

Electrical apparatus for explosive gas atmospheres —

Part 0: General requirements

The European Standard EN 60079-0:2006 has the status of a
British Standard

ICS 29.260.20

National foreword

This British Standard was published by BSI. It is the UK implementation of EN 60079-0:2006. It is identical with IEC 60079-0:2004. It supersedes BS EN 60079-0:2004 which will be withdrawn on 1 October 2008.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by tags (e.g. [C] <C>).

The UK participation in its preparation was entrusted to Technical Committee GEL/31, Equipment for explosive atmospheres.

A list of organizations represented on GEL/31 can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Electrical apparatus for explosive gas atmospheres
Part 0: General requirements
(IEC 60079-0:2004, modified)

Matériel électrique pour atmosphères
explosives gazeuses
Partie 0: Règles générales
(CEI 60079-0:2004, modifiée)

Elektrische Betriebsmittel für
gasexplosionsgefährdete Bereiche
Teil 0: Allgemeine Anforderungen
(IEC 60079-0:2004, modifiziert)

This European Standard was approved by CENELEC on 2005-09-13. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 31/474A/FDIS, future edition 4 of IEC 60079-0, prepared by IEC TC 31, Electrical apparatus for explosive atmospheres, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60079-0 on 2004-03-01.

A draft amendment to the European Standard EN 60079-0:2004, prepared by the Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres - General requirements, was submitted to the formal vote and was approved by CENELEC on 2005-09-13 to be combined with the published standard and published as new edition of EN 60079-0.

This European Standard supersedes EN 60079-0:2004.

The following dates were fixed:

- | | | |
|---|-------|------------|
| – latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2007-02-01 |
| – latest date by which the national standards conflicting with the amendment have to be withdrawn | (dow) | 2008-10-01 |

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive 94/9/EC. See Annex ZZ.

Clauses, subclauses, notes, tables and figures which are additional to those in IEC 60079-0 are prefixed “Z”.

Annexes ZA, ZB and ZZ have been added by CENELEC.

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INTRODUCTION

It is acknowledged that, with developments in technology, it will 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. In this case, the letter “s” has been reserved to indicate a method of protection that is not fully defined in the standards. Compliance with this standard cannot be claimed in these circumstances.

ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES –

Part 0: General requirements

1 Scope

This part of IEC 60079 specifies the general requirements for construction, testing and marking of electrical apparatus and Ex components intended for use in explosive gas atmospheres.

Unless modified by one of the parts in the IEC 60079 series, electrical apparatus complying with this standard is intended for use in hazardous areas in which explosive gas atmospheres, caused by mixtures of air and gases, vapours or mists, exist under normal atmospheric conditions of

- 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.

The application of electrical apparatus in atmospheric conditions outside this range may need special consideration.

NOTE 1 The determination of the maximum surface temperature is based on an operational ambient temperature of -20 °C to $+40\text{ °C}$, if not otherwise specified by the manufacturer. See also 5.1.1.

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

NOTE 3 Requirements given in this standard result from an ignition hazard assessment made on electrical equipment. The ignition sources taken into account are those found associated with this type of equipment, such as hot surfaces, mechanically generated sparks, thermite reactions, electrical arcing and static electric discharge in normal industrial environments. For other ignition sources like adiabatic compression, shock waves, exothermic chemical reaction, self ignition of dust, naked flames, hot gases/liquids the apparatus are subjected to a hazard analysis that identifies and lists all of the potential sources of ignition by the electrical apparatus and the measures to be applied to prevent them becoming effective.

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

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

- IEC 60079-1: Flameproof enclosures "d";
- IEC 60079-2: Pressurized enclosures "p";
- IEC 60079-5: Powder filling "q";
- IEC 60079-6: Oil immersion "o";
- IEC 60079-7: Increased safety "e";
- IEC 60079-11: Intrinsic safety "i";
- IEC 60079-15: Type of protection "n";
- IEC 60079-18: Encapsulation "m".

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

- IEC 60079-25
- IEC 60079-26
- IEC 62013-1
- IEC 62086-1.

