

INTERNATIONAL STANDARD

**Explosive atmospheres -
Part 1: Equipment protection by flameproof enclosures "d"**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**Explosive atmospheres -
Part 1: Equipment protection by flameproof enclosures "d"**

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This eighth edition cancels and replaces the seventh edition published in 2014. This edition constitutes a technical revision.

The significant changes between IEC Standard, IEC 60079-1, Edition 8 (this document) and IEC 60079-1:2014 (Edition 7) are as listed below:

		Type		
Changes	Clause / Subclause	Minor and editorial changes	Extension	Major technical changes
Scope Clarification of terminology	1	X		
Normative references Additional references were added	2	X		
Terms and definitions Additional terms were added and existing terms were clarified	3	X		
Level of Protection "da" Catalytic sensors now permitted for portable, transportable or fixed gas detection equipment for Group I	4.2		X	
General "dc" requirements Schedule drawing details added to explain how to control construction	4.4.2.1	X		
Ratings Electrical ratings were increased from 690 V AC or DC to 1 000 V AC or 1 500 V DC to align with the IEC definition of low voltage equipment	4.4.2.4		X	
Connection facilities Clarification of connection facility requirements for Gc equipment	4.4.2.5	X		
General Requirements Hardening materials shall not be applied to flameproof joints that are designed to be opened during installation or maintenance	5.1			C1
Spigot flameproof joint A spigot flameproof joint with only a cylindrical part is required to comply with cylindrical flameproof joint requirements	5.2.3		X	
Cylindrical flameproof joint Cylindrical flameproof joints requirements are independent of the spigot flameproof joint requirements	5.2.4		X	
Conical flameproof joints Deletion of requirement of the maximum 5° cone angle for conical flameproof joints.	5.2.6 a)		X	
Conical flameproof joints For Group IIC, enclosure volumes greater than 500 cm ³ the maximum prospective short circuit current is limited to 10 000 rms symmetrical amperes.	5.2.6 b)			C2

		Type		
Changes	Clause / Subclause	Minor and editorial changes	Extension	Major technical changes
Flanged flameproof joints for acetylene atmospheres For volumes greater than 500 cm ³ , electrical equipment having enclosures with flanged flameproof joints for acetylene atmospheres shall have a rating on interrupting contacts with a maximum prospective short circuit current of 10 000 RMS symmetrical amperes	5.2.8		X	
Other flameproof joints A new 5.2.11 was added that gives construction requirements for specific constructions having joints that incorporate flamepaths not addressed elsewhere in this document	5.2.11		X	
Table 2 and Table 3 – Change the minimum volume from 0 cm ³ to 10 cm ³ .			B1	
Cemented joints (testing cemented joints)	6.1.1			C3
Length of cemented joint (construction)	6.1.3			C4
Welded or brazed joints Joints may be made by welding or brazing. Added welding of non-metallic materials.	6.3		X	
Moulded joints	6.4	A1		
Light transmitting parts Clarification regarding control of material	9	X		
Ex Component drains and breathers Clarification of requirements on the Schedule of Limitations listed on the Ex Component certificate and in the instructions	10.10	X		
Reference pressures for breathing and draining devices Reference pressure revised for Group I and Group II	10.10.3.4.1			C5
Fasteners and openings Requirements for through the wall threaded fasteners	11.1	X		
Fasteners on which the type of protection depends Note added acknowledging that the tolerance on threads in blind holes will change following torquing of fasteners	11.2	X		
Blind holes Enclosure thickness at bottomed holes clarified	11.4	X		
Thread inserts used for threaded holes Requirements given for use of thread inserts	11.6		X	

