

BS EN 62035:2014



BSI Standards Publication

# Discharge lamps (excluding fluorescent lamps) — Safety specifications

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### **National foreword**

This British Standard is the UK implementation of EN 62035:2014. It is identical to IEC 62035:2014. It supersedes BS EN 62035:2000+A2:2012 which is withdrawn.

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.

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Published by BSI Standards Limited 2015

ISBN 978 0 580 77871 1  
ICS 29.140.30

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

### **Amendments/corrigenda issued since publication**

<b>Date</b>	<b>Text affected</b>
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English Version

**Discharge lamps (excluding fluorescent lamps) - Safety specifications  
(IEC 62035:2014 , modified)**

Lampes à décharge (à l'exclusion des lampes à fluorescence) - Prescriptions de sécurité  
(CEI 62035:2014 , modifiée)

Entladungslampen (ausgenommen Leuchtstofflampen) - Sicherheitsanforderungen  
(IEC 62035:2014 , modifiziert)

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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.

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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

This document (EN 62035:2014) consists of the text of IEC 62035:2014 prepared by SC 34A "Lamps", of IEC/TC 34 "Lamps and related equipment", together with the common modifications prepared by CLC/TC 34A "Lamps".

The following dates are fixed:

- latest date by which this document has to be implemented (dop) 2015-09-15  
at national level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting (dow) 2017-09-15  
with this document have to be withdrawn

This document supersedes EN 62035:2000.

EN 62035:2014 includes the following significant technical changes with respect to EN 62035:2000.

Photobiological safety requirements are taken care of on basis of the risk group concept of EN 62471 and the technical report IEC/TR 62778 on blue light hazard. This has consequences for terms, marking, structure of 4.6, and introduction of a new symbol "Caution, do not stare at light source". Special attention is given to blue light hazard.

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 62035:2014 was approved by CENELEC as a European Standard with agreed common modifications.

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

IEC 60432-1	NOTE Harmonized as EN 60432-1.
IEC 60927	NOTE Harmonized as EN 60927.
IEC 60598-1	NOTE Harmonized as EN 60598-1.
IEC 61347-2-9	NOTE Harmonized as EN 61347-2-9.

## COMMON MODIFICATIONS

Delete all references to E26 and E39 lamp caps in the following clauses and figures:

Annex A	Data sheet references of IEC 60061 (Table A.1)
Annex B	Torsion test values (Table B.2)
Annex C	Torsion test holders (Figure C.1)
Annex F	Maximum lamp cap temperatures (Table F.1)

## 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](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050	-	International Electrotechnical Vocabulary (IEV)	-	-
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 60061-2	-	Lamp caps and holders together with gauges for the control of interchangeability and safety - Part 2: Lampholders	EN 60061-2	-
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 60155	-	Glow-starters for fluorescent lamps	EN 60155	-
IEC 60662	-	High pressure sodium vapour lamps - Performance specifications	EN 60662	-
IEC 60695-2-10	2000	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10	2001
IEC 60923	-	Auxiliaries for lamps - Ballasts for discharge lamps (excluding tubular fluorescent lamps) - Performance requirements	EN 60923	-
IEC 61167	-	Metal halide lamps - Performance specification	EN 61167	-
IEC 61347-2-1	-	Lamp controlgear - Part 2-1: Particular requirements for starting devices (other than glow starters)	EN 61347-2-1	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
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	-	-

## CONTENTS

1	Scope .....	7
2	Normative references .....	7
3	Terms and definitions .....	8
4	General safety requirements .....	10
4.1	General .....	10
4.2	Marking .....	10
4.2.1	Lamp marking .....	10
4.2.2	Additional information to be provided .....	11
4.3	Mechanical requirements .....	11
4.3.1	Requirements for caps .....	11
4.3.2	Construction and assembly .....	12
4.4	Electrical requirements .....	13
4.4.1	Parts which can become accidentally live .....	13
4.4.2	Insulation resistance .....	13
4.4.3	Electric strength .....	13
4.5	Thermal requirements .....	14
4.5.1	General .....	14
4.5.2	Resistance to heat .....	14
4.5.3	Resistance to abnormal heat and fire .....	15
4.6	Photobiological requirements .....	15
4.6.1	UV Hazard .....	15
4.6.2	Blue light hazard .....	16
4.6.3	IR hazard .....	16
5	Particular safety requirements .....	17
5.1	High-pressure sodium vapour lamps .....	17
5.2	Metal halide lamps .....	17
5.2.1	General .....	17
5.2.2	Marking .....	17
5.2.3	Containment .....	17
6	Information for luminaire design .....	17
7	Assessment .....	17
7.1	General .....	17
7.2	Assessment of whole production by means of manufacturer's records .....	18
7.2.1	General .....	18
7.2.2	Assessment of manufacturer's records for particular tests .....	19
7.2.3	Sampling procedures for the whole production testing .....	19
7.3	Assessment of batches .....	23
7.3.1	Sampling for batch testing .....	23
7.3.2	Number of lamps in batch sample .....	23
7.3.3	Sequence of the tests .....	23
7.3.4	Rejection conditions for large batches (>500 lamps) .....	23
7.3.5	Rejection conditions for small batches (≤500 lamps) .....	24
Annex A (normative)	List of lamp caps and gauges .....	26
Annex B (normative)	Pull and torsion test values .....	27



Annex C (normative) Torsion test holders .....	28
Annex D (normative) Information for thermal tests .....	30
Annex E (normative) Measurement of pulse height for lamps with internal starting device.....	31
E.1 Introduction.....	31
E.2 Test circuit.....	31
E.2.1 Test circuit and key .....	31
E.2.2 Ballast characteristics.....	31
E.2.3 Power factor capacitor .....	32
E.2.4 Pulse height measuring circuit .....	32
E.3 Tests .....	32
E.3.1 Lamps with an internal glow switch .....	32
E.3.2 Lamps with an internal thermal switch .....	32
Annex F (informative) Information for luminaire design .....	34
F.1 Guidelines for safe lamp operation.....	34
F.2 Maximum lamp cap temperature .....	34
F.3 Cap/holder – key configuration.....	34
F.4 Protection against lamp shattering .....	34
F.5 Protection against UV radiation.....	35
F.6 Possible condition at end of lamp life .....	35
Annex G (normative) Conditions of compliance for design tests .....	36
G.1 Insulation resistance (see 4.4.2) Electric strength (see 4.4.3) .....	36
G.2 Cap construction and assembly (see 4.3.2.2 b) and 4.3.2.3 b)) .....	36
G.3 Cap creepage distance (see 4.3.1.2) Resistance to heat (see 4.5.2.1 and 4.5.2.2) Resistance to abnormal heat and fire (see 4.5.3.1) Pulse height (see 5.1.) UV radiation (see 4.6.1.3) .....	36
Annex H (normative) Symbols.....	37
H.1 General.....	37
H.2 Symbol indicating that the lamp shall be operated only in a luminaire provided with a protective shield .....	37
H.3 Symbol indicating that the lamp emits a high level of UV radiation .....	37
H.4 Symbol indicating that the lamp shall not be operated when the outer bulb is broken .....	37
H.5 Self-shielded lamp symbol indicating that the lamp can be operated in a luminaire without a protective shield .....	38
H.6 Symbol indicating not to stare at a light source, for example, a lamp, a luminaire, a video projector etc. ....	38
Annex I (normative) Containment testing procedure for metal halide lamps with quartz arc tubes .....	39
I.1 General.....	39
I.1.1 Purpose.....	39
I.1.2 Test description.....	39
I.2 Experimental setup .....	39
I.2.1 Safety precautions.....	39
I.2.2 Electrical circuit.....	39
I.2.3 Enclosure requirements .....	41
I.3 Test procedures.....	41
I.3.1 Lamp selection and preparation .....	41
I.3.2 Determination of median rupture energy .....	41

I.3.3	Rupture test procedure .....	42
I.4	Self-shielded lamp design .....	42
I.4.1	Definition of damage to the outer bulb .....	42
I.4.2	Determination of self-shielded .....	42
Annex J (normative)	Containment testing procedure for metal halide lamps with ceramic arc tubes .....	43
J.1	General.....	43
J.1.1	Purpose.....	43
J.1.2	Test description.....	43
J.2	Experimental setup .....	43
J.2.1	Safety precautions.....	43
J.2.2	Electrical circuit.....	43
J.2.3	Enclosure requirements .....	44
J.3	Test procedures.....	44
J.3.1	Lamp selection and preparation.....	44
J.3.2	Determination of median rupture energy .....	44
J.3.3	Rupture test procedure .....	45
J.4	Self-shielded lamp design .....	45
J.4.1	Definition of damage to the outer bulb .....	45
J.4.2	Determination of containment rating .....	45
Bibliography.....		47
Figure 1	– Edison screw-capped lamp .....	13
Figure C.1	– Holder for torsion test on lamps with Edison screw caps .....	28
Figure C.2	– Holder for torsion test on lamps with bayonet caps .....	29
Figure D.1	– Ball pressure test apparatus .....	30
Figure E.1	– Test circuit.....	31
Figure I.1	– Basic electrical diagram for quartz metal halide lamp containment test .....	40
Figure J.1	– Electrical diagram for containment test.....	44
Table 1	– Classification of risk groups.....	15
Table 2	– Grouping of test records – Sampling and acceptable quality levels (AQL) .....	20
Table 3	– Acceptance numbers AQL = 0,65 % .....	21
Table 4	– Acceptance numbers AQL = 2,5 % .....	22
Table 5	– Batch sample size and rejection number (for batches >500 lamps).....	24
Table 6	– Batch sample size and rejection number (for batches ≤500 lamps).....	25
Table A.1	– Data sheet references of IEC 60061 .....	26
Table B.1	– Pull test values .....	27
Table B.2	– Torsion test values.....	27
Table D.1	– Temperatures .....	30
Table E.1	– Test ballast resonance characteristics .....	32
Table E.2	– Power factor capacitor values for tests.....	32
Table F.1	– Maximum lamp cap temperatures.....	34

## DISCHARGE LAMPS (EXCLUDING FLUORESCENT LAMPS) – SAFETY SPECIFICATIONS

### 1 Scope

This International Standard specifies the safety requirements for discharge lamps (excluding fluorescent lamps) for general lighting purposes.

