IEC 61439-1

Edition 2.0 2011-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Low-voltage switchgear and controlgear assemblies – Part 1: General rules

Ensembles d'appareillage à basse tension – Partie 1: Règles générales

IEC 61439-1:2011

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2011 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.
If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.
Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub
The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.
- IEC Just Published: www.iec.ch/online_news/justpub
Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.
- Electropedia: www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.
- Customer Service Centre: www.iec.ch/webstore/custserv
If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:
Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm
Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,…). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.
- Just Published CEI: www.iec.ch/online_news/justpub
Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.
- Electropedia: www.electropedia.org
Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.
- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:
Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

IEC 61439-1

Edition 2.0 2011-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Low-voltage switchgear and controlgear assemblies – Part 1: General rules

Ensembles d'appareillage à basse tension – Partie 1: Règles générales

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX XG

ICS 29.130.20

ISBN 978-2-88912-634-7

® Registered trademark of the International Electrotechnical Commission
Marque déposée de la Commission Electrotechnique Internationale

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

CONTENTS

FOREWORD 8
INTRODUCTION 11
1 Scope 12
2 Normative references 12
3 Terms and definitions 15
3.1 General terms 15
3.2 Constructional units of ASSEMBLIES 17
3.3 External design of ASSEMBLIES 18
3.4 Structural parts of ASSEMBLIES 18
3.5 Conditions of installation of ASSEMBLIES 20
3.6 Insulation characteristics 20
3.7 Protection against electric shock 23
3.8 Characteristics 25
3.9 Verification 27
3.10 Manufacturer/user 28
4 Symbols and abbreviations 28
5 Interface characteristics 29
5.1 General 29
5.2 Voltage ratings 29
5.2.1 Rated voltage (U_n) (of the ASSEMBLY) 29
5.2.2 Rated operational voltage (U_e) (of a circuit of an ASSEMBLY) 29
5.2.3 Rated insulation voltage (U_i) (of a circuit of an ASSEMBLY) 29
5.2.4 Rated impulse withstand voltage (U_{imp}) (of the ASSEMBLY) 29
5.3 Current ratings 30
5.3.1 Rated current of the ASSEMBLY (I_{nA}) 30
5.3.2 Rated current of a circuit (I_{nc}) 30
5.3.3 Rated peak withstand current (I_{pk}) 30
5.3.4 Rated short-time withstand current (I_{cw}) (of a circuit of an ASSEMBLY) 30
5.3.5 Rated conditional short-circuit current of an ASSEMBLY (I_{cc}) 30
5.4 Rated diversity factor (RDF) 31
5.5 Rated frequency (f_n) 31
5.6 Other characteristics 31
6 Information 32
6.1 ASSEMBLY designation marking 32
6.2 Documentation 32
6.2.1 Information relating to the ASSEMBLY 32
6.2.2 Instructions for handling, installation, operation and maintenance 32
6.3 Device and/or component identification 33
7 Service conditions 33
7.1 Normal service conditions 33
7.1.1 Ambient air temperature 33
7.1.2 Humidity conditions 33
7.1.3 Pollution degree 33
7.1.4 Altitude 34
7.2 Special service conditions 34
7.3 Conditions during transport, storage and installation 34

AVA Documents
Document Sharing Hub

8 Constructional requirements 35
8.1 Strength of materials and parts 35
8.1.1 General 35
8.1.2 Protection against corrosion 35
8.1.3 Properties of insulating materials 35
8.1.4 Resistance to ultra-violet radiation 36
8.1.5 Mechanical strength 36
8.1.6 Lifting provision 36
8.2 Degree of protection provided by an ASSEMBLY enclosure 36
8.2.1 Protection against mechanical impact 36
8.2.2 Protection against contact with live parts, ingress of solid foreign bodies and water 36
8.2.3 ASSEMBLY with removable parts 37
8.3 Clearances and creepage distances 37
8.3.1 General 37
8.3.2 Clearances 38
8.3.3 Creepage distances 38
8.4 Protection against electric shock 39
8.4.1 General 39
8.4.2 Basic protection 39
8.4.3 Fault protection 40
8.4.4 Protection by total insulation 42
8.4.5 Limitation of steady-state touch current and charge 43
8.4.6 Operating and servicing conditions 43
8.5 Incorporation of switching devices and components 45
8.5.1 Fixed parts 45
8.5.2 Removable parts 45
8.5.3 Selection of switching devices and components 46
8.5.4 Installation of switching devices and components 46
8.5.5 Accessibility 46
8.5.6 Barriers 47
8.5.7 Direction of operation and indication of switching positions 47
8.5.8 Indicator lights and push-buttons 47
8.6 Internal electrical circuits and connections 47
8.6.1 Main circuits 47
8.6.2 Auxiliary circuits 48
8.6.3 Bare and insulated conductors 48
8.6.4 Selection and installation of non-protected live conductors to reduce the possibility of short-circuits 49
8.6.5 Identification of the conductors of main and auxiliary circuits 49
8.6.6 Identification of the protective conductor (PE, PEN) and of the neutral conductor (N) of the main circuits 49
8.7 Cooling 49
8.8 Terminals for external conductors 49
9 Performance requirements 51
9.1 Dielectric properties 51
9.1.1 General 51
9.1.2 Power-frequency withstand voltage 51
9.1.3 Impulse withstand voltage 51

AVA Documents
Document Sharing Hub

9.1.4 Protection of surge protective devices ... 51
9.2 Temperature rise limits ... 52
9.3 Short-circuit protection and short-circuit withstand strength ... 52
9.3.1 General ... 52
9.3.2 Information concerning short-circuit withstand strength ... 52
9.3.3 Relationship between peak current and short-time current ... 53
9.3.4 Co-ordination of protective devices ... 53
9.4 Electromagnetic compatibility (EMC) ... 53
10 Design verification ... 54
10.1 General ... 54
10.2 Strength of materials and parts ... 55
10.2.1 General ... 55
10.2.2 Resistance to corrosion ... 55
10.2.3 Properties of insulating materials ... 56
10.2.4 Resistance to ultra-violet (UV) radiation ... 58
10.2.5 Lifting ... 58
10.2.6 Mechanical impact ... 59
10.2.7 Marking ... 59
10.3 Degree of protection of ASSEMBLIES ... 59
10.4 Clearances and creepage distances ... 59
10.5 Protection against electric shock and integrity of protective circuits ... 60
10.5.1 Effectiveness of the protective circuit ... 60
10.5.2 Effective earth continuity between the exposed conductive parts of the ASSEMBLY and the protective circuit ... 60
10.5.3 Short-circuit withstand strength of the protective circuit ... 60
10.6 Incorporation of switching devices and components ... 61
10.6.1 General ... 61
10.6.2 Electromagnetic compatibility ... 61
10.7 Internal electrical circuits and connections ... 61
10.8 Terminals for external conductors ... 61
10.9 Dielectric properties ... 61
10.9.1 General ... 61
10.9.2 Power-frequency withstand voltage ... 61
10.9.3 Impulse withstand voltage ... 62
10.9.4 Testing of enclosures made of insulating material ... 64
10.9.5 External operating handles of insulating material ... 64
10.10 Verification of temperature rise ... 64
10.10.1 General ... 64
10.10.2 Verification by testing ... 64
10.10.3 Derivation of ratings for similar variants ... 70
10.10.4 Verification assessment ... 71
10.11 Short-circuit withstand strength ... 74
10.11.1 General ... 74
10.11.2 Circuits of ASSEMBLIES which are exempted from the verification of the short-circuit withstand strength ... 74
10.11.3 Verification by comparison with a reference design – Utilising a check list ... 75
10.11.4 Verification by comparison with a reference design – Utilising calculation ... 75
10.11.5 Verification by test ... 75

AVA Documents
Document Sharing Hub
Full document details: IEC 61439 1 ed 2.0 2011 (2)

10.12 Electromagnetic compatibility (EMC) 80
10.13 Mechanical operation 80
11 Routine verification 80
11.1 General 80
11.2 Degree of protection of enclosures 81
11.3 Clearances and creepage distances 81
11.4 Protection against electric shock and integrity of protective circuits 81
11.5 Incorporation of built-in components 81
11.6 Internal electrical circuits and connections 81
11.7 Terminals for external conductors 81
11.8 Mechanical operation 82
11.9 Dielectric properties 82
11.10 Wiring, operational performance and function 82
Annex A (normative) Minimum and maximum cross-section of copper conductors suitable for connection to terminals for external conductors (see 8.8) 90
Annex B (normative) Method of calculating the cross-sectional area of protective conductors with regard to thermal stresses due to currents of short duration 91
Annex C (informative) User information template 92
Annex D (informative) Design verification 96
Annex E (informative) Rated diversity factor 97
Annex F (normative) Measurement of clearances and creepage distances 106
Annex G (normative) Correlation between the nominal voltage of the supply system and the rated impulse withstand voltage of the equipment 111
Annex H (informative) Operating current and power loss of copper conductors 113
Annex I (Void) 115
Annex J (normative) Electromagnetic compatibility (EMC) 116
Annex K (normative) Protection by electrical separation 123
Annex L (informative) Clearances and creepage distances for North American region 126
Annex M (informative) North American temperature rise limits 127
Annex N (normative) Operating current and power loss of bare copper bars 128
Annex O (informative) Guidance on temperature rise verification 130
Annex P (normative) Verification of the short-circuit withstand strength of busbar structures by comparison with a tested reference design by calculation 135
Bibliography 139

