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Edition 4.0 2021-04

INTERNATIONAL STANDARD

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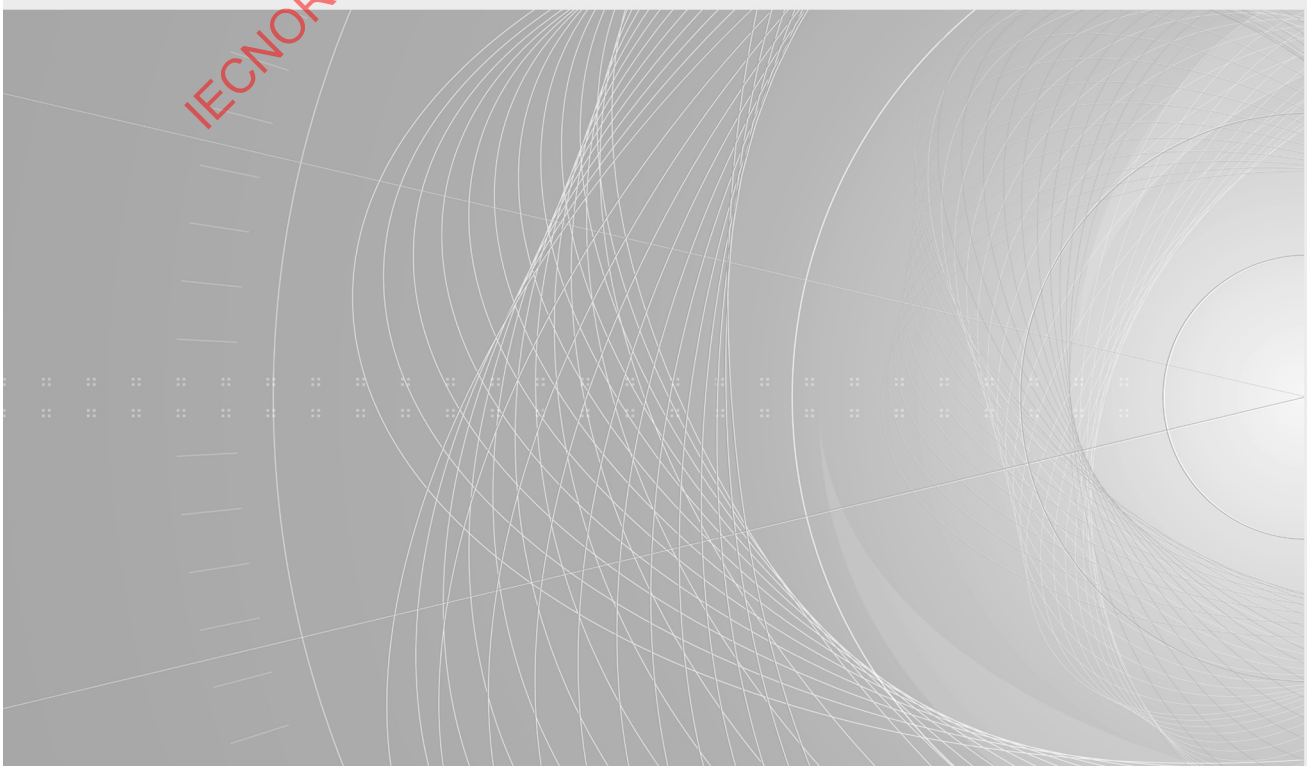
Lamps and light sources for road vehicles – Dimensional, electrical and luminous requirements



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LAMPS AND LIGHT SOURCES FOR ROAD VEHICLES – DIMENSIONAL, ELECTRICAL AND LUMINOUS REQUIREMENTS

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60809 has been prepared by subcommittee 34A: Electric light sources, of IEC technical committee 34: Lighting. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2014, Amendment 1:2017, Amendment 2:2017 and Amendment 3:2019. This edition constitutes a technical revision.

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

a) Introduction of a light technical measurement on LED light sources intended for use in front-lighting applications.
b) As the original data sheets and some figures from previous editions were not available in an editable format, they have been reproduced from their old format, following the current drafting rules and are now in single language format. Some reproductions constitute minor (obvious) editorial changes of the original text sections and original figures; no technical changes were introduced.

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

Draft	Report on voting
34A/2232/FDIS	34A/2235/RVD

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

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

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

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

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

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LAMPS AND LIGHT SOURCES FOR ROAD VEHICLES – DIMENSIONAL, ELECTRICAL AND LUMINOUS REQUIREMENTS

1 Scope

This document is applicable to electric light sources (see Note 1) for use in automotive applications, for example in road illumination devices and/or light signalling devices for road vehicles.

It is especially applicable to light sources listed in UN Resolution R.E.5 and light sources subject to other legislations.

This document specifies the technical requirements for interchangeability for example dimensional, electrical and photometrical characteristics, and includes test methods.

For the light sources listed in this document, the data sheets are contained either in this document or are included by reference to UN Resolution R.E.5.

Performance requirements are specified in IEC 60810, for example life, torsion strength, resistance to vibration and shock.

The requirements for miniature light sources for supplementary purposes, not subject to legislation, are specified in IEC 60983.

NOTE 1 The terms "lamp" and "light source" are both used in this document to mean the same product, so the two terms are interchangeable throughout this document.

NOTE 2 In various vocabularies and standards, different terms are used for "incandescent lamp" (IEC 60050-845:1987, 845-07-04), "discharge lamp" (IEC 60050-845:1987, 845-07-17) and "LED lamp". In this document "filament lamp", "discharge lamp" and "LED light source" are used, however, where only "lamp" or "light source" is written, all light sources, independent of the technology used, are meant, unless the context clearly shows that it applies to one kind of technology only. In the UN Regulations, the word "light source" is used for the products specified in this document.

NOTE 3 Wherever the term "device" is used, it is meant to designate equipment which is used as a luminaire. It can for instance take the form and purpose of a headlight or signal light.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-845, *International Electrotechnical Vocabulary – Part 845: Lighting* (available at http://www.electropedia.org/)

IEC 60051-1, *Direct acting indicating analogue electrical measuring instruments and their accessories – Part 1: Definitions and general requirements common to all parts*

IEC 60061-1, *Lamp caps and holders together with gauges for the control of interchangeability and safety – Part 1: Lamp caps* (available at http://std.iec.ch/iec60061)

IEC 60810:2017, *Lamps, light sources and LED packages for road vehicles – Performance requirements*
IEC 60810:2017/AMD1:2019

CIE 015:2018, *Colorimetry*

United Nations, Vehicle Regulations – 1958 Agreement, *Agreement concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations (Revision 3)*[1]
Available at: www.unece.org/trans/main/wp29/wp29regs.html (website checked 2021-01-18)

Addendum 3: Regulation No. 4, *Uniform provisions concerning the approval of devices for the illumination of rear registration plates of power-driven vehicles and their trailers*

Addendum 5: Regulation No. 6, *Uniform provisions concerning the approval of direction indicators for power-driven vehicles and their trailers*

Addendum 6: Regulation No. 7, *Uniform provisions concerning the approval of front and rear position lamps, stop-lamps and end-outline marker lamps for motor vehicles and their trailers*

Addendum 22: Regulation No. 23, *Uniform provisions concerning the approval of reversing and manoeuvring lamps for power-driven vehicles and their trailers*

Addendum 36: Regulation No. 37, *Uniform provisions concerning the approval of filament lamps for use in approved lamp units of power-driven vehicles and of their trailers*

Addendum 37: Regulation No. 38, *Uniform provisions concerning the approval of rear fog lamps for power-driven vehicles and their trailers*

Addendum 47: Regulation No. 48, *Uniform provisions concerning the approval of vehicles with regard to the installation of lighting and light-signalling devices*

Addendum 49: Regulation No. 50, *Uniform provisions concerning the approval of front position lamps, rear position lamps, stop lamps, direction indicators and rear-registration-plate illuminating devices for vehicles of category L*

Addendum 76: Regulation No. 77, *Uniform provisions concerning the approval of parking lamps for power-driven vehicles*

Addendum 86: Regulation No. 87, *Uniform provisions concerning the approval of daytime running lamps for power-driven vehicles*

Addendum 90: Regulation No. 91, *Uniform provisions concerning the approval of side-marker lamps for motor vehicles and their trailers*

Addendum 98: Regulation No. 99, *Uniform provisions concerning the approval of gas-discharge light sources for use in approved gas-discharge lamp units of power-driven vehicles*

Addendum 100: Regulation No. 101, *Uniform provisions concerning the approval of passenger cars powered by an internal combustion engine only, or powered by a hybrid electric power train with regard to the measurement of the emission of carbon dioxide and fuel consumption and/or the measurement of electric energy consumption and electric range, and of categories M_1 and N_1 vehicles powered by an electric power train only with regard to the measurement of electric energy consumption and electric range*

Addendum 118: Regulation No. 119, *Uniform provisions concerning the approval of cornering lamps for power-driven vehicles*

Addendum 127: Regulation No. 128, *Uniform provisions concerning the approval of light emitting diode (LED) light sources for use in approved lamp units on power-driven vehicles and their trailers*

Addendum 147: Regulation No. 148, *Uniform provisions concerning the approval of light-signalling devices (lamps) for power-driven vehicles and their trailers*

[1] Also known as *The 1958 Agreement*. In the text of this document the regulations under this agreement are referred to as, for example, UN Regulation 37 or R 37.

Addendum 148: Regulation No. 149, *Uniform provisions concerning the approval of road illumination devices (lamps) and systems for power-driven vehicles*

R.E.5, United Nations Consolidated Resolution on the common specification of light source categories (R.E.5)

R.E.5 is published by UNECE under the reference ECE/TRANS/WP.29/1127 and is available at the following address (website checked on 2021-01-18):
http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-845, IEC 60810, R.E.5 and UN-Regulation No. 48 and the following apply.

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

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

3.1
ageing period
preconditioning period of the light source before initial values are taken

[SOURCE: IEC 60050-845:2020, 845-27-108, modified – "period" has been added to the term and the note to entry has been deleted.]

3.2
category
basic design of standardized light sources

Note 1 to entry: Each specific designation, for example P21/5W, H4, D2R forms a category. Most of these designations are taken from the R.E.5.

3.3
conformity of production
compliance of the series production of a given type with the requirements of the relevant specification

Note 1 to entry: Local regulations may require checking the conformity of production by a government agency.

3.4
dipped beam
passing beam
low beam
headlight designed to illuminate the road ahead of the vehicle without causing undue glare to people in front of the vehicle carrying it, particularly to the drivers of approaching vehicles

Note 1 to entry: The term used in the UN regulation No. 48 is "passing-beam".

3.5
initial luminous flux
luminous flux measured at the end of the ageing period

3.6
life B10
time during which 10 % of a number of the tested light sources of the same type have reached the end of their individual lives

Note 1 to entry: In general the Weibull distribution method is used.

3.7
limiting value
lowest and/or highest value for a characteristic with which the light source has to comply when operated under specified conditions

3.8
luminous flux maintenance factor
ratio of the luminous flux of a light source at a given time in its operational life to its initial luminous flux, the light source being operated under specified conditions

EXAMPLE 70 % after 500 h.

Note 1 to entry: In IEC 60810 "luminous flux maintenance" is used with the same meaning

[SOURCE: IEC 60050-845:2020, 845-27-114, modified – "electric light source" has been replaced with "light source" and the 3 notes to entry have been replaced with a new note to entry and example.]

3.9
main beam
driving beam
high beam
headlight designed to illuminate the road for a considerable distance ahead of the vehicle

Note 1 to entry: The term used in the UN regulations is "driving-beam".

[SOURCE: IEC 60050-845:2020, 845-31-066, modified – "headlight" has been deleted from the terms, "driving beam" has become a second preferred term and "high beam" an admitted term; in the definition "the road" has been added, "carrying it" has been deleted and the notes to entry have been replaced with a new note to entry.]

3.10
nominal voltage
voltage used to designate a light source

Note 1 to entry: The term used in the UN regulations is "rated voltage".

Note 2 to entry: The nominal voltage is the battery voltage (6 V, 12 V or 24 V) of the road vehicle supply network.

3.11
nominal wattage
wattage used to designate a light source

3.12
non-replaceable light source
light source which cannot be removed from the device or luminaire

Note 1 to entry: Non-replaceable light sources are usually intended as components for integration into the luminaire or device by manufacturers. They are designed and intended to be indivisible parts of a lighting or light signalling device, or of parts or modules or units of such devices.

3.13
rated value
value of a characteristic specified for operation of a light source at test voltage and/or other specified conditions

Note 1 to entry: To express the "rated value" of a particular quantity, the term "value" is replaced by the quantity name, for example, rated power, rated voltage, rated current, and rated temperature.

Note 2 to entry: The standard test conditions are given in the relevant standard.

Note 3 to entry: The term used in the UN regulations is "objective value".

Note 4 to entry: In this document the rated value(s) are given in the relevant data sheets.

3.14
reference axis
axis defined with reference to the cap or base and with respect to which the positions of certain parts of the light source are referred

3.15
reference plane
plane defined with reference to the cap or base and with respect to which positions of certain parts of the light source are referred

3.16
standard lamp
étalon lamp
special light source with reduced dimensional, electrical and photometric tolerances, used for the photometric testing of lighting and light-signalling devices

Note 1 to entry: Standard lamps or standard light sources are specified for only one nominal voltage for each category.

Note 2 to entry: The term used in this document differs from the term used in general illumination.

3.17
test voltage
voltage at the light sources for which some characteristics are specified and at which they are tested

Note 1 to entry: The test voltage for filament light sources is specified for the terminals of a filament lamp or light source.

Note 2 to entry: The test voltage for discharge light sources is specified for the terminals of the input terminals of the electronic controlgear for discharge lamps or light sources.

Note 3 to entry: The test voltage for LED light sources is specified for the terminals of the input terminals of the LED light source.

3.18
type
light source which is characterized by common features relevant to the test applied

Note 1 to entry: Light sources bearing the same trade name or mark but produced by different manufacturers are considered as being of different types. Light sources produced by the same manufacturer differing only by the trade name or mark may be considered to be of the same type.

Note 2 to entry: Light sources with different bulb designs, insofar as they affect the optical results, are considered to be of different types.

Note 3 to entry: For filament light sources, light sources of different nominal voltages are considered to be of different types.

Note 4 to entry: A selective-yellow bulb or a selective-yellow additional outer bulb, solely intended to change the colour but not the other characteristics of a light source emitting white light, does not constitute a change of type of the light source.

4 Requirements and test conditions for filament lamps

4.1 General requirements

Filament lamps shall be so designed as to be and to remain in good working order when in normal use. They shall, moreover, exhibit no fault in design or manufacture.

4.2 Lamp marking

The following information shall be legibly and durably marked on all filament lamps, except for non-replaceable filament lamps:

– the trade name or mark of the manufacturer or responsible vendor;
– the nominal voltage;
– the international designation of the relevant category;
– the nominal wattage (in the sequence: high wattage filament/low wattage filament for dual filament lamps); this need not be indicated separately if it is part of the international designation of the relevant filament lamp category.

Additionally, halogen filament lamps meeting the requirements of 4.9 shall be marked with a "U".

NOTE 1 Halogen filament lamps are filament lamps whose category designation usually starts with the letter "H". Some halogen lamps complying with the requirements in 4.9 have a category designation starting with another letter.

Inscriptions other than the above may be affixed.

NOTE 2 An example of such an inscription is the approval mark or the approval code conferred by an administrative authority.

Compliance shall be checked by the following:

a) presence and legibility – by visual inspection;
b) durability – by applying the following test on unused lamps:

The area of the marking on the lamp shall be rubbed by hand with a smooth cloth, dampened with water, for a period of 15 s.

After this test the marking shall still be legible.

It shall be verified that if the marking is on the bulb, it does not affect the luminous characteristics as specified on the light source data sheet.

4.3 Bulbs

Filament lamp bulbs shall exhibit no scores or spots which might impair their optical performance. In case of doubt the visual inspection shall be carried out.

4.4 Colour

4.4.1 Colour of light

The colour of the light emitted by the filament lamp shall be white, unless otherwise specified on the relevant filament lamp data sheet. For some categories, other colour(s) of light are allowed.

The colorimetric characteristics of the light emitted, expressed in x,y chromaticity co-ordinates according to CIE 015:2018, shall lie within the following limits:

– finished filament lamps emitting white light:

W_{12}	green boundary:	y = 0,150 + 0,640 x
W_{23}	yellowish green boundary:	y = 0,440
W_{34}	yellow boundary:	x = 0,500
W_{45}	reddish purple boundary:	y = 0,382
W_{56}	purple boundary:	y = 0,050 + 0,750 x
W_{61}	blue boundary:	x = 0,310

with intersection points:

W_1: x = 0,310, y = 0,348
W_2: x = 0,453, y = 0,440
W_3: x = 0,500, y = 0,440
W_4: x = 0,500, y = 0,382
W_5: x = 0,443, y = 0,382
W_6: x = 0,310, y = 0,283

– finished filament lamps emitting selective-yellow light:

SY_{12}	green boundary:	y = 1,290 x – 0,100
SY_{23}	the spectral locus[2]	
SY_{34}	red boundary:	y = 0,138 + 0,580 x
SY_{45}	yellowish white boundary:	y = 0,440
SY_{51}	white boundary:	y = 0,940 − x

with intersection points:

SY_1: x = 0,454, y = 0,486
SY_2: x = 0,480, y = 0,519
SY_3: x = 0,545, y = 0,454
SY_4: x = 0,521, y = 0,440
SY_5: x = 0,500, y = 0,440

– finished filament lamps emitting red light:

R_{12}	yellow boundary:	y = 0,335
R_{23}	the spectral locus	
R_{34}	the purple line:	(its linear extension across the purple range of colours between the red and the blue extremities of the spectral locus).
R_{41}	purple boundary:	y = 0,980 – x

with intersection points:

R_1: x = 0,645, y = 0,335
R_2: x = 0,665, y = 0,335
R_3: x = 0,735, y = 0,265
R_4: x = 0,721, y = 0,259

[2] See CIE 015:2018.

– finished filament lamps emitting amber light:

A_{12}	green boundary:	$y = x - 0{,}120$
A_{23}	the spectral locus[2]	
A_{34}	red boundary:	$y = 0{,}390$
A_{41}	white boundary:	$y = 0{,}790 - 0{,}670\ x$

with intersection points:

A_1:	$x = 0{,}545$, $y = 0{,}425$
A_2:	$x = 0{,}560$, $y = 0{,}440$
A_3:	$x = 0{,}609$, $y = 0{,}390$
A_4:	$x = 0{,}597$, $y = 0{,}390$

The colour of the light emitted shall be measured by the method specified in Annex B.

