

# INTERNATIONAL STANDARD



**Explosive atmospheres –  
Part 31: Equipment dust ignition protection by enclosure "t"**

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**Explosive atmospheres –  
Part 31: Equipment dust ignition protection by enclosure "t"**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## CONTENTS

FOREWORD	4
INTRODUCTION	8
1 Scope	9
2 Normative references	9
3 Terms and definitions	10
4 General	10
4.1 Levels of protection	10
4.2 Equipment groups and ingress protection	11
4.3 Requirements for <del>electrical equipment</del> Ex Equipment with Level of Protection "ta"	11
4.3.1 Fault current	11
4.3.2 Maximum surface temperature	11
<del>        4.3.3 Overpressure</del>	
4.3.3 Dust exclusion	12
4.3.4 Protective Devices	12
4.3.5 Supplementary internal enclosure	13
<del>        4.3.6 Protection for arcing and sparking parts</del>	
4.3.6 Cells and batteries	13
4.4 Requirements for <del>electrical equipment</del> Ex Equipment with Level of Protection "tb" and "tc"	14
4.4.1 Fault current	14
4.4.2 Maximum surface temperature	14
4.4.3 Dust exclusion	14
4.4.4 Thermal protection	14
4.4.5 Cells and batteries	15
4.4.6 External plug and socket connections for field wiring connection	15
5 Construction	15
5.1 Joints	15
5.1.1 General	15
5.1.2 Threaded joints	15
5.1.3 Gaskets and seals	16
5.1.4 Cemented joints	16
5.1.5 Operating rods, spindles and shafts	16
5.1.6 Windows	17
5.2 Cable glands, cable transit devices and conduit sealing devices	17
5.3 Entries	17
5.3.1 Plain entries	17
5.3.2 Threaded entries	17
6 Verification and tests	18
6.1 Type tests	18
6.1.1 Type tests for dust exclusion by enclosures	18
<del>        6.1.2 Thermal tests</del>	
6.1.2 Tests to determine maximum surface temperature	19
6.2 Routine tests	20
7 Marking	20
Annex A (normative) Supplementary requirements for entry devices	21

A.1	General.....	21
A.2	Construction requirements .....	21
A.2.1	Cable glands, cable transit devices and conduit sealing devices.....	21
A.2.2	Blanking elements and thread adapters .....	21
A.3	Type tests.....	21
A.3.1	Cable glands, cable transit devices and conduit sealing devices.....	21
A.3.2	Blanking elements and thread adapters .....	21
A.4	Marking.....	21
	Bibliography.....	22

Table 1 – Level of Protection, equipment group and ingress protection (IP) relationship..... 11

Table 2 – Overload or malfunction conditions for Level of Protection "tb" ..... 20

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## EXPLOSIVE ATMOSPHERES –

## Part 31: Equipment dust ignition protection by enclosure "t"

## FOREWORD

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**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60079-31:2013. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

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

This third edition cancels and replaces the second edition published in 2013. This edition constitutes a technical revision.

The significance of changes between IEC Standard, IEC 60079-31, Edition 3.0 and IEC 60079-31, Edition 2.0, are as listed below:

Changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Document has been restructured from edition 2	Numerous	X		
Withstand of prospective short-circuit current	4.3.1		X	
Fault current rating of interrupting contacts rated greater than 10 kA for mains connected circuits	4.4.1 and 6.1.1.1			C1
Thermal protective device can include a thermal protective circuit with an appropriate sensor.	4.4.4.1		X	
Cells and batteries	4.3.6 and 4.4.5			C2
Joints employing parallel threads with an additional seal or gasket are permitted to have less than five threads.	5.1.2		X	
Gasket joints that interlock (not a butt joint) and are designed such that under the intended compression no gap between the pieces exist so that an uninterrupted periphery is formed, these joints do not need to be permanently joined.	5.1.3		X	
Overload or malfunction condition for the determination of temperature class for "tb" converter fed rotating electric machines	Table 2			C3
Additional requirements for entry devices with dust ignition protection by enclosure "t"	Annex A			C4
Thermal tests are relocated to IEC 60079-0.	Formerly 6.1.2	A1		

NOTE The technical changes referred to include the significance of technical changes in the revised IEC Standard, but they do not form an exhaustive list of all modifications from the previous version. More guidance may be found by referring to the Redline Version of the standard.

## Explanations:

### A) Definitions

#### 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.

**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.

### 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 clause 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 – For Ex Equipment having Level of Protection "tb" or "tc" which is intended for mains connection and intended to interrupt fault current above 10kA is tested according to 6.1.1.1, and is marked according to Clause 7.

C2 – For Ex Equipment having Level of Protection "ta" which contains a cell or battery, only a sealed cell or battery shall be used. For Ex Equipment having Level of Protection "tb" and "tc" where there are sparking contacts or hot surfaces, and which contains a cell or battery, only a sealed cell or battery shall be used.

C3 – Table 2 now includes malfunction conditions for temperature class determination of Level of Protection "tb" converter-fed electric machines.

C4 – Annex A added for entry devices with Type of Protection "t" including cable transit devices.

A1 – Thermal tests formerly located in 6.1.2 are relocated to IEC 60079-0 for the 2017 and later editions.

The text of this International Standard is based on the following documents:

Draft	Report on voting
31/1595/FDIS	31/1606/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

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- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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## INTRODUCTION

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## EXPLOSIVE ATMOSPHERES –

### Part 31: Equipment dust ignition protection by enclosure "t"

#### 1 Scope

This part of IEC 60079 is applicable to ~~electrical~~ equipment protected by enclosure and surface temperature limitation for use in explosive dust atmospheres. It specifies requirements for design, construction and testing of ~~electrical equipment~~ Ex Equipment and Ex Components.

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

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

This document does not apply to ~~electrical equipment~~ Ex Equipment or Ex Components 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 document does not take account of any ~~risk~~ hazard due to an emission of flammable or toxic gas from the dust.

~~Consideration of additional protective measures is required where the application of electrical equipment is in atmospheres, which can contain combustible dust and explosive gas, whether simultaneously or separately.~~

This document does not contain requirements for Ex Equipment used in areas where both combustible dust and explosive gas atmospheres can occur, whether simultaneously or separately. Requirements for explosive gas atmospheres can be found in other parts of the IEC 60079 series. Guidance on Ex Equipment to be used where combustible dust and explosive gas atmospheres occur simultaneously ("hybrid mixtures") can be found in IEC 60079-14.

Where the ~~electrical equipment~~ Ex Equipment has to meet other environmental conditions, for example, protection against ingress of water and resistance to corrosion, additional measures which do not adversely affect the integrity of the enclosure can be necessary. ~~The measures used should not adversely affect the integrity of the enclosure.~~

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60127 (all parts), *Miniature fuses*

IEC 60269 (all parts), *Low-voltage fuses*

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

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

IEC 60034-5, *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification*

ISO 965-1, *ISO general-purpose metric screw threads – Tolerances – Part 1: Principles and basic data*

ANSI/ASME B1.20.1, *Pipe threads, general purpose (inch)*

ANSI/UL 248 (all parts), *Standard for Low-Voltage Fuses*

### 3 Terms and definitions

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

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **dust ignition protection by enclosure "t"**

Type of Protection for explosive dust atmospheres where ~~electrical~~ equipment is provided with an enclosure providing dust ingress protection and a means to limit surface temperatures

#### 3.2

##### **joint**

~~place where the corresponding surfaces of two parts of an enclosure, or the conjunction of enclosures, come together~~

#### 3.3

##### **gasket**

~~compressible element provided in a joint to provide a degree of protection against the ingress of solid foreign objects and /or against ingress water/dust~~

## 4 General

### 4.1 Levels of protection

Type of Protection "t" is divided into three Levels of Protection based on the risk of the ~~electrical equipment~~ Ex Equipment and Ex Components becoming an ignition source in an explosive dust atmosphere. ~~Electrical equipment~~ Ex Equipment and Ex Components with ~~dust ignition protection by enclosure~~ Type of Protection "t" shall be ~~either~~ one of the following:

- Level of Protection "ta" ~~( for EPL "Da" ), or~~
- Level of Protection "tb" ~~( for EPL "Db" ), or~~
- Level of Protection "tc" ~~( for EPL "Dc" ).~~

~~The construction and marking requirements apply to all electrical equipment, and in addition, the requirements for "ta" as given in 4.3 and the requirements for "tb" and "tc" as given in 4.4.~~

The general requirements of Clause 4, the construction requirements of Clause 5, and the marking requirements of Clause 7, apply to all Ex "t" Equipment and Ex "t" Components.

Failure modes as defined in the industrial standard for particular internal components affecting the temperatures of the equipment shall be taken into account when considering applicable ~~fault conditions~~ malfunctions.

When a resistor is used for current limiting, it shall not be considered to fail as a short circuit if it is of metal film or of wire wound construction. The resistor shall be rated for the maximum rated voltage of the equipment.

## 4.2 Equipment groups and ingress protection

The relationship between the Level of Protection, the group, and ingress protection required is shown in Table 1.

