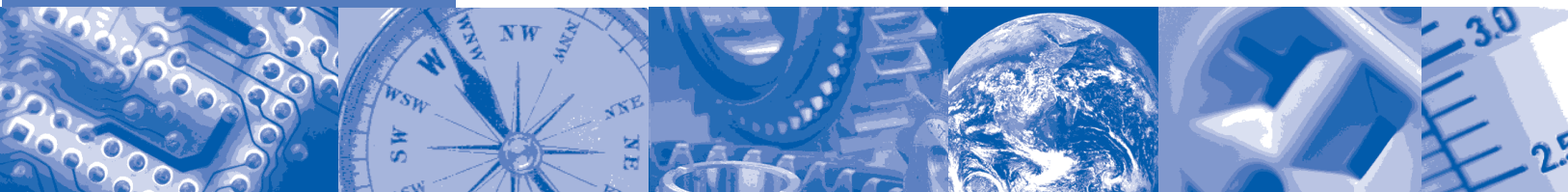


ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod)

Supersedes ANSI/ISA-12.00.01-1998 (IEC 60079-0 Mod)



Electrical Apparatus for Use in Class I, Zones 0, 1 & 2 Hazardous (Classified) Locations: General Requirements



**ISA—The Instrumentation,
Systems, and
Automation Society**

Approved 2 December 2002



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This ANSI/UL Standard for Safety, which consists of the first 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. Written comments are to be sent to the UL-RTP Standards Department, 12 Laboratory Dr., Research Triangle Park, NC 27709.

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**ISA — The Instrumentation, Systems,
and Automation Society**
ANSI/ISA – 12.00.01-2002
First Edition

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



**ISA—The Instrumentation, Systems,
and Automation Society**



Electrical Apparatus for Use in Class I, Zones 0, 1 & 2 Hazardous (Classified) Locations: General Requirements

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General Notes

This is the common ISA and UL Standard for Electrical apparatus for explosive gas atmospheres - Part 0: General requirements. It is the first edition of ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod) [superceding ANSI/ISA-12.00.01-1998 (IEC 60079-0 Mod)] and the first edition of UL 60079-0. The ISA suffix "Mod" indicates the document is a modification of the IEC document and includes U.S. deviations encompassing both additions and deletions of information.

ANSI/ISA-12.00.01-2002 (IEC 60079-0 Mod) and 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 — The Instrumentation, Systems, and Automation Society 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 2 December 2002 all products Listed or Recognized by UL must comply with the requirements in this Standard.

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Preface (ISA)

This ISA standard is based on IEC Publication 60079-0. It is the intention of the ISA SP12 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-12.00.01-2002 (IEC 60079-0 Mod). The suffix "Mod" indicates the document is a modification of the IEC document and includes U.S. deviations encompassing both additions and deletions of information.

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 maintain registers of currently valid U.S. National Standards.

This document has been prepared as part of the service of ISA—The Instrumentation, Systems, and Automation Society—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 endeavor to introduce SI-acceptable metric units in all new and revised standards, recommended practices, and technical reports to the greatest extent possible. *Standard for Use of the International System of Units (SI): The Modern Metric System*, published by the American Society for Testing & Materials as IEEE/ASTM SI 10-97, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

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This standard was approved for publication by the ISA Standards and Practices Board on 11 April 2002.

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Foreword (UL)

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

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National Differences

GENERAL

In the UL publication of this standard, National Differences from the text of International Electrotechnical Commission (IEC) Publication 60079-0, Electrical apparatus for explosive gas atmospheres - Part 0: General requirements, copyright 2000, are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

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 standard may not include all types of these National Differences.

NOTE 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.

DR – These are National Differences based on the National Electrical Code (NEC) and other U.S. Regulatory Requirements.

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

D2 – These are National Differences based on **safety practices**. These are differences for IEC requirements that may be acceptable, but adopting the IEC requirements would require considerable retesting or redesign on the manufacturer's part.

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**.

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Foreword (ISA)

All text of IEC 60079-0:1998 and amendment 1: 2000 is included. U.S. National Deviations are shown by ~~strikeout~~ through text deleted and underline under text added. Tables, or portions of tables, that are to be deleted are shown as shaded; figures to be deleted are marked with the overlay "X." There are nine annexes in this standard. Annexes A, D, E, F, G, H and I are informative and are not considered part of this Standard. Annexes B and C are normative and are considered part of this standard.

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1 Scope

This standard specifies the general requirements for construction, testing and marking of electrical apparatus, Ex cable entries and Ex components, intended for use in potentially explosive atmospheres of gas, vapor and mist defined as Class I, Zone 0, 1 or 2 by the National Electrical Code, NFPA 70.

~~This standard does not specify requirements for safety, other than those directly related to the explosion risk.~~

Apparatus covered by this standard and the associated standards noted below shall also comply with the applicable requirements for similar apparatus for use in unclassified locations. A list of commonly applied standards is shown in informative Annex E.

NOTE Requirements for safety of electrical equipment in ordinary (unclassified) locations can be found in ANSI Standards, NEMA Standards, Federal Regulations, etc.

This standard is ~~or will be~~ supplemented or modified by the following standards parts of IEC 60079 concerning specific types of protection:

- Flameproof enclosures 'd', ~~IEC 60079-1~~ (ANSI/ISA-12.22.01-2002 [IEC 60079-1 Mod]);
- Pressurized enclosures 'p', ~~IEC 60079-2~~; see Note 3;
- Powder-filling 'q', ~~IEC 60079-5~~ (ANSI/ISA-12.25.01-1998 [IEC 60079-5 Mod]);
- Oil-immersion 'o', ~~IEC 60079-6~~ (ANSI/ISA-12.26.01-1998 [IEC 60079-6 Mod]);
- Increased safety 'e', ~~IEC 60079-7~~ (ANSI/ISA-12.16.01-2002 [IEC 60079-7 Mod]);
- Intrinsic safety 'i', ~~IEC 60079-11~~ (ISA-12.02.01 [IEC 60079-11 Mod]);
- Encapsulation 'm', ~~IEC 60079-18~~ (ANSI/ISA-12.23.01-2002 [IEC 60079-18 Mod]);
- ~~Caplights for mines susceptible to firedamp under consideration.~~

This ~~part of IEC 60079 standard~~ and the ~~parts of IEC 60079 mentioned above~~ above documents are not applicable to the construction of electromedical apparatus, shot-firing exploders, test devices for exploders and for shot-firing circuits.