This International Standard is applicable to low-pressure sodium vapour lamps and to high-intensity discharge (HID) lamps, i.e. high-pressure mercury vapour lamps (including blended lamps), high-pressure sodium vapour lamps and metal halide lamps. It applies to single- and double-capped lamps, having caps as listed in Annex A.

This standard only concerns safety criteria and does not take into account performance. The performance standards IEC 60188, IEC 60192, IEC 60662, IEC 61167 and IEC 61549 should be referred to for such characteristics.

It may be expected that lamps which comply with this standard will operate safely at supply voltages between 90 % and 110 % of rated supply voltage and when operated with a ballast complying with IEC 61347-2-9 and IEC 60923, with a starting device complying with IEC 61347-2-1 and IEC 60927, and in a luminaire complying with IEC 60598-1.

### 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 60050, *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

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

IEC 60061-2, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 2: Lampholders*

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 60155, *Glow-starters for fluorescent lamps*

IEC 60662, *High-pressure sodium vapour lamps*

IEC 60695-2-10:2000, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60923, *Auxiliaries for lamps – Ballasts for discharge lamps (excluding tubular fluorescent lamps) – Performance requirements*

IEC 61347-2-1, *Lamp controlgear – Part 2-1: Particular requirements for starting devices (other than glow starters)*

IEC 61167, *Metal halide lamps - Performance specification*

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, 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 terms and definitions given in IEC 60050-845 and IEC TR 62778, as well as the following apply.

#### 3.1

##### **HID lamp**

##### **high intensity discharge lamp**

electric discharge lamp in which the light-producing arc is stabilised by wall temperature and the arc has a bulb wall loading in excess of  $3 \text{ W/cm}^2$

Note 1 to entry: HID lamps include groups of lamps known as high-pressure mercury, metal halide and high-pressure sodium lamps.

[SOURCE: IEC 60050-845:1987, 845.07.19]

#### 3.2

##### **high pressure mercury vapour lamp**

high-intensity discharge lamp in which the major portion of the light is produced, directly or indirectly, by radiation from mercury operating at a partial pressure in excess of 100 kPa

Note 1 to entry: This term covers clear, phosphor coated (mercury fluorescent) and blended lamps. In a fluorescent mercury discharge lamp, the light is produced partly by the mercury vapour and partly by the layer of phosphors excited by the ultraviolet radiation of the discharge.

[SOURCE: IEC 60050-845:1987, 845.07.20]

#### 3.3

##### **blended lamp**

##### **self-ballasted mercury lamp, US**

lamp containing in the same bulb certain elements of a mercury vapour lamp and an incandescent lamp filament connected in series

Note 1 to entry: The bulb may be diffusing or coated with phosphors.

[SOURCE: IEC 60050-845:1987, 845.07.21, modified — The words "certain elements of" are added.]]

#### 3.4

##### **high pressure sodium vapour lamp**

high-intensity discharge lamp in which the light is produced mainly by radiation from sodium vapour operating at a partial pressure of the order of 10 kPa

Note 1 to entry: The term covers lamps with clear or diffusing bulb.

[SOURCE: IEC 60050-845:1987, 845.07.23]

### 3.5

#### **low pressure sodium vapour lamp**

discharge lamp in which the light is produced by radiation from sodium vapour operating at a partial pressure of 0,1 Pa to 1,5 Pa

[SOURCE: IEC 60050-845:1987, 845.07.24]

### 3.6

#### **metal halide lamp**

high-intensity discharge lamp in which the major portion of the light is produced by radiation from a mixture of metallic vapour, metal halides and the products of the dissociation of metal halides

Note 1 to entry: The definition covers clear and coated lamps.

[SOURCE: IEC 60050-845:1987, 845.07.25, modified — The words "radiation" and "metal halides" are added.]

### 3.7

#### **nominal power**

approximate quantity value of lamp power used to designate or identify a lamp

### 3.8

#### **ultraviolet hazard efficacy of luminous radiation**

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

Note 1 to entry: Ultraviolet hazard efficacy of luminous radiation 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  $SUV(\lambda)$ . 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

#### **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

[SOURCE: IEC 60081:1997, 1.4.10]

### 3.10

#### **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

[SOURCE: IEC 60081:1997, 1.4.11]

### 3.11

#### **group**

lamps of the same generic type

EXAMPLES: High pressure mercury (vapour) lamp (3.2), blended lamp (3.3), high pressure sodium (vapour) lamp (3.4), low pressure sodium (vapour) lamp (3.5), metal halide lamp (3.6)

### 3.12

#### **type**

lamps of the same group having the same nominal wattage, bulb shape and cap

**3.13****family**

grouping of lamps characterized by common features such as materials, components and/or method of processing

**3.14****design test**

test made on a sample for the purpose of checking compliance of the design of a family, group or a number of groups with the requirements of the relevant clause or subclause

**3.15****periodic test**

test, or series of tests, repeated at intervals in order to check that a product does not deviate in certain respects from the given design

**3.16****running test**

test repeated at frequent intervals to provide data for assessment

**3.17****batch**

all lamps in one family and/or group and identified as such and put forward at one time for checking compliance

**3.18****whole production**

production during a period of 12 months of all types of lamps within the scope of this standard and nominated in a list of the manufacturer for inclusion in the certificate

**3.19****self-shielded metal halide lamp**

metal halide lamp for which the luminaire needs no protective shield

**4 General safety requirements****4.1 General**

Lamps shall be so designed and constructed that in normal use they present no danger to the user or the surroundings.

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

**4.2 Marking****4.2.1 Lamp marking**

Lamps shall be marked as follows:

- mark of origin, which may take the form of a trademark, the manufacturer's name or the name of the responsible vendor;
- nominal power (marked "W" or "watts") and/or any other indication which identifies the lamp.

In the relevant lamp performance standards, the nominal power may still be indicated as "rated" power (and the rated power as "objective" power). This wording will be corrected in future editions of these standards.

NOTE In the USA, additional product marking is required.

Marking shall be legible and durable.

Compliance is checked on unused lamps as follows:

- a) presence and legibility by visual inspection;
- b) durability by rubbing the area of the marking by hand for a period of 15 s, with a smooth cloth dampened with water. After this test the marking shall still be legible.

#### **4.2.2 Additional information to be provided**

In addition to the above lamp marking, all details and provisions which are necessary to ensure safe installation and use shall be given in the lamp manufacturer's instructions. Alternatively, the immediate lamp wrapping or container may be marked with the corresponding symbol as shown in Annex H.

NOTE In North America, a suitable cautionary notice is required. Additional use of symbols is optional.

If applicable, information shall be given about:

- a) the provision that the lamp shall be operated in an enclosed luminaire only (for symbol, see Clause H.2);
- b) the hazard associated with a high level of UV radiation emitted by the lamp (for symbol, see Clause H.3). The value of the specified ultraviolet hazard efficacy of luminous radiation shall be made available for proper luminaire design (see Clause F.5) if it exceeds 6 mW/klm for non-reflector lamps or 6 mW/(m<sup>2</sup>·klx) for a reflector lamp;
- c) the hazard associated with a high blue light radiance (for symbol see Clause H.6). The threshold illuminance below which the luminaire cannot exceed risk group 1 for blue light shall be made available for luminaire design if the lamp is in risk group 2 (see Clause F.5);
- d) the risk of the occurrence of a rectifying effect at the end of lamp life;
- e) the hazard(s) that exist(s) when the outer envelope is broken (for symbol, see Clause H.4).

### **4.3 Mechanical requirements**

#### **4.3.1 Requirements for caps**

##### **4.3.1.1 Dimensions**

If lamps use standardized caps, they shall be in accordance with the requirements on the cap data sheets of IEC 60061-1, listed in Table A.1 of this standard. Non-standardized caps shall be in line with the lamp manufacturer's documentation.

Compliance is checked on finished lamps by gauging and/or measurement. For standardized caps, the gauges of IEC 60061-3, listed in Table A.1 of this standard shall be used.

##### **4.3.1.2 Creepage distance**

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

Compliance is checked by measurement.

##### **4.3.1.3 Caps provided with keys**

For lamps using cap types incorporating keys which ensure non-interchangeability with similar lamp types, the correct cap/key version shall be used.

Compliance is checked by visual inspection.

### **4.3.2 Construction and assembly**

#### **4.3.2.1 General**

Caps shall be so constructed and assembled to the bulbs that the whole assembly remains intact and attached during and after normal operation.

Compliance is checked by carrying out the following tests.

#### **4.3.2.2 Resistance to pull**

Where lamps are so constructed that when being withdrawn from the lampholder a pull is exerted and withstood without the cap or any part of the cap or bulb being loosened or pulled apart.

Compliance is checked by the following pull test.

A pull in the direction of the lamp axis shall be applied for 1 min to:

- a) unused lamps,
- b) lamps after storage in a heating cabinet for a period of  $2\,000\text{ h} \pm 50\text{ h}$ .

The pull values and heating cabinet temperatures are given in Table B.1.

Care shall be taken that the means (clamp, etc.) of applying the pull to the lamp does not weaken the structure.

The pull shall be increased progressively from zero to the value given in Table B.1. The pull shall not be applied with a jerk.

#### **4.3.2.3 Resistance to torque**

Where lamps are so constructed that, during insertion into or withdrawal from, the lampholder, a torque is applied to the cap or parts of the cap or to the cap/bulb connection, the torque shall be withstood without any loosening of the connections. For mechanically fixed screw caps, an angular displacement between cap and bulb of not more than  $10^\circ$  is allowed.

Compliance is checked by the following torsion test.

A torque shall be applied to:

- a) unused lamps,
- b) lamps after storage in a heating cabinet for a period of  $2\,000\text{ h} \pm 50\text{ h}$ .

The torque values and the heating cabinet temperatures are given in Table B.2. The torsion test holders are specified in Figures C.1 and C.2.

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. Either the cap or the bulb may be mechanically clamped.

For some mechanically fixed screw caps, for example those positioned on a screw thread shaped sealing area, it is necessary to clamp the shell and to apply the torque in both directions.



The torque shall be increased progressively from zero to the value given in Table B.2. The torque shall not be applied with a jerk.

#### 4.4 Electrical requirements

##### 4.4.1 Parts which can become accidentally live

Metal parts intended to be insulated from live parts shall not be or become live. Any movable conductive material shall be placed, without the use of a tool, in the most onerous position before inspection.

On bayonet caps, any projection from the contact plate shall not come within 1 mm of metal parts intended to be insulated.

