



BSI Standards Publication

# Low-voltage switchgear and controlgear assemblies

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Part 1: General rules

## National foreword

This British Standard is the UK implementation of EN IEC 61439-1:2021. It is identical to IEC 61439-1:2020, incorporating corrigendum December 2021. It supersedes BS EN 61439-1:2011, which will be withdrawn on 21 May 2024.

The UK participation in its preparation was entrusted to Technical Committee PEL/121/2, Low voltage switchgear and controlgear assemblies.

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

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For the Great Britain market (England, Scotland and Wales), if UK Government has designated this publication for conformity with UKCA marking (or similar) legislation, it may contain an additional National Annex. Where such a National Annex exists, it shows the correlation between this publication and the relevant UK legislation. If there is no National Annex of this kind, the relevant Annex ZA or ZZ in the body of the European text will indicate the relationship to UK regulation applicable in Great Britain. References to EU legislation may need to be read in accordance with the UK designation and the applicable UK law. Further information on designated standards can be found at [www.bsigroup.com/standardsandregulation](http://www.bsigroup.com/standardsandregulation).

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UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of [www.gov.uk](http://www.gov.uk).

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**Compliance with a British Standard cannot confer immunity from legal obligations.**

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2021.

**Amendments/corrigenda issued since publication**

| Date           | Text affected                                                              |
|----------------|----------------------------------------------------------------------------|
| 31 August 2022 | Implementation of IEC corrigendum December 2021: Subclause 9.1.1 corrected |



English Version

Low-voltage switchgear and controlgear assemblies - Part 1:  
General rules  
(IEC 61439-1:2020)

Ensembles d'appareillage à basse tension - Partie 1:  
Règles générales  
(IEC 61439-1:2020)

Niederspannungs-Schaltgerätekombinationen - Teil 1:  
Allgemeine Festlegungen  
(IEC 61439-1:2020)

This European Standard was approved by CENELEC on 2020-06-24. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

## European foreword

The text of document 121B/99/FDIS, future edition 3 of IEC 61439-1, prepared by SC 121B "Low-voltage switchgear and controlgear assemblies" of IEC/TC 121 "Switchgear and controlgear and their assemblies for low voltage" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61439-1:2021.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2021-11-21 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2024-05-21 document have to be withdrawn

This document supersedes EN 61439-1:2011 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

## Endorsement notice

The text of the International Standard IEC 61439-1:2020 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 60038:2009              | NOTE | Harmonized as EN 60038:2011                        |
| IEC 60092 (series)          | NOTE | Harmonized as EN 60092 (series)                    |
| IEC 60112:2003              | NOTE | Harmonized as EN 60112:2003 (not modified)         |
| IEC 60112:2003/A1:2009      | NOTE | Harmonized as EN 60112:2003/A1:2009 (not modified) |
| IEC 60204 (series)          | NOTE | Harmonized as EN 60204 (series)                    |
| IEC 60204-1:2016            | NOTE | Harmonized as EN 60204-1:2018                      |
| IEC 60216 (series)          | NOTE | Harmonized as EN 60216 (series)                    |
| IEC 60228:2004              | NOTE | Harmonized as EN 60228:2005 (not modified)         |
| IEC 60269-2                 | NOTE | Harmonized as HD 60269-2                           |
| IEC 60364-4-44:2007         | NOTE | Harmonized as HD 60364-4-442:2012                  |
| IEC 60364-4-44:2007/A1:2015 | NOTE | Harmonized as HD 60364-4-443:2016                  |
| IEC 60364-5-54:2011         | NOTE | Harmonized as HD 60364-5-54:2011 (not modified)    |

|                             |      |                                                         |
|-----------------------------|------|---------------------------------------------------------|
| IEC 60364-5-55:2011         | NOTE | Harmonized as HD 60364-5-559:2012                       |
| IEC 60664-1:2007            | NOTE | Harmonized as EN 60664-1:2007 (not modified)            |
| IEC 60695-11-5:2016         | NOTE | Harmonized as EN 60695-11-5:2017 (not modified)         |
| IEC 60721-3-3:2019          | NOTE | Harmonized as EN IEC 60721-3-3:2019 (not modified)      |
| IEC 60947 (series)          | NOTE | Harmonized as EN IEC 60947 (series)                     |
| IEC 60947-1:2020            | NOTE | Harmonized as EN IEC 60947-1:2021 (not modified)        |
| IEC 60947-2                 | NOTE | Harmonized as EN 60947-2                                |
| IEC 60947-7-2:2009          | NOTE | Harmonized as EN 60947-7-2:2009 (not modified)          |
| IEC 61000-2-2:2002          | NOTE | Harmonized as EN 61000-2-2:2002 (not modified)          |
| IEC 61000-2-2:2002/A1:2017  | NOTE | Harmonized as EN 61000-2-2:2002/A1:2017 (not modified)  |
| IEC 61000-2-2:2002/A2:2018  | NOTE | Harmonized as EN 61000-2-2:2002/A2:2019 (not modified)  |
| IEC 61000-4-13:2002         | NOTE | Harmonized as EN 61000-4-13:2002 (not modified)         |
| IEC 61000-4-13:2002/A2:2015 | NOTE | Harmonized as EN 61000-4-13:2002/A2:2016 (not modified) |
| IEC 61000-6-1:2016          | NOTE | Harmonized as EN IEC 61000-6-1:2019 (not modified)      |
| IEC 61000-6-2:2016          | NOTE | Harmonized as EN IEC 61000-6-2:2019 (not modified)      |
| IEC 61000-6-3:2006          | NOTE | Harmonized as EN 61000-6-3:2007 (not modified)          |
| IEC 61082 (series)          | NOTE | Harmonized as EN 61082 (series)                         |
| IEC 61140:2016              | NOTE | Harmonized as EN 61140:2016 (not modified)              |

## Annex ZA (normative)

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

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

| <u>Publication</u> | <u>Year</u> | <u>Title</u>                                                                                                                                       | <u>EN/HD</u>                  | <u>Year</u>  |
|--------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------|
| IEC 60068-2-2      | 2007        | Environmental testing – Part 2-2: Tests – Test B: Dry heat                                                                                         | EN 60068-2-2                  | 2007         |
| IEC 60068-2-11     | 1981        | Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist                                                                     | EN 60068-2-11                 | 1999         |
| IEC 60068-2-30     | 2005        | Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)                                                          | EN 60068-2-30                 | 2005         |
| IEC 60073          | 2002        | Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators                 | EN 60073                      | 2002         |
| IEC 60085          | 2007        | Electrical insulation – Thermal evaluation and designation                                                                                         | EN 60085                      | 2008         |
| IEC 60364          | (all parts) | Low-voltage electrical installations                                                                                                               | HD 364                        | (all parts)  |
| IEC 60364-4-41     | 2005        | Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock                                        | HD 364-4-41<br>(modified)     | 2017         |
| +A1                | 2017        |                                                                                                                                                    | +A11<br>+A12                  | 2017<br>2019 |
| IEC 60364-4-44     | 2007        | Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances | HD 60364-4-442<br>(modified)  | 2012         |
| +A1                | 2015        |                                                                                                                                                    | +HD 60364-4-444<br>(modified) | 2010         |
| +A2                | 2018        |                                                                                                                                                    | +HD 60364-4-443<br>(modified) | 2016         |
| IEC 60364-5-51     | 2005        | Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules                                   | HD 60364-5-51<br>(modified)   | 2009         |
|                    |             |                                                                                                                                                    | +A11<br>+A12                  | 2010<br>2017 |

| <u>Publication</u> | <u>Year</u> | <u>Title</u>                                                                                                                                                     | <u>EN/HD</u>             | <u>Year</u> |
|--------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-------------|
| IEC 60364-5-52     | 2009        | Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems                                                | HD 60364-5-52 (modified) | 2011        |
|                    |             |                                                                                                                                                                  | +A11                     | 2017        |
| IEC 60364-5-53     | 2001        | Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control                             | -                        | -           |
| +A1                | 2002        |                                                                                                                                                                  |                          |             |
| +A2                | 2015        |                                                                                                                                                                  |                          |             |
| IEC 60439          | (all parts) | Low-voltage switchgear and controlgear assemblies                                                                                                                | EN 60439                 | (all parts) |
| IEC 60445          | 2017        | Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors | EN 60445                 | 2017        |
| IEC 60447          | 2004        | Basic and safety principles for man-machine interface, marking and identification – Actuating principles                                                         | EN 60447                 | 2004        |
| IEC 60529          | 1989        | Degrees of protection provided by enclosures (IP Code)                                                                                                           | EN 60529                 | 1991        |
| +A1                | 1999        |                                                                                                                                                                  | +A1                      | 2000        |
| +A2                | 2013        |                                                                                                                                                                  | +A2                      | 2013        |
| IEC 60664-1        | 2007        | Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests                                                    | EN 60664-1               | 2007        |
| IEC 60695-2-10     | 2013        | Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure                                             | EN 60695-2-10            | 2013        |
| IEC 60695-2-11     | 2014        | Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products (GWEPT)                               | EN 60695-2-11            | 2014        |
| IEC 60865-1        | 2011        | Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods                                                                    | EN 60865-1               | 2012        |
| IEC TR 60890       | 2014        | A method of temperature-rise verification of low-voltage switchgear and controlgear assemblies by calculation                                                    | -                        | -           |
| IEC 60947-1        | 2020        | Low-voltage switchgear and controlgear - Part 1: General rules                                                                                                   | EN IEC 60947-1           | 2021        |
| IEC 60947-4-1      | 2018        | Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters                               | EN 60947-4-1             | 2019        |
| IEC 60947-7-2      | 2009        | Low-voltage switchgear and controlgear – Part 7-2: Ancillary equipment - Protective conductor terminal blocks for copper conductors                              | EN 60947-7-2             | 2009        |

