

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

Self-ballasted LED-lamps for general lighting services –
Performance requirements

IECNORM.COM : Click to view the full PDF of IEC PAS 62612:2009



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2009 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.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: 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.

- Catalogue of IEC publications: www.iec.ch/searchpub

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

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

- Electropedia: www.electropedia.org

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

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

IECNORM.COM : Click to view the full text of IEC PAS 62072:2009

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

**Self-ballasted LED-lamps for general lighting services –
Performance requirements**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

P

ICS 29.140.01, 31.080.10

ISBN 978-2-88910-816-9

CONTENTS

FOREWORD.....	3
1 General.....	5
1.1 Scope.....	5
1.2 Statement.....	5
2 Normative references.....	5
3 Terms and definitions.....	6
4 Marking.....	8
4.1 General requirements for marking.....	8
4.2 Places of marking (see Table 1).....	8
5 Dimensions.....	8
6 Test conditions.....	8
7 Lamp wattage.....	9
8 Luminous flux.....	9
9 Correlated colour temperature and colour rendering.....	9
9.1 CCT.....	9
9.2 CRI.....	10
10 Lamp life.....	10
10.1 Lumen maintenance.....	10
10.2 Endurance test for built-in electronic ballast.....	12
11 Assessment.....	12
Annex A (normative) Method of measuring lamp characteristics.....	13
Annex B (normative) Method of measuring luminous flux for LED lamps.....	14
Bibliography.....	15
Figure 1 – Luminous flux maintenance over life.....	11
Table 1 – Places where marking is required.....	8
Table 2 – Correlated colour temperatures and chromaticity co-ordinates.....	9
Table 3 – Tolerance (categories) on nominal CCT values.....	10
Table 4 – Categories of lumen maintenance after 6 000 h.....	11

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**SELF-BALLASTED LED-LAMPS
FOR GENERAL LIGHTING SERVICES –****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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

A PAS is a technical specification not fulfilling the requirements for a standard, but made available to the public.

IEC-PAS 62612 has been processed by subcommittee 34A: Lamps, of IEC technical committee 34: Lamps and related equipment.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
34A/1318/PAS	34A/1325/RVD

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single 3-year period, following which it shall be revised to become another type of normative document, or shall be withdrawn.

IECNORM.COM : Click to view the full PDF of IEC PAS 62612:2009
Withdrawn

SELF-BALLASTED LED-LAMPS FOR GENERAL LIGHTING SERVICES –

Performance requirements

1 General

1.1 Scope

This PAS specifies the performance requirements for self-ballasted LED lamps with a supply voltage up to 250 V, together with the test methods and conditions required, intended for domestic and similar general lighting purposes, having:

- a rated wattage up to 60 W;
- a rated voltage of up to 250 V AC or DC;
- a lamp cap according to IEC 62560¹⁾.

The requirements of this PAS relate to type testing.

This PAS does not cover self-ballasted LED lamps that intentionally produce tinted or coloured light neither does it cover OLEDs.

Recommendations for whole product testing or batch testing are under consideration.

These performance requirements are additional to the requirements in IEC 62560¹⁾ (safety standard for self-ballasted LED lamps).

NOTE When operated in a luminaire, the claimed performance data can deviate from the values established via this PAS.

1.2 Statement

It may be expected that self-ballasted LED lamps which comply with this PAS will start and operate satisfactorily at voltages between 92 % and 106 % of rated supply voltage and at an ambient air temperature of between –10 °C and 40 °C and in a luminaire complying with IEC 60598-1.

For compliance with EMC requirements, reference is made to regional requirements. For relevant standards, see Bibliography.

2 Normative references

The following referenced documents are indispensable for the application 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 60061-1, *Lamp caps and holders together with gauges for the control of interchangeability and safety*

IEC 60081, *Double-capped fluorescent lamps – Performance specifications*

1) In preparation.

IEC 60598-1, *Luminaires – Part 1: General requirements and tests*

IEC 60630, *Maximum lamp outlines for incandescent lamps*

IEC/TR 61341, *Method of measurement of centre beam intensity and beam angle(s) of reflector lamps*

CIE 84:1989, *Measurement of Luminous Flux*

3 Terms and definitions

For the purposes of this PAS, the following terms and definitions apply.

For terms and definitions in the field of LED and LED modules, reference is made to IEC 62504, which is currently in preparation, and IEC 60050-845. Both will not be repeated here.

