



UL 60079-7

STANDARD FOR SAFETY

Explosive Atmospheres – Part 7: Equipment protection by increased safety "e"

UL 60079-7 2013



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UL Standard for Safety for Explosive Atmospheres – Part 7: Equipment protection by increased safety “e”,
UL 60079-7

Fourth Edition, Dated October 15, 2008

Summary of Topics

This revision to ANSI/UL 60079-7 is being issued to reflect the reaffirmation of ANSI approval. No changes in requirements have been made.

As noted in the Commitment for Amendments statement located on the back side of the title page, UL and ISA are committed to updating this bi-national standard jointly. However, the revision pages dated May 31, 2013 will not be issued by ISA as revision pages but as an update to their standard.

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.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated November 30, 2012.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the preface. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a “SUPERSEDED REQUIREMENTS” notice.

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ISA – The Instrumentation, Systems, and Automation Society
ANSI/ISA 60079-7 (12.16.01)-2008 (R2013)
Second Edition



Underwriters Laboratories Inc.
UL 60079-7
Fourth Edition

Explosive Atmospheres – Part 7: Equipment protection by increased safety “e”

October 15, 2008

(Title Page Reprinted: May 31, 2013)



ANSI/UL 60079-7-2008 (R2013)

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This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through May 31, 2013.

The most recent designation of ANSI/ISA 60079–7 and ANSI/UL 60079-7 as a Reaffirmed American National Standard (ANS) occurred on May 31, 2013. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards. Any other portions of this ANSI/UL standard that were not processed in accordance with ANSI/UL requirements are noted at the beginning of the impacted sections.

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 <http://csds.ul.com>.

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CONTENTS

General Notes	6
Preface (ISA)	7
National Differences	11
FOREWORD	12
1 Scope	14
2 Normative references	14
3 Terms and definitions	20
4 Constructional requirements for all electrical apparatus	23
4.1 General	23
4.2 Electrical connections	23
4.3 Clearances	28
4.4 Creepage distances	33
4.5 Solid electrical insulating materials	35
4.6 Windings	35
4.7 Temperature limitations	36
4.8 Wiring internal to apparatus	38
4.9 Degrees of protection provided by enclosures	38
4.10 Fasteners	39
5 Supplementary requirements for specific electrical apparatus	39
5.1 General	39
5.2 Rotating electrical machines	40
5.3 Luminaires	47
5.4 Caplights and handlights	53
5.5 Measuring instruments and instrument transformers	54
5.6 Transformers other than instrument transformers	55
5.7 Batteries	55
5.8 General purpose connection and junction boxes	62
5.9 Resistance heaters (other than trace heaters)	62
5.10 Other electrical apparatus	66
6 Type verifications and type tests	66
6.1 Dielectric strength	66
6.2 Rotating electrical machines	67
6.3 Luminaires designed for mains supply	69
6.4 Measuring instruments and instrument transformers	72
6.5 Transformers other than instrument transformers	72
6.6 Secondary batteries	73
6.7 General purpose connection and junction boxes	76
6.8 Resistance heating devices and resistance heating units	77
6.9 Terminal insulating material tests	78
7 Routine verifications and routine tests	80
7.1 Dielectric tests	80
7.2 Dielectric tests for batteries	80
7.3 Inter-turn overvoltage tests	80
8 Ex component certificates	80
8.1 General	80
8.2 Terminals	80

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9 Marking and instructions	81
9.1 General marking	81
9.2 Instructions for use	82
9.3 Warning markings	84

Annex A (normative) – Cage motors – Methods of test and of calculation

Annex B (normative) – Type tests for specific forms of resistance heating devices or resistance heating units (other than trace heater)

B.1 Resistance heating devices subjected to mechanical stresses	88
B.2 Resistance heating devices or units intended for immersion	88
B.3 Resistance heating devices or units having hygroscopic insulating material	88
B.4 Verification of limiting temperature of resistance heating devices (other than trace heaters)	88

Annex C (informative) – Cage motors – Thermal protection in service

Annex D (informative) – Resistance heating devices and units – Additional electrical protection

D.1 Objective	91
D.2 Method of protection	91

Annex E (informative) – Combinations of terminals and conductors for general purpose connection and junction boxes

E.1 General	92
E.2 Maximum dissipated power method	92
E.3 Defined arrangement method	92

Annex F (informative) – Dimensions of copper conductors

Annex G (informative) – Potential stator winding discharge risk assessment – Ignition risk factors

Annex H (normative) – Test procedure for T8, T10 and T12 lamps

H.1 Asymmetric pulse test	96
H.1.1 General	96
H.1.2 Test procedure	96
H.2 Asymmetric power test	99
H.2.1 General	99
H.2.2 Test procedure	99

