



SLOVENSKI STANDARD
oSIST prEN ISO/IEC 80079-49:2022
01-november-2022

Eksplzivne atmosfere - 49. del: Plamenske zapore - Zahtevane lastnosti, preskusne metode in omejitve uporabe (ISO/IEC/DIS 80079-49:2022)

Explosive atmospheres - Part 49: Flame arresters - Performance requirements, test methods and limits for use (ISO/IEC/DIS 80079-49:2022)

Explosive Atmosphären - Teil 49: Flammendurchschlagsicherungen - Leistungsanforderungen, Prüfverfahren und Einsatzgrenzen (ISO/IEC/DIS 80079-49:2022)

Atmosphères explosives - Partie 49: Titre manque (ISO/IEC/DIS 80079-49:2022)

Ta slovenski standard je istoveten z: prEN ISO/IEC 80079-49

ICS:

13.220.20	Požarna zaščita	Fire protection
13.230	Varstvo pred eksplozijo	Explosion protection
29.260.20	Električni aparati za eksplozivna ozračja	Electrical apparatus for explosive atmospheres

oSIST prEN ISO/IEC 80079-49:2022 en,fr,de

DRAFT INTERNATIONAL STANDARD

ISO/IEC DIS 80079-49

ISO/TMBG

Secretariat: ISO

Voting begins on:
2022-09-02Voting terminates on:
2022-11-25

Explosive atmospheres —

Part 49:

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

ICS: 13.220.20

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Reference number
ISO/IEC DIS 80079-49:2022(E)

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Published in Switzerland

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143 INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**EXPLOSIVE ATMOSPHERES - PART 49: FLAME ARRESTERS —
PERFORMANCE REQUIREMENTS, TEST METHODS AND LIMITS FOR USE****FOREWORD**

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185 International Standard ISO 80079-49 has been prepared by IEC sub-committee 31M: Non-
186 electrical equipment and protective systems for explosive atmospheres.

187 This edition cancels and replaces ISO 16852:2016, which has been technically revised.

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

- 190 a) adaptation of the relevant IEC TC 31 requirements on standards;
- 191 b) modification of the upper limit of the temperature range from 150 °C to 200 °C under the
192 condition that T_0 shall be not larger than 80 % of the auto ignition temperature of the gas-
193 air-mixture;
- 194 c) clarification of the conditions and requirements for flame arresters whose intended
195 operating conditions are outside the atmospheric conditions in clauses 7.3.4 and 7.3.5;

- 196 d) clarification of the requirements on the information for use in clause 12.1 indent f
197 concerning the burn time;
- 198 e) addition of a permission to the construction requirements both in clause 7.1 and 13.1 to
199 substitute visual inspection by performing a flow test;
- 200 f) addition of a flow chart for the evaluation of test results as Annex D.
201

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202

INTRODUCTION

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

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

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

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

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

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

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

- 231 • Equipment Group IIA is subdivided into sub-groups IIA1 and IIA,
232 • Equipment Group IIB is subdivided into sub-groups IIB1, IIB2, IIB3 and IIB, and
233 • the type “detonation arrester” is divided into four sub-types, which take into account specific
234 installation situations.

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

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

241

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 valid for pressures ranging from 80 kPa to 160 kPa and temperatures ranging from -20 °C to $+200\text{ °C}$.

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 is not applicable 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, etc.);
- 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.

ISO/IEC 80079-20-1, *Explosive atmospheres — Part 20-1: Material characteristics for gas and vapour classification — Test methods and data*

ISO/IEC 80079-34, *Explosive atmospheres — Part 34: Application of quality systems for ex product manufacture*

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

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

288 **3 Terms and definitions**

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

291 ISO and IEC maintain terminological databases for use in standardization at the following
292 addresses:

- 293 • IEC Electropedia: available at <http://www.electropedia.org/>
- 294 • ISO Online browsing platform: available at <http://www.iso.org/obp>

295 **3.1**

296 **flame arrester**

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

299 **3.2**

300 **housing**

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

303 **3.3**

304 **flame arrester element**

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

306 **3.4**

307 **stabilized burning**

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

309 **3.5**

310 **short time burning**

311 *stabilized burning* (3.4) for a specified time

312 **3.6**

313 **endurance burning**

314 *stabilized burning* (3.4) for an unlimited time

315 **3.7**

316 **explosion**

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

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

320 **3.8**

321 **deflagration**

322 *explosion* (3.7) propagating at subsonic velocity

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

324 **3.9**

325 **detonation**

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

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

3.10

stable detonation

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

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

3.11

unstable detonation

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

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

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

3.12 Characteristic safety data of explosive mixtures

3.12.1

maximum experimental safe gap

MESG

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

349 [SOURCE: ISO/IEC 80079-20-1:2017, 3.4]

3.12.2

equipment grouping

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

354 [SOURCE: ISO/IEC 80079-20-1:2017, 3.7]

3.13

bi-directional flame arrester

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

3.14

deflagration flame arrester

DEF

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

362 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

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

367 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
368 for both *stable detonations* (3.10) and *unstable detonations* (3.11).

3.16

endurance flame arrester

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

372 **3.17**
373 **static flame arrester**
374 *flame arrester* (3.1) designed to prevent flame transmission by quenching gaps

375 **3.17.1**
376 **measurable type**
377 *flame arrester* (3.1) where the quenching gaps of the *flame arrester element* (3.3) can be
378 technically drawn, measured and controlled

379 **3.17.2**
380 **non-measurable type**
381 *flame arrester* (3.1) where the quenching gaps of the *flame arrester element* (3.3) cannot be
382 technically drawn, measured or controlled

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

384 **3.18**
385 **dynamic flame arrester**
386 **high velocity vent valve**
387 deflagration proof (see 3.14) pressure relief valve designed always to have efflux velocities that
388 prevent the flame propagation against the flow direction

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

390

391 **3.19**
392 **liquid product detonation flame arrester**
393 *flame arrester* (3.1) in which the liquid product is used to form a liquid seal as a flame arrester
394 medium, in order to prevent flame transmission of a detonation

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

397 **3.19.1**
398 **liquid seal flame arrester**
399 *flame arrester* (3.1) designed to use the liquid product to form a barrier to flame transmission

400 **3.19.2**
401 **foot valve flame arrester**
402 *flame arrester* (3.1) designed to use the liquid product combined with a non-return valve to form
403 a barrier to flame transmission

404 **3.20**
405 **hydraulic flame arrester**
406 *flame arrester* (3.1) designed to break the flow of an explosive mixture into discrete bubbles in
407 a water column, thus preventing flame transmission

408 **3.21**
409 **end-of-line flame arrester**
410 *flame arrester* (3.1) that is fitted with one pipe connection only

411 **3.22**
412 **in-line flame arrester**
413 *flame arrester* (3.1) that is fitted with two pipe connections, one on each side of the flame
414 arrester