BS EN 62776:2015

BSI Standards Publication

Double-capped LED lamps designed to retrofit linear fluorescent lamps — Safety specifications

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 62776:2015. It is identical to IEC 62776:2014 incorporating corrigendum March 2015.

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 committee 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.

Published by BSI Standards Limited 2015

ISBN 978 0 580 81889 9

ICS 29.140.99

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2015.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 62776

April 2015

ICS 29.140.99

English Version

Double-capped LED lamps designed to retrofit linear fluorescent lamps - Safety specifications (IEC 62776:2014 + COR1:2015)

Lampes à LED à deux culots conçues pour remplacer des lampes à fluorescence linéaires - Spécifications de sécurité (IEC 62776:2014 + COR1:2015)

Zweiseitig gesockelte LED-Lampen als Ersatz (Retrofit) für zweiseitig gesockelte Leuchtstofflampen - Sicherheitsanforderungen (IEC 62776:2014 + COR1:2015)

This European Standard was approved by CENELEC on 2015-01-15. 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 CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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/1795/FDIS, future edition 1 of IEC 62776 + corrigendum March 2015, prepared by SC 34A "Lamps" of IEC/TC 34 "Lamps and related equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62776:2015.

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)	2015-10-15
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2018-01-15

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 62776:2014 + corrigendum March 2015 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60529:1989	NOTE	Harmonized as EN 60529:1991 (not modified).
IEC 60529:1989/A1:1999	NOTE	Harmonized as EN 60529:1991/A1:2000 (not modified).
IEC 60529:1989/A2:2013	NOTE	Harmonized as EN 60529:1991/A2:2013 (not modified).
IEC 62471	NOTE	Harmonized as EN 62471.

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

Publication	Year	Title	EN/HD	Year
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 60061-4	-	Lamp caps and holders together with gauges for the control of interchangeability and safety - Part 4: Guidelines and general information	EN 60061-4	-
IEC 60081	-	Double-capped fluorescent lamps - Performance specifications	EN 60081	-
IEC 60155	-	Glow-starters for fluorescent lamps	EN 60155	-
IEC 60360	-	Standard method of measurement of lamp cap temperature rise	EN 60360	-
IEC 60417-DB	-	Graphical symbols for use on equipment	-	-
IEC 60598-1	-	Luminaires - Part 1: General requirements and tests	EN 60598-1	-
IEC 60695-2-10	2013	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10	2013
IEC 60695-2-11 + corr. January	2000 2001	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 [1)]

1) Superseded by EN 60695-2-11:2014 (IEC 60695-2-11:2014): DOW = 2017-03-13.

Publication	Year	Title	EN/HD	Year
IEC 60921	-	Ballasts for tubular fluorescent lamps - Performance requirements	EN 60921	-
IEC 61195	-	Double-capped fluorescent lamps - Safety specifications	EN 61195	-
IEC 61347-1	2015	Lamp controlgear - Part 1: General and safety requirements	EN 61347-1	201X [2)]
IEC 61347-2-8	-	Lamp controlgear - Part 2-8: Particular requirements for ballasts for fluorescent lamps	EN 61347-2-8	-
IEC 62031	-	LED modules for general lighting - Safety specifications	EN 62031	-
IEC 62504	-	General lighting - Light emitting diode (LED) products and related equipment - Terms and definitions	EN 62504	-
IEC/TR 62778	-	Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires	-	-
ISO 4046-4	2002 [3)]	Paper, board, pulps and related terms - Vocabulary - Part 4: Paper and board grades and converted products	-	-

2) To be published.

3) Withdrawn publication.

CONTENTS

INTRODUCTION

Double-capped fluorescent lamps are installed in big volume in office lighting, street lighting, industrial lighting and much more. Double-capped LED lamps are intended as a possible replacement for G5- or G13-capped fluorescent lamps. This standard safeguards that the change from fluorescent lamp to LED lamp and the backward change from LED lamp to fluorescent lamp is carried out with safe LED lamps and under specified exchange conditions.

The establishing of a safety standard for double-capped LED lamps does not exclude future relocation as a part of IEC 60968, self-ballasted lamps (if re-edited as an umbrella standard), and further inclusion of requirements for conversion type double-capped LED lamps.

This proposal covers double-capped LED lamps with cap G5 and G13 only, where the fluorescent tube is replaced by a tubular LED lamp, without modifications to the luminaire. Only in case of electromagnetic controlgear, the starter is replaced by a LED starter.

DOUBLE-CAPPED LED LAMPS DESIGNED TO RETROFIT LINEAR FLUORESCENT LAMPS – SAFETY SPECIFICATIONS

1 Scope

This International Standard specifies the safety and interchangeability requirements, and the exchange operation together with the test methods and conditions required to show compliance of double-capped LED lamps with G5 and G13 caps, intended for replacing fluorescent lamps with the same caps, having:

– a rated power up to 125 W;
– a rated voltage of up to 250 V.

Such LED lamps are designed for replacement without requiring any internal modification of the luminaire.

The existing luminaires, into which the double-capped LED lamps are fitted, can be operated with electromagnetic or electronic controlgear.

The requirements of this standard relate only to type testing.

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

NOTE 1 Where in this standard the term “lamp(s)” is used, it is understood to stand for “double-capped retrofit LED lamp(s)”, except where it is obviously assigned to other types of lamps.

This standard does not cover double-capped conversion LED lamps where modification in the luminaire is required. The requirements in this standard are given for general lighting service (excluding for example explosive atmospheres). For lamps for other applications additional requirements may apply.

NOTE 2 This standard includes photobiological safety.