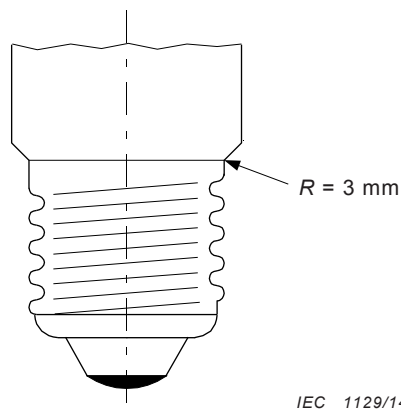


Figure 1 – Edison screw-capped lamp

On Edison screw caps any projection from the cap shell shall not project more than 3 mm from the surface of the cap (see Figure 1).

Compliance is checked by either an appropriate automatic system or by visual inspection. In addition, there shall be regular daily checks of the equipment or a verification of the effectiveness of the inspection.

##### 4.4.2 Insulation resistance

Lamps where the metal shell of the cap can be touched after insertion into the holder shall have an insulation resistance between the metal shell of the cap and the pin(s) or contacts of not less than 2 M $\Omega$ .

Compliance is checked by measurement with suitable test equipment using a d.c. voltage of 500 V.

##### 4.4.3 Electric strength

The insulation between the same parts as those referred to in 4.4.2 shall have sufficient (di)electric strength.

Compliance is checked with a 1 500 V a.c. voltage of substantially sine-wave form, with a frequency of 50 Hz or 60 Hz and applied for 1 min. Initially, not more than half the prescribed voltage shall be applied. The voltage shall then be raised rapidly to the full value.

No flash-over or breakdown shall occur during the test. Glow discharges without a drop in voltage are neglected.

## 4.5 Thermal requirements

### 4.5.1 General

Insulating material of caps, which provides protection against electric shock, shall be resistant to heat and fire.

Compliance is checked by the following tests.

These tests are not made on parts of ceramic or glass material.

### 4.5.2 Resistance to heat

#### 4.5.2.1 Heat test

The sample is tested for a period of 168 h in a heating cabinet at a temperature according to the values given in Table D.1.

At the end of the test, the specimens shall not have undergone any change impairing their future safety, especially in the following respects:

- reduction in the protection against electric shock as required under insulation resistance and electric strength;
- loosening of any part of the cap, cracks, swelling and shrinking as determined by visual inspection.

At the end of the test, the dimensions shall comply with the dimensional requirements for caps.

#### 4.5.2.2 Ball pressure test

The sample is subjected to a ball pressure test using the apparatus shown in Figure D.1.

The specimens are conditioned for 1 h in the same heating cabinet where the test will be made, at a temperature according to the values given in Table D.1.

The surface of the part under test is placed in the horizontal position. A steel ball of 5 mm diameter is pressed against this surface by a force of 20 N. If the surface under test bends, the part where the ball presses shall be supported. If the test cannot be made on the complete specimen, a suitable section may be cut from it and used as a test specimen. 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.

The test is made in a heating cabinet at a temperature according to values given in Table D.1. After 1 h, the ball shall be removed from the specimen, which is then immersed within 10 s in cold water for cooling down to approximately room temperature. The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.

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

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

### 4.5.3 Resistance to abnormal heat and fire

#### 4.5.3.1 Glow-wire test

The sample is subjected to a test using a nickel-chromium glow-wire heated to 650 °C. The test apparatus shall be that described in IEC 60695-2-10.

The glow-wire temperature and heating current shall be constant for 1 min prior to commencing the test. Care shall be 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.

The specimen to be tested is mounted vertically 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 of the specimen. The penetration of the glow-wire into the specimen is mechanically limited to 7 mm. After 30 s the specimen is withdrawn from contact with the glow-wire tip.

Any flame or glowing of the specimen shall extinguish within 30 s of withdrawing the glow-wire and any burning or molten drop shall not ignite a piece of five-layer tissue paper, specified in ISO 4046-4, spread out horizontally 200 mm ± 5 mm below the specimen.

Precautions should be taken to safeguard the health of personnel conducting tests against risk of explosion or fire, of inhalation of smoke and/or toxic products, and of toxic residues.

### 4.6 Photobiological requirements

#### 4.6.1 UV Hazard

##### 4.6.1.1 Classification

Lamps are classified into risk groups for actinic UV hazard as described in IEC 62471 for general lighting service lamps according to Table 1:

**Table 1 – Classification of risk groups**

Risk group (RG)	Ultraviolet hazard efficacy of luminous radiation (mW/klm) <sup>a</sup>
Exempt (RG 0)	≤2
Low risk (RG 1)	>2 and ≤6
Moderate risk (RG 2)	>6 and ≤60
High risk (RG 3)	>60
<sup>a</sup> In IEC 62471 exposure limits are given as effective irradiance values (unit W/m <sup>2</sup> ) and for risk group classification the values for general lighting lamps are to be reported at an illuminance level of 500 lx. For example, the borderline for risk group 0 (exempt) is 0,001 W/m <sup>2</sup> at an illuminance level of 500 lx. In other words the specific value, related to the illuminance, is 0,001 divided by 500 in W/(m <sup>2</sup> ·lx), which is 2 mW/(m <sup>2</sup> ·klx).	

Low pressure sodium lamps may be regarded as exempt (RG 0) for UV hazard without measurement.

##### 4.6.1.2 Marking

In addition to the requirements of 4.2, the immediate lamp wrapping or container of lamps shall be marked as follows or, alternatively, contain a suitable cautionary notice.

RG 0: No additional marking is required.

RG 1 and above: symbol in Clause H.2; lamps shall be operated only in a luminaire provided with a protective shield.

RG 2 and above: symbol in Clause H.3; lamp emits a high level of UV radiation.

NOTE In North America a suitable cautionary notice is required. (For further information, consult the national standards.) Use of the symbol is optional.

Compliance is checked by visual inspection.

#### **4.6.1.3 Requirements**

For lamps standardised in IEC 61167, the ultraviolet hazard efficacy of luminous radiation emitted by the lamp shall not exceed the maximum value specified on the relevant lamp data sheet.

For lamps not standardised in IEC 61167, the ultraviolet hazard efficacy of luminous radiation emitted by the lamp shall not exceed the maximum value specified by the manufacturer.

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

#### **4.6.2 Blue light hazard**

##### **4.6.2.1 Classification**

Frosted, coated, low pressure sodium lamps and high pressure sodium lamps may be regarded as low risk (RG 1) for blue light hazard without measurement. No white light source within the scope of this standard is expected to come into the high risk (RG 3) class.

Other lamps shall be assessed for blue light hazard according to IEC TR 62778.

NOTE Clause C.2 of IEC TR 62778:2012 gives a method to classify lamps where full spectral data is not available.

##### **4.6.2.2 Marking**

In addition to the requirements of 4.2, the immediate lamp wrapping or container of lamps shall be marked as follows or, alternatively, contain a suitable cautionary notice.

RG 1 or below: No additional marking is required.

RG 2: symbol H6; title: "Caution, do not stare at light source".

NOTE In North America a suitable cautionary notice is required. (For further information, consult the national standards.) Use of the symbol is optional.

Compliance is checked by visual inspection.

#### **4.6.3 IR hazard**

HID lamps for general lighting are not expected to reach an IR level that requires marking.

## 5 Particular safety requirements

### 5.1 High-pressure sodium vapour lamps

For lamps with an internal starting device, the voltage pulses generated during ignition shall not exceed the maximum pulse height as given in the information for ballast design specified on the relevant lamp data sheet in IEC 60662.

Compliance is checked by the measurement procedure described in Annex E.

### 5.2 Metal halide lamps

#### 5.2.1 General

Self-shielded lamps shall meet the following requirements.

#### 5.2.2 Marking

In addition to the requirements of 4.2, the following applies.

The immediate lamp wrapping or container shall be marked with the self-shielded lamp symbol given in Clause H.5.

NOTE In North America this symbol is not required; the lamp marking includes a luminaire code (for further information, consult the national standards).

Compliance is checked by visual inspection.

#### 5.2.3 Containment

The lamp shall be designed to contain all particles within the outer bulb in case an arc tube rupture occurs.

For test procedures and conditions of compliance, see Annexes I and J.

## 6 Information for luminaire design

Refer to Annex F for information for luminaire design.

## 7 Assessment

### 7.1 General

This clause specifies the method a manufacturer shall use to show that his product conforms to this standard on the basis of whole production assessment, in association with his test records on finished products. This method can also be applied for certification purposes. Subclause 7.2 gives details of assessment by means of the manufacturer's records.

Details of a batch test procedure which can be used to make a limited assessment of batches are given in 7.3. Requirements for batch testing are included in order to enable the assessment of batches presumed to contain unsafe lamps. As some safety requirements cannot be checked by batch testing, and as there may be no previous knowledge of the manufacturer's quality, batch testing cannot be used for certification purposes nor in any way for an approval of the batch. Where a batch is found to be acceptable, a testing agency may only conclude that there is no reason to reject the batch on safety grounds.

## 7.2 Assessment of whole production by means of manufacturer's records

### 7.2.1 General

The manufacturer shall show evidence that his products comply with the particular requirements of 7.2.2. To this end, the manufacturer shall make available all the results of his product testing pertinent to the requirements of this standard.

The test results may be drawn from working records and, as such, may not be immediately available in collated form.

The assessment shall be based in general on individual factories, each meeting the acceptance criteria of 7.2.2. However, a number of factories may be grouped together, provided they are under the same quality management. For certification purposes, one certificate may be issued to cover a nominated group of factories, but the certification authority shall have the right to visit each plant to examine the local relevant records and quality control procedures.

For certification purposes, the manufacturer shall declare a list of marks of origin and corresponding lamp families, groups and/or types which are within the scope of this standard and manufactured in a nominated group of factories. The certificate shall be taken to include all lamps so listed made by the manufacturer. Notification of additions or deletions may be made at any time.

In presenting the test results, the manufacturer may combine the results of different lamp families, groups and/or types according to column 4 of Table 2.

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.

The manufacturer shall provide sufficient test records with respect to each clause and subclause as indicated in column 5 of Table 2.

The number of nonconformities in the manufacturer's records shall not exceed the limits shown in Tables 3 or 4 relevant to the acceptable quality level (AQL) values shown in column 6 of Table 2.

The period of review for assessment purposes need not be limited to a predetermined year, but may consist of 12 consecutive calendar months immediately preceding the date of review.

