AMERICAN NATIONAL STANDARD

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Supercedes ANSI/ISA-60079-0 (12.00.01)-2005

Explosive atmospheres – Part 0: Equipment – General Requirements

ISA-60079-0 approved by ISA S&P Board 14 October 2009
ANSI/UL 60079-0 approved by ANSI 21 October 2009
ANSI/ISA-60079-0 approved by ANSI 16 November 2009

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This ANSI/UL Standard for Safety, which consists of the third edition, is under continuous maintenance, whereby each revision is ANSI approved upon publication. 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 http://csds.ul.com.

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The International Society of Automation
ANSI/ISA–60079-0
Fifth Edition

Underwriters Laboratories Inc.
ANSI/UL 60079-0
Fifth Edition

Explosive atmospheres - Part 0: Equipment - General requirements

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General Notes

This is the common ISA and UL standard for Explosive atmospheres Part 0: Equipment - General Requirements. It is the fifth edition of ANSI/ISA-60079-0 and the fifth edition of ANSI/UL 60079-0. This document is a modification of the IEC document and includes US deviations encompassing both additions and deletions of information.

ANSI/ISA-60079-0 and ANSI/UL 60079-0 contain identical requirements, and identical publication dates. The presentation and format of the standards material may differ between the two published standards.

This common standard was prepared by ISA and Underwriters Laboratories Inc. (UL).

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.

Level of harmonization

This standard adopts the IEC text with deviations.

The requirements are presented in different formats. The ISA version of the standard illustrates the national differences from the IEC text through the use of legislative text (strike-out and underline). The UL version of the standard illustrates national differences immediately following the IEC text. National differences between the UL version and the ISA version shall be word for word except for editorial changes.

Interpretations

The interpretation by the SDO of an identical or equivalent standard shall be based on the literal text to determine compliance with the standard in accordance with the procedural rules of the SDO. If more than one interpretation of the literal text has been identified, a revision shall be proposed as soon as possible to each of the SDOs to more accurately reflect the intent.

UL Effective Date

As of 21 October 2009 all products Listed or Recognized by UL must comply with the requirements in this standard except for clauses in the following list, which are effective 31 December 2012.

Clauses 6.6, 7.2.2, 7.3, 9.2 - 9.3, 26.4.1.2.2, 29.2 c)

Between 21 October 2009 and 31 December 2012, new product submittals to UL may be evaluated under all requirements in this standard or, if requested in writing, evaluated under presently effective requirements only. The presently effective requirements are contained in the Fourth edition of ANSI/UL 60079-0.

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Preface (ISA)

This ISA standard is based on the 5th edition of IEC Publication 60079-0. It is the intention of the ISA12 Committee to develop an ANSI Standard that is harmonized with IEC 60079-0 to the fullest extent possible. This preface is included for informational purposes and is not part of ANSI/ISA-60079-0. The document is a modification of the IEC document and includes U.S. deviations encompassing both additions and deletions of information.

The significant changes with respect to the previous edition are listed below:

- Requirements for explosive dust atmospheres transferred from IEC 61241-0.
- The marking Group "II" alone has been replaced by "IIA", "IIB", or "IIC" as many of the enclosure requirements are now aligned with a specific sub-group.
- Dust groups defined as Group IIIA, IIIB and IIIC.
- Limits for ultrasonic and electromagnetic radiation introduced.
- Remainder of "electrostatic" requirements transferred from IEC 60079-26.
- Equipment protection levels (EPL) introduced.
- Transition of term from "apparatus" to "equipment" (where appropriate).

The standards referenced within this document may contain provisions which, through reference in this text, constitute requirements of this document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the standards indicated within this document. Members of IEC and ISO maintain registers of currently valid International Standards. ANSI maintains registers of currently valid U.S. National Standards.

This document has been prepared as part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, Standards and Practices Board; ISA; 67 Alexander Drive; P. O. Box 12277; Research Triangle Park, NC 27709; Telephone (919) 549-8411; Fax (919) 549-8288; E-mail: standards@isa.org.

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National Differences

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60079-0, Explosive atmospheres - Part 0: Equipment - General requirements, copyright 2007, are indicated by notations (differences) and are presented in bold text.

In the ISA publication of this standard, National Differences are presented using legislative text (strike-out and underline). The national difference type is identified in an informative annex.

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 printed standard includes the national difference types within the body of the text. The ISA printed standard includes the national difference types in an annex at the back of the standard.

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1 Scope

This ~~part of IEC 60079~~ standard specifies the general requirements for construction, testing and marking of electrical equipment and Ex components intended for use in explosive atmospheres. Explosive atmospheres are identified by the National Electrical Code®, ANSI/NFPA 70 as hazardous (classified) locations and include the following specified locations:

- Class I, Zone 0
- Class I, Zone 1
- Class I, Zone 2
- Zone 20
- Zone 21
- Zone 22

Unless modified by one of the standards supplementing this standard, electrical equipment complying with this standard is intended for use in hazardous areas in which explosive atmospheres exist under normal atmospheric conditions of

- temperature –20 °C to +60 °C;
- pressure 80 kPa (0,8 bar) to 110 kPa (1,1 bar); and
- air with normal oxygen content, typically 21 % v/v.

