IEC 60947-1

Edition 5.0 2010-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

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

Appareillage à basse tension –
Partie 1: Règles générales

IEC 60947-1:2007/A1:2010

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 It also gives information on projects, withdrawn and replaced publications.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

IEC 60947-1

Edition 5.0 2010-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

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

Appareillage à basse tension – Partie 1: Règles générales

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX W

ICS 29.130.20

ISBN 978-2-88912-291-2

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
17B/1710/FDIS	17/1721/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 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.

1 General

Replace the existing note of this clause by the following new note:

NOTE The product standards forming the series of IEC standards covering low-voltage switchgear and controlgear are:

IEC 60947-2: Part 2: Circuit-breakers

IEC 60947-3: Part 3: Switches, disconnectors, switch-disconnectors and fuse combination units

IEC 60947-4: Part 4: Contactors and motor-starters

IEC 60947-5: Part 5: Control-circuit devices and switching elements

IEC 60947-6: Part 6: Multiple function equipment

IEC 60947-7: Part 7: Ancillary equipment

IEC 60947-8: Part 8: Control units for built-in thermal protection (PTC) for rotating electrical machines.

1.2 Normative references

Add the following normative references to the existing list:

IEC 60664-3:2003, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60664-5:2007, *Insulation coordination for equipment within low-voltage systems – Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm*

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

IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

IEC 60999-2:2003, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm² up to 300 mm² (included)*

IEC 61557-2, *Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 2: Insulation resistance*

2 Definitions

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

Clamping unit	2.3.26
Multiple tip contact system	2.3.29
Prepared conductor	2.3.28
Screw-type terminal	2.3.24
Screwless-type terminal	2.3.25
Unprepared conductor	2.3.27

This correction does not apply to the English text.

Add, in the alphabetical list, the following new terms and references:

Connecting device	2.3.22
Electronically controlled electromagnet	2.3.32
Electronic overload relay with current or voltage asymmetry function	T.2.2
Electronic overload relay with ground/earth fault detection function	T.2.1
Electronic overload relay with phase reversal function	T.2.3
Electronic overload relay with over voltage function	T.2.4
Electronic overload relay with under power function	T.2.6
External control device	U.1.1
Inhibit current	T.2.5
Maximum cross-section	2.3.31
Minimum cross-section	2.3.30
Non-universal clamping unit	2.3.26.2
Non-universal terminal	2.3.25.2

Replace the existing terms and definitions 2.3.22 to 2.3.28 by the following new terms and definitions:

2.3.22
connecting device
a device for the electrical connection of one (or more) conductor(s), comprising one (or more) terminal(s), either fixed to a base or forming an integral part of the equipment

[IEC 60999-1:1999, 3.3]

2.3.23
terminal
conductive part of one pole of a device for electrical connection to external circuit, composed of one or more clamping unit(s) and insulation if necessary

[IEC 60999-1:1999, 3.2, modified]

2.3.24
screw-type terminal
terminal intended for the connection and disconnection of conductors or for the inter-connection of two or more conductors, the connection being made, directly or indirectly, by means of screws or nuts of any kind

NOTE Examples are given in Annex D.

2.3.25
screwless-type terminal
terminal intended for the connection and disconnection of conductors or for the interconnection on two or more conductors, the connection being made, directly or indirectly, by means of springs, wedges, eccentrics or cones, etc.

NOTE Examples are given in Annex D.

2.3.25.1
universal terminal
terminal for the connection and disconnection of all types of conductors (rigid and flexible)

[IEC 60998-2-2:2002, 3.101.1]

2.3.25.2
non-universal terminal
terminal for the connection and disconnection of a certain kind of conductor only (for example, solid conductors only or rigid [solid and stranded] conductors only)

[IEC 60998-2-2:2002, 3.101.2]

2.3.25.3
push-wire terminal
non-universal terminal in which the connection is made by pushing in rigid (solid or stranded) conductors

[IEC 60998-2-2:2002, 3.101.3]

2.3.26

clamping unit
the part(s) of the terminal necessary for the mechanical clamping and the electrical connection of the conductor(s), including the parts which are necessary to ensure the correct contact pressure

[IEC 60999-1:1999, 3.1]

