UL 60079-1

STANDARD FOR SAFETY

Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”

UL Standard for Safety for Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”, UL 60079-1

Seventh Edition, Dated September 18, 2015

Summary of Topics

This revision of ANSI/UL 60079-1 dated January 23, 2020 includes a US National Difference for Level of Protection "db" plugs and sockets limited to EPL Gc; 13.6.5DV

This standard is an adoption of IEC 60079-1, Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d” (seventh edition, issued June 2014) with US National Differences.

The new revised requirements are substantially in accordance with Proposal (s) on this subject dated September 13, 2019.

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ANSI/UL 60079-1-2020

UL 60079-1

Standard for Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures "d"

Seventh Edition

September 18, 2015

This ANSI/UL Standard for Safety consists of the Seventh Edition including revisions through January 23, 2020.

The most recent designation of ANSI/UL 60079-1 as an American National Standard (ANSI) occurred on January 23, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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PREFACE (UL)

This UL standard is based on IEC Publication 60079-1: 2014 edition, Explosive Atmospheres - Part 1: Equipment Protection by Flameproof Enclosures "d" issued 06-2014. IEC publication IEC 60079-1 is copyrighted by the IEC.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

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National Differences

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60079-1, Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”, (seventh edition, issued by IEC June 2014), are indicated by notations (differences) and are presented in bold text using legislative text (strike-out and underline).

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

The UL standard includes the national difference types within the body of the text.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

DR – These are National Differences based on the **national regulatory requirements**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES – Part 1: Equipment protection by flameproof enclosures “d”

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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6) All users should ensure that they have the latest edition of this publication.

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8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

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

International Standard IEC 60079-1 has been prepared by IEC technical committee 31: Equipment for explosive atmospheres.

This seventh edition cancels and replaces the sixth edition, published in 2007, and constitutes a technical revision.

The significance of the changes between IEC 60079-1, Edition 7.0 (2014) and IEC 60079-1 Edition 6.0 (2007) (including Corrigendum 1 (2008)), is as listed below:

		Type		
Explanation of the significance of the changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Normative references (Removal of the edition date from the reference for IEC 60079-0)	2	X		
Requirements for level of protection “da” (Catalytic sensors of portable combustible gas detectors)	4.2		X	
Requirements for level of protection “dc” (“Enclosed break” devices from IEC 60079-15)	4.4, 15.5	X		
Flameproof joints, General requirements (Documentation clarification and examples of corrosion inhibiting grease)	5.1	X		
Flameproof joints, General requirements (Specific Conditions of Use that joints are not intended to be repaired)	5.1		X	
Flameproof joints, General requirements (Electroplating more than 0,008 mm thick)	5.1		X	
Non-threaded joints, Gap (*i*) (Intentional gaps between surface for flanged joints)	5.2.2	X		
Serrated joints (Use and test requirements)	5.2.8	X		
Multi-step joints (Not less than 3 adjacent segments and two path changes)	5.2.9		X	
Minimum width of joint and maximum gap for enclosures of groups IIA and IIB (Maximum gaps for flanged, cylindrical or spigot joints of 9,5 mm minimum width and volume greater than 2 000 cm^3)	Table 2		X	
Minimum width of joint and maximum gap for enclosures of groups I, IIA, IIB and IIC (ISO 80000-1 for constructional value rounding)	Table 2, Table 3	X		
Cylindrical threaded joints (ISO 965-1 standard in respect of thread form or quality of fit)	Table 4	X		
Taper threaded joints (External and internal thread construction)	Table 5	X		
Cemented joints (Supplemental mechanical means of securement)	6.1.2			C1
Cemented joints (Evaluation criteria if there is leakage)	6.1.2		X	
Fused glass joints (Glass-to-metal joints)	6.2		X	
Thermal tests of breathing and draining devices (Temperature class based on external surface temperature after the 10 min test period)	10.9.3.2	X		
Test of the ability of the breathing and draining device to withstand pressure (Relocated from before thermal tests to after the non-transmission test)	10.9.3.4	X		

		Type		
Explanation of the significance of the changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Ex component certificate (Service temperature range for non-metallic enclosures per IEC 60079-0)	10.9.4	X		
Fasteners and openings *(Relocation of blanking element content to 13.8 and C.2.3)*	11	X		
Fasteners and openings, Property class or yield stress *(Certificate specific condition of use)*	11.3	X		
Fasteners and openings *(Openings in the wall of the enclosure)*	11.8	X		
Materials *(Material limitation in acetylene atmospheres)*	12			C2
Entries for flameproof enclosures, General *(Metric and NPT threaded entries)*	13.1	X		
Entries for flameproof enclosures, General *(Group I non-threaded joints)*	13.1		X	
Entries for flameproof enclosures, Non-threaded holes *(Group I application)*	13.3		X	
Entries for flameproof enclosures, Cable glands *(Group I application)*	13.4		X	
Cable glands, Conduit sealing devices *(Documentation to facilitate mounting)*	13.4, 13.5	X		
Plugs and sockets and cable couplers *(Load requirement for arc-quenching test)*	13.6.4			C3
Bushings *(Documentation to facilitate mounting)*	13.7	X		
Blanking elements *(Relocated from Clause 11)*	13.8	X		
Verification and tests *(Maximum surface temperature conditions)*	Table 6	X		
Type tests *(Sequence and number of samples for tests)*	15	X		
Determination of explosion pressure, General *(Devices that can cause turbulence)*	15.2.2.2	X		
Determination of explosion pressure, General *(Number of tests for Group IIC)*	15.2.2.2	X		
Determination of explosion pressure, General *(Pressure pilling for Group IIB)*	15.2.2.4	X		
Determination of explosion pressure, General *(Equipment marked for a single gas)*	15.2.2.5DV.1	X		
Overpressure test, General *(Low ambient overpressure tests not required)*	15.2.3	X		
Overpressure test – First method (static)	15.2.3.2		X	

		Type		
Explanation of the significance of the changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
(3 times option when routine batch testing)				
Overpressure test – First method (static) *(Adjustment for low ambient due to small size of equipment)*	15.2.3.2		X	
Overpressure test – Second method (dynamic) *(Number of tests to be made)*	15.2.3.3	X		
Test for non-transmission of an internal ignition *(Clarification regarding grease)*	15.3	X		
Reduction in length of a threaded joint for non-transmission test *(ISO 965-1 and 965-3 standards in respect of thread form and quality of fit)*	Table 9	X		
Test factors to increase pressure or test gap *(Group IIC adjustments for elevated ambients)*	Table 10	X		
Test for non-transmission of an internal ignition, Groups I, IIA and IIB *(Number of tests to be made)*	15.3.2.3	X		
Test for non-transmission of an internal ignition, Group IIC testing by increased gap *(Number of tests to be made)*	15.3.3.2	X		
Test for non-transmission of an internal ignition, Group IIC *(Oxygen enrichment of test gases)*	15.3.3.4		X	
Thermal tests of enclosures with breathing and draining devices *(Temperature class based on external surface temperature after the 10 min test period)*	15.4.3.1	X		
Tests for “dc” devices *(“Enclosed break” devices from IEC 60079-15)*	15.5		X	
Routine tests, General *(Adjustment for low ambient due to small size of equipment)*	16.1.2		X	
Routine tests, General *(Options when second method is chosen)*	16.1.3	X		
Routine tests, General *(Welded joint inspection options)*	16.3		X	
Routine tests, General *(Allowance for batch testing)*	16.6		X	
Switchgear for Group I *(Clarifying need for compliance with EPL Mb types of protection)*	17.2.2, 17.2.3	X		
Non-metallic enclosures and non-metallic parts of enclosures, General *(Exception for cemented joints)*	19.1	X		
Non-metallic enclosures and non-metallic parts of enclosures, Resistance to tracking and creepage distances *(Reference to both IEC 60079-7 and or IEC 60079-15)*	19.2		X	
Non-metallic enclosures and non-metallic parts of enclosures, Requirements for type tests *(Clarification of test sequence)*	19.3	X		

		Type		
Explanation of the significance of the changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Instructions *(Indication that repair of flamepaths is not intended)*	21		X	
Bushings *(Documentation regarding numbers of cores)*	C.2.1.4	X		
Bushings *(Criteria for non-transmission test)*	C.2.1.4	X		
Bushings *(Evaluation criteria if there is leakage)*	C.2.1.4		X	
Flameproof joints, Threaded joints *(Requirement options)*	C.2.2.1	X		
Flameproof joints, Non-threaded joints *(Group I application)*	C.2.2.2		X	
Constructional requirements for Ex blanking elements *(Relocated from Clause 11)*	C.2.3.1	X		
Constructional requirements for Ex blanking elements *(Metric and NPT Ex blanking elements)*	C.2.3.2, C.2.3.3	X		
Constructional requirements for Ex blanking elements *(Group I non-threaded construction)*	C.2.3.4		X	
Sealing test, General *(Allowance for re-tightening)*	C.3.1.1	X		
Cable glands and conduit sealing devices with sealing ring *(Mandrel to be corrosion-resistant metal)*	C.3.1.2	X		
Type tests for Ex blanking elements, Torque test *(Test-block to be steel)*	C.3.3.1	X		
Tightening torque values *(Addition of < 16 mm thread size)*	Table C.1		X	
Tightening torque values *(Addition of NPT thread sizes)*	Table C.2		X	
Ex component enclosure requirements *(Markings content)*	D.3.8			C4
Ex component enclosure requirements *(Certificate content)*	D.3		X	
Utilization of an Ex component enclosure certificate to prepare an equipment certificate, Procedure *(Devices that can create significant turbulence)*	D.4.1		X	
Acceptable primary cells *(Addition of Type B cells)*	Table E.1		X	
Acceptable primary cells *(Removal of Type T cells)*	Table E.1			C5
Acceptable secondary cells *(Addition of Lithium type cells)*	Table E.2		X	
Prevention of excessive temperature and cell damage	E.4.1	X		

		Type		
Explanation of the significance of the changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
(Application of IEC 60079-11 requirement)				
Prevention of inadvertent charging of a battery by other voltage sources in the enclosure *(Construction not requiring additional protection)*	E.4.3		X	
Recharging of secondary cells inside flameproof enclosures *(Additional battery options)*	E.5.1		X	
Introduction of an alternative risk assessment method encompassing equipment protection levels' for Ex equipment *(Removal of previous Informative Annex)*	Annex G	X		
Additional requirements for Flameproof enclosures with an internal source of release (containment system) *(Addition of new Normative Annex)*	Annex G		X	
Requirements for machines with flameproof "d" enclosures fed from converters *(Addition of new Normative Annex)*	Annex H		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

decrease of technical requirements

minor technical change

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 level of 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

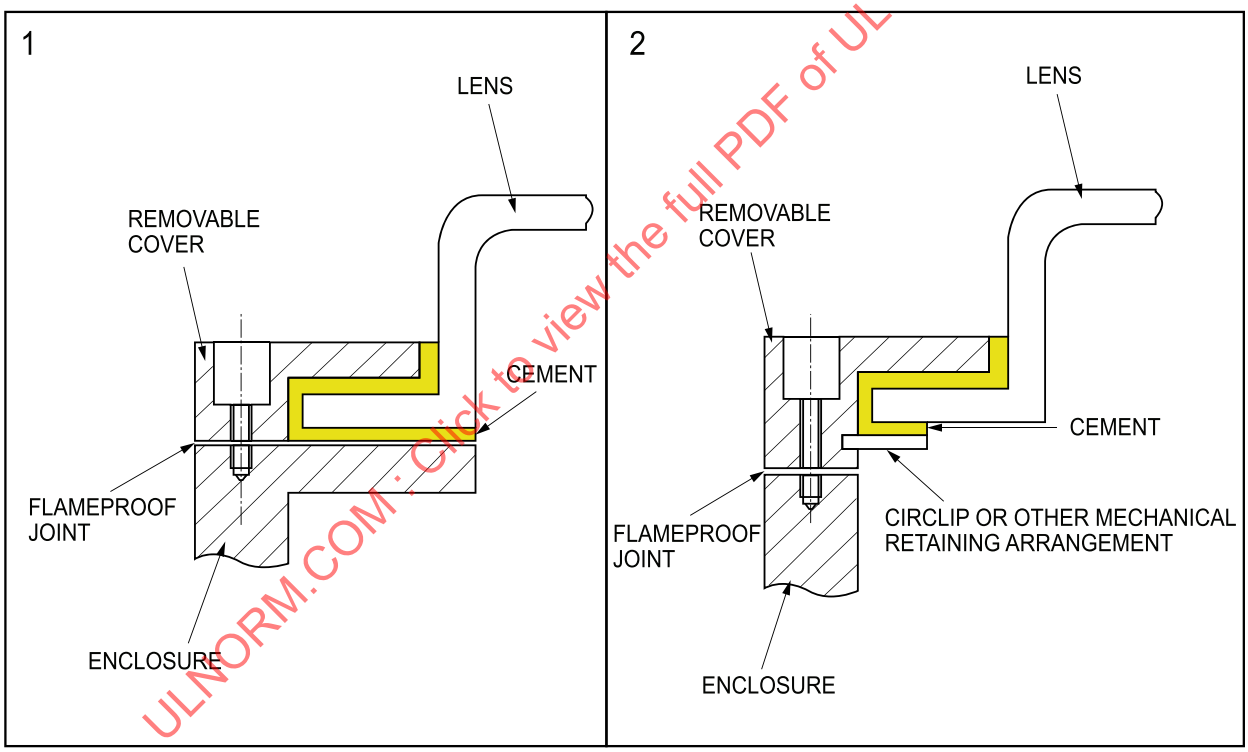
increase of technical requirements

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 'Major Technical Changes'

C1 – Supplemental mechanical means of securing the cemented joint shall not be defeated by the opening of doors or covers that are intended to be opened during installation or maintenance. For example, in the images below for a luminaire incorporating a cemented joint between the lens and the enclosure cover, the construction shown in the second image would be in accordance with this requirement, while the construction shown in the first image would not.



su1966

IEC 1932/14

C2 – Addition of material limitations of enclosures of equipment and enclosures of Ex components for external mounting, if constructed of copper or copper alloys, when used in explosive gas atmospheres containing acetylene (12.8).

C3 – Addition of power factor requirement for evaluating the ability of a plug and socket to remain flameproof during the arc-quenching period while opening a test circuit (13.6.4).

C4 – Addition of marking requirements for Ex component enclosures, in addition to the requirements for marking of Ex components given in IEC 60079-0 (D.3.8).

C5 – Removal of Type T cells as acceptable primary cells (Table E.1).

The text of this standard is based on the following documents:

FDIS	Report on voting
31/1111/FDIS	31/1125/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore. iec. ch" in the data related to the specific publication. At this date, the publication will be

• reconfirmed,

• withdrawn,

• replaced by a revised edition, or

• amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

EXPLOSIVE ATMOSPHERES – Part 1: Equipment protection by flameproof enclosures “d”

1 Scope

1DV.1 DR *Modification of Clause 1, first paragraph to replace with the following:*

1DV.1.1 This ~~part of IEC 60079~~ standard contains specific requirements for the construction and testing of electrical equipment with the type of protection flameproof enclosure “d”, intended for use in explosive gas atmospheres.

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

1DV.2 DR *Addition of 1DV.2.1*

1DV.2.1 Where references are made to IEC 60079 standards, the referenced requirements found in these standards shall apply as modified by any applicable U.S. National Differences.

2 Normative references

2DV D1 *Modification of Clause 2 references to replace with the following:*

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60079-15, Explosive atmospheres – Part 15: Equipment protection by type of protection "n"~~

IEC 60127 (all parts), Miniature fuses

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

ISA 60079-7, Explosive atmospheres – Part 7: Equipment protection by increased safety "e"

ISA 60079-11, Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"

ISA 60079-15, Explosive atmospheres – Part 15: Equipment protection by type of protection "n"

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

ISO 965-3, ISO general-purpose metric screw threads – Tolerances – Part 3: Deviations for constructional screw threads

ISO 2738, Sintered metal materials, excluding hardmetals – Permeable sintered metal materials – Determination of density, oil content and open porosity

ISO 4003, Permeable sintered metal materials – Determination of bubble test pore size

ISO 4022, Permeable sintered metal materials – Determination of fluid permeability

ANSI/ASME B1.20.1, Pipe threads, general purpose (inch)

UL 94, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 2225, Metal-Clad Cables and Cable-Sealing Fittings for Use in Hazardous (Classified) Locations

UL 60079-0, Explosive Atmospheres Part 0: Equipment – General Requirements

UL 60079-7, Explosive Atmospheres – Part 7: Equipment Protection by Increased Safety "e"

UL 60079-11, Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety "i"

UL 60079-15, Explosive Atmospheres – Part 15: Equipment Protection by Type of Protection "n"

3 Terms and definitions

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

NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426 [1][1].

[1] References in square brackets refer to the bibliography.

3.1 **flameproof enclosure "d"** enclosure in which the parts which can ignite an explosive gas atmosphere are placed and which can withstand the pressure developed during an internal explosion of

an explosive mixture, and which prevents the transmission of the explosion to the explosive gas atmosphere surrounding the enclosure

3.2 **volume** total internal volume of the enclosure

Note 1 to entry: For enclosures in which the contents are essential in service, the volume to be considered is the remaining free volume.

Note 2 to entry: For luminaries, the volume is determined without lamps fitted.

3.3 **flameproof joint or flamepath** place where the corresponding surfaces of two parts of an enclosure, or the conjunction of enclosures, come together and which prevents the transmission of an internal explosion to the explosive gas atmosphere surrounding the enclosure

3.4 **width of flameproof joint *L*** shortest path through a flameproof joint from the inside to the outside of an enclosure

Note 1 to entry: This definition does not apply to threaded joints.

3.5 **distance *l*** shortest path through a flameproof joint, when the width of the flameproof joint *L* is interrupted by holes intended for the passage of fasteners for assembling the parts of the flameproof enclosure

3.6 **gap of flameproof joint *i*** distance between the corresponding surfaces of a flameproof joint when the electrical apparatus enclosure has been assembled

Note 1 to entry: For cylindrical surfaces, forming cylindrical joints, the gap is the difference between the diameters of the bore and the cylindrical component.

3.7DV DE *Modification of Clause 3.7 to replace with the following:*

maximum experimental safe gap (for an explosive mixture) *MESG* maximum gap of a joint of 25 mm in width which prevents any transmission of an explosion during 10 tests made under the conditions specified in IEC 60079-20-1 [2]

NOTE 1 to entry: ANSI/NFPA 497 also includes information on (MESG) including a table of values.

3.8 **shaft** part of circular cross-section used for the transmission of rotary movement

3.9 **operating rod** part used for the transmission of control movements which may be rotary or linear or a combination of the two

3.10 **pressure-piling** results of an ignition, in a compartment or subdivision of an enclosure, of a gas mixture pre-compressed, for example, due to a primary ignition in another compartment or subdivision

3.11 **quick-acting door or cover** door or cover provided with a device which permits opening or closing by a simple operation, such as the movement of a lever or the rotation of a wheel

Note 1 to entry: The device is arranged so that the operation has two stages:

• one for locking or unlocking, and

• another for opening or closing.

3.12 **door or cover fixed by threaded fasteners** door or cover, the opening or closing of which requires the manipulation of one or more threaded fasteners (screws, studs, bolts or nuts)

3.13 **threaded door or cover** door or cover which is assembled to a flameproof enclosure by a threaded flameproof joint

3.14 **breathing device** device which permits an exchange between the atmosphere within an enclosure and the surrounding atmosphere and which maintains the integrity of the type of protection

3.15 **draining device** device which permits liquids to flow out from an enclosure and which maintains the integrity of the type of protection

3.16DV DR *Modification of Clause 3.16 to replace with the following:*

3.16DV.1 Ex equipment blanking element threaded blanking elements for Group I or II, and non-threaded blanking elements for Group I, that

– are intended to close unused entries,

– are tested separately from the equipment enclosure,

– have an equipment certificate, and

– are intended to be fitted to the equipment enclosure without further consideration

Note 1 to entry: This does not preclude a component certificate for Ex component blanking elements in accordance with ~~IEC~~ UL 60079-0. ~~Examples of blanking elements are shown in Figure C.1.~~

Note 2 to entry: Non-threaded blanking elements are not equipment for Group II applications.

3.17 **Ex equipment thread adapter** thread adapter tested separately from the enclosure but having an equipment certificate and which is intended to be fitted to the equipment enclosure without further consideration

Note 1 to entry: This does not preclude a component certificate for Ex component thread adapters in accordance with IEC 60079-0. Examples of thread adapters are shown in Figure C.3.

