

INTERNATIONAL STANDARD

IEC
60439-1

Fourth edition
1999-09

Low-voltage switchgear and controlgear assemblies –

Part 1: Type-tested and partially type-tested assemblies

iteh Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 60439-1:1999](https://standards.iteh.ai/standards/iec/3ca12fd-631e-4e58-95e8-4ce3cf57db83/iec-60439-1-1999)

<https://standards.iteh.ai/standards/iec/3ca12fd-631e-4e58-95e8-4ce3cf57db83/iec-60439-1-1999>

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number
IEC 60439-1:1999(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site** (www.iec.ch)

- **Catalogue of IEC publications**

The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

This summary of recently issued publications (www.iec.ch/online_news/justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

Email: custserv@iec.ch

Tel: +41 22 919 02 11

Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

IEC 60439-1

Fourth edition
1999-09

Low-voltage switchgear and controlgear assemblies –

Part 1: Type-tested and partially type-tested assemblies

iteh Standards
(<https://standards.iteh.ai>)
Document Preview

IEC 60439-1:1999

<https://standards.iteh.ai/catalog/standards/iec/3ca12fd-631e-4e58-95e8-4ce3cf57db83/iec-60439-1-1999>

© IEC 1999 Copyright - all rights reserved

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 the publisher.

International Electrotechnical Commission, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE **XD**

For price, see current catalogue

CONTENTS

	Page
FOREWORD	9
Clause	
1 General.....	13
1.1 Scope and object	13
1.2 Normative references.....	13
2 Definitions.....	19
2.1 General.....	19
2.2 Constructional units of ASSEMBLIES.....	23
2.3 External design of ASSEMBLIES	25
2.4 Structural parts of ASSEMBLIES.....	27
2.5 Conditions of installation of ASSEMBLIES	31
2.6 Protective measures with regard to electric shock.....	31
2.7 Gangways within ASSEMBLIES	33
2.8 Electronic functions	33
2.9 Insulation co-ordination.....	35
2.10 Short-circuit currents	39
3 Classification of ASSEMBLIES.....	39
4 Electrical characteristics of ASSEMBLIES.....	41
4.1 Rated voltages.....	41
4.2 Rated current (I_n) (of a circuit of an ASSEMBLY).....	41
4.3 Rated short-time current (I_{cw}) (of a circuit of an ASSEMBLY)	43
4.4 Rated peak withstand current (I_{pk}) (of a circuit of an ASSEMBLY).....	43
4.5 Rated conditional short-circuit current (I_{cc}) (of a circuit of an ASSEMBLY)	43
4.6 Rated fused short-circuit current (I_{cf}) (of a circuit of an ASSEMBLY).....	43
4.7 Rated diversity factor	43
4.8 Rated frequency	45
5 Information to be given regarding the ASSEMBLY	45
5.1 Nameplates	45
5.2 Markings.....	47
5.3 Instructions for installation, operation and maintenance.....	47
6 Service conditions.....	47
6.1 Normal service conditions.....	47
6.2 Special service conditions.....	51
6.3 Conditions during transport, storage and erection	53

Clause	Page
7 Design and construction.....	53
7.1 Mechanical design	53
7.2 Enclosure and degree of protection.....	61
7.3 Temperature rise	63
7.4 Protection against electric shock.....	65
7.5 Short-circuit protection and short-circuit withstand strength	81
7.6 Switching devices and components installed in ASSEMBLIES	87
7.7 Internal separation of ASSEMBLIES by barriers or partitions	97
7.8 Electrical connections inside an ASSEMBLY: bars and insulated conductors.....	99
7.9 Requirements for electronic equipment supply circuits.....	101
7.10 Electromagnetic compatibility (EMC).....	105
7.11 Description of the types of electrical connections of functional units	109
8 Test specifications	109
8.1 Classification of tests.....	109
8.2 Type tests.....	111
8.3 Routine tests	141
Annex A (normative) Minimum and maximum cross-sections of copper conductors suitable for connection	153
Annex B (normative) Method of calculating the cross-sectional area of protective conductors with regard to thermal stresses due to currents of short duration.....	155
Annex C (informative) Typical examples of ASSEMBLIES.....	157
Annex D (informative) Forms of internal separations.....	177
Annex E (informative) Items subject to agreement between manufacturer and user.....	183
Annex F (normative) Measurement of creepage distances and clearances	185
Annex G (normative) Correlation between the nominal voltage of the supply system and the rated impulse withstand voltage of the equipment.....	195
Bibliography.....	199
Figure 1 Ratio $\frac{\hat{U}_i + \Delta u}{\hat{U}_i}$ as a function of time	103
Figure 2 Maximum permitted harmonic component of the nominal system voltage.....	105
Figure C.1 Open-type ASSEMBLY (see 2.3.1)	157
Figure C.2 Dead-front ASSEMBLY (see 2.3.2).....	159
Figure C.3 Cubicle-type ASSEMBLY (see 2.3.3.1).....	161
Figure C.4 Multi-cubicle-type ASSEMBLY (see 2.3.3.2)	163
Figure C.5 Desk-type ASSEMBLY (see 2.3.3.3).....	165
Figure C.6 Multi-box-type ASSEMBLY (see 2.3.3.5)	167