Figure E.1 – Typical ASSEMBLY 98
Figure E.2 – Example 1: Table E.1 – Functional unit loading for an ASSEMBLY with a rated diversity factor of 0,8 100
Figure E.3 – Example 2: Table E.1 – Functional unit loading for an ASSEMBLY with a rated diversity factor of 0,8 101
Figure E.4 – Example 3: Table E.1 – Functional unit loading for an ASSEMBLY with a rated diversity factor of 0,8 102
Figure E.5 – Example 4: Table E.1 – Functional unit loading for an ASSEMBLY with a rated diversity factor of 0,8 103
Figure E.6 – Example of average heating effect calculation 104
Figure E.7 – Example graph for the relation between the equivalent RDF and the parameters at intermittent duty at t_1 = 0,5 s, I_1 = 7*I_2 at different cycle times 105

AVA Documents
Document Sharing Hub

Figure E.8 – Example graph for the relation between the equivalent RDF and the parameters at intermittent duty at $I_1 = I_2$ (no starting overcurrent) 105
Figure F.1 – Measurement of ribs 110
Figure J.1 – Examples of ports 116
Figure O.1 – Temperature rise verification methods 134
Figure P.1 – Tested busbar structure (TS) 135
Figure P.2 – Non tested busbar structure (NTS) 136
Figure P.3 – Angular busbar configuration with supports at the corners 138

Table 1 – Minimum clearances in air [a] (8.3.2) 82
Table 2 – Minimum creepage distances (8.3.3) 83
Table 3 – Cross-sectional area of a copper protective conductor (8.4.3.2.2) 83
Table 4 – Conductor selection and installation requirements (8.6.4) 84
Table 5 – Minimum terminal capacity for copper protective conductors (PE, PEN) (8.8) 84
Table 6 – Temperature-rise limits (9.2) 85
Table 7 – Values for the factor n [a] (9.3.3) 86
Table 8 – Power-frequency withstand voltage for main circuits (10.9.2) 86
Table 9 – Power-frequency withstand voltage for auxiliary and control circuits (10.9.2) 86
Table 10 – Impulse withstand test voltages (10.9.3) 87
Table 11 – Copper test conductors for rated currents up to 400 A inclusive (10.10.2.3.2) 87
Table 12 – Copper test conductors for rated currents from 400 A to 4 000 A (10.10.2.3.2) 88
Table 13 – Short-circuit verification by comparison with a reference design: check list (10.5.3.3, 10.11.3 and 10.11.4) 88
Table 14 – Relationship between prospective fault current and diameter of copper wire 89
Table A.1 – Cross-section of copper conductors suitable for connection to terminals for external conductors 90
Table B.1 – Values of k for insulated protective conductors not incorporated in cables, or bare protective conductors in contact with cable covering 91
Table C.1 – Template 92
Table D.1 – List of design verifications to be performed 96
Table E.1 – Examples of loading for an ASSEMBLY with a rated diversity factor of 0,8 99
Table E.2 – Example of loading of a group of circuits (Section B – Figure E.1) with a rated diversity factor of 0,9 104
Table E.3 – Example of loading of a group of circuits (Sub-distribution board – Figure E.1) with a rated diversity factor of 0,9 104
Table F.1 – Minimum width of grooves 106
Table G.1 – Correspondence between the nominal voltage of the supply system and the equipment rated impulse withstand voltage 112
Table H.1 – Operating current and power loss of single-core copper cables with a permissible conductor temperature of 70 °C (ambient temperature inside the ASSEMBLY: 55 °C) 113
Table H.2 – Reduction factor k_1 for cables with a permissible conductor temperature of 70 °C (extract from IEC 60364-5-52:2009, Table B.52.14) 114
Table J.1 – Tests for EMC immunity for environment A (see J.10.12.1) 120
Table J.2 – Tests for EMC immunity for environment B (see J.10.12.1) 121

AVA Documents
Document Sharing Hub
Full document details: IEC 61439 1 ed 2.0 2011 (2)

Table J.3 – Acceptance criteria when electromagnetic disturbances are present 122
Table K.1 – Maximum disconnecting times for TN systems 125
Table L.1 – Minimum clearances in air 126
Table L.2 – Minimum creepage distances 126
Table M.1 – North American temperature rise limits 127
Table N.1 – Operating current and power loss of bare copper bars with rectangular cross-section, run horizontally and arranged with their largest face vertical, frequency 50 Hz to 60 Hz (ambient temperature inside the ASSEMBLY: 55 °C, temperature of the conductor 70 °C) 128
Table N.2 – Factor k_4 for different temperatures of the air inside the ASSEMBLY and/or for the conductors 129

Documents
Document Sharing Hub
Full document details: IEC 61439 1 ed 2.0 2011 (2)

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61439-1 has been prepared by subcommittee 17D: Low-voltage switchgear and controlgear assemblies, of IEC technical committee 17: Switchgear and controlgear.

This second edition cancels and replaces the first edition published in 2009. It constitutes a technical revision.

This second edition includes the following significant technical changes with respect to the last edition of IEC 61439-1:

- revision of service conditions in Clause 7;
- numerous changes regarding verification methods in Clause 10;
- modification of routine verification in respect of clearances and creepage distances (see 11.3);

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

- adaption of the tables in Annex C and Annex D to the revised requirements and verification methods;
- revision of the EMC requirements in Annex J;
- shifting of tables from Annex H to new Annex N;
- new Annex O with guidance on temperature rise verification;
- new Annex P with a verification method for short-circuit withstand strength (integration of the content of IEC/TR 61117);
- update of normative references;
- general editorial review.

NOTE It should be noted that when a dated reference to IEC 60439-1 is made in another Part of the IEC 60439 series of assembly standards not yet transferred into the new IEC 61439 series, the superseded IEC 60439-1 still applies (see also the Introduction below).

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

FDIS	Report on voting
17D/441/FDIS	17D/446/RVD

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

In this standard, terms written in small capitals are defined in Clause 3.

The “in some countries” notes regarding differing national practices are contained in the following subclauses:

5.4
8.2.2
8.3.2
8.3.3
8.4.2.3
8.5.5
8.6.6
8.8
9.2
10.11.5.4
10.11.5.6.1
Annex L
Annex M

This publication 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.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

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

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

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

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

INTRODUCTION

The purpose of this standard is to harmonize as far as practicable all rules and requirements of a general nature applicable to low-voltage switchgear and controlgear assemblies (ASSEMBLIES) in order to obtain uniformity of requirements and verification for ASSEMBLIES and to avoid the need for verification to other standards. All those requirements for the various ASSEMBLIES standards which can be considered as general have therefore been gathered in this basic standard 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:

– this basic standard referred to as “Part 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 the relevant clause or sub-clause number of this standard followed by “Part 1” e.g. “9.1.3 of Part 1”.

A specific ASSEMBLY standard may not require and hence need not call up a general rule where it is not applicable, or it may 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 standard 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 standard that are subject to agreement between the ASSEMBLY manufacturer and the user are summarised 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 new re-structured IEC 61439 series, the following parts are envisaged:

a) IEC 61439-1: General rules
b) IEC 61439-2: Power switchgear and controlgear ASSEMBLIES (PSC-ASSEMBLIES)
c) IEC 61439-3: Distribution boards (to supersede IEC 60439-3)
d) IEC 61439-4: ASSEMBLIES for construction sites (to supersede IEC 60439-4)
e) IEC 61439-5: ASSEMBLIES for power distribution (to supersede IEC 60439-5)
f) IEC 61439-6: Busbar trunking systems (to supersede IEC 60439-2)
g) IEC/TR 61439-0: Guidance to specifying ASSEMBLIES.

This list is not exhaustive; additional Parts may be developed as the need arises.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –

Part 1: General rules

1 Scope

NOTE 1 Throughout this standard, the term ASSEMBLY (see 3.1.1) is used for a low-voltage switchgear and controlgear assembly.

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

This standard cannot be used alone to specify an ASSEMBLY or used for a purpose of determining conformity. ASSEMBLIES shall comply with the relevant part of the IEC 61439 series; Parts 2 onwards.

This standard applies to low-voltage switchgear and controlgear assemblies (ASSEMBLIES) only when required by the relevant ASSEMBLY standard as follows:

- ASSEMBLIES for which the rated voltage does not exceed 1 000 V in case of a.c. or 1 500 V in case of d.c.;
- stationary or movable ASSEMBLIES with or without enclosure;
- ASSEMBLIES intended for use in connection with the generation, transmission, distribution and conversion of electric energy, and for the control of electric energy consuming equipment;
- ASSEMBLIES designed for use under special service conditions, for example in ships and in rail vehicles provided that the other relevant specific requirements are complied with;

  NOTE 2 Supplementary requirements for ASSEMBLIES in ships are covered by IEC 60092-302.
- ASSEMBLIES designed for electrical equipment of machines provided that the other relevant specific requirements are complied with.

  NOTE 3 Supplementary requirements for ASSEMBLIES forming part of a machine are covered by the IEC 60204 series.

This standard applies to all ASSEMBLIES whether they are designed, manufactured and verified on a one-off basis or fully standardised and manufactured in quantity.

The manufacture and/or assembly may be carried out other than by the original manufacturer (see 3.10.1).

This standard does not apply to individual devices and self-contained components, such as motor starters, fuse switches, electronic equipment, etc. which will comply with the relevant product standards.

2 Normative references

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

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

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 + 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 60216 (all parts), *Electrical insulating materials – Properties of thermal endurance*

IEC 60227-3:1993, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 3: Non-sheathed cables for fixed wiring*

IEC 60245-3:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 3: Heat resistant silicone insulated cables*

IEC 60245-4:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

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 60364-4-44:2007, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

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

IEC 60364-5-53:2001, *Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control*

IEC 60364-5-54:2011, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

IEC 60439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 60445:2010, *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)*[1]

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

---

[1] There is a consolidated edition 1.1 (2001) that includes IEC 60529 (1989) and its amendment 1 (1999).

