BRITISH STANDARD

**BS 5501-8: 1988**
**EN 50 028: 1987**
*Incorporating Amendment No. 1*

# Electrical apparatus for potentially explosive atmospheres —

## Part 8: Encapsulation "m"

European Standard EN 50 028 has the status of a British Standard.

UDC 621.3-2.13.34:614.838.4:620.1

# Cooperating organizations

The European Committee for Electrotechnical Standardization (CENELEC), under whose supervision this European Standard was prepared, comprises the National Committees of the following countries.

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**Summary of pages**

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 16, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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# EN 50 028

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Key words: Electrical apparatus, potentially explosive atmosphere, explosive atmosphere, explosion protection, specific requirement, encapsulation “m”

English version

# Electrical apparatus for potentially explosive atmospheres Encapsulation “m”

Matériel électrique pour atmosphères explosibles
Encapsulage “m”

Elektrische Betriebsmittel für explosionsgefährdete Bereiche
Vergusskapselung “m”

This European Standard was ratified by CENELEC on 10 September 1986. CENELEC members are bound to comply with the requirements of the CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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**CENELEC**

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

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## Contents

## IEC Publications referred to in European Standard EN 50 028

IEC 44-4 (1980) (1st Edition), *Instrument transformers — Part 4: Measurement of partial discharges.*

IEC 127 (1974) (2nd Edition), *Cartridge fuse-links for miniature fuses.* (HD 109 S3)

IEC 269-1 (1968), *Low voltage fuses — Part 1: General requirements.*

IEC 269-2 (1973), *Low voltage fuses — Part 2: Supplementary requirements for fuses for industrial applications.*

IEC 269-2A (1975) First supplement, *Appendix A Examples of standardized fuses for industrial applications.*

IEC 269-2A (1978), Amendment No. 1.

IEC 269-3 (1973), *Low voltage fuses — Part 3: Supplementary requirements for fuses for domestic and similar applications.*

IEC 269-3 (1978), Amendment No. 1.

IEC 269-3A (1978), First supplement. *Appendix A Examples of standardized fuses for domestic and similar applications.*

IEC 269-4 (1980), *Low voltage fuses — Part 4: Supplementary requirements for fuse links for the protection of semi-conductor devices.*

## European Standards referred to in European Standard EN 50 028

EN 50 014 (1977) (1st edition), *Electrical apparatus for potentially, explosive atmospheres — General requirements* [including Amendment 1 (July 1979), Amendment 2 (June 1982), Amendment 3 (December 1982), Amendment 4 (December 1982) and Amendment 5 (February 1986)].

EN 50 019 (1977) (1st edition), *Electrical apparatus for potentially explosive atmospheres — Increased safety "e"* [including Amendment 1 (July 1979), Amendment 2 (September 1983) and Amendment 3 (December 1985)].

EN 50 020 (1977) (1st edition), *Electrical apparatus for potentially explosive atmospheres — Intrinsic safety "i"* [including Amendment 1 (July 1979) and Amendment 2 (December 1985)].

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## Section 1. General

## 1 Object and field of application

**1.1** This European Standard contains the specific requirements for construction and testing of electrical apparatus, parts of electrical apparatus and Ex components in the type of protection encapsulation "m", intended for use in potentially explosive atmospheres.

**1.2** This European Standard applies to electrical apparatus, parts of electrical apparatus and Ex components which have rated voltages not exceeding 11 kV.

**1.3** This European Standard supplements European Standard EN 50 014 "General requirements", with the following exceptions.

| **Clauses of European Standard EN 50 014 which are not applicable** | |
|---|---|
| **4.1** | Maximum surface temperature (for Ex components) |
| **5.2** | Time delay before opening an enclosure |
| **6.1** | Definition of the enclosure material |
| **6.2** (first paragraph) | Temperature index TI |
| **6.4** | Threaded holes in enclosures of plastic material |
| **8** | Fasteners |
| **9** | Interlocking devices |
| **15** | Cable and conduit entries |
| **17** | Switchgear |
| **18** | Fuses |
| **20.2** | Warning label for luminaires |
| **22.4.3.1** | Impact tests (for Ex components) |
| **22.4.4** | Tests for degree of protection for enclosures |
| **22.4.8** | Tests in explosive mixtures |
| **22.4.9** | Tests of clamping of non-armoured cables in cable entries |
| **22.4.10** | Tests of clamping of armoured cables in cable entries |

## 2 Definitions

The following definitions specific to type of protection encapsulation "m" are applicable to this European Standard; they supplement the definitions which are given in European Standard EN 50 014 "General requirements".

