BS EN 60810:2015

BSI Standards Publication

Lamps for road vehicles — Performance requirements

National foreword

This British Standard is the UK implementation of EN 60810:2015. It is identical to IEC 60810:2014. It supersedes BS EN 60810:2003+A2:2013 which is withdrawn.

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

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

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

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English Version

Lamps for road vehicles - Performance requirements (IEC 60810:2014)

Lampes pour véhicules routiers - Exigences de performances (IEC 60810:2014)

Lampen für Straßenfahrzeuge - Anforderungen an die Arbeitsweise (IEC 60810:2014)

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CENELEC

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

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Foreword

The text of document 34A/1797/FDIS, future edition 4 of IEC 60810, prepared by SC 34A "Lamps", of IEC/TC 34 "Lamps and related equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60810:2015.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2015-10-20
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2018-01-20

This document supersedes EN 60810:2003.

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Endorsement notice

The text of the International Standard IEC 60810:2014 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 60068-2-20	NOTE	Harmonized as EN 60068-2-20.
IEC 60068-2-47	NOTE	Harmonized as EN 60068-2-47.
IEC 60682	NOTE	Harmonized as EN 60682.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

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

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

Publication	Year	Title	EN/HD	Year
IEC 60050	series	International electrotechnical vocabulary	-	-
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 60068-2-6	1995	Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	1995
IEC 60068-2-14	-	Environmental testing - Part 2-14: Tests - Test N: Change of temperature	EN 60068-2-14	-
IEC 60068-2-43	-	Environmental testing - Part 2-43: Tests - Test Kd: Hydrogen sulphide test for contacts and connections	EN 60068-2-43	-
IEC 60068-2-60	-	Environmental testing - Part 2: Tests - Test Ke: Flowing mixed gas corrosion test	EN 60068-2-60	-
IEC 60410	1973	Sampling plans and procedures for inspection by attributes	-	-
IEC 60809	2014	Lamps for road vehicles - Dimensional, electrical and luminous requirements	EN 60809	2015
CISPR 25	-	Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers	EN 55025	-

Publication	Year	Title	EN/HD	Year
UNECE 1958 Agreement	-	Agreement concerning the adoption of uniform technical prescription 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 prescriptions	-	-
UNECE 38	-	1958 Agreement, Addendum 37: Regulation No. 38: Uniform provisions concerning the approval of rear fog lamps for power-driven vehicles and their trailers	-	-
UNECE 48	-	1958 Agreement, Addendum 47: Regulation No. 48: Uniform provisions concerning the approval of vehicles with regard to the installation of lighting and light-signalling devices	-	-
UNECE 101	-	1958 Agreement, 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	-	-
UNECE 123	-	1958 Agreement, Addendum 122: Regulation No. 123: Uniform provisions concerning the approval of adaptive front lighting systems (AFS) for motor vehicles	-	-
UNECE 128	-	1958 Agreement, 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	-	-
JESD22-A100D	-	Cycled temperature humidity bias life test	-	-
JESD22-A101C	-	Steady-state temperature humidity bias life test	-	-
JESD22-A104D	-	Temperature cycling	-	-
JESD22-A105C	-	Power and temperature cycling	-	-
JESD22-A106B	-	Thermal shock	-	-
JESD22-A108D	-	Temperature, bias, and operating life	-	-
JESD22-A113F	-	Preconditioning of plastic surface mount devices prior to reliability testing	-	-

Publication	Year	Title	EN/HD	Year
JESD22-A115C	-	Electrostatic discharge (ESD) sensitivity testing machine model (MM)	-	-
JESD22-B101B	-	External visual	-	-
JESD22-B103B	-	Vibration, variable frequency	-	-
JESD22-B106D	-	Resistance to solder shock for through-hole mounted devices	-	-
JESD22-B110B	-	Mechanical shock - Component and subassembly	-	-
JESD51-50	2012-04	Overview of methodologies for the thermal measurement of single- and multi-chip, single- and multi-pn-junction light-emitting diodes (LEDs)	-	-
JESD51-51	2012-04	Implementation of the electrical test method for the measurement of real thermal resistance and impedance of light-emitting diodes with exposed cooling surface	-	-
JESD51-52	2012-04	Guidelines for combining CIE 127-2007 total flux measurements with thermal measurements of LEDs with exposed cooling surface	-	-
JESD51-53	2012-05	Terms, definitions and units glossary for LED thermal testing	-	-
IPC/ECA J-STD-002C	-	Solderability tests for component leads, terminations, lugs, terminals and wires	-	-
ANSI/ESDA/JEDEC JS-001	2012	JEDEC/ESDA joint standard for electrostatic discharge sensitivity test - Human body model (HBM) - Component level	-	-

CONTENTS

LAMPS FOR ROAD VEHICLES – PERFORMANCE REQUIREMENTS

1 Scope

This International Standard is applicable to lamps (filament lamps, discharge lamps and LED light sources) to be used in headlamps, fog-lamps and signalling lamps for road vehicles. It is especially applicable to those lamps which are listed in IEC 60809. However, the standard may also be used for other lamps falling under the scope of this standard.

It specifies requirements and test methods for the measurement of performance characteristics such as lamp life, luminous flux maintenance, torsion strength, glass bulb strength and resistance to vibration and shock. Moreover, information on temperature limits, maximum lamp outlines and maximum tolerable voltage surges is given for the guidance of lighting and electrical equipment design.

For some of the requirements given in this standard, reference is made to data given in tables. For lamps not listed in such tables, the relevant data are supplied by the lamp manufacturer or responsible vendor.

The performance requirements are additional to the basic requirements specified in IEC 60809. They are, however, not intended to be used by authorities for legal type-approval purposes.

NOTE 1 In the various vocabularies and standards, different terms are used for "incandescent lamp" (IEC 60050-845:1987, 845-07-04) and "discharge lamp" (IEC 60050-845:1987, 845-07-17). In this standard, "filament lamp" and "discharge lamp" are used. However, where only “lamp” is written both types are meant, unless the context clearly shows that it applies to one type only.

NOTE 2 This standard does not apply to luminaires.

NOTE 3 In this standard, the term LED light source is used, in other standards the term LED lamps can be used to describe similar products.

2 Normative references

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

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org/)

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

IEC 60068-2-6:1995, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14*, Environmental testing – Part 2–14: Tests – Test N: Change of temperature*

IEC 60068-2-43, *Environmental testing – Part 2-43: Tests – Test Kd: Hydrogen sulphide test for contacts and connections*

IEC 60068-2-60, *Environmental testing – Part 2: Tests – Test Ke: Flowing mixed gas corrosion test*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60809:2014, *Lamps for road vehicles*

CISPR 25, *Vehicles, boats and internal combustion engines – Radio disturbance characteristics – Limits and methods of measurement for the protection of on-board receivers*

United Nations, *Agreement concerning the adoption of uniform technical prescription 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 prescriptions.*[1]
Available from Internet: www.unece.org/trans/main/wp29/wp29regs.html (website checked 2014-08-19)

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 122: Regulation No. 123, *Uniform provisions concerning the approval of adaptive front-lighting systems (AFS) for motor 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 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*

JESD22-A100D, *Cycled temperature humidity bias life test*

JESD22-A101C, *Steady-state temperature humidity bias life test*

JESD22-A104D, *Temperature cycling*

JESD22-A105C, *Power and temperature cycling*

JESD22-A106B, *Thermal shock*

JESD22-A108D, *Temperature, bias, and operating life*

JESD22-A113F, *Preconditioning of plastic surface mount devices prior to reliability testing*

JESD22-A115C, *Electrostatic discharge (ESD) sensitivity testing machine model (MM)*

JESD22-B101B, *External visual*

JESD22-B103B, *Vibration, variable frequency*

JESD22-B110B, *Mechanical shock*

JESD22-B106D, *Resistance to solder shock for through-hole mounted devices*

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1 Also known as *The 1958 Agreement*. In the text of this standard the regulations under this agreement are referred to as, for example, UN Regulation 37 or R37.

JESD51-50:2012-04, *Overview of methodologies for the thermal measurement of single- and multi-chip, single- and multi-pnjunction light-emitting diodes (LEDs)*

JESD51-51:2012-04, *Implementation of the electrical test method for the measurement of real thermal resistance and impedance of light-emitting diodes with exposed cooling surface*

JESD51-52:2012-04, *Guidelines for combining CIE 127-2007 total flux measurements with thermal measurements of leds with exposed cooling surface*

JESD51-53:2012-05, *Terms, definitions and units glossary for LED thermal testing*

ANSI/IPC/ECA J-STD-002C, *Solderability tests for component leads, terminations, lugs, terminals and wires*

ANSI/ESDA/JEDEC JS-001-2012, *Joint JEDEC/ESDA standard for electrostatic discharge sensitivity testing human body model (HBM) – component level*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-845 and IEC 60809, as well as the following apply.

3.1
life
total time (expressed in hours) during which a lamp has been operated before it becomes useless

Note 1 to entry: For filament lamps, it is considered to be so according to one of the following criteria:

a) the end of life is the time when the filament fails;

b) the life of a dual-filament lamp is the time until either filament fails, if the lamp is tested in a switching cycle involving alternative operation of both filaments

3.2
characteristic life
T (or T_c)
constant of the Weibull distribution indicating the time up to which 63,2 % of a number of tested lamps of the same type have ended their individual lives

3.3
life B3
constant of the Weibull distribution indicating the time during which 3 % of a number of the tested lamps of the same type have reached the end of their individual lives

3.4
luminous flux maintenance
ratio of the luminous flux of a lamp at a given time in its life to its initial luminous flux, the lamp being operated under specific conditions

Example 1 L_{70} is the time in hours to 70 % luminous flux maintenance.

Example 2 L_{50} is the time in hours to 50 % luminous flux maintenance.

3.5
initial luminous flux
luminous flux of a lamp measured after the ageing specified in Annex C of IEC 60809:2014, for filament lamps or in Annex D of this standard for discharge lamps or in Annex I of this standard for LED light sources

3.6
rated value
value of a characteristic specified for operation of a lamp at test voltage and/or other specified conditions

3.7
pinch temperature limit
maximum admissible pinch temperature to ensure satisfactory lamp performance in service

3.8
solder temperature limit
maximum admissible solder temperature to ensure satisfactory lamp performance in service

3.9
maximum lamp outline
contour limiting the space to be reserved for the lamp in the relevant equipment

3.10
heavy-duty lamp
lamp declared as such, by the manufacturer or responsible vendor, which shall comply with the heavy-duty test conditions specified in Table B.2 of this standard in addition to the requirements specified in IEC 60809

3.11
life B_{10}
constant of the Weibull distribution indicating the time during which 10 % of a number of the tested lamps of the same type have reached the end of their individual lives

3.12
LED package
solid state device embodying a p-n junction, emitting optical radiation when excited by an electric current

Note 1 to entry: Examples are shown in Figure 1.

Note 2 to entry: In UN terminology the term "LED" is used with the same definition.

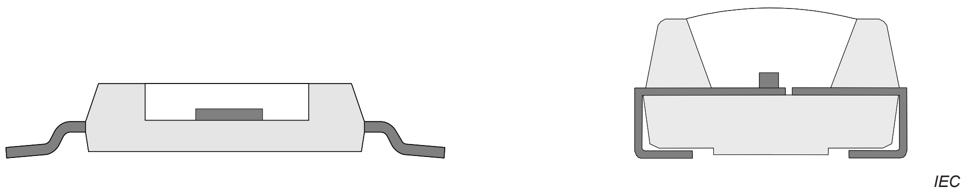


Figure 1 – Examples of LED packages

3.13
LED light source
light source where the visible radiation is emitted from one or more LED(s)

Note 1 to entry: An LED light source may or may not require an additional electronic control gear and may or may not require additional provisions for thermal management.

3.13.1
LED module
LED light source which can only be replaced with the use of mechanical tools

Note 1 to entry: LED modules are generally considered as components for use in trades, professions or industries and are generally not intended for sale to the general public.

Note 2 to entry: Examples are shown in Figures 2 and 3.

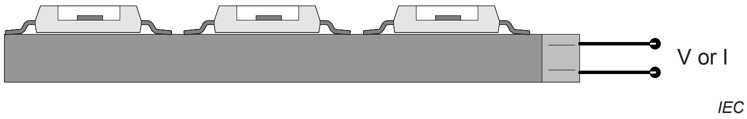


Figure 2 – Example for an LED module without integrated heatsink

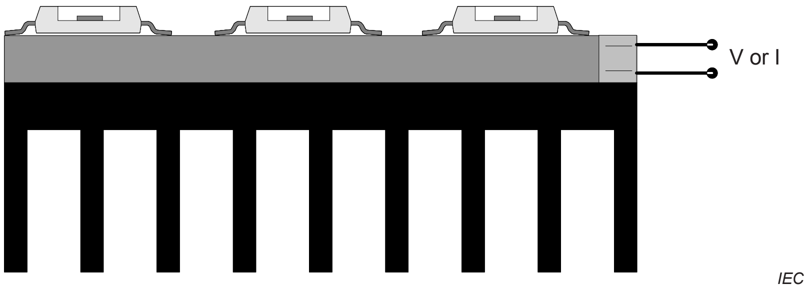


Figure 3 – Example for an LED module with integrated heatsink

3.13.2
replaceable LED light source
LED light source which can be easily replaced without the use of special tools

Note 1 to entry: Replaceable LED light sources are usually intended for sale to the general public as a replacement part.

Note 2 to entry: An example is shown in Figure 4.

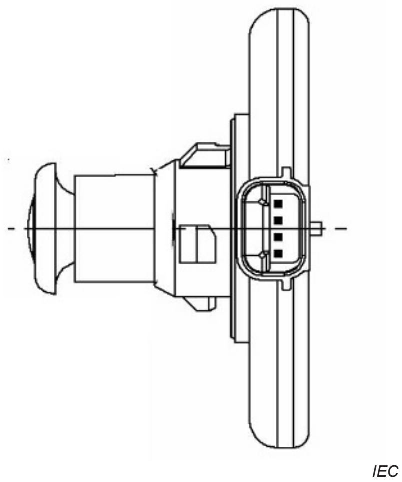


Figure 4 – Example for a replaceable LED light source

3.13.3
non-replaceable LED light source
LED light source which cannot be removed from the device or luminaire

Note 1 to entry: Non-replaceable LED 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.

