

AMERICAN NATIONAL STANDARD
ANSI/ISA-60079-0 (12.00.01)-2013
Supersedes ANSI/ISA-60079-0 (12.00.01)-2009

**Explosive atmospheres – Part 0:
Equipment – General Requirements**

Approved 26 July 2013

Commitment for Amendments

This standard is issued jointly by ISA and Underwriters Laboratories Incorporated (UL). Comments or proposals for revisions on any part of the standard may be submitted to ISA or UL at any time. Revisions to this standard will be made only after processing according to the standards development procedures of ISA and UL. ***ISA and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.***

ISBN: 978-0-876640-26-5

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The most recent designation of ANSI/ISA-60079-0 and ANSI/UL 60079-0 as an American National Standard occurred on 26 July 2013.

This ANSI/UL Standard for Safety, which consists of the sixth 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>.

ISA
ANSI/ISA-60079-0
Sixth Edition

Underwriters Laboratories Inc.
ANSI/UL 60079-0
Sixth 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 sixth edition of ANSI/ISA-60079-0 (superseding ANSI/ISA-60079-0 (12.00.01)-2009) and the sixth edition of ANSI/UL 60079-0.

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 the International Society of Automation (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

The effective date for UL is the date of publication. However, the fifth edition of UL 60079-0 will also be effective until 1 September 2018.

A UL effective date is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

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Preface (ISA)

This ISA standard is based on the 6th 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:

- Relocation of definitions for energy limitation parameters to IEC 60079-11
- Addition of note to clarify that the non-metallic “enclosure” requirements are applied to other than “enclosures” by some of the subparts
- Expansion of material specification data for plastics and elastomers, including UV resistance
- Addition of alternative qualification for O-rings
- Addition of alternative criteria for surface resistance
- Addition of breakdown voltage limit for non-metallic layers applied to metallic enclosures
- Expansion of “X” marking options for non-metallic enclosure materials not meeting basic electrostatic requirements
- Clarification that non-metallic enclosure requirements also apply to painted or coated metal enclosures
- Clarification of test to determine capacitance of accessible metal parts with reduction in acceptable capacitance
- Addition of limits on zirconium content for Group III and Group II (Gb only) enclosures
- Introduction of “X” marking for Group III enclosures not complying with basic material requirements, similar to that existing for Group II
- Addition of button-head cap screws to permitted “Special Fasteners”
- Reference for protective earthing (PE) requirements for electrical machines to IEC 60034-1
- Clarification of terminology for cable glands, blanking elements, and thread adapters
- Addition of requirements for ventilating fans
- Addition of alternative construction for disconnectors
- Removal of voltage limits on plugs and sockets
- Addition of test requirements for arc-quenching test on plugs and sockets
- Update of cell and battery information to reflect latest standards
- Revision to impact test of glass parts
- Revision to impact test procedure to address “bounce” of impact head
- Clarification of the test requirements for “service” and “surface” temperature
- Addition of temperature rise tests for converter-fed motors
- Addition of alternative test method for thermal endurance
- Removal of “charging test” and addition of note providing guidance
- Clarification of test for the measurement of capacitance
- Addition of a “Schedule of Limitations” to certificates for Ex Components

- Clarification of the marking for multiple temperature classes
- Addition of marking for converter-fed motors
- Removal of IP marking for Group III
- Addition of specific instructions for electrical machines
- Addition of specific instructions for ventilating fans
- Update to informative Annex D on converter-fed motors
- Update to informative Annex E on temperature testing of motors
- Addition of informative Annex F, flowchart for testing of non-metallic enclosures and non-metallic parts of enclosures

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 the International Society of Automation (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.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to USA users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavour to introduce SI-acceptable metric units in all new and revised standards, recommended practices, and technical reports to the greatest extent possible. IEEE/ASTM SI 10, *American National Standard for Metric Practice*, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

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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 2011, 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.

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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EXPLOSIVE ATMOSPHERES –

Part 0: Equipment – General requirements

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

See 6.1 for the relationship of the Equipment Protection Level (EPL) to the zone area classification.

The standard atmospheric conditions (relating to the explosion characteristics of the atmosphere) under which it may be assumed that electrical equipment can be operated are:

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

This standard and other standards supplementing this standard specify additional test requirements for equipment operating outside the standard temperature range, but further additional consideration and additional testing may be required for equipment operating outside the standard atmospheric pressure range and standard oxygen content, particularly with respect to types of protection that depend on quenching of a flame such as ‘flameproof enclosure “d”’ (~~IEC 60079-1~~) or limitation of energy, ‘intrinsic safety “i”’ (~~IEC 60079-11~~).