Each measured value shall lie within the required tolerance area. Moreover, in the case of filament lamps emitting white light, the measured values shall not deviate more than 0,020 units in the x and/or y direction from a point of choice on the Planckian locus[3].

For conformity of production purposes of amber and red colour only, at least 80 % of the measuring results shall lie within the required tolerance area.

4.4.2 Colour endurance

Filament lamps, but for conformity of production purposes only colour coated lamps, for use in light signalling devices, shall be operated under test conditions for colour endurance measurements as specified in Annex J.

Thereafter the colour of the light shall be measured by the method specified in Annex B, and all measuring results, but for amber and red colour at least 80 % of the measuring results for conformity of production purposes, shall be within the limits specified in 4.4.1.

In the case of colour filter coatings, no cracks in these coatings shall be visible without specific optical tools.

Test samples that have been operated under conditions as specified in Annex J shall no longer be used in light signalling devices and shall be considered end of life for that purpose.

4.4.3 Coated bulb

In the case of a coated bulb, after the ageing period described in Annex C, C.1.1, the surface of the bulb shall be lightly wiped with a cotton cloth soaked in a mixture of 70 % by volume of n-heptane and 30 % by volume of toluol. After about 5 min, the surface shall be inspected visually. It shall not show any apparent changes.

4.5 Lamp dimensions

The filament lamp dimensions shall comply with the limiting values given in the lamp drawing or on the relevant filament lamp data sheet.

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3 See CIE 015:2018.

The definition of and the measuring condition for the filament shape, length and position, shall be in accordance with the appropriate requirements of Annex A, Annex D, Annex E and Annex F respectively; this does not apply to non-replaceable filament lamps.

4.6 Caps and bases

Filament lamps shall have standard caps or bases as specified on the relevant filament lamp data sheet and shall comply with the relevant cap data sheet of IEC 60061-1. This requirement does not apply to non-replaceable filament lamps; in this case, filament lamps shall be equipped with bases that allow firm and secure fixation to the lighting or light signalling devices, or to parts/modules/units of such devices, for which these filament lamps are designed and intended.

4.7 Initial electrical and luminous requirements

Filament lamp wattage and luminous flux shall comply with the limiting values given on the relevant lamp data sheet.

The luminous flux specified on the relevant filament lamp data sheet applies for filament lamps emitting white light, unless a special colour is stated on the data sheet.

In the case where selective-yellow colour is allowed, the luminous flux of the filament lamp with selective-yellow (outer) bulb shall be at least 85 % of the specified luminous flux of the relevant filament lamps with a colourless bulb.

Compliance shall be checked by the tests specified in Annex C, Clause C.1.

4.8 Check on optical quality

4.8.1 General

This requirement applies only to double filament lamps with internal shield for headlamps emitting an asymmetrical dipped beam when the relevant regulation requires such a test.

The check on optical quality shall be carried out at a voltage such that the test luminous flux is obtained.

4.8.2 12 V lamps emitting white light

The sample which most nearly conforms to the requirements laid down for the standard filament lamp shall be tested in an appropriate standard headlamp and it shall be verified that the assembly comprising the aforesaid headlamp and the filament lamp being tested meets the light-distribution requirements laid down for the dipped beam in the relevant regulation, directive or standard.

4.8.3 6 V and 24 V lamps emitting white light

The sample which most nearly conforms to the rated dimension values shall be tested in an appropriate standard headlamp and it shall be verified that the assembly comprising the aforesaid headlamp and the filament lamp being tested meets the light-distribution requirements laid down for the dipped beam in the relevant regulation, directive or standard. Deviations not exceeding 10 % of the minimum values will be acceptable.

4.8.4 Lamps emitting selective-yellow light

Filament lamps emitting selective-yellow light shall be tested in the same manner as described in 4.8.1 and 4.8.2 in an appropriate standard headlamp to ensure that the illuminance complies with at least 85 % for 12 V filament lamps, and at least 77 % for 6 V and 24 V filament lamps, with the minimum values of the light-distribution requirements laid down for the dipped beam in the relevant regulation, directive or standard. The maximum illuminance limits remain unchanged.

In the case of a filament lamp having a selective-yellow bulb, the test shall be left out if the approval is also given to the same type of filament lamp emitting white light.

4.9 UV radiation

The UV radiation of a halogen filament lamp shall be such that:

$$k_1 \leq 2 \times 10^{-4} \text{ W/lm, and } k_2 \leq 2 \times 10^{-6} \text{ W/lm.}$$

k_1 and k_2 are calculated according to:

$$k_1 = \frac{\int_{315}^{400} \Phi\lambda \, d\lambda}{k_m \times \int_{380}^{780} \Phi\lambda \, V(\lambda) \, d\lambda}$$

and

$$k_2 = \frac{\int_{250}^{315} \Phi\lambda \, d\lambda}{k_m \times \int_{380}^{780} \Phi\lambda \, V(\lambda) \, d\lambda}$$

where

k_m = 683 lm/W;

Φ_λ is the spectral power of the radiant flux expressed in watts per nanometre (W/nm);

$V(\lambda)$ is the CIE luminosity function;

λ is the wavelength expressed in nanometres (nm).

These values shall be calculated using intervals of five nanometres.

In the case of non-replaceable filament lamps, compliance with UV radiation requirements may be exempted if this is specified in the relevant lamp data sheet.

4.10 Standard (étalon) filament lamps

Standard filament lamps shall fulfil the additional requirements as specified on the relevant filament lamp data sheets.

Bulbs of standard (étalon) filament lamps emitting white light shall not alter the chromaticity co-ordinates according to CIE 015:2018 of a luminous source having a colour temperature of 2 856 K by more than 0,010 units in the x and/or y direction. For standard (étalon) filament lamps emitting amber or red light, changes of the bulb temperature shall not affect the luminous flux, which might impair photometric measurements of signalling devices. In case of doubt compliance shall be tested in accordance with the specification mentioned.

4.11 Non-replaceable filament lamps

4.11.1 General

Subclause 4.11 and it subclauses apply to non-replaceable filament lamps and in addition these subclauses can be applied to non-replaceable light sources based on other technologies.

For non-replaceable filament lamps (either as part of a lighting or light signalling device (luminaire), or as part of parts/modules/units of such devices), compliance shall be demonstrated, with a test report or other means, with requirements relating to:

a) lifetime;

b) colour and colour endurance;

c) luminous flux maintenance factor and colour maintenance;

d) vibration and shock resistance

as specified below.

A brief technical description (data sheet) of the non-replaceable filament lamp shall be submitted by the manufacturer or responsible vendor, stating in particular:

- the part number or other identification means;
- the test voltage;
- the device (luminaire) the filament lamp is used for;
- whether "standard" or "heavy duty" test conditions apply for testing vibration and shock resistance.

For testing purposes, 20 test samples shall be used for performing the testing of non-replaceable filament lamps.

For conformity of production of non-replaceable filament lamps, compliance shall be checked with the lifetime requirements specified in 4.11.3 and for colour coated filament lamps also with colour endurance requirements specified in 4.11.4.

For conformity of production test purposes, 20 test samples per year of normal production shall be used. In the case of colour coated non-replaceable filament lamps and the colour endurance requirement, a representative distribution over different lamps may be used, provided that these are using the same colour coating technology and finishing, and that this representative distribution comprises lamps of the smallest and the largest diameter of the outer bulb, each at the highest rated wattage.

Alternatively to testing compliance, (previous) measurements or test reports of test samples may be used, under the condition that:

- the essential parameters of these test samples are identical in relation to the test under consideration;
- simulations may be used additionally, in case essential parameters of these test samples are not identical but similar in relation to the test under consideration.

4.11.2 Fixation

For testing purposes, non-replaceable filament lamps that are fixed firmly and securely with the appropriate means necessary to conduct the test or as specified by the respective test, shall be used. They do not need to be installed in the devices for which they are designed and intended, but may be fixed to parts/modules/units of the devices for which they have been designed and intended.

4.11.3 Lifetime

The life B10 of non-replaceable filament lamps shall not be less than the value given in Table 1. In case non-replaceable filament lamps are part of replaceable modules, the life B10 shall not be less than 50 % of the value given in Table 1.

Table 1 – Lifetime of non-replaceable light sources used in devices (luminaires)

Light sources used in the following lighting function	Life B10 [a] h	Corresponding UN Regulations (for information only)
Rear registration plate lamps	2 200[b]	No. 4 and No. 148
Direction indicator lamps	500	No. 6, 50 and No. 148
Front and rear position lamps	2 200[b]	No. 7, 50 and No. 148
Stop lamps	1 000	No. 7, 50 and No. 148
End-outline marker lamps	2 200	No. 7 and No. 148
Reversing lamps	100	No. 23 and No. 148
Rear fog lamps	100	No. 38 and No. 148
Parking lamps	2 200	No. 77 and No. 148
Daytime running lamps	4 000	No. 87 and No. 148
Side marker lamps	2 200[b]	No. 91 and No. 148
Cornering lamps	200	No. 119 and No. 149
Passing beam headlamp	2 000	No. 149
Bend lighting	100	No. 149
Driving beam headlamp	200	No. 149
Adaptive driving beam	800	No. 149
Front fog lamp	100	No. 149

[a] Typical "on"- times for different functions per 200 000 km drive distance with an average speed of 33,6 km/h, based on the composition of driving cycles defined in R101.

[b] In case these lamps are intended for vehicles where the devices in which they are used are also switched ON together with daytime running lamps (DRL), the value of 6 200 h shall be used.

Compliance is checked by life tests as specified in Annex A of IEC 60810:2017.

In the case of dual non-replaceable filament lamps, the applicable filament that is used for the specified device shall be taken into consideration.

4.11.4 Colour endurance

Non-replaceable filament lamps shall comply with the colour endurance requirements as specified in 4.4.

4.11.5 Luminous flux and colour maintenance

The luminous flux maintenance factor shall not be less than 70 % at life B10.

In the case of amber and red coloured non-replaceable filament lamps, the colour of the light emitted by these filament lamps shall be measured at the moment of luminous flux maintenance factor and be within the colour boundaries as defined in 4.4.1. These measurements shall be made at test voltage as indicated in the relevant data sheet and at an ambient temperature of 23 °C ± 5 °C using a suitable integrating photometer.

In the case of dual non-replaceable filament lamps, the applicable filament that is used for the specified device shall be taken into consideration.

Testing may be combined with the lifetime test.

4.11.6 Vibration and shock resistance

To assess the performance influenced by vibration or shock, the test methods and schedules detailed in Annex B of IEC 60810:2017 shall be used.

The non-replaceable filament lamps are deemed to have satisfactorily completed the wideband or narrowband random vibration test as described in Annex B of IEC 60810:2017 if they continue to function during and after the test.

The number of non-replaceable filament lamps failing one of the tests shall not be more than two.

5 Requirements and test conditions for discharge lamps

5.1 General requirements

Discharge lamps shall be so designed as to be and to remain in good working order when in normal use. They shall, moreover, exhibit no fault in design or manufacture.

5.2 Lamp marking

The following information shall be legibly and durably marked on the cap of the discharge lamps:

– the trade name or mark of manufacturer or responsible vendor;
– the nominal wattage;
– the international designation of the relevant category.

Inscriptions other than the above may be affixed.

NOTE 1 An example of such an inscription is the approval mark or the approval code conferred by an administrative authority.

NOTE 2 The ballast used for starting and operating the discharge lamps is marked with type and trade mark identification and with the nominal voltage and wattage, as indicated on the relevant data sheet.

Compliance shall be checked by the following:

a) presence and legibility – by visual inspection;
b) durability – by applying the following test on unused lamps:

The area of the marking on the lamp shall be rubbed by hand with a smooth cloth, dampened with water, for a period of 15 s.

After the test the marking shall still be legible.

5.3 Bulbs

The bulb of the discharge lamps shall exhibit no scores or spots which might impair their optical performance. In case of doubt the visual inspection shall be carried out.

The bulb shall comply with the dimensional specifications given on the relevant data sheet.

In the case of a coloured (outer) bulb after an operating period of 15 h with the ballast at test voltage, the surface of the bulb shall be lightly wiped with a cotton cloth soaked in a mixture of 70 % by volume of n-heptane and 30 % by volume of toluol. After 5 min, the surface shall be inspected visually. It shall not show any apparent changes.

5.4 Caps

Discharge lamps shall be equipped with standard caps complying with the cap data sheets of IEC 60061-1, as specified on the relevant data sheet.

The cap shall be strongly and firmly secured to the rest of the discharge lamp. To ascertain whether discharge lamps conform to the requirements above, a visual inspection, a dimension check and, where necessary, a trial fitting into the holder as specified in IEC 60061-2 shall be carried out.

5.5 Position and dimensions of electrodes, arc and black stripes

5.5.1 Measurements

An example of a method of measuring arc and electrode position is given in Annex G. Any method with equivalent measurement resolution may be used.

5.5.2 Electrodes

The geometric position and dimensions of the electrodes shall be as specified on the relevant data sheet.

Compliance shall be checked before the ageing period, the discharge lamp unlit and using optical methods through the glass envelope.

5.5.3 Arc

The shape and the displacement of the arc shall conform to the requirements as given on the relevant data sheet.

Compliance shall be checked after ageing, with the lamp supplied by the ballast at test voltage.

5.5.4 Black stripes

The position, dimensions and transmission of the black stripes (if any) shall comply with the requirements as given on the relevant data sheet.

Compliance shall be checked after ageing, with the lamp supplied by the ballast at test voltage.

5.6 Starting, run-up and hot-restrike characteristics

5.6.1 Starting

The discharge lamp shall start directly and remain alight.

5.6.2 Run-up

5.6.2.1 Lamps > 2 000 lm

When measured in accordance with the conditions specified in Annex H, a discharge lamp having a rated luminous flux which exceeds 2 000 lm shall emit at least:

– after 1 s: 25 % of its rated luminous flux,
– after 4 s: 80 % of its rated luminous flux.

The rated luminous flux is as indicated on the relevant data sheet.

5.6.2.2 Lamps ≤ 2 000 lm without black stripes

When measured in accordance with the conditions specified in Annex H, a discharge lamp having a rated luminous flux which does not exceed 2 000 lm shall emit at least:

– after 1 s: 800 lm,
– after 4 s: 1 000 lm.

The rated luminous flux is as indicated on the relevant data sheet.

5.6.2.3 Lamps ≤ 2 000 lm with black stripes

When measured in accordance with the conditions specified in Annex H, a gas-discharge lamp having a rated luminous flux which does not exceed 2 000 lm but does contain black stripes shall emit at least:

– after 1 s: 700 lm,
– after 4 s: 900 lm.

The rated luminous flux is as indicated on the relevant data sheet.

5.6.2.4 Lamps with more than one rated value, and one of them ≤ 2 000 lm

When measured in accordance with the conditions specified in Annex H, a discharge lamp having more than one rated luminous flux and at least one of them does not exceed 2 000 lm shall emit at least:

– after 1 s: 800 lm,
– after 4 s: 1 000 lm.

The rated luminous flux is as indicated on the relevant data sheet.

5.6.3 Hot-restrike

After being switched-off for a period as indicated on the relevant data sheet, when switched-on, the lamp shall restart directly.

After 1 s the lamp shall emit at least 80 % of its rated luminous flux.

5.6.4 Compliance

Compliance shall be checked by the tests specified in Annex H.

5.7 Electrical and photometric characteristics

5.7.1 Voltage and wattage

The voltage and wattage of the lamp shall be within the limits given on the relevant data sheet.

5.7.2 Luminous flux

The luminous flux shall be within the limits given on the relevant data sheet. In the case where white and yellow are specified for the same type, the rated value applies to the lamp emitting white light, whereas the luminous flux of the lamp emitting yellow light shall be at least 68 % of the specified value.

5.7.3 Compliance

Compliance shall be checked by the tests specified in Annex H.

5.8 Colour

The colour of the light emitted shall be white unless yellow is specified on the relevant data sheet.

In case of white, the colorimetric characteristics, expressed in chromaticity co-ordinates according to CIE 015:2018, shall lie within the limits given on the relevant data sheet.

In case of yellow, the chromaticity coordinates (x,y) according to CIE 015:2018 of the light emitted shall lie inside the chromaticity areas defined by the following boundaries:

SY_{12}	green boundary:	$y = 1{,}290\,x - 0{,}100$
SY_{23}	the spectral locus[4]	
SY_{34}	red boundary:	$y = 0{,}138 + 0{,}580\,x$
SY_{45}	yellowish white boundary:	$y = 0{,}440$
SY_{51}	white boundary:	$y = 0{,}940 - x$

with intersection points:

SY_1: $x = 0{,}454$, $y = 0{,}486$
SY_2: $x = 0{,}480$, $y = 0{,}519$
SY_3: $x = 0{,}545$, $y = 0{,}454$
SY_4: $x = 0{,}521$, $y = 0{,}440$
SY_5: $x = 0{,}500$, $y = 0{,}440$

The minimum red content of the light of a discharge lamp emitting white light shall be such that

$k_{red} \geq 0{,}05$.

k_{red} is calculated according to:

4 See CIE 015:2018.

$$k_{red} = \frac{\int_{610}^{780} \Phi\lambda \, V(\lambda) \, d\lambda}{\int_{380}^{780} \Phi\lambda \, V(\lambda) \, d\lambda}$$

where $\Phi_\lambda, V(\lambda)$ and λ are as defined in 4.9.

This value shall be calculated using intervals of one nanometre.

Compliance is checked by the tests specified in Annex H.

5.9 UV radiation

The maximum UV content of the light of a discharge lamp shall be such that

$k_{UV} \leq 10^{-5}$ W/lm.

k_{UV} is calculated according to:

$$k_{UV} = \frac{\int_{250}^{400} \Phi\lambda \, S(\lambda) \, d\lambda}{k_m \times \int_{380}^{780} \Phi\lambda \, V(\lambda) \, d\lambda}$$

where $k_m, \Phi_\lambda, V(\lambda)$ and λ are as defined in 4.9 and $S(\lambda)$ is the spectral weighting function in accordance with Table 2.

This value shall be calculated using intervals of one nanometre.

