

BS EN 62271-1:2008+A1:2011



BSI Standards Publication

High-voltage switchgear and controlgear —

Part 1: Common specifications

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National foreword

This British Standard is the UK implementation of EN 62271-1:2008+A1:2011. It is identical to IEC 62271-1:2007, incorporating amendment 1:2011. It supersedes BS EN 62271-1:2008, which will be withdrawn on 21 July 2014.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Amendments/corrigenda issued since publication

Date	Text affected
31 October 2011	Implementation of IEC amendment 1:2011 with CENELEC endorsement A1:2011

**High-voltage switchgear and controlgear -
Part 1: Common specifications
(IEC 62271-1:2007)**

Appareillage à haute tension -
Partie 1: Spécifications communes
(CEI 62271-1:2007)

Hochspannungs-Schaltgeräte
und -Schaltanlagen -
Teil 1: Gemeinsame Bestimmungen
(IEC 62271-1:2007)

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 17A/799/FDIS, future edition 1 of IEC 62271-1, prepared by SC 17A, High-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62271-1 on 2008-11-01.

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The following dates were fixed:

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at national level by publication of an identical
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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2011-11-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62271-1:2007 was approved by CENELEC as a European Standard without any modification.

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

IEC 60068-1	NOTE	Harmonized as EN 60068-1:1994 (not modified).
IEC 60099-4	NOTE	Harmonized as EN 60099-4:2004 (modified).
IEC 60664-1	NOTE	Harmonized as EN 60664-1:2007 (not modified).
IEC 62271-100	NOTE	Harmonized as EN 62271-100:2001 (not modified).
ISO 9001	NOTE	Harmonized as EN ISO 9001:2000 (not modified).

Foreword to amendment A1

The text of document 17A/962/FDIS, future amendment 1 to IEC 62271-1:2007, prepared by SC 17A, High-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 62271-1:2008 on 2011-07-21.

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The following dates were fixed:

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Endorsement notice

The text of amendment 1:2011 to the International Standard IEC 62271-1:2007 was approved by CENELEC as an amendment to the European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60034-1	- ¹⁾	Rotating electrical machines - Part 1: Rating and performance	EN 60034-1	2004 ²⁾
IEC 60038 (mod)	1983	IEC standard voltages ³⁾	HD 472 S1 + corr. February + A1	1989 2002 1995
IEC 60050-131	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Part 131: Circuit theory	-	-
IEC 60050-151	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Part 151: Electrical and magnetic devices	-	-
IEC 60050-191	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 191: Dependability and quality of service	-	-
IEC 60050-351	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Part 351: Control technology	-	-
IEC 60050-441	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 441: Switchgear, controlgear and fuses	-	-
IEC 60050-446	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 446: Electrical relays	-	-
IEC 60050-551	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Part 551: Power electronics	-	-
IEC 60050-581	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Part 581: Electromechanical components for electronic equipment	-	-
IEC 60050-601	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 601: Generation, transmission and distribution of electricity - General	-	-

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

³⁾ The title of HD 472 S1 is: Nominal voltages for low voltage public electricity supply systems.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-604	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 604: Generation, transmission and distribution of electricity - Operation	-	-
IEC 60050-605	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 605: Generation, transmission and distribution of electricity - Substations	-	-
IEC 60050-811	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 811: Electric traction	-	-
IEC 60050-826	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Part 826: Electrical installations	-	-
IEC 60051-1	- ¹⁾	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 1: Definitions and general requirements common to all parts	EN 60051-1	1998 ²⁾
IEC 60051-2	- ¹⁾	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 2: Special requirements for ammeters and voltmeters	EN 60051-2	1989 ²⁾
IEC 60051-4	- ¹⁾	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 4: Special requirements for frequency meters	EN 60051-4	1989 ²⁾
IEC 60051-5	- ¹⁾	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 5: Special requirements for phase meters, power factor meters and synchroscopes	EN 60051-5	1989 ²⁾
IEC 60059	- ¹⁾	IEC standard current ratings	EN 60059	1999 ²⁾
IEC 60060-1 + corr. March	1989 1990	High-voltage test techniques - Part 1: General definitions and test requirements	HD 588.1 S1	1991
IEC 60064 (mod)	- ¹⁾	Tungsten filament lamps for domestic and similar general lighting purposes - Performance requirements	EN 60064 + A11	1995 ²⁾ 2007
IEC 60068-2	Series	Environmental testing - Part 2: Tests	EN 60068-2	Series
IEC 60071-1	2006	Insulation co-ordination - Part 1: Definitions, principles and rules	EN 60071-1	2006
IEC 60071-2	1996	Insulation co-ordination - Part 2: Application guide	EN 60071-2	1997
IEC 60073	- ¹⁾	Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators	EN 60073	2002 ²⁾
IEC 60081	- ¹⁾	Double-capped fluorescent lamps - Performance specifications	EN 60081	1998 ²⁾
IEC/TR 60083	- ¹⁾	Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC	-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60085	- ¹⁾	Electrical insulation - Thermal evaluation and designation	EN 60085	2008 ²⁾
IEC 60115-4	Series	Fixed resistors for use in electronic equipment - Part 4: Sectional specification: Fixed power resistors	-	-
IEC 60130	Series	Connectors for frequencies below 3 MHz	EN 60130	Series
IEC 60227	Series	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V	- ⁴⁾	-
IEC 60228	- ¹⁾	Conductors of insulated cables	EN 60228 + corr. May	2005 ²⁾ 2005
IEC 60245	Series	Rubber insulated cables - Rated voltages up to and including 450/750 V	- ⁵⁾	-
IEC 60255-8 (mod)	- ¹⁾	Electrical relays - Part 8: Thermal electrical relays	EN 60255-8	1998 ²⁾
IEC 60255-21-1	- ¹⁾	Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section 1: Vibration tests (sinusoidal)	EN 60255-21-1	1995 ²⁾
IEC 60255-21-3	- ¹⁾	Electrical relays - Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment - Section 3: Seismic tests	EN 60255-21-3	1995 ²⁾
IEC 60269-2 (mod)	- ¹⁾	Low-voltage fuses - Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to I	HD 60269-2	2007 ²⁾
IEC 60270	- ¹⁾	High-voltage test techniques - Partial discharge measurements	EN 60270	2001 ²⁾
IEC 60296	- ¹⁾	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear	EN 60296 + corr. September	2004 ²⁾ 2004
IEC 60309-1	- ¹⁾	Plugs, socket-outlets and couplers for industrial purposes - Part 1: General requirements	EN 60309-1 + A11	1999 ²⁾ 2004
IEC 60309-2	- ¹⁾	Plugs, socket-outlets and couplers for industrial purposes - Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories	EN 60309-2 + A11	1999 ²⁾ 2004
IEC 60376	- ¹⁾	Specification of technical grade sulfur hexafluoride (SF_6) for use in electrical equipment	EN 60376	2005 ²⁾

⁴⁾ The HD 21 series, which is related to, but not directly equivalent with the IEC 60227 series, applies instead.

