

INTERNATIONAL STANDARD

NORME INTERNATIONALE



AMENDMENT 2
AMENDEMENT 2

**Switches for household and similar fixed electrical installations –
Part 2-1: Particular requirements – Electronic switches**

**Interrupteurs pour installations électriques fixes domestiques et analogues –
Partie 2-1: Prescriptions particulières – Interrupteurs électroniques**

ITeH STANDARD PREVIEW
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IEC 60669-2-1:2002/AMD2:2015
<http://standards.iteh.ai/catalog/standards/sist/26a1263c-2040-4480-b51a-43d536ec150c/iec-60669-2-1-2002-amd2-2015>





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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.120.40

ISBN 978-2-8322-2303-1

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FOREWORD

This amendment has been prepared by subcommittee 23B: Plugs, Socket outlets and switches, of IEC technical committee 23: Electrical accessories.

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

FDIS	Report on voting
23B/1175/FDIS	23B/1183/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,
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- replaced by a revised edition, or
- amended.

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2 Normative references

Modify the date of "CISPR 15:2000" to "CISPR 15:2013".

Add the following new reference:

IEC 62756-1, *Digital load side transmission lighting control – Part 1: Basic requirements*

3 Definitions

Add the following new terms and definitions:

3.126

self ballasted lamp

unit which cannot be dismantled without being permanently damaged which is provided with a lamp cap or caps and incorporating a light source and any additional elements necessary for starting and stable operation of the light source

NOTE In the text self ballasted lamp are also called CFL_i or LED_i where "i" means that the control gear is incorporated in the lamp.

3.127

externally ballasted lamp

lamp other than an incandescent lamp which cannot be dismantled without being permanently damaged which is provided with a lamp cap and incorporating a light source to be controlled by a separate lamp control gear

NOTE For lamp control gear, see definitions in IEC 61347-1

3.128

conduction angle

- for a leading edge (forward phase) dimmer, phase angle measured from the point where conduction begins to the end of the half wave (zero crossing)
- for a trailing edge (reverse phase) dimmer, phase angle measured from the beginning of a half wave (zero crossing) to the point where conduction is switched off

5 General notes on tests

5.4 Replace the existing Table 101 by the following new Table 101:

Table 101 – Number of specimens

Type of electronic switch	Number for general tests	Additional specimens for clause or subclause						
		18.2	19.101	19.102	19.109	24	26	101 and 102
Marked with one rated current and one rated voltage	3	3 ^a	3 ^a	3 ^a	3 ^a	3	1	3 ^c
two rated voltages	6	6 ^a	6 ^a	6 ^a	6 ^a	6	1	6 ^{b,c,d}

^a Only for electronic switches with mechanical and electromechanical switching devices; only the complete contact mechanism may be submitted.

^b It may be necessary to provide three additional specimens for the test of 101.3.

^c When the tests of Clause 26 have been passed successfully, the specimen can be used for these tests.

^d It may be necessary to provide 3 additional specimens for the test of 101.1.1.2.

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7 Classification

7.1.101 Replace the existing list of dashed items, by the following new list:

- incandescent lamps
- externally ballasted lamps (e.g. fluorescent lamps, CFL, LED)
- motors
- self ballasted lamps (e.g. CFLi, LEDi)
- declared load.

8 Marking

8.1 Replace the penultimate paragraph starting with "For general purpose" by the following new paragraph:

For electronic switches with included automatic function if the manufacturer's declared number of operations is higher than that indicated in subclauses 19.101, 19.102, 19.104 and 19.109, then this shall be stated in the accompanying instruction sheet.

8.2 Replace "Fluorescent lamps" by "Externally ballasted fluorescent lamps".

8.3 Replace the text of the addition by:

If a dimmer is intended to be used together with an iron core transformer, information shall be given in the manufacturer's instructions that only a transformer intended to be used with a dimmer shall be used.

