IEC 62717

Edition 1.0 2014-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

LED modules for general lighting – Performance requirements

Modules de LED pour éclairage général – Exigences de performance

IEC 62717:2014-12(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LED MODULES FOR GENERAL LIGHTING – 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.
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International Standard IEC 62717 has been prepared by subcommittee 34A: Lamps, of IEC technical committee 34: Lamps and related equipment.

This first edition cancels and replaces IEC PAS 62717 published in 2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC PAS 62717.

- all terms and definitions are aligned with IEC 62504 and relevant documents of CIE. For example, general terms like "rated value" are shifted to IEC 62504.
- a statement on the applicability on a population is included.
- the normative references are completed and cleaned from standards that are not in use.
- with regard to EMC, references to harmonic currents are given.
- the change, which has an effect on most parts of the standard, is the split of failure mechanisms into abrupt failures and luminous flux depreciation. Consequently, new

terms and definitions, new requirements for lumen maintenance and a complete new structure and contents of Annex C are introduced.

- transition from t_{pmax} to t_{prated} is made, with the background that there is not one t_{pmax}, but a choice of t_p(rated) values, in combination with lifetime.
- places where to mark (product, packaging, data sheets) are changed, and as a consequence of the split of failure mechanisms, new parameters are listed. Further, changes in the endurance test (ramping speed of temperature) are reflected in marking.
- the concept of displacement factor instead of power factor is introduced. This led to new definitions, requirements and Annexes E and F.
- the requirements on luminous efficacy are changed.
- the requirements, associated with the family concept are reviewed.
- statistics, based on confidence intervals are removed. This concerns requirements and limits for LED module power and luminous flux and deletion of Annex E.
- new requirements for lumen maintenance are introduced.
- as part of the endurance test, the maximum light decrease after accelerated operation life test is now fixed.
- with regard to the discussion on type test and sample size, the number of pieces in a test sample is drastically reduced, see Table 7.
- Annex A on measuring methods is completely restructured and reviewed, for example for ambient temperature and for shortening of stabilisation time when conducting subsequent light output measurements.
- for electrical characteristics, the ageing time may be chosen as 500 h.
- for photometric data file formats, reference is given to IEC 62722-1.
- mistakes in the photometric code (Annex D) are corrected.
- Annex G on optimised test duration is removed; instead, an INF sheet shall be published.
- from the luminaire standard, a new Annex H on “Test equipment for temperature measurement” is taken over.
- finally, the Bibliography is updated.

The text of this standard is based on the following documents:

FDIS	Report on voting
34A/1796/FDIS	34A/1817/RVD

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

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

In this standard, the following print types are used:

– requirements: roman type.

– *test specifications: italic type*.

– notes: smaller roman type.

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

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

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INTRODUCTION

The first edition of a performance standard (precursor: IEC PAS 62717) for LED modules for general lighting applications acknowledges the need for relevant tests for this new source of electrical light, sometimes called “solid state lighting”. The publication is closely related to simultaneously developed performance standard publication (which also started with a Publicly Available Specification) for luminaires in general (IEC 62722-1) and for LED-luminaires (IEC 62722-2-1). Changes in the LED module standard will have an impact on the luminaire standards and vice versa, due to the behaviour of LED. Therefore, in the development of the present standard, a close collaboration between experts of both products has taken place.

The provisions in the standard represent the technical knowledge of experts from the fields of the semiconductor (LED chip) industry and of those of the traditional electrical light sources.

Three types of LED-modules are covered: with integral controlgear, with means of control on board, but with separate controlgear (“semi-ballasted”), and with complete separate controlgear.

