

BS EN 60968:2015



BSI Standards Publication

Self-ballasted fluorescent lamps for general lighting services — Safety requirements

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National foreword

This British Standard is the UK implementation of EN 60968:2015. It is derived from IEC 60968:2015 incorporating corrigendum March 2015. It supersedes BS EN 60968:2013+A11:2014 which is withdrawn.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by tags **C** **C**.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by IEC corrigendum March 2015 is indicated in the text by **AC1** **AC1**.

The UK participation in its preparation was entrusted by Technical Committee CPL/34, Lamps and Related Equipment, to Subcommittee CPL/34/1, Electric lamps.

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

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

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Date	Text affected
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EUROPEAN STANDARD

EN 60968

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2015

ICS 29.140.30

English Version

**Self-ballasted fluorescent lamps for general lighting services -
Safety requirements
(IEC 60968:2015, modified + COR1:2015, modified)**

Lampes à fluorescence à ballast intégré pour l'éclairage
général - Règles de sécurité
(IEC 60968:2015, modifiée + COR1:2015, modifiée)

Leuchtstofflampen mit eingebautem Vorschaltgerät für
Allgemeinbeleuchtung - Sicherheitsanforderungen
(IEC 60968:2015, modifiziert + COR1:2015, modifiziert)

This European Standard was approved by CENELEC on 2015-03-30. 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.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 34A/1811/FDIS, future edition 3 of IEC 60968 prepared by subcommittee 34A "Lamps", of IEC/TC 34 "Lamps and related equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60968:2015.

A draft amendment, which covers common modifications to IEC 60968 (34A/1811/FDIS), was prepared by CLC/TC 34A "Lamps" and approved by CENELEC.

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) 2016-03-30
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-03-30

This document supersedes EN 60968:2013.

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 60968:2015 + COR1:2015 was approved by CENELEC as a European Standard with agreed common modifications.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60061-1	-	Lamp caps and holders together with gauges for the control of interchangeability and safety - Part 1: Lamp caps	EN 60061-1	-
IEC 60061-3	-	Lamp caps and holders together with gauges for the control of interchangeability and safety - Part 3: Gauges	EN 60061-3	-
IEC 60360	-	Standard method of measurement of lamp cap temperature rise	EN 60360	-
IEC 60598-1	-	Luminaires – Part 1: General requirements and tests	EN 60598-1	-
IEC 60695-2-10	-	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10	-
IEC 60695-2-11	2000	Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products	EN 60695-2-11	2001
IEC 60901	-	Single-capped fluorescent lamps - Performance specifications	EN 60901	-
IEC 61199	-	Single-capped fluorescent lamps – Safety specifications	EN 61199	-
IEC 61347-1	2015	Lamp controlgear – Part 1: General and safety requirements	EN 61347-1	2015
ISO 4046-4	2002	Paper, board, pulps and related terms - Vocabulary - Part 4: Paper and board grades and converted products		

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SELF-BALLASTED FLUORESCENT LAMPS FOR GENERAL LIGHTING SERVICES – SAFETY REQUIREMENTS

FOREWORD

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International Standard IEC 60968 has been prepared by subcommittee 34A: Lamps, of IEC technical committee 34: Lamps and related equipment.

This third edition cancels and replaces the second edition published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition, where additions have been made to the following:

- a) caps and prevention of cap misuse;
- b) interchangeability;
- c) mechanical and electrical strength;
- d) creepage distances and clearances;
- e) end of lamp life precaution;
- f) abnormal operation;

- g) test conditions for dimmable and three-way lamps;
- h) water contact related marking;
- i) verification, and assessment;
- j) information for luminaire design in the form of annexes.

The text of this third edition is based on the following documents:

FDIS	Report on voting
34A/1811/FDIS	34A/1838/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

SELF-BALLASTED FLUORESCENT LAMPS FOR GENERAL LIGHTING SERVICES – SAFETY REQUIREMENTS

1 Scope

This International Standard specifies the safety and interchangeability requirements, together with the test methods and conditions required to show compliance of tubular fluorescent lamps with integrated means for controlling starting and stable operation (self-ballasted fluorescent lamps).

These lamps are intended for domestic and similar general lighting purposes, having a rated voltage of 50 V to 250 V, having a rated frequency of 50 Hz or 60Hz and having IEC 60061-1 compliant caps.

For a cap-holder system not specifically mentioned in this standard, the relevant information on safety related tests provided by the manufacturer will apply.

The requirements of this standard relate only to type testing.

Recommendations for whole product testing or batch testing are given in Annex A.

This part of the standard covers photobiological safety according to IEC 62471 and IEC TR 62471-2. Blue light and infrared hazards are below the level which requires marking.

2 Normative references

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

IEC 60061-1, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps*

IEC 60061-3, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 3: Gauges*

IEC 60360, *Standard method of measurement of lamp cap temperature rise*

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

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

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end products*

IEC 60901, *Single-capped fluorescent lamps – Performance specifications*

IEC 61199, *Single-capped fluorescent lamps – Safety specifications*

IEC 61347-1:2015, *Lamp controlgear – Part 1: General and safety requirements*

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 this document, the following terms and definitions apply:

3.1

self-ballasted lamp

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

3.2

nominal value

approximate quantity value used to designate or identify a lamp

[SOURCE: IEC 60901:1997, 1.4.3]

3.3

rated value

quantity value for a characteristic of a lamp for specified operating conditions

Note 1 to entry: The value and the conditions are specified in this standard, or assigned by the manufacturer or responsible vendor.

[SOURCE: IEC 60901:1997, 1.4.4, modified — The second sentence is moved to a note to entry.]

3.4

cap temperature rise

Δt_s

surface temperature rise (above ambient) of a standard test lampholder fitted to the lamp's cap, when measured in accordance with the standard method described in IEC 60360

[SOURCE: IEC 60432-1:1999, 1.3.8]

3.5

live part

conductive part which may cause an electric shock in normal use

3.6

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

3.7

type test sample

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

3.8

specific effective radiant UV power

effective power of the UV radiation of a lamp related to its luminous flux

Note 1 to entry: The specific effective radiant UV power is expressed in mW/klm.