This standard is not applicable to electrical resistance heat tracing cables. The requirements for electrical resistance heat tracing cables are located in IEEE 515, *Standard for Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications* and supercede those of ANSI/ISA-12.16.01-2002 (IEC 60079-7 Mod). All components of a heat tracing system intended to be in a hazardous (classified) location, that are not covered by IEEE 515, shall be evaluated using this standard and the applicable sub-parts.

NOTE 1 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.

NOTE 2 In addition to the types of protection listed above, ~~IEC 60079-15~~ (ISA-12.12.02-2002) is applicable for use in potentially explosive atmospheres.

~~NOTE 2 Apparatus not conforming with this standard or the standards listed in this clause, may be considered safe by a national or other authorised body for use in potentially explosive atmospheres. In such cases, the apparatus is identified with the symbol 's'.~~

NOTE 3 The requirements for pressurization can be found in ANSI/NFPA 496, "Pressurized Enclosures for Electrical Equipment," along with additional guidance in ISA-RP12.4-1996, "Pressurized Enclosures."

2 Normative References

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

<u>ANSI/NFPA 70:1999</u>	<u>National Electrical Code®</u>
<u>ANSI/NFPA 496</u>	<u>Pressurized Enclosures for Electrical Equipment</u>
<u>ANSI/NFPA 497</u>	<u>Classification of Flammable Liquids, Gases or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas</u>
<u>ANSI/UL 746B</u>	<u>Standard for Polymeric Materials – Long-Term Property Evaluations</u>
IEC 60034-5: 1991	Rotating electrical machines Part 5: Classification of degrees of protection provided by enclosures of rotating electrical machines (IP Code)
~~IEC 60079-1: 1990~~	~~Electrical apparatus for explosive gas atmospheres Part 1: Construction and verification test of flameproof enclosures of electrical apparatus~~
<u>ANSI/ISA-12.22.01-2002 (IEC 60079-1 Mod)</u>	<u>Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations Type of Protection — Flameproof "d"</u>
~~IEC 60079-2: 1983~~	~~Electrical apparatus for explosive gas atmospheres Part 2: Electrical apparatus, type of protection 'p'~~
IEC 60079-3: 1990	Electrical apparatus for explosive gas atmospheres Part 3: Spark-test apparatus for intrinsically safe circuits
IEC 60079-4: 1975	Electrical apparatus for explosive gas atmospheres Part 4: Method of test for ignition temperature
~~IEC 60079-5: 1996~~	~~Electrical apparatus for explosive gas atmospheres Part 5: Powder filling 'q'~~
<u>ANSI/ISA-12.26.01-1998 (IEC 60079-6 Mod)</u>	<u>Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations: Type of Protection — Oil-Immersion "o"</u>
~~IEC 60079-6: 1995~~	~~Electrical apparatus for explosive gas atmospheres Part 6: Oil-Immersion 'o'~~
<u>ANSI/ISA-12.25.01-1998 (IEC 60079-5 Mod)</u>	<u>Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations: Type of Protection — Powder Filling "q"</u>

~~IEC 60079-7: 1990~~	~~Electrical apparatus for explosive gas atmospheres Part 7: Increased safety 'e'~~
<u>ANSI/ISA-12.16.01-2002 (IEC 60079-7 Mod)</u>	<u>Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations: Type of Protection — Increased Safety “e”</u>
~~IEC 60079-11: 1991~~	~~Electrical apparatus for explosive gas atmospheres Part 11: Intrinsic safety 'i'~~
<u>ISA-12.02.01 (IEC 60079-11 Mod)</u>	<u>Electrical Apparatus for Use in Class I, Zones 0, 1, & 2 Hazardous (Classified) Locations: Intrinsic Safety “i”</u>
~~IEC 60079-15: 1987~~	~~Electrical apparatus for explosive gas atmospheres Part 15: electrical apparatus with type of protection 'n'~~
<u>ANSI/ISA-12.12.01-2000</u>	<u>Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations</u>
~~IEC 60079-18: 1992~~	~~Electrical apparatus for explosive gas atmospheres Part 18: Encapsulation 'm'~~
<u>ANSI/ISA-12.23.01-2002 (IEC 60079-18 Mod)</u>	<u>Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations: Type of Protection — Encapsulation “m”</u>
IEC 60079-20: 1996	Electrical apparatus for explosive gas atmospheres, Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus
IEC 60192: 1973	Low pressure sodium vapour lamps
~~IEC 60216-1: 1990~~	~~Guide for the determination of thermal endurance properties of electrical insulating materials Part 1: General guidelines for aging procedure and evaluation of test results~~
~~IEC 60216-2: 1990~~	~~Guide for the determination of thermal endurance properties of electrical insulating materials Part 2: Choice of test criteria~~
IEC 60529: 1989	Degrees of protection provided by enclosures (IP Code)
IEC 60662: 1980	High-pressure sodium vapour lamps
ISO 60048: 1979	Vulcanized rubbers - Determination of hardness (hardness between 30 and 85 IRHD)
<u>ISA-RP12.4-1996</u>	<u>Pressurized Enclosures</u>
~~ISO 60178: 1975~~	~~Plastics - Determination of flexural properties of rigid plastics~~
~~ISO 60179: 1982~~	~~Plastics - Determination of Charpy impact strength of rigid materials~~
~~ISO 60262: 1973~~	~~ISO general purpose metric screw threads - Selected sizes for screws, bolts and nuts~~