Figure C.7	Busbar trunking system (2.3.4)	169
Figure C.8	Mounting structure (see 2.4.2)	171
Figure C.9	Fixed parts (see 2.2.5, 2.4.3, 2.4.4)	173
Figure C.10	Withdrawable part (see 2.2.7)	175
Figure D.1	Symbols used in figures D.2	177
Figure D.2	Forms 1 and 2	179
Figure D.2	Forms 3 and 4	181
Figure F.1	Measurement of ribs	185
Table 1	Values of rated diversity factor	45
Table 2	Temperature-rise limits	63
Table 3	Cross-sectional area of protective conductors (PE, PEN)	73
Table 3A	Cross-sectional area of a copper bonding conductor	75
Table 4		85
Table 5	Conductor selection and installation requirements	87
Table 6	Electrical conditions for the different positions of withdrawable parts	95
Table 7	List of verifications and tests to be performed on TTA and PTTA	113
Table 8	Test copper conductors for test currents up to 400 A inclusive	117
Table 9	Standard cross-sections of copper conductors corresponding to the test current	119
Table 10		125
Table 11		125
Table 12	Relationship between prospective fault current and diameter of copper wire	131
Table 13	Dielectric withstand voltages for impulse, power frequency and d.c. tests	147
Table 14	Minimum clearances in air	147
Table 15	Test voltages across the open contacts of equipment suitable for isolation	149
Table 16	Minimum creepage distances	151
Table A.1		153
Table B.1	Values of k for insulated protective conductors not incorporated in cables, or bare protective conductors in contact with cable covering	155
Table G.1	Correspondence between the nominal voltage of the supply system and the equipment rated impulse withstand voltage, in the case of overvoltage protection by surge-arresters according to IEC 60099-1	197

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –**Part 1: Type-tested and partially type-tested assemblies**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60439-1 has been prepared by subcommittee 17D: Low-voltage switchgear and controlgear assemblies, of IEC technical committee 17: Switchgear and controlgear.

This fourth edition cancels and replaces the third edition published in 1992, the corrigendum of December 1993, amendment 1 (1995), amendment 2 (1996) and amendment 3 (1999). This fourth edition constitutes a technical revision.

The text of this standard is based on the third edition, amendments 1 and 2, and the following documents:

FDIS	Report on voting
17D/214A/FDIS	17D/221/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A, B, F and G form an integral part of this standard.

Annexes C, D and E are for information only.

The committee has decided that this publication remains valid until 2002. At this date, in accordance with the committee's decision, the publication will be

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

Withdawn

iTech Standards
(<https://standards.itih.ai>)
Document Preview

<https://standards.itih.ai/standards/iec/3caf2fd-631e-4e58-95e8-4ce3cf57db83/iec-60439-1-1999>

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES –

Part 1: Type-tested and partially type-tested assemblies

1 General

1.1 Scope and object

This International Standard applies to low-voltage switchgear and controlgear ASSEMBLIES (type-tested ASSEMBLIES (TTA) and partially type-tested ASSEMBLIES (PTTA)), the rated voltage of which does not exceed 1 000 V a.c. at frequencies not exceeding 1 000 Hz, or 1 500 V d.c.

This standard also applies to ASSEMBLIES incorporating control and/or power equipment, the frequencies of which are higher. In this case, appropriate additional requirements will apply.

This standard applies to stationary or movable ASSEMBLIES with or without enclosure.

NOTE Additional requirements for certain specific types of assemblies are given in supplementary IEC standards.

This standard applies to 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.