The application of electrical equipment in atmospheric conditions outside this range requires special consideration and may require additional assessment and testing.

NOTE 1 Although the normal atmospheric conditions above give a temperature range for the atmosphere of -20°C to +60°C, the normal ambient temperature range for the equipment is -20°C to +40°C, unless otherwise specified and marked. See 5.1.1.

NOTE 2 In designing equipment for operation in explosive atmospheres under conditions other than the atmospheric conditions given above, this standard may be used for guidance. However, additional testing related specifically to the intended conditions of use is recommended. This is particularly important when the types of protection 'flameproof enclosure "d"' ~~(IEC 60079-1)~~ and 'intrinsic safety "i"' ~~(IEC 60079-11 or IEC 61241-11)~~ are applied.

NOTE 3 Requirements given in this standard result from an ignition hazard assessment made on electrical equipment. The ignition sources taken into account are those found associated with this type of equipment, such as hot surfaces, mechanically generated sparks, thermite reactions, electrical arcing and static electric discharge in normal industrial environments.

~~NOTE 4 It is acknowledged that, with developments in technology, it may be possible to achieve the objectives of the IEC 60079 series of standards in respect of explosion prevention by methods that are not yet fully defined. Where a manufacturer wishes to take advantage of such developments, this International Standard, as well as other standards in the IEC 60079 series, may be applied in part. It is intended that the manufacturer prepare documentation that clearly defines how the IEC 60079 series of standards has been applied, together with a full explanation of the additional techniques employed. The designation "Ex s" has been reserved to indicate a type of protection that is not defined by the IEC 60079 series of standards, but may be referenced in national requirements.~~

NOTE 5 Where an explosive gas atmosphere and a combustible dust atmosphere are, or may be, present at the same time, the simultaneous presence of both should be considered and may require additional protective measures.

This standard does not specify requirements for safety, other than those directly related to the explosion risk. Ignition sources like adiabatic compression, shock waves, exothermic chemical reaction, self ignition of dust, naked flames and hot gases/liquids, are not addressed by this standard.

NOTE 6 Such equipment should be subjected to a hazard analysis that identifies and lists all of the potential sources of ignition by the electrical equipment and the measures to be applied to prevent them becoming effective.

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This standard is supplemented or modified by the following standards concerning specific types of protection:

– ~~IEC 60079-1~~ ANSI/ISA 60079-1 (12.22.01): Gas – Flameproof enclosures "d";
– ~~IEC 60079-2~~ ANSI/ISA 60079-2 (12.04.01): Gas – Pressurized enclosures "p";
– ~~IEC 60079-5~~ ANSI/ISA 60079-5 (12.25.01): Gas – Powder filling "q";
– ~~IEC 60079-6~~ ANSI/ISA 60079-6 (12.26.01): Gas – Oil immersion "o";
– ~~IEC 60079-7~~ ANSI/ISA 60079-7 (12.16.01): Gas – Increased safety "e";
– ~~IEC 60079-11~~ ANSI/ISA 60079-11 (12.02.01): Gas – Intrinsic safety "i";
– ~~IEC 60079-15~~ ANSI/ISA 60079-15 (12.12.01): Gas – Type of protection “n”;
– ~~IEC 60079-18~~ ANSI/ISA 60079-18 (12.23.01): Gas ~~and Dust~~ – Encapsulation "m";
– ~~IEC 61241-1~~ ANSI/ISA 61241-1 (12.10.03): Dust – Protection by enclosures “tD”;
– ~~IEC 61241-2 (IEC 61241-4)~~ ANSI/ISA 61241-2 (12.10.06): Dust – Pressurization “pD”;
– ~~IEC 61241-11~~ ANSI/ISA 61241-11 (12.10.04): Dust – Intrinsic safety “iD”.
– ANSI/ISA 61241-18 (12.10.07): Dust – Encapsulation “mD”.

~~NOTE 7 The former requirements of IEC 61241-18, Encapsulation “mD”, have been incorporated in IEC 60079-18.~~

This standard is supplemented or modified by the following equipment standards:

~~IEC 60079-25: Electrical apparatus for explosive gas atmospheres – Part 25: Intrinsically safe systems~~

~~IEC 60079-26 Explosive atmospheres – Part 26: Equipment with equipment protection level (EPL) Ga~~

ANSI/ISA 60079-26 (12.00.03):Electrical equipment for use in Class I, Zone 0 hazardous (classified) locations

~~IEC 60079-28: Explosive atmospheres – Part 28: Protection of equipment and transmission systems using optical radiation~~

~~IEC 62013-1: Caplights for use in mines susceptible to firedamp – Part 1: General requirements – Construction and testing in relation to the risk of explosion~~

~~IEC 60079-30-1: Explosive atmospheres – Part 30-1: Electrical resistance trace heating – General and testing requirements.~~

ANSI/IEEE 515: Standard for Testing, Design, Installation, and Maintenance of Electrical Heat Tracing for Industrial Applications.

