

Electrical apparatus for explosive gas atmospheres —

Part 15: Type of protection “n”

The European Standard EN 60079-15:2003 has the status of a
British Standard

ICS 29.260.20

National foreword

This British Standard is the official English language version of EN 60079-15:2003. It was derived by CENELEC from IEC 60079-15:2001. It supersedes BS EN 50021:1999 which remains current as obsolescent but will be withdrawn no later than 1 July 2006. It also partially supersedes DD ENV 50269:1997 which is also withdrawn.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by tags [C] [C].

The UK participation in its preparation was entrusted by Technical Committee GEL/31, Electrical apparatus for use in explosive atmospheres, to Subcommittee GEL/31/14, Types of protection ‘e’ and ‘n’, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 79 and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 2 October 2003

© BSI 2 October 2003

ISBN 0 580 42725 0

English version

Electrical apparatus for explosive gas atmospheres
Part 15: Type of protection "n"
(IEC 60079-15:2001, modified)

Matériel électrique pour atmosphères
explosives gazeuses
Partie 15: Mode de protection "n"
(CEI 60079-15:2001, modifiée)

Elektrische Betriebsmittel für
gasexplosionsgefährdete Bereiche
Teil 15: Zündschutzart "n"
(IEC 60079-15:2001, modifiziert)

This European Standard was approved by CENELEC on 2003-07-01. 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Lithuania, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the International Standard IEC 60079-15:2001, prepared by IEC TC 31, Electrical apparatus for explosive atmospheres, together with common modifications prepared by SC 31-5, Apparatus type of protection "n", of Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 60079-15 on 2003-07-01.

This European Standard supersedes EN 50021:1999.

This European Standard covers essential requirements of the EC Directive 94/9/EC (the ATEX Directive).

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2004-07-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2006-07-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this draft European Standard, Annex ZA is normative.

Annexe ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60079-15:2001 was approved by CENELEC as a European Standard with agreed common modifications.

CONTENTS

Clause	Page
1 Scope	8
2 Normative references.....	8
3 Definitions	11
4 General	18
4.1 Potential ignition sources	18
4.2 Apparatus grouping	18
4.3 Temperatures	18
4.3.1 Maximum surface temperature	18
4.3.2 Ambient temperatures.....	18
4.3.3 Surface temperature and ignition temperature	18
4.4 Electrical apparatus	18
4.5 Ex components.....	19
4.6 Other requirements.....	19
5 Construction	19
5.1 Degree of protection	19
5.2 Mechanical strength.....	20
5.3 Guards for light transmitting parts	20
5.4 Circulating currents.....	20
5.5 Non-metallic enclosures, non-metallic parts of enclosures.....	20
6 Connection facilities and wiring	21
6.1 General	21
6.2 Connection for external conductors	21
7 Clearances, creepage distances and separations	24
8 Electric strength.....	31
8.1 Insulation from earth or frame	31
8.2 Insulation between conductive parts.....	31
9 Supplementary requirements for non-sparking rotating machines	32
9.1 General	32
9.2 Degree of protection	32
9.2.1 Machine enclosure.....	32
9.2.2 Terminal boxes	32
9.2.3 Conduit stopping boxes, cable sealing and dividing boxes	32
9.3 Connection facilities for external conductors	32
9.4 Neutral point connections	32
9.5 Radial air gap	33
9.6 Ventilation systems.....	33
9.6.1 General	33
9.6.2 Ventilation openings for external fans.....	34
9.6.3 Construction and mounting of the ventilation system	34
9.6.4 Clearances for the ventilation system	34
9.6.5 Materials for fans and fanhoods	34

Clause	Page
9.7 Bearing seals and shaft seals	34
9.7.1 Non-rubbing seals and labyrinths	34
9.7.2 Rubbing seals	34
9.8 Rotor cages	35
9.8.1 Rotor cages built from bars connected to end rings	35
9.8.2 Cast rotor cages	35
9.9 Surface temperature limitation	35
9.9.1 Prevention of thermal ignition	35
9.9.2 Operation with a frequency convertor or a non-sinusoidal supply	36
10 Supplementary requirements for non-sparking fuses and fuse assemblies	36
11 Supplementary requirements for non-sparking luminaires	37
11.1 General	37
11.2 Construction	37
11.2.1 General	37
11.2.2 Enclosure of lamp	37
11.2.3 Mounting arrangement	37
11.2.4 Lampholders	37
11.2.5 Auxiliaries	38
11.2.6 Reflectors	39
11.2.7 Creepage distances and clearances	39
11.2.8 Terminals	40
11.2.9 External and internal wiring	41
11.2.10 Endurance tests and thermal tests	41
11.2.11 Resistance to dust and moisture	42
11.2.12 Insulation resistance and electric strength	42
11.3 Other apparatus containing light sources	42
12 Supplementary requirements for non-sparking instruments and low power apparatus	43
13 Supplementary requirements for non-sparking current transformers	43
14 Supplementary requirements for non-sparking plugs and sockets	43
15 Supplementary requirements for non-sparking cells and batteries	44
15.1 Categorization of cells and batteries	44
15.2 General requirements for cells and batteries of types 1 and 2	45
15.3 Charging of type 1 cells and batteries	46
15.4 Charging of type 2 cells and batteries	46
15.5 Requirements for type 3 secondary batteries	47
15.5.1 Types of permissible batteries	47
15.5.2 Battery containers	47
15.5.3 Cells	48
15.5.4 Connections	48
15.6 Verification and tests	49
15.6.1 Insulation resistance	49
15.6.2 Shock test	49
16 Other electrical apparatus	49

