

Electrical apparatus for explosive gas atmospheres —

Part 18: Construction, test and marking of type of protection encapsulation “m” electrical apparatus

The European Standard EN 60079-18:2004 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN 60079-18:2004, incorporating Corrigendum April 2006. It is identical with IEC 60079-18:2004. It supersedes BS 5501-8:1988 which remains current as obsolescent but will be withdrawn no later than 1 April 2007.

The UK participation in its preparation was entrusted to Technical Committee GEL/31, Electrical apparatus for use in explosive atmospheres, which has the responsibility to:

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**Electrical apparatus for explosive gas atmospheres
Part 18: Construction, test and marking of type of protection
encapsulation "m" electrical apparatus
(IEC 60079-18:2004)**

Matériel électrique pour atmosphères
explosives gazeuses
Partie 18: Construction, essais
et marquage des matériels électriques
du type de protection par encapsulage "m"
(CEI 60079-18:2004)

Elektrische Betriebsmittel für
gasexplosionsgefährdete Bereiche
Teil 18: Konstruktion, Prüfung und
Kennzeichnung elektrischer Betriebsmittel
mit der Schutzart Vergusskapselung "m"
(IEC 60079-18:2004)

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Foreword

The text of document 31/482/FDIS, future edition 2 of IEC 60079-18, 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 60079-18 on 2004-04-01.

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The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2007-04-01

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

Annexes ZA and ZZ have been added by CENELEC.

The contents of the corrigendum of April 2006 have been included in this copy.

Endorsement notice

The text of the International Standard IEC 60079-18:2004 was approved by CENELEC as a European Standard without any modification.

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ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES –

Part 18: Construction, test and marking of type of protection encapsulation “m” electrical apparatus

1 Scope

This part of IEC 60079 gives the specific requirements for the construction, testing and marking of electrical apparatus, parts of electrical apparatus and Ex components with the type of protection encapsulation “m”.

This part of IEC 60079 only applies for encapsulated electrical apparatus, encapsulated parts of electrical apparatus and encapsulated Ex components (hereinafter always referred to as “m” apparatus) where the rated voltage does not exceed 10 kV with a relative tolerance of +10 %.

This standard supplements the general requirements in IEC 60079-0.

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

IEC 60079-7:2001, *Electrical apparatus for explosive gas atmospheres – Part 7: Increased safety “e”*

IEC 60079-11:1999, *Electrical apparatus for explosive gas atmospheres – Part 11: Intrinsic safety “i”*

IEC 60079-26:—, *Electrical apparatus for explosive gas atmospheres – Part 26: Construction, test and marking of Group II Zone 0 electrical apparatus*

IEC 60086-1, *Primary batteries – Part 1: General*

IEC 60127 (all parts), *Miniature fuses*

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

IEC 60622, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-cadmium prismatic rechargeable single cells*

IEC 60664-1:1992, *Insulation co-ordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*
Amendment 1 (2000)
Amendment 2 (2002)

IEC 60691, *Thermal links – Requirements and application guide*

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

IEC 61558-2-6, *Safety of power transformers, power supply units and similar – Part 2: Particular requirements for safety isolating transformers for general use*

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

IEC 61951-2, *Secondary cells and batteries containing alkaline and other non-acid electrolytes – Portable sealed rechargeable single cells – Part 2: Nickel-metal hydride*

IEC 61960-1, *Secondary lithium cells and batteries for portable applications – Part 1: Secondary lithium cells*

IEC 62326-4-1, *Printed boards – Part 4: Rigid multilayer printed boards with interlayer connections – Sectional specification – Section 1: Capability detail specification – Performance levels A, B and C*

ISO 62, *Plastics – Determination of water absorption*

ANSI/UL 248-1, *Standard for low-voltage fuses – Part 1: General requirements*

3 Definitions

For the purposes of this document, the terms and definitions given in IEC 60079-0 and the following definitions specific to encapsulation “m” apply.

3.1

encapsulation “m”

type of protection whereby parts that are capable of igniting an explosive atmosphere by either sparking or heating are enclosed in a compound in such a way that the explosive atmosphere cannot be ignited under operating or installation conditions

3.2

compounds

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

3.3

temperature range of the compound

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

3.4

continuous operating temperature (COT) of the compound

temperature within which, according to the details given by the manufacturer, the properties of the compound, during operation, satisfy the requirements of this standard on a permanent basis during the foreseen lifetime of the apparatus

3.5

encapsulation

process of applying the compound to enclose any electrical device(s) by suitable means

3.6

free surface

compound surface exposed to the explosive atmospheres

3.7

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 specifications within stated limits and any other operational tolerance is part of normal operation.

3.8

void

unintentional space created as a consequence of the encapsulation process

3.9

free space

intentionally created space surrounding components or space inside components

3.10

switching contact

mechanical contact which is intended for making and breaking of an electrical circuit

4 General

4.1 Apparatus group and temperature classification

If required, “m” apparatus shall be grouped and classified in accordance with Clauses 4 and 5 of IEC 60079-0.

4.2 Level of protection

Electrical apparatus with encapsulation “m” shall be either in level of protection “ma” or in level of protection “mb”.

The requirements of this standard shall apply to both levels of protection unless otherwise stated.

If a non-resetting protective device according to IEC 60127 or IEC 60691 is used, then only one device is necessary for both levels of protection.

4.3 Level of protection “ma”

“m” apparatus of level of protection “ma” shall not be capable of causing ignition in each of the following circumstances:

- a) in normal operation and installation conditions;
- b) any specified abnormal conditions;
- c) in defined failure conditions.

For level of protection “ma”, the working voltage at any point in the circuit shall not exceed 1 kV.