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 60061-4, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 4: Guidelines and general information*

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

IEC 60155, *Glow-starters for fluorescent lamps*

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

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

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

IEC 60695-2-10:2013, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods; Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2000[1], *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end products*

IEC 60921, *Ballasts for tubular fluorescent lamps – Performance requirements*

IEC 61195, *Double-capped fluorescent lamps – Safety specifications*

IEC 61347-1:— [2], *Lamp controlgear – Part 1: General and safety requirements*

IEC 61347-2-8, *Lamp controlgear – Part 2-8: Particular requirements for ballasts for fluorescent lamps*

IEC 62031, *LED modules for general lighting – Safety specifications*

IEC 62504, *General lighting - Light emitting diode (LED) products and related equipment - Terms and definitions*

IEC TR 62778, *Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62504, IEC 62031 as well as the following apply.

3.1
double-capped retrofit LED lamp
tubular LED lamp which can be used as a replacement for double-capped fluorescent lamps without requiring any internal modification in the luminaire and which, after installation, maintains the same level of safety of the replaced lamp in the luminaire

Note 1 to entry: The replacement of a glow starter according to IEC 60155 with LED replacement starter having the same dimensions and fit, for the correct functioning of the double-capped LED lamp is not considered as a modification to the luminaire.

---

1 First edition. This edition has been replaced in 2014 by IEC 60695-2-11:2014, *Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products (GWEPT)*

2 To be published.

3.2
double-capped conversion LED lamp
double-capped LED lamp which can be used as a replacement for another type of lamp with modification to the luminaire

3.3
rated voltage
voltage 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.

3.4
rated power
power marked on the lamp

3.5
rated frequency
frequency marked on the lamp

3.6
cap temperature rise
Δt_s
surface temperature rise (above ambient) of the lamp cap

3.7
live part
conductive part which may cause an electric shock in normal use

3.8
type
double-capped LED lamp, representative of the production

3.9
type test
conformity test on one or more double-capped LED lamps with similar cap, representative of the production

3.10
type test sample
one or more double-capped LED lamps with similar cap, submitted by the manufacturer or responsible vendor for the purpose of the type test

3.11
ultraviolet hazard efficacy of luminous radiation
$K_{S,v}$
quotient of an ultraviolet hazard quantity to the corresponding photometric quantity

Note 1 to entry: Ultraviolet hazard efficacy of luminous radiation is expressed in mW/klm

Note 2 to entry: The ultraviolet hazard efficacy of luminous 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, such as mechanical damage or discoloration.

4 General requirements and general test requirements

4.1 The lamps shall be so designed and constructed that in normal use they function safely causing no danger to the user or surroundings.

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

4.2 Double-capped LED lamps shall normally not be opened for tests. In the case of doubt based on the inspection of the lamp and the examination of the lamp circuit diagram, and in agreement with the manufacturer or responsible vendor, lamps shall be specially prepared so that a fault condition can be simulated and shall be submitted for testing (see Clause 13). Opened lamps or inspection of internal component parts of the lamp may be required to verify conformity with Clauses 11, 12 and 14 of this standard.

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

4.4 When the lamp fails safely during one of the tests, it is replaced, provided that no fire, smoke or flammable gas is produced. Further requirements on failing safe are given in Clause 13.

4.5 Internal wiring shall be carried out as in Clause 5.3 of IEC 60598-1.

4.6 For construction of the electrical circuit, 15.1 and 15.2 of IEC 61347-1:— shall be regarded and for the other parts, Clauses 4.11, 4.12 and 4.25 of IEC 60598-1 shall be regarded.

5 Marking

5.1 Marking on the lamp

Lamps shall be clearly and durably marked with the following markings, the size of which shall be minimum 2 mm for letters/numbers and 5 mm for symbols.

a) Mark of origin (this may take the form of a trademark, the manufacturer's name or the name of the responsible vendor).

b) Rated voltage or voltage range (marked "V" or "volts").

NOTE 1 The rated voltage or voltage range of the lamp can differ from the open circuit voltage.

c) Rated power (marked "W" or "watts").

d) Rated frequency or frequency range (marked in "Hz" or "kHz").

e) Double-capped LED lamps suitable to be used in combination with some type of ballast only (e.g. with magnetic ballast) shall be marked with the symbol as in Figure 1 and/or Figure 2.

[SOURCE: 60417-6095 (2011-11)]

Figure 1 – Lamp suitable for high frequency operation

[SOURCE: 60417-6094 (2011-11)]

Figure 2 – Lamp suitable for 50 Hz or 60 Hz operation

f) Double-capped LED lamps shall be marked according to Figure 3 and with the following information: “This lamp is not suitable to be used in emergency luminaires designed for double-capped fluorescent lamp(s)”.

NOTE 2 For the future, additional requirements to support use for emergency lighting can be developed

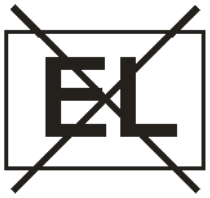


Figure 3 – Lamp not suitable for emergency operation

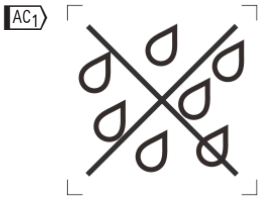
g) If double-capped LED lamps need to be used with components which replace the starter, they shall be marked with the type reference of the LED replacement starter. The LED replacement starter shall be marked as in Figure 4.

NOTE: The symbol is under development as IEC 60417-Pr14-181.

Figure 4 – LED replacement starter

h) Provide information on the ingress of dust and water.

For lamps that should be used in dry conditions or in a luminaire that provides protection, see Figure 5.



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

Figure 5 – Lamp to be used in dry conditions or in a luminaire that provides protection

i) Rated ambient temperature range of the lamp.

5.2 Marking on the lamp, on the immediate lamp wrapping (or container) or in the instructions

In addition, the following information shall be given by the lamp manufacturer on the lamp or immediate lamp wrapping or container or in the instruction manual. Explanation of Figures 1 and 2 shall be given in the instruction manual.

a) Rated current (marked “A” or “ampere”).

b) Special conditions or restrictions which shall be observed for lamp operation, for example operation in dimming circuits. Where lamps are not suitable for dimming, the lamps may be marked according to Figure 6.

