AMERICAN NATIONAL STANDARD

# ANSI/ISA-60079-7 (12.16.01)-2008 (R2013)

**Supercedes ANSI/ISA-60079-7 (12.16.01)-2002**

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

**Approved 31 May 2013**

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

**Commitment for Amendments**

This standard is issued jointly by ISA and Underwriters Laboratories Incorporated (UL). Comments or proposals for revisions on any part of the standard may be submitted to ISA or UL at any time. Revisions to this standard will be made only after processing according to the standards development procedures of ISA and UL. ***ISA and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.***

---

**ISBN: 978-0-876640-23-4**
**Copyright © 2013**
**By ISA**
These materials are subject to copyright claims of IEC, ANSI, and ISA. All rights reserved. Not for resale. Printed in the United States of America. No part of this publication may be reproduced in any form, including an electronic retrieval system, without the prior written permission of ISA. All requests pertaining to this standard should be submitted to ISA.

---

**ISBN**
**Copyright © 2013 Underwriters Laboratories Incorporated**
Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

The most recent designation of ANSI/ISA-60079-7 and ANSI/UL 60079-7 as an American National Standard occurred on 31 May 2013.

This ANSI/UL Standard for Safety, which consists of the fourth edition, is under continuous maintenance, whereby each revision is ANSI approved upon publication. 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.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

**ISA**
**ANSI/ISA-60079-7**
***Fourth Edition***

**Underwriters Laboratories Inc.**
**ANSI/UL 60079-7**
***Fourth Edition***

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

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

This page intentionally left blank.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

# 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 and Underwriters Laboratories Inc. (UL).

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 deviations.

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 15 October 2011.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

This page intentionally left blank.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

# Preface

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.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to USA users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI-acceptable metric units in all new and revised standards, recommended practices, and technical reports to the greatest extent possible. *Standard for Use of the International System of Units (SI): The Modern Metric System*, published by the American Society for Testing & Materials as IEEE/ASTM SI 10-97, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA standards, recommended practices, and technical reports. Participation in the ISA standards-making process by an individual in no way constitutes endorsement by the employer of that individual, of ISA, or of any of the standards, recommended practices, and technical reports that ISA develops.

**CAUTION — ISA ADHERES TO THE POLICY OF THE AMERICAN NATIONAL STANDARDS INSTITUTE WITH REGARD TO PATENTS. IF ISA IS INFORMED OF AN EXISTING PATENT THAT IS REQUIRED FOR USE OF THE STANDARD, IT WILL REQUIRE THE OWNER OF THE PATENT TO EITHER GRANT A ROYALTY-FREE LICENSE FOR USE OF THE PATENT BY USERS COMPLYING WITH THE STANDARD OR A LICENSE ON REASONABLE TERMS AND CONDITIONS THAT ARE FREE FROM UNFAIR DISCRIMINATION.**

**EVEN IF ISA IS UNAWARE OF ANY PATENT COVERING THIS STANDARD, THE USER IS CAUTIONED THAT IMPLEMENTATION OF THE STANDARD MAY REQUIRE USE OF TECHNIQUES, PROCESSES, OR MATERIALS COVERED BY PATENT RIGHTS. ISA TAKES NO POSITION ON THE EXISTENCE OR VALIDITY OF ANY PATENT RIGHTS THAT MAY BE INVOLVED IN IMPLEMENTING THE STANDARD. ISA IS NOT RESPONSIBLE FOR IDENTIFYING ALL PATENTS THAT MAY REQUIRE A LICENSE BEFORE IMPLEMENTATION OF THE STANDARD OR FOR INVESTIGATING THE VALIDITY OR SCOPE OF ANY PATENTS**

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

**BROUGHT TO ITS ATTENTION. THE USER SHOULD CAREFULLY INVESTIGATE RELEVANT PATENTS BEFORE USING THE STANDARD FOR THE USER'S INTENDED APPLICATION.**