**Table 1 – Level of Protection, equipment group and ingress protection (IP) relationship**

Level of Protection	Group IIIC	Group IIIB	Group IIIA
"ta"	IP6X	IP6X	IP6X
"tb"	IP6X	IP6X	IP5X
"tc"	IP6X	IP5X	IP5X

~~Ingress protection shall be determined in accordance with degree of protection (IP) of enclosures as specified in IEC 60079-0 for level of protection "tb" and "tc". For Level of Protection "ta" the level of depression shall be increased to at least 4 KPa for a period of least 8 h. Any grease in the joints shall be removed before the IP test is performed.~~

~~When IP5X is required, all enclosures including rotating machines, shall satisfy the test and acceptance requirements of IP5X, as specified in IEC 60529.~~

## 4.3 Requirements for ~~electrical equipment~~ Ex Equipment with Level of Protection "ta"

### 4.3.1 Fault current

~~For Level of Protection "ta", the electrical equipment shall be rated for connection to a circuit having a prospective short circuit current of not greater than 10 kA. Where the prospective short circuit current withstand is less than 10 kA, it shall be marked according to Clause 7.~~

Ex Equipment shall be rated for connection to a circuit with a prospective short circuit current of not greater than 1,5 kA and marked according to Clause 7.

### 4.3.2 Maximum surface temperature

These requirements ~~for maximum surface temperature for "ta" electrical equipment~~ modify and supplement the requirements of IEC 60079-0.

~~The marked maximum surface temperature shall be measured on the external surfaces of the enclosure and the surfaces of the internal components for electrical equipment with types of protection "ta" in accordance with 6.1.2. The highest of the measured temperatures shall be the basis for the maximum surface temperature marking.~~

The marked maximum surface temperature, as determined according to 6.1.2, shall be the higher of the measured temperatures a) or b):

- the surfaces of the internal components where there is no supplementary enclosure, or,
- the temperature on the external surfaces of the supplementary enclosure.

NOTE 1 Partial rupture of the external enclosure is considered to be a potential rare malfunction and is considered in the temperature determination for "ta" equipment.

NOTE 2 Level of Protection "ta" is typically applied for instrumentation where the maximum available short circuit current is in the mA range. Due to the limited thermal dissipation available to Level of Protection "ta" equipment, the maximum normal power dissipation is generally limited to a few watts.

### ~~4.3.3 Overpressure~~

~~A positive internal pressure of 4 kPa shall be applied to the enclosure in accordance with 6.1.1.3 prior to the dust exclusion test.~~

### 4.3.3 Dust exclusion

Dust exclusion by enclosure shall be carried out in accordance with 6.1.1.

### 4.3.4 Protective Devices

#### 4.3.4.1 General

If the ~~electrical equipment~~ Ex Equipment is capable of exceeding the marked maximum surface temperature as a result of the temperature test of 6.1.2 under expected malfunction or for rare malfunction conditions, a protective device ~~is required~~ shall be used. The protective device may be a thermal protective device according to 4.3.4.2 or an overcurrent protective device according to 4.3.4.3 which may be directly integrated into the ~~electrical equipment~~ Ex Equipment or be external to the ~~electrical equipment~~ Ex Equipment.

Where the external protective device is not provided by the manufacturer as part of the ~~electrical equipment~~ Ex Equipment, the ~~marking~~ certificate number shall include the ~~symbol~~ "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 required ratings and performance characteristics of the protective device. The protective device shall be capable of interrupting the maximum current of the circuit in which it is installed. ~~If the electrical equipment contains a cell or battery and a control device is provided to prevent overheating of the cell or battery, the control device can also be considered as a protective device, provided it also protects the complete electrical equipment from exceeding the maximum surface temperature.~~

The response time of the thermal protective device or overcurrent protective device shall be taken into account and be adequate for the necessary over temperature protection.

#### 4.3.4.2 Thermal protective devices

When required by 4.3.4.1, the ~~electrical equipment~~ Ex Equipment shall be protected by one or more integral thermal protective devices. Thermal protective devices shall not be of a self-resettable type and shall be duplicated unless conforming to ~~IEC 60127 series or~~ IEC 60691, in which case only one device is necessary.

~~Alternatively, if it can be demonstrated that an overcurrent protective device can be used to provide thermal protection, such a device may be used. The overcurrent protective device used in this way shall conform to IEC 60127 series and shall be rated at not more than 170 % of the maximum rated current of the electrical equipment. When an overcurrent protective device is not also used as a thermal protective device, it is permissible for the overcurrent protective device to be located outside the enclosure of the electrical equipment. In this case, the marking shall include the symbol "X" in accordance with IEC 60079-0 and the Specific Conditions of Use shall detail the required overcurrent protective device.~~

~~The response time of the thermal protective devices should be taken into account and be adequate for the necessary overtemperature protection.~~

NOTE ~~When no such information exists, a common practice is to use 1.7 × rated current~~

#### 4.3.4.3 Overcurrent protective devices

As an alternative to 4.3.4.2, if it is demonstrated that an overcurrent protective device or devices provide thermal protection, such a device, or devices may be used. The overcurrent protective device may be located outside the enclosure of the Ex Equipment. In this case, the certificate number 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 performance characteristics required by the overcurrent protective devices.

At least one of the protective devices shall be capable of interrupting the maximum available short circuit current of the circuit in which it is installed.

Overcurrent protective devices shall be duplicated unless conforming to the IEC 60127 series, IEC 60269 series or ANSI/UL 248 series, in which case only one device is necessary.

#### 4.3.5 Supplementary internal enclosure

Where normally arcing and sparking parts are incorporated, these parts shall have a supplementary enclosure inside the main enclosure and the maximum surface temperature of that enclosure is used to determine the marked surface temperature of the equipment in accordance with 4.3.2.

When hot internal components are enclosed in a supplementary enclosure, the maximum surface temperature of that enclosure shall be used to determine the marked surface temperature of the equipment in accordance with 4.3.2.

The supplementary enclosure shall:

- have a continuous operating temperature at least equal to the lower specified ambient temperature and at least 20 K greater than the maximum service temperature for non-metallic materials,
- undergo the resistance to impact test in accordance with 6.1.1.2 with no hot and cold impact testing required,
- be IP6X in accordance with IEC 60529 following the resistance to impact without thermal endurance to heat and cold.

These requirements replace the requirements of IEC 60079-0 for such an enclosure.

#### ~~4.3.6 Protection for arcing and sparking parts~~

~~Where normally arcing and sparking parts are incorporated, these parts shall have a supplementary enclosure inside the main enclosure. This supplementary enclosure shall meet the requirements for a "tc" enclosure with the following exceptions and modifications:~~

- ~~• The tests for thermal endurance to heat and cold and resistance to light, specified in 6.1.1.1 are not applicable,~~
- ~~• A COT of at least equal to the lower specified ambient temperature and at least 20 K greater than the maximum service temperature applies for non-metallic materials,~~
- ~~• The internal enclosure is not considered to have external surfaces and the resistance to ultraviolet light and electrostatic requirements are not applicable,~~
- ~~• The requirements for threaded entries, hinges, and requirements for threaded fasteners are not applicable,~~
- ~~• Resistance to impact test is performed in accordance with 6.1.1.2 with no hot and cold impact testing required,~~
- ~~• Pressure test is not applied,~~
- ~~• IP6X is required.~~

#### 4.3.6 Cells and batteries

Only sealed primary cells or batteries shall be used. A control device shall be provided to prevent overheating of the cell or battery. The control device may also be considered as a thermal protective device or overcurrent protective device as given in 4.3.4, provided it also protects the complete Ex Equipment from exceeding the maximum surface temperature.

#### 4.4 Requirements for ~~electrical equipment~~ Ex Equipment with Level of Protection "tb" and "tc"

##### 4.4.1 Fault current

Ex Equipment having Level of Protection "tb" or "tc" which is intended for mains connection to a circuit with a maximum available short circuit current above 10 kA, shall be tested in accordance with 6.1.1.1, and be marked according to Clause 7.

NOTE Limiting the maximum available short circuit current could be achieved by several means including the use of current limiting fuses or current limiting circuit breakers.

##### 4.4.2 Maximum surface temperature

The marked maximum surface temperature shall be measured on the external surfaces of the enclosure for ~~electrical equipment~~ Ex Equipment with ~~types~~ Level of Protection "tb" or "tc" in accordance with 6.1.2 ~~with no dust layer on the external surfaces under normal operating conditions~~.

##### 4.4.3 Dust exclusion

Dust exclusion by enclosure shall be carried out in accordance with 6.1.1.

##### 4.4.4 Thermal protection

###### 4.4.4.1 General

For Level of Protection "tb", if the Ex Equipment is capable of exceeding the marked maximum surface temperature as a result of the temperature test of 6.1.2, a protective device shall be used. The protective device may be a thermal protective device according to 4.4.4.2 or an overcurrent protective device according to 4.4.4.3 which may be directly integrated into the Ex Equipment or be external to the Ex Equipment.

Where the external protective device is not provided by the manufacturer as part of the Ex Equipment, the certificate number shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use shall detail the required ratings and characteristics of the protective device. The protective device shall be capable of interrupting the maximum current of the circuit in which it is installed.

###### 4.4.4.2 Thermal protective devices

When required by 4.4.4.1 the Ex Equipment shall be protected by one or more integral thermal protective devices. Thermal protective devices shall not be of a self-resettable type and shall be duplicated unless conforming to the IEC 60691 series, in which case only one device is necessary.