Clause	Page
17 General supplementary requirements for apparatus producing arcs, sparks or hot surfaces.....	49
18 Supplementary requirements for enclosed-break devices and non-incendive components producing arcs, sparks or hot surfaces	50
18.1 Type testing.....	50
18.2 Ratings.....	50
18.3 Construction of enclosed-break devices	50
19 Supplementary requirements for hermetically sealed devices producing arcs, sparks or hot surfaces	51
20 Supplementary requirements for sealed devices or encapsulated devices producing arcs, sparks or hot surfaces.....	51
20.1 Sealed devices or encapsulated devices other than for luminaires.....	51
20.2 Encapsulated devices for luminaires	51
20.3 Sealed devices for luminaires	52
21 Supplementary requirements for energy-limited apparatus and circuits producing arcs, sparks or hot surfaces	52
21.1 General	52
21.2 Associated energy-limited apparatus.....	52
21.3 Energy-limited apparatus	52
21.4 Self protected energy-limited apparatus	53
21.5 Separation of conducting parts.....	53
21.6 Plugs and sockets	53
21.7 Protection against polarity reversal	53
21.8 Requirements for components on which energy limitation depends.....	53
21.8.1 Ratings of components	53
21.8.2 Fuses	53
21.8.3 Shunt safety components.....	54
22 Supplementary requirements for restricted-breathing enclosures protecting apparatus producing arcs, sparks or hot surfaces.....	54
23 Supplementary requirements for n-pressurization protecting apparatus producing arcs, sparks or hot surfaces	55
23.1 Forms of n-pressurization	55
23.2 Requirements for n-pressurization enclosures.....	55
23.2.1 Degree of protection of enclosure	55
23.2.2 Doors and covers.....	55
23.2.3 Mechanical strength.....	55
23.2.4 Apertures, partitions and internal components	55
23.2.5 Spark and particle barriers.....	55
23.3 Temperature limits.....	56
23.4 Safety provisions and safety devices (except for static pressurization).....	56
23.5 Safety provisions and safety devices for static pressurization	56
23.6 Supply of protective gas.....	56
24 General information on verification and tests	56
25 Specification documentation	56
26 Type tests.....	57
26.1 General	57
26.2 Test configuration.....	57

Clause	Page
26.3 Tests for enclosures	57
26.3.1 Order of tests	57
26.3.2 Thermal endurance tests	57
26.3.3 Mechanical strength tests	58
26.3.4 Tests for degree of protection (IP code) by enclosures	58
26.4 Test for cable entry clamping method.....	59
26.5 Test for enclosed-break devices and non-incendive components.....	60
26.5.1 Preparation of enclosed-break device samples.....	60
26.5.2 Preparation of non-incendive component samples.....	60
26.5.3 Test conditions for enclosed-break devices and non-incendive components.....	60
26.6 Tests for sealed devices and encapsulated devices	60
26.6.1 Apparatus.....	61
26.6.2 Procedure.....	61
26.6.3 Test for encapsulated devices for luminaires	62
26.6.4 Test for sealed devices for luminaires	62
26.7 Assessment and test of energy-limited apparatus and circuits	63
26.8 Tests for restricted-breathing enclosures	63
26.8.1 Apparatus with provision for routine checking of restricted-breathing properties	63
26.8.2 Apparatus without provision for routine checking of restricted-breathing properties	63
26.8.3 Apparatus where the nominal volume of the enclosure changes due to pressure	63
26.9 Test for apparatus with n-pressurization.....	63
26.9.1 Maximum overpressure test	63
26.9.2 Leakage test.....	63
26.9.3 Purging test for leakage compensation and filling procedure for static pressurization	63
26.9.4 Verification of minimum overpressure	63
26.9.5 Verification of the ability of the n-pressurization enclosure to limit internal pressure	64
26.10 Test for screw lampholders	64
26.11 Test for starter holders for luminaires.....	64
26.12 Tests for ballasts in circuits with ignitors.....	65
26.12.1 Number of samples	65
26.12.2 Conditioning prior to high-voltage impulse test.....	65
26.12.3 High-voltage impulse test.....	66
26.13 Tests for electronic starters for tubular fluorescent lamps and for ignitors for high pressure sodium or metal halide lamps	68
26.13.1 General.....	68
26.13.2 Humidity test.....	68
26.13.3 Voltage test.....	68
26.13.4 Cut-out device test.....	69
26.13.5 Life test	69
26.14 Test for wiring of luminaires subject to high-voltage impulses from ignitors	70
26.15 Shock test for batteries	70
26.16 Insulation resistance test for batteries	70