This part of IEC 60079, along with other parts in the IEC 60079 series and the additional standards mentioned above, is not applicable to the construction of electromedical apparatus, shot-firing exploders, test devices for exploders and for shot-firing circuits.

☐ This European Standard EN 60079-0 covers Category M2, 2G and 3G apparatus and partly also Category M1 and 1G.

In all cases where apparatus are involved the references to zones shall be read:

Zone 1	Category 2G
Zone 2	Category 3G ☐

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.

IEC 60034-5, *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification*

IEC 60079-1, *Electrical apparatus for explosive gas atmospheres – Part 1: Flameproof enclosures "d"*

IEC 60079-2, *Electrical apparatus for explosive gas atmospheres – Part 2: Pressurized enclosures "p"*

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

IEC 60079-5, *Electrical apparatus for explosive gas atmospheres – Part 5: Powder filling "q"*

IEC 60079-6, *Electrical apparatus for explosive gas atmospheres – Part 6: Oil-immersion "o"*

IEC 60079-7, *Electrical apparatus for explosive gas atmospheres – Part 7: Increased safety "e"*

IEC 60079-10, *Electrical apparatus for explosive gas atmospheres – Part 10: Classification of hazardous areas*

IEC 60079-11, *Electrical apparatus for explosive gas atmospheres – Part 11: Intrinsic safety "i"*

IEC 60079-15, *Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection "n"*

IEC 60079-18, *Electrical apparatus for explosive gas atmospheres – Part 18: Encapsulation "m"*

IEC 60079-25: *Electrical apparatus for explosive gas atmospheres – Part 25: Intrinsically safe systems*¹

IEC 60079-26: *Electrical apparatus for explosive gas atmospheres – Part 26: Construction, test and marking of zone 0 electrical apparatus*²

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, *Guide for the determination of thermal endurance properties of electrical insulating materials – Part 2: Choice of test criteria*

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

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

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

IEC 61150, *Alkaline secondary cells and batteries – Sealed nickel-cadmium rechargeable monobloc batteries in button cell design*

IEC 61436, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-metal hydride rechargeable single cells*

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

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 62086-1: *Electrical apparatus for explosive gas atmospheres – Electrical resistance trace heating – Part 1: General and testing requirements*

¹ To be published.

² In preparation.

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

ISO 178, *Plastics – Determination of flexural properties*

ISO 179, *Plastics – Determination of Charpy impact properties*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ISO 4762, *Hexagon socket head cap screws*

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

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

3 Terms and definitions

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

3.1

ambient temperature

temperature of the air or other media, in the immediate vicinity of the apparatus or component

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

3.2

associated apparatus

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

NOTE Associated apparatus may be either:

- a) electrical apparatus which has an alternative type of protection included in this standard for use in the appropriate explosive gas atmosphere;
- b) electrical apparatus not so protected and which therefore is not to be used within an explosive gas atmosphere, for example, a recorder which is not of itself in an explosive gas atmosphere but is connected to a thermocouple situated within an explosive gas atmosphere where only the recorder input circuit is energy limited.

3.3

cells and batteries

3.3.1

battery

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

3.3.2

capacity

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

3.3.3

cell

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

3.3.4

charging

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

3.3.5

deep discharge

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

3.3.6

inherently safe (ihs) cell (or battery)

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

3.3.7

maximum open-circuit voltage (of a cell or battery)

maximum attainable voltage under normal conditions, that is, from either a new primary cell, or a secondary cell just after a full charge

NOTE See Tables 6 and 7 which show the maximum open-circuit voltage for acceptable cells.

