FLAMQUENCH™
Flameless Explosion Venting

Introduction

Gas explosion hazards are traditionally recognized as being a 'natural enemy' to people and property. However, as a result of numerous explosions with devastating effects, we now recognize that fire and explosion hazards exist in processes handling combustible dust/air mixtures. Since the early 1970s, and more recently laid down within the 'new approach' European directives, it is general practice in explosion protection for industry to achieve an acceptable level of safety against these hazards by:

- preventing the occurrence of explosive atmospheres;
- preventing ignition sources to initiate explosions;
- limiting the effects of explosions, or even halting explosions, which may endanger lives or capital investment.

Practical measures to accomplish the latter is the use of explosion pressure venting, explosion suppression (to protect process vessels from explosion over-pressurization) and isolation techniques to prevent explosions from spreading throughout a process.

Explosion pressure relief is possible through the use of low-mass rupture membranes (explosion vents) which provide instantaneous, predictable and unrestricted pressure relief. Although explosion venting may be desirable due to its inherent passive nature and relatively low cost, hazards arising from external effects and other aspects need to be considered. When an explosion vent is opened by the pressure wave of a dust or gas explosion, it will not only relieve the explosion pressure but also vent unburnt product, heat, flame, and combustion products into the surrounding atmosphere (fig. 1). In many cases this is not acceptable, unless this area is

- a non-manned area, including safety measures to prevent people from entering the area (lock-outs etc)
- free from any other combustibles that might become airborne under explosion venting pressure effects and be ignited by the explosion flame. This effect is commonly referred to as a 'secondary explosion'.

Flameless Explosion Venting: Safety Function

The use of vent flame filters (fig. 2), designed and tested for use on dust/air mixtures, will result in the elimination of explosion flame from vented equipment. While the explosion is allowed to run full course inside the protected equipment, only pressure will be vented into the surrounding atmosphere and a secondary explosion avoided.
The unique Fike FlamQuench (fig. 3) combines all features of Fike explosion vents with the advantages of a fully tested and accepted vent flame filter for dust explosions.

Fig. 1

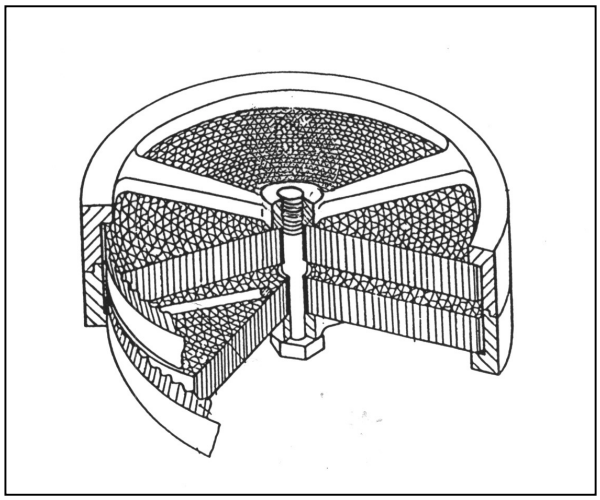


Fig. 2

Fig. 3

Flameless Explosion Venting: Working principle

Flame propagation can be stopped by energy dissipation. If the propagating flame is directed through a specially constructed heat exchanger module/vent flame filter (fig. 4) the temperature of the combustion zone will drop below the ignition temperature of the fuel, preventing the propagation of the explosion beyond the flame filter. Depending on the rate of combustion of the fuel, the maximum allowable flame dissipating gap dimension can be established. The dissipating gap is critical to the effectiveness of the vent flame filter and must have been proven by extensive testing. This well established method of flame filtering has been successfully applied to devices being used on combustible gases and vapours and has more recently been proven for devices specifically designed for combustible dusts.

Fig. 4

The Fike FlamQuench™

To cover the widest possible range of industrial applications Fike FlamQuench (fig. 5) is available in two basic models :

- **Model FQ-1**, FlamQuench model for use with a free outlet (fig. 6 – table 1 - 2nd colum)
- **Model FQ-2**, FlamQuench model for use with ducted outlet (fig. 6 – table 1 - 3rd colum)

It may be desirable for equipment located within dusty, hygienic and/or manned areas to use ducting to allow the safe removal of the explosion pressure and debris to safe areas. Different from venting alone, the use of venting ducts will not decrease the venting efficiency because the explosion no longer propagates into the duct beyond the flame filter. The FlamQuench model FQ-2, using a filter with different gap width, will relieve the explosion pressure through a duct that can be welded onto the weld-on flange on top of the FQ-2 (included, see fig. 6).