Note 2 to entry: The effective power of the UV radiation is obtained by weighting the spectral power distribution of the lamp with the UV hazard function $S_{UV}(\lambda)$. Information about the relevant UV hazard function is given in IEC 62471. It only relates to possible hazards regarding UV exposure of human beings. It does not deal with the possible influence of optical radiation on materials, like mechanical damage or discoloration.

3.9

test family

lamp groups which are distinguished by common features of materials relevant to the test applied

4 General requirements and general test requirements

4.1 Self-ballasted lamps shall be so designed and constructed that in normal use they function reliably and cause no danger to the user or surroundings.

In general, compliance is checked by carrying out all the tests specified.

4.2 All measurements unless otherwise specified in this standard, shall be carried out at rated voltage and frequency and in a draught-proof room. The ambient temperature shall be from 23 °C to 27 °C inclusive and shall not vary by more than 1 °C during the measurements.

If lamps are rated for alternative frequencies the test shall be carried out at the most onerous of these.

The test voltages are specified in the relevant clauses.

4.3 Self-ballasted lamps are non-repairable, factory sealed units. They shall not be opened for any tests with exemption of 13.2. In the case of substantiated doubt based on the inspection of the lamp and the examination of the circuit diagram, and in agreement with the manufacturer or responsible vendor, lamps specially prepared so that a fault condition can be simulated shall be submitted for testing (see Clause 13 and Clause 15).

5 Marking

5.1 Lamp marking

The following information shall be marked on the lamp.

- 1) Mark of origin (this may take the form of a trademark, the manufacturer's name or the name of the responsible vendor).
- 2) Rated voltage(s) or rated voltage range (marked "V" or "volts").
- 3) Rated power (marked "W" or "watts").
- 4) Rated frequency (frequencies) (marked in "Hz").
- 5) Any further information needed to identify the product type e.g. model number or type reference.

5.2 Additional marking

In addition the following information shall be given by the lamp manufacturer either on the lamp, the packaging or in the installation instructions.

- 1) Rated lamp current.
- 2) For lamps with a weight significantly higher than that of the lamps for which they are a replacement, attention should be drawn to the fact that the increased weight may reduce the mechanical stability of certain luminaires.

- 3) Lamps that are not suitable for dimming shall be marked according to Figure 1 or be provided with a written cautionary notice. The marking shall be provided on the packaging or accompanying information and its height shall be at least 5 mm.



Figure 1 – Dimming not allowed

- 4) Lamps shall be marked with the symbol according to Figure 2. The marking shall be provided on the packaging or accompanying information. The symbol is not needed if a written cautionary notice is provided.

AC₁



[SOURCE: IEC 60417-6179-1 (2014-10)] AC₁

Figure 2 – Lamp to be used in dry conditions or in a luminaire that provides protection

5.3 Compliance of marking

Compliance is checked by the following.

- 1) *Presence and legibility of the marking required in 5.1 – by visual inspection.*
- 2) *The durability of the marking is checked by trying to remove it by rubbing lightly for 15 s with a piece of cloth soaked in water. The marking shall be legible after the test.*
- 3) *Availability of information required in 5.2 – by visual inspection.*

5.4 Locations where marking is required (See Table 1)

Table 1 – Locations where marking is required

Marking item	Product	Product Packaging	Product datasheets or leaflets
Mark of origin	x	x	x
Rated voltage(s) or rated voltage range	x	x	x
Rated power	x	x	x
Rated frequency	x	x	x
Product identification	x	x	x
Rated lamp current	-	x	x
Access weight	-	x	x
Dimming restriction	-	x	x
Water contact prevention	-	x	x
x = required – = not required but optional			

6 Interchangeability, mass and bending moment

6.1 Interchangeability

Interchangeability shall be ensured by the use of caps in accordance with IEC 60061-1.

Compliance of the finished lamp shall be checked by the use of gauges for checking the dimensions controlling interchangeability in accordance with IEC 60061-3.

6.2 Bending moment and mass imparted by the lamp at the lampholder

The value of the bending moment, imparted by the lamp at the lampholder shall not exceed the value given in Table 2. The bending moment shall be determined by measuring the downward force of the lamp (e.g. by means of a scale) at the tip of the bulb of the horizontally held lamp and multiplying this force by the distance between the tip of the bulb and the pivot point. The pivot line shall lie at the bottom end of the cylindrical part (for Edison and bayonet caps) or at the end of the contact pins (for pin caps). It shall be supported by an upright held thin metal sheet or a similar means. Sample test arrangement for bending moment test is shown in Figure 3. For lamps with caps different to those in Table 2, the effect of the bending moment shall be regarded and limited. A measurement method for these lamps with these caps is under consideration. It shall be taken care that the luminaire surface where the lampholder is fixed to, can withstand the bending moment. For the calculation of this bending moment, the length of the lampholder shall be taken into account when measuring the overall length. This shall be ensured for the elevated temperature during operation in order to check the possible softening of the surface material.

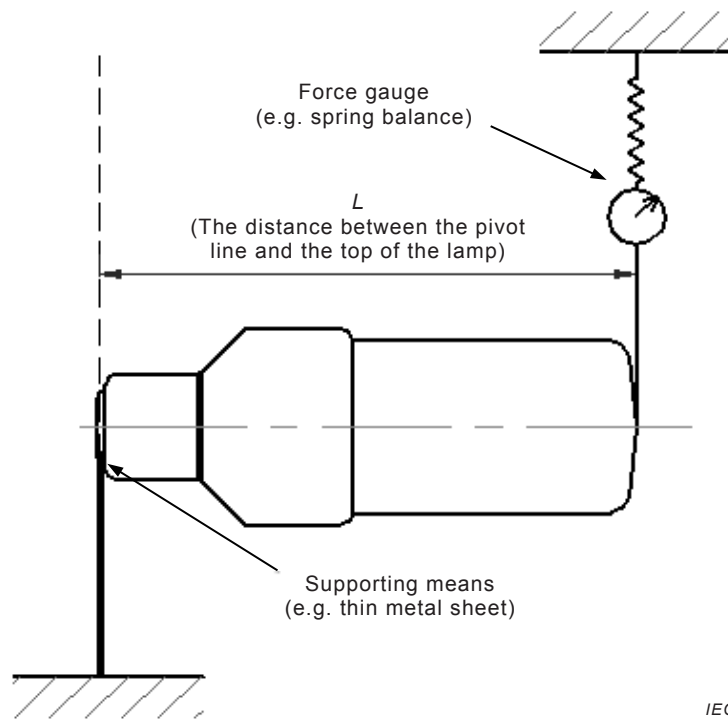


Figure 3 – Sample test arrangement for bending moment imparted by the lamp at the lampholder

The mass as given in Table 2 shall not be exceeded.

