# IEC/PAS 62722-2-1

Edition 1.0 2011-06

# PUBLICLY AVAILABLE SPECIFICATION

## PRE-STANDARD

**Luminaire performance –**
**Part 2-1: Particular requirements for LED luminaires**

IEC/PAS 62722-2-1:2011(E)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE P

ICS 29.140.40

ISBN 978-2-88912-000-0

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

# LUMINAIRE PERFORMANCE –

# Part 2-1: Particular requirements for LED luminaires

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IEC-PAS 62722-2-1 has been processed by subcommittee 34D: Luminaires, 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** |
| 34D/995/PAS | 34D/1013/RVD |

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# INTRODUCTION

The first edition for a performance PAS for LED luminaires for general lighting applications acknowledges the need for relevant tests for luminaires using this new source of electrical light, sometimes called “solid state lighting”. The publication is seen in close context with simultaneously developed and edited publication of performance standards (or PAS) for luminaires in general and for LED modules. Changes in the LED luminaires PAS will have impact on the module standards and vice versa, due to the behaviour of LED. Therefore, in the development of the present PAS, mutual consultancy of 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 and luminaires.

# LUMINAIRE PERFORMANCE –

# Part 2-1: Particular requirements for LED luminaires

## 1 Scope

This PAS specifies the performance requirements for LED luminaires, together with the test methods and conditions, required to show compliance with this PAS. It applies to LED luminaires for general lighting purposes, where claims of operational performance are made.

The following types of LED luminaires are distinguished:

– Type A – Luminaires using LED modules that have not been shown to comply with IEC/PAS 62717;

– Type B – Luminaires using LED modules that have been shown to comply with IEC/PAS 62717;

– Type C – Luminaires using a LED lamp and covered in IEC/PAS 62722-1.

NOTE The definition of the LED module is given in IEC/TS 62504.

The requirements of this PAS only relate to type testing.

This PAS does not cover LED luminaires that intentionally produce coloured light; neither does it cover luminaires using OLEDs (organic LEDs).

These performance requirements are additional to the requirements in IEC/PAS 62722-1.

As this PAS has been simultaneously developed and edited with the PAS for LED modules, where appropriate the compliance of the modules to the provisions of IEC/PAS 62717 may be transferred to the whole luminaire.

Life time of LED luminaires 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. For that reason the acceptance or rejection of a manufacturer's life time claim, past 25 % of rated life (with a maximum of 6 000 h), is out of the scope of this PAS.

Instead of life time validation this PAS has opted for lumen maintenance categories at a defined finite test time. Therefore, the category number does not imply a prediction of achievable life time. The categories 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 PAS is different from the life time metrics claimed by manufacturers. For explanation of recommended life time metrics see IEC/PAS 62717, Annex C.

It may be expected that LED luminaires 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 within the declared range of the manufacturer.

The requirements of this PAS apply in addition to the IEC/PAS 62722-1.

## 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/PAS 62722-1, *Luminaire performance – Part 1: General requirements*

IEC/PAS 62717, *LED modules for general lighting – Performance requirements*

IEC/TS 62504, *General lighting – LEDs and LED modules – Terms and definitions*

## 3 Terms and definitions

For the purposes of this PAS, the provisions of Clause 3 of IEC/PAS 62717 apply. In addition, the following definitions are given:

**3.1**
**LED luminaire**
luminaire incorporating LED light sources

**3.2**
**family of LED luminaires**
group of LED luminaires that have

– LED modules with the same method of control and operation (self-ballasted, semi-ballasted, non-ballasted);
– LED modules with the same classification according to the method of installation (reference is made to IEC 62031, Clause 6);
– the same class of protection against electrical shock;
– the same design characteristics, distinguished by common features of materials, components, and/or method of processing and heat management.

**3.3**
**temperature**
ambient temperature around the luminaire related to the performance of the luminaire

NOTE 1 $t_q \leq t_a$. For $t_a$, see 1.2.25 of IEC 60598-1.

