

Lamp controlgear —

Part 1: General and safety requirements

ICS 29.140.99

National foreword

This British Standard is the UK implementation of EN 61347-1:2008+A2:2013. It is derived from IEC 61347-1:2007, incorporating amendments 1:2010 and 2:2012. It supersedes BS EN 61347-1:2008+A1:2011 which will be withdrawn on 1 January 2016.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated in the text by A1 A1.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by tags (e.g. C C).

The UK participation in its preparation was entrusted by Technical Committee CPL/34, Lamps and related equipment, to Subcommittee CPL/34/3, Auxiliaries for lamps.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

The publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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31 July 2011	Incorporation of IEC amendment 1:2010, with CENELEC endorsement A1:2011.
30 June 2013	Implementation of IEC amendment 2:2012 with CENELEC endorsement A2:2013: Annex ZA updated

**Lamp controlgear -
Part 1: General and safety requirements
(IEC 61347-1:2007, modified)**

Appareillages de lampes -
Partie 1: Exigences générales
et exigences de sécurité
(CEI 61347-1:2007, modifiée)

Geräte für Lampen -
Teil 1: Allgemeine
und Sicherheitsanforderungen
(IEC 61347-1:2007, modifiziert)

This European Standard was approved by CENELEC on 2008-04-16. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of the International Standard IEC 61347-1:2007, prepared by SC 34C, Auxiliaries for lamps, of IEC TC 34, Lamps and related equipment, together with the common modifications prepared by the Technical Committee CENELEC TC 34Z, Luminaires and associated equipment, was submitted to the formal vote and was approved by CENELEC as EN 61347-1 on 2008-04-16.

This European Standard supersedes EN 61347-1:2001 + corrigendum July 2003 + A1:2008.

The definition clause has been extended (rated no-load output voltage, controllable ballasts, control terminals, control signal). General requirements for lamp control gear which do not have their own enclosure have been added. The informative information (for ballasts in lamp standards) is now transformed into a normative requirement (in ballast standards). The test schedule has been minimised where possible, see 5.7 and Annex J. For printed circuit boards, the (non-) inflammability requirements have been specified. An annex on conformity testing during manufacture has been added.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2009-05-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2011-05-01

This Part 1 is to be used in conjunction with the appropriate Part 2, which contains clauses to supplement or modify the corresponding clauses in Part 1, to provide the relevant requirements for each type of product.

NOTE In this standard, the following print types are used:

- Requirements proper: in roman type.
- *Test specifications: in italic type.*
- Explanatory matter: in smaller roman type.

Clauses, subclauses, notes, tables and figures which are additional to those in IEC 61347-1:2007 are prefixed „Z“.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61347-1:2007 was approved by CENELEC as a European Standard with agreed common modifications.

Foreword to amendment A1

The text of amendment 1:2010 to the International Standard IEC 61347-1:2007, prepared by SC 34C, Auxiliaries for lamps, of IEC TC 34, Lamps and related equipment, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A1 to EN 61347-1:2008 on 2011-02-01 without any modification.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2012-02-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2014-02-01

Endorsement notice

The text of amendment 1:2010 to the International Standard IEC 61347-1:2007 was approved by CENELEC as an amendment to the European Standard without any modification.

Foreword to amendment A2

The text of document 34C/1023/FDIS, future amendment 2 to edition 2 of IEC 61347-1, prepared by SC 34C "Auxiliaries for lamps" of IEC/TC 34 "Lamps and related equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61347-1:2008/A2:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-10-01
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-01-01

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

Endorsement notice

The text of the International Standard IEC 61347-1:2007/A2:2012 was approved by CENELEC as a European Standard without any modification.

In the Bibliography of EN 61347-1:2008, the following notes have to be **deleted** for the standards indicated:

IEC 60216-1:2001	NOTE	Harmonised as EN 60216-1:2001 (not modified).
IEC 60664-1:1992 + A1:2000 + A2:2002	NOTE	Harmonised as EN 60664-1:2003 (not modified).
IEC 60664-4:2005	NOTE	Harmonised as EN 60664-4:2006 (not modified).
IEC 60664-5:2003	NOTE	Harmonised as EN 60664-5:2003 (not modified).

In the Bibliography of EN 61347-1:2008, **replace** the existing references by the following new references:

IEC 61347-2-1	NOTE	Harmonised as EN 61347-2-1.
IEC 61347-2-2:2011	NOTE	Harmonised as EN 61347-2-2:2012 (not modified)

CONTENTS

INTRODUCTION.....	7
1 Scope	8
2 Normative references	8
3 Terms and definitions	10
4 General requirements	15
5 General notes on tests.....	15
6 Classification.....	16
7 Marking	16
8 Terminals	19
9 Provisions for protective earthing.....	19
10 Protection against accidental contact with live parts	20
11 Moisture resistance and insulation	22
12 Electric strength	23
13 Thermal endurance test for windings of ballasts	23
14 Fault conditions	27
15 Construction.....	32
16 Creepage distances and clearances.....	32
17 Screws, current-carrying parts and connections.....	34
18 Resistance to heat, fire and tracking	34
19 Resistance to corrosion	35
20 No-load output voltage.....	35
Annex A (normative) Test to establish whether a conductive part is a live part which may cause an electric shock	36
Annex B (normative) Particular requirements for thermally protected lamp controlgear	37
Annex C (normative) Particular requirements for electronic lamp controlgear with means of protection against overheating	45
Annex D (normative) Requirements for carrying out the heating tests of thermally protected lamp controlgear	48
Annex E (normative) Use of constant S other than 4 500 in t_w tests.....	51
Annex F (normative) Draught-proof enclosure.....	54
Annex G (normative) Explanation of the derivation of the values of pulse voltages	55
Annex H (normative) Tests.....	61
Annex I (normative) Additional requirements for built-in magnetic ballasts with double or reinforced insulation	67
Annex J (normative) Schedule of more onerous requirements.....	70
Annex K (informative) Conformity testing during manufacture	71
Annex L (normative) Particular additional requirements for controlgears providing SELV	73
Annex M (informative) Dielectric strength test voltages for controlgear intended for the use in impulse withstand Category III	82
Annex N (normative) Requirements for insulation materials used for double or reinforced insulation	