Table 2 – Bending moments and masses

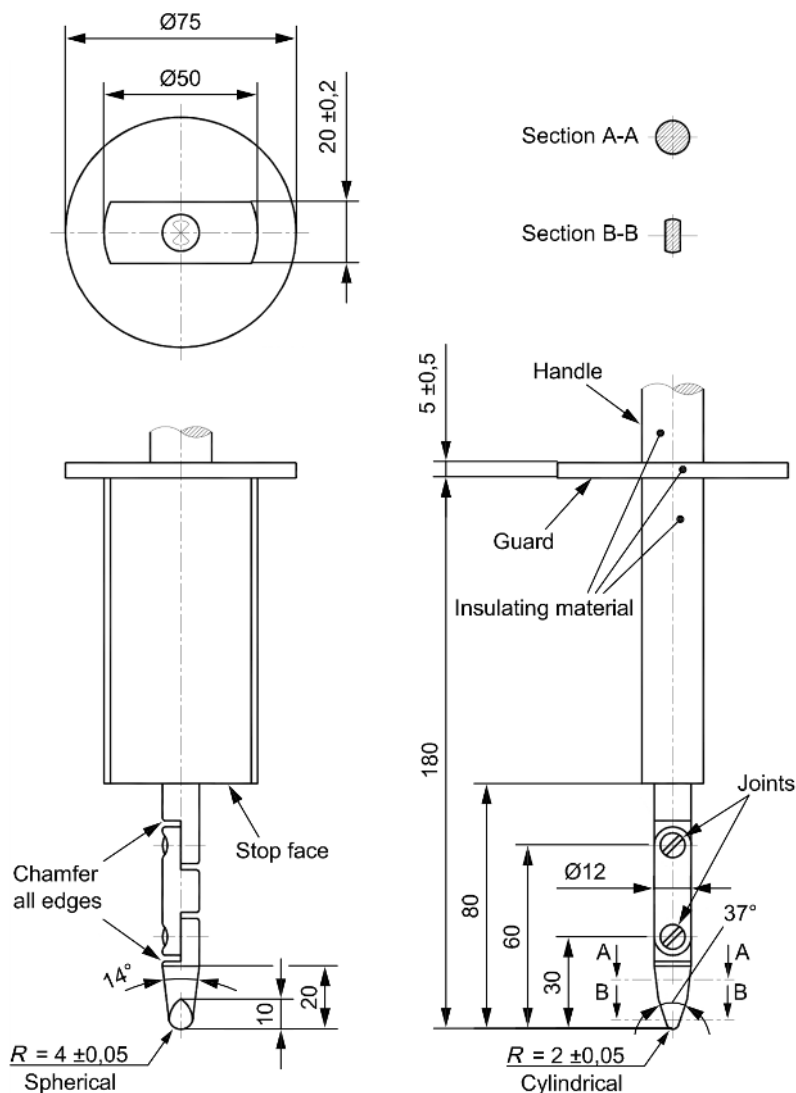
Cap	Bending moment Nm	Mass kg
B15d	1	^a
B22d	2	1
E11	0,5	^a
E12	0,5	^a
E14	1	^a
[C] Text deleted [C]		
E27	2	1
[C] Text deleted [C]		
E40	1 ^a	^a
GU10	0,1	^a
GZ10	0,1	^a
GX53	0,3	^a
R7s	^a	1 ^a
^a Under consideration.		

7 Protection against electric shock

The lamps shall be so constructed that, without any additional enclosure in the form of a luminaire, no internal metal parts, basic insulated external metal parts or live metal parts of the lamp cap or of the lamp itself are accessible when the lamp is installed in a lampholder according to the relevant IEC lampholder data sheet.

Compliance is checked by means of the test finger specified in Figure 4 with a force of 10 N if necessary.

Linear dimensions in millimetres



IEC

Material: metal, except where otherwise specified.

Tolerances on dimensions without specific tolerance:

- on angles: $\begin{matrix} +0 \\ -10 \end{matrix}$
- on linear dimensions:
 - up to 25 mm: $\begin{matrix} +0 \\ -0,05 \end{matrix}$
 - over 25 mm: $\pm 0,2$ mm

Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0° to +10° tolerance.

Figure 4 – Standard test finger (according to IEC 60529)

Requirements for lamps with GX53 caps are under consideration.

External metal parts other than current-carrying metal parts of the cap shall not be or become live. For testing, any movable conductive material shall be placed in the most onerous position without using a tool.

Compliance is checked by means of the insulation resistance and electric strength test (see Clause 8).

8 Insulation resistance and electric strength

8.1 General

Insulation resistance and electric strength shall be adequate between live parts of the lamp and accessible parts of the lamp.

During the test, the supply contacts of the cap are short-circuited. Accessible parts of the lamp are fully covered with metal foil. Care shall be taken that the metal foil is placed so that no flashover occurs at the edges. The creepage distance between the foil and the live parts shall be equal to or greater than the creepage distance of reinforced insulation according to Clause 11 of IEC 60598-1, with a maximum distance of 6 mm.

The lamp shall be conditioned for 48 h in a cabinet containing air with a relative humidity between 91 % and 95 %. The temperature of the air is maintained within 1 °C of any convenient value between 20 °C and 30 °C. The tests of 8.2 and 8.3 shall be carried out in the humidity cabinet under the above conditions.

8.2 Insulation resistance

Insulation resistance shall be measured with a DC voltage of approximately 500 V, 1 min after application of the voltage.

The insulation resistance between live parts of the cap and the foil shall be not less than 4 MΩ. The requirements of Annex A of IEC 61347-1: — shall be complied with.