Note 2 to entry: An example is shown in Figure 5.

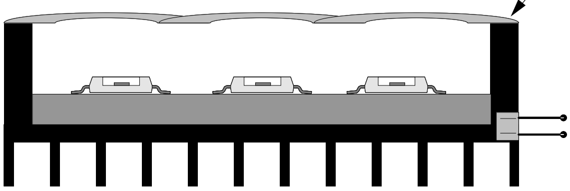


Figure 5 – Example for a non-replaceable LED light source

3.14
T_p of a LED light source
temperature at a specified location on the surface of the LED light source (T_p-point) that can be measured during operation of the light source and that can be correlated to the temperature of the p-n junction of the LED

Note 1 to entry: The T_p point is generally specified by the manufacturer of the LED light source or by its datasheet.

3.15
electronic light source controlgear
one or more component(s) between supply and light source to control voltage and/or electrical current of the light source

3.16
case temperature
T_s
temperature of the thermocouple attachment point on the LED package as defined by the manufacturer of the package

4 Requirements and test conditions for filament lamps

4.1 Basic function and interchangeability

Filament lamps shall comply with IEC 60809.

4.2 Torsion strength

The cap shall be strong and firmly secured to the bulb.

Compliance is checked before and after the life test by submitting the filament lamp to the following torque values:

- filament lamps with bayonet caps
  - with 9 mm shell diameter: 0,3 Nm[2];
  - with 15 mm shell diameter: 1,5 Nm[2];
  - with 20 mm shell diameter: 3,0 Nm[2];
- filament lamps with screw caps
  - with 10 mm shell diameter: 0,8 Nm[2].

[2] Under consideration.

The torque shall not be applied suddenly but shall be increased progressively from 0 to the specified amount.

Values are based on a non-compliance level of 1 %.

4.3 Characteristic life T

The life T measured on a test quantity of at least 20 filament lamps shall be at least 96 % of the rated value, given in Table 3.

Compliance is checked by life tests as prescribed in Annex A.

4.4 Life B3

The life B3 shall not be less than the rated value given in Table 3.

Compliance is checked by life tests as prescribed in Annex A.

The number of filament lamps failing before the required time shall not exceed the values in Table 1.

Table 1 – Conditions of compliance for life B3

Number of filament lamps tested	Acceptance number
23 to 35	2
36 to 48	3
49 to 60	4
61 to 74	5
75 to 92	6

4.5 Luminous flux maintenance

The luminous flux maintenance shall be not less than the rated value given in Table 4. This value is based on a non-compliance level of 10 %.

4.6 Resistance to vibration and shock

In the event of service life being influenced by vibration or shock, the test methods and schedules detailed in Annex B shall be used to assess the performance.

The filament lamps are deemed to have satisfactorily completed the wideband or narrowband random vibration test as described in Annex B, if they continue to function during and after the test.

The number of filament lamps failing one of the tests shall not exceed the values in Table 2 (values are based on the AQL of 4 %).

Table 2 – Conditions of compliance for the vibration test

Number of filament lamps tested	Acceptance number
14 to 20	2
21 to 32	3
33 to 41	4
42 to 50	5
51 to 65	6

4.7 Glass-bulb strength

In the event of bulbs being impaired by mechanical handling for their assembly in equipment, the test methods and schedules defined in Annex C shall be used to assess the performance. The bulbs shall withstand the specified compression strength.

5 Filament lamp data

Rated life and luminous flux-maintenance values for road vehicle filament lamps are tested under the conditions prescribed in Annex A.

Tables 3 and 4 provide rated life and luminous flux maintenance values for continuous operation.

Table 3 – Rated life values for continuous operation

Filament lamp data sheet number		Type	12 V			24 V		
IEC 60809[a]	UN[b]	Category	Test V	B3 /h	Tc /h	Test V	B3 /h	Tc /h
Lamps for front lighting applications								
2310	R37-H1	H1	13,2	150	400	28,0	90	250
2320	-	H2	13,2	90	250	28,0	90	250
2330	R37-H3	H3	13,2	150	400	28,0	90	250
2120	R37-H4	H4 (HB/LB)	13,2	125/250	250/500	28,0	100/200	200/400
2315	R37-H7	H7	13,2	300	500	28,0	200	400
2365	R37-H8	H8, H8B	13,2	400	800			
2370	R37-H9	H9, H9B	13,2	250	500			
2375	R37-H10	H10	13,2	800	1600			
2380	R37-H11	H11, H11B	13,2	350	600	28,0	300	600
2385	R37-H12	H12	13,2	480	970			
-	R37-H13	H13,H13A (HB/LB)	13,2	170/1200	350/2500			
-	R37-H15	H15 (HB/DRL)	13,2	250/2000	500/4000	28,0	200/1500	400/3000
-	R37-H16	H16, H16B	13,2	500	1000			
-	R37-H17	H17	13,2	100/350	200/700			
3430	R37-H27W	H27W/1 H27W/2	13,5	90	190			
2325	R37-HB3	HB3/ HB3A	13,2	250	500			
2335	R37-HB4	HB4/ HB4A	13,2	850	1700			
2420	R37-HIR2	HIR2	13,2	300	600			
2130	R37-HS1	HS1 (HB/LB)	13,2	150/150	300/300			
2340	R37-HS2	HS2	13,2	100	250			
-	R37-P24W	PSX24W	13,2	1000	2000			
-	R37-P24W	PX24W	13,2	1000	2000			
-	R37-PSX26W	PSX26W	13,2	1000	2000			
2110	R37-R2	R2 (HB / LB)	13,2	30/60	90/160			
2150	R37-S1/S2	S2	13,2	100/100	200/200			
Lamps for signalling applications								
		C5W	13,5	350	750	28,0	120	350
3410	R37-H6W	H6W, HY6W	13,5	350	700			
-	R37-H10W	H10W/1	13,5	150	400			
-	R37-H10W	HY10W/1	13,5	300	600			
3420	R37-H21W	H21W	13,5	200	400	28,0	90	180
-	R37-HY21W	HY21W	13,5	200	400	28,0	90	180
-	R37-P13W	P13W	13,5	4000	8000			
-	R37-P19W	P19W	13,5	1000	2000			

Filament lamp data sheet number		Type	12 V			24 V		
IEC 60809[a]	UN[b]	Category	Test V	B3 /h	Tc /h	Test V	B3 /h	Tc /h
3310	R37-P21W	P21W	13,5	120	320	28,0	60	160
3120	R37-P21/4W	P21/4W	13,5	60/600	160/1600	28,0	60/600	160/1600
3110	R37-P21/5W	P21/5W	13,5	60/600	160/1600	28,0	60/600	160/1600
-	R37-P24W	P24W	13,5	750	1500			
3315	R37-P27W	P27W	13,5	550	1320			
-	R37-P27/7W	P27/7W	13,5	550/3690	1320/8820			
-	R37-PR21W	PR21W	13,5	120	320	28,0	60	160
-	R37-PR21/4W	PR21/4W	13,5	60/600	160/ 1600			
-	R37-PR21/5W	PR21/5W	13,5	60/600	160/1600			
-	R37-P27/7W	PR27/7W	13,5	550/3600	1300/8000			
-	R37-P19W	PSY19W	13,5	1200	2400			
-	R37-P24W	PSY24W	13,5	1000	2000			
-	R37-P19W	PY19W	13,5	1200	2400			
3311	R37-PY21W	PY21W	13,5	120	320	28,0	60	160
-	R37-P24W	PY24W	13,5	1000	2000			
3141	R37-PY27/7W	PY27/7W	13,5	550/3600	1300/8000			
3320	R37-R5W	R5W	13,5	100	300	28,0	80	225
3330	R37-R10W	R10W	13,5	100	300	28,0	80	225
-	R37-R10W	RY10W	13,5	100	300			
3340	R37-T4W	T4W	13,5	300	750	28,0	120	350
4310	R37-W3W	W3W	13,5	500	1500	28,0	400	1100
4320	R37-W5W	W5W	13,5	200	500	28,0	120	350
4340	R37-W16W	W16W	13,5	250	700			
4321	R37-W5W	WY5W	13,5	200	500			
4120	R37-C21W	C21W	13,5	40	110			

The values indicated are minimum requirements. Depending on some particular customers' specifications, different values may be obtained, i.e. shorter life/higher luminous flux or longer life/lower luminous flux. This shall be negotiated between filament lamp manufacturers and their customers.

If there is no direct contact between the customer and supplier, the information on deviation from recommended life time data shall be given on the package and/or in publicly available technical documentation

[a] If a UN sheet number is referenced, the IEC sheet number refers to a data sheet withdrawn with Amendment 5 of Edition 2 of IEC 60809 and is given for information only.

[b] The number is front of the dash indicates the number of the UN regulation.

Table 4 – Rated luminous flux-maintenance values for continuous operation

Filament lamp data sheet number		Type	12 V			24 V		
IEC 60809[e]	UN[f]	Category	Test V	Luminous flux maintenance		Test V	Luminous flux maintenance	
				h	%		h	%
Lamps for front lighting applications								
2110	R37-R2	R2	13,2	55[c] 110[d]	85 70	28,0 28,0	55[c] 110[d]	85 70
2120	R37-H4	H4	13,2	110[c] 225[d]	85 85	28,0	110[c] 225[d]	85 85
2125	-	H6	14,0	75[c] 150[d]	85 80	–	–	–
2305		H5	14,0	75	85	–	–	–
2310	R37-H1	H1	13,2	170	90	28,0	170	90
2320		H2	13,2	170	90	28,0	170	90
2330	R37-H3	H3	13,2	170	90	28,0	170	90
3110	R37-P21/5W	P21/5W	13,5	110[a] 750[b]	70 70	28,0	110[a] 750[b]	70 70
3120	R37-P21/4W	P21/4W	13,5	110[a]750[b]	70 70	28,0	Under consideration	Under consideration
3310	R37-P21W	P21W	13,5	110	70	28,0	110	70
3320	R37-R5W	R5W	13,5	150	70	28,0	150	70
3330	R37-R10W	R10W	13,5	150	70	28,0	150	70
3340	R37-T4W	T4W	13,5	225	70	28,0	225	70
4110	R37-C5W	C5W	13,5	225	60	28,0	225	60
4120	R37-C21W	C21W	13,5	75	60	–	–	–
4310	R37-W3W	W3W	13,5	750	60	28,0	750	60
4320	R37-W5W	W5W	13,5	225	60	28,0	225	60

The values indicated are minimum requirements. Depending on some particular customers' specifications, different values may be obtained, i.e. shorter life/higher luminous flux or longer life/lower luminous flux. This shall be negotiated between filament lamp manufacturers and their customers.

Luminous flux-maintenance values for extended operation times are under consideration.

[a] High-wattage filament.

[b] Low-wattage filament.

[c] Main or upper beam filament.

[d] Dipped or lower beam filament.

[e] If a UN sheet number is referenced, the IEC sheet number refers to a data sheet withdrawn with Amendment 5 of Edition 2 of IEC 60809 and is given for information only.

[f] The number is front of the dash indicates the number of the UN regulation.

6 Requirements and test conditions for discharge lamps

6.1 Basic function and interchangeability

Discharge lamps shall comply with the technical requirements of IEC 60809.

6.2 Mechanical strength

6.2.1 Bulb-to-cap connection

The bulb shall be strongly secured to the cap. Compliance is checked by means of the bulb deflection test conducted in accordance with Annex E.

6.2.2 Cable-to-cap connection (if any*)*

If the cable has a fixed connection to the cap, it shall withstand a pulling force of 60 N. The force shall be applied in the direction of the (straight) cable.

6.3 Characteristic life T

The life T measured on a test quantity of at least 20 lamps shall be not less than the value declared by the manufacturer, which shall be at least 3 000 h. Compliance is checked by tests as prescribed in Annex D.

6.4 Life B3

The life B3 measured on a test quantity of at least 20 lamps shall be not less than the value declared by the manufacturer, which shall be at least 1 500 h. Compliance is checked by tests as prescribed in Annex D.

6.5 Luminous flux maintenance

The luminous flux maintenance shall be at least 60 % of the initial luminous flux. Compliance is checked by tests as prescribed in Annex D.

Values are based on a non-compliance level of 10 %.

6.6 Resistance to vibration and shock

In the event of service life being influenced by vibration and shock, the test methods and schedules in Annex B shall be used to assess the performance.

The discharge lamps are deemed to have satisfactorily completed the wideband or narrowband random vibration test as described in Annex B, if they continue to function during and after the test. Moreover, the position of the electrodes shall comply with the dimensional requirements as prescribed in the relevant standard.

Values are based on a non-compliance level of 4 %.

Precautions should be taken to avoid potential hazards due to high voltages, UV radiation and risk of bulb breakage during starting, run-up and operation of some discharge lamp types.

6.7 Discharge lamps with integrated starting device

The total weight of the lamp shall not exceed 75 g. Information for ballast design is given in Annex G.

6.8 Discharge lamps with integrated starting device and integrated ballast

The total weight of the lamp shall not exceed 120 g.

The centre of gravity of lamps using IEC cap PK32d shall be positioned within the shape of a cylinder as indicated by the shaded areas in Figure 6.

