



BSI Standards Publication

Explosive atmospheres

Part 49: Flame arresters — Performance requirements,
test methods and limits for use

National foreword

This British Standard is the UK implementation of EN ISO/IEC 80079-49:2024. It is identical to ISO/IEC 80079-49:2024. It supersedes BS EN ISO 16852:2016, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EXL/23/1, Flame arresters.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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© The British Standards Institution 2024
Published by BSI Standards Limited 2024

ISBN 978 0 539 18629 1

ICS 13.220.10; 13.220.20

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2024.

Amendments/corrigenda issued since publication

Date	Text affected
<hr/>	

English Version

**Explosive atmospheres - Part 49: Flame arresters -
Performance requirements, test methods and limits for
use (ISO/IEC 80079-49:2024)**

Atmosphères explosives - Partie 49: Arrête flammes -
Exigences de performance, méthodes d'essai et limites
d'utilisation (ISO/IEC 80079-49:2024)

Explosive Atmosphären - Teil 49:
Flammendurchschlagsicherungen -
Leistungsanforderungen, Prüfverfahren und
Einsatzgrenzen (ISO/IEC 80079-49:2024)

This European Standard was approved by CEN on 5 February 2024.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

This document (EN ISO/IEC 80079-49:2024) has been prepared by Technical Committee ISO/TMB "Technical Management Board - groups" in collaboration with Technical Committee CEN/TC 305 "Potentially explosive atmospheres - Explosion prevention and protection" the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2025, and conflicting national standards shall be withdrawn at the latest by October 2025.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 16852:2016.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For the relationship with EU Legislation, see informative Annex ZA, which is an integral part of this document.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Endorsement notice

The text of ISO/IEC 80079-49:2024 has been approved by CEN as EN ISO/IEC 80079-49:2024 without any modification.

Annex ZA (informative)

Relationship between this European Standard and the essential requirements of Directive 2014/34/EU aimed to be covered

This European Standard has been prepared under a Commission's standardization request M/596 to provide one voluntary means of conforming to essential requirements of Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (recast).

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 2014/34/EU

Essential Requirements of Directive 2014/34/EU	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.0.1 Principles of integrated explosion safety	Clause 5; 14.1; 14.2; 14.3; Annex E.1	
1.0.2 Design and manufacture considerations	7.1; 7.2; Clause 14; Annex C; Annex E.1	
1.0.3 Special checking and maintenance conditions	Annex C; Clause 12	
1.0.4 Surrounding area conditions	14.1; Annex E.1	
1.0.5 Marking	Clause 13	
1.0.6 Instructions	Clause 12; Annex E	
1.1.1 Operational stresses on material	7.1; 14.1; Annex C; Annex E.1	
1.1.2 Reaction of material	14.1; Annex C; Annex E.1	
1.1.3 Wear of material	7.1; 14.1; Annex E.1	
1.2.1 Design and construction for safe operation	5.1; 14.1, Annex E.1; 14.2; 14.3; 14.4; 7.1	
1.2.3 Enclosed structures and prevention of leaks	14.5; 14.2	
1.2.5 Additional means of protection	Clause 12	
1.2.8 Overloading of equipment	7.3.4; 10.1; 11.1	

Essential Requirements of Directive 2014/34/EU	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.2.9 Flameproof enclosure systems	7.3; 14.2; 14.3	
1.3.1 Hazards arising from different ignition sources	14.1; Annex E.1	
1.3.2 Hazards arising from static electricity	Annex B; Annex C	
1.4.1 External effects	14.1; Annex E.1	
1.4.2 Mechanical, thermal and chemical stresses	14.1; Annex E.1	
1.6.4 Hazards arising from connections	14.3	
3.0.1 Dimensioning	Clauses 6; 7; 8; 9; 10; 11	
3.0.2 Design and position	Clauses 6; 7; 8; 9; 10; 11	
3.0.4 Outside interference	13.3	
3.1.2 Shock waves	14.4; 7.3.3	

Table ZA.2 — Applicable Standards to confer presumption of conformity as described in this Annex ZA