NOTE: The symbol is under development as IEC 60417-Pr14-205.

Figure 6 – Dimming not allowed

5.3 Instruction manual

5.3.1 General

In addition to the information listed in 5.2, double-capped LED lamps shall be accompanied by instructions, describing all necessary steps for the replacement of the fluorescent lamp with a LED lamp, such as replacement of the starter.

All required instructions detailed by this safety standard shall be given either on the lamp, on the product packaging or in the manufacturer’s instructions provided with the lamp. The meaning of the symbols shown in 5.1 and 5.2 should be clearly explained (using words) in the instruction manual.

The content of the instructions shall include the following.

5.3.2 Declaration of the product

The provisions requested under the following items 1) to 5) shall be supplied.

1) A list of all parts supplied shall be provided.

2) The type of the fluorescent lamp that the LED lamp is designed to replace shall be declared.
3) Provide a warning that no modifications of the luminaire which the LED lamp is to be used with are to be made.
4) The ambient temperature range for which the lamp is rated shall be declared. Where the minimum ambient temperature of the range is higher than –20 °C or the maximum ambient temperature of the range lower than +60 °C the instruction manual for the lamp shall contain the following information.

   "This lamp may not be suitable for use in all applications where a traditional fluorescent lamp has been used. The temperature range of this lamp is more restricted. In cases of doubt regarding the suitability of the application the manufacturer of this lamp should be consulted."

   NOTE This standard is based on the assumption that the normal expected ambient temperature range of the fluorescent lamps that may be replaced by these retro-fit products is –20 °C to +60 °C.
5) Declare: "This lamp is designed for general lighting service (excluding for example explosive atmospheres)."

5.3.3 Graphical instruction

This clause can be used instead of 5.3.4. The steps for applying the product to an existing luminaire shall be as given in Figure 7. If no starter replacement is needed, steps 4 and 5 in Figure 7 and in 5.3.4 are omitted.

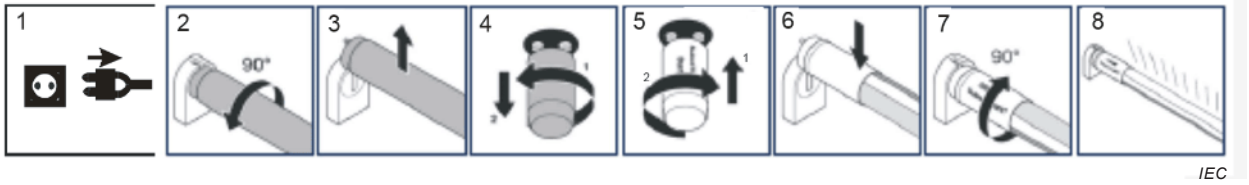


Figure 7 – Schematic steps of removing a fluorescent lamp and inserting a double-capped LED lamp designed to retrofit linear fluorescent lamp

5.3.4 Mounting

This clause can be used instead of 5.3.3. Describe the steps needed in line with the graphical instruction in Figure 7.

Example for a retrofit version.

(1) Switch off electricity.
(2) and (3) Remove the conventional lamp.
(4) Remove the starter.
(5) Click the LED replacement starter into the starter holder.
(6) Insert the LED lamp into the lampholder.
(7) Secure the position by turning the lamp by 90°.
(8) Switch on electricity and check for lamp starting.

5.4 Compliance

Compliance with 5.1 to 5.3 is checked by the following:

Presence and legibility of the marking by visual inspection.

The durability of the marking – as far as applied on the lamp – is checked by trying to remove it by rubbing lightly for 15 s with a piece of cloth soaked with water and, after drying, for a further 15 s with a piece of cloth soaked with hexane. The marking shall be legible after the test.

Availability of information required in 5.2 and 5.3 – by visual inspection.

6 Interchangeability

6.1 Interchangeability of the cap

Interchangeability shall be assured by the use of caps in accordance with IEC 60061-1 and gauges in accordance with IEC 60061-3; see Table 1.

Compliance is checked by using the relevant gauges.

Table 1 – Interchangeability gauges and lamp cap dimensions

Lamp cap	Cap sheet in IEC 60061-1	Cap dimensions to be checked by the gauge	Gauge sheet in IEC 60061-3
G5	7004-52	All dimensions to be checked	7006-46 and 7006-46A
G13	7004-51	All dimensions to be checked	7006-44 and 7006-45

If double-capped LED lamps need to operate in combination with a LED replacement starter which replaces the glow starter, this LED replacement starter shall be supplied together with the lamp. This device shall comply with dimensions, electrical, mechanical and thermal tests required in Section 1 of IEC 60155.

6.2 Mass

The entire mass of a lamp shall not exceed 200 g for a G5-capped lamp and 500 g for a G13-capped lamp.

Compliance is checked by weighing the lamp.

6.3 Dimensions

6.3.1 Requirements

The length of the lamp shall not change significantly within the specified ambient temperature range of the lamp.

Compliance is checked by the tests in 6.3.2 to 6.3.6.

NOTE For the purpose of this standard, the minimum and maximum temperature range for fluorescent lamps has been assumed to be –20 °C to +60 °C. Lamp lengths critical for stress at the holders at elevated temperatures and critical for contact making at lowered temperatures are considered.

6.3.2 Dimensions at 25 °C (non-operating)

Double-capped LED lamps for use in fluorescent luminaires shall comply with the dimensions and tolerances of the corresponding lamps as defined in IEC 60081 at 25 °C. The lamp dimension as specified in corresponding IEC 60081 datasheet shall be measured. Resulting dimensions shall be noted as $A_{25°C}$, $B_{25°C}$, $C_{25°C}$, and $D_{25°C}$

Compliance is checked by inspection.