**2.1**
**encapsulation "m"**

a type of protection in which the parts which could ignite an explosive atmosphere by either sparking or heating are enclosed in a compound in such a way that this explosive atmosphere cannot be ignited

**2.2**
**compounds**

thermosetting, thermoplastic and elastomeric materials with or without fillers and/or additives, are considered after their solidification to be compounds

**2.3**
**temperature range of the compound**

the range of temperatures within which the properties of the compound, in either operation or storage, permit the compliance with the requirements of this European Standard

**2.4**
**continuous operating temperature of the compound**

the maximum temperature to which the compound can be subjected continuously according to the data given by the manufacturer of the compound

**2.5**
**encapsulation**

the process of applying the compound to enclose electrical device(s) by suitable means such as embedding or potting

**2.6**
**embedding**

the process of completely encasing electrical device(s) by pouring a compound over it in a mould, and removing the enclosed device from the mould after solidification of the compound

**2.7**
**potting**

an embedding process in which the mould remains attached to the encased electrical device(s)

## Section 2. Requirements for compounds and construction

## 3 Requirements for compounds

**3.1** The documents presented by the manufacturer and verified by the testing station in accordance with **22.2** of European Standard EN 50 014 "General requirements" shall describe precisely the compound(s) used as well as the production method during encapsulation.

**3.2** The description shall include:

the name and address of the manufacturer of the material;

the exact and complete reference of the material, its colour as well as the kind and percentage of fillers and other additives, when they are included;

NOTE An ISO designation should be used where possible

surface treatments, such as varnishes etc., where they are used;

the temperature range of the compound(s);

the continuous operating temperature of the compound.

**3.3** The testing station is not required to verify compliance of the material with its description.

## 4 Constructional requirements

### 4.1 General

**4.1.1** The choice of the compound(s) to be used for a specific application is dependent on the task each compound has to perform. Only the properties of the compound(s) on which the type of protection "m" depends shall be taken into account.

The requirements of **6.3** (Electrostatic charges of enclosures of plastics material) of European Standard EN 50 014 apply to the surface of the compound in encapsulated electrical apparatus or encapsulated parts of electrical apparatus or encapsulated Ex components when such a surface is freely exposed to the environment.

The requirements of **6.3** of European Standard EN 50 014 do not apply when encapsulated parts of electrical apparatus or encapsulated Ex components are designed to be mounted within an additional enclosure.

**4.1.2** The encapsulation shall be made without voids, but it is permitted to encapsulate components (relays, transistors, etc.) with internal voids up to 100 $cm^3$. The thickness of compound between such components shall be at least 3 mm; where the void is less than 1 $cm^3$ the thickness of the compound may be reduced to 1 mm.

Switching contacts shall have an additional housing before encapsulation. If the rated contact current exceeds 6 A, the additional housing shall be inorganic.

**4.1.3** Encapsulated electrical apparatus, encapsulated parts of electrical apparatus, or encapsulated Ex components designed to be connected to an external source of supply shall be suitable for a prospective short circuit current of 4 000 A unless the marking includes the value of the permitted prospective short circuit current.

**4.1.4** The type of protection encapsulation "m" shall be maintained even in the case of recognized overloads and any single internal electrical fault which could cause either an overvoltage or overcurrent, for example:

short circuit of any component;

open circuit due to any component failure;

fault in the printed circuitry;

etc.

NOTE If a fault can lead to one or more subsequent faults, e.g. overrating of a component, the primary and subsequent faults are considered to be a single fault.
Components as specified in **4.1.5** of this European Standard are considered as not subject to fault.
Distances as specified in **4.3** of this European Standard are considered as not subject to fault.
For criteria of acceptance see **6.2.1.3** of this European Standard.

**4.1.5** The following components shall be considered as not subject to fault when encapsulated in accordance with this European Standard:

film type resistors;

wire resistors with single layer in helical form;

coils with single layer in helical form;

plastic foil capacitors;

paper capacitors;

ceramic capacitors

when they are used at no more than 2/3 of their rated voltage and power as specified by the manufacturer of the respective components.

optocouplers designed for segregation of different circuits, when:

a) the sum $U$ of the r.m.s, values of the voltages of the two circuits is not more than 1 000 V and

b) the rated voltage of the optocouplers determined in accordance with **6.2.4** of this European Standard is at least 1,5 times $U$.

transformers, coils and motor-windings, which comply with European Standard EN 50 019 "Increased safety "e"" including those that use wire sizes less than 0,25 mm diameter and which are also protected against inadmissible internal temperatures;

transformers which comply with **7.1** of European Standard EN 50 020 "Intrinsic safety "i"" except those of type 2(a) of **7.1.2**.