Clause	Page
27 Routine verifications and tests	71
27.1 General	71
27.2 Specific routine tests	71
28 Marking	71
29 Instructions	74
30 Manufacturer's responsibility	75
 Annex ZA (normative) Normative references to international publications with their corresponding European publication	 76
 Bibliography	 79
 Figure 1 – Parts of a secondary cell	 17
Figure 2 – Illustration of entry points and branching points	24
Figure 3 – Examples for determining clearances and creepage distances	31
Figure 4a – Example of acceptable spring leaf screwless terminal	41
Figure 4b – Example of non-acceptable spring leaf screwless terminal	41
Figure 5 – High-voltage impulse test circuit	67
Figure 6 – Full lightning impulse	68
 Table 1 – Minimum cross-sectional area of protective conductors	 22
Table 2 – Minimum creepage distances, clearances and separations	26
Table 3 – Tracking resistance of insulating materials	27
Table 4 – Separation in compound-filled cable sealing boxes	27
Table 5 – Assumed working voltage of neutral points	33
Table 6 – Creepage distances and clearances at peak values of pulse voltages greater than 1,5 kV	40
Table 7 – Types and use of cells and batteries	45
Table 8 – Insertion torque	64
Table 9 – Minimum removal torque	64
Table 10 – Electric strength test voltage	66

ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES –

Part 15: Type of protection "n"

1 Scope

Ⓒ This European Standard specifies requirements for the construction, testing and marking for Group II electrical apparatus with type of protection 'n', intended for use only in areas where explosive atmospheres of gas, vapour and mist are unlikely to occur or if they do occur, are likely to do so infrequently or for a short period only.

This standard is applicable to non-sparking electrical apparatus and also to apparatus with parts or circuits producing arcs or sparks or having hot surfaces which, if not protected in one of the ways specified in this standard, could be capable of igniting a surrounding explosive atmosphere.

A non-incendive component is limited in use to the particular circuit for which it has been shown to be non-ignition capable and, therefore, cannot be separately assessed as complying with this standard.

This standard is applicable to electrical equipment and components of Group II, Category 3G. Such equipment is designed to be capable of functioning in conformity with the operating parameters established by the manufacturer and ensuring a normal level of protection.

Equipment in this category ensures the requisite level of protection during normal operation.

NOTE 1 In this standard the word 'apparatus' has the same meaning as the word 'equipment' used in the Directive.

Compliance with this European Standard does not imply any removal of, or lowering of, the requirements of any other European Standard with which the electrical apparatus complies.

This standard supplements, and may enhance, the requirements for apparatus for normal industrial applications.

NOTE 2 The application of this standard may require the exercise of engineering judgement because of the wide range of apparatus and technologies covered. If apparatus is to be certified the relevant requirements may need to be agreed between the manufacturer and the testing station.

NOTE 3 This standard makes several specific references to IEC 60079-0. It is not intended that apparatus with type of protection "n" should comply with IEC 60079-0 in its entirety, or that the level of protection achieved by compliance with this standard should be equal to the level of protection achieved by compliance with IEC 60079-0 and any of the types of protection listed therein. Ⓒ

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60079. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60079 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid standards.

IEC 60034 (all parts), *Rotating electrical machines*

IEC 60034-1:1996, *Rotating electrical machines – Part 1: Rating and performance* ¹

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

IEC 60050-411, *International Electrotechnical Vocabulary – Chapter 411: Rotating machinery*

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

IEC 60050(486), *International Electrotechnical Vocabulary – Chapter 486: Secondary cells and batteries*

IEC 60060 (all parts), *High-voltage test techniques*

IEC 60061 (all parts), *Lamp caps and holders together with gauges for the control of interchangeability and safety*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 60079-0:1998, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements* ²

IEC 60079-2, *Electrical apparatus for explosive gas atmospheres – Part 2: Electrical apparatus, type of protection "p"* ³

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

IEC 60081, *Double-capped fluorescent lamps – Performance specifications*

IEC 60112, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*

IEC 60155, *Glow-starters for fluorescent lamps*

IEC 60216-1:1990, *Guide for the determination of thermal endurance properties of electrical insulating materials – Part 1: General guidelines for ageing procedures and evaluation of test results* ⁴

IEC 60216-2, *Guide for the determination of thermal endurance properties of electrical insulating materials – Part 2: Choice of test criteria*

IEC 60238:1998, *Edison screw lampholders* ⁵

IEC 60269-3, *Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications)*

¹ A consolidated edition 10.2 exists (1999) that includes IEC 60034-1 (1996), its amendment 1 (1997) and its amendment 2 (1999).

² A consolidated edition 3.1 exists (2000) that includes IEC 60079-0 (1998) and its amendment 1 (2000).

³ Fourth edition in preparation.

⁴ Fifth edition in preparation.

⁵ A consolidated edition 7.1 exists (2000) that includes IEC 60238 (1998) and its amendment 1 (1999).