## EN IEC 61439-1:2021 (E)

| <u>Publication</u> | <u>Year</u> | <u>Title</u>                                                                                                                                                  | <u>EN/HD</u>  | <u>Year</u> |
|--------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------|
| IEC 61000-4-2      | 2008        | Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test                                    | EN 61000-4-2  | 2009        |
| IEC 61000-4-3      | 2006        | , Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test         | EN 61000-4-3  | 2006        |
| +A1                | 2007        |                                                                                                                                                               | +A1           | 2008        |
| +A2                | 2010        |                                                                                                                                                               | +A2           | 2010        |
| IEC 61000-4-4      | 2012        | Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test                            | EN 61000-4-4  | 2012        |
| IEC 61000-4-5      | 2014        | Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test                                                      | EN 61000-4-5  | 2014        |
| +A1                | 2017        |                                                                                                                                                               | +A1           | 2017        |
| IEC 61000-4-6      | 2013        | Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields    | EN 61000-4-6  | 2014        |
|                    |             |                                                                                                                                                               | +AC1          | 2015        |
| IEC 61000-4-8      | 2009        | Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test                             | EN 61000-4-8  | 2010        |
| IEC 61000-4-11     | 2004        | Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests | EN 61000-4-11 | 2004        |
| +A1                | 2017        |                                                                                                                                                               | +A1           | 2017        |
| IEC 61000-6-2      | 2016        | Electromagnetic compatibility (EMC) - Part 6-2: Generic standards – Immunity standard for industrial environments                                             | EN 61000-6-2  | 2019        |
| IEC 61000-6-3      | 2006        | Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments           | EN 61000-6-3  | 2007        |
| +A1                | 2010        |                                                                                                                                                               | +A1           | 2011        |
| IEC 61000-6-4      | 2018        | Electromagnetic compatibility (EMC) – Part 6-4: Generic standards –Emission standard for industrial environments                                              | EN 61000-6-4  | 2019        |
| IEC 61082-1        | 2014        | Preparation of documents used in electrotechnology – Part 1: Rules                                                                                            | EN 61082      | 2015        |
| IEC 61180          | 2016        | High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment                                         | EN 61180      | 2016        |
| IEC 61439          | (all parts) | Low-voltage switchgear and controlgear assemblies                                                                                                             | EN 61439      | (all parts) |

| <u>Publication</u> | <u>Year</u> | <u>Title</u>                                                                                                                                                                                            | <u>EN/HD</u>        | <u>Year</u>    |
|--------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------|
| IEC 61545          | 1996        | Connecting devices - Devices for the connection of aluminium conductors in clamping units of any material and copper conductors in aluminium bodied clamping units                                      | -                   | -              |
| IEC 61921          | 2017        | Power capacitors - Low-voltage power factor correction banks                                                                                                                                            | EN 61921            | — <sup>1</sup> |
| IEC 62208          | 2011        | Empty enclosures for low-voltage switchgear and controlgear assemblies - General requirements                                                                                                           | EN 62208            | 2011           |
| IEC 81346-1        | 2009        | Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules                                                       | EN 81346-1          | 2009           |
| IEC 81346-2        | 2019        | Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 2: Classification of objects and codes for classes                   | EN IEC 81346-2      | 2019           |
| CISPR 11           | 2015        | Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement                                                                          | EN 55011 (modified) | 2016           |
| +A1                | 2016        |                                                                                                                                                                                                         | +A11                | 2020           |
| +A2                | 2019        |                                                                                                                                                                                                         |                     |                |
| CISPR 32           | 2015        | Electromagnetic compatibility of multimedia equipment – Emission requirements                                                                                                                           | EN 55032 (modified) | 2015           |
| +A1                | 2019        |                                                                                                                                                                                                         | +A11                | 2020           |
| ISO 178            | 2010        | Plastics – Determination of flexural properties                                                                                                                                                         | EN ISO 178          | 2010           |
| +A1                | 2013        |                                                                                                                                                                                                         | +A1                 | 2013           |
| ISO 179-1          | 2010        | Plastics – Determination of Charpy impact properties -- Part 1: Non-instrumented impact test                                                                                                            | EN ISO 179-1        | 2010           |
| ISO 179-2          | 1997        | Plastics – Determination of Charpy impact properties -- Part 2: Instrumented impact test                                                                                                                | EN ISO 179-2        | 1999           |
| +A1                | 2011        |                                                                                                                                                                                                         | +A1                 | 2012           |
| ISO 2409           | 2013        | Paints and varnishes – Cross-cut test                                                                                                                                                                   | EN ISO 22409        | 2013           |
| ISO 4628-3         | 2016        | Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Assessment of degree of rusting | EN ISO 4628-3       | 2016           |
| ISO 4892-2         | 2013        | Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps                                                                                                                    | EN ISO 4892-2       | 2013           |

<sup>1</sup> Under preparation. Stage at time of preparation FprEN 61921:2017.

## Annex ZZ (informative)

### Relationship between this European standard and the safety objectives of Directive 2014/35/EU [2014 OJ L96] aimed to be covered

This European standard has been prepared under a Commission's standardisation request relating to harmonised standards in the field of the Low Voltage Directive, M/511, to provide one voluntary means of conforming to safety objectives of Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZ.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding safety objectives of that Directive, and associated EFTA regulations.

**Table ZZ.1 — Correspondence between this European standard and Annex I of Directive 2014/35/EU [2014 OJ L96]**

| Safety objectives of Directive 2014/35/EU | Clause(s) / sub-clause(s) of this EN                                                                                                                           | Remarks / Notes |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| (1)(a)                                    | Clauses 6                                                                                                                                                      |                 |
| (1)(b)                                    | Clauses 6                                                                                                                                                      |                 |
| (1)(c)                                    | See safety objectives 2 a) to 2 d) and 3 a) to 3 c) in this table                                                                                              |                 |
| (2)(a)                                    | Clauses 8.2, 8.3, 8.4, 8.5, 10.5, 10.6, 10.9, 11.4, 11.5                                                                                                       |                 |
| (2)(b)                                    | Clauses 7.1, 7.2, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 9.1, 9.2, 9.3, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.9, 10.10, 10.11, 11.2, 11.3, 11.4, 11.5, 11.6, 11.9 |                 |
| (2)(c)                                    | Clauses 6.2, 7.2, 8.1, 8.2, 8.5, 9.2, 9.3, 9.4, 10.2, 10.3, 10.6, 10.10, 10.11, 11.2, 11.5, 11.8, annex J                                                      |                 |
| (2)(d)                                    | Clauses 5, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 9.1, 9.2, 9.3, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.9, 10.10, 10.11, 11.2, 11.3, 11.4, 11.5, 11.9, 11.10       |                 |
| (3)(a)                                    | Clauses 6.2, 7.2, 8.1, 8.2, 9.3, 10.2, 10.11, 11.8                                                                                                             |                 |
| (3)(b)                                    | Clause 7.1, 7.2, 8.1, 8.2, 8.3, 8.7, 9.1, 9.2, 9.3, 9.4, 10.2, 10.3, 10.4, 10.6, 10.9, 10.10, 10.11, 10.12, 11.2, 11.3, 11.9                                   |                 |

| Safety objectives of Directive 2014/35/EU | Clause(s) / sub-clause(s) of this EN                                                                                                     | Remarks / Notes |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| (3)(c)                                    | Clauses 5.3, 5.4, 8.1, 8.5, 8.6, 9.2, 9.3, 10.2, 10.5, 10.6, 10.7, 10.10, 10.11, 11.4, 11.5, 11.6, 11.8, 11.10, annex E, annex I annex P |                 |

WARNING 1: Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2: Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

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# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –

### Part 1: General rules

#### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61439-1 has been prepared by subcommittee 121B: Low-voltage switchgear and controlgear assemblies, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This third edition cancels and replaces the second edition published in 2011. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) clarification that power electric converter systems, switch mode power supplies, uninterruptable power supplies and adjustable speed power drive systems are tested to their particular products standard, but when they are incorporated in assemblies the incorporation is in accordance with the IEC 61439 series of standards;
- b) introduction of a group rated current for circuits within a loaded assembly and the refocusing of temperature-rise verification on this new characteristic;

- c) addition of requirements in respect of DC;
- d) introduction of the concept of class I and class II assemblies regarding protection against electric shock.