**4.1.6** The fixing of the encapsulated electrical apparatus, encapsulated parts of electrical equipment or encapsulated Ex component shall not affect the type of protection encapsulation "m".

### 4.2 Thickness of the layer of compound

**4.2.1** The thickness of the compound between the free surface of the compound and the components/conductors in the encapsulation shall be at least 3 mm.

However, for very small encapsulated electrical apparatus, encapsulated parts of electrical apparatus or encapsulated Ex components having no free surface exceeding 2 $cm^2$, a thickness of at least 1 mm is allowed. If in this case the impact test according to European Standard EN 50 014 "General requirements" or the electric strength test of **6.2.4** of this European Standard cannot be passed on the encapsulated electrical apparatus or encapsulated parts of electrical apparatus, the testing station shall issue a certificate having the sign "x" and requiring other means of protection, e.g. an additional mechanical protection.

**4.2.2** Where the encapsulated electrical apparatus, encapsulated parts of the electrical apparatus or the encapsulated Ex component includes a metal protective housing (potting), the thickness of the layer between the housing and any component or conductor shall be at least 1 mm.

However, for rotating machines with windings in slots, the slot insulation shall have a minimum thickness of 0,2 mm and shall be elongated at the end of the slot by at least 5 mm and shall be protected by the required minimum thickness of compound in accordance with **4.2.1** of this European Standard.

**4.2.3** Where the encapsulated electrical apparatus, encapsulated parts of the electrical apparatus or the encapsulated Ex component includes a protective housing made of insulating material (potting), no minimum thickness of the layer between the housing and any component or conductor is required if the thickness of the protective housing is at least 1 mm; if this thickness is less than 1 mm, the sum of the thickness of housing and compound layer shall comply with **4.2.1** of this European Standard.

The insulating material of the protective housing shall satisfy the requirements of this European Standard.

### 4.3 Distances through the compound

It is not necessary to consider the possibility of a fault occurring as described in **4.1.4** of this European Standard if the distances between bare live parts, mechanically fixed in relation to each other before encapsulating,

of the same circuit;

of a circuit and earthed metallic parts;

of two separate circuits;

are at least equal to the values of Table 1.

**Table 1 — Minimum distances through the compound**

| Rated voltage for the insulation | Minimum distance |
|---|---|
| V r.m.s. | mm |
| 380 | 1 |
| 500 | 1,5 |
| 660 | 2 |
| 1 000 | 2,5 |
| 1 500 | 4 |
| 3 000 | 7 |
| 6 000 | 12 |
| 10 000 | 20 |

NOTE The rated voltage may exceed the values stated in the table by 10 %.

### 4.4 Temperature limitation

Neither the certified maximum surface temperature nor the continuous operating temperature of the compound shall be exceeded in normal service.

The encapsulated electrical apparatus, encapsulated parts of electrical apparatus or encapsulated Ex component shall be protected so that under electrical fault conditions in accordance with **4.1.3** and **4.1.4** of this European Standard, the type of protection encapsulation "m" is not affected.

This may be achieved by a non self-resetting internal or external, electrical or thermal, protecting device.

NOTE The encapsulated electrical apparatus, encapsulated parts of electrical apparatus or the encapsulated Ex component may contain additionally a self-resetting protecting device.

### 4.5 External connections

**4.5.1** Contrary to **14.1** of the European Standard EN 50 014 "General requirements", non portable encapsulated electrical apparatus of Group I may have a permanently connected cable.

**4.5.2** The entrance of all electrical conductors including cables into the compound shall be achieved in such a way as to ensure a seal against the possible entry of explosive atmosphere into the encapsulated electrical apparatus, encapsulated parts of electrical apparatus or encapsulated Ex components. This can be obtained by having at least 5 mm bare electrical conductor within the compound.

**4.5.3** In the case where connection is made by cable permanently connected to the encapsulated electrical apparatus or encapsulated parts of electrical apparatus, the pull test in accordance with **6.2.3** of this European Standard shall be carried out.

### 4.6 Protection of bare live parts

Bare live parts which pass through the surface of the compound shall be protected by one of the types of protection listed in **1.1** of European Standard EN 50 014 "General requirements".

### 4.7 Adhesion

Where parts are not completely embedded in the compound, e.g. a printed circuit board partly encapsulated, the adhesion of the compound to such parts shall be assured by the use of a procedure specified by the manufacturer of the assembly, such as casting, glueing and/or varnishing procedures, preceded by an etching of this surface if necessary, in such a way that no moisture can enter between the compound and the parts.