IEC 60400, *Lampholders for tubular fluorescent lamps and starter holders*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60598-1:1996, *Luminaires – Part 1: General requirements and tests*

IEC 60598-2 (all parts), *Luminaires – Part 2: Particular requirements*

IEC 60662:1992, *High-pressure sodium vapour lamps*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests* ⁶

IEC 60920, *Ballasts for tubular fluorescent lamps – General and safety requirements*

IEC 60922, *Auxiliaries for lamps – Ballasts for discharge lamps (excluding tubular fluorescent lamps) – General and safety requirements*

IEC 60924, *D.C. supplied electronic ballasts for tubular fluorescent lamps – General and safety requirements*

IEC 60926, 1995, *Auxiliaries for lamps – Starting devices (other than glow starters) – General and safety requirements* ⁷

IEC 60927, 1996, *Auxiliaries for lamps – Starting devices (other than glow starters) – Performance requirements* ⁸

IEC 60928: 1995, *Auxiliaries for lamps – A.C. supplied electronic ballasts for tubular fluorescent lamps – General and safety requirements* ⁹

IEC 60998-2-4, 1991, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-4: Particular requirements for twist-on connecting devices*

IEC 61048, *Capacitors for use in tubular fluorescent and other discharge lamp circuits – General and safety requirements* ¹⁰

IEC 61049, *Capacitors for use in tubular fluorescent and other discharge lamp circuits – Performance requirements*

IEC 61184, *Bayonet lampholders*

⁶ A consolidated edition 1.1 exists (2000) that includes IEC 60664 (1992) and its amendment 1 (2000).

⁷ A consolidated edition 2.1 exists (2000) that includes IEC 60926 (1995) and its amendment 1 (1999).

⁸ A consolidated edition 2.1 exists (2000) that includes IEC 60927 (1996) and its amendment 1 (1999).

⁹ A consolidated edition 2.1 exists (1999) that includes IEC 60928 (1995) and its amendment 1 (1999).

¹⁰ A consolidated edition 1.2 exists (1999) that includes IEC 61048 (1991), its amendment 1 (1995) and its amendment 2 (1999).

3 Definitions

For the purpose of this part of IEC 60079, the definitions given in IEC 60079-0 as well as the following definitions apply.

NOTE Definitions marked ¹⁾ differ from the equivalent definitions in IEC 60079-0. It is proposed that the definitions in IEC 60079-0 be modified to accommodate the slight differences needed for use with this standard, at which time definitions in this standard will be deleted.

3.1

cable sealing box

auxiliary enclosure provided specifically for the purpose of sealing the insulation of a cable (for example, oil insulated cable) where it is connected to an apparatus. The enclosure may also provide for the connection of separate cable tails to the cable

3.2

(electrochemical) cell or battery

electrochemical system capable of storing in chemical form the electric energy received and which can give it back by reversion

[IEV 486-01-01]

3.2.1

secondary cell

assembly of electrodes and electrolyte which constitutes the basic unit of a secondary battery

[IEV 486-01-02]

NOTE 1 A cell consists substantially of positive and negative plates and separators, of the items needed for assembling and connecting (plate lugs, group bars, terminal posts), of the cell container, and the electrolyte.

NOTE 2 A sketch illustrating various parts of a cell is given in figure 1. This sketch is included for descriptive purposes only and is not intended to imply any requirements or preference for a particular form of construction.

3.2.2

secondary battery

two or more secondary cells connected together and used as a source of electric energy

[IEV 486-01-03]

3.2.3

container (of a cell)

container for the plate pack and electrolyte of a cell made of a material impervious to attack by the electrolyte

[IEV 486-02-20]

3.2.4

(battery) container

enclosure to contain the battery

NOTE The cover is a part of the battery container.

3.2.5

battery capacity

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

NOTE The SI unit for electrical charge is the coulomb (1 C = 1 As) but in practice, battery capacity is usually expressed in ampere-hours (Ah).

[IEV 486-03-01]

3.2.6

plate pack

assembly of the positive and negative plate groups with separators

[IEV 486-02-15]

3.2.7

intercell connector

conductor of electricity used for carrying current between cells

[IEV 486-02-31]

3.3

clearance

shortest distance in air between two conductive parts

(IEC 60664-1)

3.4

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

3.5

creepage distance

shortest distance along the surface of an electrically insulating material between two conductive parts

3.6

duty cycle

repetitive variation of load in which the cycle time is too short for thermal equilibrium to be attained in the first cycle

[IEV 411-51-07]

3.7

encapsulated device

device, which may or may not contain voids, which is so constructed that it is totally immersed in an encapsulating compound so that it is sealed to prevent entry of an external atmosphere

NOTE For the purpose of this standard an encapsulated device is considered to be a particular form of sealed device. It does not provide equivalent protection to encapsulated apparatus constructed in accordance with IEC 60079-18.

3.8

enclosed-break device

device incorporating electrical contacts that are made and broken and that will withstand an internal explosion of the flammable gas or vapour which may enter it without suffering damage and without communicating the internal explosion to the external flammable gas or vapour

3.9

energy limitation

concept applicable to circuits in which no spark or any thermal effect produced in the test conditions prescribed in this standard is capable of causing ignition of a given flammable gas or vapour

3.9.1

energy-limited apparatus

electrical apparatus in which the circuits and components are constructed according to the concept of energy limitation

3.9.2

associated energy-limited 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. Associated energy-limited apparatus may be either:

- a) electrical apparatus which has an alternative method of protection included in this standard for use in the appropriate explosive gas atmosphere;
- b) electrical apparatus which has an alternative type of protection listed in IEC 60079-0 for use in the appropriate explosive gas atmosphere;
- c) electrical apparatus not so protected and which therefore shall not 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

3.9.3

self protected energy-limited apparatus

apparatus which contains energy-limited sparking contacts, the circuits (including, energy-limiting components and devices) supplying energy-limited power to these contacts, as well as the non-energy limited source of supply to the circuit

3.10

Ex component ¹⁾

part of electrical apparatus or a module (other than an Ex cable entry), 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

 NOTE Directive 94/9/EC defines a component as:

Any item essential to the safe functioning of equipment and protective systems but with no autonomous function. In this standard, the words 'Ex component' have the same meaning as the word 'component used in the Directive'. 