The response time of the thermal protective devices shall be adequate for the necessary over temperature protection.

#### 4.4.4.3 Overcurrent protective devices

As an alternative to 4.4.4.2, if it is demonstrated that an overcurrent protective device can be used to provide thermal protection, such a device may be used. It is permissible for the overcurrent protective device to be located outside the enclosure of the Ex Equipment. In this case, the certificate number shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use shall detail the required overcurrent protective device. The protective device shall be capable of interrupting the maximum current of the circuit in which it is installed.

Overcurrent protective devices shall be duplicated unless conforming to the IEC 60127 series, IEC 60269 series, or ANSI/UL 248 series, in which case only one device is necessary.

#### 4.4.5 Cells and batteries

Only sealed cells or batteries shall be used. A control device shall be provided to prevent overheating of the cell or battery. The control device may also be considered as a thermal protective device or overcurrent protective device as given in 4.4.4.2 or 4.4.4.3, provided it also protects the complete Ex Equipment from exceeding the maximum surface temperature.

#### 4.4.6 External plug and socket connections for field wiring connection

External plug and socket connections for field wiring connection shall meet one of the following requirements:

- a) they shall be interlocked mechanically or electrically, or otherwise designed so that they cannot be separated when the contacts are energized and the contacts cannot be energized when plug and socket are separated; or
- b) plug and socket connectors for Level of Protection "tc", shall be fixed together by a mechanical means other than the friction between the plug and socket; and for Level of Protection "tb", shall be fixed together by means of special fasteners.

## 5 Construction

### 5.1 Joints

#### 5.1.1 General

All joints in the structure of the enclosure, whether permanently closed or designed to be opened from time to time, ~~shall fit closely together within the tolerances specified in the documentation. They~~ shall be effectively sealed against the ingress of dust and shall comply with the ~~following~~ particular requirements in 5.1.2 to 5.1.6 and be subjected to the test of 6.1.1.

The use of grease alone to maintain the integrity of the seal is not considered to satisfy this requirement.

#### 5.1.2 Threaded joints

- ~~The number of engaged threads for all threaded joints, employing parallel threads without an additional seal or gasket shall be not less than five threads and with a tolerance quality of medium or fine according to ISO 965-1. Tapered threaded joints without an additional seal or gasket shall engage no less than 3½ threads.~~
- ~~Hinges shall not be used as a means of maintaining a seal unless:~~
  - ~~correct compression of the gasket is achieved without causing undue movement, stress or distortion to the gasket; and~~
  - ~~they are manufactured from materials that would not affect the correct function of the sealing means.~~

The number of engaged threads for all threaded joints, employing parallel threads without an additional seal or gasket shall be at least five threads and with a tolerance quality of medium or fine according to ISO 965-1.

Joints employing parallel threads with an additional seal or gasket are permitted to have less than five threads. In this case, a specific tolerance class is not required.

Tapered threaded joints without an additional seal or gasket shall engage no less than 3½ threads.

Where necessary, a means shall be provided to facilitate correct alignment of mating parts.

### **5.1.3 Gaskets and seals**

Gaskets under compression in joints may be used to ensure the effectiveness of the enclosure sealing.

All gaskets and seals shall be of one-piece continuous construction, that is with an uninterrupted periphery.

One-piece construction also includes gaskets and seals that have been permanently joined to form an uninterrupted periphery while maintaining the mechanical properties of the gasket or seal material. Alternately, gasket joints that interlock (not a butt joint) and are designed such that under the intended compression no gap between the pieces exist so that an uninterrupted periphery is formed, these joints do not need to be permanently joined.

Unless all gaskets are secured to one face of the mating surface, either by adhesive or being mechanically secured, the design of the enclosure shall be such that gaskets are correctly positioned. Except for a slight amount of lubricant necessary for assembly or an adhesive material on one side of the mating surfaces, joints using gaskets shall not be supplemented by the application of a sealant material.

A flexible seal, for example a bellows, shall be such that it is not over-stressed at any point and shall be protected from external mechanical damage and secured at each end by mechanical means.

Hinges shall not be used as a means of maintaining a seal unless the correct compression of the gasket is achieved without causing undue movement, stress or distortion to the gasket. The hinges shall be manufactured from materials that would not affect the correct function of the sealing means.

These requirements do not apply to internal seals of cable glands.

### **5.1.4 Cemented joints**

Cemented joints shall not be used on mating parts which need to be removed to gain access to field wiring connections or in-service adjusting facilities.

### **5.1.5 Operating rods, spindles and shafts**

Openings in enclosures for rods, spindles or shafts shall have means to inhibit the ingress of dust, other than only grease or compound, both when the spindles, rods or shafts are in motion and when they are at rest.

## 5.1.6 Windows

### 5.1.6.1 Windows employing a cemented joint

A window design employing a cemented joint shall be such that it is cemented either directly into the wall of the enclosure so as to form with the latter an inseparable assembly, or into a frame such that the assembly can be replaced as a unit.

### 5.1.6.2 Windows employing a gasket joint

A window design employing a gasket for dust exclusion shall be such that it is mounted directly in the wall or cover of the enclosure. ~~No separate detachable frame is required.~~ Alternatively, a window employing a gasket may be mounted in a separate frame such that the assembly can be replaced as a unit.

## 5.2 Cable glands, cable transit devices and conduit sealing devices

~~Cable glands, whether integral or separate, shall meet the requirements of IEC 60079-0, and the joint requirements of 5.1. In addition, cable glands shall meet the requirements of Table 1.~~

~~Where cable glands are separate:~~

- ~~— threaded cable glands may be evaluated as Ex Equipment cable gland,~~
- ~~— other cable glands may be evaluated only as an Ex Component,~~
- ~~— cable glands with other thread forms to those specified here may be evaluated only with the electrical equipment or as an Ex component.~~

Cable glands, cable transit devices, and conduit sealing devices, whether integral or separate, shall meet the requirements of IEC 60079-0 and Annex A.

## 5.3 Entries

### 5.3.1 Plain entries

The clearance holes for plain entries shall ~~have a diameter not more than 0,7 mm greater than~~ be specified in the ~~nominal diameter~~ instructions to allow the proper selection of ~~the entry thread~~ a gland or fitting. The inside of the enclosure shall be provided with sufficient room to attach a locknut to the gland or fitting.

### 5.3.2 Threaded entries

Threaded entries are considered to meet the requirements for Levels of Protection "ta", "tb" and "tc" ~~electrical equipment~~ Ex Equipment if they are one of the following:

- tapered threads with ~~not less~~ no fewer than 3½ threads according to ANSI/ASME B1.20.1;
- parallel threads with ~~not less~~ no fewer than five threads, with a tolerance class of 6H or better according to ISO 965-1;
- parallel threads with ~~less~~ fewer than five threads with a tolerance class of 6H or better according to ISO 965-1 and are provided with an additional seal or gasket. If the additional seal is not an integral part of the ~~electrical equipment~~ Ex Equipment, the ~~marking~~ certificate number shall include the ~~symbol~~ "X" suffix in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use ~~that~~ shall detail the required use of a seal or gasket. An advisory marking of the requirement for a seal or gasket may appear on the ~~electrical equipment~~ Ex Equipment as an alternative to the requirement for the "X" marking.

## 6 Verification and tests

### 6.1 Type tests

#### 6.1.1 Type tests for dust exclusion by enclosures

##### 6.1.1.1 General

Samples of the ~~electrical equipment~~ Ex Equipment shall be subjected to the thermal endurance to heat, thermal endurance to cold and impact tests specified in IEC 60079-0, and the drop test if applicable. If there is a supplementary internal enclosure, there shall be no ~~visual~~ visible damage to the supplementary internal enclosure caused by the impact testing of the ~~main~~ equipment enclosure.

The supplementary internal enclosure may be removed during the thermal endurance to heat and thermal endurance to cold tests.

~~For level of protection "tc", the test of enclosures requirements of IEC 60079-0 are modified for the thermal endurance to heat preconditioning test to replace the 20 K above the service temperature (Ts+20 K) with 10 K above the service temperature (Ts+10K).~~

After conducting the tests of enclosures in accordance with IEC 60079-0, ~~one~~ all of the samples ~~which has been subjected to the tests of enclosures~~ shall then be subjected to the pressure test of 6.1.1.3 followed by the IP test of 6.1.1.4.

Ex Equipment having Level of Protection "tb" or "tc" which is intended for mains connection and intended to interrupt fault current above 10 kA, shall be subjected to short circuit interrupting tests in accordance with the relevant industrial standard after the pressure test of 6.1.1.3 and prior to the IP tests of 6.1.1.4.

NOTE 1 Limiting the maximum available short circuit current could be achieved by several means including the use of current limiting fuses or current limiting circuit breakers.

NOTE 2 When the volume of the switching device displaces a large portion of the free internal volume of the enclosure, damage from a short circuit event can occur due to the venting of arc products from the switching device into the enclosure volume. The increase in enclosure pressure resulting from this venting could impact the ability of the enclosure seal to meet the IP requirement of this document.