Annex O (normative) Additional requirements for built-in electronic controlgear with double or reinforced insulation	87
Annex ZA (normative) Normative references to international publications with their corresponding European publications.....	91
Bibliography	90
Figure 1 – Relation between winding temperature and endurance test duration	25
Figure 2 – Creepage distances between conductors on printed boards not conductively connected to the supply mains	29
Figure 3 – Test circuit for controlgear.....	31
Figure B.1 – Test circuit for thermally protected lamp controlgear.....	43
Figure D.1 – Example of heating enclosure for thermally protected ballasts.....	50
Figure E.1 – Assessment of claimed value of S	53
Figure G.1 – Circuit for measuring short-duration pulse energy	58
Figure G.2 – Suitable circuit for producing and applying long-duration pulses.....	60
Figure H.1 – Test arrangement for heating test.....	66
Figure N.1 – Test arrangement for checking mechanical withstanding of insulating materials in thin sheet layers	86
Table 5 – Working voltage and U_{out} steps	18
Table 1 – Electric strength test voltage.....	23
Table 2 – Theoretical test temperatures for ballasts subjected to an endurance test duration of 30 days	26
Table 3 – Minimum distances for a.c. (50/60 Hz) sinusoidal voltages	33
Table 4 – Minimum distances for non-sinusoidal pulse voltages	34
Table B.1 – Thermal protection operation	41
Table B.2 – Thermal protection operation	42
Table G.1 – Component values for measurement of pulse energy	59
Table K.1 – Minimum values for electrical tests	72
Table L.1 – Symbols for marking if marking is used.....	74
Table L.2 – Values of temperatures in normal use	75
Table L.3 – Values of insulation resistances.....	77
Table L.4 – Table of dielectric strength test voltages for controlgears intended for use in impulse withstand Category II	77
Table L.5 – Table L.5 – Creepage distances (cr), clearances (cl) and distances through insulation (dti) for the impulse withstand category II material group III a (175 < CTI < 400).....	79
Table M.1 – Table of dielectric strength test voltages for controlgears intended for use in impulse withstand Category III	82
Table N.1 – Electric strength test voltage required during the mandrel test	85

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 lamp controlgear and which can be called up as required by the different parts that make up IEC 61347-2. This Part 1 is thus not to be regarded as a specification in itself for any type of lamp controlgear, and its provisions apply only to particular types of lamp controlgear, to the extent determined by the appropriate part 2 of IEC 61347.

The parts which make up IEC 61347-2, in referring to any of the clauses of this part, specify the extent to which such a clause is applicable and the order in which the tests are to be performed; they also include additional requirements as necessary. The order in which the clauses of this part are numbered has no particular significance, as the order in which their provisions apply is determined for each type of lamp controlgear by the appropriate part 2 of IEC 61347-2 series. All such parts are self-contained and therefore 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 IEC 61347-2 by the phrase "The requirements of clause n of IEC 61347-1 apply", this phrase will be interpreted as meaning that all requirements of the clause in question of Part 1 apply, except any which are clearly inapplicable to the particular type of lamp controlgear covered by the part 2 concerned.

Lamp controlgear which complies with the text of this standard will not necessarily be judged to comply with the safety principles of the standard if, when examined and tested, it is found to have other features which impair the level of safety covered by these requirements.

Lamp controlgear employing materials or having forms of construction differing from those detailed in the requirements of this standard may be examined and tested according to the intent of the requirement and, if found to be substantially equivalent, may be judged to comply with the safety principles of the standard.

Performance requirements for lamp controlgear are the subject of IEC 60921, IEC 60923, IEC 60925, IEC 60927, IEC 60929, IEC 61047 and IEC 62384 (in preparation) as appropriate for the type of lamp controlgear.

NOTE 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.

Requirements for electronic lamp controlgear for other types of lamps will be the subject of a separate standard, as the need arises.

NOTE Controlgear can consist of a printed circuit board and may incorporate the following:

- controlgear;
- lampholder(s);
- switch(es);
- supply terminals.

The lamp controlgear should comply with this standard.

The lampholders(s), switch(es) and supply terminals should comply with their own standards.

A2 Work is currently underway to modify creepage distances and clearances requirements regarding:

- working voltages with operating frequencies up to 30 kHz and with higher operating frequencies then 30 kHz;
- impulse and resonance ignition;
- basic, supplementary and reinforced insulation;
- insulation between circuits;
- coated or potted controlgear.

This information is expected to be incorporated into the future Edition 3 of IEC 61347-1. **A3**

LAMP CONTROLGEAR –

Part 1: General and safety requirements

1 Scope

This part of IEC 61347 specifies general and safety requirements for lamp controlgear for use on d.c. supplies up to 250 V and/or a.c. supplies up to 1 000 V at 50 Hz or 60 Hz.

This standard also covers lamp controlgear for lamps which are not yet standardized.

Tests dealt with in this standard are type tests. Requirements for testing individual lamp controlgear during production are not included.

Requirements for semi-luminaires are given in IEC 60598-1 (see definition 1.2.60).

A2 Particular requirements for controlgears providing safety extra low voltage (from now on SELV) are given in Annex L. **A2**

A1 NOTE It can be expected that lamp control gear which comply with this standard will not compromise safety between 90 % and 110 % of their rated supply voltage in independent use and when operated in luminaires complying with the safety standard IEC 60598-1 and the relevant part IEC 60598-2-xx and with lamps complying with the relevant lamp standards. Performance requirements may require tighter limits. **A1**

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60081, *Double-capped fluorescent lamps – Performance specifications*

A2 IEC 60216 (all parts), *Electrical insulating materials – Properties of thermal endurance*

IEC 60317-0-1:2008, *Specifications for particular types of windings wires – Part 0-1: General requirements – Enamelled round copper wire* **A2**

A1 IEC 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains* **A1**

IEC 60417, *Graphical symbols for use on equipment*

IEC 60529:1989 , *Degrees of protection provided by enclosures (IP Code)*²⁾
Amendment 1 (1999)

A2 IEC 60598-1:2008, *Luminaires – Part 1: General requirements and tests*

IEC 60598-2 (all Parts 2), *Luminaires – Part 2: Particular requirements.*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests* **A2**

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

¹⁾ There exists a consolidated edition 2.2 (2005) including the base publication and its Amendments 1 and 2.