3.11

hand-held apparatus

portable apparatus intended to be supported by one hand during normal use

3.12

hermetically-sealed device

device which is so constructed that the external atmosphere cannot gain access to the interior and in which the seal is made by fusion, for example by soldering, brazing, welding or the fusion of glass to metal

3.13

maximum external capacitance, C_o

maximum capacitance in an energy-limited circuit that can be connected to the connection facilities of the apparatus

3.14

maximum external inductance, L_o

maximum value of inductance in an energy-limited circuit that can be connected to the connection facilities of the apparatus

3.15

maximum input current, I_i

maximum current (peak a.c. or d.c.) that can be safely applied in normal operation to the connection facilities of an energy-limited apparatus

3.16**maximum input power, P_i**

maximum power that can be safely dissipated in normal operation within an energy-limited apparatus

3.17**maximum input voltage, U_i**

maximum voltage (peak a.c. or d.c.) that can be safely applied in normal operation to the connection facilities of an energy-limited apparatus

3.18**maximum internal capacitance, C_i**

total equivalent internal capacitance of the apparatus containing energy-limited circuits which is considered as appearing across the connection facilities of the apparatus in normal operation

3.19**maximum internal inductance, L_i**

total equivalent internal inductance of the apparatus containing energy-limited circuits which is considered as appearing at the connection facilities of the apparatus in normal operation

3.20**maximum output current (I_o)**

maximum current (peak a.c. or d.c.) that can be taken in normal operation, including short circuit at the terminals, from the connection facilities of an apparatus connected to an energy-limited circuit

3.21**maximum output power, P_o**

maximum power that can be taken in normal operation from the connection facilities of an apparatus connected to an energy-limited circuit

3.22**maximum output voltage, U_o**

maximum voltage (peak a.c. or d.c.) that can appear in normal operation, including open circuit conditions, at the connection facilities of an apparatus connected to an energy-limited circuit

3.23**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 energy-limited apparatus without invalidating the energy limitation

3.24**non-incendive component**

components having contacts for making or breaking a specified ignition capable circuit but in which the contacting mechanism is constructed so that the component is not capable of causing ignition of the specified explosive gas atmosphere

NOTE The housing of the non-incendive component is not intended to either exclude the explosive gas atmosphere or contain an explosion.

3.25**non-sparking device**

device constructed to minimize the risk of occurrence of arcs or sparks capable of creating an ignition hazard during conditions of use. Normal use excludes the removal or insertion of components with the circuit energized

3.26

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, for example 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.

3.27

n-pressurization

technique of applying a protective gas to an enclosure in order to prevent the formation of an explosive atmosphere inside the enclosure by maintaining an overpressure against the surrounding atmosphere

NOTE n-pressurization is based on a limited range of techniques selected from those given in IEC 60079-2 which specifies different methods of applying purge and pressurization techniques. It does not apply to circumstances where there is an internal source of release.

3.28

portable apparatus

apparatus intended to be carried by hand

3.29

restricted-breathing enclosure

enclosure that is designed to restrict the entry of gases, vapours and mists

3.30

sealed device

device which is so constructed that it cannot be opened during normal service and is sealed effectively to prevent entry of an external atmosphere

3.31

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 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.

3.32

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 predetermined value. The cell or battery cannot normally receive an addition to the electrolyte

3.33

separation

shortest distance through solid insulating material between two conductive parts

3.34

stopping box

device to prevent the flow of a gas or a liquid between apparatus and a conduit by providing sealing facilities

3.35

type of protection "n"

type of protection applied to electrical apparatus such that, in normal operation and in certain specified abnormal conditions, it is not capable of igniting a surrounding explosive gas atmosphere

NOTE 1 Additionally, the requirements of this standard are intended to ensure that a fault capable of causing ignition is not likely to occur.

NOTE 2 An example of a specified abnormal condition is a luminaire with failed lamp.

3.36

"U" symbol ¹⁾

symbol used (usually as a suffix to a certificate reference) to denote an Ex component

