

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Explosive atmospheres –
Part 18: Equipment protection by encapsulation “m”
ITeH STANDARD PREVIEW
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Atmosphères explosives –
Partie 18: Protection du matériel par encapsulage “m”
IEC 60079-18:2014
<https://standards.iteh.ai/catalog/standards/sist/a5624c1f-cc4f-456b-9fd8-0813d3a6228a/iec-60079-18-2014>



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –**Part 18: Equipment protection by encapsulation “m”**

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Standard IEC 60079-18 has been prepared by IEC technical committee 31: Equipment for explosive atmospheres.

This fourth edition cancels and replaces the third edition of IEC 60079-18 (2009), and constitutes a technical revision.

This International Standard is to be used in conjunction with IEC 60079-0, *Explosive atmospheres – Part 0: Equipment-General requirements*.

This edition includes the following significant technical changes with respect to the previous edition:

Explanation of the significance of the changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Definitions deleted and moved to IEC 60079-0	3	X		
Heading modified /added to clarify which requirements are additional requirements for “ma” level of protection only	4	X		
Thermal conductivity added	5.2		X	
Note added that it is not a requirement of this standard that conformity to the manufacturer’s specification of the compound needs to be verified	5.3.2	X		
Clarification added	6.2.2	X		
Clarification added	7.1	X		
For the determination of faults options added and clarification given	7.2		X	
Additional information included in Figure 1	7.4.1	X		
“Varnish and similar coatings are not considered to be solid insulation.” was added in this section and deleted in the definition on 3.8	7.4.2	X		
For rigid, multi-layer printed wiring boards with through connections additional standards added	7.4.3.1		X	
Protection against inadmissible temperatures and damage to the cells	7.8.3			C1
Electrical protective devices clarified and additional possibilities added	7.9.2		X	
Thermal protective devices clarified and additional possibilities added	7.9.3		X	
2/3 voltage limitation deleted	7.9.3		X	
Determination of the maximum temperature for “Da” fixed	8.2.2			C2
Stabilization of the temperature	8.2.2			C3
Thermal endurance to heat	8.2.3.1		X	
Temperature fixed as reference service temperatures and tests given as alternatives	8.2.3.1.1		X	
For the dielectric strength test procedure alternative possibilities added	8.2.4.1		X	
Alternative test methods for the required pressure test for Group I and Group II electrical equipment added	8.2.6		X	
Sealing test for build-in protective devices	8.2.8		X	
For the dielectric strength test procedure alternative possibilities added	9.2		X	
Marking	10	X	X	

Explanation of the Types of Significant Changes:**A) Definitions****1. Minor and editorial changes:**

- Clarification
- Decrease of technical requirements
- Minor technical change
- Editorial corrections

These are changes which modify requirements in an editorial or a minor technical way. They include changes of the wording to clarify technical requirements without any technical change, or a reduction in level of existing requirement.

2. Extension:

- Addition of technical options

These are changes which add new or modify existing technical requirements, in a way that new options are given, but without increasing requirements for equipment that was fully compliant with the previous standard. Therefore, these will not have to be considered for products in conformity with the preceding edition.

3. Major technical changes:

- addition of technical requirements
- increase of technical requirements

These are changes to technical requirements (addition, increase of the level or removal) made in a way that a product in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition. These changes have to be considered for products in conformity with the preceding edition. For these changes additional information is provided in item B) below.

Note These changes represent current technological knowledge. However, these changes should not normally have an influence on equipment already placed on the market.

B) Information about the background of 'Major technical changes'

C1 Clause 7.8.3 modified and additional requirements added for cells or batteries

C2 The flexibility given in IEC 60079-0 is replaced by a min. requirement. For level of protection "ma" equipment, designed for EPL "Da" the maximum surface temperature shall be determined with the equipment mounted in accordance with the manufacturer's instructions, and surrounded on all available surfaces by dust with a layer thickness of at least 200 mm

C3 The increase of the temperature during the test can be a very slow process. The final temperature shall be considered to have been reached when the rate of rise of temperature does not exceed 1 K/24 h

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The text of this standard is based on the following documents:

FDIS	Report on voting
31/1152/FDIS	31/1168/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 60079 series, published under the general title *Explosive atmospheres*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The contents of the corrigendum of July 2018 have been included in this copy.

EXPLOSIVE ATMOSPHERES –

Part 18: Equipment protection by encapsulation “m”

1 Scope

This part of IEC 60079 gives the specific requirements for the construction, testing and marking of electrical equipment, parts of electrical equipment and Ex components with the type of protection encapsulation “m” intended for use in explosive gas atmospheres or explosive dust atmospheres.