⁵⁾ The HD 22 series, *Cables of rated voltages up to and including 450/750 V and having cross-linked insulation*, which is related to, but not directly equivalent with the IEC 60245 series, applies instead.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60393-1	- ¹⁾	Potentiometers for use in electronic equipment - Part 1: Generic specification	-	-
IEC 60417	Data-base	Graphical symbols for use on equipment	-	-
IEC 60445 (mod)	- ¹⁾	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals and conductor terminations	EN 60445	2007 ²⁾
IEC 60480	- ¹⁾	Guidelines for the checking and treatment of sulphur hexafluoride (SF_6) taken from electrical equipment and specification for its re-use	EN 60480	2004 ²⁾
IEC 60502-1	- ¹⁾	Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) - Part 1: Cables for rated voltages of 1 kV ($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ kV)	-	-
IEC 60507	- ¹⁾	Artificial pollution tests on high-voltage insulators to be used on a.c. systems	EN 60507	1993 ²⁾
IEC 60512-2	Series	Connectors for electronic equipment - Tests and measurements - Part 2: Electrical continuity and contact resistance tests	EN 60512-2	Series
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 1993
IEC 60617	Data-base	Graphical symbols for diagrams	-	-
IEC 60669-1 (mod)	- ¹⁾	Switches for household and similar fixed-electrical installations - Part 1: General requirements	EN 60669-1	1999 ²⁾
IEC 60695-1	Series	Fire hazard testing - Part 1: Guidance for assessing the fire hazard of electrotechnical products	EN 60695-1	Series
IEC 60695-7	Series	Fire hazard testing - Part 7: Toxicity of fire effluent	EN 60695-7	Series
IEC 60721-1	- ¹⁾	Classification of environmental conditions - Part 1: Environmental parameters and their severities	EN 60721-1	1995 ²⁾
IEC 60721-2	Series	Classification of environmental conditions - Part 2: Environmental conditions appearing in nature	HD 478.2	Series
IEC 60721-3	Series	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities	EN 60721-3	Series
IEC 60730-2-9 (mod)	- ¹⁾	Automatic electrical controls for household and similar use - Part 2-9: Particular requirements for temperature sensing controls	EN 60730-2-9 + A11	2002 ²⁾ 2003
IEC 60730-2-13 (mod)	- ¹⁾	Automatic controls for household and similar use - Part 2-13: Particular requirements for humidity sensing controls	EN 60730-2-13	2008 ²⁾

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC/TR 60815	1986	Guide for the selection of insulators in respect of polluted conditions	-	-
IEC 60909-0	- ¹⁾	Short-circuit currents in three-phase a.c. systems - Part 0: Calculation of currents	EN 60909-0	2001 ²⁾
IEC/TR 60909-1	- ¹⁾	Short-circuit currents in three-phase a.c. systems - Part 1: Factors for the calculation of short-circuit currents according to IEC 60909-0	-	-
IEC 60932 ⁶⁾	- ¹⁾	Additional requirements for enclosed switchgear and controlgear from 1 kV to 72,5 kV to be used in severe climatic conditions	-	-
IEC 60947-2	- ¹⁾	Low-voltage switchgear and controlgear - Part 2: Circuit-breakers	EN 60947-2	2006 ²⁾
IEC 60947-3	- ¹⁾	Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	EN 60947-3	200X ⁷⁾
IEC 60947-4-1	- ¹⁾	Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters	EN 60947-4-1	2001 ²⁾
IEC 60947-4-2	- ¹⁾	Low-voltage switchgear and controlgear - Part 4-2: Contactors and motor-starters - AC semiconductor motor controllers and starters	EN 60947-4-2	2000 ²⁾
IEC 60947-5-1	- ¹⁾	Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices	EN 60947-5-1 + corr. July	2004 ²⁾ 2005
IEC 60947-7-1	- ¹⁾	Low-voltage switchgear and controlgear - Part 7-1: Ancillary equipment - Terminal blocks for copper conductors	EN 60947-7-1	2002 ²⁾
IEC 60947-7-2	- ¹⁾	Low-voltage switchgear and controlgear - Part 7-2: Ancillary equipment - Protective conductor terminal blocks for copper conductors	EN 60947-7-2	2002 ²⁾
IEC 61000-4-1	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-1: Testing and measurement techniques - Overview of IEC 61000-4 series	EN 61000-4-1	2007 ²⁾
IEC 61000-4-4	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	2004 ²⁾
IEC 61000-4-11	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	2004 ²⁾

⁶⁾ IEC 60932 is superseded by IEC/TS 62271-304, which is harmonized as CLC/TS 62271-304.

⁷⁾ To be ratified.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-4-17	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-17: Testing and measurement techniques - Ripple on d.c. input power port immunity test	EN 61000-4-17	1999 ²⁾
IEC 61000-4-18	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-18: Testing and measurement techniques - Damped oscillatory wave immunity test	EN 61000-4-18 + corr. September	2007 ²⁾ 2007
IEC 61000-4-29	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests	EN 61000-4-29	2000 ²⁾
IEC 61000-5	Series	Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines	EN 61000-5	Series
IEC 61000-6-2	- ¹⁾	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments	EN 61000-6-2 + corr. September	2005 ²⁾ 2005
IEC/TS 61000-6-5	- ¹⁾	Electromagnetic compatibility (EMC) - Part 6-5: Generic standards - Immunity for power station and substation environments	-	-
IEC 61020-4	- ¹⁾	Electromechanical switches for use in electronic equipment - Part 4: Sectional specification for lever (toggle) switches	-	-
IEC 61180-1	- ¹⁾	High-voltage test techniques for low-voltage equipment - Part 1: Definitions, test and procedure requirements	EN 61180-1	1994 ²⁾
IEC/TS 61634 ⁸⁾	- ¹⁾	High-voltage switchgear and controlgear - Use and handling of sulphur hexafluoride (SF ₆)	-	-
IEC 61810	Series	Electromechanical elementary relays	EN 61810	Series
IEC 62063	- ¹⁾	High-voltage switchgear and controlgear - The use of electronic and associated technologies in auxiliary equipment of switchgear and controlgear	-	-
IEC 62262	- ¹⁾	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)	EN 62262	2002 ²⁾
IEC 62271-2 ⁹⁾	- ¹⁾	High-voltage switchgear and controlgear - Part 2: Seismic qualification for rated voltages of 72,5 kV and above	EN 62271-2	2003 ²⁾
IEC/TR 62271-300	- ¹⁾	High-voltage switchgear and controlgear - Part 300: Seismic qualification of alternating current circuit-breakers	-	-
IEC 62326-1	- ¹⁾	Printed boards - Part 1: Generic specification	EN 62326-1	2002 ²⁾

⁸⁾ IEC/TS 61634 is superseded by IEC/TR 62271-303.