The text of this International Standard is based on the following documents:

| FDIS         | Report on voting |
|--------------|------------------|
| 121B/99/FDIS | 121B/103/RVD     |

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

The reader's attention is drawn to the fact that Annex N lists all the "in-some-countries" clauses on differing practices of a less permanent nature regarding this document.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61439 series, under the general title *Low-voltage switchgear and controlgear assemblies*, can be found on the IEC website.

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

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

The contents of the corrigendum of December 2021 have been included in this copy.

## INTRODUCTION

The purpose of this document is to harmonize as far as practicable all rules and requirements of a general nature applicable to low-voltage switchgear and controlgear assemblies, in order to obtain uniformity of requirements and verification for assemblies and to avoid the need for verification in other standards. All those requirements for the various assembly standards which can be considered as general have therefore been gathered in this document together with specific subjects of wide interest and application, e.g. temperature-rise, dielectric properties, etc.

For each type of low-voltage switchgear and controlgear assembly, only two main standards are necessary to determine all requirements and the corresponding methods of verification:

- the basic standard, (this document) referred to as “IEC 61439-1” in the specific standards, covering the various types of low-voltage switchgear and controlgear assemblies;
- the specific assembly standard hereinafter also referred to as the relevant assembly standard.

For a general rule to apply to a specific assembly standard, it should be explicitly referred to by quoting this document followed by the relevant clause or subclause number e.g. “IEC 61439-1:2020, 9.1.3”.

A specific assembly standard may not require, and hence need not call up, a general rule where it is not applicable, or it can add requirements if the general rule is deemed inadequate in the particular case, but it may not deviate from it unless there is substantial technical justification detailed in the specific assembly standard.

Where, in this document, a cross-reference is made to another clause, the reference is to be taken to apply to that clause as amended by the specific assembly standard, where applicable.

Requirements in this document that are subject to agreement between the assembly manufacturer and the user are summarized in Annex C (informative). This schedule also facilitates the supply of information on basic conditions and additional user specifications to enable proper design, application and utilization of the assembly.

For the IEC 61439 series, the following parts are published:

- a) IEC 61439-1: General rules
- b) IEC 61439-2: Power switchgear and controlgear assemblies (PSC-assemblies)<sup>1</sup>
- c) IEC 61439-3: Distribution boards intended to be operated by ordinary persons (DBO)
- d) IEC 61439-4: Particular requirements for assemblies for construction sites (ACS)
- e) IEC 61439-5: Assemblies for power distribution in public networks
- f) IEC 61439-6: Busbar trunking systems (busways)
- g) IEC 61439-7: Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicle charging stations
- h) IEC TR 61439-0: Guidance to specifying assemblies.

This list is not exhaustive; additional parts can be developed as the need arises.

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<sup>1</sup> IEC 61439-2 includes requirements for assemblies for use in photovoltaic installations.

# LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –

## Part 1: General rules

### 1 Scope

This part of IEC 61439 lays down the general definitions and service conditions, construction requirements, technical characteristics and verification requirements for low-voltage switchgear and controlgear assemblies.

NOTE Throughout this document, the term assembly(s) (see 3.1.1) is used for a low-voltage switchgear and controlgear assembly(s).

For the purpose of determining assembly conformity, the requirements of the relevant part of the IEC 61439 series, Part 2 onwards, apply together with the cited requirements of this document. For assemblies not covered by Part 3 onward, Part 2 applies.

This document applies to assemblies only when required by the relevant assembly standard as follows:

- assemblies for which the rated voltage does not exceed 1 000 V AC or 1 500 V DC;
- assemblies designed for a nominal frequency of the incoming supply or supplies not exceeding 1 000 Hz;
- assemblies intended for indoor and outdoor applications;
- stationary or movable assemblies with or without an enclosure;
- assemblies intended for use in connection with the generation, transmission, distribution and conversion of electric energy, and for the control of electrical energy consuming equipment.

This document does not apply to individual devices and self-contained components such as motor starters, fuse switches, power electronic converter systems and equipment (PECS), switch mode power supplies (SMPS), uninterruptable power supplies (UPS), basic drive modules (BDM), complete drive modules (CDM), adjustable speed power drives systems (PDS), and other electronic equipment which comply with their relevant product standards. This document describes the integration of devices and self-contained components into an assembly or into an empty enclosure forming an assembly.

For some applications involving, for example, explosive atmospheres, functional safety, there can be a need to comply with the requirements of other standards or legislation in addition to those specified in the IEC 61439 series.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-11:1981, *Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators*

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*  
IEC 60364-4-41:2005/AMD1:2017

IEC 60364-5-51:2005, *Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules*

IEC 60364-5-52:2009, *Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems*

IEC 60439 (all parts), *Low-voltage switchgear and controlgear assemblies*<sup>2</sup>

IEC 60445:2017, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 60447:2004, *Basic and safety principles for man-machine interface, marking and identification – Actuating principles*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*<sup>3</sup>  
IEC 60529:1989/AMD1:1999  
IEC 60529:1989/AMD2:2013

IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC 60865-1:2011, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*

IEC TR 60890:2014, *A method of temperature-rise verification of low-voltage switchgear and controlgear assemblies by calculation*

IEC 60947-4-1:2018, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

<sup>2</sup> Withdrawn. The IEC 60439 series has been cancelled and replaced by the IEC 61439 series.

<sup>3</sup> There is a consolidated document edition 2.2 (2013) that includes IEC 60529 (1989) and its Amendment 1 (1999) and Amendment 2 (2013).

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio frequency, electromagnetic field immunity test*<sup>4</sup>

IEC 61000-4-3:2006/AMD1:2007

IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*<sup>5</sup>

IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-11:2004/AMD1:2017

IEC 61000-6-3:2006, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61000-6-3:2006/AMD1:2010

IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61082-1:2014, *Preparation of documents used in electrotechnology – Part 1: Rules*

IEC 61180:2016, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 61921:2017, *Power capacitors – Low-voltage power factor correction banks*

IEC 62208:2011, *Empty enclosures for low-voltage switchgear and controlgear assemblies – General requirements*

IEC 81346-1:2009, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules*

IEC 81346-2:2019, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 2: Classification of objects and codes for classes*

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<sup>4</sup> There is a consolidated edition 3.2 (2010) that includes IEC 61000-4-3 (2006) and Amendment 1 (2007) and Amendment 2 (2010).

<sup>5</sup> There is consolidated edition 3.1 (2017) that includes IEC 61000-4-5 (2014) and its Amendment 1 (2017).

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*  
 CISPR 11:2015/AMD1:2016  
 CISPR 11:2015/AMD2:2019

CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements*  
 CISPR 32:2015/AMD1:2019

ISO 178:2010, *Plastics – Determination of flexural properties*  
 ISO 178:2010/AMD1:2013

ISO 179-1:2010, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 179-2:1997, *Plastics – Determination of Charpy impact properties – Part 2: Instrumented impact test*  
 ISO 179-2:1997/AMD1:2011

ISO 2409:2013, *Paints and varnishes – Cross-cut test*

ISO 4628-3:2016, *Paints and varnishes – Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance – Part 3: Assessment of degree of rusting*

ISO 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1 General terms

##### 3.1.1

##### **low-voltage switchgear and controlgear assembly**

combination of one or more low-voltage switching devices together with associated control, measuring, signalling, protective, regulating equipment, with all the internal electrical and mechanical interconnections and structural parts, as defined by the original manufacturer, which can be assembled in accordance with the original manufacturer's instructions

Note 1 to entry: Throughout this document, the term assembly(s) is used for a low-voltage switchgear and controlgear assembly(s)

Note 2 to entry: The term "switching device" includes mechanical switching devices and semiconductor switching devices, e.g. soft starters, semiconductor relays, frequency converters. The auxiliary circuits may also include electro-mechanical devices, e.g. control relays, terminal blocks, and electronic devices, e.g. electronic motor control devices, electronic measurement and protection devices, bus communication, programmable logic controller systems.

**3.1.2****assembly system**

full range of mechanical and electrical components (enclosures, busbars, functional units, auxiliary circuits and associated controls, etc.), as defined by the original manufacturer, which can be assembled in accordance with the original manufacturer's instructions in order to produce various assemblies

**3.1.3****main circuit**

all the conductive parts of an assembly included in a circuit which is intended to transmit electrical energy

[SOURCE: IEC 60050-441:2000, 441-13-02]

**3.1.4****auxiliary circuit**

all the conductive parts of an assembly included in a circuit (other than the main circuit) intended to control, measure, signal, regulate and process data, etc.

Note 1 to entry: The auxiliary circuits of an assembly include the control and the auxiliary circuits of the switching devices.

[SOURCE: IEC 60050-441:2000, 441-13-03, modified – In the definition, "assembly of switchgear and controlgear" has been replaced with "assembly", and at the end of the definition "and process data, etc." has been added.]

**3.1.5****busbar**

low-impedance conductor to which several electric circuits can be connected at separate points

Note 1 to entry: The term "busbar" is generic and does not presuppose the material, the geometrical shape, size or dimensions of the conductor(s).

[SOURCE: IEC 60050-151:2001, 151-12-30, modified – The text of the note has been replaced.]