##### 6.1.1.2 Impact test ~~for~~ on supplementary internal enclosures

~~The~~ An impact test ~~for~~ on supplementary internal enclosures shall be performed in accordance with the resistance to impact test of IEC 60079-0 using the nominal 1 kg mass dropped from a nominal height of 0,2 m. There shall be no damage which invalidates the ~~type of~~ required ingress protection.

##### 6.1.1.3 Pressure test

A positive internal pressure of at least:

- (4 ± 0,4) kPa for Level of Protection "ta" ~~electrical equipment~~, or
- (2 ± 0,2) kPa for Level of Protection "tb" and "tc" ~~electrical equipment~~,

shall be applied to the ~~electrical equipment~~ Ex Equipment for 60<sub>-0</sub><sup>10</sup> s at least 60 seconds but not more than 70 seconds.

Any breathing or draining device may be sealed for this test if the pressure cannot be maintained. Any seals of the breathing or draining device shall be removed and the sample shall be subjected to the IP test in the condition it is in after the completion of this test. This test is not required for cable glands evaluated as Ex Equipment cable gland.

If the design of the ~~electrical equipment~~ Ex Equipment is such that any gaskets or seals are physically constrained from moving, for example an "O" ring in a groove, this test is not required to be conducted for Levels of Protection "tb" and "tc" ~~electrical equipment~~ Ex Equipment.

The pressure test is not performed on a supplementary internal enclosure.

#### 6.1.1.4 IP test

~~The samples shall be IP tested for the different level of protection as given in Table 1. Any grease in the joints shall be removed before the IP test is performed.~~

The ingress protection specified in Table 1 shall be determined in accordance with degree of protection (IP) of enclosures as specified in IEC 60079-0, with the following modifications:

For Level of Protection "ta":

- The level of depression shall be increased to at least 4 kPa for a period of at least 8 h.

For Level of Protection "tb" and "tc":

- When IP5X or IP6X is required for rotating machines, the test requirements of IEC 60034-5 and acceptance requirements of IEC 60529 shall apply.
- Grease in joints shall be removed before the IP test is performed; except in the case of shafts in rotating machines where the supplied lubricant is retained.

#### 6.1.2 Thermal tests

~~For "tb" and "tc" electrical equipment the test shall be carried out as described in IEC 60079-0.~~

~~For "ta" electrical equipment, the maximum surface temperature test of IEC 60079-0 is conducted with the electrical equipment surrounded by at least a 200 mm layer of dust on all sides. The final temperature shall have been considered to have been reached when the rate of rise of temperature does not exceed 1 K/24h. This test is carried out as described in IEC 60079-0 and with one additional fault applied to the electrical equipment.~~

~~NOTE See IEC 60079-0 for the specification of the test dust~~

#### 6.1.2 Tests to determine maximum surface temperature

For Levels of Protection "ta", "tb" and "tc", the tests shall be carried out as described in IEC 60079-0.

For Level of Protection "ta" overload and malfunction shall be simulated by dissipating 1,5 times the input power as measured under normal operation and measuring the maximum surface temperature on the external surface of the main enclosure. Temperatures on internal components or the external surface of the supplementary enclosure are determined at rated input power.

NOTE The simulation is often achieved by substitution of the internal components with a resistor capable of dissipating the intended power.

For Level of Protection "tb", overload and malfunction conditions are as specified in Table 2.

**Table 2 – Overload or malfunction conditions for Level of Protection "tb"**

Type of Ex Equipment	Overload or malfunction conditions
Luminaires (without ballast)	None
Luminaires with electro-magnetic ballasts	$U_n + 10\%$ Rectifier effect simulated by diode
Luminaires with electronic ballasts	As specified for the applicable standard for industrial equipment
Electric Machines – mains supply connected	None
Electric machines – converter connected	<p>None if electric machine is evaluated with a specific converter and a specified duty as described by IEC 60079-0, or;</p> <p>If the electric machine is not evaluated with a specific converter and a specified duty as described by IEC 60079-0, overload as necessary to confirm that the required direct thermal protection, normally in the stator winding, has sufficient margin to be able to detect excessive temperatures at the rotor, bearings, bearing caps and shaft extensions. The margin may be determined by test or calculation. In this case, the use of the thermal protection is made mandatory by identification of this Specific Condition of Use in the certificate.</p> <p>NOTE Direct thermal protection of the bearings is often appropriate to represent the maximum surface temperatures of the parts of concern. It has been found that for some motors, direct thermal protection of the winding set at 160 °C can be appropriate for maximum surface temperature T200°C, but this would still need to be confirmed by test or calculation.</p>
Resistors	None
Electromagnets	$U_n$ and worst-case air-gap
Other equipment	As specified by the applicable standard for industrial equipment
<p>NOTE For test voltage and current parameters, see the maximum surface temperature requirements in IEC 60079-0.</p>	

**6.2 Routine tests**

There are no additional routine tests required for Levels of Protection "ta", "tb", or "tc".

**7 Marking**

These requirements supplement the requirements of IEC 60079-0, which are applicable to Levels of Protection "ta", "tb" and "tc". The symbol for the Type of Protection used shall be "ta", "tb", or "tc", as applicable.

~~Where the electrical equipment is only suitable for a maximum rated prospective short circuit current for "ta" electrical equipment at the supply connection point to the electrical equipment of less than 10 kA, the prospective short circuit current shall be marked.~~

Ex Equipment having Level of Protection "ta" shall be marked to indicate suitability for connection to a supply with a maximum available short circuit current of 1,5 kA.

Ex Equipment having Level of Protection "tb" or "tc" which is intended for mains connection and which contains one or more circuit breakers shall be marked to indicate the maximum available short circuit rating of the mains supply with which the Ex Equipment was determined to comply in 6.1.1.1.

## **Annex A** (normative)

### **Supplementary requirements for entry devices**

#### **A.1 General**

This annex contains the requirements which apply to the construction and testing of entry devices having Type of Protection "t" in addition to the requirements found in IEC 60079-0.

Group III entry devices include cable glands, cable transit devices, conduit sealing devices, blanking elements and thread adaptors as Ex Equipment or Ex Components.

#### **A.2 Construction requirements**

##### **A.2.1 Cable glands, cable transit devices and conduit sealing devices**

Cable glands, cable transit devices and conduit sealing devices, whether integral or separate, shall meet the joint requirements of 5.1 and the marking requirements of Clause A.4.

##### **A.2.2 Blanking elements and thread adaptors**

Blanking elements shall meet the joint requirements of 5.1, and the threading requirements of 5.2, 5.3.

Thread adaptors may use thread forms other than those in 5.3.2, whether as an Ex Equipment thread adaptor or as a thread adaptor fitted and assessed as a factory-assembled part of the enclosure.

#### **A.3 Type tests**

##### **A.3.1 Cable glands, cable transit devices and conduit sealing devices**

Cable glands, cable transit devices and conduit sealing devices, shall comply with the "Test for degree of protection (IP) of cable glands" in IEC 60079-0 as modified by 6.1.1.

##### **A.3.2 Blanking elements and thread adaptors**

Blanking elements and thread adaptors shall comply the "Test for degree of protection (IP) of cable glands" in IEC 60079-0 as modified by 6.1.1.

#### **A.4 Marking**

Group III entry devices shall be marked in accordance with Clause 7. The specific thread type and size thread shall be marked in accordance with IEC 60079-0.

## Bibliography

IEC 60050-426, *International Electrotechnical Vocabulary (IEV) – Part 426: ~~Equipment for~~ Explosive atmospheres*

IEC 60079-14, *Explosive atmospheres - Part 14: Electrical installations design, selection and erection*

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# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Explosive atmospheres –  
Part 31: Equipment dust ignition protection by enclosure "t"**

**Atmosphères explosives –  
Partie 31: Protection contre l'inflammation de poussières par enveloppe "t"  
relative à l'appareil**

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## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references .....	8
3 Terms and definitions .....	9
4 General .....	9
4.1 Levels of protection.....	9
4.2 Equipment groups and ingress protection .....	9
4.3 Requirements for Ex Equipment with Level of Protection "ta" .....	10
4.3.1 Fault current.....	10
4.3.2 Maximum surface temperature.....	10
4.3.3 Dust exclusion.....	10
4.3.4 Protective Devices.....	10
4.3.5 Supplementary internal enclosure.....	11
4.3.6 Cells and batteries.....	11
4.4 Requirements for Ex Equipment with Level of Protection "tb" and "tc" .....	11
4.4.1 Fault current.....	11
4.4.2 Maximum surface temperature.....	12
4.4.3 Dust exclusion.....	12
4.4.4 Thermal protection.....	12
4.4.5 Cells and batteries.....	12
4.4.6 External plug and socket connections for field wiring connection .....	13
5 Construction.....	13
5.1 Joints.....	13
5.1.1 General .....	13
5.1.2 Threaded joints.....	13
5.1.3 Gaskets and seals .....	13
5.1.4 Cemented joints.....	14
5.1.5 Operating rods, spindles and shafts.....	14
5.1.6 Windows.....	14
5.2 Cable glands, cable transit devices and conduit sealing devices .....	14
5.3 Entries.....	14
5.3.1 Plain entries .....	14
5.3.2 Threaded entries .....	14
6 Verification and tests .....	15
6.1 Type tests.....	15
6.1.1 Type tests for dust exclusion by enclosures.....	15
6.1.2 Tests to determine maximum surface temperature.....	16
6.2 Routine tests .....	17
7 Marking .....	17
Annex A (normative) Supplementary requirements for entry devices.....	18
A.1 General.....	18
A.2 Construction requirements .....	18
A.2.1 Cable glands, cable transit devices and conduit sealing devices.....	18
A.2.2 Blanking elements and thread adapters .....	18

A.3	Type tests .....	18
A.3.1	Cable glands, cable transit devices and conduit sealing devices .....	18
A.3.2	Blanking elements and thread adapters .....	18
A.4	Marking .....	18
	Bibliography .....	19
	Table 1 – Level of Protection, equipment group and ingress protection (IP) relationship .....	10
	Table 2 – Overload or malfunction conditions for Level of Protection "tb" .....	16

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# INTERNATIONAL ELECTROTECHNICAL COMMISSION

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## EXPLOSIVE ATMOSPHERES –

### Part 31: Equipment dust ignition protection by enclosure "t"

#### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
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- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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

This third edition cancels and replaces the second edition published in 2013. This edition constitutes a technical revision.