3.3.8

nominal voltage

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

3.3.9

open cell or battery

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

[IEV 486-01-18]

3.3.10

primary cell or battery

electrochemical system capable of producing electrical energy by chemical reaction

3.3.11

reverse charging

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

3.3.12

sealed gas-tight cell or battery

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

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

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

3.3.13

sealed valve-regulated cell or battery

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

[IEV 486-01-20 and IEV 486-01-21, modified]

3.3.14

secondary cell or battery

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

3.4

bushing

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

3.5**cable gland**

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

3.5.1**clamping device**

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

3.5.2**compression element**

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

3.5.3**sealing ring**

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

3.5.4**Ex cable gland**

cable gland tested separately from the apparatus enclosure but certified as an apparatus and which can be fitted to the apparatus enclosure during installation

3.6**certificate**

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

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

3.7**conduit entry**

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

3.8**connection facilities**

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

3.9**continuous operating temperature (COT)**

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

3.10**degree of protection of enclosure (IP)**

numerical classification according to IEC 60529 preceded by the symbol IP applied to the enclosure of electrical apparatus 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 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.

3.11

electrical apparatus

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.

3.12

electrical parameters – apparatus with energy limitation

3.12.1

maximum external capacitance

C_o

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

3.12.2

maximum external inductance

L_o

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

3.12.3

maximum input current

I_i

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

3.12.4

maximum input power

P_i

power that can be applied to the connection facilities of apparatus without invalidating the type of protection

3.12.5

maximum input voltage

U_i

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

3.12.6

maximum internal capacitance

C_i

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

3.12.7

maximum internal inductance

L_i

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

3.12.8**maximum output current** I_o

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

3.12.9**maximum output power** P_o

maximum electrical power that can be taken from the apparatus

3.12.10**maximum output voltage** U_o

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

3.12.11**maximum r.m.s. a.c. or d.c. voltage** U_m

maximum voltage that can be applied to the non energy-limited connection facilities of associated apparatus without invalidating the type of protection

3.13**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 apparatus

3.14**Ex component**

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

3.15**explosive gas atmosphere**

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

3.16**explosive test mixture**

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

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

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

3.18**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 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 their particular design, they 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 and specified by the manufacturer, including recognized overloads;
- any other operating condition specified by the manufacturer.

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

3.19

normal operation

operation of apparatus 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.

3.20

rated value

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

3.21

rating

set of rated values and operating conditions

3.22

service temperature

temperature reached when the apparatus is operating at rated conditions

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

3.23

symbol “U”

symbol used to denote an Ex component

3.24

symbol “X”

symbol used to denote special conditions for safe use

3.25

terminal compartment

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

3.26

type of protection

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

3.21

category

within an apparatus group, a category is the classification according to the required level of protection

NOTE 1 The term “apparatus” used throughout this standard, has the same meaning as the term “equipment” used in EC Directive 94/9/EC.

NOTE 2 The categories are defined as given in Annex ZA. 

4 Apparatus grouping and temperature classification

4.1 Apparatus grouping

Electrical apparatus for explosive gas atmospheres is divided into the following:

- Group I: electrical apparatus for mines susceptible to firedamp;
- Group II: electrical apparatus for places with an explosive gas 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 Group II

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

4.2.1 Group II subdivisions

For the types of protection "d", "i", "nC" and "nL", 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 ratio (MIC ratio) for intrinsically safe electrical apparatus (see IEC 60079-12 and IEC 60079-20).

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

4.2.2 Group II – Surface temperature marking

For all types of protection, apparatus of Group II shall be marked as a function of its maximum surface temperature according to 5.3.2.2.

4.2.3 Apparatus for a particular explosive atmosphere

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

5 Temperatures

5.1 Environmental influences

5.1.1 Ambient temperature

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

Electrical apparatus designed for use in a different range of ambient temperatures is considered to be special, and the ambient temperature range shall then be stated by the manufacturer. 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 used to indicate special conditions of use that include a special range of ambient temperature. See item i) of 29.2 and Table 1.

Table 1 – 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	T_a or T_{amb} with the special range, for example, $-30\text{ °C} \leq T_a \leq +40\text{ °C}$ or the symbol "X"

5.1.2 External source of heating or cooling

Where the electrical apparatus is intended to be physically connected to a separate external source of heating or cooling, such as a heated or cooled process vessel or pipeline, the ratings of this source shall be stated.