This part applies only for encapsulated electrical equipment, encapsulated parts of electrical equipment and encapsulated Ex components (hereinafter always referred to as “m” equipment) where the rated voltage does not exceed 11 kV.

The application of electrical equipment in atmospheres, which may contain explosive gas as well as combustible dust simultaneously, may require 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 does not take account of any risk due to an emission of flammable or toxic gas from the dust.

This standard supplements and modifies the general requirements of IEC 60079-0. Where a requirement of this standard conflicts with a requirement of IEC 60079-0, the requirement of this standard takes precedence.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-7, *Explosive atmospheres – Part 7: Equipment protection by increased safety “e”*

IEC 60079-11, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”*

IEC 60079-15, *Explosive atmospheres – Part 15: Equipment protection by type of protection “n”*

IEC 60079-26, *Explosive atmospheres – Part 26: Equipment with equipment protection level (EPL) Ga*

IEC 60079-31, *Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure “t”*

IEC 60127 (all parts), *Miniature fuses*

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

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

IEC 60730-2-9, *Automatic electrical controls for household and similar use – Part 2-9: Particular requirements for temperature sensing controls*

IEC 60738-1, *Thermistors – Directly heated positive temperature coefficient – Part 1: Generic specification*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61558-1, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

IEC 61558-2-6, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*

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*

ANSI/UL 248 (all parts), *Standard for low-voltage fuses*

ANSI/UL 746B, *Standard for polymeric materials – Long term property evaluations*

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ANSI/UL 796, *Printed-Wiring Boards*

IPC-A-600, *Acceptability of Printed Boards*

IPC-6012, *Qualification and Performance Specification for Rigid Printed Boards*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60079-0 and the following definitions apply.

NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426.

3.1

encapsulation “m”

type of protection whereby parts that are capable of igniting an explosive atmosphere by either sparking or heating are fully enclosed in a compound or other non-metallic enclosure with adhesion in such a way as to avoid ignition of a dust layer or explosive atmosphere under operating or installation conditions

3.2

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 IEC 60079-18

3.3

free surface

compound surface exposed to the explosive atmospheres and/or dust layers

3.4

switching contact

mechanical contact, which makes and breaks an electrical circuit

3.5

adhesion

moisture, gas and dust tight permanent bonding of a compound to a surface

3.6

countable fault

fault which occurs in parts of electrical equipment conforming to the constructional requirements

3.7

infallible separation

separation between electrically conductive parts that is considered as not subject to short circuits

3.8

solid insulation

insulation material which is extruded or moulded, but not poured

Note 1 to entry: Insulators fabricated from two or more pieces of electrical insulating material, which are solidly bonded together may be considered as solid.

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4 General

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4.1 Level of protection (equipment protection level (EPL))

Electrical equipment with encapsulation “m” shall be either:

- a) level of protection “ma” (EPL “Ma, Ga, Da”),
- b) level of protection “mb” (EPL “Mb, Gb, Db”), or
- c) level of protection “mc” (EPL “Gc, Dc”).

The requirements of this standard apply to all levels of protection for encapsulation “m” unless otherwise stated.

4.2 Additional requirements for levels of protection “ma” and “mb”

Components without additional protection shall be used only if they cannot damage the encapsulation mechanically or thermally in the case of any fault conditions specified in this standard.

Alternatively, where a fault of an internal component may lead to failure of encapsulation “m” due to increasing temperature, the requirements of 7.9 shall apply.

4.3 Additional requirements for level of protection “ma”

The working voltage at any point in the circuit shall not exceed 1 kV.

4.4 Rated voltage and prospective short circuit current

The rated voltage and the prospective short circuit current shall be specified such that the limiting temperature is not exceeded for the relevant level of protection “ma”, “mb” or “mc”.

5 Requirements for compounds

5.1 General

The documentation shall specify the compound(s) used and the processing method(s), including measures to prevent the formation of voids.

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

NOTE Proper selection of the compound allows for the expansion of components during operation and in the event of allowable faults.

5.2 Specification

The specification for the compound shall include the following:

- a) the name and address of the manufacturer of the compound,
- b) the exact and complete reference of the compound 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) the dielectric strength in accordance with IEC 60243-1 at the maximum service temperature of the compound determined according to 8.2.2 a) if available; if not available, the requirements of 5.3.2 shall be applied,
- f) temperature range of the compound(s) (including maximum continuous operating temperature (COT) and minimum continuous operating temperature (COT)),
- g) in the case of “m” equipment where the compound is part of the external enclosure, the temperature index TI value as defined by IEC 60079-0. As an alternative to the TI, the relative thermal index (RTI-mechanical) may be determined in accordance with ANSI/UL 746B,
- h) the colour of the compound used for the test samples, where the compound specification will be influenced by changing the colour,
- i) Thermal conductivity if utilizing the alternative test method in 6.2.2.