NOTE 2 For a given life time, the $t_q$ temperature is a fixed value, not a variable.

NOTE 3 There can be more than one $t_q$ temperature, depending on the life time claim.

**3.4**
**LED light source**
unit supplied as being a LED lamp or LED module

## 4 Product information

Information on the parameters shown in Table 1 shall be provided by the manufacturer or responsible vendor on the product datasheets, leaflets or website.

NOTE This information is in addition to the mandatory marking required by IEC 60598-1.

*Compliance is checked by inspection.*

**Table 1 – Product information[1)]**

| | |
|---|---|
| a) | Rated input power (in W) |
| b) | Photometric code [2)] |
| c) | Rated luminous flux (in lm) |
| d) | Rated life (in h) of the LED module in the luminaire and the associated rated lumen maintenance ($L_x$) |
| e) | Failure fraction ($F_y$), corresponding to the rated life of the LED module in the luminaire |
| f) | Lumen maintenance code [3)] |
| g) | Rated chromaticity co-ordinate values both initial and maintained [4)] |
| h) | Correlated Colour Temperature (CCT in K) |
| i) | Rated Colour Rendering Index (CRI) |
| j) | Ambient temperature ($t_q$) for a luminaire [5)] |
| k) | LED luminaire efficacy (in lm/W) |
| l) | Aging time, if different to 0 h |
| 1) | Regional requirements may apply and overrule. |
| 2) | See Annex D of IEC/PAS 62717. |
| 3) | See Table 6 of IEC/PAS 62717. |
| 4) | See Table 5 of IEC/PAS 62717. |
| 5) | See last paragraph of Clause A.1 to understand the relation between $t_p$ and $t_q$. |

## 5 Not used

## 6 Test conditions

### 6.1 General 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*" LED luminaires of the same type. The number "*n*" shall be a minimum of products as given in Table 3. LED luminaires used in the endurance tests shall not be used in other tests.

Each sample luminaire shall comply with all the relevant tests except for the tests of Clause 10 where one sample is required for each of the three separate tests. In order to reduce the time of testing, the manufacturer or responsible vendor may submit additional luminaires or parts of luminaires provided that these are of the same materials and design as the original luminaire and that the results of the test are the same as if carried out on an identical luminaire.

LED luminaires with dimming control shall be adjusted to maximum output for all tests.

LED luminaires with adjustable colour point shall be adjusted / set to one fixed value as indicated by the manufacturer of responsible vendor.

LED luminaires of linear geometry and variable length shall be tested at a length at which the parameters are given (e. g. performance per x cm).

### 6.2 Luminaires with LED modules not in compliance with IEC/PAS 62717

#### 6.2.1 Testing where reliability data of components available

Test duration is 10 % of rated life time up to a maximum of 2 000 h for LED luminaires making use of components where long term test data are available.

*Compliance criteria for allowance of 2 000 h test duration:*

*Component test data for the principle components shall cover at least 25 % of rated LED module lifetime up to a maximum of 6 000 h. The principle components, where applicable, shall be LED packages, electronics, diffusers (incl. remote phosphors), lenses, reflectors and active cooling systems.*

Apart from the full set of data provided upon the 2 000 h, the manufacturer or responsible vendor shall also provide the expected data for at least 25 % of rated LED module lifetime up to a maximum of 6 000 h of

– chromaticity co-ordinates;
– lumen maintenance code.

Testing of principle components is not within the scope of this document.

NOTE The method of how to obtain reliability data of principle components and their interaction on LED module level is under consideration.

#### 6.2.2 Testing where no reliability data of components available

If component long term test data is not available, the manufacturer shall conduct testing for 25 % of rated life up to a maximum of 6 000 h.

#### 6.2.3 Creation of module families to reduce test effort

##### 6.2.3.1 General

The provisions of Subclause 6.2.1 of IEC/PAS 62717 apply to the LED luminaire.

##### 6.2.3.2 Variations within family

The provisions of Subclause 6.2.2 of IEC/PAS 62717 apply to the LED luminaire.

