The Flame Arrester

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Historically the petroleum industry has always had some form of protection at the end of the vent pipe.

In 1909 a report by the Departmental Committee on Petroleum Spirit to Winston Churchill who was Home Secretary at the time extolled the virtue of a "*safety device to prevent back-fire into the vessel and the possible explosion of an explosive mixture of petroleum spirit vapour and air inside".*

This device impeded the passage of flame to the vapour in a tank and worked on the well known Davey Lamp principle.

A flame arrester therefore is either a device to stop a flame entering a pipe, the type we see at the end of a vent pipe and it is called an *"end of line flame arrester".*

A flame arrestor can also stop a flame propagation traveling along a pipe line and these are called *"in line flame arresters".*

Flame arresters are designed and installed to protect the safety of workers, the public, property and the environment.

To achieve a common safety standard and also to remove barriers to free trade, the EU issued a Directive to cover safety equipment and protective systems for use in potentially explosive atmospheres (ATEX) Directive 94/9/EC. This has been brought into UK law by the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR)

To reinforce this CEN approved a harmonised standard for flame arresters EN 12874[1] on 24 November 2000. The United Kingdom and all other CEN member states are now bound to give this European Standard the status of a national standard without any alteration.

Therefore BS EN 12874:2001 (Flame arresters - Performance requirements, test methods and limits for use) superseded the BS 7244 on 30.Jun 2003. The only time a BS 7244 arrester can now be sold or installed is if they are repaired units being put back into service in the **same** application.

The use of protective systems:

If an explosive atmosphere is ignited then a deflagration (explosion at subsonic velocity) starts and if the explosion propagates at supersonic speed then a detonation is achieved.[2]

Therefore the use of the correct protective system such as flame arresters depends on certain conditions e.g. temperature, operating pressure, composition of used gas (explosion group) and distance between potential source of ignition and the flame arrester. Therefore it is crucial to use flame arresters only for the conditions they have been designed and certified.

Static flame arresters are the most common design. There are measurable and non-measurable types in the market.

Measurable type:

Flame arrester elements of measurable type are made of two metal ribbons one corrugated and the other plain. The ribbons are coiled together with reproducible flame quenching gaps.

Consequently flame arrester elements of measurable type can be manufactured within clearly defined tolerances.

Non-Measurable type:

"Flame arrester where the quenching gaps of the flame arrester element cannot be technically drawn measured or controlled (e.g. random structures such as knitted mesh, sintered metal and gravel beds)".[3]

Those "Flame arrester elements of the non-measurable type shall be manufactured 50% thicker than the elements tested to ensure that they have flame quenching capabilities no less than the flame arrester element tested. The thickness of the flame arrester element is defined as being the distance between the protected and unprotected surface of the flame arrester element".[4]

Different Types of Flame Arresters:

In BS EN 12874 there is a description on how to prove different types of flame arresters.

E.g.:

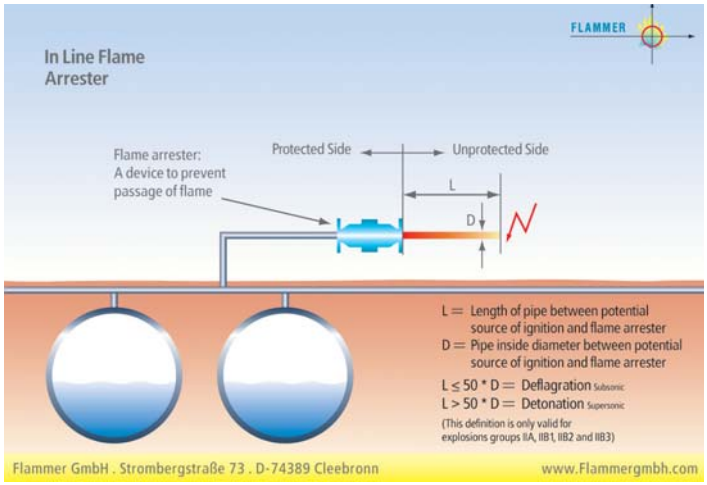
Inline deflagration, inline detonation, end of line deflagration, end of line deflagration short time burning, end of line deflagration endurance burning, liquid line detonation, pre volume etc..