11 Provision for earthing

Add the following new subclause 11.101:

11.101 The printed conductors of printed circuit boards may be used to provide protective earthing continuity only under the following conditions:

- at least two tracks are used each having independent soldering points which will withstand a single short circuit test similar to 101.3 and immediately after the switch shall fulfill the requirements of 11.4, or
- a single track is used with two independent means of connection on each end which will withstands a single short circuit test similar to 101.3 and immediately after the switch shall fulfill the requirements of 11.4.

In addition,

- the material of the printed circuit board shall consist of epoxide woven glass fabric copper-clad laminated sheet and
- the printed circuit board shall comply with the overload test according to 101.1.1.2.

13 Constructional requirements

13.101 Delete the first paragraph.

17 Temperature rise

Replace, in the compliance statement, the existing text starting with "Electronic switches for incandescent lamps" through to and including Note 3 by the following:

For electronic switches which can be loaded with incandescent lamps (lamps rated for the supply voltage, including halogen lamps) the following applies:

- If the rated power of some of the loads is expressed in W and is higher or equal to the rated power of other loads expressed in VA , electronic switches shall be loaded with halogen lamps or tungsten filament lamps so that, at the rated voltage of the load, the rated load will be obtained.

NOTE 1 As the characteristics of halogen lamps of different power are equivalent, lamps of any power can be used to reach the rated load.

- If the rated power of some of the loads is expressed in W and is lower than the rated power of other loads expressed in VA , electronic switches shall be loaded with all types of load in accordance with the manufacturer's instructions.
- If the rated power of the self ballasted lamps, or externally ballasted lamps, expressed in W is higher than 25 % of the rated power of the incandescent lamps the test shall be done with all types of load.

For electronic switches which are not designed for incandescent lamps the following applies:

- Electronic switches for self ballasted lamps (eg. LEDi, CFLi) are loaded with lamps so that, at the rated voltage of the load, the rated load will be obtained. Dimmers shall be loaded with dimmable self ballasted lamps. If for these types of electronic switches, the maximum number of self ballasted lamps and the rating of the lamp are given by the manufacturer, the electronic switch is loaded accordingly. If more than one configuration is given by the manufacturer, the test is repeated for all configurations.
- Electronic switches for other types of lamp are tested in accordance with the manufacturer's instructions.

Other electronic switches shall be loaded with the type of load as stated in the manufacturer's instructions.

NOTE 2 The rated loads are verified with the electronic switch short-circuited.

For electronic TDS, 17.1 of IEC 60669-2-3:2006 is applicable.

The electronic switches are loaded until steady-state temperature is reached at a voltage between 0,9 and 1,1 times rated voltage, whichever is the more unfavourable.

Dimmers operating with leading and trailing edge shall be tested in both modes with the relevant load.

In lamp dimmers and speed controllers, the setting is adjusted such that the highest temperature rise will occur.

Flush-mounted electronic switches are mounted in flush-mounted boxes. The box is placed in a block of wood filled around the box with plaster, so that the front edge of the box does not protrude and is not more than 5 mm below the front surface of the wood block.

The test assembly shall be allowed to dry for not less than seven days when first made.

Renumber existing notes 4, 5, 6, 7 and 8 as notes 3, 4, 5, 6 and 7 respectively.

18 Making and breaking capacity

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

- for electronic switches for the control of self ballasted lamps, as specified in 18.1 of part 1.*

18.1 *Delete “or more” at the end of the last dashed item.*

19 Normal operation

Replace the existing fourth and fifth paragraphs by the following new paragraphs:

Compliance is checked by the tests of 19.101, 19.102, 19.103, 19.104, 19.105 and 19.109, during which the electronic switches are tested at their rated voltage and loaded as specified in Clause 17, unless otherwise specified.

For electronic switches with included automatic function the number of operations for tests of subclauses 19.101, 19.102, 19.104 and 19.109 is that specified in the relevant subclause. If a manufacturer declares a number of operations higher than those indicated in the relevant subclause, the tests shall be made according to the declared value.

NOTE 1 The correlation between the tests of 19.102 and 19.109 is under consideration.

Sticking of the contacts, which does not prevent the next operation of the switch, is not regarded as welding.