²⁾ There exists a consolidated edition 2.1 (2001) including the base publication and its Amendment 1.  **Documents** **Document Sharing Hub**

- Ⓐ IEC 60065:2001, *Audio, video and similar electronic apparatus – Safety requirements*
- IEC 60085:1987, *Electrical insulation – Thermal classification and designation* Ⓐ
- IEC 60691:2002, *Thermal-links – Requirements and application guide*
- IEC 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*
- IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*
- IEC 60730-2-3, *Automatic electrical controls for household and similar use – Part 2: Particular requirements for thermal protectors for ballasts for tubular fluorescent lamps*
- Ⓐ IEC 60884-2-4, *Plugs and socket-outlets for household and similar purposes – Part 2-4: Particular requirements for plugs and socket outlets for SELV* Ⓐ
- IEC 60901, *Single-capped fluorescent lamps – Performance specifications*
- Ⓐ IEC 60906-3, *IEC System of plugs and socket-outlets for household and similar purposes – Part 3: SELV plugs and socket-outlets, 16 A 6 V, 12 V, 24 V, 48 V, a.c. and d.c.* Ⓐ
- IEC 60921:2004, *Ballasts for tubular fluorescent lamps – Performance requirements*
- IEC 60923:2005, *Auxiliaries for lamps – Ballasts for discharge lamps (excluding tubular fluorescent lamps) – Performance requirements*
- IEC 60929:2006, *AC-supplied electronic ballasts for tubular fluorescent lamps – Performance requirements*
- Ⓐ IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements* Ⓐ
- IEC 60990:1999, *Methods of measurement of touch current and protective conductor current*
- IEC 61189-2, *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*
- IEC 61347-2 (all parts), *Lamp controlgear – Part 2: Particular requirements*
- IEC 61347-2-8, *Lamp controlgear – Part 2-8: Particular requirements for ballasts for fluorescent lamps*
- IEC 61347-2-9:2000, *Lamp controlgear – Part 2-9: Particular requirements for ballasts for discharge lamps (excluding fluorescent lamps)*
Amendment 1 (2003)
Amendment 2 (2006)
- Ⓐ IEC 61558-1:2005, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*
- IEC 61558-2-6:2009, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers* Ⓐ

Ⓐ IEC 61558-2-16:2009, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units* Ⓐ

ISO 4046-4:2002, *Paper, board, pulp and related terms – Vocabulary – Part 4: Paper and board grades and converted products*

3 Terms and definitions

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

3.1

lamp controlgear

one or more components between the supply and one or more lamps which may serve to transform the supply voltage, limit the current of the lamp(s) to the required value, provide starting voltage and preheating current, prevent cold starting, correct power factor or reduce radio interference.

3.1.1

built-in lamp controlgear

lamp controlgear generally designed to be built into a luminaire, a box, an enclosure or the like and not intended to be mounted outside a luminaire, etc. without special precautions.

NOTE The controlgear compartment in the base of a road lighting column is considered to be an enclosure.

3.1.2

independent lamp controlgear

lamp 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 lamp controlgear and without any additional enclosure.

NOTE This may consist of a built-in lamp controlgear housed in a suitable enclosure which provides all the necessary protection according to its markings.

3.1.3

integral lamp controlgear

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

3.2

ballast

unit inserted between the supply and one or more discharge lamps which by means of inductance, capacitance, or a combination of inductance and capacitance, serves mainly to limit the current of the lamp(s) to the required value.

NOTE It may also include means for transforming the supply voltage and arrangements which help provide starting voltage and pre-heating current.

3.2.1

d.c. supplied electronic ballast

d.c. to a.c. inverter using semiconductor devices which may include stabilizing elements for supplying power to one or more fluorescent lamps

3.2.2

reference ballast

special inductive ballast designed for the purpose of providing comparison standards for use in testing ballasts and for the selection of reference lamps, and essentially characterized by a stable voltage-to-current ratio, which is relatively uninfluenced by variations in current, temperature and magnetic surroundings (see also Annex C of IEC 60921 and Annex A of IEC 60923)

3.2.3

controllable ballast

electronic ballast whose lamp operating characteristics can be changed by means of a signal via mains or extra control input

3.3

reference lamp

lamp selected for testing ballasts which, when associated with a reference ballast, has electrical characteristics which are close to the rated values as stated in the relevant lamp standard

3.4

calibration current of a reference ballast

value of the current on which are based the calibration and control of the reference ballast

NOTE Such a current should preferably be approximately equal to the rated running current of the lamps for which the reference ballast is suitable.

3.5

supply voltage

voltage applied to the complete circuit of lamp(s) and lamp controlgear

3.6

working voltage

highest r.m.s. voltage which may occur across any insulation at rated supply voltage, transients being neglected, in open-circuit conditions or during normal operation

3.7

design voltage

voltage declared by the manufacturer to which all the lamp controlgear characteristics are related. This value is not less than 85 % of the maximum value of the rated voltage range

3.8

voltage range

range of supply voltage over which the ballast is intended to be operated

3.9

rated no-load output voltage

the output voltage when the ballast is connected to rated supply voltage at rated frequency, with no load on the output, transient and starting phase being neglected

3.10

supply current

current supplied to the complete circuit of lamp(s) and lamp controlgear

3.11

live part

conductive part which may cause an electric shock in normal use. The neutral conductor is, however, regarded as a live part

NOTE The test to determine whether or not a conductive part is a live part which may cause an electric shock is given in Annex A.

3.12

type test

test or series of tests made on a type-test sample for the purpose of checking compliance of the design of a given product with the requirements of the relevant standard

3.13

type-test sample

sample consisting of one or more similar units submitted by the manufacturer or responsible vendor for the purpose of a type test

3.14

circuit power factor

λ

power factor of the combination of lamp controlgear and the lamp or lamps for which the lamp controlgear is designed

3.15

high power factor ballast

ballast having a circuit power factor of at least 0,85 (leading or lagging)

NOTE 1 The value 0,85 takes into account the distortion of the current waveform.

NOTE 2 For North America, a high power factor is defined as a power factor of at least 0,9.

3.16

rated maximum temperature

t_c

highest permissible temperature which may occur on the outer surface (at the indicated place, if marked) under normal operating conditions and at the rated voltage or the maximum of the rated voltage range

3.17

rated maximum operating temperature of a lamp controlgear winding

t_w

winding temperature assigned by the manufacturer as the highest temperature at which 50 Hz/60 Hz lamp controlgear may be expected to have a service life of at least 10 years' continuous operation

3.18

rectifying effect

effect which may occur at the end of lamp life when one cathode is either broken or has insufficient electron emission, resulting in the arc current being constantly unequal in consecutive half-cycles

3.19

test duration of endurance test

D

optional duration of the endurance test on which the temperature conditions are based

3.20

degradation of insulation of a ballast winding

S

constant which determines the degradation of ballast insulation

3.21

ignitor

device intended to generate voltage pulses to start discharge lamps and which does not provide for the preheating of electrodes

NOTE The element that releases the starting voltage pulse may be either triggered or non-triggered.