LED MODULES FOR GENERAL LIGHTING – PERFORMANCE REQUIREMENTS

1 Scope

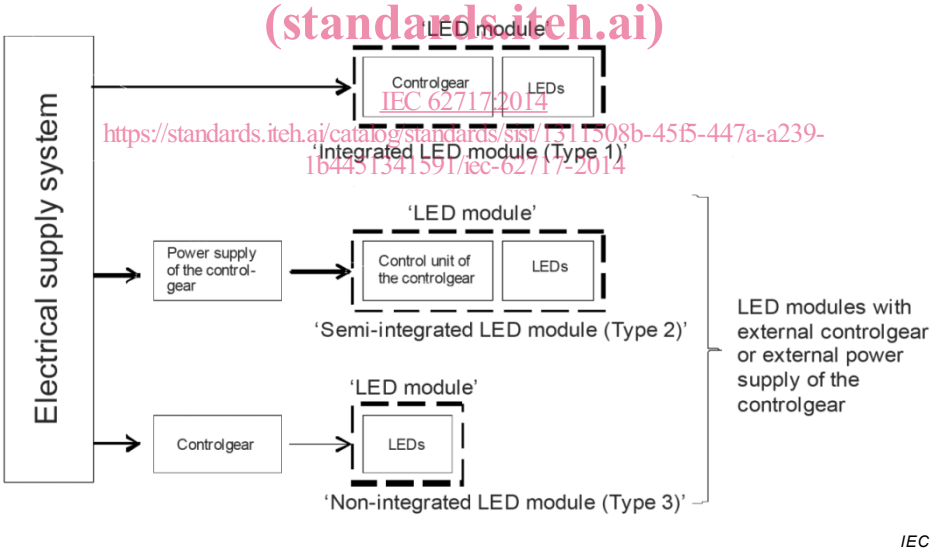
1.1 General

This International Standard specifies the performance requirements for LED modules, together with the test methods and conditions, required to show compliance with this standard. The following types of LED modules are distinguished and schematically shown in Figure 1:

Type 1: integrated LED modules for use on d.c. supplies up to 250 V or on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz.

Type 2: LED modules operating with part of separate controlgear connected to the mains voltage, and having further control means inside ("semi-integrated") for operation under constant voltage, constant current or constant power.

Type 3: LED modules where the complete controlgear is separate from the module (non-integrated) for operation under constant voltage, constant current or constant power.



The power supply of the controlgear for semi-ballasted LED modules (Type 2) is an electronic device capable of controlling currents, voltage or power within design limits.

The control unit of the controlgear for semi-ballasted LED modules (Type 2) is an electronic device to control the electrical energy to the LEDs.

A LED module with separate controlgear can be either a non-ballasted LED module or a semi-ballasted LED module.

Figure 1 – Types of LED modules

The requirements of this standard relate only to type testing.

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

This standard covers LED modules, based on inorganic LED technology that produces white light.

Life time of LED modules is in most cases much longer than the practical test times. Consequently, verification of manufacturer's life time claims cannot be made in a sufficiently confident way, because projecting test data further in time is not standardised. For that reason the acceptance or rejection of a manufacturers life time claim, past an operational time as stated in 6.1, is out of the scope of this standard.

Instead of life time validation this standard has opted for lumen maintenance codes at a defined finite test time. Therefore, the code number does not imply a prediction of achievable life time. The categories, represented by the code, are lumen-depreciation character categories showing behaviour in agreement with manufacturer's information which is provided before the test is started.

In order to validate a life time claim, an extrapolation of test data is needed. A general method of projecting measurement data beyond limited test time is under consideration.

The pass/fail criterion of the life time test as defined in this standard is different from the life time metrics claimed by manufacturers. For explanation of recommended life time metrics, see Annex C.

NOTE When modules are operated in a luminaire, the claimed performance data can deviate from the values established via this standard due to e.g. luminaire components that impact the performance of the LED module.

The separate electronic controlgear for LED modules as mentioned in Type 2 and Type 3 is not part of the testing against the requirements of this standard.

Protection for water and dust ingress, see B.3.

1.2 Statement

It may be expected that integrated LED modules which comply with this standard will start and operate satisfactorily at voltages between 92 % and 106 % of rated supply voltage. LED modules with separate controlgear are expected to start and operate satisfactorily in combination with the specified controlgear complying with IEC 61347-2-13 and IEC 62384. All LED modules are expected to start and operate satisfactorily when operated under the conditions specified by the LED module manufacturer and in a luminaire complying with IEC 60598-1.

The requirements for individuals apply for 95 % of the population.

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 60050-845:1987, *International Electrotechnical Vocabulary – Chapter 845: Lighting*

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

IEC 60068-3-5:2001, *Environmental testing – Part 3-5: Supporting documentation and guidance – Confirmation of the performance of temperature chambers*

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

IEC 61000-3-2:2005[1], *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*
IEC 61000-3-2:2005/AMD 1:2008
IEC 61000-3-2:2005/AMD 2:2009

IEC 61000-4-7, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

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

IEC 61347-2-13, *Lamp controlgear – Part 2-13: Particular requirements for d.c. or a.c. supplied electronic controlgear for LED modules*

IEC 62031:2008, *LED modules for general lighting – Safety specifications*

IEC 62504, *General lighting – Light emitting diode (LED) products and related equipment – Terms and definitions*

CIE 13.3:1995, *Method of measuring and specifying colour rendering properties of light sources*

CIE 121:1996, *The photometry and goniophotometry of luminaires*

CIE 177:2007, *Colour rendering of white LED light sources*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62504 and IEC 60050-845, as well as the following apply.

3.1
test voltage, current or power
input voltage, current or power at which tests are carried out

Note 1 to entry: Specification of test voltage, current or power is given in A.2.