No visible separation shall be detectable after the tests of **6.2.1** of this European Standard.

### 4.8 Primary and secondary cells, batteries and accumulators

Only cells, batteries and accumulators which in normal use under the specified conditions given by their manufacturer do not release gas, do not release electrolyte or do not produce excessive temperature rise, may be encapsulated.

The encapsulated electrical apparatus, encapsulated parts of electrical apparatus or encapsulated Ex components shall be so constructed as to allow a venting of gas to the outside atmosphere, unless precautions acceptable to the testing station are applied to avoid gas release or cell deformation affecting the type of protection encapsulation "m".

When encapsulating cells, batteries or accumulators in compound, it is necessary to consider the expansion tolerances, e.g. by the application of flexible elastomer around the cell, battery or accumulator so that no undue pressure can be applied to the compound.

Where the charging device is not within the same enclosure the certificate shall indicate the required charging conditions and the apparatus shall be marked X in accordance with **26.2.9** of the European Standard EN 50 014 "General requirements".

Tests according to **6.2.5** of this European Standard shall be passed successfully.

### 4.9 Fuses

The fusing element shall be of the enclosed type before encapsulation, e.g. in glass or ceramic.

For voltages above 60 V, fuses shall have a breaking capacity in accordance with IEC Publication 127 or 269.

The maximum temperature caused by the rupturing of the fuse may exceed the continuous operating temperature of the compound on condition that the type of protection encapsulation "m" is not affected, e.g. by cracks. However, the surface temperature of the encapsulated electrical apparatus or encapsulated parts of electrical apparatus shall not exceed the certified temperature or temperature class.

## Section 3. Verification and tests

## 5 General

**5.1** For the type of protection encapsulation "m" the requirements of European Standard EN 50 014 "General requirements" concerning verification and tests are supplemented by the requirements of section 3 of this European Standard.

The requirements given in **22.4.7** of European Standard EN 50 014 for non-metallic enclosures and non-metallic parts of enclosures, apply to the surface of encapsulated electrical apparatus, encapsulated parts of electrical apparatus and encapsulated Ex components, when the surface is freely exposed to the environment.

**5.2** In the case where encapsulated parts of electrical apparatus or encapsulated Ex components are not freely exposed to the environment, e.g. when mounted in an additional enclosure, **22.4.7.5** (Resistance to light), **22.4.7.6** (Resistance to chemical agent for Group I electrical apparatus), **22.4.7.7** (Mechanical tests) and **22.4.7.8** (Insulation resistance test) of

European Standard EN 50 014 “General requirements” shall not be applied.

**5.3** After carrying out the procedures of **22.4.7** of European Standard EN 50 014 “General requirements”, only one of the two samples used in each test series shall be chosen by the testing station and submitted to the additional relevant tests in **6.2** of this European Standard (see annex B to this European Standard for guidance on the order of type tests).

## 6 Type tests

### 6.1 Tests for compounds

#### 6.1.1 *Electric strength test*

A disk of compound 50 mm ± 2 mm in diameter and 3 mm ± 0,2 mm thick shall be tested with a voltage of 4 kV and with a frequency between 48 Hz and 62 Hz, between electrodes of 30 mm ± 2 mm diameter placed at the centre of the disk. The voltage shall be applied for at least 5 minutes at the highest temperature of the temperature range defined in **2.3** of this European Standard.

No flashover or breakdown shall occur during this test.

#### 6.1.2 *Water absorption test*

This test shall be carried out only on samples of the compound(s) which are intended to be used in a moist environment during the operation of the encapsulated electrical apparatus.

Three dry samples of this (these) compound(s), of 50 mm ± 2 mm diameter and 3 mm ± 0,2 mm thick, are weighed. They are then immersed for 24 h in tap water at a temperature of 23 °C ± 2 K. They are then taken out of the water, wiped off and weighed again.

The increase in mass shall not exceed 1 %.

### 6.2 Tests for encapsulated electrical apparatus, encapsulated parts of electrical apparatus and encapsulated Ex components

#### 6.2.1 *Thermal tests*

##### 6.2.1.1 *Maximum temperatures*

A sample of encapsulated electrical apparatus, encapsulated part of electrical apparatus or encapsulated Ex component shall be subjected to a type test to ensure that:

- the temperature limits defined in **4.4** of this European Standard are not exceeded in normal service;
- the maximum surface temperature is not exceeded under fault conditions defined in **4.1.4** of this European Standard.