		Type		
Changes	Clause / Subclause	Minor and editorial changes	Extension	Major technical changes
Threaded entries Removal of limitation of restricting blanking element with thread adaptor.	13.1.1	A2		
Non-threaded entries for Groups I, IIA and IIB Requirements for IIA and IIB	13.2		X	
Cable glands Requirements for non-threaded cable glands	13.3		X	
Fluid entries Requirements for fluid entries	13.9		X	
Cells and batteries used in flameproof enclosures Added a calling clause to Annex E.	14	X		
Verification and tests Overload or malfunction conditions in Table 6 for rotating machines	Table 6			C6
Tests of ability of the enclosure to withstand pressure Enclosure parts tested separately, while not previously prohibited, is now defined	16.2		X	
Determination of explosion pressure Addressing interfering signals during testing	16.2.2.1		X	
Determining reference pressure for reduced temperatures Reduced ambient temperature determination	16.2.2.2			C7
Igniting an explosive mixture and measuring the pressure Increase in the number of ignitions for Groups I, IIA and IIB	16.2.2.3			C8
Rotating electric machines Text and figures related to the 15.2.2.3 revisions were deleted, but this was not previously related only to electrical machines	16.2.2.4	X		
Equipment marked for specific gases Clarification of construction and test requirements	16.2.2.5	X		
Specific Conditions of Use regarding high reference pressures	16.2.2.6			C9
Overpressure test – First method (static) Clarifies the relative pressure options	16.2.3.2	X		
Other flameproof joints in accordance with 5.2.11	16.3.1		B2	
Equipment of Groups I, IIA and IIB	16.3.2	X		
First method – Testing by increased test gap	16.3.3.2			C10

		Type		
Changes	Clause / Subclause	Minor and editorial changes	Extension	Major technical changes
Second method – Testing by increased pressure	16.3.3.3			C11
Third method – Testing by oxygen enrichment of test gases	16.3.3.4			C12
Preparation of "dc" samples	16.5.2	X		
Test conditions	16.5.3		X	
Test procedure	16.5.3.2		X	
Routine tests	17	X		
Batch testing	17.6			C13
Switchgear for Group I	18	X		
Lampholders and lamp caps	19	X		
Non-metallic enclosures and non-metallic parts of enclosures	20	X		
Marking	21	X		
Instructions	22			C14
Annex A	Annex A	X		
Annex B	Annex B (normative)		X	
C.1 General Ex Equipment and Ex Component flameproof entry devices suitable for reference pressures greater than 2 000	C.1		X	
C.2.1 Sealing methods	C.2.1.1	X		
C.2.1.4 Bushings Clarified the construction and testing requirements for bushings and their mounting	C.2.1.4	X		
C.2.2.1 Threaded flameproof joints	C.2.2.1	X		
Non-threaded flameproof joints (Groups I, IIA or IIB only)	C.2.2.2		X	
C.2.3.1 General requirements Revised permissions into requirements	C.2.3.1			C15
NPT Ex blanking elements Aligned with C.2.2.1 with the addition of tool securing. A shoulder is now permitted with construction requirement such that it will not bottom on the enclosure	C.2.3.3		X	
Non-threaded blanking elements for Group IIA or IIB The addition of IIA or IIB but only as Ex Components	C.2.3.5		B3	
Construction requirements for Ex thread adapters Extension permitting metric thread adapters of other than co-axial construction	C.2.4		X	
Overpressure test Clarification of the source for the test values	C.3.3.2	X		

		Type		
Changes	Clause / Subclause	Minor and editorial changes	Extension	Major technical changes
Overpressure test Clarification of the source for the test values	C.3.4.3	X		
Empty flameproof enclosures as Ex Components	Annex D (normative)	X		
Electrochemical systems Extension of the permitted battery chemistries. All of the electrochemical systems found in the General Requirements document are added with the exception of lead acid chemistry	E.2		X	
General requirements for cells – General Extension to permit two or more cells in parallel and the connection of two or more batteries in series	E.3.1		X	
Restrictions of use Clarified the requirements with the proper use of terms	E.3.2	X		
Added requirements for cells connected in series	E.3.5	X		
Added requirements for cells connected in parallel	E.3.6		X	
Added requirements for cells in series connected in parallel	E.3.7		X	
No additional protection needed Relocation of the existing requirements	E.3.8	X		
Safety device required Added requirements for battery management system	E.4.1.2			C17
Protection against cell polarity reversal or reverse charging by another cell in the same battery Clarified requirements for battery management system	E.4.2	X		
Prevention of inadvertent charging of a battery by other voltage sources in the enclosure Clarification of the requirements	E.4.3	X		
Recharging of secondary cells inside flameproof enclosures A single malfunction of the charging system is now considered.	E.5			C18
Ratings of protective components used as safety devices Editorial clarifications	E.6	X		
Containment systems Annex G has been significantly re-written.	Annex G (normative)			C19
ETD requirements for machines used with converters	Annex H			C20