3.18 **Ex component enclosure** empty flameproof enclosure provided with an Ex component certificate, without the internal equipment being defined, so as to enable the empty enclosure to be made available for incorporation into an equipment certificate without the need for repetition of type testing

4 Level of protection (equipment protection level, EPL)

4.1 General

Electrical equipment with flameproof enclosure “d” shall be one of the following:

– level of protection “da” (EPL “Ma” or “Ga”);

– level of protection “db” (EPL “Mb” or “Gb”); or

– level of protection “dc” (EPL “Gc”).

The requirements of this standard shall apply to all levels of protection unless otherwise stated.

4.2 Requirements for level of protection “da”

Level of protection “da” is only applicable to catalytic sensors of portable combustible gas detectors.

The following are the additional specific requirements for level of protection “da” that modify or supplement the requirements of this standard:

– the maximum free internal volume shall not exceed 5 cm^3;

– the electrical conductors into the sensor shall employ a sealed joint, in accordance with Clause 6, directly in the wall of the enclosure;

– the breathing device of the sensor shall comply with Clause 10, and shall be bonded to the wall of the enclosure so as to eliminate any gaps (such as cementing per 6.1 or sinter bonding) or shall be press-fitted to the wall of the enclosure with supplemental mechanical means of securing (such as swaging);

– supplied by a circuit of Level of Protection “ia”, with a maximum dissipated power limited to 3,3 W for Group I and 1,3 W for Group II; and

NOTE Catalytic elements operate normally at a high temperature. If the power dissipation is increased beyond normal operating levels, the element fails to an open circuit. Therefore, the required power limitation provides a limitation of the external surface temperature.

– the non-transmission tests of 15.3 or 15.4.4 (if applicable) are modified to increase the number of non-transmission tests as shown in Table 1.

Table 1
Number of non-transmission tests for level of protection “da”

Equipment group	Number of non-transmission tests
I	50
IIA	50
IIB	50
IIC	50 hydrogen and 50 acetylene

4.3 Requirements for level of protection “db”

Other than specific requirements for level of protection “da” and “dc”, all other requirements of this standard shall apply to level of protection “db”.

4.4 Requirements for level of protection “dc”

4.4.1 General

The requirements for level of protection “dc” are applicable to electrical equipment and Ex components with electrical switching contacts and are found in 4.4.2 through 4.4.3.

4.4.2 Construction of “dc” devices

4.4.2.1 General

The requirements of 4.4.2.2 through 4.4.2.5 replace those of Clause 5 through Clause 13. For equipment in level of protection “dc” that is intended for connection to field wiring, Clause 13 applies.

4.4.2.2 Free internal volume

The free internal volume shall not exceed 20 cm^3.

4.4.2.3 Seal protection

Enclosures for level of protection “dc” that do not serve as the external equipment enclosure shall be capable of withstanding normal handling and assembly operations without damage to seals. When the enclosure for level of protection “dc” also serves as the external equipment enclosures, the enclosure requirements of IEC 60079-0 apply.

4.4.2.4 Continuous operating temperature (COT) requirements

Poured seals and encapsulating compounds shall have a continuous operating temperature (COT) range that includes a minimum temperature that is below, or equal to, the minimum service temperature and a maximum temperature that is at least 10 K above the maximum service temperature.

4.4.2.5 Ratings

Devices shall be limited to a maximum rating of 690 V a.c., r.m.s. or d.c. and 16 A a.c. r.m.s. or dc.

4.4.3 Tests for “dc” devices

For devices involving level of protection “dc”, components shall be subjected to the type test specified in 15.5. After the test, the device or component shall show no visible signs of damage, no external ignition shall occur, and there shall be no failure to clear the arc when the switch contacts are opened.

5 Flameproof joints

5.1 General requirements

5.1DV.1 DR *Modification of Clause 5.1, to replace with the following:*

All flameproof joints, whether permanently closed or designed to be opened from time to time, shall comply, in the absence of pressure, with the appropriate requirements of Clause 5.

The design of joints shall be appropriate to the mechanical constraints applied to them.

The dimensions given in 5.2 to 5.5 specify the essential parameters of flamepaths. In instances where any of the following apply (for example, in order to comply with the test for non-transmission of an internal ignition):

– the minimum length of the flameproof joint as stated by the documentation is greater than the relevant minimum; or

– the maximum gap of the flameproof joint as stated by the documentation is less than the relevant maximum; or

– the minimum number of threads engaged for the flameproof joint as stated by the documentation is more than the relevant minimum;

NOTE 1 ~~IEC~~ UL 60079-0 defines the documentation as the documents that give a full and correct specification of the explosion safety aspects of the electrical equipment.

the equipment ~~certificate number shall include the "X" suffix in accordance with the~~ shall be marked according to ~~marking requirements of IEC~~ UL 60079-0 to indicate that there are ~~and the~~ specific conditions of use listed in the instructions ~~on the certificate and in the~~. The instructions shall detail one of the following:

– dimensions of the flameproof joints shall be detailed; or

– specific drawing referenced that details the dimensions of the flameproof joints; or

– specific guidance noted to contact the original manufacturer for information on the dimensions of the flameproof joints; or

– specific indication that the flameproof joints are not intended to be repaired.

NOTE 2 ~~IEC~~ UL 60079-0 permits the use of an advisory marking on the equipment as an alternative to the conditions of use in the instructions ~~for the requirements for the "X" marking~~.

The surface of joints may be protected against corrosion.

Coating with paint or powder-coat finish is not permitted. Other coating material may be used if the material and application procedure have been shown not to adversely affect the flameproof properties of the joint.

Corrosion inhibiting grease, such as petrolatum or soap-thickened mineral oils, may be applied to joint surfaces before assembly. The grease, if applied, shall be of a type that does not harden because of ageing, does not contain an evaporating solvent, and does not cause corrosion of the joint surfaces. Verification of suitability shall be in accordance with the grease manufacturer's specifications.

Joint surfaces may be electroplated. The metal plating, if applied, shall be in accordance with the following:

– if not more than 0,008 mm thick, no additional consideration is necessary;

– if more than 0,008 mm thick, then the maximum gap without the plating shall still be in accordance with the applicable joint requirements, and shall be tested for flame transmission based on the gap dimension that would exist without the plating.

Note: Anodizing of aluminum enclosures is not considered to be plating.

A thread locking compound shall be permitted as a sealant on threaded joints that are not intended to be opened after assembly.

5.2 Non-threaded joints

5.2.1 Width of joints (*L*)

The width of joints shall not be less than the minimum values given in Table 2 and Table 3.

The width of joints for cylindrical metallic parts press-fitted into the walls of a metallic flameproof enclosure of a volume not greater than 2 000 cm^3 may be reduced to 5 mm, if

a) the design does not rely only on an interference fit to prevent the part being displaced during the type tests of Clause 15,

b) the assembly meets the impact test requirements of IEC 60079-0, taking the worst-case interference fit tolerances into account, and

c) the external diameter of the press-fitted part, where the width of the joint is measured, does not exceed 60 mm.

NOTE There is no prohibition of press-fit combinations of other than metallic parts into metallic flameproof enclosures. In these other combinations, the minimum width of joint requirements of Table 2 or Table 3 apply.

5.2.2 Gap (*i*)

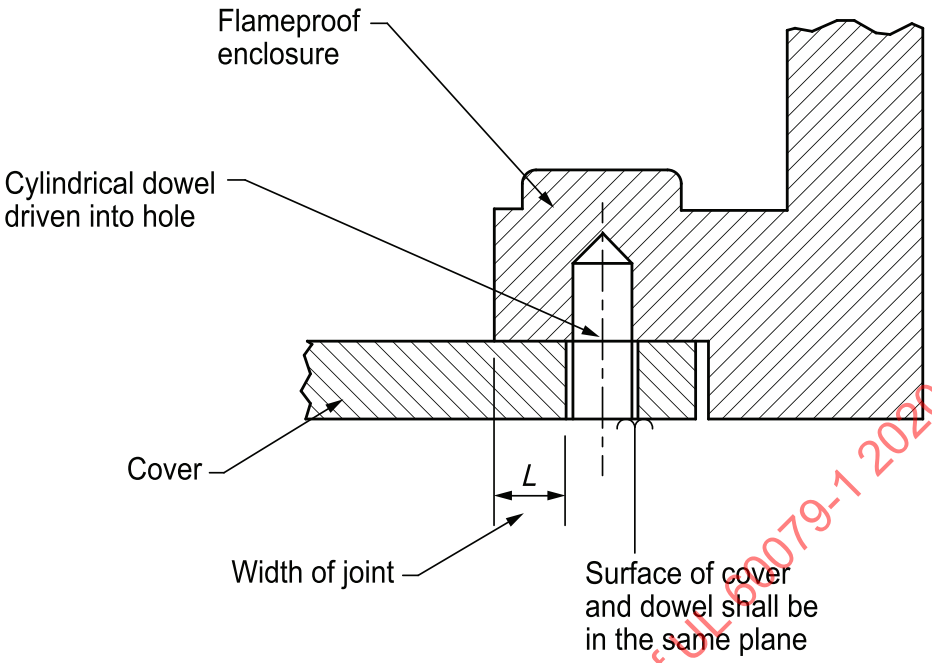
The gap, if one exists, between the surfaces of a joint shall nowhere exceed the maximum values given in Table 2 and Table 3.

The surfaces of joints shall be such that their average roughness R_a does not exceed 6,3 µm.

NOTE Average roughness is derived from ISO 468. Determination can be made by visual comparison to a reference plate.

For flanged joints of other than quick-acting doors or covers, there shall be no intentional gap between the surfaces other than that created by the flatness tolerances of the mating parts.

For electrical equipment of Group I, it shall be possible to check, directly or indirectly, the gaps of flanged joints of covers and doors designed to be opened from time to time. Figure 1 shows an example of construction for indirect checking of a flameproof joint.



IEC 1933/14

Figure 1

Example of construction for indirect checking of a flanged Group I flameproof joint

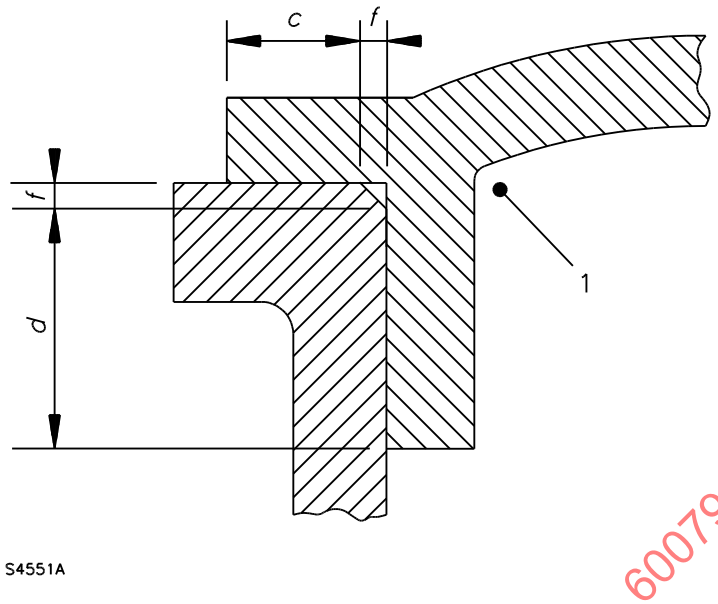
5.2.3 Spigot joints

For the determination of the width *L* of spigot joints, one of the following shall be taken into account:

– the cylindrical part and the plane part (see Figure 2a). In this case, the gap shall nowhere exceed the maximum values given in Table 2 and Table 3; or

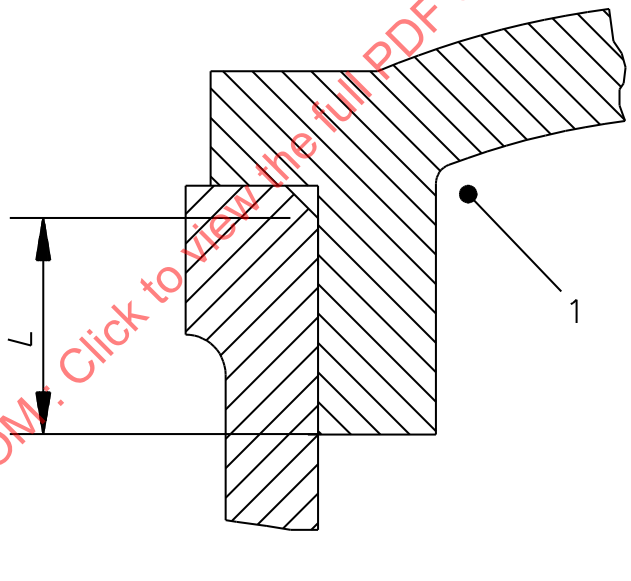
– the cylindrical part only (see Figure 2b). In this case, the plane part need not comply with the requirements of Table 2 and Table 3.

NOTE For gaskets, see also 5.4.



IEC 1900/14

Figure 2a – Cylindrical part and plane part



IEC 1900/14

Figure 2b – Cylindrical part only

Key

L = *c* + *d* (I, IIA, IIB, IIC)

c ≥ 6,0 mm (IIC)

≥ 3,0 mm (I, IIA, IIB)

d ≥ 0,50 L (IIC)

f ≤ 1,0 mm (I, IIA, IIB, IIC)

1 interior of enclosure

Figure 2

Spigot joints

5.2.4 Holes in joint surfaces

5.2.4.1 General

Where a plane joint or the plane part or partial cylindrical surface (see 5.2.6) of a joint is interrupted by holes intended for the passage of threaded fasteners for assembling the parts of a flameproof enclosure, the distance *l* to the edge of the hole shall be equal to or greater than

a) 6 mm when the width of joint *L* is less than 12,5 mm,

b) 8 mm when the width of joint *L* is equal to or greater than 12,5 mm but less than 25 mm,

c) 9 mm when the width of joint *L* is equal to or greater than 25 mm.

NOTE The requirements for clearance holes of fasteners are specified in IEC 60079-0.

The distance *l* is determined as follows.

5.2.4.2 Flanged joints with holes outside the enclosure (see Figure 3 and Figure 5)

The distance *l* is measured between each hole and the inside of the enclosure.

5.2.4.3 Flanged joints with holes inside the enclosure (see Figure 4)

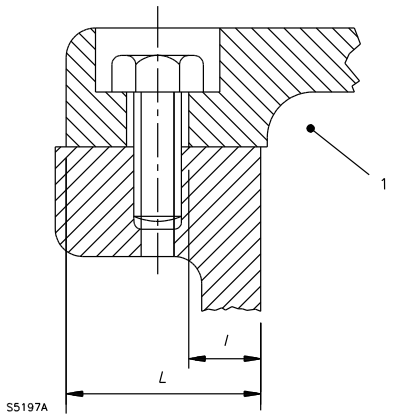
The distance *l* is measured between each hole and the outside of the enclosure.

5.2.4.4 Spigot joints where, to the edges of the holes, the joint consists of a cylindrical part and a plane part (see Figure 6)

The distance *l* is defined as follows:

– the sum of the width *a* of the cylindrical part and the width *b* of the plane part, if *f* is less than or equal to 1 mm and if the gap of the cylindrical part is less than or equal to 0,2 mm for electrical equipment of Groups I and IIA, 0,15 mm for electrical equipment of Group IIB, or 0,1 mm for electrical equipment of Group IIC (reduced gap); or

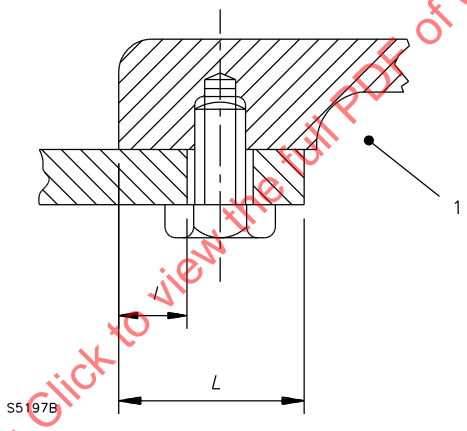
– the width *b* of the plane part alone, if either of the above-mentioned conditions is not met.



IEC 1902/14

Figure 3

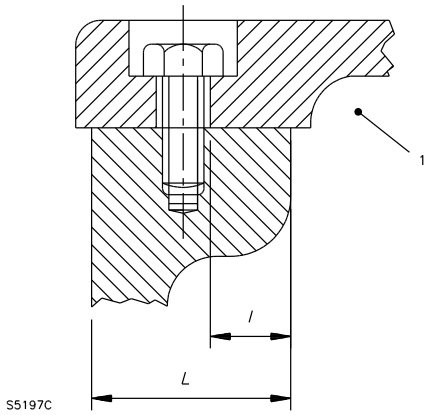
Holes in surfaces of flanged joints, example 1



IEC 1903/14

Figure 4

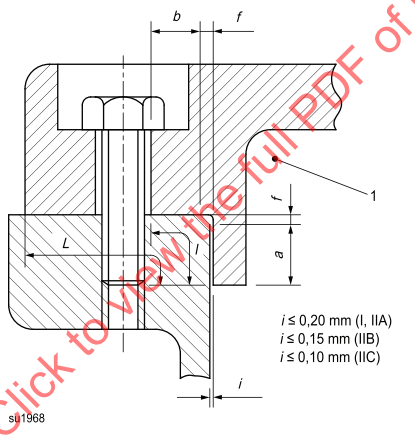
Holes in surfaces of flanged joints, example 2



IEC 1904/14

Figure 5

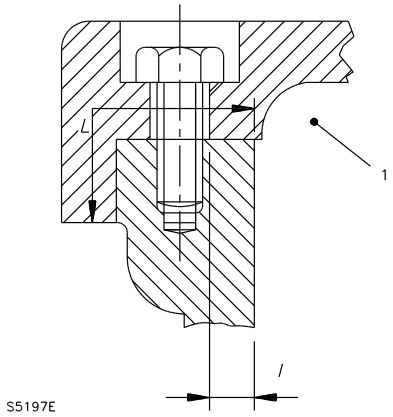
Holes in surfaces of flanged joints, example 3



IEC 1905/14

Figure 6

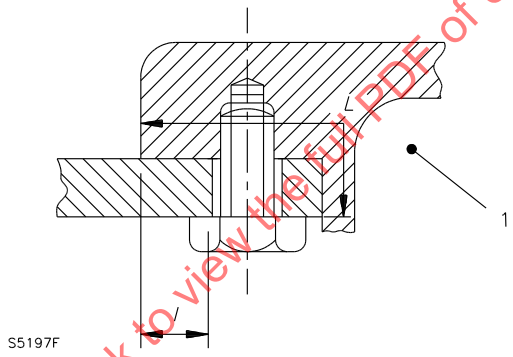
Holes in surfaces of spigot joints, example 1



IEC 1906/14

Figure 7

Holes in surfaces of spigot joints, example 2



IEC 1907/14

Key

1 interior of enclosure

Figure 8

Holes in surfaces of spigot joints, example 3

5.2.4.5 Spigot joints where, to the edges of the holes, the joint consists only of the plane part (see Figure 7 and Figure 8), in so far as plane joints are permitted (see 5.2.7)

The distance *l* is the width of the plane part between the inside of the enclosure and a hole, where the hole is outside the enclosure (see Figure 7), or between a hole and the outside of the enclosure where the hole is inside the enclosure (see Figure 8).

5.2.5 Conical joints

Where joints include conical surfaces, the width of the joint and the gap normal to the joint surfaces shall comply with the relevant values in Table 2 and Table 3. The gap shall be uniform through the conical part. For electrical equipment of Group IIC, the cone angle shall not exceed 5°.