~~ISO 60273: 1979~~	~~Fasteners – Clearance Holes for bolts and screws~~
~~ISO 60286-2: 1988~~	~~ISO system of limits and fits – Part 2 Tables of standard tolerance grades and limit deviations for holes and shafts~~
~~ISO R 60527: 1966~~	~~Plastics – Determination of tensile properties~~
~~ISO 60965-1: 1980~~	~~ISO general purpose metric screw threads – Tolerances – Part 1: Principles and basic data~~
~~ISO 60965-2: 1980~~	~~ISO general purpose metric screw threads – Tolerances – Part 2: Limits of sizes for general purpose bolt and nut threads – medium quality~~
~~ISO 61817: 1985~~	~~Rubber, vulcanized – Determination of the effect of liquids~~
ISO 61818: 1975	Vulcanized rubbers of low hardness (10 to 35 IRHD) - Determination of hardness
~~ISO 64014: 1988~~	~~Hexagon head bolts – Product grades A and B~~
~~ISO 64017: 1988~~	~~Hexagon head screws – Product grades A and B~~
~~ISO 64026: 1977~~	~~Hexagon socket set screws with flat point~~
~~ISO 64027: 1977~~	~~Hexagon socket set screws with cone point~~
~~ISO 64028: 1977~~	~~Hexagon socket set screws with dog point~~
~~ISO 64029: 1977~~	~~Hexagon socket set screws with cup point~~
~~ISO 64032: 1986~~	~~Hexagon nuts, style 1 – Product grades A and B~~
~~ISO 64762: 1989~~	~~Hexagon socket head cap screws – Product grade A~~
ISO 64892: 1981	Plastics - Methods of exposure to laboratory light sources

3 Definitions and symbols

For the purpose of this ~~part of IEC 60079~~ standard, the following definitions apply:

3.1 electrical apparatus:

items applied as a whole or in part for the utilization of electrical energy. These include, among others, items for the generation, transmission, distribution, storage, measurement, regulation, conversion, and consumption of electrical energy and items for telecommunications.

3.2 potentially explosive atmosphere:

an atmosphere which could become explosive (the danger is a potential one).

3.3 explosive gas atmosphere:

a mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapor or mist, in which after ignition, combustion spreads throughout the unconsumed mixture.

3.4 explosive test mixture:

a specified explosive mixture used for the testing of electrical apparatus for potentially explosive atmospheres.

3.5 ignition temperature of an explosive gas atmosphere:

the 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 vapor mixture with air.

3.6 service temperature:

the temperature reached when apparatus is operating at its rating.

3.7 maximum service temperature:

the highest value of the service temperatures.

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

3.8 maximum surface temperature:

the highest temperature which is attained in service under the most adverse conditions (but within the recognized tolerances) by any part or surface of an electrical apparatus, which would be able to produce an ignition of the surrounding explosive atmosphere.

NOTE 1 The manufacturer will prescribe the product standard, and also in his particular design, he should take into account the following other conditions: fault conditions specified in the standard for the type of protection concerned; all operating conditions specified in any other standard specified by him including recognized overloads; any other operating condition specified by him.

NOTE 2 The relevant surface temperature may be internal or external, depending upon the type of protection concerned.

3.9 enclosure:

all the walls, doors, covers, cable entries, rods, spindles, shafts, etc., which contribute to the type of protection of and/or the degree of protection (IP) of the electrical apparatus.

3.10 type of protection:

the specific measures applied to electrical apparatus to avoid ignition of a surrounding explosive atmosphere.

3.11 degree of protection of enclosure (IP):

a numerical classification according to IEC 60529 preceded by the symbol IP applied to the enclosure of electrical apparatus to provide for:

- 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, and
- protection of the electrical apparatus against ingress of solid foreign objects and where indicated by the classification,
- protection of the electrical apparatus against harmful ingress of water.

NOTE The enclosure which provides the degree of protection IP is not necessarily identical to the apparatus enclosure for the types of protection listed in Clause 1.

3.12 rated value:

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

3.13 rating:

the set of rated values and operating conditions.

3.14 cable entry:

a device permitting the introduction of one or more electric and/or fibre optics cables into an electrical apparatus so as to maintain the relevant type of protection.

3.15 Ex cable entry:

a cable entry tested separately from the apparatus enclosure but evaluated ~~certified~~ as apparatus and which can be fitted to the apparatus enclosure during installation without further evaluation ~~certification~~.

3.16 conduit entry:

a means of introducing a conduit into an electrical apparatus so as to maintain the relevant type of protection.

3.17 compression element:

an element of a cable entry acting on the sealing ring to enable the latter to fulfill its function.

3.18 clamping device:

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

3.19 sealing ring:

a ring used in a cable or conduit entry to ensure the sealing between the entry and the cable or conduit.

3.20 terminal compartment:

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

3.21 connection facilities:

terminals screws and other parts used for the electrical connection of conductors of external circuits.

3.22 bushing:

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

3.23 Ex component:

a part of electrical apparatus for potentially explosive atmospheres, which is not intended to be used alone in such atmospheres and requires additional evaluation ~~certification~~ when incorporated into electrical apparatus or systems for use in potentially explosive atmospheres.

3.24 "X" symbol:

~~"X" is the symbol used as a suffix to a certificate reference to denote special conditions for safe use.~~

3.25 "U" symbol:

~~"U" is the symbol used as a suffix to a certificate reference to denote an Ex component.~~

NOTE — The symbols "X" and "U" should not be used together.