⁹⁾ IEC 62271-2 is superseded by IEC 62271-207, which is harmonized as EN 62271-207.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
CISPR 11 (mod)	- ¹⁾	Industrial scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement	EN 55011	2007 ²⁾
CISPR 16-1	Series	Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus	EN 55016-1	Series
CISPR 18-2	- ¹⁾	Radio interference characteristics of overhead power lines and high-voltage equipment - Part 2: Methods of measurement and procedure for determining limits	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 1: Common specifications

FOREWORD

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International Standard IEC 62271-1 has been prepared by subcommittee 17A: High-voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.

This standard cancels and replaces IEC 60694 published in 1996. This first edition of IEC 62271-1 constitutes a technical revision.

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

FDIS	Report on voting
17A/799/FDIS	17A/804/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 reader's attention is drawn to the fact that Annex K lists all of the “in-scope” documents.

clauses on differing practices of a less permanent nature relating to the subject of this standard.

The list of all parts of the IEC 62271 series under the general title, *High-voltage switchgear and controlgear*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 1: Common specifications

1 General

1.1 Scope

This part of IEC 62271 applies to a.c. switchgear and controlgear designed for indoor and outdoor installation and for operation at service frequencies up to and including 60 Hz on systems having voltages above 1 000 V.

This standard applies to all high-voltage switchgear and controlgear except as otherwise specified in the relevant IEC standards for the particular type of switchgear and controlgear.

NOTE For the use of this standard, high voltage (see IEC 601-01-27) is the rated voltage above 1 000 V. However, the term medium voltage (see IEC 601-01-28) is commonly used for distribution systems with voltages above 1 kV and generally applied up to and including 52 kV.

1.2 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 60038:1983, *IEC standard voltages*

IEC 60050-131, *International Electrotechnical Vocabulary (IEV) – Part 131: Circuit theory*

IEC 60050-151, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices*

IEC 60050-191, *International Electrotechnical Vocabulary (IEV) – Chapter 191: Dependability and quality of service*

IEC 60050-351, *International Electrotechnical Vocabulary (IEV) – Part 351: Control technology*

IEC 60050-441, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*

IEC 60050-446, *International Electrotechnical Vocabulary (IEV) – Chapter 446: Electrical relays*

IEC 60050-551, *International Electrotechnical Vocabulary (IEV) – Power electronics*

IEC 60050-581, *International Electrotechnical Vocabulary (IEV) – Chapter 581: Electro-mechanical components for electronic equipment*

IEC 60050-601, *International Electrotechnical Vocabulary (IEV) – Chapter 601: Generation, transmission and distribution of electricity – General*

IEC 60050-604, *International Electrotechnical Vocabulary (IEV) – Chapter 604: Generation, transmission and distribution of electricity – Operation*

IEC 60050-605, *International Electrotechnical Vocabulary (IEV) – Chapter 605: Generation, transmission and distribution of electricity – Substations*

IEC 60050-811, *International Electrotechnical Vocabulary (IEV) – Chapter 811: Electric traction*

IEC 60050-826, *International Electrotechnical Vocabulary (IEV) – Part 826: Electrical installations*

IEC 60051-1, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 1: Definitions and general requirements common to all parts*

IEC 60051-2, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 2: Special requirements for ammeters and voltmeters*

IEC 60051-4, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 4: Special requirements for frequency meters*

IEC 60051-5, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 5: Special requirements for phase meters, power factor meters and synchrosopes*

IEC 60059, *IEC standard current ratings*

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

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

IEC 60068-2 (all parts), *Environmental testing – Part 2: Tests*

IEC 60071-1:2006, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2:1996, *Insulation co-ordination – Part 2: Application guide*

IEC 60073, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

IEC 60081, *Double-capped fluorescent lamps – Performance specifications*

IEC/TR 60083, *Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC*

IEC 60085, *Electrical insulation – Thermal classification*

IEC 60115-4 (all parts), *Fixed resistors for use in electronic equipment – Part 4: Sectional specification: Fixed power resistors*

IEC 60130 (all parts), *Connectors for frequencies below 3 MHz*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60228, *Conductors of insulated cables*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*

IEC 60255-8, *Electrical relays – Part 8: Thermal electrical relays*

IEC 60255-21-1, *Electrical relays – Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment – Section One: Vibration tests (sinusoidal)*

IEC 60255-21-3, *Electrical relays – Part 21: Vibration, shock, bump and seismic tests on measuring relays and protection equipment – Section 3: Seismic tests*

IEC 60269-2, *Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to I*

IEC 60270, *High-voltage test techniques – Partial discharge measurements*

IEC 60296, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

IEC 60309-1, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*

IEC 60309-2, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

IEC 60376, *Specification of technical grade sulfur hexafluoride (SF₆) for use in electrical equipment*

IEC 60393-1, *Potentiometers for use in electronic equipment – Part 1: Generic specification*

IEC 60417, *Graphical symbols for use on equipment*

IEC 60445, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals and conductors terminations*

IEC 60480, *Guidelines for the checking and treatment of sulfur hexafluoride (SF₆) taken from electrical equipment and specification for its re-use*

IEC 60502-1, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) – Part 1: Cables for rated voltages of 1 kV ($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ kV)*

IEC 60507, *Artificial pollution tests on high-voltage insulators to be used on a.c. systems*

IEC 60512-2 (all parts), *Connectors for electronic equipment – Tests and measurements – Part 2: Electrical continuity and contact resistance tests*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60617, *Graphical symbols for diagrams*

IEC 60669-1, *Switches for household and similar fixed-electrical installations – Part 1: General requirements*

IEC 60695-1 (all parts), *Fire hazard testing – Part 1: Guidance for assessing the fire hazard of electrotechnical products*

IEC 60695-7 (all parts), *Fire hazard testing – Part 7: Toxicity of fire effluent*

IEC 60721-1, *Classification of environmental conditions – Part 1: Environmental parameters*

and their severities

IEC 60721-2 (all parts), *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Temperature and humidity*

IEC 60721-3 (all parts), *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities*

IEC 60730-2-9, *Automatic electrical controls for household and similar use – Part 2-9: Particular requirements for temperature sensing controls*

IEC 60730-2-13, *Automatic electrical controls for household and similar use – Part 2-13: Particular requirements for humidity sensing controls*

IEC 60815:1986, *Guide for the selection of insulators in respect of polluted conditions*

IEC 60909-0, *Short-circuit currents in three-phase a.c. systems – Part 0: Calculation of currents*

IEC 60909-1, *Short-circuit currents in three-phase a.c. systems – Part 1: Factors for the calculations of short-circuit currents according to IEC 60909-0*

IEC 60932, *Additional requirements for enclosed switchgear and controlgear from 1 kV to 72,5 kV to be used in severe climatic conditions*

IEC 60947-2, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-4-1, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

IEC 60947-4-2, *Low-voltage switchgear and controlgear – Part 4-2: Contactors and motor-starters – AC semiconductor motor controllers and starters*

IEC 60947-5-1, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*

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

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

IEC 61000-4-1, *Electromagnetic compatibility (EMC) – Part 4-1: Testing and measurement techniques – Overview of IEC 61000-4 series*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques Electrical fast transient/burst immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-18, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