NOTE The insulation resistance of bayonet caps between shell and contacts is under consideration.

8.3 Electric strength

Electric strength shall be measured between the live parts and the foil and shall withstand a voltage test for 1 min with an AC voltage as follows.

Initially, no more than half the voltage prescribed in Table 10.2 of IEC 60598-1 for Class II luminaires is applied between the contacts and the metal foil. It is then gradually raised to the full value.

No flashover or breakdown shall occur during the test.

9 Mechanical strength

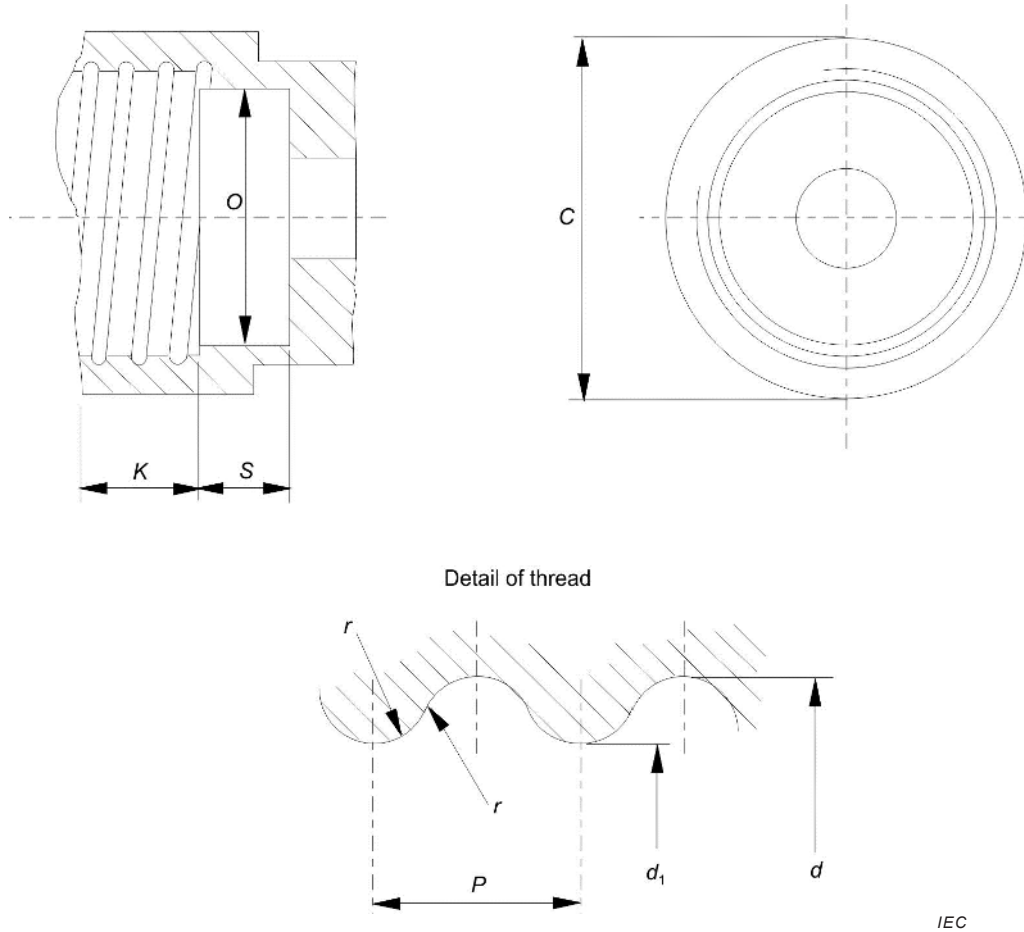
9.1 General

The lamp construction shall withstand externally applied axial pull and bending moment. For the measurement method, see A.2.1 of IEC 61199. Pull force resistance for GRZ10d and GRZ10t caps shall be as specified in A.1.1 of IEC 61199, for GR10q caps.

9.2 Torsion resistance

9.2.1 Torsion resistance of unused lamps

In order to test the connection of the cap to the lamp shell the torsion resistance of unused lamps is tested as follows.



Surface finish of screw thread $R_a = 0,4 \mu\text{m}$ minimum (see note).

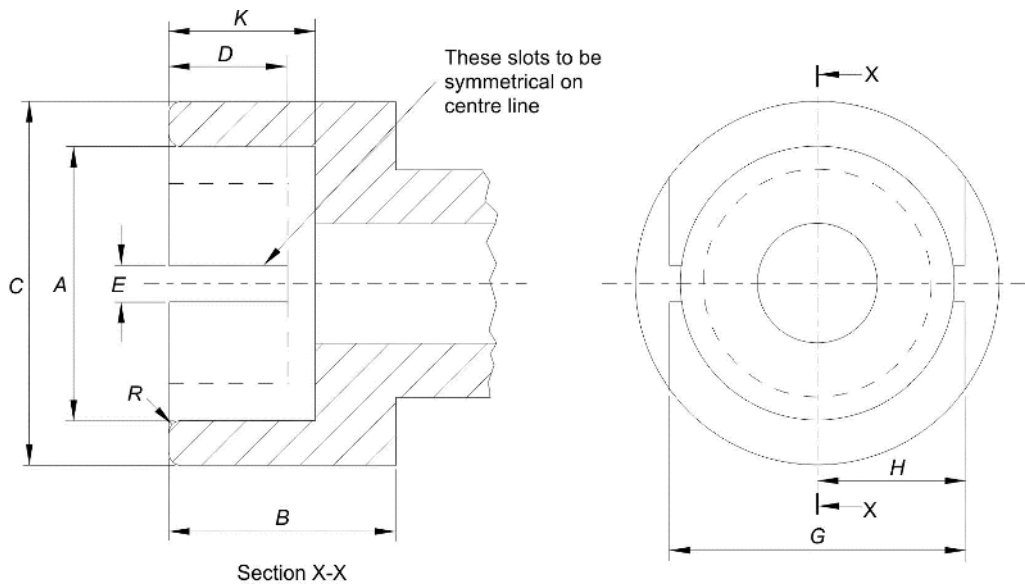
NOTE A smoother surface can result in mechanical overloading of the cap, see also C.1.2 of IEC 60432-1,.