For the encapsulated apparatus, encapsulated parts of electrical apparatus and encapsulated Ex components without external load, the test shall be carried out as defined in **22.4.6.1** of European Standard EN 50 014 “General requirements” but with supply voltages of $U_n$ + 10 % and $U_n$ – 10 %.

For the encapsulated electrical apparatus, encapsulated parts of electrical apparatus and encapsulated Ex components with external load, the test shall be carried out by adjusting the current to the highest value which does not cause the protecting device to operate.

The final temperature is considered to be reached when its rate of rise does not exceed 2 K/h.

NOTE The protection device may for example be a fuse complying with IEC 127 and the test current may be $1{,}7/_n$.

##### 6.2.1.2 *Thermal cycling test*

The sample shall be fitted with one or more temperature sensors placed in the compound at places judged by the testing station to be the hottest. If the sample contains windings, the temperature may be measured by a change of electrical resistance of these windings.

The following test procedure is also shown diagrammatically in annex A.

The electrical power shall be switched off from the sample and the sample shall be completely at room temperature of 21 °C ± 2 K. It is then brought into an environment of ($T_{Amax}$ + 10) °C ± 2 K, where $T_{Amax}$ is the specified maximum ambient temperature in service. It is considered that the temperature of the sample has stabilized when the difference between the temperatures inside and outside the sample is less than 2 K. After the sample has reached the stabilized temperature of ($T_{Amax}$ + 10) °C ± 2 K, it is energized within a range 90 % to 110 % of the rated voltage, at a voltage which gives the most unfavourable condition unless:

- other European Standards or CENELEC harmonization documents prescribe other tolerances or overloads for equivalent industrial apparatus; or
- the sample has internal thermal protective device(s). In this case the sample need only be energized by using the voltage which produces a temperature level that just does not cause the non self-resetting thermal protective device to operate.

NOTE Internal thermal protective devices may be bridged by the testing station for test purposes.

The internal temperature change is observed until a stable temperature distribution is reached. It is assumed that this is the case when the gradient of the internal temperature has become less than 2 K/h. The minimum duration of energizing is one hour.

The internal temperature shall not exceed the specified continuous operating temperature of the compound (see **2.4** and **4.4** of this European Standard).

The sample is de-energized, removed from the ($T_{Amax}$ + 10) °C environment and allowed to cool to the room temperature. The 2 K temperature differential between the inside and outside of the sample is again taken as the criterion of having reached room temperature.

The sample is now brought into an environment of ($T_{Amin}$ – 5) °C ± 2 K where $T_{Amin}$ is the specified minimum ambient temperature.

It is considered that the temperature of the sample has stabilized when the difference between the temperatures inside and outside the sample is less than 2 K.

After the sample has reached the stabilized temperature of ($T_{Amin}$ – 5) °C ± 2 K, it is again energized within a range of 90 % to 110 % of the rated voltage, at a voltage which gives the most unfavourable condition of the electrical apparatus unless other European Standard or CENELEC harmonization documents prescribe other tolerances or overloads for equivalent industrial apparatus.

The internal temperature change is observed until a stable temperature distribution is reached. It is assumed that this is the case when the gradient of the internal temperature has become less than 2 K/h. The minimum duration of energizing is half an hour.

The same sample is then de-energized and allowed to cool to ($T_{Amin}$ – 5) °C ± 2 K. The minimum duration for cooling is half an hour unless the 2 K temperature differential criterion requires a longer time.

The power is again switched on and the energizing and de-energizing cycle repeated. In all, three complete cycles are to be carried out before the sample is removed from the ($T_{Amin}$ – 5) °C environment and allowed to reheat at room temperature.

**6.2.1.3** *Acceptance criteria*

After the thermal tests the sample shall be subjected to visual inspection; no visible damage of the compound that could impair the type of protection shall be evident, such as cracks in the compound, exposure of encapsulated parts, flaking, impermissible shrinkage, discoloration, swelling, decomposition, or softening. In addition, the compound shall not show evidence of overheating.

**6.2.2** ***Mechanical tests***

The mechanical tests in accordance with **22.4.3** of European Standard EN 50 014 "General requirements" shall not be made on encapsulated electrical apparatus, encapsulated parts of electrical apparatus or encapsulated Ex components designed to be used only inside an enclosure which can withstand such tests.

In such a case the testing station shall issue:

either a certificate for the electrical apparatus having the sign "X" and requiring an additional enclosure;

or a certificate for an Ex component having the sign "U".