**3.1.6****main busbar**

busbar to which one or several distribution busbars and/or incoming and outgoing units are connected

Note 1 to entry: Conductors that are connected between a functional unit and a main busbar are not considered as a part of the main busbar.

**3.1.7****distribution busbar**

busbar within one section which is connected to a main busbar and from which outgoing units are supplied

Note 1 to entry: Conductors that are connected between a functional unit and a distribution busbar are not considered as a part of the distribution busbars.

**3.1.8****functional unit**

part of an assembly comprising all the electrical and mechanical elements including switching devices that contribute to the fulfilment of the same function

Note 1 to entry: The conductors connecting a functional unit to the main or distribution busbars and to the terminals for external conductors are part of the functional unit. Other conductors which are connected to a functional unit, but which are external to its compartment or enclosed protected space (e.g. auxiliary cables connected in a common compartment) are not considered to form part of the functional unit.

### 3.1.9

#### **incoming unit**

functional unit through which electrical energy is normally fed into the assembly

### 3.1.10

#### **outgoing unit**

functional unit through which electrical energy is normally supplied to one or more external circuits

### 3.1.11

#### **short-circuit protective device**

##### **SCPD**

device intended to protect a circuit or parts of a circuit against short-circuit currents by interrupting them

[SOURCE: IEC 60947-1:2020, 3.4.21]

### 3.1.12

#### **current-limiting device**

SCPD that, within a specified range of current, prevents the let-through current from reaching the prospective peak value and which limits the let-through energy ( $I^2t$ )

Note 1 to entry: The let-through current is also referred to as the cut-off current (see IEC 60050-441:2000, 441-17-12).

Note 2 to entry: Examples of current-limiting devices are current-limiting circuit-breakers in accordance with IEC 60947-2 and fuses in accordance with IEC 60269-2.

### 3.1.13

#### **non-current-limiting device**

SCPD that, within a specified range of current, allows the let-through current to reach the prospective peak value and which can have a rated short-time withstand current ( $I_{cw}$ ) enabling it to withstand the let-through energy for the duration of the short-time current

### 3.1.14

#### **line conductor**

##### **L**

DEPRECATED: phase conductor (in AC systems)

DEPRECATED: pole conductor (in DC systems)

conductor which is energized in normal operation and capable of contributing to the transmission or distribution of electric energy but which is not a neutral or mid-point conductor

[SOURCE: IEC 60050-195:1998, 195-02-08]

### 3.1.15

#### **relevant assembly standard**

standard within the IEC 61439 series, Part 2 onwards, covering a generic type of assembly

EXAMPLE Power switchgear and controlgear assemblies (PSC-assemblies).

## 3.2 Constructional units of assemblies

### 3.2.1

#### **fixed part**

part consisting of components assembled and wired on a common support and which is designed for fixed installation

**3.2.2****removable part**

part consisting of components assembled and wired on a common support which is intended to be removed entirely from the assembly and replaced whilst the main circuit to which it is connected may be live

**3.2.3****connected position**

position of a removable part when it is fully connected for its intended function

**3.2.4****removed position**

position of a removable part when it is outside the assembly, and mechanically and electrically separated from it

**3.2.5****insertion interlock**

device preventing the introduction of a removable part into a location not intended for that removable part

**3.2.6****fixed connection**

connection which can be connected with or without a tool and only disconnected by means of a tool

**3.2.7****section**

constructional unit of an assembly between two successive vertical delineations

**3.2.8****sub-section**

constructional unit of an assembly between two successive horizontal or vertical delineations within a section

**3.2.9****compartment**

section or sub-section enclosed except for openings necessary for interconnection, control or ventilation

**3.2.10****transport unit**

part of an assembly or a complete assembly suitable for transportation without being dismantled

**3.2.11****shutter**

part of an assembly which can be moved between:

- a position in which it permits engagement of the contacts of a removable part with fixed contacts, and
- a position in which it becomes a part of a cover or a partition shielding the fixed contacts

[SOURCE: IEC 60050-441:2000, 441-13-07, modified – The text has been editorially reformatted into two bullet points.]

### 3.3 External design of assemblies

#### 3.3.1

##### **open-type assembly**

assembly consisting of a supporting structure which supports the electrical equipment, the live parts of the electrical equipment being accessible

#### 3.3.2

##### **dead-front assembly**

open-type assembly with a front cover, the live parts possibly being accessible from directions other than the front

#### 3.3.3

##### **enclosed assembly**

assembly which is enclosed on all sides with the possible exception of its mounting surface in such a manner as to provide a defined degree of protection

#### 3.3.4

##### **cubicle-type assembly**

enclosed assembly of the floor-standing type, which may comprise several sections, sub-sections or compartments

#### 3.3.5

##### **multi-cubicle-type assembly**

combination of a number of mechanically joined cubicle-type assemblies

#### 3.3.6

##### **desk-type assembly**

enclosed assembly with a horizontal or inclined control panel, or a combination of both, that incorporates control, measuring, and signalling apparatus, etc.

#### 3.3.7

##### **box-type assembly**

enclosed assembly intended to be mounted on a vertical plane

#### 3.3.8

##### **multi-box-type assembly**

combination of box-type assemblies mechanically joined together, with or without a common supporting frame, the electrical connections passing between two adjacent boxes through openings in the adjoining faces

#### 3.3.9

##### **wall-mounted surface type assembly**

assembly for installation on the surface of a wall

#### 3.3.10

##### **wall-mounted recessed type assembly**

assembly for installation into a wall recess, where the enclosure does not support the portion of wall above

#### 3.3.11

##### **floor-standing assembly**

assembly for installation on the floor

### **3.4 Structural parts of assemblies**

#### **3.4.1**

##### **supporting structure**

structure forming part of an assembly designed to support various components of the assembly and any enclosure

#### **3.4.2**

##### **mounting structure**

structure not forming part of an assembly, designed to support an assembly

#### **3.4.3**

##### **mounting plate**

plate designed to support various components and suitable for installation in an assembly

#### **3.4.4**

##### **mounting frame**

framework designed to support various components and suitable for installation in an assembly

#### **3.4.5**

##### **enclosure**

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

[SOURCE: IEC 60050-195:1998, 195-02-35]

#### **3.4.6**

##### **cover**

external part of the enclosure of an assembly

#### **3.4.7**

##### **door**

hinged or sliding cover

#### **3.4.8**

##### **removable cover**

cover which is designed for closing an opening in the external enclosure and which can be removed for carrying out certain operations and maintenance work

#### **3.4.9**

##### **cover plate**

part of an assembly which is used for closing an opening in the external enclosure and designed to be held in place by screws or similar means

Note 1 to entry: It is not normally removed after the equipment is put into service.

Note 2 to entry: The cover plate can be provided with cable entries.

#### **3.4.10**

##### **partition**

part of an assembly separating one compartment from other compartments

[SOURCE: IEC 60050-441:2000, 441-13-06]

#### **3.4.11**

##### **barrier**

part providing protection against direct contact from any usual direction of access

[SOURCE: IEC 60050-195:1998, 195-06-15, modified – “(electrically) protective” has been deleted from the term.]

### **3.4.12**

#### **obstacle**

part preventing unintentional direct contact, but not preventing direct contact by deliberate action

Note 1 to entry: Obstacles are intended to prevent unintentional contact with live parts but not intentional contact by deliberate circumvention of the obstacle. They are intended to protect skilled, competent, authorised or instructed persons but are not intended to protect ordinary persons.

[SOURCE: IEC 60050-195:1998, 195-06-16, modified – “(electrically) protective” has been deleted from the term. Note 1 to entry has been added.]

### **3.4.13**

#### **terminal shield**

part enclosing terminals and providing a defined degree of protection against access to live parts by persons or objects

### **3.4.14**

#### **cable entry**

part with openings which permit the passage of cables into the assembly

### **3.4.15**

#### **protected space**

part of an assembly intended to enclose electrical components, and which provides defined protection against external influences and contact with live parts

## **3.5 Conditions of installation of assemblies**

### **3.5.1**

#### **assembly for indoor installation**

assembly that is designed for use in locations where the normal service conditions for indoor use as specified in 7.1 apply

### **3.5.2**

#### **assembly for outdoor installation**

assembly that is designed for use in locations where the normal service conditions for outdoor use as specified in 7.1 apply

### **3.5.3**

#### **stationary assembly**

assembly that is designed to be fixed at its place of installation, for instance to the floor or to a wall, and to be used at this place

### **3.5.4**

#### **movable assembly**

assembly which is designed so that it can readily be moved from one place of use to another

## **3.6 Insulation characteristics**

### **3.6.1**

#### **clearance**

shortest distance in air between two conductive parts

Note 1 to entry: This distance can be measured along a string stretched the shortest way between these conductive parts.

[SOURCE: IEC 60050-581:2008, 581-27-76, modified – Note 1 to entry has been added.]

**3.6.2****creepage distance**

shortest distance along the surface of a solid insulating material between two conductive parts

Note 1 to entry: A joint between two pieces of solid insulating material is considered part of the surface.