It also applies to ASSEMBLIES designed for use under special service conditions, for example in ships, in rail vehicles, for machine tools, for hoisting equipment or in explosive atmospheres, and for domestic (operated by unskilled persons) applications, provided that the relevant specific requirements are complied with.

This standard does not apply to individual devices and self-contained components, such as motor starters, fuse switches, electronic equipment, etc. complying with their relevant standards.

The object of this standard is to lay down the definitions and to state the service conditions, construction requirements, technical characteristics and tests for low-voltage switchgear and controlgear ASSEMBLIES.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60038:1983, *IEC standard voltages*

IEC 60050(441):1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*

IEC 60050(471):1984, *International Electrotechnical Vocabulary (IEV) – Chapter 471: Insulators*

IEC 60050(604):1987, *International Electrotechnical Vocabulary (IEV) – Chapter 604: Generation, transmission and distribution of electricity – Operation*

IEC 60050(826):1982, *International Electrotechnical Vocabulary (IEV) – Chapter 826: Electrical installations of buildings*

IEC 60060, *High-voltage test techniques*

IEC 60071-1:1976, *Insulation co-ordination – Part 1: Terms, definitions, principles and rules*

IEC 60073:1996, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indication devices and actuators*

IEC 60099-1:1991, *Surge arresters – Part 1: Non-linear resistor type gapped surge arresters for a.c. systems*

IEC 60112:1979, *Method for determining the comparative and the proof-tracking indices of solid insulating materials under moist conditions*

IEC 60146-2:1974, *Semiconductor convertors – Part 2: Semiconductor self-commutated convertors*

IEC 60158-2:1982, *Low-voltage controlgear – Part 2: Semiconductor contactors (solid state contactors)*

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 60227-4:1992, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 4: Sheathed cables for fixed wiring*

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

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

IEC 60269, *Low-voltage fuses*

IEC 60364-3:1993, *Electrical installations of buildings – Part 3: Assessment of general characteristics*

IEC 60364-4-41:1992, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock*

IEC 60364-4-443:1995, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 44: Protection against overvoltages – Section 443: Protection against overvoltages of atmospheric origin or due to switching **

IEC 60364-4-46:1981, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 46: Isolation and switches*

* There is a consolidated edition 2.1 (1999) that includes IEC 60364-4-443 (1995) and its amendment 1 (1998).

IEC 60364-5-54:1980, *Electrical installations of buildings – Part 5: Selection and erection of electrical equipment – Chapter 54: Earthing arrangements and protective conductors*

IEC 60417 (all parts), *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets*

IEC 60445:1988, *Identification of equipment terminals and of terminations of certain designated conductors, including general rules for an alphanumeric system*

IEC 60446:1989, *Identification of conductors by colours or numerals*

IEC 60447:1993, *Man-machine interface (MMI) – Actuating principles*

IEC 60502:1994, *Extruded solid dielectric insulated power cables for rated voltages from 1 kV to 30 kV*

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

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

IEC 60750:1983, *Item designation in electrotechnology*

IEC 60865 (all parts), *Short-circuit currents – Calculation of effects*

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

IEC 60947-1:1988, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-3:1999, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-4-1:1990, *Low-voltage switchgear and controlgear – Part 4: Contactors and motor-starters – Section 1: Electromechanical contactors and motor-starters*

IEC 61000-4-2:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test – Basic EMC Publication*

IEC 61000-4-3:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 3: Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient burst immunity test – Basic EMC Publication*

IEC 61000-4-5:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 5: Surge immunity tests*

IEC 61117:1992, *A method for assessing the short-circuit withstand strength of partially type-tested assemblies (PTTA)*

CISPR 11:1990, *Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment*

2 Definitions

For the purpose of this International Standard, the following definitions apply.

NOTE Certain definitions in this clause are taken unchanged or modified from those of IEC 60050 (IEV) or from other IEC publications.

2.1 General

2.1.1

low-voltage switchgear and controlgear assembly (ASSEMBLY)

a combination of one or more low-voltage switching devices together with associated control, measuring, signalling, protective, regulating equipment, etc., completely assembled under the responsibility of the manufacturer with all the internal electrical and mechanical inter-connections and structural parts (see 2.4)

NOTE 1 Throughout this standard, the abbreviation ASSEMBLY is used for a low-voltage switchgear and controlgear assembly.

NOTE 2 The components of the ASSEMBLY may be electromechanical or electronic.