		Type		
Changes	Clause / Subclause	Minor and editorial changes	Extension	Major technical changes
Recommendation to improve the effectiveness of the determination of explosion pressure Proposals from the IECEx proficiency testing program	Annex I (informative)	X		

NOTE The technical changes referred to include the significance of technical changes in the revised IEC Standard, but they do not form an exhaustive list of all modifications from the previous version. More guidance can be found by referring to the Redline Version of the standard.

Explanations:

A) Definitions

Minor and editorial changes

clarification

- a) decrease of technical requirements
- b) minor technical change
- c) editorial corrections

These are changes which modify requirements in an editorial or a minor technical way. They include changes of the wording to clarify technical requirements without any technical change, or a reduction in the level of an existing requirement.

Extension

addition of technical options

These are changes which add new or modify existing technical requirements, in a way that new options are given, but without increasing requirements for equipment that was fully compliant with the previous standard. Therefore, these will not have to be considered for products in conformity with the preceding edition.

Major technical changes

addition of technical requirements
increase of technical requirements

These are changes to technical requirements (addition, increase of the level or removal) made in a way that a product in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition. These changes have to be considered for products in conformity with the preceding edition. For these changes additional information is provided in clause B) below.

NOTE These changes represent current technological knowledge. However, these changes should not normally have an influence on equipment already placed on the market.

B) Information about the background of changes

A1 – Added clarification for the application of bushing requirements to moulded joints.

A2 – Removed limitation of not allowing the use of a blanking element with a thread adaptor.

B1 – Experience has shown that for enclosures volumes less than or equal to 10 cm³ the energy of an ignition is insufficient to require the construction shown in Table 2 or Table 3. For volume ≤ 10 cm³, the flameproof joint lengths need not comply with the values given in Table 2 or Table 3, provided the requirements of Clauses 14 through 16 are satisfied and the compliant construction is detailed in the schedule drawings.

B2 – Other Flameproof joints – Due to the critical aspect regarding the dimensional control for this type of construction, particular attention is to be given for the tests in order to measure accurately the parameters of flameproof joints (the length, the gaps and the angle between the adjacent parts of the flameproof joints).

B3 – Non-threaded blanking elements permitted for Group IIA or IIB. Previously permitted only for Group I.

C1 – For Ex "d" enclosures, a new requirement for use of material that hardens after the flameproof joint is assembled (for example, a locking compound on threaded flameproof joints). See Clause 5.1.

C2 – For Ex "d" enclosures where flameproof joints include conical surfaces, the length of the flameproof joint and the gap normal to the flameproof joint surfaces are to comply with the relevant values of the cylindrical flameproof joint dimensions in Table 2 and Table 3 as applicable. The gap is to be uniform through the conical part. For Group IIC, enclosure volumes greater than 500 cm³, the maximum prospective short circuit current is limited to 10 000 RMS symmetrical amperes.

C3 – It is recognized that in the past some designs complied with the construction identified in either a) or b) although the requirement was not clear to comply with those requirements, nor to document it, so a) and b) have been added to ensure compliance with designs that have been evaluated with only the cemented joint or having combined cemented joints.

C4 – Requirements for material used to facilitate retention of the cement while curing shall neither be taken into account in the determination of the shortest continuous length of the cement nor interrupt it.

C5 – Reference pressure revised for Group I and Group II. The Ex breathing and draining device is to be submitted to a type test for resistance to pressure carried out by means of a static pressure test as specified in 16.2.3.2 at the following minimum test values:

- a) 2 000 kPa for equipment of Group I; or
- b) 3 000 kPa for equipment of Group II.

C6 – Electric machines that are converter fed are to be evaluated for overload conditions during determination of the maximum surface temperature.

