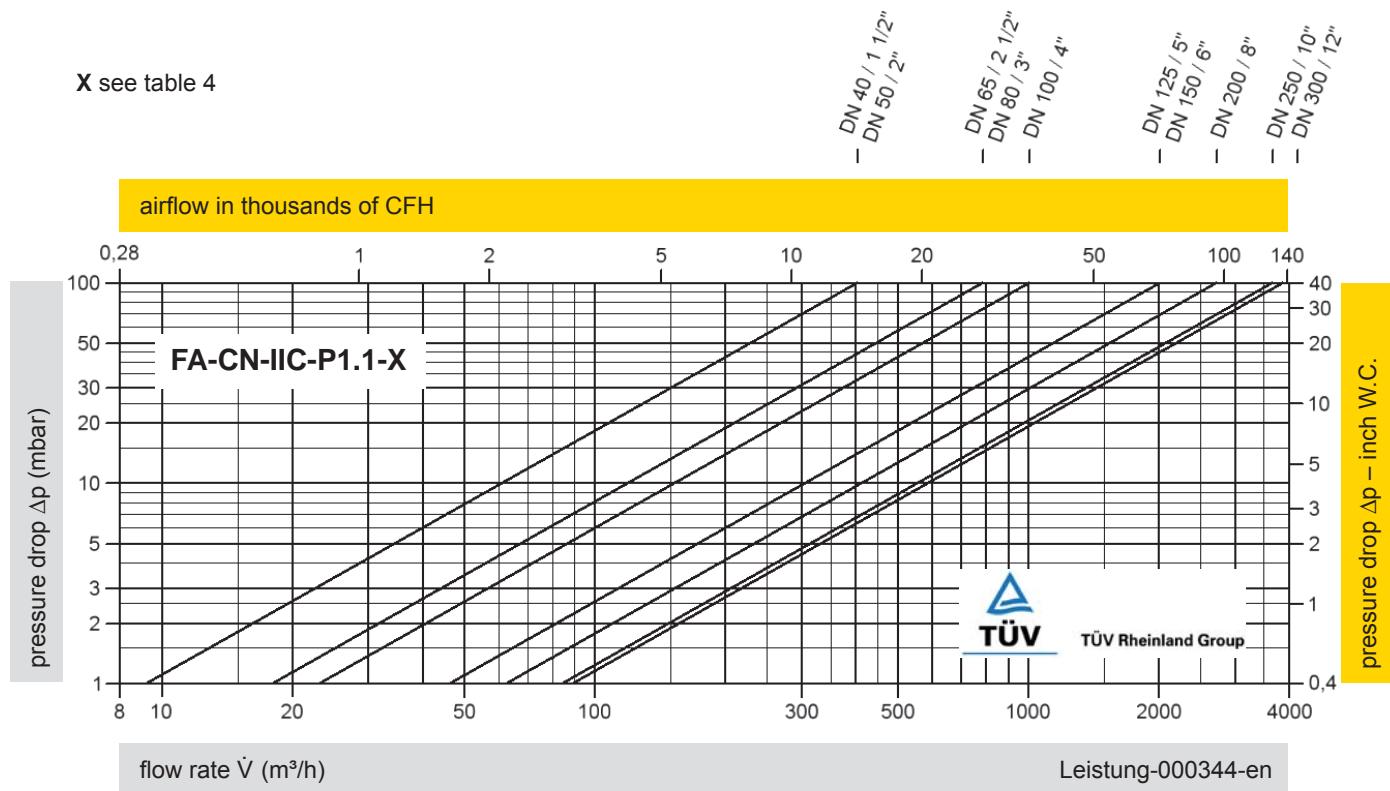


In-Line Deflagration Flame Arrester

Flow Capacity Chart

PROTEGO® FA-CN-IIC

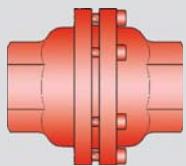
X see table 4



The flow capacity chart has been determined with a calibrated and TÜV certified flow capacity test rig.
Volume flow \dot{V} in (m^3/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".

