

Explosive atmospheres —

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

ICS 29.260.20

National foreword

This British Standard is the UK implementation of EN 60079-28:2007. It is identical to IEC 60079-28:2006.

The UK participation in its preparation was entrusted to Technical Committee EXL/31, Equipment for explosive atmospheres.

A list of organizations represented on this committee can be obtained on request to its secretary.

The publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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

INTERPRETATION SHEET 1

This interpretation sheet has been prepared by IEC technical committee 31: Equipment for explosive atmospheres.

The text of this interpretation sheet is based on the following documents:

ISH	Report on voting
31/1102/ISH	31/1114/RVD

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

IEC 60079-28:2006 (1st edition) *Explosive atmospheres – Protection of equipment and transmission systems using optical radiation*

Following decision No 12 of the TC 31 meeting in Melbourne in 2011, the issuing of an Interpretation Sheet for IEC 60079-28:2006 (1st edition) was requested, in order to clarify the scope of the existing standard.

Question

Does the scope of this standard cover

- 1) non-array divergent LEDs;
- 2) luminaires;
- 3) optical radiation sources for Mb, Gb or Gc applications which comply with Class 1 limits in accordance with IEC 60825-1;
- 4) single or multiple optical fibre cables not part of optical fibre equipment; or
- 5) enclosed equipment involving an enclosure that fully contains the optical radiation and that complies with a suitable type of protection?

Answer

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 (other than for Group I) 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 only).

- 3) Optical radiation sources for Mb, Gb or Gc applications which comply with Class 1 limits in accordance with IEC 60825-1.
- 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 Gb, Mb or Gc);
 - comply with the relevant industrial standards (for Gc).
- 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), or
 - an enclosure for which protection regarding ingress of an explosive atmosphere is provided, such as pressurized "p" enclosures, restricted breathing "nR" enclosure", 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 For these scope exclusions it is anticipated that the enclosures are not opened in the explosive atmosphere, so that ingress is protected.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 60079-28

March 2007

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English version

**Explosive atmospheres -
Part 28: Protection of equipment and transmission systems
using optical radiation
(IEC 60079-28:2006)**

Atmosphères explosives -
Partie 28: Protection du matériel
et des systèmes de transmission
utilisant le rayonnement optique
(CEI 60079-28:2006)

Explosionsfähige Atmosphäre -
Teil 28: Schutz von Einrichtungen
und Übertragungssystemen,
die mit optischer Strahlung arbeiten
(IEC 60079-28:2006)

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Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 31/631/FDIS, future edition 1 of IEC 60079-28, prepared by IEC TC 31, Equipment for explosive atmospheres, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60079-28 on 2006-10-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2007-10-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2009-10-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive 94/9/EC. See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60079-28:2006 was approved by CENELEC as a European Standard without any modification.

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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. Often the installation is inside or close to potentially explosive atmospheres, and 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 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.
- 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 at the focus of a strong beam, producing plasma and a shock wave both eventually acting as the 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.

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.

This standard details the integrated system used to control the ignition hazard from equipment using optical radiation in hazardous locations.

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

NOTE 1 See items 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 will take 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.

2 Normative references

The following referenced documents are indispensable for the application 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 (all parts), *Electrical apparatus for explosive gas atmospheres*

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

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

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*

3 Terms and definitions

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

NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426 [1]¹.

3.1

absorption

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

[IEV 731-03-14]

3.2

beam diameter (or beam width)

the distance between two diametrically opposed points where the irradiance is a specified fraction of the beam's peak irradiance

[IEV 731-01-35]

NOTE Most commonly applied to beams that are circular or nearly circular in cross section.

3.3

beam strength

a general term used in this standard referring to an optical beam's power, irradiance, energy, or radiant exposure

¹ Figures in square brackets refer to the bibliography.

3.4

core

the central region of an optical fibre through which most of the optical power is transmitted

[IEV 731-02-04]

3.5

cladding

that dielectric material of an optical fibre surrounding the core

[IEV 731-02-05]

3.6

fibre bundle

an assembly of unbuffered optical fibres

[IEV 731-04-09]

3.7

fibre optic terminal device

an assembly including one or more opto-electronic devices which converts an electrical signal into an optical signal, and/or vice versa, which is designed to be connected to at least one optical fibre

[IEV 731-06-44]

NOTE A fibre optic terminal device always has one or more integral fibre optic connector(s) or optical fibre pigtails(s).

3.8

inherently safe optical radiation

visible or infrared radiation that is incapable of producing sufficient energy under normal or specified fault conditions to ignite a specific hazardous atmospheric mixture

NOTE This definition is analogous to the term "intrinsically safe" applied to electrical circuits.

3.9

irradiance

the radiant power incident on an element of a surface divided by the area of that element

[IEV 731-01-25]

3.10

light (or visible radiation)

any optical radiation capable of causing a visual sensation directly on a human being

[IEV 731-01-04]

NOTE 1 Nominally covering the wavelength in vacuum range of 380 nm to 800 nm.

NOTE 2 In the laser and optical communication fields, custom and practice in the English language have extended usage of the term light to include the much broader portion of the electromagnetic spectrum that can be handled by the basic optical techniques used for the visible spectrum.

3.11

minimum ignition energy

MIE

lowest electrical energy stored in a capacitor which upon discharge is sufficient to effect ignition of the most ignitable explosive atmosphere under specified test conditions

3.12

optical fibre

filament shaped optical waveguide made of dielectric materials

[IEV 731-02-01]

3.13

optical fibre cable

an assembly comprising one or more optical fibres or fibre bundles inside a common covering designed to protect them against mechanical stresses and other environmental influences while retaining the transmission qualities of the fibres

[IEV 731-04-01]

3.14

optical fibre communication system

OFCS

engineered, end-to-end assembly for the generation, transference and reception of optical radiation arising from lasers, LEDs or optical amplifiers, in which the transference is by means of optical fibre for communication and/or control purposes

3.15

free space optical communication system

FSOCS

an installed, portable, or temporarily mounted, through-the-air system typically used, intended or promoted for voice, data or multimedia communications and/or control purposes via the use of modulated optical radiation produced by a laser or IR-LED. "Free space" means indoor and outdoor optical wireless applications with both non-directed and directed transmission. Emitting and detecting assemblies may or may not be separated.

NOTE The above definitions are from IEC TC 76. This standard is not only dealing with "communication systems", so a more general definition could be useful.

3.16

optical (or radiant) power

the time rate of flow of radiant energy with time

[IEV 731-01-22]

3.17

optical radiation

electromagnetic radiation at wavelengths in vacuum between the region of transition to X-rays and the region of transition to radio waves, that is approximately between 1 nm and 1 000 µm

[IEV 731-01-03]

NOTE In the context of this standard, the term "optical" refers to wavelengths ranging from 380 nm to 10 µm.