Column 1 Reference in Clause 2	Column 2 International Standard Edition	Column 3 Title	Column 4 Corresponding European Standard Edition
ISO/IEC 80079-34	ISO/IEC 80079-34:2020	Explosive atmospheres – Part 34: Application of quality systems for ex product manufacture	EN ISO/IEC 80079-34:2020
IEC 60079-0	IEC 60079-0:2017	Explosive atmospheres – Part 0: Equipment – General requirements	EN IEC 60079-0:2018 ¹
IEC 60079-1	IEC 60079-1:2014	Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"	EN 60079-1:2014 ²

¹ As impacted by EN IEC 60079-0:2018/AC:2020-02

² As impacted by EN IEC 60079-1:2014/AC:2018-09

The documents listed in the Column 1 of Table ZA.2, in whole or in part, are normatively referenced in this document, i.e. are indispensable for its application. The achievement of the presumption of conformity is subject to the application of the edition of Standards as listed in Column 4 or, if no European Standard Edition exists, the International Standard Edition given in Column 2 of Table ZA.2.

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

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EXPLOSIVE ATMOSPHERES –

Part 49: Flame arresters – Performance requirements, test methods and limits for use

FOREWORD

- 1) ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.
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ISO/IEC 80079-49 has been prepared by subcommittee 31M: Non-electrical equipment and protective systems for explosive atmospheres, of ISO/IEC joint technical committee 1: Information technology.

This edition cancels and replaces ISO 16852:2016, which has been technically revised. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to ISO 16852:2016:

- a) adaptation of the relevant IEC TC 31 requirements on standards;
- b) modification of the upper limit of the temperature range from 150 °C to 200 °C under the condition that T_0 shall be not larger than 80 % of the auto ignition temperature of the gas-air-mixture;
- c) change of the term "explosion group" to "equipment group" due to editorial requirements in IEC/TC 31;
- d) clarification of the conditions and requirements for flame arresters whose intended operating conditions are outside the atmospheric conditions in 7.3.4 and 7.3.5;

- e) clarification of the requirements on the information for use in Clause 12 f) concerning the burn time;
- f) addition of a permission to the construction requirements both in 7.1 and 14.1 to substitute visual inspection by performing a flow test;
- g) addition of a flow chart for the evaluation of test results as Annex D.

The text of this International Standard is based on the following documents:

Draft	Report on voting
31M/212/FDIS	31M/223/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

A list of all parts in the ISO/IEC 80079 series, published under the general title *Explosive atmospheres*, can be found on the IEC website.

NOTE The following print types are used:

- Words in *italic* font in the text are defined in Clause 3.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

INTRODUCTION

Flame arresters are protective systems fitted to openings of enclosures or to pipe work and are intended to allow fluid flow but prevent flame transmission if a flammable mixture is ignited. They have widely been used for decades in the chemical and oil industry, and a variety of national standards is available. This document was prepared with an aim to establish an international basis by harmonizing and incorporating recent national developments and standards as far as reasonable.

This document addresses performance requirements and test methods, as well as limits for use for flame arresters.

Only the minimum safety requirements for flame arresters to prevent flame transmission are specified.

The hazard identification of common applications found in industry leads to the specification of the test methods. These test methods reflect standard practical situations and, as such, form the heart of this document because they also allow classification of the various types of flame arresters and then determination of the limits of use.

A considerable number of test methods and test conditions had to be taken into account for two main reasons.

- a) Different types of flame arresters are covered with respect to the operating principle (static, hydraulic, liquid, dynamic) and each type clearly needs its specific test set-up and test procedure.
- b) It is necessary to adapt flame arresters to the special conditions of application (gas, installation) because of the conflicting demands of high flame quenching capability and low pressure loss. This situation is completely different from the otherwise similar principle of protection by flameproof enclosure, for example for electrical equipment, where the importance of process gas flow through any gaps is negligible and importance is placed on the flame quenching effect of the gap.

Consequently, in this document, the testing and classification related to Equipment Groups and installation conditions have been subdivided more than is usually the case in other parts of the ISO/IEC 80079 and IEC 60079 series of standards. In particular,

- Equipment Group IIA is subdivided into sub-groups IIA1 and IIA,
- Equipment Group IIB is subdivided into sub-groups IIB1, IIB2, IIB3 and IIB, and
- the type "detonation arrester" is divided into four sub-types, which take into account specific installation situations.

