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colour inside

Explosive atmospheres –
Part 28: Protection of equipment and transmission systems using optical radiation

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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EXPLOSIVE ATMOSPHERES –

Part 28: Protection of equipment and transmission systems using optical radiation

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.
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This Redline version provides you with a quick and easy way to compare all the changes between this standard and its previous edition. A vertical bar appears in the margin wherever a change has been made. Additions and deletions are displayed in red, with deletions being struck through.

International Standard IEC 60079-28 has been prepared by IEC technical committee 31: Equipment for explosive atmospheres.

This second edition cancels and replaces the first edition, published in 2006, and constitutes a technical revision.

The significance of the changes between IEC 60079-28, Edition 2.0 (2015) and IEC 60079-28, Edition 1.0 (2006), is as listed below:

Significance of changes with respect to IEC 60079-28:2006

		Type		
Significant Changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Scope: Expansion to include Group III and EPLs Da, Db and Dc	1		x	
Scope: Clarification and list of exclusions for optical radiation sources	1		x	
Normative references: Deletion of IEC 60079-10, and addition of IEC 60050-426 and 60050-731	2	x		
Terms and definitions: Some definitions not used in the standard deleted. New definitions added.	3	x		
General requirements: Introduction of an ignition hazard assessment moved to 4, statement for presence of absorbers added, Explanation of EPLs deleted	4	x		
Table 1: EPLs versus protection types moved from 5.5 to 5.1, table modified and extended	5.1	x	x	
Structure of Table 2 changed and extended explanation in the notes, but with the same limit values	5.2.2.1	x		
Table 3 for Group III added	5.2.2.1		x	
Table 4 replaces Figure 1 for better application	5.2.2.1	x		
Detailed requirements for the measurement of optical power added	5.2.2.2		x	
Detailed requirements for the measurement of optical irradiance added	5.2.2.3		x	
Requirements for the assessment of optical pulses for Group II much more detailed	5.2.3.1 5.2.3.2 5.2.3.3 5.2.3.4	x		
Requirements for the assessment of optical pulses for Group I and Group III added	5.2.3.5		x	
Ignition tests: Notes 1 and 2 added	5.2.4	x		
Over-power/energy fault protection: Title changed and wording modified for clarity	5.2.5	x		
Radiation inside optical fibre or cable: requirements added, e.g. pull test	5.3.2			C1
Radiation inside enclosures: IP 6X enclosures, “p” or “t” enclosures added	5.3.3		x	
Optical system with interlock “op sh” Table 3 deleted, Figure 1 with interlock cutoff delay times added	5.4		x	
Type verifications and tests: structure changed (editorial, without changing the requirements)	6	x		
Marking: markings required by IEC 60079-0 deleted. Examples of marking: example with combination of op is with other types of protection added	7	x		

		Type		
Significant Changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Ignition hazard assessment: Flow chart in Figure C.1 modified for better understanding	Annex C	x		
Old Annex E (Introduction of EPLs) deleted. New Annex E provides a flow chart for the assessment of pulses according to 5.2.3	Annex E	x		
Relevant IEC-Standards moved to Clause 2	Formerly Annex F	x		

Explanation of the Types of Significant Changes:

A) Definitions

1) Minor and editorial changes:
- Clarification
- Decrease of technical requirements
- Minor technical change
- Editorial corrections

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

2) Extension: Addition of technical options

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

3) Major technical changes:
- addition of technical requirements
- increase of technical requirements

These are changes to technical requirements (addition, increase of the level or removal) made in a way that a product in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition. These changes have to be considered for products in conformity with the preceding edition. For these changes additional information is provided in 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 the protection concept "protected radiation op pr" some requirements like a pull test for optical fibres or cables have been added.

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

FDIS	Report on voting
31/1178/FDIS	31/1193/RVD

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

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

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

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

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Optical equipment in the form of lamps, lasers, LEDs, optical fibers etc. is increasingly used for communications, surveying, sensing and measurement. In material processing, optical radiation of high irradiance is used. ~~Often~~ Where the installation is inside or close to ~~potentially~~ explosive atmospheres, ~~and~~ the radiation from such equipment may pass through these atmospheres. Depending on the characteristics of the radiation it might then be able to ignite a surrounding explosive atmosphere. The presence or absence of an additional absorber, such as particles, significantly influences the ignition.