NOTE 1 Although the standard atmospheric conditions above give a temperature range for the atmosphere of -20 °C to $+60\text{ °C}$, the normal ambient temperature range for the equipment is -20 °C to $+40\text{ °C}$, unless otherwise specified and marked. See 5.1.1. It is considered that -20 °C to $+40\text{ °C}$ is appropriate for most equipment and that to manufacture all equipment to be suitable for a standard atmosphere upper ambient temperature of $+60\text{ °C}$ would place unnecessary design constraints.

NOTE 2 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, mechanical impacts resulting in thermite reactions, electrical arcing and static electric discharge in normal industrial environments.

NOTE 3 ~~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 special protection. A standard for special protection "s", IEC 60079-33, is in preparation.

NOTE 4 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 5 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.

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 (12.12.02): Gas – Type of protection "n";
- ~~IEC 60079-18~~ ANSI/ISA-60079-18 (12.23.01): Gas and dust – Encapsulation "m";
- ~~IEC 60079-31~~ ANSI/ISA-60079-31 (12.10.03): Dust – Protection by enclosure "t"
- ~~IEC 61241-4~~ ANSI/ISA-61241-2 (12.10.06): Dust – Pressurization "pD".

NOTE 6 Additional information on types of protection for non-electrical equipment can be found in ISO/IEC 80079-36 (to be published).

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

~~IEC 60079-13: Explosive atmospheres – Part 13: Equipment protection by pressurized room "p"~~

~~IEC 60079-25~~ ANSI/ISA-60079-25 (12.02.05): Explosive atmospheres – Part 25: Intrinsically safe electrical systems

~~IEC 60079-26~~ ANSI/ISA-60079-26 (12.00.03): Explosive atmospheres – Part 26: Equipment with equipment protection level (EPL) Ga

~~IEC 60079-28~~ ANSI/ISA-60079-28 (12.21.02): 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 7 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,
- 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, 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 enclosure “d”~~

ANSI/ISA-60079-1 (12.22.01), Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”

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

ANSI/ISA-60079-2 (12.04.01), Electrical Apparatus for Explosive Gas Atmospheres – Part 2 Pressurized Enclosures “p”

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

ANSI/ISA-60079-5 (12.25.01), Explosive Atmospheres – Part 5: Equipment Protection by Powder Filling “q”

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

ANSI/ISA-60079-6 (12.26.01), Explosive Atmospheres – Part 6: Equipment Protection by Oil Immersion “o”

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

ANSI/ISA-60079-7 (12.16.01), Explosive Atmospheres – Part 7: Equipment Protection by Increased Safety “e”

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

ANSI/ISA-60079-11 (12.02.01), Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety “i”

~~IEC 60079-15, Explosive atmospheres – Part 15: Equipment protection by type of protection “n”~~

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, Explosive atmospheres – Part 18: Equipment protection by encapsulation “m”~~

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 60079-20-1, Explosive Atmosphere Part 20-1: Material characteristics for gas and vapour classification, test methods and data~~

~~IEC 60079-25: Explosive atmospheres – Part 25: Intrinsically safe systems~~

ANSI/ISA-60079-25: Explosive 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~~

ANSI/ISA-60079-28: Explosive atmospheres – Part 28: Protection of equipment and transmission systems using optical radiation

~~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 “t”~~

ANSI/ISA-60079-31, Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure “t”

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*

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

IEC 60254 (all parts), *Lead-acid traction batteries*

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*

IEC 60896-11, *Stationary lead-acid batteries – Part 11: Vented types – General requirements and methods of tests*

IEC 60896-21, *Stationary lead-acid batteries – Part 21: Valve regulated types – Methods of test*

IEC 60952 (all parts), *Aircraft batteries*

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

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

ANSI/ISA-61241-2 (12.10.06), Electrical Apparatus for Use in Zone 21 and Zone 22 Hazardous (Classified) Locations — Protection by Pressurization "pD"

IEC 61427, *Secondary cells and batteries for photovoltaic energy systems (PVES) – General requirements and methods of test*

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

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 61960, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications*

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 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 3601-1, *Fluid power systems – O-rings – Part 1: Inside diameters, cross-sections, tolerances and designation codes*

ISO 3601-2, *Fluid power systems – O-rings – Part 2: Housing dimensions for general applications*

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 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 7380, *Hexagon socket button head screws*

ISO 14583, *Hexalobular socket pan head screws*

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

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

3 Terms and definitions

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

NOTE 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

area, hazardous

area in which an explosive atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of electrical apparatus

3.3

area, non-hazardous

area in which an explosive atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus

3.4

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.

3.5

cells and batteries

3.5.1

battery

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

3.5.2

capacity

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

3.5.3

cell

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

3.5.4

charging

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

3.5.5

deep discharge

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

3.5.6

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 11 and 12 which show the maximum open-circuit voltage for acceptable cells.