IEC 61000-4-17, *Electromagnetic compatibility (EMC) – Part 4-17: Testing and measurement techniques – Ripple on d.c. input power port immunity test*

IEC 61000-4-29, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests*

IEC 61000-5 (all parts), *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61000-6-5, *Electromagnetic compatibility (EMC) – Part 6-5: Generic standards – Immunity for power station and substation environments*

IEC 61020-4, *Electromechanical switches for use in electronic equipment – Part 4: Sectional specification for lever (toggle) switches*

IEC 61180-1, *High-voltage test techniques for low-voltage equipment – Part 1: Definitions, test and procedure requirements*

IEC 61634, *High-voltage switchgear and controlgear – Use and handling of sulphur hexafluoride (SF₆) in high-voltage switchgear and controlgear*

IEC 61810 (all parts), *Electromechanical elementary relays*

IEC 62063, *High-voltage switchgear and controlgear – The use of electronic and associated technologies in auxiliary equipment of switchgear and controlgear*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

IEC 62271-2, *High-voltage switchgear and controlgear – Part 2: Seismic qualification for rated voltages of 72,5 kV and above*

IEC/TR 62271-300, *High-voltage switchgear and controlgear – Part 300: Seismic qualification of alternating current circuit-breakers*

IEC 62326-1, *Printed boards – Part 1: Generic specification*

CISPR 11, *Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement*

CISPR 16-1 (all parts), *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

CISPR 18-2, *Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits*

2 Normal and special service conditions

Unless otherwise specified, high-voltage switchgear and controlgear, including the operating devices and the auxiliary equipment which form an integral part of them, are intended to be used in accordance with their rated characteristics and the normal service conditions listed in 2.1.

If the actual service conditions differ from these normal service conditions, high-voltage switchgear and controlgear and associated operating devices and auxiliary equipment shall be designed to comply with any special service conditions required by the user, or appropriate arrangements shall be made (refer to 2.2).

NOTE 1 Appropriate action should also be taken to ensure proper operation under such conditions of other components, such as relays.

NOTE 2 Detailed information concerning classification of environmental conditions is given in IEC 60721-3-3 (indoor) and IEC 60721-3-4 (outdoor).

2.1 Normal service conditions

2.1.1 Indoor switchgear and controlgear

- a) The ambient air temperature does not exceed 40 °C and its average value, measured over a period of 24 h, does not exceed 35 °C.

The preferred values of minimum ambient air temperature are –5 °C, –15 °C and –25 °C.

- b) The influence of solar radiation may be neglected.
- c) The altitude does not exceed 1 000 m.
- d) The ambient air is not significantly polluted by dust, smoke, corrosive and/or flammable gases, vapours or salt. The manufacturer will assume that, in the absence of specific requirements from the user, there are none.
- e) The conditions of humidity are as follows:
- the average value of the relative humidity, measured over a period of 24 h, does not exceed 95 %;
 - the average value of the water vapour pressure, over a period of 24 h, does not exceed 2,2 kPa;
 - the average value of the relative humidity, over a period of one month, does not exceed 90 %;
 - the average value of the water vapour pressure, over a period of one month, does not exceed 1,8 kPa.

For these conditions, condensation may occasionally occur.

NOTE 1 Condensation can be expected where sudden temperature changes occur in periods of high humidity.

NOTE 2 To withstand the effects of high humidity and condensation, such as breakdown of insulation or corrosion of metallic parts, switchgear designed for such conditions should be used.

NOTE 3 Condensation may be prevented by special design of the building or housing, by suitable ventilation and heating of the station or by the use of dehumidifying equipment.

- f) Vibrations due to causes external to the switchgear and controlgear or earth tremors are insignificant relative to the normal operating duties of the equipment. The manufacturer will assume that, in absence of specific requirements from the user, there are none.

NOTE 4 The interpretation of the term “insignificant” is the responsibility of the user or specifier of the equipment. Either the user is not concerned with seismic events, or his analysis shows that the risk is “insignificant”.

2.1.2 Outdoor switchgear and controlgear

- a) The ambient air temperature does not exceed 40 °C and its average value, measured over a period of 24 h, does not exceed 35 °C.

The preferred values of minimum ambient air temperature are –10 °C, –25 °C, –30 °C and –40 °C.

Rapid temperature changes should be taken into account.

- b) Solar radiation up to a level of 1 000 W/m² (on a clear day at noon) should be considered.

NOTE 1 Under certain levels of solar radiation, appropriate measures, for example roofing, forced ventilation, test simulating solar gain, etc., may be necessary, or derating may be used, in order not to exceed the specified temperature rises ΔT and design pressure limits ΔP .

NOTE 2 Details of global solar radiation are given in IEC 60721-2-4.

- c) The altitude does not exceed 1 000 m.
- d) The ambient air may be polluted by dust, smoke, corrosive gas, vapours or salt. The pollution does not exceed pollution level II (medium) according to Table 1 of IEC 60815.
- e) The ice coating shall be considered in the range from 1 mm up to, but not exceeding, 20 mm.
- f) The wind speed does not exceed 34 m/s (corresponding to 700 Pa on cylindrical surfaces).

NOTE 3 Characteristics of wind are described in IEC 60721-2-2.

- g) Consideration should be given to condensation or precipitations that may occur.

NOTE 4 Characteristics of precipitation are defined in IEC 60721-2-2.

- h) Vibrations due to causes external to the switchgear and controlgear or earth tremors are insignificant relative to the normal operating duties of the equipment. The manufacturer will assume that, in the absence of specific requirements from the user, there are none.

NOTE 5 The interpretation of the term “insignificant” is the responsibility of the user or specifier of the equipment. Either the user is not concerned with seismic events, or his analysis shows that the risk is “insignificant”.