Fig. 5

Fike FlamQuench: Model Designation

Example:

FQ – 1 – CV-S – 1000 - A

FlamQuench

- **1** - model for use without duct pipe
- **2** - model for use with duct pipe

pressure relief vent type

CV flat composite
CV-S pre-bulged composite

nominal size

200-1200: in millimeters
for use with DIN 2632 flanges
8-44 : in inches
for use with 150 ASA flanges
X : special configuration

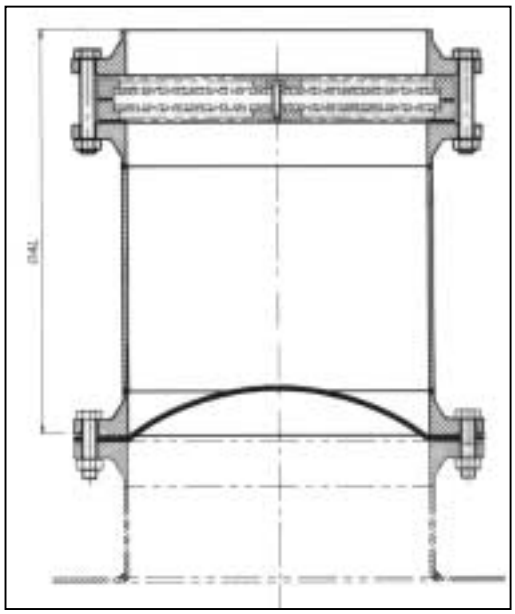
material code

A: pipe spool and vent flame filter housing: carbon steel white painted vent AISI 304 (+ Teflon), flame filter AISI 321 SST (DIN 1.4541)
B: all SST
C: other (specify)

FlamQuench™ Dimensions

Nominal Size		Model FQ-1 L (mm)		Model FQ-2 L (mm)	
DN	INCH	PN10	ANSI	PN10	ANSI
200	8	300	290	322	363
250	10	343	344	381	415
300	12	405	405	447	488
350	14	440	460	473	552
400	16	494/490	512	527	603
-	18	-	566	-	666
500	20	602/620/604	621	632	722
600	24	710	726	736	831
700	-	825	-	847	-
-	30	-	916	-	978
800	32	923	973	949	1036
900	36	1038	1094	1083	1161
1000	40	1144	1196	1162	1269
-	42	-	1252	-	1327
-	44	-	1308	-	1384
1200	-	1354	-	1384	-

Table 1



Model FQ-2 Fig. 6

FlamQuench™ Explosion Vent Models

Model CV

The CV type explosion vent consists of 2 sheets of stainless steel with predetermined burst pattern and a Teflon seal. This type of vent can be made in virtually any dimension or configuration. It will burst in either direction at the same burst pressure and is recommended for general use with operating pressures or negative pressures not exceeding 50% of minimum burst pressure (fig. 7).

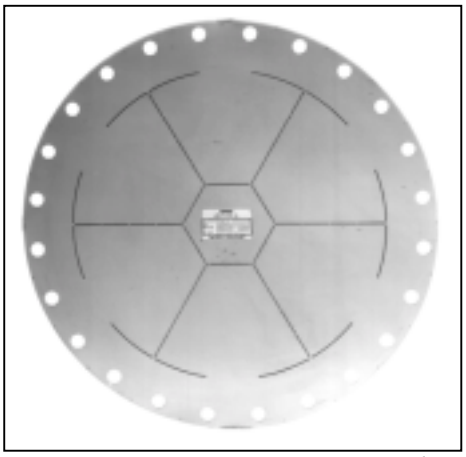


Fig. 7

Model CV-S

The CV-S type explosion vent consists of a stainless steel slotted top section with predetermined burst pattern, a Teflon seal, and a pre-cut vacuum support. Vent and vacuum support are pre-bulged to withstand negative pressures. Small sizes are full vacuum resistant. The CV-S type vent is recommended for cycling duty, operating pressures up to 70% of minimum burst pressure, and for specified vacuum rating (fig. 8).