Annex I (informative) – Introduction of an alternative risk assessment method encompassing 'Equipment Protection Levels' for Ex Equipment

I.1 Historical Background	102
I.2 Introduction	103
I.2.1 Coal Mining (Group I):	103
I.2.2 Gases (Group II):	103
I.2.3 Dusts (Group III):	104
I.3 Risk of ignition protection afforded	105
I.4 Implementation	105

Bibliography

General Notes

This is the common ISA and UL Standard for Explosive Atmospheres – Part 7: Equipment protection by increased safety “e”. It is the fourth edition of ANSI/ISA 60079-7 and the fourth edition of ANSI/UL 60079-7. The document is a modification of the IEC document and includes U.S. deviations encompassing both additions and deletions of information.

ANSI/ISA 60079-7 and ANSI/UL 60079-7 contain identical requirements, and identical publication dates. The presentation and format of the standards material may differ between the two published standards.

This common Standard was prepared by ISA – The Instrumentation, Systems, and Automation Society and Underwriters Laboratories Inc. (UL).

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.

Level of harmonization

This standard adopts the IEC text with national differences.

The requirements are presented in different formats. The ISA version of the standard illustrates the national differences from the IEC text through the use of legislative text (strike-out and underline). The UL version of the standard illustrates national differences immediately following the IEC text. National differences between the UL version and the ISA version shall be word for word except for editorial changes.

Interpretations

The interpretation by the SDO of an identical or equivalent standard shall be based on the literal text to determine compliance with the standard in accordance with the procedural rules of the SDO. If more than one interpretation of the literal text has been identified, a revision shall be proposed as soon as possible to each of the SDOs to more accurately reflect the intent.

UL Effective Date

The requirements in this standard are effective October 15, 2011

A UL effective date is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

Preface (ISA)

This ISA standard is based on IEC Publication 60079-7. It is the intention of the ISA12 Committee to develop an ANSI Standard that is harmonized with IEC 60079-7 to the fullest extent possible.

This preface, as well as all footnotes and annexes, is included for information purposes and is not part of ANSI/ISA-60079-7 (12.16.01)-2008 (R2013).

The standards referenced within this document may contain provisions which, through reference in this text, constitute requirements of this document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent editions of the standards indicated within this document. Members of IEC and ISO maintain registers of currently valid International Standards. ANSI maintains registers of currently valid U.S. National Standards.

This document has been prepared as part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, Standards and Practices Board; ISA; 67 Alexander Drive; P. O. Box 12277; Research Triangle Park, NC 27709; Telephone (919) 549-8411; Fax (919) 549-8288; E-mail: standards@isa.org.

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Foreword (ISA)

The entire text of IEC 60079-7:2006 is included in this document. U.S. National Deviations are shown by ~~strikeout~~ through deleted text and underlining of added text. There are ten annexes in this standard. Annexes A and B are normative and form part of the requirements of this standard. Annexes C, D, E, F, G, H, I, J, and K are informative and are not considered part of this standard.

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National Differences

In the UL publication of this standard, National Differences from the text of International Electrotechnical Commission (IEC) Publication 60079-7, Explosive Atmospheres – Part 7: Equipment protection by increased safety “e” are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

In the ISA publication of this standard, National Differences are presented using legislative text (strike-out and underline). The national difference type is identified in an informative annex.

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.

Note: The UL printed standard includes the national difference types within the body of the text. The ISA printed standard includes the national difference types in an annex at the back of the standard.

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

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**.

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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES – Part 7: Equipment protection by increased safety "e"

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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International Standard IEC 60079-7 has been prepared by IEC technical committee 31: Equipment for explosive atmospheres.

This fourth edition cancels and replaces the third edition published in 2001, and constitutes a technical revision.

The significant changes with respect to the previous edition are listed below:

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- requirements for electrical connections expanded and clarified,
- requirements for luminaire ballasts expanded and clarified,
- requirements for evaluation and testing of motor rotors clarified.

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

FDIS	Report on voting
31/623/FDIS	31/639/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 list of all parts of IEC 60079 series, 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 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

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EXPLOSIVE ATMOSPHERES – Part 7: Equipment protection by increased safety "e"

1 Scope

This part of IEC 60079 specifies the requirements for the design, construction, testing and marking of electrical apparatus with type of protection increased safety "e" intended for use in explosive gas atmospheres. This standard applies to electrical apparatus where the rated voltage does not exceed 11 kV r.m.s. a.c. or d.c. Additional measures are applied to ensure that the apparatus does not produce arcs, sparks, or excessive temperatures in normal operation or under specified abnormal conditions.

