

INTERNATIONAL STANDARD

NORME INTERNATIONALE



AMENDMENT 2
AMENDEMENT 2

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

Appareillage à basse tension –
Partie 1: Règles générales

<https://standards.iteh.ai/standards/iec/60947-1-2007/amd2-2014>
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FOREWORD

This amendment has been prepared by subcommittee 17B: Low-voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.

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

FDIS	Report on voting
121A/15/FDIS	121A/21/RVD

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

The committee has decided that the contents of this amendment and the base 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- withdrawn,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.

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1.1 Scope and object

Replace the existing text of this subclause by the following new text:

This standard applies, when required by the relevant product standard, to low-voltage switchgear and controlgear hereinafter referred to as "equipment" or "device" and intended to be connected to circuits the rated voltage of which does not exceed 1 000 V a.c. or 1 500 V d.c.

This standard states the general rules and common safety requirements for low-voltage switchgear and controlgear, including:

- definitions;
- characteristics;
- information supplied with the equipment;
- normal service, mounting and transport conditions;
- constructional and performance requirements;
- verification of characteristics and performance;
- environmental aspects.

This standard does not apply to low-voltage switchgear and controlgear assemblies which are dealt with in IEC 61439 series, as applicable.

1.2 Normative references

Delete the existing reference to "IEC 60439-1:1999" and its Amendment 1.

Replace the existing references by the following new references:

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

IEC 61000-3-3:2013, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*

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

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

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

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

CISPR 11:2009, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
Amendment 1 (2010)

Add, to the existing references, the new amendments as follows:

IEC 60947-5-1:2003, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*
Amendment 1 (2009)

IEC 61000-3-2:2005, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*
Amendment 1 (2008)
Amendment 2 (2009)

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
Amendment 1 (2007)
Amendment 2 (2010)

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*
Amendment 1 (2009)

Add the following new normative references as follows:

IEC 60092-504:2001, *Electrical installations in ships – Part 504: Special features – Control and instrumentation*

IEC 60300-3-5:2001, *Dependability management – Part 3-5: Application guide – Reliability test conditions and statistical test principles*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61649:2008, *Weibull analysis*

IEC 62061:2005, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*

IEC 62430:2009, *Environmentally conscious design for electrical and electronic products*

IEC 62474:2012, *Material declaration for products of and for the electrotechnical industry*

ISO 13849-1:2006, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

2 Definitions

Replace, in the alphabetical list, the existing references to these terms, modified by Amendment 1, by the following new references:

Electronically controlled electromagnet	2.3.36
Maximum cross-section	2.3.35
Minimum cross-section	2.3.34
Multiple tip contact system	2.3.33

Replace, in the alphabetical list, the entry "Over-current discrimination" by the following new entry:

Over-current selectivity	2.5.23
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Add, in the alphabetical list, the following new terms and references:

Flexible conductor	2.3.32
Individual enclosure	2.2.23
Insulation coordination barrier	2.1.23
Rated control circuit supply voltage	2.5.67
Rated control circuit voltage	2.5.66
Rigid conductor	2.3.31
Solid conductor	2.3.29
Solid insulation	2.1.22
Stranded conductor	2.3.30

2.1 General terms

Add, at the end of the existing subclause, the following new terms and definitions:

2.1.22

solid insulation

solid insulating material interposed between two conductive parts

2.1.23

insulation coordination barrier

solid insulating material that is not an integral part, provided for the purpose of increasing either creepage distances or clearance distances or both

2.2 Switching devices

Add, at the end of the existing subclause, the following new term and definition:

2.2.23

individual enclosure

enclosure designed and dimensioned to contain one equipment only

2.3 Parts of switching devices

Add, after the existing definition 2.3.28 added by Amendment 1, the following new terms and definitions and renumber the existing definitions 2.3.29 to 2.3.32 as 2.3.33 to 2.3.36 respectively:

2.3.29

solid conductor

conductor consisting of a single wire

NOTE 1 The solid conductor may be circular or shaped

NOTE 2 Solid conductor is defined as class 1 conductor in IEC 60228, or by IEC 60344, or equivalent AWG/kcmil.