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

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

5.2 Service temperature

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

5.3 Maximum surface temperature

5.3.1 Determination of maximum surface temperature

Maximum surface temperature shall be determined for rated duty of the electrical apparatus but with the voltage chosen according to 26.5.1 or the specific requirement of the standard for the type of protection, and when the apparatus is subjected to maximum ambient temperature and, where relevant, the maximum rated external source of heating.

5.3.2 Limitation of maximum surface temperature

5.3.2.1 Group I electrical apparatus

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

This maximum surface temperature shall not exceed

- 150 °C on any surface where coal dust can form a layer,
- 450 °C where coal dust is not expected to form a layer (for example, due to sealing or ventilation), provided that the actual maximum surface temperature is marked on the apparatus.

NOTE When choosing Group I electrical apparatus, 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.

5.3.2.2 Group II electrical apparatus

Group II electrical apparatus shall be marked according to item f) of 29.2 and shall be either

- classified in a temperature class given in Table 2, or
- defined by the maximum surface temperature determined by 26.5.1, or
- if appropriate, restricted to the specific gas for which it is intended.

Table 2 – 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

NOTE More than one temperature class may be established for different ambient temperatures and different external sources of heating and cooling.

5.4 Surface temperature and ignition temperature

The maximum surface temperature shall not exceed the lowest ignition temperature of the explosive atmospheres concerned unless subjected to the requirements of 5.5.

5.5 Small components

Small components, for example transistors or resistors, whose temperature exceeds that permitted for the temperature classification, shall be acceptable providing that they conform to one of the following:

- a) when tested in accordance with 26.5.3, small components shall not cause ignition of the flammable mixture and any deformation or deterioration caused by the higher temperature shall not impair the type of protection; or
- b) for T4 and Group I classification, small components shall conform to Table 3; or
- c) for T5 classification, the surface temperature of a component with a surface area smaller than 1 000 mm² (excluding lead wires) shall not exceed 150 °C.

Table 3 – Assessment for T4 classification according to component size and ambient temperature

Total surface area excluding wire terminations	Requirement for T4 classification
< 20 mm ²	Surface temperature ≤ 275 °C
≥ 20 mm ²	Power dissipation ≤ 1,3 W ^a
≥ 20 mm ² ≤ 1 000 mm ²	Surface temperature ≤ 200 °C
^a Reduced to 1,2 W with 60 °C ambient temperature or 1,0 W with 80 °C ambient temperature.	

For potentiometers, the surface to be considered shall be that of the resistance element and not the external surface of the component. The mounting arrangement and the heat-sinking and cooling effect of the overall potentiometer construction shall be taken into consideration during the test. Temperature shall be measured on the track with that current which flows under the test conditions required by the standard for the specific type of protection. If this results in a resistance value of less than 10 % of the track resistance value, the measurements shall be carried out at 10 % of the track resistance value.

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 Group II electrical apparatus or the corresponding maximum surface temperature for Group I electrical apparatus, if there is no risk of 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 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.

6 Requirements for all electrical apparatus

6.1 General

Electrical apparatus and Ex components for use in explosive gas atmospheres shall

- a) comply with the requirements of this standard, together with one or more of the specific standards listed in Clause 1, and

NOTE 1 These specific standards may vary the requirements of this standard.

- b) be constructed in accordance with the applicable safety requirements of the relevant industrial standards.

NOTE 2 It is not a requirement of this standard that a certification body check compliance with this requirement. The manufacturer should indicate compliance by marking the apparatus or component in accordance with Clause 29 (and by stating the basis of compliance in the documentation, see Clause 28).

NOTE 3 If the electrical apparatus or Ex component is intended to withstand particularly adverse service conditions (for example, rough handling, humidity effects, ambient temperature variations, effects of chemical agents, corrosion), these should be specified to the manufacturer by the user. If certification is sought, it is not a requirement of this standard that the certification body confirm suitability for the adverse conditions. Special precautions should be taken when vibration effects on terminals, fuse holders, lampholders and current-carrying connections in general may impair safety, unless they comply with specific standards.