1DV.1 DR Modification of the first paragraph, replace with the following:

1DV.1.1 This standard specifies the requirements for the design, construction, testing and marking of electrical apparatus with type of protection increased safety "e" intended for use in Class I, Zone 1, Groups IIA, IIB, and IIC hazardous (classified) locations. This standard applies to electrical apparatus where the rated voltage does not exceed 11 kV r.m.s. a.c. or d.c. Additional measures are applied to ensure that the apparatus does not produce arcs, sparks, or excessive temperatures in normal operation or under specified abnormal 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.

1DV.2 DR Modification of the second paragraph:

1DV.2.1 Replace "IEC 60079-0" with "UL 60079-0".

NOTE Increased safety "e" can provide Equipment Protection Levels (EPL) Mb or Gb. For further information, see Annex I.

1.1DV.1 DR Addition of 1.1DV.1.1:

1.1DV.1.1 The U.S. version of IEC 60079-7 does not include requirements for Group I electrical apparatus.

1.2DV.1 DR Addition of 1.2DV.1.1:

1.2DV.1.1 Where references are made to other IEC standards, the referenced requirements found in these standards shall apply as modified by any applicable U.S. National Differences.

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 60034-1,
Rotating electrical machines – Part 1: Rating and performance

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IEC 60034-5,
Rotating electrical machines – Part 5: Degrees of protection provided by the internal design of rotating electrical machines (IP code) – Classification

IEC 60044-6,
Instrument transformers – Part 6: Requirements for protective current transformers for transient performance

IEC 60050(426),
International Electrotechnical Vocabulary (IEV) – Chapter 426: Electrical apparatus for explosive atmospheres

IEC 60061-1,
Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps

IEC 60061-2,
Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 2: Lampholders

IEC 60064,
Tungsten filament lamps for domestic and similar general lighting purposes – Performance requirements

IEC 60068-2-6,
Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)

IEC 60068-2-27: 1987,
Environmental testing – Part 2: Tests – Test Ea and guidance: Shock

IEC 60068-2-42,
Environmental testing – Part 2-42: Tests – Test Kc: Sulphur dioxide test for contacts and connections

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

IEC 60079-1,
Electrical apparatus for explosive gas atmospheres – Part 1: Flameproof enclosures "d"

IEC 60079-11,
Electrical apparatus for explosive gas atmospheres – Part 11: Equipment protection by intrinsic safety "i"

IEC 60085,
Electrical insulation – Thermal classification

IEC 60112,
Method for the determination of the proof and the comparative tracking indices of solid insulating materials

IEC 60228,
Conductors of insulated cables

IEC 60238,
Edison screw lampholders

IEC 60317-3:2004,
Specifications for particular types of winding wires – Part 3: Polyester enamelled round copper wires, class 155

IEC 60317-7:1990,
Specifications for particular types of winding wires – Part 7: Polyimide enamelled round copper wire, class 220

IEC 60317-8:1990,
Specifications for particular types of winding wires – Part 8: Polyesterimide enamelled round copper wire, class 180

IEC 60317-13:1990,
Specifications for particular types of winding wires – Part 13: Polyester or polyesterimide overcoated with polyamide-imide enamelled round copper wire, class 200

IEC 60364-3,
Electrical installations of buildings – Part 5-55: Selection and erection of electrical equipment – Other equipment

IEC 60400,
Lampholders for tubular fluorescent lamps and starterholders

IEC 60432-1,
Incandescent lamps – Safety specifications – Part 1: Tungsten filament lamps for domestic and similar general lighting purposes

IEC 60529,
Degrees of protection provided by enclosures (IP Code)

IEC 60664-1:1992,
Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements, and tests

IEC 60947-1,
Low-voltage switchgear and controlgear – Part 1: General rules

IEC 60947-7-1,
Low-voltage switchgear and controlgear – Part 7: Ancillary equipment – Section 1: Terminal blocks for copper conductors

IEC 60947-7-2,
Low-voltage switchgear and controlgear – Part 2 – Ancillary equipment – Section 1: Protective conductor terminal blocks for copper conductors

IEC 60999-1,
Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)

IEC 60999-2,
Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm² up to 300 mm² (included)

IEC 61195:1999,
Double-capped fluorescent lamps – Safety specifications

IEC 61347-2-3:2000,
Lamp controlgear – Part 2-3: Particular requirements for a.c. supplied electronic ballasts for fluorescent lamps
Amendment 1(2004)
Amendment 2 (2006)

IEC 62086-1,
Electrical apparatus for explosive gas atmospheres – Electrical resistance trace heating – Part 1: General and testing requirements

ISO 2859-1,
Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

2DV.1 DR Modification of Clause 2 title:

2DV.1.1 Delete "Normative".