For level of protection “ma”, components without additional protection shall only be used if they cannot damage the encapsulation mechanically or thermally in the case of any fault.

Alternatively, where a fault of an internal component may lead to failure of the encapsulation system due to increasing temperature, the requirements of 6.2 shall apply.

NOTE Certain components whose application is allowed according to this standard for level of protection “mb” can possibly make the protective measure ‘encapsulation’ ineffective by mechanical or thermal damage as a consequence of internal reactions. This risk should be excluded for level of protection “ma” apparatus.

4.4 Level of protection “mb”

“m” apparatus of level of protection “mb” shall not be capable of causing ignition in each of the following circumstances:

- a) in normal operation and installation conditions;
- b) in defined failure conditions.

4.5 Supply specifications

The limiting values of the supply (rated voltage and the prospective short circuit current) shall be stated to ensure that, under the relevant level of protection “ma” or “mb”, the limiting temperature is not exceeded. Any protective device used shall comply with the requirements of 7.9.

5 Requirements for compounds

5.1 General

The documentation shall specify the compound(s) used and the processing method(s).

As a minimum, those properties of the compound(s) on which the encapsulation “m” depends shall be provided.

Due consideration shall be given in the selection of encapsulating materials to allow for the expansion of components during operation and in the event of allowable faults.

5.2 Specification

The manufacturer shall attest on his own responsibility that the material complies with the compound specification.

The specification shall include:

- a) the name and address of the manufacturer of the compound,
- b) the exact and complete reference of the material, and, if relevant percentage of fillers and any other additives, the mixture ratios and the type designation,
- c) if applicable, any treatment of the surface of the compound(s), for example varnishing,
- d) if applicable, to obtain correct adhesion of the compound to a component any requirement for pre-treating of the component for example cleaning, etching,
- e) if appropriate, the result of the water absorption test in accordance with 8.1. Where this test has not been performed, to indicate this special condition of use the apparatus shall be marked "X" in accordance with item i) of 29.2 of IEC 60079-0,
- f) the dielectric strength in accordance with IEC 60243-1 at the maximum temperature of the apparatus determined according to 8.2.2,
- g) temperature range of the compound(s) (upper and lower continuous operating temperature),
- h) in the case of "m" apparatus where the compound is part of the external enclosure the temperature index TI value as defined by 7.1.3 d) of IEC 60079-0. As an alternative to the TI, the relative thermal index (RTI-mechanical impact) may be determined in accordance with ANSI/UL 746B¹,
- i) the colour of the compound used for the test samples where the compound specification will be influenced by changing the colour.

6 Temperatures

6.1 General

The maximum surface temperature and the maximum value of the continuous operating temperature of the compound shall not be exceeded during normal operation. The "m" apparatus shall be protected in such a way that the encapsulation "m" is not affected under specified fault conditions.

6.2 Temperature limitation

When a protective device is required to limit temperatures for safety reasons, it shall be a non-resetting internal or external, electrical or thermal device. One device is required for level of protection "mb" and two devices for level of protection "ma". The thermal coupling of the device to the component being monitored shall be sufficient. For functional reasons the "m" apparatus may also contain an additional resettable protective device.

If the non-resetting protective device complies with IEC 60127 or IEC 60691, only one device is necessary for both levels of protection.

Where the apparatus may be subject to fault, see 7.2.1, or where there is the possibility of an increased temperature, for example by an unfavourable input voltage in accordance with 7.2.1 or an unfavourable load, these shall be taken into account in determining the limiting temperature.

¹ ANSI/UL 746B, *Polymeric Materials – Long-Term Property Evaluations*

6.3 Determination of the limiting temperature

6.3.1 Maximum surface temperature of the test sample

The maximum surface temperature shall be determined using the test method given in 8.2.2 in accordance with the supply conditions specified in 4.5. This temperature shall be used to determine the temperature class.

6.3.2 Temperature of the components in the compound

The hottest component(s) shall be determined. The maximum temperature in the compound, adjacent to the hottest component(s), shall be determined using the test method given in 8.2.2 for normal operation.

NOTE The determination of the hottest component may be done by calculation or manufacturer's specification or by a practical test prior to encapsulating the components.

7 Constructional requirements

7.1 General

Where the encapsulation forms part of the external enclosure it shall comply with the requirements for non metallic enclosures and parts of non metallic enclosures.

If additional protective measures are required by the user in order to satisfy the requirements of this standard, for example, additional mechanical protection, to indicate this special condition of use the apparatus shall be marked "X" in accordance with item i) of 29.2 of IEC 60079-0. Appropriate action shall be taken to accommodate the expansion of components during normal operation and in the event of faults according to 7.2.

In 7.2 to 7.9 the requirements differ according to whether the compound adheres to the enclosure. Where adhesion is specified, the aim is to prevent the ingress of explosive atmospheres and moisture at the boundary surfaces (for example enclosure-compound, compound-parts that are not completely embedded in the compound, such as printed wiring boards, connection terminals, etc.). If additional treatment for the boundary surfaces is required in order to ensure adhesion, this shall be included in the manufacturer's documentation.

Where adhesion is required to maintain the type of protection, it shall be maintained after completion of all the prescribed tests.

NOTE The choice of the compound(s) to be used for a specific application is dependent on the task each compound has to perform. In general, testing a compound once is not sufficient for universal use for encapsulation "m".

7.2 Determination of faults

7.2.1 Fault examination

The encapsulation protection shall be maintained even in the case of an unfavourable input condition (but between 90 % and 110 % of the rated parameter) and unfavourable output load and of any internal electrical fault (one fault for level of protection "mb" and two faults for level of protection "ma"), for example in the event of

- a short circuit in any component;
- the failure of any component;
- a fault in the printed circuitry.