

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Controlgear for electric light sources – Safety –
Part 1: General requirements**

**Appareillages de commande pour les sources de lumière électriques – Sécurité –
Partie 1: Exigences générales**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CONTROLGEAR FOR ELECTRIC LIGHT SOURCES – SAFETY –

Part 1: General requirements

FOREWORD

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IEC 61347-1 has been prepared by subcommittee 34C: Auxiliaries for lamps, of IEC technical committee 34: Lighting. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2015 and Amendment 1:2017. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) complete review of document structure, including but not limited to what is individually described under items b) to s);
- b) removal of requirements for electromagnetic controlgear;

- c) addition of more specific requirements for control circuit insulation and corresponding marking;
- d) merging of thermal test requirements for transformers into a new Clause 16;
- e) clarification of specifications for the moisture resistance test;
- f) update of the normative reference to standards of the transformer series IEC 61558;
- g) correction of the normative reference for PCB testing with respect to flames and fire;
- h) update of further normative references where appropriate;
- i) allowance of an alternative DC electric strength test;
- j) addition of specific provisions for the use of bridging capacitors;
- k) update of fire hazard testing requirements;
- l) introduction of requirements for PELV applications;
- m) clearance distances now generally based on peak instead of RMS voltage values;
- n) introduction of a new type of protected emergency lighting controlgear;
- o) review and clarification of touch current and voltage requirements;
- p) clarification of the test sequence for independent controlgear with respect to the application of the IEC 60598 series versus the IEC 61347 series;
- q) introduction of reduced touch voltages and currents for interrupted DC voltage applications or pulse width modulation (PWM);
- r) changes concerning the recommendations for electric strength routine testing;
- s) merging of requirements for safety isolating controlgear from former Annex L into the main body of the document;
- t) introduction of Annex N intended to address touch current measurement;
- u) introduction of Annex O intended to provide information on document reorganization.

The text of this International Standard is based on the following documents:

Draft	Report on voting
34C/1596/FDIS	34C/1604/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

This document is to be used in conjunction with the appropriate part of the IEC 61347-2 series.

NOTE In this document, the following print type is used:

– *compliance statements: in italic type.*

A list of all parts in the IEC 61347 series, published under the general title *Controlgear for electric light sources – Safety*, can be found on the IEC website.

Future documents in this series will carry the new general title as cited above. Titles of existing documents in this series will be updated at the time of the next edition.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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INTRODUCTION

This part of IEC 61347 provides a set of general and safety requirements and tests which are considered to be generally applicable to most types of controlgear for light sources and which can be called up as required by the different parts that make up the IEC 61347-2 series. This document is not a specification in itself for any type of controlgear, and its provisions apply only to particular types of controlgear, to the extent determined by the appropriate part of the IEC 61347-2 series. The various parts of the IEC 61347-2 series refer to the clauses of this document to the extent to which such a clause is applicable and the order in which the tests are performed; they also include additional requirements as necessary. The order in which the clauses of this document are numbered has no particular significance, as the order in which their provisions apply is determined for each type of controlgear by the appropriate part of the IEC 61347-2 series. All such parts of the IEC 61347-2 series do not contain references to each other.

Where the requirements of any of the clauses of this part of IEC 61347 are referred to in the various parts that make up the IEC 61347-2 series by the phrase "IEC 61347-1, Clause N applies", this phrase will be interpreted as meaning that all the requirements of the clause in question of this document apply, except any which are clearly inapplicable to the particular type of controlgear for light sources covered by the part of the IEC 61347-2 series concerned.

Performance requirements for controlgear for electric light sources are the subject of the appropriate performance standard, for example IEC 61047 and IEC 62384 as appropriate for the type of controlgear.

Safety requirements ensure that electrical equipment constructed in accordance with these requirements does not endanger the safety of persons, domestic animals or property when properly installed and maintained and used in applications for which it was intended.

CONTROLGEAR FOR ELECTRIC LIGHT SOURCES – SAFETY –

Part 1: General requirements

1 Scope

This part of IEC 61347 specifies general safety requirements for controlgear for electric light sources for use on DC supplies up to 1 500 V or AC supplies up to 1 000 V at 50 Hz or 60 Hz.

NOTE 1 In the remainder of this document "light source" is used instead of "electric light source".

This document is only applicable in conjunction with the relevant part(s) of the IEC 61347-2 series.

NOTE 2 As far as covered in the scope of the relevant part of the IEC 61347-2 series, this document is also applicable to controlgear used for electric sources producing optical radiation with the same technology used for purposes different than illumination and producing radiation other than visible spectrum.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-2-14:2009¹, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60127 (all parts), *Miniature fuses*

IEC 60317-0-1:2013, *Specifications for particular types of winding wires – Part 0-1: General requirements – Enamelled round copper wire*
IEC 60317-0-1:2013/AMD1:2019

IEC 60384-14:2023, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60598 (all parts), *Luminaires*

IEC 60598-1:2020, *Luminaires – Part 1: General requirements and tests*

IEC 60695-2-10:2021, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2021, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

¹ Withdrawn.

IEC 60695-11-5:2016, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60691:2023, *Thermal-links – Requirements and application guide*

IEC 60990:2016, *Methods of measurement of touch current and protective conductor current*

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61180:2016, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

IEC 61189-2:2006, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies – Part 2: Test methods for materials for interconnection structures*

IEC 61249-2 (all parts), *Materials for printed boards and other interconnecting structures – Part 2: Reinforced base materials, clad and unclad*

IEC 61558-1:2017, *Safety of transformers, reactors, power supply units and combinations thereof – Part 1: General requirements and tests*

IEC 61558-2-1, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-1: Particular requirements and tests for separating transformers and power supply units incorporating separating transformers for general applications*

IEC 61558-2-4, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-4: Particular requirements and tests for isolating transformers and power supply units incorporating isolating transformers for general applications*

IEC 61558-2-6, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers for general applications*

IEC 61558-2-13, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-13: Particular requirements and tests for auto-transformers and power supply units incorporating auto-transformers for general applications*

IEC 61558-2-16:2021, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units for general applications*

IEC 61643-11:2011, *Low-voltage surge protective devices – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods*

IEC 62368-1:2023, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

ISO 8820 (all parts), *Road vehicles – Fuse-links*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

controlgear

control gear

<for an electric light source> unit inserted between the power supply and at least one light source, which serves to supply the light source(s) with its (their) rated voltage, rated current or rated power, and which can consist of one or more separate components

Note 1 to entry: A controlgear can include means for igniting, dimming, correcting the power factor and suppressing radio interference, and further control functions.

Note 2 to entry: A controlgear can be partly or totally integrated in the light source.

Note 3 to entry: The terms "control gear" and "controlgear" are interchangeable. In IEC standards, the term "controlgear" is commonly used.

Note 4 to entry: In this document, whenever this is unambiguous, the shortened term "controlgear" is used instead of "controlgear for an electric light source".

[SOURCE: IEC 60050-845:2020, 845-28-048, modified – The first preferred term has become an admitted term; "or rated current" has been replaced by ", rated current or rated power"; the existing Note 2 to entry has been deleted and current Note 4 to entry has been added.]

3.2

built-in controlgear

controlgear designed to be built into a luminaire, a box, an enclosure or the like and not intended to be mounted outside a luminaire

[SOURCE: IEC 60050-845:2020, 845-28-053, modified – "lamp control gear" has been replaced by "controlgear" and Note 1 to entry has been deleted.]

3.3

built-in controlgear with basic insulation

built-in electronic controlgear providing basic insulation between live parts and all parts of the enclosure (complete or partial) that can come in contact with the luminaire body when incorporated

3.4

built-in controlgear with double insulation

built-in electronic controlgear providing double or reinforced insulation between hazardous live parts and all parts of the enclosure (complete or partial) that can come in contact with the luminaire body when incorporated

Note 1 to entry: A possible application for such controlgear is a metal encased Class II luminaire.

3.5**independent controlgear**

controlgear consisting of one or more separate elements so designed that it can be mounted separately outside a luminaire, with protection according to the marking of the controlgear and without any additional enclosure

Note 1 to entry: An independent controlgear can consist of a built-in controlgear housed in a suitable enclosure which provides all the necessary protection according to its markings.

[SOURCE: IEC 60050-845:2020, 845-28-055, modified – "lamp controlgear" has been replaced by "controlgear".]

3.6**integral controlgear**

controlgear that forms a non-replaceable part of a luminaire and which cannot be tested separately from the luminaire

[SOURCE: IEC 60050-845:2020, 845-28-054, modified – "lamp controlgear" has been replaced by "controlgear".]

3.7**electromagnetic controlgear**

DEPRECATED: (electromagnetic) ballast

controlgear which by means of inductance, or a combination of inductance and capacitance serves mainly to limit the current of the light source(s)

[SOURCE: IEC 60050-845:2020, 845-28-052, modified – "DEPRECATED: (electromagnetic) ballast" has been added; "electric lamp(s)" has been replaced by "light source(s)".]

3.8**electronic controlgear**

controlgear comprising of semiconductors and other electronic components

3.9**non-isolating controlgear**

controlgear providing no insulation between input and output circuits

Note 1 to entry: Sometimes the term "auto-wound" is used in the sense of non-isolating controlgear.

3.10**separating controlgear**

controlgear providing basic insulation between input and output circuits

3.11**isolating controlgear**

controlgear providing double or reinforced insulation between input and output circuits

3.12**safety isolating controlgear**

isolating controlgear providing either safety extra-low voltage (SELV) or protective extra-low voltage (PELV)

3.13

class I controlgear

independent controlgear in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution in such a way that means are provided for the connection of accessible conductive parts to the protective (earthing) conductor in the fixed wiring of the installation in such a way that accessible conductive parts cannot become hazardous live in the event of a failure of the basic insulation

Note 1 to entry: Class I controlgear can have parts with double or reinforced insulation.