[SOURCE: IEC 60050-151:2001, 151-15-50, modified – Note 1 to entry has been added.]

**3.6.3****overvoltage**

voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions

[SOURCE: IEC 60664-1:2007, 3.7]

**3.6.4****temporary overvoltage**

overvoltage at power frequency of several seconds duration

**3.6.5****transient overvoltage**

short duration overvoltage of a few milliseconds or less, oscillatory or non-oscillatory, usually highly damped

[SOURCE: IEC 60050-614:2016, 614-03-14, modified – In the definition, “short duration overvoltage” has replaced “overvoltage with a duration”. Note 1 to entry and Note 2 to entry have been deleted.]

**3.6.6****power-frequency withstand voltage**

RMS value of a power-frequency sinusoidal voltage which does not cause breakdown under specified conditions of test

[SOURCE: IEC 60947-1:2020, 3.7.55]

**3.6.7****impulse withstand voltage**

highest peak value of impulse voltage of prescribed form and polarity which does not cause breakdown of insulation under specified conditions

[SOURCE: IEC 60050-442:2014, 442-09-18]

**3.6.8****pollution**

addition of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation

[SOURCE: IEC 60050-442:1998, 442-01-28, modified – In the definition, “can produce a permanent reduction of dielectric strength” has been replaced with “can result in a reduction of electric strength” and Note 1 to entry was deleted.]

**3.6.9****pollution degree**

<of environmental conditions> conventional number based on the amount of conductive or hygroscopic dust, ionized gas or salt, and on the relative humidity and its frequency of occurrence resulting in hygroscopic absorption or condensation of moisture leading to reduction in dielectric strength and/or surface resistivity

Note 1 to entry: The pollution degree to which the insulating materials of devices and components are exposed may be different from that of the macro-environment where the assemblies are located because of protection offered by means such as an enclosure or internal heating to prevent absorption or condensation of moisture.

Note 2 to entry: For the purpose of this document, the pollution degree is of the micro-environment inside the assembly, unless otherwise stated in the applicable clause.

[SOURCE: IEC 60947-1:2020, 3.7.57, modified – Notes to entry have been adapted for the conditions associated with assemblies.]

### **3.6.10 environment**

#### **3.6.10.1 micro-environment**

immediate environment of the insulation which particularly influences the dimensioning of the creepage distances

Note 1 to entry: It is the effect of the micro-environment on the creepage and/or clearance distance that determines the selection of the insulation within the assembly. The micro-environment may be better or worse than the macro-environment.

[SOURCE: IEC 60050-851:2008, 851-15-16, modified – Note 1 to entry has been added.]

#### **3.6.10.2 macro-environment**

environment of the room or other location in which the assembly is installed or used

[SOURCE: IEC 60050-442:2014, modified – In the definition, the term “equipment” has been replaced by “assembly”.]

### **3.6.11 overvoltage category**

<of a circuit or within an electrical system> conventional number based on limiting (or controlling) the values of prospective transient overvoltages occurring in a circuit (or within an electrical system having different nominal voltages) and depending upon the means employed to influence the overvoltages

Note 1 to entry: In an electrical system, the transition from one overvoltage category to another of lower category is obtained through appropriate means complying with interface requirements, such as an overvoltage protective device or a series-shunt impedance arrangement capable of dissipating, absorbing, or diverting the energy in the associated surge current, to lower the transient overvoltage value to that of the desired lower overvoltage category.

[SOURCE: IEC 60947-1:2020, 3.7.59]

### **3.6.12 surge protective device SPD**

device designed to protect the electrical apparatus from high transient overvoltages and to limit the duration and frequently the amplitude of the follow-on current

[SOURCE: IEC 60947-1:2020, 3.4.22, modified – The term "surge arrester" was replaced with "surge protective device" and "SPD".]

### **3.6.13 insulation coordination**

mutual correlation of insulating characteristics of electrical equipment taking into account the expected micro-environment and other influencing stresses

[SOURCE: IEC 60050-442:2014, modified – In the definition, ‘electrical’ has replaced ‘electric’.]

**3.6.14****inhomogeneous field**

electric field which has not an essentially constant voltage gradient between electrodes

[SOURCE: IEC 60947-1:2020, 3.7.62]

**3.6.15****tracking**

progressive formation of conducting paths which are produced on the surface of a solid insulating material, due to the combined effects of electric stress and electrolytic contamination on this surface

[SOURCE: IEC 60947-1:2020, 3.7.63]

**3.6.16****comparative tracking index****CTI**

numerical value of the maximum voltage in volts which a material can withstand without tracking and without a persistent flame occurring under specified test conditions

Note 1 to entry: The value of each test voltage and the CTI should be divisible by 25.

[SOURCE: IEC 60947-1:2020, 3.7.64, modified – Note 1 to entry has been added.]

**3.6.17****disruptive discharge**

phenomenon associated with the failure of insulation under electrical stress, in which the discharge completely bridges the insulation under test, reducing the voltage between the electrodes to zero or nearly zero

Note 1 to entry: A disruptive discharge in a solid dielectric produces permanent loss of dielectric strength; in a liquid or gaseous dielectric, the loss may be only temporary.

Note 2 to entry: The term "sparkover" is used when a disruptive discharge occurs in a gaseous or liquid dielectric.

Note 3 to entry: The term "flashover" is used when a disruptive discharge occurs over the surface of a dielectric in a gaseous or liquid medium.

Note 4 to entry: The term "puncture" is used when a disruptive discharge occurs through a solid dielectric.

**3.7 Protection against electric shock****3.7.1****live part**

conductive part intended to be energized under normal conditions, including a neutral conductor or mid-point conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

Note 1 to entry: This term does not necessarily imply a risk of electric shock. When the neutral conductor is effectively earthed it is not a hazardous live part and therefore not switched in TN-S or TN-C-S systems unless specifically required by other standards.

[SOURCE: IEC 61140:2016, 3.4, modified – Note 1 to entry has been replaced.]

**3.7.2****hazardous live part**

live part which, under certain conditions, can give a harmful electric shock

[SOURCE: IEC 61140:2016, 3.5, modified – Note 1 to entry was deleted.]

### 3.7.3

#### **exposed-conductive-part**

conductive part of the assembly, which can be touched and which is not normally live, but which can become live when basic insulation fails

Note 1 to entry: A conductive part of the assembly which can only become live through contact with an exposed-conductive-part which has become live, is not considered to be an exposed-conductive-part itself.

[SOURCE: IEC 60050-195:1998, 195-06-10, modified – In the definition, “equipment” has been replaced by “the assembly”. Note 1 to entry has been added.]

### 3.7.4

#### **protective conductor**

#### **PE**

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

Note 1 to entry: As an example, the protective conductor can electrically connect the following parts:

- exposed-conductive-parts;
- extraneous conductive parts;
- main earthing terminal;
- earth electrode;
- earthed point of the source or artificial neutral.

Note 2 to entry: A protective conductor is sometimes referred to a protective earthing conductor.

[SOURCE: IEC 60050-826:2004, 826-13-22, modified – The note 1 has been replaced and note 2 added.]

### 3.7.5

#### **neutral conductor**

#### **N**

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

[SOURCE: IEC 60050-195:1998, 195-02-06, modified – The abbreviated term “N” has been added and “electric” was replaced with “electrical”.]

### 3.7.6

#### **PEN conductor**

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

[SOURCE: IEC 60050-195:1998, 195-02-12]

### 3.7.7

#### **fault current**

current resulting from an insulation failure, the bridging of insulation or incorrect connection in an electrical circuit

### 3.7.8

#### **basic protection**

protection against electric shock under fault-free conditions

Note 1 to entry: Basic protection is intended to prevent contact with live parts and generally corresponds to protection against direct contact.

[SOURCE: IEC 60050-195:1998, 195-06-01 modified – Note 1 to entry has been added]

**3.7.9****basic insulation**

insulation of hazardous live parts, which provides basic protection

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-826:2004, 826-12-14]

**3.7.10****fault protection**

protection against electric shock under single-fault conditions

Note 1 to entry: Failure of basic insulation (3.7.9) is an example of a single fault condition.

Note 2 to entry: Fault protection generally corresponds to protection against indirect contact, mainly regarding failure of basic insulation.

[SOURCE: IEC 60050-195:1998, 195-06-02, modified – The notes to entry have been added.]

**3.7.11****PELV system**

electric system in which the voltage cannot exceed the values given in IEC 60364-4-41:2005, Clause 414;

- under normal conditions and
- under single fault conditions, except earth faults in other electric circuits

Note 1 to entry: PELV is the abbreviation for protective extra low-voltage.

Note 2 to entry: The PELV circuits and/or exposed-conductive-parts of equipment supplied by the PELV circuits can be earthed.

[SOURCE: IEC 60050-826:2004, 826-12-32, modified – The IEC 60364-4-41:2005 reference has been added to the definition. Note 2 to entry has been added.]

**3.7.12****SELV system**

electric system in which the voltage cannot exceed the values given in IEC 60364-4-41:2005, Clause 414:

- under normal conditions and
- under single fault conditions, including earth faults in other electric circuits

Note 1 to entry: SELV is the abbreviation for safety extra low-voltage.