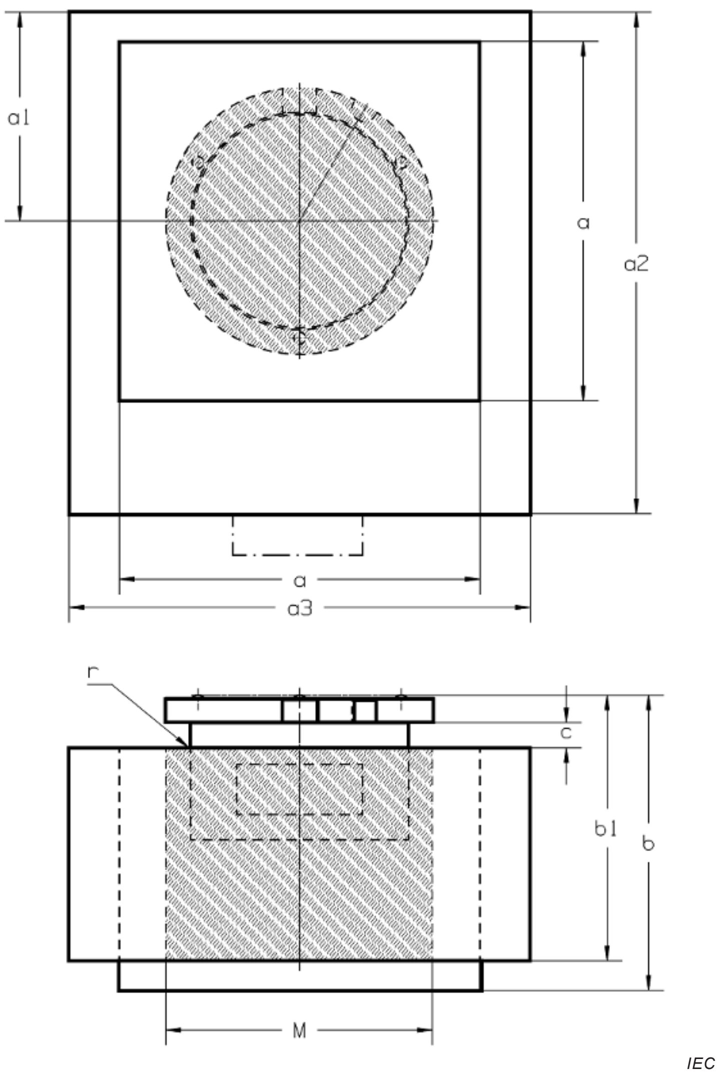


Figure 6 – Position of the centre of gravity (shaded areas)

7 Requirements and test conditions for LED light sources

7.1 Basic function and interchangeability

LED light sources shall:

- be so designed as to be and to remain in good working order when in normal use;
- exhibit no fault in design or manufacture;
- exhibit no scores or spots on their optical surfaces which might impair their efficiency and their optical performance.

Replaceable LED light sources shall be equipped with caps complying with IEC 60061-1. The cap shall be strong and firmly secured to the rest of the LED light source.

To ascertain whether LED light sources conform to these requirements above, a visual inspection, a dimension check and, where necessary, a trial fitting shall be carried out.

7.2 UV radiation

The UV-radiation of the LED light source shall be determined according to 5.9 of IEC 60809:2014. If $k_{UV} \leq 10^{-5}$ W/lm the light source is of the low-UV type.

7.3 Luminous flux and colour maintenance

The luminous flux maintenance value L_{70} and the colour maintenance shall be measured on a test quantity of at least 20 LED light sources according to the procedure given in Annex I.

For very small production batches, a test quantity less than 20 may be acceptable.

The manufacturer shall declare and determine the L_{70}-T_c and L_{70}-B_{10} values.

The measured values shall be not less than the value declared by the manufacturer.

For LED light sources which were approved under the corresponding UN Regulation 128, the L_{70}-B_{10} values shall be not less than specified in the Table 5.

Table 5 – Minimum L_{70}-B_{10} values for standardised LED light sources

Category according to UN R 128	Minimum L_{70}-B_{10} h
LR1	2 200 [a] 1 000 [b]

[a] low power function
[b] high power function

Table 6 shows typical "on"-time values for the different functions per 100 000 km, for information.

Table 6 – Typical "on"-times for the different functions per 100 000 km drive distance, based on an average speed of 33,6 km/h [a]

Intended application	Typical "on" times in hours per 100 000 km drive distance
Rear registration plate lamp	1 100 [b]
Direction indicator lamp	250
Front and rear position lamp	1 100 [b]
Stop lamp	500
End-outline marker lamp	1 100
Reversing lamp	50
Rear fog lamp	50
Daytime running lamp (DRL)	2 000
Side marker lamp	1 100 [b]
Cornering lamp	100
Low beam lamp (passing beam)	1 000
High beam lamp (driving beam)	100 [c]
Front fog lamp	100

[a] The average driving speed is based on the composition of driving cycles defined in R101.

[b] In case these light sources are intended for vehicles where these functions are also switched ON together with the DRL function, then the value of 3 100 shall be used.

[c] In case these light sources are intended for vehicles which use the 'adaptive driving beam' function of UN R123, then the value of 200 shall be used.

If the specific requirements of the intended use are known for the LED light source, these should be taken into account.

Compliance is checked by the tests prescribed in Annex I.

Values are based on a non-compliance level of 10 %.

Example for LED light source life-time data are given in Table 7.

Table 7 – Example for product data

Type	Intended use	L_{70}, B_{10}	L_{70}, T_c
MD0815	Stop lamp	1 500 h	2 500 h

7.4 Resistance to vibration and shock

In the event of service life being influenced by vibration and shock, the test methods and schedules in Annex B shall be used to assess the performance.

The light sources are deemed to have satisfactorily completed the wideband or narrowband random vibration test as described in Annex B, if they continue to function during and after the test.

Values are based on a non-compliance level of 4 %.

7.5 Electromagnetic compatibility

Replaceable LED light sources shall be classified according to CISPR 25.

7.6 Powered thermal cycling test

This test is intended to determine the ability of the LED light source to withstand changes of ambient temperatures.

LED light sources shall be tested according to test condition “Nb” of IEC 60068-2-14, under the following conditions (see Figure 7):

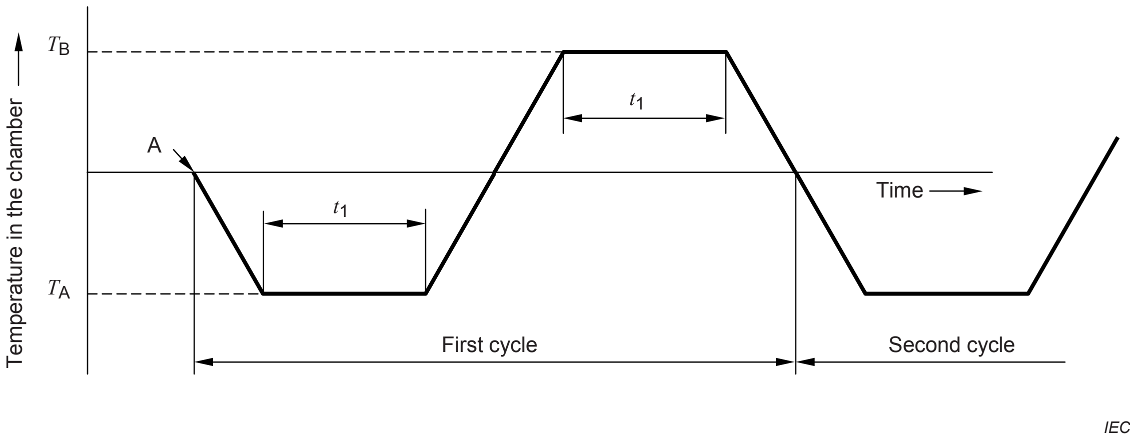
- rate of change of temperature is 3 K/min;
- the exposure time t_1 shall be a minimum of 2 h;
- the number of cycles shall be 15;
- the test shall be performed on a minimum of 20 LED light sources;
- during the testing, the LED light source shall be continuously switched on and off in 5 minute intervals (5 min on, 5 min off, 5 min on, etc.);
- the test voltage shall be chosen according to Clause I.2 of this standard;
- temperatures T_A and T_B shall be chosen according to the classes defined in Table 8.

Table 8 – Temperature classes for the powered thermal cycling test

	Lower temperature T_A	Higher temperature T_B
Class A	– 40 °C	+ 60 °C
Class B	– 40 °C	+ 85 °C

For LED light sources that require an external light source control gear, the light source control gear may also be subjected to this test.

LED light sources that require additional provisions for thermal management shall be tested with these provisions in place. A description of the thermal management design shall be included in the test report.



Key

A start of first cycle

Figure 7 – Extract from IEC 60068-2-14 Test Nb, showing the temperature cycle profile

After the powered thermal cycling test, the electrical and photometrical performance of the LED light source shall be tested.

The LED light sources are deemed to have satisfactorily completed the test if they continue to function after the test and if the photometrical and electrical performance is within the specifications provided by the manufacturer.

Values are based on a non-compliance level of 10 %.

8 Requirements and test conditions for LED packages

8.1 LED package stress test qualification

This Clause 8[3] defines minimum stress test driven qualification requirements and references test conditions for qualification of LED packages.

The purpose of this specification is to determine that a LED package is capable of passing the specified stress tests and thus can be expected to give a certain level of quality/reliability in automotive lighting applications.

“Stress test qualification” according to this document is defined as successful completion of the test requirements outlined in this document.

Subclause 8.6 defines a set of qualification tests that shall be considered for new LED package qualifications. In case of requalification associated with a design or process change, a limited set of qualification tests may be considered, see Annex L.

Where appropriate, family qualifications can be done, a rationale should be given by the supplier.

Examples for families:

- same chip technology in different LED packages;
- same phosphor systems in different LED packages.

This IEC standard makes reference to other IEC standards or standards from other organizations (e.g. JEDEC). Where relevant, further details on the test definitions can be found in these documents. Test conditions in this standard may deviate from test conditions in the reference documents (e.g. PTMCL condition 2). In such a case, further definitions in the reference document shall still be applied as appropriate.

The results of LED package testing may be reported by using the communication sheet as specified in Annex K.

8.2 Test samples

8.2.1 Lot requirements

Unless specified otherwise in 8.6, a total of minimum 78 LED packages taken from 3 different batches of 26 each shall be used for each test. For family qualification, the 3 different batches shall be considered to represent the whole variety of the qualification family.

8.2.2 Production requirements

All qualification LED packages shall be produced on tooling and processes at the manufacturing site that will be used to support LED package deliveries at projected production volumes.

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3 The approach on LED package stress test qualification as described in this standard is derived from a similar approach developed by the Automotive Electronics Council (AEC – Q101: Stress test qualification for automotive grade discrete semiconductors).

8.2.3 Pre- and post-stress test requirements

Electrical and photometric values (forward voltage, luminous flux or radiant power and/or intensity, colour parameter) shall be measured at the nominal test conditions as defined in the product specification before and after stress testing (see also 8.6.1).

NOTE A simple light/no light test is under consideration for testing at different temperatures.

All LED packages used for qualification shall meet the product specification parameters measured at the nominal test conditions before stress testing.

8.2.4 Assembly of LED packages on test boards

LED packages may need to be assembled on test boards. An appropriate choice of test board, interconnect material and process shall be made by the manufacturer. The choice of test board, interconnect material and process shall be documented for each individual test in the test report.

8.2.5 Moisture pre-conditioning (MP)

Moisture preconditioning is applicable to surface mountable devices designed for reflow soldering. All qualification LED packages used for the following tests:

- 8.6.4 TMCL,
- 8.6.5 WHTOL, and
- 8.6.6 PTMCL.

shall be subject to moisture preconditioning according to JESD22-A113F. The initial electrical and photometrical test according to 8.6.1 shall be executed after the moisture pre-conditioning.

8.2.6 Thermal resistance (TR) test

The thermal resistance shall be tested according to JESD51-50, JESD51-51, JESD51-52 and JESD51-53; the resulting $R_{\text{th electr}}$ and the optical power radiation of the LED package for the calculation of "$R_{\text{th,real}}$" should be recorded.

8.3 Definition of failure criteria

A LED package shall be considered to have failed if any of the following criteria applies.

- Forward voltage V_f at the nominal drive current I_f deviates by more than ± 10 % of the initial value.
- Radiant power or luminous flux or intensity at the nominal drive current I_f deviates by more than
  - ± 20 % of the initial value, or
  - ± 30 % of the initial value

  where these options of ± 20 % or ± 30 % are at the choice of the manufacturer.
  - A deviation of ± 50 % of the initial value may be acceptable for some interior lighting applications (e.g. LED packages for instrument clusters).
- Colour coordinates x,y at the nominal drive current I_f of white LED deviate by more than ± 0,01 from the initial value. The permitted deviation for saturated colour LED's is under consideration.
- The LED package exhibits externally visible physical damage attributable to the environmental test (e.g. delamination). However, if the cause of failure is agreed (by the manufacturer and the user) to be due to mishandling or ESD, the failure shall be

discounted, but reported as part of the data submission. A microscope with a magnification in a range of 40X to 50X shall be used.

Failures in the interconnect to the test board or in the test board that are not related to a LED package failure shall be discounted, but reported as part of the data submission.

8.4 Choice between test conditions

A manufacturer shall select a specific luminous flux maintenance class according to 8.3 prior to the qualification testing. The appropriate pass/fail criteria shall be applicable.

Furthermore, the manufacturer shall choose between different classes of test conditions where applicable (e.g. TMCL cycle condition 1 to 4 in 8.6.4). The test condition shall be documented in the test report.

In general, it may be assumed that passing the harsher test conditions implies that the more relaxed conditions would also be passed (e.g. passing TMCL condition 3 implies that TMCL conditions 1 and 2 would also be passed).

8.5 Criteria for passing qualification/requalification

All LED packages under test shall pass the tests, otherwise the LED package or LED package family is considered to have failed.

LED packages that have failed the acceptance criteria of tests required by this document require the supplier to satisfactorily determine root cause and corrective action to assure the user that the failure mechanism is understood and contained and the corrective and preventive actions are confirmed to be effective by repeating the applicable qualification test(s) successfully.

8.6 Qualification test definition

8.6.1 Pre- and post- electrical and photometric test

All LED packages shall be tested at nominal drive current according to the following requirements of the appropriate LED package specification (manufacturer's datasheet) prior to and after the following tests except for 8.6.2 and 8.6.10:

- luminous flux or radiant power or intensity (whichever is appropriate);
- forward voltage;
- colour coordinates or dominant or peak wave length (whichever is appropriate).

NOTE The choice between dominant and peak wavelength is under consideration.

In addition, the forward voltage at the minimum (or lower) and maximum drive current shall be recorded.

8.6.2 Pre- and post- external visual (EV) test

The construction, marking and workmanship of the LED package shall be inspected according to JESD22-B101B prior to and after the following tests except for 8.6.10.

8.6.3 High temperature operating life (HTOL) test

The purpose of this test is to evaluate the performance of the LED package under stress due to high temperature operation. The test shall be conducted according to JESD22-A108D; the following test conditions apply:

- Duration 1 000 h.

