

# Electrical apparatus for use in the presence of combustible dust —

## Part 18: Protection by encapsulation “mD”

The European Standard EN 61241-18:2004 has the status of a  
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## National foreword

This British Standard is the official English language version of EN 61241-18:2004. It is identical with IEC 61241-18:2004.

The UK participation in its preparation was entrusted by Technical Committee GEL/31, Electrical apparatus for explosive atmospheres, to Subcommittee GEL/31/20, Electrical apparatus for use in the presence of combustible dusts, which has the responsibility to:

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**Electrical apparatus for use in the presence of combustible dust**  
**Part 18: Protection by encapsulation "mD"**  
(IEC 61241-18:2004)

Matériels électriques pour utilisation en  
présence de poussières combustibles  
Partie 18: Protection par encapsulage  
"mD"  
(CEI 61241-18:2004)

Elektrische Betriebsmittel zur Verwendung  
in Bereichen mit brennbarem Staub  
Teil 1: Schutz durch Vergusskapselung  
"mD"  
(IEC 61241-18:2004)

This European Standard was approved by CENELEC on 2004-10-01. 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.

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## 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 document 31H/176/FDIS, future edition 1 of IEC 61241-18, prepared by SC 31H, Apparatus for use in the presence of combustible dust, of IEC TC 31, Electrical apparatus for explosive atmospheres, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61241-18 on 2004-10-01.

This standard is to be used in conjunction with EN 61241-0 \*).

The following dates were fixed:

- latest date by which the EN has to be implemented  
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This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive(s). See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

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## Endorsement notice

The text of the International Standard IEC 61241-18:2004 was approved by CENELEC as a European Standard without any modification.

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\*) In preparation.

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## INTRODUCTION

Many dusts which are generated, processed, handled and stored, are combustible. When ignited they can burn rapidly and with considerable explosive force if mixed with air in the appropriate proportions. It is often necessary to use electrical apparatus in locations where such combustible materials are present, and suitable precautions must therefore be taken to ensure that all such apparatus is adequately protected so as to reduce the likelihood of ignition of the external explosive atmosphere. In electrical apparatus, potential ignition sources include electrical arcs and sparks, hot surfaces, and frictional sparks.

Areas where dusts, flyings and fibres in air occur in dangerous quantities are classified as hazardous and are divided into 3 zones according to the level of risk.

Generally, electrical safety is ensured by the implementation of one of two considerations, i.e. that electrical apparatus be located where reasonably practicable outside hazardous areas and that electrical apparatus be designed, installed and maintained in accordance with measures recommended for the area in which the apparatus is located.

Combustible dust can be ignited by electrical apparatus in several ways:

- by surfaces of the apparatus that are above the minimum ignition temperature of the dust concerned. The temperature at which a type of dust ignites is a function of the properties of the dust, whether the dust is in a cloud or layer, the thickness of the layer and the geometry of the heat source;
- by arcing or sparking of electrical parts such as switches, contacts, commutators, brushes, or the like;
- by discharge of an accumulated electrostatic charge;
- by radiated energy (for example, electromagnetic radiation);
- by mechanical sparking or frictional sparking or heating associated with the apparatus.

In order to avoid ignition hazards it is necessary that

- the temperature of surfaces, on which dust can be deposited, or which would be in contact with a dust cloud, is kept below the temperature limitation specified in this standard;
- any electrical sparking parts, or parts having a temperature above the temperature limit specified in IEC 61241-14
  - are contained in an enclosure which adequately prevents the ingress of dust, or
  - the energy of electrical circuits is limited so as to avoid arcs, sparks or temperatures capable to ignite combustible dust;
- any other ignition sources are avoided.

Compliance with this standard will only provide the required level of safety if the electrical apparatus is operated within its rating and is installed and maintained according to the relevant codes of practice or requirements, for example in respect of protection against over-currents, internal short-circuits, and other electrical faults. In particular, it is essential that the severity and duration of an internal or external fault be limited to values that can be sustained by the electrical apparatus without damage.