There are four possible ignition mechanisms:

a) Optical radiation is absorbed by surfaces or particles, causing them to heat up, and under certain circumstances this may allow them to attain a temperature which will ignite a surrounding explosive atmosphere.

b) Thermal ignition of a gas volume, where the optical wavelength matches an absorption band of the gas or vapour.

c) Photochemical ignition due to photo dissociation of oxygen molecules by radiation in the ultraviolet wavelength range.

d) Direct laser induced breakdown of the gas or vapour at the focus of a strong beam, producing plasma and a shock wave both eventually acting as ignition source. These processes can be supported by a solid material close to the breakdown point.

The most likely case of ignition occurring in practice with lowest radiation power of ignition capability is case a). Under some conditions for pulsed radiation, case d) also will become relevant. These two cases are addressed in this standard. Although one should be aware of ignition mechanism b) and c) explained above, they are not addressed in this standard due to the very special situation with ultraviolet radiation and with the absorption properties of most gases (see Annex A).

This standard describes precautions and requirements to be taken when using optical radiation transmitting equipment in explosive gas or dust atmospheres. It also outlines a test method, which can be used in special cases to verify that a beam is not ignition capable under selected test conditions, if the optical limit values cannot be guaranteed by assessment or beam strength measurement.

There is equipment outside the scope of this standard because the optical radiation associated with this equipment is considered not to be a risk of ignition for the following reasons:

– due to low radiated power or divergent light, and

– as hot surfaces created due to a too small distance from the radiation source to an absorber which is already considered by general requirements for lighting equipment.

~~Optical equipment is used in most cases in conjunction with electrical equipment, for which clear and detailed requirements and standards for use in potentially explosive atmospheres exist. One purpose of this standard is to inform industry about potential ignition hazards associated with the use of optical systems in hazardous locations as defined in IEC 60079-10 and the adequate protection methods.~~

In most cases the optical equipment is associated with electrical equipment and where the electrical equipment is located in a hazardous area then other parts of the IEC 60079 series will also apply. This standard provides guidance for:

a) Ignition hazards associated with optical systems in explosive atmospheres as defined in IEC 60079-10-1 and IEC 60079-10-2, and,

b) Control of ignition hazards from equipment using optical radiation in explosive atmospheres.

This standard is related to the integrated system used to control the ignition hazard from equipment using optical radiation in ~~hazardous locations~~ explosive atmospheres.

EXPLOSIVE ATMOSPHERES –

Part 28: Protection of equipment and transmission systems using optical radiation

1 Scope

~~This part of IEC 60079 explains the potential ignition hazard from equipment using optical radiation intended for use in explosive gas atmospheres. It also covers equipment, which itself is located outside but its emitted optical radiation enters such atmospheres. It describes precautions and requirements to be taken when using optical radiation transmitting equipment in explosive gas atmospheres. It also outlines a test method, which can be used to verify a beam is not ignition capable under selected test conditions, if the optical limit values cannot be guaranteed by assessment or beam strength measurement.~~

This part of IEC 60079 specifies the requirements, testing and marking of equipment emitting optical radiation intended for use in explosive atmospheres. It also covers equipment located outside the explosive atmosphere or protected by a Type of Protection listed in IEC 60079-0, but which generates optical radiation that is intended to enter an explosive atmosphere. It covers Groups I, II and III, and EPLs Ga, Gb, Gc, Da, Db, Dc, Ma and Mb.

This standard contains requirements for optical radiation in the wavelength range from 380 nm to 10 μm. It covers the following ignition mechanisms:

- Optical radiation is absorbed by surfaces or particles, causing them to heat up, and under certain circumstances this may allow them to attain a temperature which will ignite a surrounding explosive atmosphere.
- In rare special cases, direct laser induced breakdown of the gas at the focus of a strong beam, producing plasma and a shock wave both eventually acting as ignition source. These processes can be supported by a solid material close to the breakdown point.

NOTE 1 See a) and d) of the introduction.

This standard does not cover ignition by ultraviolet radiation and by absorption of the radiation in the explosive mixture itself. Explosive absorbers or absorbers that contain their own oxidizer as well as catalytic absorbers are also outside the scope of this standard.

This standard specifies requirements for equipment intended for use under atmospheric conditions.

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

~~NOTE 2 Although one should be aware of ignition mechanism b) and c) explained in the introduction, they are not addressed in this standard due to the very special situation with ultraviolet radiation and with the absorption properties of most gases (see Annex B).~~

~~NOTE 3 Safety requirements to reduce human exposure hazards from fibre optic communication systems are found in IEC 60825-2:2000.~~

~~NOTE 4 Types of protection "op is", "op pr", and "op sh" can provide equipment protection levels (EPL) Ga, Gb, or Gc. For further information, see Annex E.~~

This standard applies to optical fibre equipment and optical equipment, including LED and laser equipment, with the exception of the equipment detailed below:

1) Non-array divergent LEDs used for example to show equipment status or backlight function.
2) All luminaires (fixed, portable or transportable), hand lights and caplights; intended to be supplied by mains (with or without galvanic isolation) or powered by batteries:
   – with continuous divergent light sources (for all EPLs),
   – with LED light sources (for EPL Gc or Dc only).