- If no derating is required, the testing shall be done at:
  - T_s= 85 °C with the maximum drive current, and
  - at the max. specified T_s with the corresponding maximum rated drive current.
- If derating is required, the testing shall be done:
  - with the maximum drive current at the corresponding max. rated T_s, and
  - at the max. specified T_s with the corresponding maximum rated drive current.

8.6.4 Temperature cycling (TMCL) test

The purpose of this test is to evaluate the performance of the LED package under stress due to temperature cycles without operation of the LED. The LED package shall be tested according to JESD 22-A104D; the following test conditions apply:

- duration 1 000 cycles;
- soak mode 4 (minimum soak time 15 min).

The following minimum and maximum temperatures for T_s shall be chosen by the manufacturer:

- TMCL condition 1: $T_{s,min}$ = –40 °C; $T_{s,max}$ = 85 °C;
- TMCL condition 2: $T_{s,min}$ = –40 °C; $T_{s,max}$ = 100 °C;
- TMCL condition 3: $T_{s,min}$ = –40 °C; $T_{s,max}$ = 110 °C;
- TMCL condition 4: $T_{s,min}$ = –40 °C; $T_{s,max}$ = 125 °C.

The TMCL condition closest to the manufacturer’s operating temperature range according to the appropriate LED package specification (manufacturer's datasheet) shall be chosen unless the manufacturer wishes to test compliance with a more severe cycle condition. The choice of the TMCL cycle condition and the transfer time shall be reported.

8.6.5 Wet high temperature operating life (WHTOL) test

The purpose of this test is to evaluate the performance of the LED package under stress due to temperature and humidity during steady state operation. The LED package shall be tested according to JESD22-A101C; the following test conditions apply:

- duration 1 000 h;
- T_s =85 °C;
- 85 % RH;
- power cycle 30 min on/30 min off.

The tests shall be performed at the corresponding minimum and maximum rated drive current (i.e. rating at T_s =85 °C).

8.6.6 Power temperature cycling (PTMCL) test

The purpose of this test is to evaluate the performance of the LED package under stress due to temperature cycles during operation of the LED package. The LED package shall be tested according to JESD 22-A105C; the following test conditions apply:

- duration 1 000 temperature cycles;
- power cycle 5 min on/5 min off operated at the corresponding maximum rated drive current.

The manufacturer shall select one of the following test types:

- PTMCL condition 1: T_s –40 °C to 85 °C, (test condition A according to JESD 22-A105C);

- PTMCL condition 2: T_s –40 °C to 105 °C, (transition and dwell time according to test condition A of JESD 22-A105C);
- PTMCL condition 3: T_s –40 °C to 125 °C, (test condition B according to JESD 22-A105C).

The PTMCL condition closest to the manufacturer's operating temperature range according to the appropriate LED package specification (manufacturer's datasheet) shall be chosen unless the manufacturer wishes to test compliance with a more severe cycle condition. The choice of the PTMCL condition shall be reported.

8.6.7 Electrostatic discharge, human body model (ESD-HBM) test

The purpose of this test is to evaluate the performance of the LED package under stress due to electrostatic discharge using the human body model. The LED package shall be tested according to ANSI/ESDA/JEDEC JS-001-2012.

8.6.8 Electrostatic discharge, machine model (ESD-MM) test

The purpose of this test is to evaluate the performance of the LED package under stress due to electrostatic discharge using the machine model. The LED package shall be tested according to JESD 22-A115C.

8.6.9 Destructive physical analysis (DPA) test

The purpose of this test is to evaluate the capability of the device's internal materials, design, and workmanship to withstand forces induced by various stresses induced during environmental testing.

Perform DPA according to Annex J on random samples of good units after completion of PTMCL test, WHTOL test, H2S and FMGC test (2 samples per lot). The post electrical and photometrical test of these samples shall be executed before the destructive physical analysis.

8.6.10 Physical dimensions (PD) test

Verify physical dimensions according to LED package mechanical drawing.

8.6.11 Vibrations variable frequency (VVF) test

The purpose of this test is to evaluate the performance of the LED package under stress due to mechanical vibrations with variable frequency. The LED package shall be tested according to JESD22-B103B.

Use a constant displacement of 1,5 mm (double amplitude) over the range of 20 Hz to 100 Hz and a 200 m/s^2 constant peak acceleration over the range of 100 Hz to 2 kHz.

8.6.12 Mechanical shock (MS) test

The purpose of this test is to evaluate the performance of the LED package under stress due to mechanical shock. The LED package shall be tested according to JESD22-B110B.

- 15 000 m/s^2 for 0,5 ms;
- 5 shocks in each direction, 3 orientations (+ and – $x/y/z$ direction, i.e. 30 shocks).

This test is not applicable if wire bonds are casted.

8.6.13 Resistance to soldering heat (RSH-TTW) test

The purpose of the TTW ("through the wave") test is to evaluate the performance of the LED package under stress due to soldering heat. The LED package shall be tested according to JESD22-B106D.

This test only applies to LED packages that are declared to be solderable by wave soldering by the manufacturer.

8.6.14 Resistance to soldering heat (RSH-reflow) test

The purpose of this test is to evaluate the performance of the LED package under stress due to soldering heat. The LED package shall be tested according to JESD22-A113F; alternative: ANSI/IPC/ECA J-STD-002C.

Reflow soldering shall be tested 3 times at 260 °C. Testing according to 8.6.1 shall be carried out before and after each reflow.

This test applies only to LED packages that are specified for reflow soldering.

8.6.15 Solderability (SO) test

Details for this test are under consideration.

8.6.16 Thermal shock (TMSK) test

The purpose of this test is to evaluate the performance of the LED package under stress due to thermal shock. The LED package shall be tested according to JESD22-A106B. The following conditions shall apply:

- duration 1 000 cycles;
- TMSK cycle condition 1: $T_{s,min}$ = –40 °C; $T_{s,max}$ = 85 °C;
- TMSK cycle condition 2: $T_{s,min}$ = –40 °C; $T_{s,max}$ = 125 °C;
- liquid to liquid.

The cycle condition closest to the manufacturer's operating temperature range according to the appropriate LED package specification (manufacturer's datasheet) shall be chosen unless the manufacturer wishes to test compliance with a more severe cycle condition. The choice of the TMSK cycle condition shall be reported.

8.6.17 Hydrogen sulphide (H2S) test

The resistance to hydrogen sulphide shall be tested according to IEC 60068-2-43; the following test conditions apply:

- air temperature 40 °C;
- 90 % RH;
- H_2S concentration: 10×10^{-6} to 15×10^{-6};
- duration 336 h.

8.6.18 Pulsed operating life (PLT) test

The purpose of this test is to evaluate the performance of the LED package under stress due to pulsed operation. The LED package shall be tested according to JESD 22-A108D.

- duration 1 000 h;
- T_s = 55 °C;
- pulse width 100 μs, duty cycle 3 %.

The LED package shall be operated at the corresponding maximum rated drive current.

8.6.19 Dew (DEW) test

The purpose of this test is to evaluate the performance of the LED package under stress due to dew deposition. The LED package shall be tested according to JESD 22-A100D.

The LED package shall be cycled from 30 °C to 65 °C. 65 °C shall be maintained for 4 h to 8 h before reducing the temperature to 30 °C. This cycle shall continue for 1 008 h, with relative humidity maintained between 90 % to 98 % in the test chamber.

No bias shall be applied during this test.

8.6.20 Flowing mixed gas corrosion (FMGC) test

The resistance to corrosive gas atmosphere shall be tested according to IEC 60068-2-60; the following test conditions apply:

- test method 4;
- air temperature 25 °C;
- 75 % RH;
- H_2S concentration: 10×10^{-9};
  NO_2 concentration: 200×10^{-9};
  Cl_2 concentration: 10×10^{-9};
  SO_2 concentration: 200×10^{-9};
- Duration 500 h.

Annex A
(normative)

Life test conditions for filament lamps

A.1 Ageing

Filament lamps shall be aged at their test voltage for approximately 1 h. For dual-filament lamps, each filament shall be aged separately. Filament lamps which fail during the ageing period shall be omitted from the test results.

A.2 Test voltage

Measurements shall be carried out at the test voltage specified in Clause 5 of this standard which shall be a stable d.c. or a.c. voltage with a frequency between 40 Hz and 60 Hz.

In the case of non-replaceable filament lamps (defined in IEC 60809), the filament lamp shall be operated at the test voltage specified in the relevant data sheet. In case an electronic regulator is used, such as pulse width modulation (PWM), this non-replaceable filament lamp should be operated in such a way that it does not negatively affect the lifetime of the filament lamp.

NOTE The test voltage is deemed to be stable when the momentary fluctuations do not exceed 1 % and the deviation of the average over the test period does not exceed 0,5 % of the specified value.

A.3 Operating position and operating conditions

Filament lamps shall be operated on a vibration-free test rack with both lamp axis and filament(s) horizontal. In the special case of double-filament lamps which include a shield, this shall be under the dipped or lower-beam filament (H-H line horizontal). In the case of filament lamps with an axial filament, the longer filament support shall be positioned above the filament.

The lamps shall be tested under normal ambient temperature conditions; assumption is 25 °C ± 10 °C.

A.4 Switching cycle

A.4.1 Single-filament lamps

A.4.1.1 Filament lamps for continuous operation

Filament lamps shall be switched off twice daily for periods of not less than 15 min, such periods not being considered as part of the life.

A.4.1.2 Filament lamps for intermittent operation

Filament lamps for intermittent operation as used in stop-lamps and flashing direction indicators shall be operated in the following switching cycle:

- 15 s on for intermittent (flashing) operation;
- 15 s off;
- flashing frequency: 90/min;

- on/off ratio 1:1.

The whole flashing operation time is considered as life.

A.4.2 Dual-filament lamps for headlamps

The filaments shall be operated alternately according to the following cycle and starting with the lower beam filament:

- dipped or lower-beam filament: 15 h on/45 min off;
- main or upper-beam filament: 7,5 h on/45 min off.

The end of the life is determined by failure of either filament.

The off periods are not considered as part of the life.

NOTE The life of the lower-beam filament represents two-thirds of the total life, the life of the upper-beam filament one-third.

A.4.3 Dual-filament lamps for light signalling equipment

A.4.3.1 General

Life testing shall be carried out for each filament separately. Life testing of the low-wattage filament shall be carried out on filament lamps other than those used for life testing of the high-wattage filament.

A.4.3.2 Filaments for continuous operation

The switching cycle shall be as specified in A.4.1.1.

A.4.3.3 Filaments for intermittent operation

The switching cycle shall be as specified in A.4.1.2.

A.5 Luminous flux and colour maintenance

Tests may be interrupted for determination of the luminous flux and colour maintenance.

Annex B
(normative)

Vibration tests

B.1 General

These tests are designed to ensure that lamps satisfactorily completing this schedule will not be adversely affected by shock and vibration in normal service.

Two levels of test are specified which are referred to as "standard test" and "heavy-duty test" and the appropriate level shall be selected for the intended vehicle usage.

The acceleration levels and frequency spectra used in these tests are based on extensive investigations into the characteristics experienced at lamp mounting positions on a wide range of vehicles and in normal service conditions.

Although the standard test relates to normal vehicle service conditions, investigations have shown that the more arduous conditions given by heavy goods vehicles require lamps of a greater mechanical strength.

Within the constraints of dimensional and photometric specifications, the ultimate strength of an incandescent lamp is limited by the properties of the filament material. These restrict the mechanical stress to which a lamp can be subjected.

Higher vibration levels may impair the performance of lamps.

Two tests methods are specified:

a) a wideband random vibration test (WBR);
b) a narrowband random vibration test (NBR).

The WBR test is the preferred one, as simulation of service conditions can be achieved most accurately by the use of WBR equipment. However, studies have indicated that a relationship exists between WBR and NBR vibrations. For the purpose of this standard, both tests are equal for testing motor vehicle lamps to vibration resistance.

Analysis of vibration measurements, taken under transient conditions such as door, boot and bonnet closures, shows compatibility with the significant features of both the WBR and NBR test programmes.

The generally accepted requirements of a fatigue life of 10^7 reversals are encompassed by the schedule in IEC 60068-2-6.

Measurements of vibration and shock characteristics in service reveal frequencies of up to 20 000 Hz.

A vibration level is expressed as acceleration spectral density (ASD). It is the spectral density of an acceleration variable and is given in units of acceleration squared per unit frequency.

ASD spectrum defines the way ASD varies within the frequency range.

The ASD levels at frequencies above 1 000 Hz are, however, so low as to be insignificant, as the resonant frequencies of the critical construction features of most automobile lamps fall within the range of 200 Hz to 800 Hz. This, together with problems in the design of fixtures suitable for operation at frequencies above this level, has led to the adoption of 1 000 Hz as the maximum limit for the test schedules (excluding half bandwidth).

B.2 Test conditions

B.2.1 General

Figure B.1 details the preferred arrangement of equipment for the testing of lamps of WBR or NBR tests.

In order to be assured of reliable and reproducible test results, the following procedures should be followed.

B.2.2 Mounting (see IEC 60068-2-47)

The lamp caps shall be fastened rigidly to the work holders on the vibration head. This may be achieved by clamping, soldering or embedding. Electrical connection to the lamps shall be made by the use of soldered wires or other means such that electrical connection is ensured during the whole test.

On tests including higher frequencies, it is essential that fixtures are designed in such a way that the propagation path (the distance between lamp and moving coil) is always shorter than the one-quarter wavelength of the velocity of sound in the fixture material.

B.2.3 Measuring points

A measuring point is the position at which measurements are made to ensure that the test requirements are met. The measuring point shall be on the fixture as close as possible to the position at which the lamp is held and the detector shall be rigidly connected to it.

If several lamps are mounted on a single fixture, the measuring point may be related to the fixture generally rather than the lamp fixing points.

The resonant frequency of the fully loaded fixture shall always be higher than the maximum test frequency.

B.2.4 Control point

The signal from the transducer mounted at the measuring point shall be used as a means of maintaining the specified vibration characteristics.

B.2.5 Conditioning

Filament lamps shall be aged for 30 min at test voltage as given in the relevant data sheets of IEC 60809 or in the relevant data sheets of non-replaceable filament lamps. No ageing period is required for discharge lamps, but lamps which fail before starting a vibration test shall be omitted from the test results.