2DV.2 DR Modification of Clause 2 references:

2DV.2.1 Replace with the following references:

IEC 60034-1,
Rotating electrical machines – Part 1: Rating and performance

IEC 60034-5,
Rotating electrical machines – Part 5: Degrees of protection provided by the internal design of rotating electrical machines (IP code) – Classification

IEC 60044-6,
Instrument transformers – Part 6: Requirements for protective current transformers for transient performance

IEC 60050(426),
International Electrotechnical Vocabulary (IEV) – Chapter 426: Electrical apparatus for explosive atmospheres

IEC 60061-1,
Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps

IEC 60061-2,
Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 2: Lampholders

IEC 60064,
Tungsten filament lamps for domestic and similar general lighting purposes – Performance requirements

IEC 60068-2-6,
Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)

IEC 60068-2-27: 1987,
Environmental testing – Part 2: Tests – Test Ea and guidance: Shock

IEC 60068-2-42,
Environmental testing – Part 2-42: Tests – Test Kc: Sulphur dioxide test for contacts and connections

UL 60079-0
Electrical apparatus for explosive gas atmospheres – Part 0: General requirements

UL 60079-1
Electrical apparatus for explosive gas atmospheres – Part 1: Flameproof enclosures "d"

UL 60079-11
Electrical apparatus for explosive gas atmospheres – Part 11: Equipment protection by intrinsic safety "i"

IEC 60085,
Electrical insulation – Thermal classification

IEC 60112,
Method for the determination of the proof and the comparative tracking indices of solid insulating materials

IEC 60238,
Edison screw lampholders

IEC 60317-3:2004,
Specifications for particular types of winding wires – Part 3: Polyester enamelled round copper wires, class 155

IEC 60317-7:1990,
Specifications for particular types of winding wires – Part 7: Polyimide enamelled round copper wire, class 220

IEC 60317-8:1990,
Specifications for particular types of winding wires – Part 8: Polyesterimide enamelled round copper wire, class 180

IEC 60317-13:1990,
Specifications for particular types of winding wires – Part 13: Polyester or polyesterimide overcoated with polyamide-imide enamelled round copper wire, class 200

IEC 60364-3,
Electrical installations of buildings – Part 5-55: Selection and erection of electrical equipment – Other equipment

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IEC 60400,
Lampholders for tubular fluorescent lamps and starterholders

IEC 60432-1,
Incandescent lamps – Safety specifications – Part 1: Tungsten filament lamps for domestic and similar general lighting purposes

IEC 60529,
Degrees of protection provided by enclosures (IP Code)

IEC 60664-1:1992,
Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements, and tests

UL 60947-7-1
Low-voltage switchgear and controlgear – Part 7: Ancillary equipment – Section 1: Terminal blocks for copper conductors

UL 60947-7-2
Low-voltage switchgear and controlgear – Part 2 – Ancillary equipment – Section 1: Protective conductor terminal blocks for copper conductors

IEC 61195:1999,
Double-capped fluorescent lamps – Safety specifications

IEC 61347-2-3:2000,
Lamp controlgear – Part 2-3: Particular requirements for a.c. supplied electronic ballasts for fluorescent lamps
Amendment 1(2004)
Amendment 2 (2006)

IEC 62086-1,
Electrical apparatus for explosive gas atmospheres – Electrical resistance trace heating – Part 1: General and testing requirements

ISO 2859-1,
Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

C78.1,
Fluorescent Lamps – Rapid Start Types – Dimensional and Electrical Characteristics

C81.61,
Electric Lamp Bases

C81.62,
Lampholders for Electric Lamps

IEEE 515,
IEEE Recommended Practice for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications

**NFPA 70:2005,
National Electrical Code®**

**UL 486E
Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors**

**UL 508
Industrial Control Equipment**

**UL 746A
Standard for Polymeric Materials - Short Term Property Evaluations**

**UL 840
Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment**

**UL 1059
Terminal Blocks**

3 Terms and definitions

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

3DV.1 DR Modification of the first paragraph:

3DV.1.1 Replace "document" with "standard" and "IEC 60079-0" with "UL 60079-0".

For the definitions of any other terms, particularly those of a more general nature, reference should be made to IEC 60050(426) or other appropriate parts of the IEV (International Electrotechnical Vocabulary).

3.1 clearance – shortest distance in air between two conductive parts

3.2 connections, factory – terminations intended for connection during a manufacturing process under controlled conditions

3.3 connections, field-wiring – terminations intended for connection by the installer in the field

3.4 creepage distance – shortest distance along the surface of an electrically insulating material between two conductive parts

3.5 increased safety "e" – type of protection applied to electrical apparatus in which additional measures are applied so as to give increased security against the possibility of excessive temperatures and of the occurrence of arcs and sparks in normal service or under specified abnormal conditions

NOTE 1 This type of protection is denoted by "e". The "additional measures" are those required for compliance with this standard.