2.3.26.1
universal clamping unit
clamping unit intended for all types of conductors

2.3.26.2
non-universal clamping unit
clamping unit intended for certain types of conductors only, for example:
– push-wire clamping unit for solid conductors only
– push-wire clamping unit for rigid (solid and stranded) conductors only

NOTE On push-wire clamping unit the connection is made by simple insertion of rigid conductors. (see 7.1.8.1)

2.3.27
unprepared conductor
conductor which has been cut and the insulation of which has been removed for insertion into a terminal

NOTE A conductor the shape of which is arranged for introduction into a terminal or the strands of which are twisted to consolidate the end is considered to be an unprepared conductor.

2.3.28
prepared conductor
conductor, the strands of which are soldered or the end of which is fitted with a cable lug, eyelet, etc.

Add, after definition 2.3.28, the following new terms and definitions 2.3.29 to 2.3.32 :

2.3.29
multiple tip contact system
contact system comprising more than one contact gap per pole, which can be switched, in series and/or in parallel

2.3.30
minimum cross-section
value of the smallest connectable conductor cross-section stated by the manufacturer as suitable for the terminal

NOTE The manufacturer may declare several minimum cross-sections depending on the type of conductor, for example rigid, stranded, flexible, with or without ferrule.

2.3.31
maximum cross-section
value of the largest connectable conductor cross-section stated by the manufacturer as suitable for the terminal

NOTE 1 The manufacturer may declare several maximum cross-sections depending on the type of conductor, for example rigid, stranded, flexible, with or without ferrule.

NOTE 2 The term “rated cross-section” used in IEC 60947-7-1 and IEC 60999-2 and the term “rated connecting capacity” of a clamping unit used in IEC 60999-1 are considered equivalent when referring to certain thermal,

mechanical and electrical requirements, as stated by the manufacturer and as specified in their relevant product standard.

2.3.32
electronically controlled electromagnet
electromagnet in which the coil is controlled by a circuit with active electronic elements

4 Characteristics

*In the existing line "*Rated ultimate short-circuit breaking capacity*" of the list, replace "*4.3.2.4*" by "*a*".*

*In the existing line "*Rated uninterrupted current*" of the list, replace "*a*" by "*4.3.2.4*".*

4.5.1 Electrical control circuits

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

4.5.1 Electrically or electronically controlled circuits

Characteristics of electrical and electronic control circuits:

– type of current;
– rated frequency or d.c.;
– rated control circuit voltage U_c (a.c., d.c.);
– rated control supply voltage U_s (a.c., d.c.), where applicable;
– nature of external control circuit devices (contacts, sensors, optocouplers, electronic active components, etc);
– power consumption.

NOTE 1 In case of an electrical control circuit a distinction has been made above between the control circuit voltage U_c, which is the voltage which would appear across the "a" contacts (see 2.3.12) in the control circuit, and the control supply voltage U_s, which is the voltage applied to the input terminals of the control circuit of the equipment and may be different from the control circuit voltage, due to the presence of built-in transformers, rectified, resistors, etc.

NOTE 2 In case of an electronically control circuit a distinction is made between the control circuit voltage U_c, which is the controlling input signal, and the control supply voltage U_s, which is the voltage applied to energize the power supply terminals of the control circuit equipment and may be different from U_c due to the presence of built-in transformers, rectifiers, resistors, electronic circuitry, etc.

The rated control circuit voltage and rated frequency, if any, are the values on which the operating and temperature-rise characteristics of the control circuit are based. The correct operating conditions are based upon a value of the control supply voltage not less than 85 % of its rated value, with the highest value of control circuit current flowing, nor more than 110 % of its rated value.

The electronic part of an electronically controlled electromagnet may form an integral part or a separate part provided it is an intrinsic function of the device. In both cases, the device shall be tested with this electronic part mounted as in normal use.

Annex U gives examples and illustrations of different circuit configurations.

The ratings and characteristics of control circuit devices shall comply with the requirements of IEC 60947-5 (see the note of Clause 1).

4.7 Relays and releases

Add, at the end of the existing list, the following new dashed item:

– extended functions as given in Annex T.

