

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 2
AMENDEMENT 2

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

**Appareillage à basse tension –
Partie 3: Interrupteurs, sectionneurs, interrupteurs-sectionneurs et combinés-
fusibles**

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FOREWORD

This amendment has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

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

FDIS	Report on voting
121A/42/FDIS	121A/46/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 publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

1 General

1.2 Normative references

Replace the existing subclause by the following new subclause:

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 60050-441:1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441 Switchgear, controlgear and fuses*
IEC 60050-441:1984/AMD1:2000

IEC 60269 (all parts), *Low-voltage fuses*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60417-DB:2002¹, *Graphical symbols for use on equipment*

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*
IEC 60947-1:2007/AMD1:2010
IEC 60947-1:2007/AMD2:2014

¹ "DB" refers to the IEC on-line database.

IEC 60947-2:2006, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*
IEC 60947-2:2006/AMD1:2009
IEC 60947-2:2006/AMD2:2013

IEC 60947-4-1:2009, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*
IEC 60947-4-1:2009/AMD1:2012

IEC 60947-5-1:2003, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*
IEC 60947-5-1:2003/AMD1:2009

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*
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

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

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

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

CISPR 11:2009, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2009/AMD1:2010

CISPR 22:2008, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

2 Terms and definitions

Replace the title and text of the existing clause, modified by Amendment 1, by the following new title and text:

2 Terms, definitions and index of terms

2.1 General

For the purposes of this document, the terms and definitions given in IEC 60050-441 and IEC 60947-1 as well as the following apply.

2.2 Alphabetical index of terms

	Reference
D	
Disconnecter.....	2.3.1
Disconnecter-fuse.....	2.3.5
Disconnecter-fuse single opening.....	2.3.5.1
Disconnecter-fuse double opening.....	2.3.5.2
F	
Fuse-combination unit.....	2.3.2
Fuse-disconnector.....	2.3.6
Fuse-disconnector single opening.....	2.3.6.1
Fuse-disconnector double opening.....	2.3.6.2
Fuse-switch.....	2.3.4
Fuse-switch single opening.....	2.3.4.1
Fuse-switch double opening.....	2.3.4.2
Fuse-switch-disconnector.....	2.3.8
Fuse-switch-disconnector single opening.....	2.3.8.1
Fuse-switch-disconnector double opening.....	2.3.8.2
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Semi-independent manual operation.....	2.3.10
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Switch-disconnector-fuse.....	2.3.7
Switch-disconnector-fuse single opening.....	2.3.7.1
Switch-disconnector-fuse double opening.....	2.3.7.2
Switch-fuse.....	2.3.3
Switch-fuse single opening.....	2.3.3.1
Switch-fuse double opening.....	2.3.3.2

2.3 Terms and definitions

2.3.1

disconnecter

mechanical switching device which, in the open position, complies with the requirements specified for the isolating function

Note 1 to entry: A disconnecter is capable of opening and closing a circuit when either a negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the poles of the disconnecter occurs. It is also capable of carrying currents under normal circuit conditions and carrying, for a specified time, currents under abnormal conditions such as those of short-circuit.

[SOURCE: IEC 60050-441:1984, 441-14-05, modified – reference to isolating function instead of isolating distance]

2.3.2

fuse-combination unit

combination of a mechanical switching device and one or more fuses in a composite unit, assembled by the manufacturer or in accordance with his instructions

[SOURCE: IEC 60050-441:1984, 441-14-04]

2.3.3

switch-fuse

switch in which one or more poles have a fuse in series in a composite unit

[SOURCE: IEC 60050-441:1984, 441-14-14]

2.3.3.1

switch-fuse single opening

switch-fuse which provides an interruption in the circuit on one side of the fuse-link only

Note 1 to entry: With this arrangement safety precautions may be necessary when removing fuse-links.

2.3.3.2

switch-fuse double opening

switch-fuse which provides an interruption in the circuit on both sides of the fuse-link

Note 1 to entry: With this arrangement safety precautions may be necessary when removing fuse-links.

2.3.4

fuse-switch

switch in which a fuse-link or fuse-carrier with fuse-link forms the moving contact

[SOURCE: IEC 60050-441:1984, 441-14-17]

2.3.4.1

fuse-switch single opening

fuse-switch which provides an interruption in the circuit on one side of the fuse-link only

Note 1 to entry: With this arrangement, safety precautions may be necessary when removing fuse-links.