Sticking of contacts is permitted if the contacts can be separated with a force applied to the actuator of a value which does not damage the switch mechanically.

Electronic switches including electronic circuits which close the contact of the contact mechanism always at zero-crossing $\pm 20^\circ$ phase angle, shall be tested together with their electronic circuit.

Renumber the existing notes as notes 2, 3, 4, and 5 respectively.

19.101 *Add, in the first sentence, “with or without step down converters” after “lamp circuits”.*

19.102 *Replace the entire existing text of this subclause by the following new text:*

Contact mechanisms incorporated in electronic switches, intended for externally ballasted lamps (e.g. fluorescent lamps, CFL, LED) are checked by the test circuit indicated in Figure 103 Load A with the following test conditions.

NOTE The test with Load B is not applicable.

The prospective short-circuit current (rms) of the supply shall be between 3 kA and 4 kA at $\cos \varphi = 0,9 \pm 0,05$ (lagging). F is a copper-wire fuse of 0,1 mm nominal diameter having a length not less than 50 mm.

R1 is a resistor limiting the current to approximately 100 A.

The twin-core cable shall have a suitable length to give a resistance R_3 equal to $0,25 \Omega$ in the test circuit to the load. It shall have a cross-sectional area of $1,5 \text{ mm}^2$ when switches with rated current up to and including 10 A are being tested and $2,5 \text{ mm}^2$ when switches with rated current over 10 A up to and including 16 A are being tested.

The load shall consist of:

- a capacitor bank C_1 , giving a capacitance according to Table 103. The capacitors shall be connected with $2,5 \text{ mm}^2$ conductors having the shortest possible length;
- an inductor L_1 and a resistor R_2 , adjusted to give the power factor $0,9 \pm 0,05$ (lagging) and the test current $I_n^{+5}_0$ % through the specimen.

Table 103 – Relationship between rated current and capacitance

Rated current A	Capacitance μF
Up to and including 1	12
Up to and including 2	24
Up to and including 3	35
Up to and including 4	48
Up to and including 5	58
Up to and including 6	70
Up to and including 7	77
Up to and including 8	96
Up to and including 9	105
Up to and including 10	140
Up to and including 16	140
NOTE The circuit parameters have been chosen to represent the lamp loads used in the most practical applications.	

Compliance is checked by the following test.

For the test, new specimens are used.

The tolerance of the test voltage is ± 5 %. The circuit details and the manner of operation of the selector switch S are as described in 18.1.

The number of operations is as follows.

For electronic switches with a rated current up to and including 10 A: 10 000 operations with 30 operations per minute.

For electronic switches with rated current above 10 A up to and including 16 A: 5 000 operations with 15 operations per minute.

The test specimens shall be connected to the test circuit with cables of length $(1 \pm 0,1) \text{ m}$ so that the temperature rise measurement can be made without disturbing the terminals.

The metal support of the switch, if any, on which the switch is mounted, and the accessible metal parts of the switch, if any, shall be earthed through a wire fuse which shall not blow during the test. The fuse element shall consist of a copper wire of $0,1 \text{ mm}$ diameter and not less than 50 mm in length.

During this test, the switch shall be operated so that the test apparatus does not interfere with the normal action of the switch mechanism and the free movement of the actuating member.

There shall be no forced actuation. The on-period shall be $25 \left(\begin{smallmatrix} +5 \\ 0 \end{smallmatrix} \right)$ % of the total cycle and the off-period $75 \left(\begin{smallmatrix} 0 \\ -5 \end{smallmatrix} \right)$ %.

Add the following new subclause:

19.109 Contact mechanisms incorporated in electronic switches intended for self ballasted lamps are tested as in 19.102 except for the requirements related to the power supply which are given for information only.

NOTE 1 The calculations are based on the following parameters in order to have the required values for inrush current and I^2t

- a prospective short-circuit current (rms) of the supply of 3 kA at $\cos \varphi = 0,9$ (lagging).
- a resistance $R3$ equal to $0,25 \Omega$ and an inductance L equal to $20 \mu\text{H}$ simulating the twin-core cable in the test circuit.