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

3.37

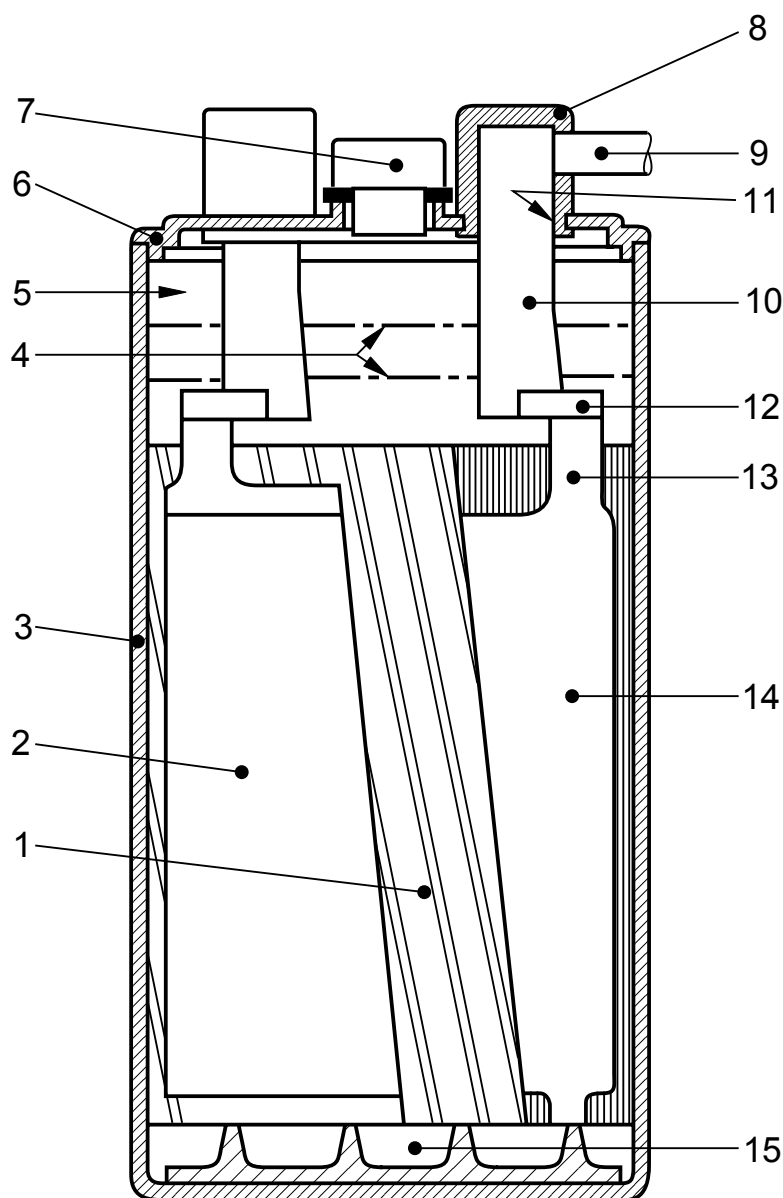
working voltage

highest r.m.s. value of the a.c. or d.c. voltage which may occur (locally) across any insulation at rated supply volts, transients being disregarded, in open circuit conditions or under normal operating conditions

3.38

"X" symbol ¹⁾

symbol used (usually as a suffix to a certificate reference) to denote special conditions for safe use



IEC 087/01

NOTE This sketch is included for descriptive purposes only and is not intended to imply any requirements or preference for a particular form of construction.

Key

- | | |
|-------------------------------|---|
| 1 Separator | 9 Intercell connector |
| 2 Positive plate | 10 Terminal post |
| 3 Cell container | 11 Electrolyte-tight terminal post seal |
| 4 Electrolyte level (max/min) | 12 Group bar |
| 5 Headspace | 13 Plate lug |
| 6 Electrolyte-tight lid seal | 14 Negative plate |
| 7 Filler and vent plug | 15 Slurry space |
| 8 Post encapsulation | |

Figure 1 – Parts of a secondary cell

4 General

4.1 Potential ignition sources

The apparatus shall not in normal operation and in certain abnormal conditions specified by this standard:

- a) produce an operational arc or spark unless that arc or spark is prevented from causing ignition of a surrounding explosive atmosphere by one of the methods described in clauses 17 to 23;
- b) develop a maximum surface temperature in excess of the maximum value appropriate to the temperature class of the apparatus, unless the temperature of the surface or hot spot is prevented from causing ignition of a surrounding explosive atmosphere by one of the methods described in clauses 17 to 23 as appropriate, or is otherwise shown to be safe as specified in 4.3.3.

NOTE Contacts with provision for sliding are considered as sparking in normal operation unless precautions are taken such as clamping of the contact itself to the conductive track.

4.2 Apparatus grouping

Apparatus shall be designated as group II unless specified otherwise in this standard when it shall be designated as one of the following subgroups of group II: IIA, IIB or IIC.

Where electrical apparatus is for use only in a particular gas, it shall be tested accordingly and it shall be marked with the symbol II and the name or chemical formula of the gas (see clause 28).

NOTE For the purpose of this standard, the allocation of gases is as for the apparatus groupings in IEC 60079-0.

4.3 Temperatures

4.3.1 Maximum surface temperature

Subclause 5.1.2 of IEC 60079-0 applies.

The internal parts of enclosed-break devices, restricted-breathing enclosures, hermetically sealed devices, lamps, sealed devices, n-pressurization enclosures (but see 23.3 for qualification) or components or apparatus complying with 4.3.3 need not comply with the requirements for maximum surface temperature.

4.3.2 Ambient temperatures

Subclause 5.2 of IEC 60079-0 applies.

4.3.3 Surface temperature and ignition temperature

Subclause 5.3 of IEC 60079-0 applies, including the reference to IEC 60079-11 for relaxations which may be applicable to type "n" apparatus having small components, thin wires or printed circuit tracks.