A manufacturer who has met, but no longer meets, the specified criteria shall not be disqualified from claiming compliance with this standard provided he can show that:

- a) action has been taken to remedy the situation as soon as the trend was reasonably confirmed from his test records;
- b) the specified acceptance level was re-established within a period of:
  - 1) six months for 4.3.2.2 b) and 4.3.2.3 b);
  - 2) one month for the other clauses and subclauses.

When compliance is assessed after corrective action has been taken in accordance with items a) and b), the test records of these lamp families, groups and/or types which do not comply shall be excluded from the 12-month summation for their period of non-compliance. The test results relating to the period of corrective action shall be retained in the records.

A manufacturer who has failed to meet the requirements of a clause or subclause where grouping of the test results is permitted, shall not be disqualified for the whole of the lamp families, groups and/or types so grouped if he can show by additional testing that the problem is present only in certain families, groups and/or types so grouped. In this case, either these families, groups and/or types are dealt with in accordance with a) and b) as above or they are deleted from the list of families, groups and/or types which the manufacturer may claim are in conformity with the standard.

In the case of a family, group and/or type which has been deleted from the list, it may be reinstated if satisfactory results are obtained from tests on a number of lamps equivalent to the minimum annual sample specified in Table 2, required by the clause or subclause where non-compliance occurred. This sample may be collected over a short period of time.

In the case of new products, there may be features which are common to existing lamp families, groups and/or types, and these can be taken as being in compliance if the new product is taken into the sampling scheme as soon as manufacture is started. Any feature not so covered shall be tested before production starts.

### **7.2.2 Assessment of manufacturer's records for particular tests**

Table 2 specifies the type of test and other information which applies to the method of assessing compliance to the requirements of various clauses and subclauses.

A design test needs be repeated only when a substantial change is made in the physical or mechanical construction, materials, or manufacturing process used to manufacture the relevant product. Tests are required for only those properties affected by the change.

### **7.2.3 Sampling procedures for the whole production testing**

The conditions of Table 2 apply.

The whole production running tests shall be applied at least once per production day. They may also be based on in-process inspection and testing.

The frequency of application of the various tests may be different, providing the conditions of Table 2 are met.

Whole production tests shall be made on samples randomly selected at a rate not less than that indicated in column 5 of Table 2. Lamps selected for one test need not be used for other tests.

For whole production testing of the requirements for accidentally live parts (see 4.4.1), the manufacturer shall demonstrate that there is a continuous 100 % inspection.

**Table 2 – Grouping of test records –  
Sampling and acceptable quality levels (AQL)**

1 Subclause	2 Test	3 Type of test	4 Permitted accumulation of test records	5 Minimum annual sample per accumulation		6 AQL <sup>a</sup> %
				For lamps made most of the year	For lamps made infrequently	
4.2.1	Marking – legibility	Running	All families with the same method of marking	200	32	2,5
4.2.1	Marking – durability	Periodic	All families with the same method of marking	50	20	2,5
4.2.2	Marking – additional information	Running	By group and type	200	32	2,5
4.3.1.1	Dimensional requirements for caps	Periodic	By group and type	32		2,5
4.3.1.2	Cap creepage distance	Design	All families using the same cap	Use Clause G.3		–
4.3.1.3	Cap key configuration	Periodic	By group and type	125		0,65
4.3.2.2 a)	Construction and assembly of cap/bulb (unused) – pull test	Periodic	All families using the same cap and attachment method	200	80	0,65
4.3.2.2 b)	Construction and assembly of cap/bulb (after heating test) – pull test	Design	All families using the same cap and attachment method	Use Clause G.2		
4.3.2.3 a)	Construction and assembly of cap/bulb (unused) – torque test	Periodic	All families using the same cap and attachment method	200	80	0,65
4.3.2.3 b)	Construction and assembly of cap/bulb (after heating test) – torque test	Design	All families using the same cap and attachment method	Use Clause G.2		
4.4.1	Accidentally live parts	All tests	By group and type	–		
4.4.2	Insulation resistance	Design	All families using the same cap and attachment method	Use Clause G.1		
4.4.3	Electric strength	Design	All families using the same cap and attachment method	Use Clause G.1		
4.5.2.1	Heat test	Design	All families using the same cap	Use Clause G.3		
4.5.2.2	Ball pressure test	Design	All families using the same cap	Use Clause G.3		
4.5.3.1	Glow-wire test	Design	All families using the same cap	Use Clause G.3		
4.6.1.2	Marking UV RG	Running	By group and type	200		32
4.6.1.3	UV	Design	By group and type	Use Clause G.3		
4.6.2.1	BLH assessment	Design	By family	b		
4.6.2.2	Marking BLH RG	Running	By group and type	200		32
5.1.	Pulse height HPS	Design	By group and type	Use Clause G.3		
5.2.2	Marking self-shielded	Running	By group and type	200	32	2,5
5.2.3	Containment	Design	By family	Use Annex I or Annex J as appropriate		

<sup>a</sup> For the use of this term, see IEC 60410.

<sup>b</sup> Under consideration.



Table 3 provides the acceptance numbers related to AQL of 0,65% as mentioned in Table 2.

**Table 3 – Acceptance numbers AQL = 0,65 %**

Number of lamps in manufacturer's records	Acceptance number	Number of lamps in manufacturer's records	Qualifying limit for acceptance as percentage of lamps in records %
80	1	2 001	1,03
81 to 125	2	2 100	1,02
126 to 200	3	2 400	1,00
201 to 260	4	2 750	0,98
261 to 315	5	3 150	0,96
316 to 400	6	3 550	0,94
401 to 500	7	4 100	0,92
501 to 600	8	4 800	0,90
601 to 700	9	5 700	0,88
701 to 800	10	6 800	0,86
801 to 920	11	8 200	0,84
921 to 1 040	12	10 000	0,82
1 041 to 1 140	13	13 000	0,80
1 141 to 1 250	14	17 500	0,78
1 251 to 1 360	15	24 500	0,76
1 361 to 1 460	16	39 000	0,74
1 461 to 1 570	17	69 000	0,72
1 571 to 1 680	18	145 000	0,70
1 681 to 1 780	19	305 000	0,68
1 781 to 1 890	20	1 000 000	0,67
1 891 to 2 000	21		

Table 4 provides the acceptance numbers related to AQL of 2,5% as mentioned in Table 2.

**Table 4 – Acceptance numbers AQL = 2,5 %**

Number of lamps in manufacturer's records	Acceptance number	Number of lamps in manufacturer's records	Qualifying limit for acceptance as percentage of lamps in records %
32	2	1 001	3,65
33 to 50	3	1 075	3,60
51 to 65	4	1 150	3,55
66 to 80	5	1 250	3,50
81 to 100	6	1 350	3,45
101 to 125	7	1 525	3,40
126 to 145	8	1 700	3,35
146 to 170	9	1 925	3,30
171 to 200	10	2 200	3,25
201 to 225	11	2 515	3,20
226 to 255	12	2 950	3,15
256 to 285	13	3 600	3,10
286 to 315	14	4 250	3,05
316 to 335	15	5 250	3,00
336 to 360	16	6 400	2,95
361 to 390	17	8 200	2,90
391 to 420	18	11 000	2,85
421 to 445	19	15 500	2,80
446 to 475	20	22 000	2,75
476 to 500	21	34 000	2,70
501 to 535	22	60 000	2,65
536 to 560	23	110 000	2,60
561 to 590	24	500 000	2,55
591 to 620	25	1 000 000	2,54
621 to 650	26		
651 to 680	27		
681 to 710	28		
711 to 745	29		
746 to 775	30		
776 to 805	31		
806 to 845	32		
846 to 880	33		
881 to 915	34		
916 to 955	35		
956 to 1 000	36		

### **7.3 Assessment of batches**

#### **7.3.1 Sampling for batch testing**

The lamps for testing shall be selected in accordance with a mutually agreed method so as to ensure proper representation. Selection shall be randomly made as nearly as possible from one-third of the total number of containers in the batch, with a minimum of 10 containers. For small batches of special lamp types, the lamps for testing shall be randomly selected.

In order to cover the risk of accidental breakage, a certain number of lamps in addition to the test quantity shall be selected. These lamps shall only be substituted for lamps of the test quantities, if necessary to make up the required quantities of lamps for the tests.

It is not necessary to replace an accidentally broken lamp if the results of the test are not affected by its replacement, provided the required quantity of lamps for the following test is available. If replaced, such a broken lamp shall be neglected in calculating results.

Lamps having broken bulbs when removed from the packaging after transit shall not be included in the test.

#### **7.3.2 Number of lamps in batch sample**

For batches of over 500 lamps there shall be at least 315 sample lamps (see Table 5).

For small batches of less than, or equal to, 500 lamps (normally consisting of special lamp types) the number of sample lamps shall be determined from the sample plan in Table 6.

#### **7.3.3 Sequence of the tests**

The testing shall be carried out in the order of the subclause numbers listed in Tables 5 or 6, up to and including 5.2.2. Subsequent tests may involve damage to the lamp and each test sample shall be taken separately from the original sample.

#### **7.3.4 Rejection conditions for large batches (>500 lamps)**

Rejection is established if any rejection number in Table 5, with due regard to Annex G, is reached irrespective of the quantity tested. A batch shall be rejected as soon as the rejection number for a particular test is reached.

### 7.3.5 Rejection conditions for small batches ( $\leq 500$ lamps)

Rejection is established if any rejection number in Table 6 is reached irrespective of the quantity tested. A batch shall be rejected as soon as the rejection number for a particular test is reached.

**Table 5 – Batch sample size and rejection number  
(for batches  $> 500$  lamps)**

Subclause	Test	Number of lamps tested	Rejection number
4.2.1	Marking – legibility	125	8
4.2.1	Marking – durability	32	3
4.2.2	Marking – additional information	125	8
4.3.2.2 a)	Construction and assembly of cap/bulb (unused) – pull test	80	2
4.3.2.3 a)	Construction and assembly of cap/bulb (unused) – torque test	80	2
4.3.1.1	Dimensional requirements for caps	32	3
4.3.1.2	Cap creepage distance	Apply Clause G.3	
4.3.1.3	Cap key configuration	80	2
4.4.1	Accidentally live parts	315	1
4.4.2	Insulation resistance	Apply Clause G.1	
4.4.3	Electric strength	Apply Clause G.1	
5.1	Pulse height	Apply Clause G.3	
4.6.1.2	Marking UV RG	125	8
4.6.1.3	UV	Apply Clause G.3	
4.6.2.1	BLH assessment	a	
4.6.2.2	Marking BLH RG	125	8
5.2.2	Marking (self-shielded)	125	8
4.3.2.2 b)	Construction and assembly of cap/bulb (after heating test) – pull test	Apply Clause G.2	
4.3.2.3 b)	Construction and assembly of cap/bulb (after heating test) – torque test	Apply Clause G.2	
4.5.2.1	Heat test	Apply Clause G.3	
4.5.2.2	Ball-pressure test	Apply Clause G.3	
4.5.3.1	Glow-wire test	Apply Clause G.3	
5.2.3	Containment	a	

<sup>a</sup> Under consideration.