Note 2 to entry: Class I controlgear can have parts in which protection against shock relies on operation at safety extra-low voltage (SELV) or protective extra-low voltage (PELV).

3.14

class II controlgear

independent controlgear in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as double insulation or reinforced insulation are provided, there being no provision for protective earthing or reliance upon installation conditions

3.15

class III controlgear

independent controlgear in which protection against electric shock relies on supply at safety extra-low voltage (SELV) or protective extra-low voltage (PELV) and in which voltages higher than those of SELV or PELV are not generated

3.16

controllable controlgear

controlgear whose light sources operating characteristics can be changed by means of a signal via the mains supply or control input(s)

Note 1 to entry: Signal control is either wired or wireless.

3.17

enclosure

<of a controlgear> housing affording the type and degree of protection suitable for the intended application

[SOURCE: IEC 60050-151:2001, 151-13-08, modified – The domain "<of a controlgear>" has been added.]

3.18

protective earthing

earthing for purposes of electrical safety

[SOURCE: IEC 60050-195:2021, 195-01-11, modified – "protective grounding, US" has been removed.]

3.19

functional earthing

earthing for purposes other than electrical safety

[SOURCE: IEC 60050-195:2021, 195-01-13, modified – "functional grounding, US" has been removed.]

3.20

frame terminal

core terminal

terminal connected to the frame or core whose potential is taken as reference

3.21**control signal**

wired or wireless signal, which can be an AC or DC voltage or current, and which by analogue, digital or other means can be modulated to exchange information with the controlgear

3.22**control terminals**

terminals, other than power supply terminals, to the electronic controlgear, which are used to exchange information with the controlgear

Note 1 to entry: The power supply terminals can also be used to exchange information with the controlgear.

Note 2 to entry: Control terminals can additionally provide supply current or voltage to enable the exchange of information, e.g. as specified in IEC 62386-250.

3.23**surge protective device****SPD**

device that is intended to protect the controlgear from transient overvoltages and to divert surge currents

Note 1 to entry: A surge protective device contains at least one non-linear component.

[SOURCE: IEC 60050-614:2016, 614-03-48, modified – "SPD" has been added; "electrical apparatus" has been replaced by "controlgear".]

3.24**mains supply**

AC or DC power distribution system (external to the controlgear) that supplies operating power to the controlgear

[SOURCE: IEC 60664-1:2020, 3.1.2, modified – "equipment" has been replaced by "controlgear" and the Note 1 to entry has been deleted.]

3.25**rated supply voltage**

<of controlgear> value of the supply voltage under which the controlgear is intended to be operated and declared by the manufacturer or responsible vendor

3.26**rated supply current**

<of controlgear> value of the supply current under which the controlgear is intended to be operated and declared by the manufacturer or responsible vendor

3.27**rated supply voltage range**

<of controlgear> value range of the rated supply voltage

3.28**rated supply frequency**

<of controlgear> value of the supply frequency under which the controlgear is intended to be operated and declared by the manufacturer or responsible vendor

3.29**working voltage**

highest RMS voltage which can occur across any insulation at any rated supply voltage or rated supply voltage range, transient overvoltages being neglected, under normal and under abnormal conditions, including no-load

3.30**working frequency**

frequency of the voltage which can occur across any insulation at any rated supply voltage or rated supply voltage range, under normal and under abnormal conditions, including no-load

Note 1 to entry: Transient overvoltages and ignition voltages are neglected.

3.31**working peak voltage**

highest peak voltage which can occur across any insulation at any rated supply voltage or rated supply voltage range, under normal and under abnormal conditions, including no-load

Note 1 to entry: Working peak voltage can include transient overvoltages from the mains supply, ignition voltages, repetitive peak voltages. Inclusion or exclusion of these phenomena is specified in the corresponding clauses of this document.

3.32**output working voltage**

DEPRECATED: maximum working voltage

U_{out}

working voltage between the output terminals or between the output terminals and earth

Note 1 to entry: Transient overvoltages and ignition voltages are neglected.

Note 2 to entry: U_{out} is intended for the design of insulation of parts connected to the output terminals.

3.33**output working peak voltage**

DEPRECATED: maximum working peak output voltage

$\hat{U}_{out}$

repetitive working peak voltage between the output terminals or between the output terminals and earth

Note 1 to entry: Transient overvoltages and ignition voltages are neglected.

Note 2 to entry: $\hat{U}_{out}$ is intended for the design of insulation of parts connected to the output terminals.

Note 3 to entry: $\hat{U}_{out}$ is intended for the design of creepage distances.

3.34**equivalent transformed peak voltage**

U_p

transformed working peak voltage, which is a conversion of a repetitive high voltage peak, equivalent to an ignition pulse voltage

Note 1 to entry: The value of the declared equivalent transformed peak voltage is the essential parameter for selecting the associated components.

Note 2 to entry: To determine the equivalent transformed peak voltage for basic insulation (" U_p basic") the worst-case combination of the working peak voltage and working frequency shall be considered, which corresponds to the maximum clearance according to Table 15 for basic insulation.

Note 3 to entry: To determine the equivalent transformed peak voltage for reinforced insulation (" U_p reinforced") the worst-case combination of the working peak voltage and working frequency shall be considered, which corresponds to the maximum clearance according to Table 16 for reinforced insulation.

Note 4 to entry: Transient overvoltages are neglected.

3.35**rated output voltage**

declared output voltage at rated supply voltage, rated supply frequency and rated output power

Note 1 to entry: No-load conditions are not included.

3.36**rated output current**

declared output current at rated supply voltage, rated supply frequency and rated output power

Note 1 to entry: Short-circuit conditions are not included.

3.37**ignition voltage**

peak voltage applied to ignite a discharge lamp

3.38**ignition pulse voltage**

peak ignition voltage with a total duration of $\leq 750 \mu\text{s}$ (summation of all pulses durations) within 10 ms, with the duration time (width) of each pulse being measured at the level of 50 % of the maximum absolute peak value

Note 1 to entry: Ignition pulse waveforms, which are considered as ignition pulse voltage, should not contain any dominant frequency above 30 kHz or should be usually highly damped (after 20 μs the peak voltage level should be less than one half of the maximum peak voltage). For the assessment of the dominant frequency IEC 60664-4:2005, Annex E should be consulted.

3.39**interrupted DC**

DC signal changing between zero and a certain level with a certain frequency, where the time of the signal being at the certain level can vary within one period

Note 1 to entry: The abbreviated form of direct current "DC" is used to avoid confusion when used in combination with "voltage" and "current" signal (e.g. interrupted DC voltage).

3.40**extra-low voltage****ELV**

voltage which does not exceed 50 V AC or 120 V ripple-free DC between conductors or between any conductor and earth

Note 1 to entry: Ripple-free is conventionally defined as an RMS ripple voltage of not more than 10 % of the DC component.

3.41**SELV system**

safety extra-low-voltage system

electric system in which the voltage cannot exceed the value of extra-low voltage:

- under normal conditions,
- under abnormal operating conditions and
- under single fault conditions, including earth faults in other electric circuits

Note 1 to entry: In this document "SELV" and "SELV circuit" are used when a SELV system is meant.

Note 2 to entry: Maximum voltages lower than 50 V AC RMS or 120 V ripple-free DC are specified in particular requirements, especially when direct contact with live parts is allowed.

[SOURCE: IEC 60050-195:2021, 195-06-28, modified – "safety extra-low-voltage system" has been added as an admitted term; "– under abnormal operating conditions" has been added; the existing Note 1 to entry has been replaced with two new Notes to entry.]

3.42

FELV system

functional extra-low-voltage system

electric system with ELV voltage for functional reason and not fulfilling the requirements for SELV or PELV

Note 1 to entry: In this document "FELV" and "FELV circuit" are used when a FELV system is meant.

Note 2 to entry: FELV systems have simple separation from the mains supply.

Note 3 to entry: A FELV circuit is not safe to touch and can be connected to protective earth.

[SOURCE: IEC 61558-1:2017, 3.7.19, modified – In the term and admitted term, "circuit" has been replaced by "system"; in the definition, "ELV circuit having the" has been replaced by "electric system with" and the Notes to entry have been added.]

3.43

PELV system

protective extra-low-voltage system

electric system in which the voltage cannot exceed the value of extra-low voltage:

- under normal conditions,
- under abnormal conditions and
- under single fault conditions, except earth faults in other electric circuits

Note 1 to entry: In this document "PELV" and "PELV circuit" are used when a PELV system is meant.

[SOURCE: IEC 60050-195:2021, 195-06-29, modified – "protective extra-low-voltage system" has been added as an admitted term; "– under abnormal conditions" has been added and the existing Note 1 to entry has been replaced with a new Note 1 to entry.]

3.44

basic insulation

insulation that provides basic protection

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-195:2021, 195-06-06]

3.45

basic protection

protection against electric shock under normal conditions

[SOURCE: IEC 60050-195:2021, 195-06-01]

3.46

supplementary insulation

independent insulation applied in addition to basic insulation that provides fault protection

[SOURCE: IEC 60050-195:2021, 195-06-07]

3.47

fault protection

protection against electric shock under single fault conditions

[SOURCE: IEC 60050-195:2021, 195-06-02]

3.48**double insulation**

insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-195:2021, 195-06-08]

3.49**reinforced insulation**

insulation that provides a degree of protection against electric shock equivalent to double insulation

Note 1 to entry: Reinforced insulation can comprise several layers that cannot be tested singly as basic insulation or supplementary insulation.