4.8 Co-ordination with short-circuit protective devices (SCPD)

Replace the existing note by the following new note:

NOTE IEC/TR 61912-1 gives guidance on co-ordination with SCPDs.

5.1 Nature of information

In the list of characteristics, add after "- rated impulse withstand voltage (see 4.3.1.3)*", the following new dashed item:*

– relay or release characteristics (see 4.7);

Add the following new text before the existing note of this subclause:

– length of insulation to be removed before insertion of the conductor into the terminal;
– maximum number of conductors which may be clamped.

For non-universal screwless terminals:

– "s" or "sol" for terminals declared for rigid-solid conductors;
– "r" for terminals declared for rigid (solid and stranded) conductors;
– "f" for terminals declared for flexible conductors .

In the case of electronically controlled electromagnets, other information may also be necessary, for example control circuit configuration (see 4.5 and Annex U).

5.2 Marking

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

In the case of electronically controlled electromagnets, information other than that given in 5.1 may also be necessary (see also 4.5 and Annex U).

The indication "s", "sol", "r" or "f" for non-universal screwless terminals shall be marked on the device or, if the space available is not sufficient, on the smallest package unit or in technical information provided with the product.

In the case of a group of terminals located together, a single marking on the device is acceptable.

7.1.2.1 General materials requirements

Replace the first paragraph of this subclause by the following new paragraph:

Parts of insulating materials which might be exposed to thermal stresses due to electrical effects within the equipment shall not be adversely affected by abnormal heat and by fire.

Delete the existing last paragraph of this subclause.

7.1.2.2 Glow wire testing

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

The suitability of materials used is verified by:

a) making tests on the equipment; or

b) making tests on sections taken from the equipment; or

c) making tests on any parts of identical material having representative thickness; or

d) providing data from the insulating material supplier fulfilling the requirements according to IEC 60695-2-12.

The suitability shall be determined with respect to resistance to abnormal heat and fire.

The manufacturer shall indicate which methods, amongst a), b), c) and d) shall be used.

7.1.2.3 Test based on flammability category

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

Alternatively, the manufacturer may provide data from the insulating material supplier fulfilling the requirements given in Annex M.

7.1.7.1 Additional constructional requirements

Replace the existing third dashed item of the list by the following new dashed item:

– visibility of all moving main contacts.

7.1.8.1 Constructional requirements

Replace the second paragraph of this subclause by the following new paragraph:

Terminal connections shall be such that the force to connect the conductors may be applied by screws, screwless-type or other equivalent means so as to ensure that the necessary contact pressure is maintained.

Add, after the existing Note 1 of this subclause, the following new text:

Screwless-type clamping units, unless otherwise specified by the manufacturer, shall accept rigid and flexible conductors as indicated in Table 1.

On screwless-type clamping unit, the connection or disconnection of conductors shall be made as follows:

– on universal clamping units by the use of a general purpose tool or a convenient device, integral with the clamping unit to open it for the insertion or withdrawal of the conductors;

– on push-wire clamping units by simple insertion. For the disconnection of the conductors an operation other than a pull only on the conductor shall be necessary. The use of a general purpose tool or of a convenient device, integral with the clamping unit is allowed in order to "open" it and to assist the insertion or the withdrawal of the conductor.

7.1.10.2 Protective earth terminal

In the last paragraph of this subclause, replace the reference to 2.1.1.5 by a reference to 2.1.15.

7.2.1.2 Limits of operation of power operated equipment

Add, after the existing fourth paragraph of this subclause, the following new text:

The limits between which an equipment, with an electronically controlled electromagnet, shall drop out and open fully are

– for d.c.: 75 % to 10 % of their rated control supply voltage U_s,

– for a.c.: 75 % to 20 % of their rated control supply voltage U_s, or 75 % to 10 % of their rated control supply voltage U_s if specified by the manufacturer.

Add, after the last existing paragraph of this subclause, the following new paragraph:

The drop out time may need to be specified for particular applications. In this case the drop out time shall be measured during the test associated with the verification of this subclause.

7.2.3 Dielectric properties

Add, at the end of the first paragraph, the following new second sentence:

For reduced clearances and creepage distances through the use of coating see IEC 60664-3; for clearances and creepage distances equal to or less than 2 mm see IEC 60664-5.

