

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Lamps, light sources and led packages for road vehicles –
Performance requirements**

**Lampes, sources lumineuses et led encapsulées pour véhicules routiers –
Exigences de performances**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2017 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Lamps, light sources and led packages for road vehicles –
Performance requirements**

**Lampes, sources lumineuses et led encapsulées pour véhicules routiers –
Exigences de performances**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.140.99

ISBN 978-2-8322-4818-8

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD	8
1 Scope	10
2 Normative references	10
3 Terms and definitions	12
4 Requirements and test conditions for filament lamps	16
4.1 Basic function and interchangeability	16
4.2 Torsion strength	16
4.3 Characteristic life T_C	16
4.4 Life B_3	16
4.5 Luminous flux maintenance	17
4.6 Resistance to vibration and shock	17
4.7 Glass-bulb strength	17
5 Filament lamp data	17
6 Requirements and test conditions for discharge lamps	22
6.1 Basic function and interchangeability	22
6.2 Mechanical strength	22
6.2.1 Bulb-to-cap connection	22
6.2.2 Cable-to-cap connection (if any)	22
6.3 Characteristic life T_C	22
6.4 Life B_3	22
6.5 Luminous flux maintenance	22
6.6 Resistance to vibration and shock	22
6.7 Discharge lamps with integrated starting device	22
6.8 Discharge lamps with integrated starting device and integrated ballast	23
7 Requirements and test conditions for LED light sources	23
7.1 Basic function and interchangeability	23
7.2 UV radiation	24
7.3 Luminous flux and colour maintenance	24
7.4 Resistance to vibration and shock	26
7.5 Electromagnetic compatibility	27
7.6 Powered thermal cycling test	27
7.7 Mass	28
7.8 Typical circuits for LED light sources	28
7.8.1 General	28
7.8.2 Typical circuits for LR3, LR5, LY3, LY5, LW3 and LW5 LED light sources	28
7.8.3 Typical circuits for LR4 LED light sources	29
7.9 Maximum power consumption	30
7.10 Overvoltage test	30
7.11 Reverse voltage test	30
7.12 Transient voltage test (field decay)	31
7.13 Transient voltage test (load dump)	32
7.14 Electrostatic discharge test (ESD)	33
7.15 Pulsed operating life (PLT) test	33
8 Requirements and test conditions for LED packages	33
8.1 LED package stress test qualification	33

8.2	Test samples	34
8.2.1	Lot requirements.....	34
8.2.2	Production requirements.....	34
8.2.3	Pre- and post-stress test requirements	34
8.2.4	Assembly of LED packages on test boards	35
8.2.5	Moisture pre-conditioning (MP)	35
8.2.6	Thermal resistance (TR) test	35
8.3	Definition of failure criteria	35
8.4	Choice between test conditions.....	36
8.5	Criteria for passing qualification/requalification	36
8.6	Qualification test.....	36
8.6.1	Pre- and post- electrical and photometric test	36
8.6.2	Pre- and post- external visual (EV) test	36
8.6.3	High temperature operating life (HTOL) test	36
8.6.4	Temperature cycling (TMCL) test.....	37
8.6.5	Wet high temperature operating life (WHTOL) test.....	37
8.6.6	Power temperature cycling (PTMCL) test.....	37
8.6.7	Electrostatic discharge, human body model (ESD-HBM) test	38
8.6.8	Electrostatic discharge, machine model (ESD-MM) test	38
8.6.9	Destructive physical analysis (DPA) test.....	38
8.6.10	Physical dimensions (PD) test	38
8.6.11	Vibrations variable frequency (VVF) test.....	38
8.6.12	Mechanical shock (MS) test.....	38
8.6.13	Resistance to soldering heat (RSH-TTW) test.....	38
8.6.14	Resistance to soldering heat (RSH-reflow) test.....	39
8.6.15	Solderability (SO) test.....	39
8.6.16	Thermal shock (TMSK) test	39
8.6.17	Hydrogen sulphide (H ₂ S) test	39
8.6.18	Pulsed operating life (PLT) test.....	39
8.6.19	Dew (DEW) test.....	40
8.6.20	Flowing mixed gas corrosion (FMGC) test	41
8.6.21	Wire bond pull test (WBP).....	41
8.6.22	Bond shear test (BS)	42
8.6.23	Die shear test (DS)	42
Annex A	(normative) Life test conditions for filament lamps	43
A.1	Ageing	43
A.2	Test voltage	43
A.3	Operating position and operating conditions.....	43
A.4	Switching cycle	43
A.4.1	Single-filament lamps	43
A.4.2	Dual-filament lamps for headlamps	44
A.4.3	Dual-filament lamps for light signalling equipment	44
A.5	Luminous flux and colour maintenance	44
Annex B	(normative) Vibration tests	45
B.1	General.....	45
B.2	Test conditions	46
B.2.1	General	46
B.2.2	Mounting (see IEC 60068-2-47)	46
B.2.3	Measuring points	46