NOTE 2 Apparatus producing arcs or sparks in normal service is excluded by this definition of increased safety.

3.6 initial starting current I_A

– highest r.m.s. value of current absorbed by an a.c. motor when at rest or by an a.c. magnet with its armature clamped in the position of maximum air gap when supplied at rated voltage and rated frequency

NOTE Transient phenomena are ignored.

3.7 limiting temperature – maximum permissible temperature for apparatus or parts of apparatus equal to the lower of the two temperatures determined by

- a) the danger of ignition of the explosive gas atmosphere,
- b) the thermal stability of the materials used

NOTE This temperature may be the maximum surface temperature (see both 3.18 and Clause 5 of IEC 60079-0) or a lower value (see 4.7).

3.8 normal service, motors – continuous operation at the nameplate rating (or set of ratings) including starting conditions

3.9 rated dynamic current I_{dyn}

– peak value of the current, the dynamic effect of which the electrical apparatus can sustain without damage

3.10 rated short-time thermal current I_{th}

– r.m.s. value of the current required to heat up the conductor within 1 s from the temperature reached in rated service at the maximum ambient temperature to a temperature not exceeding the limiting temperature

3.11 rated voltage – value of voltage assigned by the manufacturer to a component, device or equipment and to which operation and performance characteristics are referred

3.12 resistance-heating devices and resistance-heating units

3.12DV.1 DE Modification of 3.12

3.12DV.1.1 Replace "devices" with "equipment".

3.12.1 resistance-heating device – part of a resistance heating unit comprising one or more heating resistors, typically composed of metallic conductors or an electrically conductive material suitably insulated and protected

3.12.1DV.1 DR Modification of 3.12.1

3.12.1DV.1.1 Replace "device" with "equipment".

3.12.2 resistance-heating unit – apparatus comprising an assembly of one or more resistance heating devices associated with any devices necessary to ensure that the limiting temperature is not exceeded

NOTE It is not intended that the devices necessary to ensure that the limiting temperature is not exceeded should have type of protection "e", or any type of protection when they are located outside the hazardous area.

3.12.3 workpiece – object to which a resistance-heating device or unit is applied

3.12.4 temperature self-limiting characteristic – characteristic whereby the thermal output of a resistance-heating device at its rated voltage decreases as the temperature of its surroundings increases until the device reaches a temperature at which its thermal output is reduced to a value at which there is no further rise in temperature

NOTE The temperature of the surface of the element is then effectively that of its surroundings.

3.12.5 stabilized design – concept where the temperature of the resistance-heating device or unit will, by design and use, stabilize below the limiting temperature, under the most unfavourable conditions, without the need for a safety device to limit the temperature

3.13 short-circuit current I_{sc}

maximum r.m.s. value of the short-circuit current to which the apparatus may be subjected in service

NOTE This maximum value is recorded in the documentation according to Clause 24 of IEC 60079-0.

3.13DV.1 DR Modification of Note:

3.13DV.1.1 Replace "IEC 60079-0" with "UL 60079-0."

3.14 starting current ratio I_A/I_N

– ratio between initial starting current I_A and rated current I_N

3.15 time t_E

– time, in seconds, taken for an a.c. rotor or stator winding, when carrying the initial starting current I_A , to be heated up to the limiting temperature from the temperature reached in rated service at the maximum ambient temperature (see Figure A.1)

3.16 trace heater – device designed for the purpose of producing heat on the principle of electrical resistance and typically composed of one or more metallic conductors or an electrically conductive material suitably electrically insulated and protected

3.16DV.1 DR Modification of 3.16:

3.16DV1.1. Replace "device" with "equipment".

3.17 working voltage – highest r.m.s. value of the a.c. or d.c. voltage across any particular insulation which can occur when the equipment is supplied at rated voltage

NOTE 1 Transients are disregarded.

NOTE 2 Both open-circuit conditions and normal operating conditions are taken into account.

4 Constructional requirements for all electrical apparatus

4.1 General

The requirements of this clause apply, unless otherwise stated in Clause 5, to all electrical apparatus with type of protection "e" and are themselves supplemented for certain electrical apparatus by the supplementary requirements in Clause 5.

4.2 Electrical connections

4.2.1 General

Electrical connections are sub-divided into those for field-wiring and for factory wiring and into permanent types and re-connectable / re-wirable types for convenience in detailing the appropriate requirements.

Each type shall, as applicable:

- a) be constructed in such a way that the conductors cannot slip out from their intended location during tightening of a screw or after insertion;
- b) provide a means to avoid loosening of the connection in service;
- c) be such that contact is assured without damage to the conductors such that would impair the ability of the conductors to fulfil their function, even if multi-stranded conductors are used in connections intended for direct clamping of a single conductor;
- d) provide a positive compression force to assure contact pressure in service;
- e) be constructed in such a way that the contact they assure is not appreciably impaired by temperature changes occurring in normal service;
- f) except as permitted by the earth continuity test of IEC 60079-0, provide contact pressure that is not applied through insulating materials;

4.2.1DV.1 DR Modification of f):

4.2.1DV.1.1 Delete "except as permitted by the earth continuity test of IEC 60079-0".