NOTE Components such as power connections, splices, end terminations, as well as cable entries, fittings, and seals, are to be evaluated according to the type of protection employed.

This standard with the additional standards mentioned above, are not applicable to the construction of

- electromedical apparatus,
- shot-firing exploders,

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- test devices for exploders, and
- shot-firing circuits.

2 ~~Normative~~ references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI/NFPA 70:2008, *National Electrical Code*

ANSI/UL 347, *High Voltage Industrial Control Equipment*

ANSI/UL 486E, *Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors*

ANSI/UL 508, *Industrial Control Equipment*

IEC 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-5*, Rotating electrical machines – Part 5: Classification of degrees of protection provided by the enclosures of rotating electrical machines (IP Code)*

IEC 60050(426), *International Electrotechnical Vocabulary (IEV) – Chapter 426: Electrical apparatus for explosive atmospheres*

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

ANSI/ISA-60079-1 (12.22.01)*, Electrical Apparatus for Use in Hazardous (Classified) Locations: Type of Protection - Flameproof "d"*

~~IEC 60079-2*, Explosive atmospheres – Part 2: Equipment protection by pressurized enclosures "p"*~~

ISA-60079-2 (12.04.01), Electrical Apparatus for Explosive Gas Atmospheres – Part 2 Pressurized Enclosures "p"

IEC 60079-4*, Electrical apparatus for explosive gas atmospheres – Part 4: Method of test for ignition temperature*

~~IEC 60079-5*, Explosive atmospheres – Part 5: Equipment protection by powder filling "q"*~~

ANSI/ISA-60079-5 (12.25.01), *Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations: Type of Protection – Power filling "q"*

~~IEC 60079-6, *Explosive atmospheres – Part 6: Equipment protection by oil-immersion "o"*~~

ANSI/ISA-60079-6 (12.26.01), *Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations: Type of Protection – Oil-Immersion "o"*

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

ANSI/ISA-60079-7 (12.16.01), *Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations: Type of Protection – Increased Safety "e"*

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

ANSI/ISA-60079-11 (12.02.01), *Electrical Apparatus for Use in Class I, Zones 0, 1, & 2 Hazardous (Classified) Locations: Intrinsic Safety "i"*

~~IEC 60079-15, *Electrical apparatus for explosive gas atmospheres – Part 15: Construction, test and marking of type of protection "n" electrical apparatus*~~

ANSI/ISA-60079-15 (12.12.02), *Electrical Apparatus for Use in Class I, Zone 2 Hazardous (Classified) Locations: Type of Protection "n"*

~~IEC 60079-18, *Electrical apparatus for explosive gas atmospheres – Part 18: Construction, test and marking of type of protection encapsulation "m" electrical apparatus*~~

ANSI/ISA-60079-18 (12.23.01), *Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations: Type of Protection – Encapsulation "m"*

~~IEC 60079-25: *Electrical apparatus for explosive gas atmospheres – Part 25: Intrinsically safe systems*~~

~~IEC 60079-26: *Explosive atmospheres – Part 26: Equipment with equipment protection level (EPL)Ga*~~

ANSI/ISA 60079-26 (12.00.03):*Electrical equipment for use in Class I, Zone 0 hazardous (classified) locations*

~~IEC 60079-30-1: *Explosive atmospheres – Part 30-1: Electrical resistance trace heating – General and testing requirements*~~

~~IEC 60079-31, *Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosures "tD"*~~

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

IEC 60095-1, *Lead-acid starter batteries – Part 1: General requirements and methods of test*

IEC 60192, *Low-pressure sodium vapour lamps – Performance specifications*

IEC 60216-1, *Electrical insulating materials – Properties of thermal endurance – Part 1: Ageing procedures and evaluation of test results*

IEC 60216-2, *Electrical insulating materials – Thermal endurance properties – Part 2: Determination of thermal endurance properties of electrical insulating materials – Choice of test criteria*

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IEC 60243-1, *Electrical strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60423, *Conduits for electrical purposes – Outside diameters of conduits for electrical installations and threads for conduits and fittings*

ANSI/IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60622, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-cadmium prismatic rechargeable single cells*

IEC 60623, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells*

IEC 60662, *High-pressure sodium vapour lamps*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

~~IEC 60947-1, *Low-voltage switchgear and controlgear – Part 1: General rules*~~

ANSI/UL 60947-1, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 61056-1, *General purpose lead-acid batteries (valve-regulated types) – Part 1: General requirements, functional characteristics – Methods of tests*

~~IEC 61241-1, *Electrical apparatus for use in the presence of combustible dust – Part 1: Protection by enclosures "tD"*~~

ANSI/ISA 61241-1(12.10.03), *Electrical Apparatus for Use in Zone 21 and Zone 22 Hazardous (Classified) Locations — Protection by Enclosures "tD"*

~~IEC 61241-4, *Electrical apparatus for use in the presence of combustible dust – Part 4: Type of protection "pD"*~~

ANSI/ISA-61241-4(12.10.06), *Electrical Apparatus for Use in Zone 21 and Zone 22 Hazardous (Classified) Locations — Protection by Pressurization "pD"*