Notes:

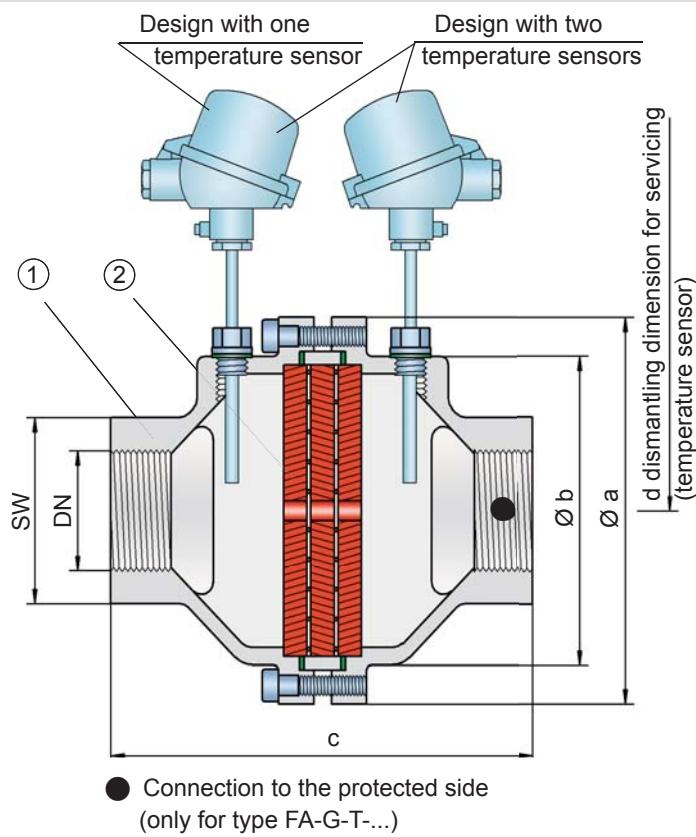




In-Line Deflagration Flame Arrester

concentric design,
bidirectional

PROTEGO® FA-G



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 arresters are available for explosion groups IIA, IIB3 and IIC (NEC groups D, C (MESG ≥ 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 in accordance with the current ATEX Directive 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 G 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 ≥ 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
(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-

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-

*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)	
> 0.90 mm	IIA	D	
≥ 0.65 mm	IIB3	C	Special approvals upon request
< 0.50 mm	IIC	B	

Table 3: Selection of max. operating pressure

	DN	G ½	G ¾	G 1	G 1 ¼	G 1 ½	G 2	
Expl. Gr.	IIA	P _{max}	1.4/20.3	1.4/20.3	1.4/20.3	1.4/20.3	1.5/21.7	1.5/21.7
	IIB3	P _{max}	1.2/17.4	1.2/17.4	1.2/17.4	1.2/17.4	1.2/17.4	1.2/17.4
	IIC	P _{max}	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9	1.1/15.9

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	
-	Designation	higher operating temperatures upon request

Table 5: Material selection

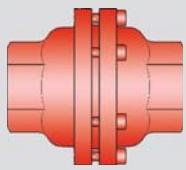
Design	B	C	
Housing	Stainless Steel	Hastelloy	
Gasket	PTFE	PTFE	
FLAMEFILTER®*	Stainless Steel	Hastelloy	* the FLAMEFILTER® is also available in the materials Tantalum, Inconel, Copper, etc. when the listed housing materials are used.

Special materials upon request.