2.2 Special service conditions

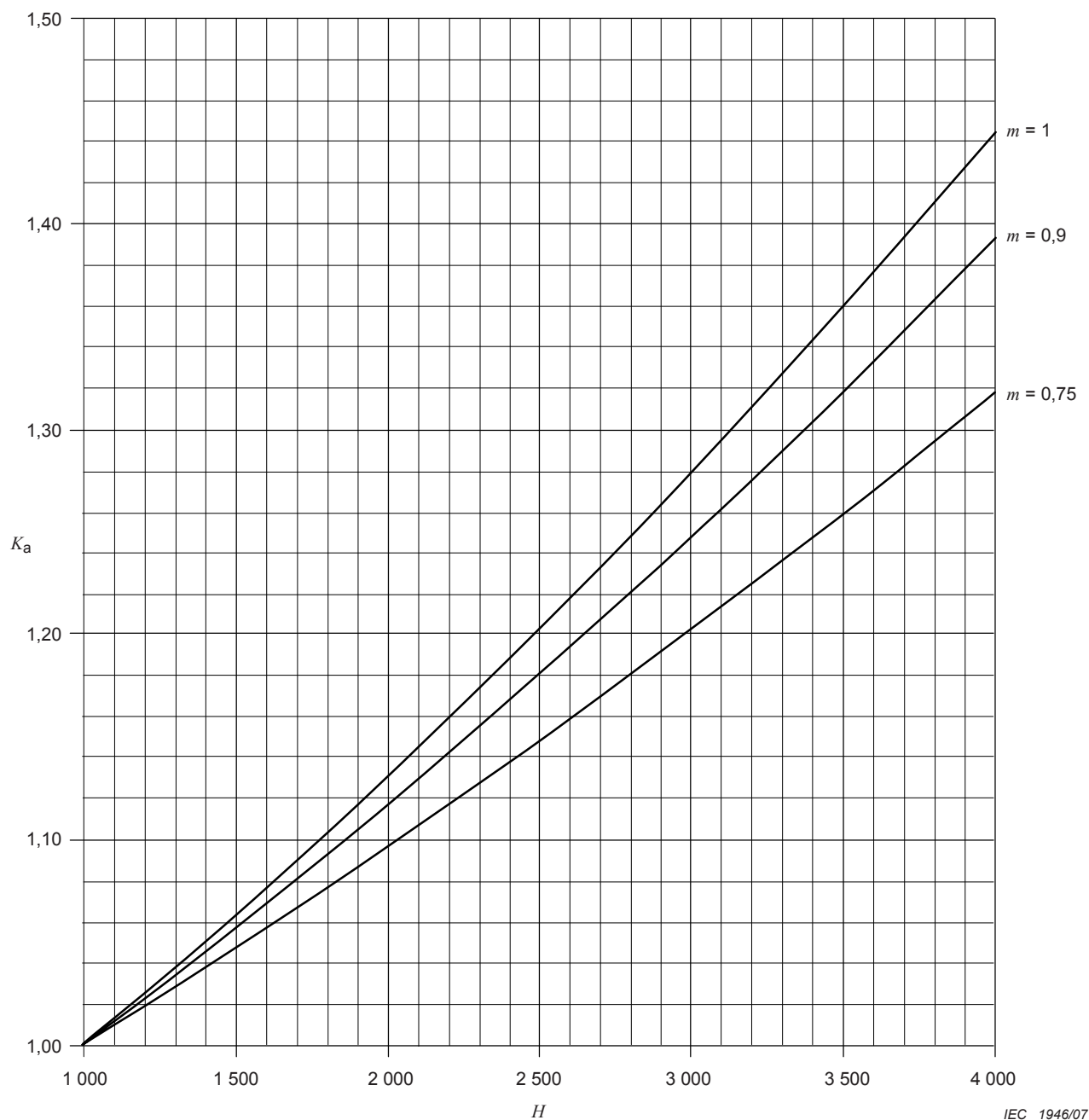
When high-voltage switchgear and controlgear is used under conditions different from the normal service conditions given in 2.1, the user's requirements should refer to standardized steps as follows.

2.2.1 Altitude

For installations at an altitude higher than 1 000 m, the insulation withstand level of external insulation at the service location shall be determined by multiplying the rated insulation levels by a factor K_a in accordance with Figure 1.

NOTE 1 For internal insulation, the dielectric characteristics are identical at any altitude and no special precautions need to be taken. For external and internal insulation, refer to IEC 60071-2.

NOTE 2 For low-voltage auxiliary and control equipment, no special precautions need to be taken if the altitude is lower than 2 000 m. For higher altitudes, refer to IEC 60664-1.



The altitude correction factor can be calculated from 4.2.2 of IEC 60071-2 with the following equation, which is modified to reflect that no correction is required up to 1 000 m:

$$K_a = e^{m(H-1000)/8150}$$

where

H is the altitude, in metres;

m is taken as a fixed value in each case for simplification as follows:

$m = 1$ for power-frequency, lightning impulse and phase-to-phase switching impulse voltages;

$m = 0,9$ for longitudinal switching impulse voltage;

$m = 0,75$ for phase-to-earth switching impulse voltage.

Figure 1 – Altitude correction factor

2.2.2 Pollution

For installation in polluted ambient air, pollution level III (heavy) or IV (very heavy) of IEC 60815 should be specified for outdoor installation.

For indoor installation, reference can be made to IEC 60932.

2.2.3 Temperature and humidity

For installation in a place where the ambient temperature can be outside the normal service condition range stated in 2.1, the preferred ranges of minimum and maximum temperature to be specified should be

- a) –50 °C and +40 °C for very cold climates;
- b) –5 °C and +55 °C for very hot climates.

In certain regions with frequent occurrence of warm humid winds, sudden changes of temperature may occur resulting in condensation even indoors.

In tropical indoor conditions, the average value of relative humidity measured during a period of 24 h can be 98 %.

2.2.4 Vibrations, shock or tilting

Standard switchgear and controlgear is designed for mounting on substantially level structures, free from excessive vibration, shock, or tilting. Where any of these abnormal conditions exists, requirements for the particular application should be specified by the user.

For installations where earthquakes are likely to occur, the severity level in accordance with IEC 62271-300 or IEC 62271-2 should be specified by the user.

2.2.5 Wind speed

In some regions, for example in North America, a value for the wind speed is 40 m/s.

2.2.6 Other parameters

When special environmental conditions prevail at the location where switchgear and controlgear is to be put in service, they should be specified by the user by reference to IEC 60721.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050(131), IEC 60050(151), IEC 60050(191), IEC 60050(351), IEC 60050(441), IEC 60050(446), IEC 60050(551), IEC 60050(581), IEC 60050(601), IEC 60050(604), IEC 60050(605), IEC 60050(811), and IEC 60050(826), some of which are recalled hereunder, as well as the following, apply.

NOTE Terms and definitions are classified in accordance with IEC 60050(441). . References from other than IEC 60050(441) are classified so as to be aligned with the classification used in IEC 60050(441).

3.1 General terms

3.1.1

switchgear and controlgear

general term covering switching devices and their combination with associated control,

measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures

[IEV 441-11-01]

3.1.2

external insulation

distances in atmosphere and surfaces in contact with open air of solid insulation of the equipment which are subject to dielectric stresses and to the effects of atmospheric and other external conditions such as pollution, humidity, vermin, etc.

[IEV 604-03-02]

3.1.3

IP code

coding system to indicate the degrees of protection provided by an enclosure against access to hazardous parts, ingress of solid foreign objects, ingress of water and to give additional information in connection with such protection

[3.4 of IEC 60529]

3.1.4

protection provided by an enclosure against access to hazardous parts

protection of persons against

- contact with hazardous mechanical parts;
- contact with hazardous low-voltage live parts;
- approach to hazardous high-voltage live parts below adequate clearance inside an enclosure

NOTE This protection may be provided

- by means of the enclosure itself;
- by means of barriers as part of the enclosure or distances inside the enclosure.