~~IEC 61241-11, *Electrical apparatus for use in the presence of combustible dust – Part 11: Protection by intrinsic safety "iD"*~~

ANSI/ISA 61241-11(12.10.04), *Electrical Apparatus for Use in Zone 20, 21, and Zone 22 Hazardous (Classified) Locations — Protection by Intrinsic Safety "iD"*

ANSI/ISA-61241-18 (12.10.07), *Electrical Apparatus for Use in Zone 20, 21, and Zone 22 Hazardous (Classified) Locations — Protection by Encapsulation "mD"*

IEC 61951-1, *Secondary cells and batteries containing alkaline and other non-acid electrolytes – Portable sealed rechargeable single cells – Part 1: Nickel-cadmium*

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IEC 61951-2, *Secondary cells and batteries containing alkaline and other non-acid electrolytes – Portable sealed rechargeable single cells – Part 2:Nickel-metal hydride*

~~IEC 62013-1, *Caplights for use in mines susceptible to firedamp – Part 1: General requirements – Construction and testing in relation to the risk of explosion*~~

~~ISO 48, *Rubber, vulcanized or thermoplastic – Determination of hardness (hardness between 10 IRHD and 100 IRHD)*~~

~~ISO 178, *Plastics – Determination of flexural properties*~~

ISO 179 (all parts), *Plastics – Determination of Charpy impact properties*

ISO 262, *ISO general-purpose metric screw threads – Selected sizes for screws, bolts and nuts*

ISO 273, *Fasteners – Clearance holes for bolts and screws*

ISO 286-2, *ISO system of limits and fits – Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

ISO 527-2, *Plastics – Determination of tensile properties – Part 2: Test conditions for moulding and extrusion plastics*

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 1817, *Rubber, vulcanized – Determination of the effect of liquids*~~

ISO 4014, *Hexagon head bolts – Product grades A and B*

ISO 4017, *Hexagon head screws – Product grades A and B*

ISO 4026, *Hexagon socket set screws with flat point*

ISO 4027, *Hexagon socket set screws with cone point*

ISO 4028, *Hexagon socket set screws with dog point*

ISO 4029, *Hexagon socket set screws with cup point*

ISO 4032, *Hexagon nuts, style 1 – Product grades A and B*

ISO 4762, *Hexagon socket head cap screws*

ISO 4892-1, *Plastics – Methods of exposure to laboratory light sources – Part 1: General guidance*

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ANSI/UL 746B, *Polymeric Materials – Long-Term Property Evaluations*

ANSI/UL 746C, *Polymeric Materials – Use in Electrical Equipment Evaluations*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

For the definitions of any other terms, particularly those of a more general nature, reference should be made to IEC 60050(426) or other appropriate parts of the IEV (International Electrotechnical Vocabulary).

3.1
ambient temperature
temperature of the air or other media, in the immediate vicinity of the equipment or component

NOTE This does not refer to the temperature of any process media, unless the equipment or component is totally immersed in the process media. See 5.1.1.

3.2
associated apparatus
electrical apparatus which contains both energy-limited and non-energy-limited circuits and is constructed so that the non-energy-limited circuits cannot adversely affect the energy-limited circuits

NOTE Associated apparatus may be either:

a) electrical apparatus which has an alternative type of protection included in this standard for use in the appropriate explosive atmosphere;

b) electrical apparatus not so protected and which therefore is not to be used within an explosive atmosphere, for example, a recorder which is not of itself in an explosive atmosphere but is connected to a thermocouple situated within an explosive atmosphere where only the recorder input circuit is energy limited.

3.3
cells and batteries

3.3.1
battery
assembly of two or more cells electrically connected to each other to increase the voltage or capacity

3.3.2
capacity
quantity of electricity or electric charge, which a fully charged battery can deliver under specified conditions

3.3.3
cell
assembly of electrodes and electrolyte which constitutes the smallest electrical unit of a battery

3.3.4
charging
act of forcing current through a secondary cell or battery in the opposite direction to the normal flow to restore the energy

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3.3.5
deep discharge
event which reduces a cell voltage below that recommended by the cell or battery manufacturer

3.3.6
inherently safe (ihs) cell (or battery)
primary cell or battery in which the short-circuit current and maximum surface temperature are limited to a safe value by its internal resistance

3.3.7
maximum open-circuit voltage (of a cell or battery)
maximum attainable voltage under normal conditions, that is, from either a new primary cell, or a secondary cell just after a full charge

NOTE See Tables 10 and 11 which show the maximum open-circuit voltage for acceptable cells.

3.3.8
nominal voltage
(of a cell or battery) is that specified by the manufacturer

3.3.9
vented cell or battery
secondary cell, or battery, having a cover provided with an opening through which gaseous products may escape

3.3.10
primary cell or battery
electrochemical system capable of producing electrical energy by chemical reaction

3.3.11
reverse charging
act of forcing current through either a primary cell or secondary cell in the same direction as the normal flow, for example, in an expired battery

3.3.12
sealed gas-tight cell or battery
cell or battery which remains closed and does not release either gas or liquid when operated within the limits of charge or temperature specified by the manufacturer

NOTE 1 Such cells and batteries may be equipped with a safety device to prevent dangerously high internal pressure. The cell or battery does not require addition to the electrolyte and is designed to operate during its life in its original sealed state.