Compliance is checked by connecting the load B as given in Figure 103 via the electronic switch under test to a power supply. The values for the maximum peak value and the maximum I^2t of the inrush current are given in Table 108.

NOTE 2 The test with Load A is not applicable.

For electronic switches with rated power for SBL lamps up to and including 250 W: 40 000 operations with 30 operations per minute.

For electronic switches with rated power for SBL lamps higher than 250 W: 40 000 operations with 15 operations per minute.

NOTE 3 $R1$ is the total series resistance in the lamp circuit including the ESR (equivalent series resistance) value of the capacitor.

The values of $R1$ and C in load B shall be chosen in order to reach the values (± 5 %) for I_{peak} and I^2t as given in Table 108 when the switching contact closes at $(90 \pm 5)^\circ$ phase-angle. The value of $R2$ shall be chosen to reach the rated power in W (± 5 %).

Table 108 – Values for I_{peak} and I^2t depending on the type of distribution system

Rated Power (W)	I_{peak} A	I^2t A ² s	I_{peak} A	I^2t A ² s
	Distribution system: 220/380, 230/400 240/415	Distribution system: 220/380, 230/400 240/415	Distribution system: 120/208 127/220	Distribution system: 120/208 127/220
15	22	0,08	69	0,56
30	41	0,3	109	1,9
60	73	1,2	162	5,9
100	108	2,8	200	11,5
150	142	5,5	231	18,5
200	170	9	248	24,5
250	192	13	255	30
300	209	16,5	260	35
350	223	20,5	262	39
400	235	24,5	263	43

NOTE For values not given in the table the test values are determined by interpolation.

Table 109 – Calculated circuit parameters

Rated power (W)	R1 (Ω)	C (μF)	R1 (Ω)	C (μF)
	230 V	230 V	120 V	120 V
15	13	20	1,36	70
30	6,5	40	0,65	140
60	3,25	80	0,28	280
100	1,9	125	0,17	445
150	1,25	180	0,11	640
200	0,95	240	0,10	830
250	0,8	310	0.10	1000
300	0,7	355	0.11	1250
350	0,64	420	0.13	1500
400	0,59	480	0.135	1660

The values in Table 109 are given for information only. The circuit shall be adjusted to reach the I_{peak} and I^2t values of Table 108.

23 Creepage distances, clearances and distances through sealing compound

Add, in Table 20, the following new Note 3 after the existing Note 2:

NOTE 3 Items 101 and 102 apply to electronic RCS and TDS only.

26 EMC requirements

Replace, in the fourth paragraph, "three new specimens" by "one new specimen".

26.1 Immunity

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

Electronic switches shall be designed so that the switch state (on or off) and/or the setting value are protected against interference. The operation of the switch shall be protected against continuous interference (e.g. IEC 61000-4-3; IEC 61000-4-6; IEC 61000-4-8).

For the following tests, the electronic switch is mounted as in normal use in the relevant box, if any, and loaded with all kinds of loads according to the manufacturers specifications, unless otherwise stated in the relevant paragraph of Clause 26.

The electronic switch is loaded at 100 % of the rated load for dimming devices and with a functional load for other electronic switches.

The electronic switch shall be tested according to Table 104 with or without operation as specified in the relevant paragraph of Clause 26.

If the load connected to the electronic switch is controlled by mechanical switching devices (e.g. relays), and no semiconductor devices are present in the load circuit, the test is conducted with a resistive load only.

For the tests without operation, the electronic switch is tested in the following states:

- a) in the on-state,
 - For electronic switches where the setting can alter (e.g. dimming devices) the conduction angle is set at $(100 \pm 5)^\circ$ which results in an output power (rms).
 - A variation of P_o less than $\pm 10\%$ is not considered to be a change of the setting.
- b) in the off-state.

For the tests with operation, the electronic switch shall be switched ON/OFF with a minimum operating rate of 1 operation/second. As an alternative, where the setting can alter (e.g. dimming devices), the setting value can be changed e.g. from minimum to maximum.