3.26 ~~certificate:~~

~~a document confirming that the apparatus is in conformity with the requirements, the type tests and, where appropriate, the routine tests in the standard referred to therein. A certificate can relate to Ex apparatus or an Ex component.~~

NOTE — A certificate may be produced by the manufacturer, the user, or a third party, for example, an IEC Ex Accepted Certification Body, a national certification body, or an authorised person.

4 Apparatus grouping and temperature classification

4.1 Electrical apparatus for potentially explosive atmospheres is divided into the following:

- Group 1: Electrical apparatus for mines susceptible to firedamp;

NOTE Group I electrical apparatus is not within the scope of this ISA standard.

- Group II: Electrical apparatus for places with a potentially explosive atmosphere, other than mines susceptible to firedamp.

~~Electrical apparatus 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 apparatus shall then be marked appropriately (for example "Ex d I/IIB T3" or "Ex d I/II (NH₃)").~~

4.2 Electrical apparatus of Group II may be subdivided according to the nature of the potentially explosive atmosphere for which it is intended.

4.2.1 For the types of protection flameproof enclosure "d", and intrinsic safety "i", electrical apparatus of Group II is subdivided into IIA, IIB and IIC as required in the specific standards concerning these types of protection.

NOTE 1 This subdivision is based on the maximum experimental safe gap (MESG) for flameproof enclosures or the minimum ignition current (MIC) for intrinsically safe electrical apparatus (see Annex A).

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

4.2.2 For all types of protection, apparatus of Group II shall be marked as a function of its maximum surface temperature according to 5.1.2.

4.3 The electrical apparatus may be tested for a particular explosive atmosphere. In this case it shall be evaluated ~~certified~~ and marked accordingly.

5 Temperatures

5.1 Maximum surface temperature

~~5.1.1 For electrical apparatus of Group I the maximum surface temperature shall be specified in relevant documentation according to 23.2.~~

~~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 expected to form a layer (for example due to sealing or ventilation), provided that:~~
 - a) ~~the actual maximum surface temperature is marked on the apparatus; or~~
 - b) ~~the symbol X is placed after the certificate reference to indicate the conditions for safe use.~~

NOTE — When choosing electrical apparatus of Group I, 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.

5.1.2 Group II electrical apparatus shall be arranged and marked according to 27.2 f) and shall be

- either preferably classified in a temperature class given in Table 1;
- or defined by the actual maximum surface temperature;
- or, if appropriate, restricted to the specific gas for which it is intended.

Table 1 — Classification of maximum surface temperatures for Group II electrical apparatus

Temperature class	Maximum surface temperature °C
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

5.2 Ambient temperatures

Electrical apparatus shall normally be designed for use in the ambient temperature range between - 20°C and + 40°C; in this case, no additional marking is necessary.

When the electrical apparatus is designed for use in a different range of ambient temperatures, it is considered to be special; the ambient temperature range shall then be stated by the manufacturer, and specified in the certificate; the marking shall then include either the symbol T_a or T_{amb} together with the special range of ambient temperatures or, if this is impracticable, the symbol X shall be placed after the certificate reference, according to 27.2 i) (see Table 2).

Table 2 - Ambient temperatures in service and additional marking

Electrical Apparatus	Ambient temperature in service	Additional marking
Normal	Maximum: + 40°C Minimum: - 20°C	None
Special	Stated by the manufacturer and -specified in the certificate	T_a or T_{amb} with the special range, for example: $-30^{\circ}\text{C} \leq T_a \leq +40^{\circ}\text{C}$ or the symbol X

5.3 Surface temperature and ignition temperature

The lowest ignition temperature of the explosive atmospheres concerned shall be above the maximum surface temperature. However, for components having a total surface area of not more than 10 cm², their surface temperature may exceed that for the temperature class marked on the electrical apparatus ~~for Group II or the corresponding maximum surface temperature for Group I~~, if there is no risk of thermal ignition from these components. ~~with~~ A safety margin of

- 50 K for T1, T2 and T3;
- 25 K for T4, T5 and T6 ~~and Group I~~.

~~This safety margin of~~ shall be ensured by experience of similar components or by tests of the electrical apparatus itself in representative explosive mixtures.

NOTE During the tests, the safety margin may be provided by increasing the ambient temperature.

More specific relaxations for the surface temperature of small components, such as are used in "i" circuits, are given in ~~IEC 60079-11~~ ISA-12.02.01 (IEC 60079-11 Mod).

6 Requirements for all electrical apparatus

6.1 Electrical apparatus for use in potentially explosive atmospheres shall comply with the requirements of this standard as modified by the specific standards for the types of protection as listed in Clause 1.

NOTE If the electrical apparatus has to withstand particularly adverse service conditions (for example rough handling, humidity effects, ambient temperature variations, effects of chemical agents, corrosion) these have to be specified to the manufacturer by the user. ~~and are not the responsibility of the testing station.~~

6.2 Enclosures which can be opened more quickly than the time necessary:

- a) to allow incorporated capacitors, charged by a voltage of 200 V or more, to discharge to a value of residual energy of
 - 0.2 mJ for electrical apparatus of ~~Group I~~ or Group IIA; or
 - 0.06 mJ for electrical apparatus of Group IIB; or
 - 0.02 mJ for electrical apparatus of Group IIC, including apparatus marked Group II only; or
 - double the above energy levels if the charging voltage is less than 200 V;
- b) or to allow the cooling of enclosed hot components to a surface temperature below the temperature class of the electrical apparatus shall either be marked with the warning

WARNING — AFTER DE-ENERGISING, DELAY Y MINUTES BEFORE OPENING,

Y being the value in minutes of the delay required; or alternatively the apparatus may be marked with the warning:

WARNING — DO NOT OPEN WHEN AN EXPLOSIVE GAS ATMOSPHERE MAY BE PRESENT.

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

7.1 General

The following requirements, and those of 23.4.7, apply to non-metallic enclosures and non-metallic parts of enclosures on which the type of protection depends.