NOTE 2 The above definition is taken from IEC 60079-11. It differs from the definitions in IEV 486-01-20 and IEV 486-01-21 by virtue of the fact that it applies to either a cell or battery.

3.3.13
sealed valve-regulated cell or battery
cell or battery which is closed under normal conditions but which has an arrangement which allows the escape of gas if the internal pressure exceeds a pre-determined value. The cell cannot normally receive an addition to the electrolyte

3.3.14
secondary cell or battery
electrically rechargeable electrochemical system capable of storing electrical energy and delivering it by chemical reaction

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3.3.15
container (battery)
enclosure to contain the battery

NOTE The cover is a part of the battery container.

3.4
bushing
insulating device carrying one or more conductors through an internal or external wall of an enclosure

3.5
cable gland
device permitting the introduction of one or more electric and/or fibre optics cables into an electrical equipment so as to maintain the relevant type of protection

3.5.1
clamping device
element of a cable gland for preventing tension or torsion in the cable from being transmitted to the connections

3.5.2
compression element
element of a cable gland acting on the sealing ring to enable the latter to fulfil its function

3.5.3
sealing ring
ring used in a cable gland or with a conduit entry to ensure the sealing between the entry and the cable or conduit

3.5.4
ex cable gland
cable gland tested separately from the equipment enclosure but certified as equipment and which can be fitted to the equipment enclosure during installation

3.6
certificate
document that assures the conformity of a product, process, system, person, or organization with specified requirements

NOTE The certificate may be either the supplier's declaration of conformity or the purchaser's recognition of conformity or certification (as a result of action by a third party) as defined in ISO/IEC 17000.

3.7
conduit entry
means of introducing a conduit into electrical equipment so as to maintain the relevant type of protection

3.8
connection facilities
terminals, screws or other parts, used for the electrical connection of conductors of external circuits

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3.9
continuous operating temperature
COT
maximum temperature which ensures the stability and integrity of the material for the expected life of the equipment, or part, in its intended application

3.10
degree of protection of enclosure
IP
numerical classification according to IEC 60529 preceded by the symbol IP applied to the enclosure of electrical equipment to provide

– protection of persons against contact with, or approach to, live parts and against contact with moving parts (other than smooth rotating shafts and the like) inside the enclosure,
– protection of the electrical equipment against ingress of solid foreign objects, and
– where indicated by the classification, protection of the electrical equipment against harmful ingress of water

NOTE 1 The detailed test requirements for rotating electrical machines are in IEC 60034-5.

NOTE 2 The enclosure which provides the degree of protection IP is not necessarily identical to the equipment enclosure for the types of protection listed in the Foreword.

3.11
dust
generic term including both combustible dust and combustible flyings

3.11.1
combustible dust
finely divided solid particles, 500 µm or less in nominal size, which may be suspended in air, may settle out of the atmosphere under their own weight, may burn or glow in air, and may form explosive mixtures with air at atmospheric pressure and normal temperatures

NOTE 1 This includes dust and grit as defined in ISO 4225.

NOTE 2 The term solid particles is intended to address particles in the solid phase and not the gaseous or liquid phase, but does not preclude a hollow particle.

3.11.1.1

conductive dust
~~combustible dust with electrical resistivity equal to or less than 10^3 Ω·m~~ metal dust

~~NOTE IEC 61241-2-2 contains the test method for determining the electrical resistivity of dusts.~~

3.11.1.2
non-conductive dust
~~combustible dust with electrical resistivity greater than 10^3 Ω·m~~ dust other than metal dust

3.11.2
combustible flyings
solid particles, including fibres, greater than 500 µm in nominal size which may be suspended in air and could settle out of the atmosphere under their own weight

NOTE Examples of flyings include rayon, cotton (including cotton linters and cotton waste), sisal, jute, hemp, cocoa fibre, oakum, and baled waste kapok.

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3.12
dust-tight enclosure
enclosure capable of excluding the ingress of observable dust particle deposits

3.13
dust-protected enclosure
enclosure in which the ingress of dust is not totally excluded, but is unlikely to enter in sufficient quantity to interfere with the safe operation of the equipment and does not accumulate in a position within the enclosure where it is liable to cause an ignition hazard

3.14
electrical equipment
items applied as a whole or in part for the utilization of electrical energy

NOTE These include, amongst others, items for the generation, transmission, distribution, storage, measurement, regulation, conversion and consumption of electrical energy and items for telecommunications.