[461-01-06, modified]

2.3.30

stranded conductor

conductor consisting of a number of wires, all or some of which are wound in a helix

NOTE Stranded conductor is defined as class 2 conductor in IEC 60228, or by IEC 60344, or equivalent AWG/kcmil.

[151-12-36, modified]

2.3.31

rigid conductor

solid or stranded conductor having wires of such diameters, or so assembled, that the conductor is not suitable for use in a flexible cable

2.3.32

flexible conductor

stranded conductor having wires of diameters small enough and so assembled that the conductor is suitable for use in a flexible cable

NOTE Flexible conductor is defined as class 5 or class 6 conductor in IEC 60228, or by IEC 60344, or equivalent AWG/kcmil.

[461-01-11, modified]

2.5 Characteristic quantities

2.5.23

over-current discrimination

Replace the existing term by the new following term:

over-current selectivity

Replace, in the existing note of this definition, the word “discrimination” by “selectivity”.

Delete the existing source “[441-17-15]”.

Add, after the existing definition 2.5.65, the following new terms and definitions:

2.5.66

rated control circuit voltage

U_c

rated voltage which is controlling the input signal of the control device

2.5.67

rated control circuit supply voltage

U_s

rated voltage applied to energize the power supply terminals of the control circuit

4 Characteristics

Add, in the existing table, the following new line:

Characteristic	Symbol	Subclause
Pole impedance of the switching device	Z	4.3.7

Replace, in the existing line “Rated conditional short-circuit current”, the symbol “–” by “ I_q ”, as follows:

Characteristic	Symbol	Subclause
Rated conditional short-circuit current	I_q	4.3.6.4

Replace the existing line “Rated control supply voltage” as follows:

Characteristic	Symbol	Subclause
Rated control circuit supply voltage	U_s	4.5.1

4.3.6.1 Rated short-time withstand current (I_{cw})

Replace the existing text of this subclause by the following new text:

The rated short-time withstand current of an equipment is the value of short-time current, assigned to the equipment by the manufacturer, that the equipment can carry without damage, under the test conditions specified in the relevant product standard.

4.3.6.4 Rated conditional short-circuit current

Replace the existing title of this subclause by the following new title:

4.3.6.4 Rated conditional short-circuit current (I_q)

Add, before the existing Subclause 4.4, the following new subclause:

4.3.7 Pole impedance of the switching device (Z)

The pole impedance may be stated by the manufacturer and is determined by measuring the voltage drop resulting from the current flowing through the pole.

4.5.1 Electrically or electronically controlled circuits

Replace the existing fourth dashed item, modified by Amendment 1, by the following new dash:

- rated control circuit supply voltage U_s (a.c., d.c.), where applicable;

Replace the existing Note 1 added by Amendment 1 by the following new note:

NOTE 1 Distinction is made between the rated control circuit voltage U_c and the rated control circuit supply voltage U_s which may be different from U_c due to the presence of built-in transformers, rectifiers, resistors, electronic circuitry, etc.

Delete the existing Note 2 added by Amendment 1.

Replace the existing paragraph after Note 2, added by Amendment 1, by the following new paragraph:

The correct operating conditions are based upon a value of the control circuit supply voltage not less than 85 % of its rated value U_s , with the highest value of control circuit current flowing, nor more than 110 % of its rated value.

5.1 Nature of information

Replace the existing eighteenth dashed item under "Characteristics" by the following new dash:

- control circuit supply voltage, kind of current and frequency, if different from those of the control coil;

Add, in the existing list "Characteristics" after the item "suitability for isolation", the following two new dashed items:

- pole impedance of the switching device (Z);
- material declaration as per Annex W;

5.3 Instructions for installation, operation and maintenance

Move the first sentence of the second existing paragraph to the end of the first paragraph.

Replace the second sentence of the second paragraph by the following new sentence:

For equipment only suitable in environment A (see 7.3.1), the manufacturer shall provide the following notice in documentation, available as information to potential customers and with the product for users:

Add, after the existing Subclause 5.3, the following new subclause:

5.4 Environmental information

Material declarations according to Annex W shall be provided if required by the relevant product standard.

6.1.1 Ambient air temperature

Replace, in the existing Note 1 “IEC 60439-1” by “IEC 61439 series”.

7.1.2.2 Glow wire testing

Replace, in the existing note, “IEC 60695-2-2” by “IEC 60695-11-5”.