The significance of changes between IEC Standard, IEC 60079-31, Edition 3.0 and IEC 60079-31, Edition 2.0, are as listed below:

Changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Document has been restructured from edition 2	Numerous	X		
Withstand of prospective short-circuit current	4.3.1		X	
Fault current rating of interrupting contacts rated greater than 10 kA for mains connected circuits	4.4.1 and 6.1.1.1			C1
Thermal protective device can include a thermal protective circuit with an appropriate sensor.	4.4.4.1		X	
Cells and batteries	4.3.6 and 4.4.5			C2
Joints employing parallel threads with an additional seal or gasket are permitted to have less than five threads.	5.1.2		X	
Gasket joints that interlock (not a butt joint) and are designed such that under the intended compression no gap between the pieces exist so that an uninterrupted periphery is formed, these joints do not need to be permanently joined.	5.1.3		X	
Overload or malfunction condition for the determination of temperature class for "tb" converter fed rotating electric machines	Table 2			C3
Additional requirements for entry devices with dust ignition protection by enclosure "t"	Annex A			C4
Thermal tests are relocated to IEC 60079-0.	Formerly 6.1.2	A1		

NOTE The technical changes referred to include the significance of technical changes in the revised IEC Standard, but they do not form an exhaustive list of all modifications from the previous version. More guidance may be found by referring to the Redline Version of the standard.

## Explanations:

### A) Definitions

#### 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.

**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.

## 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 clause 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 – For Ex Equipment having Level of Protection "tb" or "tc" which is intended for mains connection and intended to interrupt fault current above 10kA is tested according to 6.1.1.1, and is marked according to Clause 7.

C2 – For Ex Equipment having Level of Protection "ta" which contains a cell or battery, only a sealed cell or battery shall be used. For Ex Equipment having Level of Protection "tb" and "tc" where there are sparking contacts or hot surfaces, and which contains a cell or battery, only a sealed cell or battery shall be used.

C3 – Table 2 now includes malfunction conditions for temperature class determination of Level of Protection "tb" converter-fed electric machines.

C4 – Annex A added for entry devices with Type of Protection "t" including cable transit devices.

A1 – Thermal tests formerly located in 6.1.2 are relocated to IEC 60079-0 for the 2017 and later editions.

The text of this International Standard is based on the following documents:

Draft	Report on voting
31/1595/FDIS	31/1606/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

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

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

## INTRODUCTION

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent. IEC takes no position concerning the evidence, validity, and scope of this patent right.

The holder of this patent right has assured IEC that s/he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with IEC. Information may be obtained from the patent database available at <http://patents.iec.ch>.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those in the patent database. IEC shall not be held responsible for identifying any or all such patent rights.

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## EXPLOSIVE ATMOSPHERES –

### Part 31: Equipment dust ignition protection by enclosure "t"

#### 1 Scope

This part of IEC 60079 is applicable to equipment protected by enclosure and surface temperature limitation for use in explosive dust atmospheres. It specifies requirements for design, construction and testing of Ex Equipment and Ex Components.

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

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

This document does not apply to Ex Equipment or Ex Components 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 document does not take account of any hazard due to an emission of flammable or toxic gas from the dust.

This document does not contain requirements for Ex Equipment used in areas where both combustible dust and explosive gas atmospheres can occur, whether simultaneously or separately. Requirements for explosive gas atmospheres can be found in other parts of the IEC 60079 series. Guidance on Ex Equipment to be used where combustible dust and explosive gas atmospheres occur simultaneously ("hybrid mixtures") can be found in IEC 60079-14.

Where the Ex Equipment has to meet other environmental conditions, for example, protection against ingress of water, and resistance to corrosion, additional measures which do not adversely affect the integrity of the enclosure can be necessary.

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60127 (all parts), *Miniature fuses*

IEC 60269 (all parts), *Low-voltage fuses*

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

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

IEC 60034-5, *Rotating electrical machines – Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification*

ISO 965-1, *ISO general-purpose metric screw threads – Tolerances – Part 1: Principles and basic data*

ANSI/ASME B1.20.1, *Pipe threads, general purpose (inch)*

ANSI/UL 248 (*all parts*), *Standard for Low-Voltage Fuses*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **dust ignition protection by enclosure "t"**

Type of Protection for explosive dust atmospheres where equipment is provided with an enclosure providing dust ingress protection and a means to limit surface temperatures

### 4 General

#### 4.1 Levels of protection

Type of Protection "t" is divided into three Levels of Protection based on the risk of the Ex Equipment and Ex Components becoming an ignition source in an explosive dust atmosphere. Ex Equipment and Ex Components with Type of Protection "t" shall be one of the following:

- Level of Protection "ta" for EPL "Da";
- Level of Protection "tb" for EPL "Db";
- Level of Protection "tc" for EPL "Dc".

The general requirements of Clause 4, the construction requirements of Clause 5, and the marking requirements of Clause 7, apply to all Ex "t" Equipment and Ex "t" Components.

Failure modes as defined in the industrial standard for particular internal components affecting the temperatures of the equipment shall be taken into account when considering applicable malfunctions.

When a resistor is used for current limiting, it shall not be considered to fail as a short circuit if it is of metal film or of wire wound construction. The resistor shall be rated for the maximum rated voltage of the equipment.

#### 4.2 Equipment groups and ingress protection

The relationship between the Level of Protection, the group, and ingress protection required is shown in Table 1.

**Table 1 – Level of Protection, equipment group and ingress protection (IP) relationship**

Level of Protection	Group IIIC	Group IIIB	Group IIIA
"ta"	IP6X	IP6X	IP6X
"tb"	IP6X	IP6X	IP5X
"tc"	IP6X	IP5X	IP5X

### 4.3 Requirements for Ex Equipment with Level of Protection "ta"

#### 4.3.1 Fault current

Ex Equipment shall be rated for connection to a circuit with a prospective short circuit current of not greater than 1,5 kA and marked according to Clause 7.

#### 4.3.2 Maximum surface temperature

These requirements modify and supplement the requirements of IEC 60079-0.

The marked maximum surface temperature, as determined according to 6.1.2, shall be the higher of the measured temperatures a) or b):

- a) the surfaces of the internal components where there is no supplementary enclosure, or,
- b) the temperature on the external surfaces of the supplementary enclosure.

NOTE 1 Partial rupture of the external enclosure is considered to be a potential rare malfunction and is considered in the temperature determination for "ta" equipment.

NOTE 2 Level of Protection "ta" is typically applied for instrumentation where the maximum available short circuit current is in the mA range. Due to the limited thermal dissipation available to Level of Protection "ta" equipment, the maximum normal power dissipation is generally limited to a few watts.

#### 4.3.3 Dust exclusion

Dust exclusion by enclosure shall be carried out in accordance with 6.1.1.

#### 4.3.4 Protective Devices

##### 4.3.4.1 General

If the Ex Equipment is capable of exceeding the marked maximum surface temperature as a result of the temperature test of 6.1.2 under expected malfunction or for rare malfunction conditions, a protective device shall be used. The protective device may be a thermal protective device according to 4.3.4.2 or an overcurrent protective device according to 4.3.4.3 which may be directly integrated into the Ex Equipment or be external to the Ex Equipment.

Where the external protective device is not provided by the manufacturer as part of the Ex Equipment, the certificate number 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 required ratings and performance characteristics of the protective device. The protective device shall be capable of interrupting the maximum current of the circuit in which it is installed.

The response time of the thermal protective device or overcurrent protective device shall be taken into account and be adequate for the necessary over temperature protection.

#### 4.3.4.2 Thermal protective devices

When required by 4.3.4.1, the Ex Equipment shall be protected by one or more integral thermal protective devices. Thermal protective devices shall not be of a self-resettable type and shall be duplicated unless conforming to IEC 60691, in which case only one device is necessary.

#### 4.3.4.3 Overcurrent protective devices

As an alternative to 4.3.4.2, if it is demonstrated that an overcurrent protective device or devices provide thermal protection, such a device, or devices may be used. The overcurrent protective device may be located outside the enclosure of the Ex Equipment. In this case, the certificate number 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 performance characteristics required by the overcurrent protective devices.