However, for sealing rings (see 3.19) on which the type of protection depends, the proof furnished according to B.3.3 is sufficient.

7.1.1 The documents according to 23.2 shall specify both the material and the manufacturing process of the enclosure or part of the enclosure.

7.1.2 The specification for plastic materials shall include:

- a) the name of the manufacturer;
- b) the exact and complete reference of the material, including its color, percentage of fillers, and any other additives if used;
- c) the possible surface treatments, such as varnishes, etc.;
- d) ~~the temperature index TI corresponding to the 20 000 h point on the thermal endurance graph without loss of flexural strength exceeding 50%, determined in accordance with IEC 60216-1 and IEC 60216-2 and based on the flexing property in accordance with ISO 178. If the material does not break in this test before exposure to the heat, the index shall be based on the tensile strength in accordance with ISO 527-2 with test bars of type 1A or 1B. The relative thermal index (RTI) shall be determined in accordance with ANSI/UL 746B.~~

~~The data by which these characteristics are defined shall be supplied by the manufacturer.~~

~~7.1.3 The testing station is not required to verify compliance of the material with its definition.~~

7.2 Thermal endurance

The plastic materials shall have a relative thermal index (RTI) ~~temperature index TI~~ corresponding to the 20,000 h point (see 7.1.2) of at least 20 K greater than the temperature of the hottest point of the enclosure or the part of the enclosure (see 23.4.6.1) having regard to the maximum ambient temperature in service (see 5.2).

The endurance to heat and to cold of the enclosures or parts of enclosures of plastic materials shall be satisfactory (see 23.4.7.3 and 23.4.7.4).

7.3 Electrostatic charges on enclosures or parts of enclosures of plastic material

The following requirements apply only to plastic enclosures to plastic parts of enclosures, and to other exposed plastic parts of electrical apparatus for

- non-fixed electrical apparatus;
- fixed apparatus with plastic parts that are likely to be rubbed or cleaned on site.

~~7.3.1 Electrical apparatus of Group I~~

~~Enclosures of plastic material with surface area projected in any direction of more than 100 cm² shall be so designed that under normal conditions of use, maintenance and cleaning, danger of ignition due to electrostatic charges is avoided.~~

~~This requirement shall be satisfied by suitable selection of the material so that the insulation resistance, measured according to the method given in 23.4.7.8 does not exceed 1 GΩ at (23 ± 2)°C and (50 ± 5)% relative humidity, or by virtue of the size, shape and layout, or other protective methods, such that dangerous electrostatic charges are not likely to occur.~~

~~If, however, the danger of ignition cannot be avoided in the design, a warning label shall indicate the safety measures to be applied in service.~~

NOTE 1 — When selecting electrical insulating materials, attention should be paid to maintaining a minimum insulation resistance to avoid problems arising from touching exposed plastic parts that are in contact with live parts.

NOTE 2 — Further restrictions may apply to plastic enclosures for use in areas where an explosive gas atmosphere is present continuously or is present for long periods.

7.3.2 Electrical apparatus of Group II

Enclosures shall be so designed that under normal conditions of use, maintenance and cleaning, danger of ignition due to electrostatic charges is avoided. This requirement shall be satisfied by either of the following:

- a) by suitable selection of the material so that the insulation resistance of the enclosure, measured in accordance to 23.4.7.8, does not exceed 1 GΩ at (23 ± 2)°C and (50 ± 5)% relative humidity;
- b) or by limitation of the surface area of plastic enclosures or plastic parts of enclosures as follows (see also note 2):
 - for Group IIA and IIB apparatus to a maximum of 100 cm² except that this may be increased to a maximum of 400 cm² if the exposed areas of plastics are surrounded by conductive earthed frames;
 - for Group IIC apparatus, including light-transmitting parts, to a maximum of 20 cm² except that this may be increased to a maximum of 100 cm² if the plastic parts are additionally protected against the occurrence of dangerous electrostatic charges;
- c) or by virtue of the size, shape and lay-out, or other protective methods, such that dangerous electrostatic charges are not likely to occur.

If the danger of ignition cannot be avoided in the design of the apparatus, a warning label shall indicate the safety measures to be applied in service.

NOTE 1 — When selecting electrical insulating materials, attention should be paid to maintaining a minimum insulation resistance to avoid problems arising from touching exposed plastic parts that are in contact with live parts.

NOTE 2 — Further restrictions may apply to plastic enclosures for use in areas where an explosive gas atmosphere is present continuously or is present for long periods (zone 0).

7.4 Threaded holes

Threaded holes for fasteners which secure covers intended to be opened in service for adjustment, inspection and other operational reasons may only be tapped into the plastic material when the thread form is compatible with the plastic material of the enclosure.

8 Enclosures containing light metals

~~8.1 — Materials used in the construction of enclosures of electrical apparatus of Group I shall not contain, by weight:~~

- a) ~~more than 15% in total of aluminum, magnesium and titanium; and~~
- b) ~~more than 6% in total of magnesium and titanium.~~

8.2 Material used in the construction of enclosures of electrical apparatus of Group II shall not contain, by mass, more than 7.5% magnesium.

8.3 Threaded holes in enclosures for fasteners which secure covers intended to be opened in service for adjustment, inspection, and other operational reasons may only be tapped in the material of the enclosure when the thread form is compatible with the material used for the enclosure.

~~8.4 The provisions of 8.1 do not apply to Group I surveying instruments carried by persons.~~

9 Fasteners

9.1 General

Parts necessary to achieve a standard type of protection or used to prevent access to uninsulated live parts shall be capable of being released or removed only with the aid of a tool.

Fastening screws for enclosures of materials containing light metals may be made of light metal or plastics if the material of the fastener is compatible with that of the enclosure.