Table 6: Type of connection

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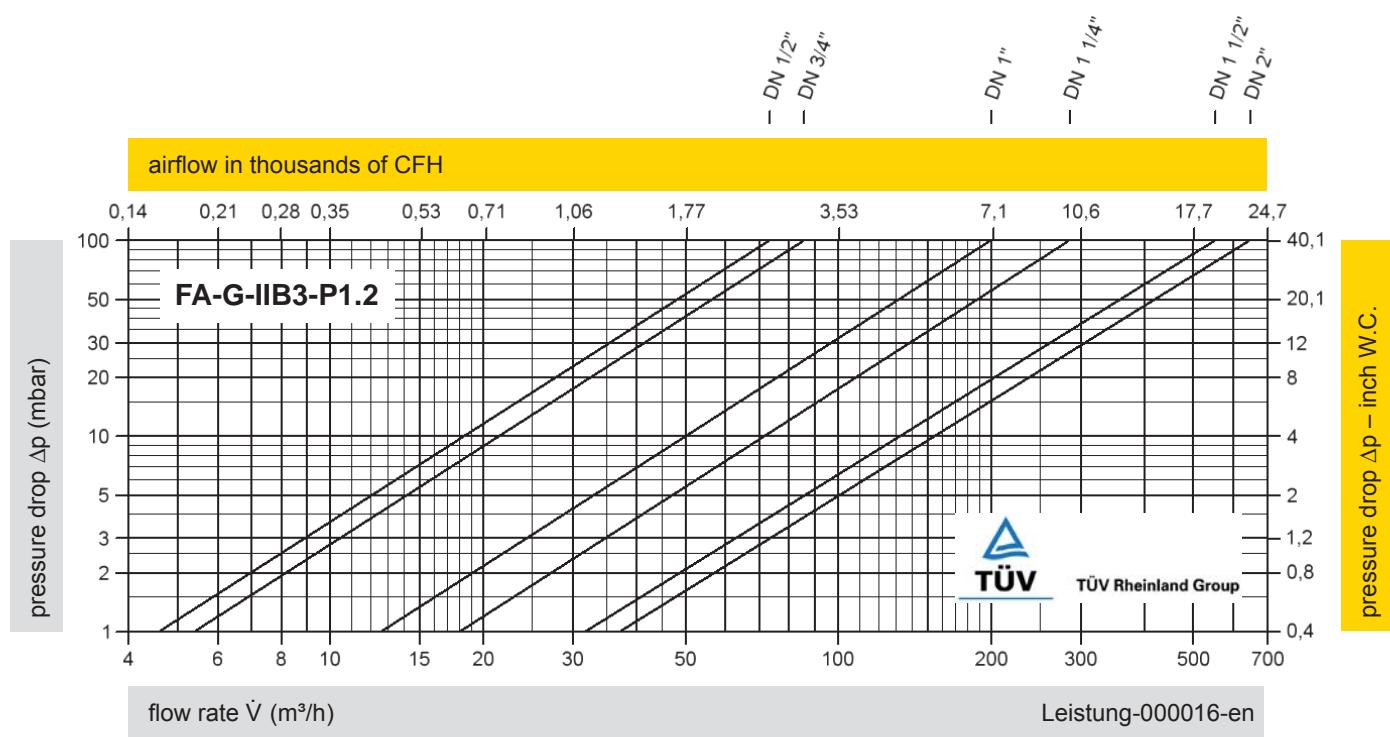
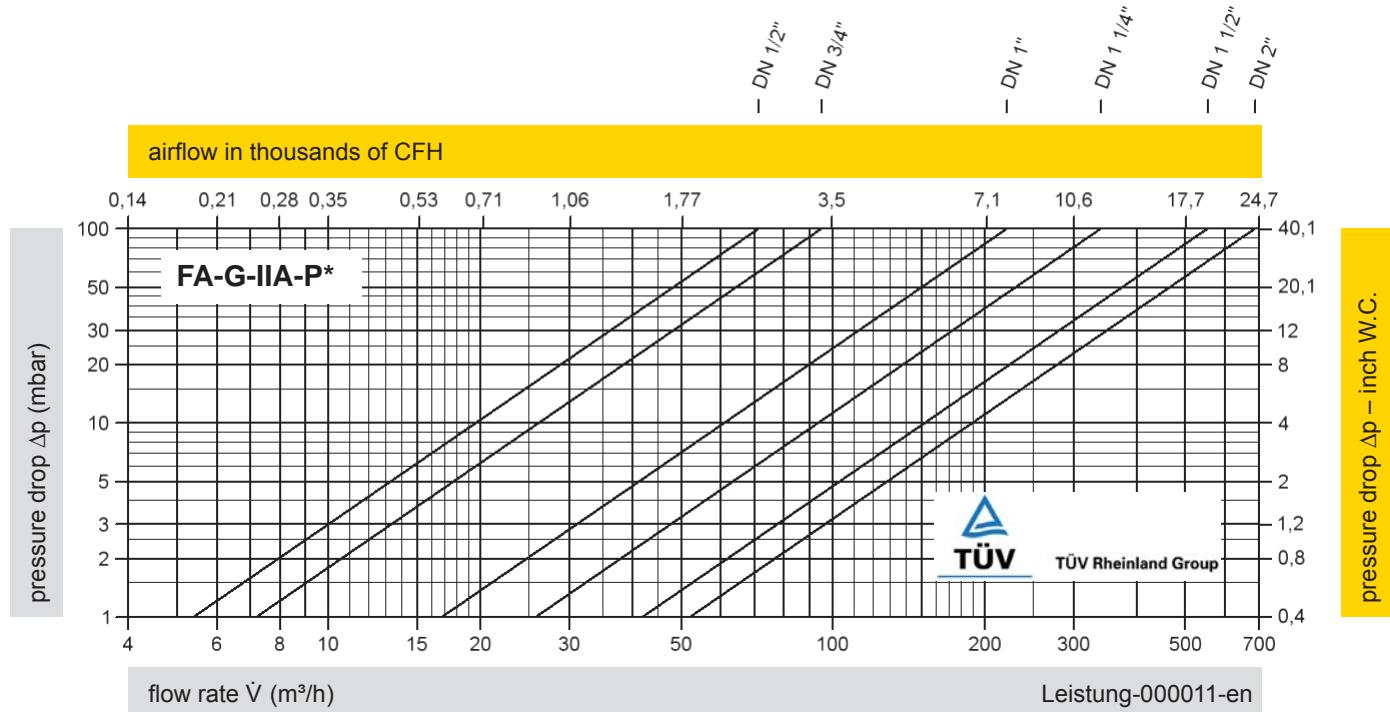