AVA Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

IEC 60695-2-10:2000, *Fire Hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60695-11-5:2004, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60865-1:1993, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*

IEC 60890:1987, *A method of temperature-rise assessment by extrapolation for partially type-tested assemblies (PTTA) of low-voltage switchgear and controlgear*

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*

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*[2]

IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2005, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6:2008, *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 61000-4-13:2002, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low-frequency immunity tests*[3]

IEC 61000-6-4:2006, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*[4]

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

IEC 61180 (all parts), *High-voltage test techniques for low-voltage equipment*

---

2 There is a consolidated edition 3.2 (2010) that includes IEC 61000-4-3 (2006) and amendment 1 (2007) and amendment 2 (2010).

3 There is a consolidated edition 1.1 (2009) that includes IEC 61000-4-13 (2002) and its amendment 1 (2009).

4 There is a consolidated edition 2.1 (2011) that includes IEC 61000-6-4 (2006) and its amendment 1 (2010).

Documents
Document Sharing Hub

IEC/TS 61201:2007, *Use of conventional touch voltage limits – Application guide*

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

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

IEC 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

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

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

CISPR 11:2009, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*[5]

CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

ISO 178:2001, *Plastics – Determination of flexural properties*

ISO 179 (all parts), *Plastics – Determination of Charpy impact strength*

ISO 2409:2007, *Paints and varnishes – Cross-cut test*

ISO 4628-3:2003, *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 4892-2:2006, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

3 Terms and definitions

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

3.1 General terms

3.1.1
low-voltage switchgear and controlgear assembly
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

3.1.2
ASSEMBLY system
full range of mechanical and electrical components (enclosures, busbars, functional units, 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

[5] There is a consolidated edition 5.1 (2010) that includes CISPR 11 (2009) and its amendment 1 (2010).

Documents
Document Sharing Hub

3.1.3
main circuit (of an ASSEMBLY)
all the conductive parts of an ASSEMBLY included in a circuit which is intended to transmit electrical energy

[IEC 60050-441:1984, 441-13-02]

3.1.4
auxiliary circuit (of an ASSEMBLY)
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 The auxiliary circuits of an ASSEMBLY include the control and the auxiliary circuits of the switching devices.

[IEC 60050-441:1984, 441-13-03, modified]

3.1.5
busbar
low-impedance conductor to which several electric circuits can be separately connected

NOTE The term "busbar" does not presuppose the geometrical shape, size or dimensions of the conductor.

3.1.6
main busbar
busbar to which one or several distribution busbars and/or incoming and outgoing units can be connected

3.1.7
distribution busbar
busbar within one section which is connected to a main busbar and from which outgoing units are supplied

NOTE Conductors that are connected between a functional unit and a 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 Conductors which are connected to a functional unit but which are external to its compartment or enclosed protected space (e.g. auxiliary cables connected to 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

[2.2.21 of IEC 60947-1:2007]

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

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 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 is connected or 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 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

[IEC 60050-441:1984, 441-13-07, modified]

AVA Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

3.3 External design of ASSEMBLIES

3.3.1
open-type ASSEMBLY
ASSEMBLY consisting of a 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; live parts may be 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, which incorporates control, measuring, 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

3.4 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

AVA Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

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

[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 It is not normally removed after the equipment is put into service.

NOTE 2 The cover plate can be provided with cable entries.

3.4.10
partition
part of the enclosure of a compartment separating it from other compartments

3.4.11
barrier
part providing protection against direct contact from any usual direction of access

[IEC 60050-195:1998, 195-06-15, modified]

3.4.12
obstacle
part preventing unintentional direct contact, but not preventing direct contact by deliberate action

[IEC 60050-195:1998, 195-06-16, modified]

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

NOTE 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 or instructed persons but are not intended to protect ordinary persons.

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
enclosed 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 which is designed for use in locations where the normal service conditions for indoor use as specified in 7.1 are fulfilled

3.5.2
ASSEMBLY for outdoor installation
ASSEMBLY which is designed for use in locations where the normal service conditions for outdoor use as specified in 7.1 are fulfilled

3.5.3
stationary ASSEMBLY
ASSEMBLY which 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
the distance between two conductive parts along a string stretched the shortest way between these conductive parts

[IEC 60050-441:1984, 441-17-31]

3.6.2
creepage distance
the shortest distance along the surface of a solid insulating material between two conductive parts

[IEC 60050-151:2001, 151-15-50]

NOTE A joint between two pieces of insulating material is considered part of the surface.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

3.6.3
overvoltage
any voltage having a peak value exceeding the corresponding peak value of the maximum steady-state voltage at normal operating conditions

[definition 3.7 of IEC 60664-1:2007]

3.6.4
temporary overvoltage
overvoltage at power frequency of relatively long duration (several seconds)

[definition 3.7.1 of IEC 60664-1:2007, modified]

3.6.5
transient overvoltage
short duration overvoltage of a few milliseconds or less, oscillatory or non-oscillatory, usually highly damped

[IEC 60050-604:1987, 604-03-13]

3.6.6
power-frequency withstand voltage
r.m.s. value of a power-frequency sinusoidal voltage which does not cause breakdown under specified conditions of test

[definition 2.5.56 of IEC 60947-1: 2007]

NOTE The power-frequency withstand voltage is equivalent to the short-term temporary overvoltage in IEC 60664-1.

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

[definition 3.8.1 of IEC 60664-1: 2007]

3.6.8
pollution
any addition of solid, liquid or gaseous foreign matter, that can result in a reduction of the dielectric strength or surface resistivity of insulation

[definition 3.11 of IEC 60664-1: 2007, modified]

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 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 devices or components are located because of protection offered by means such as an enclosure or internal heating to prevent absorption or condensation of moisture.

NOTE 2 For the purpose of this standard, the pollution degree is of the micro-environment.

[definition 2.5.58 of IEC 60947-1: 2007]

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

3.6.10
micro-environment (of a clearance or creepage distance)
immediate environment of the insulation which particularly influences the dimensioning of the creepage distances

NOTE The micro-environment of the creepage distance or clearance and not the environment of the ASSEMBLY or components determines the effect on the insulation. The micro-environment may be better or worse than the environment of the ASSEMBLY or components.

[definition 3.12.2 of IEC 60664-1:2007, modified]

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 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.

[definition 2.5.60 of IEC 60947-1: 2007]

3.6.12
surge arrester
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

[definition 2.2.22 of IEC 60947-1: 2007]

3.6.13
insulation co-ordination
correlation of insulating characteristics of electrical equipment with the expected overvoltages and the characteristics of overvoltage protective devices on the one hand, and with the expected micro-environment and the pollution protective means on the other hand

[definition 2.5.61 of IEC 60947-1: 2007, modified]

3.6.14
inhomogeneous (non-uniform) field
electric field which has not an essentially constant voltage gradient between electrodes

[definition 2.5.63 of IEC 60947-1: 2007]

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

[definition 2.5.64 of IEC 60947-1: 2007]

3.6.16
comparative tracking index
CTI
numerical value of the maximum voltage in volts at which a material withstands 50 drops of a defined test liquid without tracking

NOTE The value of each test voltage and the CTI should be divisible by 25.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

[definition 2.5.65 of IEC 60947-1: 2007, modified]

3.6.17
disruptive discharge
phenomena 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 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 The term "sparkover" is used when a disruptive discharge occurs in a gaseous or liquid dielectric.

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

NOTE 4 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
conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention not a PEN conductor

NOTE This term does not necessarily imply a risk of electric shock.

[IEC 60050-195:1998, 195-02-19, modified]

3.7.2
hazardous live part
live part which, under certain conditions, can give a harmful electric shock

[IEC 60050-195:1998, 195-06-05]

3.7.3
exposed conductive part
conductive part of the ASSEMBLY, which can be touched and which is not normally live, but which may become a hazardous live part under fault conditions

[IEC 60050-826:2004, 826-12-10, modified]

3.7.4
protective conductor
(identification: PE)
conductor provided for purposes of safety, for example protection against electric shock

[IEC 60050-826:2004, 826-13-22]

NOTE 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.

3.7.5
neutral conductor
N
conductor electrically connected to the neutral point and capable of contributing to the distribution of electric energy

AVA Documents
Document Sharing Hub

[IEC 60050-195:1998, 195-02-06, modified]

3.7.6
PEN conductor
conductor combining the functions of both a protective earthing conductor and a neutral conductor

[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

[IEC 60050-195:1998, 195-06-01]

NOTE Basic protection is intended to prevent contact with live parts and generally corresponds to protection against direct contact.

3.7.9
basic insulation
insulation of hazardous live parts, which provide basic protection

[IEC 60050-195:1998, 195-06-06]

NOTE This concept does not apply to insulation used exclusively for functional purposes.

3.7.10
fault protection
protection against electric shock under single-fault conditions (e.g. failure of basic insulation)

[IEC 60050-195:1998, 195-06-02, modified]

NOTE Fault protection generally corresponds to protection against indirect contact, mainly with regard to failure of basic insulation.

3.7.11
extra-low voltage
ELV
any voltage not exceeding the relevant voltage limit specified in IEC 61201

3.7.12
skilled person
person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create

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

3.7.13
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

[IEC 60050-826:2004, 826-18-02]

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

3.7.14
ordinary person
person who is neither a skilled person nor an instructed person

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

3.7.15
authorized person
skilled or instructed person, who is empowered to execute defined work

3.8 Characteristics

3.8.1
nominal value
value of a quantity used to designate and identify a component, device, equipment or system

NOTE The nominal value is generally a rounded value.