   NOTE 2 Continuous divergent LED light sources for other than EPL Gc or Dc are not excluded from the standard due to the uncertainty of potential ignition concerns regarding high irradiance.
3) Optical radiation sources for EPL Mb, Gb or Gc and Db or Dc applications which comply with Class 1 limits in accordance with IEC 60825-1.

   NOTE 3 The referenced Class 1 limits are those that involve emission limits below 15 mW measured at a distance from the optical radiation source in accordance with IEC 60825-1, with this measured distance reflected in the Ex application.
4) Single or multiple optical fibre cables not part of optical fibre equipment if the cables:
   – comply with the relevant industrial standards, along with additional protective means, e.g. robust cabling, conduit or raceway (for EPL Gb, Db, Mb, Gc or Dc),
   – comply with the relevant industrial standards (for EPL Gc or Dc).
5) Enclosed equipment involving an enclosure that fully contains the optical radiation and that complies with a suitable type of protection as required by the involved EPL, with the enclosure complying with one of the following conditions:
   – An enclosure for which an ignition due to optical radiation in combination with absorbers inside the enclosure would be acceptable such as flameproof "d" enclosures (IEC 60079-1), or
   – An enclosure for which protection regarding ingress of an explosive gas atmosphere is provided, such as pressurized "p" enclosures (IEC 60079-2), restricted breathing “nR” enclosure (IEC 60079-15), or
   – An enclosure for which protection regarding ingress of an explosive dust atmosphere is provided, such as dust protection "t" enclosures" (IEC 60079-31), or
   – An enclosure for which protection regarding ingress of absorbers is provided (such as IP 6X enclosures) and where no internal absorbers are to be expected.

NOTE 4 For these scope exclusions based on enclosure constructions, it is anticipated that the enclosures are not opened in the explosive atmosphere, so that ingress is protected.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050, *International Electrotechnical Vocabulary*

~~IEC 60079 (all parts), *Electrical apparatus for explosive gas atmospheres*~~

IEC 60079-0, ~~*Electrical apparatus for explosive gas atmospheres*~~ *Explosive atmospheres* – *Part 0: Equipment – General requirements*

IEC 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

~~IEC 60079-10, *Electrical apparatus for explosive gas atmospheres – Part 10: Classification of hazardous areas*~~

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

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

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*

~~IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*~~

~~IEC 61511 (all parts), *Functional safety – Safety instrumented systems for the process industry sector*~~

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Edition 2.0 2015-05

INTERNATIONAL STANDARD

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Explosive atmospheres –
Part 28: Protection of equipment and transmission systems using optical radiation

Atmosphères explosives –
Partie 28: Protection du matériel et des systèmes de transmission utilisant le rayonnement optique



IEC 60079-28:2015-05(en-fr)

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EXPLOSIVE ATMOSPHERES –

Part 28: Protection of equipment and transmission systems using optical radiation

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Table 3 for Group III added	5.2.2.1		x	
Table 4 replaces Figure 1 for better application	5.2.2.1	x		
Detailed requirements for the measurement of optical power added	5.2.2.2		x	
Detailed requirements for the measurement of optical irradiance added	5.2.2.3		x	
Requirements for the assessment of optical pulses for Group II much more detailed	5.2.3.1 5.2.3.2 5.2.3.3 5.2.3.4	x		
Requirements for the assessment of optical pulses for Group I and Group III added	5.2.3.5		x	
Ignition tests: Notes 1 and 2 added	5.2.4	x		
Over-power/energy fault protection: Title changed and wording modified for clarity	5.2.5	x		
Radiation inside optical fibre or cable: requirements added, e.g. pull test	5.3.2			C1
Radiation inside enclosures: IP 6X enclosures, “p” or “t” enclosures added	5.3.3		x	
Optical system with interlock “op sh” Table 3 deleted, Figure 1 with interlock cutoff delay times added	5.4		x	
Type verifications and tests: structure changed (editorial, without changing the requirements)	6	x		
Marking: markings required by IEC 60079-0 deleted. Examples of marking: example with combination of op is with other types of protection added	7	x		
Ignition hazard assessment: Flow chart in Figure C.1 modified for better understanding	Annex C	x		
Old Annex E (Introduction of EPLs) deleted. New Annex E provides a flow chart for the assessment of pulses according to 5.2.3	Annex E	x		
Relevant IEC-Standards moved to Clause 2	Formerly Annex F	x		