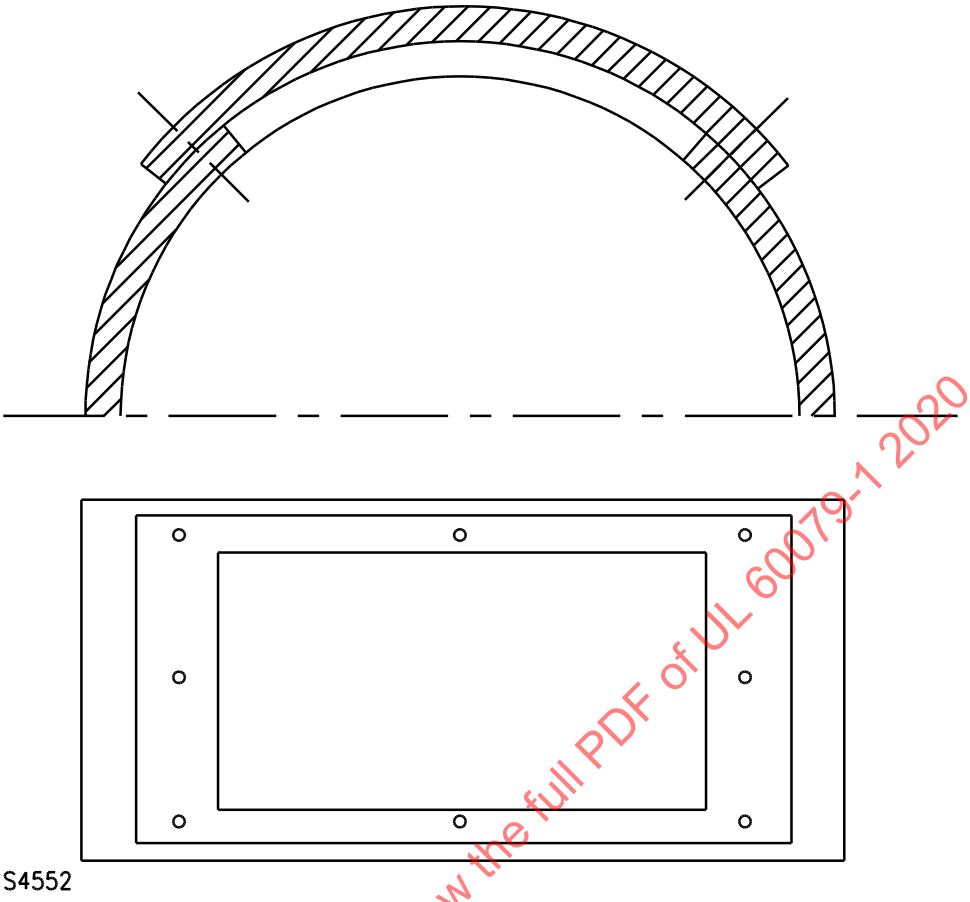
NOTE The cone angle is taken to be the angle between the major axis of the cone and the surface of the cone.

5.2.6 Joints with partial cylindrical surfaces (not permitted for Group IIC)

There shall be no intentional gap between the two parts (see Figure 9a).

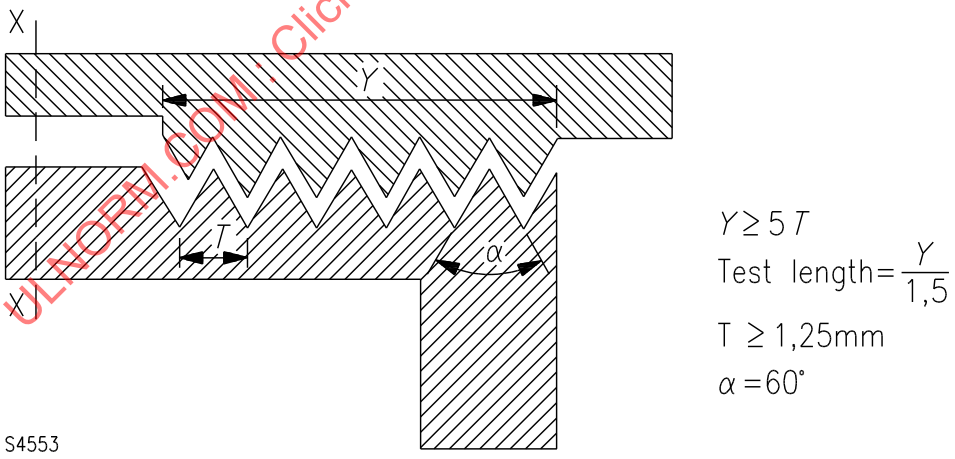
The width of the joint shall comply with the requirements of Table 2.

The diameters of the cylindrical surfaces of the two parts forming the flameproof joint, and their tolerances, shall ensure compliance with the relevant requirements for the gap of a cylindrical joint as given in Table 2.



IEC 1908/14

Figure 9a – Example of a joint with partial cylindrical surfaces



IEC 1909/14

Figure 9b – Example of serrated joint

Figure 9

Examples of joint constructions

5.2.7 Flanged joints for acetylene atmospheres

Flanged joints are only permitted for electrical equipment of Group IIC intended for use in explosive gas atmospheres containing acetylene provided all of the following conditions are met:

– gap $i \leq 0{,}04$ mm;

– width $L \geq 9{,}5$ mm; and

– volume ≤ 500 cm^3.

5.2.8 Serrated joints

Serrated joints need not comply with the requirements of Table 2 and Table 3 but shall have

– at least five fully engaged serrations,

– a pitch greater than or equal to 1,25 mm, and

– an included angle of 60° (± 5°).

Serrated joints shall only be used for joints that are fixed in place during operation.

Serrated joints shall satisfy the test requirements of 15.3, with a) the test gap, i_E, between the mating serrations as specified in 15.3, based on the manufacturer's maximum constructional gap, i_C, and b) the test length reduced to $Y / 1{,}5$.

If the manufacturer's maximum constructional gap is different to that shown in Table 2 or Table 3 for a flanged joint of the same length (determined by multiplying the pitch by the number of serrations), the "conditions of use" requirements of 5.1 apply.

See Figure 9b.

5.2.9 Multi-step joints

5.2.9DV.1 DR *Modification of Clause 5.2.9 to replace with the following:*

5.2.9DV.1.1 A multi-step joint shall consist of not less than 3 adjacent segments where the path changes direction not less than two times by 90° ± 5°.

Multi-step joints need not comply with the requirements of Table 2 or Table 3 but shall satisfy the test requirements of 15.3 with the test length of each segment reduced to not more than 75 % of the manufacturer's specified design minimum lengths.

For flameproof enclosures that incorporate multi-step joints, the equipment ~~certificate number~~ shall ~~include the "X" suffix~~ be marked in accordance with the marking requirements of ~~IEC~~ UL 60079-0 and the ~~specific conditions of use listed on the certificate~~ instructions shall detail one of the following:

– dimensions of the flameproof joints shall be detailed; or

– specific drawing referenced that details the dimensions of the flameproof joints; or

– specific guidance noted to contact the original manufacturer for information on the dimensions of the flameproof joints; or

– specific indication that the flameproof joints are not intended to be repaired.

NOTE 1 ~~IEC~~ UL 60079-0 permits the use of an advisory marking on the equipment as an alternative to the conditions of use in the instructions for the requirements for the "X" marking .

NOTE 2 Multi-step joints are distinct from labyrinth joints on rotating shafts as addressed in this standard (see 8.1.3).

Table 2
Minimum width of joint and maximum gap for enclosures of Groups I, IIA and IIB

Type of joint		Minimum width of joint *L*	Maximum gap mm														
			For a volume (cm^3) $V \leq 100$			For a volume (cm^3) $100 < V \leq 500$			For a volume (cm^3) $500 < V \leq 2\,000$			For a volume (cm^3) $2\,000 < V \leq 5\,750$			For a volume (cm^3) $V > 5\,750$		
		mm	I	IIA	IIB	I	IIA	IIB	I	IIA	IIB	I	IIA	IIB	I	IIA	IIB
Flanged, cylindrical or spigot joints		6	0,30	0,30	0,20	–	–	–	–	–	–	–	–	–	–	–	–
		9,5	0,35	0,30	0,20	0,35	0,30	0,20	0,08	0,08	0,08	–	0,08	0,08	–	0,08	–
		12,5	0,40	0,30	0,20	0,40	0,30	0,20	0,40	0,30	0,20	0,40	0,20	0,15	0,40	0,20	0,15
		25	0,50	0,40	0,20	0,50	0,40	0,20	0,50	0,40	0,20	0,50	0,40	0,20	0,50	0,40	0,20
Cylindrical joints for shaft glands of rotating electrical machines with:	Sleeve bearings	6	0,30	0,30	0,20	–	–	–	–	–	–	–	–	–	–	–	–
		9,5	0,35	0,30	0,20	0,35	0,30	0,20	–	–	–	–	–	–	–	–	–
		12,5	0,40	0,35	0,25	0,40	0,30	0,20	0,40	0,30	0,20	0,40	0,20	–	0,40	0,20	–
		25	0,50	0,40	0,30	0,50	0,40	0,25	0,50	0,40	0,25	0,50	0,40	0,20	0,50	0,40	0,20
		40	0,60	0,50	0,40	0,60	0,50	0,30	0,60	0,50	0,30	0,60	0,50	0,25	0,60	0,50	0,25
	Rolling-element bearings	6	0,45	0,45	0,30	–	–	–	–	–	–	–	–	–	–	–	–
		9,5	0,50	0,45	0,35	0,50	0,40	0,25	–	–	–	–	–	–	–	–	–
		12,5	0,60	0,50	0,40	0,60	0,45	0,30	0,60	0,45	0,30	0,60	0,30	0,20	0,60	0,30	0,20
		25	0,75	0,60	0,45	0,75	0,60	0,40	0,75	0,60	0,40	0,75	0,60	0,30	0,75	0,60	0,30
		40	0,80	0,75	0,60	0,80	0,75	0,45	0,80	0,75	0,45	0,80	0,75	0,40	0,80	0,75	0,40

Constructional values rounded according to ISO 80000-1 [3] should be taken into consideration when determining the maximum gap.

NOTE In this edition of IEC 60079-1, two new columns were introduced into Table 2 that subdivided the previous single "$V > 2\,000$" column into a "$2\,000 < V < 5\,750$" column and a "$V > 5\,750$" column. This subdivision was made to introduce maximum gap dimensions for flanged, cylindrical or spigot joints with minimum width of joint *L* of 9,5 mm where none existed previously. Specifically, it introduced the values "0,08" for Groups IIA and IIB when volume is "$2\,000 < V < 5\,750$" and "0,08" for Group IIA when volume is "$V > 5\,750$". These maximum gap values and the associated volume subdivisions are based on historic US Class I, Division 1 explosion-proof gap dimensions documented in ANSI/UL 1203 [4].

Table 3
Minimum width of joint and maximum gap for Group IIC enclosures

Type of joint	Minimum width of joint *L* mm	Maximum gap mm For a volume cm³ *V* ≤ 100	For a volume cm³ 100 < *V* ≤ 500	For a volume cm³ 500 < *V* ≤ 2 000	For a volume cm³ *V* > 2 000
Flanged joints[a]	6	0,10	–	–	–
	9,5	0,10	0,10	–	–
	15,8	0,10	0,10	0,04	–
	25	0,10	0,10	0,04	0,04
Spigot joints (Figure 2a) *c* ≥ 6 mm, *d* ≥ 0,5 *L*, *L* = *c* + *d*, *f* ≤ 1 mm	12,5	0,15	0,15	0,15	–
	25	0,18[b]	0,18[b]	0,18[b]	0,18[b]
	40	0,20[c]	0,20[c]	0,20[c]	0,20[c]
Cylindrical joints Spigot joints (Figure 2b)	6	0,10	–	–	–
	9,5	0,10	0,10	–	–
	12,5	0,15	0,15	0,15	–
	25	0,15	0,15	0,15	0,15
	40	0,20	0,20	0,20	0,20
Cylindrical joints for shaft glands of rotating electrical machines with rolling element bearings	6	0,15	–	–	–
	9,5	0,15	0,15	–	–
	12,5	0,25	0,25	0,25	–
	25	0,25	0,25	0,25	0,25
	40	0,30	0,30	0,30	0,30

[a] Flanged joints are permitted for explosive mixtures of acetylene and air only in accordance with 5.2.7.

[b] Maximum gap of cylindrical part increased to 0,20 mm if f < 0,5 mm.

[c] Maximum gap of cylindrical part increased to 0,25 mm if f < 0,5 mm.

The constructional values rounded according to ISO 80000-1 should be taken into consideration when determining the maximum gap.

5.3 Threaded joints

Threaded joints shall comply with the requirements given in Table 4 or Table 5.

Table 4
Cylindrical threaded joints

Pitch	≥ 0,7 mm[a]
Thread form and quality of fit	Medium or fine tolerance quality according to ISO 965-1 and ISO 965-3[b]
Threads engaged	≥ 5
Depth of engagement	
Volume ≤ 100 cm³	≥ 5 mm
Volume > 100 cm³	≥ 8 mm

Table 4 Continued on Next Page

Table 4 Continued

[a] Where the pitch exceeds 2 mm, special manufacturing precautions may be necessary (for example, more threads engaged) to ensure that the electrical equipment can pass the test for non-transmission of an internal ignition which is prescribed in 15.3.
[b] Cylindrical threaded joints which do not conform with ISO 965-1 and ISO 965-3 in respect of thread form or quality of fit are permitted if the test for non-transmission of an internal ignition, prescribed in 15.3, is passed, when the width of the threaded joint specified by the manufacturer is reduced by the amount specified in Table 9.

Table 5DV DR *Modification of Table 5DV to replace with the following:*

Table 5DV
Taper threaded joints [a, c]

Threads provided on each part	**≥ 5 [b]**
[a] Internal and external thread shall have the same nominal size. **[b] Threads shall conform to the NPT requirements of ANSI/ASME B1.20.1 and shall be made-up wrench tight. External threaded parts shall be provided with:** **1) an effective thread length not less than the "L2" dimension; and** **2) if a shoulder is provided, a length not less than the "L4" dimension between the face of the shoulder and end of the thread.** **Internal threads shall gauge at "flush" to "~~2~~ 3-1/2 turns large" using an L1 plug-gauge.** **[c] Where the tapered threaded joint consists of both the internal and external threaded parts with at least 4,5 fully engaged threads, the requirements of footnote b in this table need not be applied.**	
NOTE See Annex C for tapered thread requirements applicable to flameproof entry devices.	

5.4 Gaskets (including O-rings)

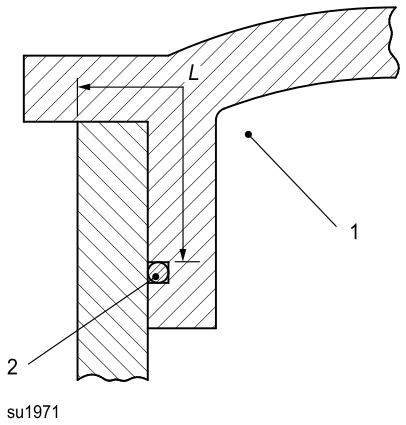
If a gasket of compressible or elastic material is used, for example, to protect against the ingress of moisture or dust or against leakage of a liquid, it shall be applied as a supplement, that is to say neither be taken into account in the determination of the width of the flameproof joint nor interrupt it.

The gasket shall then be mounted so that

a) the permissible gap and width of flanged joints or the plane part of a spigot joint are maintained, and

b) the minimum width of joint of a cylindrical joint or the cylindrical part of a spigot joint are maintained before and after compression.

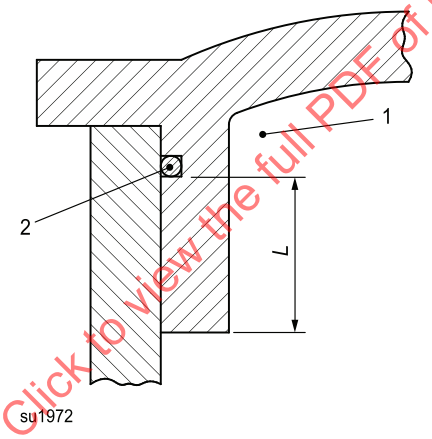
These requirements do not apply to cable glands (see 13.4) or to joints which contain a sealing gasket of metal or of a non-flammable compressible material with a metallic sheath. Such a sealing gasket contributes to the explosion protection, and in this case the gap between each surface of the plane part shall be measured after compression. The minimum width of the cylindrical part shall be maintained before and after compression.



IEC 1910/14

Figure 10

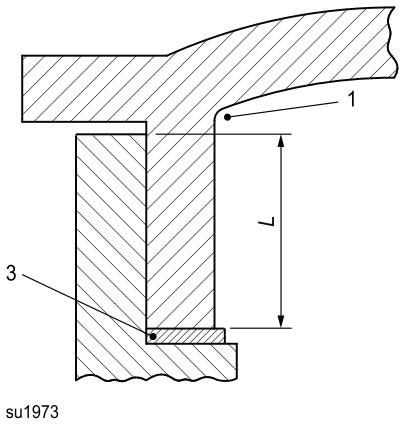
Illustration of the requirements concerning gaskets – Example 1



IEC 1911/14

Figure 11

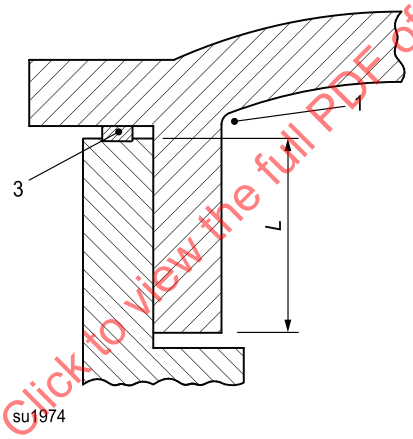
Illustration of the requirements concerning gaskets – Example 2



IEC 1912/14

Figure 12

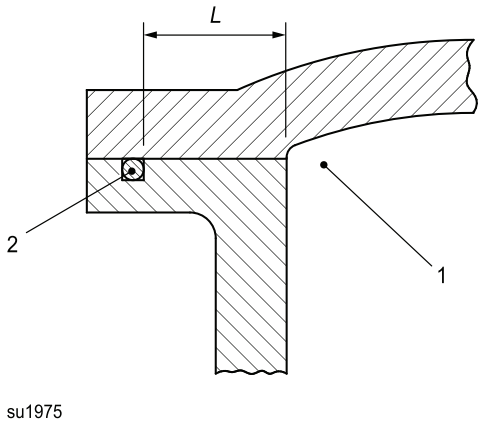
Illustration of the requirements concerning gaskets – Example 3



IEC 1913/14

Figure 13

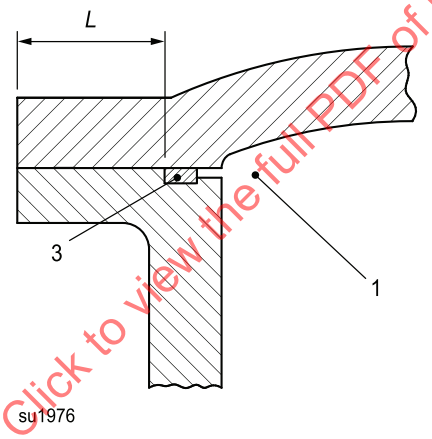
Illustration of the requirements concerning gaskets – Example 4



IEC 1914/14

Figure 14

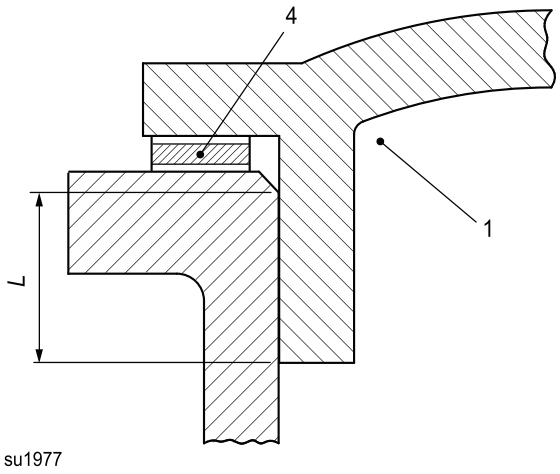
Illustration of the requirements concerning gaskets – Example 5



IEC 1915/14

Figure 15

Illustration of the requirements concerning gaskets – Example 6



IEC 1916/14

Key

1 interior of enclosure

2 O-ring

3 gasket

4 metallic or metal sheath gasket

Figure 16

Illustration of the requirements concerning gaskets – Example 7

5.5 Equipment using capillaries

The capillaries shall either comply with the gap dimensions given in Table 2 or Table 3 for cylindrical joints using 0 as the diameter of the inner part, or when the capillaries do not conform to the gaps given in these tables, the equipment shall be evaluated in accordance with the test for non-transmission of an internal ignition given in 15.3.

6 Sealed joints

6.1 Cemented joints

6.1.1 General

Parts of a flameproof enclosure may be cemented either directly into the wall of the enclosure so as to form with the latter an inseparable assembly, or into a metallic frame such that the assembly can be replaced as a unit without damaging the cement.