Table 2 – Spectral weighting function

λ	$S(\lambda)$	λ	$S(\lambda)$	λ	$S(\lambda)$
250	0,430	305	0,060	355	0,000 16
255	0,520	310	0,015	360	0,000 13
260	0,650	315	0,003	365	0,000 11
265	0,810	320	0,001 0	370	0,000 09
270	1,000	325	0,000 50	375	0,000 077
275	0,960	330	0,000 41	380	0,000 064
280	0,880	335	0,000 34	385	0,000 053
285	0,770	340	0,000 28	390	0,000 044
290	0,640	345	0,000 24	395	0,000 036
295	0,540	350	0,000 20	400	0,000 030
300	0,300				

Wavelengths chosen are representative, other values shall be interpolated.

Compliance shall be checked by the tests specified in Annex H.

5.10 Standard (étalon) discharge lamps

Standard discharge lamps shall comply with the requirements applicable to production lamps and to the specific requirements as stated in the relevant data sheet. In the case of a type emitting white and yellow light, the standard lamp shall emit white light.

6 Requirements and test conditions for LED light sources

6.1 General requirements

LED light sources shall be so designed as to be and to remain in good working order when in normal use. They shall, moreover, exhibit no fault in design or manufacture.

6.2 Light source marking

The following information shall be legibly and durably marked on all LED light sources:

– the trade name or mark of the manufacturer or responsible vendor;
– the nominal voltage or voltage range;
– the international designation of the relevant category.

Inscriptions other than the above may be affixed.

NOTE An example of such an inscription is the approval mark or the approval code conferred by an administrative authority.

Compliance shall be checked by the following:

a) presence and legibility – by visual inspection;
b) durability – by applying the following test on unused light source:

The area of the marking on the lamp shall be rubbed by hand with a smooth cloth, dampened with water, for a period of 15 s.

After this test, the marking shall still be legible.

6.3 Optical surfaces

LED light sources shall exhibit no scores or spots on their optical surfaces which might impair their efficiency and their optical performance. In case of doubt a visual inspection shall be carried out.

6.4 Colour of light

The colour of the light emitted by the LED light source shall be white, unless otherwise specified on the relevant filament lamp data sheet. For some categories, other colour(s) of light are allowed.

The colorimetric characteristics of the light emitted, expressed in x,y chromaticity co-ordinates according to CIE 015:2018, shall lie within the limits as specified in 4.4.1.

6.5 Lamp dimensions

The LED light source dimensions shall comply with the limiting values given in the lamp drawing or on the relevant data sheet.

The values of light centre lengths of Lx3A, Lx3B, Lx4A, Lx4B, Lx5A, Lx5B[5], L1A/6 and L1B/6 are measured as follows.

Measurements shall be made on finished light sources, at an ambient temperature of 23 °C ± 5 °C.

Measurement shall be made at test voltage as specified in the relevant LED light source category sheet.

LED light sources shall first be aged at their test voltage for at least forty-eight hours.

For multi-function LED light sources, each function shall be aged separately.

Before starting a test, the LED light source shall be operated for 30 min at test voltage.

For LED light sources with two functions, both functions shall be operated at the same time during the measurement, unless specified otherwise in the relevant data sheet.

In the case of LR4A and LR4B, the minor function and major function shall also be operated and measured separately, and the light centre length of the minor function shall be 2,5 mm (tolerance of ±0,5 mm under consideration) and the light centre length of the major function shall be 3,0 mm ± 0,3 mm.

In Annex K a method of measuring the value of the light centre length is given.

6.6 Caps and bases

Replaceable LED light sources shall have standard caps or bases as specified on the relevant data sheet and shall comply with the relevant cap data sheet of IEC 60061-1.

The cap shall be strongly and firmly secured to the rest of the LED light source. To ascertain whether LED light sources conform to the requirements above, a visual inspection, a dimension check and, where necessary, a trial fitting into the holder as specified in IEC 60061-2 shall be carried out.

6.7 Initial electrical and photometrical requirements

LED light source wattage, luminous flux and intensity distribution (e.g. normalized luminous intensity distribution, cumulative luminous flux) shall comply with the limiting values given on the relevant data sheet.

The colorimetric characteristics of the light emitted, expressed in x,y co-ordinates according to CIE 015:2018, shall lie within the limits as specified in 4.4.1.

Compliance shall be checked by the tests specified in Annex C, Clause C.2.

In Annex L a method is given to determine the maximum luminance gradient of LED light sources intended for road illumination devices.

6.8 Red content

For LED light sources emitting white light, the minimum red content of the light shall be such that

5 The x represents R, Y and W.

k_{red} ≥ 0,05 (see 5.8).

6.9 UV radiation

If the light source is claimed to be of the low-UV type, the maximum UV content of the light of a LED light source shall be such that $k_{UV} \leq 10^{-5}$ W/lm .

6.10 Standard (étalon) light sources

Standard LED light sources shall fulfil the additional requirements as specified on the relevant data sheets.

7 Sampling and conditions of compliance

Requirements for sampling and conditions of compliance, except for non-replaceable filament lamps, are specified in the relevant regulation, for example UN Regulations No. 37, No. 99 and No. 128.

Requirements for sampling and conditions of compliance for non-replaceable filament lamps, are specified in the relevant regulation for devices, using non-replaceable filament lamps.

NOTE At date of publication these are specified in UN Regulations Nos. 4, 6, 7, 23, 38, 50, 77, 87, 91 and 119.

8 Lamp data sheets

8.1 General

Data sheets listed in Table 3 and in 8.3 are numbered so that:

– the first part of the lamp data sheet number represents the number of this document (60809) followed by the letters "IEC";
– the second part represents the lamp data sheet number;
– the third part on the sheet indicates the edition of the sheet.

In the case where a reference is made from this document to the lamp data sheet in R.E.5, the name of the lamp data sheet in R.E.5 is shown.

In Annex I the overview of lamp types and their application is given.

Many data sheets in this document have been copied from previous editions of the standard, pre-dating the general change to IEC standard numbers. In these data sheets the sheet number and reference number to the cap standard still refer to the old numbering. For data sheets dated before 2014, read the sheet reference as 60809-IEC-xxxx instead of 809-IEC-xxxx, and read references to IEC 61-1 as IEC 60061-1.

8.2 List of specific lamp types

Table 3 – List of specific lamp types

IEC sheet no. [a]	Sheet no. [b] in R.E.5	Category	Voltage V	Wattage W	Cap
60809-IEC-2110-	R2	R2	6 12 24	45/40 45/40 55/50	P45t P45t P45t
60809-IEC-2120-	H4	H4	12 24	60/55 75/70	P43t-38 P43t-38
60809-IEC-2125-	-	H6	12	65/55	PZ43t
60809-IEC-2130-	HS1	HS1	6 12	35/35 35/35	PX43t PX43t
60809-IEC-2132-	HS5	HS5	12	35/30	P23t
60809-IEC-2135-	-	HB1	12	65/45	P29t
60809-IEC-2140-	S1/S2	S1	6 12	25/25 25/25	BA20d BA20d
60809-IEC-2150-	S1/S2	S2	6 12	35/35 35/35	BA20d BA20d
60809-IEC-2160-	-	S4	6 12	15/15 15/15	BAX15d BAX15d
60809-IEC-2305-	-	H5	12	50	PY43d
60809-IEC-2310-	H1	H1	6 12 24	55 55 70	P14.5s P14.5s P14.5s
60809-IEC-2315-	H7	H7	12 24	55 70	PX26d PX26d
60809-IEC-2320-	-	H2	6 12 24	55 55 70	X511 X511 X511
60809-IEC-2325-	HB3	HB3 HB3A	12 12	60 60	P20d P20d
60809-IEC-2330-	H3	H3	6 12 24	55 55 70	PK22s PK22s PK22s
60809-IEC-2335-	HB4	HB4 HB4A	12 12	51 51	P22d P22d
60809-IEC-2340-	HS2	HS2	6 12	15 15	PX13.5s PX13.5s
60809-IEC-2350-	-	HS3	6	2,4	PX13.5s
60809-IEC-2360-	S3	S3	6 12	15 15	P26s P26s
60809-IEC-2365-	H8	H8	12	35	PGJ19-1
60809-IEC-2370-	H9	H9	12	65	PGJ19-5
60809-IEC-2375-	H10	H10	12	42	PY20d
60809-IEC-2380-	H11	H11	12 24	55 70	PGJ19-2 PGJ19-2
60809-IEC-2385-	H12	H12	12	53	PZ20d
60809-IEC-2410-	HIR1	HIR1	12	65	PX20d
60809-IEC-2420-	HIR2	HIR2	12	55	PX22d
60809-IEC-3110-	P21/5W	P21/5W	6 12 24	21/5 21/5 21/5	BAY15d BAY15d BAY15d
60809-IEC-3120-	P21/4W	P21/4W	6 12 24	21/4 21/4 21/4	BAZ15d BAZ15d BAZ15d
60809-IEC-3130-	W21/5W	W21/5W	12	21/5	W3x16q

IEC sheet no. [a]	Sheet no. [b] in R.E.5	Category	Voltage V	Wattage W	Cap
60809-IEC-3135-	WR21/5W	WR21/5W	12	21/5	WY3x16q
60809-IEC-3140-	PR27/7W	PR27/7W	12	27/7	W2.5x16q
60809-IEC-3141-	PY27/7W	PY27/7W	12	27/7	WX2.5x16q
60809-IEC-3310-	P21W	P21W	6 12 24	21 21 21	BA15s(BA15d) BA15s(BA15d) BA15s(BA15d)
60809-IEC-3311-	PY21W	PY21W	12 24	21 21	BAU15s BAU15s
60809-IEC-3315-	P27W	P27W	12	27	W2.5x16d
60809-IEC-3320-	R5W	R5W	6 12 24	5 5 5	BA15s(BA15d) BA15s(BA15d) BA15s(BA15d)
60809-IEC-3330-	R10W	R10W	6 12 24	10 10 10	BA15s(BA15d) BA15s(BA15d) BA15s(BA15d)
60809-IEC-3340-	T4W	T4W	6 12 24	4 4 4	BA9s BA9s BA9s
60809-IEC-3410-	H6W	H6W	12	6	BAX9s
60809-IEC-3420-	H21W	H21W	12 24	21 21	BAY9s BAY9s
60809-IEC-3430	H27W	H27W/1 H27W/2	12 12	27 27	PG13 PGJ13
60809-IEC-4110-	C5W	C5W	6 12 24	5 5 5	SV8.5 SV8.5 SV8.5
60809-IEC-4120-	C21W	C21W	12	21	SV8.5
60809-IEC-4305-	W2.3W	W2.3W	12	2,3	W2x4.6d
60809-IEC-4310	W3W	W3W	6 12 24	3 3 3	W2.1x9.5d W2.1x9.5d W2.1x9.5d
60809-IEC-4320-	W5W	W5W	6 12 24	5 5 5	W2.1x9.5d W2.1x9.5d W2.1x9.5d
60809-IEC-4321-	W5W	WY5W	6 12 24	5 5 5	W2.1x9.5d W2.1x9.5d W2.1x9.5d
60809-IEC-4330-	W21W	W21W	12	21	W3x16d
60809-IEC-4335-	WY21W	WY21W	12	21	WX3x16d
60809-IEC-4340-	W16W	W16W	12	16	W2.1x9.5d
60809-IEC-5010-	T1.4W	T1.4W	12	1,4	P11.5d
60809-IEC-7110-	DxS	D1S D2S D3S D4S	12 12 12 12	35 35 35 35	PK32d-2 P32d-2 PK32d-5 P32d-5
60809-IEC-7120-	DxR	D1R D2R D3R D4R	12 12 12 12	35 35 35 35	PK32d-3 P32d-3 PK32d-6 P32d-6
60809-IEC-9310-	-	B1.13W	2,7	1,13	PX13.5s
60809-IEC-9610-	-	B0.6W	6	0,6	E10
60809-IEC-9620-	-	B2.4W	6	2,4	EP10/14x11
-	H6W	HY6W	12	6	BAZ9s
-	H8	H8B	12	35	PGJY19-1
-	H9	H9B	12	65	PGJY19-5
-	H10W	H10W/1 HY10W	12 12	10 10	BAU9s BAUZ9s

IEC sheet no. [a]	Sheet no. [b] in R.E.5	Category	Voltage V	Wattage W	Cap
-	H11	H11B	12 24	55 70	PGJY19-2 PGJY19-2
-	H13	H13 H13A	12 12	55/60 55/60	P26.4t PJ26.4t
-	H14	H14	12	55/60	P38t
-	H15	H15	12 24	15/55 20/60	PGJ23t-1 PGJ23t-1
-	H16	H16 H16B	12 12	19 19	PGJ19-3 PGJY19-3
-	H17	H17	12	35	PU43t-4
-	H18	H18	12	65	PY26d-1
-	H19	H19	12	55 / 60	PU43t-3
-	H20	H20	12	70	PY26d-6
-	H21W	HY21W	12 24	21 21	BAW9s BAW9s
-	HS5A	HS5A	12	45/40	PX23t
-	P13W	P13W PW13W	12 12	13 13	PG18.5d-1 WP3.3x14.5-7
-	PC16W	PC16W PCY16W PCR16W PW16W PWR16W PWY16W	12 12 12 12 12 12	16 16 16 16 16 16	PU20d-1 PU20d-2 PU20d-7 WP3.3x14.5-8 WP3.3x14.5-9 WP3.3x14.5-10
-	P19W	P19W PY19W PR19W PS19W PSY19W PSR19W PW19W PWR19W PWY19W	12 12 12 12 12 12 12 12 12	19 19 19 19 19 19 19 19 19	PGU20-1 PGU20-2 PGU20-5 PG20-1 PG20-2 PG20-5 WP3.3x14.5-1 WP3.3x14.5-2 WP3.3x14.5-5
-	PR21/5W	PR21/5W	12 24	21/5 21/5	BAW15d BAW15d
-	PR21W	PR21W	12 24	21 21	BAW15s BAW15s
-	PR21/4W	PR21/4W	12 24	21/4 21/4	BAU15d BAU15d
-	PY21/5W	PY21/5W	12	21/5	BA15d-3 (100°/130°).
-	R37-P24W	P24W PX24W PY24W PR24W PS24W PSX24W PSY24W PSR24W PW24W PWR24W PWY24W	12 12 12 12 12 12 12 12 12 12 12	24 24 24 24 24 24 24 24 24 24 24	PGU20-3 PGU20-7 PGU20-4 PGU20-6 PG20-3 PG20-7 PG20-4 PG20-6 WP3.3x14.5-3 WP3.3x14.5-4 WP3.3x14.5-6
-	PSX26W	PSX26W	12	26	PG18.5d-3
-	P27/7W	P27/7W	12	27/7	WU2.5x16
-	R5W	RR5W	6 12 24	5 5 5	BAW15s BAW15s BAW15s

IEC sheet no. [a]	Sheet no. [b] in R.E.5	Category	Voltage V	Wattage W	Cap
-	R10W	RR10W RR10W RR10W RY10W RY10W RY10W	6 12 24 6 12 24	10 10 10 10 10 10	BAW15s BAW15s BAW15s BAU15s BAU15s BAU15s
-	W5W	WR5W	6 12 24	5 5 5	W2.1x9.5d W2.1x9.5d W2.1x9.5d
-	W10W	W10W W10W WY10W WY10W	6 12 6 12	10 10 10 10	W2.1x9.5d W2.1x9.5d W2.1x9.5d W2.1x9.5d
-	W15/5W	W15/5W	12	15/5	WZ3x16q
-	W16W	WY16W	12	16	W2.1x9.5d
-	WP21W	WP21W WPY21W	12 12	21 21	WY2.5x16d WZ2.5x16d
-	WT21W	WT21W	12 24	21 21	WUX2.5x16d WUX2.5x16d
		WTY21W	12 24	21 21	WUY2.5x16d WUY2.5x16d
-	WT21/7W	WT21/7W	12	21/7	WZX2.5x16q
		WTY21/7W	12	21/7	WZY2.5x16q
		WTY21/7W	12	21/7	WZY2.5x16q
-	WY2.3W	WY2.3W	12	2,3	W2x4.6d
-	D5S	D5S	12	25	PK32d-7
-	D6S	D6S	12	25	P32d-1
-	D8S	D8S	12	25	PK32d-1
-	D8R	D8R	12	25	PK32d-8
-	D9S	D9S	12	27 / 35	PK32d-9
-	H17	H17	12	35	PU43t-4
-	PY21/5W	PY21/5W	12	21/5	BA15d-3 (100°/130°).
-	LR1	LR1	12	0,75/3,5	PGJ21t-1
-	LW2	LW2	12	1/12	PGJY50
-	L3	LR3A / LR3B	12	3	PGJ18,5d-1
		LW3A / LW3B	12	4	PGJ18,5d-24
		LY3A / LY3B	12	4	PGJ18,5d-15
-	LR4	LR4A / LR4B	12	3 / 0,75	PGJ18,5t-5
-	L5	LR5A / LR5B	12	3	PGJ18,5d-10
		LW5A / LW5B	12	6	PGJ18,5d-28
		LY5A / LY5B	12	6	PGJ18,5d-19
-	L1/6	L1A/6 / L1B/6	12	6	PGJ18,5d-29

[a] If an R.E.5 sheet number is referenced in the second column, the IEC sheet number refers to a data sheet withdrawn with Amendment 5 (2012) of Edition 2 of IEC 60809:1995 and is given for information only.

[b] The content in this column indicates the name of the lamp data sheet in R.E.5. where the specific data sheet number(s) can be found.

