



SLOVENSKI STANDARD
SIST EN 60079-28:2007
01-november-2007

9_gd`cn]j bY`Ura cgZfY!'&, "XY.`NUý]HJcdfYa Yž`_]i dcfUV`Ucdh] bc`gYj Ub`Yž]b
 g]ghYa cj `nUdfYbcg`cdh] bY[UgYj Ub`Uf197 * \$\$+- !&, .&\$\$* Ł

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

Explosionsfähige Atmosphäre - Teil 28: Schutz von Einrichtungen und Übertragungssystemen, die mit optischer Strahlung arbeiten

Atmospheres explosives - Partie 28: Protection du matériel et des systemes de transmission utilisant le rayonnement optique

<https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-8af02aa8fca0/sist-en-60079-28-2007>

Ta slovenski standard je istoveten z: EN 60079-28:2007

ICS:

29.260.20	Ò\^ dã } ãq ææã æ ^\•] : ã} æ\ : !æ læ	Electrical apparatus for explosive atmospheres
-----------	----------------------------------------------	------------------------------------------------

SIST EN 60079-28:2007

en,fr,de

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 60079-28:2007

<https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-8af02aa8fca0/sist-en-60079-28-2007>

EUROPEAN STANDARD

EN 60079-28

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 2007

ICS 29.260.20

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)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

This European Standard was approved by CENELEC on 2006-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60079-1	NOTE	Harmonized as EN 60079-1:2004 (not modified). https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-0e2aa8fc045b/iec-60079-1-2006
IEC 60079-2	NOTE	Harmonized as EN 60079-2:2004 (not modified).
IEC 60079-7	NOTE	Harmonized as EN 60079-7:2007 (not modified).
IEC 60079-14	NOTE	Harmonized as EN 60079-14:2003 (not modified).
IEC 60079-15	NOTE	Harmonized as EN 60079-15:2005 (not modified).
IEC 60079-26	NOTE	Harmonized as EN 60079-26:2004 (not modified).
IEC 61241-0	NOTE	Harmonized as EN 61241-0:2006 (modified).
IEC 61241-4	NOTE	Harmonized as EN 61241-4:2006 (not modified).
IEC 61241-10	NOTE	Harmonized as EN 61241-10:2004 (not modified).
IEC 61241-11	NOTE	Harmonized as EN 61241-11:2006 (not modified).
IEC 61241-18	NOTE	Harmonized as EN 61241-18:2004 (not modified).

Annex ZA
(normative)

**Normative references to international publications
with their corresponding European publications**

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60079	Series	Electrical apparatus for explosive gas atmospheres	EN 60079	Series
IEC 60079-0 (mod)	- ¹⁾	Electrical apparatus for explosive gas atmospheres - Part 0: General requirements	EN 60079-0	2006 ²⁾
IEC 60079-10	- ¹⁾	Electrical apparatus for explosive gas atmospheres - Part 10: Classification of hazardous areas	EN 60079-10	2003 ²⁾
IEC 60079-11	- ¹⁾	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"	EN 60079-11	2007 ²⁾
IEC 60825-2	- ¹⁾	Safety of laser products - Part 2: Safety of optical fibre communication systems (OFCS)	EN 60825-2	2004 ²⁾
IEC 61508	Series	Functional safety of electrical/electronic/programmable electronic safety-related systems	EN 61508	Series
IEC 61511	Series	Functional safety - Safety instrumented systems for the process industry sector	EN 61511	Series

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

Annex ZZ (informative)

Coverage of Essential Requirements of EC Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers only the following essential requirements out of those given in Annex II of the EC Directive 94/9/EC:

- ER 1.0.1 to ER 1.0.4, ER 1.0.5 (partly)
- ER 1.2.1, ER 1.2.6, ER 1.2.8 to ER 1.2.9
- ER 1.3.1
- ER 1.5.1
- ER 2.1.1 (partly)
- ER 2.2.1 (partly)
- ER 2.3.1 (partly)

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

(standards.iteh.ai)

[SIST EN 60079-28:2007](https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-8af02aa8fca0/sist-en-60079-28-2007)

<https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-8af02aa8fca0/sist-en-60079-28-2007>

NORME
INTERNATIONALE
INTERNATIONAL
STANDARD

CEI
IEC

60079-28

Première édition
First edition
2006-08

Atmosphères explosives –

Partie 28:

**Protection du matériel et des systèmes de
transmission utilisant le rayonnement optique**

iTeh STANDARD PREVIEW

Explosive atmospheres –

Part 28: [SIST EN 60079-28:2007](https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-8af02aa81ca0/sist-en-60079-28-2007)

**Protection of equipment and transmission
systems using optical radiation**

© IEC 2006 Droits de reproduction réservés — Copyright - all rights reserved

Aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'éditeur.