Dimensions in millimetres

Dimension	E12	E14	☐ Text	☐ Text	E27	Tolerance
C	15,27	20,0	deleted ☐	deleted ☐	32,0	Min.
K	9,0	11,5			13,5	0,0 -0,3
O	9,5	12,0			23,0	+0,1 -0,1
S	4,0	7,0			12,0	Min.
d	11,89	13,89			26,45	+0,1 -0,0
d ₁	10,62	12,29			24,26	+0,1 -0,0
P	2,540	2,822			3,629	-
r	0,792	0,822			1,025	-

The drawing illustrates the essential dimensions of the holder which need only be checked if doubt arises from the application of the test.

Figure 5 – Holder for torsion test on lamps with screw caps



IEC

Dimension	B15 mm	B22 mm	Tolerance mm
A	15,27	22,27	+0,03
B	19,0	19,0	Min.
C	21,0	28,0	Min.
D	9,5	9,5	Min.
E	3,0	3,0	+0,17
G	18,3	24,6	±0,3
H	9,0	12,15	Min.
K	12,7	12,7	±0,3
R	1,5	1,5	Approximate

The drawing illustrates the essential dimensions of the holder which need only be checked if doubt arises from the application of the test.

Figure 6 – Holder for torsion test on lamps with bayonet caps

Table 3 – Torsion test values for unused lamps

Cap	Torsion moment Nm
B15d	1,15
B22d	3
E11	0,8
E12	0,8
E14	1,15
☐ Text deleted ☐	
E27	3
☐ Text deleted ☐	
E40	5
GX53	3

Before each use, the test holder for screw caps shall be checked to ensure that it is clean and completely free of lubricants and grease.

The cap of the test lamp shall be placed in the appropriate holder shown in Figure 5 and 6. Either the cap or the part of the lamp which is used for inserting or removing the lamp may be mechanically clamped.

Torque shall be applied steadily to the appropriate lamp component, so that no jerk occurs. The application of the torque may follow either of the following schemes.

- a) *The required torque shall be applied, according to the limits given in Table 3.*
- b) *Higher torque values than the relevant limit shall be applied so that the value of torque for failure is obtained. In this case, the equipment is to be provided with suitable means for measuring torque over a wide range of failure levels.*

Compliance:

The cap shall remain firmly attached to the bulb or that part of the lamp which is used for inserting or removing the lamp when subjected to the torque levels listed in Table 3 above. Some lamps are made with parts designed to be moved after insertion (for example a light sensor). Movement of these parts does not constitute non-compliance.

In the case of un-cemented caps, relative movement between cap and bulb is permitted provided it does not exceed 10°.

In case of doubt of the electrical integrity of the lamp after the test, repeat the test in Clause 7.

9.2.2 Torsion resistance of lamps after a defined time of usage

The torsion resistance of used lamps is under consideration.

9.3 Axial strength of Edison caps

The lamps shall be screwed into gauge of Table 4. After full insertion an axial force of Table 4 is applied to the central contact. See Figure 7

In case axial strength of the cap does not decrease when the unmounted cap was assembled to the finished lamp, test results on the unmounted cap can be applied.

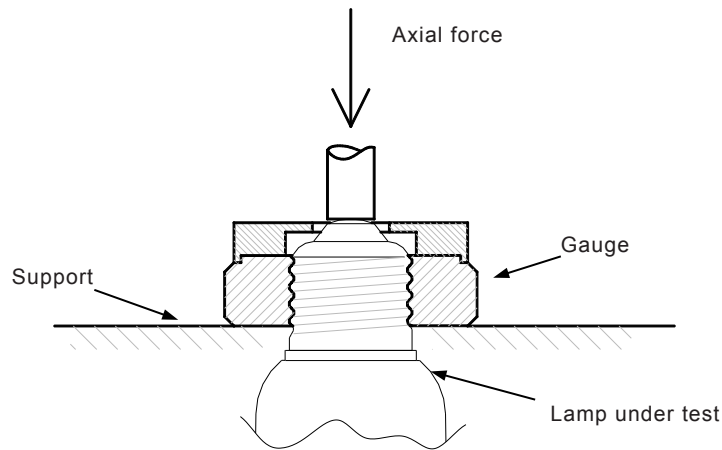
NOTE The gauges are used to hold the lamp. Calibration is not required.

Compliance:

After this test the insulation around the central contact shall remain intact. The application of the torque in 9.2 shall not lead to impressing the bottom part of the cap into the shell.

Table 4 – Values for axial force

Cap	Gauge	Axial force N	Additional information
E11	7006-6-1	Under consideration	
E12	7006-27H-1	Under consideration	The portion for contact making check is not needed; Full threaded gauge with T1 height; C and H dimensions are irrelevant
E14	7006-27F-1	80	
Text	Text		
E27	7006-27B-1	120	
Text	Text		
E40	7006-27-7	Under consideration	



IEC

Figure 7 – Test equipment for applying an axial force

10 Cap temperature rise

The cap temperature rise Δt_s of the complete lamp during run-up, stabilization period and after stabilization shall not exceed the values mentioned in Table 5 below when measured under the conditions specified in IEC 60360.

Table 5 – Maximum cap temperature rise

Cap	Temperature rise K
B15d	120
B22d	125
E12	90
E14	120
[C] Text deleted [C]	
[C] Text deleted [C]	
[C] Text deleted [C]	
E27	120
[C] Text deleted [C]	

For GRZ10d and GRZ10t cap requirements and conditions of compliance as specified in 4.9 of IEC 61199 for GR10q caps apply.

Measurement shall be carried out at maximum rated voltage.

11 Resistance to heat

Self-ballasted lamps shall be sufficiently resistant to heat. External parts of insulating material providing protection against electric shock, and parts of insulating material retaining live parts in position shall be sufficiently resistant to heat.

Compliance is checked by subjecting the material to a ball-pressure test by means of the apparatus shown in Figure 8.