**Table 6 – Batch sample size and rejection number  
(for batches ≤500 lamps)**

Subclause	Test	Number of lamps tested	Rejection number
4.2.1	Marking – legibility	20	3
4.2.1	Marking – durability	2	1
4.2.2	Marking – additional information	20	3
4.3.2.2 a)	Construction and assembly of cap/bulb (unused) – pull test	8	1
4.3.2.3 a)	Construction and assembly of cap/bulb (unused) – torque test	8	1
4.3.1.1	Dimensional requirements for caps	2	1
4.3.1.2	Cap creepage distance	2	1
4.3.1.3	Cap key configuration	8	1
4.4.1	Accidentally live parts (batch size <125)	100 %	1
	Accidentally live parts (batch size 125 to 500)	125	1
4.4.2	Insulation resistance	20	1
4.4.3	Electric strength	20	1
5.1	Pulse height	2	1
4.6.1.2	Marking UV RG	a	a
4.6.1.3	UV	2	1
4.6.2.1	BLH assessment	a	a
4.6.2.2	Marking BLH RG	a	a
5.2.2	Marking (self-shielded)	20	3
4.3.2.2b)	Construction and assembly of cap/bulb (after heating test) – pull test	8	1
4.3.2.3b)	Construction and assembly of cap/bulb (after heating test) – torque test	8	1
4.5.2.1	Heat test	2	1
4.5.2.2	Ball pressure test	2	1
4.5.3.1	Glow-wire test	2	1
5.2.3	Containment	a	a
Based on single reduced sampling plan (see ISO 2859-1).			
a Under consideration.			

## Annex A (normative)

### List of lamp caps and gauges

Table A.1 gives the data sheet references of IEC 60061.

**Table A.1 – Data sheet references of IEC 60061**

Cap type	Cap data sheet number in IEC 60061-1	Gauge data sheet number in IEC 60061-3
B22d	7004-10	7006-4A, 4B, 10, 11
B22d-3	7004-10A	7006-19
BY22d	7004-17	7006-4A, 17A
E26	7004-21A	7006-27D, 27E, 29L
E26/50x39	Under consideration	7006-27D, 27E, 29L
E27	7004-21	7006-27B, 27C, 28A, 50, 51A
E27/51x39	7004-27	7006-27B, 27C, 28A, 50, 51
E39	7004-24A	7006-24A, 24B, 24C
E40	7004-24	7006-27, 28D, 52, 53
Fc2	7004-114	7006-114
G12	7004-63	7006-80
PG12	7004-64	7006-81
RX7s	7004-92A	Under consideration
<p>NOTE 1 There are two variations of E26 caps which are not fully compatible, i.e. E26/24 caps used in North America and E26/25 caps used in Japan.</p> <p>NOTE 2 The list is not exhaustive.</p>		

## Annex B (normative)

### Pull and torsion test values

Tables B.1 and B.2 provide pull and torsion test values respectively.

**Table B.1 – Pull test values**

Cap type	Unused lamps	Lamps after 2 000 h heating	
	Pull value N	Temperature °C	Pull value N
G12	120 <sup>a</sup>	280 <sup>a</sup>	90 <sup>a</sup>
PG12	160 <sup>a</sup>	210 <sup>a</sup>	120 <sup>a</sup>
* Under consideration.			

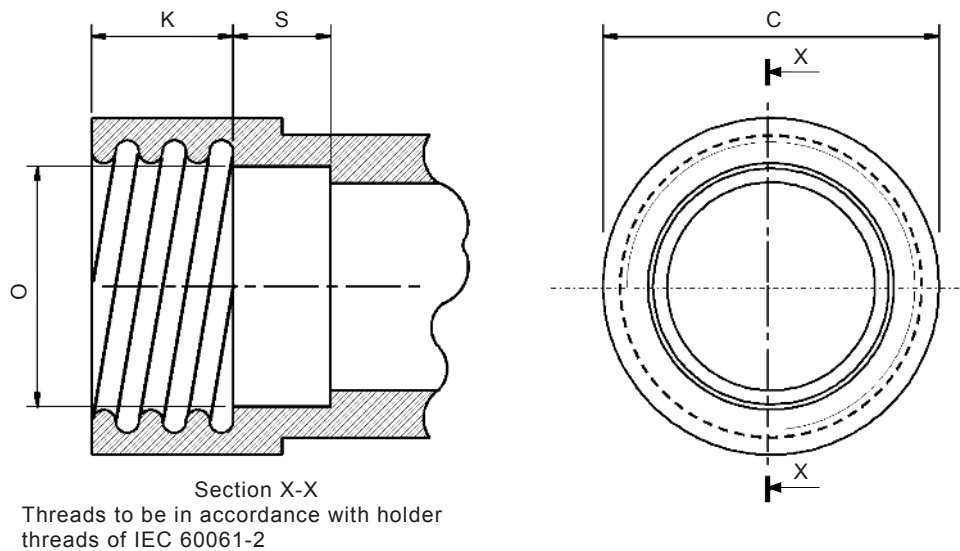
**Table B.2 – Torsion test values**

Cap type	Unused lamps	Lamps after 2 000 h heating	
	Torque value Nm	Temperature °C	Torque value Nm
B22d and B22d-3	3,0	210	Under consideration
BY22d	3,0	150	Under consideration
E26 and E26/50x39	3,0	165 <sup>a b</sup>	2,5
E27 and E27/51x39	3,0	210	2,5
E39	5,0	230 <sup>a b</sup>	Under consideration
E40	5,0	250 <sup>c</sup>	Under consideration
<sup>a</sup> Japanese practice. <sup>b</sup> In North America, the temperature shall be identical to the maximum cap temperature given in the ANSI lamp designation code for each lamp type. <sup>c</sup> For high-pressure sodium vapour lamps, 150 W and lower: 210 °C.			

## Annex C (normative)

### Torsion test holders

Figures C.1 and C.2 show holders for torsion tests for lamps with Edison screw caps and lamps with bayonet caps respectively.

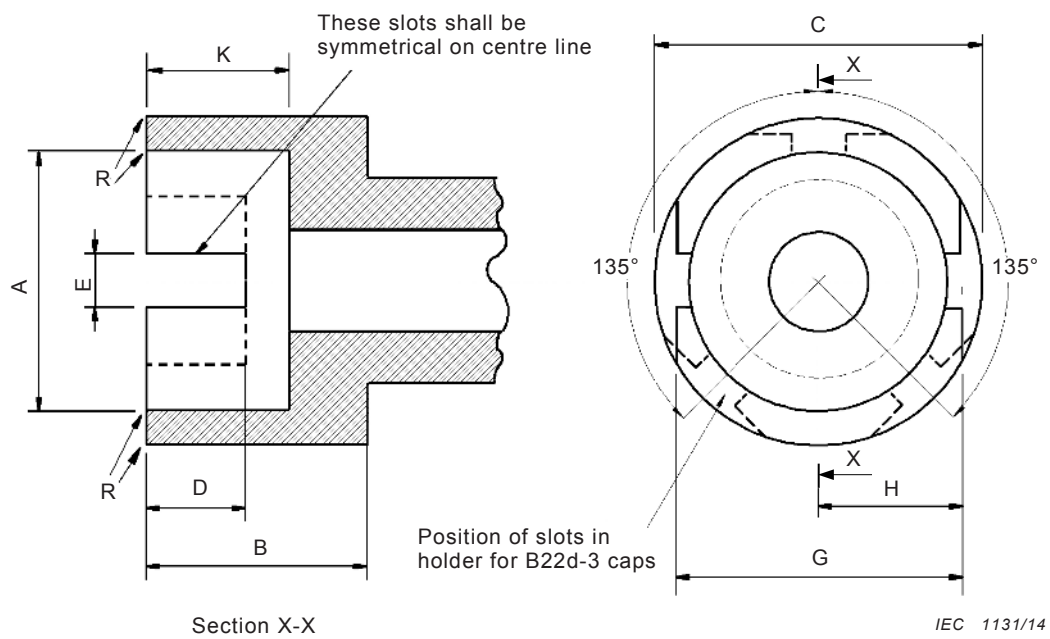


IEC 1130/14

Dimension	E26 mm	E27 mm	E39 mm	E40 mm	Tolerance mm
C	32,0	32,0	47,0	47,0	Min.
K	11,0	13,5	19,0	19,0	+0/-0,3
O	23,0	23,0	34,0	34,0	±0,1
S	12,0	12,0	13,0	13,0	Min.

Figure C.1 – Holder for torsion test on lamps with Edison screw caps





Dimension	B22d and BY22d mm	Tolerance mm
A	22,27	+0,03
B	19,0	Min.
C	28,0	Min.
D	9,5	Min.
E	3,0	+0,17
G	24,6	±0,3
H	12,15	Min.
K	12,7	±0,3
R	1,5	Approximate

Figure C.2 – Holder for torsion test on lamps with bayonet caps

## Annex D (normative)

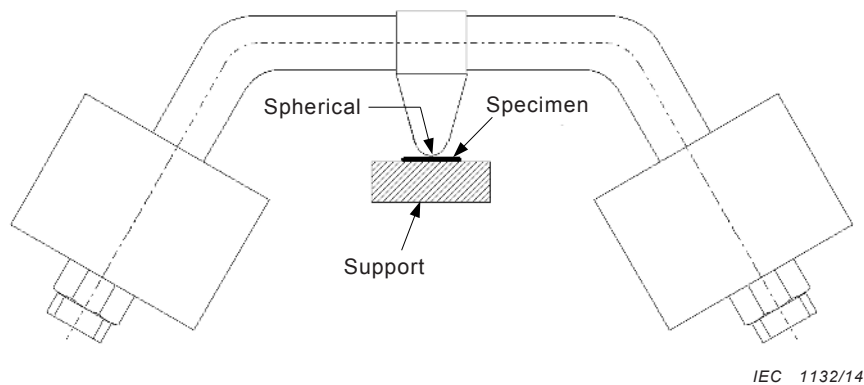
### Information for thermal tests

Table D.1 shows the temperature for various cap types.