Add, at the end of existing note, the following new sentence:

The needle flame test is used as an alternative test for addressing flame retardancy requirements for shipboard applications.

7.1.4 Clearances and creepage distances

Replace the existing text of this subclause by the following new three subclauses:

7.1.4.1 General

For equipment tested according to 8.3.3.4 of this standard, minimum values are given in Table 13 and Table 15.

Electrical requirements are given in 7.2.3.

In the other cases, guidance for minimum values is given in the relevant product standard.

NOTE Depending on the risk level (severity of harm and the probability of occurrence), the non-accessibility to hazardous-live parts is considered under normal service conditions (see 6.1) or under single-fault conditions (see 4.2 of IEC 61140:2001, 7.1.10 and Annex N).

7.1.4.2 Insulation coordination barriers for creepage distances

When solid insulation is used as an insulation coordination barrier to comply with required creepage distances, the material used shall comply with the glow wire requirements in 7.1.2.2 or the flammability requirements in 7.1.2.3.

7.1.4.3 Insulation coordination barriers for clearance distances

When solid insulation is used as an insulation coordination barrier to comply with required clearance distances and does not physically support or maintain the relative position of uninsulated parts involved, the barrier material shall comply with the glow wire requirements in 7.1.2.2 and shall conform to the glow-wire test requirements of 8.2.1.1.1 at a temperature of 650 °C or the AI values in Table M.2. Alternatively the material shall comply with the requirements in 7.1.4.2.

7.2.1.2 Limits of operation of power operated equipment

Replace, in the first existing paragraph, “control supply voltage” by “control circuit supply voltage”.

Replace, in the existing paragraph, after the note, “rated control supply voltage” by “rated control circuit supply voltage”.

Replace, in the first (one occurrence) and second dashed items (two occurrences) of the fifth existing paragraph, introduced by Amendment 1, “rated control supply voltage” by “rated control circuit supply voltage”.

7.2.1.4 Limits of operation of shunt releases

Replace, in the existing paragraph, “rated control supply voltage” by “rated control circuit supply voltage”.

7.2.2.5 Control circuits

Add, after the existing text, the following new paragraph:

Digital inputs and/or digital outputs contained in switchgear and controlgear, and intended to be compatible with programmable logic controllers (PLCs) are covered by Annex S.

7.2.2.8 Other parts

Replace, in the existing text, “plastics and insulating materials” by “insulating parts”.

7.2.3.3 Clearances

Replace, in the second sentence of the second paragraph, “are higher than” by “are equal to or higher than”.

7.2.3.5 Solid insulation

Delete the last existing sentence of this subclause.

Add, at the end of this subclause, the following new note:

NOTE For more information on the design of solid insulation, see 5.3.1 of IEC 60664-1:2007.

Add, before the existing Subclause 7.3, the following new subclause:

7.2.8 Pole impedance

Where the pole impedance is given, it shall be tested according to 8.3.3.8.

7.3.3.1 Equipment not incorporating electronic circuits

Replace the existing text of this subclause by the following new text:

The requirements for electromagnetic emissions for equipment not incorporating electronic circuits are deemed to be satisfied, and no verification is necessary.

NOTE For equipment not incorporating electronic circuits, electromagnetic disturbances can only be generated by equipment during occasional switching operations. The duration of the disturbances is less than 200 ms in accordance with CISPR 22.

The frequency, the level and the consequences of these emissions are considered as part of the normal electromagnetic environment of low-voltage installations.

7.3.3.2.1 Limits for high-frequency emissions

Replace the first three existing paragraphs of this subclause by the following new text and new note:

The high-frequency (greater than 9 kHz) continuous emissions from equipment incorporating electronic switching circuits shall not exceed the limits specified in the relevant product standard, based on CISPR 11 for environment A and for environment B.

NOTE One-time disturbances no longer than 200 ms need no further evaluation.

8.2 Compliance with constructional requirements

Replace, in the 4th existing dash of the list, “the mechanical properties of terminals” by “the mechanical and electrical properties of terminals”.

8.2.4.1 General conditions for tests

Replace, in the second sentence, the reference to “IEC 60028” by “IEC 60228”.