B.2.6 Axis of vibration

Field measurements on vehicles have shown that automobile lamps are usually subjected to greater stresses in the vertical plane than in either of the horizontal planes. It is therefore recommended that a vertical direction of excitation be used for testing with the principal lamp axis and filament(s) horizontal.

B.2.7 WBR test – Basic motion

The basic motion of the control point on the test fixture (see Figure B.1) shall be rectilinear and of a stochastic nature with a normal (Gaussian) distribution of instantaneous acceleration values. Peak values are limited to three times the r.m.s. value as determined by the ASD profile and its frequency range (i.e. "3σ-clipping"). Experience has shown that a peak factor set to 2,3 at the exciter corresponds to a 3 σ test signal at the control point because of filtering by the vibrator (see ISO 5344).

B.3 Test conditions

B.3.1 General

The test voltage for filament lamps shall be in accordance with IEC 60809 or with the specification in the relevant data sheets of non-replaceable filament lamps. For discharge lamps, the conditions of D.2 of this standard apply.

The specific vibration test conditions are given as follows (see Table B.1):

Table B.1 – Vibration test on motor vehicle lamps – Test conditions

Narrowband random vibration test	Standard test conditions	Table B.2
	Heavy-duty test conditions	Table B.3
Wideband random vibration test	Standard test conditions	Table B.4

B.3.2 Narrowband random vibration tests

Table B.2 – Vibration test on motor vehicle lamps – Standard test conditions

Narrowband random vibration test		
1	**Frequency range**	30 Hz to 1 050 Hz
2	**Bandwidth**	100 Hz
3	**Sweep range**	80 Hz to 1 000 Hz
4	**Sweep rate**	1 octave/min
5	**Sweep duration (full cycle)**	7,3 min
6	**ASD spectrum**	0,12 g^2/Hz (= 3,5 g eff.) from 80 Hz to 150 Hz 0,014 g^2/Hz (= 1,2 g eff.) from 150 Hz to 1 000 Hz
7	**Tolerance of the acceleration values**	±1 dB
8	**Test duration**	20 h
9	**Switching cycle**	20 min lit to 10 min unlit
10	**Compressor speed**	10 dB/s

Table B.3 – Vibration test on motor vehicle lamps – Heavy-duty test conditions

Narrowband random vibration test		
1	**Frequency range**	30 Hz to 1 050 Hz
2	**Bandwidth**	100 Hz
3	**Sweep range**	80 Hz to 1 000 Hz
4	**Sweep rate**	1 octave/min
5	**Sweep duration (full cycle)**	7,3 min
6	**ASD spectrum**	0,36 g^2/Hz (= 6,0 g eff.) from 80 Hz to 150 Hz 0,09 g^2/Hz (= 3,0 g eff.) from 150 Hz to 1 000 Hz
7	**Tolerance of the acceleration values**	±1 dB
8	**Test duration**	20 h
9	**Switching cycle**	10 min lit to 10 min unlit
10	**Compressor speed**	10 dB/s

B.3.3 Wideband random vibration tests

Test requirements are given in Table B.4 for standard service.

Requirements for heavy-duty service are under consideration.

Table B.4 – Vibration test on motor vehicle lamps – Standard test conditions

Wideband random vibration test			
1	**Frequency range**	12 Hz to 1 002 Hz	
2	**ASD spectrum**	Hz	g^2/Hz
		12	0,01
		12 to 24	0,01 to 0,15
		24 to 54	0,15
		54 to 1 002	0,15 to 0,008 2
3	**Total r.m.s. acceleration level**	5,4 g ± 1 dB	
4	**Tolerance of the true ASD values**	±3 dB	
5	**Switching cycle**	20 min lit to 10 min unlit	
6	**Test duration**	20 h	

NOTE 1 The acceleration level increases logarithmically with the logarithm of the frequency in the range 12 Hz to 24 Hz (12 dB/octave) and it decreases in the range 54 Hz to 1 002 Hz (–3 dB/octave). Outside the specified frequency range, the ASD level has to decrease with gradients as steep as possible.

NOTE 2 All data are provisional.

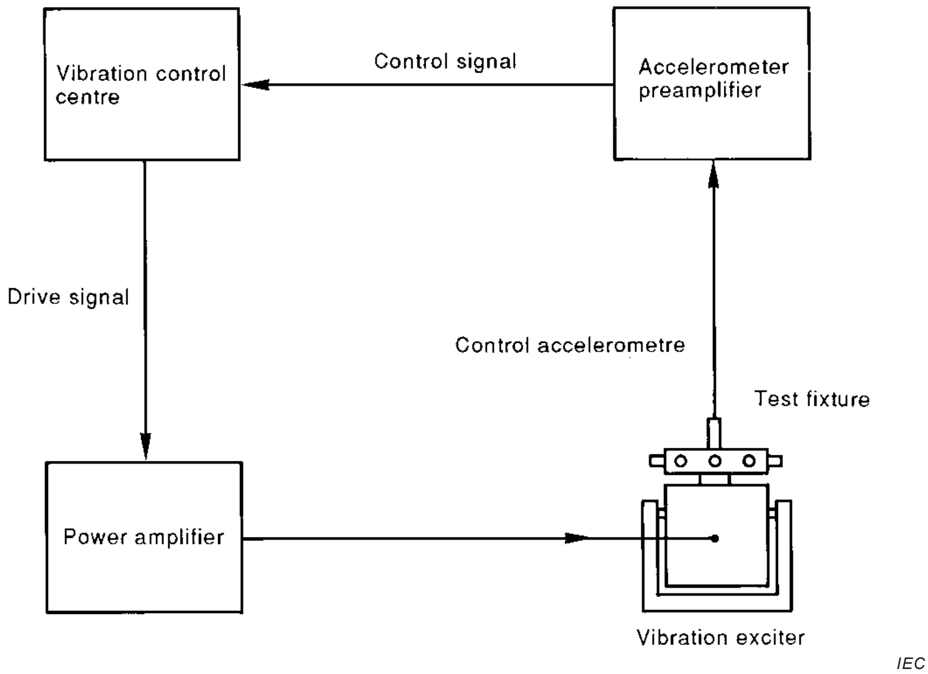


Figure B.1 – Recommended equipment layout for vibration testing

Annex C
(normative)

Glass-bulb strength test

C.1 General

If required, the test specified in Annex C shall be used to determine the glass-bulb strength of certain road vehicle filament lamps.

This test is necessary for these filament lamps because mechanical handling is utilized for their assembly in equipment.

C.2 Test equipment and procedure

C.2.1 Principle of the test equipment (see Figure C.1)

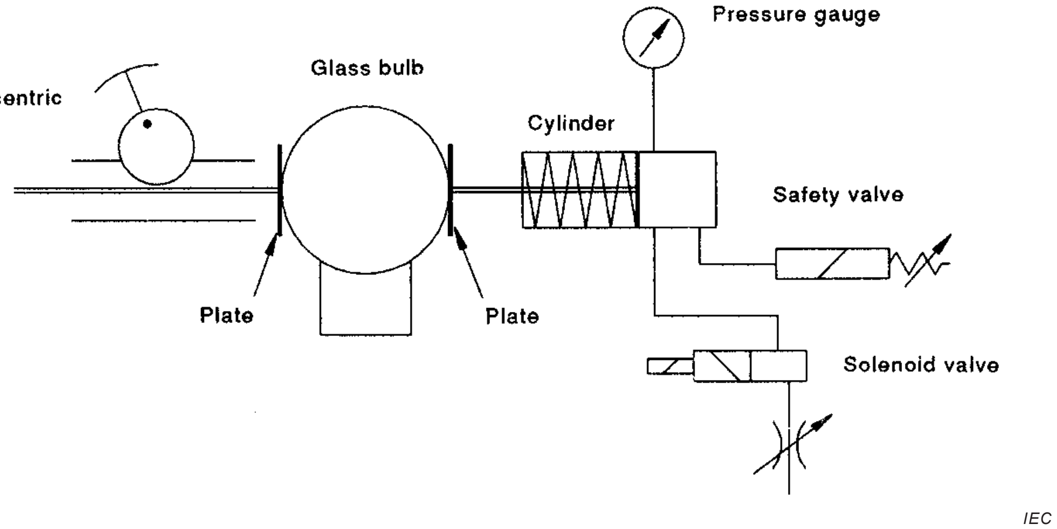


Figure C.1 – Diagrammatic sketch of the principle of the test equipment

The test apparatus consists mainly of

- a pneumatic cylinder applying the necessary force;
- two plates transmitting the force onto the test sample;
- a measuring apparatus indicating the applied force.

C.2.2 Test conditions

This apparatus shall test bulbs with a maximum diameter of 50 mm. The bulb shall be tested with a slowly increasing compressive force. In no case shall bulbs be exposed to a shock load.

The increase of force from 0 N to 200 N shall be in 4 s to 5 s during which period the force increases approximately in a linear manner.

It shall be possible to limit the maximum force of the apparatus to 200 N by a compression safety valve. The apparatus shall incorporate a suitable protective screen to prevent injury from glass fragments in the event of a bulb failure during the test.

C.2.3 Requirements for plates

Each plate shall have a plane smooth surface with a diameter of approximately 20 mm and shall be of hardened tool steel. The hardness of the plates shall lie between 55 Rockwell and 60 Rockwell (HRC).

C.3 Requirements

The compression strength of the bulb shall not fall below the values stated in Table C.1 taking an AQL 1 % as a basis.

Table C.1 – Compression strength

Category	Minimum glass-bulb strength N
R2	40
P21W	40
P21/5W	40
R5W	40
R10W	40
T4W	40
W3W	40
W5W	40

C.4 Evaluation

C.4.1 General

One of the following procedures shall be applied.

C.4.2 Assessment based on attributes

Set the test apparatus at the minimum force specified in Table C.1. A first sample is selected randomly from the batch, the number selected being determined by the batch size (see Table C.2). The number of bulbs failing are compared with the acceptance and rejection numbers. If there is no decision, a second sample is tested in accordance with Table C.2.

Table C.2 – Inspection by attributes – Double sampling plan

Batch size	Sample	Accept	Reject
1 201 to 3 200	1st sample $n1$ = 80 2nd sample $n2$ = 80	1 4	4 5
3 201 to 10 000	1st sample $n1$ = 125 2nd sample $n2$ = 125	2 6	5 7
10 001 to 35 000	1st sample $n1$ = 200 2nd sample $n2$ = 200	3 8	7 9
35 001 to 150 000	1st sample $n1$ = 315 2nd sample $n2$ = 315	5 12	9 13
If a second sample has to be taken, the number of filament lamps failing in the combined sample is compared with the acceptance and rejection numbers in the corresponding line.			

This random test, based on attributes, corresponds with IEC 60410.

C.4.3 Assessment based on variables

The size of the sample (selected randomly) is determined by the batch size as shown in Table C.3.

Each filament lamp is tested until it fails and the value at which this occurs is recorded.

The result is assessed as follows.

The lower quality statistic (Q_L) is calculated using the equation:

$$Q_L = \frac{\overline{X} - 40}{S}$$

where

$\overline{X}$ is the mean value of all the results in the sample;

S is the standard deviation.

$$S = \sqrt{\frac{\sum_{i=1}^{i=n} (X_i - \overline{X})^2}{n-1}}$$

where

X_i is the value of individual results;

n is the number of results.

The test is passed if: $Q_L \geq K$

where

K is the acceptability constant determined from Table C.3.

Table C.3 – Inspection by variables – "S" method of assessment

Batch size	Sample size	Acceptability constant K
1 201 to 3 200	15	1,79
3 201 to 10 000	20	1,82
10 001 to 35 000	25	1,85
35 001 to 150 000	35	1,89

NOTE 1 The statistical basis of this method assumes that the distribution of results is normal, or nearly so.

NOTE 2 Tests for normality can be made by the use of probability paper plots in accordance with ISO 2854.

NOTE 3 This test, based on variables, corresponds with ISO 3951.

Annex D
(normative)

Life and luminous flux maintenance test conditions for discharge lamps

D.1 Ageing

No ageing period is required, but lamps which fail before starting the life test shall be omitted from the test results.

For lamps subject to the luminous flux maintenance test, the initial luminous flux shall be measured after 10 switching cycles as prescribed in D.4.

D.2 Test circuit and test voltage

Discharge lamps shall be tested with the ballast submitted by the lamp manufacturer and, preferably, designed to operate the lamp in a nominal 12 V system. The test voltage to the ballast shall be 13,5 V. The power supply to the ballast shall be sufficient to secure the high-current flow.

D.3 Burning position and operating conditions

Discharge lamps shall be operated in free air with an ambient temperature of 25 °C ± 5 °C. The burning position shall be horizontal within 10°, with the lead wire down.

Precautions should be taken to avoid potential hazards due to high voltages, UV radiation and risk of bulb breakage during starting, run-up and operation of some discharge lamp types.

D.4 Switching cycle

One switching cycle is built up of the following 10 on-off periods (see Table D.1):

Table D.1 – Switching cycle

Period	On min	Off min
1	20	0,2
2	8	5
3	5	3
4	3	3
5	2	3
6	1	3
7	0,5	3
8	0,3	0,3
9	20	4,7
10	20	15

The total duration of one switching cycle is 120 min, during which the lamp is switched on for 79,8 min and switched off for 40,2 min. The time during which the lamp is switched off is not considered as part of the life.

Life tests may be interrupted for the purpose of the luminous flux maintenance test.

D.5 Luminous flux maintenance

The luminous flux maintenance is measured after the lamp has been operated 75 % of the characteristic life as declared by the manufacturer.

Annex E
(normative)

Bulb deflection test

E.1 General

If required, the test specified in this annex shall be used to determine the strength of the bulb-to-cap connection of discharge lamps.