3.22 protective earth (ground)



(IEC 60417-5019 (2002-10))

terminal to which are connected parts which are connected to earth for safety reasons

3.23 functional earth (ground)



(IEC 60417-5017 (2002-10))

terminal to which are connected parts which may be necessary to connect to earth for reasons other than safety

A2 NOTE 1 to entry: In some cases, functional earthing may be necessary to facilitate starting and/or to avoid radio interference. **A2**

3.24 frame (chassis)



(IEC 60417-5020 (2002-10))

terminal whose potential is taken as reference

3.25 control terminals

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

NOTE The power supply terminals can also be used to exchange information with the ballast.

3.26 control signal

signal, which may be an a.c. or d.c. voltage, and which by analogue, digital or other means may be modulated to exchange information with the ballast

A2 3.27 extra-low voltage ELV

voltage which does not exceed 50 V a.c. or 120 V ripple free d.c. between conductors, or between any conductor and earth (voltage band 1 of IEC 60449:1973)

Note 1 to entry: "Ripple free" is conventionally defined for sinusoidal ripple voltage as a ripple content of not more than 10 % r.m.s. The maximum peak value does not exceed 140 V for a nominal 120 V ripple-free d.c. system.

3.28 safety extra low voltage SELV

ELV in a circuit which is isolated from the mains supply by insulation not less than that between the primary and secondary circuits of a safety isolating transformer according to IEC 61558-2-6

Note 1 to entry: Maximum voltage lower than 50 V a.c. r.m.s. or 120 V ripple free d.c. may be specified in particular requirements, especially when direct contact with current-carrying parts is allowed.

Note 2 to entry: The voltage limit should not be exceeded at any load between full loads and no-load when the source is a safety isolation transformer.

Note 3 to entry: "Ripple free" is conventionally an r.m.s. ripple voltage not more than 10 % of the d.c. component: the maximum peak value does not exceed 140 V for a nominal 120 V ripple free d.c. system and 70 V for a nominal 60 V ripple free system. **A2**

A2 3.29

body

term used in this standard as a general term which includes all accessible metal parts, shafts, handles, knobs, grips and the like, accessible metal fixing screws and metal foil applied on accessible surfaces of insulating material and does not include non-accessible metal parts

3.30

impulse withstand category

DEPRECATED: overvoltage category

numeral defining a transient overvoltage condition

Note 1 to entry: Impulse withstand categories I, II, III and IV are used. For detailed information, see IEC 60664-1 and IEC 60598-1.

3.31

class I lamp 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 live in the event of a failure of the basic insulation

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

Note 2 to entry: Class I lamp independent controlgear may have parts in which protection against shock relies on operation at safety extra-low voltage (SELV)

3.32

class II lamp 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

3.33

class III lamp controlgear

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

3.34

protective impedance device

component or assembly of components the impedance and construction of which are such as to ensure that steady state touch current and charge are limited to a non-hazardous level

3.35

maximum working voltage

U_{out}

maximum occurring working voltage (r.m.s.) between the output terminals or between the output terminals and earth, during normal or abnormal operating condition

Note 1 to entry: Transients and ignition voltages have to be neglected.

3.36

basic insulation

insulation of parts which provide protection against electrical shock under fault-free conditions **A2**

3.37

double insulation

insulation of parts with two layers of insulation which provide protection against electrical shock under single fault condition

3.38

reinforced insulation

Insulation of parts which provide a degree of protection as double insulation 

4 General requirements

Lamp controlgear shall be so designed and constructed that in normal use it operates without danger to the user or surroundings.

Compliance is checked by carrying out all the tests specified.

-  Requirements for insulation materials used for double or reinforced insulation of controlgear are specified in Annex N of this standard. 

In addition, independent lamp controlgear shall comply with the requirements of IEC 60598-1, including the classification and marking requirements of that standard such as IP classification,  marking, etc. Built-in ballasts with double or reinforced insulation shall comply additionally with the requirements of Annex I.

-  Built-in electronic controlgear with double or reinforced insulation shall comply additionally with the requirements of Annex O. 

Some built-in lamp controlgear do not have their own enclosure and are composed of printed circuit boards and electrical components thereon, and shall comply with the requirements of IEC 60598-1 when built into the luminaire. Integral lamp controlgear not having their own enclosure shall be treated as integral components of luminaires defined in Clause 0.5 in IEC 60598-1 and shall be tested assembled in the luminaire.

NOTE It is recommended for the luminaire manufacturer to confer about the relevant test requirements with the controlgear manufacturer, if necessary.

In the lamp safety standards, "Information for ballast design" is given for the safe operation of lamps. This shall be regarded as normative when testing ballasts.

-  Controlgears providing SELV shall comply with the additional requirements given in Annex L. This includes especially insulation resistance, electric strength, creepage distances and clearances between the primary and secondary circuit. 

5 General notes on tests

5.1 Tests according to this standard are type tests.

NOTE The requirements and tolerances permitted by this standard are related to testing of a type-test sample submitted by the manufacturer for that purpose. Compliance of the type-test sample does not ensure compliance of the whole production of a manufacturer with this safety standard.

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

5.2 Unless otherwise specified, the tests are carried out at an ambient temperature of 10 °C to 30 °C.

5.3 Unless otherwise specified, the type test is carried out on one sample consisting of one or more items submitted for the purpose of the type test.

In general, all tests are carried out on each type of lamp controlgear or, where a range of similar lamp controlgear is involved, for each wattage in the range or on a representative selection from the range, as agreed with the manufacturer.

Certain countries require that three samples of lamp controlgear be tested and, in such cases, if more than one sample fails, then the type is rejected. If one sample fails, the test is repeated using three other samples and all of these shall comply with the test requirements.

A2 If the tests of 14.3 or 15.5 of IEC 61558-1:2005 have to be made, three additional samples are needed. These samples are used only for the test of 14.3 or 15.5 of IEC 61558-1:2005, respectively. **A2**

5.4 The tests shall be carried out in the order listed in this standard unless otherwise specified in parts 2 of IEC 61347.

5.5 For the thermal test, independent lamp controlgear shall be mounted in a test corner consisting of three dull-black painted wooden/wood fibre boards 15 mm to 20 mm thick and arranged so as to resemble two walls and the ceiling of a room. The lamp controlgear is secured to the ceiling as close as possible to the walls, the ceiling extending at least 250 mm beyond the other side of the lamp controlgear.

5.6 For d.c. supplied ballasts intended for use from a battery supply it is permissible to substitute a d.c. power source other than a battery, provided that the source impedance is equivalent to that of a battery.

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

5.7 When testing lamp control gear to the requirements of this standard, earlier test reports may be updated in accordance with this edition by submitting a new sample for test together with the previous test report.