Several techniques are available for the explosion protection of electrical apparatus in hazardous areas. This standard describes the safety features of these types of explosion-protection techniques and specifies the installation procedures to be adopted. It is most important that the correct selection and installation procedures be followed to ensure the safe use of electrical apparatus in hazardous areas.

## ELECTRICAL APPARATUS FOR USE IN THE PRESENCE OF COMBUSTIBLE DUST –

### Part 18: Protection by encapsulation “mD”

#### 1 Scope

This standard is to be read in conjunction with IEC 61241-0, the requirements of which apply to electrical apparatus protected by encapsulation and surface temperature limitation unless specifically excluded.

This part of IEC 61241 is applicable to electrical apparatus protected by encapsulation type of protection “mD” and surface temperature limitation for use in areas where combustible dust may be present in quantities which could lead to a fire or explosion hazard. It specifies requirements for design, construction and testing of electrical apparatus, parts of electrical apparatus and Ex components where the rated voltage does not exceed 10 kV.

NOTE 1 The actual working voltage may exceed the value given above by up to 10 %.

NOTE 2 IEC 61241-14 (“Electrical apparatus for use in the presence of combustible dust – Part 14: Selection and installation”) gives guidance on the selection and installation of the apparatus. Apparatus within the scope of this standard may also be subjected to additional requirements in other standards – for example, IEC 60079-0 (“Electrical apparatus for explosive gas atmospheres – Part 0: General requirements”).

The application of electrical apparatus in atmospheres which may contain explosive gas as well as combustible dust, whether simultaneously or separately, requires additional protective measures.

This standard does not apply to dusts of explosives which do not require atmospheric oxygen for combustion, or to pyrophoric substances.

This standard is not applicable to electrical apparatus intended for use in underground parts of mines as well as those parts of surface installations of such mines endangered by firedamp and/or combustible dust. This standard does not take account of any risk due to an emission of flammable or toxic gas from the dust.

This standard does not include other types of protection and is only applicable to protection by encapsulation.

#### 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 60079-7:2001, *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 60086-1, *Primary batteries – Part 1: General*

IEC 60127 (all parts), *Miniature fuses*

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

IEC 60285, *Alkaline secondary cells and batteries – Sealed nickel-cadmium cylindrical rechargeable single cells*<sup>1</sup>

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 61241-0:—, *Electrical apparatus for use in the presence of combustible dust – Part 0: General requirements*

IEC 61241-1:—, *Electrical apparatus for use in the presence of combustible dust – Part 1: Protection by enclosures “tD”*

IEC 61241-11:—, *Electrical apparatus for use in the presence of combustible dust – Part 11: Protection by intrinsic safety “iD”*<sup>2</sup>

IEC 61436, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-metal hydride rechargeable single cells*<sup>3</sup>

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

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*

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

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<sup>1</sup> Cancelled and replaced by IEC 61951-1 (2003).

<sup>2</sup> To be published.

<sup>3</sup> Cancelled and replaced by IEC 61951-2 (2003).

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions, specific to protection by encapsulation "mD", apply. They supplement the definitions given in IEC 61241-0.

#### 3.1

##### **encapsulation "mD"**

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 as to avoid ignition of a dust layer or cloud 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**

the 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**

the 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**

the 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**

the 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 Temperature classification**

Encapsulation "mD" apparatus shall be classified in accordance with Clause 5 of IEC 61241-0.

### **4.2 Level of protection**

Electrical apparatus with encapsulation "mD" shall be either level of protection "maD" or level of protection "mbD".

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 "maD"**

Level of protection "maD" 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 "maD" the working voltage at any point in the encapsulation circuit shall not exceed 1 kV.

For level of protection "maD", 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 "mbD" 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 "maD" apparatus.

### **4.4 Level of protection "mbD"**

Level of protection "mbD" 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.