3.1

self-ballasted LED-lamp

unit which cannot be dismantled without being permanently damaged, provided with a lamp cap conforming to IEC 60061-1 and incorporating a LED light source and any additional elements necessary for starting and stable operation of the light source

3.2

type

LED lamps that, independent of the type of cap, have an identical photometric and electrical rating

3.3

rated value

quantity value for a characteristic of a LED-lamp for specific operating conditions

The value and the conditions are specified in this PAS, or assigned by the manufacturer or responsible vendor.

3.4

test voltage

voltage at which tests are carried out

3.5

lumen maintenance

luminous flux at a given time in the life of a LED-lamp divided by the initial value of the luminous flux of the lamp and expressed as a percentage of the initial luminous flux

3.6

initial values

photometric and electrical characteristics at the end of the ageing period and/or stabilization time

3.7

life (of an individual LED-lamp)

length of time during which a complete LED-lamp provides more than 50 % (or 70 % alternatively; see Note 3) of the rated luminous flux, under standard test conditions

A LED-lamp has thus reached its end of life when it no longer provides 50 % (or 70 % alternatively) of the rated luminous flux. Life is always published in combination with the failure rate (see Note 4 and 3.9).

NOTE 1 LED lamps have a different end of life characteristic than conventional lamps, because they are not subject to sudden lamp failure but will typically dim over time in a gradual way.

NOTE 2 The built-in electronic driver, however, may show a sudden end of life failure. The definition under 3.7 implies that a LED-lamp giving no light at all, due to electronic driver failure, has actually reached end of life, since it no longer complies with the minimum luminous flux level as declared by the manufacturer or responsible vendor.

NOTE 3 The maximum lumen maintenance reduction figure may vary depending on the application of the LED lamp. This PAS uses a value of 50 % (L_{50}) as an example, which is often used for consumer applications. For professional applications, a lumen maintenance figure of 70 % (L_{70}) can be chosen. Dedicated information on the chosen percentage is to be provided by the manufacturer.

NOTE 4 End of lamp life is normally determined when 50 % of the lamps has failed, indicated in combination with the chosen lumen maintenance value: L_{70} , F_{50} or L_{50} , F_{50} . For professional applications, the value L_{70} , F_{10} is advised, meaning 10 % of the lamps has failed when the point of 70 % lumen maintenance has been reached.

3.8

rated lamp life

length of time during which a complete LED-lamp provides more than 50 % (or 70 % alternatively) of the rated luminous flux, published in combination with the failure rate, as declared by the manufacturer or responsible vendor

NOTE 1 For sample size, see Clause 6.

NOTE 2 Note 1, Note 2 and Note 4 of 3.7 apply.

3.9

failure rate

F_x

percentage of a number of tested lamps of the same type that have reached the end of their individual lives

NOTE 1 For self-ballasted LED lamps, the failure rate expresses the combined effect of LED and ballast failure.

NOTE 2 For self-ballasted LED lamps, normally a failure rate of 10 % or/and 50 % are being applied, indicated as F_{10} or/and F_{50} .

3.10

colour code

colour characteristics of a LED-lamp giving white light are defined by the correlated colour temperature and the colour rendition index

3.11

stabilisation time

time which the LED-lamp requires to obtain stable thermal conditions

3.12

ageing

preconditioning period of the LED-lamps

3.13

type test

test or series of tests made on a type test sample for the purpose of checking compliance of the design of a given product with the requirements of the relevant standard

3.14

type test sample

sample consisting of one or more similar units submitted by the manufacturer or responsible vendor for the purpose of the type test

4 Marking

4.1 General requirements for marking

For this performance PAS, the following data are to be provided visible (in addition to the mandatory data of IEC 62560) by the manufacturer or responsible vendor, and placed as specified in 4.2.