Full type testing may not generally be necessary and the product and the previous test results shall only be reviewed against any amended clause marked "R" as scheduled in normative Annex J: Schedule of more onerous requirements.

6 Classification

Lamp controlgear is classified, according to the method of installation, as

- built-in;
- independent;
- integral.

7 Marking

7.1 Items to be marked

The parts that make up IEC 61347-2 state which of the following items shall be marked as mandatory markings or provided as information to be given either on the lamp controlgear or made available in the manufacturer's catalogue or similar.

A2 For controlgear without an enclosure, and classified as built-in (e.g. open printed circuit board assembly), only items a) and b) are to be considered mandatory for marking on the controlgear. Other mandatory markings required by the IEC 61347-2 part shall be provided as information to be given either on the controlgear or made available in the manufacturer's catalogue or similar. **A2**

- a) Mark of origin (trade mark, manufacturer's name or name of the responsible vendor/supplier).
- b) Model number or type reference of the manufacturer.

- c) Symbol for independent lamp controlgear  if applicable.
- d) The correlation between replaceable and interchangeable parts, including fuses, of lamp controlgear shall be marked unambiguously by legends on the lamp controlgear or, with the exception of fuses, be specified in the manufacturer's catalogue.
- e) Rated supply voltage (or voltages, if there are several), voltage range, supply frequency and supply current(s); the supply current may be given in the manufacturer's literature.

- A2** f) The earthing terminals (if any) shall be identified by the symbol  or .

These symbols shall not be placed on screws or other easily removable parts.

If the lamp control gear is market with an earthing symbol, the manufacturer's instruction shall contain the information whether it is permitted to use the control gear also without connection to earth.

NOTE For the use of symbols, see IEC 60417. **A2**

- g) The claimed value of the rated maximum operating temperature of the winding following the symbol t_w , values increasing in multiples of 5 °C.
- h) Indication that the lamp controlgear does not rely upon the luminaire enclosure for protection against accidental contact with live parts.
- i) Indication of the cross-section of conductors for which the terminals, if any, are suitable.

Symbol: relevant value(s) in square millimetres (mm²) followed by a small square.

- j) The lamp type and rated wattage or wattage range for which the lamp controlgear is suitable, or the designation as indicated on the lamp data sheet of the type(s) of lamp(s) for which the lamp controlgear is designed. If the lamp controlgear is intended to be used with more than one lamp, the number and rated wattages of each lamp shall be indicated.

NOTE 1 For lamp controlgear specified in IEC 61347-2-2, it is assumed that a marked wattage range includes all ratings within the range unless otherwise indicated in the manufacturer's literature.

- k) Wiring diagram indicating the position and purpose of terminals. In the case of lamp controlgear having no terminals, a clear indication shall be given on the wiring diagram of the significance of the code used for connecting wires. Lamp controlgear that operates in specific circuits only shall be identified accordingly, for example by marking or wiring diagram.
- l) Value of t_c .

If this relates to a certain place on the lamp controlgear, this place shall be indicated or shall be specified in the manufacturer's catalogue.

- m) Symbol for temperature declared, thermally protected controlgear  (see Annex B). The dots in the triangle shall be replaced by the value of the rated maximum case temperature in degrees Celsius assigned by the manufacturer, values increasing in multiples of 10.

- n) Heat sink(s) required additional to the lamp controlgear.
- o) The limiting temperature of the winding under abnormal conditions which shall be respected when the controlgear is built into a luminaire, as information for luminaire design.

NOTE 2 In the case of lamp controlgear intended for circuits which do not produce abnormal conditions, or are for use only with starting devices which exempt the lamp controlgear from the abnormal conditions of Annex C of IEC 60598-1, the winding temperature under abnormal conditions is not indicated.

- p) The test period for the endurance test for lamp controlgear which, at the manufacturer's choice, shall be tested for a period longer than 30 days, may be indicated with the symbol D, followed by the appropriate number of days, 60, 90 or 120 in 10-day periods, the whole being placed between the brackets immediately after the t_w indication. For example, (D6) for controlgear to be tested for a period of 60 days.

NOTE 3 The standard endurance test period of 30 days need not be indicated.

- q) For lamp controlgear for which a constant S other than 4 500 is claimed by the manufacturer, the symbol S together with its appropriate value in thousands, for example "S6", if S has a value of 6 000.

NOTE 4 Preferred values of S are: 4 500, 5 000, 6 000, 8 000, 11 000, 16 000.

- r) The rated no-load output voltage, when it is higher than the supply voltage.

- A2** s) Symbol indicating the kind of controlgear providing SELV.

- t) The earthing terminals of an independent controlgear used for the connection of lamp compartments (if any) shall be marked with the symbol:



This symbol shall not be placed on screws or other easily removable parts. The symbol size of the earthing terminals of an independent controlgear used for the connection of lamp compartments shall be at least 5 mm (over all, including letters).

- u) Declaration of the maximum working voltage U_{out} (r.m.s.) between

- output terminals, or
- any output terminal and earth (if applicable)

in steps as described in Table 5.

Table 5 – Working voltage and U_{out} steps

Working voltage	< 50 V	< 500 V	> 500 V
U_{out} in steps of	1 V	10 V	50 V

The highest of the specified voltage values shall be marked on the controlgear as "Output working voltage = ...V" or "U-OUT = ...V" or " U_{out} = ...V".

NOTE 5 Item u) is not applicable to terminals with SELV-circuits as defined in IEC 61558-1. **A2**

7.2 Durability and legibility of marking

Marking shall be durable and legible.

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 petroleum spirit.

The marking shall be legible after the test.

NOTE The petroleum spirit used should consist of a solvent hexane with a content of aromatics of maximum 0,1 % volume percentage, a kauri-butanol value of 29, an initial boiling-point of approximately 65 °C, a dry-point of approximately 69 °C and a density of approximately 0,68 g/cm³.

8 Terminals

Screw terminals shall comply with Clause 14 of IEC 60598-1.

Screwless terminals shall comply with Clause 15 of IEC 60598-1.

9 Earthing

9.1 Provisions for protective earthing (Symbol: IEC 60417-5019 (2006-08))

Earthing terminals shall comply with the requirements of Clause 8. The electrical connection/clamping means shall be adequately locked against loosening, and it shall not be possible to loosen the electrical connection/clamping means by hand without the use of a tool. For screwless terminals, it shall not be possible to loosen the clamping means/electrical connection unintentionally.

All parts of an 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 screw and the other parts of the 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 according to 7.2.3 of IEC 60598-1:2008.