E.2 Test set-up and procedure

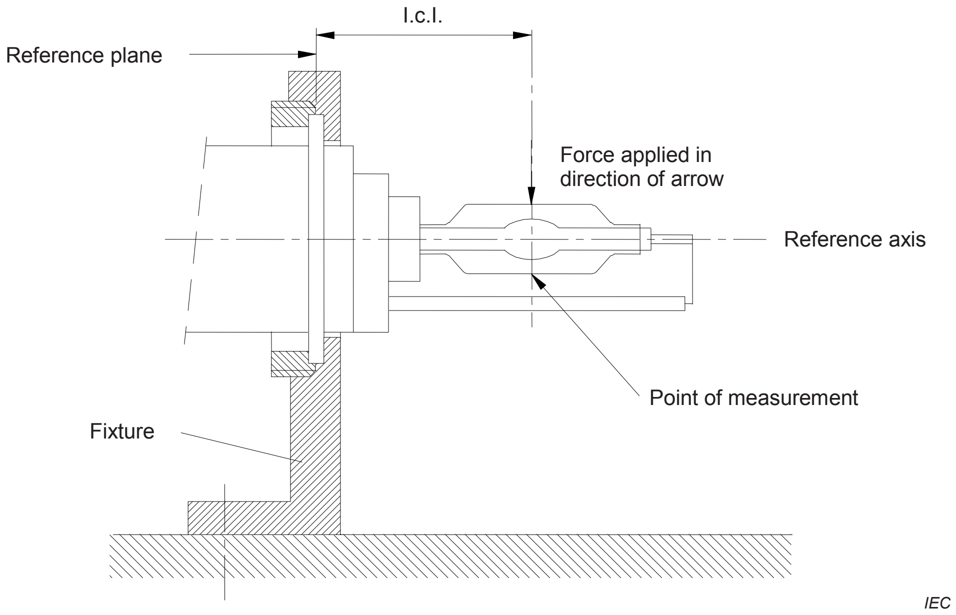


Figure E.1 – Sketch of the test set-up

The lamp shall be rigidly and horizontally mounted in the fixture (see Figure E.1), with the reference notch in the up position. A force of 18 N is applied on the glass bulb

- at a distance from the reference plane equal to the light centre length of the lamp;
- perpendicular to the reference axis;
- using a rod with a hard rubber tip with a minimum spherical radius of 1 mm;
- four times, spaced 90° apart, starting in the vertical direction.

NOTE The spacing of 90° is approximate, depending on the position of the outer supply wire.

The force shall be gradually increased from 0 N to 18 N.

The bulb deflection shall be measured at the glass surface 180° opposite to the force application.

A different lamp shall be used for each force application at 0°, 90°, 180° and 270°.

E.3 Requirement

The deflection shall not exceed 0,13 mm in the direction of the force applied.

Annex F
(informative)

Guidance for equipment design

F.1 Pinch temperature limit

Headlamps, fog-lamps and signalling lamps should be so designed that in operation the pinch temperature of halogen lamps does not exceed 400 °C.

Specially prepared filament lamps are required for the pinch temperature test and reference should be made to the filament lamp supplier.

NOTE For pinch temperature measuring method, see IEC 60682.

F.2 Solder temperature limit

Headlamps, fog-lamps and signalling lamps should be so designed that in operation the solder temperature of filament lamps does not exceed the following limits:

- 290 °C for single-filament lamps;
- 270 °C for double-filament lamps.

F.3 Maximum filament lamp outline

Maximum filament lamp outline is provided for the guidance of designers of lighting equipment and is based on a maximum sized filament lamp inclusive of bulb-to-cap eccentricity and tilt. Observance of these requirements in the equipment design will ensure mechanical acceptance of filament lamps complying with IEC 60809. Details are given in Figures F.2 to F.5.

F.4 Maximum surge voltage

Maximum surge voltage values are provided for the guidance of designers of electrical equipment. They are specified as maximum tolerable duration as a function of the height of voltage surge.

This does not imply that values shorter than the specified ones have a negligible effect on filament lamp performance, but only that a higher voltage or duration in any case harm the filament lamp and should be avoided. Values in graphical form are given in Figure F.1.

F.5 Recommended instructions for use and handling of halogen filament lamps

It is recommended that the following points be included in any instructions for use if supplied with halogen filament lamps covered by this standard. Symbols as shown in Annex H (Clause H.2 to H.5) may be used in addition or as an alternative to text information.

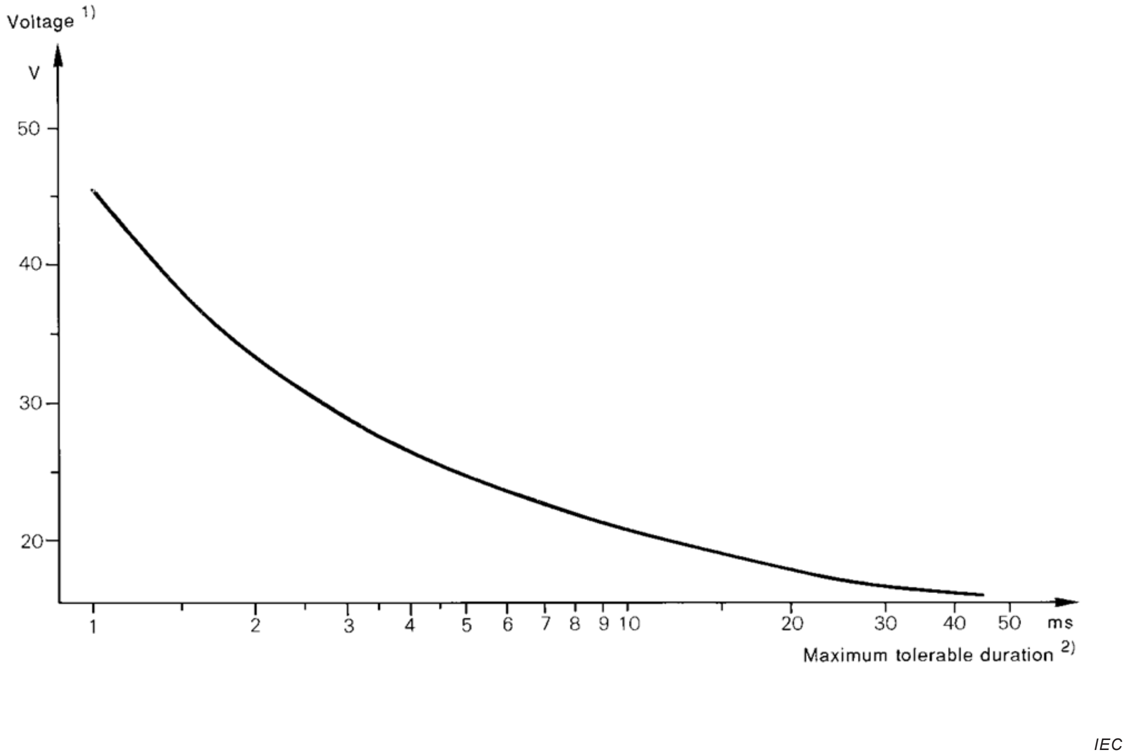
– Halogen filament lamps operate at high bulb temperatures and care should be taken to avoid touching the bulb in any circumstances.
– If filament lamps with quartz bulb are touched, they should be cleaned before use with a lint-free cloth moistened with methylated spirit.
– Filament lamps with scratched or otherwise damaged bulbs should not be used.

NOTE In some instances filament lamp manufacturers give information that the filament lamp contains gas under pressure and recommend protective measures when handling it.

F.6 Recommended instructions for use and handling of discharge lamps

It is recommended that the following points are included in any instructions for use if supplied with discharge lamps covered by this standard. Symbols as shown in Annex H (H.2 to H.10) may be used in addition or as an alternative to text information.

- Care should be taken to avoid touching the bulb in any circumstances. The use of protective gloves and eye protection is advised. If the bulb is touched, it should be cleaned before use with a lint-free cloth moistened with methylated spirit. Lamps with scratched bulbs should not be used.
- Discharge lamps operate with a suitable ballast which produces very high voltage when switching and during operation. During operation, the bulb of the discharge lamp emits UV-radiation. In order to avoid any safety risk or impairment of health, the discharge lamps should only be used in closed headlamps.
- Discharge lamps operate at high temperatures. Before handling, the lamp should be left to cool down for an appropriate time and the supply voltage to the ballast should be disconnected.



1 Voltage surges are superimposed on a stabilized voltage of 14,5 V after a burning period of at least 30 s. The voltage shown on the graph above is the sum of the stabilized 14,5 V and the voltage surge.

2 If this maximum tolerable duration is exceeded, a certain percentage of filament lamps will fail immediately. The resulting influence on the non-failing filament lamps is being studied.

NOTE Data for 24 V filament lamps are under consideration. Further details of the surge are under consideration.

Figure F.1 – Voltage surges for 12 V filament lamps – Maximum tolerable duration for a voltage surge as a function of its height

Dimensions in millimetres

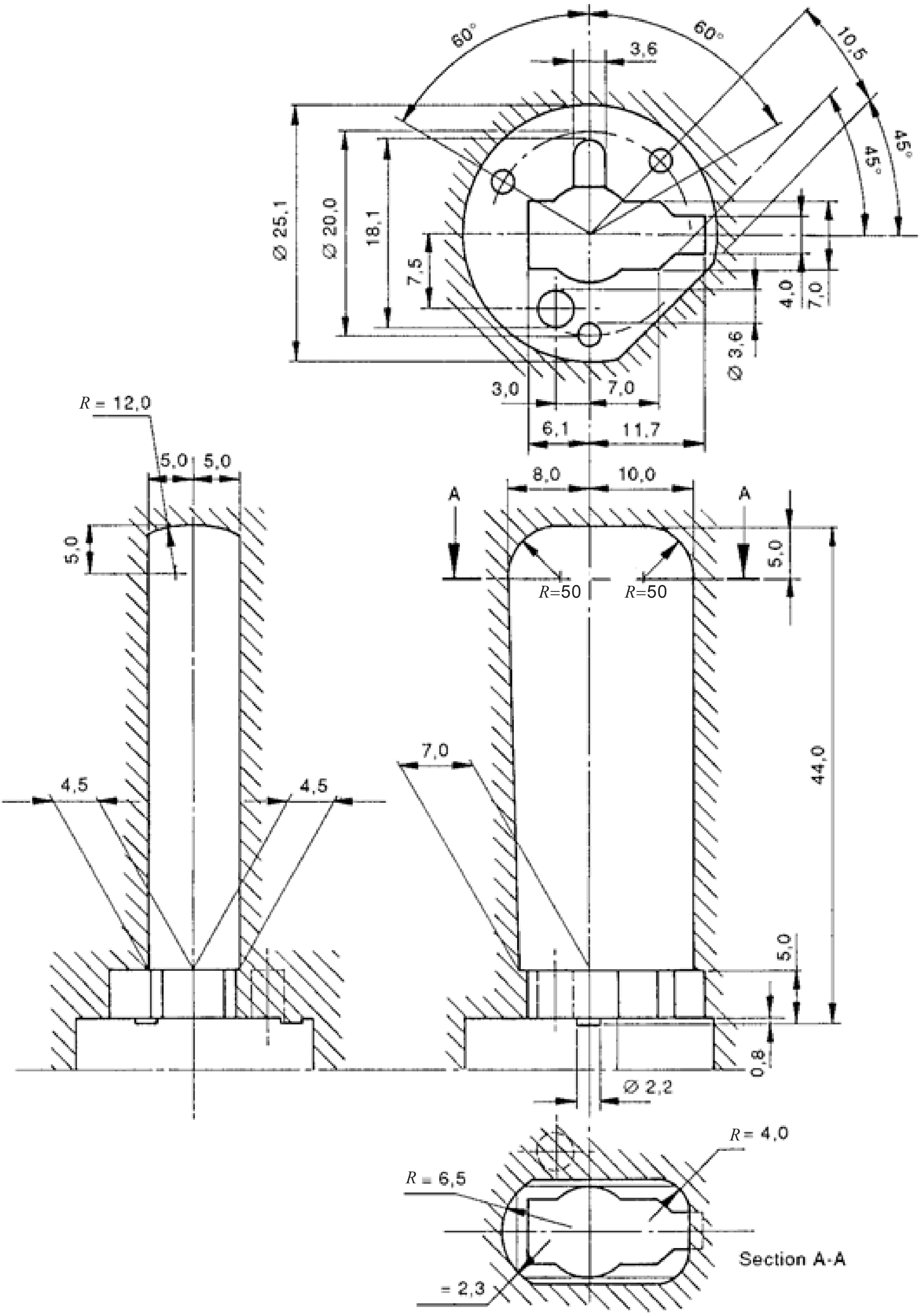
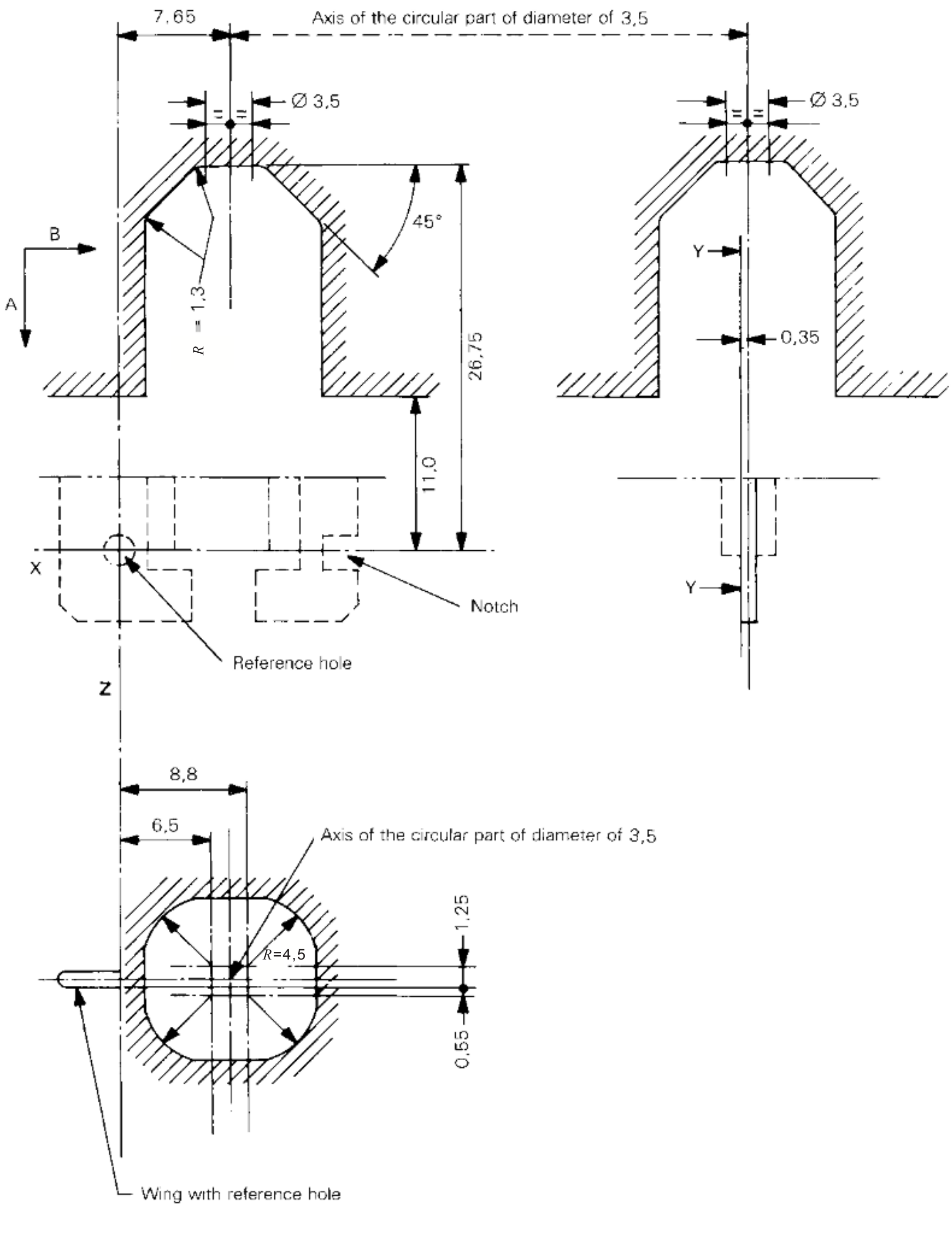