**HOWEVER, ISA ASKS THAT ANYONE REVIEWING THIS STANDARD WHO IS AWARE OF ANY PATENTS THAT MAY IMPACT IMPLEMENTATION OF THE STANDARD NOTIFY THE ISA STANDARDS AND PRACTICES DEPARTMENT OF THE PATENT AND ITS OWNER. ADDITIONALLY, THE USE OF THIS STANDARD MAY INVOLVE HAZARDOUS MATERIALS, OPERATIONS OR EQUIPMENT. THE STANDARD CANNOT ANTICIPATE ALL POSSIBLE APPLICATIONS OR ADDRESS ALL POSSIBLE SAFETY ISSUES ASSOCIATED WITH USE IN HAZARDOUS CONDITIONS. THE USER OF THIS STANDARD MUST EXERCISE SOUND PROFESSIONAL JUDGMENT CONCERNING ITS USE AND APPLICABILITY UNDER THE USER'S PARTICULAR CIRCUMSTANCES. THE USER MUST ALSO CONSIDER THE APPLICABILITY OF ANY GOVERNMENTAL REGULATORY LIMITATIONS AND ESTABLISHED SAFETY AND HEALTH PRACTICES BEFORE IMPLEMENTING THIS STANDARD.**

The following people served as members of the ISA Subcommittee ISA12.16:

| NAME | COMPANY |
|---|---|
| K. Boegli, Chair | Phoenix Contact |
| M. Coppler, Managing Director | Det Norske Veritas Certification Inc. |
| T. Crawford | Intertek Testing Services |
| S. Czaniecki | Endress + Hauser Canada |
| P. House | Thermon Industries |
| J. Jonscher | Adalet PLM |
| P. Kelly | UL LLC |
| J. Kuczka | Killark |
| W. Lawrence | FM Approvals LLC |
| E. Massey | Baldor Electric Co. |
| J. McCormick | Siemens Process Analytics |
| J. Miller | Detector Electronics Corp. |
| O. Murphy | Honeywell Inc. |
| T. Schnaare | Rosemount Inc. |
| R. Seitz | Artech Engineering |

The following people served as members of ISA Committee ISA12:

| NAME | COMPANY |
|---|---|
| T. Schnaare, Chair | Rosemount Inc. |
| W. Lawrence, Vice Chair | FM Approvals LLC |
| M. Coppler, Managing Director* | Det Norske Veritas Certification Inc. |
| R. Allen | Honeywell Inc. |
| D. Ankele | UL LLC |
| S. Bihler | Zone Safe Solutions Inc. |
| K. Boegli | Phoenix Contact |
| D. Burns | Shell P&T – Innovation / R&D |
| C. Casso | Nabors Industries |
| M. Dona | Santos Ltd. |
| T. Dubaniewicz | NIOSH |
| D. El Tawy | Solar Turbines, Inc. |
| A. Engler* | Det Norske Veritas DNV |

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

| | |
|---|---|
| W. Fiske | Intertek |
| R. Holub | The DuPont Company Inc. |
| D. Jagger | Bifold-Fluid Power |
| P. Jonscher | Adalet PLM |
| P. Kovscek | Industrial Scientific Corporation |
| J. Kuczka | Killark |
| E. Leubner | Cooper Crouse-Hinds |
| N. Ludlam | FM Approvals Ltd. |
| R. Masek | CSA Group |
| E. Massey | Balder Electric Co. |
| J. Miller | Detector Electronics Corporation |
| A. Page | Consultant |
| R. Seitz | Artech Engineering |
| R. Sierra | USCG |
| M. Spencer | Columbia Gas Transmission |
| J. Thomas | Schlumberger |
| D. Wechsler | American Chemistry Council |
| R. Wigg | E-x Solutions International Pty. Ltd. |

* One vote per company

This standard was approved for publication by the ISA Standards and Practices Board on 2 April 2013.

