

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**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**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –**Part 28: Protection of equipment and transmission systems using optical radiation**

FOREWORD

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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

Significant Changes	Clause	Type		
		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		
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.

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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)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-426, IEC 60050-731, IEC 60079-0 and the following apply.

3.1

absorption

in a propagation medium, the conversion of electromagnetic wave energy into another form of energy, for instance heat

[SOURCE: IEC 60050-731:1991, 731-03-14]