3.2
luminous flux maintenance factor
lumen maintenance factor
Unit: %

ratio, expressed as a percentage x, of the luminous flux emitted by the light source at a given time in its life to its initial luminous flux emitted

Note 1 to entry: The lumen maintenance factor of a LED light source includes optical parts degradation, the effect of decrease of the luminous flux output of the LED package and failure(s) of individual LED packages if the LED light source contains more than one LED package.

3.3
initial value
photometric and electrical characteristics at the end of the ageing period and stabilisation time

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[1] Third edition. This edition has been replaced in 2014 by IEC 61000-3-2:2014, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase).*

[SOURCE: IEC 62612:2013, 3.4, modified — The word 'colorimetric' and the note to entry have been deleted]

3.4
maintained value
photometric and electrical characteristic at an operational time under standard test conditions, including stabilisation time

Note 1 to entry: The test conditions are given in this standard.

3.5
parametric failure
luminous flux
failure of an operating LED module to produce luminous flux higher than or equal to the luminous flux relating to the lumen maintenance factor x

Note 1 to entry: For the purpose of this standard, the LED product is a LED module.

Note 2 to entry: For illustration of gradual failure mode, causing a parametric failure, see Figure C.1.

3.6
abrupt failure
failure of a LED product to operate or to produce luminous flux

Note 1 to entry: For the purpose of this standard, the LED product is a LED module.

Note 2 to entry: The term "complete failure" is commonly used for the same purpose.

Note 3 to entry: For illustration of abrupt failure mode, see Figure C.1.

3.7
median useful life (of LED modules)
life (of LED modules)
L_x

length of time during which 50% (B_{50}) of a population of operating LED modules of the same type have parametrically failed to provide at least percentage x of the initial luminous flux

Note 1 to entry: The median useful life includes operating LED modules only.

[SOURCE: IEC 60050-845:1987, 845-07-61, modified – new definition]

3.8
abrupt failure probability
$F(t)$
probability of an LED module, taken from a population of LED modules of the same type, to fail to operate after a given time, t

Note 1 to entry: $LSF(t) = 1 - F(t)$, LSF is Lamp Survival Factor, [CIE 097 modified].

3.9
abrupt failure value
AFV
percentile of LED modules failing to operate at median useful life, L_x

Note 1 to entry: $AFV = F(L_x) \times 100\ \%$; $LSF(L_x) = 1 - F(L_x)$

Note 2 to entry: Example: Given L_x=20 000 h and $AFV = F(20\ 000\ h) \times 100\ \% = 7\ \%$ results in $LSF(20\ 000\ h) = 1 - 0{,}07 = 0{,}93$.

3.10
time to abrupt failure
C_y
length of time during which y % of a population of initially operating LED modules of the same type fail to produce any luminous flux

Note 1 to entry: The time to abrupt failure includes inoperative LED modules only.

Note 2 to entry: $C_{AFV} = L_x$.

3.11
combined failure value
CFV
percentile of LED modules failing by either parametric or abrupt failure modes at median useful life, L_x

Note 1 to entry: $CFV = 50 + 0{,}5 \times AFV$

Note 2 to entry: Example: Given AFV = 15% results in $CFV = 50 + 0{,}5 \times 15 = 57{,}5\%$

3.12
combined life (of LED lamps)
M_xF_y
length of time during which y% (F_y) of a population of initially operating LED lamps of the same type failed by either parametric or abrupt failure modes

Note 1 to entry: The combined life (of LED lamps) includes operating and non-operating LED lamps.

3.13
median combined life (of LED lamps)
M_x
length of time during which 50 % (F_{50}) of a population of initially operating LED lamps of the same type have failed by either parametric or abrupt failure modes

Note 1 to entry: The median combined life (of LED lamps) includes operating and non-operating LED lamps.

3.14
photometric code[2]
colour designation of a LED module giving white light is defined by the Correlated Colour Temperature and the general colour rendering index

Note 1 to entry: The definition of photometric code is given in IEC 62504 as light colour designation.

3.15
***t_p*-point**
the designated location of the point where to measure the performance temperatures t_p and $t_{p\ rated}$ at the surface of the LED module

3.16
***t_p* temperature**
temperature at the t_p-point, related to the performance of the LED module

Note 1 to entry: $t_p \leq t_c$. This is only the case if the location of t_p and t_c is the same. For t_c, see 3.10 of IEC 62031:2008.

Note 2 to entry: For a given life time, the t_p temperature is a fixed value, not a variable.

Note 3 to entry: There can be more than one t_p, depending on the lifetime claim.

2 Under consideration.