NOTE Designation A, B, C and D refer to the sheet 60081-IEC-01 of IEC 60081.

6.3.3 Variation of dimension A due to self-heating at 25 °C

The lamp is placed in a draught free environment and operated at its rated supply voltage. Dimension A is measured after the lamp is stabilised and noted as $A_{operating}$. The difference in length is calculated from the value measured in this operating state:

$$\Delta A = A_{operating} - A_{25°C}$$

When stable conditions have been reached, the surface temperature on the lamp shall not exceed the value in 6.4.1.

6.3.4 Dimension B at minimum ambient temperature

The lamp is placed in a climate chamber at the minimum ambient temperature, i.e. –20 °C, or at the minimum specified ambient temperature (t_{min}). After having attained the temperature (t_{min}) for 1 h (u.c), the lamp is taken off the climate chamber and the length of the lamp is measured immediately. Care has to be taken that during measurement no significant change of temperature of the lamp occurs. The temperature of the lamp is recorded during the length measurement of dimension B. The value at minimum of the rated temperature range shall be considered for compliance and noted as B_{tmin}.

6.3.5 Dimension A at maximum ambient temperature

The lamp is placed in the climate chamber at the maximum ambient temperature, i.e. +60 °C or at the maximum specified ambient temperature, t_{max}. After having attained the temperature t_{max} for 1 h (u.c.), the lamp is taken off the climate chamber and the length of the lamp is measured immediately. Care has to be taken that during measurement no significant change of temperature of the lamp occurs. The temperature of the lamp is recorded during the length measurement, after having taken it off from the climate chamber. The length A at the maximum of the rated ambient temperature range shall be noted as A_{tmax}.

6.3.6 Compliance

The following formulae apply:

$A1 = A_{tmax} + \Delta A - A_{25°C}\ (t_{max} - 25\ °C) \cdot 11{,}7*10^{-6}$

$B1 = B_{tmin} - A_{25°C}\ (t_{min} - 25\ °C) \cdot 11{,}7*10^{-6}$

Compliance is checked as follows:

– *Dimension A1 shall be within the limits of the corresponding dimensions according to the relevant lamp data sheet from IEC 60081.*

– *Dimension B1 shall be within the limits of the corresponding dimensions according to the relevant lamp data sheet from IEC 60081.*

NOTE Acceptable length variation of the LED lamp is based on thermal expansion of a general luminaire construction assuming a steel tray construction for mounting the lampholders and having a thermal expansion coefficient of $11{,}7 \cdot 10^{-6}$/°C.

6.4 Temperature

6.4.1 Temperature requirement

Except the lamp caps, the LED lamp temperature shall not be higher than 75 °C measured on any location of the lamp. The requirement applies for lamp surfaces which can be touched with a test finger.

6.4.2 Power requirement

The power consumed by the LED lamp shall not be higher than that of the fluorescent lamp that it replaces as described in IEC 60081.

6.4.3 Compliance

The lamp is measured positioned horizontally at 25 °C ambient temperature in free air. For details of this test set-up, see Annex B, IEC 61195. The lamp under test shall consist of a complete unit, operated at its rated supply voltage. When stable conditions have been reached, the maximum surface temperature on the lamp and the power consumed shall be measured. These shall not exceed the values in 6.4.1 and 6.4.2.

6.5 Safety of the lamp in case a wrong starter-lamp combination is used

The following combinations shall be tested:

– fluorescent starter with LED lamp;

– LED replacement starter with fluorescent lamp;

– one fluorescent lamp replaced by a LED lamp in case of two fluorescent lamps connected in series with the same controlgear (e.g. 2 x 18 W) and equipped with starter and LED replacement starter replacing the starter shall show compliance for all possible combinations. For LED replacement starter which replace starter with a short circuit (e.g. a fuse) or open circuit, the test of the combination with “LED replacement starter with fluorescent lamp”, is not required.

If lamps are marked with a voltage range, rated voltage is taken as the maximum of the voltage range marked unless the manufacturer declares another voltage as the most critical one.

Compliance:

Same as 13.6, repeated below:

During the tests 13.2 to 13.5, the lamp shall not catch fire, or produce flammable gases or smoke and live parts shall not become accessible.

To check if gases liberated from component parts are flammable or not, a test with a high-frequency spark generator is made.

To check if accessible parts have become live, a test in accordance with 8.2 is made.

After testing according to 13.2 to 13.5, the lamp shall meet the insulation resistance requirements of 8.3.

7 Pin-safety during insertion

G5 and G13 lamp caps do not assure the insertion of both ends of the lamp simultaneously, for this reason there shall not be any electrical continuity between the two ends of the lamp during the insertion.

With the lamp pins inserted into only one lampholder the voltage present at the un-inserted pins shall not be capable of causing an electric shock. Following IEC 60598-1, Section 8, basic insulation during lamp insertion is sufficient.