The test conditions lead to the limits for use which are most important for the user. This document specifies this safety relevant information and its dissemination through the manufacturer's written instructions for use and the marking of the flame arresters.

The limits for use are also a link to more general (operational) safety considerations and regulations, which remain the responsibility the user and regulators. Annex B and Annex C offer some guidance on these aspects.

EXPLOSIVE ATMOSPHERES –

Part 49: Flame arresters – Performance requirements, test methods and limits for use

1 Scope

This document specifies the requirements for flame arresters that prevent flame transmission when explosive gas-air or vapour-air mixtures are present. It establishes uniform principles for the classification, basic construction and information for use, including the marking of flame arresters, and specifies test methods to verify the safety requirements and determine safe limits of use.

This document is applicable to pressures ranging from 80 kPa to 160 kPa and temperatures ranging from –20 °C to +200 °C.

NOTE 1 For flame arresters with operational conditions inside the scope, but outside atmospheric conditions, see Annex E.

NOTE 2 In designing and testing flame arresters for operation under conditions other than those specified above, this document can be used as a guide. This document can also be used to design any additional testing related to the specific conditions of use. This is particularly important when high temperatures and pressures are applied. The test mixtures might need to be modified in these cases.

This document does not apply to the following:

- external safety-related measurement and control equipment that might be required to keep the operational conditions within the established safe limits;

NOTE 3 Integrated measurement and control equipment, such as integrated temperature and flame sensors as well as parts which, for example, intentionally melt (retaining pin), burn away (weather hoods) or bend (bimetallic strips), are within the scope of this document.

- flame arresters used for explosive mixtures of vapours and gases, which tend to self-decompose (for example, acetylene) or which are chemically unstable;
- flame arresters used for carbon disulfide, due to its special properties;
- flame arresters whose intended use is for mixtures other than gas-air or vapour-air mixtures (for example, higher oxygen-nitrogen ratio, chlorine as oxidant);
- flame arrester test procedures for reciprocating internal combustion engines;

NOTE 4 Flame arresters for specific applications (e.g. reciprocating internal combustion engines) can use this document as a guide for design but be subject to testing related to their specific use.

- fast acting valves, extinguishing systems and other explosion isolating systems;
- Flame arresters used in gas detectors (those being covered for example, by IEC 60079-29-1 and IEC 62990-1).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

ISO/IEC 80079-34, *Explosive atmospheres – Part 34: Application of quality management systems for Ex Product manufacture*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60079-0 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

flame arrester

device fitted to the opening of an enclosure, or to the connecting pipe work of a system of enclosures, and whose intended function is to allow flow but prevent the transmission of flame

3.2

housing

portion of a *flame arrester* (3.1) whose principal function is to provide a suitable enclosure for the *flame arrester element* (3.3) and allow mechanical connections to other systems

3.3

flame arrester element

portion of a *flame arrester* (3.1) whose principal function is to prevent flame transmission

3.4

stabilized burning

steady burning of a flame stabilized at, or close to, the *flame arrester element* (3.3)

3.5

short time burning

stabilized burning (3.4) for a specified time

3.6

endurance burning

stabilized burning (3.4) for an unlimited time

3.7

explosion

abrupt oxidation or decomposition reaction producing an increase in temperature, pressure, or both simultaneously

[SOURCE: ISO 8421-1:1987, 1.13]

3.8

deflagration

explosion (3.7) propagating at subsonic velocity

[SOURCE: ISO 8421-1:1987, 1.11]

3.9

detonation

explosion (3.7) propagating at supersonic velocity and characterized by a shock wave

[SOURCE: ISO 8421-1:1987, 1.12]

3.10

stable detonation

detonation (3.9) progressing through a confined system without significant variation of velocity and pressure characteristics

Note 1 to entry: For the atmospheric conditions, test mixtures and test procedures of this document, typical velocities range between 1 600 m/s and 2 200 m/s.

3.11

unstable detonation

detonation (3.9) during the transition of a combustion process from a *deflagration* (3.8) into a *stable detonation* (3.10)

Note 1 to entry: The transition occurs in a limited spatial zone, where the velocity of the combustion wave is not constant and where the explosion pressure is significantly higher than in a stable detonation. The position of this transition zone depends, amongst other factors, on pipe diameter, pipe configuration, test gas and explosion group.

Note 2 to entry: An unstable detonation presents a higher level of hazard than a stable detonation due to higher flame speeds and pressures.

3.12

characteristic safety data of explosive mixtures

3.12.1

maximum experimental safe gap

MESG

maximum gap of a joint of 25 mm in width which prevents any transmission of an explosion during tests made under the conditions specified in ISO/IEC 80079-20-1

[SOURCE: ISO/IEC 80079-20-1:2017, 3.4, modified – "in ISO/IEC 80079-20-1" added and Note 1 to entry deleted.]

3.12.2

safe gap

maximum gap of a joint of 25 mm in width which prevents any transmission of an explosion during tests made under the conditions specified in ISO/IEC 80079-20-1 for the specified vapour/gas mixture

3.12.3

equipment grouping

classification system of equipment related to the explosive atmosphere for which they are intended to be used

Note 1 to entry: In a large part of the safety equipment industry "explosion group" is used as an alternative term.

[SOURCE: ISO/IEC 80079-20-1:2017, 3.7, modified – Note 1 to entry replaced.]

3.13

bi-directional flame arrester

flame arrester (3.1) that prevents flame transmission from both sides

3.14

deflagration flame arrester

DEF

flame arrester (3.1) designed to prevent the transmission of a *deflagration* (3.8)

Note 1 to entry: It can be an *end-of-line flame arrester* (3.21) or an *in-line flame arrester* (3.22).

3.15

detonation flame arrester

DET

flame arrester (3.1) designed to prevent the transmission of a detonation

Note 1 to entry: It can be an *end-of-line flame arrester* (3.21) or an *in-line flame arrester* (3.22), and can be used for both *stable detonations* (3.10) and *unstable detonations* (3.11).

3.16

endurance flame arrester

flame arrester (3.1) that prevents flame transmission during and after *endurance burning* (3.6)

3.17

static flame arrester

flame arrester (3.1) designed to prevent flame transmission by quenching gaps

3.17.1

measurable type

flame arrester (3.1) where the quenching gaps of the *flame arrester element* (3.3) can be technically drawn, measured and controlled

3.17.2

non-measurable type

flame arrester (3.1) where the quenching gaps of the *flame arrester element* (3.3) cannot be technically drawn, measured or controlled

EXAMPLE Random structures such as knitted mesh, sintered materials and gravel beds.

3.18

dynamic flame arrester

high velocity vent valve

deflagration proof (see 3.14) pressure relief valve designed always to have efflux velocities that prevent the flame propagation against the flow direction

Note 1 to entry: It can be endurance burn proof (see 3.16).

3.19

liquid product detonation flame arrester

flame arrester (3.1) in which the liquid product is used to form a liquid seal as a flame arrester medium, in order to prevent flame transmission of a stable or unstable detonation without restriction (type 4 or type 2)

Note 1 to entry: There are two types of liquid product detonation flame arrester for use in liquid product lines: liquid seals and foot valves.

3.19.1

liquid seal flame arrester

flame arrester (3.1) designed to use the liquid product to form a barrier to flame transmission

3.19.2

foot valve flame arrester

flame arrester (3.1) designed to use the liquid product combined with a non-return valve to form a barrier to flame transmission

3.20

hydraulic flame arrester

flame arrester (3.1) designed to break the flow of an explosive mixture into discrete bubbles in a water column, thus preventing flame transmission

3.21

end-of-line flame arrester

flame arrester (3.1) that is fitted with one pipe connection only

3.22

in-line flame arrester

flame arrester (3.1) that is fitted with two pipe connections, one on each side of the flame arrester

3.23

pre-volume flame arrester

VDEF

flame arrester (3.1) that, after ignition by an internal ignition source, prevents flame transmission from inside an explosion-pressure-resistant containment (for example, a vessel or closed pipe work) to the outside, or into the connecting pipe work

Note 1 to entry: Explosion-pressure resistance is a property of vessels and equipment designed to withstand the expected explosion pressure without becoming permanently deformed.