The material, preparation, application, and curing conditions (such as time, temperature, etc.) of the cementing shall be included in documentation prepared in accordance with IEC 60079-0.

An unaltered sample of the cemented joint assembly representative of production shall be used for evaluation and testing purposes.

A flameproof joint in accordance with Clause 5, which also incorporates cement, and which is tested without the cement in accordance with 15.3, does not need to fulfill the requirements of Clause 6.

6.1.2 Mechanical strength

Cemented joints are only intended to ensure the sealing of the flameproof enclosure of which they form a part. Arrangements shall be made in the construction so that the mechanical strength of the assembly does not depend upon the adhesion of the cement alone. Supplemental mechanical means of securing the cemented joint shall not be defeated by the opening of doors or covers that are intended to be opened during installation or maintenance.

Cemented joints shall be subjected to the following tests:

a) Two samples representative of production shall be subjected to an overpressure test with water in accordance with 15.2.3.2. The test is considered satisfactory if blotting paper, placed under each sample under test, is free from any trace of leakage.

b) Either the same two samples from a) above, or a separate set of samples, shall be subjected to the tests of enclosures in IEC 60079-0, as applicable. Subsequent to this conditioning, the samples shall be subjected to an overpressure test with water in accordance with 15.2.3.2. The test is considered satisfactory if blotting paper, placed under each sample under test, is free from any trace of leakage.

NOTE The tests of enclosures in IEC 60079-0 permit the tests to be conducted on either a set of two samples or a set of four samples, with the difference being the number of tests conducted on each sample.

If there is any leakage on the blotting paper as a result of the test on the samples from 6.1.2 b), then the cemented joint for one sample that leaks after being subjected to the tests of enclosures and hydraulic pressure testing shall be subjected to the following tests:

– the flame erosion test in 19.4 but with no modifications to the cemented joints of the test samples, followed by

– the test for non-transmission in 15.3.2.1, or the test for non-transmission in 15.3.3.3 or 15.3.3.4, as applicable for the equipment group, with no further modifications to the cemented joints of the test sample.

The cemented joint is judged satisfactory if this test for non-transmission is satisfactory.

Routine overpressure testing of cemented joints (per Clause 16) shall be performed whenever 1,5 times or 3 times the reference pressure is necessary to comply with 6.1.2.

6.1.3 Width of cemented joints

The shortest path through a cemented joint from the inside to the outside of a flameproof enclosure of volume *V* shall be

≥ 3 mm if	$V \leq 10\ cm^3$
≥ 6 mm if	$10\ cm^3 < V \leq 100\ cm^3$
≥ 10 mm if	$V > 100\ cm^3$

6.2 Fused glass joints

6.2.1 General

6.2.1DV.1 DE *Modification of Clause 6.2.1 to replace with the following:*

Fused glass joints are glass-to-metal joints formed by the application of molten glass into a metal frame that results in either a chemical or physical bond between the glass and the metal frame.

NOTE 1: Fused glass joints do not have a flamepath and therefore do not need to be subjected to the tests of non-transmission.

NOTE 2: Fused ceramic joints also result in a chemical or physical bond between the ceramic and the metal frame and are evaluated in the same manner as a fused glass joint.

6.2.2 Width of fused glass joints

The path through a fused glass joint from the inside to the outside of a flameproof enclosure shall be ≥ 3 mm.

7 Operating rods

Where an operating rod passes through the wall of a flameproof enclosure, the following requirements shall be met:

– if the diameter of the operating rod exceeds the minimum width of the joint specified in Table 2 and Table 3, the width of the joint shall be at least equal to this diameter but without, however, having to exceed 25 mm;

– if the diametrical clearance is liable to be enlarged as a result of wear in normal service, appropriate arrangements shall be made to facilitate a return to the original state, for example, by means of a replaceable bushing. Alternatively, gap enlargement due to wear may be prevented by the use of bearings complying with Clause 8.

8 Supplementary requirements for shafts and bearings

8.1 Joints of shafts

8.1.1 General

Flameproof joints of shafts of rotating electrical machines shall be arranged so as not to be subject to wear in normal service.

The flameproof joint may be

– a cylindrical joint (see Figure 17),

– a labyrinth joint (see Figure 18),

– a joint with a floating gland (see Figure 19).

8.1.2 Cylindrical joints

Where a cylindrical joint contains grooves for the retention of grease, the region containing the grooves shall neither be taken into account when determining the width of a flameproof joint nor interrupt it (see Figure 17).

The minimum radial clearance *k* (see Figure 20) of shafts of rotating electrical machines shall not be less than 0,05 mm.

8.1.3 Labyrinth joints

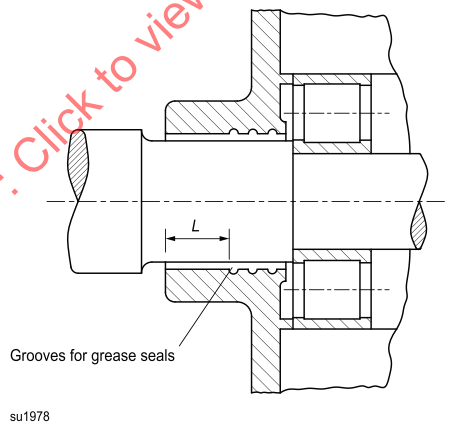
Labyrinth joints which do not comply with the requirements of Table 2 and Table 3 may nevertheless be considered as complying with the requirements of this standard if the tests specified in Clauses 14 through 16 are satisfied.

The minimum radial clearance *k* (see Figure 20) of shafts of rotating electrical machines shall not be less than 0,05 mm.

8.1.4 Joints with floating glands

The determination of the maximum degree of float of the gland shall take account of the clearance in the bearing and the permissible wear of the bearing as specified by the manufacturer. The gland may move freely radially with the shaft and axially on the shaft but the gland shall remain concentric with the shaft. A device shall prevent rotation of the gland (see Figure 19).

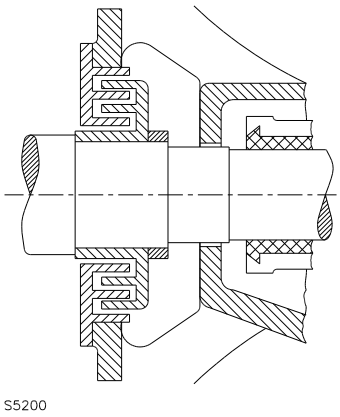
Floating glands are not permitted for electrical equipment of Group IIC.



IEC 1917/14

Figure 17

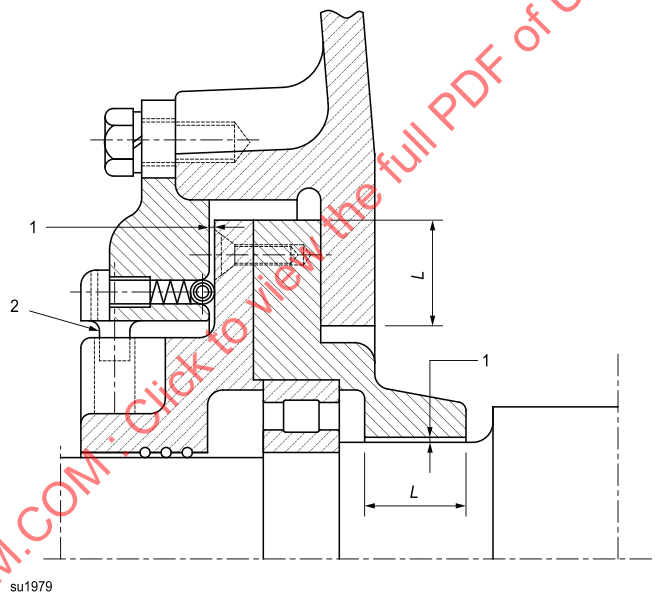
Example of cylindrical joint for shaft of rotating electrical machine



IEC 1918/14

Figure 18

Example of labyrinth joint for shaft of rotating electrical machine



IEC 1919/14

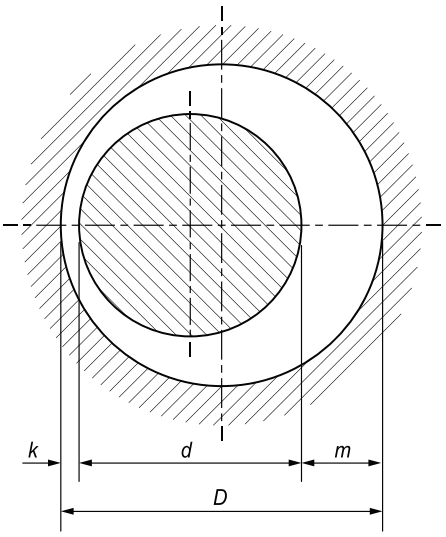
Key

1 gap

2 stop to prevent rotation of gland

Figure 19

Example of joint with floating gland for shaft of rotating electrical machine



Key

k	minimum radial clearance permissible without rubbing
m	maximal radial clearance taking *k* into account
D-d	diametral clearance

su1980

IEC 1920/14

Figure 20

Joints of shaft glands of rotating electrical machines

8.2 Bearings

8.2.1 Sleeve bearings

A flameproof joint of a shaft gland associated with a sleeve bearing shall be provided in addition to the joint of the sleeve bearing itself and shall have a width of joint at least equal to the diameter of the shaft but not exceeding 25 mm.

If a cylindrical or labyrinth flameproof joint is used in a rotating electrical machine with sleeve bearings, at least one face of the joint shall be of non-sparking metal (for example, leaded brass) whenever the air gap between stator and rotor is greater than the minimum radial clearance *k* (see Figure 20) specified by the manufacturer. The minimum thickness of the non-sparking metal shall be greater than the air gap.

Sleeve bearings are not permitted for rotating electrical machines of Group IIC.

8.2.2 Rolling-element bearings

In shaft glands equipped with rolling-element bearings, the maximum radial clearance *m* (see Figure 20) shall not exceed two-thirds of the maximum gap permitted for such glands in Table 2 and Table 3.

NOTE 1 It is acknowledged that, with assemblies, all parts will not exist in their worst case dimensions simultaneously. A statistical treatment of the tolerances, such as “RMS”, can be required for *m* and *k* verification.

NOTE 2 It is not a requirement of this standard that the manufacturer’s *m* and *k* calculations be verified. Neither is it a requirement of this standard that *m* and *k* be verified by measurement.

9 Light-transmitting parts

For light-transmitting parts of other than glass, the requirements in Clause 19 of this standard apply.

NOTE Mountings of light-transmitting parts, of any material that produces internal mechanical stress in those parts, can result in failure of the light-transmitting part.

10 Breathing and draining devices which form part of a flameproof enclosure

10.1 General

Breathing and draining devices shall incorporate permeable elements which can withstand the pressure created by an internal explosion in the enclosure to which they are fitted, and which shall prevent the transmission of the explosion to the explosive atmosphere surrounding the enclosure.

They shall also withstand the dynamic effects of explosions within the flameproof enclosure without permanent distortion or damage which would impair their flame-arresting properties. They are not intended to withstand continuous burning on their surfaces.

These requirements apply equally to devices for the transmission of sound but do not cover devices for

– relief of pressure in the event of internal explosion,

– use with pressure lines containing gas which is capable of forming an explosive mixture with air and is at a pressure in excess of 1,1 times atmospheric pressure.

10.2 Openings for breathing or draining

The openings for breathing or draining shall not be produced by deliberate enlargement of gaps of flanged joints.

NOTE Environmental contaminants (such as from the accumulation of dust or paint) can cause breathing and draining devices to become inoperative in service.

10.3 Composition limits

The composition limits of the materials used in the device shall be specified either directly or by reference to an existing applicable specification.

The elements of breathing or draining devices for use in an explosive gas atmosphere containing acetylene shall comprise not more than 60 % of copper by mass to limit acetylide formation.

10.4 Dimensions

The dimensions of the breathing and draining devices and their component parts shall be specified.

10.5 Elements with measurable paths

Interstices and measurable lengths of path need not comply with the values given in Table 2 and Table 3, provided that the elements pass the tests of Clauses 14 through 16.

Additional requirements for crimped ribbon elements and multiple screen elements are given in Annex A.

10.6 Elements with non-measurable paths

Where the paths through the elements are not measurable (for example, sintered metal elements), the element shall comply with the relevant requirements of Annex B.

The elements are classified according to their density as well as their pore size in accordance with the standard methods for the particular material and the particular manufacturing methods (see Annex B).

10.7 Removable devices

10.7.1 General

If a device can be dismantled, it shall be designed to avoid reduction or enlargement of the openings during re-assembly.

10.7.2 Mounting arrangements of the elements

The breathing and draining elements shall be sintered, or fixed by other suitable methods:

– either directly into the enclosure to form an integral part of the enclosure; or

– in a suitable mounting component, which is clamped or screwed into the enclosure so that it is replaceable as a unit.

Alternatively, the element can be mounted, for example press-fitted in accordance with 5.2.1, so as to form a flameproof joint. In this case, the appropriate requirements of Clause 5 shall be applied, with the exception that the surface roughness of the element need not comply with 5.2.2, if the element arrangement passes the type test in Clauses 14 through 16.

If necessary, a clamping ring or similar means can be used to maintain the integrity of the enclosure. The breathing or draining element can be mounted

– either from within, in which case the accessibility of screws and clamping ring shall be possible only from the inside; or

– from outside the enclosure, in which case the fasteners shall comply with Clause 11.

10.8 Mechanical strength

The device and its guard, if any, shall, when mounted normally, pass the test for resistance to impact of IEC 60079-0.

10.9 Breathing devices and draining devices when used as Ex components

10.9.1 General

In addition to 10.1 through 10.7 inclusive, the following requirements shall apply to breathing and draining devices which are evaluated as Ex components.

10.9.2 Mounting arrangements of the elements and components

The breathing and draining elements shall be sintered or cemented in accordance with Clause 6, or fixed by other methods into a suitable mounting part to form the mounting component.

The mounting component is secured by clamping or by fasteners or screwed into the enclosure as a replaceable unit complying with the relevant requirements of Clauses 5 and 6 and, where appropriate, Clause 11.

10.9.3 Type tests for breathing and draining devices used as Ex components

10.9.3.1 General

Attachment of the sample device under test shall be made on the end of the test rig enclosure in the same manner as it would normally be mounted on a flameproof enclosure. The test shall be performed on the sample after the impact test of 10.8 and in accordance with 10.9.3.2 to 10.9.3.4.

The impact test may be performed on the sample, separate from the test enclosure, when it is mounted on a plate that forms the end part of the test rig enclosure.

For devices with non-measurable paths, the maximum bubble test pore size of the sample shall be not less than 85 % of the specified maximum bubble test pore size. See B.1.2.

10.9.3.2 Thermal tests

10.9.3.2.1 General

10.9.3.2.1DV DR *Modification of Clause 10.9.3.2.1 to replace with the following*

After the bubble test in ~~10.9.3~~ 10.9.3.1, breathing and draining devices as Ex components shall be subjected to the thermal tests based on the maximum intended flameproof enclosure volume, but no less than the volume of the test rig in Figure 21.

NOTE When using the test rig in Figure 21, the maximum volume is approximately 2,5 l.

Breathing and draining devices intended for multiple use in any single flameproof enclosure shall be tested additionally with the enclosure.

10.9.3.2.2 Test procedure

For enclosure volumes of less than or equal to 2,5 l, the test rig assembly with all four sections, as shown in Figure 21, shall be used, and the test procedure shall be carried out as follows:

a) the position of the ignition source shall be at the enclosure inlet and 50 mm from the inside of the end-plate housing the device and the results observed;

b) the test mixtures shall be as for 15.4.3.1, as appropriate;

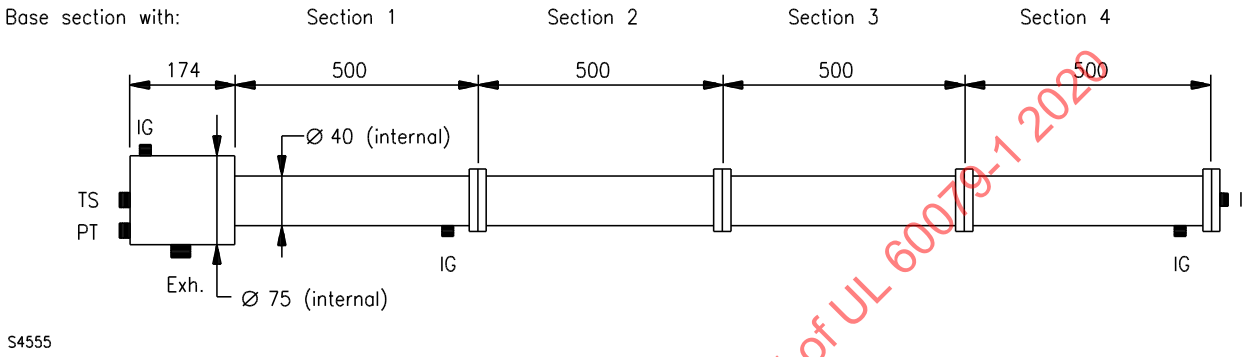
c) the temperature of the external surface of the device shall be monitored during tests;

d) any device shall be operated as specified by the manufacturer's documentation. After each of five tests, the explosive mixture shall be maintained external to the device for a sufficient time to allow any

continuous burning on the face of the device to become evident, for at least 10 min, so as to increase the temperature of the external surface of the device or to make temperature transfer to the outer face possible; and

NOTE The temperature of the external surface after the 10 min test period is used in determining the temperature class in accordance with 10.9.3.3.3.

e) the tests shall be carried out five times for each gas mixture for the gas groups in which the device is intended for use.



IEC 1921/14

Key

TS test sample position

I inlet

Exh. exhaust outlet

IG ignition source

PT pressure transducer

Figure 21

Component test rig for breathing and draining devices

For enclosure volumes of greater than 2,5 l, a representative enclosure of the intended volume shall be used, and the test procedure shall be carried out as follows:

1) the test mixtures shall be as for 15.4.3.1, as appropriate;

2) the temperature of the external surface of the device shall be monitored during tests;

3) any device shall be operated as specified by the manufacturer's documentation. After each of five tests, the explosive mixture shall be maintained external to the device for a sufficient time to allow any continuous burning on the face of the device to become evident, for at least 10 min, so as to increase the temperature of the external surface of the device or to make temperature transfer to the outer face possible; and

4) the tests shall be carried out five times for each gas mixture for the gas groups in which the device is intended for use.

10.9.3.2.3 Acceptance criteria

During the thermal tests, no flame transmission shall occur and no continuous burning shall be observed. The device shall show no evidence of thermal or mechanical damage or deformation which could affect its flame-arresting properties.

The measured external surface temperature rise of the device shall be multiplied by a safety factor of 1,2 and added to the maximum service temperature of the device for the determination of the temperature class of the electrical equipment.

NOTE Breathing and draining devices which fail any of the tests of 10.9 are excluded from evaluation as a component device. However, when used as an integral part of a flameproof enclosure, they are tested with the specific enclosure in accordance with 15.4.

10.9.3.3 Test for non-transmission of an internal ignition

10.9.3.3.1 General

10.9.3.3.1DV DR *Modification of Clause 10.9.3.3.1 to replace with the following*

After the bubble test in ~~10.9.3~~ 10.9.3.1, this test shall be carried out on a standard test rig, as illustrated in Figure 21, and made in accordance with 15.4.4, with the following additions and modifications.

10.9.3.3.2 Test procedure

The position of the ignition source shall be as shown in Figure 21:

a) at the inlet end; and

b) at 50 mm from the inside of the end-plate housing the device.

For the purposes of the test, the test rig shall be assembled for each gas group, in accordance with Figure 211, and have the following number of sections:

– Group I and Group IIA:	one section of test rig assembly;
– Group IIB and Group IIC:	four sections of test rig assembly.

The gas mixture within the test rig enclosure shall be ignited and the tests shall be made five times at each ignition point.

For breathing and draining devices of Groups I, IIA and IIB having either measurable paths or non-measurable paths, the non-transmission test of 15.3.2 shall be applied.

For breathing and draining devices of Group IIC with measurable paths, the non-transmission test of 15.3.3 and either 15.4.4.3.2 or 15.4.4.3.3 shall be applied.

For breathing or draining devices of Group IIC with non-measurable paths, 15.4.4.3.2 (method A) or 15.4.4.3.3 (method B) shall be applied.

