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Električne naprave za potencialno eksplozivne atmosfere – 28. del: Zaščita opreme in prenosnih sistemov z optičnim sevanjem

Electrical apparatus for explosive atmospheres – Part 28: Protection of equipment and transmission systems using optical radiation

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Titre : CEI 60079-28 Ed. 1.0: Matériel électrique pour atmosphères explosives gazeuses Partie 28: Protection de l'équipement et des systèmes de transmission utilisant le rayonnement optique

Title : IEC 60079-28 Ed. 1.0: Electrical apparatus for explosive gas atmospheres Part 28: Protection of equipment and transmission systems using optical radiation

Note d'introduction:

Une introduction a été ajoutée afin de faciliter la compréhension des remarques faites lors de la préparation du projet de norme CEI 60079-28

Introductory note:

An "Introduction" has been provided to allow an understanding of the considerations made during the preparation of the draft for IEC 60079-28.

ATTENTION	ATTENTION
CDV soumis en parallèle au vote (CEI) et à l'enquête (CENELEC)	**Parallel IEC CDV/CENELEC Enquiry**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL APPARATUS FOR EXPLOSIVE GAS 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: Electrical apparatus for explosive atmospheres.

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

FDIS	Report on voting
XX/XX/FDIS	XX/XX/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.

The committee has decided that the contents of this publication will remain unchanged until 2XXX. At this date, the publication will be

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- withdrawn;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

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 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 engineering and installation practices to control the ignition hazard from equipment using optical radiation in hazardous locations.

ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES –

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

1 Scope

This Standard 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 ignition source. These processes can be supported by a solid material close to the breakdown point.

NOTE 1: 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.

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 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: Safety of laser products - Part 2: Safety of optical fibre communication systems.

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 60050-426: 1990: *International Electrotechnical Vocabulary. Chapter 426: Electrical apparatus for explosive atmospheres*

IEC 60079-0 2004: *Electrical apparatus for explosive gas atmospheres Part 0: General requirements*

IEC 60079-10: 2002: *Electrical apparatus for explosive gas atmospheres - Part 10: Classification of hazardous areas*

IEC 60079-11:1999: *Electrical apparatus for explosive gas atmospheres - Part 11: Intrinsic safety*

IEC 60825-2:2000: *Safety of laser products - Part 2: Safety of optical fibre communication systems*

IEC 60050-731:1991: *International electrotechnical vocabulary Chapter 731: Optical fibre communication*

IEC 61508: *Parts 1 through 7: Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61511:2003: *Part 1 and 3: Functional safety - Safety instrumented systems for the process industry sector*

3 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. (IEC 60050-731:1991-10)

3.2
beam diameter (or beam width):
the distance between two diametrically opposed points where the irradiance is a specified fraction of the beams peak irradiance. (IEC 60050-731:1991-10)

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.

3.4
core:
the central region of an optical fibre through which most of the optical power is transmitted. (IEC 60050-731:1991-10)

3.5
cladding:
that dielectric material of an optical fibre surrounding the core. (IEC 60050-731:1991-10)

3.6
fibre bundle:
an assembly of unbuffered optical fibres. (IEC 60050-731:1991-10)

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. (IEC 60050-731:1991-10)

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. (IEC 60050-731:1991-10)

3.10
light (or visible radiation):
any optical radiation capable of causing a visual sensation directly on a human being. (IEC 60050-731:1991-10)

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. (IEC 60050-731:1991-10)

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. (IEC 60050-731:1991-10, see Annex D)

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. (IEC 60050-731:1991-10)

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 1000 µm. (IEC 60050-731:1991-10)

NOTE — In the context of this Standard, the term “optical” refers to wavelengths ranging from 380 nm to 10 µm.

3.18
protected optical fibre cable:
optical fibre cable protected from releasing optical radiation into the atmosphere during normal operating conditions and foreseeable malfunctions by additional armouring, conduit, cable tray or raceway..

3.19
radiant energy:
energy that is emitted, transmitted or received via electromagnetic waves. (IEC 60050-731:1991-10)

3.20
radiant exposure:
the radiant energy incident on an element of a surface divided by the area of that element. (IEC Dictionary Pub. 50-393-04-89 and 845-01-42)