For electronic switches whose cycle of operation is limited by their application (for example, passive infrared, time delay electronic switches, etc.), the rate of operation during the tests shall be specified by the manufacturer.

Table 104 – Immunity tests (overview)

EM phenomena	Test set-up	Subclause	Test specification
Voltage dips and short interruptions	IEC 61000-4-11:1994	26.1.1	Table 105
Surge	IEC 61000-4-5: 1995	26.1.2	Table 110
Fast transients (burst)	IEC 61000-4-4:1995	26.1.3	Table 106
Electrostatic discharge	IEC 61000-4-2:1995	26.1.4	± 4 kV contact discharge ± 8 kV air discharge
Radiated electromagnetic field test	IEC 61000-4-3:2002	26.1.5	3 V/m
Radio frequency voltage	IEC 61000-4-6:1996	26.1.6	3 V r.m.s
Power frequency magnetic field	IEC 61000-4-8:1993	26.1.7 ^a	3 A/m, 50 Hz

^a This test is applicable only to electronic switches containing devices susceptible to magnetic fields, for example, Hall elements, electrodynamic microphones, etc.

26.1.1 Voltage dips and short interruptions

Add, after the existing first paragraph, the following new paragraphs:

The test shall be done on the power supply lines of the electronic switch.

During the test, the electronic switch is not operated.

Replace the first three existing paragraphs after Table 105 by the following new paragraphs:

During the test, the state and setting of the electronic switch may alter, flickering is neglected.

After the test, the electronic switch shall be in the original state and setting and shall operate as intended.

26.1.2 Surge immunity test for 1,2/50 wave impulses

Replace the existing second to sixth paragraphs by the following:

During the test, the electronic switch is not operated.

The test is carried out according to IEC 61000-4-5 by applying two positive discharges and two negative discharges at each of the following angles 0°, 90°, 180° and 270°, at a repetition rate of (60 ± 5) s with an open-circuit test voltage according to Table 110.

A test with lower voltages is not required.

If the product has a metallic mounting surface when mounted as in normal use, the test is repeated between line and earth with a test voltage according to Table 110.

Table 110 – Surge immunity test voltages

Conductors / Terminals	Coupling	Test voltage kV
Mains	Line to line	1
	Line to earth	2

During the test, the state and setting of the electronic switch may alter, flickering is neglected.

After the test, the electronic switch shall be in the original state and setting and shall operate as intended.

26.1.3 Electrical fast transient/burst test

Add after the existing first paragraph the following new paragraph:

During the test, the electronic switch is not operated.

Replace the existing third to seventh paragraphs including Table 106 by the following:

The levels of the repetitive fast transients consisting of bursts coupled into the supply and control terminals/terminations of the electronic switch is specified in Table 106.

Table 106 – Fast transient test values

Open-circuit output test voltage ± 10 %		
Level	Supply terminals/terminations kV	Control terminals/terminations kV
2	± 1	± 0,5

The repetition rate is 5 kHz.

The duration of the test shall be not less than 60^{+5}_0 s, but not less than the time necessary for the electronic switch to respond for each positive and negative polarity.

During the test, the state and setting of the electronic switch may alter, flickering caused by the electronic switch is allowed.

After the test, the electronic switch shall be in the original state and setting and shall operate as intended.

26.1.4 Electrostatic discharge test

Replace in the first paragraph, second sentence the words “incandescent lamps” by “resistive load”.

Add after the existing first paragraph the following new paragraphs:

During the test, the electronic switch is not operated.

A test with lower voltages is not required.

Replace the existing sixth to eighth paragraphs included by the following new paragraphs:

During the test, the state and setting of the electronic switch may alter, flickering is neglected.

After the test, the electronic switch shall be in the original state and setting and shall operate as intended.

Electronic switches with an adjustable time delay device (for example, passive infra-red switches) shall be adjusted in such a way that the time delay is higher than the testing time.

26.1.5 Radiated electromagnetic field test

Add at the end of the existing first paragraph the following new paragraph:

Electronic switches shall be loaded with resistive load only.