10.9.3.3.3 Acceptance criteria

During the test, no ignition shall be transmitted to the surrounding test chamber.

10.9.3.4 Test of the ability of the breathing and draining device to withstand pressure

10.9.3.4.1 Test procedure

The reference test pressures in each gas group are

– Group I	1 200 kPa,
– Group IIA	1 350 kPa,
– Group IIB	2 500 kPa,
– Group IIC	4 000 kPa.

For the purpose of the test, a thin flexible membrane is fitted over the inner surfaces of the breathing and draining devices. The reference pressure shall be one of the relevant pressures given above for the gas group for which the component is intended.

One of the following overpressure tests shall be applied:

– 1,5 times the reference pressure for a period of at least 10 s. Then each component shall be submitted to a routine test; or

– 4 times the reference pressure for a period of at least 10 s. If this test is successful, the manufacturer is not required to apply the routine test to all future components of the tested type.

10.9.3.4.2 Acceptance criteria

After the overpressure tests, the device shall show no permanent deformation or damage affecting the type of protection.

10.9.4 Ex component certificate

10.9.4DV.1 DR *Modification of Clause 10.9.4 to replace with the following:*

10.9.4DV.1.1.1 Ex component ~~certificate~~ <u>instructions</u>

The Ex component ~~certificate~~ <u>instructions</u> shall include, ~~in the schedule of limitations,~~ the details necessary to properly select a breathing or draining device for attachment to a type tested flameproof enclosure. The ~~schedule of limitations~~ <u>instructions</u> shall include, as a minimum, the following:

a) the maximum recorded surface temperature obtained during the type test corrected to 40 °C, or to the higher marked ambient;

b) service temperature range for non-metallic enclosures and non-metallic parts of enclosures;

c) the maximum permitted enclosure volume (based on the thermal test) if greater than 2,5 l;

d) ~~a requirement that each Ex component or package of Ex components be accompanied by a copy of the certificate , together with the manufacturer's declaration stating~~

~~– compliance with the certificate conditions, and~~

~~– confirmation of the~~ material of construction, maximum bubble test pore size and minimum density, where applicable; and

e) special mounting instructions, if any.

11 Fasteners and openings

11.1 Fasteners accessible from the outside and necessary for the assembly of the parts of a flameproof enclosure shall

– for Group I, be special fasteners complying with the requirements of IEC 60079-0, with the head shrouded or provided in counter-bored holes or inherently protected by the equipment construction,

– for Group II, be special fasteners complying with the requirements of IEC 60079-0.

NOTE For Group I applications, the intent behind requiring shrouding or counter-boring is to provide some basic protection of the fastener head from impact.

11.2 Fasteners of plastic material or light alloys are not permitted.

11.3DV.1 DR *Modification of Clause 11.3. to replace with the following:*

In carrying out the type tests specified in Clause 15, the screws and nuts specified by the manufacturer shall be used.

The property class of the screw or nut, or yield stress and type of the screw or nut, used during testing shall be either:

– marked on the equipment in accordance with Table 14, point a), or

– specified in the relevant ~~certificate~~ instructions as a specific condition of use.

NOTE See Annex F for additional informative details on mechanical properties for screws and nuts.

11.4 Studs shall comply with 11.3 and shall be securely fixed, i.e. they shall be welded or riveted or permanently attached to the enclosure by another equally effective method.

11.5 Fasteners shall not pass through the walls of a flameproof enclosure unless they form a flameproof joint with the wall and are non-detachable from the enclosure, for example by welding, riveting or an equally effective method.

11.6 In the case of holes for screws or studs which do not pass through the walls of flameproof enclosures, the remaining thickness of the wall of the flameproof enclosure shall be at least one-third of the nominal diameter of the screw or stud with a minimum of 3 mm.

11.7 When screws are fully tightened into blind holes in enclosure walls, with no washer fitted, at least one full thread shall remain free at the base of the hole.

11.8 Openings, other than for entry devices, may be provided in the wall of a flameproof enclosure for optional installation of devices such as pushbuttons. If the optional device is not installed in the resulting opening at the time of manufacturing, the opening shall be closed by a device such that the flameproof properties of the enclosure are maintained.

NOTE The thread forms for these openings are not restricted to those specified for entry devices (see Clause 13).

11.9 Threaded doors or covers shall be additionally secured by means of a hexagon socket set screw, or some equally effective method.

12 Materials

12.1 Flameproof enclosures shall withstand the relevant tests prescribed in Clauses 14 through 16.

12.2 When several flameproof enclosures are assembled together, the requirements of this standard apply to each of them separately, and in particular to the partitions separating them and to all the bushings and operating rods which pass through the partitions.

12.3 When an enclosure contains several intercommunicating compartments, or when it is subdivided because of the disposition of the internal parts, pressures and rates of rise of pressure greater than normal may be produced.

Such phenomena shall be precluded as far as possible by the construction. If it is impossible to avoid these phenomena, the resulting higher stresses shall be taken into account in the construction of the enclosure.

12.4

12.4DV D1 *Modification to delete Clause 12.4. This clause does not apply.*

~~**When cast iron is used, the material shall be not less than the quality 150.**~~

~~**NOTE Cast iron quality 150 is defined by ISO 185.**~~

12.5 Liquids shall not be used in flameproof enclosures when there is a risk of producing oxygen, or an explosive mixture, more hazardous than that for which the enclosure was designed, by the decomposition of these liquids. They may, however, be used if the enclosure passes the tests prescribed in Clauses 14 through 16 for the type of explosive mixture produced; however, the surrounding explosive atmosphere shall be appropriate to the group for which the electrical equipment is constructed.

12.6 In flameproof enclosures of Group I, insulating materials subjected to electrical stresses capable of causing arcs in air and which result from rated currents of more than 16 A (in switching equipment such as circuit-breakers, contactors, isolators) shall have a comparative tracking index equal to or greater than CTI 400 M.

NOTE CTI is determined in accordance with IEC 60112.

However, if the above-mentioned insulating materials do not pass this test, they may be used if their volume is limited to 1 % of the total volume of the empty enclosure or if a suitable detection device enables the power supply to the enclosure to be disconnected, on the supply side, before possible decomposition of the insulating material leads to dangerous conditions. The presence and effectiveness of such a device shall be verified.

12.7 Flameproof enclosures shall not be made of zinc, or made of zinc alloy of 80 % zinc or greater.

NOTE Zinc and zinc alloys tend to deteriorate rapidly (particularly tensile strength), especially in warm, moist air. It is also considered more reactive than most other metals. As such, the restriction above was implemented.

12.8DV D1 *Modification of Clause 12.8. to replace with the following:*

In explosive gas atmospheres containing acetylene, enclosures of equipment and enclosures of Ex components for external mounting, if constructed of copper or copper alloys:

– shall be coated with tin, nickel, or by other coatings; or

– shall have the maximum copper content of the alloy limited to ~~60~~ 30 %.

Flameproof entry devices as defined in Annex C are not considered an enclosure surface requiring coating or copper content restriction.

NOTE The restriction of the use of copper in acetylene atmospheres is due to the potential formation of acetylides on the surface that can be ignited by friction or impact.

13 Entries for flameproof enclosures

13.1 General

The flameproof properties of the enclosure are not altered if all entries meet the relevant requirements given in this clause and shall be one of the following:

– internal metric threads with a tolerance class of 6H or better according to ISO 965-1 and ISO 965-3, and any chamfer or undercut is limited to a maximum depth of 2 mm from the external wall surface;

– external metric threads with a threaded part of at least 8 mm in length and at least eight full threads. If the thread is provided with an undercut, then a non-detachable and non-compressible washer or equivalent device shall be fitted to ensure the required length of thread engagement;

NOTE 1 The requirement for at least eight full threads is to ensure that at least five full threads will be engaged when the part is installed in a threaded entry – taking into account the presence of any chamfer or undercut.

– internal NPT threads in accordance with Table 5;

– external NPT threads in accordance with Table 5; or

– for Group I applications only, non-threaded joint in accordance with 5.2.

NOTE 2 This requirement is not intended to apply to integral cable glands or similar entry devices provided by the manufacturer as part of the enclosure.

13.2 Threaded holes

13.2DV DR *Modification of Clause 13.2. to replace with the following:*

Metric ~~T~~ threaded holes in enclosures to facilitate cable glands or ~~conduit entries~~ fittings other than NPT shall have the thread type and size identified, for example M25~~ or 1/2NPT~~. This may be accomplished by

– marking of the specific thread type and size adjacent to the hole in accordance with Table 15DV.1,

– marking of the specific thread type and size on the nameplate in accordance with Table 15DV.1,

– identification of the specific thread type and size as part of the installation instruction document, with a reference marking on the nameplate in accordance with Table 15DV.1.

The manufacturer shall state the following in the documents defining the electrical equipment:

a) the places where entries can be fitted; and

b) the maximum permitted number of these entries.

Each entry shall have no more than one thread adapter when an adapter is used. A blanking element shall not be used with an adapter.

NPT threaded entries shall not be smaller than trade size ½ nor larger than trade size 6. Where an integral bushing (historically known as a conduit stop) is not provided, the inner end of the entry shall be smooth and well-rounded. The dimensions of an integral bushing, if provided, shall be as shown in Table 16DV.1.

NPS threaded entries may be provided for an enclosure for Group IIA or IIB locations and shall use a National Standard Pipe Straight (NPS) thread per ANSI/ASME B1.20.1 and shall include an integral bushing and shall provide for five full threads of engagement. The dimensions of the integral bushing shall be as shown in Table 16DV.1.

Table 16DV DR *Addition of Table 16DV.1*

Table 16DV.1
Integral bushing diameter based on conduit trade size

Trade Size of Conduit (in)	Throat diameter of integral bushing (mm)	
	Minimum	Maximum
1/2	14	16
3/4	19	21
1	24	27
1-1/4	32	35
1-1/2	37	41

Table 16DV.1 Continued on Next Page

Table 16DV.1 Continued

Trade Size of Conduit (in)	Throat diameter of integral bushing (mm)	
	Minimum	Maximum
2	47	53
2-1/2	56	63
3	70	78
3-1/2	81	90
4	92	102
5	115	128
6	139	154

13.3 Non-threaded holes (for Group I only)

For Group I only, plain (non-threaded) holes to facilitate the installation of cable glands or bushings shall state the following in the documents defining the electrical equipment:

a) minimum width of joint "*L*" and maximum gap for flanged, cylindrical or spigot joint;

b) mounting stud or bolt specifications (such as diameter, thread, tensile strength, length, head type, torque) and position (such as pitch circle diameter and spacing);

c) keeper plate, and associated fastener (s), dimension requirements and position (such as quantity, spacing of the holes to support the gland, diameter, coupling means);

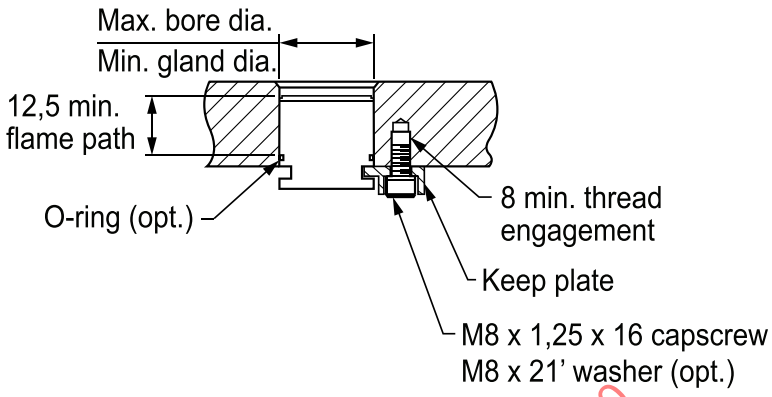
d) minimum tensile strength requirement of materials, fasteners, etc. (based on equipment reference pressure);

e) maximum and minimum thread engagement for the holes in the enclosure; and

f) information that will relate the length of fasteners to thickness of the keeper plate under the fastener head to ensure that the fasteners will have correct engagement and will allow correct space at the bottom of holes in accordance with 11.7 where applicable.

Figure 22 provides an example of how the possible documentation could appear.

Nominal entry size	Max. bore dia.	Min. gland dia.
50,8	50,96	50,56
63,5	63,62	63,22
76,2	76,35	75,95
95,3	95,40	95,00
108	108,10	107,70
114,3	114,5	114,10



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Material details and minimum tensile strength should be specified and may be tabulated in a materials table elsewhere in the documentation. Drill hole depth of fastener holes, keeper plate details (thickness, geometry, tensile strength), quantity and location of mounting fasteners should be provided.

Figure 22

Example of possible documentation

13.4 Cable glands

13.4DV DR *Modification of Clause 13.4. to replace with the following:*

Cable glands, whether integral or separate, shall meet the requirements of this standard, the relevant requirements of Annex C and create, on the enclosure, the joint widths and gaps prescribed in Clause 5.

Where cable glands are integral with the enclosure or specific to the enclosure, they shall be tested as part of the enclosure concerned.

~~**Where cable glands are separate:**~~

~~**a) threaded Ex cable glands and non-threaded Ex cable glands (for Group I only) can be evaluated as equipment. Such cable glands do not have to be submitted to the tests of 15.1, nor to the routine test of Clause 16;**~~

~~**b) other cable glands can only be evaluated as an Ex component; and**~~

~~**c) sufficient information shall be provided in the documentation to facilitate the mounting in holes according to 13.2 or 13.3, as applicable.**~~

13.5 Conduit sealing devices

13.5.1DV DR *Modification of Clause 13.5.1 to replace with the following:*

Conduit sealing devices, whether integral or separate, shall meet the requirements of this standard, the requirements of C.2.1.2 and C.3.1.2 with "conduit sealing device" substituted for "cable gland" and create, on the enclosure, the joint widths and gaps prescribed in Clause 5.

~~**NOTE As such constructions preclude reuse, the requirement of C.2.1.2 that a conduit sealing device be capable of being fitted and removed without disturbing the compound seal after the specified curing period of the compound cannot be applied.**~~

Where conduit sealing devices are integral with the enclosure or specific to the enclosure, they shall be tested as part of the enclosure concerned.

Where conduit sealing devices are separate:

– threaded Ex conduit sealing devices can be evaluated as equipment. Such conduit sealing devices do not have to be submitted to the tests of 15.2, nor to the routine test of Clause 16;

– other conduit sealing devices can only be evaluated as an Ex component; and

– sufficient information shall be provided in the documentation to facilitate the installation in holes according to 13.2.

13.5.2 Conduit entries are permitted only for electrical equipment of Group II.

13.5.3DV DR *Modification of Clause 13.5.3 to replace with the following:*

A sealing device such as a stopping box with setting compound shall be provided, either as part of the flameproof enclosure or immediately at the entrance thereto. It shall satisfy the type test for sealing prescribed in Annex C. Alternatively, an explosionproof conduit seal is permitted to be applied by the installer or user of the equipment according to the National Electrical Code®. ~~**An evaluated sealing device may be applied by the installer or user of the equipment according to instructions provided by the manufacturer of the equipment.**~~

NOTE A sealing device is considered as fitted immediately at the entrance of the flameproof enclosure when the device is fixed to the enclosure either directly or through an accessory necessary for coupling.

~~**The sealing compound(s) and method(s) of application shall be specified in the certificate either of the stopping box or of the complete flameproof equipment. The part of the stopping box between the sealing compound and the flameproof enclosure shall be treated as a flameproof enclosure, i.e. the joints shall comply with Clause 5 and the assembly shall be submitted to the tests for non-transmission of 15.3.**~~

~~**The distance from the face of the seal closest to the enclosure (or intended end-use enclosure), and the outside wall of the enclosure (or intended end-use enclosure) shall be as small as practical, but in no case more than the size of the conduit or 50 mm, whichever is the lesser.**~~

13.6 Plugs and sockets and cable couplers

13.6DV DR *Modification of Clause 13.6 to add the following NOTE:*

NOTE In the US, a cable coupler is for Group I only.

13.6.1 If attached on a flameproof enclosure plugs and sockets shall be constructed and mounted so that they do not alter the flameproof properties of the enclosure on which they are mounted, even when the two parts of the plugs and sockets are separated.

13.6.2 The widths and the gaps of the flameproof joints (see Clause 5) of the flameproof enclosures of plugs and sockets and cable couplers shall be determined by the volume which exists at the moment of separation of the contacts other than those for earthing or bonding or those which are parts of circuits complying with IEC 60079-11.

13.6.3 For plugs and sockets and cable couplers, the flameproof properties of the enclosure shall be maintained in the event of an internal explosion, both when the plugs and sockets or cable couplers are connected together and at the moment of separation of the contacts, other than those for earthing or bonding or those which are parts of circuits complying with IEC 60079-11.

13.6.4 If not connected to an interlocking switch which ensures a time delay between switching of the load and disconnecting the plug and socket, the plug and socket shall remain flameproof during the arc-quenching period while opening a test circuit of the rated voltage and rated current. For a.c. circuits, the test circuit power factor shall be less than or equal to 0,6, unless the equipment is marked for resistive loads only.

13.6.5DV DR *Modification of Clause 13.6.5 to replace with the following:*

The requirements of 13.6.2 through 13.6.4 inclusive do not apply to plugs and sockets or to cable couplers fixed together by means of special fasteners conforming to 11.1 and which bear a marking in accordance with Table 14, point b). Plugs and sockets with this construction shall be marked only for EPL Gc.

13.7 Bushings

13.7DV DR *Modification of Clause 13.7 to replace with the following:*

Bushings, whether integral or separate, shall meet the requirements of this standard, the relevant requirements of Annex C and create, on the enclosure, the joint widths and gaps prescribed in Clause 5.

Where bushings are integral with the enclosure or specific to the enclosure, they shall be tested as part of the enclosure concerned.

Where bushings are separate they shall be evaluated as Ex components.~~:~~

~~a) threaded Ex bushings for Group I or II, and non-threaded Ex bushings for Group I, can be evaluated as equipment. Such bushings do not have to be submitted to the tests of 15.2, nor to the routine test of Clause 16;~~

~~b) other bushings can only be evaluated as an Ex component; and~~

~~c) sufficient information shall be provided in the documentation to facilitate the mounting in holes according to 13.2 or 13.3, as applicable.~~

13.8 Blanking elements

13.8DV DR *Modification of Clause 13.8 to replace with the following:*

If, at the determination of the manufacturer, entries provided in a flameproof enclosure are not intended to always be used, they shall be closed by Ex equipment or Ex component blanking elements so that the flameproof properties of the enclosure are maintained.

Ex Equipment or component blanking elements shall comply with Annex C.

~~**Ex component blanking elements are only suitable when specified as part of the Ex equipment certificate.**~~

A blanking element shall not be used with a thread adapter.

Sufficient information shall be provided in the ~~documentation~~ installation instructions to facilitate the mounting in holes according to 13.2 or 13.3, as applicable.

14 Verification and tests

The requirements of IEC 60079-0 concerning verification and testing are, for the type of protection flameproof enclosure “d”, supplemented by the following requirements.

The determination of the maximum surface temperature specified in IEC 60079-0 shall be made under the conditions defined in Table 6 of this standard.

Table 6
Conditions for the determination of maximum surface temperature

Type of electrical apparatus	Overload or malfunction conditions
Luminaires (without ballast)	None
Luminaires with electro-magnetic ballasts	U_n + 10% Rectifier effect simulated by diode
Luminaires with electronic ballasts	As specified by the applicable standard for industrial equipment
Motors	None
Resistors	None
Electromagnets	U_n and worst-case air-gap
Other equipment	As specified by the applicable standard for industrial equipment
NOTE For test voltage and current parameters, see the maximum surface temperature requirements in IEC 60079-0.	

15 Type tests

15.1 General

The type tests shall be carried out in the following sequence:

a) determination of the explosion pressure (reference pressure) in accordance with 15.2.2 on one sample that may or may not have been subjected to the tests of enclosures in accordance with IEC 60079-0;

b) overpressure test in accordance with 15.2.3 on one of the samples which has been subjected to the tests of enclosures in accordance with IEC 60079-0; and

c) test for non-transmission of an internal ignition in accordance with 15.3 on one sample that may or may not have been subjected to the tests of enclosures in accordance with IEC 60079-0 and may or may not have been subjected to the test from b) above.

For non-metallic enclosures or non-metallic parts of enclosures, the test sequence above is modified by the requirements for non-metallic enclosures and non-metallic parts of enclosures in this standard.