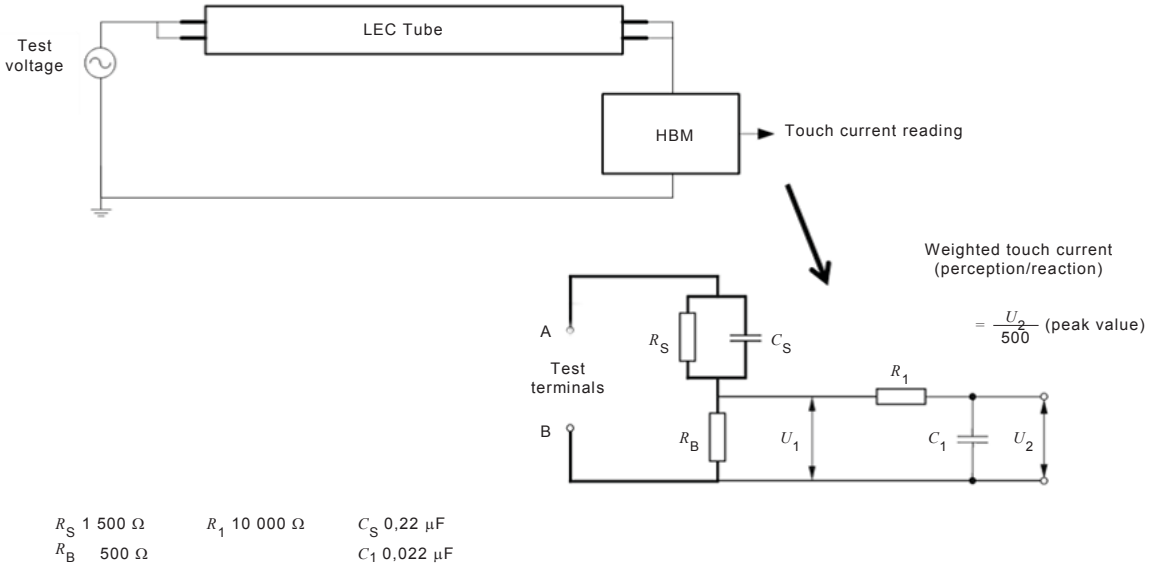
An accessible protection measure that may accidentally be deactivated and hereby deactivate the protection against electric shock is not permissible.

NOTE An accessible protective measure could be a button that closes a switch, when the lamp is fully mounted.

Compliance is checked by the following tests:

1) *Electric strength test: based on possibility of 250 V on the lampholder during insertion, the electric strength test shall be conducted with 1 500 V (2 U + 1 000 V) between both ends of the lamp. Initially, no more than half the voltage is applied between the pins or contacts of one cap and the pins or contacts of the other cap. It is then gradually raised to the full value. No flashover or breakdown shall occur during the test.*
2) *Insulation resistance: measured with about 500 V d.c. the minimum resistance shall be 2 MΩ*
3) *Creepage distances and clearance: regarding clearance, Table 9 of IEC 61347-1:— shall be applied based on 250 V working voltage including mains supply transients.*

   Creepage distances shall not be less than the required minimum clearance.
4) *Touch current: applying a test voltage of 500 V r.m.s. (50 Hz or 60 Hz), the touch current shall not exceed 0,7 mA peak when measured in accordance with Figure 8.*



Key

HBM = Human Body Model, for explanation see IEC 60598-1, Annex G.

Figure 8 – Test configuration for touch current measurement

8 Protection against accidental contact with live parts

8.1 General

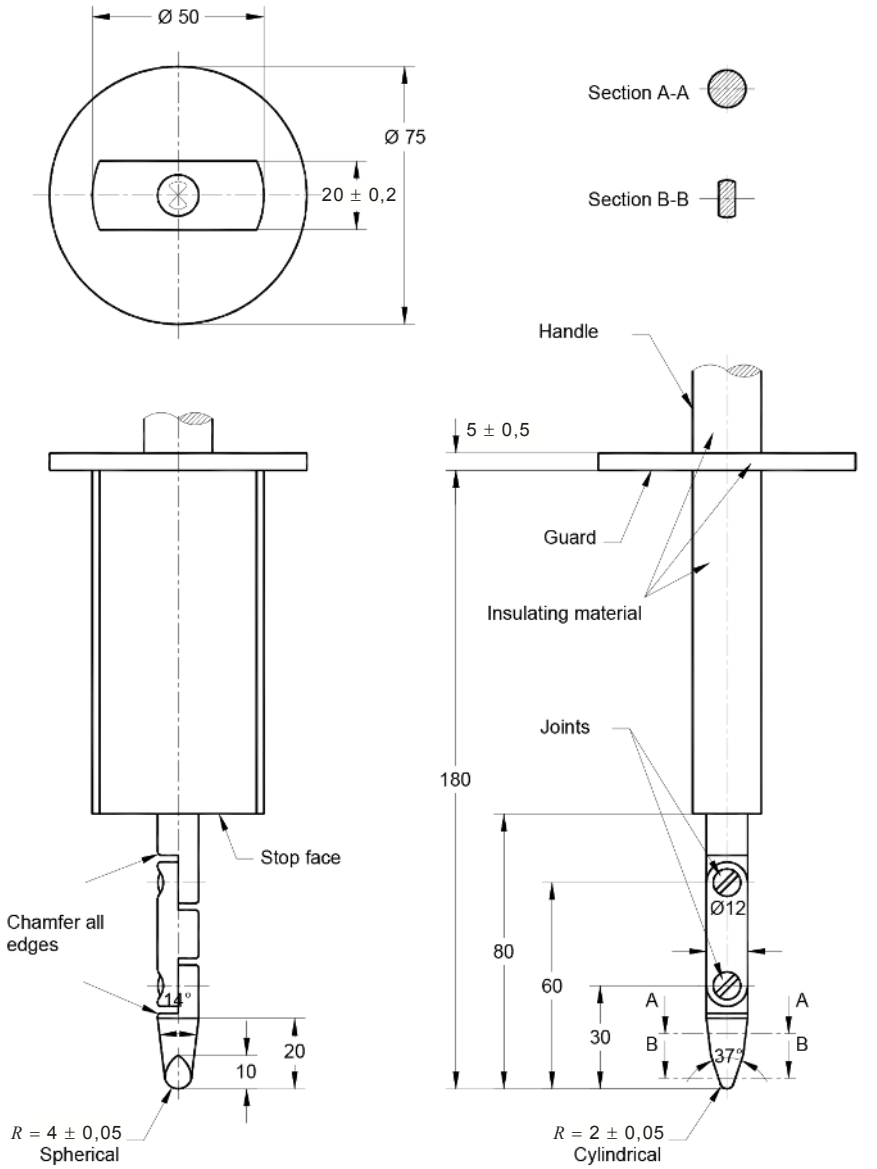
Insulation resistance and electric strength shall be adequate between live parts of the lamp and accessible parts of the lamp. Concerning caps, the requirements of 2.4 and 2.5 of IEC 61195 apply. For the other parts of the lamp, the following requirements apply.