7.3.1 General

Add, after the existing Note 2 of this subclause, the following new paragraph:

For the purpose of this standard, the phrase “electronic circuit” excludes circuits in which all components are passive (including diodes, resistors, varistors, capacitors, surge suppressors, inductors).

7.3.2.2 Equipment incorporating electronic circuits

Delete the existing second paragraph of this subclause.

8.2.4 Mechanical properties of terminals

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

8.2.4 Mechanical and electrical properties of terminals

8.2.4.2 Tests of mechanical strength of terminals

Replace, in the existing first paragraph of this subclause, "cross-sectional area" *by* " cross-section".

Add, after the existing first paragraph of this subclause, the following new paragraph:

Screwless-type clamping unit according to 7.1.8.1 are tested with conductors of the maximum cross-section.

8.2.4.3 Testing for damage to and accidental loosening of conductors (flexion test)

Replace, in the existing item a) of this subclause, "smallest cross-section" *by* "minimum cross-section".

Replace, in the existing item b) of this subclause, "largest cross-section" *by* "maximum cross-section".

Replace, in the existing item c) of this subclause, "smallest and largest cross-sections" *by* "minimum and maximum cross-sections".

8.2.4.4.1 Round copper conductors

Replace the existing third paragraph of this subclause by the following paragraph:

The force shall be applied without jerks for 1 min, in the direction of the axis of the conductor.

8.2.4.5 Test for insertability of unprepared round copper conductors having the maximum specified cross-section

In the existing title of this subclause, replace "maximum specified cross-section" *by* "maximum cross-section".

Add, after the existing subclause 8.2.4.6, the two following new subclauses 8.2.4.7 and 8.2.4.8:

8.2.4.7 Electrical performance of screwless-type clamping units

Subclauses 9.8 of IEC 60999-1 and 9.8 of IEC 60999-2 apply.

NOTE 1 The terms “smallest cross-sectional area” and “largest cross-sectional area” of IEC 60999 series are respectively "minimum cross section" (2.3.30) and "maximum cross section" (2.3.31) defined in this standard.

NOTE 2 The test current generally applied is I_{th} or I_{the} declared for the product.

The detailed test requirements may be adapted in the product standards.

NOTE 3 The product standard should consider the practicality of the detailed test requirements.

8.2.4.8 Ageing test for screwless-type clamping units

Subclauses 9.10 of IEC 60999-1 and 9.10 of IEC 60999-2 apply.

NOTE 1 The terms “smallest cross-sectional area” and “largest cross-sectional area” of IEC 60999 series are respectively "minimum cross section" (2.3.30) and "maximum cross section" (2.3.31) defined in this standard.

NOTE 2 The test current generally applied is I_{th} or I_{the} declared for the product.

The detailed test requirements may be adapted in the product standards.

NOTE 3 The product standard should consider the practicality of the detailed test requirements.

8.2.5.2.1 Dependent and independent manual operation

Add, after the existing third paragraph of this subclause, the following new paragraph:

Where the device has more than one contact system in series, all contact systems that are in series shall be held in the closed position.

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

Verification shall be made according to 8.2.5.3.1.

8.2.5.2.2 Dependent power operation

Add, after the first paragraph of this subclause, the following new paragraph:

Where the device has more than one contact system in series, all contact systems that are in series shall be held in the closed position.

8.2.5.2.3 Independent power operation

Add, after the first paragraph of this subclause, the following new paragraph:

Where the device has more than one contact system in series, all contact systems that are in series shall be held in the closed position.

8.3.3.2.1 Power operated equipment

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

In the case of a power operated equipment with electronically controlled electromagnet, supplied with a.c., where a drop out range is declared with limits between 75 % to 10 % of their rated control supply voltage U_s, the equipment shall, in addition, be submitted to the capacitive drop out test as follows:

A capacitor C shall be inserted in series in the supply circuit U_s, the total length of the connecting conductors being ≤3 m. The capacitor is short-circuited by a switch of negligible impedance. The supply voltage shall then be adjusted to 110 % U_s.

It shall be verified that the equipment drops out when the switch is operated to the open position.