4.2 Places of marking (see Table 1)

Table 1 – Places where marking is required

	(A) Product and packaging ^a	(B) Product datasheets or leaflets ^a
a) Rated luminous flux of the LED lamp, expressed in lumen, also in the case of spot lamps for which normally only the rated luminous intensity in combination with the beam angle (according IEC/TR 61341) is given.	x	x
b) Lamp colour code (See ILCOS* and NOTE 1). NOTE 1 Example of lamp colour code 830/4A, meaning CRI between 77 and 86, a nominal CCT of 3 000 K, a CCT spread within a 4-step MacAdams ellipse and a drop in lumen output of max 10 % at 25 % of rated lamp life (with a maximum duration of 6 000 h). NOTE 2 The actual luminous intensity (coupled to a specific beam angle) is not an element of this PAS, but the related luminous flux (from which the beam intensity and angle are originated) is subject of further testing; via calculation, it can be determined whether the rated luminous intensities are realistic within the beam angle specified by the manufacturer. *: Extension for LED in preparation.	x	x
c) Rated life and the related lumen maintenance factor (L_x)	x	x
e) Failure rate (F_x), corresponding to the rated life	–	x
f) Lumen maintenance category (Cat A to E, see 10.1)	–	x
g) Rated correlated colour temperature including tolerance category (Cat 1 to Cat 8, see Clause 9).	–	x
h) Rated colour rendition index	–	x
x = required – = not required		
^a Marking according to one of both columns is required. For non-professional purposes, column (A), and for professional purposes, column (B) is applicable.		

5 Dimensions

The LED-lamp dimensions shall comply with the requirements as indicated by the manufacturer or responsible vendor. The outlines of the LED-lamp shall not exceed those of the lamp to be replaced (see also IEC 60630).

6 Test conditions

Test conditions for testing electrical and photometric characteristics, lumen maintenance and life are given in Annex A.

All tests are measured on “n” lamps. The number “n” is declared by the manufacturer or responsible vendor, but shall be a minimum of 20 lamps.

Lamps which are intended for retrofit purposes shall be equipped with adequate means of cooling.

7 Lamp wattage

The power dissipated by the LED-lamp shall not exceed the rated wattage by more than 15 %.

8 Luminous flux

The initial luminous flux of a LED lamp measured shall not be less than 90 % of the rated luminous flux.

9 Correlated colour temperature and colour rendering

9.1 CCT

Reference is made to IEC 60081, Annex D: Chromaticity co-ordinates. The rated correlated colour temperature (CCT) of a lamp shall preferably be one of the following six values:

2 700 K, 3 000 K, 3 500 K, 4 000 K, 5 000 K or 6 500 K

For reference purposes, the standardized chromaticity co-ordinates corresponding to these CCT values are given in Table 2 (IEC 60081, Clause D.2, modified).

Table 2 – Correlated colour temperatures and chromaticity co-ordinates

Colour Indication	CCT	x	y
F 6500	6400	0,313	0,337
F 5000	5000	0,346	0,359
F 4000	4040	0,380	0,380
F 3500	3450	0,409	0,394
F 3000	2940	0,440	0,403
F 2700	2720	0,463	0,420

The initial CCT of a LED lamp is measured as the value after an operation time of 25 % of rated lamp life (with a maximum duration of 6 000 h). The measured actual CCT values (both initial and at 25 % of rated lamp life with a maximum duration of 6 000 h) are expressed as fitting within one of 8 categories (see Table 3), which correspond to a particular MacAdams ellipse around the rated CCT value, whereby the size of the ellipse (expressed in n -steps) is a measure for the tolerance/deviation of an individual lamp.

The measured CCT value of a LED lamp (the initial value and at 25 % of rated lamp life with a maximum duration of 6 000 h) shall not move beyond the CCT tolerance category as indicated by the manufacturer or responsible vendor (see Table 1).

Table 3 – Tolerance (categories) on nominal CCT values

MacAdams ellipse type	CCT category
All measured CCT's within a 1-step ellipse	Cat 1
All measured CCT's within a 2-step ellipse	Cat 2
All measured CCT's within a 3-step ellipse	Cat 3
All measured CCT's within a 4-step ellipse	Cat 4
All measured CCT's within a 5-step ellipse	Cat 5
All measured CCT's within a 6 step ellipse	Cat 6
All measured CCT's within a 7 step ellipse	Cat 7
All measured CCT's not within a 7 step ellipse	Cat 8

NOTE This PAS applies to retrofit LED lamps for which it is important that the CCT corresponds as much as possible to the lamps to be replaced. Tolerances are based on the CIE 1931 MacAdam ellipses as normally applied for (compact) fluorescent lamps and other discharge lamps.

9.2 CRI

The initial colour rendition index (CRI) of a LED lamp is measured as is the value after a total operation time of 25 % of rated lamp life (with a maximum duration of 6 000 h). The measured actual CRI values (both initial and at 25 % of rated lamp life with a maximum duration of 6 000 h) shall not have decreased by more than 5 points from the rated CRI value (see Table 1).