Note 2 to entry: SELV circuits have basic insulation between live parts and earth.

[SOURCE: IEC 60050-826:2004, 826-12-31, modified – The IEC 60364-4-41:2005 reference has been added to the definition. Note 2 to entry has been added.]

**3.7.13****(electrically) skilled person**

person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create

[SOURCE: IEC 60050-826:2004, 826-18-01]

**3.7.14****competent person**

person who can judge the work assigned and recognize possible hazards on the basis of professional training, experience and knowledge of the relevant equipment

Note 1 to entry: Several years of practice in the relevant technical field may be taken into consideration in assessment of professional training.

[SOURCE: IEC 60050-851:2008, 851-11-10]

### **3.7.15**

#### **instructed person**

person adequately advised or supervised by skilled persons to enable him or her to perceive risks and to avoid hazards electricity can create

[SOURCE: IEC 60050-826:2004, 826-18-02, modified – "(electrically)" was deleted from the main term.]

### **3.7.16**

#### **ordinary person**

person who is neither a skilled person nor an instructed person

[SOURCE: IEC 60050-826:2004, 826-18-03]

### **3.7.17**

#### **authorized person**

skilled or instructed person who is empowered to execute defined work

### **3.7.18**

#### **mid-point conductor**

M

conductor electrically connected to the mid-point and capable of the transmission of electrical energy

Note 1 to entry: The term mid-point conductor is most frequently associated with DC applications.

[SOURCE: IEC 60050-195:1998, 195-02-07, modified – In the definition, "contributing to the distribution" has been replaced by "the transmission". Note 1 to entry has been added.]

### **3.7.19**

#### **PEM conductor**

conductor combining the functions of both a protective earthing conductor and a mid-point conductor

[SOURCE: IEC 60050-195:1998, 195-02-13]

### **3.7.20**

#### **PEL conductor**

conductor combining the functions of both a protective earthing conductor and a line conductor

[SOURCE: IEC 60050-195:1998, 195-02-14]

### **3.7.21**

#### **supplementary insulation**

independent insulation applied in addition to basic insulation for fault protection

[SOURCE: IEC 60050-826:2004, 826-12-15]

### **3.7.22**

#### **double insulation**

insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-826:2004, 826-12-16]

### 3.7.23

#### **reinforced insulation**

insulation of hazardous-live-parts which provides a degree of protection against electric shock equivalent to double insulation

Note 1 to entry: Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

Note 2 to entry: Reinforced insulation complies with IEC 60664-1:2007.

[SOURCE: IEC 60050-826:2004, 826-12-17, modified – New Note 2 to entry.]

### 3.7.24

#### **class I assembly**

assembly with at least one provision for a basic protection and a connection to a protective conductor as provision for a fault protection

Note 1 to entry: See IEC 61140:2016, 7.3 for further details.

Note 2 to entry: A class I assembly can have an insulated enclosure for basic protection and a protective conductor to facilitate fault protection for external circuits supplied through the class I assembly.

### 3.7.25

#### **class II assembly**

assembly which is provided with the following;

- basic insulation as provision for basic protection, and
  - supplementary insulation as provision for fault protection,
- or in which;
- basic protection and fault protection are provided by reinforced insulation

Note 1 to entry: See IEC 61140:2016, 7.4

## 3.8 Characteristics

### 3.8.1

#### **nominal value**

value of a quantity used to designate and identify a component, device, equipment or system

Note 1 to entry: The nominal value is generally a rounded value.

[SOURCE: IEC 60050-151:2001, 151-16-09]

### 3.8.2

#### **limiting value**

in a specification of a component, device, equipment or system, the greatest or smallest admissible value of a quantity

[SOURCE: IEC 60050-151:2001, 151-16-10]

### 3.8.3

#### **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

[SOURCE: IEC 60050-151:2001, 151-16-08]

### 3.8.4

#### **rating**

set of rated values and operating conditions

[SOURCE: IEC 60050-151:2001, 151-16-11]

### 3.8.5

#### **nominal voltage**

approximate value of voltage used to designate or identify an electrical system

[SOURCE: IEC 60050-601:1985, 601-01-21, modified – Deletion of "(of a system)" from the term and addition of "electrical" in the definition.]

### 3.8.6

#### **short-circuit current**

$I_c$

overcurrent resulting from a short-circuit due to a fault or an incorrect connection in an electric circuit

[SOURCE: IEC 60050-441:2000, 441-11-07]

### 3.8.7

#### **prospective short-circuit current**

$I_{cp}$

current which would flow if the supply conductors to the circuit are short-circuited by a conductor of negligible impedance located as near as practicable to the supply terminals of the assembly

Note 1 to entry: For AC and DC applications, the current is the RMS value and the mean value in sustained conditions, respectively.

### 3.8.8

#### **cut-off current**

#### **let-through current**

$I_{lt}$

maximum instantaneous value of current attained during the breaking operation of a switching device or a fuse

Note 1 to entry: This concept is of particular importance when the switching device or the fuse operates in such a manner that the prospective peak current of the circuit is not reached.

[SOURCE: IEC 60050-441:2000, 441-17-12]

### 3.8.9

#### **voltage ratings**

#### **3.8.9.1**

#### **rated voltage**

$U_n$

highest nominal voltage of the electrical system, declared by the assembly manufacturer, to which the main circuit(s) of the assembly is (are) designed to be connected

Note 1 to entry: In polyphase circuits, it is the voltage between lines.

Note 2 to entry: Transients are disregarded.

Note 3 to entry: The value of the supply voltage may exceed the rated voltage due to permissible system tolerances.

Note 4 to entry: The voltage is the RMS value and the mean value for AC and DC applications, respectively.

**3.8.9.2****rated operational voltage** $U_e$ 

value of voltage, AC (RMS) or DC (mean value), declared by the assembly manufacturer for the assembly or a circuit of an assembly, which, combined with the rated current, determines its application

Note 1 to entry: In polyphase circuits, it is the voltage between lines.

**3.8.9.3****rated insulation voltage** $U_i$ 

RMS withstand voltage value, assigned by the assembly manufacturer (3.10.2) to the assembly or to a circuit of an assembly, characterizing the specified (long-term) withstand capability of the insulation

Note 1 to entry: In polyphase circuits, it is the voltage between lines.

Note 2 to entry: The rated insulation voltage is not necessarily equal to the rated operational voltage of equipment, which is primarily related to functional performance.

[SOURCE: IEC 60664-1 2007, 3.9.1, modified – The symbol  $U_i$  has been added. In the definition, “manufacturer” has been replaced by “assembly manufacturer (3.10.2)” and ‘equipment or to a part of it’ has been replaced by ‘assembly or to a circuit of an assembly’. Note 1 to entry has been added.]

**3.8.9.4****rated impulse withstand voltage** $U_{imp}$ 

impulse withstand voltage value, assigned by the assembly manufacturer for an assembly or a circuit of an assembly, characterizing the specified withstand capability of the insulation against transient overvoltages

[SOURCE: IEC 60664-1 2007, 3.9.2, modified – “withstand” has been added to term; the symbol  $U_{imp}$  has been added. In the definition, ‘to the equipment or to a part of it’ has been replaced by ‘for an assembly or a circuit of an assembly’.]

**3.8.10****current ratings****3.8.10.1****rated current**

value of uninterrupted current, declared by the assembly manufacturer which can be carried without the temperature-rise of various parts of the assembly exceeding specified limits under specified conditions

Note 1 to entry: For rated current of the assembly ( $I_{nA}$ ) see 3.8.10.7 and 5.3.1; for rated current of a main circuit ( $I_{nC}$ ) see 3.8.10.5 and 5.3.2; and for group rated current of a main circuit ( $I_{ng}$ ) see 3.8.10.6 and 5.3.3.

Note 2 to entry: Normally it is not necessary to take into account the inrush currents for motors, transformers, etc. when determining the rated current of a circuit.

**3.8.10.2****rated peak withstand current** $I_{pk}$ 

value of peak short-circuit current declared by the assembly manufacturer, that can be withstood under specified conditions

### 3.8.10.3 rated short-time withstand current

$I_{cw}$   
RMS value of AC or mean value of DC short-time current, declared by the assembly manufacturer, that can be withstood under specified conditions, defined in terms of current and time

Note 1 to entry: Rated short-time withstand current is not the same as an internal arc fault rating as given in IEC TR 61641.

### 3.8.10.4 rated conditional short-circuit current

$I_{cc}$   
value of the prospective short-circuit current, declared by the assembly manufacturer, that can be withstood for the total operating time (clearing time) of the SCPD under specified conditions

### 3.8.10.5 rated current of a main circuit

$I_{nc}$   
rated current which a main circuit can carry when it is the only main circuit within a section of an assembly that is carrying current

Note 1 to entry: The rated current of a main circuit can be lower than the rated currents of the devices installed in the main circuit, according to the respective device standards.

Note 2 to entry: Due to the complex factors determining the rated currents, no standard values can be given.

Note 3 to entry: An assembly can comprise of only a single section.