8.2.4.7 Electrical performance of screwless-type clamping units

Replace, in the existing Note 1 introduced by Amendment 1, the references “(2.3.30)” and “(2.3.31)” by “(2.3.24)” and “(2.3.35)” respectively.

Replace the existing Note 2 introduced by Amendment 1 by the following new note:

NOTE 2 For the largest cross-sectional area the test current generally applied is I_{th} or I_{the} declared for the product. For the smallest cross-sectional area, the test current is given in Table 4 and Table 5 of IEC 60947-1:2009.

8.2.4.8 Ageing test for screwless-type clamping units

Replace, in the existing Note 1 introduced by Amendment 1, the references “(2.3.30)” and “(2.3.31)” by “(2.3.34)” and “(2.3.35)” respectively.

Replace the existing Note 2 introduced by Amendment 1 by the following new note :

NOTE 2 For the largest cross-sectional area the test current generally applied is I_{th} or I_{the} declared for the product. For the smallest cross-sectional area, the test current is given in Table 4 and Table 5 of IEC 60947-1:2009.

8.3.2 General test conditions

Replace, in the existing note, “IEC 60439” by “IEC 61439 series”.

8.3.2.1 General requirements

Delete the existing note.

8.3.2.2.3 Recovery voltage

Replace, in the existing Note 1, “system voltage” by “supply network voltage”.

8.3.3.2.1 Power operated equipment

Replace, in the second existing paragraph, introduced by Amendment 1, “rated control supply voltage” by “rated control circuit supply voltage”.

Replace the fifth existing paragraph added by Amendment 1 by the following new paragraph:

The value of the capacitor shall be

$$C = 30 + 200\,000 / (f \times U)$$

where

C is expressed in nF;

f is the minimum rated frequency expressed in Hz;

U is the maximum value of U_s expressed in V.

8.3.3.3.1 Ambient air temperature

Replace the second existing paragraph by the following new paragraph:

During the test, the ambient temperature shall be between +10 °C and +40 °C and shall not vary by more than 10 K. The ambient temperature shall not vary by more than 3 K during the last quarter of the test or the last hour of the test, whichever is the shorter. The test shall be conducted until this condition is achieved.

Delete the third existing paragraph of this subclause.

8.3.3.4.1 Type tests

Delete Note 2 in the existing item 1).

Renumber, in the existing item 1), "Note 3" and "Note 4" added by Amendment 1 as "Note 2" and "Note 3" respectively.

Replace, in the existing item 3) c), the text modified by Amendment 1 by the following new text and new note:

The test voltage shall be applied to for 60 s in accordance with items i), ii) and iii) of 2) c) above.

NOTE For devices already type-tested according to this standard and its Amendment 1 or earlier, a re-testing according to 60 s is not necessary.

Replace, in the existing item 6), the existing text "Under consideration" by "Equipment with d.c. ratings only shall be tested with d.c. test voltage".

Add, before the existing Subclause 8.3.4, the following new subclause:

8.3.3.8 Pole impedance

The pole impedance shall be determined during the test and with the conditions given in 8.3.3.3.4. The test in an enclosure is not deemed necessary even if the switching device can be used in an individual enclosure.

The voltage drop U_d shall be measured between the line and load terminals (terminals included) of the switching device using the same measuring points as for the temperature rise. The measurement shall be performed after a time sufficient for the temperature-rise to reach a steady-state value.

The impedance per pole is defined as follows:

$$Z = U_d / I_{th} [\Omega]$$

The declared value (see 5.1 modified by this Amendment 2), in the case of multiple identical poles, shall be the average value obtained from the tests.

Care should be taken that voltage drop measurement does not significantly affect the temperature rise nor affect significantly the impedance.

NOTE The method is the same irrespective of the number of poles of the switching device.

8.4 Tests for EMC

Replace the existing text of this subclause by the following new text:

Emission and immunity tests are type tests and shall be carried out using the manufacturer's instructions for installation in accordance with the reference EMC standards.

The product standard shall specify any particular test condition (e.g. use of an enclosure) and additional measures necessary to verify the performance criteria of the product (e.g. application of dwell times).

Add, before the existing Subclause 8.4.2, the following new subclause:

8.4.1.2.9 Harmonics in the supply

Under consideration.