10 Lamp life

Life of a self-ballasted LED lamp (as defined in 3.7) is the combined result of the lumen maintenance performance (see 10.1) and the life of the built-in electronic ballast (see 10.2) for which an endurance test is used as an indication for its reliability and life. Both elements are tested.

Reference is made to the definitions of 3.7 and 3.9, describing the indicated percentage of tested lamps of a total batch (B50 or B10) that may fail the requirements of the tests under 10.1 and 10.2.

10.1 Lumen maintenance

As the typical life of a self-ballasted LED lamp is (very) long, it is within the scope of this PAS regarded unpractical and time-consuming to measure the actual lumen reduction over life (L_{50} or L_{70}). For that reason, this PAS relies on approximation methods to determine the expected life (L_{50} or L_{70}) of any self-ballasted LED lamp.

The actual LED behavior with regard to lumen-maintenance may differ considerably per type and per manufacturer. It is not possible to express the lumen-maintenance of all LED's in simple mathematical relations. A fast initial decrease in lumen output does not automatically imply that a particular LED will not make its rated life.

This PAS has opted for "lumen maintenance categories" that cover the initial decrease in lumen until 25 % of rated lamp life has elapsed with a maximum duration of 6 000 h. Depending on the life definition (L_{50} or L_{70}), there are five (in case of L_{50}) or three (in case of L_{70}) categories each covering an additional 10 % of lumen maintenance compared to the initial lumen output at 0 h (see Table 4).

Table 4 – Categories of lumen maintenance after 6 000 h

Luminous flux decrease at 6 000 h as % of 0 h value	$\Delta \phi$ category
Measured flux decreased by no more than 10 % of rated flux	Cat A
Measured flux decreased by no more than 20 % of rated flux	Cat B
Measured flux decreased by no more than 30 % of rated flux	Cat C
Measured flux decreased by no more than 40 % of rated flux	Cat D
Measured flux decreased by no more than 50 % of rated flux	Cat E

The initial luminous flux shall be measured, which measurement is repeated at 25 % of rated lamp life (with a maximum duration of 6 000 h). The initial luminous flux value is normalized to 100 %; it is used as the first data point for determining lamp life. The measured luminous flux value at 25 % of rated lamp life (with a maximum duration of 6 000 h) shall be expressed as a percentage of the initial value.

It is recommended to measure the lumen maintenance at 1 000 h intervals (expressed as a percentage of the initial value) for a total equal to 25 % of rated lamp life (with a maximum duration of 6 000 h). This will give additional insight as to the reliability of the measured values.

A self-ballasted LED-lamp is considered having passed the test when the following criteria have been met.

- a) The measured flux value at 25 % of rated lamp life (with a maximum duration of 6 000 h) shall never be less than the maximum lumen maintenance related to the rated life (L_{50} or L_{70}) as defined and provided by the manufacturer or responsible vendor.
- b) The measured lumen maintenance shall correspond with the “lumen maintenance category” as defined and provided by the manufacturer or responsible vendor: Cat A to Cat E for L_{50} (or Cat A to Cat C for L_{70}).