B.2.4	Control point.....	46
B.2.5	Conditioning	46
B.2.6	Axis of vibration	46
B.2.7	WBR test – Basic motion	47
B.3	Test conditions	47
B.3.1	General	47
B.3.2	Narrowband random vibration tests.....	47
B.3.3	Wideband random vibration tests	48
Annex C	(normative) Glass-bulb strength test	50
C.1	General.....	50
C.2	Test equipment and procedure.....	50
C.2.1	Principle of the test equipment.....	50
C.2.2	Test conditions	50
C.2.3	Requirements for plates.....	51
C.3	Requirements	51
C.4	Evaluation.....	52
C.4.1	General	52
C.4.2	Assessment based on attributes	52
C.4.3	Assessment based on variables.....	52
Annex D	(normative) Life and luminous flux maintenance test conditions for discharge lamps	54
D.1	Ageing	54
D.2	Test circuit and test voltage	54
D.3	Burning position and operating conditions.....	54
D.4	Switching cycle	54
D.5	Luminous flux maintenance.....	56
Annex E	(normative) Bulb deflection test.....	57
E.1	General.....	57
E.2	Test set-up and procedure	57
E.3	Requirement	57
Annex F	(informative) Guidance on equipment design	58
F.1	Pinch temperature limit	58
F.2	Solder temperature limit.....	58
F.3	Maximum filament lamp outline	58
F.4	Maximum surge voltage	58
F.5	Recommended instructions for use and handling of halogen filament lamps.....	58
F.6	Recommended instructions for use and handling of discharge lamps	59
Annex G	(informative) Ballast design	64
Annex H	(informative) Symbols.....	65
H.1	General.....	65
H.2	Symbol indicating that lamps operate at high temperatures.....	66
H.3	Symbol indicating that care should be taken to avoid touching the bulb.....	66
H.4	Symbol indicating that the use of protective gloves is advised.....	66
H.5	Symbol indicating that lamps with scratched or otherwise damaged bulbs should not be used.....	66
H.6	Symbol indicating that before handling, the lamp shall be switched off.....	66
H.7	Symbol indicating that the use of eye protection is advised	66
H.8	Symbol indicating that during operation, the lamp emits UV-radiation	67

H.9	Symbol indicating that the lamp shall be operated only in a luminaire with a protective shield.....	67
H.10	Symbol indicating dangerous voltage	68
H.11	Pictogram for instruction "Non-ECE"	68
H.12	Pictogram for instruction "Interior lighting only"	69
Annex I (normative)	Luminous flux maintenance test conditions for LED light sources	70
I.1	Ageing	70
I.2	Test voltage	70
I.3	Operating conditions	70
I.3.1	Test rack	70
I.3.2	LED light sources with integrated thermal management.....	70
I.3.3	LED light sources with external thermal management.....	70
I.4	Switching cycle	71
I.4.1	Single-function LED light sources	71
I.4.2	Dual-function LED light sources for headlamps.....	71
I.4.3	Multiple-function LED light sources for light signalling equipment	71
I.5	Luminous flux maintenance measurements	72
I.6	Colour measurement.....	72
Annex J (normative)	Destructive physical analysis for LED packages	73
J.1	Description	73
J.2	Equipment	73
J.3	Procedure	73
J.4	Failure criteria.....	73
Annex K (informative)	Communication sheet LED package testing.....	74
Annex L (normative)	Re-testing matrix for LED packages testing	77
Annex M (informative)	Guidelines for LED packages robustness validation	78
M.1	General.....	78
M.2	Test samples	80
M.2.1	Lot requirements.....	80
M.2.2	Production requirements.....	81
M.2.3	Pre- and post-stress test requirements	81
M.2.4	Assembly of LED packages on test boards	81
M.3	Definition of end-of-test criteria	81
M.4	Test sequence of over-stress testing.....	81
M.5	Over-stress test definition	82
M.5.1	Pre- and post-electrical and photometric test	82
M.5.2	Pre- and post-external visual (EV) test	82
M.5.3	High temperature operating life (HTOL) and low temperature operating life (LTOL) tests.....	82
M.5.4	Temperature cycling (TMCL) test.....	83
M.5.5	Wet high temperature operating life (WHTOL) test.....	83
M.5.6	Power temperature cycling (PTMCL) test.....	84
M.5.7	Thermal shock (TMSK) test	84
M.6	Destructive physical analysis (DPA) test	85
M.7	Projection models	85
Bibliography		89
Figure 1	Examples of LED packages.....	14