**Table D.1 – Temperatures**

Cap type	Temperature °C
BY22d	150 <sup>a</sup>
G12	280 <sup>a</sup>
PG12	210 <sup>a</sup>
<sup>a</sup> Under consideration.	

Figure D.1 shows a ball pressure test apparatus.



**Figure D.1 – Ball pressure test apparatus**

## Annex E (normative)

### Measurement of pulse height for lamps with internal starting device

#### E.1 Introduction

High-pressure sodium vapour lamps with an internal starting device unit, being either a glow switch or a thermal switch, generate voltage pulses during ignition. This annex describes the method for measuring the height of these pulses. Since the magnitude of the pulses generated by an internal starting device unit is dependent upon the ballast employed, its characteristics shall be specified.

#### E.2 Test circuit

##### E.2.1 Test circuit and key

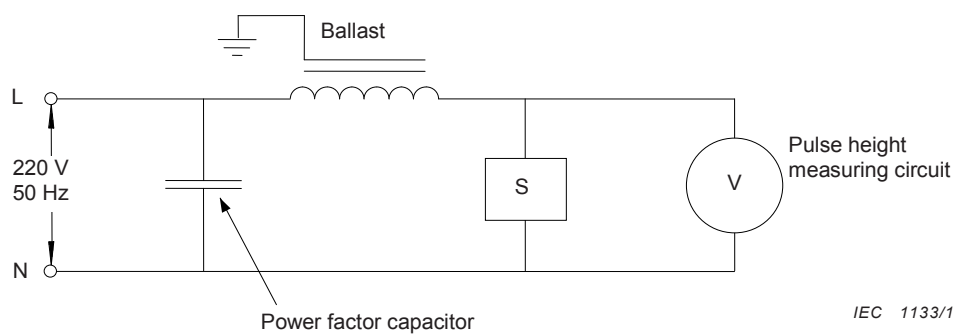


Figure E.1 – Test circuit

Voltage pulses shall be measured using the circuit in Figure E.1.

In this circuit:

- for lamps with internal glow switch, S is a starting device unit of the type used in the lamp (see second paragraph in E.3.1);
- for lamps with internal thermal switch, S is the lamp itself;
- the ballast shall have characteristics as described in E.2.2;
- the power factor capacitor shall have a value as given in E.2.3;
- the pulse height measuring circuit shall be as specified in E.2.4;
- the cable capacitance between the ballast and lamp or starting device shall not exceed 20 pF.

##### E.2.2 Ballast characteristics

Measurement of the pulse height shall be carried out using a ballast complying with the requirements of IEC 60923 and having resonance characteristics as given in Table E.1

The resonance characteristics are determined by applying a voltage of the order of 20 V across the ballast and measuring the current at various frequencies. During these measurements any provision for earthing the ballast shall be connected to the terminal

designated as the line terminal. Ballast resonance characteristics may be adjusted by the use of suitable capacitors.

**Table E.1 – Test ballast resonance characteristics**

Lamp	50 W HV	70 W HV	150 W	250 W	400 W
Resonance frequency (kHz) $\pm$ 10%	u.c. <sup>a</sup>	18	30	40	35
Impedance at resonance frequency (k $\Omega$ ) $\pm$ 10%	u.c. <sup>a</sup>	120	40	30	20
<sup>a</sup> Under consideration. These resonance characteristics are representative of those 230 V reactor ballasts which are commercially available leading to the highest value of pulse voltage.					

### E.2.3 Power factor capacitor

The power factor capacitor to be used shall have a value as given in Table E.2.

**Table E.2 – Power factor capacitor values for tests**

Lamp	50 W HV	70 W HV	150 W	250 W	400 W
Capacitance ( $\mu$ F) $\pm$ 10%	u.c. <sup>a</sup>	10	20	30	40
<sup>a</sup> Under consideration.					

### E.2.4 Pulse height measuring circuit

For lamps with internal glow switch, the measuring circuit is that described in IEC 60155.

For lamps with internal thermal switch, the measuring circuit is that described in IEC 61347-2-1.

NOTE It is recognized that the above measuring circuits will not accurately detect very narrow high-voltage pulses. Experience has shown that such pulses do not cause practical problems.

## E.3 Tests

### E.3.1 Lamps with an internal glow switch

Measurement shall be taken using the test circuit of Clause E.2. The relevant pulse height value is the highest voltage recorded on either of the two voltmeters of the measuring circuit, referred to in E.2.4, during a period of 30 s. The test is sufficient for both cold start and hot restrike conditions.

In lamps with internal glow switch, pulse voltages are limited by the starting device unit itself. Therefore, for the purpose of this test, starting device units of the type used in the lamps should be taken and not the complete lamps. Such separate starting device units should be provided by the lamp manufacturer. If, however, the working conditions were to change when testing the starting device unit separately from the lamp, the complete lamps should be tested.

### E.3.2 Lamps with an internal thermal switch

Tests shall be carried out on complete lamps, which have to be conditioned before testing. The pulse height shall be measured for both the cold start and hot restrike conditions.

Complete lamps should be tested, because in lamps with an internal thermal switch the pulse voltage limitation is effected by a combination of starting device unit design and arc tube characteristics.

a) Cold start condition

For initial conditioning, the lamps shall be operated for at least 2 h prior to any test, then switched off and remain unlit for at least 1 h.

After initial conditioning, the lamps shall be ignited and allowed to run for 5 s to 10 s, switched off and remain unlit for at least a further 15 min.

A measurement shall then be taken using the test circuit of Clause E.2. The relevant pulse height value is the highest voltage recorded on either of the two voltmeters of the measuring circuit, referred to in E.2.4, up to 5 s after the lamp strikes.

Further measurement may be taken on the same lamp without a repeat of the initial conditioning, provided the lamp is run for only 5 s to 10 s and remains unlit for a minimum of 15 min.

b) Hot restrike condition

The lamps shall be operated for at least 15 min. The supply shall then be interrupted to extinguish the lamp and then be restored.

A measurement shall be taken using the test circuit of Clause E.2. The relevant pulse height value is the highest voltage recorded on either of the two voltmeters of the measuring circuit, referred to in E.2.4, up to 5 s after the lamp restrikes.

A repeat measurement may be taken after a further 15 min operation.

## Annex F (informative)

### Information for luminaire design

#### F.1 Guidelines for safe lamp operation

To ensure safe lamp operation, it is essential to observe the following recommendations.

#### F.2 Maximum lamp cap temperature

The luminaire designer should ensure that under normal operating conditions the cap temperature of the lamp does not exceed the maximum cap temperature value shown in Table F.1.

The method of measurement for bayonet and Edison screw caps is described in Annex K of IEC 60432-1:1999.

**Table F.1 – Maximum lamp cap temperatures**

Cap type	Maximum cap temperature °C
B22d and B22d-3	210
BY22d	150
E26 and E26/50×39	165 <sup>a b</sup>
E27 and E27/51×39	210
E39	230 <sup>a b</sup>
E40	250 <sup>c</sup>
Fc2	d
G12	280 <sup>d</sup>
PG12	210 <sup>d</sup>
RX7s	d
<sup>a</sup> Japanese practice. <sup>b</sup> In North America the maximum cap temperature for each lamp type is given in the ANSI lamp designation code. <sup>c</sup> For high-pressure sodium vapour lamps, 150 W and lower: 210 °C. <sup>d</sup> Under consideration.	

#### F.3 Cap/holder – key configuration

The luminaire designer should ensure that, if applicable, a holder with the correct key version for the intended lamp/ballast combination is installed in the luminaire.

#### F.4 Protection against lamp shattering

For many types of metal halide lamps, there is a risk of the lamp shattering. In instances where lamp manufacturers warn against the possibility of lamps shattering, or as referenced

on the relevant lamp data sheets in IEC 61167, adequate protective shielding measures should be taken in the luminaire to protect against this hazard.

## **F.5 Protection against UV radiation**

Some types of lamps emit a high level of UV radiation (risk group 2 or higher). In instances where the lamp manufacturer provides a cautionary notice or symbol (see Clause H.2), requiring the use of a protective shield on the luminaire, as well as a UV cautionary notice or symbol (see Clause H.3), a protective shield with adequate UV absorption according to IEC 60598-1, Annex P, should be used. (For lamps standardized in IEC 61167, the maximum specific effective radiant UV power is specified on the lamp datasheet. For non-standardized lamps, the maximum value should be obtained from the lamp manufacturer.)

Some types of lamps emit a low level of UV radiation (risk group 1). In instances where the lamp manufacturer provides a cautionary notice or symbol (see Clause H.2), requiring the use of a protective shield on the luminaire, but does not provide a UV cautionary notice or symbol, the requirements of IEC 60598-1, Annex P, do not apply to the protective shield. In this case, any glass will reduce the UV radiation to a sufficiently low level.

## **F.6 Possible condition at end of lamp life**

For certain high pressure sodium vapour lamps and certain metal halide lamps, the following information is given with regard to rectification at their end of life.

- a) For most high-pressure sodium lamps there is a risk that a number of lamps may exhibit a rectifying effect at the end of lamp life. This can lead to overloading of the lamp controlgear (ballast, transformer and/or starting device). Adequate protective measures should be taken to ensure that safety is maintained under this condition.

The following lamp types are not liable to rectification:

- high-pressure sodium lamps with a nominal power of 1 000 W;
- high-pressure sodium lamps which are designed as a replacement for high-pressure mercury lamps;
- other high-pressure sodium lamps for which the manufacturer states that the lamp is not liable to rectification.

- b) For some types of metal halide lamps there is a risk that a number of lamps may exhibit a rectifying effect at the end of lamp life. This can lead to overloading of the lamp controlgear (ballast, transformer and/or starting device). In instances where the lamp manufacturer warns against the possibility of rectification, adequate protective measures should be taken to ensure that safety is maintained under this condition.

The following lamp types are liable to rectification:

- metal halide lamps identified on the lamp data sheet in IEC 61167 as being liable to end-of-life rectification;
- other metal halide lamps for which the lamp manufacturer states that the lamp is liable to end-of-life rectification.