8.3 Data sheets not transferred to UN R.E.5

The specifications in the data sheets below are technically equal to the specifications in Edition 3. Editorial changes are implemented to the referenced standards to correct obvious translation errors and to comply with the current drafting rules.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: H6
CAP: PZ43t

page1/3

Table 1 – Electrical characteristics

Nominal voltage	[V]	12
Nominal wattage	[W]	65/55
Test voltage	[V]	13,2

The drawings are intended only to illustrate the essential dimensions of the filament lamp.
Dimension in millimetres

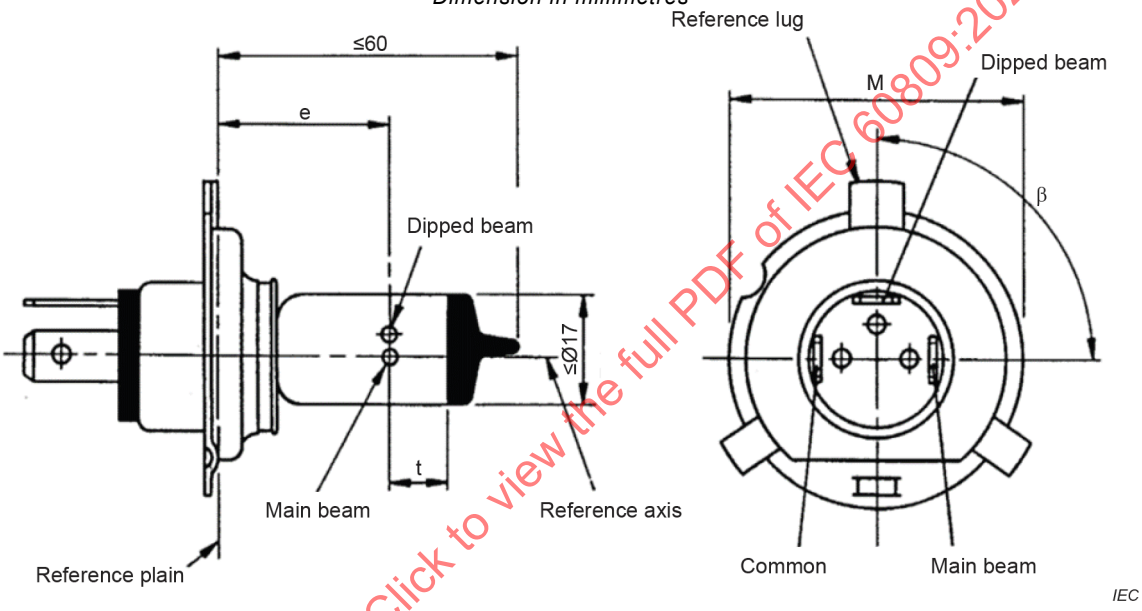


Figure 1 – Filament lamp drawing

Cap

In accordance with IEC 60061-1 (sheet 7004-22).

Reference axis

The reference axis is perpendicular to the reference plane and passes through the centre of the circle of diameter M.

Bulb

The bulb shall be colourless.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: H6
CAP: PZ43t

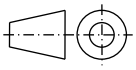


Table 2 – Filament lamps characteristics and dimensions

Characteristics		Values	Tolerances and limiting values
			Production lamps
Nominal voltage		12 V	12 V
Rated wattage	[W]		
Main-beam filament		-	76 max. 1)
Dipped-beam filament		-	64 max. 2)
Rated luminous flux	[lm]		
Main-beam filament		1 320	±15 %
Dipped-beam filament		880	±15 %
Dimensions	[mm]	6	
e 3)		26,0	±0,3
t		-	3,0 min.
Lateral deviation		-	0,5 max. 4)
β 5)		90°	±15° 4)

1) Calculated values at 5,76 A max..
2) Calculated values at 4,85 A max..
3) This dimension specifies the main-beam filament.
4) Under consideration.
5) Reference lug rotation with respect to filament (degrees).

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: H6
CAP: PZ43t

page3/3

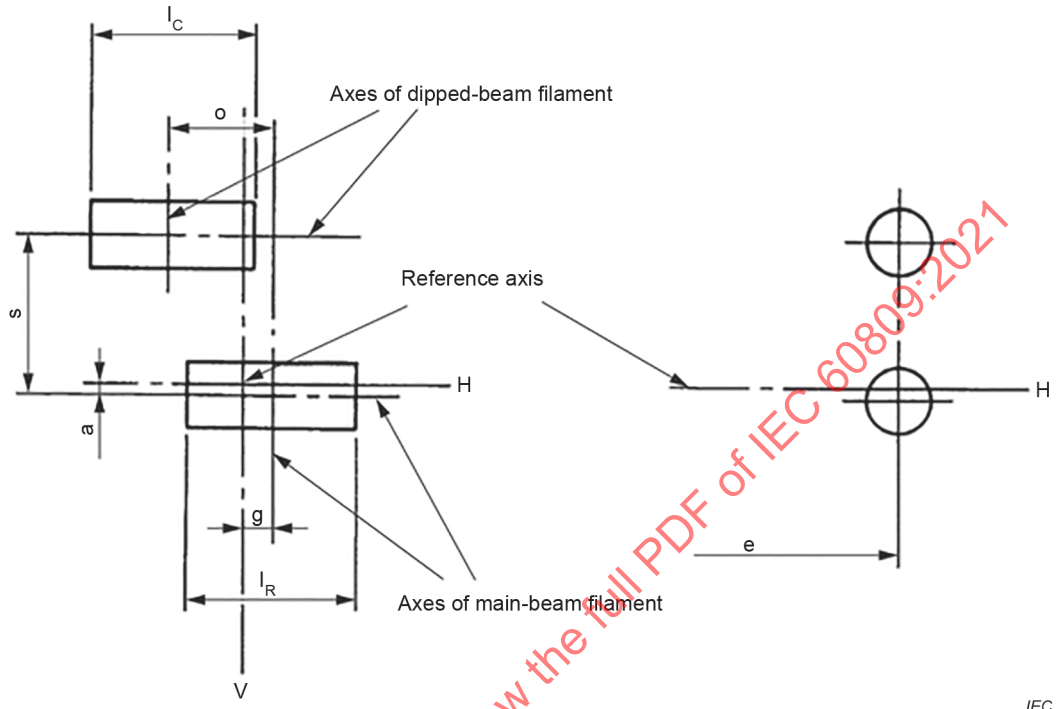


Figure 2 – Positions of filament

Table 3 – Positions of filament

Type	a	g	o	s	l_C	l_R
12 V	0 + 0,35 1)	0 + 0,35 1)	2,4 nom.	2,4 nom.	6,0 max.	6,0 max.

1) Under consideration

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: HB1
CAP: P29t

Table 1 – Electrical characteristics

Nominal voltage	[V]	12
Nominal wattage	[W]	65/45
Test voltage	[V]	13,2

The drawings are intended only to illustrate the essential dimensions of the filament lamp.
Dimensions in millimetres

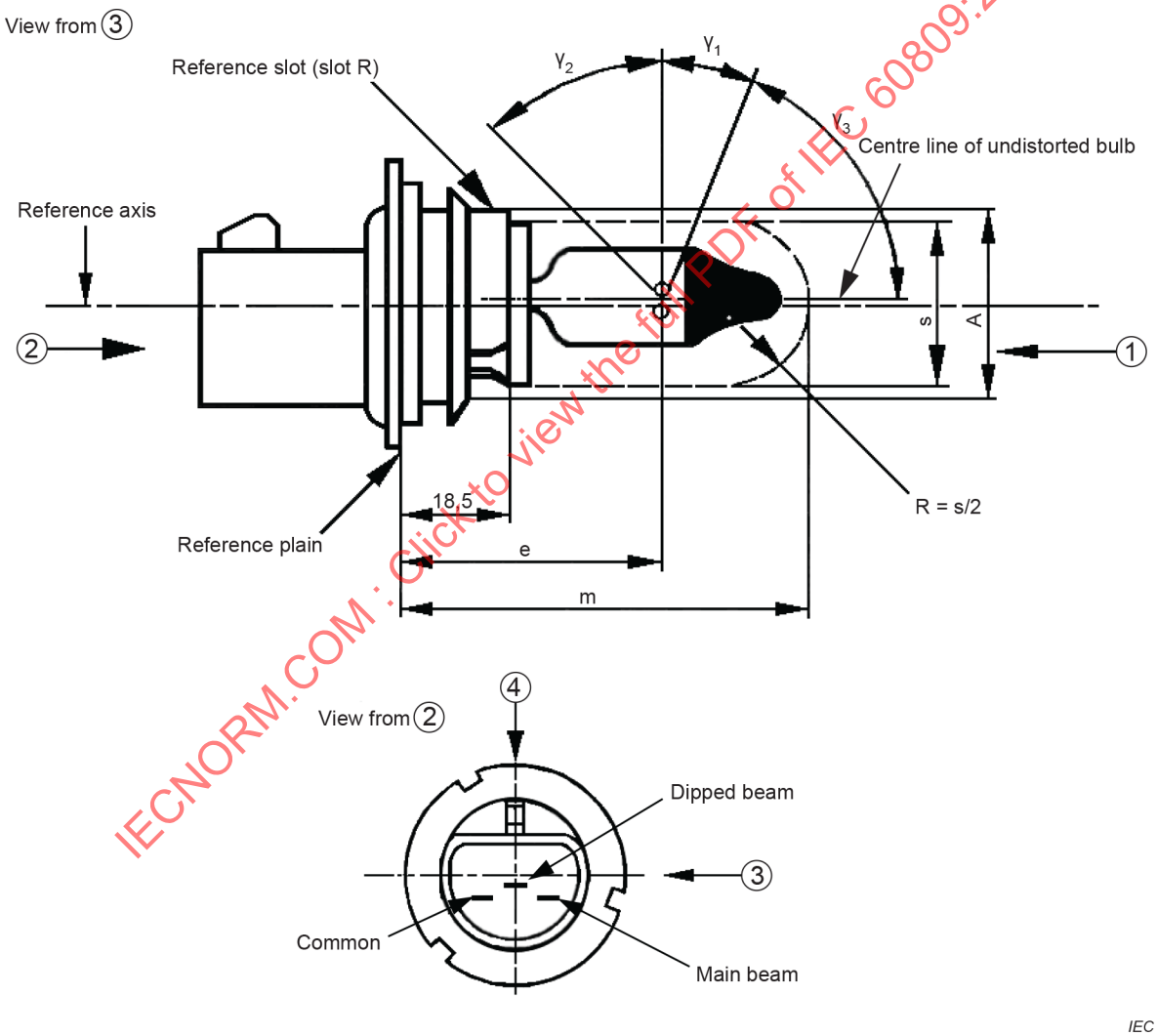
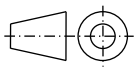


Figure 1 – Filament lamp drawing

Cap
P29t in accordance with IEC 60061-1 (sheet 7004-66).
Maximum lamp outline
It shall be possible to insert the lamp into a cylinder of diameter s concentric with the reference axis and limited at one end by a plane parallel to and 18,5 mm distant from the reference plane and at the other end by a hemisphere of radius s/2.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: HB1
CAP: P29t



Reference axis

The reference axis is the line perpendicular to the reference plane and passing through the centre of the circle of diameter A.

Bulb

Colourless, with black top obscuration.

The glass bulb periphery shall be optical distortion free and cylindrical within angles γ_1 and γ_2.

This requirement applies to the whole bulb circumference within angles γ_1 and γ_2.

The obscuration shall extend at least over angle γ_3 and shall be at least as far as the undistorted part of the bulb defined by angle γ_1.

The apex of angles γ_1, γ_2 and γ_3 is the intersection between the axis of the undistorted bulb with a plane parallel to and 44,5 mm distant (dimension e) from the reference plane.

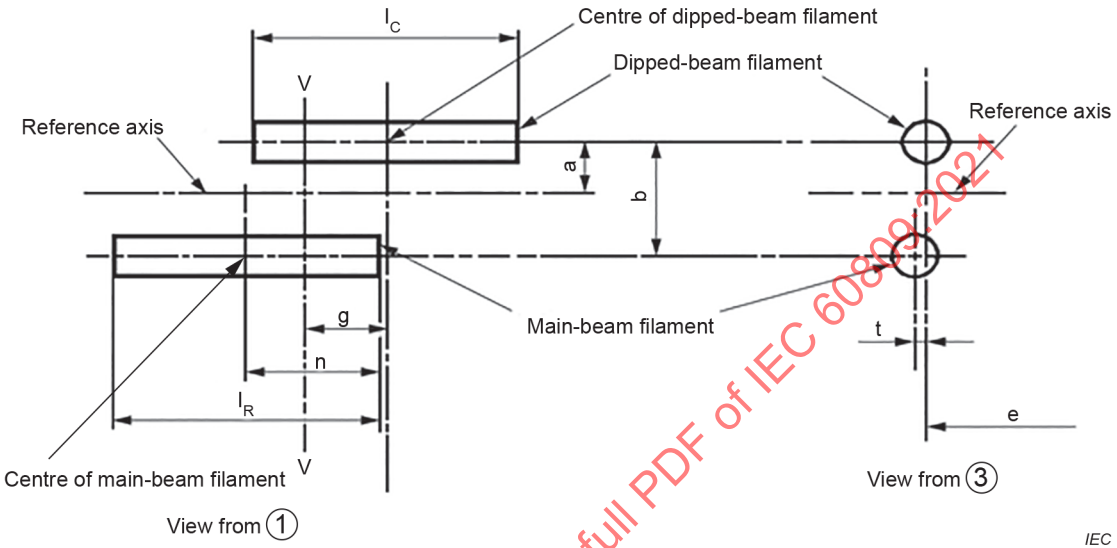
Table 2 – Filament lamps characteristics and dimensions

Characteristics		Values	Tolerances and limiting values	
			Production lamps	Standard lamps
Nominal voltage		12 V	12 V	12 V
Rated wattage	[W]			
Main-beam filament		-	73 max.	73 max.
Dipped-beam filament		-	52 max.	52 max
Rated luminous flux	[lm]			
Main-beam filament		1 320	±12 %	. [1)]
Dipped-beam filament		770	±12 %	. [1)]
Dimensions	[mm]			
A		28,55	±0,05	±0,05
e		44,50	±0,25	±0,15
m		-	70 max.	70 max.
s		24,50	nom.	nom.
γ_1		38°	±5°	± 5°
γ_2		-	43° min.	43° min.
γ_3		52°	±5°	±5°

1) Test luminous flux 990 lm and 570 lm at approximately 12 V.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: HB1
CAP: P29t

Position of filaments
Dimensions in millimetres



The plane V-V is perpendicular to the reference plane and contains the reference axis as the centre line of the slot R of the cap.

Figure 2 – Positions of filament

Table 3 – Filament dimensions

Dimensions [1]	Values	Tolerances and limiting values	
		Production lamps	Standard lamps
Nominal voltage	12 V	12 V	12 V
a	1,15	±0,38	±0,20
b	2,30	±0,64	±0,25
g	1,20	±0,38	±0,20
l_C	4,80	±0,40	±0,40
l_R	4,80	±0,40	±0,40
n	2,40	±0,80	±0,40
t	0,00	±0,64	±0,25

1) The method of measurement is specified in Annex F.

2) The deviation of the straightness of the dipped-beam filament shall not exceed 0,3 times the actual diameter of the coil.

3) The deviation of the straightness of the main-beam filament shall not exceed 0,4 times the actual diameter of the coil.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: S4
CAP: BAX15d

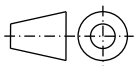


Table 1 – Electrical characteristics

Nominal voltage	[V]	6	12
Nominal wattage	[W]	15/15	15/15
Test voltage	[V]	6,75	13,5

The drawings are intended only to illustrate the essential dimensions of the filament lamp.
Dimensions in millimetres

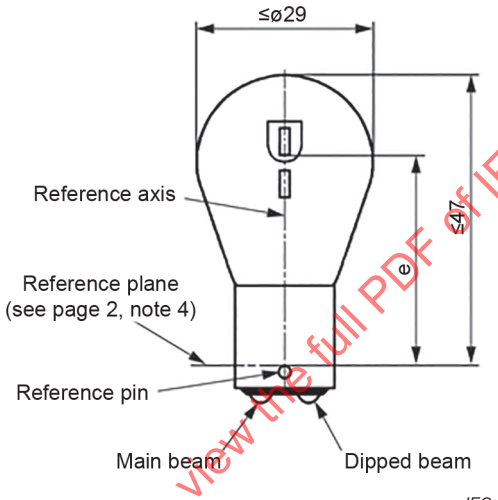


Figure 1 – Filament lamp drawing

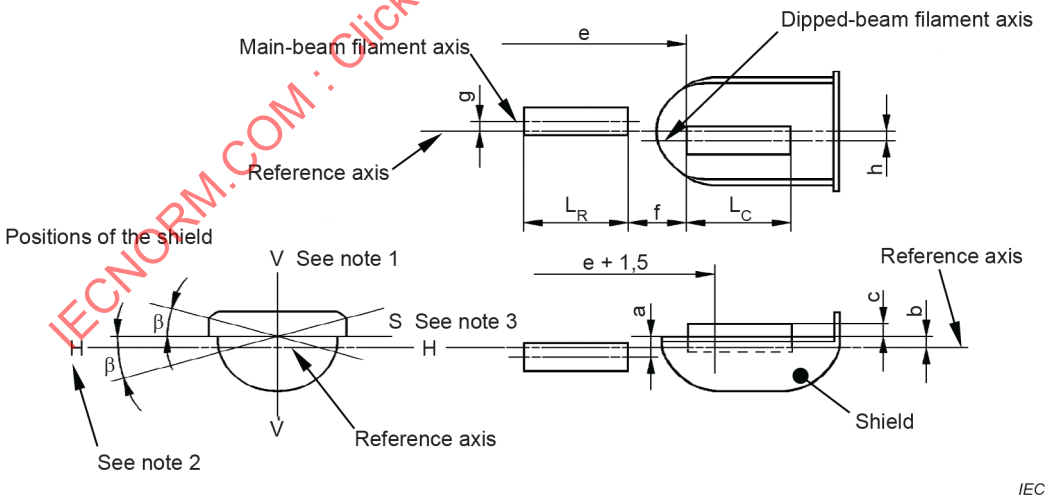
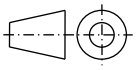


Figure 2 – Positions of filament

NOTES

1) Plane V-V contains the reference axis and the centre line of the reference pin.
2) The plane H-H contains the reference axis and is perpendicular to plane V-V.
3) Plane S-S denotes the position of the plane through the shield edges parallel to plane H-H.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: S4
CAP: BAX15d



Cap
BAX15d in accordance with IEC 60061-1 (sheet 7004-18).
Bulb
Colourless or selective-yellow.