3.5.7

nominal voltage

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

3.5.8**vented cell or battery**

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

3.5.9**primary cell or battery**

electrochemical system capable of producing electrical energy by chemical reaction

3.5.10**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

3.5.11**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 IEC 486-01-20 and IEC 486-01-21 by virtue of the fact that it applies to either a cell or battery.

3.5.12**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

3.5.13**secondary cell or battery**

electrically rechargeable electrochemical system capable of storing electrical energy and delivering it by chemical reaction

3.5.14**container (battery)**

enclosure to contain the battery

NOTE The cover is a part of the battery container.

3.6**bushing**

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

3.7**cable gland**

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

3.7.1**clamping device**

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

3.7.2**compression element**

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

3.7.3**sealing ring**

ring used in a cable gland to ensure the sealing between the cable gland and the cable

3.7.4**Ex Equipment 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.

3.7.5**cable transit device**

an entry device, intended for one or more cables, with a seal made up of one or more separate elastomeric modules or parts of modules (modular internal seal), which are compressed together when the device is assembled and mounted as intended.

NOTE Cable transit devices can also serve as Ex blanking Elements when the elastomeric modules provided allow for this function.

3.8**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.

3.8.1**Ex Component Certificate**

a certificate prepared for an Ex Component. See 3.28.

3.8.2**Equipment Certificate**

A certificate prepared for equipment other than an Ex Component. Such equipment may include Ex Components, but additional evaluation is always required as part of their incorporation into equipment. See 3.7.4, 3.25, 3.27, 3.28, and 3.29.

3.9**compound (for encapsulation)**

any thermosetting, thermoplastic, epoxy resin or elastomeric materials with or without fillers and/or additives, in their solid state; used for encapsulation

3.10**conduit entry**

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

3.11**connection facilities**

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

3.12**connections, factory**

terminations intended for connection during a manufacturing process under controlled conditions

3.13**connections, field-wiring**

terminations intended for connection by the installer in the field

3.14**continuous operating temperature****COT**

temperature range which ensures the stability and integrity of the material for the expected life of the equipment, or part, in its intended application

3.15**converter (for use with electrical machines)**

unit for electronic power conversion, changing one or more electrical characteristics and comprising one or more electronic switching devices and associated components, such as transformers, filters, commutation aids, controls, protections, and auxiliaries, if any

NOTE A Converter may also be known as a frequency converter, a converter drive, an inverter drive, a variable speed drive, or a variable frequency drive.

3.16**converter, soft-start**

converter which limits the input current to the electrical machine during the starting process.

NOTE It is intended that the soft-start converter is used only during the starting process and is then isolated from the power system when the electrical machine is running.

3.17**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.

3.18**dust**

generic term including both combustible dust and combustible flyings

3.18.1**combustible dust**

~~dust particles that are 500 microns or smaller (material passing a U.S. No. 35 Standard Sieve as defined in ASTM E 11, Standard Specification for Wire Cloth and Sieves for Testing Purposes) and present a fire or explosion hazard when dispersed and ignited in air, 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.

NOTE 3 ~~See ASTM E 1226, Standard Test Method for Explosibility of Dust Clouds, or ISO 6184/1, Explosion protection systems - Part 1: Determination of explosion indices of combustible dusts in air, for procedures for determining the explosibility of dusts. Dusts are considered to be combustible dusts unless it has been confirmed by test that they are not combustible dusts per ISO 6184/1 or ANSI/ASTM E1226.~~

3.18.1.1**conductive dust**

~~combustible metal dust with electrical resistivity equal to or less than $10^{-3} \Omega \cdot m$~~

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

3.18.1.2**non-conductive dust**

~~combustible dust other than combustible metal dust with electrical resistivity greater than $10^{-3} \Omega \cdot m$~~

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

3.18.2**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.

3.19**dust-tight enclosure**

enclosure capable of excluding the ingress of observable dust particle deposits

3.20**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

3.21**elastomer**

a macromolecular material which returns rapidly to approximately its initial dimensions and shape after substantial deformation by a weak stress and release of the stress (IEV 212-04-05)

NOTE The definition applies to room temperature test conditions.

3.22

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.

3.23

encapsulation

process of applying a compound to enclose an electrical device(s) by suitable means

3.24

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

3.25

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

3.26

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 equipment evaluated against this standard, the 2011 NEC does not recognize the concept of employing the equipment protection level in a complete risk assessment during the area classification of an installation. EPLs are designated as G for gas, D for dust, or M for mining and are then followed by a letter (a, b, or c) to give the user a better understanding as to whether the equipment provides either (a) a "very high," (b) a "high," or (c) an "enhanced" level of protection against ignition of an explosive atmosphere. Therefore, this document reflects that a very high level of protection (a) is used for Zone 0 and Zone 20, a high level of protection (b) is used for Zone 1 and Zone 21 and an enhanced level of protection (c) is used for Zone 2 and Zone 22.~~

3.26.1

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

3.26.2

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

3.26.3

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

3.26.4**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

3.26.5**EPL Gc**

equipment for explosive gas atmospheres, having an "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)

3.26.6**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

3.26.7**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

3.26.8**EPL Dc**

equipment for explosive dust atmospheres, having an "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)

3.27**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.