Figure 2 – Example of an LED module without integrated heatsink	14
Figure 3 – Example of an LED module with integrated heatsink	14
Figure 4 – Example of a replaceable LED light source	15
Figure 5 – Example of a non-replaceable LED light source	15
Figure 6 – Position of the centre of gravity (shaded areas).....	23
Figure 7 – Extract from IEC 60068-2-14 Test Nb, showing the temperature cycle profile	27
Figure 8 – Typical electrical circuit for an LR3, LR5, LY3, LY5, LW3 and LW5 LED light source	29
Figure 9 – Typical electrical circuit for an LR4 LED light source	29
Figure 10 – Profile of pulse 1 from ISO 7637-2	31
Figure 11 – Profile of pulse 2a from ISO 7637-2	32
Figure 12 – Temperature–humidity characteristics for the DEW test.....	41
Figure B.1 – Recommended equipment layout for vibration testing	49
Figure C.1 – Diagrammatic sketch of the principle of the test equipment.....	50
Figure D.1 – Superposition of on/off switching and power switching cycle	55
Figure E.1 – Sketch of the test set-up	57
Figure F.1 – Voltage surges for 12 V filament lamps – Maximum tolerable duration for a voltage surge as a function of its height	59
Figure F.2 – Maximum filament lamp outlines H1	60
Figure F.3 – Maximum filament lamp outlines H2	61
Figure F.4 – Maximum filament lamp outlines H3	62
Figure F.5 – Maximum filament lamp outlines P21W, PY21W, P21/4W and P21/5W	63
Figure H.1 – Pictogram for instruction "Non-ECE"	68
Figure H.2 – Pictogram for instruction "Interior lighting only"	69
Figure M.1 – Concept of over-stress testing for two stress parameters	79
Figure M.2 – Flow diagram for the robustness validation process.....	80
Table 1 – Conditions of compliance for life B_3	17
Table 2 – Conditions of compliance for the vibration test	17
Table 3 – Rated life values for continuous operation	18
Table 4 – Rated luminous flux-maintenance values for continuous operation	21
Table 5 – Minimum $L_{70}B_{10}$ values for replaceable LED light sources	25
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	26
Table 7 – Example of product data.....	26
Table 8 – Temperature classes for the powered thermal cycling test.....	27
Table 9 – Maximum mass for LED light sources	28
Table 10 – Maximum power consumption.....	30
Table 11 – Test parameters for pulse 1 from ISO 7637-2	31
Table 12 – Test parameters for pulse 2a from ISO 7637-2	32
Table B.1 – Vibration test on motor vehicle lamps – Test conditions	47
Table B.2 – Vibration test on motor vehicle lamps – Standard test conditions (narrowband)	47
Table B.3 – Vibration test on motor vehicle lamps – Heavy-duty test conditions	48

Table B.4 – Vibration test on motor vehicle lamps – Standard test conditions (wideband).....	48
Table C.1 – Compression strength.....	51
Table C.2 – Inspection by attributes – Double sampling plan	52
Table C.3 – Inspection by variables – "S" method of assessment	53
Table D.1 – On/off switching cycle	54
Table D.2 – Power switching cycle.....	55
Table D.3 – Fast power switching cycle	56
Table G.1 – Open circuit voltage.....	64
Table I.1 – Examples of possible product data	71
Table M.1 – Typical over-stress matrix for two stress parameters	82
Table M.2 – Acceleration models	86

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LAMPS, LIGHT SOURCES AND LED PACKAGES FOR ROAD VEHICLES – PERFORMANCE REQUIREMENTS

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60810 has been prepared by subcommittee 34A: Lamps, of IEC technical committee 34: Lamps and related equipment.

This fifth edition cancels and replaces the fourth edition published in 2014 and Amendment 1:2017. This edition constitutes a technical revision.

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

- a) update and clarification of the title and scope;
- b) introduction of new LED light sources;
- c) introduction of requirements for LED light sources;
- d) introduction of guidelines on LED package robustness validation for LED packages.

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

FDIS	Report on voting
34A/2021/FDIS	34A/2033/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

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

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

LAMPS, LIGHT SOURCES AND LED PACKAGES FOR ROAD VEHICLES – PERFORMANCE REQUIREMENTS

1 Scope

This document is applicable to filament lamps, discharge lamps, LED light sources and LED packages to be used in road vehicles, i.e. in headlamps, fog-lamps, signalling lamps and interior lighting. It is especially applicable to those lamps and light sources which are listed in IEC 60809.

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 as guidance for lighting and electrical equipment design.

For some of the requirements given in this document, 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 document, "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 document does not apply to luminaires.

NOTE 3 In this document, 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 are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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 60068-2-58, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

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

IEC 60809:2014, *Lamps for road vehicles – Dimensional, electrical and luminous requirements*

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

ISO 7637-2:2011, *Road vehicles – Electrical disturbances from conduction and coupling – Part 2: Electrical transient conduction along supply lines only*

ISO 10605, *Road vehicles – Test methods for electrical disturbances from electrostatic discharge*

United Nations Vehicle Regulations – 1958 Agreement, *Agreement concerning the adoption of uniform technical prescriptions 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*

(available at www.unece.org/trans/main/wp29/wp29regs.html)¹

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

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

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

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

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

JESD22-A104E, *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*

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

JESD22-B110B, *Mechanical shock*

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

JESD22-B116:1998, *Wire Bond Shear Test Method*

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*

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*

MIL-STD-883E:2015, *Visual Inspection Criteria*

ZVEI "Guideline for Customer Notifications of Product and/or Process Changes (PCN) of Electronic Components specified for Automotive Applications" 4th revised Edition, October 2016, Rev. 3

3 Terms and definitions

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

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

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

3.1 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

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