In-Line Deflagration Flame Arrester

Flow Capacity Charts

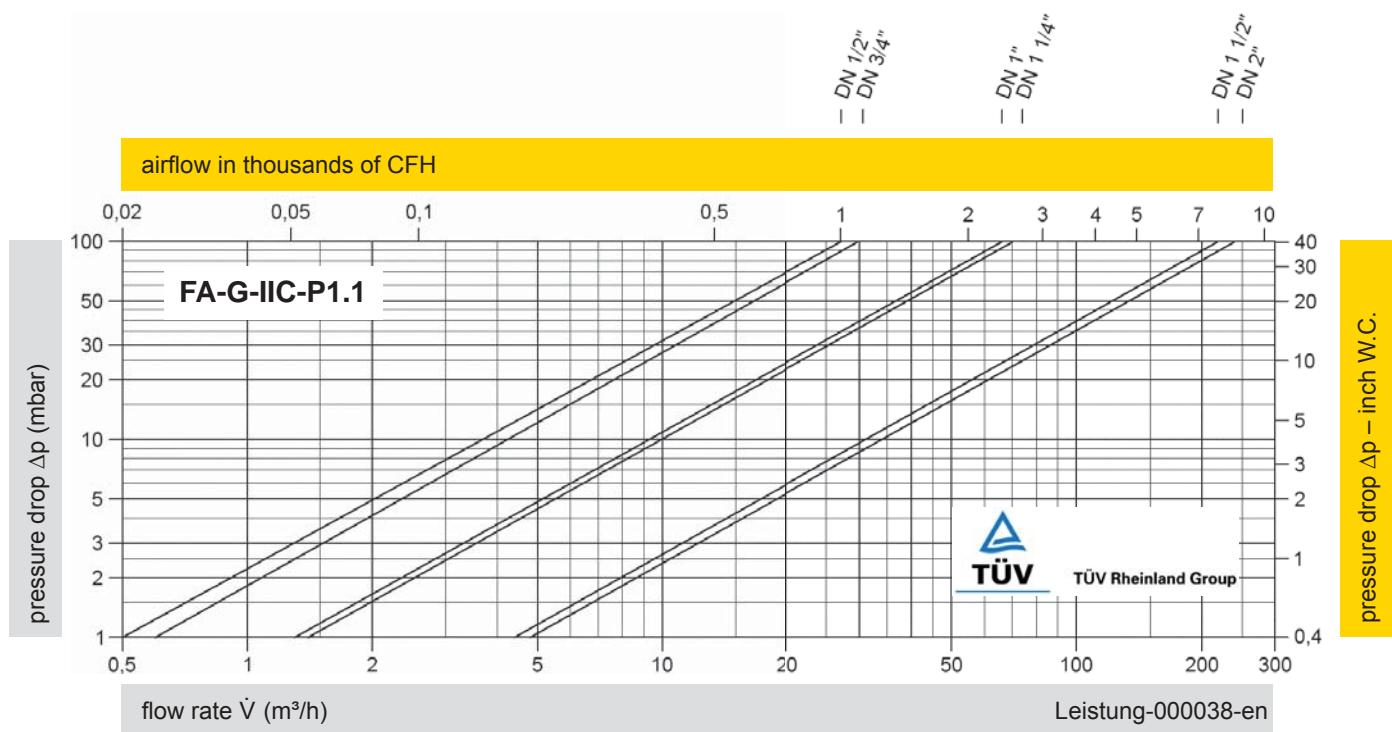
PROTEGO® FA-G-IIA, IIB3 and IIC

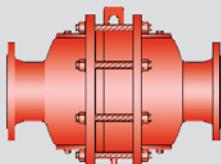
P* see table 3



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

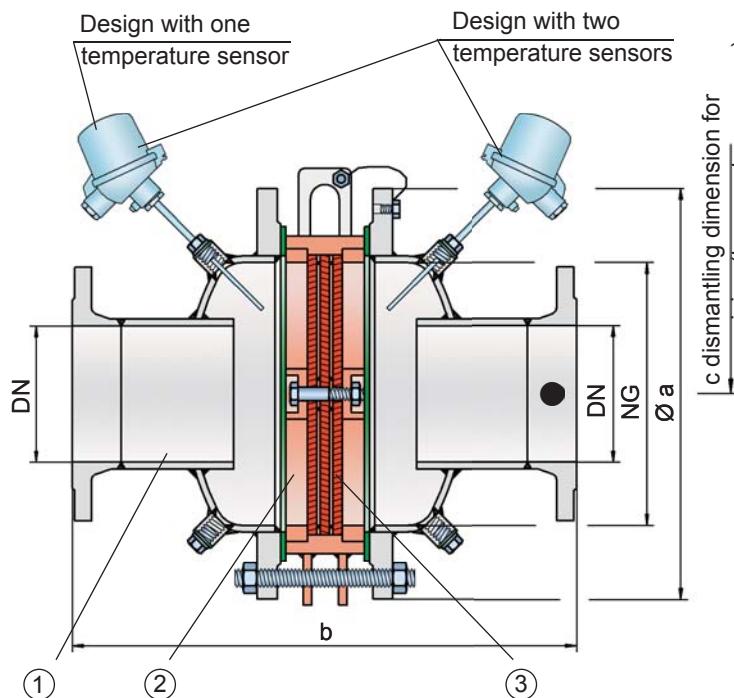




In-Line Deflagration Flame Arrester

concentric design,
bidirectional

PROTEGO® FA-I



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

Function and Description

In the development of the PROTEGO® FA-I in-line deflagration flame arrester, special effort was made to optimize the fluid dynamic flow characteristics. For a given flange connection size of the flame arrester, the FLAMEFILTER® size can be chosen for the most adequate flow capacity. When installing the deflagration flame arrester, make sure that the distance between potential ignition sources and 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 \geq 0.65 mm)).