Testing may deviate from this sequence in that the static or dynamic overpressure test may be carried out either after the test for non-transmission of an internal ignition or on another sample which has also been subjected to those other tests affecting mechanical strength already applied to the first sample. In no case, after the overpressure test, shall the joints of the enclosure have suffered a permanent deformation nor shall the enclosure have suffered any damage affecting the type of protection.

The enclosure shall, in general, be tested with all the enclosed equipment in place. However, this may be replaced by equivalent models.

If an enclosure is designed to take different types of equipment and components, with the detailed mounting arrangements declared by the manufacturer, the enclosure may be tested empty, provided that this is the most severe condition for explosion pressure development, and that compliance with the other safety requirements of IEC 60079-0 can be confirmed.

15.1DV.1 DR *Modification of Clause 15.1, fifth paragraph to replace with the following:*

If the enclosure is designed so that it can be used in the absence of part of the enclosed equipment, the tests shall be made under the conditions considered to be the most severe. In both cases, the ~~certificate~~ instructions shall indicate the types of enclosed equipment permitted and their mounting arrangements.

Joints of removable parts of flameproof enclosures shall be tested in the worst-case assembly conditions.

15.2 Tests of ability of the enclosure to withstand pressure

15.2.1 General

15.2.1DV DR *Modification of Clause 15.2.1 to replace with the following:*

The object of these tests is to verify that the enclosure can withstand the pressure of an internal explosion.

The enclosure shall be subjected to tests in accordance with 15.2.2 and 15.2.3.

The tests are considered satisfactory if the enclosure suffers no permanent deformation or damage invalidating the type of protection. In addition, the joints shall in no place have been permanently enlarged.

For equipment marked with a nameplate interrupting rating greater than 10 000 r. m. s. symmetrical amperes, reference pressure tests are to be conducted under short-circuit conditions based on the marked maximum interrupting rating.

15.2.2 Determination of explosion pressure (reference pressure)

15.2.2.1 General

15.2.2.1DV DR *Modification of Clause 15.2.2.1 to replace with the following:*

The reference pressure is the highest value of the maximum smoothed pressure, relative to atmospheric pressure, observed during these tests. For smoothing, a low-pass filter with a 3 dB point of 5 kHz ± 0.5 kHz shall be used.

For electrical equipment intended for use at an ambient temperature below –20 °C, the reference pressure shall be determined by one of the following methods.

– For all electrical equipment, the reference pressure shall be determined at a temperature not higher than the minimum ambient temperature.

– For all electrical equipment, the reference pressure shall be determined at normal ambient temperature using the defined test mixture (s), but at increased pressure. The absolute pressure of the test mixture *(P)*, in kPa, shall be calculated by the following formula, using $T_{a, min}$ in °C:

$$P = 100[293 / T_{a,\min} + 273)]\ kPa$$

– For electrical equipment of Group IIA or IIB ~~other than rotating electrical machines (such as electric motors, generators and tachometers) that involve simple internal geometry (see Annex D) with an enclosure volume not exceeding 3 l, when empty, such that~~ where pressure-piling is not considered likely, the reference pressure shall be determined at normal ambient temperature using the defined test mixture (s), but is to be assumed to have a reference pressure increased by the "test factors for reduced ambient conditions" given in Table 7.

~~– For electrical equipment other than rotating electrical machines (such as electric motors, generators and tachometers) that involve simple internal geometry (see Annex D) with an enclosure volume not exceeding 10 l, when empty, such that pressure piling is not considered likely, the reference pressure shall be determined at normal ambient temperature using the defined test mixture (s), but is to be assumed to have a reference pressure increased by the "test factors for reduced ambient conditions" given in Table 7. Under this alternative, the test pressure for the overpressure type test in 15.2.3.2 shall be 4 times the increased reference pressure. The 1,5 times routine test is not permitted.~~

Table 7
Test factors for reduced ambient conditions

Minimum ambient temperature °C	Test factor
≥ –20 (see Note)	1,0
≥ –30	1,37
≥ –40	1,45
≥ –50	1,53
≥ –60	1,62
NOTE This covers equipment designed for the standard ambient temperature range specified in IEC 60079-0. Consideration should be given to applications in which the temperature inside the flameproof enclosure may be substantially lower than the rated ambient temperature.	

15.2.2.2 Each test consists of igniting an explosive mixture inside the enclosure and measuring the pressure developed by the explosion.

The mixture shall be ignited by one or more ignition sources. However, when the enclosure contains a device which produces sparks capable of igniting the explosive mixture, this device may be used to produce the explosion. (It is nevertheless not necessary to produce the maximum power for which the device is designed.)

The pressure developed during the explosion shall be determined and recorded during each test. The locations of the ignition sources as well as those of the pressure recording devices are left to the discretion of the testing laboratory to find the combination which produces the highest pressure. When detachable gaskets are provided by the manufacturer, these shall be fitted to the enclosure under test.

The continuous effects of devices inside enclosures, such as rotating devices, which can create significant turbulence that may result in an increase in reference pressure shall be considered. See also 15.2.2.3.

The number of tests to be made and the explosive mixture to be used, in volumetric ratio with air and at atmospheric pressure, are as follows:

– electrical equipment of Group I: three tests with (9,8 ± 0,5) % methane;

– electrical equipment of Group IIA: three tests with (4,6 ± 0,3) % propane;

– electrical equipment of Group IIB: three tests with (8 ± 0,5) % ethylene;

– electrical equipment of Group IIC: five tests with (14 ± 1) % acetylene and five tests with (31 ± 1) % hydrogen.

15.2.2.3 Rotating electrical machines shall be tested at rest and running. When they are tested running, they may be driven either by their own source of power or by an auxiliary motor. The minimum test speed shall be at least 90 % of the maximum rated speed of the machine.

NOTE If the motor is intended to be converter driven, manufacturer specified rated speed often covers both present and future converter applications.

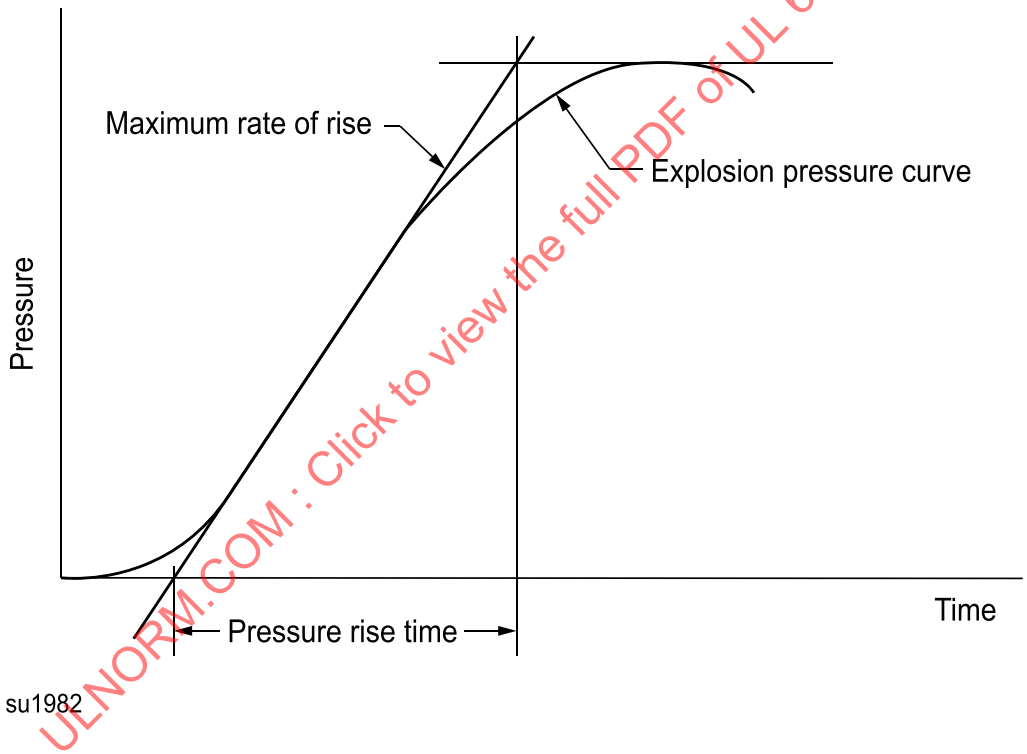
All motors shall be tested with at least two transducers, with one located in the end-turn area at each end of the motor. Ignition shall be initiated at each end of the motor, in turn, with the motor both at rest and running. This will result in at least four series of tests. If a termination compartment is provided that is

interconnected to the motor and is not sealed, a three transducer setup and additional test series is to be considered.

15.2.2.4 For Group IIB, in cases where pressure piling may occur during the test of flameproof enclosures, the tests shall be made at least five times with each gas of 15.2.2.2 for the applicable gas group. Afterwards they shall be repeated at least five times with a mixture of (24 ± 1) % hydrogen/methane (85/15).

NOTE 1 The need to conduct this repeat testing is based on the principles that (1) when pressure piling is not involved, ethylene will result in worst case representative pressures, and (2) when pressure piling is involved, it will not. Therefore, under this premise, when pressure piling is an issue, the additional testing with the mixture of (24 ± 1) % hydrogen/methane (85/15) is included.

NOTE 2 There is presumption of pressure-piling when either (1) the pressure values obtained during a series of tests involving the same configuration, deviate from one to another by a factor of ≥1,5, or (2) the pressure rise time is less than 5 ms. Two graphs are provided below for guidance on how to consider pressure rise time. When referring to these two graphs below, the pressure rise time is based on the elapsed time at the point of the maximum rate of rise of the pressure. This is normally the elapsed time between 10 % and 90 % of the maximum pressure. Actual waveforms sometimes exhibit a more regular shape as shown in Figure 23, or an irregular shape as shown in Figure 24. When determining the pressure rise time, a plateau such as shown at the beginning of the waveform in Figure 24 is excluded.



IEC 1923/14

Figure 23

Example of a regular shaped waveform

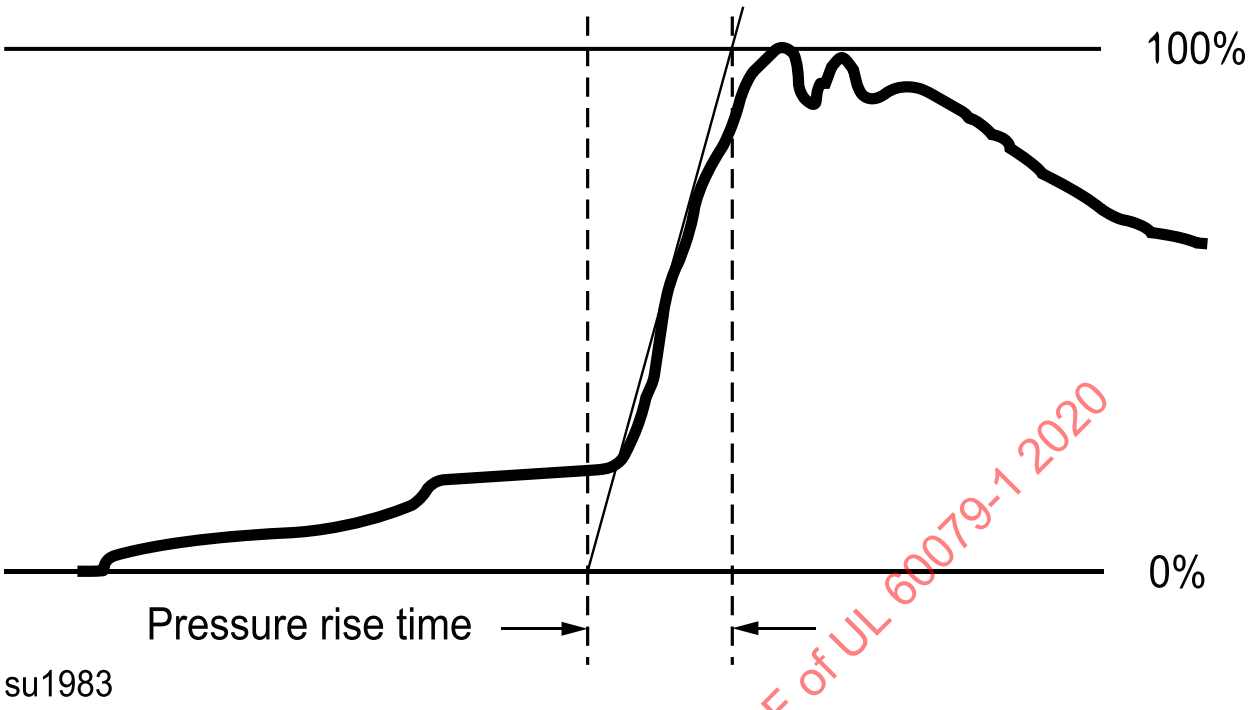


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Figure 24

Example of an irregular shaped waveform

15.2.2.5DV.1 DR *Modification of Clause 15.2.2.5 to replace with the following:*

Electrical equipment marked for a single gas shall be subjected to at least five explosion tests with the mixture of that gas with air at atmospheric pressure that gives the highest explosion pressure. Such electrical equipment shall then be evaluated not for the corresponding equipment group but only for the single gas considered.

NOTE A series of tests over the flammable range is used to determine the mixture with air that gives the highest explosion pressure.

Where exclusion of a specific gas or gases is required, the ~~certificate number~~ equipment shall ~~include the "X" suffix~~ be marked in accordance with the marking requirements of ~~IEC~~ UL 60079-0 and the specific conditions of use listed on the ~~certificate~~ instructions shall detail this exclusion.

Double marking can be applied for a specific gas and for the next lowest group to the group of this gas (for example, IIB + H_2), if the enclosure has been submitted not only to the tests for the specific gas, but also to those necessary for the lower group.

15.2.3 Overpressure test

15.2.3.1 General

15.2.3.1DV DE *Modification of Clause 15.2.3.1 to replace with the following:*

This test shall be made using either of the following methods, which are considered as equivalent.

NOTE – Some materials such as cast iron exhibit changes in material properties at extreme low temperatures such as a reduction in tensile strength.

15.2.3.2 Overpressure test – First method (static)

The relative pressure applied shall be

– 1,5 times the reference pressure; or

– 4 times the reference pressure for enclosures not subject to routine overpressure testing; or

– 3 times the reference pressure for enclosure where the routine overpressure testing is replaced by a batch test (see 16.6); or

– at the pressures given in Table 8, when reference pressure determination has been impracticable due to the small size of the equipment.

Table 8
Relative pressures for small equipment

Volume cm^3	Group	Pressure[a] kPa
≤10	I, IIA, IIB, IIC	1 000
>10	I	1 000
>10	IIA, IIB	1 500
>10	IIC	2 000
[a] For equipment intended for use at an ambient temperature below –20 °C, the above pressures shall be increased by the appropriate test factors noted in Table 7.		

The period of application of the pressure shall be at least 10 s.

The test is performed once on each sample, as applicable.

The overpressure test shall be considered satisfactory if the test result is in compliance with 15.2.1 and if there is no leakage through the walls of the enclosure.

NOTE A non-compressible hydraulic media is normally used for these tests. If a compressible media such as air or inert gas is used, failure of the enclosure can result in personal injury or property damage.

15.2.3.3 Overpressure test – Second method (dynamic)

The dynamic tests shall be carried out in such a way that the maximum pressure to which the enclosure is subjected is 1,5 times the reference pressure.

When the test is carried out with mixtures specified in 15.2.2.2, these may be precompressed to produce an explosion pressure of 1,5 times the reference pressure.

The test shall be made once only, except for electrical equipment of Group IIC for which each test shall be made three times with each gas.

NOTE If there is a product with inter-connected chambers, the intent is not necessarily that one ignition be initiated in each compartment. Tests are conducted for each of the configurations considered necessary. A high pressure in a compartment may reduce the likelihood of propagation, while a low pressure may increase it.

The overpressure test shall be considered satisfactory if the test result is in compliance with 15.2.1.

15.3 Test for non-transmission of an internal ignition

15.3.1 General

Gaskets (see 5.4) shall be removed. While some grease may remain, excessive grease shall be removed (see 5.1). The enclosure is placed in a test chamber. The same explosive mixture is introduced into the enclosure and the test chamber at the same pressure.

The flamepath lengths (engagement) of threaded joints of the test specimen(s) shall be reduced according to Table 9.

The flamepath lengths of spigot, cylindrical and flanged joints of the test specimen(s) shall not be greater than 115 % of the minimum length(s) stated by the manufacturer.

Flanged gaps of spigot joints, where the width of the joint *L* consists only of a cylindrical part (see Figure 2b) shall be enlarged to values of not less than 1 mm for Groups I and IIA, not less than 0,5 mm for Group IIB and not less than 0,3 mm for Group IIC.

Gap requirements for the test specimen(s) are included in 15.3.2 (for Groups I, IIA and IIB) and in 15.3.3 (for Group IIC).

For equipment with flamepaths other than threaded joints, and intended for use at an ambient temperature above 60 °C, the non-transmission tests shall be conducted under one of the following conditions:

– at a temperature not less than the specified maximum ambient temperature; or

– at normal ambient temperature using the defined test mixture at increased pressure according to the factors in Table 10; or

– at normal atmospheric pressure and temperature, but with the test gap i_E increased by the factors noted in Table 10.

If enclosures are constructed from different materials with different temperature coefficients, and if this has an influence on the gap dimensions (e. g. in case of a glass window forming a cylindrical gap with a metallic frame), one of the following shall apply for the flame transmission test:

– the calculated maximum gap, $i_{C,T}$, taking into account the maximum constructional gap at 20 °C and the gap enlargement at specified maximum ambient temperature, $T_{a,max}$, shall be verified by increasing the test gap i_E to at least 90 % of the calculated maximum gap at $T_{a,max}$; or

– the calculated maximum gap $i_{C,T}$, taking into account the maximum constructional gap at 20 °C and the gap enlargement at specified maximum ambient temperature $T_{a,max}$, shall be verified by using the defined test mixture at increased pressure according to the formula

$$P_v = (i_{C,T} / i_E) \times (0,9)$$

Table 9
Reduction in length of a threaded joint for non-transmission test

Type of threaded joint	Reduction in length by			
	Groups I, IIA and IIB 15.3.2		Group IIC 15.3.3	
	15.3.2.1	15.3.2.2	15.3.3.2	15.3.3.3 or 15.3.3.4
Cylindrical, complying with ISO 965-1 and ISO 965-3 in respect of thread form and medium or better quality of fit	No reduction	No reduction	No reduction	No reduction
Cylindrical, not complying with ISO 965-1 and ISO 965-3 in respect of thread form or quality of fit	1/3	1/2	1/2	1/3
NPT	No reduction	No reduction	No reduction	No reduction

Table 10
Test factors to increase pressure or test gap (i_E)

Temperature up to °C	Group I 12,5 % CH_4/H_2	Group IIA 55 % H_2	Group IIB 37 % H_2	Group IIC 27,5 % H_2 7,5 % C_2H_2
60	1,00	1,00	1,00	1,00
70	1,06	1,05	1,04	1,11
80	1,07	1,06	1,05	1,13
90	1,08	1,07	1,06	1,15
100	1,09	1,08	1,06	1,16
110	1,10	1,09	1,07	1,18
120	1,11	1,10	1,08	1,20
125	1,12	1,11	1,09	1,22

For Group IIC, test factors per 15.3.3 are also required to be introduced into the test pressure or test gap in addition to the test factors above.

Electrical equipment marked for a single gas shall be subjected to non-transmission tests based on the corresponding equipment group for the single gas considered.

15.3.1DV.1 DR *Modification of Clause 15.3.1, tenth paragraph to replace with the following:*

15.3.1DV.1.1.1 If tested at a distance less than that indicated in Table 11DV.1, this equipment shall have the minimum distance of obstructions specified ~~on~~ in the ~~certificate~~ instructions. Also, the equipment may be marked in accordance with Table 15DV.1.

Table 11DV D2 *Modification of Table 11DV.1 to replace with the following:*

Table 11DV.1
Minimum distance of obstructions from flameproof "d" flange openings

Gas group	Minimum distance mm
IIA	10
IIB	30
IIC	40
NOTE ~~IEC 60079-14~~ The National Electrical Code limits the installation of equipment employing type of protection "d" that incorporates flanged (flat) joints. Specifically, the flanged joints of such equipment are not permitted to be installed closer to solid objects that are not part of the equipment, than the dimensions shown in Table 11DV.1, unless the equipment is so tested.	

NOTE For other than simple geometries, multiple test configurations are employed to confirm non-transmission.