4.4 Electrical apparatus

Electrical apparatus with type of protection "n" shall comply with the requirements of this standard.

4.5 Ex components

4.5.1 Ex components with type of protection "n" shall comply with the relevant requirements of this standard and may be:

- a) an empty enclosure;
- b) components or assemblies of components.

4.5.2 Ex components may be mounted:

- a) completely within an apparatus enclosure (for example a terminal, ammeter, lampholder, heater or indicator); or
- b) completely external to the apparatus enclosure (for example an earth terminal); or
- c) partly within and partly external to the apparatus enclosure (for example an indicating lamp or push-button switch).

4.5.3 In the case of mounting completely within the enclosure, additional testing or assessment is only necessary with regard to those aspects of operation or construction of the component which are affected by its mounting within the enclosure (for example, surface temperature, creepage distance and clearance, and other conditions dependent upon mounting when the component is mounted).

4.5.4 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 requirements of this standard.

4.6 Other requirements

Electrical apparatus and Ex components shall be constructed in accordance with the principles of good engineering practice in safety matters.

NOTE 1 If certification is sought, it is not the responsibility of the certifying body or testing station to check compliance with this requirement. The manufacturer should indicate compliance by marking the apparatus or component in accordance with clause 28 and by stating the basis of compliance in the documentation (see clause 29).

NOTE 2 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 have to be specified to the manufacturer by the user. If certification is sought, it is not the responsibility of the certifying body or testing station to 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.

5 Construction

5.1 Degree of protection

5.1.1 Unless specified elsewhere in this standard, the enclosure of the apparatus, when tested in accordance with 26.3.4 shall provide at least the degree of protection described in a) or b) unless safety would not be impaired by contact with solid foreign bodies or water (for example, strain gauges, resistance thermometers, thermocouples) in which case the documentation (see clause 29) shall explain why and shall prescribe any special installation requirements which may be necessary and in which case the apparatus shall be marked with the symbol "X" (see clause 28):

- a) IP54 where there are bare live parts or IP44 where there are insulated live parts;
- b) IP4X where there are bare live parts or IP2X where there are insulated live parts and the apparatus is intended for installation only in locations providing adequate protection against the entry of solid foreign objects or water capable of impairing safety, and the apparatus is marked with the symbol "X" (see clause 28).

For protected apparatus, the degree of protection shall be marked according to clause 28.

NOTE For requirements for rotating electrical machines, see clause 9.

5.1.2 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.

5.1.3 Where the enclosure is completed by the installation of the apparatus the marking shall include the symbol "X" and the manufacturer shall provide relevant information in the documentation in accordance with clause 29.

5.2 Mechanical strength

Enclosures shall be capable of satisfying the criteria for compliance of the impact test given in 26.3.3.1. Hand-held apparatus shall additionally be capable of satisfying the criteria for compliance of the drop test given in 26.3.3.2. Apparatus shall be marked with the symbol "X" when required according to the chosen level of test.

5.3 Guards for light transmitting parts

Every guard provided for the protection of a light-transmitting part shall have a mesh size of up to but not exceeding 50 mm × 50 mm.

5.4 Circulating currents

Precautions shall be taken where necessary to guard against any effect due to the presence of circulating currents caused by stray magnetic fields, for example, arcs or sparks occurring as a result of interrupting such currents, or excessive temperatures caused by such currents.

NOTE 1 Current may flow in any enclosure or in any supporting structure (internal or external to the enclosure) in the presence of stray magnetic fields, if made of conducting materials.

NOTE 2 In order to ensure reliable current transfer without risk of sparking under adverse operating conditions, such as vibration or corrosion, precautions that can be taken include:

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

5.5 Non-metallic enclosures, non-metallic parts of enclosures

5.5.1 Non-metallic materials shall have a temperature index TI corresponding to the 20 000 h point (see IEC 60216-1 and IEC 60216-2) or a continuous operating temperature (COT) of at least 10 K greater than the temperature of the hottest point of the enclosure or part of the enclosure having regard to the maximum ambient temperature in rated service according to data supplied by the material manufacturer.

5.5.2 The enclosure shall be resistant to ageing; this shall be tested in accordance with 26.3.2.1 and 26.3.2.2.

5.5.3 Where the enclosure is expected to be exposed to sunlight, or other source of UV radiation, the materials shall be resistant to light. This shall either be declared in the data provided by the manufacturer or by testing in accordance with 23.4.7.5 of IEC 60079-0. For apparatus where the enclosure does not comply with the requirements, it shall be marked with an "X" and information given in the documentation in accordance with clause 29.

5.5.4 The following requirements apply only to plastic enclosures, to plastic parts on 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.

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 either by suitable selection of the material so that the insulation resistance, measured according to the method given in 23.4.7.8 of IEC 60079-0, does not exceed 1 GΩ at (23 ± 2) °C and (50 ± 5) % relative humidity or, where by selection 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 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.

5.5.5 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 plastic material when the thread form is compatible with the plastic material of the enclosure.

6 Connection facilities and wiring

6.1 General

The contact pressure of electrical connections shall be reliably maintained in normal operation. In particular it shall not be adversely affected by dimensional changes in service (due to temperature, humidity, etc.) of insulating materials.