Explanation of the Types of Significant Changes:

A) Definitions

1) Minor and editorial changes:
- Clarification
- Decrease of technical requirements
- Minor technical change
- Editorial corrections

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

2) Extension: Addition of technical options

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

3) Major technical changes:
- addition of technical requirements
- increase of technical requirements

These are changes to technical requirements (addition, increase of the level or removal) made in a way that a product in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition. These changes have to be considered for products in conformity with the preceding edition. For these changes additional information is provided in 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 the protection concept "protected radiation op pr" some requirements like a pull test for optical fibres or cables have been added.

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

FDIS	Report on voting
31/1178/FDIS	31/1193/RVD

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

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

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

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

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Optical equipment in the form of lamps, lasers, LEDs, optical fibers etc. is increasingly used for communications, surveying, sensing and measurement. In material processing, optical radiation of high irradiance is used. Where the installation is inside or close to explosive atmospheres, the radiation from such equipment may pass through these atmospheres. Depending on the characteristics of the radiation it might then be able to ignite a surrounding explosive atmosphere. The presence or absence of an additional absorber, such as particles, significantly influences the ignition.

There are four possible ignition mechanisms:

a) Optical radiation is absorbed by surfaces or particles, causing them to heat up, and under certain circumstances this may allow them to attain a temperature which will ignite a surrounding explosive atmosphere.

b) Thermal ignition of a gas volume, where the optical wavelength matches an absorption band of the gas or vapour.

c) Photochemical ignition due to photo dissociation of oxygen molecules by radiation in the ultraviolet wavelength range.

d) Direct laser induced breakdown of the gas or vapour at the focus of a strong beam, producing plasma and a shock wave both eventually acting as ignition source. These processes can be supported by a solid material close to the breakdown point.

The most likely case of ignition occurring in practice with lowest radiation power of ignition capability is case a). Under some conditions for pulsed radiation case d) also will become relevant. These two cases are addressed in this standard. Although one should be aware of ignition mechanism b) and c) explained above, they are not addressed in this standard due to the very special situation with ultraviolet radiation and with the absorption properties of most gases (see Annex A).

This standard describes precautions and requirements to be taken when using optical radiation transmitting equipment in explosive gas or dust atmospheres. It also outlines a test method, which can be used in special cases to verify that a beam is not ignition capable under selected test conditions, if the optical limit values cannot be guaranteed by assessment or beam strength measurement.

There is equipment outside the scope of this standard because the optical radiation associated with this equipment is considered not to be a risk of ignition for the following reasons:

– due to low radiated power or divergent light, and

– as hot surfaces created due to a too small distance from the radiation source to an absorber which is already considered by general requirements for lighting equipment.

In most cases the optical equipment is associated with electrical equipment and where the electrical equipment is located in a hazardous area then other parts of the IEC 60079 series will also apply. This standard provides guidance for:

a) Ignition hazards associated with optical systems in explosive atmospheres as defined in IEC 60079-10-1 and IEC 60079-10-2, and,

b) Control of ignition hazards from equipment using optical radiation in explosive atmospheres.

This standard is related to the integrated system used to control the ignition hazard from equipment using optical radiation in explosive atmospheres.

EXPLOSIVE ATMOSPHERES –

Part 28: Protection of equipment and transmission systems using optical radiation

1 Scope

This part of IEC 60079 specifies the requirements, testing and marking of equipment emitting optical radiation intended for use in explosive atmospheres. It also covers equipment located outside the explosive atmosphere or protected by a Type of Protection listed in IEC 60079-0, but which generates optical radiation that is intended to enter an explosive atmosphere. It covers Groups I, II and III, and EPLs Ga, Gb, Gc, Da, Db, Dc, Ma and Mb.

This standard contains requirements for optical radiation in the wavelength range from 380 nm to 10 μm. It covers the following ignition mechanisms:

- Optical radiation is absorbed by surfaces or particles, causing them to heat up, and under certain circumstances this may allow them to attain a temperature which will ignite a surrounding explosive atmosphere.
- In rare special cases, direct laser induced breakdown of the gas at the focus of a strong beam, producing plasma and a shock wave both eventually acting as ignition source. These processes can be supported by a solid material close to the breakdown point.

NOTE 1 See a) and d) of the introduction.

