



BSI Standards Publication

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

National foreword

This British Standard is the UK implementation of EN IEC 60809:2021+A1:2023. It is identical to IEC 60809:2021, incorporating amendment 1:2023. It supersedes BS EN IEC 60809:2021, which is withdrawn.

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

The UK participation in its preparation was entrusted to Technical Committee CPL/34/1, Electric lamps.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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English Version

Lamps and light sources for road vehicles - Dimensional,
electrical and luminous requirements
(IEC 60809:2021)

Lampes et sources lumineuses pour véhicules routiers -
Exigences dimensionnelles, électriques et lumineuses
(IEC 60809:2021)

Lampen und Lichtquellen für Straßenfahrzeuge - Maße,
elektrische und lichttechnische Anforderungen
(IEC 60809:2021)

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European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 34A/2232/FDIS, future edition 4 of IEC 60809, prepared by SC 34A "Electric light sources" of IEC/TC 34 "Lighting" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60809:2021.

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- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2024-05-12

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The text of the International Standard IEC 60809:2021 was approved by CENELEC as a European Standard without any modification.

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

IEC 60983	NOTE	Harmonized as EN 60983
IEC 62504	NOTE	Harmonized as EN 62504

European foreword to amendment A1

The text of document 34A/2370/FDIS, future IEC 60809/AMD1, prepared by SC 34A "Electric light sources" of IEC/TC 34 "Lighting" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60809:2021/A1:2023.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2024-09-13
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-12-13

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Endorsement notice

The text of the International Standard IEC 60809:2021/AMD1:2023 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

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

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-845	-	International Electrotechnical Vocabulary. - Lighting	-	-
IEC 60051-1	-	Direct acting indicating analogue electrical measuring instruments and their accessories - Part 1: Definitions and general requirements common to all parts	EN 60051-1	-
IEC 60061-1	-	Lamp caps and holders together with gauges for the control of interchangeability and safety. Part 1: Lamp caps	EN 60061-1	-
IEC 60810	2017	Lamps, light sources and LED packages for road vehicles - Performance requirements	EN IEC 60810	2018
+ A1	2019		+ A1	2019
+ A2	2022		+ A2	2022
IEC 62707-1	2013	LED-binning - Part 1: General requirements and white colour grid intended for automotive applications	EN 62707-1	2014
+ A1	2018		+ A1	2018
CIE 015	-	Colorimetry	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

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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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 62707-1:2013, *LED-binning – Part 1: General requirements and white colour grid intended for automotive applications*

IEC 62707-1:2013/AMD1:2018 

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 M₁ and N₁ 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*

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 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*

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.

A1 3.19
matrix light source
MLS

LED light source consisting of a grid of individually operated pixels in two perpendicular directions

Note 1 to entry: The grid consists of m pixels in direction x (row) and n pixels in direction y (column).

3.20
pitch p_x and pitch p_y

nominal distance (centre-to-centre) in direction x respectively in direction y between adjacent pixels in an MLS having a rectilinear grid pattern

3.21
pixel

smallest element of a matrix light source that is capable of being operated individually **A1**

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:	$y = 0,335$
----------	------------------	-------------

² See CIE 015:2018.

R₂₃ the spectral locus
R₃₄ the purple line: (its linear extension across the purple range of colours between the red and the blue extremities of the spectral locus).
R₄₁ purple boundary: $y = 0,980 - x$

with intersection points:

R₁: $x = 0,645, y = 0,335$
R₂: $x = 0,665, y = 0,335$
R₃: $x = 0,735, y = 0,265$
R₄: $x = 0,721, y = 0,259$

– finished filament lamps emitting amber light:

A₁₂ green boundary: $y = x - 0,120$
A₂₃ the spectral locus²
A₃₄ red boundary: $y = 0,390$
A₄₁ white boundary: $y = 0,790 - 0,670 x$

with intersection points:

A₁: $x = 0,545, y = 0,425$
A₂: $x = 0,560, y = 0,440$
A₃: $x = 0,609, y = 0,390$
A₄: $x = 0,597, y = 0,390$

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 locus³.

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.

³ See CIE 015:2018.

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.

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:

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

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 coordinates 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 its 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 $23\text{ °C} \pm 5\text{ °C}$ 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

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

k_{red} is calculated according to:

⁴ See CIE 015:2018.

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

where Φ_{λ} , $V(\lambda)$ 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

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

k_{UV} is calculated according to:

$$k_{\text{UV}} = \frac{\int_{250}^{400} \Phi_{\lambda} S(\lambda) d\lambda}{k_{\text{m}} \times \int_{380}^{780} \Phi_{\lambda} V(\lambda) d\lambda}$$

where k_{m} , Φ_{λ} , $V(\lambda)$ 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, $\overline{A_1}$ Lx5B, Lx6A, Lx6B⁵ $\overline{A_1}$, L1A/6 and L1B/6 are measured as follows.

Measurements shall be made on finished light sources, at an ambient temperature of $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

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 $\pm 0,5\text{ mm}$ under consideration) and the light centre length of the major function shall be $3,0\text{ mm} \pm 0,3\text{ mm}$.

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.