**6.2.3** ***Cable pull test***

This test shall not be carried out on Ex components.

The test required in **4.5.3** of this European Standard shall be carried out in the following way.

A tensile force corresponding to a value in newtons equal to:

either 20 times the value in millimetres of the diameter of the cable;

or 5 times the mass of the encapsulated electrical apparatus;

whichever is the smaller value but at least 1 N shall be applied on the cable in the direction of the cable entrance into the compound for a duration of one hour.

No visible displacement between the compound and the cable shall be observed.

**6.2.4** ***Electric strength tests***

The electric strength tests shall be carried out as follows:

*a)* between galvanically separated circuits;

*b)* between each circuit and all the earthed parts;

*c)* between each circuit and the surface of the encapsulation, which may be clad if necessary, with a conductive foil.

The test voltage shall be $2U$ + 1 000 V with a minimum of 1 500 V a.c., 48 Hz to 62 Hz or d.c. voltage equal to the a.c. peak voltage where an a.c. test voltage would damage the electronic parts within the compound. $U$ shall be taken as:

for *a)*, the sum of the rated voltages of the two circuits being tested,

for *b)* and *c)*, the rated voltage of the circuit being tested.

The test voltage shall be increased steadily to the specified value in a period not less than 10 s, and then maintained for at least 60 s. No flashover or breakdown shall occur.

NOTE Additional tests may be necessary on high voltage equipment to verify that partial discharge within the compound and corona effects do not affect the insulation properties of the compound.

**6.2.5** ***Tests for encapsulated primary and secondary cells, batteries and accumulators***

The sample shall be fitted with one or more internal temperature sensors as described in **6.2.1** of this European Standard.

**6.2.5.1** *Discharge test*

The sample shall be placed in an environment of $T_{Amax}$ °C ± 2 K where $T_{Amax}$ is the specified maximum ambient temperature. The 2 K temperature differential criterion is used as described in **6.2.1** of this European Standard.

The discharge test shall be carried out in such a manner that the fully charged encapsulated cell, battery or accumulator is completely discharged by an appropriate external load according to one of the following cases:

1 mΩ when the encapsulated electrical apparatus, encapsulated parts of electrical apparatus or encapsulated Ex components contain a current limiting resistor or electronic device;

a value adjusted in such a way that the current flowing is equal to 1,7 times the rated current of any encapsulated fuse;

a value that will just not cause any encapsulated thermal protection device to operate.

If the load is encapsulated with the cell, battery or accumulator or is fixed to the sample it shall be considered as short circuited unless the load is not subject to fault (see **4.1.5** of this European Standard).

The maximum temperatures of cells, batteries or accumulators and of the surface of the compound shall be measured to ensure that the requirements of **4.4** of this European Standard are satisfied.

The acceptance criteria are those defined in **6.2.1.3** of this European Standard.

**6.2.5.2** *Electric strength test*

The electric strength test of **6.2.4** of this European Standard shall be carried out only if the encapsulated cells, batteries or accumulators are to be used not as a sole source of power but in conjunction with other sources of power and galvanically connected to them.

## 7 Routine tests

### 7.1 Visual check

The encapsulated electrical apparatus, encapsulated parts of electrical apparatus or encapsulated Ex components shall be subjected to visual inspection. No visible damage of the compound shall be evident, such as cracks, exposure of the encapsulated parts, flaking, impermissible shrinkage, discoloration, swelling, decomposition or softening.

### 7.2 Electric strength test

The electric strength test shall be carried out applying the conditions stated in **6.2.4** as follows:

between separate circuits accessible from the outside;

between all circuits accessible from the outside connected together and all external metal parts connected together;

between every circuit which is accessible from the outside having an operating voltage of more than 60 V and every part accessible from the outside close to this circuit.

### 7.3 Checking the electrical data

The electrical data shall be checked by measurement of voltage, current and active power.

### 7.4 Voltage transformers

In the case of voltage transformers having voltages above 1 kV, the loss angle shall be measured in accordance with the method for the measurement of partial discharges defined in IEC Publication 44-4.

# Section 4. Marking

## 8 Marking

### 8.1 Marking of electrical apparatus

The encapsulated electrical apparatus and encapsulated parts of electrical apparatus shall carry at least the minimum marking described in the European Standard EN 50 014 “General requirements”.

The supplementary marking specific to the type of protection, encapsulation “m” prescribed in **26,2** (10) of the European Standard EN 50 014 “General requirements” is as follows:

**8.1.1** The sign of the type of protection: “m”.

NOTE This sign will be transferred in due course to the European Standard EN 50 014 “General requirements”.