The value of the capacitor shall be

$$C\ (\text{nF}) = 30 + 200\,000 / (f \times U_s)$$

where

f is the minimum rated frequency (Hz);
U_s is the maximum rated supply voltage (V).

For example for a coil rated 12...24 V ~ 50 Hz, the capacitor value is 196 nF (calculation made with U_s max).

The test voltage is the highest value of the declared rated supply voltage range U_s.

NOTE The value of the capacitor simulates a typical control wiring of 100 m long cable of 1,5 mm2 (0,3 nF/m that is 30 nF for 100 m) connected to a static output having a 1,3 mA leakage current (200 000 in the formula ≈ 10 E+9 *1,3 E-3/2*π).

8.3.3.3.2 Measurement of the temperature of parts

Replace the fifth paragraph of this subclause by the two following new paragraphs:

For electromagnet coils, the method of measuring the temperature by variation of resistance shall generally be used. Other methods are permitted only if it is impracticable to use the resistance method, for example for electronically controlled electromagnet. When measured by another method than the resistance method the limits of temperature rise permitted shall be adjusted accordingly. The product standard shall state the method and the limits.

In the case of an electronically controlled electromagnet, coil temperature measuring by variation of resistance may be impracticable; in such a case, other methods are permitted, e.g. thermocouples or other suitable methods. When measured by another method than the resistance method the limits of temperature rise permitted shall be adjusted accordingly. The product standard shall state the method and the limits.

8.3.3.4.1 Type tests

Add, at the end of item 1), the following new text:

For the dielectric test between phases, all circuits between these phases may be disconnected for the test.

NOTE 3 The purpose of this test is to check the functional insulation only.

When the circuits of equipment include devices such as motors, instruments, snap switches, capacitors and solid state devices which, according to their relevant specifications, have been subjected to dielectric test voltages lower than those specified in this standard, such devices shall be disconnected for the test.

Where the control circuit normally connected to the main circuit is disconnected, the method used to maintain the main contacts closed shall be indicated in the test report.

For the dielectric test between phase and earth, all circuits shall be connected.

NOTE 4 The connection of all circuits for this test takes into account the function of protection against electric shock of the insulation between phase and earth.

Printed circuit boards and modules with multi-point connectors may be disconnected or replaced by dummies during the insulation test. This does not apply, however, to auxiliaries for which, in case of an insulation fault, voltage may pass onto accessible parts not connected to the housing or from the side of higher voltage to the side of lower voltage, e.g. auxiliary transformers, measuring equipment, pulse transformers, the insulation stress of which is equal to that for the main circuit.

Replace the last paragraph of item 2) a) by the following new paragraph:

Clearances equal to or larger than the values of case A of Table 13 may be verified by measurement, according to the method described in Annex G.

Replace the last paragraph of item 3) a), by the following new paragraph:

The values of Table 12A are deemed to cover the ability to withstand temporary overvoltages (see the footnote b of Table 12A).

Add, after the first paragraph of item 3) b), the following new note:

NOTE "practically sinusoidal" means that the ratio between the peak value and the r.m.s. value is $\sqrt{2}$ ±3 %.

Delete the last existing sentence of item 3) b).

Replace the existing text of item 3) c), by the following new text and note:

The test voltage shall be applied to for 5 s in accordance with items i), ii) and iii) of 2) c) above.

NOTE The product standard may increase the test duration to 60 s.

8.3.4.1.2 Test circuit

Replace the existing first paragraph of item c) by the following new paragraph:

In each test circuit (Figures 9, 10, 11 and 12), the resistors and reactors are inserted between the supply source S and the equipment D under test. The positions of the closing device A and the current sensing devices (I_1, I_2, I_3) may be different. The closing device A may be located on low voltage side or alternatively on the primary side. In the latter case the testing station has to demonstrate that the voltage wave is not distorted by the residual flux of the short-circuit transformer. The connections of the equipment under test to the test circuit shall be stated in the relevant product standard.