Figure F.2 – Maximum filament lamp outlines H1

Dimensions in millimetres



Key

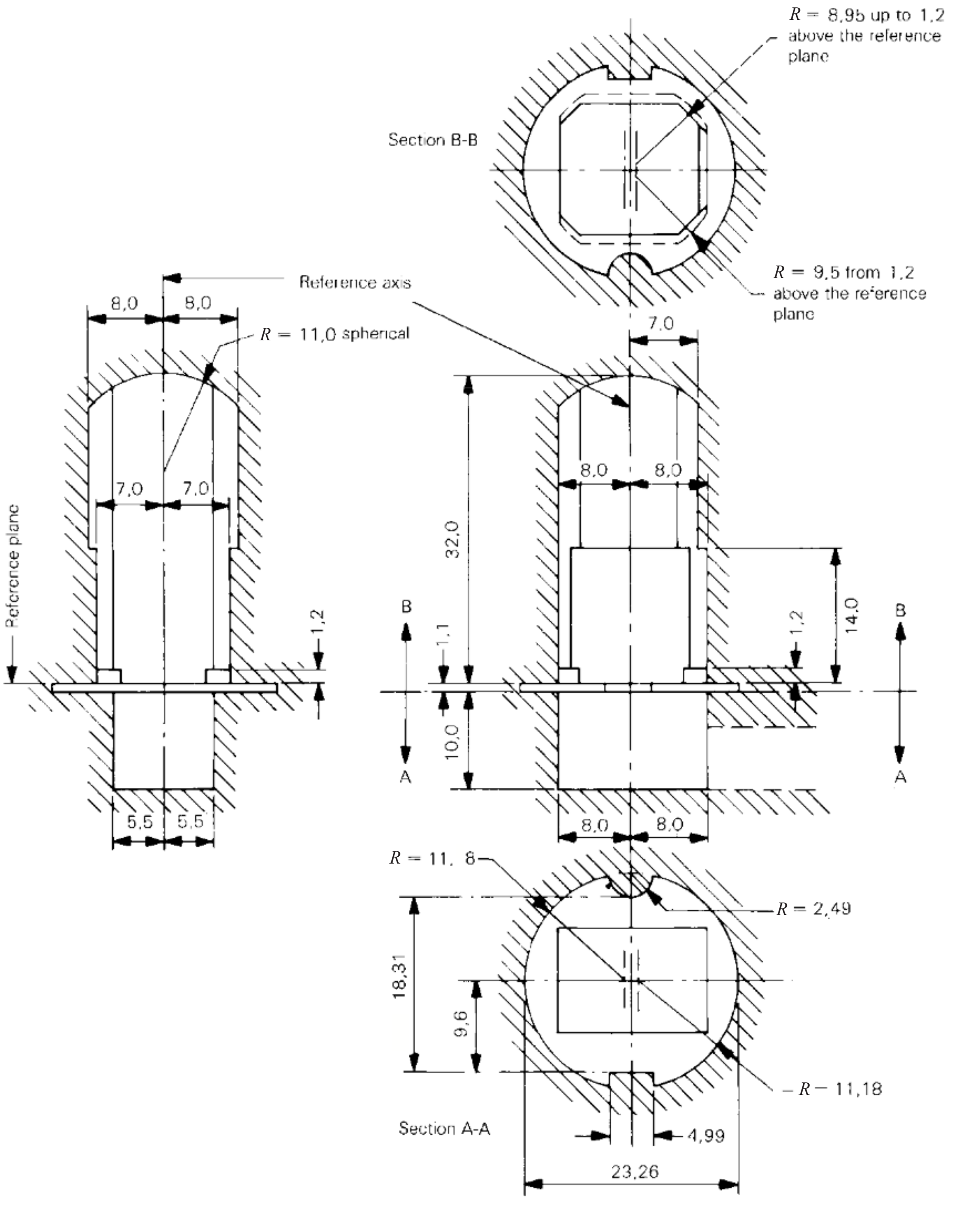
X reference axis common to the reference hole and the notch

Z reference plane containing reference axis of the hole and perpendicular to X axis

Y supporting plane of the wings

Figure F.3 – Maximum filament lamp outlines H2

Dimensions in millimetres



[1] Maximum lamp outline for the passage of the insulated cable and connector tab.

Figure F.4 – Maximum filament lamp outlines H3

Dimensions in millimetres

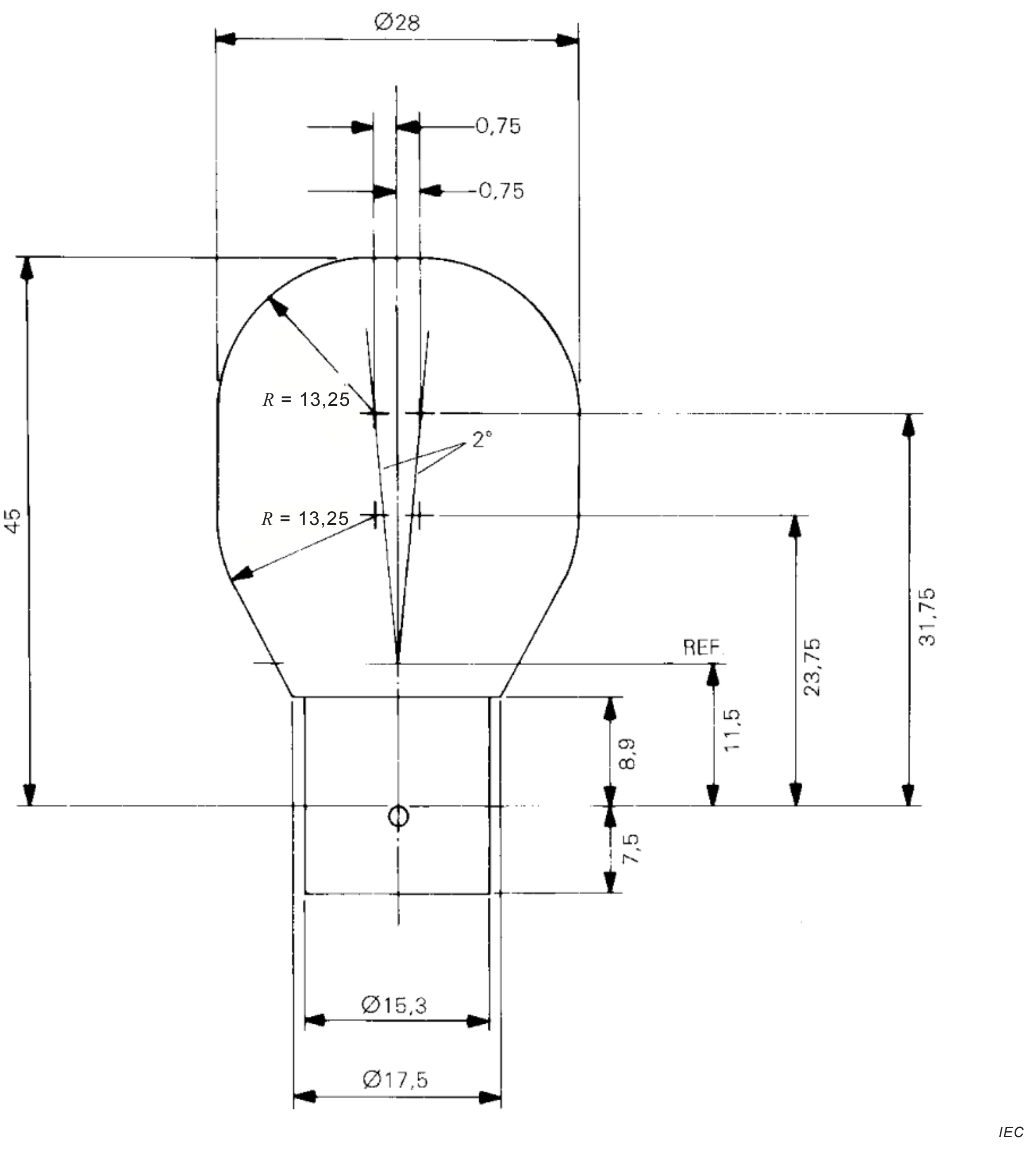


Figure F.5 – Maximum filament lamp outlines P21W, PY21W, P21/4W and P21/5W

Annex G
(informative)

Information for ballast design

Discharge lamps with integrated starting device may make use of a spark gap to generate the high-voltage starting pulse. The ballast should provide an open-circuit voltage as follows (see Table G.1).

Table G.1 – Open circuit voltage

Open- circuit voltage (r.m.s.)	V	min.	360
		max.	600

Annex H
(informative)

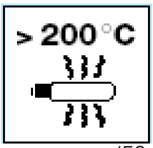
Symbols

H.1 General

Annex H concerns symbols as referred to in Clauses F.5 and F.6.

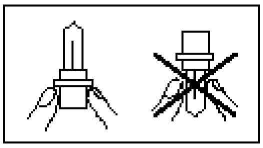
The height of graphical symbols shall not be less than 5 mm, and for letters, not less than 2 mm.

H.2 Symbol indicating that lamps operate at high temperatures



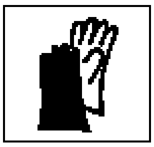
IEC

H.3 Symbol indicating that care should be taken to avoid touching the bulb



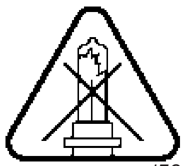
IEC

H.4 Symbol indicating that the use of protective gloves is advised



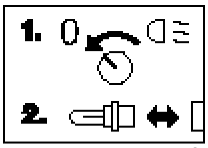
IEC

H.5 Symbol indicating that lamps with scratched or otherwise damaged bulbs should not be used



IEC

H.6 Symbol indicating that before handling, the lamp shall be switched off

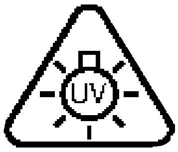


IEC

H.7 Symbol indicating that the use of eye protection is advised

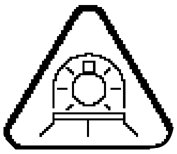
IEC

H.8 Symbol indicating that during operation, the lamp emits UV-radiation



IEC

H.9 Symbol indicating that the lamp shall be operated only in a luminaire with a protective shield



IEC

H.10 Symbol indicating dangerous voltage

IEC

Annex I
(normative)

Luminous flux maintenance test conditions for LED light sources

I.1 Ageing

LED light sources shall be aged at their test voltage for 48 h under the operating conditions specified in I.3. LED light sources which fail during the ageing period shall be omitted from the test results.

I.2 Test voltage

Measurements shall be carried out at a test voltage of:

- 6,75 V for products intended for a 6 V board voltage;
- 13,5 V for products intended for a 12 V board voltage;
- 28 V for products intended for a 24 V board voltage.

The applied voltage shall be a stable d.c.

If the LED light source is intended to be operated by an electronic light source control gear, the test voltage shall be applied to the input terminals of the control gear. In this case, the output of the electronic light source controlgear, e.g. voltage, electrical current, power, operating mode, etc. shall be described in the test report.

NOTE The test voltage is deemed to be stable when the momentary fluctuations do not exceed 1 % and the deviation of the average over the test period does not exceed 0,5 % of the specified value.

I.3 Operating conditions

I.3.1 Test rack

LED light sources shall be operated on a vibration-free test rack.

I.3.2 LED light sources with integrated thermal management

LED light sources with integrated thermal management shall be installed in a chamber with the following characteristics:

– well-mixed air, but no excessive forced convection across the light source;
– ambient air temperature in the chamber: 25 °C ± 10 °C.

I.3.3 LED light sources with external thermal management

LED light sources, for which the thermal management is intended to be achieved in conjunction with the luminaire/device or a separate thermal management component, shall be operated at the specified base temperature T_p. The base temperature T_p shall be included in the test report and shall be part of the luminous flux maintenance declaration by the manufacturer.

NOTE Control of the T_p temperature during testing can be achieved by active or passive methods e. g. a heat-sink, a heat-sink combined with a cooling fan or a Peltier-cooling-element.

Examples for possible product data are given in Table I.1.

Table I.1 – Examples for possible product data

Type	L_{70},T_c h	L_{70}, B_{10} h
Product designation at T_p =100 °C	2 500	1 500
Product designation at T_p =70 °C	3 500	2 500

I.4 Switching cycle

I.4.1 Single-function LED light sources

I.4.1.1 LED light sources for continuous operation

LED light sources shall be switched off twice daily for periods of not less than 15 min, such periods not being considered as part of the life.