Table 2 – Filament dimensions

Dimensions [1]		Values		Tolerances and limiting values		
				Production lamps		Standard lamps
Nominal voltage		6 V	12 V	6 V	12 V	6 V
Rated wattage	[W]					
Main-beam filament		15			±6 %	±6 %
Dipped-beam filament		15			±6 %	±6 %
Rated luminous flux	[lm]					
Main-beam filament				180 min.		[1]
Dipped-beam filament				125 min. / 190 max.		[1]
Dimensions	[mm]					
e			33,6		±0,35	±0,15
f			1,8		±0,35	±0,2
$L_C - L_R$			3,5		±1,0	±0,5
c [2]			0,4		±0,35	±0,15
b [2]			0,2		±0,35	±0,15
a [2]			0,6		±0,35	±0,15
h			0,0		±0,5	±0,2
g			0,0		±0,5	±0,2
β [2][3]			0,0		±2°30'	±1°

[1] Test luminous flux 240 lm (main-beam filament) and 160 lm (dipped-beam filament) at approximately 6 V.

[2] Dimensions a, b, c and β refer to a plane parallel to the reference plane and cutting the two edges of the shield at a distance e + 1,5 mm.

[3] Admissible angular deviation of the plane through the shield edges from the objective position.

[4] The reference plane is perpendicular to the reference axis and touches the upper surface of the reference pin having a length of 2 mm.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: H5
CAP: PY43t

Table 1 – Electrical characteristics

Nominal voltage	[V]	12
Nominal wattage	[W]	50
Test voltage	[V]	13,2

The drawings are intended only to illustrate the essential dimensions of the filament lamp.
Dimensions in millimetres

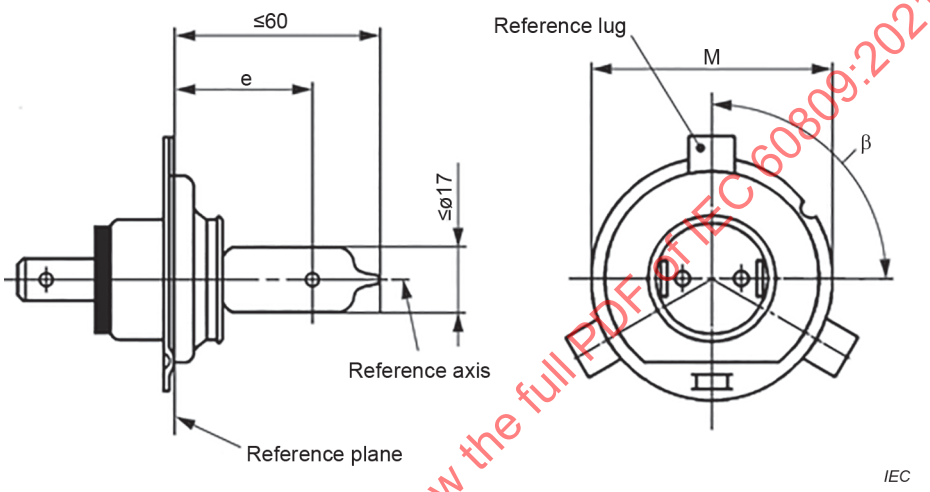


Figure 1 – Filament lamp drawing

Cap

PY43d in accordance with IEC 60061-1 (sheet 7004-88).

Reference axis

The reference axis is the line perpendicular to the reference plane and passes through the centre of the circle of diameter M.

Bulb

The bulb shall be colourless.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: H5
CAP: PY43t

Table 2 – Filament lamps characteristics and dimensions

Characteristics		Values	Tolerances and limiting values
		Production lamps	
Nominal voltage		12 V	12 V
Rated wattage	[W]	-	58 max.[1)]
Rated luminous flux	[lm]	1 210	±15 %
Dimensions	[mm]		
e		44,50	±0,25
Lateral deviation		-	0,5 max.[2)]
β[3)]		24,50	±15°[2)]

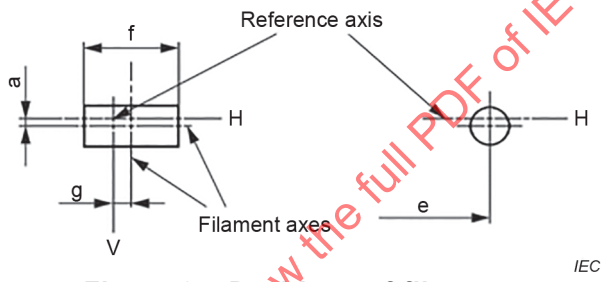


Figure 2 – Positions of filament

Table 3 – Filament dimensions

Dimensions in millimetres

Type	a	g	f
12 V	0 + 0,35 [4)]	0 + 0,35 [4)]	6,0 max.

1) Calculated values at 4,39 A max.

2) Under consideration.

3) Reference lug rotation with respect to filament (degrees).

4) Under consideration.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: H2
CAP: X511

Table 1 – Electrical characteristics

Nominal voltage	[V]	6	12	24
Nominal wattage	[W]	55	55	70
Test voltage	[V]	6,3	13,2	28,0

The drawings are intended only to illustrate the essential dimensions of the filament lamp.
Dimensions in millimetres

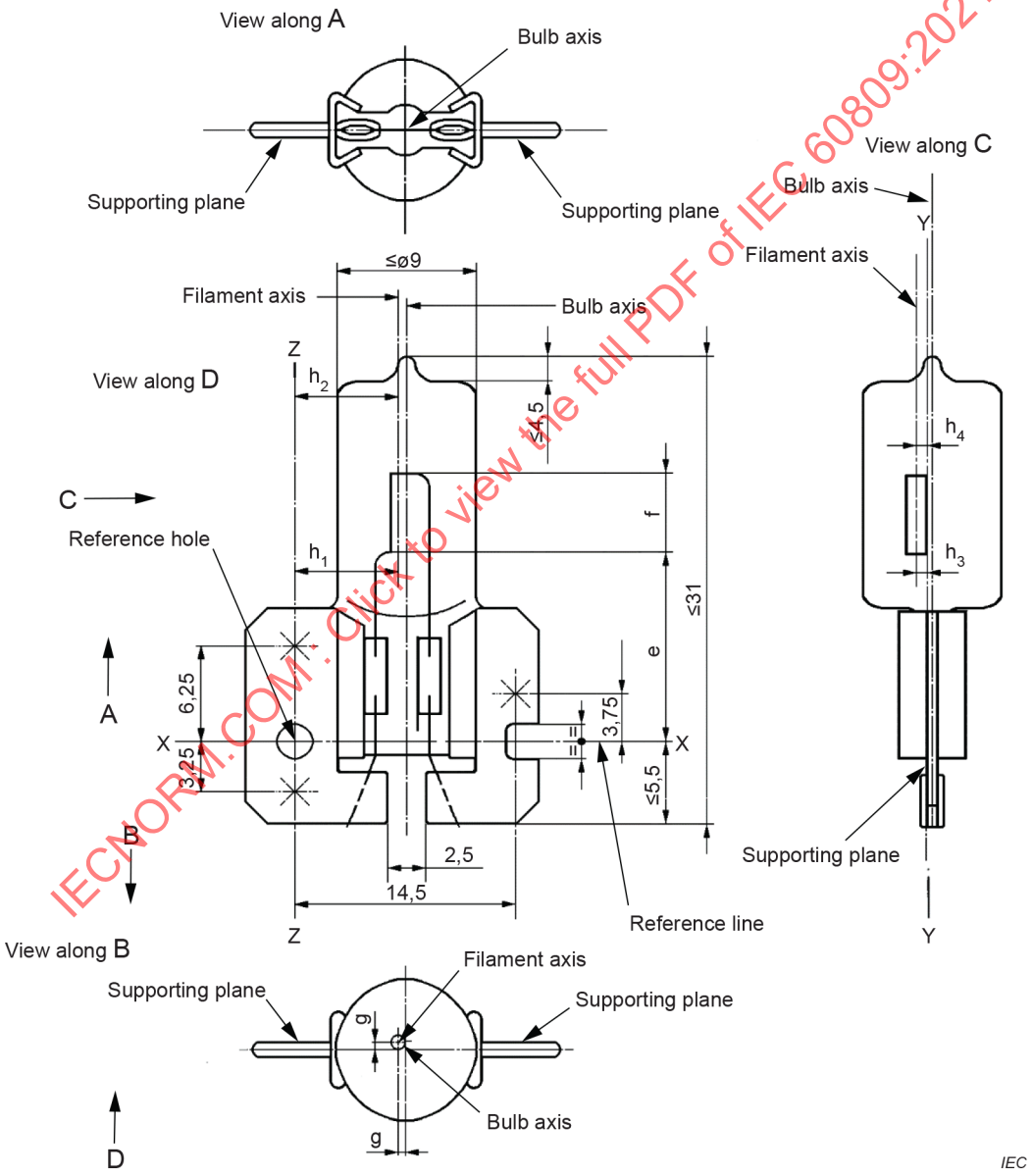


Figure 1 – Filament lamp drawing

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: H2
CAP: X511

Cap
X511 in accordance with IEC 60061-1 (sheet 7004-99).
The three crosses on the supporting plane show the position of the three bosses defining the plane on the holder. Within a circle 3 mm in diameter centred on these points there should be no apparent deformation and no notches affecting the position of the lamp.
Bulb
Colourless or selective-yellow.

Table 2 – Filament lamps characteristics and dimensions

Dimensions [1]		Values			Tolerances and limiting values			
					Production lamps			Standard lamps
Nominal voltage		6 V	12 V	24 V	6 V	12 V	24 V	12 V
Rated wattage	[W]	-	-	-	63 max.	68 max.	84 max.	68 max.
Rated luminous flux	[lm]	1 300	1 800	2 150	±15 %			[1]
Dimensions	[mm]							
e [3]		12,25			[2]			±0,15
f [3]		4,5	5,5		±1,0			±0,5
g [4] [5]		0,5 d			±0,5 d			±0,25 d
h_1 [6]		0,4			[2]			±0,20
h_2 [6]		0,2			[2]			±0,15
h_3 [4][6]		0,6			[2]			±0,15
h_4 [6]		0,0			[2]			±0,2

[1] Test luminous flux 1 300 lm at approximately 12 V.

[2] To be checked by means of the box system, page 3.

[3] The ends of the filament are defined as the points where, when the viewing direction is as defined by D (page 1), the projection of the outside of the end turns nearest or farthest from the cap crosses a line parallel to and at a distance of 7,1 mm from the Z-Z line. (special instructions for coiled-coil filaments are under consideration.)

[4] d diameter of filament.

[5] To be measured in a cross-section perpendicular to the axis of the bulb and passing through that end of the filament which is near to the cap.

[6] The offsets h_1 and h_2 shall be measured for Z-Z in a plane parallel to the supporting plane.
The offsets h_3 and h_4 shall be measured for Y-Y in a plane perpendicular to the supporting plane.
The points to be measured are those where the projection of the outside of the end turns nearest to or farthest from the cap crosses the filament axis.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: H2
CAP: X511

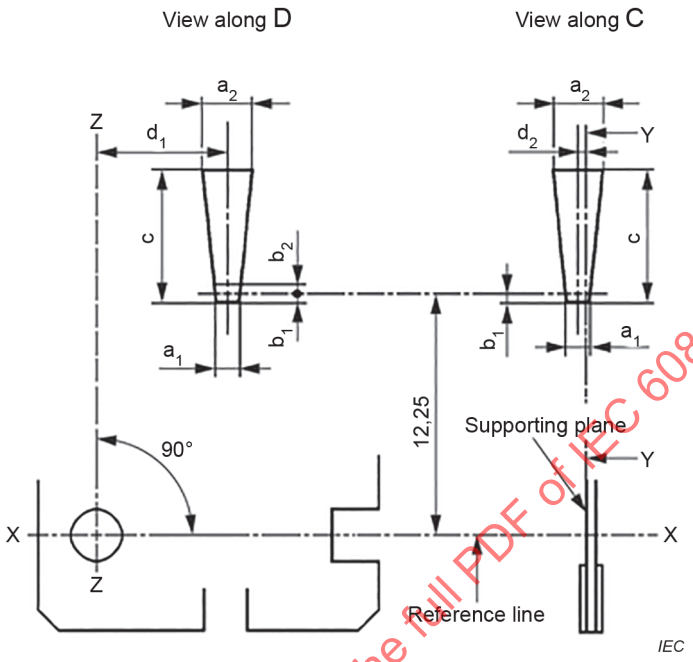


Figure 2 – Filament location check system (box system) (see Clause A.10, Annex A)
Dimensions in millimetres

Table 3 – Filament dimensions
Dimensions in millimetres

Type	a_1	a_2	b_1	b_2	c	d_1	d_2
6 V	d + 0,5	d + 1,0	0,25	0,25	6	7,1	0,5d − 0,35
12 V	d + 0,5	d + 1,0	0,25	0,25	7	7,1	0,5d − 0,35
24 V	d + 1,0	d + 1,0	0,25	0,25	7	7,1	0,5d – 0,35

d = diameter of the filament

The end of the filament which is nearer to the cap shall lie between b_1 and b_2.

The end of the filament is defined in note 3, on page 2.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: HS3
CAP: PX13.5s

Page 1/3

Table 1 – Electrical characteristics

Nominal voltage	[V]	6
Nominal wattage	[W]	2,4
Test voltage	[V]	6

The drawings are intended only to illustrate the essential dimensions of the filament lamp.

Dimensions in millimetres

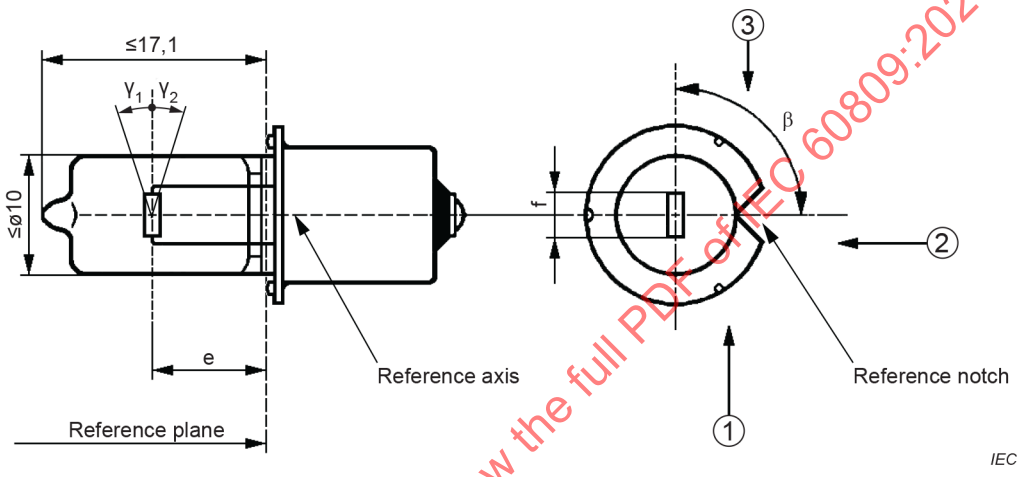


Figure 1 – Filament lamp drawing

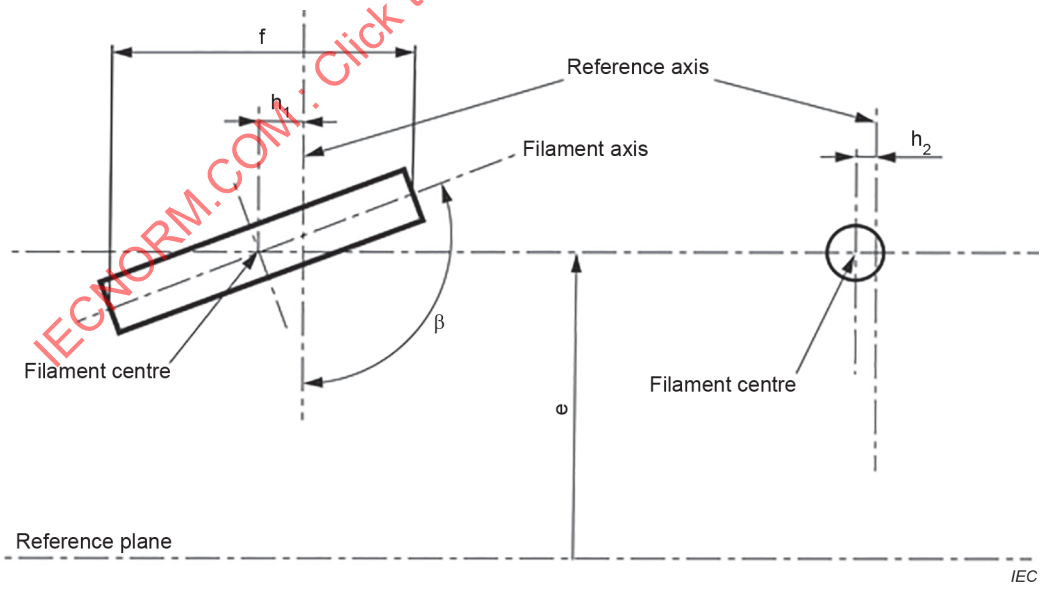
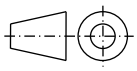


Figure 2 – View of filament showing dimensions e, f, h_1 and h_2

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: HS3
CAP: PX13.5s



Cap
PX13.5s in accordance with IEC 60061-1 (sheet 7004-35).
Bulb
The bulb shall be colourless.
Reference axis
The reference axis is perpendicular to the reference plane and passes through the intersection of this plane with the axis of the cap ring.

Table 2 – Filament lamps characteristics and dimensions

Dimensions [1]	Values	Tolerances and limiting values	
		Production lamps	Standard lamps
Nominal voltage	6 V	6 V	6 V
Rated wattage [W]	2,4	±8 %	±8 %
Rated luminous flux [lm]	36	±15 %	[1]
Dimensions [mm]			
e	6,55	[2]	±0,15
f [4]	1,25	±0,35	±0,25
h_1	0,0	[2]	±0,15
h_2	0,0	[2]	±0,15
β [3]	90°	±20°	±5°
γ_1 [5]	-	30° min.	30° min.
γ_2 [5]	-	25° min.	30° min.

[1] Test luminous flux 36 lm at approximately 6,0 V.

[2] To be checked by means of the box system, page 3.

[3] Both the filament axis and the plane of the internal mount with regard to the reference notch shall lie within the tolerance of angle ß.

[4] The ends of the filament are defined by the intersections of the outside of the first and the last light emitting turns having substantially the correct helix angle with the filament axis, seen from direction ②.

[5] In the area between the outer legs of the angles γ_1 and γ_2 the bulb shall have no optical distorting areas and the curvature of the bulb shall have a radius of not less than 50 % of the actual bulb diameter.