[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

[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

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

3.8.4
rating
set of rated values and operating conditions

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

3.8.5
nominal voltage (of an electrical system)
approximate value of voltage used to designate or identify an electrical system

[IEC 60050-601:1985, 601-01-21 modified]

3.8.6
short-circuit current
I_c
over-current resulting from a short circuit due to a fault or an incorrect connection in an electric circuit

[IEC 60050-441:1984, 441-11-07]

3.8.7
prospective short-circuit current
I_{cp}
r.m.s. value of the 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 (see 10.11.5.4)

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

3.8.8
cut-off current
let-through current
maximum instantaneous value of current attained during the breaking operation of a switching device or a fuse

NOTE 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.

[IEC 60050-441:1984, 441-17-12]

3.8.9
voltage ratings

3.8.9.1
rated voltage
U_n
highest nominal voltage of the electrical system, a.c. (r.m.s.) or d.c., declared by the ASSEMBLY manufacturer, to which the main circuit(s) of the ASSEMBLY is (are) designed to be connected

NOTE 1 In polyphase circuits, it is the voltage between phases.

NOTE 2 Transients are disregarded.

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

3.8.9.2
rated operational voltage (of a circuit of an ASSEMBLY)
U_e
value of voltage, declared by the ASSEMBLY manufacturer, which combined with the rated current determines its application

NOTE In polyphase circuits, it is the voltage between phases.

3.8.9.3
rated insulation voltage
U_i
r.m.s withstand voltage value, assigned by the ASSEMBLY manufacturer to the equipment or to a part of it, characterising the specified (long-term) withstand capability of the insulation

[definition 3.9.1 of IEC 60664-1: 2007, modified]

NOTE 1 In polyphase circuits, it is the voltage between phases.

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

3.8.9.4
rated impulse withstand voltage
U_{imp}
impulse withstand voltage value, declared by the ASSEMBLY manufacturer, characterising the specified withstand capability of the insulation against transient overvoltages

[definition 3.9.2 of IEC 60664-1: 2007, modified]

Documents
Document Sharing Hub
Full document details: IEC 61439 1 ed 2.0 2011 (2)

3.8.10
current ratings

3.8.10.1
rated current
value of 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 For rated current of the ASSEMBLY (I_{nA}) see 5.3.1, and for rated current of a circuit (I_{nc}) see 5.3.2.

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}
r.m.s value of short-time current, declared by the ASSEMBLY manufacturer, that can be withstood under specified conditions, defined in terms of a current and time

3.8.10.4
rated conditional short-circuit current
I_{cc}
value of prospective short-circuit current, declared by the ASSEMBLY manufacturer, that can be withstood for the total operating time (clearing time) of the short-circuit protective device (SCPD) under specified conditions

NOTE The short-circuit protective device may form an integral part of the ASSEMBLY or may be a separate unit.

3.8.11
rated diversity factor
RDF
per unit value of the rated current, assigned by the ASSEMBLY manufacturer, to which outgoing circuits of an ASSEMBLY can be continuously and simultaneously loaded taking into account the mutual thermal influences

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 A circuit may be assigned a number or a range of rated frequencies or be rated for both a.c. and d.c.

3.8.13
electromagnetic compatibility
EMC

NOTE For EMC related terms and definitions, see J.3.8.13.1 to J.3.8.13.5 of Annex J.

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 Design verification may comprise one or more equivalent methods see 3.9.1.1, 3.9.1.2 and 3.9.1.3

AVA Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

3.9.1.1
verification test
test made 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 Verification tests are equivalent to type tests.

3.9.1.2
verification comparison
structured comparison of a proposed design for an ASSEMBLY, or parts of an ASSEMBLY, with a reference design verified by test

3.9.1.3
verification assessment
design verification of strict design rules or calculations applied to a sample of an ASSEMBLY or to parts of ASSEMBLIES to show that the design meets the requirements of the relevant ASSEMBLY standard

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

3.10 Manufacturer/user

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 The ASSEMBLY manufacturer may be a different organisation to the original manufacturer.

3.10.3
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	Subclause
CTI	comparative tracking index	3.6.17
ELV	extra-low voltage	3.7.11
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	3.8.10.4
I_{cp}	prospective short-circuit current	3.8.7
I_{cw}	rated short-time withstand current	3.8.10.3
I_{nA}	rated current of the ASSEMBLY	5.3.1

AVA Documents
Document Sharing Hub
Full document details: IEC 61439 1 ed 2.0 2011 (2)

Symbol/Abbreviation	Term	Subclause
I_{nc}	rated current of a circuit	5.3.2
I_{pk}	rated peak withstand current	3.8.10.2
N	neutral conductor	3.7.5
PE	protective conductor	3.7.4
PEN	PEN conductor	3.7.6
RDF	rated diversity factor	3.8.11
SCPD	short-circuit protective device	3.1.11
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 it is connected and 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.

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 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 or higher than the values stated for U_n and for U_e for the same circuit.

NOTE For single-phase circuits derived from IT systems (see IEC 60364-5-52), the rated insulation voltage should be at least equal to the voltage between phases of the supply.

5.2.4 Rated impulse withstand voltage (U_{imp}) (of the ASSEMBLY)

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.

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

AVA Documents Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

5.3 Current ratings

5.3.1 Rated current of the ASSEMBLY (I_{nA})

The rated current of the ASSEMBLY is the smaller of:

– the sum of the rated currents of the incoming circuits within the ASSEMBLY operated in parallel;

– the total current which the main busbar is capable of distributing 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 rated current of an incoming circuit may 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.

NOTE 3 The rated current of the ASSEMBLY is the maximum permissible load current which can be distributed by the ASSEMBLY and which cannot be exceeded by adding further outgoing units.

5.3.2 Rated current of a circuit (I_{nc})

The rated current of a circuit is the value of the current that can be carried by this circuit loaded alone, under normal service conditions. This current shall be carried without the temperature rise of the various parts of the ASSEMBLY exceeding the limits specified in 9.2.

NOTE 1 The rated current of a circuit may be lower than the rated currents of the devices (according to the respective device standard) installed in this circuit.

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

5.3.3 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).

5.3.4 Rated short-time withstand current (I_{cw}) (of a circuit of an ASSEMBLY)

The rated short-time withstand current shall be equal to or higher than the prospective r.m.s. 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.

For a.c., the value of the current is the r.m.s. value of the a.c. component.

5.3.5 Rated conditional short-circuit current of an ASSEMBLY (I_{cc})

The rated conditional short-circuit current shall be equal to or higher than the prospective r.m.s. value of short-circuit current (I_{cp}) for a duration limited by the operation of the short-circuit protective device that protects the ASSEMBLY.

The breaking capacity and current limitation characteristic (I^2t, I_{pk}) of the specified short-circuit protective device shall be stated by the ASSEMBLY manufacturer, taking into consideration the data given by the device manufacturer.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

5.4 Rated diversity factor (RDF)

The rated diversity factor is the per unit value of the rated current, assigned by the ASSEMBLY manufacturer, to which outgoing circuits of an ASSEMBLY can be continuously and simultaneously loaded taking into account the mutual thermal influences.

Rated diversity factor can be stated:

- for groups of circuits;
- for the whole ASSEMBLY.

The rated diversity factor multiplied by the rated current of the circuits shall be equal to or higher than the assumed loading of the outgoing circuits. The assumed loading of outgoing circuits shall be addressed by the relevant ASSEMBLY standard.

NOTE 1 The assumed loading of the outgoing circuits can be a steady continuous current or the thermal equivalent of a varying current (See Annex E).

The rated diversity factor is applicable with the ASSEMBLY operating at rated current (I_{nA}).

NOTE 2 The rated diversity factor recognizes that multiple functional units are in practice not fully loaded simultaneously or are intermittently loaded.

See Annex E for further details.

NOTE 3 In Norway, the overload protection of conductors shall not solely be based on the use of diversity factors of the downstream circuits.

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.

NOTE 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 specific service conditions of a functional unit (e.g. type of coordination, overload characteristics);
b) pollution degree (see 3.6.9);
c) types of system earthing 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;
g) intended for use by skilled or ordinary persons (see 3.7.12 and 3.7.14);
h) electromagnetic compatibility (EMC) classification (see Annex J);
i) special service conditions, if applicable (see 7.2);
j) external design (see 3.3);
k) mechanical impact protection, if applicable (see 8.2.1);
l) the type of construction – fixed or removable parts (see 8.5.1 and 8.5.2.);
m) the nature of short-circuit protective device(s) (see 9.3.2);
n) measures for protection against electric shock;

Documents
Document Sharing Hub

o) overall dimensions (including projections e.g handles, covers, doors), if required;

p) the 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) IEC 61439-X (the specific part “X” shall be identified).

NOTE The relevant ASSEMBLY standard may 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.

6.2.2 Instructions for handling, installation, operation and maintenance

The ASSEMBLY manufacturer shall provide in documents or catalogues the conditions, if any, for the handling, installation, operation and maintenance of the ASSEMBLY and the equipment contained therein.

If necessary, the instructions shall indicate the measures that are of particular importance for the proper and correct transport, handling, installation and operation of the ASSEMBLY. The provision of weight details is of particular importance in connection with the transport and handling of ASSEMBLIES.

The correct location and installation of lifting means and the thread size of lifting attachments, if applicable, shall be given in the ASSEMBLY manufacturer's documentation or the instructions on how the ASSEMBLY has to be handled.

The measures to be taken, if any, with regard to EMC associated with the installation, operation and maintenance of the ASSEMBLY shall be specified (see Annex J).