8.2 Test to establish whether a conductive part may cause an electric shock during operation

The lamps shall be so constructed that, without any additional enclosure in the form of a luminaire, the following parts are not accessible when the lamp is installed in a lampholder according to the relevant IEC lampholder data sheet:

– internal metal parts,
– basic insulated external metal parts other than caps,
– live metal parts of the lamp cap,
– live metal parts of the lamp itself.

The accessibility is checked with a test finger specified in Figure 9, with a force of 10 N.



Material: metal, except where otherwise specified

Tolerances on dimensions without specific tolerance:

on angles: on linear dimensions:

AC1 $^{+0°}_{-10'}$ AC1

- up to 25 mm: $^{+0\ mm}_{-0,05\ mm}$
- over 25 mm: ± 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 9 – Standard test finger (according to IEC 60529)

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: To check whether accessible parts have become live, a test in accordance with IEC 61347-1:—, Annex A is made. The lamp is operated on a reference circuit as described in IEC 60081, B.1.2, B.1.3 and B.1.4.

8.3 Insulation resistance

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.

Insulation resistance shall be measured in the humidity cabinet with a d.c. voltage of approximately 500 V, 1 min after application of the voltage.

The insulation resistance between live parts of the cap and accessible parts of the lamp (accessible parts of insulating material are covered with metal foil) shall be not less than 4 MΩ.

8.4 Electric strength

Immediately after the insulation resistance test, the same parts as specified above shall withstand a voltage test for 1 min with an a.c. voltage or a d.c. voltage equal to the peak voltage of the prescribed a.c. voltage as follows.

The use of a.c. or d.c. voltage is to be advised by the manufacturer.

NOTE The electric strength test with an equivalent d.c. voltage is under consideration.

During the test, the supply contacts of the cap are short-circuited. Accessible parts of insulating material of the lamp are covered with metal foil. Initially, no more than half the voltage prescribed in IEC 60598-1, Table 10.2, and reference d) for double or reinforced insulation is applied between the contacts and the metal foil or accessible conductive parts. It is then gradually raised to the full value. Care shall be taken that the metal foil is so placed that no flashover occurs at the edges of the insulation.

No flashover or breakdown shall occur during the test. Measurements shall be carried out in the humidity cabinet.

9 Mechanical requirements for caps

9.1 Construction and assembly

Caps shall be so constructed and assembled to the tubes that they remain attached during and after operation.

Compliance is checked by the following tests.

9.2 Torque test on unused lamps

For unused lamps, compliance is checked by applying a torque test to the pins, as follows.

The lamp cap shall remain firmly attached to the tube and there shall be no rotational movement between component parts of the cap exceeding an angular displacement of 6° when subjected to the torque levels listed in Table 2.

Table 2 – Torque values for unused lamps

Cap type	Torque value Nm
G5	0,5
G13	1,0

The torque shall not be applied suddenly, but shall be increased progressively from zero to the value specified in Table 2.

The test holder for the application of the torque is shown in Annex A of IEC 61195.

In case of lamps with adjustable caps, before applying the torque test, the lamp cap shall be rotated to its extreme positions. Both extreme positions shall be tested.

9.3 Torque test after heat treatment

LED lamps having a crimp, screw or similar mechanical connection used for fixing the cap to the tube, are exempt from this clause.

Following a heating treatment for a period of 2 000 h ± 50 h at a temperature of 80 °C ± 5 °C, the cap shall remain firmly attached to the tube and there shall be no rotational movement between the component parts of the cap exceeding an angular displacement of 6° when subjected to the torque levels specified in Table 3. In case of other kind of fixation of the cap of the tube than that used for fluorescent lamps, a shorter heating period down to 100 h, is allowed. The effect of adhesive materials connecting cap and tube shall be as rigid as the adhesive material used for fluorescent lamps.

NOTE The heating time, the properties of other kind of fixation of the cap, e.g. with adhesives and its application procedure are under consideration

In case of lamps with adjustable caps, before applying the torque test, the lamp cap shall be rotated to its extreme positions. Both extreme positions shall be tested.

Table 3 – Torque values after heating treatment

Cap type	Torque value[a] Nm
G5	0,3
G13	0,6
[a] Under consideration.	

9.4 Repetition of 8.2

After the mechanical strength test, the sample shall comply with the requirements of accessibility (see 8.2).

10 Cap temperature rise

Lamp cap temperature rise is checked by the test set-up specified in Annex B of IEC 61195.

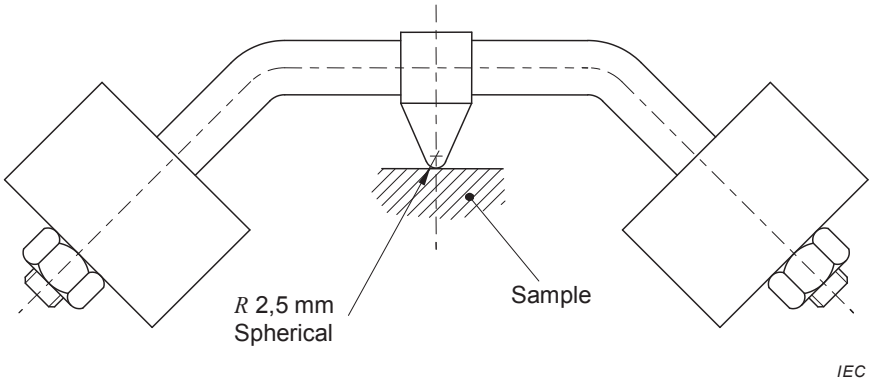
Compliance:

The lamp cap temperature rise above ambient temperature shall not exceed 95 K.