3.28**Ex Component**

part of electrical equipment or a module, ~~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

3.29**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.

3.30**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

3.31**explosive dust atmosphere**

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

3.32**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

3.33**explosive test mixture**

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

3.34**firedamp**

flammable mixture of gases naturally occurring in a mine

NOTE Firedamp consists mainly of methane, but always contains small quantities of other gases, such as nitrogen, carbon dioxide, and hydrogen, and sometimes ethane and carbon monoxide. The terms firedamp and methane are used frequently in mining practice as synonyms.

3.35**free space**

intentionally created space surrounding components or space inside components

3.36**galvanic isolation**

arrangement within equipment which permits the transfer of signals or power between two circuits without any direct electrical connection between the two

NOTE Galvanic isolation frequently utilizes either magnetic (transformer or relay) or opto-coupled elements.

3.37**ignition temperature of an explosive gas atmosphere**

lowest temperature of a heated surface which, under specified conditions according to IEC 60079-20-1, will ignite a flammable substance in the form of a gas or vapour mixture with air

3.38**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.

3.39**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.

3.40

limiting temperature

maximum permissible temperature for equipment or parts of equipment equal to the lower of the two temperatures determined by:

- a) the danger of ignition of the explosive atmosphere;
- b) the thermal stability of the materials used

3.41

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).

3.41.1

expected malfunction

disturbances or equipment malfunctions which normally occur in practice

3.41.2

rare malfunction

type of malfunction, which may happen, but only in rare instances. Two independent expected 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

3.42

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.

3.43

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.

3.44**level of protection**

subdivision of a Type of Protection, correlating with the Equipment Protection Level, that differentiates the likelihood of the equipment becoming a source of ignition

NOTE For example, Type of Protection intrinsic safety “i” is subdivided into Levels of Protection “ia”, “ib”, and “ic”; which correlate with Equipment Protection Levels Ga, Gb, and Gc (for explosive gas atmospheres).

3.45**plastic**

a material which contains as an essential ingredient a high polymer and which at some stage in its processing into finished products can be shaped by flow

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NOTE Elastomers, which are also shaped by flow, are not considered as plastics.

3.46**radio frequency**

electromagnetic waves from 9 kHz to 60 GHz

3.46.1**continuous transmission**

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

3.46.2**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

3.46.3**thermal initiation time**

time (over which the threshold power is averaged) 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.

3.46.4**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

3.46.5**threshold power**

P_{th}

product of the effective output power of the transmitter multiplied by the antenna gain

NOTE 1 The gain is produced by an antenna concentrating radiation in a particular direction and is always related to a specified reference antenna.

NOTE 2 The threshold power is considered to be equal to the Effective Isotropic Radiated Power (EIRP) per ITU-R BS.561-2.

NOTE 3 Cables and connections introduce additional gain (loss).

3.47**rated value**

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

3.48**rating**

set of rated values and operating conditions

3.49**replaceable battery pack**

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

3.50**service temperature**

maximum or minimum temperature reached at specific points of the equipment when the equipment is operating at rated conditions, including ambient temperature and any external sources of heating or cooling. See 5.2

NOTE Equipment may reach different service temperatures in different parts.

3.51**spacings, electrical**

separation distances between conductive parts at different electrical potentials

3.51.1**clearance**

shortest distance in air between two conductive parts

3.51.2**creepage distance**

shortest distance along the surface of a solid insulating material between two conductive parts

3.51.3**distance through casting compound**

shortest distance through a casting compound between two conductive parts

3.51.4**distance through solid insulation**

shortest distance through solid insulation between two conductive parts

3.51.5**distance under coating**

shortest distance between conductive parts along the surface of an insulating medium covered with insulating coating

3.52**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.~~

3.53**~~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.~~

3.54**termination compartment**

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

3.55**test, routine**

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

3.56**test, type**

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

3.57**type of protection**

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

3.58**void**

unintentional space created as a consequence of the encapsulation process

3.59**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.

3.60**cord connector**

a fitting intended to terminate a cord to a box or similar device and reduce the strain at points of termination and may include an explosionproof, dust-ignitionproof, or flameproof seal

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 1 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 (NH₃)").

NOTE 2 In the US, the authority having jurisdiction for underground mines is the Mine Safety and Health Administration (MSHA) of the federal government. There are additional regulations beyond the requirements detailed here that will also apply.

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.

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 60079-20-1 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.