I.4.1.2 LED light sources for intermittent operation

LED light sources for intermittent operation as used in direction indicators shall be operated in the following switching cycle:

- 115 min continuous on or flashing, as appropriate;
- 5 min off;
- flashing frequency: 90/min; on/off ratio 1:1.

The whole flashing operation time is considered as life.

I.4.2 Dual-function LED light sources for headlamps

The functions shall be operated alternately according to the following cycle and starting with the lower beam function:

- passing-beam function: 15 h on/45 min off;
- driving-beam function: 7,5 h on/45 min off.

The lifetime values for the light source are determined by the lower performing of the two functions.

The off periods are not considered as part of the life.

NOTE The operation of the passing-beam function represents two-thirds of the total life, the operation of the driving-beam function one-third.

I.4.3 Multiple-function LED light sources for light signalling equipment

Luminous flux maintenance testing may be carried out either for each function separately, or with all functions operated simultaneously or with the functions operated alternately.

In case of an alternate operation, each function shall be operated with a minimum on-period of 10 h.

If different operating conditions (e.g. dimming) are used for the same LED light source in order to fulfil different functions, luminous flux maintenance testing may be carried out at the most onerous conditions.

For LED light sources for continuous operation, the switching cycle shall be as specified in I.4.1.1.

For LED light sources for intermittent operation, the switching cycle shall be as specified in I.4.1.2.

I.5 Luminous flux maintenance measurements

Tests may be interrupted for determination of the luminous flux maintenance.

Luminous flux maintenance measurements should be carried out at regular intervals, at a minimum time interval of 1 000 h.

For the measurement of the luminous flux, an integrating method shall be used. The LED light source shall be operated in a dry and still atmosphere at an ambient temperature of 23 °C ± 5 °C.

LED light sources, for which the thermal management is intended to be achieved by additional provisions, shall be operated at the specified performance temperature T_p.

Measurements shall be carried out when photometric stability has occurred.

The moment at which the photometry is stable is defined as the point in time at which the variation of the photometric value is less than 3 % within any 15-minute period.

I.6 Colour measurement

The colour of the emitted light shall be measured, using an integrating method, at the same time as the luminous flux maintenance measurements and under the same conditions as specified in I.5.

The colour shall be expressed in CIE-coordinates and shall remain within the respective colour boundaries as given in 4.4.1 of IEC 60809:2014 (for colour specification, see also UN Regulation R48, Subclause 2.28).

If the colour of the emitted light has shifted outside the respective colour specification, the light source shall be considered to have failed and the luminous flux maintenance test shall be stopped.

If the colour of the emitted light is produced by a combination of light source radiation and secondary optics, all colour measurements shall be carried out with secondary optics.

In this case, the optical properties of the secondary optics shall be described in the test report.

Annex J
(normative)

Destructive physical analysis for LED packages

J.1 Description

The purpose of this examination is to determine the capability of a LED package's internal materials, design, and workmanship to withstand forces induced by various stresses induced during environmental testing.

J.2 Equipment

The following equipment is required:

a) optical microscope having magnification capability of up to 50X;

b) de-capsulation equipment.

J.3 Procedure

The following procedure shall be followed:

c) LED packages selected for this test shall have successfully completed environmental testing as defined in 8.6.4 or 8.6.5 (TMCL test and WHTOL test).

d) The LED packages shall be opened or de-capsulated in order to expose the internal die/substrate and determine the extent of any mechanical damage. The process used to de-capsulate the LED package shall insure that it does not cause degradation of the leads and bonds. The internal die or substrate shall be completely exposed and free of packaging material.

e) The LED packages shall be examined under a magnification of up to 50X to the criteria listed in J.4.

f) Failed LED packages shall be analysed to determine the cause of the failure. A failure analysis report documenting this analysis shall be prepared on all failures. If the analysis shows that the failure was caused by the package opening process, the test shall be repeated on a second group of LED packages.

J.4 Failure criteria

LED packages shall be considered to have failed if they exhibit any of the following:

a) visible evidence of non-conforming to the LED packages' certificate of design, construction and qualification;

b) visible evidence of corrosion, contamination, delamination or metallization voids;

c) visible evidence of die/substrate cracks or defects;

d) visible evidence of wire, die, or termination bond defects;

e) visible evidence of dendrite growth or electromigration.

Annex K
(informative)

Communication sheet LED package testing

SUBJECT: LED package stress test qualification according to IEC 60810

DEVICE:		**Report No.:**	
Family package:		**Date:**	

Key product data: [Reference to applicable product specification sheet]

nominal drive current I_f

min. drive current I_f

max. drive current I_f

min. operating temperature $T_{s,\ min}$

max. operating temperature $T_{s,\ max}$

TEST PERFORMED	CONDITION	DURATION/ TEST REPEATS	SAMPLE SIZE	FAILURES		
				Elec	Photo	Vis
8.6.3 High temperature operating life (HTOL) *JESD22-A108D*	T_S = __°C I_F = __ mA T_S = __°C I_F = __ mA	1 000 h	3x26			
8.6.4 Temperature cycling (TMCL) *JESD22-A104D*	Preconditioning: Jedec level __ TMCL condition _ -__°C/+___°C __min each extreme Transfer time __ s	1 000 cycles	3x26			
8.6.5 Wet high temperature operating life – min rated drive current (WHTOL) *JESD22-A101C*	Preconditioning: Jedec Level __ T_S = 85°C, RH= 85 %; I_F = __ mA $t_{on / off}$ = 30 min	1 000 h	3x26			
8.6.6 Power temperature cycling (PTMCL) *JESD22-A105C*	Preconditioning: Jedec level __ PTMCL condition _: -__/+___°C I_F = __ mA $t_{on / off}$ = 5 min	1 000 h	3x26			
8.6.7 Electrostatic discharge (ESD-HBM) *JS-001-2012*	Human body model 8 000 V		3x26			
8.6.8 Electrostatic discharge (ESD-MM) *JESD22-A115C*	Machine model 400 V		3x26			
8.6.10 Physical dimension (PD)	According to data sheet		3x26			
8.6.11 Vibrations variable frequency (VVF) *JESD22-B103B*	**Constant displacement:** 1,5 mm (20 Hz to 100 Hz) **Peak acceleration:** 200 m/s^2 (100 Hz to 2 000 Hz) Duration one cycle: ≥ 4 min Cycles per axis: 4 Number of axes: 3 (X;Y;Z)	1x	3x26			
8.6.12 Mechanical shock (MS) *JESD22-B110B*	**Shock type:** Half sinus **Max. acceleration:** 1 500 g **Shock duration:** 0,5 ms **Number of shocks**: 5 in each direction **Number of directions:** 6 (±X, ±Y, ±Z) → 30 shocks total	1x	3x26			
8.6.13 Resistance to soldering heat (RSH-TTW) *JESD22-B106D*	TTW-soldering	3x	3x26			
8.6.14 Resistance to soldering heat (RSH-reflow) *JESD22-A113F*	Reflow soldering 260 °C	3x	3x26			

TEST PERFORMED	CONDITION	DURATION/ TEST REPEATS	SAMPLE SIZE	FAILURES		
				Elec	Photo	Vis
8.6.15 Solderability (SO) *IEC 60068-2-20*	Wetting 245 °C, 3 s Dewetting 260 °C, 10 s	1x	1x11			
8.6.16 Thermal shock (TMSK) *JESD22-A106B*	TMSK condition _: -__°C/+___°C (liquid-to-liquid)	1 000 cycles	3x26			
8.6.17 Hydrogen sulphide (H2S) *IEC 60068-2-43*	T_A = 40 °C RH=90 % 10 – 15 × 10^{-6} H_2S	336 h	3x26			
8.6.18 Pulsed operating life (PLT) *JESD22-A108D*	T_S = 55 °C I_F = __ mA t = 100 µs; D = 3 %	1 000 h	3x26			
8.6.19 Dew test (DEW) *JESD22-A100C*	$T_{A\ min}$ = 30 – 65 °C Time at 65 °C __h r.h.= 90 % to 98 %;	1 008 h	3x26			
8.6.20 Flow mixed gas corrosion (FMGC) *IEC 60068-2-60*	Test method 4 T_A = 25 °C RH=75 %.	500 h	3x26			

Failure criteria:

Electrical: V_f (I_f (nominal) = __ mA) > __ V; ±10 % from initial value

Photometrical:

- Radiant power/luminous flux: I_V (I_f (nominal) = __ mA) absolute limit: ± __% max.
- Colour coordinates: x (I_f (nominal) = __ mA) < 0,01
  y (I_f (nominal) = __ mA) < 0,01

Visual: e.g. broken or damaged package or leads

Conclusion: **The tested devices fulfil the reliability requirements.**

Annex L
(normative)

Re-testing matrix for LED package testing

Table L.1 specifies retesting requirements for product/process changes

NOTE Table L.1 was developed based on the ZVEI document.

Table L.1 – Retesting matrix

Legend:

X = Test is recommended
C = Test is recommended based on LED type and risk assessement
na = not applicable for this change

* This test only applies to LED packages that are declared to be solderable by wave soldering by the manufacturer
**This test applies only to LED packages that are specified for reflow soldering

			Type of Change	8.6.3 High Temperature Operating Life (HTOL)	8.6.4 Temperature Cycling (TMCL)	8.6.5 Wet High Temperature Operating Life (WHOTL)	8.6.6 Power Temperature Cycling (PTMCL)	8.6.7 Electrostatic Discharge Human Body Model (ESD-HBM)	8.6.8 Electrostatic Discharge Machine Model (ESD-MM)	8.6.10 Physical Dimensions (PD) of LED package	8.6.11 Vibrations Variable Frequency (VVF)	8.6.12 Mechanical Shock (MS)	8.6.13 Resistance to Soldering Heat (RSH-TTW) *	8.6.14 Resistance to Soldering Heat (RSH-reflow) **	8.6.15 Solderability (SO)	8.6.16 Thermal Shock (TMSK)	8.6.17 Hydrogen Sulphide (H_2S)	8.6.18 Pulsed Operating Life (PLT)	8.6.19 DEW Test (DEW)	8.6.20 Flow Mixed Gas Corrosion (FMGC)
Design			Design changes in active elements	X	na	X	X	X	X	na	na	na	na	na	na	na	na	X	X	na
Design			Design changes in routing	X	X	X	X	na	na	na	na	na	X	X	na	X	X	X	X	X
Design			LED package	X	X	X	X	na	na	X	X	X	X	X	X	X	X	C	X	X
			LED Chip size / shrink	X	X	X	X	X	X	na	na	na	X	X	na	na	na	X	na	na
Process	Wafer Production	New Material	Wafer substrate material	X	C	C	X	C	C	na	na	na	X	X	na	C	C	X	C	C
Process	Wafer Production	New Material	Wafer diameter	X	na	X	na	C	C	na	na	na	X	X	na	na	na	X	na	na
Process	Wafer Production	New Material	Final wafer thickness	X	X	na	X	C	C	na	na	na	na	na	na	na	na	X	na	na
Process	Wafer Production	New Material	Electrical active doping / implantation element	X	na	C	na	C	C	na	na	na	na	na	na	na	na	X	na	na
Process	Wafer Production	New Material	Oxide / dielectrics	X	na	X	X	C	C	na	na	na	na	na	na	na	na	X	C	na
Process	Wafer Production	New Material	Metallization (chip frontside)	X	X	X	X	C	C	na	na	na	na	na	na	X	X	X	X	X
Process	Wafer Production	New Material	Metallization (chip backside)	X	X	X	X	C	C	na	na	na	X	X	na	X	X	X	X	X
Process	Wafer Production	New Material	Passivation / die coating	X	X	X	C	C	C	na	na	na	na	na	na	na	C	na	C	C
Process	Wafer Production		Change in process technique	C	C	C	C	na	na	na	na	na	na	na	na	C	C	C	C	C
Process	Wafer Production		Change of material supplier with impact on agreed specifications	X	na	na	X	na	na	na	na	na	X	X	na	na	na	X	na	na
Process	Assembly	New Material	Package	C	X	C	C	na	na	X	C	C	X	X	na	C	C	na	C	C
Process	Assembly	New Material	Leadframe base material	na	X	X	C	na	na	na	na	na	X	X	X	C	X	na	C	X
Process	Assembly	New Material	Leadframe finsihing material	na	X	X	X	na	na	na	na	na	X	X	X	C	X	na	C	X
Process	Assembly	New Material	Die attach material	X	X	X	X	na	na	na	C	C	X	X	na	C	X	na	C	X
Process	Assembly	New Material	Bond wire material	X	X	C	X	na	na	na	C	C	X	X	na	C	C	X	na	C
Process	Assembly	New Material	LED package susbtrate (BGA)	C	X	X	C	na	na	na	na	na	X	X	X	C	X	na	C	X
Process	Assembly	New Material	Phosphor material / architecure	X	C	X	X	na	na	na	C	C	X	X	na	C	C	na	C	C
Process	Assembly	New Material	Mould compund, encapsulation / sealing material	X	X	X	C	na	na	na	na	na	X	X	X	C	X	na	C	X
Process	Assembly		Change in process technique (e.g. die attach, bonding, plating, ...)	X	X	X	C	na	na	na	C	C	C	C	na	C	C	C	C	C
Process	Assembly		Change of material supplier with impact on agreed specifications	X	X	X	C	na	na	na	na	na	X	X	C	C	C	na	C	C
Logistics / Capacity / Testing	Equipment		Production from a new equipment / tool uses a different technology	C	X	C	C	na	na	na	na	na	X	X	C	C	na	na	na	na
Logistics / Capacity / Testing	Equipment		Production from a new equipment / tool uses same basic technology	na	C	C	C	na	na	na	na	na	na	na	C	C	na	na	na	na
Logistics / Capacity / Testing	Equipment		Change in the final testing equipment type use of a different technology	na	na	na	C	X	X	na	na	na	na	na	C	na	na	C	na	na
Logistics / Capacity / Testing	Process flow		Move of all or part of wafer fab to a different and not previously released location/ site / subcontractor	X	X	X	C	X	X	na	na	na	X	X	na	C	na	X	na	na
Logistics / Capacity / Testing	Process flow		Move of all or part of assembly to a different and not previously released location/ site / subcontractor	X	X	X	C	C	C	C	C	C	X	X	C	C	X	na	C	C

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[4] This publication was withdrawn.

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