9.2 Provisions for functional earthing (Symbol: IEC 60417-5018 (2011-07))

Functional earthing terminals shall comply with the requirements of Clause 8 and 9.1.

The functional earthing contact (potential) of a lamp controlgear shall be insulated from the live parts by double or reinforced insulation.

9.3 Lamp controlgear with conductors for protective earthing by tracks on printed circuit boards

If a printed circuit board track is used for earthing internally, in the independent, built-in or integral lamp controlgear, it shall withstand the following test.

A current from an a.c. 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 metal parts in turn.

After the test and after cooling the controlgear to ambient temperature, the requirements of 7.2.3 of IEC 60598-1:2008 shall apply. 

9.4 Earthing of built-in lamp controlgear

It is allowed to earth built-in lamp controlgear by means of fixing the controlgear to earthed metal of the luminaire.

For compliance, see 7.2 of IEC 60598-1:2008.

If a lamp controlgear has an earthing terminal, this terminal shall only be used for earthing the built-in lamp controlgear.

Earthing of the luminaire or other equipment via the built-in lamp controlgear is not allowed.

9.5 Earthing via independent controlgear

9.5.1 Earth connection to other equipment

Independent lamp controlgear may have earthing terminals that allow the onward earth connection to other equipment in the installation. For looping or through connection, the conductor shall have a minimum cross-section of 1,5 mm² and be of copper, or an equivalent conductive material shall be used.

Protective earthing wires within the luminaire shall be in line with 5.3.1.1 and Clause 7 of IEC 60598-1:2008. For looping-through, a minimum cross section of 1,5 mm² is required.

Compliance is checked by inspection and measurement.

9.5.2 Earthing of the lamp compartments powered via the independent lamp controlgear

Independent lamp controlgear may have earthing terminals that allow the earthing of the lamp compartment, which are powered by this controlgear. In this case, the earth path between the input and output earth terminals of the controlgear shall withstand the following test.

A current from an a.c. source of 25 A is passed for 1 min between the earthing terminal or earthing contact (via the track on the printed circuit board, if used for protective earth) and each of the accessible metal parts in turn.

After the test and after cooling the control gear at ambient temperature, a current of at least 10 A, derived from the source with a no-load voltage not exceeding 12 V, shall be passed between the earthing terminal or earthing contact and each of the accessible metal parts in turn. The voltage drop between the earthing terminal or earthing contact and the accessible metal part shall be measured and the resistance shall be calculated from the current and the voltage drop. In no case shall the calculated resistance value exceed 0,5 Ω.

The output earthing terminals to the lamp compartment shall be marked as described in 7.1 t). 

10 Protection against accidental contact with live parts

10.1 Lamp controlgear which do not rely upon the luminaire enclosure for protection against electric shock shall be sufficiently protected against accidental contact with live parts (see Annex A) when installed as in normal use.

Integral lamp controlgear, which relies upon the luminaire enclosure for protection, shall be tested according to its intended use.

Lacquer or enamel is not considered to be adequate protection or insulation for the purpose of this requirement.

Parts providing protection against accidental contact shall have adequate mechanical strength and shall not work loose in normal use. It shall not be possible to remove them without the use of a tool.

Compliance is checked by inspection and by a manual test, and with regard to protection against accidental contact, by means of the test finger as shown in Figure 1 of IEC 60529 using an electrical indicator to show contact. This finger is applied in all possible positions, if necessary, with a force of 10 N.

It is recommended that a lamp be used for the indication of contact and that the voltage be not less than 40 V.

10.2 Lamp controlgear incorporating capacitors of total capacitance exceeding 0,5 μF shall be constructed so that the voltage at the lamp controlgear terminations does not exceed 50 V, 1 min after disconnection of the lamp controlgear from a source of supply at rated voltage.

A2 10.3 For controlgears providing SELV, the accessible conductive parts shall be electrically separated from live parts by at least double or reinforced insulation. There shall be no connection between the output circuit and the body or the protective earthing circuit, if any. Moreover, the construction shall be such that there is no possibility of any connection between these circuits, either directly or indirectly, through other conductive parts, except by deliberate action (see 10.4).

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

The expression "circuits" also covers windings of internal transformers (HF and others) of the controlgear.

In controlgears providing ELV conductive parts are regarded as live parts and shall be insulated accordingly.

Compliance is checked by inspection, relevant insulation tests and measurements. See also Annex L.

10.4 Controlgears providing SELV may have accessible conductive parts in the SELV circuit; if: the rated output voltage under load does not exceed 25 V r.m.s. or 60 V d.c. ripple free d.c. where the voltage exceeds 25 V r.m.s. or 60 V ripple free d.c., the touch current does not exceed:

- for a.c.: 0,7 mA (peak);
- for d.c.: 2,0 mA;
- the no-load output does not exceed 35 V peak or 60 V ripple free d.c.

NOTE The limits given are based on IEC 60364-4-41.

Compliance is checked by measuring the output voltage when steady conditions are established, the controlgear being connected to rated supply voltage and rated frequency. For the test under load the controlgear is loaded with a resistance which would give rated output (current or wattage respectively) at rated output voltage. For controlgears with more than one supply voltage, the requirements are applicable for each of the rated supply voltages.

The touch current is checked by measurement in accordance with Annex G from IEC 60598-1.

For controlgears providing SELV with rated output voltages or currents exceeding the values given above 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 r.m.s. for 1 min. **A2**

A2 Accessible conductive parts separated by double or reinforced insulation, e.g. live parts and the body or primary and secondary circuits, may be bridged (conductive bridged) by resistors or Y2 capacitors provided they consists of at least two separate components of the same rated value (resistance or capacitance) and are rated for the total working voltage and whose impedance is unlikely to change significantly during the individual lifetime of the controlgear. In addition, accessible conductive parts separated by double or reinforced insulation from live parts, as above, may be bridged by a single Y1 capacitor.

Y1 or Y2 capacitors shall comply with relevant requirements of IEC 60384-14 and if resistors are used they shall comply with the requirements of test (a) in 14.1 of IEC 60065:2001. **A2**

11 Moisture resistance and insulation

Lamp controlgear shall be moisture-resistant. They shall not show any appreciable damage after being subjected to the following test.

The lamp controlgear is placed in the most unfavourable position of normal use, in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %. The temperature of the air at all places where samples can be located shall be maintained within 1 °C of any convenient value t between 20 °C and 30 °C.

Before being placed in the humidity cabinet, the sample is brought to a temperature between t and $(t + 4)$ °C. The sample shall be kept in the cabinet for 48 h.

NOTE In most cases, the sample may be brought to the specified temperature between t and $(t + 4)$ °C by keeping it in a room at this temperature for at least 4 h before the humidity treatment.