If an ASSEMBLY specifically intended for environment A is to be used in environment B the following warning shall be included in the operating instructions:

CAUTION
This product has been designed for environment A. Use of this product in environment B may cause unwanted electromagnetic disturbances in which case the user may be required to take adequate mitigation measures.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

Where necessary, the above-mentioned documents shall indicate the recommended extent and frequency of maintenance.

If the circuitry is not obvious from the physical arrangement of the apparatus installed, suitable information shall be supplied, for example wiring diagrams or tables.

6.3 Device and/or component identification

Inside the ASSEMBLY, it shall be possible to identify individual circuits and their protective devices. Identification tags shall be legible, permanent and appropriate for the physical environment. Any designations used shall be in compliance with IEC 81346-1 and IEC 81346-2 and identical with those used in the wiring diagrams, which shall be in accordance with IEC 61082-1.

7 Service conditions

7.1 Normal service conditions

ASSEMBLIES conforming to this standard are intended for use under the normal service conditions detailed below.

NOTE If components, for example relays, electronic equipment, are used which are not designed for these conditions, appropriate steps should be taken to ensure proper operation.

7.1.1 Ambient air temperature

7.1.1.1 Ambient air temperature for indoor installations

The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C.

The lower limit of the ambient air temperature is –5 °C.

7.1.1.2 Ambient air temperature for outdoor installations

The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C.

The lower limit of the ambient air temperature is –25 °C.

7.1.2 Humidity conditions

7.1.2.1 Humidity conditions for indoor installations

The relative humidity of the air does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humidity may be permitted at lower temperatures, for example 90 % at +20 °C. Moderate condensation should be borne in mind which may occasionally occur due to variations in temperature.

7.1.2.2 Humidity conditions for outdoor installations

The relative humidity may temporarily be as high as 100 % at a maximum temperature of +25 °C.

7.1.3 Pollution degree

The pollution degree (see 3.6.9) refers to the environmental conditions for which the ASSEMBLY is intended.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

For switching devices and components inside an enclosure, the pollution degree of the environmental conditions in the enclosure is applicable.

For the purpose of evaluating clearances and creepage distances, the following four degrees of pollution in the micro-environment are established.

Pollution degree 1:

No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.

Pollution degree 2:

Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.

Pollution degree 3:

Conductive pollution occurs or dry, non-conductive pollution occurs which is expected to become conductive due to condensation.

Pollution degree 4:

Continuous conductivity occurs due to conductive dust, rain or other wet conditions.

Pollution degree 4 is not applicable for a micro-environment inside the ASSEMBLY to this standard.

Unless otherwise stated, ASSEMBLIES for industrial applications are generally for use in a pollution degree 3 environment. However, other pollution degrees may be considered to apply, depending upon particular applications or the micro-environment.

NOTE The pollution degree of the micro-environment for the equipment may be influenced by installation in an enclosure.

7.1.4 Altitude

The altitude of the site of installation does not exceed 2 000 m.

NOTE For equipment to be used at higher altitudes, it is necessary to take into account the reduction of the dielectric strength, the switching capability of the devices and of the cooling effect of the air.

7.2 Special service conditions

Where any special service conditions exist, the applicable particular requirements shall be complied with or special agreements shall be made between the ASSEMBLY manufacturer and the user. The user shall inform the ASSEMBLY manufacturer if such exceptional service conditions exist.

Special service conditions include, for example:

a) values of temperature, relative humidity and/or altitude differing from those specified in 7.1;

b) applications where variations in temperature and/or air pressure take place at such a speed that exceptional condensation is liable to occur inside the ASSEMBLY;

c) heavy pollution of the air by dust, smoke, corrosive or radioactive particles, vapours or salt;

d) exposure to strong electric or magnetic fields;

AVA Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

e) exposure to extreme climatic conditions;

f) attack by fungus or small creatures;

g) installation in locations where fire or explosion hazards exist;

h) exposure to heavy vibration, shocks, seismic occurrences;

i) installation in such a manner that the current-carrying capacity or breaking capacity is affected, for example equipment built into machines or recessed into walls;

j) exposure to conducted and radiated disturbances other than electromagnetic, and electromagnetic disturbances in environments other than those described in 9.4;

k) exceptional overvoltage conditions or voltage fluctuations;

l) excessive harmonics in the supply voltage or load current.

7.3 Conditions during transport, storage and installation

A special agreement shall be made between the ASSEMBLY manufacturer and the user if the conditions during transport, storage and installation, for example temperature and humidity conditions, differ from those defined in 7.1.

8 Constructional requirements

8.1 Strength of materials and parts

8.1.1 General

ASSEMBLIES shall be constructed of materials capable of withstanding the mechanical, electrical, thermal and environmental stresses that are likely to be encountered in specified service conditions.

The external shape of the ASSEMBLY enclosure can vary to suit the application and use, some examples have been defined in 3.3. These enclosures may also be constructed from various materials e.g. insulating, metallic or a combination of these.

8.1.2 Protection against corrosion

Protection against corrosion shall be ensured by the use of suitable materials or by protective coatings to the exposed surface, taking account of the normal service conditions (see 7.1). Compliance to this requirement is checked by the test of 10.2.2.

8.1.3 Properties of insulating materials

8.1.3.1 Thermal stability

For enclosures or parts of enclosures made of insulating materials, thermal stability shall be verified according to 10.2.3.1.

8.1.3.2 Resistance of insulating materials to heat and fire

8.1.3.2.1 General

Parts of insulating materials which might be exposed to thermal stresses due to internal electrical effects, and the deterioration of which might impair the safety of the ASSEMBLY, shall not be adversely affected by normal (operational) heat, abnormal heat or fire.

8.1.3.2.2 Resistance of insulating materials to heat

The original manufacturer shall select insulating materials either by reference to the insulation temperature index (determined for example by the methods of IEC 60216) or by compliance with IEC 60085.

AVA Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

8.1.3.2.3 Resistance of insulating materials to abnormal heat and fire due to internal electric effects

Insulating materials used for parts necessary to retain current carrying parts in position and parts which might be exposed to thermal stresses due to internal electrical effects, and the deterioration of which might impair the safety of the ASSEMBLY, shall not be adversely affected by abnormal heat and fire and shall be verified by the glow-wire test in 10.2.3.2. For the purpose of this test, a protective conductor (PE) is not considered as a current-carrying part.

For small parts (having surface dimensions not exceeding 14 mm x 14 mm), an alternative test may be used (e.g. needle flame test, according to IEC 60695-11-5). The same procedure may be applicable for other practical reasons where the metal material of a part is large compared to the insulating material.

8.1.4 Resistance to ultra-violet radiation

For enclosures and external parts made of insulating materials which are intended to be used outdoor, resistance to ultra-violet radiation shall be verified according to 10.2.4.

8.1.5 Mechanical strength

All enclosures or partitions including locking means and hinges for doors shall be of a mechanical strength sufficient to withstand the stresses to which they may be subjected in normal service, and during short-circuit conditions (see also 10.13).

The mechanical operation of removable parts, including any insertion interlock, shall be verified by test according to 10.13.

8.1.6 Lifting provision

Where required, ASSEMBLIES shall be provided with the appropriate provision for lifting. Compliance is checked according to the test of 10.2.5.

8.2 Degree of protection provided by an ASSEMBLY enclosure

8.2.1 Protection against mechanical impact

The degree of protection provided by an ASSEMBLY enclosure against mechanical impact, if necessary, shall be defined by the relevant ASSEMBLY standards and verified in accordance with IEC 62262 (see 10.2.6).

8.2.2 Protection against contact with live parts, ingress of solid foreign bodies and water

The degree of protection provided by any ASSEMBLY against contact with live parts, ingress of solid foreign bodies and water is indicated by the IP code according to IEC 60529 and verified according to 10.3

NOTE 1 In the United States of America (USA), Canada and in Mexico enclosure “type” designations are used to specify “the degree of protection” provided to the ASSEMBLY. For applications in the USA, the appropriate enclosure type designation should be used as specified in NEMA 250. For applications in Canada, the appropriate enclosure type designation should be used as specified in CSA standard C22.2 No. 94.1 and 94.2. For applications in Mexico, the appropriate enclosure Type designation should be used as specified in NMX-J-235/1-ANCE y NMX-J-235/2-ANCE

The degree of protection of an enclosed ASSEMBLY shall be at least IP 2X, after installation in accordance with the ASSEMBLY manufacturer's instructions. The degree of protection provided from the front of a dead front ASSEMBLY shall be at least IP XXB.

For fixed ASSEMBLIES not subject to tilting in normal service IP X2 is not applicable.

AVA Documents
Document Sharing Hub

For ASSEMBLIES for outdoor use having no supplementary protection, the second characteristic numeral shall be at least 3.

NOTE 2 For outdoor installation, supplementary protection may be protective roofing or the like.

Unless otherwise specified, the degree of protection indicated by the ASSEMBLY manufacturer applies to the complete ASSEMBLY when installed in accordance with the ASSEMBLY manufacturer's instructions, for example sealing of the open mounting surface of an ASSEMBLY, etc.

Where the ASSEMBLY does not have the same IP rating throughout, the ASSEMBLY manufacturer shall declare the IP rating for the separate parts.

Different IP ratings shall not impair the intended use of the ASSEMBLY.

NOTE 3 Examples include:

- Operating face IP 20, other parts IP 00.
- Drain holes in the base IP XXD, other parts IP 43.

No IP codes can be given unless the appropriate verifications have been made according to 10.3.

Enclosed ASSEMBLIES, for outdoor and indoor installation, intended for use in locations with high humidity and temperatures varying within wide limits, shall be provided with suitable arrangements (ventilation and/or internal heating, drain holes, etc.) to prevent harmful condensation within the ASSEMBLY. However, the specified degree of protection shall at the same time be maintained.