2.3.4.2

fuse-switch double opening

fuse-switch which provides an interruption in the circuit on both sides of the fuse-link

NOTE 1 to entry: With this arrangement, safety precautions may be necessary when removing fuse-links.

2.3.5

disconnecter-fuse

disconnecter in which one or more poles have a fuse in series in a composite unit

[SOURCE: IEC 60050-441:1984, 441-14-15]

2.3.5.1

disconnecter-fuse single opening

disconnecter-fuse which provides an opening in the circuit on at least one side of the fuse-link, that satisfies the requirements specified for the isolating function

Note 1 to entry: With this arrangement, safety precautions may be necessary when removing fuse-links.

2.3.5.2

disconnecter-fuse double opening

disconnecter-fuse which provides an opening in the circuit that satisfies the requirements specified for the isolating function on both sides of the fuse-link

2.3.6

fuse-disconnector

disconnecter in which a fuse-link or fuse-carrier with fuse-link forms the moving contact

[SOURCE: IEC 60050-441:1984, 441-14-18]

2.3.6.1

fuse-disconnector single opening

fuse-disconnector which provides an opening in the circuit on at least one side of the fuse-link that satisfies the requirements specified for the isolating function

Note 1 to entry: With this arrangement, safety precautions may be necessary when removing fuse-links.

2.3.6.2**fuse-disconnector double opening**

fuse-disconnector which provides an opening in the circuit, that satisfies the requirements specified for the isolating function, on both sides of the fuse-link

2.3.7**switch-disconnector-fuse**

switch-disconnector in which one or more poles have a fuse in series in a composite unit

[SOURCE: IEC 60050-441:1984, 441-14-16]

2.3.7.1**switch-disconnector-fuse single opening**

switch-disconnector-fuse which provides an interruption in the circuit on at least one side of the fuse-link that satisfies the requirements specified for the isolating function

Note 1 to entry: With this arrangement, safety precautions may be necessary when removing fuse-links.

2.3.7.2**switch-disconnector-fuse double opening**

switch-disconnector-fuse which provides an interruption in the circuit on both sides of the fuse-link that satisfies the requirements specified for the isolating function

2.3.8**fuse-switch-disconnector**

switch-disconnector in which a fuse-link or fuse-carrier with fuse-link forms the moving contact

[SOURCE: IEC 60050-441:1984, 441-14-19]

2.3.8.1**fuse-switch-disconnector single opening**

fuse-switch-disconnector which provides an interruption in the circuit on at least one side of the fuse-link that satisfies the requirements specified for the isolating function

Note 1 to entry: With this arrangement, safety precautions may be necessary when removing fuse-links.

2.3.8.2**fuse-switch-disconnector double opening**

fuse-switch-disconnector which provides an interruption in the circuit on both sides of the fuse-link that satisfies the requirements specified for the isolating function

2.3.9**single pole operated three pole device**

mechanical unit consisting of three individually operable single pole switches and/or disconnecting units according to this part, rated as a complete unit for use in a three-phase system

Note 1 to entry: These mechanical units are intended for power distribution systems where switching and/or isolation of an individual phase may be necessary and they should not be used for the switching of the primary circuit of three-phase equipment.

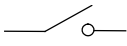
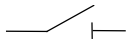
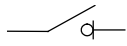
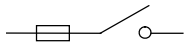
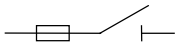
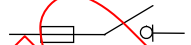
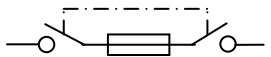
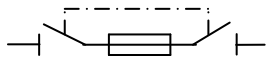




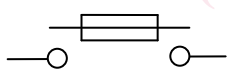

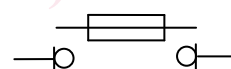
2.3.10**semi-independent manual operation**

operation solely by means of directly applied manual energy such that the manual force is increased up to a threshold value beyond which the independent switching operation is achieved unless deliberately delayed by the operator

2.4 Summary of the equipment types

A summary of equipment definitions and relevant diagrams is given in Table 1.