Note regarding service operation

Because the filament of halogen lamps operates at higher temperatures than those of conventional lamps, it is necessary to ensure that these lamps are not subjected to generator voltages in excess of 8,0 V in order to avoid rapid failure.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: HS3
CAP: PX13.5s

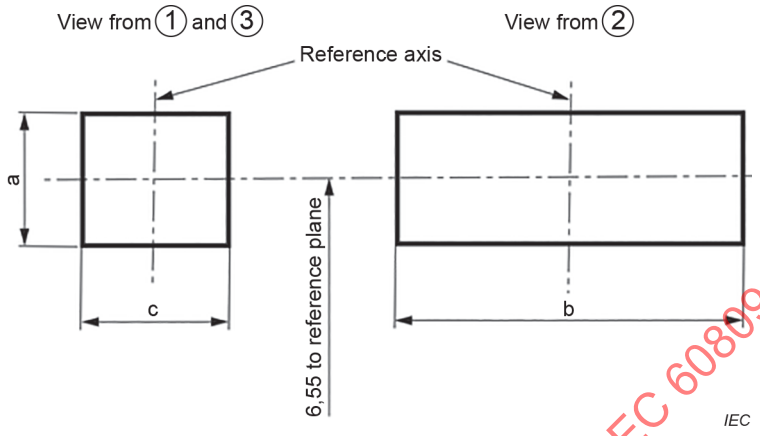


Figure 3 – Filament location check system (box system) (see Clause A.10, Annex A)
Dimensions in millimetres

Table 3 – Filament dimensions
Dimensions in millimetres

Type	a	b	c
6 V	d + 0,5	2,1	1,1

d diameter of the filament

The projection of the filament in viewing direction ①, ② and ③ shall lie completely within the limits defined.

If the filament is covered by the mounting parts seen from directions ① or ③, the mounting parts, in addition to the filament, shall lie completely within dimension c.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: B1.13W
CAP: PX13.5s

Page 1/1

Table 1 – Electrical characteristics

Nominal voltage	[V]	2,7
Nominal wattage	[W]	1,13
Test voltage	[V]	2,7

The drawings are intended only to illustrate the essential dimensions of the filament lamp.

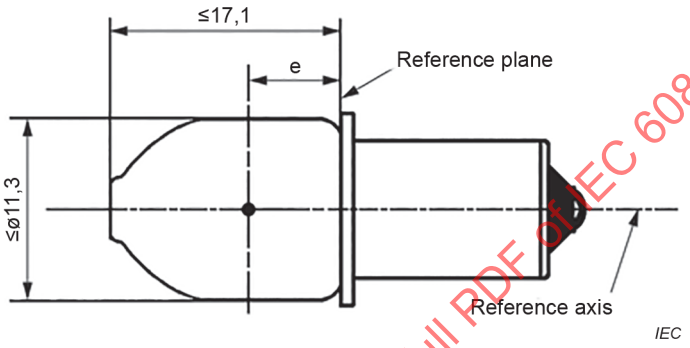


Figure 1 – Filament lamp drawing
Dimensions in millimetres

Cap
PX13.5s in accordance with IEC 60061-1 (sheet 7004-35).
Bulb
The bulb shall be colourless.

Table 2 – Filament lamps characteristics and dimensions

Characteristics		Values	Tolerances and limiting values	
			Production lamps	Standard lamps
Rated wattage	[W]	1,13	±10 %	±10 %
Rated luminous flux	[lm]	9,4	±20 %	[1]
Dimensions	[mm]			
e		6,35	±0,25	±0,15
Lateral deviation[2]		0,0	Max. 0,4	Max. 0,2

[1] Test luminous flux 9,4 lm at approximately 2,7 V.

[2] Lateral deviation of filament from the reference axis.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: B0.6W
CAP: E10

Page 1/1

Table 1 – Electrical characteristics

Nominal voltage	[V]	6
Nominal wattage	[W]	0,6
Test voltage	[V]	6

The drawings are intended only to illustrate the essential dimensions of the filament lamp.

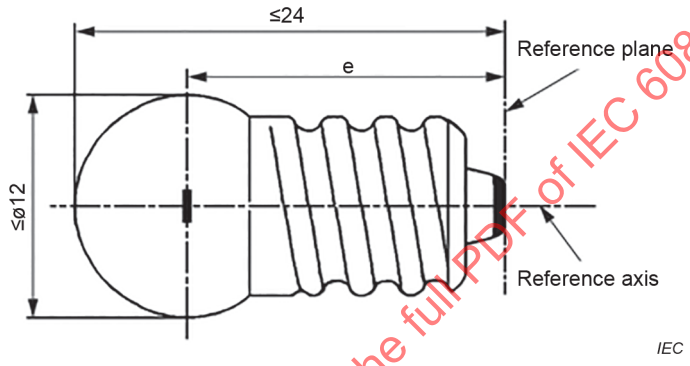


Figure 1 – Filament lamp drawing
Dimensions in millimetres

Cap
E10 in accordance with IEC 60061-1 (sheet 7004-22).
Bulb
The bulb shall be colourless.

Table 2 – Filament lamps characteristics and dimensions

Characteristics		Values	Tolerances and limiting values	
			Production lamps	Standard lamps
Rated wattage	[W]	6	±10 %	±10 %
Rated luminous flux	[lm]	0,6	±33 %	[1]
Dimensions	[mm]	6		
e		18,0	±1	±0,15
Lateral deviation[2]		0,0	Max. 1,0	Max. 0,2

[1] Test luminous flux 3,0 lm at approximately 6 V.

[2] Lateral deviation of filament from the reference axis.

ROAD VEHICLE
FILAMENT LAMP
DATA SHEET
CATEGORY: B2.4W
CAP: EP10/14x11

Page 1/1

Table 1 – Electrical characteristics

Nominal voltage	[V]	6
Nominal wattage	[W]	2,4
Test voltage	[V]	6

The drawings are intended only to illustrate the essential dimensions of the filament lamp.

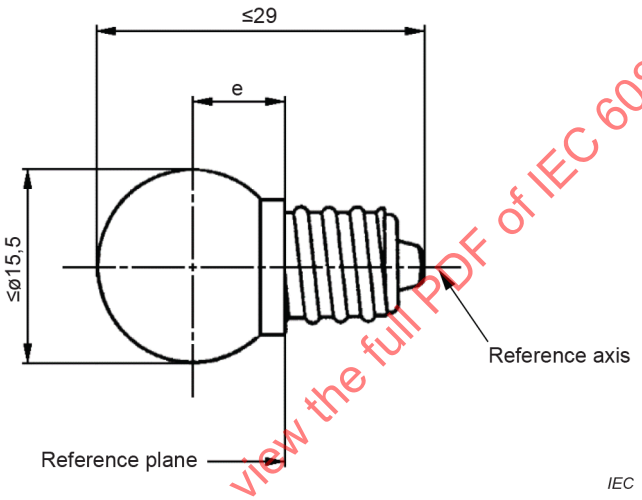


Figure 1 – Filament lamp drawing
Dimensions in millimetres

Cap
E10 in accordance with IEC 60061-1 (sheet 7004-22).
Bulb
The bulb shall be colourless.

Table 2 – Filament lamps characteristics and dimensions

Characteristics		Values	Tolerances and limiting values	
			Production lamps	Standard lamps
Rated wattage	[W]	2,4	±10 %	±6 %
Rated luminous flux	[lm]	24	±20 %	1)
Dimensions	[mm]	6		
e		8,75	±0,5	±0,15
Lateral deviation 2)		0,0	Max. 1,0	Max. 0,2

1) Test luminous flux 24 lm at approximately 6 V.

2) Lateral deviation of filament from the reference axis.

Annex A
(normative)

Filament shape, length and position

A.1 General

When the shape of the filament is shown on a filament lamp data sheet, the filament shall have basically the same shape.

A.2 Filaments shown as points

If the filament is shown as a point on the filament lamp data sheet, the filament shape is optional and the luminous centre of the filament shall be determined as specified in Figure A.2.

A.3 Line filaments

The correct position and shape of line filaments shall be checked as specified on the relevant filament lamp data sheet. Measurements shall be carried out at a voltage between 90 % and 100 % of test voltage. Filament lamps shall be measured in a normal operating position.

A.4 Coiled-coil filaments

A coiled-coil filament is regarded in the same way as a single coil filament with its primary coil assumed to represent the wire of a single coil filament.

A.5 Extreme filament turns

Unless otherwise specified in the relevant filament lamp data sheet, the extreme filament turns are defined as the first and last turn, which, in projection, are fully at the correct helix angle. A turn is considered to be at the correct helix angle if its pitch does not exceed 150 % of the average pitch.

A.6 Filament extremities

A.6.1 General

Unless otherwise specified in the relevant filament lamp data sheet, the extremities of a line filament are established by the position of the apex of the projection of the first and last filament turn, provided that the angle with the leg of the filament does not exceed 90° (see Figure A.1).

A.6.2 Axial filaments

For axial filaments, the extreme position of apexes to be taken into consideration shall be determined by rotation of the filament lamp around its reference axis until the most extreme position is reached.

A.6.3 Transverse filaments

For transverse filaments, the filament axis shall be brought into a position perpendicular to the projection direction.

A.7 Determination of filament length

Unless otherwise specified in the relevant filament lamp data sheet, the filament length is the distance between the filament extremities as defined in Clause A.6 (see Figure A.1) measured either parallel with, or perpendicular to, the reference axis according to the type of filament. Apexes outside the point of connection to the current lead-in legs shall be disregarded for the determination of the filament length.

A.8 Filament offsets

Unless otherwise specified in the relevant filament lamp data sheet, in cases where the filament position is dimensioned by offsets, these are defined as the distances between the intersection points of the extreme turns as defined in Clause A.5, with the actual filament axis and the filament reference line (see Figure A.1).

A.9 Lateral deviation

Unless otherwise specified in the relevant filament lamp data sheet, in cases where the filament position is toleranced by lateral deviations, these are defined as the distance between the reference axis or plane and the centre of the filament, determined as specified in Clause A.2. Lateral deviations are mostly given in two mutually perpendicular planes. These two deviations, together with the tolerance on the light centre length, determine the deviation of the centre of the filament with respect to an x, y, z system of co-ordinates (see Figure A.3).

A.10 Filament location check system (box system)

The filament shape and position of some filament lamps with line filaments are checked by means of a so-called box system. This system is used to determine whether the filament is correctly positioned relative to the reference plane and also whether the light centre length is within certain limits. Magnified targets of the permitted limits as given on the relevant filament lamp data sheet are drawn on the test screens and positioned correctly with respect to the reference axis and reference plane. Images of the filament with the same degree of magnification are then projected onto the test screens. These images shall fall entirely within the target areas and, if required, the ends or centre of the filament shall fall within the specified limits.

The ends of the filament are defined as the points, where, when viewing in a given direction, the projection of the outside of the first and last turn crosses the filament reference line. The centre of the filament is the halfway distance between the crossings.

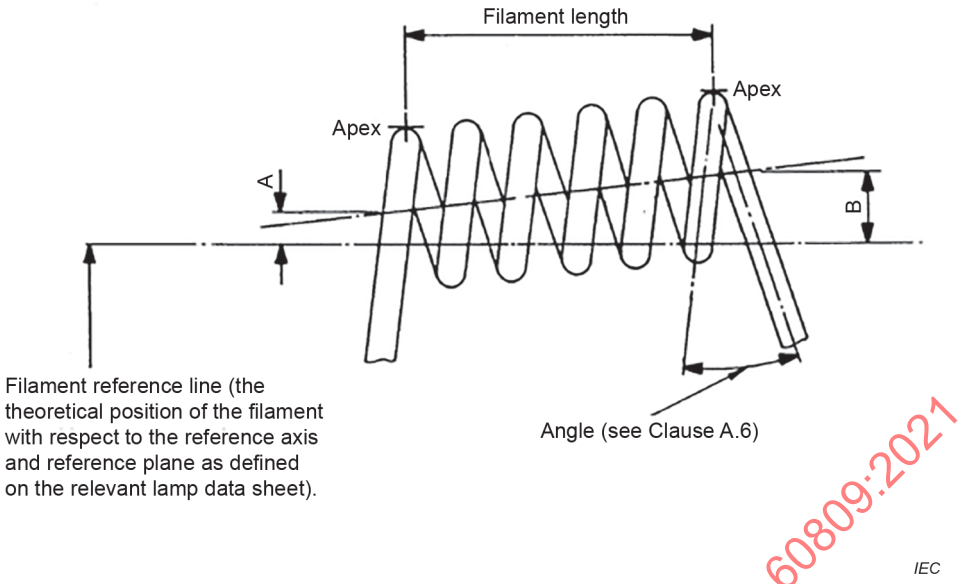


Figure A.1 – Determination of apexes, filament length and filament offsets (A and B)

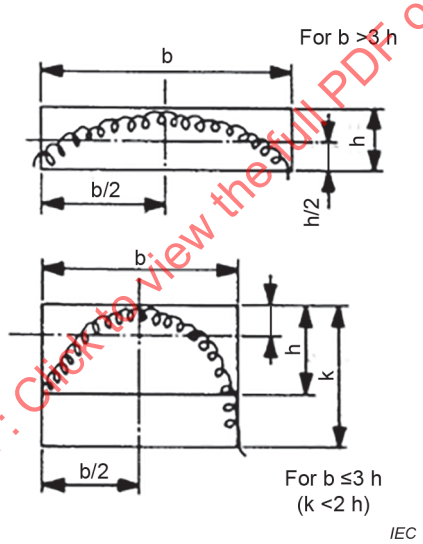


Figure A.2 – Determination of filament centre

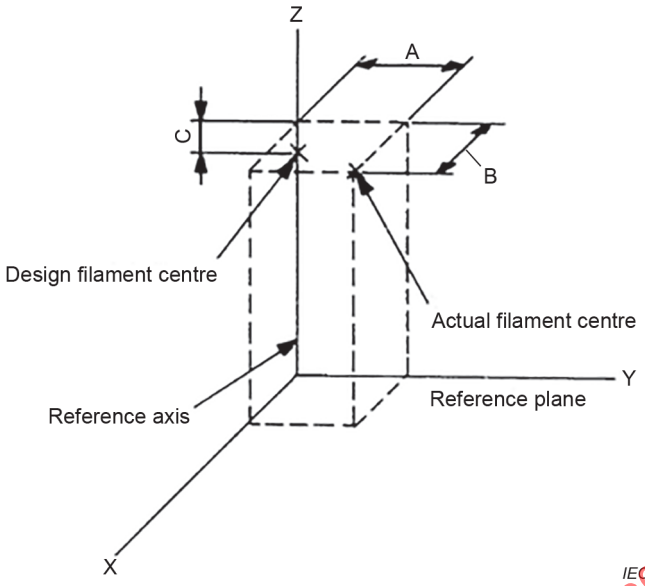


Figure A.3 – Determination of lateral deviations (A and B) and tolerance on the light centre length (C)

Annex B
(normative)

Measurement method of the colour of filament lamps

B.1 General

Measurements shall be made on finished lamps. Filament lamps with a secondary (outer) bulb acting as colour filter shall be handled as a filament lamp with a primary bulb.

Tests shall be made at an ambient temperature of 23 °C ± 5 °C.

Tests shall be made at test voltage as specified in the relevant filament lamp data sheet.

Filament lamps shall be measured preferably in the normal operating position. In case of dual filament lamps, the high wattage (major) filament only shall be operated.

Before starting a test, the stabilization of the temperature of the filament lamp shall be obtained by operating at test voltage for 10 min.

B.2 Colour

Colour tests shall be made with a measuring system that determines x,y chromaticity co-ordinates according to CIE 015:2018 of the received light with a resolution of ±0,002.

The chromaticity co-ordinates shall be measured with a colorimetric receiver integrating over a right circular cone subtending an angle of minimum 5° and maximum 15° at the centre of the filament.

B.3 Measuring directions

B.3.1 General

Initially, the receiver shall be positioned perpendicular to the lamp axis and to the filament axis (or plane in case of a curved filament). After measurement, the receiver shall be moved around the filament lamp in bi-directional steps of about 30° until the area specified in B.3.2 or B.3.3 is covered. In each position, a measurement shall be made. However, no measurement shall be made when:

– the centre line of the receiver coincides with the filament axis; or
– the line of sight between the receiver and the filament is blocked by opaque (non-transmittent) parts of the light source, such as lead wires or a second filament, if any.

B.3.2 Filament lamps used in headlamps

Measurements shall be made in directions around the filament lamp with the centre line of the receiver aperture located within an angle ±30° from the plane perpendicular to the lamp axis and with the origin in the centre of the filament (see Figure B.1). In the case of filament lamps with two filaments, the centre of the main-beam filament shall be taken as the origin.

B.3.3 Filament lamps used in light signalling devices

Measurements shall be made around the filament lamp (see Figure B.2), with the exception of:

– the area claimed or covered by the cap of the filament lamp,
– the immediate transition area along the cap.

In the case of filament lamps with two filaments, the centre of the major filament shall be taken as the origin.

In the case of filament lamp categories with a specified distortion-free angle, the measurement shall be done only within the defined angle.

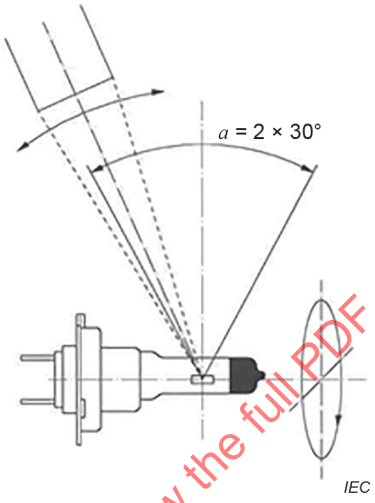


Figure B.1 – Positions of the colorimetric receiver when measuring lamps used in headlamps

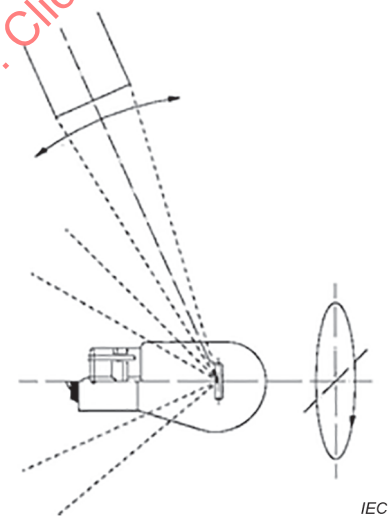


Figure B.2 – Positions of the colorimetric receiver when measuring lamps used in light signalling devices

Annex C
(normative)

Test conditions for electrical and luminous characteristics

C.1 Filament lamps

C.1.1 Ageing

Filament lamps shall be aged at their test voltage for approximately 1 h. The test voltage is indicated on the relevant filament lamp data sheet. For dual-filament lamps, each filament shall be aged separately.