[SOURCE: IEC 60050-195:2021, 195-06-09]

3.50**functional insulation**

insulation between conductive parts, necessary for the proper functioning of the equipment

[SOURCE: IEC 60050-195:2021, 195-02-41]

3.51**solid insulation**

insulation made from solid non-conducting material interposed between two conductive parts

3.52**thin sheet insulation**

insulation constructed of thin sheets (two or more) of insulating materials, interposed between two conductive parts

3.53**clearance**

shortest distance in air between two conductive parts

[SOURCE: IEC 60050-581:2008, 581-27-76]

3.54**creepage distance**

shortest distance along the surface of a solid insulating material between two conductive parts

[SOURCE: IEC 60050-151:2001, 151-15-50]

3.55**distance through insulation**

DTI

shortest distance through solid insulation between two conductive parts

3.56**live part**

conductive part intended to be energized under normal operating conditions, including the neutral conductor and mid-point conductor, but excluding the PEN conductor, PEM conductor and PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

Note 2 to entry: In previous documents, "live parts" were referred to as "active parts".

[SOURCE: IEC 60050-195:2021, 195-02-19, modified – The domain has been deleted and the Notes to entry have been added.]

3.57**hazardous live part**

live part that, under certain conditions, can give a harmful electric shock

Note 1 to entry: The neutral conductor is always regarded as a hazardous live part.

Note 2 to entry: In previous documents, "hazardous live parts" were referred to as "live parts".

[SOURCE: IEC 60050-195:2021, 195-06-05, modified – The existing Note 1 to entry has been replaced with a new Note 1 to entry and the Note 2 to entry has been added.]

3.58**critical frequency**

f_{crit}

frequency at which the reduction of the breakdown voltage of a clearance occurs

[SOURCE: IEC 60664-4:2005, 3.4, modified – The term "critical frequency" has been added.]

3.59**homogeneous field**

electric field which has an essentially constant voltage gradient between electrodes

[SOURCE: IEC 60664-1:2020, 3.1.26, modified – The Note 1 to entry has been deleted.]

3.60**inhomogeneous field**

electric field which does not have an essentially constant voltage gradient between electrodes

[SOURCE: IEC 60664-1:2020, 3.1.27, modified – The admitted term "non-uniform field" and the Note 1 to entry have been deleted.]

3.61**transient overvoltage**

overvoltage with a duration of a few milliseconds or less, oscillatory or non-oscillatory, usually highly damped

Note 1 to entry: The duration of a transient overvoltage on the sine wave voltage is the time interval in which the superimposed transient voltage exceeds 10 % of its maximum value.

[SOURCE: IEC 60050-614:2016, 614-03-14, modified – The Notes to entry have been replaced with a new Note 1 to entry.]

3.62**overvoltage category**

DEPRECATED: impulse withstand category

numeral defining a transient overvoltage condition

Note 1 to entry: The rated impulse withstand voltage, as indicated in Table 1, is used to classify equipment energized directly from the mains supply according to impulse withstand voltage capabilities.

Rated impulse withstand voltages for equipment selected according to the nominal voltage are provided to distinguish different levels of availability of equipment with regard to continuity of service and an acceptable risk of failure. Insulation coordination can be achieved in the whole installation by transient overvoltage protection of the equipment corresponding to the classified rated impulse voltage, reducing the risk of failure to an acceptable level.

Transient overvoltages transmitted by the supply distribution system are not significantly attenuated downstream in most installations.

Table 1 – Required rated impulse withstand voltage of equipment

Voltage line-to-neutral derived from nominal AC or DC voltages up to and including V	Nominal voltage of the installation V		Rated impulse withstand voltage kV			
	Three-phase	Single-phase	Overvoltage category			
			I	II	III	IV
50			0,33	0,5	0,8	1,5
100		60	0,5	0,8	1,5	2,5
150		100 ^a 100 to 200 ^a 120 to 240	0,8	1,5	2,5	4
300	200 ^a 230/400 277/480		1,5	2,5	4	6
600	400/690		2,5	4	6	8
1 000	1 000		4	6	8	12
1 250 ^b		> 1 000 and ≤ 1 250 ^b	4	6	8	12
1 500 ^b		> 1 250 and ≤ 1 500 ^b	6	8	10	15
NOTE This table is based on IEC 60664-1:2020, Table F.1. For further information, see IEC 60664-1:2020, Annex B and Annex F. ^a Practice in Japan. ^b Direct current only.						

3.63**type test**

conformity test made on one or more items representative of the production

[SOURCE: IEC 60050-151:2001, 151-16-16]

3.64**routine test**

conformity test made on each individual item during or after manufacture

[SOURCE: IEC 60050-151:2001, 151-16-17]

3.65**sample**

one or more sampling items intended to provide information on the population or on the material provided by the manufacturer or responsible vendor

[SOURCE: IEC 60050-151:2001, 151-16-19, modified – "provided by the manufacturer or responsible vendor" has been added.]

3.66**sample item**

one of the individual items in a population of similar items, or a portion of material forming a cohesive entity and taken from one place and at one time

[SOURCE: IEC 60050-151:2001, 151-16-18]

3.67**rated case temperature** t_c

highest permissible temperature under normal operating conditions and at (the most onerous value of the) rated supply voltage (range) related to an indicated place on the controlgear and declared by the manufacturer or responsible vendor

Note 1 to entry: For controlgear with an enclosure, the rated case temperature typically relates to a dedicated place on the controlgear enclosure.

3.68**temperature declared thermally protected controlgear**

electronic controlgear incorporating thermal protection means against overheating to prevent the controlgear enclosure temperature exceeding the indicated value

3.69**normal operating condition**

operating condition that represents as closely as possible the range of normal use that can reasonably be expected

[SOURCE: IEC 60050-903:2014, 903-01-21]

3.70**normal condition**

condition in which all means of protection are intact

[SOURCE: IEC 60050-903:2013, 903-02-07]

3.71**single fault condition**

condition in which there is a fault of a single protection (but not a reinforced protection) or of a single component or a device

Note 1 to entry: If a single fault condition results in one or more other fault conditions, all are considered as one single fault condition.

Note 2 to entry: Single fault conditions are covered by the requirements of this document.

[SOURCE: IEC 60050-903:2013, 903-01-15, modified – Note 2 to entry has been added.]

3.72

abnormal operating condition

operating condition that is not a normal operating condition and is not a single fault condition of the equipment itself

EXAMPLE Load-side short circuits, load-side end-of-life effects.

[SOURCE: IEC 60050-903:2014, 903-01-22, modified – The examples have been added.]

4 General requirements

4.1 General

Controlgear shall be so designed and constructed that with intended use they cause no danger to the user or surroundings. Accordingly, requirements, tests and compliances are provided in this document to reduce the risk of harm to a tolerable level under normal operating conditions, abnormal operating conditions and single fault conditions.

NOTE 1 This document has been drafted using the risk assessment principles given in ISO/IEC Guide 51.

The requirements in this document are based on overvoltage category II which is considered appropriate for controlgear for electric light sources.

Annex L provides recommendations which would allow controlgear to have a higher overvoltage capability according to overvoltage category III.

Independent controlgear shall additionally comply with the applicable clauses of the relevant parts of the IEC 60598-2 series most closely related to its construction and use as declared by the manufacturer.

NOTE 2 Compliance with both a document from the IEC 60598 series and a document from the IEC 61347 series implies compliance to the more severe requirement.

NOTE 3 The safety of integral (and some types of built-in) controlgear partly relies on the luminaire design. Therefore, the complete safety assessment can only be performed together with the final product, e.g. a luminaire according to the applicable part of the IEC 60598 series.

NOTE 4 Independent controlgear can be classified as class I controlgear, class II controlgear or class III controlgear.

Thermally protected controlgear shall additionally comply with Annex B.

Annex M provides information for luminaire design.

Where the terms "voltage" and "current" are used, these imply the RMS values, unless otherwise stated.

4.2 Transformers

The requirements given in this document related to transformers are deemed to be complied with when the transformer already complies with the following:

- the applicable requirements of IEC 61558-2-16 for associated transformers, depending on the type of insulation between primary and secondary circuits if the internal operational frequency exceeds 500 Hz;
- the applicable requirements of IEC 61558-2-1, IEC 61558-2-4, IEC 61558-2-6 or IEC 61558-2-13, depending on the type of insulation between primary and secondary circuits if the internal operational frequency does not exceed 500 Hz.

NOTE Information on "internal operational frequency" can be found in IEC 61558-1:2017, 3.5.3.2.

4.3 Information for controlgear design in light sources standards

4.3.1 In accordance with IEC guidelines, IEC standards are divided into those covering either safety or performance.

4.3.2 In light sources safety standards, "information for controlgear design" is given for the safe operation of light sources; this shall be regarded as normative when testing controlgear to this document.

Compliance is achieved by fulfilling the requirements specified in the relevant light source safety standards.

4.3.3 In light sources performance standards, "information for controlgear design" is given for the correct performance of light sources; this shall be regarded as informative when testing controlgear to this document.

5 General notes on tests

5.1 General

Tests shall be carried out according to Annex E, unless otherwise specified.

The tests specified in this document are type tests.

NOTE 1 The requirements and tolerances are related to testing of a type sample.

NOTE 2 Conformity of production is the responsibility of the manufacturer and can include routine tests and quality assurance in addition to type testing.

Recommendations for routine testing of individual controlgear during manufacture are given in Annex G.

For schedule of more onerous requirements introduced in this document with respect to the previous editions, refer to Annex F.

5.2 Sample size

One sample item is used for all tests, unless otherwise specified in the corresponding clause.

To allow for parallel testing and reduced test times, different sample items of the same type from a single sample may be used for test concerned, unless specified otherwise.