3.15
electrical parameters – apparatus with energy limitation

3.15.1
maximum external capacitance
C_o
maximum capacitance that can be connected to the connection facilities of the apparatus without invalidating the type of protection

3.15.2
maximum external inductance
L_o
maximum value of inductance that can be connected to the connection facilities of the apparatus without invalidating the type of protection

3.15.3
maximum input current
I_i
maximum current (peak a.c. or d.c.) that can be applied to the connection facilities of apparatus without invalidating the type of protection

3.15.4
maximum input power
P_i
maximum power that can be applied to the connection facilities of apparatus without invalidating the type of protection

3.15.5
maximum input voltage
U_i
maximum voltage (peak a.c. or d.c.) that can be applied to the connection facilities of apparatus without invalidating the type of protection

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3.15.6
maximum internal capacitance
C_i
maximum equivalent internal capacitance of the apparatus which is considered as appearing across the connection facilities

3.15.7
maximum internal inductance
L_i
maximum equivalent internal inductance of the apparatus which is considered as appearing at the connection facilities

3.15.8
maximum output current
I_o
maximum current (peak a.c. or d.c.) in apparatus that can be taken from the connection facilities of the apparatus

3.15.9
maximum output power
P_o
maximum electrical power that can be taken from the apparatus

3.15.10
maximum output voltage
U_o
maximum voltage (peak a.c. or d.c.) that can appear at the connection facilities of the apparatus at any applied voltage up to the maximum voltage

3.15.11
maximum r.m.s. a.c. or d.c. voltage
U_m
maximum voltage that can be applied to the non energy-limited connection facilities of associated apparatus without invalidating the type of protection

3.16
enclosure
all the walls, doors, covers, cable glands, rods, spindles, shafts, etc. which contribute to the type of protection and/or the degree of protection IP of the electrical equipment

3.17
equipment (for explosive atmospheres)
general term including apparatus, fittings, devices, components, and the like used as a part of, or in connection with, an electrical installation in an explosive atmosphere

3.18
equipment protection level
EPL
level of protection assigned to equipment based on its likelihood of becoming a source of ignition and distinguishing the differences between explosive gas atmospheres, explosive dust atmospheres, and the explosive atmospheres in mines susceptible to firedamp

~~NOTE The equipment protection level may optionally be employed as part of a complete risk assessment of an installation, see IEC 60079-14.~~ Although the marking identifying the equipment protection level (EPL) may appear on

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equipment evaluated against this standard, the 2008 NEC does not recognize the concept of employing the equipment protection level in a complete risk assessment of an installation.

3.18.1
EPL Ma
equipment for installation in a mine susceptible to firedamp, having a "very high" level of protection, which has sufficient security that it is unlikely to become an ignition source in normal operation, during expected malfunctions or during rare malfunctions, even when left energized in the presence of an outbreak of gas

3.18.2
EPL Mb
equipment for installation in a mine susceptible to firedamp, having a "high" level of protection, which has sufficient security that it is unlikely to become a source of ignition in normal operation or during expected malfunctions in the time span between there being an outbreak of gas and the equipment being de-energized

3.18.3
EPL Ga
equipment for explosive gas atmospheres, having a "very high" level of protection, which is not a source of ignition in normal operation, during expected malfunctions or during rare malfunctions

3.18.4
EPL Gb
equipment for explosive gas atmospheres, having a "high" level of protection, which is not a source of ignition in normal operation or during expected malfunctions,

3.18.5
EPL Gc
equipment for explosive gas atmospheres, having a "enhanced" level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences (for example failure of a lamp)

3.18.6
EPL Da
equipment for explosive dust atmospheres, having a "very high" level of protection, which is not a source of ignition in normal operation, during expected malfunctions, or during rare malfunctions

3.18.7
EPL Db
equipment for explosive dust atmospheres, having a "high" level of protection, which is not a source of ignition in normal operation or during expected malfunctions

3.18.8
EPL Dc
equipment for explosive dust atmospheres, having a "enhanced" level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences (for example failure of a lamp)

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3.19
Ex blanking element
threaded blanking element tested separately from the equipment enclosure but having an equipment certificate and which is intended to be fitted to the equipment enclosure without further consideration

NOTE 1 This does not preclude an Ex component certificate for blanking elements

NOTE 2 Non-threaded blanking elements are not equipment.

3.20
Ex component
part of electrical equipment or a module (other than an Ex cable gland), ~~marked with the symbol "U"~~, which is not intended to be used alone and requires additional consideration when incorporated into electrical equipment or systems for use in explosive atmospheres

3.21
Ex 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 This does not preclude an Ex component certificate for thread adapters.

3.22
explosive atmosphere
mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour, dust, fibres, or flyings which, after ignition, permits self-sustaining propagation

3.23
explosive dust atmosphere
mixture with air, under atmospheric conditions, of flammable substances in the form of dust, or flyings which, after ignition, permits self-sustaining propagation

3.24
explosive gas atmosphere
mixture with air, under atmospheric conditions, of flammable substances in the form of gas or vapour, which, after ignition, permits self-sustaining flame propagation

3.25
explosive test mixture
specified explosive mixture used for the testing of electrical equipment for explosive gas atmospheres

3.26
ignition temperature of an explosive gas atmosphere
lowest temperature of a heated surface which, under specified conditions according to IEC 60079-4, will ignite a flammable substance in the form of a gas or vapour mixture with air

3.27
ignition temperature of a dust layer
lowest temperature of a hot surface at which ignition occurs in a dust layer of specified thickness on a hot surface

NOTE The ignition temperature of a dust layer may be determined by the test method given in IEC 61241-2-1.