9.2 ~~Special fasteners~~

~~When any of the standards for a specific standard type of protection requires a special fastener, this shall conform to the following:~~

- ~~the thread shall be coarse pitch in accordance with ISO 262, with a tolerance fit of 6g/6H in accordance with ISO 965;~~
- ~~the head of the screw or nut shall be in accordance with ISO 4014, ISO 4017, ISO 4032 or ISO 4762, and in the case of hexagon socket set screws ISO 4026, ISO 4027, ISO 4028 or ISO 4029;~~
- ~~the holes of the electrical apparatus shall comply with the requirements of 9.3.~~

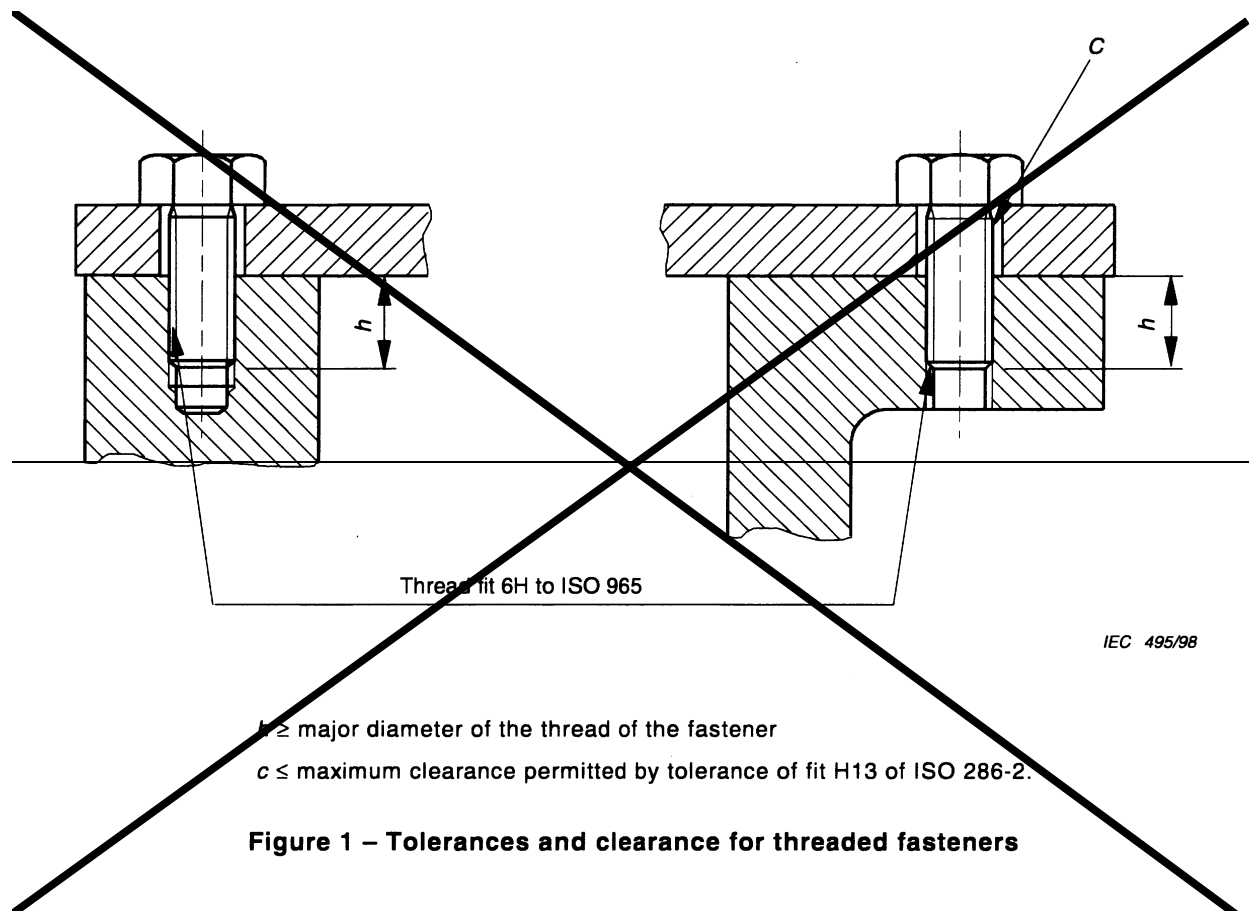
NOTE — For Group I the heads of special fasteners liable to mechanical damage in normal service which may invalidate the type of protection should be protected, for example by the use of shrouds or counter-bored holes.