## **Annex G** (normative)

### **Conditions of compliance for design tests**

#### **G.1 Insulation resistance (see 4.4.2)** **Electric strength (see 4.4.3)**

Each test shall be assessed separately.

First sample: 125

Rejection number: 2

– Accept when no failure has been found.

– If one failure found, take a second sample.

Second sample: 125

Rejection number: 2 (in the combined sample)

#### **G.2 Cap construction and assembly (see 4.3.2.2 b) and 4.3.2.3 b))**

Sample size: 80

Rejection number: 2

#### **G.3 Cap creepage distance (see 4.3.1.2)** **Resistance to heat (see 4.5.2.1 and 4.5.2.2)** **Resistance to abnormal heat and fire (see 4.5.3.1)** **Pulse height (see 5.1.)** **UV radiation (see 4.6.1.3)**

Each test shall be assessed separately.

First sample: 5

Rejection number: 2

– Accept when no failure has been found.

– If one failure found, take a second sample.

Second sample: 5

Rejection number: 2 (in the combined sample)



## **Annex H** (normative)

### **Symbols**

#### **H.1 General**

The following symbols are referenced in 4.2.2 and 5.2.2, as well as in Annex F. The height of graphical symbols shall not be less than 5 mm and of letters not less than 2 mm.

#### **H.2 Symbol indicating that the lamp shall be operated only in a luminaire provided with a protective shield**



[SOURCE: IEC 60417-6071 (2011-09)]

#### **H.3 Symbol indicating that the lamp emits a high level of UV radiation**



[SOURCE: 60417-6040 (2010-08)]

#### **H.4 Symbol indicating that the lamp shall not be operated when the outer bulb is broken**

NOTE The bulb shape shown can be varied to show the actual shape of the lamp.



**H.5 Self-shielded lamp symbol indicating that the lamp can be operated in a luminaire without a protective shield**



[SOURCE: 60417-6030 (2009-11)]

**H.6 Symbol indicating not to stare at a light source, for example, a lamp, a luminaire, a video projector etc.**

Symbol title: Caution, do not stare at light source



## **Annex I**

### **(normative)**

## **Containment testing procedure for metal halide lamps with quartz arc tubes<sup>1</sup>**

### **I.1 General**

#### **I.1.1 Purpose**

This method of measurement applies to metal halide lamps with quartz arc tubes, that are designed to contain all particles within the outer bulb should an arc tube rupture occur. These lamps are permitted to be used in open luminaires. This is not a sufficient procedure for evaluation of particle containment designs which employ protective coatings, e.g. a plastic coating over the outer bulb.

#### **I.1.2 Test description**

The test consists of discharging a capacitor through an operating lamp to simulate an end-of-life arc tube rupture. In the first part of the test, the median energy required to ensure rupture of the arc tube is determined. In the second part of the test, arc tubes are forced to rupture at the median energy, and the lamps are examined for damage to the outer bulb. The test differs from real end-of-life situations in a number of ways, including: a) the lamps are new, b) a high energy input into the arc tubes is required to make them rupture, leading to higher pressures and greater energies than typical end-of-life ruptures, and c) the arc tube rupture mechanism may not be the same as that for end-of-life lamps.

### **I.2 Experimental setup**

#### **I.2.1 Safety precautions**

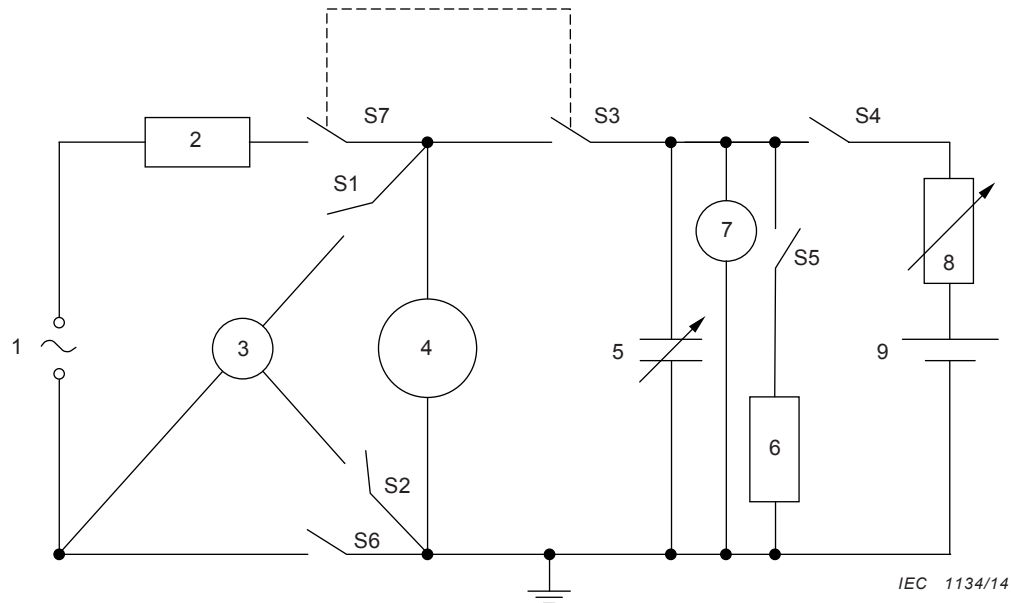
High voltages and high electrical energy levels are involved in this test, so extreme caution is required. Fragments of hot lamp parts can be ejected if the outer bulb is damaged, so a physical enclosure is required. Precautions should be taken to contain and clean up mercury and other hazardous materials from the lamp in the event of penetration of the outer bulb.

#### **I.2.2 Electrical circuit**

The basic electrical circuit used for containment testing of metal halide lamps is shown in Figure I.1. The main components include: (1) a power supply for operating the lamp, (2) a ballast for limiting current to the lamp, (9) a d.c. power supply for charging the discharge capacitor, (5) a discharge capacitor for storing energy for the containment test, (8) a charging resistor for charging the discharge capacitor, (6) a discharge resistor for discharging the capacitor after the test, (3) a VAW meter for measuring the lamp electrical operating characteristics and (7) a voltmeter for measuring the capacitor voltage. Specific details for designing and operating such a circuit can be found in SR91.

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<sup>1</sup> Lamps, complying with the requirements of this annex are sometimes called “containment rated”, “open rated” or “self-shielded”, the latter expression being preferred.

**Key**

1	lamp power supply	6	discharge resistor
2	ballast or Hi-pot inductor	7	voltmeter
3	VAW meter	8	charging resistor
4	lamp	9	capacitor DC power supply
5	discharge capacitor	S1...S7	switches

NOTE The switches are shown in open state. This does not correlate to a certain step in I.3.2.

**Figure I.1 – Basic electrical diagram for quartz metal halide lamp containment test**

Since circuit impedance can affect the test results, the lead wires between the discharge capacitor and the lamp shall be less than 1 m long and have a cross sectional area of 20 mm<sup>2</sup> or larger, except in the last section, where a smaller diameter may be used to facilitate connection to a lampholder.

The capacitor discharge d.c. power supply shall be capable of charging the discharge capacitor to any voltage up to 5 000 V. The value of the charging resistor can be adjusted so that the power supply can charge the capacitor within a reasonable amount of time.

The discharge capacitor may be adjusted to a value of 10 µF to 50 µF (higher values may be required for lamps of higher power) and shall be capable of handling 5 000 V.

The lamp power supply shall be capable of supplying the lamp with sufficient voltage and current to operate the lamp at its rated operating power. A timing circuit may be inserted into the circuit so that the capacitor is discharged at the point in the electrical phase when the current is at its maximum.

The operational ballast may comprise a suitable linear reactor or commercial ballast, with a suitable impedance as specified in the applicable lamp standard. It shall be capable of withstanding short-term high voltage pulses of 5 000 V.

The switches shall be capable of withstanding short-term high voltage pulses of 5 000 V in their open condition.

The discharge resistor shall have a rating of at least 1 000  $\Omega$  and 25 W.

### **I.2.3 Enclosure requirements**

The enclosure for containment testing of metal halide lamps shall be constructed of materials capable of withstanding the impact of hot particles (particles of up to 1,1 g at 1 200 °C travelling at 50 m/s). Suitable materials include sheet metal and impact-resistant, high-temperature polymers. Metal enclosures shall be electrically grounded.

The enclosure shall be equipped with a suitable lamp holder for operating the lamp under test in the base up position, or in the specified operating position of the lamp.

The dimensions of the enclosure are not critical, but they should be large enough to accept the lamp under test and provide sufficient clearance at the sides and below the lamp.

## **I.3 Test procedures**

### **I.3.1 Lamp selection and preparation**

Lamps for this test shall be selected randomly from normal production or from pilot runs. The lamp construction dimensions shall fall within the values of the lamp data sheets or the manufacturer's specified values.

### **I.3.2 Determination of median rupture energy**

In order to determine the median energy setting needed to rupture the arc tube within the lamp, the following procedure shall be carried out, with reference to Figure I.1. Note that these steps need to be carried out for each different lamp type.

- 1) Take care that the condition at the beginning is that the energy sources of charging and lamp operation are not connected, lamp not inserted.
- 2) Select an initial energy value of at least 5 J by selecting the capacitor d.c. power supply voltage according to  $U = (2 E / C)^{1/2}$ , where  $U$  is the capacitor voltage in volts (V),  $E$  is the energy in joules (J), and  $C$  is the capacitor value in farads (F).
- 3) Open switches S1, S2, S3, S4; close switches S5, S6 and S7.
- 4) Insert a lamp into the test lampholder.
- 5) Turn on the lamp power supply and adjust to approximately the correct parameters to operate the lamp. Use of this power supply may or may not require additional means of starting.
- 6) Close the enclosure securely.
- 7) After 5 min, close switches S1 and S2, and open switch S6.
- 8) Determine the lamp electrical operating point by means of the VAW meter and adjust the power supply as necessary to bring the lamp to its rated operating point.
- 9) Allow the lamp to operate for 20 min.
- 10) While waiting for the lamp to warm up, turn on the capacitor d.c. power supply, open switch S5 and close switch S4 to begin charging the capacitor; monitor the capacitor voltage by means of the voltmeter.
- 11) After the capacitor has reached its final charge and the lamp has operated at least 20 min, close switch S6 and open switches S1, S2 and S4.
- 12) Open switch S7 that triggers the closing of switch S3 to discharge the capacitor through the lamp.
- 13) After the discharge, open switch S3 and close switch S5; turn off both power supplies.