Table 1 – Summary of equipment definitions

Functions		
Making and breaking current	Isolating	Making, breaking and isolating
Switch 	Disconnecter 	Switch-disconnector 
Fuse-combination units		
Switch-fuse single opening ^a 	Disconnecter-fuse single opening ^a 	Switch-disconnector-fuse single opening ^a 
Switch-fuse double opening ^b 	Disconnecter-fuse double opening 	Switch-disconnector-fuse double opening ^b 
Fuse-switch single opening ^a 	Fuse-disconnector single opening ^a 	Fuse-switch-disconnector single opening ^a 
Fuse-switch double opening ^b 	Fuse-disconnector double opening 	Fuse-switch-disconnector double opening ^b 
NOTE Equipment shown as single opening may comprise multiple openings in series.		
^a The fuse may be on either side of the contacts of the equipment.		
^b Depending on the design, breaking may take place on one or both sides of the fuse-link.		

4.2 Type of equipment

Replace the existing text of this subclause including 4.2.1, 4.2.2, 4.2.3 and changes introduced in Amendment 1 by the following:

The following information shall be stated:

- number of poles;
- kind of current (a.c. or d.c.);
- in the case of a.c., number of phases and rated frequency;
- number of positions of the main contacts (if more than two);
- breaking arrangement for fused devices (single opening or double opening).

5.2 Marking

Replace the existing item 5.2.2.c) by the following:

- c) rated operational currents (or rated powers) with the corresponding rated operational voltage and utilization category (see 4.3.1, 4.3.2 and 4.4);

Replace the existing item 5.2.2 e) by the following:

- e) for fuse-combination units, the fuse characteristics and maximum rated current and the maximum power loss of the fuse-link;

7.1.2 Materials

Delete the heading "7.1.2 Materials" (and associated text modified by Amendment 1). Retain "7.1.2.2 Glow wire testing".

7.1.4 Clearance and creepage distances

Delete the existing title and text of 7.1.4 (as modified by Amendment 1).

7.1.7.2 Supplementary requirements for equipment with provision for electrical interlocking with contactors or circuit breakers

Delete the existing title and text of 7.1.7.2 (as modified by Amendment 1).

7.1.7.3 Supplementary requirements for equipment provided with means for padlocking the open position

Delete the existing title and text of 7.1.7.3 (as modified by Amendment 1).

7.1.12 Degrees of protection of enclosed equipment

Delete the existing title and text of 7.1.12 (as modified by Amendment 1).

7.3.1 Vacant

Replace the title "7.3.1 Vacant" by the following title and text:

7.3.1 General

Subclause 7.3.1 of IEC 60947-1:2007/AMD1:2010 applies.

8.2.5.2 Method of test

Delete the existing title and text of 8.2.5.2 (as modified by Amendment 1).

8.2.5.3 Condition of equipment during and after test

Delete the existing title and text of 8.2.5.3 (as modified by Amendment 1, except Table 9).

8.3.3.1 Temperature rise

Replace the second existing paragraph modified by Amendment 1, starting by "The test shall be carried out ... ", by the following:

As a minimum the test shall be carried out at the rated operational current I_e . At the manufacturer's discretion, when I_{th} and/or I_{the} are higher than I_e , the higher value may be used. In the case of an AC-20 or DC-20 rating, the temperature rise test shall be carried out at I_{th} , or I_{the} if the device is in a specified enclosure.

8.3.3.5 Leakage current

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

The leakage current shall be checked across the contact gaps as follows:

- a) disconnecter and switch-disconnector: between load and line terminals;
- b) disconnecter-fuse, switch-disconnector-fuse, fuse-disconnector and fuse-switch-disconnector single opening: between load and line terminals;
- c) disconnecter-fuse, switch-disconnector-fuse, fuse-disconnector and fuse-switch-disconnector double opening: (i) between line terminals and the fuse-links; (ii) between load terminals and the fuse-links; and (iii) between load and line terminals.

Add, after the existing Annex C, the following new Annex D:

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Annex D (normative)

Switches, disconnectors, switch-disconnectors and fuse-combination units for use in photovoltaic (PV) d.c. applications

D.1 General

As part of the answer to the challenge of sustainable development, the number of photovoltaic (PV) installations is increasing. This latest development in photovoltaic (PV) technology is challenging the conventional approach to energy sources and power distribution systems, including their operating conditions and environment.

PV applications have particular characteristics and require equipment with specific performance. These performance requirements are identified for IEC 60947-3 products in this annex.

NOTE The abbreviation "PV" (photovoltaic) is used in this annex.

The provisions of IEC 60947-3 are applicable to equipment specified in this annex, where specifically identified. Clauses, subclauses, tables, figures and annexes of IEC 60947-3 thus applicable are identified by their particular reference, for example as "4.3.4.1", "Table 2" or "Annex A".