3.24

integrated temperature sensor

temperature sensor integrated into the flame arrester, as specified by the manufacturer of the flame arrester, in order to provide a signal suitable to activate counter measures

4 Abbreviated terms and symbols

A_0	free area of a static flame arrester element
A_p	nominal cross sectional area of the flame arrester connection
A_t	cross sectional area on the unprotected side of the flame arrester element
A_u	effective open area of the flame arrester element on the protected side
D	pipe diameter
D_M	minimum diameter of the pipe on the protected side of a dynamic flame arrester
L_M	maximum length without undamped oscillations
L_m	pipe length upstream of the dynamic flame arrester used in flame transmission test
L_p	pipe length on the protected side
L_r	pipe length between flame arrester and restriction
L_u	pipe length on the unprotected side, maximum allowable run-up length for installation
L_1, L_2, L_3, L_4	pipe lengths in the flow test
p_{md}	time average value of the detonation pressure in the time interval of 200 μ s after arrival of the detonation shock wave
p_{mu}	maximum time average value of the transient pressure of an unstable detonation over a time interval of 200 μ s
p_t	pressure in the pressure test
p_T	pressure in the flow test of an end-of-line flame arrester
p_{TB}	pressure before ignition
p_0	maximum operational pressure
Δp	pressure drop in the flow test of an in-line flame arrester
p_E	maximum pressure for the endurance burning test of dynamic flame arresters
p_m	pressure which can cause the maximum temperature at endurance burning test
R_A	ratio of the effective open area of the flame arrester element to pipe cross sectional area
R_U	ratio of the free volume of the flame arrester element to the whole volume
t_{BT}	burning time
$t_{P_{peak}}$	time at which the peak pressure correlating to the leading shock front is achieved in the test
T_{TB}	temperature of the flame arrester before ignition
T_0	maximum operational temperature of the flame arrester
v_{max}	maximum flow velocity during the volume flow-pressure drop measurement (flow test)
v_{min}	minimum flow velocity during the volume flow-pressure drop measurement (flow test)
$\dot{V}$	volume flow rate
$\dot{V}_c$	critical volume flow rate
$\dot{V}_{CL}$	flow rate at closing point of dynamic flame arresters

$\dot{V}_0$	minimum volume flow rate for endurance burning on dynamic flame arresters
$\dot{V}_E$	maximum volume flow rate for endurance burning on dynamic flame arresters
$\dot{V}_K$	maximum volume flow rate for dynamic flame arresters at the set pressure
$\dot{V}_m$	volume flow rate leading to maximum temperature
V_M	minimum volume in the protected tank
$\dot{V}_{\max}$	safe volume flow rate
$\dot{V}_s$	safe volume flow rate including a safety margin
$\dot{V}_t$	maximum volume flow <i>rate</i> leading to flame transmission
$Z_{R\min}$	minimum water seal immersion depth at rest above the outlet openings of the immersion tubes
Z_R	immersion depth at rest, corresponding to $Z_{R\min}$ plus the manufacturer's recommended safety margin
$Z_{0\min}$	minimum operational water seal immersion depth when the mixture flow displaces the water from the immersion tubes, where $Z_{0\min} > Z_{R\min}$
Z_0	operational immersion depth, corresponding to $Z_{0\min}$ plus the manufacturer's recommended safety margin

All pressure values are absolute pressures.

NOTE Symbols in the figures for the flame arrester are in line with ISO 14617-7.

5 Hazards and flame arrester classifications

5.1 Flame transmission classification: deflagration, stable and unstable detonation

The ignition of an explosive mixture will initiate a deflagration. A flame arrester covering only this hazard is classified as a deflagration flame arrester.

NOTE 1 A deflagration when confined in a pipe will usually accelerate and can undergo transition through an unstable to a stable detonation provided sufficient pipe length is available. This pipe length will vary depending upon the initial conditions of the mixture and the pipe work configuration.

A flame arrester tested in accordance with 7.3.3.2 or 7.3.3.3 is classified as a stable detonation flame arrester and is suitable for deflagrations and stable detonations.

NOTE 2 Unstable detonations are a specific hazard requiring higher performance flame arresters than for stable detonations.