This standard does not cover ignition by ultraviolet radiation and by absorption of the radiation in the explosive mixture itself. Explosive absorbers or absorbers that contain their own oxidizer as well as catalytic absorbers are also outside the scope of this standard.

This standard specifies requirements for equipment intended for use under atmospheric conditions.

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

This standard applies to optical fibre equipment and optical equipment, including LED and laser equipment, with the exception of the equipment detailed below:

1) Non-array divergent LEDs used for example to show equipment status or backlight function.
2) All luminaires (fixed, portable or transportable), hand lights and caplights; intended to be supplied by mains (with or without galvanic isolation) or powered by batteries:
   – with continuous divergent light sources (for all EPLs),
   – with LED light sources (for EPL Gc or Dc only).

   NOTE 2 Continuous divergent LED light sources for other than EPL Gc or Dc are not excluded from the standard due to the uncertainty of potential ignition concerns regarding high irradiance.
3) Optical radiation sources for EPL Mb, Gb or Gc and Db or Dc applications which comply with Class 1 limits in accordance with IEC 60825-1.

   NOTE 3 The referenced Class 1 limits are those that involve emission limits below 15 mW measured at a distance from the optical radiation source in accordance with IEC 60825-1, with this measured distance reflected in the Ex application.
4) Single or multiple optical fibre cables not part of optical fibre equipment if the cables:

- comply with the relevant industrial standards, along with additional protective means, e.g. robust cabling, conduit or raceway (for EPL Gb, Db, Mb, Gc or Dc),
- comply with the relevant industrial standards (for EPL Gc or Dc).

5) Enclosed equipment involving an enclosure that fully contains the optical radiation and that complies with a suitable type of protection as required by the involved EPL, with the enclosure complying with one of the following conditions:
   - An enclosure for which an ignition due to optical radiation in combination with absorbers inside the enclosure would be acceptable such as flameproof "d" enclosures (IEC 60079-1), or
   - An enclosure for which protection regarding ingress of an explosive gas atmosphere is provided, such as pressurized "p" enclosures (IEC 60079-2), restricted breathing “nR” enclosure (IEC 60079-15), or
   - An enclosure for which protection regarding ingress of an explosive dust atmosphere is provided, such as dust protection "t" enclosures" (IEC 60079-31), or
   - An enclosure for which protection regarding ingress of absorbers is provided (such as IP 6X enclosures) and where no internal absorbers are to be expected.

NOTE 4 For these scope exclusions based on enclosure constructions, it is anticipated that the enclosures are not opened in the explosive atmosphere, so that ingress is protected.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050, *International Electrotechnical Vocabulary*

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

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

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

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ATMOSPHÈRES EXPLOSIVES –

Partie 28: Protection du matériel et des systèmes de transmission utilisant le rayonnement optique

AVANT-PROPOS

1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

La Norme internationale IEC 60079-28 a été établie par le comité d'études 31 de l'IEC: Équipements pour atmosphères explosives.

Cette deuxième édition annule et remplace la première édition, parue en 2006. Cette édition constitue une révision technique.

Le contenu des modifications entre l'IEC 60079-28,édition 2.0 (2015) et l'IEC 60079-28, édition 1.0 (2006) est précisé ci-dessous:

Signification des modifications par rapport à l'IEC 60079-28:2006

		Type		
Modifications majeures	**Article / paragraphe**	**Modifications mineures et rédactionnelles**	**Extension**	**Modifications techniques majeures**
Domaine d'application: Extension incluant le Groupe III et les EPL Da, Db et Dc	1		x	
Domaine d'application: Clarification et liste des exclusions pour les sources de rayonnement optique	1		x	
Références normatives: Suppression de l'IEC 60079-10 et ajout de l'IEC 60050-426 et de l'IEC 60050-731	2	x		
Termes et définitions: Suppression de quelques définitions non utilisées dans la norme. Ajout de nouvelles définitions	3	x		
Exigences générales: Introduction d'une évaluation des dangers d'inflammation déplacée à l'Article 4, ajout de l'énoncé pour la présence d'absorbeurs, Suppression de l'explication des EPL	4	x		
Tableau 1: Déplacement de la comparaison entre EPL et modes de protection de 5.5 à 5.1, tableau modifié et étendu	5.1	x	x	
Modification de la structure du Tableau 2 et extension de l'explication dans les notes, mais avec les mêmes valeurs limites	5.2.2.1	x		
Ajout du Tableau 3 pour le Groupe III	5.2.2.1		x	
Le Tableau 4 remplace la Figure 1 pour une meilleure application	5.2.2.1	x		
Ajout des exigences détaillées pour le mesurage de la puissance optique	5.2.2.2		x	
Ajout des exigences détaillées pour le mesurage de l'éclairement optique	5.2.2.3		x	
Ajout de nombreux détails sur les exigences pour l'évaluation des impulsions optiques pour le Groupe II	5.2.3.1 5.2.3.2 5.2.3.3 5.2.3.4	x		
Ajout des exigences pour l'évaluation des impulsions optiques pour le Groupe I et le Groupe III	5.2.3.5		x	
Essais d'inflammation: Ajout des notes 1 et 2	5.2.4	x		
Protection contre les défauts de surpuissance et d'énergie: Modification du titre et de la formulation pour plus de clarté	5.2.5	x		
Rayonnements à l'intérieur de la fibre ou du câble optique: ajout des exigences, par exemple essai de traction	5.3.2			C1
Rayonnement à l'intérieur des enveloppes: Ajout des enveloppes IP 6X, des enveloppes "p" ou "t"	5.3.3		x	
Système optique avec asservissement "op sh" Suppression du Tableau 3, ajout du retard de coupure asservie sur la Figure 1	5.4		x	
Vérifications et essais de type: modification de la structure (rédactionnelle, sans modification des exigences)	6	x		
Marquage: Suppression des marquages requis par l'IEC 60079-0. Exemples de marquage: ajout de l'exemple avec la combinaison de op is et d'autres modes de protection	7	x		

		Type		
Modifications majeures	**Article / paragraphe**	**Modifications mineures et rédactionnelles**	**Extension**	**Modifications techniques majeures**
Évaluation des dangers d'inflammation: Modification du schéma fonctionnel de la Figure C.1 pour une meilleure compréhension	Annexe C	x		
Suppression de l'ancienne Annexe E (Présentation des EPL). La nouvelle Annexe E présente un schéma fonctionnel pour l'évaluation des impulsions conformément à 5.2.3	Annexe E	x		
Déplacement des normes IEC pertinentes à l'Article 2	Ancien-nement Annexe F	x		

Explication des types de modifications significatives:

A) Définitions

1) Modifications mineures et rédactionnelles

- Clarification
- Assouplissement des exigences techniques
- Modification technique mineure
- Corrections d'ordre rédactionnel

Il s'agit de modifications techniques mineures ou d'ordre rédactionnel, apportées aux exigences. Elles comportent des modifications de la formulation permettant de clarifier les exigences techniques sans aucune modification technique ou d'assouplir le niveau de l'exigence existante.

2) Extension: Addition d'options techniques

Il s'agit de modifications qui ajoutent de nouvelles exigences techniques ou modifient les existantes pour proposer de nouvelles options sans augmenter pour autant le niveau des exigences pour les matériels totalement conformes à la norme précédente. Ces modifications ne sont donc pas à prendre en compte pour les produits conformes à l'édition précédente.

3) Modifications techniques majeures:

- addition d'exigences techniques
- augmentation du niveau des exigences techniques

Il s'agit de modifications apportées aux exigences techniques (addition, augmentation ou assouplissement du niveau) permettant d'indiquer qu'un produit conforme à l'édition précédente n'est pas toujours en mesure de satisfaire aux exigences données dans la dernière édition. Ces modifications sont à prendre en compte pour les produits conformes à l'édition précédente. Concernant ces modifications, des informations supplémentaires sont données dans l'Article B) ci-dessous.

NOTE Ces modifications représentent les connaissances technologiques actuelles. Il convient néanmoins que ces modifications n'aient en principe pas d'influence sur les matériels déjà commercialisés.

B) Informations de base concernant les 'modifications techniques majeures'

C1 En ce qui concerne le concept de protection "rayonnement protégé op pr", certaines exigences comme un essai de traction pour les fibres ou les câbles optiques ont été ajoutées.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
31/1178/FDIS	31/1193/RVD

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

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60079, publiées sous le titre général *Atmosphères explosives*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de cette publication 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 à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

IMPORTANT – Le logo *"colour inside"* qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

INTRODUCTION

Les matériels optiques sous forme de lampes, lasers, diodes électroluminescentes (LED), fibres optiques, etc. sont de plus en plus utilisés dans la communication, la surveillance, la détection et le mesurage. Dans les traitements de matériau, des rayonnements optiques de fort éclairement sont utilisés. Lorsque l'installation est située dans ou à proximité d'atmosphères explosives, le rayonnement d'un tel matériel peut traverser ces atmosphères. Selon ses caractéristiques, le rayonnement peut alors être capable d'enflammer une atmosphère explosive environnante. La présence ou l'absence d'absorbeurs supplémentaires tels que des particules, a une influence significative sur l'inflammation.

