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

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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

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

This International Standard is to be used in conjunction with IEC 60079-0.

Users of this document are advised that interpretation sheets clarifying the interpretation of this document can be published. Interpretation sheets are available from the IEC webstore and can be found in the "history" tab of the page for each document.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

The significance of the changes between the current edition of IEC 60079-28 (Edition 3) and IEC 60079-28 (Edition 2) is as listed below:

Significance of changes with respect to IEC 60079-28:2015

		Type		
Significant Changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Ignition test is removed	Clause 6; Annex A (of Ed.2)			C1
Clarification of the applicability of IEC 60079-28 for laser equipment, optical fibre equipment and any optical system that converts light into convergent beams with focal points within the hazardous area only.	1	X		
Change title from "Radiation inside enclosures" to "Radiation entering or leaving enclosures" and text reworded	4.3.3	X		
The structure of this document was modified; new clause "Type verifications and tests" added	5	X		
New subclause "Optical detector"	5.1		X	
The possibility to do calculations for the assessment of optical power is clarified	5.2		X	
Additional examples for the marking are added.	6		X	
Annex C removed	Annex C (of Ed.2)	X		

NOTE 1 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 can be found by referring to the Redline Version of the standard.

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 2 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 changes

C1 The alternative option of an ignition test is removed because questions have been raised regarding the repeatability of the verification test across test labs. Additionally, it was identified that an application of a safety factor is not sufficiently defined and not possible to apply for real test samples.

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

Draft	Report on voting
31/1887/FDIS	31/1933/RVD

Full information on the voting for the approval of this International Standard 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. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

INTRODUCTION

Optical systems in the form of light sources utilizing optical components such as filters or lenses, optical fibres etc. include but are not limited to 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 systems can 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 might 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 document. Although it is important that users be aware of ignition mechanisms b) and c) explained above, they are not addressed in this document due to the very special situation with ultraviolet radiation and with the absorption properties of most gases (see Annex A).

This document describes precautions and requirements to be taken when using optical radiation in explosive gas or dust atmospheres.

There are optical systems outside the scope of this document because the optical radiation associated with these systems 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.

When optical systems are associated with electrical Ex Equipment and where the electrical Ex Equipment is located in a hazardous area then other parts of the IEC 60079 series will also apply. This document provides guidance for:

– Ignition hazards associated with optical systems in explosive atmospheres as defined in IEC 60079-10-1 and IEC 60079-10-2; and

– Control of ignition hazards from Ex Equipment using optical radiation in explosive atmospheres.

1 Scope

This part of IEC 60079 specifies additional requirements for Ex Equipment, Ex associated equipment or Ex Components containing optical systems emitting optical radiation, which is exposed to explosive atmospheres. These additional requirements are applicable for all equipment groups and all Equipment Protection Levels (EPL).

This document 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 might 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.

– Annex A provides guidance when considering ignition mechanisms that influence the hazard of optics in explosive atmospheres.

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

This document applies to

a) laser equipment; and

b) optical fibre equipment; and

c) any optical system that converts light into convergent beams with focal points within the hazardous area only.

This document does not apply to:

d) laser equipment for EPL Mb, Gb, Gc, Db or Dc applications which complies with Class 1 limits in accordance with IEC 60825-1; or

NOTE 2 The Class 1 limits are 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. The Class 1 limit values are not considered capable of igniting an explosive atmosphere.

NOTE 3 Compliance with Class 1 limits is typically documented in the form of a datasheet or user manual provided by the manufacturer of the laser equipment.

e) Single or multiple optical fibre cables not part of optical fibre equipment if the cables:

1) comply with the relevant industrial standards for optical fibre cables, along with additional protective means, for example robust cabling, conduit or raceway (for EPL Gb, Db, Mb, Gc or Dc); or

2) comply with the relevant industrial standards for optical fibre cables (for EPL Gc or Dc); or

f) Optical radiation sources as defined in a) to c) above where the optical radiation is fully contained in an enclosure complying with one of the following Types of Protection suitable for the EPL, or the minimum ingress protection rating specified:

NOTE 4 Fully contained means that no optical radiation can escape.

1) flameproof "d" enclosures (IEC 60079-1); or

NOTE 5 A flameproof "d" enclosure is suitable because an ignition due to optical radiation in combination with absorbers inside the enclosure is contained.

2) pressurized "p" enclosures (IEC 60079-2); or

NOTE 6 A pressurized "p" enclosure is suitable because there is protection against ingress of an explosive atmosphere.

3) restricted breathing "nR" enclosure (IEC 60079-15); or

NOTE 7 A restricted breathing "nR" enclosure is suitable because there is protection against ingress of an explosive atmosphere.

4) dust protection "t" enclosures" (IEC 60079-31); or

NOTE 8 A dust protection "t" enclosure is suitable because there is protection against ingress of an explosive dust atmosphere.

5) an enclosure that provides a minimum ingress protection of IP 6X and where no internal absorbers are to be expected and complying with "Tests of enclosures" in IEC 60079-0.

NOTE 9 An enclosure of a minimum ingress protection of IP 6X and complying with "Tests of enclosures" in IEC 60079-0 is suitable because there is protection against the ingress of absorbers. It is anticipated that when the enclosures are opened, entrance of any absorbers is avoided.

This document 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 document.

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.

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

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

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

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

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

3 Terms and definitions

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

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

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

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