C7 – When the minimum ambient temperature is such that the test gases are not flammable, the test is to be conducted at a temperature that represents the minimum temperature at which the test gases remain gaseous.

C8 – For Groups I, IIA and IIB, the requirement for three tests for the determination of reference pressure used up to Edition 7 of this document (2014) represented a suitable means to address the determination of reference pressure where pressure piling did not occur. For Edition 8, the number of tests was revised to five for Groups I, IIA and IIB to simplify the determination of reference pressure where pressure piling might or might not occur. As a part of this simplification, the hydrogen/methane tests have also been removed. The requirements for the number of tests and test mixtures to be performed in the determination of reference pressure in Edition 7 are considered equivalent to the number of tests and test mixtures to be performed in the determination of reference pressure in Edition 8.

C9 – Specific Conditions of Use regarding high reference pressures the Ex Equipment certificate number is to include the suffix "X" in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use listed on the certificate are to state that flameproof entry devices are to be capable of withstanding 1,5 times this pressure.

C10 – First method – Testing by increased test gap. The test is performed five times for each ignition source location with each mixture, with each ignition source location determined based on the configuration of the enclosure. If the equipment is intended for use solely with hydrogen or solely with acetylene, the tests are to be performed only with the corresponding explosive test mixture. For enclosures with flanged flameproof joints according to 5.2.8 and with volumes greater than 500 cm³, the number of tests above are to be increased from five to ten with the corresponding acetylene gas-air mixture.

C11 – Second method – Testing by increased pressure. The test is to be performed five times for each ignition source location with each mixture, with each ignition source location determined based on the configuration of the enclosure. If the equipment is intended for use solely with hydrogen or solely with acetylene, the tests are to be performed only with the corresponding explosive test mixture. For enclosures with flanged flameproof joints according to 5.2.8 and with volumes greater than 500 cm³, the number of tests above is to be increased from five to ten with the corresponding acetylene gas-air mixture.

C12 – Third method - Testing by oxygen enrichment of test gases. The test is to be performed five times for each ignition source location with each mixture, with each ignition source location determined based on the configuration of the enclosure. If the equipment is intended for use solely with hydrogen or solely with acetylene, the tests are to be performed only with the corresponding explosive test mixture. For enclosures with flanged flameproof joints according to 5.2.8 and with volumes greater than 500 cm³, the number of tests above is to be increased from five to ten with the corresponding acetylene gas-air mixture.

C13 – Batch testing – For any non-compliant results, 100 % of remaining sample shall be tested at 1,5 times the reference pressure. Future batches shall be routine tested at 1,5 times the reference pressure until confidence is established to reconsider batch testing.

C14 – Instructions are to include:

- b) procedures for repairing threaded flameproof joints employing a locking compound, if required by 5.1.
- c) guidance for the selection of flameproof entry devices as well as flameproof breathing and draining devices for equipment with reference pressure values greater than 2 000 kPa for Group II or 1 333 kPa for Group I.
- d) when either a non-threaded entry or entry device is incorporated to facilitate its installation, the following is to be specified as applicable.

C15 – Revised permissions into requirements for items b) and c).

C16 – Non-threaded blanking elements permitted for Group IIA or IIB.

C17 – Added requirements for battery management system.

C18 – Recharging of secondary cells inside flameproof enclosures - the charging conditions are to be fully specified in the manufacturer's documents and safety devices are to be fitted to ensure that these conditions are not exceeded even with a single malfunction in the charging system.

C19 – Annex G has been significantly re-written. Some of the significant changes include:

- The requirements for limited release containment systems were modified to include containment systems that release flammable substances and non-flammable substances in normal operation.
- Design and test requirements were added for limited release containment systems that limit the release by inherent design of the containment system, instead of relying on flow limiting devices.
- A venting test was added to validate that the breathing/draining device is adequate for the release rate of the limited release containment system.
- The overpressure and leakage test requirements were modified to better align with IEC 60079-26, and IEC TS 60079-40, and to clarify the test methods.
- The equipment grouping and temperature classification for the equipment must include the substance within the limited release containment system.
- Routine test requirements were added for specific containment system constructions.