Table 15 – Minimum creepage distances

Replace the existing Table 15 by the following new Table 15:

Table 15 – Minimum creepage distances

Rated insulation voltage of equipment or working voltage a.c. r.m.s. or d.c. [b, c]	Minimum creepage distances for equipment subject to long term stress													
	Printed wiring material													
	Pollution degree													
	1	2	1	2			3				4			
	Material groups													
	All	All except IIIb	All	I	II	III	I	II	IIIa	IIIb	I	II	IIIa	IIIb
V	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0,025	0,04	0,08	0,4	0,4	0,4	1	1	1		1,6	1,6	1,6	
12,5	0,025	0,04	0,09	0,42	0,42	0,42	1,05	1,05	1,05		1,6	1,6	1,6	
16	0,025	0,04	0,1	0,45	0,45	0,45	1,1	1,1	1,1		1,6	1,6	1,6	
20	0,025	0,04	0,11	0,48	0,48	0,48	1,2	1,2	1,2		1,6	1,6	1,6	
25	0,025	0,04	0,125	0,5	0,5	0,5	1,25	1,25	1,25		1,7	1,7	1,7	
32	0,025	0,04	0,14	0,53	0,53	0,53	1,3	1,3	1,3		1,8	1,8	1,8	
40	0,025	0,04	0,16	0,56	0,8	1,1	1,4	1,6	1,8		1,9	2,4	3	
50	0,025	0,04	0,18	0,6	0,85	1,2	1,5	1,7	1,9		2	2,5	3,2	
63	0,04	0,063	0,2	0,63	0,9	1,25	1,6	1,8	2		2,1	2,6	3,4	
80	0,063	0,1	0,22	0,67	0,95	1,3	1,7	1,9	2,1		2,2	2,8	3,6	
100	0,1	0,16	0,25	0,71	1	1,4	1,8	2	2,2		2,4	3	3,8	
125	0,16	0,25	0,28	0,75	1,05	1,5	1,9	2,1	2,4		2,5	3,2	4	
160	0,25	0,4	0,32	0,8	1,1	1,6	2	2,2	2,5		3,2	4	5	
200	0,4	0,63	0,42	1	1,4	2	2,5	2,8	3,2		4	5	6,3	
250	0,56	1	0,56	1,25	1,8	2,5	3,2	3,6	4		5	6,3	8	
320	0,75	1,6	0,75	1,6	2,2	3,2	4	4,5	5		6,3	8	10	
400	1	2	1	2	2,8	4	5	5,6	6,3		8	10	12,5	
500	1,3	2,5	1,3	2,5	3,6	5	6,3	7,1	8		10	12,5	16	
630	1,8	3,2	1,8	3,2	4,5	6,3	8	9	10		12,5	16	20	a
800	2,4	4	2,4	4	5,6	8	10	11	12,5		16	20	25	
1 000	3,2	5	3,2	5	7,1	10	12,5	14	16		20	25	32	
1 250			4,2	6,3	9	12,5	16	18	20		25	32	40	
1 600			5,6	8	11	16	20	22	25		32	40	50	
2 000			7,5	10	14	20	25	28	32		40	50	63	
2 500			10	12,5	18	25	32	36	40		50	63	80	
3 200			12,5	16	22	32	40	45	50	a	63	80	100	
4 000			16	20	28	40	50	56	63		80	100	125	
5 000			20	25	36	50	63	71	80		100	125	160	
6 300			25	32	45	63	80	90	100		125	160	200	
8 000			32	40	56	80	100	110	125		160	200	250	
10 000			40	50	71	100	125	140	160		200	250	320	

a Values of creepage distances in this area have not been established. Material group IIIb is in general not recommended for application in pollution degree 3 above 630 V and in pollution degree 4.

b As an exception, for rated insulation voltages 127 V, 208 V, 415/440 V, 660/690 V and 830 V, creepage distances corresponding to the lower values 125 V, 200 V, 400 V, 630 V and 800 V respectively may be used.

c The values of creepage distances stated for 250 V can be used for 230 V (±10 %) nominal voltage.

NOTE 1 It is appreciated that tracking or erosion will not occur on insulation subjected to working voltages of 32 V and below. However, the possibility of electrolytic corrosion has to be considered and for this reason minimum creepage distances have been specified.

NOTE 2 Voltage values are selected in accordance with the R_{10} series.