**8.1.2** Input and output electrical data, e.g. voltage, current, etc.

**8.1.3** External fuse data, insofar as it is necessary.

**8.1.4** Permitted prospective short circuit current of the external electric supply source if different from 4 000 A (see **4.1.3** of this European Standard).

**8.2 Marking of Ex components**

Encapsulated Ex components shall carry at least the minimum marking prescribed in the European Standard EN 50 014 “General requirements”.

The supplementary marking specific to the type of protection, encapsulation “m”, prescribed in **26.5** (8) of European Standard EN 50 014 “General requirements” is as follows:

**8.2.1** The sign of the type of protection “m”.

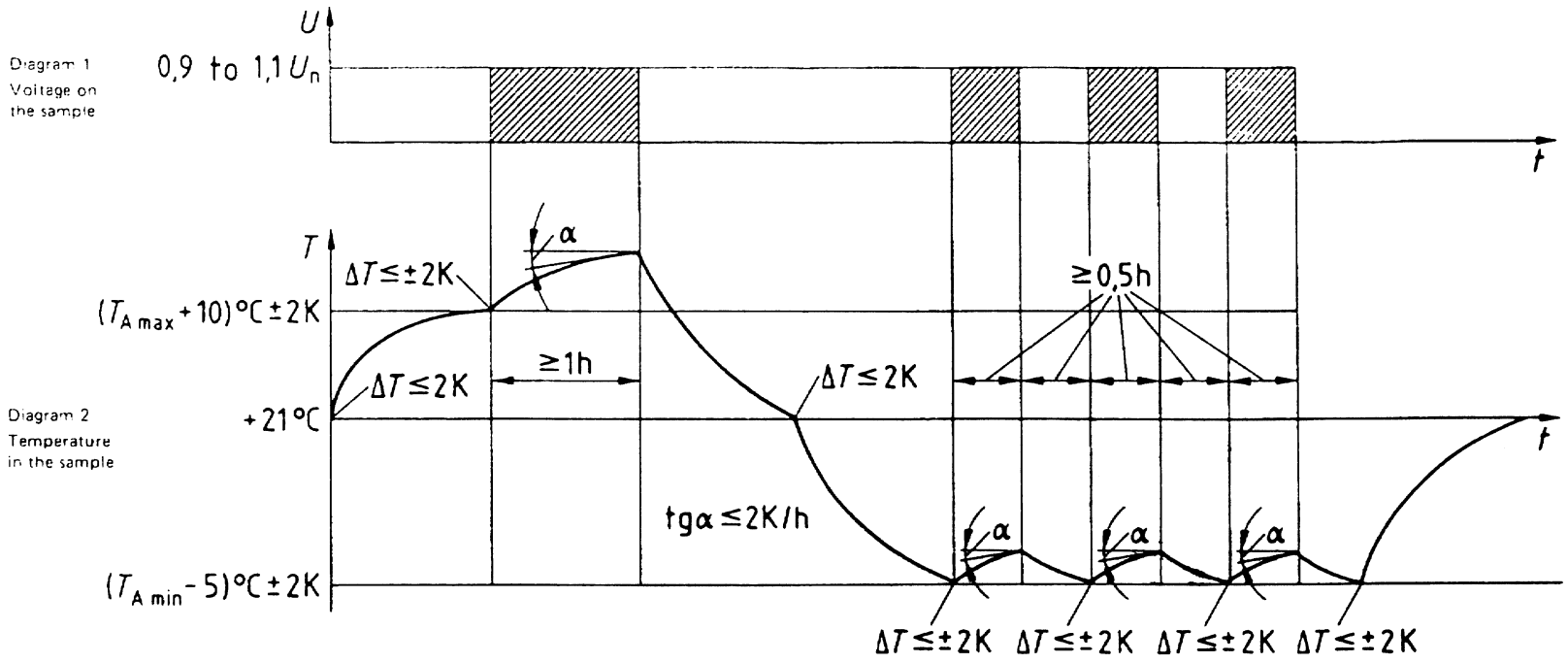
NOTE This sign will be transferred in due course to the European Standard EN 50 014 “General requirements”.

**8.2.2** Input and output electrical data, e.g. voltage, current, etc.

**8.2.3** External fuse data, insofar as it is necessary.

**8.2.4** Permitted prospective short circuit current of the external electric supply source if different from 4 000 A (see **4.1.3** of this European Standard).