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 in accordance with the current ATEX Directive 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

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- 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 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
Expl.	IIB3 b*	364 / 14.33	364 / 14.33	464 / 18.27	596 / 23.46	650 / 25.59	700 / 27.56	800 / 31.50	900 / 35.43	1000 / 39.37	1100 / 43.31	1350 / 53.15	1450 / 57.09
c	500 / 19.69	500 / 19.69	520 / 20.47	570 / 22.44	620 / 24.41	670 / 26.38	700 / 31.50	900 / 35.43	1000 / 39.37	1100 / 43.31	1350 / 53.15	1450 / 57.09	

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

Table 2: Selection of the explosion group

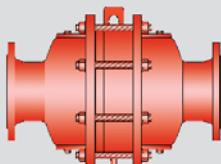
MESG	Expl. Gr. (IEC/CEN)	Gas Group (NEC)	
> 0.90 mm	IIA	D	Special approvals upon request
≥ 0.65 mm	IIB3	C	

Table 3: Selection of max. operating pressure

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

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
IIA	P _{max}	1.2 / 17.4	1.3 / 18.8	1.3 / 18.8	1.2 / 17.4	1.1 / 15.9							
	Designation	-	-	-	-	-	-	-	-	-	-	-	-
	(L/D) _{max}	50	50	40	40	35	35	35	30	30	30	25	25
IIB3	P _{max} (bar /psi)	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	Tmaximum allowable operating temperature in °C	higher operating temperatures upon request
-	Designation	

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.

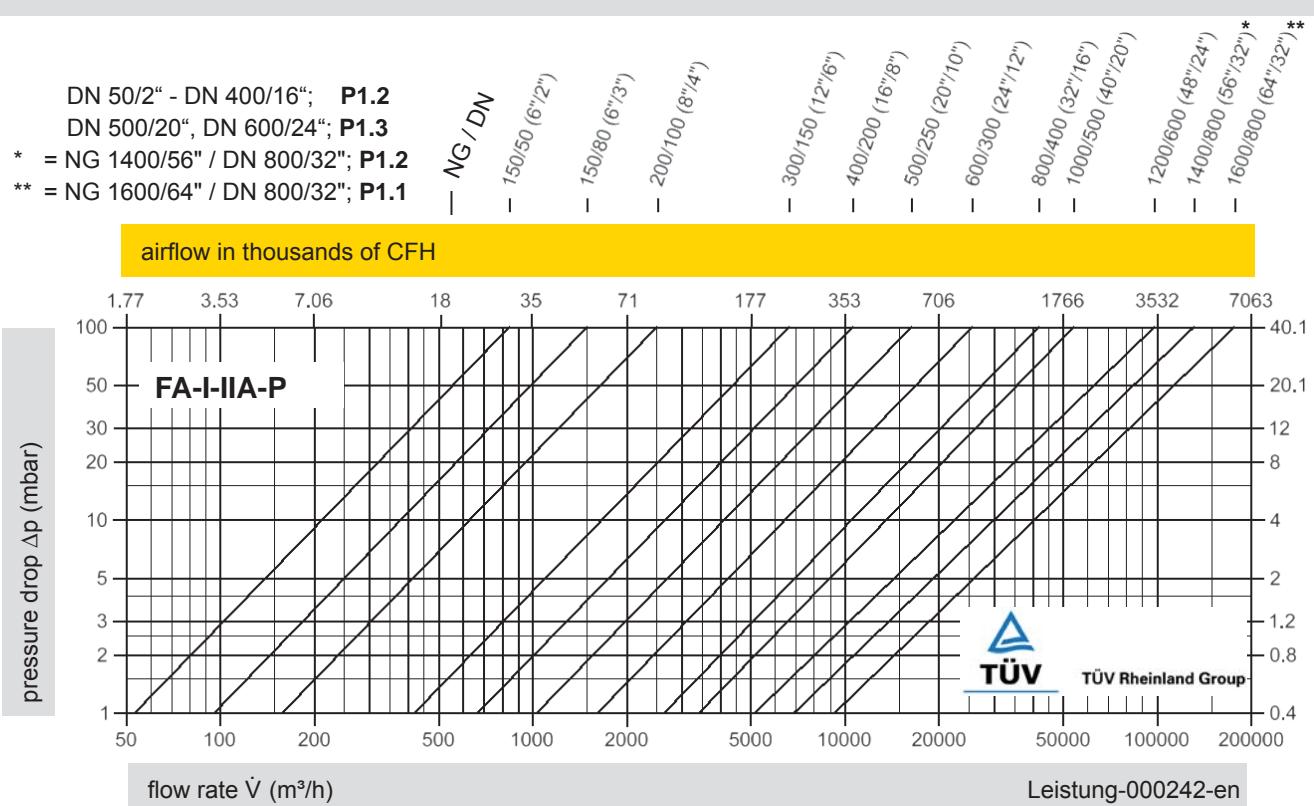
Table 7: Material combinations of the flame arrester unit