| NAME | COMPANY |
|---|---|
| E. Cosman, Vice President | The Dow Chemical Company |
| D. Bartusiak | ExxonMobil Chemical Co. |
| P. Brett | Honeywell Inc. |
| J. Campbell | Consultant |
| M. Coppler | Det Norske Veritas Certification Inc. |
| B. Dumortier | Schneider Electric |
| D. Dunn | Aramco Services Co. |
| J. Federlein | Federlein & Assoc. Inc. |
| J. Gilsinn | Kenexis Consulting |
| E. Icayan | Atkins |
| J. Jamison | Spectra Energy Ltd. |
| K. P. Lindner | Endress + Hauser Process Solutions AG |
| V. Maggioli | Feltronics Corp. |
| T. McAvinew | Instrumentation and Control Engineering, LLC |
| V. Mezzano | Fluor Corporation |
| C. Monchinski | Automated Control Concepts Inc. |
| R. Reimer | Rockwell Automation |
| S. Russell | Valero Energy Corp. |
| N. Sands | DuPont |
| H. Sasajima | Azbil Corp. |
| T. Schnaare | Rosemount Inc. |
| J. Tatera | Tatera & Associates Inc. |
| I. Verhappen | Industrial Automation Networks Inc. |
| W. Weidman | WCW Consulting |
| J. Weiss | Applied Control Solutions LLC |
| M. Wilkins | Yokogawa IA Global Marketing (USMK) |
| D. Zetterberg | Chevron Energy Technology Co. |

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

This page intentionally left blank.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

# National Differences

## GENERAL

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", copyright 2006, are indicated by notations (differences) and are presented in bold text.

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.

**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 or figure. 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 or figure 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, or figure of the base IEC text.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

This page intentionally left blank.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

# CONTENTS


1 Scope ..... 19
2 ~~Normative~~ References ..... 19
3 Terms and Definitions ..... 22
4 Constructional requirements for all electrical apparatus ..... 24
4.1 General ..... 24
4.2 Electrical connections ..... 25
4.3 Clearances ..... 28
4.4 Creepage distances ..... 33
4.5 Solid electrical insulating materials ..... 34
4.6 Windings ..... 34
4.7 Temperature limitations ..... 35
4.8 Wiring internal to apparatus ..... 37
4.9 Degrees of protection provided by enclosures ..... 37
~~4.10 Fasteners~~ ..... 37
5 Supplementary requirements for specific electrical apparatus ..... 38
5.1 General ..... 38
5.2 Rotating electrical machines ..... 38
5.3 Luminaires ..... 43
5.4 Cap lights and handlights ..... 48
5.5 Measuring instruments and instrument transformers ..... 48
5.6 Transformers other than instrument transformers ..... 49
5.7 Batteries ..... 49
5.8 General purpose connection and junction boxes ..... 55
5.9 Resistance heaters (other than trace heaters) ..... 55
5.10 Other electrical apparatus ..... 57
6 Type verifications and type tests ..... 57
6.1 Dielectric strength ..... 57
6.2 Rotating electrical machines ..... 58
6.3 Luminaires designed for mains supply ..... 60
6.4 Measuring instruments and instrument transformers ..... 62
6.5 Transformers other than instrument transformers ..... 63
6.6 Secondary batteries ..... 63
6.7 General purpose connection and junction boxes ..... 66
6.8 Resistance heating devices and resistance heating units ..... 66
6.9 Terminal insulating material tests ..... 67
6.10 Terminal dielectric tests ..... 67
7 Routine verifications and routine tests ..... 69
7.1 Dielectric tests ..... 69
7.2 Dielectric tests for batteries ..... 69
7.3 Inter-turn overvoltage tests ..... 69
8 Ex component certificates ..... 69


Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

8.1 General ... 69
8.2 Terminals ... 69
9 Marking and instructions ... 70
9.1 General marking ... 70
9.2 Instructions for use ... 71
9.3 Warning markings ... 72
Annex A (normative) Cage motors – Methods of test and of calculation ... 73
Annex B (normative) Type tests for specific forms of resistance heating devices or resistance heating units (other than trace heater) ... 75
Annex C (informative) Cage motors – Thermal protection in service ... 77
Annex D (informative) Resistance heating devices and units – Additional electrical protection ... 79
Annex E (informative) Combinations of terminals and conductors for general purpose connection and junction boxes ... 81
Annex F (informative) Dimensions of copper conductors ... 83
Annex G (informative) Potential stator winding discharge risk assessment – Ignition risk factors ... 85
Annex H (normative) Test procedure for T8, T10 and T12 lamps ... 87
Annex I (informative) Introduction of an alternative risk assessment method encompassing 'Equipment Protection Levels' for Ex Equipment ... 93
Annex J (informative) Bibliography ... 99
Annex K (informative) United States major deviations ... 101

Figure 1 – Determination of creepage distances and clearances ... 33
Figure 2 – Minimum values of the time $t_E$ of motors in relation to the starting current ratio $I_A/I_N$ ... 41
Figure 3 – Arrangement for the luminaire vibration test ... 62
Figure A.1 – Diagram illustrating the determination of time $t_E$ ... 74
Figure E.1 – Example of defined terminal/conductor arrangement table ... 82
Figure H.1 – Asymmetric pulse test circuit ... 88
Figure H.2 – Asymmetric power detection circuit ... 90
Figure H.3 – Flow Chart – Asymmetric power test ... 91

Table 1 – Creepage distances and clearances ... 29
Table 2 – Tracking resistance of insulating materials ... 33
Table 3 – Limiting temperatures for insulated windings ... 36
Table 4 – Potential air gap sparking risk assessment for cage rotor ignition risk factors ... 40
Table 5 – Minimum distance between lamp and protective cover ... 44
Table 6 – Creepage distances and clearances for screw lamp caps ... 45
Table 7 – Resistance to the effect of short-circuit currents ... 48
Table 8 – Explosion test mixtures ... 59
Table 9 – Insertion torque and minimum removal torque ... 60

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

Table 10 – Value for pull-out tests ..... 68
Table 11 – Creepage distances and clearances for screw lamp caps ..... 72
Table 12 – Text of warning markings ..... 72
Table F.1 – Standard cross-sections of copper conductors ..... 83
Table G.1 – Potential stator winding discharge risk assessment – Ignition risk factors ..... 85
Table I.1 – Traditional relationship of EPLs to Zones (no additional risk assessment) ..... 95
Table I.2 – Description of risk of ignition protection provided ..... 96

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

This page intentionally left blank.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

## Foreword

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.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

This page intentionally left blank.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

## 1 Scope

This ~~part of IEC 60079~~ 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 hazardous (classified) locations ~~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.

This standard supplements and modifies the general requirements of ANSI/ISA-60079-0 ~~IEC 60079-0~~. Where a requirement of this standard conflicts with a requirement of ANSI/ISA-60079-0 ~~IEC 60079-0~~, the requirement of this standard takes precedence.

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

## 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*

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*~~

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

ANSI/ISA-60079-0 (12.00.01)-2005, Electrical Apparatus for Use in Class I, Zones 0, 1, & 2 Hazardous (Classified) Locations – General Requirements

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

ANSI/ISA-60079-1 (12.22.01), Electrical Apparatus for Use in Class I, Zone 1 Hazardous (Classified) Locations – Type of Protection – Flameproof "d

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

ANSI/ISA-60079-11 (12.02.01), Electrical Apparatus for Use in Class I, Zones 0, 1, & 2 Hazardous (Classified) Locations – Type of Protection "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*~~

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

ANSI/UL 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*~~

ANSI/UL 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*~~

ANSI/UL 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 mm$^2$ up to 35 mm$^2$ (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 mm$^2$ up to 300 mm$^2$ (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*