Specially prepared sample items may be used, where required. In general, all tests are carried out on each type of controlgear or, where a range of similar controlgear is involved, for each power in the range or on a representative selection from the range.

5.3 Test sequence

Where the outcome of the test can depend on the sequence of the testing, independent controlgear testing according to the IEC 60598 series shall be conducted after the testing according to the IEC 61347 series.

NOTE The tests in this document are carried out in the clause order specified in the relevant parts of the IEC 61347-2 series.

5.4 DC supplied controlgear

For controlgear intended to be supplied by a battery it is permissible to use a DC power source other than a battery, provided that the source impedance is equivalent to that of a battery.

NOTE 1 Impedance values can be typically found in the relevant battery data sheets.

NOTE 2 A non-inductive capacitor of appropriate rated voltage and with a capacitance of at least 50 μF , connected across the supply terminals of the controlgear, normally provides a source impedance simulating that of a battery.

6 Information and marking

6.1 General

This document provides a list of information and marking items that can be referred to from relevant parts of the IEC 61347-2 series.

6.2 Information and marking items

- a1) Mark of origin (trademark, manufacturer's name or name of the responsible vendor or supplier).
- a2) Model number or type reference of the manufacturer.
- b1) Installation type, according to Table 2.

Table 2 – Marking according to installation type

Controlgear type	Marking
Independent	 [SOURCE: IEC 60417-5138 (2002-10)]
Built-in (with double insulation) ^a	 [SOURCE: IEC 60417-6295 (2014-09)]
NOTE 1 Marking of integral controlgear is not required, see 6.4. NOTE 2 For double or reinforced insulated controlgear fulfilling the requirements for both built-in and independent controlgear, the symbol IEC 60417-6295 can be used in conjunction with the symbol IEC 60417-5172. ^a See 3.4.	

- b2) Explanation of the meaning of the marking according to b1), if marked.
- b3) Indication that the controlgear relies upon the luminaire enclosure for protection against accidental contact with hazardous live parts, if applicable.
- c1) Isolation type between the input and output power circuits in the controlgear:
 - non-isolating controlgear;
 - separating controlgear;
 - isolating controlgear;
 - safety isolating controlgear.
- c2) Symbols to identify the isolation type between the input and output power circuits in the controlgear according to Table 3.

Table 3 – Symbols according to output isolation type

Controlgear type	Symbol	
Non-isolating controlgear	No symbol required	
Separating controlgear	 [SOURCE: IEC 60417-5156 (2003-08)]	
Isolating controlgear	 [SOURCE: IEC 60417-5221 (2002-10)]	
Safety isolating controlgear:		
– SELV output	SELV	 ^a [SOURCE: IEC 60417-5222 (2002-10)]
– PELV output	PELV	
^a Marking is optional.		

- c3) Explanation of the meaning of symbols according to c2).
- c4) Information if SELV outputs may be used for PELV applications.
- c5) Information for built-in controlgear if conductive enclosure is not insulated from SELV circuits.
- c6) Information for built-in controlgear, if conductive enclosure is not insulated from FELV circuits by supplementary insulation.
- c7) Information for built-in controlgear, if conductive enclosure is not insulated from other circuits (see 12.2.4) by basic insulation.

- d1) Emergency lighting controlgear (EL-type): .
- d2) For centrally supplied EL-type controlgear that fulfil the test of Clause 11 with the test circuit of Figure 2: statement that the controlgear is provided with internal protection that supports selectivity in the case of installation with fuse gG 16 A.
- d3) For centrally supplied EL-type controlgear: statement that additional protective measures are required to ensure the availability of central emergency lighting supply, under controlgear fault conditions.
- e1) Rated supply voltage (or voltages, if there are several), rated supply voltage range.
- e2) Rated supply frequency (frequencies) or "DC", or both, as appropriate.

NOTE 1 DC operation can be indicated either by "DC" or "0 Hz".

- e3) Rated supply current(s).
- f1) Marking for earthing terminal(s):

- for protective earthing:  [SOURCE: IEC 60417-5019 (2006-08)];
- for functional earthing:  [SOURCE: IEC 60417-5018 (2011-07)].

- f2) For built-in controlgear a statement that either the use of controlgear without earthing is permitted or earthing of protective earthing terminals is always required, if applicable.
- f3) Symbol for earthing terminals of independent controlgear, compliant with 8.2.3.2 (if any):



[SOURCE: IEC 60417-6296 (2014-09)]

NOTE 2 The symbol comprises the circular marking and the text above.

- f4) The letter "E", if the protective earthing terminals of built-in controlgear are solely intended for continuity or termination of a(n) (external) protective earthing conductor.
- g1) Identification of position(s) of replaceable and interchangeable parts (except fuses).
- g2) For replaceable fuses: relevant characteristics, in particular the rated current and the time-current characteristics.
- g3) Marking for replaceable fuses, together with g2):  [SOURCE: IEC 60417-5016 (2002-10)]
- h) Indication of the cross-section of conductors for which the terminals, if any, are suitable followed by the unit square millimeters (mm²) or followed by a small square.

EXAMPLE 2,5[□] or 2,5 mm².

- i) The light source type and rated power or power range for which the controlgear is designed, or the designation as indicated on the lamp data sheet of the type(s) of lamp(s) for which the controlgear is designed. If the controlgear is intended to be used with more than one lamp, the number and rated power of each lamp shall be indicated.
- j1) Wiring diagram indicating the position and purpose of terminals. In the case of controlgear having no terminals, a clear indication shall be given on the wiring diagram of the significance of the code used for connecting wires.
- j2) Identification of terminals.
- j3) Classification of insulation between control circuits and input circuits, as well as between control circuits and output circuits, e.g. basic insulation or reinforced insulation.

NOTE 3 Maintaining the declared insulation barrier can be dependent on other external components or products connected to the same control bus. This is the responsibility of the control system designer, not the controlgear manufacturer.

- j4) Marking on control terminals, if control circuits are not insulated from the mains supply:



[SOURCE: IEC 60417-6042 (2010-11)]

NOTE 4 In some countries (e.g. Australia and New Zealand), basic insulated control terminals are required to be marked with the symbol ISO 7000-0434A (2004-01).

- j5) For controlgear without insulation between SELV output and SELV control circuits the following information, or similar:

WARNING – Electric Shock Risk – Not to be used where interconnection of controlgear, via the control circuit may be possible, due to increase of the touch current.

- k1) Value of t_c .
- k2) Specific place on the controlgear where t_c refers to (if t_c is related to such a specific place).

- l1) For temperature declared thermally protected controlgear:

symbol  for indication of the maximum temperature on the outer surface of the controlgear enclosure. The dots in the triangle shall be replaced by the value of the temperature (without the related unit, i.e. °C and in steps of 10 K).

- l2) For temperature declared thermally protected controlgear: type declaration in accordance with classification as given in Clause B.3.

- m) Specification of the heat sink(s) required additionally to the controlgear, if applicable.

- n1) Output working voltage U_{out} measured between output terminals and between any output terminal and earth, whichever is the higher value as

"Output working voltage = ...V" or "U-OUT = ...V" or " U_{out} = ...V",

in steps as described in Table 4.

Table 4 – Voltage steps

Voltage	AC	< 50 V	$50\text{ V} \leq U < 500\text{ V}$	$\geq 500\text{ V}$
	DC	$\leq 120\text{ V}$	$120\text{ V} < U < 500\text{ V}$	
In steps of (V)		1	10	50

In the case of multiple output circuits, each circuit may be identified individually by the appropriate U_{out} value.

- n2) Equivalent transformed peak voltage U_p between:

- output terminals;
- any output terminal and earth.

At least the highest of these voltage values shall be declared, for (the purpose of the design of) basic and reinforced insulation (of parts connected to the output) (U_p [basic] = xx kV and U_p [reinforced] = xx kV)

U_p marking is not required for safety isolating controlgear or if U_p is smaller or equal to 0,5 kV.

NOTE 5 The definition of the equivalent transformed peak voltage U_p is given under 3.34. Guidance and an example of the calculation of this parameter is given in Annex J.

- n3) For working frequencies exceeding 30 kHz if creepage distances have to be enlarged (use of Table 13 instead of Table 12): the output working peak voltage $\hat{U}_{out}$ and its corresponding frequency between

- output terminals,
- any output terminal and earth,

in steps as described in Table 4.

This requirement is not applicable to safety isolating controlgear.

- o) Symbols that may be used in conjunction with marking requirements according to Table 5.

Table 5 – Further markings

Marking	Description
PRI	Input
SEC	Output
N	Neutral ^a
L	Line ^a
 [SOURCE: IEC 60417-5032 (2002-10)]	Alternating current ^a
 [SOURCE: IEC 60417-5031 (2002-10)]	Direct current ^a
 [SOURCE: IEC 60417-5033 (2002-10)]	Both direct and alternating current ^a
 [SOURCE: IEC 60417-5020 (2002-10)]	Frame terminal or core terminal
^a This symbol can be used for input and output.	

p) Rated output voltage(s).

q) Rated output current(s).

6.3 Durability and legibility of marking

Markings shall not be put on parts that can be inadvertently removed, unless they apply to such particular parts.

Markings shall be durable and legible.

Markings shall be readable with normal vision.

NOTE 1 Normal vision can, if necessary, include corrective lenses.

Compliance is checked by inspection and by trying to remove the marking by rubbing lightly for 15 s each time, with two pieces of cloth, one soaked with water and the other with aliphatic solvent hexane. As an alternative, a reagent grade hexane with a minimum of 85 % as n-hexane may be used.

NOTE 2 n-hexane according to ACS (American Chemical Society) is identified as CAS# 110-54-3.

The marking shall be legible after the test. If the marking is on a separable label, the label shall remain fixed to the controlgear.