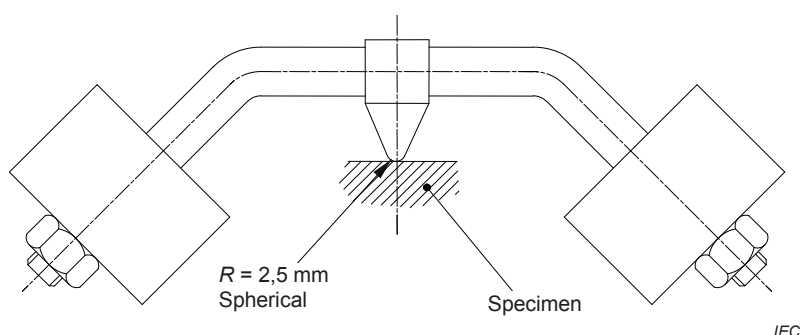


Figure 8 – Ball-pressure apparatus

The test is made in a heating cabinet at a temperature of $(25 \pm 5) ^\circ\text{C}$ in excess of the operating temperature of the relevant part according to Clause 10, with a minimum of $125 ^\circ\text{C}$ for parts retaining live parts in position and $80 ^\circ\text{C}$ ¹ for other parts. The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter pressed against this surface with a force of 20 N.

¹ Under consideration.

The test load and the supporting means are placed within the heating cabinet for a sufficient time to ensure that they have attained the stabilized testing temperature before the test commences.

The part to be tested is placed in the heating cabinet, for a period of 10 min, before the test load is applied.

If the surface under test bends, the part where the ball presses is supported. For this purpose if the test cannot be made on the complete specimen, a suitable part may be cut from it.

The specimen shall be at least 2,5 mm thick, but if such a thickness is not available on the specimen then two or more pieces are placed together.

After 1 h the ball is removed from the specimen, which is then immersed for 10 s in cold water for cooling down to approximately room temperature. The diameter of the impression is measured, and shall not exceed 2 mm.

In the event of curved surfaces the shorter axis is measured if the indent is elliptical.

In case of doubt, the depth of the impression is measured and the diameter calculated using the formula $\phi = 2\sqrt{p(5-p)}$, in which p = depth of impression.

The test is not made on parts of ceramic material.

12 Resistance to flame and ignition

Parts of insulating material retaining live parts in position and external parts of insulating material providing protection against electric shock are subjected to the glow-wire test in accordance with IEC 60695-2-10 and IEC 60695-2-11 subject to the following details.

- *The test specimen is a complete lamp. It may be necessary to take away parts of the lamp to perform the test, but care is taken to ensure that the test conditions are not significantly different from those occurring in normal use.*
- *The test specimen is mounted on the carriage and pressed against the glow-wire tip with a force of 1 N, preferably 15 mm, or more, from the upper edge, into the centre of the surface to be tested. The penetration of the glow-wire into the specimen is mechanically limited to 7 mm.*

If it is not possible to make the test on a specimen as described above because the specimen is too small, the above test is made on a separate specimen of the same material, 30 mm square and with a thickness equal to the smallest thickness of the specimen.

- *The temperature of the tip of the glow-wire is 650 °C. After 30 s the specimen is withdrawn from contact with the glow-wire tip.*

The glow-wire temperature and heating current are constant for 1 min prior to commencing the test. Care is taken to ensure that heat radiation does not influence the specimen during this period. The glow-wire tip temperature is measured by means of a sheathed fine-wire thermocouple constructed and calibrated as described in IEC 60695-2-10.

- *Any flame or glowing of the specimen shall extinguish within 30 s of withdrawing the glow-wire, and any flaming drop shall not ignite a piece of the tissue paper, spread out horizontally 200 mm ± 5 mm below the specimen. The tissue paper is specified in 4.187 of ISO 4046-4:2002.*
- *The test is not made on parts of ceramic material.*

13 Fault conditions

13.1 General requirements

The lamps shall not impair safety when operated under fault conditions which may occur during the intended use.

13.2 Test conditions

Each of the following fault conditions is applied in turn, as well as any other associated fault conditions that may arise from it as logical consequences. Only one component at a time is subjected to a fault condition.

- a) *In a switch-start circuit, the starter is short-circuited.*
- b) *The lamp does not start, because one of the electrodes is broken.*
- c) *The lamp does not start, although the electrode circuits are intact (de-activated lamp).*
- d) *The lamp operates, but one of the electrodes is de-activated or broken (rectifying effect).*
- e) *Opening or bridging other points in the circuit where the diagram or construction indicates that such a fault condition may impair safety.*

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

Components or devices in which a short-circuit does not occur shall not be bridged. Similarly, components or devices in which an open circuit cannot occur shall not be interrupted.

Manufacturers or responsible vendors shall produce evidence that the components behave in a way that does not impair safety, for instance, by showing compliance with the relevant specification.

Compliance is checked by operating the sample free burning, vertical cap up position at room temperature and at the most critical test voltage between 90 % and 110 % of the rated voltage.

In case a rated voltage range is declared, the test has to be carried out at the most critical test voltage between 90 % and 110 % of the mean voltage of that declared range or at the most critical test voltage within the declared voltage range, whatever range is greater.

In case of alternative rated voltages the test shall be performed separately for each rated voltages.

Example 1:

*Declared voltage range: 220 V to 240 V: → Test voltage within 207 V to 253 V.
(90 % to 110 % of 230 V is wider than declared range)*

Example 2:

*Declared voltage range: 170 V to 280 V: → Test voltage within 170 V to 280 V.
(Declared range is wider than 90 % to 110 % of 225 V).*

In the case of fault conditions a), or e), compliance is checked by operating the sample free burning at room temperature and at the most critical test voltage until stable conditions have been reached, then introducing the fault condition.

In the case of fault conditions b), c) or d), the same operating conditions apply but the fault condition is introduced before starting the test.

The sample is then tested for a further 8 h. During this test it shall not catch fire, or produce flammable gases and live parts shall not become accessible.

To check if accessible parts have become live, a test in accordance with Clause 7 is made. The insulation resistance (see 8.1) is checked with a d.c. voltage of approximately 1 000 V.

13.3 Test setup for non-starting lamp

Test setup for c) in 13.2.