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

ANSI C81.61, *Electric Lamp Bases*

ANSI C81.62, *Lampholders for Electric Lamps*

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

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

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

ANSI/UL 508, *Industrial Control Equipment*

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

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

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

ANSI/UL 1059, *Terminal Blocks*

## 3 Terms and Definitions

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

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

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

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~~ equipment and resistance-heating units**

**3.12.1**
**resistance-heating ~~device~~ equipment**
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

**3.12.2**
**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

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

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~~ANSI/ISA-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~~ equipment 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

**3.17**
**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.

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

## 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;

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 neither the conductor~~s~~ nor the clamping mechanism is ~~are not~~ 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.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

### 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 copper conductors of cross-section equal to at least that corresponding to the rated current of the electrical apparatus.

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 copper conductors that can be safely connected shall be specified in the descriptive documentation according to ~~IEC 60079-0~~ ANSI/ISA-60079-0.

NOTE: ANSI/UL 1059 and ANSI/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 ANSI/UL 60947-7-1~~IEC 60947-7-1~~, ANSI/UL 60947-7-2 ~~IEC 60947-7-2~~, ANSI/UL 1059, or ANSI/UL 486E~~, IEC 60999-1, or IEC 60999-2~~

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.

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

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~~ANSI/UL 60947-7-1.

NOTE 1 The temperature rise limit in ANSI/UL 1059 is more restrictive and is limited to a rise of 30K at 100% of rated current.

NOTE 2 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 $mm^2$ (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.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

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 ANSI/ISA-60079-0 ~~IEC 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.

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

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

#### 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.

NOTE If an interlock is provided, ANSI/ISA-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.

Documents
Document Sharing Hub
Copyright International Society of Automation
Full document details: ANSI ISA 60079-7-2008 (2013)

**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 |
| 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.

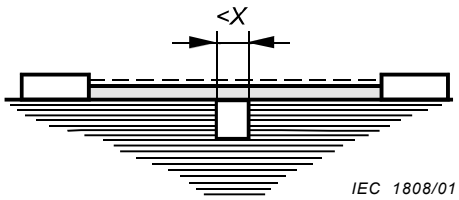
NOTE These examples are identical with those given in IEC 60664-1.

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

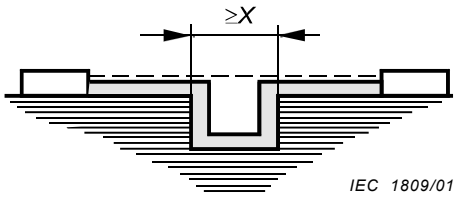
Example 1




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.

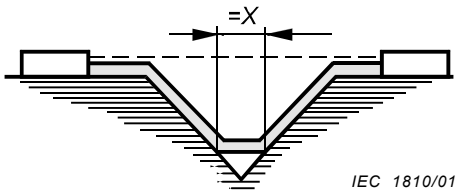
Example 2




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 path follows the contour of the groove.

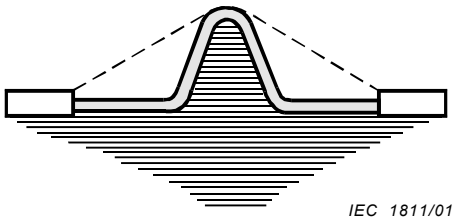
Example 3




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.

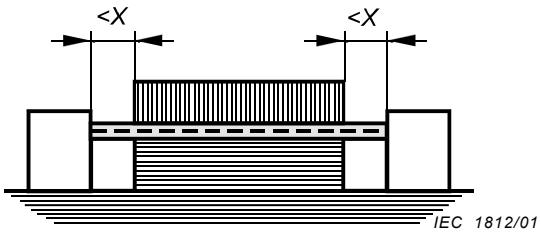
1 clearance 2 creepage distance

Copyright International Society of Automation

Documents
Document Sharing Hub

Full document details: ANSI ISA 60079-7-2008 (2013)

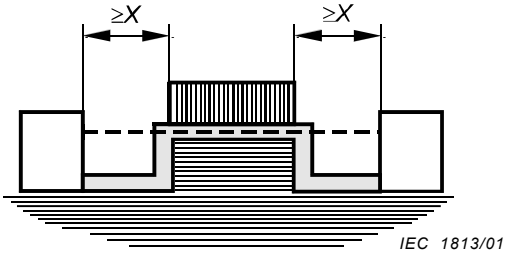
Example 5




Condition: Path under consideration includes an uncemented joint with groove less than $X$ mm wide on each side.