6.4 Built-in controlgear without an enclosure and integral controlgear

For integral controlgear or controlgear without an enclosure and classified as built-in (e.g. open printed circuit board assembly), only items a1) and a2) shall be marked on the controlgear. For built-in controlgear without an enclosure, all other required marking items shall be made available in the manufacturer's technical documentation or similar.

7 Terminals

Terminals shall comply with a) or b):

a) the following sections of IEC 60598-1:2020:

- Section 14 for screw terminals;
- Section 15 for screwless terminals.

NOTE 1 IEC 60598-1:2020, Sections 14 and 15 only provide requirements for clamping units. All other requirements (e.g. creepage and clearance, resistance to heat and fire) are covered in this controlgear document.

b) the requirements of the relevant IEC terminal standards.

Their marking and individual ratings shall suit the conditions which can occur in use.

Terminals complying with the requirements of their own standard and used in accordance with their intended use, shall only meet the requirements of this document where there are no requirements in the terminal standard.

NOTE 2 Example terminal standards are IEC 60947-7-4, IEC 60838-2-2, and the IEC 60998 series.

Compliance is checked by inspection and the relevant tests.

8 Earthing

8.1 General

Protective earthing shall comply with 8.2.

Functional earthing shall comply with 8.3.

Controlgear with an integrated SPD requiring connection to earth for proper working shall be provided with protective earthing connection.

NOTE 1 The connection to functional earth is not considered to ensure safety.

Built-in controlgear with double insulation may only be provided with protective earthing terminals as far as solely intended for continuity or termination of a(n) (external) protective earth conductor or with functional earthing terminals.

NOTE 2 For built-in controlgear with double insulation, protection against electric shock under fault conditions is ensured by supplementary or reinforced insulation. Therefore, earthing of such controlgear does not constitute a level of protection against electric shock.

8.2 Protective earthing

8.2.1 Constructional requirements

Protective earthing circuits shall be insulated from live parts by basic insulation. This requirement does not prevent the PELV connection to earth for functional reasons.

Conductive parts of controlgear which shall be connected to earth for electrical safety reasons shall be reliably connected to the protective earthing terminal or protective earthing contact of the controlgear.

The electrical connection or clamping means for protective earth shall be adequately locked against loosening, and it shall not be possible to loosen the electrical connection or clamping means by hand without the use of a tool. For screwless terminals, it shall not be possible to loosen the clamping means or electrical connection unintentionally.

All parts of a protective earthing terminal shall be such as to minimize the danger of electrolytic corrosion resulting from contact with the earth conductor or any other metal in contact with them.

The screws and the other parts of the protective earthing terminal shall be made of brass or other metal no less resistant to corrosion, or material with a non-rusting surface and at least one of the contact surfaces shall be bare metal.

Compliance is checked by visual inspection and according to 8.2.4.2.

8.2.2 Earthing via printed circuit board tracks

Printed circuit board (PCB) tracks may be used for internal earthing. For such PCB tracks, 8.2.4 applies.

8.2.3 Earthing via independent controlgear

8.2.3.1 Earthing connection to other equipment

Independent controlgear may have earthing terminals that allow the onward earthing connection to other equipment in the installation. Through wiring within the controlgear shall have a minimum cross-section of 1,5 mm² and be of copper. Other materials may be used, provided that an equivalent conductivity is reached.

For looping or through connection, the terminal shall be able to clamp wires with a minimum cross-section of 1,5 mm².

Compliance is checked by inspection and according to 8.2.4.2.

8.2.3.2 Earthing of light source compartments powered via independent controlgear

Independent controlgear may have earthing terminals that allow the earthing of the light source compartment, which are powered by this controlgear. For such terminals, 8.2.4 applies.

Printed circuit board (PCB) tracks may be used for this purpose.

8.2.4 Conditioning and compliance

8.2.4.1 Conditioning of PCB track and light source compartments

A current from an AC source of 25 A is passed for 1 min between the earthing terminal or earthing contact via the track on the printed circuit board and each of the accessible conductive parts in turn.

Before applying 8.2.4.2, the controlgear is cooled down to ambient temperature.

8.2.4.2 Compliance

Compliance with the requirements is checked by visual inspection and by the following test.

A current of 10 A, derived from a source with a no-load voltage not exceeding 15 V, shall be passed for at least 1 min between the earthing terminal or earthing contact and each of the other parts connected to earth in turn.

The voltage drop between the earthing terminal or earthing contact and the part concerned shall be measured and the resistance calculated from the current and the voltage drop.

In no case shall the resistance exceed 0,5 Ω.

NOTE In the case of a controlgear with a supply cord, the earthing contact is at the plug or supply end of the flexible cable or cord.

8.3 Functional earthing

Functional earthing circuits shall be insulated:

- from live parts by at least basic insulation; this requirement does not prevent the PELV connection to earth for functional reasons;
- from hazardous live parts by double or reinforced insulation.

9 Protection against accidental contact with hazardous live parts

9.1 General

Controlgear which does not rely upon the luminaire enclosure for protection against electric shock shall be sufficiently protected against accidental contact with hazardous live parts when installed as in normal use.

EXAMPLE Independent controlgear or built-in controlgear having an enclosure designed to be accessible under normal use, including when the luminaire is opened for light source replacement.

Annex A shall be used to establish whether any conductive part is a hazardous live part. However, Annex A is not applicable for SELV and PELV circuits where this is covered by 9.4 and 9.5.

Lacquer or enamel is not considered to be adequate protection or insulation for the purpose of protection against accidental contact with hazardous live parts.

Parts providing protection against accidental contact shall have adequate mechanical strength and shall not work loose in normal use.

For built-in controlgear with double or reinforced insulation it shall not be possible to touch conductive parts of the enclosure (complete or partial) protected by basic insulation only.

FELV parts are regarded as hazardous live parts and shall be insulated accordingly.

It shall not be possible to remove parts providing protection against accidental contact with hazardous live parts without the use of a tool.

Compliance is checked by inspection and, with regard to protection against accidental contact, by means of the test finger as shown in IEC 61032:1997, Figure 2, "test probe B" using an electrical indicator to show contact. This finger is applied in all possible positions, if necessary, with a force of 10 N.

NOTE Typically, a light source or buzzer supplied with not less than 40 V is used as an electrical indicator.

9.2 Capacitors

Controlgear incorporating capacitors of total capacitance exceeding 0,5 μF shall be constructed so that the voltage at the controlgear terminations does not exceed 50 V, 1 min after disconnection of the controlgear from a power source providing the rated supply voltage or the maximum of the rated supply voltage range.

The disconnection (start of discharge time) shall be done when the peak of the rated supply voltage is reached.

The measurement is made in full load and no-load conditions with an instrument having an input impedance consisting of a resistance of at least 100 MΩ and with an input capacitance of 25 pF or less.

9.3 ELV limits

Voltages in ELV circuits shall not exceed the limits specified in Table 6.

Table 6 – ELV limits

Waveform type	Working voltage V	Working peak voltage V
AC	50	70,7
DC	120	140
Interrupted DC	120	140

Compliance is checked by measuring the voltage in any part of the ELV circuit under the following conditions:

- *the controlgear output current or power shall be set to the rated value which would give the maximum output voltage, including no-load; for load conditions a suitable load shall be used;*
- *the maximum output voltage shall then be found by varying the load in small steps.*

NOTE 1 Not all controlgear have the maximum output voltage in no-load condition.

NOTE 2 The maximum output voltage can be found typically at lower output current or output power.

NOTE 3 For halogen controlgear, a resistor, and for LED controlgear, a suitable diode, constitutes a suitable load.

The measured output voltage shall not exceed the limits specified in Table 6:

- *at each combination of minimum and maximum rated supply voltage and minimum and maximum of rated supply frequency and*
- *in addition, with reversed input voltage polarity.*

9.4 SELV and PELV touch currents

In SELV and PELV circuits the value of the leakage current coming from any other (internal) circuit (including the primary circuit connected to the mains supply) of the controlgear to the SELV or PELV circuit shall be limited. Touch current between different SELV or PELV circuits and between SELV or PELV circuits and earth potential shall not exceed the limits specified in Table 7.

NOTE 1 Terminals in SELV/PELV circuits can become indirectly accessible by connected parts in the final application.

NOTE 2 Earth is always considered to be accessible.

Touch currents shall be measured in accordance with Annex N, using the measurement network described in Clause N.2 together with the set-up and test sequence of N.3.2 and N.3.3.

Controlgear, providing interrupted DC output and having an output voltage lower than the limits in Table 8, shall be measured without modulation and with the output voltage set to the maximum.

NOTE 3 In many controlgear it is possible to exclude the modulation by setting the output to the maximum dimming position. In case it is not possible, a special prepared sample is provided for this test.

Table 7 – Touch current limits

Waveform type	Max. current mA
AC	0,7 (peak)
DC	2,0 (RMS)
Interrupted DC ($f < 10$ Hz or $f > 200$ Hz)	0,7 (peak)
Interrupted DC ($10 \text{ Hz} \leq f \leq 200 \text{ Hz}$)	0,41 (peak)
NOTE 1 Limits for AC and DC are based on IEC 61140:2016.	
NOTE 2 Limits for interrupted DC are based on KOUWENHOVEN, W.B. et al., <i>Electric Shock Effects of Frequency</i> (1936).	

9.5 Safety isolating controlgear which does not rely upon the luminaire enclosure for protection against electric shock

9.5.1 General

SELV and PELV circuits shall comply with touch voltage limits measured between any two accessible conductive parts as required in 9.5.2.

If the touch voltage exceeds the values given in 9.5.2 controlgear may have accessible conductive parts if the touch current measured between any two accessible conductive parts does not exceed the limits in 9.5.3.