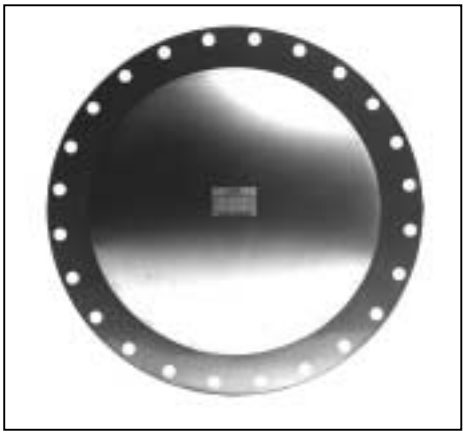


Fig. 8

For more specific information concerning Explosion Vent Models used in the FlamQuench, please consult our brochure 8.0300.00 or contact Fike.

FlamQuench™ Features

Proven performance
Extensive testing by FSA (Forschungsgesellschaft für angewandte Systemsicherheit und Arbeitsmedizin), division of BGNG (Berufsgenossenschaft für Nahrungsmittel und Gaststätten), has validated the design of the Fike FlamQuench for volumes up to 10.000 m^3, and dust classes including St3 (K_{St} > 300 bar.m/s) (ref. Dr. W.Bartknecht - Report 1/1992). The FlamQuench cannot be used against hazards with a minimum ignition energy MIE < 5 mJ and a minimum ignition temperature MIT < 400 °C.

Directed explosion venting
The Fike FlamQuench model FQ-1 will relieve the explosion pressure to a free outlet. The FlamQuench model FQ-2, using a different vent flame filter, will relieve the explosion pressure through a ducted outlet of maximum 6m length.

Predetermined burst pressure
Due to its longstanding manufacturing experience, Fike is able to manufacture explosion vents with tight tolerances. In the absence of specific requirements, Fike uses the ISO 6718 standard with regard to burst sample quantities. The required quantity of each lot is tested under static conditions and each design of explosion vent has been tested under actual explosion conditions.

Re-usable vent flame filter
After venting of a dust or gas explosion, the vent flame filter can be re-used after cleaning and replacement of the Fike explosion vent.

Noise reduction
Large-scale explosion tests have confirmed that the Fike FlamQuench reduced considerably the noise of the explosion during venting.

Suitable for high-strength and low-strength enclosures
Fike FlamQuench can be used on systems with a design pressure up to 3 bar. This feature allows the use of the Fike FlamQuench on a wide range of industrial applications.

Interface with process control
In order to make sure that upon explosion the equipment under protection is safely shut down, the Fike FlamQuench comes standard with a Fike explosion vent with integrated rupture indicator suitable for intrinsically safe circuitry. Upon venting the normally closed contact rupture indicator will open and provide a signal for safe shutdown of the equipment as well as activation of the appropriate alarm functions. The rupture indicator cable is glanded off in an EEx e (IP65) junction box, installed on a bracket at the side of the FlamQuench spool piece (included, see fig. 3). For safety reasons, Fike recommends to integrate the rupture indicator into an intrinsically safe circuitry only (circuitry or EEx i barrier not included).

FlamQuench™ Sizing

As specified by the VDI 3673 guideline, the use of vent systems is allowed only when the vent capability is determined. The venting capability of the Fike FlamQuench has been thoroughly evaluated by large-scale tests. This makes it possible for Fike's design engineers to assist you in calculating the ideal FlamQuench solution. In order to assist you, Fike needs the following information:

1. Equipment volume to be protected in m^3
2. Maximum rate of pressure rise of dust/air mixture in equipment to be protected (K_{St} value)
3. Equipment design pressure in barg (P)
4. Maximum explosion pressure of the dust/air mixture in an unvented explosion (in barg)
5. Static opening pressure of the explosion vent device (in barg)
6. Minimum ignition energy and minimum ignition temperature of dust/air mixture

For sizing of Fike FlamQuench system on gas, vapour, or hybrid mixtures, consult Fike.

Should you require additional information on the FlamQuench or Flameless Venting in general, please contact us.

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flow & process solutions





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REGOM INSTRUMENTS s.r.o.
tel.: +420 241 402 206, +420 241 433 152
fax: +420 241 400 290, +420 241 433 151
e-mail: regom@regom.cz
skype: regom-office
www.regom.com

REGOM INSTRUMENTS s.r.o.
Brabcova 1159 / 2
147 00 Praha 4
CZECH REPUBLIC

Tel: **+420 241 402 206**
Fax: **+420 241 400 290**
Mail: **regom@regom.cz**
Skype: **regom-office**

www.regom.cz