### 3.8.10.6 group rated current of a main circuit

$I_{ng}$   
rated current which a main circuit can carry considering the mutual thermal influences of the other circuits that are simultaneously loaded in the same section of the assembly

Note 1 to entry:  $I_{ng}$  can equal  $I_{nc}$  in some designs of assembly.

Note 2 to entry: An assembly can comprise only a single section.

### 3.8.10.7 rated current of an assembly

$I_{nA}$   
rated current which can be distributed by an assembly without the temperature-rise of any of the parts exceeding specified limits

Note 1 to entry: The rated current of the assembly is not to be exceeded if further circuits are added in the future.

### 3.8.10.8 design current (of an electric circuit)

$I_B$   
electric current intended to be carried by an electric circuit in normal operation

Note 1 to entry:  $I_B$  is normally provided by the user.

[SOURCE: IEC 60050-826:2004, 826-11-10, modified – Note 1 to entry has been added.]

### 3.8.11 rated diversity factor RDF

value, calculated by dividing the group rated current of an outgoing main circuit  $I_{ng}$  by the rated current  $I_{nc}$  of the same outgoing main circuit, where  $I_{ng}$  and  $I_{nc}$  are derived by test

Note 1 to entry: RDF therefore represents the per unit value of  $I_{nc}$ , to which two or more outgoing circuits in the same section of an assembly can be continuously and simultaneously loaded taking into account the mutual thermal influences.

Note 2 to entry: For a group of circuits that are continuously and simultaneously loaded, the rated current of a circuit ( $I_{nc}$ ) multiplied by the rated diversity factor (RDF) normally is not less than the design current ( $I_B$ ) of the circuit normally provided by the user i.e.  $I_{nc} \times RDF \geq I_B$ .

### **3.8.12** **rated frequency**

$f_n$   
value of frequency, declared by the assembly manufacturer, for which a circuit is designed and to which the operating conditions refer

Note 1 to entry: A circuit may be assigned a number or a range of rated frequencies or be rated for both AC and DC.

### **3.8.13** **electromagnetic compatibility** **EMC**

ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

Note 1 to entry: For EMC related terms and definitions see Annex J.

[SOURCE: IEC 60050-161:2018, 161-01-07, modified – Note 1 to entry has been added.]

## **3.9 Verification**

### **3.9.1** **design verification**

verification made on a sample of an assembly or on parts of assemblies to show that the design meets the requirements of the relevant assembly standard

Note 1 to entry: Design verification may comprise one or more equivalent methods. See 3.9.1.1, 3.9.1.2 and 3.9.1.3.

#### **3.9.1.1** **verification test**

test conducted on a sample of an assembly or on parts of assemblies to verify that the design meets the requirements of the relevant assembly standard

Note 1 to entry: Verification tests are equivalent to type tests as in the IEC 60439 series of standards.

#### **3.9.1.2** **verification comparison**

structured comparison of a proposed design for an assembly, or parts of an assembly, with a reference design(s) verified by test

#### **3.9.1.3** **verification assessment**

design verification using strict design rules and/or calculations applied to an assembly or to parts of assemblies to show that the design meets the requirements of the relevant assembly standard

#### **3.9.1.4** **reference design**

design of an assembly or parts of an assembly that has been verified by test

### **3.9.2**

#### **routine verification**

verification of each assembly performed during and/or after manufacture to confirm whether it complies with the requirements of the relevant assembly standard

### **3.9.3**

#### **inspection**

action comprising careful scrutiny, including visual scrutiny where conditions are obvious, of an item carried out either without dismantling, or with the addition of partial dismantling as required, supplemented by means such as measurement, in order to arrive at a reliable conclusion as to the condition of an item

[SOURCE: IEC 60050-426:2008, 426-14-02, modified – The definition has been modified.]

## **3.10 Manufacturer**

### **3.10.1**

#### **original manufacturer**

organization that has carried out the original design and the associated verification of an assembly in accordance with the relevant assembly standard

### **3.10.2**

#### **assembly manufacturer**

organization taking the responsibility for the completed assembly

Note 1 to entry: The assembly manufacturer can be the same or a different organization to the original manufacturer.

### **3.11**

#### **user**

party who will specify, purchase, use and/or operate the assembly, or someone acting on their behalf

## **4 Symbols and abbreviations**

Alphabetical list of terms with symbols and abbreviations together with the subclause where they are first used:

| Symbol/Abbreviation | Term                                                                               | Term number |
|---------------------|------------------------------------------------------------------------------------|-------------|
| CTI                 | comparative tracking index                                                         | 3.6.16      |
| EMC                 | electromagnetic compatibility                                                      | 3.8.13      |
| $f_n$               | rated frequency                                                                    | 3.8.12      |
| $I_c$               | short-circuit current                                                              | 3.8.6       |
| $I_{cc}$            | rated conditional short-circuit current of an assembly or a circuit of an assembly | 3.8.10.4    |
| $I_{lt}$            | cut-off current, let-through current                                               | 3.8.8       |
| $I_{cp}$            | prospective short-circuit current                                                  | 3.8.7       |
| $I_{cw}$            | rated short-time withstand current                                                 | 3.8.10.3    |
| $I_B$               | design current (of an electric circuit)                                            | 3.8.10.8    |
| $I_{nA}$            | rated current of an assembly                                                       | 3.8.10.7    |
| $I_{nc}$            | rated current of a main circuit                                                    | 3.8.10.5    |
| $I_{ng}$            | group rated current of a main circuit                                              | 3.8.10.6    |
| $I_{pk}$            | rated peak withstand current                                                       | 3.8.10.2    |
| L                   | line conductor                                                                     | 3.1.14      |
| M                   | mid-point conductor                                                                | 3.7.18      |
| N                   | neutral conductor                                                                  | 3.7.5       |
| PE                  | protective conductor                                                               | 3.7.4       |
| PEL                 | PEL conductor                                                                      | 3.7.20      |
| PEM                 | PEM conductor                                                                      | 3.7.19      |
| PELV                | protective extra low-voltage                                                       | 3.7.11      |
| PEN                 | PEN conductor                                                                      | 3.7.6       |
| RDF                 | rated diversity factor                                                             | 3.8.11      |
| SCPD                | short-circuit protective device                                                    | 3.1.11      |
| SELV                | safety extra low-voltage                                                           | 3.7.12      |
| SPD                 | surge protective device                                                            | 3.6.12      |
| $U_e$               | rated operational voltage                                                          | 3.8.9.2     |
| $U_i$               | rated insulation voltage                                                           | 3.8.9.3     |
| $U_{imp}$           | rated impulse withstand voltage                                                    | 3.8.9.4     |
| $U_n$               | rated voltage                                                                      | 3.8.9.1     |

## 5 Interface characteristics

### 5.1 General

The characteristics of the assembly shall ensure compatibility with the ratings of the circuits to which they are connected plus the installation conditions and shall be declared by the assembly manufacturer using the criteria identified in 5.2 to 5.6.

### 5.2 Voltage ratings

#### 5.2.1 Rated voltage ( $U_n$ ) (of the assembly)

The rated voltage shall be at least equal to the nominal voltage of the electrical system.

NOTE For further details on nominal system voltage see IEC 60038.

### 5.2.2 Rated operational voltage ( $U_e$ ) (of a circuit of an assembly)

The rated operational voltage of any circuit shall not be less than the nominal voltage of the electrical system to which it is to be connected. If the nominal voltage is given for a three-phase system, the rated operational voltage of single-phase circuits shall not be less than the nominal voltage divided by  $\sqrt{3}$ .

If different from the rated voltage of the assembly, the appropriate rated operational voltage of the circuit shall be stated.

### 5.2.3 Rated insulation voltage ( $U_i$ ) (of a circuit of an assembly)

The rated insulation voltage of a circuit of an assembly is the voltage value to which dielectric test voltages and creepage distances are referred.

The rated insulation voltage of a circuit shall be equal to or higher than the values stated for  $U_n$  and for  $U_e$  for the same circuit.

For single-phase circuits derived from IT systems (see IEC 60364-5-52:2009), the rated insulation voltage shall be at least equal to the voltage between the line conductors of the supply.

### 5.2.4 Rated impulse withstand voltage ( $U_{imp}$ ) (of the assembly)

The rated impulse voltage of an assembly is the voltage value to which clearance distances and solid insulation withstand to transient overvoltage are referred.

The rated impulse withstand voltage shall be equal to or higher than the values stated for the transient overvoltages occurring in the electrical system(s) to which the circuit is designed to be connected.

The preferred values of rated impulse withstand voltage are those given in Table G.1.

## 5.3 Current ratings

### 5.3.1 Rated current of an assembly ( $I_{nA}$ )

The rated current of an assembly is the lowest value of:

- the total group rated current  $I_{ng}$  of the incoming circuit(s), which is either the group rated current of the single incoming circuit or the sum of the group rated currents of the incoming circuits operated in parallel and simultaneously within the assembly;
- the total current that the main busbar can distribute in the particular assembly arrangement.

This current shall be carried without the temperature-rise of the individual parts exceeding the limits specified in 9.2.