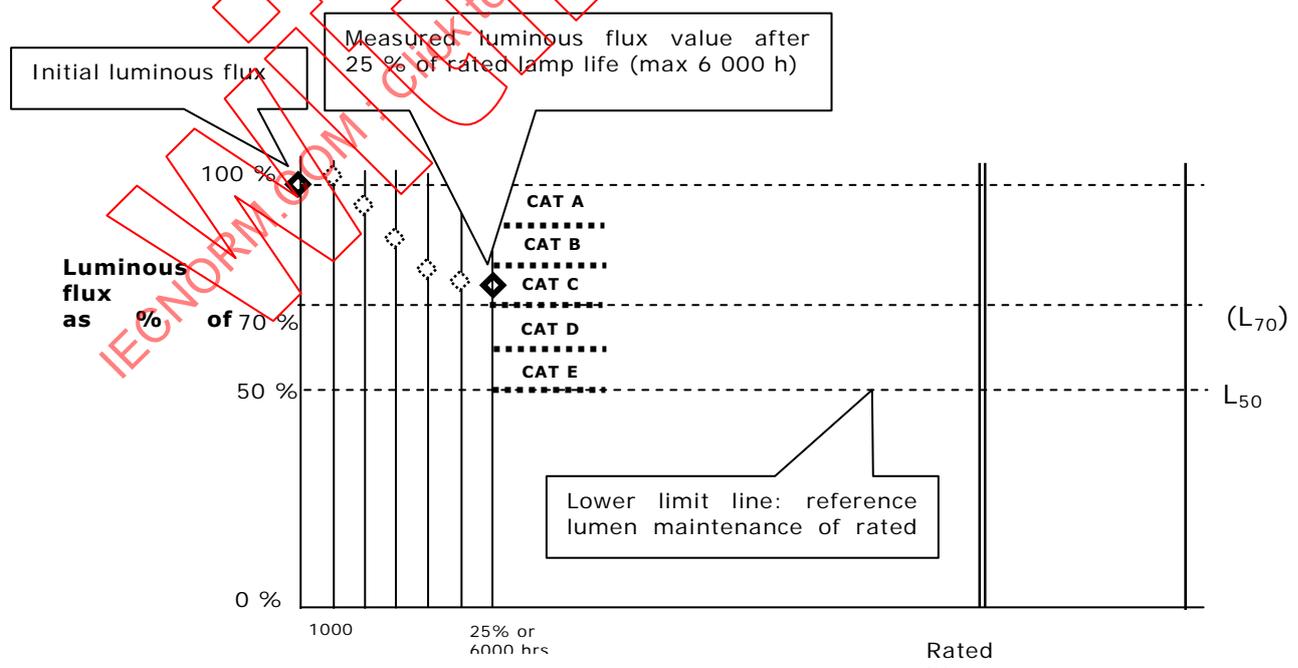


Figure 1 – Luminous flux maintenance over life

10.2 Endurance test for built-in electronic ballast

Since a self-ballasted LED lamp is a unit, which cannot be dismantled without being permanently damaged (see 3.1), the built-in electronic ballast has to be tested as part of a complete LED lamp. See also the text under Clause 10 with regard to the indicated percentage of tested lamps of a total batch (F_{50} or F_{10}) that may fail the requirements of the test.

10.2.1 The LED lamp shall be subjected to a temperature cycling shock test and a supply voltage-switching test as follows.

a) Temperature cycling shock test

The non-energised LED lamp shall be stored firstly at -10 °C for 1 h. The lamp is then immediately moved into a cabinet having a temperature of $+50\text{ °C}$ (see 1.2) and stored for 1 h. Five such cycles shall be carried out.

b) Supply voltage switching test

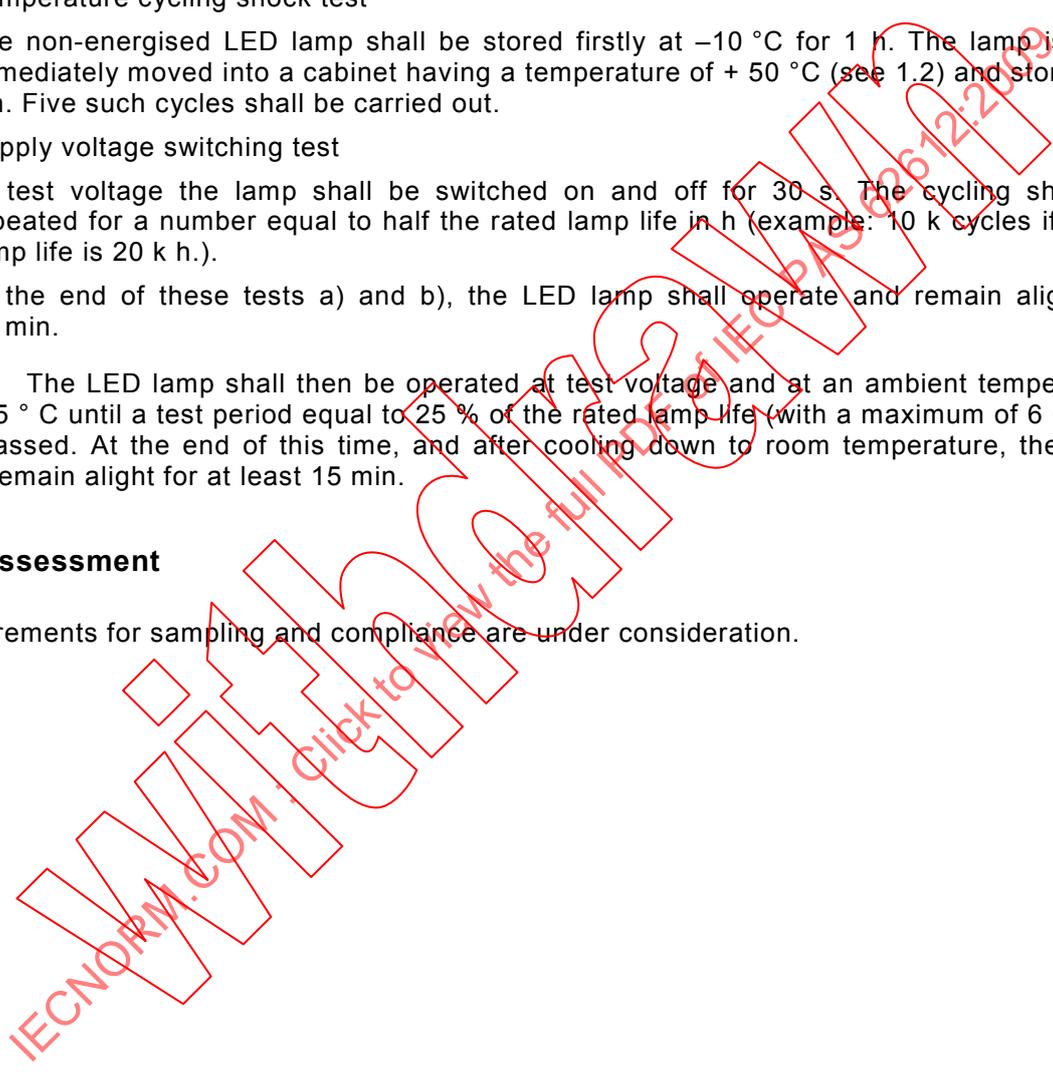
At test voltage the lamp shall be switched on and off for 30 s. The cycling shall be repeated for a number equal to half the rated lamp life in h (example: 10 k cycles if rated lamp life is 20 k h.).