- g) not be specified to accommodate more than one individual conductor in a clamping point unless specifically designed and assessed for doing so;
- h) if intended for stranded conductors, employ a means to protect the conductors and distribute the contact pressure evenly. The method of applying contact pressure shall be capable, on installation, of reliably forming the stranded conductor into an effectively solid shape that does not subsequently change in service. Alternatively, the method of applying the contact pressure should be such that it is designed to accommodate any settlement of the strands in service;
- i) for screw connections, have a specified torque value;
- j) for screwless connections intended for class 5 and/or class 6 fine-stranded conductors according to IEC 60228, the fine-stranded wire shall be equipped with a ferrule or the termination shall have a method to open the clamping mechanism so that the conductors are not damaged during the installation of the conductor.

4.2.1DV.2 DR Modification of item j), replace with the following:

4.2.1DV.2.1 for screwless connections, shall have a method to open the clamping mechanism so that neither the conductors nor the clamping mechanism is damaged during the installation of the conductor.

NOTE 1 The use of aluminium wire may cause difficulties by compromising critical creepage and clearance distances when anti-oxidant materials are applied. The connection of aluminium wire to terminals may be accomplished by the use of suitable bi-metallic connection devices providing a copper connection to the terminal.

NOTE 2 Special precautions against vibration and mechanical shock may be required.

NOTE 3 Special precautions against electrolytic corrosion should be considered.

NOTE 4 Special precautions against corrosion should be considered where ferrous materials are used.

NOTE 5 The limiting temperature of the insulation of terminal blocks and accessories will usually be based on the limiting temperature of the insulation in accordance with item a) of 4.7.2 but the limiting temperature allocated to the terminal when used in equipment will also depend on the maximum cable insulation temperature rating of the cable which is to be connected.

4.2.2 Field wiring connections**4.2.2.1 General**

Terminals for field wiring shall be generously dimensioned to permit the effective connection of conductors of cross-section equal to at least that corresponding to the rated current of the electrical apparatus.

4.2.2.1DV.1 DR Modification of the first paragraph:**4.2.2.1DV.1.1 Add "copper" before "conductors".**

Connections shall be located in a position such that where required to be inspected in service they are reasonably accessible.

The number and size of conductors that can be safely connected shall be specified in the descriptive documentation according to IEC 60079-0.

4.2.2.1DV.2 DR Modification of the third paragraph and the addition of a Note:**4.2.2.1DV.2.1 Add "copper" before "conductors" and replace "IEC 60079-0" with "UL 60079-0".**

NOTE: UL 1059 and UL 486E require terminals to be identified with the permitted wire sizes in AWG or kcmil.

4.2.2.2 Connections made using terminals complying with IEC 60947-7-1, IEC 60947-7-2, IEC 60999-1, or IEC 60999-2

4.2.2.2DV.1 DC Modification of Clause 4.2.2.2 title with the following:

4.2.2.2DV.1.1 Connections made using terminals complying with UL 60947-7-1, UL 60947-7-2, UL 1059, or UL 486E

Such terminals are intended for the connection of copper conductors with the insulation locally removed and without the addition of intermediate parts other than those replicating the form of a bare conductor, such as a ferrule.

Terminals shall be subject to the terminal insulation material tests of 6.9.

4.2.2.2DV.2 DC Addition of the following paragraph:

4.2.2DV.2.1 Terminals with a rated voltage greater than 1500 V shall be subjected to the applicable examination and tests of UL 1059 and UL 486E except for the dielectric tests which shall be conducted in accordance with 6.10DV.1.

Terminals shall be capable of being fixed in their mountings.

The temperature rise of the conductor bar shall not exceed 45 K at a test current of 110 % of rated current according to the method of the temperature-rise test of IEC 60947-7-1.

4.2.2.2DV.3 DR Modification of the fourth paragraph and the addition of Note 0:

4.2.2DV.3.1 Replace “IEC 60947-7-1” with “UL 60947-7-1”.

NOTE 0: The temperature rise limit in UL 1059 is more restrictive and is limited to a rise of 30K at 100% of rated current.

NOTE 1 This test relates to the absolute maximum current rating of the terminal when tested without any enclosure. For practical purposes, when terminals are used in multiple within enclosures, it will be necessary to establish reduced current ratings according to the particular circumstances. See 5.8, 6.7 and Annex E.