8.2.3 ASSEMBLY with removable parts

The degree of protection indicated for ASSEMBLIES normally applies to the connected position (see 3.2.3) of removable parts.

If, after the removal of a removable part, it is not possible to maintain the original degree of protection e.g. by closing a door, an agreement shall be reached between the ASSEMBLY manufacturer and the user as to what measures shall be taken to ensure adequate protection. Information provided by the ASSEMBLY manufacturer may take the place of such an agreement.

When shutters are used to provide adequate protection to live parts they shall be secured to prevent unintentional removal.

8.3 Clearances and creepage distances

8.3.1 General

The requirements for clearances and creepage distances are based on the principles of IEC 60664-1 and are intended to provide insulation co-ordination within the installation.

The clearances and creepage distances of equipment that form part of the ASSEMBLY shall comply with the requirements of the relevant product standard.

When incorporating equipment into the ASSEMBLY, the specified clearances and creepage distances shall be maintained during normal service conditions.

For dimensioning clearances and creepage distances between separate circuits, the highest voltage ratings shall be used (rated impulse withstand voltage for clearances and rated insulation voltage for creepage distances).

AVA Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

The clearances and creepage distances apply to phase to phase, phase to neutral, and except where a conductor is connected directly to earth, phase to earth and neutral to earth.

For bare live conductors and terminations (e.g. busbars, connections between equipment and cable lugs), the clearances and creepage distances shall at least be equivalent to those specified for the equipment with which they are directly associated.

The effect of a short-circuit up to and including the declared rating(s) of the ASSEMBLY shall not reduce permanently the clearances or creepage distances between busbars and/or connections, below the values specified for the ASSEMBLY. Deformation of parts of the enclosure or of the internal partitions, barriers and obstacles due to a short-circuit shall not reduce permanently the clearances or creepage distances below those specified in 8.3.2 and 8.3.3 (see also 10.11.5.5).

8.3.2 Clearances

The clearances shall be sufficient to enable the declared rated impulse withstand voltage (U_{imp}) of a circuit to be achieved. The clearances shall be as specified in Table 1 unless a design verification test and routine impulse withstand voltage test is carried out in accordance with 10.9.3 and 11.3, respectively.

The method of determining clearances by measurement is given in Annex F.

NOTE In the United States of America (USA) and Mexico National Electrical Codes, are used to specify minimum clearances. In the USA National Electric Code NFPA 70, Article 408.56 is applicable. In Mexico NOM-001-SEDE is applicable. For these applications, it is recommended that clearances be selected using Annex L, Table L.1 of this standard. For applications in Canada minimum electrical clearances are specified in the Canadian Electrical Code, Part 2 Product Safety Standards.

8.3.3 Creepage distances

The original manufacturer shall select a rated insulation voltage(s) (U_i) for the circuits of the ASSEMBLY from which the creepage distance(s) shall be determined. For any given circuit the rated insulation voltage shall not be less than the rated operational voltage (U_e).

The creepage distances shall not, in any case, be less than the associated minimum clearances.

Creepage distances shall correspond to a pollution degree as specified in 7.1.3 and to the corresponding material group at the rated insulation voltage given in Table 2.

The method of determining creepage distances by measurement is given in Annex F.

NOTE 1 For inorganic insulating materials, e.g. glass or ceramics, which do not track, creepage distances need not be greater than their associated clearances. However, the risk of disruptive discharge should be considered.

NOTE 2 In the United States of America (USA) and Mexico National Electrical Codes are used to specify minimum creepage distances. In the USA National Electric Code NFPA 70, Article 408.56 is applicable. In Mexico NOM-001-SEDE is applicable. For these applications, it is recommended that creepage distances be selected using Annex L, Table L.2 of this standard. For applications in Canada minimum creepage distances are specified in the Canadian Electrical Code, Part 2 Product Safety Standards.

By using ribs of a minimum height of 2 mm the creepage distance may be reduced but, irrespective of the number of ribs, shall be not less than 0,8 of the value of Table 2 and not less than the associated minimum clearance. The minimum base of the rib is determined by mechanical requirements (see Clause F.2).

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

8.4 Protection against electric shock

8.4.1 General

The apparatus and circuits in the ASSEMBLY shall be so arranged as to facilitate their operation and maintenance, and at the same time to ensure the necessary degree of safety.

The following requirements are intended to ensure that the required protective measures are obtained when an ASSEMBLY is installed in an electrical system conforming to the IEC 60364 series.

NOTE For generally accepted protective measures refer to IEC 61140 and IEC 60364-4-41.

Those protective measures, which are of particular importance for an ASSEMBLY, are reproduced in 8.4.2 to 8.4.6.

8.4.2 Basic protection

8.4.2.1 General

Basic protection is intended to prevent direct contact with hazardous live parts.

Basic protection can be achieved either by appropriate constructional measures on the ASSEMBLY itself or by additional measures to be taken during installation; this may require information to be given by the ASSEMBLY manufacturer.

An example of additional measures to be taken is the installation of an open-type ASSEMBLY without further provisions in a location where access is only permitted for authorized personnel.

Where basic protection is achieved by constructional measures one or more of the protective measures given in 8.4.2.2 and 8.4.2.3 may be selected. The choice of the protective measure shall be declared by the ASSEMBLY manufacturer if not specified within the relevant ASSEMBLY standard.

8.4.2.2 Basic insulation provided by insulating material

Hazardous live parts shall be completely covered with insulation that can only be removed by destruction or by the use of a tool.

The insulation shall be made of suitable materials capable of durably withstanding the mechanical, electrical and thermal stresses to which the insulation may be subjected in service.

NOTE Examples are electrical components embedded in insulation and insulated conductors.

Paints, varnishes and lacquers alone are not considered to satisfy the requirements for basic insulation.

8.4.2.3 Barriers or enclosures

Air insulated live parts shall be inside enclosures or behind barriers providing at least a degree of protection of IP XXB.

Horizontal top surfaces of accessible enclosures having a height equal to or lower than 1,6 m above the standing area, shall provide a degree of protection of at least IP XXD.

Barriers and enclosures shall be firmly secured in place and have sufficient stability and durability to maintain the required degrees of protection and appropriate separation from live

AVA Documents
Document Sharing Hub

parts under normal service conditions, taking account of relevant external influences. The distance between a conductive barrier or enclosure and the live parts they protect shall not be less than the values specified for the clearances and creepage distances in 8.3.

Where it is necessary to remove barriers or open enclosures or to remove parts of enclosures, this shall be possible only if one of the conditions a) to c) is fulfilled:

a) By the use of a key or tool, i.e. any mechanical aid, to open the door, cover or overide an interlock.

b) After isolation of the supply to live parts, against which the barriers or enclosures afford basic protection, restoration of the supply being possible only after replacement or reclosure of the barriers or enclosures. In TN-C systems, the PEN conductor shall not be isolated or switched. In TN-S systems and TN-C-S systems the neutral conductors need not be isolated or switched (see IEC 60364-5-53:2001, 536.1.2).

   Example: By interlocking the door(s) with a disconnector so that they can only be opened when the disconnector is open, and closing of the disconnector without the use of a tool is impossible while the door is open.

NOTE In Norway, the neutral conductor shall be isolated or switched.

c) Where an intermediate barrier providing a degree of protection of at least IP XXB prevents contact with live parts, such a barrier being removable only by the use of a key or tool.

8.4.3 Fault protection

8.4.3.1 Installation conditions

The ASSEMBLY shall include protective measures and be suitable for installations designed to be in accordance with IEC 60364-4-41. Protective measures suitable for particular installations (e.g. railways, ships) shall be subject to agreement between the ASSEMBLY manufacturer and the user.

When a TT earthing system is being used in the electrical network one of the following measures shall be applied in the ASSEMBLY:

a) double or reinforced insulation of the incoming connections, or

b) residual current device (RCD) protection on the incoming circuit

Such provisions are subject to agreement between user and manufacturer.

8.4.3.2 Requirements for the protective conductor to facilitate automatic disconnection of the supply

8.4.3.2.1 General

Each ASSEMBLY shall have a protective conductor to facilitate automatic disconnection of the supply for:

a) protection against the consequences of faults (e.g. failure of basic insulation) within the ASSEMBLY;

b) protection against the consequences of faults (e.g. failure of basic insulation) in external circuits supplied through the ASSEMBLY.

The requirements to be complied with are given in the following subclauses.

Requirements for identification of the protective conductor (PE, PEN) are given in 8.6.6.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

8.4.3.2.2 Requirements for earth continuity providing protection against the consequences of faults within the ASSEMBLY

All exposed conductive parts of the ASSEMBLY shall be interconnected together and to the protective conductor of the supply or via an earthing conductor to the earthing arrangement.

These interconnections may be achieved either by metal screwed connections, welding or other conductive connections or by a separate protective conductor.

NOTE With metal parts of the ASSEMBLY where abrasion resistant finishes are used, e.g. gland plates with powder coatings, connection for protective earthing requires removal or penetration of the coating.

The method to verify the earth continuity between the exposed conductive parts of the ASSEMBLY and the protective circuit is given in 10.5.2.

For the continuity of these connections the following shall apply:

a) When a part of the ASSEMBLY is removed, for example for routine maintenance, the protective circuits (earth continuity) for the remainder of the ASSEMBLY shall not be interrupted.

   Means used for assembling the various metal parts of an ASSEMBLY are considered sufficient for ensuring continuity of the protective circuits if the precautions taken guarantee permanent good conductivity.