- 14) If the arc tube ruptured at step 12, then repeat steps 3 to 13 until 8 lamps have been tested. If at least 4 out of 8 arc tubes ruptured, then the energy and voltage values shall be recorded, and these values shall be used for the rest of the test as described in I.3.3.
- 15) If the arc tube did not rupture in step 12, or if fewer than 4 out of 8 arc tubes ruptured in the ensuing attempts, then the voltage at the discharge capacitor shall be increased to obtain an energy increase of at least 5 J, and steps 3 to 14 shall be repeated. If the arc tubes do not rupture reliably after increasing the voltage, an increase in capacitance may be required.

### **I.3.3 Rupture test procedure**

After the median energy required to ensure rupture of the arc tube has been determined (see I.3.2), the following procedure shall be carried out to determine whether the lamps are self-shielded.

Follow steps 3 to 13 in the I.3.2 (with the median energy value that ensures rupture of the arc tube, as determined in that subclause). This procedure shall be followed until all the lamps of the test group have been evaluated. The quantity of lamps in the test group shall be sufficient to ensure at least 10 arc tubes rupture.

## **I.4 Self-shielded lamp design**

### **I.4.1 Definition of damage to the outer bulb**

Each of the lamps with ruptured arc tubes shall be examined for damage to the outer bulb. For the purposes of this test, damage to the outer bulb constitutes any shattering, punctures, or holes in the bulb wall. Scratches, cracks and chips on the bulb wall are allowed, as long as all fragments are contained within the bulb, and the bulb remains intact.

### **I.4.2 Determination of self-shielded**

If none of the lamps from I.3.3 shows any damage to the outer bulb (as defined in I.4.1), then the lamp construction is self-shielded. If two or more of these lamps show damage to the outer bulb (as defined in I.4.1), then the lamp construction is not self-shielded. If only one of the lamps in the test group shows any damage to the outer bulb and this damage is limited to a hole of less than 3 mm diameter in the bulb wall, then the test shall be repeated with a new quantity of test lamps sufficient to ensure at least 10 arc tube ruptures. If none of the lamps in this second test group shows damage to the outer bulb, then the construction is self-shielded. If one or more of the lamps in this second test group shows any damage to the outer bulb, then the construction is not self-shielded.

## **Annex J** (normative)

### **Containment<sup>2</sup> testing procedure for metal halide lamps with ceramic arc tubes**

#### **J.1 General**

##### **J.1.1 Purpose**

This method of measurement applies to metal halide lamps with ceramic arc tubes that are designed to contain all particles within the outer bulb should an arc tube rupture occur. These lamps are permitted to be used in open luminaires. This is not a sufficient procedure for evaluation of particle containment designs which employ protective coatings, e.g. a plastic coating over the outer bulb.

##### **J.1.2 Test description**

The test consists of switching extra impedance in parallel with the operational ballast to increase the energy in the arc tube and thereby simulate an end-of-life arc-tube rupture. In the first part of the test, the median energy required to ensure rupture of the arc tube is determined. In the second part of the test, arc tubes are forced to rupture at the median energy, and the lamps are examined for damage to the outer bulb. The test differs from real end-of-life situations in a number of ways, including: a) the lamps are new, b) a high energy input into the arc tubes is required to make them rupture, leading to higher pressures and greater energies than typical end-of-life ruptures, and c) the arc tube rupture mechanism may not be the same as that for end-of-life lamps.

#### **J.2 Experimental setup**

##### **J.2.1 Safety precautions**

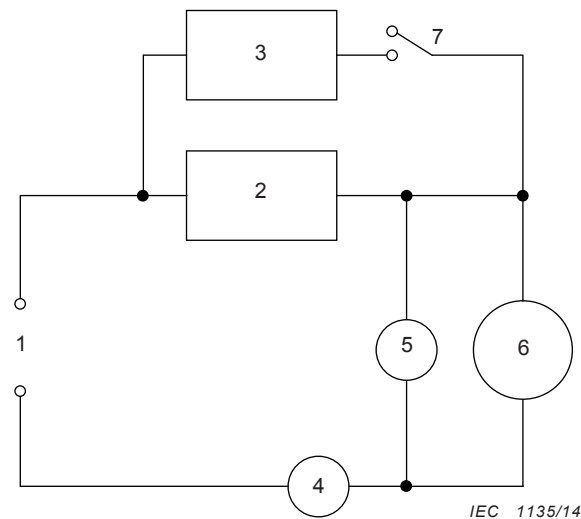
High electrical energy levels are involved in this test, so extreme caution is required. Fragments of hot lamp parts can be ejected if the outer bulb is damaged, so a physical enclosure is required. Precautions should be taken to contain and clean up mercury and other hazardous materials from the lamp in the event of penetration of the outer bulb.

##### **J.2.2 Electrical circuit**

The basic electrical circuit used for containment testing of metal halide lamps is shown in Figure J.1. The main components include: (1) a power supply for operating the lamp and supplying extra energy to rupture the arc tube, (2) an operational ballast for operating the lamp, (3) an extra impedance to switch in parallel with the operational ballast, and (5) voltmeter and (4) ammeter for measuring the lamp electrical operating characteristics. The lamp power supply shall be capable of supplying the lamp with sufficient voltage and current to operate the lamp at its nominal operating power and at an increased energy level sufficient to rupture the arc tube (typically 5 to 20 times the nominal operating power). The operational ballast may comprise a suitable linear reactor or commercial ballast, with a suitable impedance as specified in the applicable lamp standard. The extra impedance may comprise a variable linear reactor, a reactor ballast, or a combination of reactor ballasts. The wiring and switches shall be capable of handling at least 40 A.

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<sup>2</sup> Lamps, complying with the requirements of this annex are sometimes called "containment rated", "open rated" or "self-shielded", the latter expression being preferred.

**Key**

1	power supply	4	ammeter
2	operational ballast	5	voltmeter
3	extra impedance	6	lamp
		7	switch

The voltmeter and ammeter may be set up to be switched out of the circuit if desired.

**Figure J.1 – Electrical diagram for containment test**

### J.2.3 Enclosure requirements

The enclosure for containment testing of metal halide lamps shall be constructed of materials capable of withstanding the impact of hot particles (particles of up to 1,1 g at 1 200 °C travelling at 50 m/s). Suitable materials include sheet metal and impact-resistant, high-temperature polymers. Metal enclosures shall be electrically grounded.

The enclosure shall be equipped with a suitable lamp holder for operating the lamp under test in the base up position, or in the specified operating position of the lamp.

The dimensions of the enclosure are not critical, but they should be large enough to accept the lamp under test and provide sufficient clearance at the sides and below the lamp.

## J.3 Test procedures

### J.3.1 Lamp selection and preparation

Lamps for this test shall be selected randomly from normal production or from pilot runs. The lamp construction dimensions shall fall within the manufacturer's specified values.

### J.3.2 Determination of median rupture energy

In order to determine the median energy setting needed to rupture the arc tube within the lamp, the following procedure shall be carried out, with reference to Figure J.1. Note that these steps need to be carried out for each different lamp type.

- 1) Take care that the condition at the beginning is that the energy sources of charging and lamp operation are not connected, lamp not inserted.



- 2) Select an impedance for the extra impedance of about 20 % of that of the operational ballast.

NOTE Practical impedance values determined for some typical lamp types are shown below. Note that these values can vary for different arc tube constructions.

- 39 W lamp            59  $\Omega$  (HPS 250 W ballast),
- 70 W lamp            38  $\Omega$  (HPS 400 W ballast),
- 150 W lamp          17  $\Omega$  (HPS 1 000 W (100 V) ballast).

- 3) Open the switch and insert a lamp in the test lampholder.
- 4) Turn on the power supply and set the supply voltage to the rated voltage or greater for the lamp under test. Up to 110 % of rated voltage and/or 120 % of rated power is permitted.
- 5) Ignite the lamp and close the enclosure securely.
- 6) Operate the lamp for at least 10 min.
- 7) Close the switch to increase the energy in the arc tube.
- 8) Observe whether or not the arc tube ruptures within about 5 s.
- 9) Open the switch and turn off the power supply.
- 10) If the arc tube ruptured in step 8, then repeat steps 3) to 9) until 8 lamps have been tested. If at least 4 out of 8 lamps ruptured, then the voltage and impedance values shall be recorded, and these values shall be used for the second part of the test (see J.3.3).
  - a) If the arc tube stayed on but did not rupture within about 5 s, then the extra impedance value shall be decreased, and steps 3) to 10) shall be repeated.
  - b) If the arc tube extinguished instead of rupturing, then the supply voltage shall be increased and the impedance of the operational ballast may be increased to assure operation of the lamp up to 120 % of rated power during the 10-min warm-up period. Thereafter steps 3) to 10) shall be repeated.

### J.3.3 Rupture test procedure

After the median energy required to ensure rupture of the arc tube has been determined (see J.3.2), the following procedure shall be carried out to determine whether the lamps are self-shielded.

Follow steps 3) to 9) in J.3.2 (with the median energy value that ensures rupture of the arc tube, as determined in that subclause). This procedure shall be followed until all the lamps of the test group have been evaluated. The quantity of lamps in the test group shall be sufficient to ensure at least 10 arc tube ruptures.

## J.4 Self-shielded lamp design

### J.4.1 Definition of damage to the outer bulb

Each of the lamps with ruptured arc tubes shall be examined for damage to the outer bulb. For the purposes of this test, damage to the outer bulb constitutes any shattering, punctures, or holes in the bulb wall. Scratches, cracks and chips on the bulb wall are allowed, as long as all fragments are contained within the bulb, and the bulb remains intact.

### J.4.2 Determination of containment rating

If none of the lamps from J.3.3 shows any damage to the outer bulb (as defined in J.4.1), then the lamp construction is self-shielded. If two or more of these lamps show damage to the outer bulb (as defined in J.4.1), then the lamp construction is not self-shielded. If only one of the lamps in the test group shows any damage to the outer bulb and this damage is limited to a hole of less than 3 mm diameter in the bulb wall, then the test shall be repeated with a new quantity of test lamps sufficient to ensure at least 10 arc tube ruptures. If none of the lamps in this second test group shows damage to the outer bulb, then the construction is self-shielded.

If one or more of the lamps in this second test group shows any damage to the outer bulb, then the construction is not self-shielded.

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