At least one of the protective devices shall be capable of interrupting the maximum available short circuit current of the circuit in which it is installed.

Overcurrent protective devices shall be duplicated unless conforming to the IEC 60127 series, IEC 60269 series or ANSI/UL 248 series, in which case only one device is necessary.

#### 4.3.5 Supplementary internal enclosure

Where normally arcing and sparking parts are incorporated, these parts shall have a supplementary enclosure inside the main enclosure and the maximum surface temperature of that enclosure is used to determine the marked surface temperature of the equipment in accordance with 4.3.2.

When hot internal components are enclosed in a supplementary enclosure, the maximum surface temperature of that enclosure shall be used to determine the marked surface temperature of the equipment in accordance with 4.3.2.

The supplementary enclosure shall:

- have a continuous operating temperature at least equal to the lower specified ambient temperature and at least 20 K greater than the maximum service temperature for non-metallic materials,
- undergo the resistance to impact test in accordance with 6.1.1.2 with no hot and cold impact testing required,
- be IP6X in accordance with IEC 60529 following the resistance to impact without thermal endurance to heat and cold.

These requirements replace the requirements of IEC 60079-0 for such an enclosure.

#### 4.3.6 Cells and batteries

Only sealed primary cells or batteries shall be used. A control device shall be provided to prevent overheating of the cell or battery. The control device may also be considered as a thermal protective device or overcurrent protective device as given in 4.3.4, provided it also protects the complete Ex Equipment from exceeding the maximum surface temperature.

### 4.4 Requirements for Ex Equipment with Level of Protection "tb" and "tc"

#### 4.4.1 Fault current

Ex Equipment having Level of Protection "tb" or "tc" which is intended for mains connection to a circuit with a maximum available short circuit current above 10 kA, shall be tested in accordance with 6.1.1.1, and be marked according to Clause 7.

NOTE Limiting the maximum available short circuit current could be achieved by several means including the use of current limiting fuses or current limiting circuit breakers.

#### **4.4.2 Maximum surface temperature**

The marked maximum surface temperature shall be measured on the external surfaces of the enclosure for Ex Equipment with Level of Protection "tb" or "tc" in accordance with 6.1.2.

#### **4.4.3 Dust exclusion**

Dust exclusion by enclosure shall be carried out in accordance with 6.1.1.

#### **4.4.4 Thermal protection**

##### **4.4.4.1 General**

For Level of Protection "tb", if the Ex Equipment is capable of exceeding the marked maximum surface temperature as a result of the temperature test of 6.1.2, a protective device shall be used. The protective device may be a thermal protective device according to 4.4.4.2 or an overcurrent protective device according to 4.4.4.3 which may be directly integrated into the Ex Equipment or be external to the Ex Equipment.

Where the external protective device is not provided by the manufacturer as part of the Ex Equipment, the certificate number shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use shall detail the required ratings and characteristics of the protective device. The protective device shall be capable of interrupting the maximum current of the circuit in which it is installed.

##### **4.4.4.2 Thermal protective devices**

When required by 4.4.4.1 the Ex Equipment shall be protected by one or more integral thermal protective devices. Thermal protective devices shall not be of a self-resettable type and shall be duplicated unless conforming to the IEC 60691 series, in which case only one device is necessary.

The response time of the thermal protective devices shall be adequate for the necessary over temperature protection.

##### **4.4.4.3 Overcurrent protective devices**

As an alternative to 4.4.4.2, if it is demonstrated that an overcurrent protective device can be used to provide thermal protection, such a device may be used. It is permissible for the overcurrent protective device to be located outside the enclosure of the Ex Equipment. In this case, the certificate number shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use shall detail the required overcurrent protective device. The protective device shall be capable of interrupting the maximum current of the circuit in which it is installed.

Overcurrent protective devices shall be duplicated unless conforming to the IEC 60127 series, IEC 60269 series, or ANSI/UL 248 series, in which case only one device is necessary.

#### **4.4.5 Cells and batteries**

Only sealed cells or batteries shall be used. A control device shall be provided to prevent overheating of the cell or battery. The control device may also be considered as a thermal protective device or overcurrent protective device as given in 4.4.4.2 or 4.4.4.3, provided it also protects the complete Ex Equipment from exceeding the maximum surface temperature.

#### 4.4.6 External plug and socket connections for field wiring connection

External plug and socket connections for field wiring connection shall meet one of the following requirements:

- a) they shall be interlocked mechanically or electrically, or otherwise designed so that they cannot be separated when the contacts are energized and the contacts cannot be energized when plug and socket are separated; or
- b) plug and socket connectors for Level of Protection "tc", shall be fixed together by a mechanical means other than the friction between the plug and socket; and for Level of Protection "tb", shall be fixed together by means of special fasteners.

### 5 Construction

#### 5.1 Joints

##### 5.1.1 General

All joints in the structure of the enclosure, whether permanently closed or designed to be opened from time to time, shall be effectively sealed against the ingress of dust and shall comply with the particular requirements in 5.1.2 to 5.1.6 and be subjected to the test of 6.1.1.

The use of grease alone to maintain the integrity of the seal is not considered to satisfy this requirement.

##### 5.1.2 Threaded joints

The number of engaged threads for all threaded joints, employing parallel threads without an additional seal or gasket shall be at least five threads and with a tolerance quality of medium or fine according to ISO 965-1.

Joints employing parallel threads with an additional seal or gasket are permitted to have less than five threads. In this case, a specific tolerance class is not required.

Tapered threaded joints without an additional seal or gasket shall engage no less than 3½ threads.

Where necessary, a means shall be provided to facilitate correct alignment of mating parts.

##### 5.1.3 Gaskets and seals

Gaskets under compression in joints may be used to ensure the effectiveness of the enclosure sealing.

All gaskets and seals shall be of one-piece continuous construction, that is with an uninterrupted periphery.

One-piece construction also includes gaskets and seals that have been permanently joined to form an uninterrupted periphery while maintaining the mechanical properties of the gasket or seal material. Alternately, gasket joints that interlock (not a butt joint) and are designed such that under the intended compression no gap between the pieces exist so that an uninterrupted periphery is formed, these joints do not need to be permanently joined.

Unless all gaskets are secured to one face of the mating surface, either by adhesive or being mechanically secured, the design of the enclosure shall be such that gaskets are correctly positioned. Except for a slight amount of lubricant necessary for assembly or an adhesive material on one side of the mating surfaces, joints using gaskets shall not be supplemented by the application of a sealant material.

A flexible seal, for example a bellows, shall be such that it is not over-stressed at any point and shall be protected from external mechanical damage and secured at each end by mechanical means.

Hinges shall not be used as a means of maintaining a seal unless the correct compression of the gasket is achieved without causing undue movement, stress or distortion to the gasket. The hinges shall be manufactured from materials that would not affect the correct function of the sealing means.

These requirements do not apply to internal seals of cable glands.

#### **5.1.4 Cemented joints**

Cemented joints shall not be used on mating parts which need to be removed to gain access to field wiring connections or in-service adjusting facilities.

#### **5.1.5 Operating rods, spindles and shafts**

Openings in enclosures for rods, spindles or shafts shall have means to inhibit the ingress of dust, other than only grease or compound, both when the spindles, rods or shafts are in motion and when they are at rest.

#### **5.1.6 Windows**

##### **5.1.6.1 Windows employing a cemented joint**

A window design employing a cemented joint shall be such that it is cemented either directly into the wall of the enclosure so as to form with the latter an inseparable assembly, or into a frame such that the assembly can be replaced as a unit.

##### **5.1.6.2 Windows employing a gasket joint**

A window design employing a gasket for dust exclusion shall be such that it is mounted directly in the wall or cover of the enclosure. Alternatively, a window employing a gasket may be mounted in a separate frame such that the assembly can be replaced as a unit.

### **5.2 Cable glands, cable transit devices and conduit sealing devices**

Cable glands, cable transit devices, and conduit sealing devices, whether integral or separate, shall meet the requirements of IEC 60079-0 and Annex A.

### **5.3 Entries**

#### **5.3.1 Plain entries**

The clearance holes for plain entries shall be specified in the instructions to allow the proper selection of a gland or fitting. The inside of the enclosure shall be provided with sufficient room to attach a locknut to the gland or fitting.

#### **5.3.2 Threaded entries**

Threaded entries are considered to meet the requirements for Levels of Protection "ta", "tb" and "tc" Ex Equipment if they are one of the following:

- tapered threads with no fewer than 3½ threads according to ANSI/ASME B1.20.1;
- parallel threads with no fewer than five threads, with a tolerance class of 6H or better according to ISO 965-1;
- parallel threads with fewer than five threads with a tolerance class of 6H or better according to ISO 965-1 and are provided with an additional seal or gasket. If the additional seal is not

an integral part of the Ex Equipment, the certificate number shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the Specific Conditions of Use shall detail the required use of a seal or gasket. An advisory marking of the requirement for a seal or gasket may appear on the Ex Equipment as an alternative to the requirement for the "X" marking.