##### 6.2.3.3 Compliance testing of family members

The provisions of Subclause 6.2.3 of IEC/PAS 62717 apply to the LED luminaire.

### 6.3 LED modules in compliance with IEC/PAS 62717

Tests are only carried out of initial performance test.

### 6.4 Performance requirements

The performance criteria given in Table 2 apply only to LED luminaires and the required testing for each type of luminaire is indicated by an “x”. All other data is available from the respective product standard.

**Table 2 – Performance criteria of which testing are required**
(x = required, – = not required)

| Clause or subclause of this PAS (in brackets clause or subclause of IEC/PAS 62717) | Testing | LED luminaire using LED module not in compliance with IEC/PAS 62717 (Type A) [a] | Luminaire using LED modules in compliance with IEC/PAS 62717 (Type B) [b] |
|---|---|---|---|
| 7 | Power | x | x |
| 8.1 | Luminous flux | x | x |
| 8.2.3 | Luminous Intensity distribution | x | x |
| 8.2.4 | Peak intensity value(s) [c] | x | x |
| 8.2.5 | Beam angle value [c] | x | x |
| 8.3 | Efficacy | x | x |
| 9.1 | Chromaticity tolerance initial | x | – |
| 9.1 | Chromaticity tolerance maintained | x | – |
| 9.2 | Correlated colour temperature initial | x | – |
| 9.3 | CRI initial | x | – |
| 9.3 | CRI maintained | x | – |
| 10.2 | Lumen maintenance | x | – |
| 10.3 (10.3.2) | Temperature cycling, energised | x | – |
| 10.3 (10.3.3) | Supply voltage switching | x | – |
| 10.3 (10.3.4) | Accelerated operation life test | x | – |
| Clause A.1 | LED module temperature | x | x |

[a] Where the LED manufacturers provide data according to IEC/PAS 62717, the tests on the luminaire may be carried out according to the column for Type B luminaires.

[b] Testing requirements for Type B LED luminaires will depend on requirements of IEC/PAS 62717. It is not the intention to remeasure the values of a product complying with its own standard. However where luminaires combine different modules in one luminaire, certain parameters may be required to be measured e. g. if there is a mixing of colours the final CRI and CCT needs to be measured in the luminaire.

[c] Applicable to luminaires which modify the light distribution of the light from the LED module.

## 7 Total input power

Total input power shall be measured at the supply to the luminaire or in case of remote control gear, at the supply to the control gear. The provisions of Clause 7 of IEC/PAS 62717 apply to the LED luminaire.

NOTE For calculation of confidence intervals, see Annex E of IEC/PAS 62717.

## 8 Light output

### 8.1 Luminous flux

The provisions of Subclause 8.1 of IEC/PAS 62717 apply to the LED luminaire. In addition the provisions in Clause A.1, Paragraph 2 of this document apply where a declared ambient air temperature other than 25 °C is advised by the manufacturer.

### 8.2 Luminous intensity distribution, peak intensity and beam angle

#### 8.2.1 General

The provisions of Subclause 8.2.1 of IEC/PAS 62717 apply to the LED luminaire

#### 8.2.2 Measurement

The provisions of Subclause 8.2.2 of IEC/PAS 62717 apply to the LED luminaire.

#### 8.2.3 Luminous intensity distribution

The provisions of Subclause 8.2.3 of IEC/PAS 62717 apply to the LED luminaire.

#### 8.2.4 Peak intensity

The provisions of Subclause 8.2.4 of IEC/PAS 62717 apply to the LED luminaire.

#### 8.2.5 Beam angle

The provisions of Subclause 8.2.5 of IEC/PAS 62717 apply to the LED luminaire.

### 8.3 Luminaire efficacy

The provisions of Subclause 8.3 of IEC/PAS 62717 apply to the LED luminaire.

The luminaire efficacy shall be calculated from the measured luminous flux divided by the measured input power. Luminaire efficacy shall not be less than 90 % of the rated luminaire efficacy.