[3.6 of IEC 60529]

3.1.5

IK code

coding system to indicate the degree of protection provided by an enclosure against harmful external mechanical impacts

[3.3 of IEC 62262]

3.1.6

maintenance

combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function

[IEV 191-07-01]

3.1.7

scheduled maintenance

preventive maintenance carried out in accordance with an established time schedule

[IEV 191-07-10]

3.1.8

inspection

visual investigation of the principal features of the switchgear and controlgear in service

without dismantling

NOTE 1 This inspection is generally directed toward pressures and/or levels of fluids, tightness, position of relays, pollution of insulating parts, but actions such as lubricating, cleaning, washing, etc. which can be carried out with the switchgear and controlgear in service are also included.

NOTE 2 Observations resulting from inspection can lead to the decision to carry out overhaul.

3.1.9

diagnostic tests

comparative tests of the characteristic parameters of switchgear and controlgear to verify that it performs its functions, by measuring one or more of these parameters

NOTE The result from diagnostic tests can lead to the decision to carry out overhaul.

3.1.10

examination

inspection with the addition of partial dismantling, as required, supplemented by means such as measurements and non-destructive tests in order to reliably evaluate the condition of the switchgear and controlgear

3.1.11

overhaul

work performed with the objective of repairing or replacing parts which are found to be out of tolerance by inspection, test, examination, or as required by manufacturer's maintenance manual, in order to restore the component and/or the switchgear and controlgear to an acceptable condition (within tolerance)

3.1.12

down time

time interval during which an item is in a down state

[IEV 191-09-08]

3.1.13

failure

termination of the ability of an item to perform a required function

NOTE 1 After failure the item has a fault.

NOTE 2 "Failure" is an event, as distinguished from "fault", which is a state.

NOTE 3 This concept as defined does not apply to items consisting of software only.

[IEV 191-04-01]

3.1.14

major failure (of switchgear and controlgear)

failure of switchgear and controlgear which causes the cessation of one or more of its fundamental functions.

A major failure will result in an immediate change in the system operating conditions, for example, the backup protective equipment will be required to remove the fault or will result in mandatory removal from service within 30 min for unscheduled maintenance

3.1.15

minor failure (of switchgear and controlgear)

any failure of a constructional element or a subassembly which does not cause a major failure of the switchgear and controlgear

3.1.16

defect

imperfection in the state of an item (or inherent weakness) which can result in one or more failures of the item itself, or of another item under the specific service or environmental or maintenance conditions, for a stated period of time

3.1.17

ambient air temperature

temperature, determined under prescribed conditions, of the air surrounding the complete switching device or fuse

NOTE For switching devices or fuses installed inside an enclosure, it is the temperature of the air outside the enclosure.

[IEV 441-11-13]

3.1.18

servicing level

ground level or fixed permanent floor level from which an authorized person can operate a device

3.1.19

non-exposed type

type of component of which no live part can readily be touched

3.1.20

monitoring

observation of the operation of a system or part of a system to verify correct functioning by detecting incorrect functioning, this being done by measuring one or more variables of the system and comparing the measured values with the specified values

[IEV 351-18-24, modified]

NOTE Several definitions are given for this term in the IEV. They are related to different cases of application. The reference given above is to be applied in the present case.

3.1.21

supervision

activity, performed either manually or automatically, intended to observe the state of an item

NOTE 1 Automatic supervision may be performed internally or externally to the item.

[IEV 191-07-26]

NOTE 2 Several definitions are given for this term in the IEV. They are related to different cases of application. The reference given above is to be applied in the present case.

3.2 Assemblies of switchgear and controlgear

3.2.1

test specimen

complete switchgear and controlgear when the poles are mechanically linked (i.e. one operating mechanism) or when the type tests are mainly three-pole type tests. If this is not the case, a test specimen is one pole of the complete switchgear and controlgear. Where permitted in the relevant IEC standard, a test specimen may be a representative sub-assembly

3.3 Parts of assemblies

3.3.1

transport unit

part of switchgear and controlgear intended for transportation without being dismantled

3.3.2

busbar

[IEV 605-02-02]

3.4 Switching devices

Definitions of particular switching devices will be found in the specific product standards.

3.4.1

vacuum interrupter

switching component in which high-voltage electrical contacts operate in a highly evacuated, hermetically sealed environment

3.5 Parts of switchgear and controlgear

3.5.1

enclosure

housing affording the type and degree of protection suitable for the intended application

[IEV 826-12-20]

NOTE This definition taken from IEC 60050(826) needs the following explanations under the scope of this standard.

- a) Enclosures provide protection of persons or livestock against access to hazardous parts.
- b) Barriers, shapes of openings or any other means (whether attached to the enclosure or formed by the enclosed equipment) suitable to prevent or limit the penetration of the specified test probes, are considered as a part of the enclosure, when they are secured in position either by means of interlocks, keys, or by hardware requiring a tool to be removed.

3.5.2

hazardous part

part that is hazardous to approach or touch

[3.5 of IEC 60529]

3.5.3

contact (of a mechanical switching device)

conductive part designed to establish circuit continuity when they touch and which, due to their relative motion during an operation, open or close a circuit or, in the case of hinged or sliding contacts, maintain circuit continuity

[IEV 441-15-05]

3.5.4

auxiliary circuit (of a switching device)

all the conductive parts of a switching device which are intended to be included in a circuit other than the main circuit and the control circuits of the device

NOTE Some auxiliary circuits fulfil supplementary functions such as signaling, interlocking, etc., and, as such, they may be part of the control circuit of another switching device.

[IEV 441-15-04]

3.5.5

control circuit (of a switching device)

all the conductive parts (other than the main circuit) of a switching device which are included in a circuit used for the closing operation or opening operation, or both, of the device

[IEV 441-15-03]

3.5.6

auxiliary switch (of a mechanical switching device)

switch containing one or more control and/or auxiliary contacts mechanically operated by a switching device

[IEV 441-15-11]

3.5.7

control switch (for control and auxiliary circuits)

mechanical switching device which serves the purpose of controlling the operation of switchgear or controlgear, including signaling, electrical interlocking, etc.

NOTE A control switch consists of one or more contact elements with a common actuating system.

[IEV 441-14-46]

3.5.8

auxiliary contact

contact included in an auxiliary circuit and mechanically operated by the switching device

[IEV 441-15-10]

3.5.9

control contact

contact included in a control circuit of a mechanical switching device and mechanically operated by this device

[IEV 441-15-09]

3.5.10

connection (bolted or the equivalent)

two or more conductors designed to ensure permanent circuit continuity when forced together by means of screws, bolts or the equivalent

3.5.11

position indicating device

part of a mechanical switching device which indicates whether it is in the open, closed, or where appropriate, earthed position

[IEV 441-15-25]

3.5.12

monitoring device

device intended to observe automatically the status of an item

3.5.13

pilot switch

non-manual control switch actuated in response to specified condition of an actuating quantity

NOTE The actuating quantity may be pressure, temperature, velocity, liquid level, elapsed time, etc.

[IEV 441-14-48]

3.5.14

low-energy contact

contact designed to be used in very low-energy circuits, for example, for monitoring or information technology

NOTE Typical applications are contacts inserted into a load circuit through which flows a current of some mA at a voltage not exceeding 10 V at the terminals.

