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Explosive atmospheres —

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

Atmosphères explosives —

Partie 49: Arrête flammes — Exigences de performance, méthodes d'essai et limites d'utilisation

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CONTENTS

EXPLOSIVE ATMOSPHERES –

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

FOREWORD

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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/XX/XXXX	31M/XX/XXX

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

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.

Words *in italics* in the text are defined in Clause 3.

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

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 This includes the design requirements but excludes as installed testing;

– 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 µs 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 µs
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
Δ_p	pressure drop in the flow test of an in-line flame arrester