Il existe quatre mécanismes possibles d'inflammation.

a) Le rayonnement optique est absorbé par les surfaces ou particules, provoquant leur échauffement et, dans certaines circonstances, celles-ci peuvent atteindre une température qui amorce l'inflammation de l'atmosphère explosive environnante.

b) L'inflammation thermique d'un volume de gaz, où la longueur d'onde optique correspond à une bande d'absorption du gaz ou de la vapeur.

c) L'inflammation photochimique due à la photodissociation des molécules d'oxygène par le rayonnement dans l'étendue des longueurs d'onde des ultraviolets.

d) Le craquage direct d'un gaz ou de la vapeur par laser, au point de focalisation d'un faisceau puissant, produisant un plasma et une onde de choc, les deux agissant en définitive comme source d'inflammation. Ces processus peuvent prendre naissance dans un matériau solide proche de son point de craquage.

En pratique, le cas le plus probable d'inflammation à partir de la puissance minimale d'inflammation d'un rayonnement est le cas a). Dans certaines conditions pour le rayonnement à impulsions, le cas d) devient applicable. La présente norme traite ces deux cas. Il convient que les mécanismes d'inflammation b) et c) expliqués ci-dessus soient connus de tous; ils ne sont cependant pas repris dans la présente norme à cause de la situation très particulière du rayonnement ultraviolet et des propriétés d'absorption de la plupart des gaz (voir Annexe A).

La présente norme décrit les précautions à prendre et les exigences lors de l'utilisation de matériels transmettant des rayonnements optiques dans des atmosphères explosives gazeuses ou poussiéreuses. Elle souligne également une méthode d'essai, qui peut être utilisée dans les cas particuliers pour vérifier qu'un faisceau n'est pas capable d'inflammation dans des conditions d'essai choisies, si les valeurs limites optiques ne peuvent pas être garanties par l'évaluation ou le mesurage de la force du faisceau.

Il existe des matériels ne relevant pas du domaine d'application de la présente norme du fait que le rayonnement optique associé à ces matériels n'est pas considéré comme un risque d'inflammation pour les raisons suivantes:

– en raison d'une faible puissance rayonnée ou d'une lumière divergente, et

– étant donné que les surfaces chaudes, créées en raison d'une trop faible distance entre la source de rayonnement et un absorbeur, sont déjà couvertes par les exigences générales des matériels d'éclairage.

Dans la plupart des cas, le matériel optique est associé à un matériel électrique, et lorsque le matériel électrique est situé dans une zone dangereuse, d'autres parties de la série IEC 60079 s'appliquent également. La présente norme fournit des lignes directrices relatives:

a) aux dangers d'inflammation associés aux systèmes optiques situés dans des atmosphères explosives telles que définies dans l'IEC 60079-10-1 et l'IEC 60079-10-2, et,

b) à la surveillance des dangers d'inflammation des matériels utilisant le rayonnement optique dans des atmosphères explosives.

La présente norme est relative au système intégré utilisé pour surveiller le danger d'inflammation des matériels utilisant le rayonnement optique dans des atmosphères explosives.

ATMOSPHÈRES EXPLOSIVES –

Partie 28: Protection du matériel et des systèmes de transmission utilisant le rayonnement optique

1 Domaine d'application

La présente partie de l'IEC 60079 spécifie les exigences, les essais et le marquage du matériel émettant des rayonnements optiques destiné à être utilisé dans des atmosphères explosives. Elle couvre également le matériel situé à l'extérieur de l'atmosphère explosive ou protégé par un mode de protection indiqué dans l'IEC 60079-0, mais qui génère des rayonnements optiques qui sont destinés à pénétrer dans une atmosphère explosive. Elle couvre les Groupes I, II et III, et les EPL Ga, Gb, Gc, Da, Db, Dc, Ma et Mb.

La présente norme contient des exigences pour le rayonnement optique dans l'étendue de longueur d'onde de 380 nm à 10 μm .Elle couvre les mécanismes d'inflammation suivants:

- Le rayonnement optique est absorbé par les surfaces ou particules, provoquant leur échauffement et, dans certaines circonstances, celles-ci peuvent atteindre une température qui amorce l'inflammation de l'atmosphère explosive environnante.
- Dans certains cas rares particuliers, le craquage direct d'un gaz par laser, au point de focalisation d'un faisceau puissant, produisant un plasma et une onde de choc, les deux agissant en définitive comme source d'inflammation. Ces processus peuvent prendre naissance dans un matériau solide proche de son point de craquage.