Terminals for connecting conductors of rated cross-section not exceeding 4 mm² (12 AWG) shall also be suitable for the effective connection of conductors at least two ISO wire sizes smaller if not otherwise specified in the certificate. See Annex F.

NOTE 2 Subclause 4.2.2.2 is primarily intended to give requirements for terminals as components. When mounted in equipment any consequent limitations given in this standard apply.

4.2.2.3 Field wiring connection facilities integral to “e” apparatus or components

Terminals shall meet the requirements of 4.2.2.2, where applicable.

Temperatures for the verification of the thermal stability of materials shall be determined using a test sample configured to represent the complete apparatus, from a heating perspective, in accordance with IEC 60079-0.

4.2.2.3DV.1 DR Modification of the second paragraph:

4.2.2.3DV.1.1 Replace “IEC 60079-0” with “UL 60079-0”.

4.2.2.4 Connections designed to be used with cable lugs and similar devices

Such connections shall be fixed in their mountings.

A means of securing the cable to prevent rotation or movement shall be provided to avoid either loosening or compromising creepage and clearance. Alternatively, it shall be demonstrated that such rotation or movement is not reasonably foreseeable.

4.2.2.5 Connections using permanent arrangements

These connections are typically tails with crimping or soldering facilities that are intended to be connected during installation using appropriate connection methods.

Either a means of fixing the completed connections to a suitable location is to be provided or the completed connections are to be provided with means of reliably insulating them to the requirements of this standard.

If the method of connection is by soldering, a method of providing mechanical support of the completed connection shall be provided. The security of the joint shall not be permitted to rely solely on the solder.

4.2.3 Factory connections

4.2.3.1 General

Factory connections shall be either fixed in a specific location or be provided with means of meeting the creepage and clearance requirements of this standard.

4.2.3.2 Field wiring connection methods used for factory connections

Any of the connection methods suitable for use as field wiring connections may be used for a factory connection, except in this case, the terminal insulation material tests of 6.9 need not be conducted.

4.2.3.3 Permanent connections

Permanent connections shall only be made by

- a) crimping,
- b) brazing,
- c) welding,
- d) soldering, provided that the conductors are not supported by the soldered connection alone.

4.2.3.3DV.1 DC Addition of the following paragraph:

4.2.3.3DV.1.1 Terminals with a rated voltage greater than 1500 V shall be subjected to the applicable examination and tests of UL 1059 and UL 486E except for the dielectric tests which shall be conducted in accordance with 6.10DV.1.

4.2.3.4 Pluggable connections

These connections are designed to be readily connected or disconnected during assembly, maintenance, or repair.

NOTE Typical examples are plug-in components, and card edge connectors.

Pluggable connections shall provide the following:

- a) each connection shall employ at least two contact arrangements where the effectiveness of each is substantially independent of the other;
- b) each connection or group of connections shall be provided with a mechanical retaining device, which, excluding internal friction, provides a force resisting separation of at least 30 N. Where a group of individual connections is mechanically linked and the separable component weighs more than 0,25 kg or carries more than 10 cables, special consideration shall be given to the security of the connection;
- c) for a lightweight connecting component relying on friction to remain in place and not attached in any way outside of the connection points, the separating force in Newtons shall be greater than 200 times the weight of the component and a mechanical retaining device is not required. The force shall be applied gradually near the centre of the component;
- d) if the factory connection may remain energised when separated, it shall be provided with an interlock to prevent separation when energised or shall be marked in accordance with item b) of Table 12. For small items, adjacent marking can be provided.

4.2.3.4DV.1 DE Modification of 4.2.3.4(c):

4.2.3.4DV.1.1 Delete "lightweight" before "connecting".

4.2.3.4DV.2 DC Addition of NOTE:

NOTE If an interlock is provided, UL 60079-0 requires that the type of protection selected be suitable for application in the explosive gas atmosphere.

4.2.3.5 Terminal bridging connections

These connections are designed to be made one-time only and not connected or disconnected during maintenance or repair.

A terminal bridging connection shall have a separating force in Newtons that is greater than 200 times the weight of the component. The force shall be applied gradually near the centre of the component.

4.3 Clearances

Clearances between bare conductive parts at different potentials shall be as given in Table 1 with a minimum value for external connections of 3 mm.

Spacings at wiring terminals shall be evaluated with the conductor size that produces the minimum clearance.

NOTE For requirements for lamps with screw caps, see 5.3.3.1.

Clearances shall be determined as a function of the working voltage. Where the apparatus is intended for more than one rated voltage or for a range of rated voltage, the value of working voltage to be used shall be based on the highest value of rated voltage. In determining the clearances, examples 1 to 11 (inclusive) in Figure 1 illustrate the features to be taken into account and the appropriate clearances.