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CODE PRIX
PRICE CODE

W

Pour prix, voir catalogue en vigueur
For price, see current catalogue

CONTENTS

FOREWORD.....	7
INTRODUCTION.....	11
1 Scope.....	13
2 Normative references.....	15
3 Terms and definitions.....	15
4 General requirements.....	21
4.1 Optical equipment.....	21
4.2 Risk levels.....	21
5 Types of protection.....	23
5.1 General.....	23
5.2 Requirements for inherently safe optical radiation “op is”.....	23
5.3 Requirements for protected optical radiation “op pr”.....	27
5.4 Optical radiation interlock with optical fibre breakage “op sh”.....	29
5.5 Suitability of types of protection.....	29
6 Type verifications and tests.....	31
6.1 Test set-up for ignition tests.....	31
6.2 Reference test.....	33
6.3 Test mixtures.....	35
6.4 Tests for pulse trains and pulses between 1 ms and 1 s duration.....	35
7 Marking.....	35
7.1 General.....	35
7.2 Marking information.....	37
7.3 Examples of marking.....	37
Annex A (normative) Reference test data.....	39
Annex B (informative) Ignition mechanisms.....	41
Annex C (normative) Ignition hazard assessment.....	53
Annex D (informative) Typical optical fibre cable design.....	57
Annex E (informative) Introduction of an alternative risk assessment method encompassing “equipment protection levels” for Ex equipment.....	59
Bibliography.....	69
Figure 1 – Figure B.1 with limit lines for intermediate areas for non-combustible targets, T1 – T4 atmospheres, apparatus group IIA, IIB or IIC.....	25
Figure B.1 – Minimum radiant igniting power with inert absorber target ($\alpha_{1064\text{ nm}}=83\%$, $\alpha_{805\text{ nm}}=93\%$) and continuous wave-radiation of 1 064 nm.....	47
Figure B.2 – Minimum radiant igniting power with inert absorber target ($\alpha_{1064\text{ nm}}=83\%$, $\alpha_{805\text{ nm}}=93\%$) and continuous wave-radiation (PTB: 1 064 nm, HSL: 805 nm, [24]: 803 nm) for some n-alkanes.....	49
Figure C.1 – Ignition hazard assessment.....	53
Figure D.1 – Example multi-fibre optical cable design for heavy duty applications.....	57
Figure D.2 – Typical single optical fibre cable design.....	57

Table 1 – Relationship between EPL and the probability of an ignition source.....	21
Table 2 – Safe optical power and irradiance for hazardous locations categorized by apparatus group and temperature class	23
Table 3 – Optical interlock availability or ignition risk reduction factor by EPL.....	29
Table 4 – Application of types of protection for optic systems based on EPLs	31
Table A.1 – Reference values for ignition tests with a mixture of propane in air at 40 °C mixture temperature	39
Table B.1 – AIT (auto ignition temperature), MESG (maximum experimental safe gap) and measured ignition powers of the chosen combustibles for inert absorbers as the target material ($\alpha_{1\ 064\ \text{nm}}=83\ \%$, $\alpha_{805\ \text{nm}}=93$)	45
Table B.2 – Comparison of measured minimum igniting optical pulse energy ($Q_{e,p}^{i,\text{min}}$) at 90 μm beam diameter with auto ignition temperatures (AIT) and minimum ignition energies (MIE) from literature [25] at concentrations in percent by volume (φ)	51
Table E.1 – Traditional relationship of EPLs to zones (no additional risk assessment)	63
Table E.2 – Description of risk of ignition protection provided	65

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 60079-28:2007](https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-8af02aa8fca0/sist-en-60079-28-2007)

<https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-8af02aa8fca0/sist-en-60079-28-2007>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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

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

FDIS	Report on voting
31/631/FDIS	31/650/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 of the IEC 60079 series, under the general title *Explosives atmospheres*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 60079-28:2007](https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-8af02aa8fca0/sist-en-60079-28-2007)

<https://standards.iteh.ai/catalog/standards/sist/e03283fc-8876-40d6-840d-8af02aa8fca0/sist-en-60079-28-2007>

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.