11 Resistance to heat

The lamp 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 parts to a ball-pressure test by means of the apparatus shown in Figure 10.



[Source IEC 60598-1, Figure 10]

Figure 10 – Ball-pressure test apparatus

The test is made in a heating cabinet at a temperature of (25 ± 5) °C in excess of the operating temperature of the relevant part according to Clause 10, with a minimum of 125 °C for parts retaining live parts in position and 75 °C 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.

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.

The surface where the ball presses should not bend, if necessary the surface shall be 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

$$\Phi = 2\sqrt{p(5-p)}$$

where p is the 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^2 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 ± 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

Lamps – dimmable and non-dimmable – shall not impair safety when operated under fault conditions which may occur during the intended use. Each of the following fault conditions is applied in turn, as well as any other associated fault condition that may arise from them as logical consequence.

13.2 Testing under extreme electrical conditions

If lamps are marked with a voltage range, the voltage at which they are tested is taken as the maximum of the voltage range marked unless the manufacturer declares another voltage as the most critical one. The lamp is switched on at ambient temperature (definition as in IEC 62504 and conditions as in Clause H.1 of IEC 61347-1:—) and adjusted to the most critical electrical conditions as indicated by the manufacturer or the power is increased until 150 % of the rated power is reached. The test is continued until the lamp is thermally stabilised. A stable condition is reached, if the lamp cap temperature does not change by

more than 1 K in 1 h (test as described in IEC 60360). The lamp shall withstand the extreme electrical conditions for at least 15 min, after stabilization is reached.

A lamp which either withstands the extreme electrical conditions for 15 min or fails safe, has passed the test.

If the lamp contains an automatic protective device or circuit which limits the power, it is subjected to a 15 min operation at this limit. If the device or circuit effectively limits the power over this period, the lamp has passed the test, provided the compliance (see Clause 4 and 13.6) is fulfilled.

13.3 Short-circuit across capacitors

Only one component at a time is subjected to a fault condition.

13.4 Fault conditions across electronic components

Open or bridge points in the circuit where such a fault condition may impair safety.

Only one component at a time is subjected to a fault condition.

13.5 Compliance

During the tests 13.2 to 13.5 the lamp shall not catch fire, or produce flammable gases or smoke and live parts shall not become accessible.

To check if gases liberated from component parts are flammable or not, a test with a high-frequency spark generator is made.

To check if accessible parts have become live, a test in accordance with 8.2 is made.

After testing according to 13.2 to 13.5, the lamp shall meet the insulation resistance requirements of 8.3.

To avoid any overheating of the ballast into the luminaire, during any of the above mentioned fault conditions, the impedance of the lamp shall be checked by measuring the voltage and the current across the lamp. The total impedance of the lamp in stable condition shall not be lower than the values indicated in Table 4 below for the corresponding fluorescent lamp parameters

Table 4 – Minimum LED lamp impedances

Cap type	Lamp length mm	Impedance Ω
G13	450	25,0
G13	550	25,0
G13	600	50,0
G13	900	40,0
G13	970	50,0
G13	1 050	20,0
G13	1 150	20,0
G13	1 200	40,0
G13	1 500	25,0
G13	1 800	25,0
G13	2 400	25,0
G5	150	140,0
G5	225	140,0
G5	300	140,0
G5	525	100,0
G5	550	60,0
G5	850	60,0
G5	1 150	60,0
G5	1 450	60,0

Overload due to rectifications of the supply current of the ballast in the luminaire, shall be prevented. During any of the above mentioned fault conditions the peak value of the positive semi waveform of the supply current shall be measured and compared with the peak of the negative semi waveform. The difference between the two values shall in stable conditions be less than 30 % of the maximum value. However, it is regarded in compliance, if, in single fault conditions, steady-state r.m.s. current through the lamp stays lower than the r.m.s. current of the corresponding fluorescent lamp in normal condition.

13.6 Further requirements

In addition to the fault conditions described in 13.2 to 13.5, fault conditions in 14.2 and 14.4 of IEC 61347-1:— and the additional tests in 13.7 are carried out.

13.7 Safety of the lamp with different types of controlgear

It shall be safeguarded that a LED lamp with G5 and G13 caps can be operated safely in a luminaire designed for a conventional fluorescent lamp with the same dimensions and with any type of controlgear.

The following tests have to be carried out.

– The LED lamp shall be inserted in a circuit with magnetic ballast designed to supply a conventional fluorescent lamp with the same dimensions. The ballast shall comply with IEC 61347-2-8 and Clause 8 of IEC 60921, and be suitable for the corresponding fluorescent lamp. The ballast shall be designed for the supply voltage marked on the LED lamp.

– The LED lamp shall be inserted into a circuit according to Figure A.5 of IEC 60081. The supply voltage and the resistor shall be the rated voltage and resistance of the HF

reference or measurement ballast on the lamp data sheet. For fluorescent lamps with reference condition given at 50 Hz or 60Hz and no HF measurement ballast, the HF ballast reference resistor value is calculated following $R = U_{lamp}^2/P_{lamp}$. The test voltage is calculated as twice the specified lamp voltage at 50 Hz.

The free pins of each cap of the lamp (if any) are connected together or left open choosing the most unfavourable condition.

If the LED lamp is intended to replace a range of fluorescent lamps, the maximum of the rated power of the fluorescent lamps and the maximum rated voltage shall be used for the test.

13.8 Compliance for test with different types of controlgear

During the tests of 13.7 the lamp shall not catch fire, or produce flammable gases or smoke and live parts shall not become accessible.