## 6 Verification and tests

### 6.1 Type tests

#### 6.1.1 Type tests for dust exclusion by enclosures

##### 6.1.1.1 General

Samples of the Ex Equipment shall be subjected to the thermal endurance to heat, thermal endurance to cold and impact tests specified in IEC 60079-0, and the drop test if applicable. If there is a supplementary internal enclosure, there shall be no visible damage to the supplementary internal enclosure caused by the impact testing of the equipment enclosure.

The supplementary internal enclosure may be removed during the thermal endurance to heat and thermal endurance to cold tests.

After conducting the tests of enclosures in accordance with IEC 60079-0, all of the samples shall then be subjected to the pressure test of 6.1.1.3 followed by the IP test of 6.1.1.4.

Ex Equipment having Level of Protection "tb" or "tc" which is intended for mains connection and intended to interrupt fault current above 10 kA, shall be subjected to short circuit interrupting tests in accordance with the relevant industrial standard after the pressure test of 6.1.1.3 and prior to the IP tests of 6.1.1.4.

NOTE 1 Limiting the maximum available short circuit current could be achieved by several means including the use of current limiting fuses or current limiting circuit breakers.

NOTE 2 When the volume of the switching device displaces a large portion of the free internal volume of the enclosure, damage from a short circuit event can occur due to the venting of arc products from the switching device into the enclosure volume. The increase in enclosure pressure resulting from this venting could impact the ability of the enclosure seal to meet the IP requirement of this document.

##### 6.1.1.2 Impact test on supplementary internal enclosures

An impact test on supplementary internal enclosures shall be performed in accordance with the resistance to impact test of IEC 60079-0 using the nominal 1 kg mass dropped from a nominal height of 0,2 m. There shall be no damage which invalidates the required ingress protection.

##### 6.1.1.3 Pressure test

A positive internal pressure of at least:

- $(4 \pm 0,4)$  kPa for Level of Protection "ta", or
- $(2 \pm 0,2)$  kPa for Level of Protection "tb" and "tc",

shall be applied to the Ex Equipment for at least 60 seconds but not more than 70 seconds.

Any breathing or draining device may be sealed for this test if the pressure cannot be maintained. Any seals of the breathing or draining device shall be removed and the sample shall be subjected to the IP test in the condition it is in after the completion of this test. This test is not required for cable glands evaluated as Ex Equipment cable gland.

If the design of the Ex Equipment is such that any gaskets or seals are physically constrained from moving, for example an "O" ring in a groove, this test is not required to be conducted for Levels of Protection "tb" and "tc" Ex Equipment.

The pressure test is not performed on a supplementary internal enclosure.

**6.1.1.4 IP test**

The ingress protection specified in Table 1 shall be determined in accordance with degree of protection (IP) of enclosures as specified in IEC 60079-0, with the following modifications:

For Level of Protection "ta":

- The level of depression shall be increased to at least 4 kPa for a period of at least 8 h.

For Level of Protection "tb" and "tc":

- When IP5X or IP6X is required for rotating machines, the test requirements of IEC 60034-5 and acceptance requirements of IEC 60529 shall apply.
- Grease in joints shall be removed before the IP test is performed; except in the case of shafts in rotating machines where the supplied lubricant is retained.

**6.1.2 Tests to determine maximum surface temperature**

For Levels of Protection "ta", "tb" and "tc", the tests shall be carried out as described in IEC 60079-0.

For Level of Protection "ta" overload and malfunction shall be simulated by dissipating 1,5 times the input power as measured under normal operation and measuring the maximum surface temperature on the external surface of the main enclosure. Temperatures on internal components or the external surface of the supplementary enclosure are determined at rated input power.

NOTE The simulation is often achieved by substitution of the internal components with a resistor capable of dissipating the intended power.

For Level of Protection "tb", overload and malfunction conditions are as specified in Table 2.

**Table 2 – Overload or malfunction conditions for Level of Protection "tb"**

Type of Ex Equipment	Overload or malfunction conditions
Luminaires (without ballast)	None
Luminaires with electro-magnetic ballasts	$U_n + 10\%$ Rectifier effect simulated by diode
Luminaires with electronic ballasts	As specified for the applicable standard for industrial equipment
Electric Machines – mains supply connected	None
Electric machines – converter connected	<p>None if electric machine is evaluated with a specific converter and a specified duty as described by IEC 60079-0, or;</p> <p>If the electric machine is not evaluated with a specific converter and a specified duty as described by IEC 60079-0, overload as necessary to confirm that the required direct thermal protection, normally in the stator winding, has sufficient margin to be able to detect excessive temperatures at the rotor, bearings, bearing caps and shaft extensions. The margin may be determined by test or calculation. In this case, the use of the thermal protection is made mandatory by identification of this Specific Condition of Use in the certificate.</p> <p>NOTE Direct thermal protection of the bearings is often appropriate to represent the maximum surface temperatures of the parts of concern. It has been found that for some motors, direct thermal protection of the winding set at 160 °C can be appropriate for</p>

Type of Ex Equipment	Overload or malfunction conditions
	maximum surface temperature T200°C, but this would still need to be confirmed by test or calculation.
Resistors	None
Electromagnets	$U_n$ and worst-case air-gap
Other equipment	As specified by the applicable standard for industrial equipment
NOTE For test voltage and current parameters, see the maximum surface temperature requirements in IEC 60079-0.	

## 6.2 Routine tests

There are no additional routine tests required for Levels of Protection "ta", "tb" or "tc".

## 7 Marking

These requirements supplement the requirements of IEC 60079-0, which are applicable to Levels of Protection "ta", "tb" and "tc". The symbol for the Type of Protection used shall be "ta", "tb", or "tc", as applicable.

Ex Equipment having Level of Protection "ta" shall be marked to indicate suitability for connection to a supply with a maximum available short circuit current of 1,5 kA.

Ex Equipment having Level of Protection "tb" or "tc" which is intended for mains connection and which contains one or more circuit breakers shall be marked to indicate the maximum available short circuit rating of the mains supply with which the Ex Equipment was determined to comply in 6.1.1.1.

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## **Annex A** (normative)

### **Supplementary requirements for entry devices**

#### **A.1 General**

This annex contains the requirements which apply to the construction and testing of entry devices having Type of Protection "t" in addition to the requirements found in IEC 60079-0.

Group III entry devices include cable glands, cable transit devices, conduit sealing devices, blanking elements and thread adaptors as Ex Equipment or Ex Components.

#### **A.2 Construction requirements**

##### **A.2.1 Cable glands, cable transit devices and conduit sealing devices**

Cable glands, cable transit devices and conduit sealing devices, whether integral or separate, shall meet the joint requirements of 5.1 and the marking requirements of Clause A.4.

##### **A.2.2 Blanking elements and thread adaptors**

Blanking elements shall meet the joint requirements of 5.1, and the threading requirements of 5.2, 5.3.

Thread adaptors may use thread forms other than those in 5.3.2, whether as an Ex Equipment thread adapter or as a thread adapter fitted and assessed as a factory-assembled part of the enclosure.

#### **A.3 Type tests**

##### **A.3.1 Cable glands, cable transit devices and conduit sealing devices**

Cable glands, cable transit devices and conduit sealing devices, shall comply with the "Test for degree of protection (IP) of cable glands" in IEC 60079-0 as modified by 6.1.1.

##### **A.3.2 Blanking elements and thread adaptors**

Blanking elements and thread adaptors shall comply the "Test for degree of protection (IP) of cable glands" in IEC 60079-0 as modified by 6.1.1.

#### **A.4 Marking**

Group III entry devices shall be marked in accordance with Clause 7. The specific thread type and size thread shall be marked in accordance with IEC 60079-0.

## Bibliography

IEC 60050-426, *International Electrotechnical Vocabulary (IEV) – Part 426: Explosive atmospheres*

IEC 60079-14, *Explosive atmospheres - Part 14: Electrical installations design, selection and erection*

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## SOMMAIRE

AVANT-PROPOS.....	22
INTRODUCTION.....	26
1 Domaine d'application .....	27
2 Références normatives .....	27
3 Termes et définitions .....	28
4 Généralités.....	28
4.1 Niveaux de protection .....	28
4.2 Groupes d'appareils et protection contre la pénétration.....	29
4.3 Exigences relatives aux Appareils Ex avec le niveau de protection "ta" .....	29
4.3.1 Courant de défaut.....	29
4.3.2 Température maximale de surface .....	29
4.3.3 Exclusion des poussières .....	29
4.3.4 Dispositifs de protection .....	29
4.3.5 Enveloppe interne supplémentaire.....	30
4.3.6 Piles et batteries.....	30
4.4 Exigences relatives aux Appareils Ex avec les niveaux de protection "tb" et "tc" .....	31
4.4.1 Courant de défaut.....	31
4.4.2 Température maximale de surface .....	31
4.4.3 Exclusion des poussières .....	31
4.4.4 Protection thermique .....	31
4.4.5 Piles et batteries.....	32
4.4.6 Connexions à contacts mâles et femelles externes pour connexions filaires en exploitation .....	32
5 Construction .....	32
5.1 Joints.....	32
5.1.1 Généralités .....	32
5.1.2 Joints filetés .....	32
5.1.3 Garnitures et scellements .....	32
5.1.4 Joints scellés.....	33
5.1.5 Tiges de manœuvre, broches et arbres de puissance .....	33
5.1.6 Fenêtres .....	33
5.2 Entrées de câbles, dispositifs de passage de câbles et dispositifs d'étanchéité de conduits .....	34
5.3 Entrées .....	34
5.3.1 Entrées lisses .....	34
5.3.2 Entrées filetées .....	34
6 Vérification et essais .....	34
6.1 Essais de type .....	34
6.1.1 Essais de type pour l'exclusion des poussières par enveloppes .....	34
6.1.2 Essais permettant de déterminer la température maximale de surface.....	35
6.2 Essais individuels de série .....	36
7 Marquage .....	36
Annexe A (normative) Exigences supplémentaires pour les dispositifs d'entrée .....	38
A.1 Généralités .....	38
A.2 Exigences de construction .....	38