NOTE 3 For various reasons, for example transport or production, certain steps of assembly may be made in a place outside the factory of the manufacturer.

2.1.1.1

type-tested low-voltage switchgear and controlgear assembly (TTA)

a low-voltage switchgear and controlgear ASSEMBLY conforming to an established type or system without deviations likely to significantly influence the performance, from the typical ASSEMBLY verified to be in accordance with this standard

NOTE 1 Throughout this standard, the abbreviation TTA is used for a type-tested low-voltage switchgear and controlgear assembly.

NOTE 2 For various reasons, for example transport or production, certain steps of assembly may take place outside the factory of the manufacturer of the TTA. Such an ASSEMBLY is considered as a TTA provided the assembly is performed in accordance with the manufacturer's instructions in such a manner that compliance of the established type or system with this standard is assured, including submission to applicable routine tests.

2.1.1.2

partially type-tested low-voltage switchgear and controlgear assembly (PTTA)

a low-voltage switchgear and controlgear ASSEMBLY, containing both type-tested and non-type-tested arrangements, provided that the latter are derived (e.g. by calculation) from type-tested arrangements which have complied with the relevant tests (see table 7).

NOTE Throughout this standard, the abbreviation PTTA is used for a partially type-tested switchgear and controlgear assembly.

2.1.2

main circuit (of an ASSEMBLY)

all the conductive parts of an ASSEMBLY included in a circuit which is intended to transmit electrical energy [IEV 441-13-02]

2.1.3

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, process data, etc. [IEV 441-13-03 modified]

NOTE The auxiliary circuits of an ASSEMBLY include the control and the auxiliary circuits of the switching devices.

2.1.4**busbar**

a 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.

2.1.4.1**main busbar**

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

2.1.4.2**distribution busbar**

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

2.1.5**functional unit**

a part of an ASSEMBLY comprising all the electrical and mechanical elements 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.

2.1.6**incoming unit**

a functional unit through which electrical energy is normally fed into the ASSEMBLY

2.1.7**outgoing unit**

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

2.1.8**functional group**

a group of several functional units which are electrically interconnected for the fulfilment of their operational functions

2.1.9**test situation**

a condition of an ASSEMBLY or part of it in which the relevant main circuits are open but not necessarily disconnected (isolated) whilst the associated auxiliary circuits are connected, allowing tests of the operation of incorporated devices

2.1.10**disconnected situation**

a condition of an ASSEMBLY or a part of it in which the relevant main circuit and associated auxiliary circuits are disconnected (isolated)

2.1.11**connected situation**

a condition of an ASSEMBLY or part of it in which the relevant main circuit and associated auxiliary circuits are connected for their normally intended function

2.2 Constructional units of ASSEMBLIES

2.2.1

section (see figure C.4)

a constructional unit of an ASSEMBLY between two successive vertical delineations

2.2.2

sub-section

a constructional unit of an ASSEMBLY between two successive horizontal delineations within a section

2.2.3

compartment

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

2.2.4

transport unit

a part of an ASSEMBLY or a complete ASSEMBLY suitable for shipping without being dismantled

2.2.5

fixed part (see figure C.9)

a part consisting of components assembled and wired on a common support and which is designed for fixed installation (see 7.6.3)

2.2.6

removable part

a part which may be removed entirely from the ASSEMBLY and replaced even though the circuit to which it is connected may be live

2.2.7

withdrawable part (see figure C.10)

a removable part which can be moved from the connected position to the disconnected position and to a test position, if any, whilst remaining mechanically attached to the ASSEMBLY

NOTE The isolating distance may relate either to the main circuits only or to the main circuits and the auxiliary circuits (see 2.2.10), see also table 6.

2.2.8

connected position

the position of a removable or withdrawable part when it is fully connected for its normally intended function

2.2.9

test position

a position of a withdrawable part in which the relevant main circuits are open on its supply side but not necessarily disconnected (isolated) and in which the auxiliary circuits are connected, allowing tests of the operation of the withdrawable part, that part remaining mechanically attached to the ASSEMBLY

NOTE The opening may also be achieved without any mechanical movement of the withdrawable part by operation of a suitable device.

2.2.10

disconnected position (isolated position)

a position of a withdrawable part in which an isolating distance (see 7.1.2.2) is established in main and auxiliary circuits, the withdrawable part remaining mechanically attached to the ASSEMBLY

NOTE The isolating distance may also be established without any mechanical movement of the withdrawable part by operation of a suitable device.