C.1.2 Test conditions

Electrical and photometric measurements shall be carried out at test voltage.

C.1.3 Electrical instrumentation

Electrical measurements shall be carried out with instruments being of a precision appropriate to the requirements (equivalent to at least class 0,2 in accordance with IEC 60051-1).

C.1.4 Photometry

The luminous flux shall be measured in a suitable integrating photometer.

C.2 LED light sources

C.2.1 Test conditions

LED light sources shall be aged at their test voltage for at least forty-eight hours. For multi-function LED light sources, each function shall be aged separately.

LED Light sources of all categories with integrated heat sink shall be measured at ambient temperature of (23 ± 2) °C in still air. For these measurements, the minimum free space as defined in the data sheets shall be maintained.

Light sources of all categories which have a specified performance temperature, T_b, shall be measured by stabilising the T_b-point at the temperature specified on the category data sheet.

C.2.2 Luminous flux

C.2.2.1 In the case of an integrated heat sink

A luminous flux measurement using an integrating method shall be made after 1 min and after 30 min of operation. The luminous flux values, as measured after 30 min, shall comply with the minimum and maximum requirements.

Additionally, unless otherwise specified on the data sheet,

i) either the luminous flux value measured after 30 min shall be between 100 % and 80 % of the luminous flux value measured after 1 min,

   or

ii) the luminous flux value measured after 1 min shall comply with the minimum and maximum requirements, and in addition the luminous flux value measured after 30 min shall not deviate by more than ±20 % from the luminous flux value measured after 1 min.

C.2.2.2 In all other cases where a T_b -point is defined

A luminous flux measurement using an integrating method shall be made after stabilization of temperature T_b at the value given in the relevant data sheet.

The luminous flux values, as measured after stabilization of temperature T_b at the value given in the relevant data sheet, shall comply with the minimum and maximum requirements.

C.2.2.3 Flux-voltage dependency

Measurements shall be carried out at relevant test voltage and at the minimum and maximum values of the relevant voltage range. Unless specified more tightly on the data sheet, the following deviation of the luminous flux at the tolerance interval limits shall not be exceeded (see Table C.1).

Table C.1 – Luminous flux tolerance limits

Rated voltage	Minimum voltage	Maximum voltage
6	6,0	7,7
12	12,0	14,0
24	24,0	28,0
Corresponding luminous flux tolerance[a]	±30 %	±15 %

[a] The maximum luminous flux deviation at the tolerance limits is calculated by using the measured flux at test voltage as reference. In-between test voltage and voltage range limits, the luminous flux behaviour shall be substantially uniform.

C.2.3 Normalized luminous intensity

The normalized luminous intensity shall comply with the value as given in the relevant data sheet.

The luminous intensity measurements shall be started after:

a) 30 min of stabilization time, or

b) stabilization of temperature T_b at the value given in the relevant data sheet.

Measurements shall be carried out at relevant test voltage.

Normalized luminous intensity of a test sample is calculated by dividing the luminous intensity distribution by the luminous flux as determined after 30 min.

C.2.4 Colour

The colour of the light emitted, measured under the same conditions as the luminous flux, shall be within the required colour boundaries.

C.2.5 Power consumption

A power consumption measurement shall be made under the same conditions as described for the luminous flux measurements.

Power consumption measurements shall be carried out at relevant test voltage.

Values obtained shall comply with the minimum and maximum requirements of the relevant data sheet.

C.2.6 Luminous flux and colour at elevated temperature

C.2.6.1 General

If the LED light source data sheet specifies luminous flux and/or colour at elevated temperature(s), the following measurement method shall apply.

C.2.6.2 Measurement set-up and calibration

The measurement set-up consists of a temperature chamber and a photometric measurement system (e.g. a spectrometer) with an optional fibre optics cable, see Figure C.1. The spectrometer and the optional fibre optics cable shall be suitable for wavelengths from 380 nm to 780 nm.

The LED light source is placed inside the temperature chamber and the fibre optics cable or the sensor is placed in a fixed position in the main optical axis of the LED light source. The holder material of the LED light source shall have a thermal conductivity less than 1,0 W/(m · K), for example polycarbonate. The temperature sensor shall be placed inside the temperature chamber close to the LED light source at the height of the LED light source but such that it is not directly exposed to radiation or convection from the LED light source. The size of the temperature chamber shall be chosen to have a minimum dimension of three times the dimension of the LED light source in all directions. The position of the LED light source shall be sufficiently in the centre of the temperature chamber to avoid negative impact from the walls. The orientation of the LED light source during the testing shall be horizontal or, if relevant, in the intended orientation of the application. The orientation shall be noted in the test report. Measurement shall be performed in still air, this means no forced air convection directly onto the light source.

For calibrating the measurement set-up, an additional reference measurement of the luminous flux and spectral content shall be performed in an integrating sphere at 23 °C ± 2 °C. This measurement in the integrating sphere is used to calibrate the measurement set-up, taking into account the light source category specific emission characteristics, holder, optical path and spectrometer.

Ensure that any humidity-condensation or any equipment-vibration does not negatively impact the measurement. In addition the humidity-condensation or any equipment-vibration should not affect the measurements.

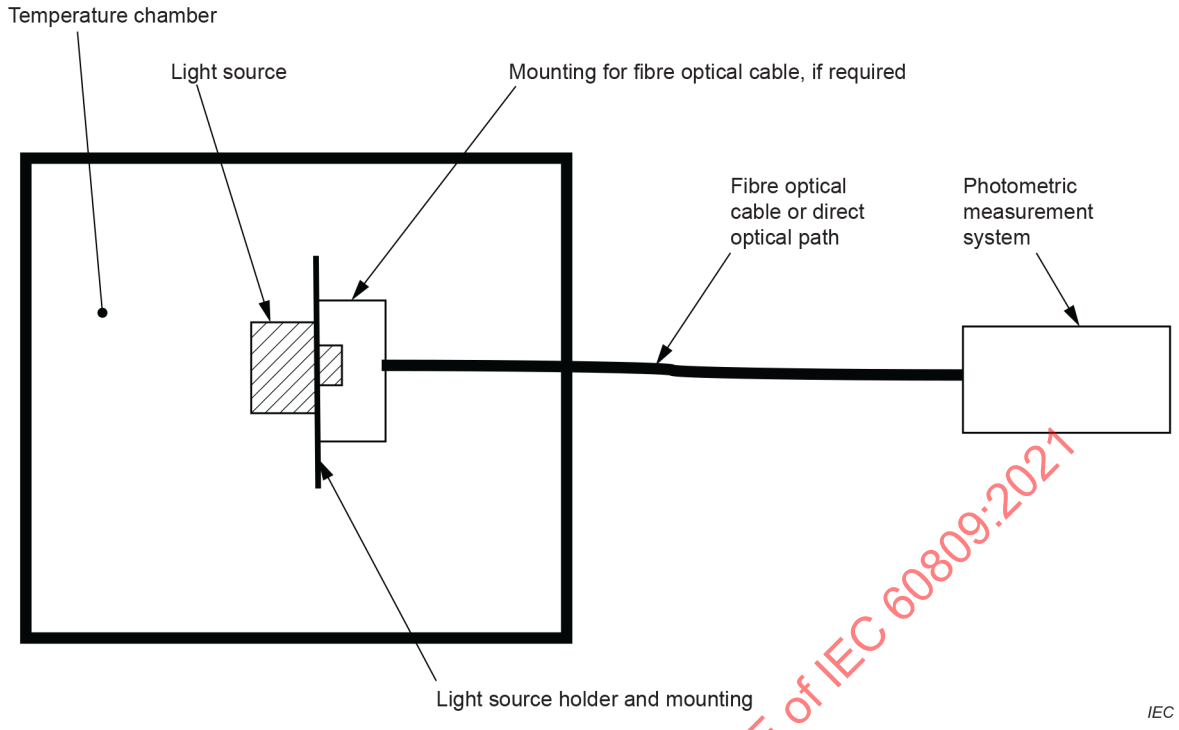


Figure C.1 – Schematic representation of the set-up to measure the luminous flux and colour at elevated temperature

C.2.6.3 Measurement

The measurement at elevated temperature shall be performed after operation of 30 min at the specified elevated temperature with a tolerance of ±2 °C.

C.2.6.4 Alternative methods

The measurement set-up consists of the temperature chamber, integrating sphere and the photometric measurement system (e.g. the multi-channel photo detector) with the fibre optical cable, see Figure C.2.

The LED light source is placed inside the integrating sphere in the temperature chamber.

The photometric measurement system is placed outside the temperature chamber.

The size of the integrating sphere is desirably Ø500 mm or more.

The temperature sensor shall be placed inside the integrated sphere close to the LED light source but such that it is not directly exposed to radiation or convection from the LED light source.

Other measurement conditions are in accordance with C.2.6.2.

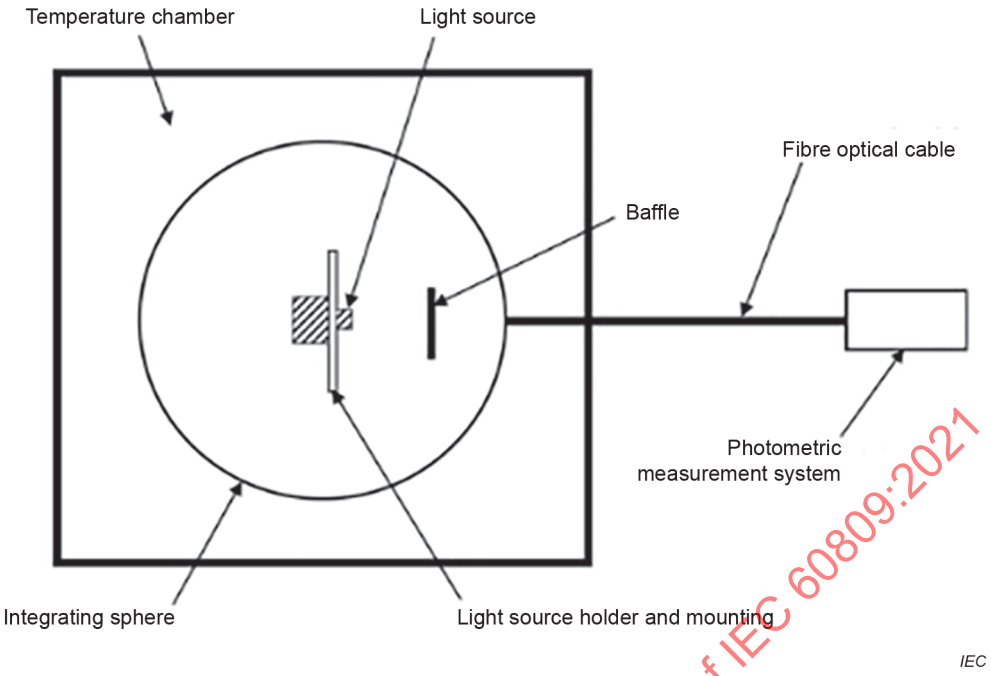


Figure C.2 – Schematic representation of the set-up to measure the luminous flux and colour at elevated temperature

Annex D
(normative)

Measurement method of internal elements of R2 lamps

D.1 General test conditions

D.1.1 Measurement position

Filament lamps shall be measured in a horizontal normal operating position, reference notch down.

D.1.2 Ageing

Each filament shall be aged for approximately 1 h at test voltage. Immediately prior to a measurement, the filament shall be operated for at least 2 min at test voltage.

D.1.3 Test conditions

Measurement on filaments shall be carried out at test voltage.

D.2 Reference axis, reference plane and planes for measurements

D.2.1 Reference axis

The reference axis is the line perpendicular to the reference plane and passing through the centre of the 45 mm cap ring diameter.

D.2.2 Reference plane

The reference plane is the plane formed by the seating points of the cap ring.

D.2.3 Plane V-V

Plane V-V is the plane perpendicular to the reference plane containing the reference axis and the centre line of the locating notch.

D.2.4 Plane H-H

Plane H-H is the plane perpendicular to the reference plane and to plane V-V containing the reference axis.

D.2.5 Plane X-X

Plane X-X is the plane perpendicular to the reference plane, containing the reference axis and forming an angle of 15° to plane H-H which is turned clockwise towards the locating notch, seen from the top of the bulb.

D.2.6 Plane Y1-Y1

Plane Y1-Y1 is a plane parallel to the reference plane at a distance of 30 mm from it.

D.2.7 Plane Y2-Y2

Plane Y2-Y2 is a plane parallel to the reference plane at a distance of 33 mm from it.

In the case of very short filaments, an intersection of plane Y2-Y2 with the filament may not be possible. In this case, plane Y2-Y2 will be moved in the direction of plane Y1-Y1 until intersections are possible. These intersections are then MP 13 and MP 14 and shall be measured.

D.3 Viewing directions (see Figure D.1)

D.3.1 Viewing direction ①

Viewing direction ① is perpendicular to plane V-V, seen from the side of the left-hand shield edge.

D.3.2 Viewing direction ②

Viewing direction ② is perpendicular to plane H-H, seen from the side opposite to the location notch.

D.3.3 Viewing direction ③

Viewing direction ③ is parallel to plane X-X and the reference plane, seen from the right-hand side of the shield turned 15°.

D.4 Measuring points (MP)

The following points as specified in Figure D.2 shall be measured. Measurements shall be made perpendicular to the viewing directions respectively:

Viewing direction ①

MP 1 and MP 12	The intersections of the silhouette of the shield edge with planes Y1-Y1 land Y2-Y2.
MP 2 and MP 13	The intersection of the upper rim of the envelope of the dipped-beam filament with planes Y1-Y1 and Y2-Y2, farthest from plane H-H.

In the case of very short filaments, an intersection of plane Y2-Y2 with the filament may not be possible. In this case, plane Y2-Y2 will be moved in the direction of plane Y1-Y1 until intersections are possible. Then the intersections MP 13 and MP 14 shall be measured.

MP 4 and MP 8	The intersections of the outer part of respectively the first and last luminous turn of the dipped-beam filament with the silhouette of the shield.
MP 5	Apex for the coil turn as defined for MP 11.
MP 11	The centre of the main-beam filament, being the centre of – the coil turn farthest from the reference plane for arc-shaped filaments, – the middle turn for transversal, or at least partly transversal filaments.

Viewing direction ②

MP 7	The centre of the coil turn as defined for MP 11.
MP 6 and MP 14	The intersections of the dipped-beam filament axis with planes Y1-Y1 and Y2-Y2.
MP 9 and MP 10	The intersections of the edges of the sunk area of the shield with plane Y2-Y2.

In case MP 5 and MP 7 are no visible from viewing direction ②, both points shall be measured from the opposite side.

Viewing direction ③

MP 3 and MP 15 The intersections of the silhouette of the 15° bent part of the shield with planes Y1-Y1 and Y2-Y2.

D.5 Dimensions to be measured

Table D.1 states the dimensions to be measured. Values and tolerances are given on the relevant filament lamp data sheet R2 of R.E.5.

Table D.1 – Dimensions to be measured for R2 lamps

Distance	Measured perpendicular to plane	Viewing direction	Dimension
MP 1 to MP 11	H-H	1	[a]
MP 1 to H-H MP 12 to H-H	H-H H-H	1 1	b_1/30,0 [a] b_1/33,0 [a]
MP 3 to X-X MP 15 to X-X	X-X X-X	3 3	b_2/30,0 [a] b_2/33,0 [a]
MP 9 to V-V MP 10 to V-V	V-V V-V	2 2	p/33,0 [a] q/33,0 [a]
MP 2 to MP 1 MP 13 to MP 12	H-H H-H	1 1	p/33,0 [a] q/33,0 [a]
MP 6 to V-V MP 14 to V-V	V-V V-V	2 2	p/33,0 [a] q/33,0 [a]
MP 4 to reference plane	Reference plane	1	e
MP 4 to MP 5	Reference plane	1	f
MP 7 to V-V	V-V	2	g
MP 4 to MP 8	Reference plane	1	l_c

[a] Dimension to be measured at the distance from the reference plane indicated in millimetres after the stroke.