# Annex A Test procedure during thermal cycling test according to 6.2.1.2




$T_{Amax}$ : Specified maximum ambient temperature in service
$T_{Amin}$ : Specified minimum ambient temperature in service
$U_n$ : Rated voltage
tgα : Temperature gradient
$\Delta T$ : Temperature difference between the inside and outside of the sample

## Annex B (Supplementary information)

### Order of type tests

**B.1** Tests for compounds should be carried out on separate test pieces and no order is required.

The tests are:

Electric strength test: **6.1.1** of EN 50 028

Water absorption test: **6.1.2** (if applicable) of EN 50 028

If the compound forms a surface which is freely exposed to the environment (e.g. can be touched in service by the user) the following tests should also be carried out:

Insulation resistance: **22.4.7.8** of EN 50 014 (Amendment 3)

Resistance to light: **22.4.7.5** of EN 50 014 (Amendment 3)

**B.2** Tests for encapsulated electrical apparatus, encapsulated parts of electrical apparatus or encapsulated Ex components should be carried out in the following order:

1) Maximum temperatures: **6.2.1.1** and **6.2.5** (if applicable) of EN 50 028

2) Thermal endurance to heat: **22.4.7.3** of EN 50 014 (Amendment 3)

3) Thermal endurance to cold: **22.4.7.4** of EN 50 014 (Amendment 3)

4) Thermal cycling: **6.2.1.2** of EN 50 028

5) Electric strength: **6.2.4** of EN 50 028

If the compound forms a surface which is freely exposed to the environment (e.g. can be touched in service by the user) the tests are continued as follows:

6) Resistance to chemical attack (Group I only): **22.4.7.6** of EN 50 014 (Amendment 3)

7) Mechanical tests: **22.4.7.7** of EN 50 014 (Amendment 3)

8) Cable pull test: **6.2.3** of EN 50 028

NOTE 1 If the internal components are damaged during tests 2 and 3, a separate sample should be used for test 4.

NOTE 2 Tests 2 and 3 should be made in non-energized condition.

NOTE 3 Tests 6 and 8 are carried out if relevant.

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## National appendix A

The United Kingdom participation in the preparation of this European Standard was entrusted by the General Electrotechnical Engineering Standards Committee (GEL/-) to Technical Committee GEL/114, upon which the following bodies were represented:

Association of British Mining Equipment Companies
Association of Consulting Engineers
BEAMA Ltd.
British Coal Corporation
British Electrical Systems Association (BEAMA Ltd)
British Gas Plc
British Industrial Truck Association
Chief and Assistant Chief Fire Officers Association
Civil Aviation Authority (Airworthiness Division)
Council for Electrical Equipment for Flammable Atmospheres (Beama)
Department of Transport — Marine Directorate
ERA Technology Ltd
Energy Industries Council
Engineering Equipment and Materials Users Association
Fire Offices Committee
GAMBICA (BEAMA Ltd)
Gland Manufacturers Technical Committee
Health and Safety Executive
Lighting Industry Federation Ltd
Ministry of Defence
Sira Limited
Trades Union Congress
United Kingdom Offshore Operators Association

## National appendix B

The British Standards corresponding to the European Standards, CENELEC Harmonization Document and IEC International Standards listed immediately prior to clause **1**, Scope, are as follows:

| **European Standard** | **British Standard** (titles and content identical) |
|---|---|
| | EN 50 014:1977BS 5501-1:1977<br>*Electrical apparatus for potentially explosive atmospheres*<br>Part 1: *General requirements* |
| | EN 50 019:1977BS 5501-6:1977<br>*Electrical apparatus for potentially explosive atmospheres*<br>Part 6: *Increased safety "e"* |
| | EN 50 020:1977BS 5501-7:1977<br>*Electrical apparatus for potentially explosive atmospheres*<br>Part 7: *Intrinsic safety "i"* |

| **CENELEC Harmonization Document** | **British Standard** |
|---|---|
| CENELEC HD 109 S3 | BS 4265:1977 (1984)<br>*Specification for cartridge fuse links for miniature fuses* |
| **IEC International Standard** | **British Standard** |
| IEC 44-4:1980 | BS 6184:1981<br>*Method for measuring partial discharges in instrument transformers* (Identical) |
| IEC 127:1974 | BS 4265:1977 (1984)<br>*Specification for cartridge fuse links for miniature fuses* (Identical) |

NOTE There are no British Standard equivalents for IEC 269-1:1968, IEC 269-2:1973, IEC 269-2A:1975, IEC 269-3:1973, IEC 269-3A:1978 and IEC 269-4:1980. The technical committee has reviewed their provisions and has decided that they are acceptable for use in conjunction with this standard.

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