In order to achieve the specified conditions within this cabinet, it is necessary to ensure constant circulation of the air within, and, in general, to use a cabinet which is thermally insulated.

Before the insulation test, visible drops of water, if any, are removed by means of blotting paper.

Immediately after the moisture treatment, the insulation resistance shall be measured with a d.c. voltage of approximately 500 V, 1 min after application of the voltage. Lamp controlgear having an insulating cover or envelope shall be wrapped with metal foil.

A2 Insulation resistance shall be not less than 2 MΩ for basic insulation and 4 MΩ for double or reinforced insulation between live parts and the body. For insulation between primary and secondary circuits, in controlgear providing SELV, other values apply (see Annex L).

Insulation shall be adequate

- a) between live parts and outer metal parts, including fixing screws and metal foil in contact with outer insulating parts;
- b) between live parts and control terminals, where relevant.

In the case of lamp controlgear having an internal connection or component between one or more output terminals and the earth terminal, such a connection shall be removed during this test.

For the test the input and output terminals shall be bonded together. Controlgear, having insulation cover or envelope is wrapped with metal foil. **A2**

12 Electric strength

Lamp controlgear shall have adequate electric strength.

Immediately after the measurement of the insulation resistance, the lamp controlgear shall withstand an electric strength test for 1 min applied between the parts specified in Clause 11.

The test voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz shall correspond to the values in Table 1. Initially, not more than half the specified voltage shall be applied, the voltage then being raised rapidly to the prescribed value.

Table 1 – Electric strength test voltage

Working voltage U		Test voltage V
Basic insulation for voltages of SELV		500
Up to and including 50 V		500
Above 50 V up to and including 1 000 V	Basic insulation	$2 U + 1\,000$
	Supplementary insulation	$2 U + 1\,000$
	Double or reinforced insulation	$4 U + 2\,000$
Where both reinforced insulation and double insulation are used, care shall be taken that the voltage applied to the reinforced insulation does not overstress the basic insulation or the supplementary insulation.		
When testing the controlgear the input should be tested with a test voltage which corresponds with the supply voltage and the output related part should be tested with a test voltage which corresponds with U_{out} .		

For solid or thin sheet insulation used for double or reinforced insulation Annex N applies. **A2**

No flashover or breakdown shall occur during the test.

The high-voltage transformer 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.

The overcurrent relay shall not trip when the output current is less than 100 mA.

The r.m.s. value of the test voltage applied shall be measured to within $\pm 3\%$.

The metal foil referred to in Clause 11 shall be placed so that no flashover occurs at the edges of the insulation.

Glow discharges without drop in voltage are neglected.

13 Thermal endurance test for windings of ballasts

Windings of ballasts shall have adequate thermal endurance.

Compliance is checked by the following test.

A2 NOTE 5 For windings included in controlgears providing SELV, see modifications specified in IEC 61558-1, Annex U. **A2**

The purpose of this test is to check the validity of the rated maximum operating temperature (t_w) marked on the ballast. The test is carried out on seven new ballasts which have not been subjected to the preceding tests. They shall not be used for further testing.

This test may also be applied to ballasts which form an integral part of a luminaire and which cannot be tested separately, thereby enabling such integral ballasts to be made with a t_w value.

Before the test, each ballast shall start and operate a lamp normally, and the lamp arc current shall be measured under normal conditions of operation and at a rated voltage. Details of the thermal endurance test are prescribed below. The thermal conditions shall be so adjusted that the objective duration of the test is as indicated by the manufacturer. If no indication is given, the test period shall be 30 days.

The test is carried out in an appropriate oven.

The ballast shall function electrically in a manner similar to that in normal use, and, in the case of capacitors, components or other auxiliaries not subjected to the test, these shall be disconnected and reconnected again in the circuit but outside the oven. Other components which do not influence the operating conditions of the windings may be removed.

NOTE 1 Where it is necessary to disconnect capacitors, components or other auxiliaries, it is recommended that the manufacturer supplies special ballasts with these parts removed and any necessary additional connections brought out from the ballast.

In general, to obtain normal operating conditions, the ballast is tested with the appropriate lamp.

The ballast container, if of metal, is earthed. Lamps are always kept outside the oven.

For certain inductive ballasts of simple impedance (for example, switch-start choke ballasts), the test is made without a lamp or resistor, provided the current is adjusted to the same value as found with the lamp at rated supply voltage.

The ballast is connected to the power supply so that the voltage stress between the lamp controlgear winding and earth is similar to the one in the lamp method.

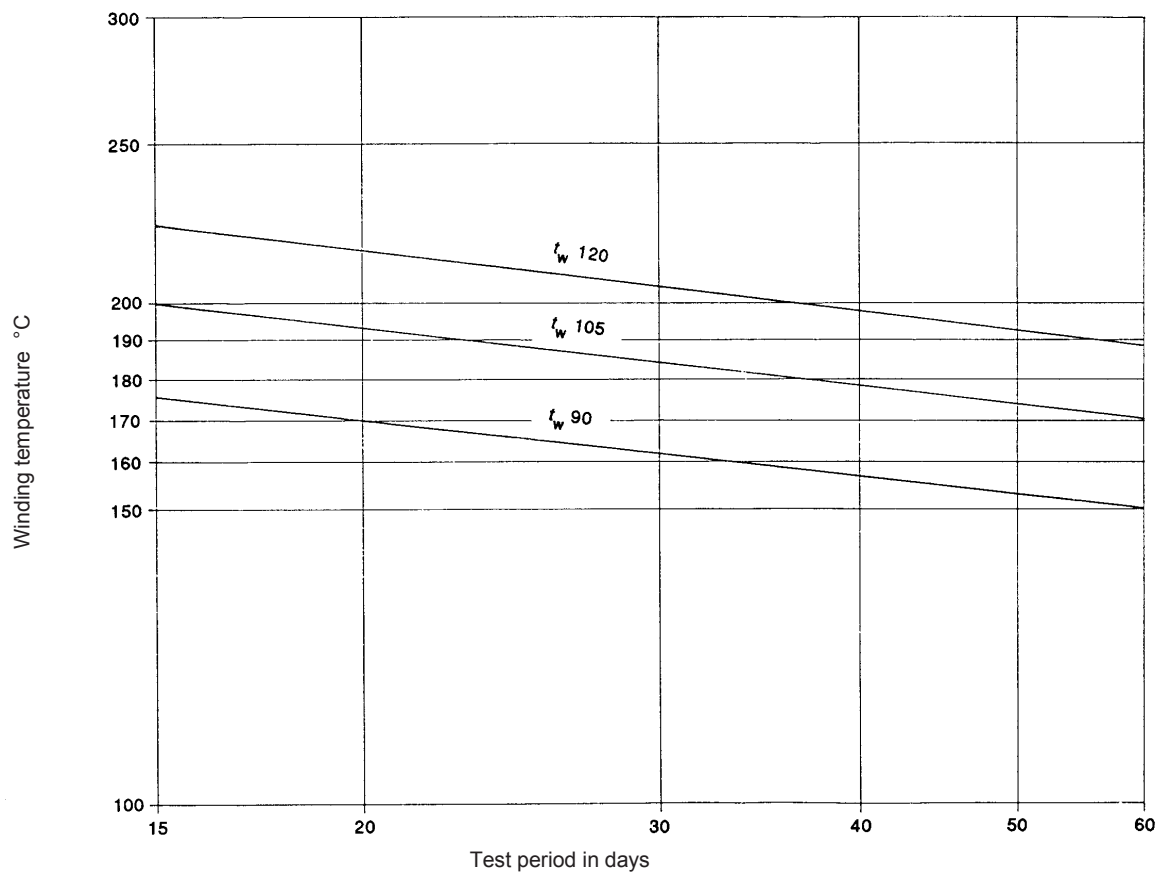
Seven ballasts are placed in the oven, and the rated supply voltage applied to each of the circuits.