   Flexible or pliable metal conduits shall not be used as protective conductors unless they are designed for that purpose.

b) For lids, doors, cover plates and the like, the usual metal screwed connections and metal hinges are considered sufficient to ensure continuity provided that no electrical equipment exceeding the limits of extra low voltage (ELV) is attached to them.

If apparatus with a voltage exceeding the limits of extra-low voltage are attached to lids, doors, or cover plates additional measures shall be taken to ensure earth continuity. These parts shall be fitted with a protective conductor (PE) whose cross-sectional area is in accordance with Table 3 depending on the highest rated operational current I_e of the apparatus attached or, if the rated operational current of the attached apparatus is less than or equal to 16 A, an equivalent electrical connection especially designed and verified for this purpose (sliding contact, hinges protected against corrosion).

Exposed conductive parts of a device that cannot be connected to the protective circuit by the fixing means of the device shall be connected to the protective circuit of the ASSEMBLY by a conductor whose cross-sectional area is chosen according to Table 3.

Certain exposed conductive parts of an ASSEMBLY that do not constitute a danger

– either because they cannot be touched on large surfaces or grasped with the hand,
– or because they are of small size (approximately 50 mm by 50 mm) or so located as to exclude any contact with live parts,

need not be connected to a protective conductor. This applies to screws, rivets and nameplates. It also applies to electromagnets of contactors or relays, magnetic cores of transformers, certain parts of releases, or similar, irrespective of their size.

When removable parts are equipped with a metal supporting surface, these surfaces shall be considered sufficient for ensuring earth continuity of protective circuits provided that the pressure exerted on them is sufficiently high.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

8.4.3.2.3 Requirements for protective conductors providing protection against the consequences of faults in external circuits supplied through the ASSEMBLY

A protective conductor within the ASSEMBLY shall be so designed that it is capable of withstanding the highest thermal and dynamic stresses arising from faults in external circuits at the place of installation that are supplied through the ASSEMBLY. Conductive structural parts may be used as a protective conductor or a part of it.

Except where verification of the short-circuit withstand strength is not required in accordance with 10.11.2, verification shall be made in accordance with 10.5.3.

In principle, with the exception of the cases mentioned below, protective conductors within an ASSEMBLY shall not include a disconnecting device (switch, disconnector, etc.).

In the run of protective conductors links shall be permitted which are removable by means of a tool and accessible only to authorized personnel (these links may be required for certain tests).

Where continuity can be interrupted by means of connectors or plug-and-socket devices, the protective circuit shall be interrupted only after the live conductors have been interrupted and continuity shall be established before the live conductors are reconnected.

In the case of an ASSEMBLY containing structural parts, frameworks, enclosures, etc., made of conducting material, a protective conductor, if provided, need not be insulated from these parts. Conductors to voltage-operated fault detection devices including the conductors connecting them to a separate earth electrode shall be insulated when specified by their manufacturer. This can also apply to the earth connection of the transformer neutral.

The cross-sectional area of protective conductors (PE, PEN) in an ASSEMBLY to which external conductors are intended to be connected shall be not less than the value calculated with the aid of the formula indicated in Annex B using the highest fault current and fault duration that may occur and taking into account the limitation of the short-circuit protective devices (SCPDs) that protect the corresponding live conductors. The short-circuit withstand strength is verified according to 10.5.3.

For PEN conductors, the following additional requirements apply:

– the minimum cross-sectional area shall be 10 mm^2 copper or 16 mm^2 aluminium;
– the PEN conductor shall have a cross-sectional area not less than that required for a neutral conductor (see 8.6.1);
– the PEN conductors need not be insulated within an ASSEMBLY;
– structural parts shall not be used as a PEN conductor. However, mounting rails made of copper or aluminium may be used as PEN conductors.

For details of requirements for terminals for external protective conductors, see 8.8.

8.4.3.3 Electrical separation

Electrical separation of individual circuits is intended to prevent electrical shock through contact with exposed-conductive-parts, which may be energized by a fault in basic insulation of the circuit.

For this type of protection, see Annex K.

8.4.4 Protection by total insulation

NOTE According to 412.2.1.1 of IEC 60364-4-41, “total insulation” is equivalent to Class II equipment.

AVA Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

For basic and fault protection, by total insulation, the following requirements shall be met.

a) The apparatus shall be completely enclosed in insulating material which is equivalent of double or reinforced insulation. The enclosure shall carry the symbol ⧈ which shall be visible from the outside.

b) The enclosure shall at no point be pierced by conducting parts in such a manner that there is the possibility of a fault voltage being brought out of the enclosure.

   This means that metal parts, such as actuator shafts which for constructional reasons have to be brought through the enclosure, shall be insulated on the inside or the outside of the enclosure from the live parts for the maximum rated insulation voltage and the maximum rated impulse withstand voltage of all circuits in the ASSEMBLY.

   If an actuator is made of metal (whether covered by insulating material or not), it shall be provided with insulation rated for the maximum rated insulation voltage and the maximum impulse withstand voltage of all circuits in the ASSEMBLY.

   If an actuator is principally made of insulating material, any of its metal parts which may become accessible in the event of insulation failure shall also be insulated from live parts for the maximum rated insulation voltage and the maximum rated impulse withstand voltage of all circuits in the ASSEMBLY.

c) The enclosure, when the ASSEMBLY is ready for operation and connected to the supply, shall enclose all live parts, exposed conductive parts and parts belonging to a protective circuit in such a manner that they cannot be touched. The enclosure shall give at least the degree of protection IP 2XC (see IEC 60529).

   If a protective conductor, which is extended to electrical equipment connected to the load side of the ASSEMBLY, is to be passed through an ASSEMBLY whose exposed conductive parts are insulated, the necessary terminals for connecting the external protective conductors shall be provided and identified by suitable marking.

   Inside the enclosure, the protective conductor and its terminal shall be insulated from the live parts and the exposed conductive parts in the same way as the live parts are insulated.

d) Exposed conductive parts within the ASSEMBLY shall not be connected to the protective circuit, i.e. they shall not be included in a protective measure involving the use of a protective circuit. This applies also to built-in apparatus, even if they have a connecting terminal for a protective conductor.

e) If doors or covers of the enclosure can be opened without the use of a key or tool, a barrier of insulating material shall be provided that will afford protection against unintentional contact not only with the accessible live parts, but also with the exposed conductive parts that are only accessible after the cover has been opened; this barrier, however, shall not be removable except with the use of a tool.

8.4.5 Limitation of steady-state touch current and charge

If the ASSEMBLY contains items of equipment that may have steady-state touch current and charges after they have been switched off (capacitors, etc.) a warning plate is required.

Small capacitors such as those used for arc extinction, for delaying the response of relays, etc., shall not be considered dangerous.

NOTE Unintentional contact is not considered dangerous if the voltages resulting from static charges fall below a d.c. voltage of 60 V in less than 5 s after disconnection from the power supply.

8.4.6 Operating and servicing conditions

8.4.6.1 Devices to be operated or components to be replaced by ordinary persons

Protection against any contact with live parts shall be maintained when operating devices or when replacing components.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

The minimum level of protection shall be IP XXC. During the replacement of certain lamps or fuselinks openings larger than those defined by degree of protection IP XXC are allowed.

8.4.6.2 Requirements related to accessibility in service by authorized persons

8.4.6.2.1 General

For accessibility in service by authorized persons, one or more of the following requirements in 8.4.6.2.2 to 8.4.6.2.4 shall be fulfilled subject to agreement between the ASSEMBLY manufacturer and the user. These requirements shall be complementary to the basic protection specified in 8.4.2.

If doors or covers of the ASSEMBLY can be opened by authorized persons by overriding an interlock to obtain access to live parts, then the interlock shall automatically be restored on reclosing the door(s) or replacing the cover(s).

8.4.6.2.2 Requirements related to accessibility for inspection and similar operations

The ASSEMBLY shall be constructed in such a way that certain operations, according to agreement between the ASSEMBLY manufacturer and the user, can be performed when the ASSEMBLY is in service and under voltage.

Such operations may consist of:

– visual inspection of
  - switching devices and other apparatus,
  - settings and indicators of relays and releases,
  - conductor connections and marking;
– adjusting and resetting of relays, releases and electronic devices;
– replacement of fuse-links;
– replacement of indicating lamps;
– certain fault location operations, for example voltage and current measuring with suitably designed and insulated devices.

8.4.6.2.3 Requirements related to accessibility for maintenance

To enable maintenance as agreed upon between the ASSEMBLY manufacturer and the user on an isolated functional unit or isolated group of functional units in the ASSEMBLY, with adjacent functional units or groups still under voltage, necessary measures shall be taken. The choice depends on such factors as service conditions, frequency of maintenance, competence of the authorized person, as well as local installation rules. Such measures may include:

– sufficient space between the actual functional unit or group and adjacent functional units or groups. It is recommended that parts likely to be removed for maintenance have, as far as possible, retainable fastening means;
– use of barriers or obstacles designed and arranged to protect against direct contact with equipment in adjacent functional units or groups;
– use of terminal shields;
– use of compartments for each functional unit or group;
– insertion of additional protective means provided or specified by the ASSEMBLY manufacturer.

Documents
Document Sharing Hub
Full document details: IEC 61439 1 ed 2.0 2011 (2)

8.4.6.2.4 Requirements related to accessibility for extension under voltage

When it is required to enable future extension of an ASSEMBLY with additional functional units or groups, with the rest of the ASSEMBLY still under voltage, the requirements specified in 8.4.6.2.3 shall apply, subject to agreement between the ASSEMBLY manufacturer and the user. These requirements also apply for the insertion and connection of additional outgoing cables when the existing cables are under voltage.