Replace the existing third to seventh paragraphs by the following new paragraphs:

The test is carried out according to IEC 61000-4-3 by applying a field strength of 3 V/m in the frequency range 80 MHz to 1 000 MHz and 1 400 MHz to 2 000 MHz with the exception of the

exclusion band as defined in the relevant product standard for transmitters, receivers and duplex transceivers.

During the test, the electronic switch is operated, if it contains automatic functions or can be remotely controlled.

During and after the test, the electronic switch shall operate as intended, flickering is not allowed.

Flickering of lamps or irregular running of motors due to switching transients caused by frequency changes of the test equipment during the test procedure is neglected.

26.1.6 Radio-frequency voltage test

Add at the end of the existing first paragraph the following new paragraph:

Electronic switches shall be loaded with resistive load only.

Replace the fourth to sixth existing paragraphs by the following new paragraphs:

During the test, the electronic switch is operated, if it contains automatic functions or can be remotely controlled.

During and after the test, the electronic switch shall operate as intended, flickering is not allowed.

Flickering of lamps or irregular running of motors due to switching transients caused by frequency changes of the test equipment during the test procedure is neglected.

26.1.7 Power-frequency magnetic field test

Add at the end of the existing first paragraph the following new paragraph:

Electronic switches shall be loaded with resistive load only.

Replace the existing fourth to sixth paragraphs by the following new paragraphs:

During the test, the electronic switch is operated, if it contains automatic functions or can be remotely controlled.

During and after the test, the electronic switch shall operate as intended, flickering is not allowed.

Flickering of lamps or irregular running of motors due to switching transients caused by frequency changes of the test equipment during the test procedure is neglected.

26.2 Emission

26.2.1 Low-frequency emission

Add after the existing second paragraph the following new paragraph:

This requirement applies to each channel of a multichannel dimmer provided that the channels are independent from each other.

Replace the existing Note 2 by the following new note:

NOTE 2 Independent dimmers designed to dim different kinds of loads including incandescent lamps are considered as dimmers for incandescent lamps and according to IEC 61000-3-2 they need not to be tested with all different kinds of load according to Clause 7 of IEC 61000-3-2:2009, if their rated power per channel (provided that the control of the channels are independent) is less than or equal to 1000 W. Electronic switches with semiconductor switching for the load current are regarded as dimmers.

Replace the existing last paragraph by the following new paragraph:

Load terminals/terminations of electronic switches with electromechanically operated contact mechanism (for example, a relay), do not cause harmonic current emissions and are deemed

to meet the requirements of IEC 61000-3-2 without need for testing. Therefore only the mains supply terminals/terminations of those products shall be tested.

26.2.2 Radio-frequency emission

Replace the existing test sequences by the following new test sequences:

a) at the main terminals (8.1.4.2 of CISPR 15:2013):

An initial survey or scan of the complete frequency range 9 kHz to 30 MHz shall be made in on-state at the highest setting. In addition, at the following frequencies and at all frequencies at which there is a local maximum disturbance found in the initial survey above the predetermined level of 6 dB and below the limits given in CISPR 15, the control setting shall be varied for maximum disturbance while connected to the maximum load:

9 kHz, 50 kHz, 100 kHz, 160 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz and 30 MHz;

b) at the load and/or control terminals (8.1.4.3 of CISPR 15:2013):

An initial survey or scan of the complete frequency range 160 kHz to 30 MHz shall be made in on-state at the highest setting. In addition, at the following frequencies and at all frequencies at which there is a local maximum disturbance above the predetermined level of 6 dB below the limits given in CISPR 15, the control setting shall be varied for maximum disturbance while connected to the maximum load:

160 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz and 30 MHz.

101 Abnormal conditions

Add after the existing first paragraph the following new paragraph:

If in case of failure the maximum power taken by the electronic switches is less than 0,5 W, the requirements of the abnormal conditions are deemed to be met.