At the end of these tests a) and b), the LED lamp shall operate and remain alight for 15 min.

10.2.2 The LED lamp shall then be operated at test voltage and at an ambient temperature of $+45\text{ °C}$ until a test period equal to 25 % of the rated lamp life (with a maximum of 6 000 h) has passed. At the end of this time, and after cooling down to room temperature, the lamp shall remain alight for at least 15 min.

11 Assessment

Requirements for sampling and compliance are under consideration.



Annex A (normative)

Method of measuring lamp characteristics

A.1 General

All tests shall be made in a draught-free room at an ambient temperature of $(25 \pm 1) ^\circ\text{C}$ and a relative humidity of 65 % maximum.

The test voltage shall be stable within $\pm 0,5$ %, during stabilization periods, this tolerance being $\pm 0,2$ % at the moment of measurements. For ageing and luminous flux maintenance testing, the tolerance is 2 %. The total harmonic content of the supply voltage shall not exceed 3 %. The harmonic content is defined as the RMS summation of the individual harmonic components using the fundamental as 100 %.

All tests shall be carried out at rated frequency. Unless otherwise specified for a specific purpose by the manufacturer or responsible vendor, lamps shall be operated in free air in a vertical base-up position for all tests including lumen maintenance tests.

A.2 Electrical characteristics

A.2.1 Test voltage

The test voltage shall be the rated voltage (for tolerance, see Clause A.1). In the case of a voltage range, measurements shall be carried out at the mean value.

A.2.2 Ageing

Lamps don't require any ageing prior to testing.

A.2.3 Stabilization time

Measurements shall not start before the stabilisation time has elapsed. Stable operation has been reached when the temperature of the LED lamp is not increasing more than 5 K per hour.

A.3 Photometric characteristics

A.3.1 Test voltage

The test voltage shall be the rated voltage (for tolerance, see Clause A.1). In the case of a voltage range, measurements shall be carried out at the mean value.

A.3.2 Establishing lumen values

The initial luminous flux shall be measured after thermal stabilisation of the LED lamp, the time of which is 15 min. Reference is made to document CIE 84.

NOTE Method of measuring the luminous flux of LED lamps is under discussion. Annex B has been reserved for a description of an improved method as compared to CIE 84.

Annex B
(normative)

Method of measuring luminous flux for LED lamps

CIE 84:1989, Measurement of luminous flux according this PAS has not been optimised for LED lamps and an update may be required.

IECNORM.COM : Click to view the full PDF of IEC PAS 62612:2009
Withdram