## 9 Chromaticity co-ordinates, correlated colour temperature and colour rendering

### 9.1 Chromaticity co-ordinates

The provisions of Subclause 9.1 of IEC/PAS 62717 apply to the LED luminaire.

Where suitable component reliability data is available the test duration may be reduced from 6 000 h to 2 000 h and the measured chromaticity value co-ordinate values for initial and 2 000 h shall not exceed the rated colour variation category for initial and 6 000 h respectively.

### 9.2 Correlated colour temperature (CCT)

The provisions of Subclause 9.2 of IEC/PAS 62717 apply to the LED luminaire.

### 9.3 Colour rendering index (CRI)

The provisions of Subclause 9.3 of IEC/PAS 62717 apply to the LED luminaire.

Where suitable component reliability data is available the test duration may be reduced from 6 000 h to 2 000 h.

For all tested items in the sample, the measured CRI value shall not have decreased by more than

– 3 points from the rated CRI value (see Table 1) for initial CRI values;
– 4 points from the rated CRI value, when tested for 2 000 h for maintained CRI values.

## 10 LED luminaire life

### 10.1 General

The provisions of Subclause 10.1 of IEC/PAS 62717 apply to the LED luminaire.

NOTE The useful life of a luminaire refers to the lumen maintenance projections of the LED light sources integrated into that luminaire or the number of hours that a LED luminaire will deliver a sufficient amount of light in a given application.

Luminaire life, on the other hand, has to do with the reliability of the components of a LED luminaire as a system, including the electronics, materials, housing, wiring, connectors, seals, and so on. The entire system lasts only as long as the critical component with the shortest life, whether that critical component is a weather seal, an optical element, a LED, or something else. From this point of view, LED light sources are simply one critical component among many – although they are often the most reliable component in the whole lighting system.

If a LED luminaire is equipped with a replaceable LED module, luminaire life can be decoupled from the LED module and its life. This brings luminaire life closer to the current definition of luminaire life for conventional light sources.

### 10.2 Lumen maintenance

The provisions of Subclause 10.2 of IEC/PAS 62717 apply to the LED luminaire.

Where suitable component reliability data is available the test duration may be reduced from 6 000 h to 2 000 h:

– the measured flux value at 2 000 h shall never be less than the maximum lumen maintenance value related to the rated life as defined and provided by the manufacturer or responsible vendor;
– the measured lumen maintenance shall correspond with the 2 000 h lumen maintenance codes as defined and provided by the manufacturer or responsible vendor.

For all of the tested items in a sample, the measured values shall be of the same maintenance code as the provided values. All the LED modules in a sample shall pass the test.

### 10.3 Endurance test

The provisions of Subclause 10.3 of IEC/PAS 62717 apply to the LED luminaire. Endurance test shall be performed only on a LED luminaire using a LED module not in compliance with IEC/PAS 62717. For accelerated operation life test, a LED luminaire using a LED module not in compliance with IEC/PAS 62717 shall be operated at a temperature corresponding to 10 K above maximum $t_q$ advised by manufacturer or responsible vendor.

## 11 Verification

The minimum sampling size for type testing shall be as given in Table 3. The sample shall be representative of a manufacturer's production. If the LED luminaire does not change the properties of single LEDs or LED packages or LED modules it should be allowed to reference to test data of the LED manufactures.

The results of the test shall comply with the requirements given in Table 2. If the test results do not comply with these requirements, the manufacturer's test records shall be requested.

NOTE Requirements for whole production testing are under consideration.