NOTE 1 Voir les points a) et b) de l'introduction.

La présente norme ne couvre pas l'inflammation par rayonnement ultraviolet et par absorption du rayonnement dans le mélange explosif lui-même. Les absorbeurs explosifs ou absorbeurs qui contiennent leur propre oxydant/comburant de même que les absorbeurs catalytiques sont également hors du domaine d'application de la présente norme.

La présente norme spécifie les exigences pour les matériels destinés à l'utilisation dans des conditions atmosphériques.

La présente norme complète et modifie les exigences générales de l'IEC 60079-0. Lorsqu'une exigence de la présente norme entre en conflit avec une exigence de l'IEC 60079-0, l'exigence de la présente norme prévaut.

La présente norme s'applique au matériel à fibre optique et au matériel optique, y compris les LED et les matériels à laser, à l'exception des matériels décrits ci-dessous:

1) Les LED non divergentes utilisées par exemple pour afficher le statut d'un matériel ou pour une fonction de rétroéclairage.
2) Tous les luminaires (fixes, portables ou transportables), les lampes à main et les lampes-chapeaux; destinés à être alimentés par le réseau (avec ou sans isolation galvanique) ou par des batteries:
   – avec des sources lumineuses divergentes continues (pour tous les EPL),
   – avec des sources lumineuses LED (pour les EPL Gc ou Dc uniquement).

   NOTE 2 Les sources lumineuses LED divergentes continues autres que pour les EPL Gc ou Dc ne sont pas exclues de la norme en raison de l'incertitude liée à la probabilité d'inflammation associée à l'éclairement élevé.
3) Les sources de rayonnement optique pour les applications EPL Mb, Gb ou Gc et Db ou Dc qui satisfont aux limites de Classe 1 conformément à l'IEC 60825-1.

NOTE 3 Les limites de Classe 1 référencées sont celles qui impliquent des limites d'émissions inférieures à 15 mW mesurées à une certaine distance de la source de rayonnement optique conformément à l'IEC 60825-1, cette distance mesurée étant reflétée dans l'application Ex.

4) Les câbles à fibres optiques simples ou multiples ne faisant pas partie du matériel à fibre optique si les câbles:
   – satisfont aux normes industrielles pertinentes, ainsi que les moyens de protection supplémentaires, comme les câblages robustes, les conduits ou les chemins (pour EPL Gb, Db, Mb, Gc ou Dc),
   – satisfont aux normes industrielles pertinentes (pour EPL Gc ou Dc).
5) Les matériels sous enveloppe impliquant une enveloppe qui confine totalement les rayonnements optiques et qui satisfait à un mode de protection adapté tel que requis par l'EPL concerné, l'enveloppe satisfaisant à l'une des conditions suivantes:
   – Une enveloppe pour laquelle une inflammation due aux rayonnements optiques en combinaison avec des absorbeurs à l'intérieur de l'enveloppe est acceptable (par exemple, les enveloppes "d" antidéflagrantes) (IEC 60079-1), ou
   – Une enveloppe pour laquelle la protection relative à la pénétration d'une atmosphère explosive gazeuse est prévue, comme les enveloppes sous pression "p" (IEC 60079-2), l'enveloppe "nR" à respiration réduite (IEC 60079-15), ou
   – Une enveloppe pour laquelle la protection relative à la pénétration d'une atmosphère explosive poussiéreuse est prévue comme les enveloppes "t" antipoussière (IEC 60079-31), ou
   – Une enveloppe pour laquelle la protection relative à la pénétration d'absorbeurs est prévue (comme les enveloppes IP 6X) et où aucun absorbeur interne n'est prévu.

NOTE 4 Pour ces exclusions du domaine d'application fondées sur la construction des enveloppes, on prévoit que les enveloppes ne sont pas ouvertes dans l'atmosphère explosive, de sorte que l'entrée est protégée.

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. 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 60050, *Vocabulaire Electrotechnique International*

IEC 60079-0, *Atmosphères explosives – Partie 0: Matériel – Exigences générales*

IEC 60079-1, *Atmosphères explosives – Partie 1: Protection du matériel par enveloppes antidéflagrantes "d"*

IEC 60079-11, *Atmosphères explosives – Partie 11: Protection de l'équipement par sécurité intrinsèque "i"*

IEC 60079-15, *Atmosphères explosives – Partie 15: Protection du matériel par mode de protection "n"*

IEC 60825-2, *Sécurité des appareils à laser – Partie 2: Sécurité des systèmes de télécommunication par fibres optiques (STFO)*