A flame arrester tested in accordance with 7.3.3.4 or 7.3.3.5 is classified as an unstable detonation flame arrester and is suitable for deflagrations, stable detonations and unstable detonations.

The specific hazards covered by this document, the classification and the testing required for the appropriate flame arrester are listed in Table 1.

Table 1 – Flame arrester classification for deflagration, stable and unstable detonation

Application	Flame arrester classification
a) unconfined deflagration into an enclosure or vessel	end-of-line deflagration
b) confined deflagration propagating along a pipe into connecting pipe work	in-line deflagration
c) deflagration confined by an enclosure or pipe work to the outside atmosphere or into connecting apparatus	pre-volume deflagration
d) stable detonation propagating along a pipe into connecting pipe work	in-line stable detonation
e) unstable detonation propagating along a pipe into connecting pipe work	in-line unstable detonation
f) stable detonation at the end of a pipe propagating into an enclosure or vessel	end-of-line stable detonation

5.2 Flame transmission classification: stabilized burning

Stabilized burning after ignition creates additional hazards in applications where there could be a continuous flow of the explosive mixture towards the unprotected side of the flame arrester. The following situations shall be taken into account:

- if the flow of the explosive mixture can be stopped within a specific time that is between 1 min and 30 min, flame arresters which, when tested in accordance with 7.3.4, prevent flame transmission during that period of stabilized burning are suitable for that hazard, and they are classified as safe against short time burning;

NOTE Bypassing, sufficient diluting or inerting are measures equivalent to stopping the flow.

- if the flow of the explosive mixture cannot be stopped or, for operational reasons, is not intended to be stopped within 30 min, flame arresters which, when tested in accordance with 7.3.5, prevent flame transmission for this type of stabilized burning are suitable for that hazard, and they are classified as safe against endurance burning.

5.3 Index of tests

Flame arresters shall be tested to the specific Equipment Group of the explosive gas-air or vapour-air mixture (see Table 3, columns 1 and 2).

The tests to be conducted are given in Table 2.

Table 2 – Summary of tests to be conducted

Type of flame arrester		Flame transmission test	Burning test	Flow test
End-of-line deflagration flame arrester (DEF)	Short time burn proof	7.3.2.1	7.3.4	A.3
	Endurance burn proof		7.3.5	
	No stabilised burn rating		—	
In-line deflagration flame arrester (DEF)	Short time burn proof	7.3.2.2	7.3.4	A.2
	Endurance burn proof		7.3.5	
	No stabilised burn rating		—	
Pre-volume flame arrester (VDEF)	No stabilised burn rating	7.3.2.3	—	A.2 or A.3
Stable detonation flame arrester without restriction (DET4)	Short time burn proof	7.3.3.2	7.3.4	A.2
	Endurance burn proof		7.3.5	
	No stabilised burn rating		—	
Stable detonation flame arrester with restriction (DET3)	Short time burn proof	7.3.3.3	7.3.4	A.2
	Endurance burn proof		7.3.5	
	No stabilised burn rating		—	
Unstable detonation flame arrester without restriction (DET2)	Short time burn proof	7.3.3.4	7.3.4	A.2
	Endurance burn proof		7.3.5	
	No stabilised burn rating		—	
Unstable detonation flame arrester with restriction (DET1)	Short time burn proof	7.3.3.5	7.3.4	A.2
	Endurance burn proof		7.3.5	
	No stabilised burn rating		—	
Liquid product detonation flame arrester (DET4+DET2)	No stabilised burn rating	8.3	—	—
Dynamic flame arrester (high velocity vent valve) (DEF)	Deflagration proof	9.2.1, 9.2.2 and 9.2.3	—	A.3.2 and A.4
	Endurance burn proof		9.2.4	
Hydraulic flame arrester	Short time burn proof	10.2.3, 10.2.4	10.2.2	—

Flow charts showing the decision processes for the evaluation of test results of a stable detonation arrester (DET3 and DET4) and an unstable detonation arrester (DET1 and DET2) are given in Annex D.

6 General requirements

6.1 Measuring instruments

Appropriate metrological traceable calibrated measuring instruments shall be used for the tests.

The uncertainty of measurement in the tests shall be such that it can be shown that all the required test parameter limits are met.