NOTE 1 The group rated current of an incoming circuit can be lower than the rated current of the incoming device (according to the respective device standard) installed in the assembly.

NOTE 2 The main busbar in this context is a single busbar or a combination of single busbars that are normally connected in service e.g. by means of a bus-coupler.

### 5.3.2 Rated current of a main outgoing circuit ( $I_{nc}$ )

The rated current of a main outgoing circuit is the current that can be carried by the outgoing circuit when all other outgoing main circuits in the same section are not carrying current (see 10.10). This current shall be carried without the temperature-rise of the various parts of the assembly exceeding the limits specified in 9.2.

Declaration of the rated current of a circuit  $I_{nc}$  is voluntary if the group rated current  $I_{ng}$  of the circuit is declared. If  $I_{nc}$  is stated, the maximum permissible continuous load current on an individual circuit in a lightly loaded section can be assessed and the load on the individual circuit possibly allowed to exceed  $I_{ng}$ , but it is never allowed to exceed  $I_{nc}$ .

NOTE  $I_{ng}$  represents the maximum permissible continuous load current in a fully loaded section.

### 5.3.3 Group rated current of a main circuit ( $I_{ng}$ )

The group rated current of a main circuit is the current that can be carried by this circuit when it is loaded continuously and simultaneously together with at least one other circuit in the same assembly or section of the assembly, in a specific arrangement as defined by the original manufacturer. It shall be carried without the temperature-rise of the various parts of the assembly exceeding the limits specified in 9.2.

NOTE 1 Where the RDF for a design of assembly has been established in accordance with previous editions of IEC 61439 series, the  $I_{ng}$  can be calculated by  $I_{nc} \times \text{RDF}$ .

If  $I_{ng}$  is declared, the original manufacturer shall state the specific arrangements which are covered by the group rated current in terms of:

- type(s), ratings and maximum number of circuits/functional units allowed to be installed in the same assembly or section, and
- arrangement(s) of functional units within the sections and/or assemblies.

NOTE 2 For a functional unit with a given  $I_{ng}$ , the specific arrangement of assembly or section of an assembly can also be stated in terms of power loss.

NOTE 3 In most cases the same type of section provided by an original manufacturer can be equipped with a varying number and different types of circuits (functional units), depending on the needs of a specific customer. Usually, not all circuits installed in a section are required to carry their rated currents continuously and simultaneously. Therefore, the specific arrangement defined by the original manufacturer clarifies which situations are covered by a declared value of  $I_{ng}$ .

The group rated current of the main circuits, which are continuously and simultaneously loaded, shall be equal to or higher than the assumed loading of the outgoing circuits (equal to the design current  $I_B$  according to IEC 60364-1). The group rated current of the main circuits, which are continuously and simultaneously loaded, shall be equal to or higher than the assumed loading of the outgoing circuits (equal to the design current of the circuit,  $I_B$ , according to IEC 60364-1).

The assumed loading of outgoing circuits shall be addressed by the relevant assembly standard.

NOTE 4 The assumed loading of the outgoing circuits can be a steady continuous current or the thermal equivalent of a varying current (see Annex I).

$I_{ng}$  is obtained by a test according to 10.10.2.3.5 or 10.10.2.3.6 or 10.10.2.3.7, or by calculation according to 10.10.4. Using method 10.10.2.3.6 or 10.10.2.3.7,  $I_{ng}$  values are required to calculate the RDF.

An alternative to declaring  $I_{ng}$  for each type of main circuit is to declare  $I_{nc}$  for each type of main circuit and the appropriate RDF.

### 5.3.4 Rated peak withstand current ( $I_{pk}$ )

The rated peak withstand current shall be equal to or higher than the values stated for the peak value of the prospective short-circuit current of the supply system(s) to which the circuit(s) is (are) designed to be connected (see also 9.3.3).

### 5.3.5 Rated short-time withstand current ( $I_{cw}$ ) (of a main circuit of an assembly)

The rated short-time withstand current of a main circuit of an assembly shall be equal to or higher than the prospective value of the short-circuit current  $I_{cp}$  at each point of connection to the supply (see also 3.8.10.3).

Different values of  $I_{cw}$  for different durations (e.g. 0,2 s; 1 s; 3 s) may be assigned to an assembly. Maximum duration normally does not exceed 1 s.

For AC, the value of the current is the RMS value of the AC component. For DC, the value of the current is the arithmetic mean value.

### 5.3.6 Rated conditional short-circuit current ( $I_{cc}$ ) (of an assembly or a circuit of an assembly)

The rated conditional short-circuit current of an assembly or a circuit of an assembly, declared by the assembly manufacturer, is the maximum short-circuit current which that circuit when protected by a SCPD, as specified by the manufacturer, can satisfactorily withstand for the operating time of the device under the test conditions specified in 10.11.

The rated conditional short-circuit current of an assembly or a circuit of an assembly shall be equal to or higher than the prospective value of the short-circuit current  $I_{cp}$  for a duration limited by the operation of the short-circuit protective device that protects the circuit or assembly. The assembly manufacturer shall declare the breaking capacity, current limitation characteristics,  $I^2t$  and  $I_{lt}$ , of the specified short-circuit protective device, taking into consideration the data given by the device manufacturer.

## 5.4 Rated diversity factor (RDF)

As an alternative to declaring the group rated currents  $I_{ng}$  of each main outgoing circuit, their current carrying capacity under conditions of simultaneous operation can be stated in terms of the rated currents  $I_{nc}$  and the rated diversity factor.

The rated diversity factor is the per unit value of  $I_{nc}$ , to which outgoing circuits can be continuously and simultaneously loaded in the same section of the assembly in the specific arrangement(s) as defined by the original manufacturer, taking into account the mutual thermal influences. For further details on the specific arrangements, see 5.3.3.

NOTE 1 More information on RDF is given in Annex E.

The rated diversity factor multiplied by the rated current  $I_{nc}$  of the circuits shall be equal to or higher than the assumed loading of the outgoing circuits, where the assumed load current is equal to the design current  $I_B$  for continuously and simultaneously loaded circuits. If the design current  $I_B$  is not provided then the assumed loading of outgoing circuits shall be as given in the relevant assembly standard of IEC 61439 and is subject to agreement between user and manufacturer.

NOTE 2 The assumed loading of the outgoing circuits can be a steady continuous current or the thermal equivalent of a varying current (see Annex I).

## 5.5 Rated frequency ( $f_n$ )

The rated frequency of a circuit is the value of frequency to which the operating conditions are referred. Where the circuits of an assembly are designed for different values of frequency, the rated frequency of each circuit shall be given.

The frequency should be within the limits specified in the relevant IEC standards for the incorporated components. Unless otherwise stated by the assembly manufacturer, the limits are assumed to be 98 % and 102 % of the rated frequency.

## 5.6 Other characteristics

The following characteristics shall be declared:

- a) additional requirements depending on the use of a functional unit (e.g. type of coordination, overload characteristics);
- b) pollution degree of the macro-environment (see 3.6.10.2);
- c) types of earthing system for which the assembly is designed;
- d) indoor and/or outdoor installation (see 3.5.1 and 3.5.2);
- e) stationary or movable (see 3.5.3 and 3.5.4);
- f) degree of protection against contact with hazardous live parts, ingress of solid foreign bodies and water, IP code (see 8.2.2);
- g) intended for use by ordinary or authorized persons (see 3.7.16 and 3.7.17);
- h) electromagnetic compatibility (EMC) classification (see Annex J);
- i) special service conditions, if applicable (see 7.2);
- j) external design (see 3.3);
- k) degree of protection against mechanical impact, IK code, if applicable (see 8.2.1);
- l) type of construction – fixed or removable parts (see 8.5.1 and 8.5.2);
- m) type of short-circuit protective device(s) (see 9.3.2);
- n) measures for protection against electric shock;
- o) overall dimensions (including projections e.g. handles, covers, doors), if required;
- p) weight, if required.

## 6 Information

### 6.1 Assembly designation marking

The assembly manufacturer shall provide each assembly with one or more labels, marked in a durable manner and located in a place such that they are visible and legible when the assembly is installed and in operation. Compliance is checked according to the test of 10.2.7 and by inspection.

The following information regarding the assembly shall be provided on the designation label(s):

- a) assembly manufacturer's name or trade mark (see 3.10.2);
- b) type designation or identification number or any other means of identification, making it possible to obtain relevant information from the assembly manufacturer;
- c) means of identifying date of manufacture;
- d) rated current of the assembly  $I_{nA}$  (see 3.8.10.7 and 5.3.1);
- e) rated voltage of the assembly  $U_n$  (see 3.8.9.1 and 5.2.1);
- f) rated frequency of the assembly  $f_n$  (see 3.8.12 and 5.5);
- g) IEC 61439-X (the specific part "X" shall be identified).

NOTE The relevant assembly standard can specify where additional information is to be provided on the designation label.

### 6.2 Documentation

#### 6.2.1 Information relating to the assembly

All interface characteristics according to Clause 5, where applicable, shall be provided in the assembly manufacturer's technical documentation supplied with the assembly.