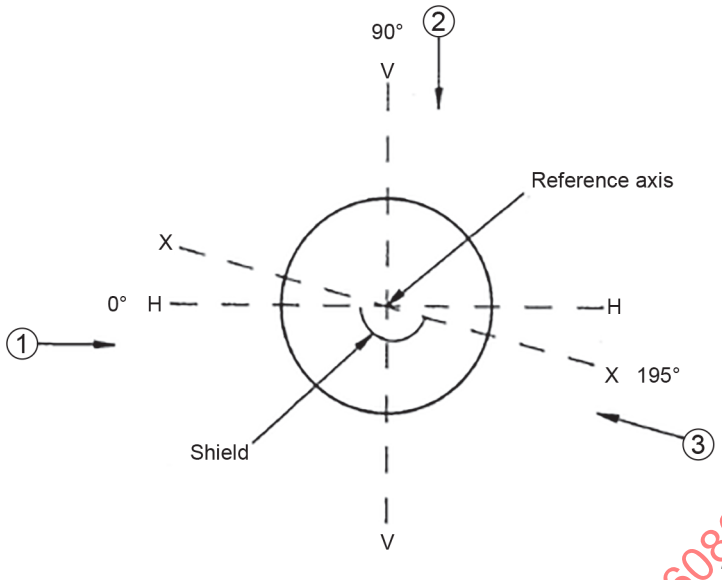


Figure D.1 – Viewing directions, seen from the top of the lamp

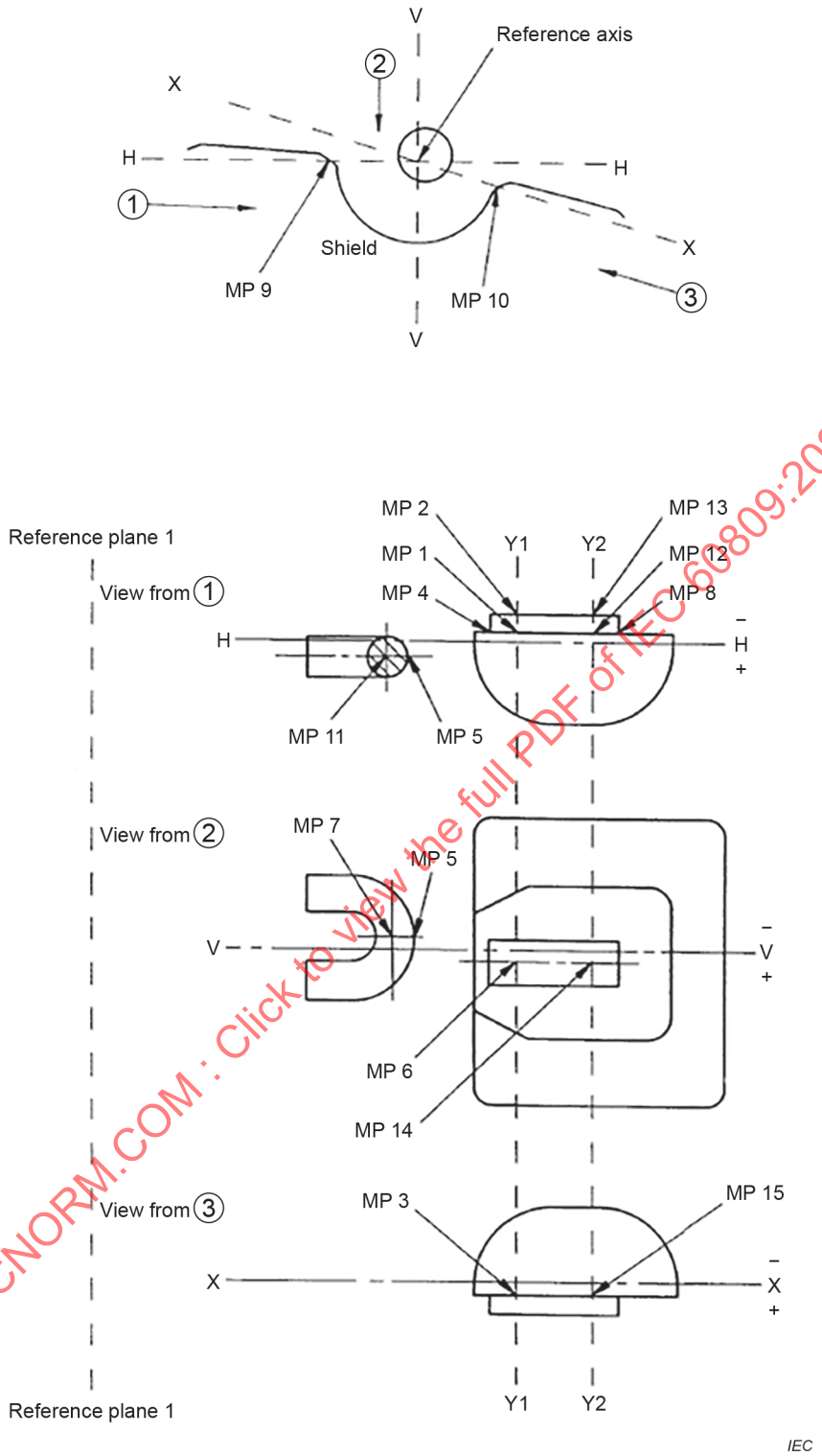


Figure D.2 – Position of measuring points of R2 lamps

Annex E
(normative)

Measurement method of internal elements of H4 and HS1 lamps

E.1 General test conditions

E.1.1 Measurement position

Filament lamps shall be measured in a horizontal normal operating position, reference lug up.

E.1.2 Ageing

Each filament shall be aged for approximately 1 h at test voltage. Immediately prior to a measurement, the filament shall be operated for at least 2 min at test voltage.

E.1.3 Test conditions

Measurement on filaments shall be carried out at test voltage.

E.2 Reference axis, reference plane and planes for measurement

E.2.1 Reference axis

The reference axis is the line perpendicular to the reference plane and passing through the centre of the circle with diameter M of the cap ring.

E.2.2 Reference plane

The reference plane is the plane formed by the seating points of the three lugs.

E.2.3 Plane V-V

Plane V-V is the plane perpendicular to the reference plane containing the reference axis and the centre line of the reference lug.

E.2.4 Plane H-H

Plane H-H is the plane perpendicular to the reference plane and to plane V-V containing the reference axis.

E.2.5 Plane X-X

Plane X-X is the plane perpendicular to the reference plane, containing the reference axis and forming an angle of 15° to plane H-H which is turned clockwise away from the reference lug, seen from the top of the bulb.

E.2.6 Plane Y1-Y1

Plane Y1-Y1 is a plane parallel to the reference plane at a distance of 29,5 mm from it (30,0 mm for the 24 V type, 30,5 mm for category H19).

E.2.7 Plane Y2-Y2

Plane Y2-Y2 is a plane parallel to the reference plane at a distance of 33,0 mm from it (31,0 mm for category HS1).

E.2.8 Plane Y3-Y3

Plane Y3-Y3 is a plane parallel to the reference plane at a distance of 23,5 mm from it (25,0 mm for category HS1 and H17, 24,5 mm for category H19).

E.2.9 Plane Y4-Y4

Plane Y4-Y4 is a plane parallel to the reference plane at a distance of 26,0 mm from it.

E.2.10 Plane Y5-Y5

Plane Y5-Y5 is a plane parallel to the reference plane at a distance of 28,95 mm from it (29,25 mm for the 24 V type).

E.3 Viewing directions (see Figure E.1)

E.3.1 Viewing direction ①

Viewing direction ① is perpendicular to plane V-V, seen from the side of the left-hand shield edge.

E.3.2 Viewing direction ②

Viewing direction ② is perpendicular to plane H-H, seen from the side of the reference lug.

E.3.3 Viewing direction ③

Viewing direction ③ is parallel to plane X-X and the reference plane, seen from the side of the right-hand shield edge.

E.3.4 Viewing direction ④

Viewing direction ④ is perpendicular to plane V-V, seen from the side of the right-hand shield edge.

E.4 Measuring points (MP)

E.4.1 General

The following points as specified in Figure E.2 and Figure E.3 shall be measured. Measurements shall be made perpendicular to the viewing directions, respectively.

E.4.2 **Shield and filaments** (see Figure E.2)

Viewing direction ①	
MP 1 and MP 12	The intersections of the main-beam filament axis with planes Y3-Y3 and Y4-Y4.
MP 3 and MP 4	The intersections of the shield edge with planes Y1-Y1 and Y2-Y2.
MP 5 and MP 6	The intersections of the envelope of the dipped-beam filament with planes Y1-Y1 and Y2-Y2 farthest from plane H-H.
MP 7	The intersection of the bulb axis with plane Y1-Y1.
MP 8 and MP 11	The intersections of the outer part of respectively the first and last luminous turns of the dipped-beam filament with the shield edge.
MP 9 and MP 10	The intersections of the outer part of respectively the first and last luminous turns of the main-beam filament with the centre line (axis) of that filament.
Viewing direction ②	
MP 12 and MP 13	The intersections of the main-beam filament axis with planes Y3-Y3 and Y4-Y4.
MP 14 and MP 15	The intersections of the dipped-beam filament axis with planes Y1-Y1 and Y2-Y2.
MP 16 and MP 17	The intersections of the shield edges with plane Y2-Y2.
MP 24 and MP 25	The intersections of the outer shield edges with plane Y2-Y2 (including shield material thickness; applies to category H19 only).
Viewing direction ③	(Categories H4 and HS1. Can be used as an equivalent alternative to viewing direction for categories H17 or H19.)
MP 18 and MP 19	The intersections of the shield edge with plane Y1-Y1 and Y2-Y2.
Viewing direction ④	(Categories H17 and H19. Not for category H4 nor HS1.)
MP 18 and MP 19	The intersections of the shield edge with plane Y1-Y1 and Y2-Y2.

E.4.3 **Top obscuration** (see Figure E.3)

Viewing direction ①	
MP 20	Intersection of the top obscuration with a plane parallel to plane V-V and containing the bulb axis.
Viewing direction ②	
MP 23	Intersection of the bulb axis with plane Y5-Y5.
MP 21 and MP 22	Intersections of the top obscuration with a plane parallel to plane H-H and containing the bulb axis.

E.5 Dimensions to be measured

Table E.1 states the dimensions to be measured. Values and tolerances are given on the relevant filament lamp data sheet H4, H17, H19 or HS1 of R.E.5.

Table E.1 – Dimensions to be measured for H4, H17, H19 and HS1 lamps

Distance (see Figure E.2)	Measured perpendicular to plane	Viewing direction	Dimension	
			12 V	24 V
MP 2 to MP 3	H-H	1	a/26,0	
MP 1 to MP 3 [a]	H-H	1	a/23,5	
MP 3 to H-H [d]	H-H	1	b_1/29,5	b_1/30,0
MP 4 to H-H [b]	H-H	1	b /33,0	
MP 18 to X-X [c,d]	X-X	3	b_2/29,5	b_2/30,0
		4		
MP 19 to X-X [c]	X-X	3	b /33,0	
		4		
MP 3 to MP 5 [d]	H-H	1	c/29,5	c/30,0
MP 4 to MP 6 [b]	H-H	1	c/33,0	
MP 7 to MP 3	H-H	1	d	
MP 8 to reference plane	Reference plane	1	e	
MP 8 to MP 9	Reference plane	1	f	
MP 13 to V-V	V-V	2	g/26,0	
MP 12 to V-V [a]	V-V	2	g/23,5	
MP 14 to V-V [d]	V-V	2	h/29,5	h/30,0
MP 15 to V-V	V-V	2	h/33,0	
MP 9 to MP 10	Reference plane	1	l_r	
MP 8 to MP 11	Reference plane	1	l_c	
MP 16 to V-V [b]	V-V	2	p/33,0	
MP 17 to V-V [b]	V-V	2	q/33,0	
Angle α (see Figure E.3)				
MP 23 to MP 20	H-H	1	α	
MP 23 to MP 21	V-V	2	α	
MP 23 to MP 22	V-V	2	α	
MP 24 to MP 25	V-V	2	B/33,0	

[a] For category HS1, this dimension shall be measured at 25,0 mm distance from the reference plane.
For category H19, this dimension shall be measured at 24,5 mm distance from the reference plane.

[b] For category HS1, this dimension shall be measured at 31,0 mm distance from the reference plane.

[c] For categories H17 and H19, viewing direction ③ is an alternative to viewing direction ④, but values and tolerances shall comply with those defined for viewing direction ④ in R.E.5.

[d] For category H19, this dimension shall be measured at 30,5 mm distance from the reference plane.

[e] To avoid measurement errors of the shield width B due to the refractions by the glass envelope, the glass envelope shall be removed. Alternatively one of the following procedures can be used, provided that it is verified to end up with the same result.

- the use of X-ray measurement;
- the use of an immersion fluid inside and outside of the envelope in a rectangular glass bath ensuring the refractive index of the immersion fluid matches that of the glass envelope close enough to avoid refractions. The immersion fluid can be filled inside the envelope after removing the top of the bulb. Internal elements shall not be touched/moved;
- the use of a correction factor, taking into account the optical offset and the measurement uncertainty.

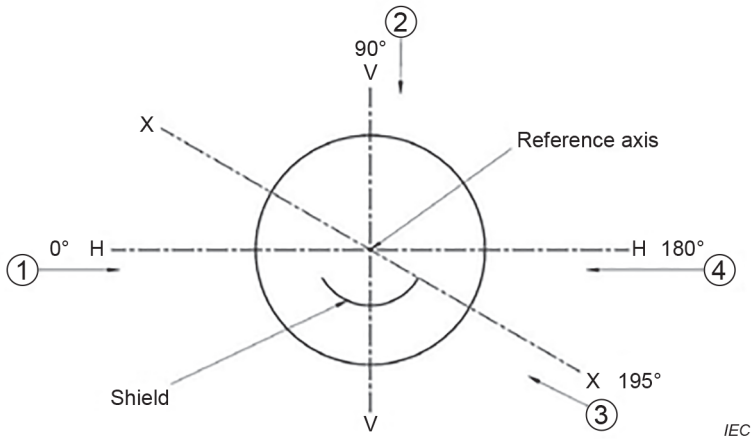


Figure E.1 – Viewing directions, seen from the top of the lamp

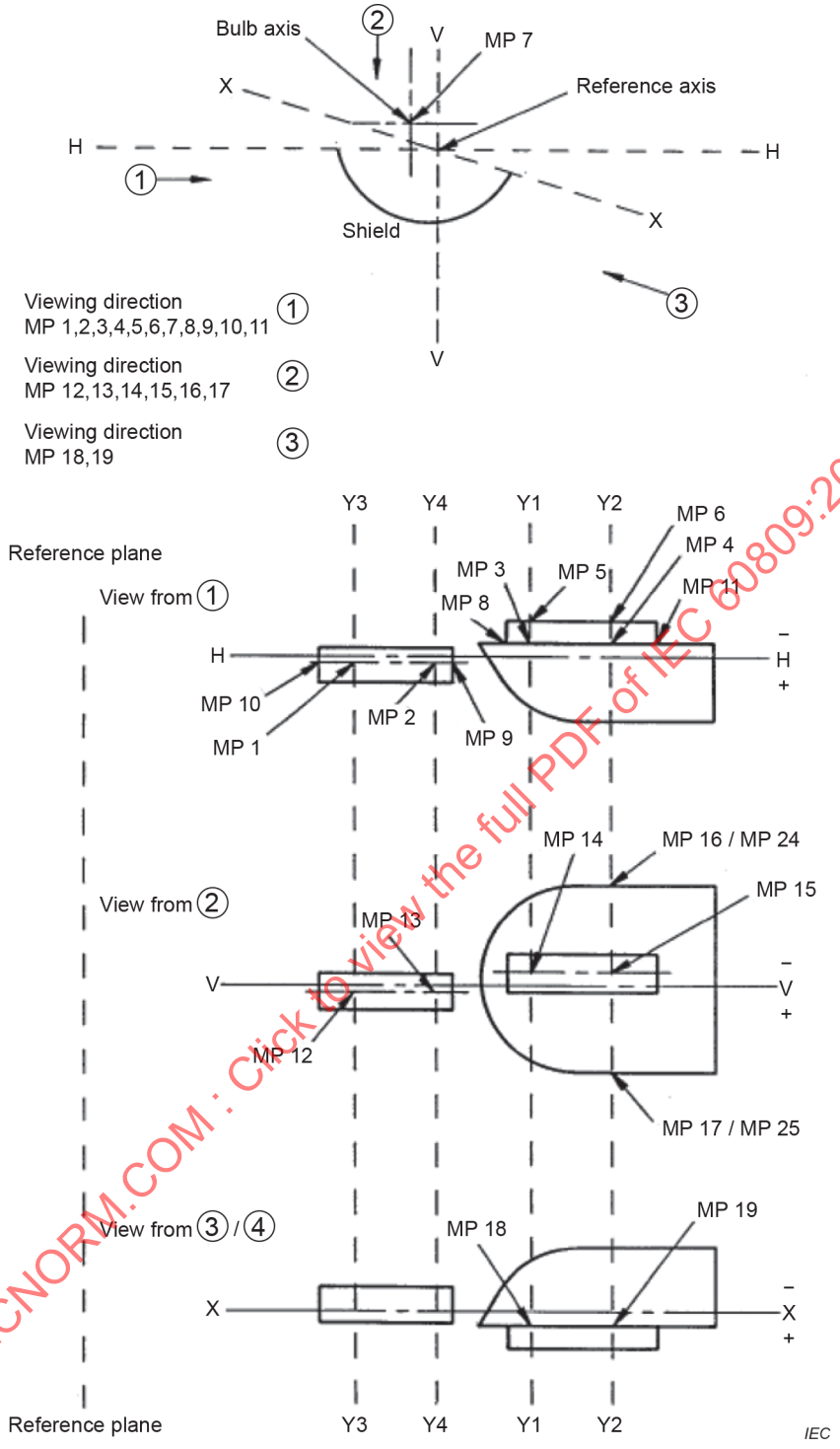


Figure E.2 – Position of measuring points of H4, H17, H19 and HS1 lamps

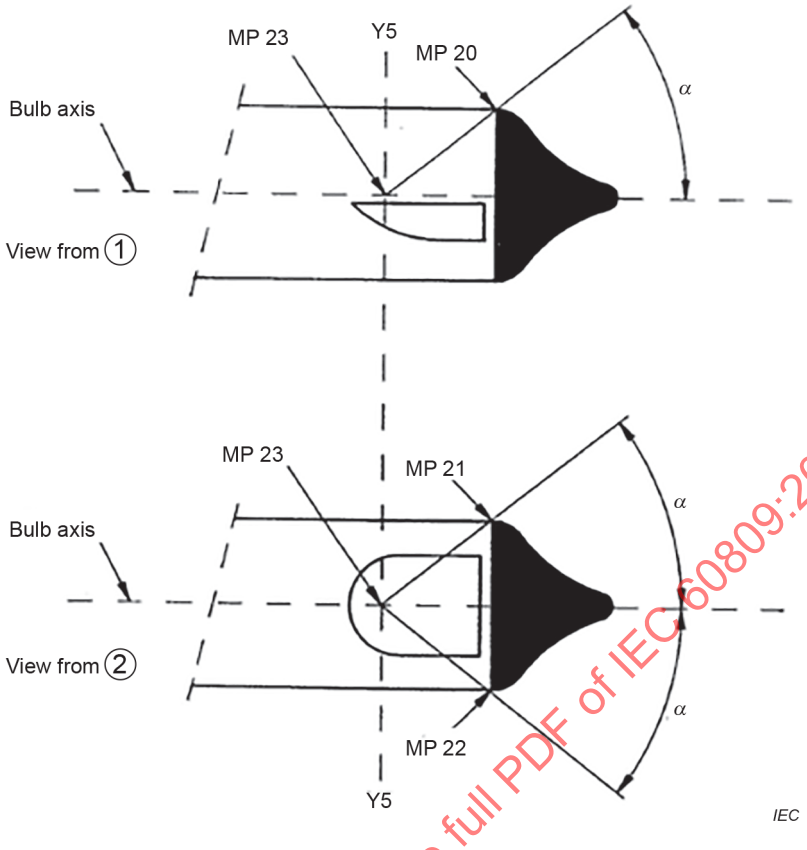


Figure E.3 – Top obscuration