A.2.1	Entrées de câbles, dispositifs de passage de câbles et dispositifs d'étanchéité de conduits .....	38
A.2.2	Dispositifs d'obturation et adaptateurs filetés .....	38
A.3	Essais de type .....	38
A.3.1	Entrées de câbles, dispositifs de passage de câbles et dispositifs d'étanchéité de conduits .....	38
A.3.2	Dispositifs d'obturation et adaptateurs filetés .....	38
A.4	Marquage .....	38
	Bibliographie.....	39

Tableau 1 – Relation entre le niveau de protection, le groupe d'appareils et la protection contre la pénétration (IP - *ingress protection*)..... 29

Tableau 2 – Conditions de surcharge ou de dysfonctionnement pour le niveau de protection "tb"..... 36

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## COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

## ATMOSPHÈRES EXPLOSIVES –

**Partie 31: Protection contre l'inflammation de poussières  
par enveloppe "t" relative à l'appareil**

## AVANT-PROPOS

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Cette troisième édition annule et remplace la deuxième édition parue en 2013. Cette édition constitue une révision technique.

L'importance des modifications entre l'IEC 60079-31, Édition 3.0 et l'IEC 60079-31, Édition 2.0 est indiquée ci-dessous:

Modifications	Article/ Paragraphe	Type		
		Modifications mineures et rédactionnelles	Extension	Modifications techniques majeures
Le document a été restructuré par rapport à l'édition 2	Plusieurs articles	X		
Tenue du courant de court-circuit présumé	4.3.1		X	
Caractéristiques assignées de courant de défaut des contacts de coupure supérieures à 10 kA pour les circuits connectés avec le secteur.	4.4.1 et 6.1.1.1			C1
Le dispositif de protection thermique peut comprendre un circuit de protection thermique avec un capteur approprié.	4.4.4.1		X	
Piles et batteries	4.3.6 et 4.4.5			C2
Les joints à filets parallèles avec scellement ou garniture supplémentaire sont autorisés à avoir moins de cinq filets.	5.1.2		X	
Il n'est pas nécessaire de raccorder en permanence les joints avec garniture à verrouillage (pas un joint bout à bout) et qui sont conçus de telle sorte que, en compression prévue, aucun espace entre les pièces n'existe au risque de former une périphérie ininterrompue.	5.1.3		X	
Conditions de surcharge ou de dysfonctionnement relatives à la détermination de la classe de température pour les machines électriques tournantes alimentées par un convertisseur "tb".	Tableau 2			C3
Exigences supplémentaires pour les dispositifs d'entrée équipés d'une protection contre l'inflammation de poussières par enveloppe "t"	Annexe A			C4
Les essais thermiques ont été intégrés à l'IEC 60079-0.	Précédemment 6.1.2	A1		

NOTE Les modifications techniques désignées incluent l'importance des modifications techniques apportées dans la version révisée de la Norme IEC, mais il ne s'agit pas d'une liste exhaustive de toutes les modifications apportées à la version précédente. Des recommandations supplémentaires peuvent être consultées dans la version Redline de la norme.

## Explications:

### A) Définitions

#### Modifications mineures et rédactionnelles

clarification  
diminution des exigences techniques  
modification technique mineure  
corrections rédactionnelles

Ces modifications portent sur les exigences et sont de nature rédactionnelle ou technique mineure. Elles comprennent des modifications de formulation destinées à clarifier les exigences techniques sans apporter de modification technique ni réduire le niveau actuel de l'exigence.

**Extension** ajout d'options techniques

Ces modifications ajoutent de nouvelles exigences techniques ou modifient les exigences techniques existantes, de manière à fournir de nouvelles options sans toutefois augmenter les

niveaux d'exigences pour les appareils qui sont totalement conformes à la norme précédente. Par conséquent, ces modifications ne doivent pas être prises en considération dans le cas de produits conformes à l'édition précédente.

### Modifications techniques majeures

ajout d'exigences techniques  
augmentation des exigences techniques

Ces modifications sont apportées aux exigences techniques (ajout, augmentation de leur niveau ou suppression) de telle manière qu'un produit conforme à l'édition précédente ne puisse pas toujours satisfaire aux exigences données dans la dernière édition. Ces modifications doivent être prises en considération dans le cas de produits conformes à l'édition précédente. Des informations supplémentaires relatives à ces modifications sont données à l'Article B) ci-dessous.

NOTE Ces modifications sont représentatives des connaissances technologiques actuelles. Toutefois, il convient qu'elles n'aient généralement aucune influence sur les appareils déjà présents sur le marché.

### B) Informations relatives aux origines des "modifications techniques majeures"

C1 – L'Appareil Ex avec le niveau de protection "tb" ou "tc" destiné à la connexion avec le secteur et destiné à interrompre tout courant de défaut supérieur à 10 kA, est soumis à l'essai selon 6.1.1.1, et est marqué selon l'Article 7.

C2 – L'Appareil Ex avec le niveau de protection "ta" qui contient une pile ou une batterie doit seulement utiliser une pile ou batterie à bac hermétique. Pour l'Appareil Ex avec le niveau de protection "tb" ou "tc", pour lequel il existe des contacts qui produisent des étincelles ou des surfaces chaudes, et qui contient une pile ou une batterie, seule une pile ou batterie à bac hermétique doit être utilisée.

C3 – Le Tableau 2 comporte désormais les conditions de dysfonctionnement pour la détermination de la classe de température des machines électriques alimentées par un convertisseur de niveau de protection "tb".

C4 – Ajout de l'Annexe A pour les dispositifs d'entrée avec le mode de protection "t", y compris les dispositifs de passage de câbles.

A1 – Les essais thermiques précédemment spécifiés en 6.1.2 ont été intégrés à l'IEC 60079-0 pour l'édition 2017 et celles à venir.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
31/1595/FDIS	31/1606/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Le présent document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). Les principaux types de documents développés par l'IEC sont décrits plus en détail sous [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

Le comité a décidé que le contenu du présent document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

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## INTRODUCTION

La Commission Électrotechnique Internationale (IEC) attire l'attention sur le fait qu'il est déclaré que la conformité avec les dispositions du présent document peut impliquer l'utilisation d'un brevet. L'IEC ne prend pas position quant à la preuve, à la validité et à la portée de ces droits de propriété.

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## ATMOSPHÈRES EXPLOSIVES –

### Partie 31: Protection contre l'inflammation de poussières par enveloppe "t" relative à l'appareil

#### 1 Domaine d'application

La présente partie de l'IEC 60079 est applicable à l'appareil protégé par enveloppe et limitation de la température de surface, pour une utilisation en atmosphère de poussières explosives. Elle spécifie les exigences de conception, de construction et d'essai pour l'Appareil Ex et les Composants Ex.

Le présent document complète et modifie les exigences générales de l'IEC 60079-0. Lorsqu'une exigence du présent document est en contradiction avec une exigence de l'IEC 60079-0, l'exigence du présent document prévaut.

Le présent document ne s'applique pas aux poussières d'explosifs dont la combustion n'exige pas l'oxygène de l'air ni aux substances pyrotechniques.

Le présent document ne s'applique ni à l'Appareil Ex ni aux Composants Ex destinés à une utilisation dans les parties souterraines des mines, ni aux parties des installations de surface des mines dans lesquelles il existe des risques de grisou et/ou de poussières combustibles.

Le présent document ne prend en compte aucun danger qui résulte d'une émission de gaz inflammable ou toxique qui provient de la poussière.

Le présent document ne contient aucune exigence relative à l'Appareil Ex utilisé dans les emplacements où les atmosphères de poussières combustibles et les atmosphères explosives gazeuses peuvent toutes deux survenir, soit de manière simultanée, soit séparément. Les autres parties de la série IEC 60079 comportent les exigences relatives aux atmosphères explosives gazeuses. L'IEC 60079-14 fournit des recommandations relatives à l'Appareil Ex à utiliser dans un environnement où surviennent de manière simultanée des atmosphères de poussières combustibles et des atmosphères explosives gazeuses ("mélanges hybrides").

Lorsque l'Appareil Ex doit satisfaire à d'autres conditions environnementales, par exemple, la protection contre la pénétration d'eau et la résistance à la corrosion, des mesures supplémentaires qui ne portent pas atteinte à l'intégrité de l'enveloppe peuvent être nécessaires.

#### 2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements* (disponible en anglais seulement)

IEC 60127 (toutes les parties), *Coupe-circuit miniatures*

IEC 60269 (toutes les parties), *Fusibles basse tension*