6.2 Mechanical strength of apparatus

The apparatus shall be subjected to the tests of 26.4. Guards relied upon to provide protection from impact shall be removable only by the use of a tool and shall remain in place for the required impact tests.

6.3 Opening times

Enclosures which can be opened more quickly than

- a) any 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, or
- b) the surface temperature of enclosed hot components reduces to below the temperature class of the electrical apparatus

shall be marked with one of the following warning markings:

- an enclosure opening delay marking as specified in item a) of 29.8; or
- an enclosure opening marking as specified in item b) of 29.8.

6.4 Circulating currents

Where necessary, precautions shall be taken to guard against any effect due to the presence of circulating currents caused by stray magnetic fields, and the arcs or sparks that may occur as a result of interrupting such currents, or excessive temperatures caused by such currents.

NOTE Examples of precautions that can be taken include:

- the provision of equipotential bonding between parts of an enclosure or structure of apparatus; or
- the provision of an adequate quantity of fasteners.

Bonding conductors shall be such that they will only conduct through the designed connection points and not through any insulated joints. In order to ensure reliable current transfer without the risk of sparking under adverse operating conditions, such as vibration or corrosion, the bonds shall be protected against corrosion and loosening in accordance with 15.5. Particular care shall be taken with bare flexible conductors in close proximity to the bonded parts.

Bonding conductors are not required where insulation ensures that circulating currents cannot flow. However, provision shall be made for adequate earthing of isolated exposed conductive parts. The insulation of such parts shall be capable of withstanding a test of 100 V r.m.s for 1 min.

6.5 Gasket retention

Where the degree of protection provided by the enclosure depends on a gasketed joint which is intended to be opened for installation or maintenance purposes, gaskets shall be attached or secured to one of the mating faces to prevent loss, damage or incorrect assembly. The gasket material shall not itself adhere to the other joint face.

NOTE An adhesive may be used for attaching a gasket to one of the mating faces.

6.21 Operating faults

6.21.1 Equipment, which is intended to be used in Zone 1, must be so designed and constructed as to prevent ignition sources arising, even in the event of frequently occurring disturbances or equipment operating faults, which normally have to be taken into account.

6.21.2 Equipment, which is intended to be used in Zone 2, must be so designed and constructed as to prevent foreseeable ignition sources which can occur during normal operation.

6.22 Overloading of equipment

Dangerous overloading of equipment must be prevented at the design stage by means of integrated measurement, regulation and control devices, such as over-current cut-off switches, temperature limiters, differential pressure switches, flow meters, time-lag relays, over speed monitors and/or similar types of monitoring devices. 

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

7.1 General

7.1.1 Applicability

The requirements given in this clause and in 26.7 shall apply to non-metallic enclosures and non-metallic parts of enclosures, on which the type of protection depends.

However, for sealing rings (see 3.5.3) on which the type of protection depends, the proof furnished according to A.3.3 shall be sufficient.

7.1.2 Specification of materials

The documents according to Clause 24 shall specify both the material and the manufacturing process of the enclosure or part of the enclosure.

7.1.3 Plastic materials

The specification for plastic materials shall include the following:

- a) the name of the manufacturer;
- b) the exact and complete reference of the material, including its colour, 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. As an alternative to the TI, the relative thermal index (RTI – mechanical impact) may be determined in accordance with ANSI/UL 746B.

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

NOTE It is not a requirement of this standard that conformity to the manufacturer's specification of the plastic material needs to be verified.

7.2 Thermal endurance

The endurance to heat and to cold of the enclosures, or parts of enclosures, of non-metallic materials shall be satisfactory (see 26.8 and 26.9).

Plastic materials shall have a TI corresponding to the 20 000 h point (see 7.1.3) of at least 20 K greater than the temperature of the hottest point of the enclosure or the part of the enclosure (see 26.5.1), having regard to the maximum ambient temperature in service (see 5.1.1).

7.3 Electrostatic charges on external non-metallic materials of enclosures

7.3.1 Applicability

The requirements of this subclause only apply to external non-metallic materials of electrical apparatus.

7.3.2 Avoidance of a build-up of electrostatic charge

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