3.5.15

cable entry

part with openings, which permit the passage of cables into the enclosure

3.5.16

cover plate

part of an enclosure which is used for closing an opening and designed to be held in place by screws or similar means. It is normally not removed after the equipment is put in service

3.5.17

partition (of an assembly)

part of an assembly separating one compartment from other compartments

[IEV 441-13-06]

3.5.18

actuator

part of the actuating system to which an external actuating force is applied

NOTE The actuator may take the form of a handle, knob, push-button, roller, plunger, etc.

[IEV 441-15-22]

3.5.19

indicating device (of a measuring instrument)

set of components of a measuring instrument intended to indicate the value of the measurand

NOTE By extension, the indicating means or setting device of any instrument such as a material measure or a signal generator.

[IEV 311-05-02]

3.5.20

splice

connecting device with barrel(s) accommodating electrical conductor(s) with or without additional provision to accommodate and secure the insulation

[IEV 581-05-11]

3.5.21

terminal

point of interconnection of an electric circuit element, an electric circuit or a network with other electric circuit elements, electric circuits or networks

NOTE 1 For an electric circuit element, the terminals are the points at which or between which the related integral quantities are defined. At each terminal, there is only one electric current from outside into the element.

NOTE 2 The term “terminal” has a related meaning in IEC 60050-151.

[IEV 131-11-11]

3.5.22

terminal block

assembly of terminals in a housing or body of insulating material to facilitate interconnection between multiple conductors

[IEV 581-06-36]

3.5.23

neutral conductor

conductor electrically connected to the neutral point and capable of contributing to the distribution of electrical energy

[IEV 826-14-07]

3.5.24
protective conductor
(symbol PE)

conductor provided for purposes of safety, for example protection against electric shock

NOTE In an electrical installation, the conductor identified PE is normally also considered as protective earthing conductor.

[IEV 826-13-22]

3.5.25
PEN conductor

earthed conductor combining the functions of both a protective conductor and a neutral conductor

[IEV 826-13-25, modified]

3.5.26
all-or-nothing relay

electrical relay which is intended to be energized by a quantity whose value is either within its operative range or effectively zero

[IEV 446-11-02]

3.5.27
thermal electrical relay

dependent-time measuring relay which is intended to protect an equipment from electrical thermal damage by the measurement of the current flowing in the protected equipment and by a characteristic curve simulating its thermal behaviour

[IEV 446-15-16]

3.5.28
(mechanical) contactor

mechanical switching device having only one position of rest, operated otherwise than by hand, capable of making, carrying and breaking currents under normal circuit conditions including operating overload conditions

NOTE Contactors may be designated according to the method by which the force for closing the main contacts is provided.

[IEV 441-14-33]

3.5.29
starter

combination of all the switching means necessary to start and stop a motor in combination with suitable overload protection

NOTE Starters may be designated according to the method by which the force for closing the main contacts is provided.

[IEV 441-14-38]

3.5.30
shunt release

release energized by a source of voltage

NOTE The source of voltage may be independent of the voltage of the main circuit.

[IEV 441-16-41]

3.5.31
switch

component fitted with an actuator and contacts to make and break a connection

[IEV 581-10-01]

3.5.32
distribution circuit

electric circuit supplying one or more distribution boards

[IEV 826-14-02]

3.5.33
final circuit (of buildings)

electric circuit intended to supply directly electric current using equipment or socket-outlets

[IEV 826-14-03]

3.5.34
toggle switch

switch having a lever (toggle), the movement of which results either directly or indirectly in the connection or disconnection of the switch terminations in a specified manner. Any indirect action through an actuating mechanism shall be such that the speed of connection and/or disconnection is independent of the speed of lever movement

[IEV 581-10-11]

3.5.35
disconnecter

mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements

NOTE A disconnecter is capable of opening and closing a circuit when either negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the poles of the disconnecter occurs. It is also capable of carrying currents under normal circuit conditions and carrying currents for a specified time under abnormal conditions such as those of short circuit.

[IEV 441-14-05]

3.5.36
operations counter

device indicating the number of operating cycles a mechanical switching device has accomplished

3.5.37
indicator light

lamp used as an indicator

[IEV 811-31-06]

3.5.38
plug and socket-outlet

means enabling the connection at will of a flexible cable to fixed wiring

NOTE The application of the means is shown in Figure 1 of IEC 60309-1.

3.5.39
cable coupler

means enabling the connection at will of two flexible cables

NOTE The application of the means is shown in Figure 1 of IEC 60309-1.

3.5.40

appliance coupler

means enabling the connection at will of a flexible cable to the equipment

NOTE The application of the means is shown in Figure 1 of IEC 60309-1.

3.5.41

connector

component which terminates conductors for the purpose of providing connection and disconnection to a suitable mating component

[IEV 581-06-01]

3.5.42

coil

set of series-connected turns, usually coaxial

[IEV 151-13-15]

3.5.43

static switching component

device in which the switching action is developed by electronic, magnetic, optical or other components without mechanical motion

3.5.44

auxiliary and control circuits

entity of

- control and auxiliary circuits, mounted on or adjacent to the switchgear or controlgear, including circuits in central control cubicles;
- equipment for monitoring, diagnostics, etc. that is part of the auxiliary circuits of the switchgear or controlgear;
- circuits connected to the secondary terminals of instrument transformers, that are part of the switchgear or controlgear

3.5.45

subassembly (of auxiliary and control circuits)

part of auxiliary and control circuits, with regard to function or position. A subassembly has its own interface and is normally placed in a separate enclosure

3.5.46

interchangeable subassembly (of a auxiliary and control circuits)

subassembly which is intended to be placed in various positions within a auxiliary and control circuits, or intended to be replaced by other similar subassemblies. An interchangeable subassembly has an accessible interface

3.5.47

electronic device

device the function of which is based on charge carriers moving through a semiconductor, a high vacuum or a gas discharge

[IEV 551-14-01]

3.5.48

interlocking device

device which makes the operation of a switching device dependent upon the position or operation of one or more other pieces of equipment

[IEV 441-16-49]

3.6 Operation

3.6.1

dependent power operation (of a mechanical switching device)

operation by means of energy other than manual, where the completion of the operation is dependent upon the continuity of the power supply (to solenoids, electric or pneumatic motors, etc.)

[IEV 441-16-14]

3.6.2

stored energy operation (of a mechanical switching device)

operation by means of energy stored in the mechanism itself prior to the completion of the operation and sufficient to complete it under predetermined conditions

NOTE This kind of operation may be subdivided according to:

- 1 the manner of storing the energy (spring, weight, etc.);
- 2 the origin of the energy (manual, electric, etc.);
- 3 the manner of releasing the energy (manual, electric, etc.).