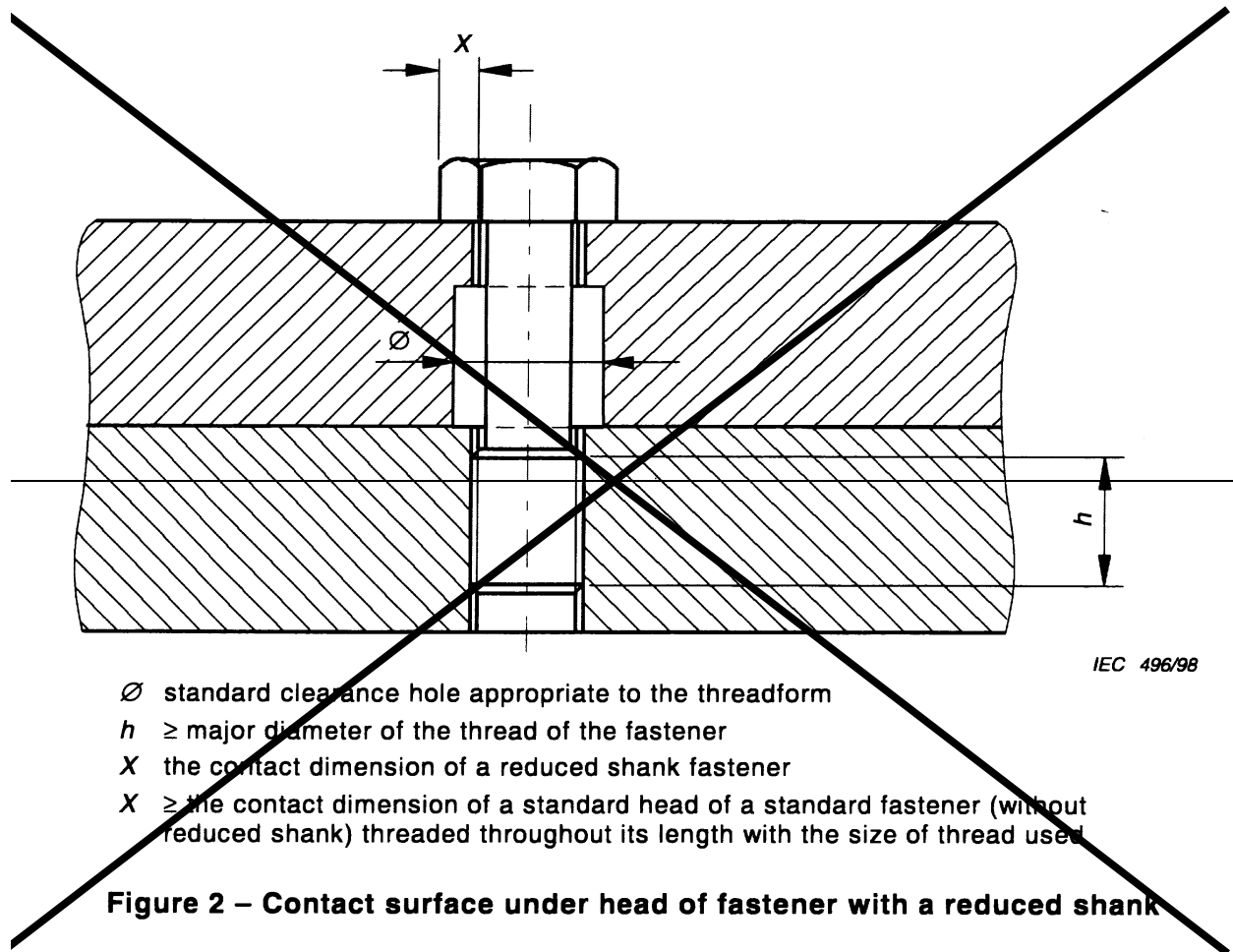
9.3 ~~Electrical apparatus — holes for special fasteners~~

9.3.1 ~~Holes for the threaded fasteners of 9.2 shall be threaded for a distance to accept a thread engagement, h, at least equal to the major diameter of the thread of the fastener (see figures 1 and 2).~~

9.3.2 ~~The thread shall have a tolerance fit of 6H in accordance with ISO 965, and either:~~

- a) ~~the hole under the head of the associated fastener shall allow a clearance not greater than a medium tolerance fit of H13 in accordance with ISO 286-2 (see figure 1 and ISO 273); or~~
- b) ~~the hole under the head (or nut) of an associated reduced shank fastener shall be threaded to enable the fastener to be retained. The dimensions of the threaded hole shall be such that the surrounding surface in contact with the head of such a fastener shall be at least equal to that of a fastener without a reduced shank in a clearance hole (see figure 2).~~





~~9.3.3 In the case of hexagon socket set screws the screw head shall have a tolerance fit of 6H in accordance with ISO 965 but shall not protrude from the threaded hole after tightening.~~

10 Interlocking devices

Interlocking devices used to maintain a type of protection shall be so constructed that their effectiveness cannot readily be defeated by the use, ~~for example, of a screwdriver or pliers of normally available tools.~~

11 Bushings

Bushings used as connection facilities, and which may be subjected to a torque while the connection or disconnection is being made, shall be mounted in such a way that all parts are secured against turning.

The relevant torque test is specified in 23.4.5.

12 Materials used for cementing

12.1 The manufacturer's documents submitted according to 23.2 of this standard shall testify that for the intended operating conditions, the materials used for cementing, and on which safety depends, have a thermal stability adequate for the minimum and maximum temperatures to which they will be subjected, within the rating of the electrical apparatus.

The thermal stability is considered adequate if the limiting values for the material are below or equal to the lowest working temperature and at least 20 K above the maximum temperature.

NOTE If the cementing has to withstand adverse service conditions, appropriate measures should be agreed between user and manufacturer (see 6.1).

~~12.2 The testing station is not required to verify the characteristics listed in the documents mentioned in 12.1.~~

13 Ex components

13.1 Ex components shall comply with the requirements given in Annex C and may be

- a) an empty enclosure;
- b) components or assemblies of components for use with apparatus complying with the requirements of one or more of the types of protection listed in Clause 1.

13.2 Ex components may be mounted

- a) completely within an apparatus enclosure (for example a type “e” terminal, ammeter, heater or indicator; a type “d” switch component or thermostat, a type “i” supply); or
- b) completely external to the apparatus enclosure (for example a type “e” earth terminal, a type “i” sensor); or
- c) partly within and partly external to the apparatus enclosure (for example a type “d” push-button switch, a limit switch or indicating lamp, a type “e” ammeter, a type “i” indicator).

13.3 In the case of mounting completely within the enclosure, the only parts to be tested or assessed when used in an apparatus are those parts which cannot be tested and/or assessed as a separate component (for example test or assessment of surface temperature, creepage distance and clearance when the component is mounted).

13.4 In the case of mounting external to the enclosure or partly within and partly external to the enclosure, the interface between the Ex component and the enclosure shall be tested or assessed for compliance with the relevant type of protection and for compliance with the mechanical tests according to 23.4.3.

14 Connection facilities and terminal compartments

14.1 Electrical apparatus which is intended for connection to external circuits shall include connection facilities, except if the electrical apparatus is manufactured with a cable permanently connected to it. ~~All apparatus constructed with permanently connected unterminated cable shall be marked with the symbol X to indicate the need for appropriate connection of the free end of the cable.~~

14.2 Terminal compartments and their access openings shall be dimensioned so that the conductors can be readily connected.