15.3.2 Electrical equipment of Groups I, IIA and IIB

15.3.2.1 The gaps i_E of the enclosure shall be at least equal to 90 % of the maximum constructional gap i_C as specified in the manufacturer's drawings ($0{,}9\ i_C \le i_E \le i_C$).

The explosive mixtures to be used, in volumetric ratio with air and at atmospheric pressure, are as follows:

– electrical equipment of Group I: (12,5 ± 0,5) % methane-hydrogen [(58 ± 1) % methane and (42 ± 1) % hydrogen] (MESG = 0,8 mm);

– electrical equipment of Group IIA: (55 ± 0,5) % hydrogen (MESG = 0,65 mm);

– electrical equipment of Group IIB: (37 ± 0,5) % hydrogen (MESG = 0,35 mm);

NOTE The explosive mixtures chosen for this test ensure that the joints prevent the transmission of an internal ignition, with a known margin of safety. This margin of safety, *K*, is the ratio of the maximum experimental safe gap of the representative gas of the group concerned to the maximum experimental safe gap of the chosen test gas.

– electrical equipment of Group I: *K* = 1,14 / 0,8 = 1,42 (methane);

– electrical equipment of Group IIA: *K* = 0,92 / 0,65 = 1,42 (propane);

– electrical equipment of Group IIB: *K* =0,65 / 0,35 = 1,85 (ethylene).

Alternatively, if the gaps of a test specimen do not fulfil the above condition, one of the following methods may be used for the type test for non-transmission of an internal ignition:

– a gas/air mixture with a smaller MESG value as given in Table 12:

Table 12
Gas/air mixtures

Group	i_E / i_C	Mixture
Group I	≥0,75	(55 ± 0,5) % hydrogen
	≥0,6	(50 ± 0,5) % hydrogen
Group IIA	≥0,75	(50 ± 0,5) % hydrogen
	≥0,6	(45 ± 0,5) % hydrogen
Group IIB	≥0,75	(28 ± 1,0) % hydrogen (28 ± 1,0) % hydrogen
	≥0,6	at 140 kPa absolute pressure

– precompression of the normal test mixtures according to the following formula:

$$P_k = (i_C / i_E) \times 0,9$$

where P_k is the precompression factor.

15.3.2.2 If enclosures of Groups IIA and IIB could be destroyed or damaged by the test in 15.3.2.1, it is permitted that the test be made by increasing the gaps above the maximum values specified by the manufacturer. The enlargement factor of the gap is 1,42 for Group IIA electrical equipment and 1,85 for Group IIB electrical equipment. The explosive mixtures to be used in the enclosure and in the test chamber, in volumetric ratio with air and at atmospheric pressure, are as follows:

– electrical equipment of Group IIA: (4,2 ± 0,1) % propane; or

– electrical equipment of Group IIB: (6,5 ± 0,5) % ethylene.

15.3.2.3 The test in 15.3.2.1 or 15.3.2.2 shall be made five times taking each test configuration into consideration. The test result is considered satisfactory if the ignition is not transmitted to the test chamber.

15.3.3 Electrical equipment of Group IIC

15.3.3.1 General

The tests in 15.3.3.2, 15.3.3.3 or 15.3.3.4 can be used for this test, and are considered satisfactory if the ignition is not transmitted to the test chamber.

NOTE The methods below are equivalent in their factors of safety, 1,5, and the minimum test gap of 90 %. This is accomplished by either increasing the pressure or by increasing the test gap dimension or by increasing the oxygen of the test mixture.

15.3.3.2 First method – Testing by increased test gap

All gaps of joints other than threaded joints shall be increased to the value

$$1,35\, i_C \le i_E \le 1,5\, i_C$$

with a minimum of 0,1 mm for flanged joints

where

i_E is the test gap;

i_C is the maximum constructional gap, as specified on the manufacturer's drawings.

The following explosive mixtures, in volumetric ratio with air and at atmospheric pressure, shall be used in the enclosure and in the test chamber:

a) (27,5 ± 1,5) % hydrogen, and

b) (7,5 ± 1) % acetylene.

Five tests taking each test configuration into consideration shall be made with each mixture. If the equipment is intended for use solely with hydrogen or solely with acetylene, the tests shall be made only with the corresponding gas mixture.

NOTE When preparing a test sample employing a cylindrical joint of a shaft gland for a rotating machine with roller element bearings, the test gap i_E is based on the diametrical clearance from Table 2 or Table 3, and not the radial clearance of 8.2.2.

15.3.3.3 Second method – Testing by increased pressure

The enclosure shall be tested with a test gap i_E according to the following formula:

$$0,9\, i_C \leq i_E \leq i_C$$

The enclosure and the test chamber are filled with one of the gas mixtures specified for the first method at a pressure equal to 1,5 times atmospheric pressure.

The test shall be carried out five times with each explosive mixture.

Alternatively, if the gaps of a test specimen do not fulfil the above condition, the following method may be used.

Precompression of the normal test mixtures according to the following formula:

$$P_k = (i_C / i_E) \times 1,35$$

where P_k is the precompression factor.

NOTE When preparing a test sample employing a cylindrical joint of a shaft gland for a rotating machine with roller element bearings, the test gap i_E is based on the diametrical clearance from Table 2 or Table 3, and not the radial clearance of 8.2.2.

15.3.3.4 Third method – Testing by oxygen enrichment of test gases

The gaps i_E of the enclosure shall be at least equal to 90 % of the maximum constructional gap i_C as specified in the manufacturer's drawings ($0,9\, i_C \leq i_E \leq i_C$).

The test mixtures to be used consist of the following, in volumetric ratio and at atmospheric pressure:

a) (40 ± 1) % hydrogen, (20 ± 1) % oxygen and the rest nitrogen; and

b) (10 ± 1) % acetylene, (24 ± 1) % oxygen and the rest nitrogen.

The tests shall be carried out five times with each test mixture. For devices intended for use only in hydrogen, only test mixture a) is required.

15.3.3.5 Number of tests for single piece production

Electrical equipment which are a single piece production shall be tested a total of five times, taking each test configuration into consideration, with unaltered test gaps and with each of the explosive mixtures specified in 15.3.3.2 at atmospheric pressure and the dimensional requirements of 5.1 apply.

15.4 Tests of flameproof enclosures with breathing and draining devices

15.4.1 General

The tests in accordance with 15.4.2 to 15.4.4 inclusive shall be carried out in the following order on a sample after the impact strength test of 10.7.2.

For devices with non-measurable paths, the maximum bubble test pore size of the sample shall not be less than 85 % of the specified maximum bubble test pore size. See Annex B.

15.4.2 Tests of ability of the enclosure to withstand pressure

15.4.2.1 The tests shall be made in accordance with 15.2 with the following additions and modifications.

15.4.2.2 For the determination of the explosion pressure in accordance with 15.2.2, breathing and draining devices shall be replaced by solid plugs.

15.4.2.3 For the overpressure test in accordance with 15.2.3, a thin flexible membrane (for example, a thin plastic sheet) shall be fitted to the inner surfaces of the breathing and draining devices. After the overpressure test, the device shall show no permanent deformation or damage likely to affect the type of protection.

NOTE The intent of the thin flexible membrane is to minimize leakage during the test without influencing the strength of the device.

15.4.3 Thermal tests

15.4.3.1 Test procedure

The enclosure, with the device(s) fitted, shall be tested in accordance with the method 15.4.4.2 but with the ignition source only in the position giving the most unfavourable thermal results.

The temperature of the external surface of the device(s) shall be monitored during the test. The test shall be carried out five times. The test mixture to be used shall be (4,2 ± 0,1) % propane in volumetric ratio with air and at atmospheric pressure. Additionally, for devices intended for use in acetylene, (7,5 ± 1,0) % acetylene in volumetric ratio with air and at atmospheric pressure shall be used.

In an enclosure where there is the possibility of a forced or induced flow of a potentially dangerous gas, the enclosure shall be arranged during the tests so that the gas can flow through the device(s) and the enclosure.

Any ventilation or sampling system shall be operated as specified in the manufacturer's documentation. After each of the five tests, the external explosive mixture shall be maintained for a sufficient time to allow

any continuous burning on the face of the device to become evident (for example, for at least 10 min so as to increase the temperature of the external surface of the device or to make heat transfer to the outer face possible).

NOTE The temperature of the external surface after the 10 min test period is used in determining the temperature class in accordance with 15.4.3.2.

15.4.3.2 Acceptance criterion

No continuous burning shall be observed. No flame transmission shall occur. The measured external surface temperature rise of the device shall be multiplied by a safety factor of 1,2 and added to the maximum service temperature of the device for the determination of the temperature class of the electrical equipment.

15.4.4 Test for non-transmission of an internal ignition

15.4.4.1 General

This test shall be made in accordance with 15.3 with the following additions and modifications.

15.4.4.2 Test procedure

An ignition source shall be placed first close to the inner surface of the breathing and draining device and subsequently in one or more places if a high peak explosion pressure and rate of rise of pressure at the face of the device is likely to occur. Where the enclosure has more than one identical device, the device to be tested shall be that which gives the most unfavourable results. The test mixture within the enclosure shall be ignited. The test shall be made five times for each position of the ignition source.

15.4.4.3 Non-transmission test for breathing and draining devices

15.4.4.3.1 General

For breathing and draining devices of Groups I, IIA and IIB, the non-transmission test of 15.3.2 shall be applied.

For breathing and draining devices of Group IIC with measurable paths, the non-transmission tests of 15.3.3 shall be applied. For breathing and draining devices of Group IIC with non-measurable paths, the non-transmission tests of 15.4.4.3.2 or 15.4.4.3.3 shall be applied.

15.4.4.3.2 Method A – Testing by increased pressure

The tests are carried out five times with each test mixture. The tests are made according to 15.3.3.3 and 15.4.4.2.

For devices intended for use only in hydrogen, only the test with the hydrogen/air mixture is required.

15.4.4.3.3 Method B – Testing by oxygen enrichment of test gases

Carbon disulphide is excluded for enclosures with a volume greater than 100 cm^3. The test mixtures to be used consist of the following, in volumetric ratio and at atmospheric pressure:

a) (40 ± 1) % hydrogen, (20 ± 1) % oxygen and the rest nitrogen; and

b) (10 ± 1) % acetylene, (24 ± 1) % oxygen and the rest nitrogen.

The tests shall be carried out five times with each test mixture, in accordance with 15.4.4.2.

For devices intended for use only in hydrogen, only test mixture a) is required.

15.4.4.4 Acceptance criterion

The test result is considered satisfactory if no ignition is transmitted to the test chamber.

15.5 Tests for “dc” devices

15.5.1 General

The tests of 15.5 replace the tests of 15.2 through 15.4.4.4.

15.5.2 Preparation of “dc” samples

Any elastomeric or thermoplastic material which is used for the purpose of sealing a cover which is intended to be opened in service, or which is unprotected against mechanical or environmental damage, shall be removed wholly or partially before the device or component is subjected to the type test when such removal will result in a more onerous test.

NOTE Any remaining non-metallic parts of the enclosure will have been subjected to the thermal endurance tests.

15.5.3 Test conditions for “dc” devices

15.5.3.1 General

The device or component, which shall be arranged to have the most adverse dimensions permitted by the construction drawings, shall be filled with and surrounded by an explosive mixture according to the stated group of the equipment, as follows:

– Group IIA: (55 ± 0,5) % hydrogen/air at atmospheric pressure;

– Group IIB: (37 ± 0,5) % hydrogen/air at atmospheric pressure;

– Group IIC: (40 ± 1) % hydrogen, (20 ± 1) % oxygen and the remainder nitrogen at atmospheric pressure or alternatively (27,5 ± 1,5) % hydrogen/air at an overpressure at a pressure equal to 1,5 times atmospheric pressure.

15.5.3.2 Test procedure

For “dc”, the explosive mixture within the device shall be ignited by the operation of the enclosed contacts when connected to the maximum rated source of energy and power, and maximum load, in terms of voltage, current, frequency and power factor. A make and break test shall be made 10 times with a fresh explosive mixture for each test and the explosive mixture surrounding the device shall not be ignited.

16 Routine tests

16.1 General

16.1.1 The following routine tests are intended to ensure that the enclosure withstands the pressure and also that it contains no holes or cracks connecting to the exterior.

The routine tests include an overpressure test made according to one of the methods described for the type tests in 15.2.3. For equipment intended for use at an ambient temperature below –20 °C, a pressure test at normal ambient temperature is sufficient.

16.1.2 The routine overpressure test may be made by the first method even when the overpressure type test has been made by the second method.

When the determination of the reference pressure has been impracticable and when a dynamic test involves a risk to the enclosed equipment (windings, etc.), the static pressures to be applied are as given in Table 13.

Table 13
Static pressures

Volume cm^3	Group	Pressure[b] kPa
≤10[a]	I, IIA, IIB, IIC	1 000
>10	I	1 000
>10	IIA, IIB	1 500
>10	IIC	2 000

[a] Applicable to welded constructions only.

[b] For equipment intended for use at an ambient temperature below –20 °C, the above pressures shall be increased by the appropriate test factors noted in Table 7.

16.1.3 When the second method is chosen, the routine test consists of – an explosion test with, inside and outside the enclosure, the appropriate explosive mixture specified in 15.2.2 (for the determination of explosion pressure) at 1,5 times atmospheric pressure, or

– an explosion test with the appropriate explosive mixture specified in 15.2.2 (for the determination of explosion pressure) at 1,5 times atmospheric pressure inside of the enclosure, followed by a non-transmission test with explosive mixtures as specified in 15.3.2.2 or 15.3.3.2 (test for non-transmission of an internal ignition, with enlarged gaps) inside and outside the enclosure at atmospheric pressure, or

– an explosion test with the appropriate explosive mixture specified in 15.2.2 (for the determination of explosion pressure) at 1,5 times atmospheric pressure, followed by a static test at a pressure of at least 200 kPa.

16.1.4 For the routine test, it is sufficient to test the enclosure empty. However, if the routine test is dynamic and the enclosed equipment influences the pressure rise during an internal explosion, the test conditions shall address this influence.

The individual parts of a flameproof enclosure (for example, cover and base) can be tested separately. The test conditions shall be such that the stresses are comparable to those to which these parts are exposed in the complete enclosure.

NOTE A non-compressible hydraulic media is normally used for these tests. If a compressible media such as air or inert gas is used, failure of the enclosure can result in personal injury or property damage.

16.2 Enclosures not incorporating a welded construction

For enclosures that do not incorporate welded constructions, routine overpressure tests are not required under either of the following conditions:

– for volumes less than or equal to 10 cm^3; or

– for volumes greater than 10 cm^3, and when the prescribed type test has been made at a static pressure equal to four times the reference pressure.

16.3 Enclosures incorporating a welded construction

For enclosures or parts of enclosures that incorporate a welded construction, the integrity of the welded construction shall be verified by means of routine overpressure testing.

Alternatively, when routine overpressure testing of a welded construction is impractical (such as due to the construction of the enclosure), and when the enclosure complies with the 4 times overpressure type test, the integrity of the welds may be verified by one of the following inspection methods:

– radiographic weld inspection; or

– ultrasonic weld inspection; or

– magnetic particle weld inspection; or

– liquid penetrant weld inspection.

NOTE ISO standards exist for each of the above weld inspection methods.

16.4 Bushings not specific to one flameproof enclosure

Routine tests are not required for bushings that are not specific to one flameproof enclosure, if the assembly procedure is sufficiently documented (see C.2.1.4).

16.5 Acceptance criteria

The routine tests are considered satisfactory if

a) the enclosure withstands the pressure without suffering permanent deformation of the joints or damage to the enclosure, and

b) when the test has been made by the dynamic followed by the static tests of 16.1.3, there is no leakage through the walls of the enclosure or, if tested dynamically, there is no transmission of an internal ignition.

16.6 Batch testing

Where the routine overpressure testing is replaced by a batch test according to the following criteria based on ISO 2859-1 [5]:

– For a production batch up to 100, a sampling of 8 needs to be tested at 1,5 times the reference pressure with no failures.

– For a production batch from 101 to 1 000, a sampling of 32 needs to be tested at 1,5 times the reference pressure with no failures.

– For a production batch from 1 001 up to 10 000, a sampling of 80 needs to be tested at 1,5 times the reference pressure with no failures.

– Batches above 10 000 must be subdivided into smaller batches.

If there is any non-compliant test results, 100 % of all remaining samples in the batch shall be tested at 1,5 times the reference pressure. Future batches should be routine tested at 1,5 times the reference pressure until confidence is established to reconsider batch testing.

NOTE Upon non-compliant test results, reconsideration of this batch testing approach is at the discretion of the party issuing the involved certificate.

17 Switchgear for Group I

17.1 General

Group I flameproof enclosures which are to be opened from time to time on site, for example, for adjustment purposes or for resetting of protection relays, and which contain remotely operated switching devices in which circuits can be made or broken by a separate influence (e. g. mechanical, electrical, electro-optical, pneumatic, acoustic, magnetic, or thermal) when this influence is not applied manually to the equipment itself, and which produce in-service arcs or sparks capable of igniting an explosive mixture, shall comply with the following requirements.

17.2 Means of isolation

17.2.1 General

All accessible conductors, except those of intrinsically safe circuits complying with IEC 60079-11 and those for bonding or earthing, shall be capable of being isolated from the supply before the opening of the flameproof enclosure.

The means of isolation of these flameproof enclosures shall be in accordance with 17.2.2, 17.2.3 or 17.2.4.

17.2.2 The means of isolation shall be fitted inside the flameproof enclosure, in which case the parts which remain energized after the means of isolation has been opened shall either:

– be protected by one of the standard types of protection of EPL Mb listed in IEC 60079-0; or

– have clearances and creepage distances between phases and to earth in accordance with the requirements of IEC 60079-7, and be protected by an enclosure that provides a degree of protection of at least IP20, arranged so that a tool cannot contact the energized parts through any openings. This does not apply to parts of intrinsically safe circuits complying with IEC 60079-11 which remain energized.

In either case, a marking in accordance with Table 14, point c), shall be provided on the cover protecting the parts which remain energized.

17.2.3 The means of isolation shall be fitted inside another enclosure complying with one of the standard types of protection of EPL Mb listed in IEC 60079-0.

17.2.4 The means of isolation shall consist of a plug and socket or a cable coupler complying with the requirements of 13.3.

17.3 Doors or covers

17.3.1 Quick-acting doors or covers

These doors or covers shall be mechanically interlocked with an isolator so that

a) the enclosure retains the properties of the flameproof enclosure, type of protection “d”, as long as the isolator is closed, and

b) the isolator can only be closed when these doors or covers ensure the properties of the flameproof enclosure, type of protection “d”.

17.3.2 Doors or covers fixed by screws

These doors or covers shall bear a marking in accordance with Table 14, point c).

17.3.3 Threaded doors or covers

These doors or covers shall bear a marking in accordance with Table 14, point c).

18 Lampholders and lamp caps

18.1 General

The following requirements apply to lampholders and lamp caps which together have to form a flameproof enclosure, type of protection “d”, so that they may be used in luminaires of increased safety, type of protection “e”.

18.2 Device preventing lamps working loose

The device which prevents lamps working loose, required in IEC 60079-7, increased safety “e”, may be omitted for threaded lampholders provided with a quick-acting switch in a flameproof enclosure, type of protection “d”, which breaks all poles of the lamp circuit before contact separation.

18.3 Holders and caps for lamps with cylindrical caps

18.3.1 Holders and caps for tubular fluorescent lamps shall comply with the dimensional requirements of data sheets Fa6 of IEC 60061.

18.3.2 For other holders, the requirements of Clause 5 shall apply, but the width of the flameproof joint between the holder and the cap shall be at least 10 mm at the moment of contact separation.

18.4 Holders for lamps with threaded caps

18.4.1 The threaded part of the holder shall be of a material which is resistant to corrosion under the likely conditions of service.

18.4.2 At the moment of contact separation when unscrewing the lamp, at least two complete turns of the thread shall be engaged.

18.4.3 For threaded lampholders E26/E27 and E39/E40, electrical contact shall be established by spring-loaded contact elements. In addition, for electrical equipment of Group IIB or IIC, the making and breaking of contact during insertion and removal of the lamp shall take place within a flameproof enclosure, type of protection “d”, of Group IIB or IIC, respectively.

For threaded lampholders E10 and E14, the requirements of 18.4.3 are not necessary.