The oven thermostats are then regulated so that the internal temperature of the oven attains a value such that the temperature of the hottest winding in each of the ballasts is approximately equal to the theoretical value given in Table 2.

For ballasts subject to a test duration longer than 30 days, the theoretical test temperatures shall be calculated by means of Equation (2) as explained in Note 3 of this clause.

After 4 h, the actual temperature of the winding is determined by the "change-in-resistance" method, and, if necessary, the oven thermostats are readjusted to approximate as closely as possible the desired test temperature. Thereafter, a daily reading of the air temperature in the oven is taken to ensure that the thermostats are maintained at the correct value to within ± 2 °C.

The winding temperatures are measured again after 24 h and the final test period for each lamp controlgear is determined from Equation (2). Figure 1 illustrates this in graphical form. The permissible difference between the actual temperature of the hottest winding of any of the ballasts under test and the theoretical value shall be such that the final test period is at least equal to, but not more than twice, the foreseen test period.



IEC 586/2000

NOTE These curves are for information only and illustrate equation (2) using a constant S of 4 500 (see Annex E).

Figure 1 – Relation between winding temperature and endurance test duration

Table 2 – Theoretical test temperatures for ballasts subjected to an endurance test duration of 30 days

Constant S	Theoretical test temperature °C					
	S4,5	S5	S6	S8	S11	S16
For $t_w =$ 90	163	155	142	128	117	108
95	171	162	149	134	123	113
100	178	169	156	140	128	119
105	185	176	162	146	134	125
110	193	183	169	152	140	130
115	200	190	175	159	146	136
120	207	197	182	165	152	141
125	215	204	189	171	157	147
130	222	211	196	177	163	152
135	230	219	202	184	169	158
140	238	226	209	190	175	163
145	245	233	216	196	181	169
150	253	241	223	202	187	175

NOTE Unless otherwise indicated on the ballast, the theoretical test temperatures specified in column S4,5 apply. The use of a constant other than S4,5 must be justified in accordance with Annex E.

NOTE 2 For the measurement of winding temperature by the "change-in-resistance" method, the following equation (1) is applicable:

$$t_2 = \frac{R_2}{R_1} (234,5 + t_1) - 234,5 \quad (1)$$

where

t_1 is the initial temperature in degrees Celsius;

t_2 is the final temperature in degrees Celsius;

R_1 is the resistance at temperature t_1 ;

R_2 is the resistance at temperature t_2 .

The constant 234,5 relates to copper windings; for aluminium, this constant should be 229.

No attempt shall be made to hold the winding temperature constant after the measurement taken after 24 h. Only the ambient air temperature shall be stabilized by the thermostatic control.

The test period for each ballast starts from the time the ballast is connected to the supply. At the end of its test, the relevant ballast is disconnected from the supply but is not removed from the oven until the tests on the other ballast have been completed.

NOTE 3 The theoretical test temperatures given in Figure 1 correspond to a working life of 10 years' continuous operation at the rated maximum operating temperature t_w .

They are computed using the following equation:

$$\log L = \log L_o + S \left(\frac{1}{T} - \frac{1}{T_w} \right) \quad (2)$$

where

L is the objective endurance test life in days (30, 60, 90 or 120);

$L_o = 3\,652$ days (10 years);

T is the theoretical test temperature in kelvins ($t + 273$);

T_w is the rated maximum operating temperature in kelvins ($t_w + 273$);

S is the constant depending on the design of the lamp controlgear and the winding insulation used.

After the test, when the ballasts have returned to room temperature, they shall satisfy the following requirements.

- a) At rated voltage, the ballast shall start the same lamp and the lamp arc current shall not exceed 115 % of the value measured before the test, as described above.

NOTE 4 This test is to determine any adverse change in the ballast setting.

- b) The insulation resistance between the winding and the ballast case, measured at approximately 500 V d.c. shall be not less than 1 MΩ.

The result of the test is considered to be satisfactory if at least six of the seven ballasts satisfy these requirements. The test is considered to have failed if more than two ballasts fail the test.

In the case of two failures, the test is repeated with seven more ballasts and no failure of these is permitted.

14 Fault conditions

Lamp controlgear shall be so designed that, when operated under fault conditions, there shall be no emission of flames or molten material or production of flammable gases. The protection against accidental contact in accordance with 10.1 shall not be impaired.

Operation under fault conditions denotes that each of the conditions specified in 14.1 to 14.4 is applied in turn and, associated with it, those other fault conditions which are a logical consequence thereof, with the provision that only one component at a time should be subjected to a fault condition.

- A2 If a lamp controlgear 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.

If a lamp controlgear marked with a functional earthing symbol and the manufacturer declared in the instructions that the use of the controlgear without functional earthing contact is permitted then the operation under fault conditions shall be made with and without earthing connection. A2

Examination of the apparatus and its circuit diagram will generally show the fault conditions which should be applied. These are applied in sequence in the order which is most convenient.

Totally enclosed lamp controlgear or components shall not be opened for examination nor for the application of internal fault conditions. However, in case of doubt, in conjunction with the examination of the circuit diagram, either the output terminals shall be short-circuited or, in agreement with the manufacturer, a specially prepared lamp controlgear shall be submitted for testing.