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3.28
ignition temperature of a dust cloud
lowest temperature of the hot inner wall of a furnace at which ignition occurs in a dust cloud in air contained therein

NOTE The ignition temperature of a dust cloud may be determined by the test method given in IEC 61241-2-1.

3.29
malfunction
equipment or components which do not perform their intended function with respect to explosion protection

NOTE For the purposes of this standard this can happen due to a variety of reasons, including:

– failure of one (or more) of the component parts of the equipment or components;
– external disturbances (e.g. shocks, vibration, electromagnetic fields);
– design error or deficiency (e.g. software errors);
– disturbance of the power supply or other services;
– loss of control by the operator (especially for handheld equipment).

3.29.1
expected malfunction
disturbances or equipment faults which normally occur in practice

3.29.2
rare malfunction
type of malfunction, which is known to happen, but only in rare instances. Two independent foreseeable malfunctions which, separately, would not create a source of ignition, but which, in combination, do create a source of ignition, are regarded as a single rare malfunction

3.30
maximum surface temperature
highest temperature which is attained in service under the most adverse conditions (but within the specified tolerances) by any part or surface of electrical equipment

NOTE 1 For electrical equipment in an explosive gas atmosphere, this temperature may occur on an internal component or on the external surface of the enclosure, depending upon the type of protection employed.

NOTE 2 For electrical equipment in an explosive dust atmosphere, this temperature occurs on the external surface of the enclosure and may include a defined dust layer condition.

3.31
normal operation
operation of equipment conforming electrically and mechanically with its design specification and used within the limits specified by the manufacturer

NOTE 1 The limits specified by the manufacturer may include persistent operational conditions, e.g. operation of a motor on a duty cycle.

NOTE 2 Variation of the supply voltage within stated limits and any other operational tolerance is part of normal operation.

3.32
radio frequencies

3.32.1
averaging time
time over which the threshold power is averaged

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3.32.2
continuous transmission
transmission where the duration of the pulse is greater than the half of the thermal initiation time

3.32.3
pulsed transmission
transmission where the duration of the pulse is shorter than the half of the thermal initiation time, but the time between two consecutive pulses, however, is longer than three times the thermal initiation time

3.32.4
thermal initiation time
time during which energy deposited by the spark accumulates in a small volume of gas around it without significant thermal dissipation

NOTE For times shorter than the thermal initiation time the total energy deposited by the spark will determine whether or not ignition occurs. For increasingly longer times, the power or rate at which energy is deposited becomes the determining factor for ignition.

3.32.5
threshold energy
Z_{th}
for a pulsed radio-frequency discharge, the maximum energy of the single pulse which can be extracted from the receiving body

3.32.6
threshold power
P_{th}
product of the effective output power of the transmitter multiplied by the antenna gain

3.33
rated value
quantity value, assigned generally by the manufacturer, for a specified operating condition of a component, device or apparatus

3.34
rating
set of rated values and operating conditions

3.35
replaceable battery pack
assembly consisting of one or more interconnected cells, along with any integrated protective components, which form a complete replaceable battery

3.36
service temperature
temperature reached when the equipment is operating at rated conditions

NOTE Each equipment may reach different service temperatures in different parts.

~~**3.37**~~
~~**symbol “U”**~~
~~symbol used to denote an Ex component~~

~~NOTE The symbol “U” is used to identify that the equipment is incomplete and is not suitable for installation without further evaluation.~~

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~~**3.38**~~
~~**symbol "X"**~~
~~symbol used to denote specific conditions of use~~

~~NOTE The symbol "X" is used to provide a means of identifying that essential information for the installation, use, and maintenance of the equipment is contained within the certificate.~~

3.39
termination compartment
separate compartment, or part of a main enclosure, communicating or not with the main enclosure, and containing connection facilities

3.40
test, routine
test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria

3.41
test, type
test of one or more devices made to a certain design to show that the design meets certain specifications

3.42
type of protection
specific measures applied to electrical equipment to avoid ignition of a surrounding explosive atmosphere

3.43
working voltage
highest r.m.s. value of the a.c. or d.c. voltage across any particular insulation which can occur when the equipment is supplied at rated voltage

NOTE 1 Transients are disregarded.

NOTE 2 Both open-circuit conditions and normal operating conditions are taken into account.

4 Equipment grouping

Electrical equipment for explosive atmospheres is divided into the following groups:

~~4.1 Group I~~

~~Electrical equipment of Group I is intended for use in mines susceptible to firedamp.~~

~~NOTE The types of protection for Group I take into account the ignition of both firedamp and coal dust along with enhanced physical protection for equipment used underground.~~

~~Electrical equipment intended for mines where the atmosphere, in addition to firedamp, may contain significant proportions of other flammable gases (i.e. other than methane), shall be constructed and tested in accordance with the requirements relating to Group I and also to the subdivision of Group II corresponding to the other significant flammable gases. This electrical equipment shall then be marked appropriately (for example, "Ex d I/IIB T3" or "Ex d I/II (NH_3)").~~

4.2 Group II

Electrical equipment of Group II is intended for use in places with an explosive gas atmosphere other than mines susceptible to firedamp.