Two separate burners of the same type that is intended to be operated in the product under test shall be connected to the output of the controlgear simulating a non-starting lamp. Refer to the schematic diagram in Figure 9.

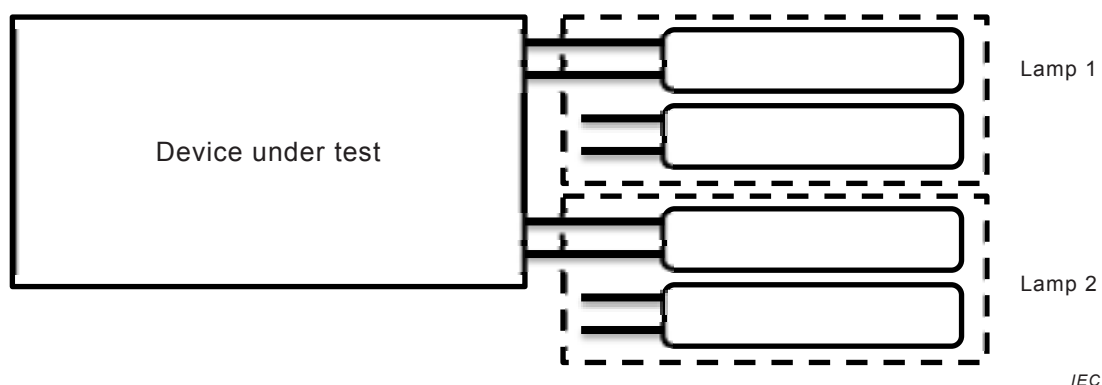


Figure 9 – Schematic diagram for non-starting lamp test

14 Creepage distances and clearances

The requirements of IEC 61347-1 apply except that for conductive accessible parts IEC 60598-1 is applicable

15 Lamp end of life

15.1 General requirements

In the case where one of the electrodes is depleted or broken, while the lamp continues to operate (partial rectification), overheating of the lamp ends shall not lead to unsafe situations.

15.2 Test setup

One of the following options shall be chosen when the manufacturer provides samples for testing.

Option 1 – Six samples shall be used for the test. Three of the samples shall have no emission-mix on one lamp electrode and the other three samples shall have no emission-mix on the other lamp electrode.

Option 2 – Six samples shall be used for the test. The samples may have minimum amount emission-mix on one or both electrode(s).

The amount of emitter is reduced in order to shorten the test time. Such lamps with prepared electrodes should have a lifetime of at least 100 h. Compliance is checked by operating the sample free burning, vertical cap up position or in the burning position indicated on the packaging at room temperature and at the most critical test voltage as provided in 13.2.

15.3 Compliance

The samples shall be observed during the test for any evidence of fire, charring or cracking of the bulb wall. The test is passed if:

- a) any flaming is contained in the enclosure,
- b) there are no burn-through openings created in the enclosure,
- c) there are no dislodged particles of glass larger than 3,8 mm,
- d) the combined area of any charred black spots does not exceed 75 mm² [not including the area described in e)],
- e) there is no charred black area around the tube wider than 3,8 mm measured perpendicular to the bulb wall.

16 Photobiological safety

16.1 UV radiation

The specific effective radiant UV power emitted by the lamp shall not exceed the value of 2mW/klm. For reflector lamps it shall not exceed the value of 2 mW/(m²·klx).

NOTE In IEC 62471 exposure limits are given as effective irradiance values (unit W/m²) and for risk group classification the values for general lighting lamps are to be reported at an illuminance level of 500 lx. The borderline for risk group exempt is 0,001 W/m² at an illuminance level of 500 lx. This means the specific value, related to the illuminance, is 0,001 divided by 500 in W/(m²·lx), which is 2 mW/(m²·klx). Since lx = lm/m² this equals 2 mW/klm specific UV power.

Measurement shall be carried out at maximum rated voltage.

Compliance is checked by spectroradiometric measurement, under the same conditions as for the lamp's electrical and photometric characteristics as given in IEC 60901.

16.2 Other photobiological effects

Not applicable.

17 Abnormal operation

Self-ballasted lamps shall not create hazard under abnormal operating conditions.

Self-ballasted lamps shall be constructed so that as a result of abnormal or careless operation, the risk of fire, mechanical damage impairing safety of protection against electric shock is obviated.

Applying non-dimmable self-ballasted lamps on a dimmer or an electronic switch is to be tested as a possible case of abnormal operation.

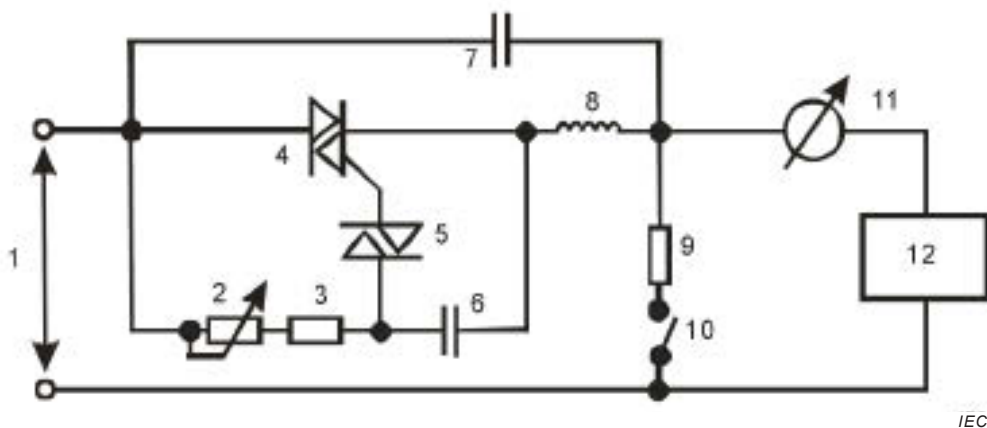
Test procedure:

Test non-dimmable lamp in test circuit shown in Figure 10.

Determine 2 (Potentiometer R1) and 10 (Switch S1) settings at which the maximum $I_{r,m,s}$ occurs.

Test at this situation, and if the lamp passively fails within 60 min, repeat the test at 10 % lower $I_{r.m.s}$. The lower $I_{r.m.s}$ shall be set in the decreasing potentiometer resistance direction.