19 Non-metallic enclosures and non-metallic parts of enclosures

19.1 General

The following requirements apply to non-metallic enclosures and non-metallic parts of enclosures, except for

a) sealing rings of cable glands or conduit sealing devices, for which Clause C.3 applies,

b) cemented joints for which Clause 6 applies, and

c) non-metallic parts on which the type of protection does not depend.

19.2 Resistance to tracking and creepage distances on internal surfaces of the enclosure walls

When an enclosure or a part of an enclosure of non-metallic material serves directly to support live bare parts, the resistance to tracking and the creepage distances on the internal surfaces of the walls of the enclosure shall comply with the requirements of IEC 60079-7 or IEC 60079-15, as applicable.

However, for enclosures of electrical equipment of Group I which may be subjected to electrical stresses capable of producing arcs in air and which result from rated currents of more than 16 A, the requirements stated in 12.6 shall be observed.

19.3 Requirements for type tests

For non-metallic enclosures and non-metallic parts of enclosures, the type tests in this standard are modified in accordance with the following sequence:

a) determination of the explosion pressure (reference pressure) in accordance with 15.2.2 on one sample that may or may not have been subjected to the tests of enclosures in accordance with IEC 60079-0;

b) overpressure test in accordance with 15.2.3 on all of the samples which has been subjected to the tests of enclosures in accordance with IEC 60079-0;

c) test for non-transmission of an internal ignition in accordance with 15.3 on one sample subjected to the tests indicated in b) above;

d) test of erosion by flame in accordance with 19.4 on the sample subjected to the tests indicated in c) above; and

e) test for non-transmission of an internal ignition in accordance with 15.3 on the sample subjected to the tests indicated in d) above.

19.4 Test of erosion by flame

This test only applies to enclosures of volume greater than 50 cm^3 and of which the flameproof joints have at least one face of plastic material.

The sample shall be prepared as described in 15.3, except that gaps of flanged joints and plane parts of spigot joints shall be set to a value between 0,1 mm and 0,15 mm.

For bushings which are common to two adjacent flameproof enclosures, the test shall be carried out in the enclosure giving the worst conditions.

The test consists of 50 ignitions of the explosive mixture specified in 15.2.2.2 for the corresponding group. In the case of electrical equipment from Group IIC, 25 ignitions shall be made with each of the two explosive mixtures specified in 15.2.2.2.

The test is judged satisfactory if the test for non-transmission in 15.3 is satisfactory.

20 Marking

20.1 General

Flameproof enclosures "d" shall be marked in accordance with IEC 60079-0 with the following *additional marking for the type of protection "d"*:

– For Level of Protection "da", complying with the requirements of 4.2 the marking shall include "da".

– For Level of Protection "db", complying with the requirements of 4.3 the marking shall include "db".

– For Level of Protection "dc", complying with the requirements of 4.4 the marking shall include "dc".

20.2 Caution and warning markings

Where any of the following markings are required, the text as described in Table 14, following the word “CAUTION” or “WARNING,” may be replaced by technically equivalent text or symbols. Multiple warnings may be combined into one equivalent warning.

Table 14
Text of caution or warning markings

Point	Reference	Caution or warning marking
a)	11.3	“CAUTION – USE FASTENERS WITH YIELD STRESS ≥ (VALUE)“, where the (value) is determined by the applicable testing
b)	13.6.5	“WARNING – DO NOT SEPARATE WHEN ENERGIZED”
c)	17.2.2, 17.3.2, 17.3.3	“WARNING – DO NOT OPEN WHEN ENERGIZED”
d)	E.3.2	“WARNING – DO NOT OPEN WHEN AN EXPLOSIVE GAS ATMOSPHERE IS PRESENT”

20.3 Informative markings

Where any of the following markings are required, the text as described in Table 15DV.1 may be replaced by technically equivalent text or symbols. Multiple warnings may be combined into one equivalent warning.

Table 15DV DR *Modification of Table 15DV.1 to replace with the following:*

Table 15DV.1
Text of informative markings

Point	Reference	Informative marking
a)	13.2	Identification of metric thread size and type, e.g. ~~"1/2 NPT",~~ "M25"
b)	13.2	"SEE INSTALLATION INSTRUCTION DOCUMENT"
c)	15.3.1	"THIS EQUIPMENT SHALL BE INSTALLED SO THAT THE FLANGED JOINT(S) ARE NOT WITHIN (VALUE) OF A SOLID OBJECT THAT IS NOT PART OF THIS EQUIPMENT" where the (value) is determined by the proximity of the solid object during flame transmission testing, with the tested values less than those stated in Table 11DV.1

20.4DV DR *Addition of Clause 20.4DV as follows:*

20.4DV.1 *Interrupting rating markings*

Flameproof equipment incorporating circuit breakers, motor controllers and similar high-current interrupting equipment shall be marked with the interrupting rating in rms symmetrical amperes.

21 Instructions

All flameproof "d" equipment shall be accompanied by instructions as required by 60079-0, including, as a minimum, details on the flamepath dimensions or indication that repair of the flamepaths is not intended, if required by 5.1.

Annex A
(normative)

Additional requirements for crimped ribbon elements and multiple screen elements of breathing and draining devices

A.1 Crimped ribbon elements and multiple screen elements shall be constructed from cupronickel, stainless steel or other metal found suitable for the application. Aluminium, titanium, magnesium and their alloys shall not be used.

See 10.3 for limits on copper content.

A.2 Where the paths through the device can be specified in the drawings and measured in the complete device, an upper and lower tolerance limit for the path dimensions shall be specified and monitored in production.

A.3 Where Clause A.2 does not apply, the relevant requirements of Annex B shall apply.

A.4 The type tests of 15.4.4 shall be carried out with samples manufactured with not less than 90 % of the largest permitted gap dimensions.

Annex B
(normative)

Additional requirements for elements, with non-measurable paths of breathing and draining devices

B.1 Sintered metal elements

B.1.1 Sintered metal elements shall be constructed from one of the following:

– stainless steel;

– 90/10 copper-tin bronze; or

– a specific metal or specific alloy found suitable for the application. Aluminium, titanium, magnesium and their alloys shall not be used.

See 10.3 for limits on copper content.

B.1.2 The maximum bubble test pore size shall be determined by the method specified in ISO 4003.

B.1.3 The density of the sintered metal element shall be determined in accordance with ISO 2738.

B.1.4 Where determination of open porosity and/or fluid permeability of elements is required in connection with functional aspects of devices, measurements shall be made in accordance with ISO 2738 and ISO 4022.

B.1.5 Sintered metal elements shall be clearly identified in the documentation by declaring

a) the material in accordance with 10.3 and B.1.1,

b) the maximum bubble test pore size in micrometers in accordance with B.1.2,

c) the minimum density in accordance with B.1.3,

d) the minimum thickness, and

e) where appropriate, the fluid permeability and open porosity in accordance with B.1.4.

B.2 Pressed metal wire elements

B.2.1 Pressed metal wire elements shall be constructed from stainless steel wire braid or another specified metal found suitable for the application.

See 10.3 for limits on copper content.

Aluminium, titanium, magnesium and their alloys shall not be used. Manufacture shall start from a wire braid which is compressed in a die to form an homogeneous matrix.

B.2.2 In order to evaluate the density, the wire diameter shall be specified. Information shall also be given on the mass, length of wire braid, thickness of the element, and mesh size. The ratio between the mass of the element and the mass of an identical volume of the same solid metal shall be between 0,4 and 0,6.

B.2.3 The maximum bubble test pore size shall be determined by the method specified in ISO 4003.

B.2.4 The density of the element shall be determined in accordance with ISO 2738.

B.2.5 Where determination of open porosity and/or fluid permeability is required in connection with functional aspects of elements, measurements shall be made in accordance with ISO 2738 and ISO 4022.

B.2.6 Metal wire elements shall be clearly identified in the documentation by declaring:

a) the material in accordance with 10.3 and B.2.1,

b) the maximum bubble test pore size in micrometers in accordance with B.2.3,

c) the minimum density in accordance with B.2.4,

d) the dimensions, including tolerances,

e) the original wire diameter, and

f) where appropriate, the fluid permeability and open porosity in accordance with B.2.5.

B.3 Metal foam elements

B.3.1DV DR *Modification of Clause B.3.1 to replace with the following:*

Metal foam elements ~~shall~~ are permitted to be produced by coating a reticulated polyurethane foam with nickel, removing the polyurethane by thermal decomposition, converting the nickel into a nickel-chrome alloy, for example, by gaseous diffusion, and compressing the material as necessary.

B.3.2 Metal foam elements shall contain at least 15 % chromium by mass.

B.3.3 The maximum bubble test pore size shall be determined by the method specified in ISO 4003.

B.3.4 The density of the element shall be determined in accordance with ISO 2738.

B.3.5 Where determination of open porosity and/or fluid permeability is required in connection with functional aspects of elements, measurements shall be made in accordance with ISO 2738 and ISO 4022.

B.3.6 Metal foam elements shall be clearly defined in the documentation by declaring:

a) the material, in accordance with 10.3, B.3.1 and B.3.2,

b) the maximum bubble test pore size in micrometers in accordance with B.3.3,

c) the minimum thickness,

d) the minimum density, and

e) where appropriate, the open porosity and fluid permeability in accordance with B.3.5.

Annex C
(normative)

Additional requirements for flameproof entry devices

C.1 General

DR *Modification of Clause C.1 to replace with the following:*

This annex contains specific requirements which apply, in addition to those in ~~IEC~~ UL 60079-0, to the construction and testing of flameproof entry devices. Entry devices include cable glands, conduit sealing devices, Ex blanking elements, Ex thread adaptors, and bushings.

The requirements for Group II cable glands of type of protection "d" are located in UL 2225.

C.2 Constructional requirements

C.2.1 Sealing methods

C.2.1.1DV DR *Modification of Clause C.2.1.1 title to replace with the following*

Group I ~~C~~cable glands ~~and conduit sealing devices~~ with elastomeric sealing rings

C.2.1.1.1DV DR *Modification of Clause C.2.1.1.1 to replace with the following:*

If a cable gland ~~or conduit sealing device~~ can accept any sealing ring with the same outside diameter but with different internal dimensions, the ring shall have a minimum uncompressed axial sealing height (i. e. gap length) between the body of the gland and sealing ring and between the sealing ring and the cable of

– 20 mm, for circular cables of diameter not greater than 20 mm, and for non-circular cables of perimeter not greater than 60 mm, or

– 25 mm, for circular cables of diameter greater than 20 mm, and for non-circular cables of perimeter greater than 60 mm.

C.2.1.1.2DV DR *Modification of Clause C.2.1.1.2 to replace with the following:*

If a cable gland ~~or conduit sealing device~~ can accept only one specific elastomeric sealing ring, this ring shall have a minimum uncompressed axial sealing height of 5 mm between body of gland and sealing ring and between cable and sealing ring.

C.2.1.2DV DR *Modification of Clause C.2.1.2 title to replace with the following*

Group I ~~C~~cable glands sealed with setting compound

The minimum length of the compound shall be 20 mm when installed.

The manufacturer shall specify:

a) the maximum diameter over cores of the cable that the gland is intended to accept; and

b) the maximum numbers of cores that can pass through the compound.

These specified values shall ensure that, throughout the required 20 mm compound length, at least 20 % of that cross-sectional area is filled with compound.

The cable gland shall be capable of being fitted and removed from electrical equipment without disturbing the compound seal after the specified curing period of the compound.

The filling compound and appropriate installation instructions shall be provided with the cable gland.

C.2.1.3DV DR *Delete Clause C.2.1.3. This clause does not apply.*

~~**Conduit sealing devices with setting compound**~~

~~**The minimum length of the compound shall be 20 mm when installed.**~~

~~**The manufacturer shall specify the maximum numbers of cores that can pass through the compound.**~~

~~**These specified values shall ensure that, throughout the required 20 mm compound length, at least 20 % of that cross-sectional area is filled with compound.**~~

~~**The filling compound and appropriate installation instructions shall be provided with the conduit sealing device.**~~

C.2.1.4 Bushings

Bushings may contain one or more conductors. When they are correctly assembled and mounted in the walls of the enclosure, all joint widths, gaps or cemented joints shall conform with the relevant requirements of Clauses 5, 6 and C.2.2. The documentation shall specify the maximum numbers of cores that can pass through the compound.

NOTE To provide adequate strength, bushing designs generally provide, throughout the required cemented joint length, at least 20 % of that cross-sectional area filled with compound.

When the bushing is formed by moulding insulation on metallic parts, the requirements of 5.2, 5.3 and 5.4 do not apply, but Clause 6 is applicable with the required non-transmission test performed with the bushing installed in a representative enclosure of the intended maximum end-application volume, with a minimum conductor length as specified in the documentation. The insulation material itself can contribute to the mechanical strength of the enclosure.

When the bushing includes parts assembled with adhesive, this is considered as a cement if it complies with the requirements of Clause 6 with the required non-transmission test performed with the bushing installed in a representative enclosure of the intended maximum end-application volume, with a minimum conductor length as specified in the documentation. Should this not be the case, the requirements of 5.2.1, 5.3 and 5.4 are applicable.

The parts of bushings outside the flameproof enclosure shall be protected in accordance with IEC 60079-0.

Bushings specific to a flameproof enclosure shall satisfy the type tests and routine tests for that enclosure.

Ex component bushings shall be submitted to a type test for resistance to pressure carried out by means of a static pressure test as specified in 15.2.3.2 at the following values:

– 2 000 kPa for electrical equipment of Group I;

– 3 000 kPa for electrical equipment of Group II.

These bushings shall be subject to a routine pressure test as specified in 16.1, except where the assembly procedure used is described in the manufacturer's documentation and is such as to ensure consistency in the manufactured products.

If the cemented joint is judged satisfactory with or without leakage, then the schedule of limitations of the Ex component certificate shall specify the maximum intended enclosure volume and the minimum specified conductor length.

C.2.2 Flameproof joints

C.2.2.1 Threaded joints

C.2.2.1DV DR *Modification of Clause C.2.2.1 to replace with the following:*

Threads forming part of a flameproof joint shall comply with the relevant requirements of 5.3 and shall be one of the following:

– metric threads with a tolerance Class of 6g/6H or better according to ISO 965-1 and ISO 965-3, and any chamfer or undercut of an internal thread is limited to a maximum depth of 2 mm from the external surface;

– tapered threads shall conform to the NPT requirements of ANSI/ASME B1.20.1;

– external threaded NPT fittings with a shoulder or interruption shall be provided with

a) an effective thread length not less than the “L2” dimension, and

b) a length not less than the “L4” dimension between the face of the shoulder and end of the fitting thread;

– internal NPT threads shall gauge at “flush” to “2 turns large” using an L1 plug-gauge;

~~**– other external thread types previously permitted by earlier editions of IEC 60079-1. When a device includes external thread types from previous editions of IEC 60079-1, the device shall be marked with an indication of the thread type. The certificate shall also identify this thread type, along with the previous edition of IEC 60079-1 from which the thread type requirements were applied.**~~

~~**NOTE 1 This allowance for the use of “other external thread types” is for the manufacture of replacement entry devices for equipment in existing installations only, that incorporate internal thread types that are no longer permitted by the current edition of IEC 60079-1.**~~

For external metric threads intended for installation in a threaded entry of a flameproof equipment, the threaded part shall be at least 8 mm in length and comprise at least eight full threads. If the thread is provided with an undercut, regardless of the size of the undercut, then a non-detachable and non-compressible washer or equivalent device shall be fitted to ensure the required length of thread engagement.

NOTE ~~2~~ The above requirement for at least eight full threads serves to ensure that at least five full threads will be engaged when the cable gland is installed in a threaded entry – taking into account the presence of any chamfer or undercut (see Clause 13).

C.2.2.2 Non-threaded joints (Group I only)

Non-threaded joints shall be for Group I only and shall comply with the relevant requirements of 5.2. Fixing method(s) shall be evaluated as part of the type tests in Clause 15. Fasteners used with the fixing method shall comply with the special fastener requirements of IEC 60079-0.

NOTE Cable adaptors and/or glands of non-threaded joints not originally assessed with the flameproof enclosure are reviewed and/or assessed to ensure the fixing methods are adequate for installation and meet the flameproof enclosure requirements.

C.2.3 Constructional requirements for Ex blanking elements

C.2.3.1 General requirements

C.2.3.1DV DR *Modification of Clause C.2.3.1 to replace with the following:*

The mechanically or frictionally locked blanking element shall comply with one or more of the following requirements:

~~**– if it is removable from the outside, this shall be possible only after disengagement of a retaining device inside the enclosure (see Figure C.1DVa));**~~

– it may be so designed that it can be fitted or removed only by the use of a tool (see Figure C.1DVb));

~~**– it may be of a special construction in which insertion is carried out by a method other than that used for removal (see Figure C.1DVc)).**~~

Modification of Figure C.1DV to delete item a) Example 1 and item c) Example 3:

They do not apply.

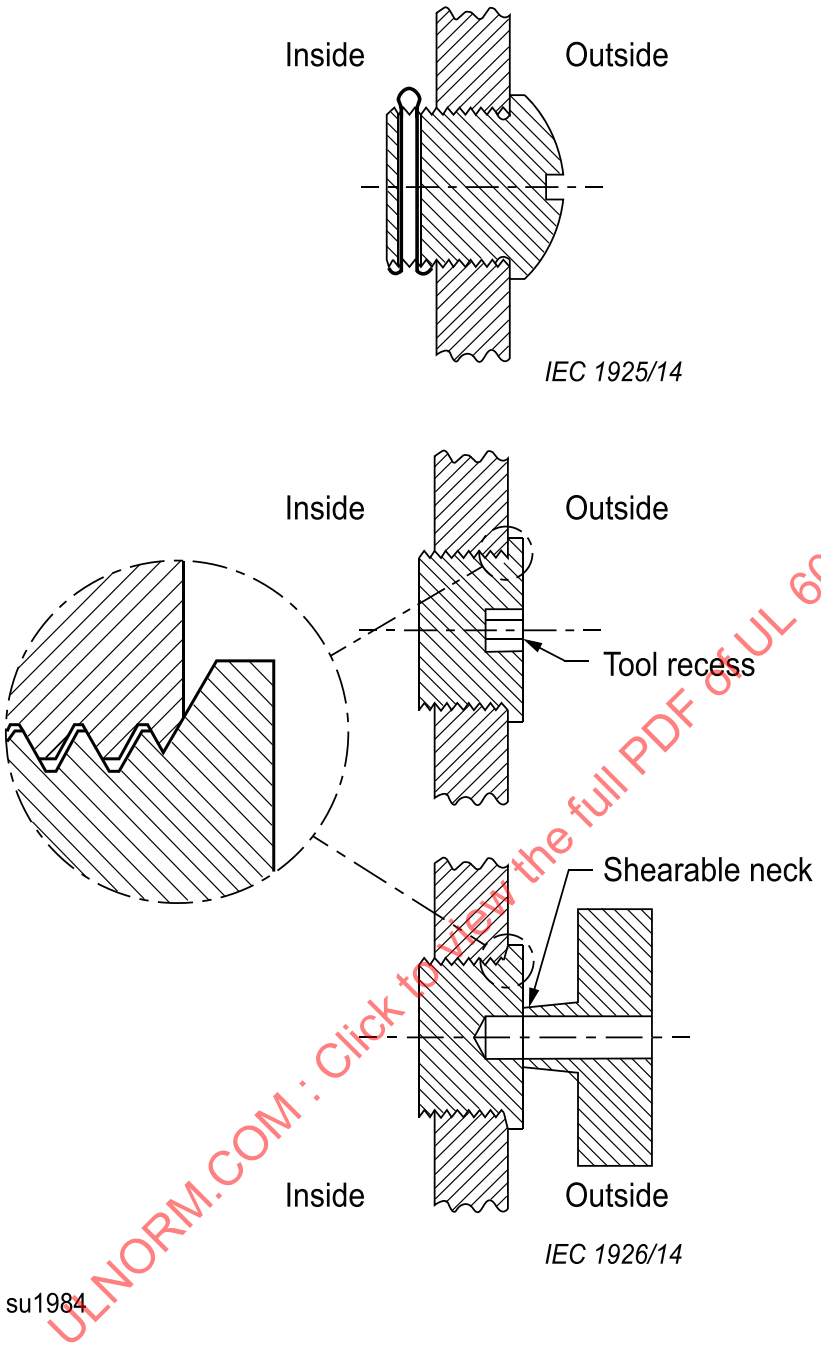

Figure C.1DV

Examples of blanking elements for unused entries