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

5.3 Properties of the compound

5.3.1 Water absorption

Either the compound shall be tested in accordance with 8.1.1 or, if this test is not performed, the certificate number for the equipment shall include the “X” suffix in accordance with the marking requirements of IEC 60079-0 and the specific conditions of use listed on the certificate shall detail the precautions necessary.

5.3.2 Dielectric strength

Where the dielectric strength according to IEC 60243-1 at the maximum service temperature according to 8.2.2 a), of the compound is not available from the material manufacturer, a test shall be performed in accordance with 8.1.2.

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

6 Temperatures

6.1 General

The service temperature of the compound, determined in accordance with IEC 60079-0, shall not exceed the maximum value of the COT of the compound. The maximum surface temperature shall be determined in accordance with IEC 60079-0 under normal operation and under fault conditions as defined in 7.2.1. The "m" equipment shall be protected in such a way that encapsulation "m" is not adversely affected under these fault conditions.

6.2 Determination of the limiting temperatures

6.2.1 Maximum surface temperature

The maximum surface temperature shall be determined using the test method given in 8.2.2 in accordance with the supply conditions specified in 4.4.

NOTE This temperature is used to determine either the temperature class for explosive gas atmospheres or the maximum surface temperature in degree Celsius for explosive dust atmospheres of the equipment, or both.

6.2.2 Temperature of the compound

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

As an alternative the determination of the temperature of the hottest component in normal operation may be done by calculation, manufacturer's specification or by testing the component under intended application conditions prior to encapsulating the component if the thermal conductivity of the compound is greater than that of air.

NOTE Thermal conductivity of air is most often defined as 0.25 W/m²K (standard conditions).

6.3 Temperature limitation

Where the equipment may be subject to fault in accordance with 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, this shall be taken into account in determining the limiting temperatures.

When a protective device is required to limit temperatures for safety reasons, it shall be an electrical or thermal device external to the equipment or directly integrated into the equipment, as defined in 7.9.

7 Constructional requirements

7.1 General

Where the compound forms part of the external enclosure it shall comply with the requirements of IEC 60079-0 for non metallic enclosures and non metallic parts of enclosures.

If the surface of the compound is totally or partly surrounded by an enclosure and the enclosure is part of the protection, the enclosure or parts of the enclosure shall comply with the enclosure requirements of IEC 60079-0.

Additional protective measures may be required to be provided by the user in the installation in order to comply with the requirements of this standard. For example, additional mechanical

protection may be required to protect the equipment from a direct impact. In such cases, the certificate number for the equipment shall include the “X” suffix in accordance with the marking requirements of IEC 60079-0 and the specific conditions of use listed in the certificate shall detail the precautions necessary.

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.). Where adhesion is required to maintain the type of protection, it shall be maintained after completion of all the prescribed tests. The choice of the compound(s) to be used for a specific application is dependent on the task each compound has to perform. Testing a compound once for a given application will not qualify that compound for all applications.

NOTE Tests for adhesion are under consideration.

7.2 Determination of faults

7.2.1 Fault examination

When tested in accordance with IEC 60079-0, encapsulation “m” shall be maintained in the case of

- a) the most unfavourable output load and
- b) up to two internal countable faults for level of protection “ma”, and up to one internal countable fault for level of protection “mb”, taking into account 7.2.2, 7.2.3 and 7.2.4.

No faults are taken into account for level of protection “mc”.

NOTE Examples of faults are: a short circuit in any component, the failure of any component and a fault between tracks in the printed wiring board, but not the opening of a track.

The failure of some components may result in an unstable condition, for example, alternating between high and low resistance. In those cases, the most onerous condition shall be considered.

If a fault leads to one or more subsequent faults, for example, due to the overload of a component, the primary and subsequent fault(s) shall be considered to be a single fault.

7.2.2 Components considered as not subject to fail

For levels of protection “ma” and “mb” the following components shall be considered as not to fail if they are encapsulated according to the requirements of this standard, if they are suitable for the service temperature and if they are not operated at more than 2/3 of their rated voltage, rated current and rated power related to the rating of the device, the mounting conditions and the temperature range specified:

- resistors,
- single-layer, spirally wound coils,
- plastic foil capacitors,
- paper capacitors,
- ceramic capacitors,
- semiconductors,
- semiconductor devices used as a protective device according to 7.9,