The extension of busbars and connection of additional units to their incoming supply shall not be made under voltage, unless the ASSEMBLY is designed for this purpose.

8.4.6.2.5 Obstacles

Obstacles shall prevent either:

– unintentional bodily approach to live parts, or
– unintentional contact with live parts during the operation of live equipment in normal service.

Obstacles may be removed without using a key or tool but shall be so secured as to prevent unintentional removal. The distance between a conductive obstacle and the live parts they protect shall not be less than the values specified for the clearances and creepage distances in 8.3.

Where a conductive obstacle is separated from hazardous live parts by basic protection only, it is an exposed conductive part, and measures for fault protection shall also be applied.

8.5 Incorporation of switching devices and components

8.5.1 Fixed parts

For fixed parts (see 3.2.1), the connections of the main circuits (see 3.1.3) shall only be connected or disconnected when the ASSEMBLY is not under voltage. In general, removal and installation of fixed parts requires the use of a tool.

The disconnection of a fixed part shall require the isolation of the complete ASSEMBLY or part of it.

In order to prevent unauthorized operation, the switching device may be provided with means to secure it in one or more of its positions.

NOTE Where working on live circuits is permitted, relevant safety precautions may be necessary.

8.5.2 Removable parts

The removable parts shall be so constructed that their electrical equipment can be safely removed from or connected to the main circuit whilst this circuit is live. The removable parts may be provided with an insertion interlock (see 3.2.5).

Clearances and creepage distances (see 8.3) shall be complied with during transfer from one position to another.

A removable part shall be fitted with a device, which ensures that it can only be removed and inserted after its main circuit has been switched off from the load.

In order to prevent unauthorized operation, the removable parts or their associated ASSEMBLY location may be provided with a lockable means to secure them in one or more of their positions.

AVA Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

8.5.3 Selection of switching devices and components

Switching devices and components incorporated in ASSEMBLIES shall comply with the relevant IEC standards.

The switching devices and components shall be suitable for the particular application with respect to the external design of the ASSEMBLY (e.g. open type or enclosed), their rated voltages, rated currents, rated frequency, service life, making and breaking capacities, short-circuit withstand strength, etc.

The rated insulation voltage, and rated impulse withstand voltage of the devices installed in the circuit shall be equal or higher than the corresponding value assigned to that circuit. In some cases overvoltage protection may be necessary e.g. for equipment fulfilling overvoltage category II (see 3.6.11).The switching devices and components having a short-circuit withstand strength and/or a breaking capacity which is insufficient to withstand the stresses likely to occur at the place of installation, shall be protected by means of current-limiting protective devices, for example fuses or circuit-breakers. When selecting current-limiting protective devices for built-in switching devices, account shall be taken of the maximum permissible values specified by the device manufacturer, having due regard to co-ordination (see 9.3.4).

Co-ordination of switching devices and components, for example co-ordination of motor starters with short-circuit protective devices, shall comply with the relevant IEC standards.

NOTE Guidance is given in IEC/TR 61912-1 and IEC/TR 61912-2.

8.5.4 Installation of switching devices and components

Switching devices and components shall be installed and wired in the ASSEMBLY in accordance with instructions provided by their manufacturer and in such a manner that their proper functioning is not impaired by interaction, such as heat, switching emissions, vibrations, electromagnetic fields, which are present in normal operation. In the case of electronic assemblies, this may necessitate the separation or screening of all electronic signal processing circuits.

When fuses are installed the original manufacturer shall state the type and rating of the fuse-links to be used.

8.5.5 Accessibility

Adjusting and resetting devices, which have to be operated inside the ASSEMBLY shall be easily accessible.

Functional units mounted on the same support (mounting plate, mounting frame) and their terminals for external conductors shall be so arranged as to be accessible for mounting, wiring, maintenance and replacement.

Unless otherwise agreed between the ASSEMBLY manufacturer and the user, the following accessibility requirements associated with floor-mounted ASSEMBLIES shall apply:

– The terminals, excluding terminals for protective conductors, shall be situated at least 0,2 m above the base of the ASSEMBLIES and, moreover, be so placed that the cables can be easily connected to them.
– Indicating instruments that need to be read by the operator shall be located within a zone between 0,2 m and 2,2 m above the base of the ASSEMBLY.
– Operating devices such as handles, push buttons, or similar shall be located at such a height that they can easily be operated; this means that their centreline shall be located within a zone between 0,2 m and 2 m above the base of the ASSEMBLY. Devices which are

AVA Documents
Document Sharing Hub

infrequently operated, e.g less than once per month, may be installed at a height up to 2,2 m.

– Actuators for emergency switching devices (see 536.4.2 of IEC 60364-5-53:2001) shall be accessible within a zone between 0,8 m and 1,6 m above the base of the ASSEMBLY.

NOTE In some countries, national codes or regulations may further limit the minimum and maximum height.

8.5.6 Barriers

Barriers for manual switching devices shall be so designed that the switching emissions do not present a danger to the operator.

To minimize danger when replacing fuse-links, interphase barriers shall be applied, unless the design and location of the fuses makes this unnecessary.

8.5.7 Direction of operation and indication of switching positions

The operational positions of components and devices shall be clearly identified. If the direction of operation is not in accordance with IEC 60447, then the direction of operation shall be clearly identified.

8.5.8 Indicator lights and push-buttons

Unless otherwise specified in the relevant product standard the colours of indicator lights and push-buttons shall be in accordance with IEC 60073.

8.6 Internal electrical circuits and connections

8.6.1 Main circuits

The busbars (bare or insulated) shall be arranged in such a manner that an internal short-circuit is not to be expected. They shall be rated at least in accordance with the information concerning the short-circuit withstand strength (see 9.3) and designed to withstand at least the short-circuit stresses limited by the protective device(s) on the supply side of the busbars.

Within one section, the conductors (including distribution busbars) between the main busbars and the supply side of functional units as well as the components included in these units may be rated on the basis of the reduced short-circuit stresses occurring on the load side of the respective short-circuit protective device within each unit, provided that these conductors are arranged so that under normal operation an internal short-circuit between phases and/or between phases and earth is not to be expected (see 8.6.4).

Unless otherwise agreed between the ASSEMBLY manufacturer and the user, the minimum cross-sectional area of the neutral within a three phase and neutral circuit shall be:

- For circuits with a phase conductor cross-sectional area up to and including 16 mm^2, 100 % of that of the corresponding phases.
- For circuits with a phase conductor cross-sectional area above 16 mm^2, 50 % of that of the corresponding phases with a minimum of 16 mm^2.

It is assumed that the neutral currents do not exceed 50 % of the phase currents.

NOTE For certain applications which lead to high values of zero sequence harmonics (e.g. 3rd order harmonics) higher cross-sections of the N conductor might be required as these harmonics of the phases are added in the N conductor and lead to high current load at higher frequencies. This is subject to special agreement between the ASSEMBLY manufacturer and the user.

The PEN shall be dimensioned as specified in 8.4.3.2.3.

Documents
Document Sharing Hub

Full document details: IEC 61439 1 ed 2.0 2011 (2)

8.6.2 Auxiliary circuits

The design of the auxiliary circuits shall take into account the supply earthing system and ensure that an earth-fault or a fault between a live part and an exposed conductive part shall not cause unintentional dangerous operation.

In general, auxiliary circuits shall be protected against the effects of short circuits. However, a short-circuit protective device shall not be provided if its operation is liable to cause a danger. In such a case, the conductors of auxiliary circuits shall be arranged in such a manner that a short-circuit is not to be expected (see 8.6.4).

8.6.3 Bare and insulated conductors

The connections of current-carrying parts shall not suffer undue alteration as a result of normal temperature rise, ageing of the insulating materials and vibrations occurring in normal operation. In particular, the effects of thermal expansion and of the electrolytic action in the case of dissimilar metals, and the effects of the endurance of the materials to the temperatures attained, shall be taken into consideration.

Connections between current-carrying parts shall be established by means that ensure a sufficient and durable contact pressure.

If verification of temperature rise is carried out on the basis of tests (see 10.10.2) the selection of conductors and their cross-sections used inside the ASSEMBLY shall be the responsibility of the original manufacturer. If verification of temperature rise is made following the rules of 10.10.3, the conductors shall have a minimum cross-section according to IEC 60364-5-52. Examples on how to adapt this standard for conditions inside an ASSEMBLY are given in the tables included in Annex H. In addition to the current-carrying capacity of the conductors, the selection is governed by:

– the mechanical stresses to which the ASSEMBLY may be subjected;
– the method used to lay and secure the conductors;
– the type of insulation;
– the type of components being connected (e.g. switchgear and controlgear in accordance with IEC 60947 series; electronic devices or equipment).

In the case of insulated solid or flexible conductors:

– They shall be rated for at least the rated insulation voltage (see 5.2.3) of the circuit concerned.
– Conductors connecting two termination points shall have no intermediate joint, e.g. spliced or soldered.
– Conductors with only basic insulation shall be prevented from coming into contact with bare live parts at different potentials.
– Contact of conductors with sharp edges shall be prevented.
– Supply conductors to apparatus and measuring instruments in covers or doors shall be so installed that no mechanical damage can occur to the conductors as a result of movement of these covers or doors.
– Soldered connections to apparatus shall be permitted in ASSEMBLIES only in cases where provision is made for this type of connection on the apparatus and the specified type of conductor is used.
– For apparatus other than those mentioned above, soldering cable lugs or soldered ends of stranded conductors are not acceptable under conditions of heavy vibration. In locations where heavy vibrations exist during normal operation, for example in the case of dredger and crane operation, operation on board ships, lifting equipment and locomotives, attention should be given to the support of conductors.

Documents
Document Sharing Hub