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	

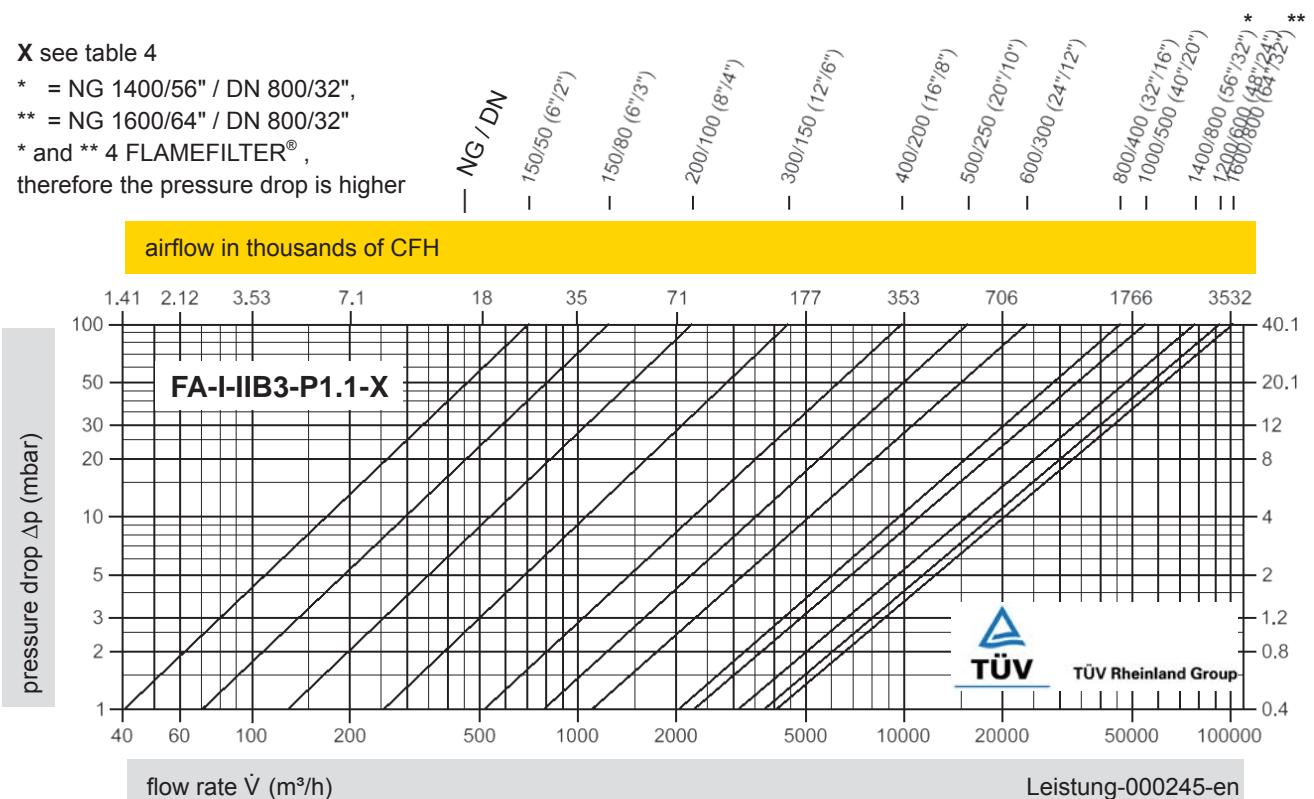
Special materials upon request.

Table 8: Flange connection type

EN 1092-1; Form B1	other types upon request
ASME B16.5; 150 lbs RFSF	



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 $V̄$ 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".



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