



UL 60079-28

STANDARD FOR SAFETY

Explosive Atmospheres – Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation

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UL Standard for Safety for Explosive Atmospheres – Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, UL 60079-28

Second Edition, Dated September 15, 2017

Summary of Topics

This revision of ANSI/UL 60079-28 is being issued to include a National Difference to the Introduction and replace "Class 1" with "Class I" in the first example of the third paragraph of Clause 7DV.

Please note that the national difference document incorporates all of the US national differences for UL 60079-28 including the revisions noted below. UL 60079-28 is based on IEC 60079-28, Edition 2.0 published May, 2015.

Editorial Revision to include a National Difference to the Introduction and replace "Class 1" with "Class I" in the first example of the third paragraph of Clause 7DV.

The requirements are substantially in accordance with Proposal(s) on this subject dated December 23, 2016 and July 28, 2017.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

THIS SECOND EDITION OF UL 60079-28 REPLACES THE FIRST EDITION OF ISA-60079-28 DATED 2012. AS OF SEPTEMBER 15, 2022, ISA-60079-28:2012 WILL BE WITHDRAWN.

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SEPTEMBER 15, 2017
(Title Page Reprinted: December 8, 2017)



ANSI/UL 60079-28-2017

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UL 60079-28

**Standard for Explosive Atmospheres – Part 28: Protection of Equipment
and Transmission Systems Using Optical Radiation**

Second Edition

September 15, 2017

This ANSI/UL Standard for Safety consists of the Second Edition including revisions through December 8, 2017.

The most recent designation of ANSI/UL 60079-28 as an American National Standard (ANSI) occurred on September 15, 2017. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page or Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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Preface (UL)

This UL Standard is based on IEC Publication 60079-28: second edition Explosive Atmospheres - Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, as revised by IEC corrigendum 1. IEC publication 60079-28 is copyrighted by the IEC.

Efforts have been made to synchronize the UL edition number with that of the corresponding IEC standard with which this standard is harmonized. As a result, one or more UL edition numbers have been skipped to match that of the IEC edition number.

The ISA-60079-28:2012 standard is being maintained until September 15, 2022 for reference purposes only.

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Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

The following people served as members of STP 60079 and participated in the review of this standard:

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National Differences

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60079-28, Explosive Atmospheres – Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation, copyright 2015, are indicated by notations (differences) and are presented within the body of the UL printed standard in bold text using legislative text (strike-out and underline).

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences based on **safety practices**. These are differences for IEC requirements that may be acceptable, but adopting the IEC requirements would require considerable retesting or redesign on the manufacturer's part.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

DR – These are National Differences based on the **national regulatory requirements**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

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 nongovernmental 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.

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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.

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		

Significance of changes with respect to IEC 60079-28:2006 Continued

Significant Changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.



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.

DV.1 DR Add the following as the last paragraph of the Introduction:

This standard also contains the minimum requirements for equipment and transmission systems using optical radiation in areas classified using the Division method.

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

1 Scope

1DV.1 DR *Modification of Clause 1 to replace with the following:*

1DV.1.1 DR This ~~part of IEC 60079 standard~~ 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 UL 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.

1.2 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.

1.3 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.

1.4 This standard specifies requirements for equipment intended for use under atmospheric conditions.

1DV.1.5 DR Annex F outlines the application of this standard for equipment and transmission systems using optical radiation in areas classified using the Division method.

1DV.1.6 DR This standard supplements and modifies the general requirements of IEC UL 60079-0. Where a requirement of this standard conflicts with a requirement of IEC UL 60079-0, the requirement of this standard takes precedence.

1DV.1.7 DR Where references are made to other IEC 60079 standards, the referenced requirements found in these standards apply as modified by any applicable U.S. National Differences.

1DV.1.8 DR This standard applies to optical fibre equipment and optical equipment, including LED and laser equipment, with the exception of the equipment detailed below:

NOTE 2 Where certifications for equipment and transmission systems using optical radiation meet one of the five exceptions below, and do not reference UL 60079-28, the certificate or other supporting documentation may have the following statement, modified appropriately:

“The output of the optical radiation source with respect to explosion protection meets Exception X) from the scope of UL 60079-28”.

The reference to “Exception X)” above is to be replaced by the actual number of the Exception that applies from the scope of UL 60079-28, e.g. “Exception 1)”, “Exception 2)”, “Exception 3)”, “Exception 4)” or “Exception 5)”.

1) Non-array divergent LEDs used for example to show equipment status or backlight function.

1DV.1.8.1 D2

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 any continuous divergent light source, including LEDs (for all EPLs).

~~– 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.~~

1DV.1.9 DR

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.

Optical radiation sources for EPL Gc and Dc applications which comply with Class I limits in accordance with the US Code of Federal Regulations, 21 CFR Part 1040.

NOTE 3 The referenced Class 1 or Class I 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 or the US Code of Federal Regulations, 21 CFR Part 1040, respectively, with this measured distance reflected in the Ex application. Class 1 limits are based on normal operating and single fault conditions, as opposed to Class I limits which are only based on normal operating conditions.

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:

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- 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 UL 60079-1), or