NOTE Requirements for wire bending space may be included in the applicable ordinary location standard, e.g., ANSI/UL 508, or in the National Electrical Code, ANSI/NFPA 70, Section 373-6(b).

14.3 Terminal compartments shall comply with one of the specific standards listed in Clause 1.

14.4 Terminal compartments shall be so designed that after proper connection of the conductors, the creepage distances and the clearances comply with the requirements, if any, of the specific standard for the type of protection concerned.

NOTE The ordinary location spacing requirements may be more restrictive than the spacing requirements in the type of protection standard.

15 Connection facilities for earthing or bonding conductors

15.1 A connection facility for the connection of an earthing or equipotential bonding conductor shall be provided inside the terminal compartment of electrical apparatus and near the other connection facilities.

~~15.2 Electrical apparatus with a metallic enclosure shall have an additional external connection facility for an earthing or equipotential bonding conductor. This external connection facility shall be electrically in contact with the facility required in 15.1. The external connection facility is not required for electrical apparatus which is designed to be moved when energized and is supplied by a cable incorporating an earthing or equipotential bonding conductor.~~

NOTE — The expression "electrically in contact" does not necessarily involve the use of a conductor.

15.3 ~~Neither~~ An internal ~~nor external~~ earthing or bonding connection facility is not required for electrical apparatus for which earthing (or bonding) is not required, such as electrical apparatus having double or reinforced insulation, or for which supplementary earthing is not necessary.

15.4 Earthing ~~or equipotential bonding~~ (equipment grounding) conductor connection facilities provided inside terminal compartments, or supplemental grounding or bonding terminals provided on the outside of enclosures, shall allow for the effective connection of at least one conductor with a cross-sectional area as specified in ANSI/NFPA-70, National Electrical Code, Section 250-122 table 3.

~~Table 3 — Minimum cross-sectional areas of protective conductors~~

Cross-sectional area of phase conductors of the installation S mm ²					Minimum cross-sectional area of the corresponding protective conductor Sp mm ²
16	<	S	≤	16	—— S
		S	≤	35	—— 16
		S	>	35	—— 0.5 S

When provided, the supplemental grounding and bonding ~~In addition, earthing or bonding~~ connection facilities on the outside of electrical apparatus shall provide for effective connection of a conductor of at least 4 mm² (10 AWG). Effective connection shall be verified by compliance with the Pullout and Secureness tests in UL 486E, *Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors*. The terminal shall be marked in accordance with 27.10.

NOTE The requirements for equipment grounding facilities and bonding are specified in the appropriate standard for electrical equipment for use in unclassified locations (see Clause 1) and may be more stringent than the requirements shown in 15.4. Refer to Annex G for additional information.

15.5 Connection facilities shall be effectively protected against corrosion. They shall also be designed so that the conductors are secured against loosening and twisting and so that the contact pressure is maintained.

Contact pressure of electrical connections shall not be affected by dimensional changes of insulating materials in service due to temperature or humidity, etc.

Special precautions shall be taken if one of the parts in contact consists of a material containing light metal. One example of a means of connecting to a material containing light metal is to use an intermediate part made from steel.

16 Cable and conduit entries

16.1 The manufacturer shall specify in the documents submitted according to 23.2, the entries intended for use with cable or conduit, their position on the apparatus and the maximum number permitted.

16.2 Cable and conduit entries shall be constructed and fixed so that they do not alter the specific characteristics of the type of protection of the electrical apparatus on which they are mounted. This shall apply to the whole range of cable dimensions specified by the manufacturer of the cable entries as suitable for use with those entries.

16.3 Cable and conduit entries may form an integral part of the apparatus, i.e. one major element or part forms an inseparable part of the enclosure of the apparatus. In such cases the entries shall be tested ~~and certified~~ with the apparatus.

NOTE Cable and conduit entries, which are separate from, but installed with the apparatus, are usually tested ~~and certified~~ separately from the apparatus but may be tested ~~and certified~~ together with the apparatus if the apparatus manufacturer so requests.

16.4 Cable entries (fittings or glands), whether integral or separate, shall meet the relevant requirements of the specific type of protection ~~Annex B~~.

NOTE 1 The ordinary location requirements for cable entries can be found in ANSI/UL 514B, "Fittings for Cable and Conduit."

NOTE 2 The requirements for cable entries, type of protection "i", can be found in ANSI/UL 514B, "Fittings for Cable and Conduit."

NOTE 3 The requirements for cable entries, type of protection "d" or "e", can be found in ANSI/UL 2225, "Metal-Clad Cables and Cable-Sealing Fittings for use in Hazardous (Classified) Locations."

~~16.5 Where the design of a Group I cable entry is such that twisting of the cable can be transmitted to the connections then an anti-rotation device shall be fitted.~~

16.6 Provision for entry into the apparatus by conduit shall be either by ~~screwing into~~ threaded holes or by ~~locking in~~ plain holes:

- in the wall of the enclosure; or
- in an adapter plate designed to be fitted in or on the walls of the enclosure; or
- into a suitable ~~stopping box~~ conduit hub, integral with or attached to the wall of the enclosure.

NOTE Installation documents, e.g., ANSI/NFPA 70 Section 501-16 (a), require grounding type devices when installing conduit in plain holes of metal enclosures.

A metric threaded entry shall be identified in accordance with 27.9 to indicate the thread type.

16.7 Blanking elements, intended to close openings in the walls of electrical apparatus, when they are not fitted with cable or conduit entries, shall, together with the enclosure wall of the apparatus, satisfy the requirements of the specific type of protection concerned. The means provided for this shall be such that the blanking element can be removed only with the aid of a tool.