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Electrical equipment of Group II is subdivided according to the nature of the explosive gas atmosphere for which it is intended.

Group II subdivisions

- IIA, a typical gas is propane
- IIB, a typical gas is ethylene
- IIC, a typical gas is hydrogen

NOTE 1 This subdivision is based on the maximum experimental safe gap (MESG) or the minimum ignition current ratio (MIC ratio) of the explosive gas atmosphere in which the equipment may be installed. (See IEC 60079-12 and IEC 60079-20 and ANSI/NFPA 497).

NOTE 2 Equipment marked IIB is suitable for applications requiring Group IIA equipment. Similarly, equipment marked IIC is suitable for applications requiring Group IIA or Group IIB equipment.

4.3 Group III

Electrical equipment of Group III is intended for use in places with an explosive dust atmosphere other than mines susceptible to firedamp.

Electrical equipment of Group III is subdivided according to the nature of the explosive dust atmosphere for which it is intended.

Group III subdivisions:

- IIIA: combustible flyings
- IIIB: non-conductive dust
- IIIC: conductive dust

NOTE 1 Equipment marked IIIB is suitable for applications requiring Group IIIA equipment. Similarly, equipment marked IIIC is suitable for applications requiring Group IIIA or Group IIIB equipment.

NOTE 2 The 2008 NEC does not recognize the identification of locations or equipment as “Group IIIA, IIIB, or IIIC”, but identifies equipment suitable for Zone 20, 21, or 22 by the use of equipment marking where a “D” is appended to the type of protection, for example “iaD” and no separate differentiation is made of combustible dusts or ignitable fibers.

4.4 Equipment for a particular explosive atmosphere

The electrical equipment may be tested for a particular explosive atmosphere. In this case, the information shall be recorded on the certificate and the electrical equipment marked accordingly.

5 Temperatures

5.1 Environmental influences

5.1.1 Ambient temperature

Electrical equipment designed for use in a normal ambient temperature range of –20 °C to +40 °C does not require marking of the ambient temperature range. However, electrical equipment designed for use ~~in other than~~ outside this normal ambient temperature range is considered to be special. The marking shall then include either the symbol T_a or T_{amb} together with both the upper and lower ambient temperatures ~~or, if this is impracticable, the symbol “X“ shall be used to indicate specific conditions of use that include the upper and lower ambient temperatures.~~ See ~~item d)of 29.2 and~~ Table 1.

NOTE The ambient temperature range may be an expanded ~~reduced~~ range, e.g. $-55°C \leq T_{amb} \leq 150°C$.

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Table 1 – Ambient temperatures in service and additional marking

Electrical equipment	Ambient temperature in service	Additional marking
Normal	Maximum: +40 °C Minimum: −20 °C	None
Special	Specified by the manufacturer	T_a or T_{amb} with the special range, for example, −30 °C ≤ T_a ≤ +40 °C ~~or the symbol "X"~~

5.1.2 External source of heating or cooling

Where the electrical equipment is intended to be physically connected to a separate external source of heating or cooling, such as a heated or cooled process vessel or pipeline, the ratings of the external source shall be specified in the manufacturer's instructions.

NOTE 1 The way in which these ratings are expressed will vary according to the nature of the source. For sources generally larger than the equipment, the maximum or minimum temperature will usually be sufficient. For sources generally smaller than the equipment, or for heat conduction through thermal insulation, the rate of heat flow may be appropriate.

NOTE 2 The influence of radiated heat may need to be considered on the final installation. See IEC 60079-14.

5.2 Service temperature

Where this standard, or the standard for the specific type of protection, requires the service temperature to be determined at any place in the equipment, the temperature shall be determined for the rating of the electrical equipment when the equipment is subjected to maximum or minimum ambient temperature and, where relevant, the maximum rated external source of heating or cooling. Service temperature testing, when required, shall be in accordance with 26.5.1.

NOTE The rating of the electrical equipment includes the ambient temperature, characteristics of the electrical supply and load, duty cycle or duty type, as assigned by the manufacturer.

5.3 Maximum surface temperature

5.3.1 Determination of maximum surface temperature

Maximum surface temperature shall be determined according to 26.5.1.3 or the specific requirement of the standard for the type of protection, and when the equipment is subjected to maximum ambient temperature and, where relevant, the maximum rated external source of heating.

~~5.3.2 Limitation of maximum surface temperature~~

~~5.3.2.1 Group I electrical equipment~~

~~For electrical equipment of Group I, the maximum surface temperature shall be specified in relevant documentation according to Clause 24.~~

~~This maximum surface temperature shall not exceed~~

- ~~150 °C on any surface where coal dust can form a layer,~~
- ~~450 °C where coal dust is not likely to form a layer (i.e., inside of a dust-protected enclosure).~~

~~NOTE When choosing Group I electrical equipment, the user should take into account the influence and the smouldering temperature of coal dusts if they are likely to be deposited in a layer on surfaces with temperatures above 150 °C.~~

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