Non-sparking connections shall be designed to prevent sparking under conditions of vibration.

NOTE 1 Information for vibration tests is given in IEC 60068-2-6 in relation to the conditions of use.

NOTE 2 Connection facilities for luminaires are specified in clause 11.

6.2 Connection for external conductors

6.2.1 Electrical apparatus intended for connection to external circuits, except for electrical apparatus manufactured with a cable permanently connected to it or provided with loose leads, shall include connection facilities. The connection facilities shall effectively be protected against corrosion, and be so designed that the conductors can be connected readily to the terminals and can be clamped without reducing significantly their cross-sectional area, in such a manner that they are gripped and secured against loosening and twisting, and that the contact pressure will be reliably maintained.

For terminals suitable for cable lugs, means shall be provided for preventing accidental non-permissible reduction of clearances.

NOTE 1 For example this may be achieved by the use of insulating barriers at least as high as the terminals or by insulating the shanks of lugs.

Where electrical apparatus is provided with loose leads, sufficient length of loose lead shall be provided to permit more than one reconnection to be made.

NOTE 2 Loose leads are often connected by a means which necessitates removing a short length of the lead each time the connection is severed and remade. The intention is that apparatus should be capable of being connected at least three times, though additional length of lead should be provided if it is known that a particular apparatus may be liable to further connections.

NOTE 3 It is intended that the form of connection used with loose leads, the provision of any necessary insulation and the maintenance of clearances and creepage distances required by clause 7 are the responsibility of the installer of the apparatus.

6.2.2 Connection facilities shall accommodate at least the size of conductor appropriate to the rated current of the equipment.

NOTE System conditions (voltage drop, for example) may make it necessary to provide terminals suitable for larger conductors than are required by thermal considerations.

6.2.3 A facility for the connection of an earthing or equipotential bonding conductor shall be provided near the other connection facilities and inside the terminal compartment of electrical apparatus except where the installation and supply lead conditions specified (for example single-core cable connections) do not require an internal earthing conductor, in which case the connections for the protective conductor may be terminated outside the terminal compartment.

Special precautions shall be taken if one of the parts in contact consists of a material containing light metal.

NOTE One example of a means of connecting to a material containing light metal is to use an intermediate part made from steel.

6.2.4 Earthing or equipotential bonding connection facilities shall allow for the effective connection of at least one conductor with a cross-sectional area as given in table 1.

Table 1 – Minimum cross-sectional area of protective conductors

Cross-sectional area of phase conductors of the installation S	Cross-sectional area of the corresponding protective conductor Sp
mm ²	mm ²
S ≤ 16	S
16 < S ≤ 35	16
S > 35	0,5 S

In addition earthing or equipotential bonding connection facilities on the outside of electrical apparatus, if provided, shall have provision for effective connection of a conductor of at least 4 mm².

6.2.5 Earthing or equipotential bonding connection facilities are not required for electrical apparatus having double or reinforced insulation or for which supplementary earthing is not necessary. Enclosures intended to be earthed by specific forms of installation, such as with earthed metallic conduit systems shall be marked with an "X".

6.2.6 Cable entries and cable entry devices shall:

- a) be constructed and mounted so that they maintain the type of protection and the specific characteristics of the apparatus. This shall apply to the whole range of cable diameters specified by the manufacturer of the cable entries as suitable for use with those cables;
- b) provide for the passage of the cable through the wall of the enclosure without damage to the cable, and for the bonding of any metal armouring, sheath or screen where required. Cable entries shall not have sharp edges capable of damaging the cable;
- c) conform to either:
 - the appropriate standard for industrial cable entries and cable entry devices where such standards exist, or
 - the requirements of IEC 60079-0 for equivalent Ex apparatus, or
 - where necessary, provide clamping of the cable in order to prevent any pulling or twisting applied to it from being transmitted to the connections. Such clamping can be provided by a clamping device, sealing ring or filling compound. The test in 26.4 shall be applied;
- d) additionally, in the case of flexible cables, the point of entry shall include a rounded edge at an angle of at least 75°, the radius R of which is at least equal to one quarter of the diameter of the maximum admissible cable in the entry, but which need not exceed 3 mm (see figure 2).

NOTE The term "cable entry" in this standard includes devices for the entry of cables containing optical fibres into the enclosure. Multi-cable "transits" are also included.

6.2.7 Conduit entries shall be constructed and mounted so that they do not alter the type of protection and the specific characteristics of the electrical apparatus on which they are mounted and shall screw into threaded holes or be locked in plain holes situated as follows:

- a) in the enclosure;
- b) in an adaptor plate designed to be fitted in or on the enclosure;
- c) in a suitable stopping box, integral with or attached to the enclosure.

6.2.8 When the temperature under rated conditions is higher than 70 °C at the cable or conduit entry point, or 80 °C at the branching point of the conductors, the outside of the electrical apparatus shall be marked as a guide for the selection by the user of the cable, or of the wiring in the conduit (see figure 2). In addition, the apparatus shall be marked with the symbol "X".

If a diversity factor is applied, in the case of multiple sources of heat, it shall be stated in the documentation (see clause 29).

6.2.9 In the case of portable apparatus any cable entry shall satisfy the appropriate clamping requirements of B.2.3.1 of IEC 60079-0.