D.1.1 Scope and object

This annex apply to d.c. switches, disconnectors, switch-disconnectors and fuse-combination units, rated up to 1 500 V d.c., intended for use in photovoltaic (PV) systems, and hereafter referred to as "PV switches, PV disconnectors, PV switch-disconnectors and PV fuse-combination units".

Switches, disconnectors, switch-disconnectors and fuse-combination units used in PV systems are subject to electrical, environmental and operational conditions that differ from the general conditions taken into account in the body of this standard. The requirements have thus been adapted to reflect these conditions of use.

The object of this annex is to state:

- the requirements for PV switches, PV disconnectors, PV switch-disconnectors and PV fuse-combination units to be used on the d.c. side of PV applications;
- the tests to verify that the product performance is consistent with the PV applications and the expected life in PV environmental conditions.

D.1.2 Normative references

Subclause 1.2 applies with the following additions:

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

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

D.2 Terms and definitions

Clause 2 applies with the following additions:

D.2.3 critical load current

I_{crit}
value of breaking current, within the range of service conditions, at which the arcing time is significantly extended

Note 1 to entry: This phenomenon, crucial for PV applications, is due to the low magnetic field coming from the arc current, creating a slow moving arc.

[SOURCE: IEC 60947-1:2007, 2.5.16, modified – addition of the Note 1 to entry.]

D.3 Classification

Clause 3 applies with the following changes:

D.3.1 According to the utilization category

For PV applications the utilization categories given in existing Table 2 are replaced by DC-PV0, DC-PV1 or DC-PV2 (see Table D.1).

D.4 Characteristics

Clause 4 applies with the following changes:

D.4.3.5.1 Ability to withstand motor switching overload currents

Subclause 4.3.5.1 is not applicable.

D.4.3.5.2 Rated making capacity

Replace, in the second paragraph of 4.3.5.2, "Table 3" by "Table D.5".

D.4.3.5.3 Rated breaking capacity

Replace, in the second paragraph of 4.3.5.3, "Table 3" by "Table D.5".

D.4.3.6.1 Rated short-time withstand current (I_{CW})

Subclause 4.3.6.1 applies as follows:

Equipment with utilization category:

- a) DC-PV1: rated short-time withstand current is not applicable;
- b) DC-PV0 and DC-PV2: in accordance with 4.3.6.1.

D.4.4 Utilization category

Replace the existing text of 4.4 by the following:

The utilization categories define the intended application and are given in Table D.1.

Each utilization category is characterized by the values of the currents and voltages, expressed as multiples of the rated operational current and rated operational voltage, as well as the time constant of the circuit. The conditions for making and breaking given in Table D.5 correspond to the application listed in Table D.1.

Table D.1 – Utilization categories

Utilization category	Typical applications
DC-PV0	Opening and closing a PV circuit to provide disconnection when no current is flowing.
DC-PV1	Connecting and disconnecting single PV string(s) where reverse currents and significant overcurrent cannot occur.
DC-PV2	Connecting and disconnecting PV circuits where significant overcurrents may prevail and where current flow can be in both directions; for example, where several strings are connected in parallel and to the same inverter, or, one or more strings with a battery.

D.5 Product information

Clause 5 applies with the following modifications:

D.5.2 Marking

Replace the last paragraph of 5.2.1 by the following new paragraph:

Devices of utilization category AC-20A, AC-20B, DC-20A, DC-20B and DC-PV0 shall be marked "Do not operate under load" unless the device is interlocked to prevent such operation.

Replace the existing item 5.2.2.c) by the following:

- c) rated operational currents (or rated powers) with the corresponding rated operational voltage and utilization category (see 4.3.1, 4.3.2 and D.4.4);

Add to the existing list in 5.2.2 the following new item h):

- h) PV category: "DC-PV0", "DC-PV1" or "DC-PV2".

Add to the existing list in 5.2.4 the following new items h), i), j) and k):

- h) diagram and method of series connecting poles of mechanical switching devices for each operational rating;
- i) appropriate connection to the PV generator and load, if applicable;
- j) "+" and "-" polarities, if applicable;
- k) suitable for indoor or outdoor use.

D.6 Normal service, mounting and transport conditions

Clause 6 applies, with the following changes:

This annex covers the use of PV switches, PV disconnectors, PV switch-disconnectors and PV fuse-combination units for use in the alternative service arrangements detailed in Table D.2.