Rule: Creepage and clearance path is the "line of sight" distance shown.

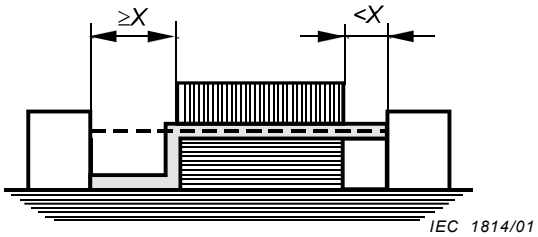
Example 6




Condition: Path under consideration includes an uncemented joint with grooves equal to or more than $X$ mm wide on each side.

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

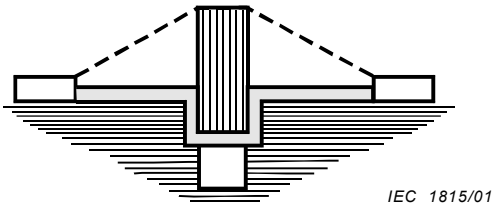
Example 7




Condition: Path under consideration includes an uncemented joint with a groove on one side less than X mm wide and the groove on the other side equal to or more than $X$ mm wide.

Rule: Clearance and creepage paths are as shown.

Example 8




Condition: Creepage distance through uncemented joint is less than creepage distance over barrier.

Rule: Clearance is the shortest direct air path over the top of the barrier.

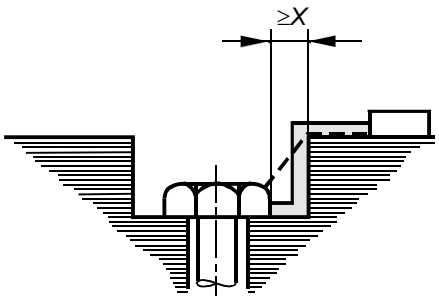
1 clearance 2 creepage distance

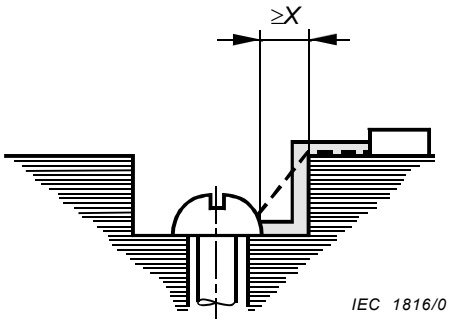
Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)

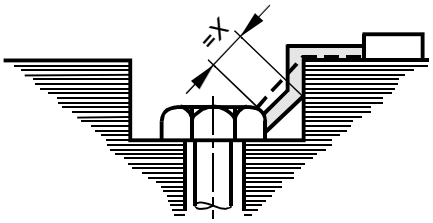
Example 9

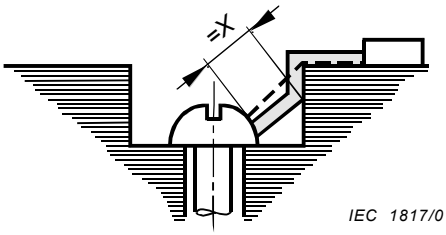



Gap between head of screw and wall of recess wide enough to be taken into account.

Example 10




Gap between head of screw and wall of recess too narrow to be taken into account.

Measurement of creepage distance is from screw to wall when the distance is equal to $X$ mm.

1 clearance 2 creepage distance

Documents
Document Sharing Hub

Copyright International Society of Automation

Full document details: ANSI ISA 60079-7-2008 (2013)