Table 1 – Creepage distances and clearances

Voltage (see Note 1) $U_{r.m.s.}$ a.c. or d.c. V	Minimum creepage distance mm			Minimum clearance mm
	Material group			
	I	II	IIIa	
10 (see Note 3)	1,6	1,6	1,6	1,6
12,5	1,6	1,6	1,6	1,6
16	1,6	1,6	1,6	1,6
20	1,6	1,6	1,6	1,6
25	1,7	1,7	1,7	1,7
32	1,8	1,8	1,8	1,8
40	1,9	2,4	3,0	1,9
50	2,1	2,6	3,4	2,1
63	2,1	2,6	3,4	2,1
80	2,2	2,8	3,6	2,2
100	2,4	3,0	3,8	2,4
125	2,5	3,2	4,0	2,5
160	3,2	4,0	5,0	3,2
200	4,0	5,0	6,3	4,0
250	5,0	6,3	8,0	5,0
320	6,3	8,0	10,0	6,0
400	8,0	10,0	12,5	6,0
500	10	12,5	16	8,0

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Table 1 – Creepage distances and clearances Continued

Voltage (see Note 1) <i>U_{r.m.s.}</i> a.c. or d.c. V	Minimum creepage distance mm			Minimum clearance mm
	Material group			
	I	II	IIIa	
630	12	16	20	10
800	16	20	25	12
1 000	20	25	32	14
1 250	22	26	32	18
1600	23	27	32	20
2 000	25	28	32	23
2 500	32	36	40	29
3 200	40	45	50	36
4 000	50	56	63	44
5 000	63	71	80	50
6 300	80	90	100	60
8 000	100	110	125	80
10 000	125	140	160	100

NOTE 1 Voltages shown are derived from IEC 60664-1 and are based on the rationalization of supply voltages given in Table 3b of IEC 60664-1. When determining the required values for creepage and clearance, the voltage value in the table may be increased by a factor of 1,1 in order to recognize the range of rated voltages in common use.

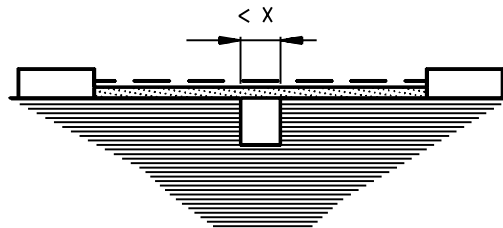
NOTE 2 The creepage distance and clearance values shown are based on a maximum supply voltage tolerance of ±10 %.

NOTE 3 At 10 V and below, the value of CTI is not relevant and materials not meeting the requirement for material group IIIa may be acceptable.

4.3DV.1 Addition of NOTE:

NOTE These examples are identical with those given in IEC 60664-1.

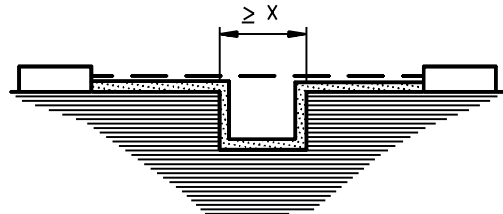
Example 1



Condition: Path under consideration includes a parallel-or converging-sided groove of any depth with a width less than X mm.

Rule: Creepage distance and clearance are measured directly across the groove as shown.

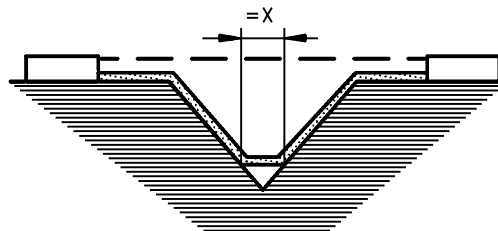
Example 2



Condition: Path under consideration includes a parallel-sided groove of any depth d equal to or more than X mm.

Rule: Clearance is the "line of sight" distance. Creepage follows the contour of the groove.

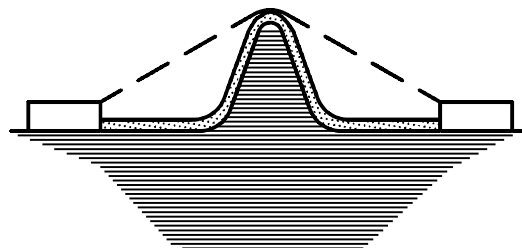
Example 3



Condition: Path under consideration includes a V-shaped groove with a width greater than X mm.

Rule: Clearance is the "line-of-sight" distance. Creepage path follows the contour of the groove but "short circuits" the bottom of the groove by X mm link.

Example 4



Condition: Path under consideration includes a rib.

Rule: Clearance is the shortest direct air path over the top of the rib. Creepage path follows the contour of the rib.

S4557

1
1 clearance

2
2 creepage distance

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