[IEV 441-16-15]

3.6.3

independent unlatched operation

stored energy operation where energy is stored and released in one continuous operation such that the speed and force of the operation are independent of the rate of applied energy

3.6.4

positively driven operation

operation which, in accordance with specified requirements, is designed to ensure that auxiliary contacts of a mechanical switching device are in the respective positions corresponding to the open or closed position of the main contacts

[IEV 441-16-12, modified]

NOTE A positively driven operating device is made by the association of a moving part, linked mechanically to the main contact of the primary circuit, without the use of springs, and a sensing element. In the case of mechanical auxiliary contacts, this sensing element can be simply the fixed contact, directly connected to the secondary terminal. In the case where the function is achieved electronically, the sensing element can be a static transducer (optical, magnetic, etc.) associated with a static switch, or associated with an electronic or electro-optic transmitting element.

3.6.5 Definitions relative to pressure (or density)

3.6.5.1

rated filling pressure p_{re} (or density ρ_{re}) for insulation and/or switching

pressure (in Pa), for insulation and/or for switching, referred to the standard atmospheric air conditions of +20 °C and 101,3 kPa (or density), which may be expressed in relative or absolute terms, to which the assembly is filled before being put into service, or automatically replenished

3.6.5.2

rated filling pressure for operation p_{rm} (or density ρ_{rm})

pressure (Pa), referred to the standard atmospheric air conditions of +20 °C and 101,3 kPa (or density), which may be expressed in relative or absolute terms, to which the control device is filled before being put into service or automatically replenished

3.6.5.3

alarm pressure p_{ae} (or density ρ_{ae}) for insulation and/or switching

pressure (Pa), for insulation and/or for switching, referred to the standard atmospheric air conditions of +20 °C and 101,3 kPa (or density), which may be expressed in relative or absolute terms, at which a monitoring signal may be provided

3.6.5.4

alarm pressure for operation p_{am} (or density ρ_{am})

pressure (Pa), referred to the standard atmospheric air conditions of +20 °C and 101,3 kPa (or density), which may be expressed in relative or absolute terms, at which a monitoring signal may be provided

3.6.5.5

minimum functional pressure p_{me} (or density ρ_{me}) for insulation and/or switching

pressure (Pa), for insulation and/or for switching, referred to the standard atmospheric air conditions of +20 °C and 101,3 kPa (or density), which may be expressed in relative or absolute terms, at which and above which rated characteristics of switchgear and controlgear are maintained

3.6.5.6

minimum functional pressure for operation p_{mm} (or density ρ_{mm})

pressure (Pa), referred to the standard atmospheric air conditions of +20 °C and 101,3 kPa (or density), which may be expressed in relative or absolute terms, at which and above which rated characteristics of switchgear and controlgear are maintained. This pressure is often designated as interlocking pressure

3.6.6 Definitions relating to gas and vacuum tightness

These definitions apply to all switchgear and controlgear which use vacuum or gas, other than ambient air at atmospheric pressure, as insulating or combined insulating and interrupting or operating medium.

3.6.6.1

gas-filled compartment

compartment of switchgear and controlgear in which the gas pressure is maintained by one of the following systems:

- a) controlled pressure system;
- b) closed pressure system;
- c) sealed pressure system.

NOTE Several gas-filled compartments may be permanently interconnected to form a common gas-system (gas-tight assembly).

3.6.6.2

controlled pressure system for gas

volume which is automatically replenished from an external compressed gas supply or internal gas source

NOTE 1 Examples of controlled pressure systems are air-blast circuit-breakers or pneumatic operating mechanisms.

NOTE 2 A volume may consist of several permanently connected gas-filled compartments.

3.6.6.3

closed pressure system for gas

volume which is replenished only periodically by manual connection to an external gas source

NOTE Example of closed pressure systems are SF₆ single-pressure circuit-breakers.

3.6.6.4

sealed pressure system

volume for which no further gas or vacuum processing is required during its expected operating life

NOTE 1 Examples of sealed pressure systems are tubes of vacuum circuit-breakers or some SF₆ circuit-breakers.

NOTE 2 Sealed pressure systems are completely assembled and tested in the factory.

3.6.6.5

absolute leakage rate

F

amount of gas escaped by time unit, expressed in $\text{Pa} \times \text{m}^3/\text{s}$

3.6.6.6

permissible leakage rate

F_p

maximum permissible absolute leakage rate of gas specified by the manufacturer for a part, a component or a sub-assembly, or by using the tightness coordination chart (TC), for an arrangement of parts, components or subassemblies connected together in one pressure system

3.6.6.7

relative leakage rate

F_{rel}

absolute leakage rate related to the total amount of gas in the system at rated filling pressure (or density). It is expressed in percentage per year or per day

3.6.6.8

time between replenishments

t_r

time elapsed between two replenishments performed either manually or automatically when the pressure (density) reaches the alarm level, to compensate the leakage rate F . This value is applicable to closed pressure systems

3.6.6.9

number of replenishments per day

N

number of replenishments to compensate the leakage rate F . This value is applicable to controlled pressure systems

3.6.6.10

pressure drop

Δp

drop of pressure in a given time caused by the leakage rate F , without replenishment

3.6.6.11

tightness coordination chart

TC

survey document supplied by the manufacturer, used when testing parts, components or sub-assemblies, to demonstrate the relationship between the tightness of a complete system and that of the parts, components and/or sub-assemblies

3.6.6.12

cumulative leakage measurement

measurement which takes into account all the leaks from a given assembly to determine the leakage rate

3.6.6.13

sniffing

action of slowly moving a leak meter sensing probe around an assembly to locate a gas leak

3.6.7 Definitions relating to liquid tightness

These definitions apply to all switchgear and controlgear which use liquids as insulating, combined insulating and interrupting, or control medium with or without permanent dielectric

3.6.7.1

controlled pressure system for liquid

volume which is automatically replenished with liquid

3.6.7.2

closed pressure system for liquid

volume which is manually replenished only periodically with liquid

3.6.7.3

absolute leakage rate

F_{liq}

amount of liquid escaped by time unit, expressed in cm³/s

3.6.7.4

permissible leakage rate

$F_{\text{p(liq)}}$

maximum permissible leakage rate specified by the manufacturer for a liquid pressure system

3.6.7.5

number of replenishments per day

N_{liq}

number of replenishments to compensate the leakage rate F_{liq} . This value is applicable to controlled pressure systems

3.6.7.6

pressure drop

ΔP_{liq}

drop in pressure in a given time caused by the leakage rate F_{liq} without replenishment

3.7 Characteristic quantities

3.7.1

isolating distance of a pole (of a mechanical switching device)

clearance between open contacts meeting the functional requirements specified for disconnectors

[IEV 441-17-35, modified]

3.7.2

degree of protection

extent of protection provided by an enclosure against access to hazardous parts, against ingress of solid foreign objects and/or ingress of water and against mechanical impact (refer to IEC 60529 and IEC 62262)

3.7.3

rated value

value of a quantity used for specification purposes, established for a specified set of operating conditions of a component, device, equipment or system

[IEV 151-16-08]

3.7.4

non-sustained disruptive discharge

NSDD

disruptive discharge associated with current interruption, that does not result in the resumption of power frequency current or, in the case of capacitive current interruption, does not result in current in the main load circuit

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