101.1.1.2 Add after the existing last paragraph the following new paragraphs:

If any of the tests specified above turn off the electronic switch before the temperature has been steady state, the following additional test shall be performed on a new set of specimens:

- The electronic switch shall be loaded to 1,1 times the rated current.
- The current is then increased by 10 % and then the temperature is allowed to stabilize. This is repeated until the conventional tripping current of the protective device is reached or the electronic switch is destroyed (no longer functioning properly or safety is impaired within the meaning of this standard).

101.3 Replace the existing text of 101.3 by the following new text:

Electronic switches shall, without endangering their surroundings, withstand the short circuit currents they may be subjected to in the load circuit.

Compliance is checked by the following test.

The electronic switch is mounted as in normal use. If additional boxes or enclosures are used they shall be tested in an enclosure complying with the relevant Part of the IEC 60670 series.

NOTE 1 In the following countries boxes and enclosures shall comply with both IEC 60670-1 and BS 4662: UK.

The electronic switch is tested in a substantially non-inductive circuit in series with a load impedance and a device for limiting the let-through I^2t .

The prospective short-circuit current of the supply shall be 1 500 A r.m.s. at a voltage equal to the rated voltage of the electronic switch under test.

The prospective let-through I^2t minimum value shall be 15 000 A²s.

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NOTE 2 The prospective current is a current that would flow in the circuit if the electronic switch, the limitation device and the load impedance were replaced by links of negligible impedance without any other change in the circuit.

NOTE 3 The prospective I^2t value is a value that would be let through by the current limiting device if the electronic switch and the load impedance were replaced by links of negligible impedance. The I^2t value may be limited by using an open wire fuse, an ignitron or other suitable devices.

NOTE 4 The I^2t value of 15 000 A²s corresponds to an unfavourable let-through I^2t value of 16 A miniature circuit-breakers measured at 1 500 A prospective short-circuit current.

The diagram of the circuit in which the electronic switch is tested is shown in Figure 102.

The impedance Z_1 (short-circuit impedance) shall be adjusted to satisfy the specified prospective short-circuit current.

The impedance Z_2 (load impedance) shall be adjusted that the electronic switch is loaded with its minimum load or with approximately 10 % of the rated load, whichever is the higher.

NOTE 5 A load is necessary for the electronic switch to be in the on-state.

The circuit is calibrated with the following tolerances: current 0/+5 %, voltage 0/+10 %, frequency \pm 5 %.

The automatic overcurrent protective device including fuses, if any, incorporated or not incorporated in the electronic switch, recommended by the manufacturer, is inserted into the circuit which is loaded. The variable control, if any, is set at the position of maximum output.

The short circuit is applied six times by the auxiliary switch A without any synchronization with respect to the voltage.

NOTE 6 Six tests are made in order to avoid the complication of point-on-wave timing.

During the test, emission of flames or burning particles, if any, shall not be dangerous to the environment.

The above requirement is fulfilled if during the test there are no emissions of flames or burning particles visible with normal or corrected vision without additional magnification.

If there is visible emission of flames or burning particles, the test shall be repeated on new specimens. Before repeating the test, a clear polyethylene film (0,05 \pm 0,01) mm thick, of a size at least 50 mm larger in each direction than the area where the flames or burning particles were seen, is fixed and reasonably stretched in a frame. The film is placed approximately perpendicular to the trajectory of the flame at a maximum distance of 10 mm from the surface of the product where the flame was emitted.

The film should have the following physical properties:

- Density at +23 °C (0,915 g/cm² up to 0,935 g/cm²);
- Melting point between +110 °C to +120 °C.

After the test

- accessible metal parts shall not be live (see Clause 10);
- emissions of flames or burning particles have not visibly perforated the film when examined by normal or corrected vision without additional magnification and the film shall be in one piece;
- the conductors, the flush mounting box and the mounting surface shall not show traces of burns. Traces which can be cleaned and do not prevent the further use of the cables or housing are ignored.

It is not necessary for the specimens to remain in operating condition. However, the contacts of any incorporated automatic protective device shall not be welded unless the electronic switch is obviously useless.

After the short circuit test the specimen is re-energized in its normal operating position, incorporated fuses if any being replaced, and its behaviour is monitored for 4 hours. The