NOTE Accordingly, touch current measurements are not required if the touch voltage does not exceed the limit value.

If the touch current also exceeds the limits given in 9.5.3, the following applies:

- for SELV circuits: at least one of the conductive parts in the SELV circuit shall be insulated by insulation capable of withstanding a test voltage of 500 V (RMS) for 1 min according to 10.3, leaving only one pole accessible;
- for PELV outputs: only the pole connected to earth may be accessible. The other pole shall be protected by an insulation capable of withstanding a test voltage of 500 V (RMS) for 1 min according to 10.3.

9.5.2 Touch voltage limits

Touch voltages in SELV circuits shall not exceed the limits given in Table 8. Touch voltages in PELV circuits shall not exceed the limits given in Table 9.

Table 8 – SELV touch voltage limits

Waveform type	Working voltage V	Working peak voltage V
AC	25	35,4
DC	60	70
Interrupted DC ($f < 10$ Hz or $f > 200$ Hz)	-	70
Interrupted DC ($10 \text{ Hz} \leq f \leq 200 \text{ Hz}$)	-	25
NOTE Limits are based on IEC 60364-4-41:2005.		

Table 9 – PELV touch voltage limits

Waveform type	Working voltage V	Working peak voltage V
AC	12	16,9
DC	30	35
Interrupted DC ($f < 10$ Hz or $f > 200$ Hz)	-	35
Interrupted DC ($10 \text{ Hz} \leq f \leq 200 \text{ Hz}$)	-	12
NOTE 1 Limits are based on IEC 60364-4-41:2005.		
NOTE 2 For background information on PELV limits refer to IEC TR 63139.		

Compliance with the voltage limits shall be checked as follows:

- *the controlgear output current or power shall be set to the rated value which would give the maximum output voltage, including no-load: for load conditions a suitable load shall be used;*
- *the maximum output voltage shall then be found by varying the load in small steps.*

NOTE 1 Terminals in SELV/PELV circuits can become indirectly accessible by connected parts in the final application.

NOTE 2 Not all controlgear have the maximum output voltage in no-load operation.

NOTE 3 The maximum output voltage can be found typically at lower output current or output power.

NOTE 4 For halogen controlgear, a resistor, and for LED controlgear, a suitable diode, constitutes a suitable load.

The measured maximum output voltage shall not exceed the limits described above:

- *at each combination of minimum and maximum rated supply voltage and minimum and maximum of rated supply frequency and*
- *in addition, with reversed input voltage polarity.*

9.5.3 Touch current limits

Touch currents shall not exceed the values given in Table 7.

Touch currents shall be measured in accordance with Annex N, using the measurement network described in Clause N.2 together with the set-ups and test sequences of N.3.1 and N.3.2.

10 Insulation resistance and electric strength

10.1 General

The insulation resistance and the electric strength of controlgear shall be adequate, considering moist conditions.

Accordingly, insulation resistance after moisture treatment is tested according to 10.2, immediately followed by an electric strength test according to 10.3.

10.2 Insulation resistance

10.2.1 Moisture treatment and testing

The controlgear shall be prepared as follows:

- surge protective devices (SPDs) shall be disconnected if compliant with IEC 61643-11:2011;
- components between one or more circuits and the earth connection shall be removed or disconnected if compliant with the requirements of 12.6;
- the input connections shall be bonded together;
- the output connections shall be bonded together;
- controlgear having an insulating enclosure shall be wrapped with a conductive foil so placed that no flashover occurs at the edges of the insulation.

Moisture treatment shall be conducted in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 % and with a temperature t at any convenient value between 20 °C and 30 °C with a tolerance of ± 1 K in all places where samples can be located.

NOTE 1 The specified conditions can be achieved by the use of a cabinet which ensures constant circulation of the air within, and, in general, by the use of a cabinet which is thermally insulated.

After the controlgear has been brought to a temperature between t and $t + 4$ K, the controlgear shall be placed in the cabinet in the most unfavourable position of normal use and shall be kept in the cabinet for 48 h.

NOTE 2 In most cases, the controlgear can be brought to the specified temperature between t and $t + 4$ K by keeping it in a room at this temperature for at least 4 h before the humidity treatment.

NOTE 3 Condensation of water can run along the wires to, for example, the controlgear terminal blocks, which can be prevented by carefully routing the wiring.

Immediately after the moisture treatment, the insulation resistance shall be measured with a DC voltage of approximately 500 V, 1 min after application of the voltage.

10.2.2 Compliance

Insulation resistance shall be not less than 2 M Ω for basic or supplementary insulation and 4 M Ω for double or reinforced insulation.

This typically includes, but is not limited to, insulation between:

- live parts and outer conductive parts, including fixing screws in contact with outer insulating parts;
- live parts and control circuits, where relevant;
- input live parts and output live parts, where relevant;
- inner and outer surfaces of enclosures of insulating material;
- live parts having different polarity at the non-protected input side of the controlgear.

10.3 Electric strength

10.3.1 General

Either the AC electric strength test (see 10.3.2) or the DC electric strength test (see 10.3.3) is performed immediately after the insulation resistance according to 10.2 with the same sample item.

NOTE The AC electric strength test is the reference method. According to IEC 60664-1:2020, 6.4.5.1 the AC test is the more severe test, but the DC test provides enough safety margin for lighting products.

The controlgear shall withstand the electric strength test for 1 min applied between the parts as specified in 10.2.2.

10.3.2 AC test

The AC test voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz shall correspond to the values in Table 10. The AC test voltage is raised uniformly from 0 V to the value specified above within not more than 5 s and held at that value for at least 60 s.

NOTE The AC electric strength test is also appropriate to check the insulation of DC circuits.

Table 10 – Electric strength test voltages

Working voltage U		Test voltage
Basic insulation for SELV or PELV		500 V
≤ 50 V		
> 50 V	Basic or supplementary insulation	$2 U + 1\,000$ V
	Double or reinforced insulation	$4 U + 2\,000$ V
Where both reinforced insulation and double insulation are used, the voltage applied to the reinforced insulation shall not overstress the basic insulation or the supplementary insulation.		
When the electric strength between the input and the enclosure is tested, the test voltage is based on the rated supply voltage. When the electric strength between the output and the enclosure is tested, the test voltage is based on U_{out} , unless otherwise required by the transformer type.		

10.3.3 DC test

The following applies:

- The DC test voltage shall be substantially ripple-free. This requirement is fulfilled if the absolute peak values of the voltage do not deviate from the absolute average value by more than 3 %. The average value of the DC test voltage shall be equal to the peak value of the AC test voltage as required in Table 10.
- The DC test voltage shall be raised uniformly from 0 V to the value specified above within not more than 5 s and held at that value for at least 60 s.

10.3.4 General test conditions and compliance

The RMS value of the test voltage applied shall be measured to have a tolerance of ± 3 %.

The high-voltage source used for the test shall be so designed that when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA for test voltages ≤ 4 kV or 80 mA for test voltages > 4 kV.

The overcurrent relay shall not trip when the output current is less than 100 mA for test voltages ≤ 4 kV or 40 mA for test voltages > 4 kV.

NOTE Short-circuit current and tripping current values are derived from IEC 61180:2016, Table 2.

No flashover or breakdown which would trip the overcurrent relay shall occur during the test.

11 Fault conditions

11.1 General

The controlgear shall not impair safety when operated under single fault conditions which can occur during the intended use.

Examination of the controlgear and its circuit diagram will generally show the relevant fault conditions which should be applied.

NOTE 1 The purpose of Clause 11 is to check if the controlgear is inherently safe.

NOTE 2 Requirements for programmable components in electronic controlgear are given in IEC 62733.

11.2 Applicable fault conditions

11.2.1 PCB tracks

PCB tracks shall be short-circuited, if creepage distances and clearances are reduced according to 13.5.3.

NOTE Conditions for such reductions apply according to 13.5.1.

11.2.2 Electronic components

Electronic components shall be short-circuited and open circuited with the exception that the short-circuit fault test shall not be applied between terminals of a component where a short-circuit does not occur according to an applicable component safety standard and the component complies with that standard and is used according to its specification.

NOTE Surge suppressors like varistors or gas discharge tubes (GDTs) are considered as electronic components. A varistor is sometimes referred to as a metal oxide varistor (MOV) or a voltage dependent resistor (VDR).

EXAMPLE Components where a short-circuit test is not applied: capacitors according to IEC 60384-14; insulating barriers provided by optocouplers according to IEC 60747-5-5; insulating barriers provided by transformers providing double or reinforced insulation.

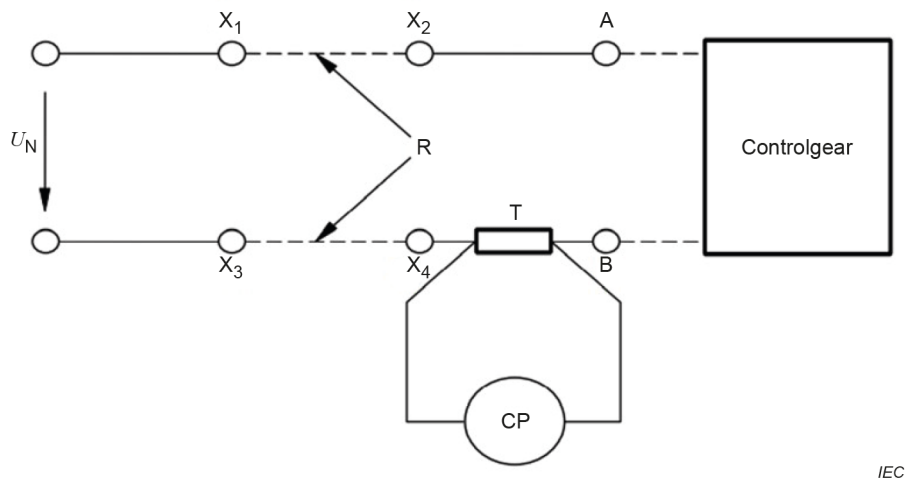
11.2.3 Insulation layers

Conductive parts protected by functional insulation layers consisting of a covering of lacquer, enamel, or textile, with resulting distances smaller than specified in 13.2 and 13.3 shall be short-circuited. This requirement does not apply to insulated winding wires in transformers in compliance with 12.8.