**Table 3 – Sample sizes**

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Clause or subclause of this PAS (in brackets clause or subclause of IEC/PAS 62717) | Test | **Reliability data of components available** Minimum sample size (units) for testing at 10 % of lifetime (2 000 h max.) | **No reliability data of components available** Minimum sample size (units) for testing at 25 % of lifetime (6 000 h max.) | **Family sample size** (units) for testing at reduced test duration after changing product feature according to 6.3 (1 000 h) | **LED Modules and in compliance with own PAS** Minimum sample size (units) for testing (0 h) |
| 7 | Power | 1 | 5 | 1 | 1 |
| 8.1 | luminous flux | 1 | 5 | 1 | 1 |
| 8.2.3 | Luminous intensity distribution | 1 | 5 | 1 | 1 |
| 8.2.4 | Intensity value | 1 | 5 | 1 | 1 |
| 8.2.5 | Angular beam value | 1 | 5 | 1 | 1 |
| 8.3 | Luminaire efficacy | 1 | 5 | 1 | 1 |
| 9.1 | Chromaticity tolerance initial | 1 | 5 | 1 | – |
| 9.1 | Chromaticity tolerance maintained | 1 | 5 | 1 | – |
| 9.2 | Correlated colour temperature initial | 1 | 5 | 1 | – |
| 9.3 | CRI initial | 1 | 5 | 1 | – |
| 9.3 | CRI maintained | 1 | 5 | 1 | – |
| 10.2 | Lumen maintenance | 1 | 5 | 1 | – |
| 10.3 (10.3.2) | Temperature cycling [a], energised | 1 | 5 | 1 | – |
| 10.3 (10.3.3) | Supply voltage [a] switching | 1 | 5 | 1 | – |
| 10.3 (10.3.4) | Accelerated operation life test [a] | 1 | 5 | 1 | – |
| Clause A.1 | LED module temperature | 1 | 5 | 1 | 1 |
| [a] New samples required for each of these three tests. | | | | | |

# Annex A
(normative)

# Method of measuring LED luminaire characteristics

## A.1 General

The provisions of Subclause A.1 of IEC/PAS 62717 apply to the LED luminaire.

Where a declared ambient air temperature other than 25 °C is advised by the manufacturer a correction factor will need to be established to correct the measured luminous flux value at 25 °C to the luminous flux value at the declared ambient. This shall be done using relative photometry in a temperature controlled cabinet.

For the luminaire designer, the information for luminaire design given in IEC/PAS 62717, Clause B.1, requires that it shall be safeguarded that the LED module performance temperature $t_p$ is not exceeded with the declared maximum ambient temperature ($t_{q\ max}$). This will be checked. The $t_p$ measurements shall be made with a thermocouple of type K or J.

*All of the tested n LED luminaires shall have passed.*

## A.2 Electrical characteristics

The provisions of Subclause A.2 of IEC/PAS 62717 apply to the LED luminaire.

## A.3 Photometric characteristics

The provisions of Subclause A.3 of IEC/PAS 62717 apply to the LED luminaire.

In addition for LED Luminaires the international and regional requirements must be followed for provision of data but format may be optional.

# Annex B
(informative)

# Explanation of recommended life time metrics

## B.1 General

Life time of LED luminaire can be far more than what practically can be verified with testing. Furthermore the decrease in light output differs per manufacturer making general prediction methods difficult. This PAS has opted for lumen maintenance categories that cover the initial decrease in luminous flux until an operational time as stated in 6.1. Due to this limited test time the claimed life of a LED luminaire cannot be confirmed nor rejected in most cases.

## B.2 Life time specification

It is recommended for LED luminaires to specify the lumen maintenance apart from the catastrophic failures in a standardised way giving more insight in light output behaviour. One can distinguish 2 types of failures:

**Gradual failure fraction** ($B_y$)
Percentage y of a number of LED modules of the same type that at their rated live designates the percentage (fraction) of failures. This failure fraction expresses only the gradual light output degradation.

**Abrupt failure fraction** ($C_y$)
Percentage y of a number of LED modules of the same type that at their rated live designates the percentage (fraction) of failures. This failure fraction expresses only the abrupt light output degradation.

The recommended metrics for specifying LED luminaire life time is explained in Annex C of IEC/PAS 62717 and differs from the pass/fail criterion of the life time test as in 10.2.

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