C20 – ETD requirements – For this provision, the certificate number is to include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use listed on the certificate are to require the use of the thermal protection.

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

Draft	Report on voting
31/1987/FDIS	31/1996/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.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60079 series, published under the general title *Explosive atmospheres*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

1 Scope

This part of IEC 60079 contains specific requirements for the construction and testing of Ex Equipment and Ex Components with the Type of Protection flameproof enclosure "d", intended for use in explosive gas atmospheres.

This document supplements and modifies the general requirements of IEC 60079-0. Where a requirement of this document conflicts with a requirement of IEC 60079-0, the requirement of this document takes precedence.

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 60061 (all parts), *Lamp caps and holders together with gauges for the control of interchangeability and safety*

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

IEC 60079-7, *Explosive atmospheres - Part 7: Equipment protection by increased safety "e"*

IEC 60079-11, *Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"*

IEC 60086-1, *Primary batteries - Part 1: General*

IEC 60127 (all parts), *Miniature fuses*

ISO 185:2020, *Grey cast irons - Classification*

ISO 228-1, *Pipe Threads Where Pressure-Tight Joints Are Not Made on the Threads - Part 1: Dimensions, Tolerances and Designation*

ISO 965-1:2013, *ISO general purpose metric screw threads - Tolerances - Part 1: Principles and basic data*

ISO 965-3:2021, *ISO general purpose metric screw threads - Tolerances - Part 3: Limit deviations for screw threads*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 4003:1977, *Permeable sintered metal materials - Determination of bubble test pore size*

ISO 80000-1:2022, *Quantities and units - Part 1: General*

ANSI/ASME B1.20.1, *Pipe threads, general purpose (inch)* ANSI/UL 248 (all parts), *Low-Voltage Fuses*

ASTM F316, *Standard Test Methods for Pore Size Characteristics of Membrane Filters by Bubble Point and Mean Flow Pore Test*

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- [2] ISO/IEC 80079-20-1, *Explosive atmospheres - Part 20-1: Material characteristics for gas and vapour classification - Test methods and data*
- [3] IEC 60079-10-1:2020, *Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres*
- [4] ISO 468, *Surface roughness - Parameters, their values and general rules for specifying requirements* (withdrawn in 1998)
- [5] ISO 2738:1999, *Sintered metal materials, excluding hard metals - Permeable sintered metal materials - Determination of density, oil content and open porosity*
- [6] ISO 4022:2018, *Permeable sintered metal materials - Determination of fluid permeability*
- [7] NFPA 70, *National Electrical Code (NEC)*
- [8] ANSI/UL 1203, *Explosion-proof electrical equipment for use in hazardous (classified) locations*
- [9] ISO 857-2, *Welding and allied processes - Vocabulary - Part 2: Soldering and brazing processes and related terms*
- [10] IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*
- [11] IEC 60079-14, *Explosive atmospheres - Part 14: Electrical installation design, selection and installation of equipment, including initial inspection*
- [12] IEC 60079-15, *Explosive atmospheres - Part 15: Equipment protection by type of protection "n"*
- [13] IEC 60622, *Secondary cells and batteries containing alkaline or other non-acid electrolytes - Sealed nickel-cadmium prismatic rechargeable single cells*
- [14] IEC 60623, *Secondary cells and batteries containing alkaline or other non-acid electrolytes - Vented nickel-cadmium prismatic rechargeable single cells*
- [15] IEC 61951-1, *Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary sealed cells and batteries for portable applications - Part 1: Nickel-Cadmium*
- [16] IEC 61951-2, *Secondary cells and batteries containing alkaline or other non acid electrolytes - Secondary sealed cells and batteries for portable applications - Part 2: Nickel-metal hydride*
- [17] IEC 61960 (all parts), *Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications*

- [18] EN 1779, *Non-Destructive Testing - Leak Testing - Criteria for Method and Technique Selection*

 - [19] Journal of Loss Prevention in the Process Industries 76:104739.(2022) *Comparison of thermal runaway pressures within sealed enclosures for nickel manganese cobalt and iron phosphate cathode lithium-ion cells. Dubaniewicz TH, Barone TL, Brown CB, Thomas RA*
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