Repeat this procedure until stable operation is achieved for minimum 60 min.



Key

1	mains	7	capacitor C2 = 68 nF to 150 nF
2	potentiometer R1 = 470 kΩ	8	induction L1 = 3 mH
3	resistor R = 3,3 kΩ	9	basic load, incandescent lamp P = 60 W
4	Triac BTA16/700	10	switch S1
5	Diac DB3	11	ammeter $I_{r.m.s}$
6	capacitor C1 = 100 nF	12	device under test (DUT) (lamp)

Figure 10 – Test circuit for testing a non-dimmable lamp at a dimmer or electronic switch

NOTE The most onerous situation for possible safety implication occurs at the maximum $I_{r.m.s}$ that does not cause an immediate (passive) failure.

Operate the lamp for 8 h at the above most onerous dimming level (potentiometer adjustment).

Compliance

Compliance is checked by operating the sample free burning, vertical cap up position or in the burning position indicated on the packaging at room temperature and at the rated voltage.

In case a voltage range is declared, the test has to be carried out at the mean voltage of that declared range.

In case of alternative rated voltages the test shall be performed separately for each rated voltages.

During this test the lamp shall not catch fire, or produce flammable gases and live parts shall not become accessible with the standard test finger of Figure 4.

18 Test conditions for dimmable and three-way lamps

Test shall be carried out at maximum power setting for Clause 10 and 16.1.

Test conditions for Clauses 13 and 14 are under consideration.

19 Whole production assessment

See Annex A.

20 Collation of type test verification

The minimum sampling size for type testing shall be as given in Table 6. The sample shall be representative of a manufacturer's production. All lamps of type test sample shall pass the tests.

Lamps may be grouped for the tests of Table 5 into families where they have common features relevant to the individual test.

Table 6 – Sampling sizes for type test

1	2	3	4
Clause or subclause	Test	Test family ^a	Minimum size of type test sample
5.1 and 5.2	Marking – presence	None	1
5.3	Marking – legibility	Same marking surface, process and material	
5.3	Marking – durability	Same marking surface, process and material	
6.1	Interchangeability	Same dimensions defined by cap gauges	1
6.2	Bending moments and mass imparted by the lamp at the lamp holder	Same design having different CCT	
7	Protection against electric shock	All lamps with the same controlgear housings and caps	1
8.2	Insulation resistance	All lamps with the same controlgear housings, caps and the same connection method between discharge tube and controlgear housing	1
8.3	Electric strength	All lamps with the same controlgear housings, caps and the same connection method between discharge tube and controlgear housing	1
9.2.1	Torsion resistance of unused lamps	Same cap fixation design, materials and process	5
9.2.2	Torsion resistance of lamps after a defined time of usage	Same cap fixation design, materials and process	^a
2	Axial strength of Edison caps	Same cap design	5
10	Cap temperature rise	Same cap design and wattage	1
11	Resistance to heat	Same material	1

1	2	3	4
Clause or subclause	Test	Test family ^a	Minimum size of type test sample
12	Resistance to flame and ignition	Same material and thickness	1
13	Fault conditions	Same controlgear and electrode design	1 ^b
14	Creepage distances and clearances	Same controlgear design and mechanical construction including the cap	1
15	Lamp end of life	Same controlgear, electrode design, same housing	6
16.1	UV radiation	Same rated power and discharge tube design	1
17	Abnormal operation	Same controlgear design and mechanical construction including the cap	5
^a Under consideration ^b Sufficient samples should be used to carry out all of the required tests once.			

21 Information for luminaire design

Refer to Annex B.

Annex A (informative)

Whole production assessment

A.1 Assessment – General

This clause specifies a method that a manufacturer may use to show whole production assessment, in association with his test records on finished products.

A.2 Whole production assessment by means of the manufacturer's records

A.2.1 In presenting the test results, the manufacturer may combine the results of different lamp test families according to Table 5.

The whole production assessment requires that the quality control procedures of a manufacturer shall satisfy recognized quality system requirements for final inspection. Within the framework of a quality system based also on in-process inspection and testing, the manufacturer may show compliance with some of the requirements of this standard by means of in-process inspection instead of finished product testing.

Table A.1 – Production assessment

1 Clause or sub- clause	2 Test	3 Type of test
5.1	Marking – presence	Running
5.2	Marking – presence	Running
5.3	Marking – legibility	Periodic
5.4	Marking – durability	Periodic
6.1	Interchangeability	Periodic
6.2	Bending moment and mass imparted by the lamp at the lamp holder'	Type
7	Protection against electric shock	Type
8.2	Insulation resistance	Type
8.3	Electric strength	Type
9.2.1	Torsion resistance of unused lamps	Periodic
9.2.2	Torsion resistance of lamps after a defined time of usage	n.a.
9.3	Axial strength of Edison caps	Type
10	Cap temperature rise	Type
11	Resistance to heat	Type
12	Resistance to flame and ignition	Type
13	Fault conditions	Type

1 Clause or sub- clause	2 Test	3 Type of test
15	Creepage distances and clearances	Type
15	Lamp end of life	Type
16.1	UV radiation	Type
17	Abnormal operation	Type

A.2.2 The manufacturer should provide sufficient test records with respect to each clause and subclause as indicated in Table A.1.

Annex B (informative)

Information for luminaire design

B.1 Water contact

All lamps within the scope of this standard should be protected from direct water contact, e. g. by drips, splashing etc., by the luminaire if rated at IPX1 or higher.

NOTE The X in the IP number indicates a missing numeral but both of the appropriate numerals are marked on the luminaire.

Bibliography

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IEC 60417, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)

IEC 60432-1, *Incandescent lamps – Safety specifications – Part 1: Tungsten filament lamps for domestic and similar general lighting purposes*

☐ NOTE Harmonized as EN 60432-1 ☐

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

☐ NOTE Harmonized as EN 60529:1991 (not modified) ☐

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

☐ NOTE Harmonized as EN 62471:2008 (modified) ☐

IEC TR 62471-2:2009, *Photobiological safety of lamps and lamp systems – Part 2: Guidance on manufacturing requirements relating to non-laser optical radiation safety*

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