NOTE This does not imply a need to short-circuit insulation between turns of coils, insulating sleeves or tubing.

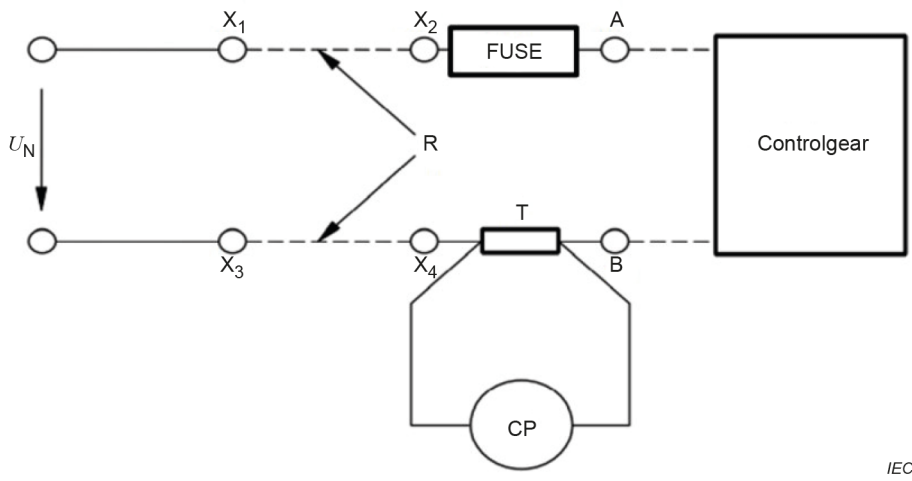
11.3 Test power supply requirements

The controlgear shall be connected to a test power supply according to the rated supply type of the controlgear (AC or DC or both) capable of passing a fault current of 160 A with a tolerance of $^{+10}_0$ %, as shown in Figure 1; for controlgear provided with internal protection that supports selectivity, according to 6.2 d2), Figure 2 applies instead.



- Key**
- U_N supply voltage
 - R additional wiring or resistor for current tuning
 - T shunt resistance, $T = 10\text{ m}\Omega$
 - X_1, X_2, X_3, X_4 terminals for the additional wiring or resistor
 - A, B terminals for the short-circuit and the controlgear
 - CP current probe

Figure 1 – Test circuit (default)



- Key**
- U_N supply voltage
 - R additional wiring or resistor for current tuning
 - T shunt resistance, $T = 10\text{ m}\Omega$
 - X_1, X_2, X_3, X_4 terminals for the additional wiring or resistor
 - A, B terminals for the short-circuit and the controlgear
 - CP current probe
 - FUSE gG 16A rated fuse according to IEC 60269-1:2006, IEC 60269-1:2006/AMD1:2009 and IEC 60269-1:2006/AMD2:2014

Figure 2 – Test circuit (for controlgear provided with internal protection that supports selectivity)

In both cases, the test is carried out as follows.

- a) Terminals A and B shall be short-circuited.

The test current shall be calibrated with additional wire or resistor between the terminals $X_1 - X_2$ and $X_3 - X_4$. The current value shall be 160 A with a tolerance of $^{+10}_0$ %. For the test circuit as shown in Figure 2, this calibration shall be made with a short-circuit link replacing the fuse. This short-circuit link shall be replaced by the fuse following the calibration.

NOTE In principle, the power supply is expected to maintain the current until the protection means of the controlgear reacts. By maintaining the calibration current of 160 A for at least 1 s, this is typically expected to be adequate to let the protection means of the controlgear react.

- b) The short-circuit shall be removed.

The controlgear shall be connected to terminals A and B.

- c) The controlgear shall be tested.

11.4 Test procedure and compliance

11.4.1 Test procedure

Each of the fault conditions given in 11.2 shall be applied.

Fault conditions shall be applied in turn, one at a time, in the order which is most convenient.

Faults that are the direct consequence of the single fault condition are deemed to be part of that single fault condition.

If the controlgear is marked with a protective earthing symbol and the manufacturer declared in the instructions that the use of the controlgear without earthing contact is permitted, then the operation under fault conditions shall be made with and without earthing connection.

For controlgear marked with a functional earthing symbol, the operation under fault conditions shall be made with and without earthing connection.

The test supply conditions (voltage or current) may be any value within the rated supply range of the controlgear, or within ± 5 % where only a single rated value is given.

Controllable controlgear (e.g. with digital addressable lighting interface) shall be tested at the most onerous setting(s) if there can be an influence on the test result.

NOTE It can be helpful to contact the manufacturer regarding the settings.

The tests shall be carried out on three sample items for each fault condition. If one of the sample items fails, the test shall be repeated once with three new sample items, none of which shall fail.

Based on the examination of the controlgear and its circuit diagram and where the result of applying the fault condition is plausible and reproducible, the fault test may be carried out on one sample item.

Each test is repeated with new controlgear because controlgear components can become stressed or damaged during a test.

The controlgear is tested with the light source(s) or equivalent load connected and the enclosure at the rated case temperature t_c . Subsequently, the fault condition is applied for 8 h or until interruption of the supply occurs. The test time may be reduced if the component temperature variation is within ± 1 K for 30 min.

For fault conditions resulting in a sudden failure of the controlgear with subsequent interruption of current consumption, it is not necessary to perform the test with the enclosure at the rated case temperature t_c .

11.4.2 Compliance

A controlgear complies with 11.2 when:

- it does not emit flames;
- it does not emit molten material;
- it does not produce flammable gases;
- hazardous live parts do not become accessible as a result of the test;
- basic, supplementary or reinforced insulation barriers remain effective.

To check whether emission of flames or molten material presents a safety hazard, the test specimen is wrapped with a wrapping tissue, as defined in ISO 4046-4:2016, 4.215, and the wrapping tissue shall not ignite.

To check whether gases liberated are flammable, a test with a high-frequency spark generator is made.

After application of the fault condition, the accessibility to potentially hazardous parts shall be in accordance with 9.1 and 9.3.

After application of the fault condition and when the controlgear has returned to ambient temperature, the insulation resistance between the parts as specified in 10.2.2 shall be not less than 2 MΩ for basic or supplementary insulation and 4 MΩ for reinforced insulation measured at approximately 500 V DC.

For temperature declared thermally protected controlgear marked according to 6.2, 11), the temperature at any place of the enclosure shall not exceed the marked value.

Additionally, for controlgear tested using the test circuit of Figure 2, the fuse of the test circuit shall not operate.

Additionally, for built-in controlgear with double insulation, at the end of the tests, when the controlgear has returned to the ambient temperature, it shall comply with an electric strength test according to 10.3 between hazardous live parts and all parts of the enclosure (complete or partial) that can come in contact with the luminaire body when incorporated; the values of the test voltage shall be reduced to 35 % of the values specified in Table 10.

NOTE Voltage values as reduced are in alignment with IEC 61558-1:2017. Even when substantially higher than the actual working voltages present, they have been shown from experience to provide a sufficient safety margin.

12 Construction

12.1 Use of fibrous materials

Non-impregnated fibrous materials shall not be used as insulation.

NOTE 1 Examples of fibrous materials are wood, cotton, silk and paper.

Wax and similar impregnators shall not be used, unless suitably restrained from migration.

NOTE 2 Insulating material is considered impregnated if the space between the fibres of the material are substantially filled with a suitable insulating coating (i.e. epoxy resin, varnish, etc.).

If impregnated fibrous materials are used, these shall withstand the glow-wire test.

Compliance is checked by inspection and by an additional glow-wire test according to 15.2.2 applied to the fibrous material at 550 °C.

12.2 Insulation between circuits and accessible parts

12.2.1 General

Given the product classification and marking information according to Clause 6, controlgear shall provide adequate insulation:

- between different electrical circuits and
- between electrical circuits and parts allowed to be accessible.

NOTE 1 Electrical circuits include control circuits.

NOTE 2 The term circuit is intended to mean all parts of the electrical circuit connected together. In principle a controlgear can have several output channels belonging to the same circuit, e.g. in the case of a shared common pole.

Annex H applies for solid or thin sheet insulation that is used below a printed circuit board and is designed to fulfil the requirements for double or reinforced insulation.

Basic insulation shall be applied between live parts of different polarity.

NOTE 3 For reductions of creepage distances and clearances, see Clause 13.

Compliance is checked according to 12.2.2, 12.2.3 and 12.2.4.

12.2.2 SELV or PELV circuits

SELV or PELV circuits shall be insulated from the mains supply by double or reinforced insulation (based upon a working voltage across the insulation).

SELV or PELV circuits shall be insulated from FELV circuits by supplementary insulation (based upon a working voltage equal to the rated supply voltage).

SELV or PELV circuits shall be insulated from other SELV circuits by basic insulation (based upon a working voltage equal to the highest voltage in the circuits).

SELV or PELV circuits shall be insulated from other non-SELV or non-PELV (except FELV) circuits by double or reinforced insulation (based upon a working voltage equal to the highest voltage in the circuits).

SELV output circuits shall be electrically separated from earth by basic insulation.