The most used flame arresters in the industry are:

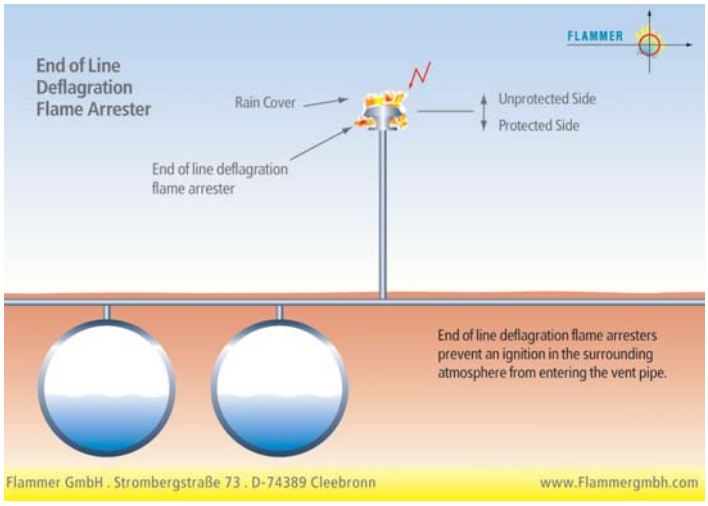
1.) Inline deflagration and inline detonation flame arrester:

Ignition of an explosive gas will trigger a deflagration (explosion at subsonic velocity).

If a flame front propagates through a pipe, its speed will increase proportionally to the length of the pipe. If a pipe is shorter than 50 times (respectively 30 times for explosions group IIB and IIC) its internal pipe diameter, the flame will propagate at subsonic speed. In this case, securing the protected side by a deflagration flame arrester will be sufficient.

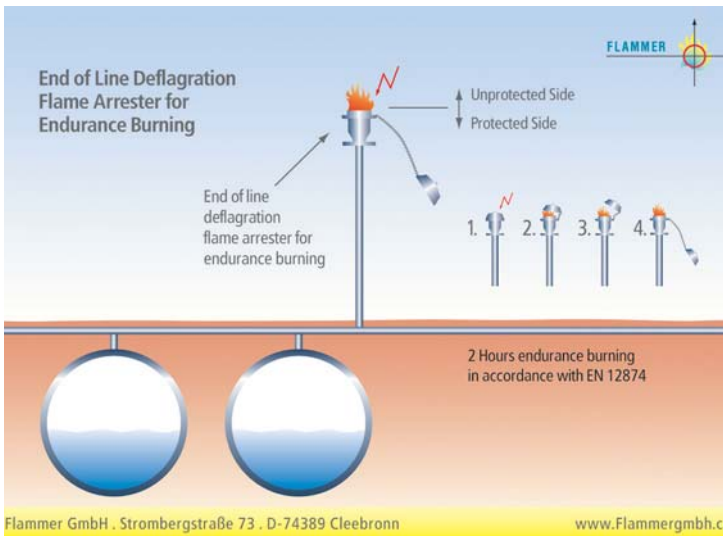


If the pipe is longer than 50 times its internal diameter (valid for explosions group IIA, IIB1, IIB2, IIB3 respective 30 times for explosions group IIB and IIC) flame will propagate at supersonic speed that means in a detonation.



A deflagration flame arrester operates at a lower pressure drop than a detonation flame arrester and is not suitable for detonation.

Inline detonation flame arresters are automatically approved as inline deflagration flame arrester.



2.) End of line deflagration flame arrester: To avoid a flame propagation from outside (atmosphere) to inside of a system e.g. storage tanks, vessels or in process plants an end of line deflagration flame arrester has to be installed. End of line deflagration flame arresters protect the impact of atmospheric deflagration and prevent flame transmission to protect equipment. These flame arresters are not tested for short time burning or endurance burning.

3.) End of line deflagration flame arrester for endurance burning:

In case of over pressure in storage tanks or process plants ignitable gases can escape constantly through the vent. If this gas is ignited then a flame will start to burn at the top of vent. Fire will burn as long as vapour is flowing out of system. As soon as the gas pressure inside of the storage tanks or process plants is equal or lower than atmospheric pressure flame will propagate into the system with all consequences for health and safety. To avoid risk in such cases an end of line deflagration flame arrester approved for endurance burning must be installed.

End of line deflagration flame arresters for endurance burning have to be approved in accordance with BS EN 12874 Chapter 6.3.5 for 2 hour constant fire at the top of flame arrester. Rain cover has to be released after a few seconds automatically.

Note: End of line deflagration flame arrester for endurance burning have to be approved for alcohol separately BS EN 12874 Chapter 12.1d).

Marking:

In accordance to 94/9 EC all autonomous protective systems (flame arresters) need a third party (notified body) certificate. Approved and certificated flame arresters have to be marked (see BS EN 12874 (12.2)) with the ATEX certificate number issued from a notified body.

DSEAR is the legal framework supporting the ATEX Directive in the UK and by not fitting the correct flame arrestor that is certified as complying with the standard, designers and installers could be breaking the law.
For more information www.flammergmbh.com

[1] BS EN 12874 (Flame arresters – Performance requirements, test methods and limits for use)

[2] BS EN 1127-1:1998 Explosive atmospheres. Explosion prevention and protection.
Basic concepts and methodology

[3] BS EN 12874 Chapter 3.1.17.2

[4] BS EN 12874 Chapter 6.3.1