To check if gases liberated from component parts are flammable or not, a test with a high-frequency spark generator is made.

To check if accessible parts have become live, a test in accordance with 8.2 is made.

After testing according to 13.8, the lamp shall meet the insulation resistance requirements of 8.3.

Low impedance between pins of one cap may lead to overheating of the cathode heating transformer according to Figure A.2 in IEC 60081. In order to avoid this effect, the current that runs between the pins shall not be greater than 0,51 A, when 3,6 V are applied to the pins of a cap. Measurement of the current shall be made 3 s to 10 s after the application of the voltage.

13.9 Safety of the lamp in case the luminaire controlgear short circuits

LED tubular lamps when used according Figure A.1 of IEC 60081 shall be tested on 250 V with both the ballast and starter short-circuited. The tests of Clause 8 shall be conducted thereafter. If the lamp fails as a consequence of the controlgear short circuit, it shall meet the requirements of 13.8.

14 Creepage distances and clearances

The requirements of IEC 61347-1, apply together with the following additional requirements.

The minimum creepage distance between contact pin(s) or contacts and the metal shell of the cap shall be in accordance with the requirements in IEC 60061-4, sheet 7007-6.

For other parts of the lamp, the creepage distance and clearance requirements of IEC 61347-1 are applicable. For accessible conductive parts (excluding the cap) the requirements of IEC 60598-1 for double or reinforced insulation apply.

Compliance is checked by measurement in the most onerous position.

15 Lamp with protection against dust and moisture

15.1 Aim of the test

Where the lamp is not marked according to 5.1, Figure 5 (for use in dry conditions or in a luminaire that provides protection), the tests under 15.2 and 15.3 have to be conducted.

15.2 Thermal endurance

Thermal endurance preconditioning shall be conducted according to IEC 60598-1, Clause 12.3, using a test period of 240 h. The lamp shall be operated at an ambient temperature according to 5.3.2, giving a lamp temperature 10 K above maximum rating.

Compliance:

After the test of 15.2 the LED lamp shall be visually inspected. It shall not have become unsafe according 4.4 and the marking shall be legible.

15.3 IP testing

The IP test of IEC 60598-1 for IP X5 and IP 6X shall be conducted on the same lamp that was subjected to the thermal endurance test before. During this testing, lampholders sealing to the diameter of the lamp ends and providing protection to the contact area of IP 65 shall be fitted.

Compliance:

See Clause 9.2 of IEC 60598-1.

16 Photobiological hazard

16.1 UV radiation

The ultraviolet hazard efficacy of luminous radiation of an LED lamp shall not exceed 2 mW/klm.

Compliance is checked by measurement of the spectral power distribution and subsequent calculation of the ultraviolet hazard efficacy of luminous radiation.

LED lamps not relying on the conversion of UV radiation are expected to not exceed the maximum allowed ultraviolet hazard efficacy of luminous radiation. They do not require measurement.

16.2 Blue light hazard

The blue light hazard shall be assessed according to IEC TR 62778, which shall be regarded as normative when testing LED lamps to this standard. LED lamps shall be classified as risk group 0 unlimited or risk group 1 unlimited. For lamps with small light sources according to IEC TR 62778 the requirement can be fulfilled if a true radiance measurement (see IEC TR 62778, 3.19) shows that the limit of 10 000 ($W/(m^2 \cdot sr)$) is not exceeded.

NOTE Clause C.2 of IEC TR 62778 gives a method to classify lamps where full spectral data is not available.

16.3 Infrared radiation

LED lamps are expected to not reach a level of infrared radiation where marking or other safety measures are required. They do not require measurement.

Annex A
(informative)

Conformity testing during manufacture

A.1 Background and recommended procedure

The tests specified in this annex should be carried out by the manufacturer on each LED lamp after production and are intended to reveal, as far as safety is concerned, unacceptable variations in material and manufacture. These tests are intended not to impair the properties and the reliability of the LED lamp and they may vary from certain type tests in the standard by lower voltages used.

More tests may have to be conducted to ensure that every LED lamp conforms with the sample approved under the type test to this specification. The manufacturer should determine these tests from his experience.

Within the framework of the quality manual, the manufacturer may vary this test procedure and its values to one better suited to his production arrangements and may make certain tests at an appropriate stage during manufacture, provided it can be proved that at least the same degree of safety is ensured as specified in this annex.

A.2 Testing

Electrical tests should be conducted on 100 % of all units produced as scheduled in Table A.1. Failed products are to be quarantined for scrap or re-working.

Visual inspections should take place to ensure the following.

a) All specified labels are securely in place and printing is legible.

b) Manufacturer’s instructions are packed with the lamp, where necessary.

Table A.1 – Minimum values for electrical tests

Test	Test details
FUNCTION TEST	**Check for lamp operation at normal operating voltage**
ELECTRIC STRENGTH	1) Checked between lamp pins and lamp cap: – Maximum breakdown current 5mA – Measured by applying a minimum voltage of 1,5 kV a.c. or 1,5 √2 kV d.c. for a minimum of 1 s 2) Checked between lamp pins and other conductive parts of the lamp: – Maximum breakdown current 5mA [a] – Measured by applying a minimum voltage of 3 kV a.c. or 3 √2 kV d.c. for a minimum of 1 s
OR	OR
INSULATION RESISTANCE	1) Checked between lamp pins and lamp cap: – Minimum resistance 2 MΩ – Measured by applying 500 V d.c. for 1 s 2) Checked between lamp pins and other conductive part of the lamp: – Minimum resistance 4 MΩ – Measured by applying 500 V d.c. for 1 s
[a] The value of 5 mA is suggested, but can be changed by the lamp manufacturer.	

Bibliography

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD 1 1999
IEC 60529:1989/AMD 2 2013

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

_____

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™