PELV circuits shall have one pole connected to earth for functional purposes. Functional earth of the PELV circuit can be connected to the protective earth circuit. Up to the point where the PELV circuit is connected to the protective earth or protective earth conductor, the earth connection of the PELV circuit shall fulfil the requirements for functional earth.

NOTE Windings of internal transformers (HF and others) of the controlgear are part of the circuits.

SELV circuits shall be insulated from the conductive enclosure of the controlgear by basic insulation, unless the information in 6.2, c5) is provided.

SELV outputs of safety isolating controlgear may be used for PELV applications in accordance with the specification of the controlgear manufacturer.

Compliance is checked by inspection and by the tests required in Clause 9, Clause 10 and Clause 13.

12.2.3 FELV circuits

FELV circuits shall be insulated from the mains supply by basic insulation (based upon a working voltage equal to the rated supply voltage).

NOTE It is not required for FELV circuits to be insulated from other FELV circuits except for functional purposes.

FELV circuits shall be insulated from conductive enclosures by supplementary insulation, unless the information in 6.1, c6) is provided.

Compliance is checked by inspection and by the tests required in Clause 9, Clause 10 and Clause 13.

12.2.4 Other circuits

Other circuits shall be insulated from the conductive enclosure of the controlgear by basic insulation, unless the information in 6.2, c7) is provided.

EXAMPLE Such other circuits include:

- input and output circuits of controlgear;
- circuits supplied by isolating transformers according to IEC 61558-2-4 or equivalent;
- circuits supplied by separating transformers according to IEC 61558-2-1 which do not fulfil the requirements for FELV.

Compliance is checked by applying the insulation requirements of this document.

12.3 Metal core printed circuits boards (MCPCBs)

The insulation properties of printed circuit boards over a metallic substrate (metal core printed circuit boards – MCPCBs) shall only be considered as a single level of insulation (basic or supplementary).

NOTE At the time of publication of this document, there was insufficient evidence for the formulation of requirements that would make it possible for MCPCBs to qualify for double or reinforced insulation.

12.4 Interrupted DC output

Independent or built-in safety isolating controlgear providing interrupted DC with working frequencies f , $10 \text{ Hz} \leq f \leq 200 \text{ Hz}$, shall limit the output voltage to 25 V peak.

NOTE This requirement is established to prevent touch currents above the limit when this controlgear is used with a luminaire with accessible parts.

12.5 Control circuits

Control circuits shall be insulated according to SELV circuit requirements with the following exceptions:

- controlgear with interfaces in accordance with IEC 62386-101 (digital addressable lighting interface):
the control circuit in the controlgear shall be insulated from the mains supply at least by basic insulation and is considered as FELV circuit and shall be insulated from all other circuits accordingly;
- controlgear with interfaces in accordance with IEC 63128 (analogue voltage dimming) or IEC 60929:2011, Clause E.3 (pulse width modulation (PWM)):
the control circuit shall be insulated from the mains supply by at least basic insulation and is considered as FELV circuit, unless marking is provided according to 6.2, j4).

NOTE 1 Controlgear without insulation between control circuits and mains supply is intended to be connected to a sensor or circuit inside of the luminaire only (not remote).

- controlgear using other protocols operated with ELV where the documented system specification details the level of insulation used in the system;
- no insulation is required where:
 - control signals are injected via the supply terminals or circuits connected to the supply via a separate terminal;
 - the control signal receiver is inside the enclosure and the signal is transmitted remotely via infra-red or radio wave transmitters;

NOTE 2 In the case of non-isolated control circuits, the terminals are marked according to 6.2, j4).

NOTE 3 At present on the market the following types of control systems are available:

- FELV control signal, basic insulation to the mains supply (e.g. digital addressable lighting interface and analogue voltage dimming);
- SELV/PELV control signal, (e.g. digital multiplex (DMX));
- control signal not insulated to the mains supply (e.g. push-button control/phase cut/step dim).

Control circuitry shall be separated from SELV outputs by at least basic insulation (based on the highest working voltage in any of the circuits), unless marking and information is provided in accordance with 6.2, j5).

NOTE 4 The insulation between the control circuitry and SELV outputs can require insulation higher than basic depending on the insulation classification of the control circuit.

Compliance is checked according to 12.2.2, 12.2.3 and 12.2.4.

12.6 Bridging of insulation

12.6.1 Resistors

Insulation between different electrical circuits and between electrical circuits and parts allowed to be accessible may be bridged by resistors. Basic and supplementary insulation may be bridged by one single resistor. For bridging double or reinforced insulation at least two separate resistors of the same rated resistance shall be connected in series, each one rated for the total working voltage.

NOTE It is assumed that the impedance of resistors in compliance with IEC 62368-1 is unlikely to change significantly during the individual lifetime of the controlgear.

Resistors shall comply with the requirements of IEC 62368-1:2023, Clause G.10.

12.6.2 Capacitors

Insulation between different electrical circuits and between electrical circuits and parts allowed to be accessible may be bridged by Y capacitors according to Table 11.

Y1, Y2 and Y4 capacitors shall comply with the relevant requirements of IEC 60384-14.

In cases where more than one capacitor is required, capacitors shall be of the same rated capacitance, each one rated for the total working voltage, and shall be connected in series.

Table 11 – Required number and type of Y capacitors

Mains supply voltage ^{a b}	Bridged insulation	Capacitor type	Required number of capacitors in series
$U \leq 150 \text{ V}$	B or S	Y4	1
		Y2	1
		Y1	1
	D or R	Y4	2
		Y2	2
		Y1	1
$150 \text{ V} < U \leq 300 \text{ V}$	B or S	Y2	1
		Y1	1
	D or R	Y2	2
		Y1	1
$300 \text{ V} < U \leq 500 \text{ V}$	B or S	Y2	1
		Y1	1
	D or R	Y2	2
		Y1	1
Key B basic insulation S supplementary insulation D double insulation R reinforced insulation ^a In the case of a capacitor connected between live parts of circuits insulated from the mains supply and accessible parts, the voltage to be considered is the voltage indicated in Table M.1. ^b Information about the use of AC rated Y capacitors with DC mains supply can be found in IEC 60384-14:2023, Annex H.			

12.7 Built-in controlgear with basic insulation and built-in controlgear with double insulation

Built-in controlgear with double insulation shall have double or reinforced insulation between hazardous live parts and the enclosure. If not provided with a full enclosure, there shall be double or reinforced insulation at least between hazardous live parts and the mounting surface (all surfaces that can come in contact with the body of the luminaire after being incorporated).

For built-in controlgear with basic insulation requirements apply analogously.

12.8 Transformers

12.8.1 General

Transformers, including their conductive parts, placed between primary and secondary circuits, shall comply with IEC 61558-1:2017, 19.1 and 19.12 with the exception of IEC 61558-1:2017, 19.1.4.7. If, however, insulated winding wires are used for controlgear with a rated supply voltage of up to 300 V, when applying IEC 61558-1:2017, Annex K, the dielectric strength test voltage for reinforced insulation is limited to 3 kV for insulated winding wires.

Compliance is checked by inspection and the relevant test described in IEC 61558-1:2017.

NOTE IEC 61558-1:2017, Annex K is called up from IEC 61558-1:2017, 19.12.

12.8.2 Components

Components used as protective devices for transformers with working frequencies not exceeding 500 Hz shall comply with the relevant requirements given in IEC 61558-1:2017, 20.7, 20.8, 20.9, 20.10, 20.11 and 20.12.

Compliance is checked by inspection and the relevant test described in IEC 61558-1:2017.

NOTE 1 This requirement is limited to controlgear with working frequencies equal to the rated supply frequency (not exceeding 500 Hz), as for HF transformers. IEC 61558-1:2017, Clause 20 is not applicable according to IEC 61558-2-16:2021, BB.4.2.

NOTE 2 Protective devices for transformers can be integrated into the transformer or separate devices.

12.9 Independent controlgear

For independent isolating and safety isolating controlgear, the input and output terminals for the connection of external wiring shall be so located that the distance measured at the point of introduction of the conductors, into these terminals, is not less than 16 mm. If a barrier is used to obtain the distance, the measurement shall be made over and around the barrier which shall be of insulating material and permanently fixed to the controlgear.

Compliance is checked by inspection and by measurement disregarding intermediate conductive parts.

NOTE The 16 mm requirement is not intended to be measured as creepage distances and clearances, but is measured around the barrier, so conjunction gaps with a thickness not allowing wires with the smallest sectional area to come in contact, are considered.

13 Creepage distances, clearances and distances through insulation

13.1 General

The minimum requirements for creepage distances (see 13.2) and clearances (see 13.3) shall be applied for basic insulation, supplementary insulation and reinforced insulation.

The requirements for distances through insulation are given in 13.4.

No minimum creepage distance and clearance requirements apply for working voltages not exceeding 25 V AC and 60 V ripple-free DC.

NOTE 1 The insulation checked according to 10.3 is considered sufficient.

The concept of creepage distances and clearances is explained in Annex K.

NOTE 2 The minimum creepage distances and clearances specified are based on the following parameters:

- for use with up to 2 000 m above sea level (for higher altitudes information can be found in IEC 60664-1);
- pollution degree 2 where normally only non-conductive pollution occurs but occasionally a temporary conductivity caused by condensation can be expected;
- equipment of overvoltage category II which is energy-consuming equipment to be supplied from the fixed installation.

NOTE 3 Calculation and structure are based on IEC 60664-1:2020 and IEC 60664-4:2005 which can also be consulted for further details (e.g. pollution degrees and overvoltage categories).

Reductions of creepage distances and clearances are allowed for controlgear which are protected against pollution using coating or potting if the requirements of Annex I are fulfilled. In this case pollution degree 1 applies.

The distance measurements of creepage distances and clearances shall be made on uncoated products.