Table 1 – Standard cross-sections of round copper conductors and approximate relationship between mm² and AWG/kcmil sizes

Replace, in the existing title of this table, "Standard" by "Nominal" and in the header of this table "Rated" by "Nominal".

Table 3 – Temperature-rise limits of accessible parts (see 7.2.2.2 and 8.3.3.3.4)

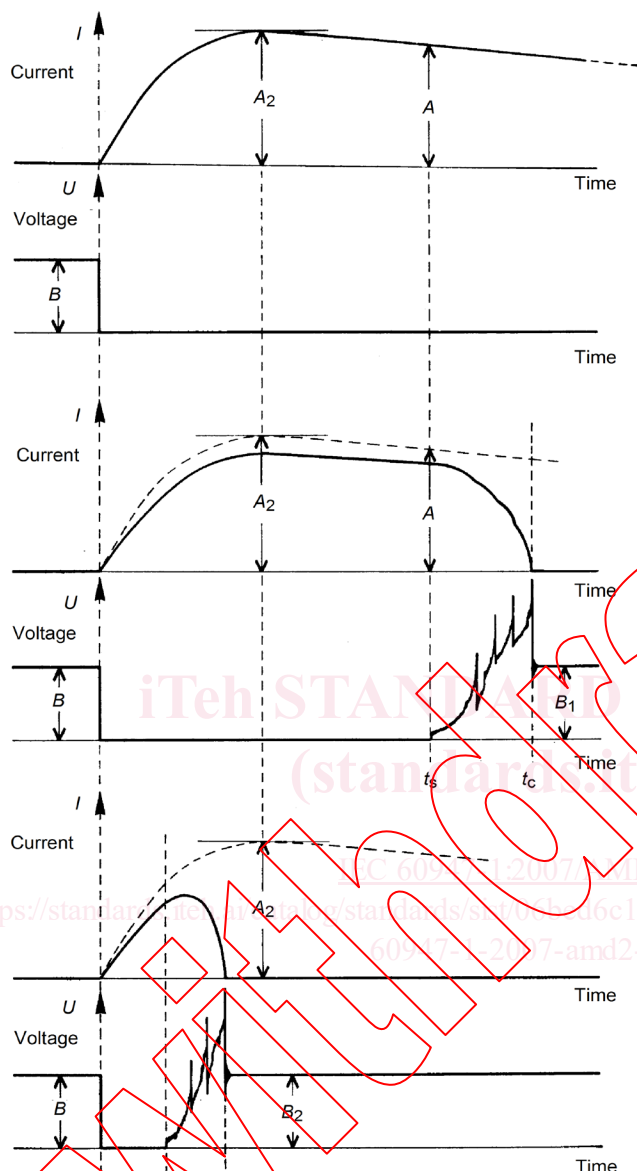
In order to delete the reference to footnote b, replace the headline "Parts which need not be touched during normal operation ^b:" by "Parts which need not be touched during normal operation".

Table 4 – Tightening torques for the verification of the mechanical strength of screw-type terminals

Replace, in the existing title of this table, "(see 8.3.2.1, 8.2.6 and 8.2.6.2)" by "(see 8.2.4.2 and 8.3.2.1)".

Figure 14 – Verification of short-circuit making and breaking capacities on d.c.

Replace the existing figure by the following new figure (addition of "A₂" in Figure 14b):



a) Calibration of the circuit
 Prospective peak making current = A_2

b) Oscillogram corresponding to a break after the current has passed its maximum value
 Short-circuit breaking capacity:
 Current $I = A$ at voltage $U = B_1$
 Short-circuit making capacity:
 Current $I = A_2$ at voltage $U = B$

c) Oscillogram corresponding to a break before the current has reached its maximum value
 Short-circuit breaking capacity:
 Current $I = A_2$ at voltage $U = B_2$
 Short-circuit making capacity:
 Current $I = A_2$ at voltage $U = B$

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Table 12A – Dielectric test voltage corresponding to the rated insulation voltage

Replace the existing footnote ^b of this table by the following new footnote:

^b Test voltages based on 6.1.3.4.1, fifth paragraph, of IEC 60664-1:2007.

Annex A – Examples of utilization categories for low-voltage switchgear and controlgear

Replace the existing title and text of this annex by the following: