

INTERNATIONAL STANDARD



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



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LUMINAIRE PERFORMANCE –

Part 2-1: Particular requirements – LED luminaires

FOREWORD

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This commented version (CMV) of the official standard IEC 62722-2-1:2023 edition 2.0 allows the user to identify the changes made to the previous IEC 62722-2-1:2014 edition 1.0. Furthermore, comments from IEC SC 34D experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 62722-2-1 has been prepared by subcommittee 34D: Luminaires, of IEC technical committee 34: Lighting. It is an International Standard.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

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

- a) alignment with IEC 62717:2014, IEC 62717:2014/AMD1:2015 and IEC 62717:2014/AMD2:2019;
- b) clarification of temperature requirements for the maintenance test, in 10.2 and Annex A;
- c) introduction of a new Annex C on methods for calculation and measurements of parameters for extension of electric and photometric data.

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

Draft	Report on voting
34D/1680/FDIS	34D/1687/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 62722 series, published under the general title *Luminaire performance* can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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.

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INTRODUCTION

~~This standard is the conversion of IEC PAS 62722-2-1 into a full IEC performance standard for LED luminaires for general lighting applications.~~ This document acknowledges the need for relevant tests for luminaires using ~~this new source of~~ LED as an electrical light source ¹. This document is seen in close context with the publication of simultaneously developed performance standards for luminaires in general and for LED modules. This document does not consider luminaires designed for LED lamps, which are covered in IEC 62722-1. Changes in LED luminaires standards have an impact on LED module standards and vice versa, due to the behaviour of LED. Therefore, for the development of this document, the mutual consultancy of experts of both products has taken place.

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

As this document has been simultaneously developed and edited with the standard for LED modules (IEC 62717), where appropriate, the compliance of the LED modules with the provisions of IEC 62717 can be transferred to the whole luminaire.

LUMINAIRE PERFORMANCE –

Part 2-1: Particular requirements – LED luminaires

1 Scope

This part of IEC 62722 specifies the performance requirements for LED luminaires, together with the test methods and conditions, ~~required to show compliance with this standard~~. It applies to LED luminaires for general lighting purposes.

Semi-luminaires are not covered under the scope of this document.

For some types of luminaires (e.g. decorative or household) the provision of performance data under the scope of this document is not appropriate. **2**

In this document, the following types of LED luminaires are distinguished.

- Type A – Luminaires using LED modules where compliance with IEC 62717⁴ ~~has been proven~~ is given.
- Type B – Luminaires using LED modules where compliance with IEC 62717⁴ ~~has not been proven~~ is not given.
- ~~— Type C — Luminaires using a LED lamp and covered in IEC 62722-1.~~

Luminaires using an LED lamp are covered in IEC 62722-1 and are not within the scope of this document. **3**

The requirements of this document ~~only~~ relate to type testing.

~~This standard does not cover Type C luminaires.~~

~~This standard 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 62722-1, Clauses 1 to 9, except where in this Part 2-1 alternative methods of measurement or limits are specified.~~ **4**

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

This document covers LED luminaires using LED modules, based on inorganic LED technology that produces white light. It does not cover luminaires using light sources based on OLED technology (organic LED technology). **5**

The lifetime of LED luminaires is in most cases much longer than the practical test times. Consequently, the verification of manufacturer's lifetime 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),~~ **6** is out of the scope of this document.

⁴ ~~To be published.~~

Instead of lifetime validation, this document has opted for lumen maintenance categories at a defined finite test time. Therefore, the category number does not imply a prediction of achievable lifetime. The categories are lumen-depreciation character categories showing behaviour in agreement with the 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.~~

~~For explanation of recommended life time metrics see IEC 62717, Annex C.~~

~~It may be expected that LED luminaires which comply with this standard 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.~~

~~Evaluation of LOR (light output ratio) for LED luminaire is under consideration.~~

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 60598-1:2020, *Luminaires – Part 1: General requirements and tests*

IEC 60598-2-3:2002, *Luminaires – Part 2-3: Particular requirements – Luminaires for road and street lighting*

IEC 60598-2-5:2015, *Luminaires – Part 2-5: Particular requirements – Floodlights*

IEC 62031:2018, *LED modules for general lighting – Safety specifications*

~~IEC 62504, General lighting – LEDs and LED modules – Terms and definitions~~

IEC 62717:2014, *LED modules for general lighting – Performance requirements*

IEC 62717:2014/AMD1:2015

IEC 62717:2014/AMD2:2019

IEC 62722-1, *Luminaire performance – Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62717 and ~~IEC 62504, as well as~~ the following apply.

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

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

3.1**LED luminaire**

luminaire designed to incorporate at least one ~~or more~~ LED light source(s)

Note 1 to entry: The LED light source(s) can be an integral part of an LED luminaire.

[SOURCE: IEC 60050-845:2020, 845-30-056]

3.2**~~family of LED luminaires~~**

~~group of LED luminaires that have~~

- ~~— LED modules with the same method of control and operation (semi-integrated, integrated);~~
- ~~— LED modules with the same classification according to the method of installation (reference is made to IEC 62031, Clause 6) and using LED module of same family as specified in 6.2 of IEC 62717 and 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.~~ **7**

3.2**rated ambient performance temperature value**

t_q

highest ambient temperature around the luminaire related to a rated performance of the luminaire under normal operating conditions, ~~both~~ as declared by the manufacturer or responsible vendor

Note 1 to entry: Rated ambient performance temperature value is expressed in °C.

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

Note 2 to entry: There can be more than one t_q temperature, depending on the lifetime claim, see 3.3.

3.3**useful life **8****

$L_x B_y$

<of LED luminaires> length of time until at maximum a percentage y of a population of operating LED luminaires of the same type have degraded to the initial luminous flux emitted multiplied by the luminous flux maintenance factor x

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

Note 2 to entry: The term "useful life" does not account for the replaceability of the LED luminaire.

Note 3 to entry: The useful life has unit h.

3.4**~~rated median useful life **9**~~**

L_x

<of LED luminaires> length of operating time during which a total of 50 % (B_{50}) of a population of operating LED luminaires of the same type have ~~parametrically failed, under standard test conditions as declared by the manufacturer or responsible vendor~~ flux degraded to the initial luminous flux emitted multiplied by the luminous flux maintenance factor x

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

Note 2 to entry: By convention, the expression "life of LED luminaires" without any modifiers is understood to mean the median useful life.

Note 3 to entry: The median useful life has unit h.

3.5

LED luminaire luminous efficacy

quotient of the luminous flux emitted by the power consumed by the LED luminaire

3.6

abrupt failure value 10

AFV

<of LED luminaires> percentile of LED luminaires having failed to operate at median useful life, L_x

Note 1 to entry: The abrupt failure value has unit one and is expressed in %.

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.

Compliance is checked by inspection.

Table 1 – Product information

Reference	Parameter
a	Rated input power (in W)
b	Photometric code ^a
c	Rated luminous flux (in lm)
d	Rated median useful life L_x (h) and ~~and the associated rated lumen maintenance factor (x)~~ the related luminous flux maintenance x^e 11
e	Rated abrupt failure value (rated AFV) (%)
f	~~Lumen~~ Luminous flux maintenance code ^b
g	Rated chromaticity coordinate values both initial and maintained ^c
h	Rated correlated colour temperature (CCT in K)
i	Rated colour rendering index (CRI)
j	Rated ambient performance temperature value (t_q) related to performance for a luminaire ^d (°C)
k	Rated LED luminaire luminous efficacy (in lm/W)
l	Ageing time, if different from 0 h
NOTE Regional legal requirements ~~may~~ can apply ~~and overrule~~ .	
^a See IEC 62717:2014, Annex D and IEC 62717:2014/AMD2:2019, Annex D. ^b See IEC 62717:2014, Table 6 and IEC 62717:2014/AMD2:2019, Table 6. ^c See IEC 62717:2014, Table 5. ^d See 6.2. ^e The rated useful life $L_x B_y$ (in hours) and the associated luminous flux maintenance factor x and percentage y can optionally be on the product datasheets, leaflets or website.	

5 ~~Not used~~ General requirements 12

Performance requirements given in this document are additional to the requirements in IEC 62722-1, except where, in this document, alternative methods of measurement or limits are specified.

Luminaires are considered within the same family if they have:

- LED modules with the same method of control and operation (semi-integrated, integrated);
- LED modules with the same classification according to the method of installation (reference is made to IEC 62031:2018, Clause 4) and using an LED module of the same family as specified in IEC 62717:2014, 6.2 and the same class of protection against electrical shock;
- the same design characteristics distinguished either by common features of materials and components, or by a method of processing and heat management or both.

Annex B provides an explanation of recommended lifetime metrics.

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. For a luminaire in a family of luminaires as described in Clause 5, the electrical and photometric data can be calculated. When calculations are used or when alternative colorimetric data is derived, the methods and conditions given in Annex C shall be used. Annex C is only valid in the case of luminaires where a single LED module is used or where all the LED modules are identical. **13**

NOTE The applicability of Annex C to light sources where the light colour is obtained by mixing different spectra emitted by different light sources can require more consideration than those provided by Annex C.

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 10.3 where one sample is required for each of the three separate tests mentioned in Table 2 and Table 3. In order to reduce the time of testing, the manufacturer or responsible vendor ~~may~~ can 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 CCT shall be adjusted ~~or~~ set to one fixed value, as indicated by the manufacturer or 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 using LED modules where compliance with IEC 62717 ~~has been proven~~ is given (Type A)

Only the tests for measurement of initial performance ~~are to~~ as detailed in 6.4 shall **14** be conducted, when the LED module is operated within its temperature limit t_p .

The information for luminaire design given in IEC 62717:2014, Clause B.1, requires LED modules to be operated within their t_p temperature limit. The t_p temperature shall be measured in accordance with the thermal test procedure defined in IEC 60598-1:2020, 12.4, (normal operation). When the luminaire is operating at its own maximum rated ambient performance temperature value (t_q), the t_p limit (for the declared performance – IEC 62717:2014, Table 2 and IEC 62717:2014/AMD2:2019, Table 2) of LED modules operating inside the luminaire shall not be exceeded. The test voltage for the luminaire shall be 1,00 times the rated voltage of the luminaire. In luminaires intended to be supplied with constant current, the test current shall be 1,00 times the rated current of the luminaire.

For luminaires for road and street lighting and floodlights intended for outdoor use only, the reduction of the measured temperature according to IEC 60598-2-3:2002, 3.12.1, and IEC 60598-2-5:2015, 5.12.1, respectively, shall not be applied for the t_p temperature of the LED module.

The ambient performance temperature t_q is measured in a draught-proof enclosure, as the air temperature, at a position near one of the perforated walls on a level with the centre of the luminaire, see IEC 60598-1, Clause K.1, item e).

6.3 Luminaires using LED modules where compliance with IEC 62717 ~~has not been proven~~ is not given (Type B)

6.3.1 General

~~The manufacturer shall conduct testing for 25 % of rated life up to a maximum of 6 000 h.~~ 15

In principle all requirements for the LED light source apply for the luminaire as detailed in 6.4. 16

6.3.2 Creation of module families to reduce test effort

6.3.2.1 General

The provisions of IEC 62717:2014, 6.2.1 apply to the LED luminaire.

6.3.2.2 Variations within family

The provisions of IEC 62717:2014, 6.2.2 apply to the LED luminaire.

6.3.2.3 Compliance testing of family members

The provisions of IEC 62717:2014, 6.2.3 apply to the LED luminaire.

6.4 Performance requirements

The performance criteria given in Table 2 apply to LED luminaires of Types A and B. All of the tested n LED luminaires shall have passed the performance requirements. The parameter given in Table 2 represents a replacement of the corresponding parameter given in IEC 62722-1. 17

NOTE As indicated in Clause 5 of this document, the performance requirements given in this Subclause 6.4 are additional to the requirements in IEC 62722-1. Additional parameters or requirements not listed in Table 2 but given in IEC 62722-1 are still applicable (e.g. the power measured in non active mode).

Table 2 – Performance criteria for which testing is required

Clause or subclause of this document (in brackets clause or subclause of IEC 62717:2014, IEC 62717:2014/AMD1:2015 and IEC 62717:2014/AMD2:2019)	Testing	Luminaires of type A ^{a b}	Luminaires of type B
6.2	LED module performance temperature	x	x
7	Power	x	x
8.1	Luminous flux	x	x
8.2.3	Luminous intensity distribution ^c	x	x
8.2.4	Peak intensity value(s) ^{c d}	x	x
8.2.5	Beam angle value ^{c d}	x	x
8.3	Luminous efficacy	x	x
9.1	Initial chromaticity tolerance of the light source ^e	–	x
9.1	Maintained chromaticity tolerance of the light source ^e	–	x
9.2	Initial correlated colour temperature of the light source ^e	–	x
9.3	CRI ^e ~~initial~~	–	x
~~9.3~~	~~CRI maintained~~ ^e 18	~~–~~	~~x~~
10.2	Lumen maintenance	–	x
10.3 (10.3.2)	Temperature cycling, energized	–	x
10.3 (10.3.3)	Supply voltage switching	–	x
10.3 (10.3.4)	Accelerated operation life test	–	x
Key x = required – = not required The required testing for each type of luminaire is indicated by an "x".			
^a Where the LED manufacturers provide data in accordance with IEC 62717, the tests on the luminaire ~~may~~ can be carried out in accordance with the column for Type A luminaires.			
^b Testing requirements for Type A LED luminaires will depend on the requirements of IEC 62717. It is not the intention to re-measure the values of a product complying with its own standard. However where luminaires combine different LED modules in one luminaire, or where secondary optics are added to the luminaire, certain parameters ~~may~~ can be required to be measured, e.g. if there is a mixing of colours, the final CRI and CCT ~~need to~~ shall be measured in the luminaire.			
^c Applicable to luminaires which modify the light distribution of the light from the LED module.			
^d Where a manufacturer claims these values.			
^e The values of 9.1, 9.2 and 9.3 relate to the light source.			

7 Input power

The provisions of IEC 62717:2014, Clause 7 apply to the LED luminaire. Power ~~shall be~~ is measured at the supply to the luminaire, see Figure 1. In case the power is not constant, the average of the power is measured over an appropriate time by taking into account the nature of the variation.

NOTE The luminaire can contain components (e.g. digital controllers or sensor) which do not consume constant power, but can be in the sleeping mode and then work and take power.

8 Photometric performance

8.1 Luminous flux

The provisions of IEC 62717:2014, 8.1 apply to the LED luminaire. In addition, the provisions in the **second** paragraph of Clause A.1 of this document apply where a rated ambient performance temperature **value** 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 IEC 62717:2014, 8.2.1 apply to the LED luminaire.

8.2.2 Measurement

The provisions of IEC 62717:2014, 8.2.2 apply to the LED luminaire.

8.2.3 Luminous intensity distribution

The provisions of IEC 62717:2014, 8.2.3 apply to the LED luminaire.

8.2.4 Peak intensity

The provisions of IEC 62717:2014, 8.2.4 apply to the LED luminaire.

8.2.5 Beam angle

The provisions of IEC 62717:2014, 8.2.5 apply to the LED luminaire.

8.3 Luminaire luminous efficacy

The LED luminaire luminous efficacy shall be calculated from the measured initial luminous flux of an LED luminaire divided by the measured initial input power of the **same LED** luminaire. For measurement of luminous flux, see 8.1. For input power measurement, see Figure 1.

9 Chromaticity coordinates, correlated colour temperature (CCT) and colour rendering

9.1 Chromaticity coordinates

The provisions of IEC 62717:2014, 9.1 apply to the LED luminaire.

9.2 Correlated colour temperature (CCT)

The provisions of IEC 62717:2014, 9.2 apply to the LED luminaire.

9.3 Colour rendering index (CRI)

The provisions of IEC 62717:2014, 9.3 and IEC 62717:2014/AMD2:2019, 9.3 apply to the LED luminaire. **19**

~~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 6 000 h for maintained CRI values.~~

10 LED luminaire life

10.1 General

The provisions of IEC 62717:2014, 10.1 apply to the LED luminaire.

10.2 Lumen maintenance

It is not necessary for LED luminaires using modules shown to be in conformity with IEC 62717 (see 6.2) ~~do not have~~ to be submitted for the test. Maintenance values declared for the module at the considered rating t_p ~~may~~ can be declared as the maintenance values of the luminaire for the related rated t_q .

Other luminaires are submitted for the test. The provisions of IEC 62717:2014, 10.2 and IEC 62717:2014/AMD2:2019, 10.2 apply to the LED luminaire except that the maintenance test shall be conducted at the rated ambient performance temperature value in the temperature interval (rated t_q , rated $t_q - 2$). ~~The provisions of 10.2 of IEC 62717 apply to the LED luminaire, except that the maximum rated temperature t_p of the LED module is not exceeded in the luminaire during testing as long as the interval (rated $t_p - 5$, rated t_p) is maintained.~~

Compliance criteria:

The measured luminous flux value shall not be less than the luminous flux value given by the rated lumen maintenance factor related to the rated median useful life.

For all 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 tests

The provisions of IEC 62717:2014, 10.3 and IEC 62717:2014/AMD2:2019, 10.3 apply to the LED luminaire.

The endurance test shall be performed only on LED luminaires using LED modules not tested for compliance with IEC 62717.

For the accelerated operation life test, LED luminaires using LED modules where compliance with IEC 62717 ~~has not been proven~~ is not given, shall be operated at a temperature corresponding to 10 K above maximum t_q advised by the manufacturer or responsible vendor. Separate samples shall be used for the endurance tests of IEC 62717:2014, 10.3.2, 10.3.3 and 10.3.4 and IEC 62717:2014/AMD2:2019, 10.3.2, 10.3.3 and 10.3.4.

Where in IEC 62717:2014, 10.3 and IEC 62717:2014/AMD2:2019, 10.3 the word "module" is mentioned, it shall be considered as "luminaire", where appropriate.

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~~, LED packages or LED modules, it should be allowed to make reference to the test data of the LED manufacturers.

The results of the test shall comply with the requirements given in Table 2.

NOTE 1 Requirements for the whole production testing are under consideration.

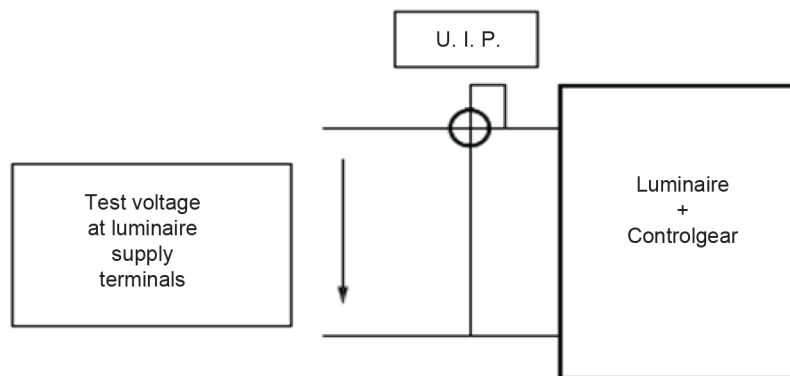
Table 3 – Sample sizes

Clause or subclause of this document (in brackets clause or subclause of IEC 62717:2014, IEC 62717:2014/AMD1:2015 and IEC 62717:2014/AMD2:2019)	Test	No reliability data of components available Minimum sample size (units) for testing at 25 % of lifetime (6 000 h max.)	LED modules where compliance with IEC 62717 ~~has been proven~~ is given Minimum sample size (units) for testing (0 h)
6.3	LED module performance temperature	Same 5 samples for all tests	1
7	Power		1
8.1	Luminous flux		1
8.2.3	Luminous intensity distribution		1
8.2.4	Intensity value		1
8.2.5	Beam angle value		1
8.3	Luminaire luminous efficacy		1
9.1	Initial chromaticity tolerance		–
9.1	Maintained chromaticity tolerance		–
9.2	Initial correlated colour temperature		–
9.3	CRI ~~initial~~		–
~~9.3~~	~~CRI maintained~~		–
10.2	Lumen maintenance	5	–
10.3 (10.3.2)	Temperature cycling, energized		–
10.3 (10.3.3)	Supply voltage switching		–
10.3 (10.3.4)	Accelerated operation life test		–

~~For a luminaire with external controlgear, the input power of the external controlgear required to operate the luminaire should be taken into account. For measurement see IEC 62442-3:2014, Figure 1, and including any controls inputs.~~

~~This is for the for the purpose of the efficacy calculation of the luminaire plus external gear.~~

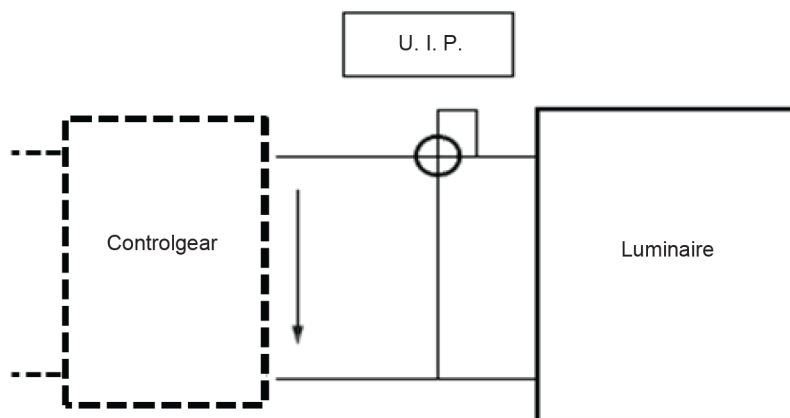
NOTE 2 For a luminaire with external controlgear, the input power of the external controlgear is taken into account when it is required to measure the efficiency of the full system (luminaire plus external controlgear). For controlgear efficiency measurement, see IEC 62442-3. **20**



Test voltage at luminaire supply terminals

IEC

a) Luminaire with integral gear (also valid for prewired controlgear and supply input lead)



Test voltage, power or current at luminaire supply terminals

IEC

b) Luminaire with external gear (external controlgear is not supplied as an integral part of the luminaire)

Figure 1 – Terminals to be used for input power measurement

Annex A (normative)

Measurement method of LED luminaire characteristics

A.1 General

The provisions of IEC 62717:2014, Clause A.1 and IEC 62717:2014/AMD2:2019, Clause A.1 apply to the LED luminaire, except that the ~~wording in the third paragraph, first sentence “in the temperature interval ($t_{p, rated} - 5, t_{p, rated}$)” does not apply to the LED luminaire~~ luminaire shall be tested at the ambient temperature of $25\text{ °C} \pm 1,2\text{ °C}$. **21**

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

In addition, for LED luminaires, international and regional requirements ~~shall be followed~~ for measurement methods and provision of data can apply ~~but format may be optional~~. The format of the data is optional.

A.2 Electrical characteristics

The provisions of IEC 62717:2014, Clause A.2 and IEC 62717:2014/AMD2:2019, Clause A.2 apply to the LED luminaire.

A.3 Photometric characteristics

The provisions of IEC 62717:2014, Clause A.3 and IEC 62717:2014/AMD2:2019, Clause A.3 apply to the LED luminaire.

Annex B (informative)

Explanation of recommended lifetime metrics

B.1 General

The lifetime of LED luminaires 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 document has opted for lumen maintenance categories that cover the initial decrease in luminous flux until an operational time as stated in 6.1. Because of this limited test time, the claimed life of an LED luminaire cannot be confirmed nor rejected in most cases.

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

Luminaire life, on the other hand, is linked with the reliability of the components of an 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, an 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 an 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.

B.2 Lifetime specification

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

a) Lifetime specification for gradual light output degradation

The gradual light output degradation of a population of LED luminaires at a certain point in time is called "useful life" and expressed in general as L_xB_y .

~~The "B life" expresses the age at which a given percentile of LED luminaires cannot meet the lumen maintenance factor x . Light output lower than the lumen maintenance factor x is called a parametric failure because the product produces less light but still operates. "B₄₀" life is the age at which 10 % of products have failed parametrically. The age at which 50 % of the items parametrically fail, the "B₅₀ life", is called median useful life. The population includes operating LED luminaires only; non-operative products are excluded.~~

LED products with a light output lower than the required luminous flux maintenance factor x are called "flux degraded", because they produce less light but still operate. " L_xB_{10} life" is the time of use at which 10 % of products have flux degraded. The time of use at which 50 % of the LED luminaires are flux degraded, the " L_xB_{50} life", is called "median useful life" and expressed as L_x . The population includes operating LED luminaires only; non-operative luminaires are excluded. **22**

b) Lifetime specification for abrupt light output degradation

The abrupt light output degradation of a population of LED luminaires at a certain point in time is called "time to abrupt failure" and expressed as C_y .

The recommended lifetime metrics for specifying LED module life is explained in IEC 62717:2014, Annex C and IEC 62717:2014/AMD2:2019, Annex C and apply to the LED luminaire. For compliance criteria see 10.2 of this document.

Annex C (normative)

Methods for calculation and measurements of parameters for extension of electric and photometric data 23

C.1 Introductory remarks

For ease of use, the abbreviated terms and symbols used in this Annex C are listed hereafter:

LUM_O	Original luminaire: a luminaire used to measure photometric, colorimetric and electrical data, where the measured parameters are used as reference.
LUM_D	Derived luminaire: a luminaire that differs from the LUM_O for the same parameters or components, for which the electrical, photometric parameters can be determined by calculation and measurements, based upon the reference measurements from the original luminaire.
Φ_O	Original flux: the total luminous flux of the LUM_O .
Φ_D	Derived flux: the luminous flux of the LUM_D .
P_O	Original input power: the electrical input power of the LUM_O .
P_D	Derived input power: the electrical power of the LUM_D .
LED_MOD_O	Original LED module: the single or multiple module(s) used in the LUM_O .
LED_MOD_D	Derived LED module: the single or multiple module(s) used in a LUM_D .
MP_O	Measured photometric parameter on original luminaire: a parameter measured in specified conditions on the LUM_O for comparison purposes.
MP_D	Measured photometric parameter on derived luminaire: a parameter measured in specified conditions on the LUM_D for comparison purposes.
	NOTE 1 The photometric parameter measured is the reading of the sensor in the photometric measuring system. This parameter is used for comparison purposes only, so, being relative measurements, it does not matter which is the physical measured quantity.
	NOTE 2 The photometric parameter measured is the reading of the sensor in the photometric measuring system. This parameter is used for comparison purposes only, so, being relative measurements, it does not matter which is the physical measured quantity.
$K\Phi$	Luminous flux factor <of the luminaire>: ratio of the luminous flux of the LUM_D to the luminous flux of the LUM_O .

C.2 General

All the tests shall be carried out in accordance with Clauses 7, 8 and 9.

The methods and conditions are limited to the single parameter variation or component variation on the LUM_O .

C.3 Method 1 – Different current setting

C.3.1 General

This method is applicable when the LUM_D differs from the LUM_O for the current setting only. This method is applicable in case of a luminaire provided with or to be associated with a controlgear that allow the possibility to set different currents on the LED module. This method is only applicable in case of an LED module intended to be supplied by a constant current controlgear and where the forward current of the LEDs is controlled by the controlgear only.

With the above conditions, the relative luminous intensity distribution of the LUM_O does not change for all the derived luminaires LUM_D since the luminaire is the same except for the different LED current setting. The differences between the LUM_O and LUM_D are only the quantity of luminous flux, the input power and consequently the luminous efficacy.

NOTE It is expected that all the other parameters do not change significantly or that the variation is so small that it is acceptable for the purposes of this document.

The procedures described in Clause C.3 provide the possibility to determine the flux versus current and the input power versus current curves as characteristics of the luminaire.

This method allows the possibility to interpolate values between different current settings. Any extrapolation beyond minimum and maximum measured values is not allowed.

C.3.2 Procedure

C.3.2.1 General

This procedure allows to calculate the derived luminous flux Φ_D and the derived input power P_D at different current settings through measurements of MP_O and MP_D .

In case the luminaire allows two different current settings only, the two measurements shall be carried out (LUM_O and LUM_D). In case of multiple current settings the test shall be carried out at least at three different values: the current setting of the LUM_O (usually the maximum current) and at least two other different current settings that cover the full range (e.g. minimum value and mean value). The difference between current settings shall be less than 40 % of the maximum current. For intermediate values linear interpolations between the two adjacent measured values are allowed. Where the minimum value is lower than 20 % of the maximum current, more than three current setting shall be considered.

C.3.2.2 Test procedure

The data of the previously tested LUM_O (in accordance with Clauses 7 and 8) with one current setting (usually the maximum current) shall be available.

The sample tested as LUM_O is placed in a fixed position:

- In case of a relative measurement in a goniophotometer, the luminous intensity shall be measured in a single direction in an area where the gradient variation of intensity is low. This direction shall also contribute significantly to the illuminating task e.g. at nadir or near the direction of maximum intensity. This direction shall be kept constant during the measurements.
- In case of a relative measurement in an integrating sphere, the luminaire position shall be kept constant during the measurements.

NOTE Being a relative measurement with the same luminaire, the restriction related to the maximum allowed dimension of the luminaire compared with the dimension of the integrating sphere, can be disregarded.

At the current to the LED module used for the complete test on the LUM_O , the parameter MP_O (relative intensity value in the goniophotometer or relative flux value in the sphere) and the input power P_O are measured followed by the measurements of those parameters for the different current settings. After any change in current setting and before measurement, the luminaire light output shall be stabilized in accordance with the relevant test procedures of Annex A.

C.3.2.3 Calculation of the derived parameters

The flux values of the other current settings will be the Φ_D , calculated in this way:

$$\Phi_D(x) = \Phi_O \times \frac{MP_D(x)}{MP_O}$$

where (x) is the current settings on each measurement.

With three or more measurements it is possible to get flux-current and power-current curves (see Figure C.1).

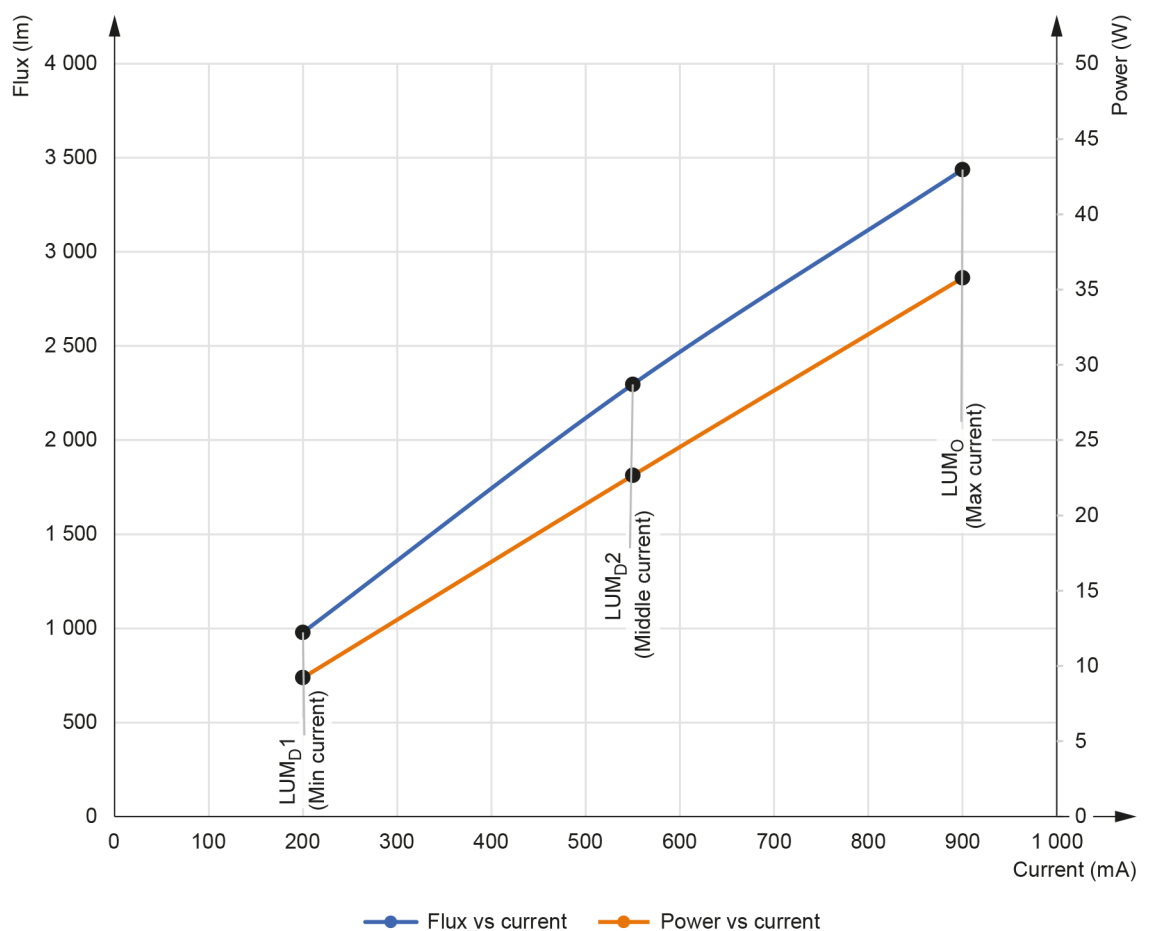
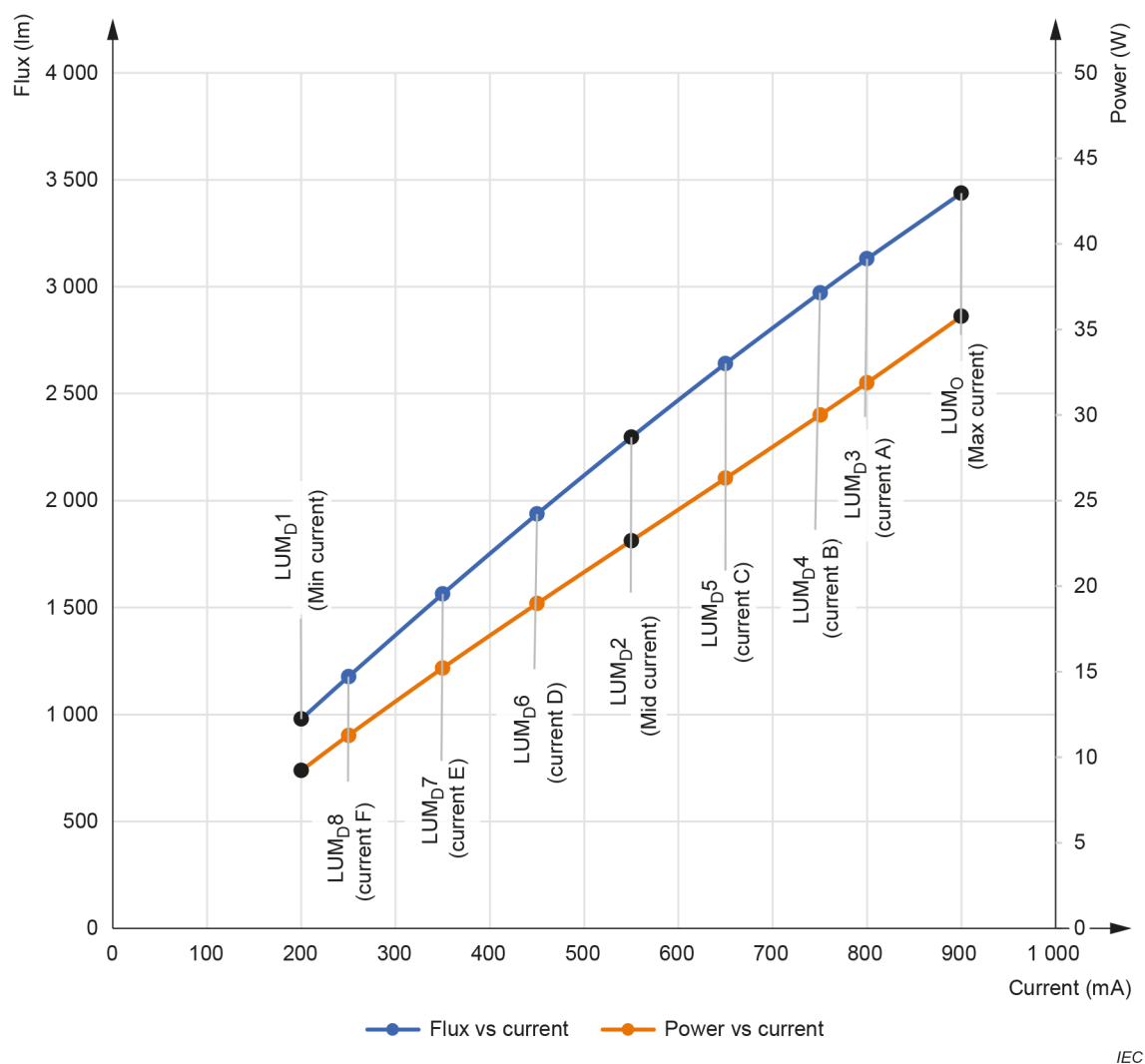


Figure C.1 – Example of flux vs current (in blue) and power vs current (in orange) curves, showing which are LUM_O or LUM_D measurements

Flux and power of the intermediate (where applicable) current settings (A, B, C, ...) can be calculated by the linear interpolation between the nearest measured values as shown in Figure C.2.



IEC

Key

The black dots are measured while the blue and orange dots are interpolated (D).

Figure C.2 – Example of flux vs current (in blue) and power vs current (in orange) curves

C.3.3 Example of applicability of Method 1 using a goniophotometer

This example of applicability of Method 1 allows the calculation of Φ_D and P_D comparing the instruments readings of the luminaire in different current conditions by using a goniophotometer. The test is carried out in the following way:

a) Test procedure

The LUM_O is tested in accordance with Clauses 7 and 8 by making the full measurements on one current setting (usually the maximum current). Then, without making any adjustment on the luminaire, place the luminaire in a fixed position so that the instrument measures the luminous intensity in a single direction, usually close to the direction of the maximum intensity. In this condition the parameter MP_O and the input power P_O shall be measured.

With the luminaire in the same position, change the current setting and make the same measurements on the derived luminaire LUM_D obtaining the parameter MP_D and input power P_D . After any change of operating condition, the luminaire shall be stabilized as required for all photometric tests by the relevant standard test procedure.

b) Calculation of the derived parameters

Use the same calculation method as in C.3.2.3.

C.4 Method 2 – Different binning (flux, CCT, CRI) of LED packages or LED modules

C.4.1 General

This method is applicable where the LED package used in the LUM_D differs from the LED package of the LUM_O for a specific performance characteristic. This case is only applicable where the LED packages do not change the geometrical characteristics (having the same chip or LED model design, geometry, dimensions, materials) and relative luminous intensity distribution. The following different performance parameters are considered:

- different luminous flux,
- different CCT,
- different CRI.

This method is not applicable where the luminaire is provided with a selective optics sensitive to the wavelength.

In general, when identical LED chips are considered, the input power of the LED module remains the same and consequently it is not necessary to make any further calculation for derived input power P_D .

C.4.2 Procedure I for method 2 ($K\Phi$ for LED modules)

C.4.2.1 General

This procedure allows to calculate a $K\Phi$ factor for the luminous flux, by comparing the luminous flux of the LED_MOD_D with the luminous flux of the LED_MOD_O. It is assumed that this $K\Phi$ factor remains the same in the luminaire so, the luminous flux of the LUM_D can be calculated by multiplying the luminous flux of the LUM_O by the $K\Phi$ factor.

This method is only applicable in case of LED modules designed to be supplied by a constant current controlgear and where the forward current of the LEDs is controlled by the controlgear only.

C.4.2.2 Test procedure

The following method is based on the comparison of the parameter measured with both the LED_MOD_O and LED_MOD_D placed in the same position in the photometric measuring system:

- In case of a relative measurement in a goniophotometer, the luminous intensity shall be measured in a single direction in an area where the gradient variation of intensity is low. This direction shall also contribute significantly to the illuminating task e.g. at nadir or near the direction of maximum intensity. This direction shall be kept constant during the measurements.
- In case of a relative measurement in an integrating sphere, the LED module position shall be kept constant during the measurements.

They shall be supplied with the same forward current and the thermal condition shall be the same so that the modules shall run at the same t_p temperature (t_p does not vary by more than 5 °C).

The test shall be carried out at the same current used in the luminaire or the highest current used in the luminaire where the LED module is intended to be installed.

By reading the photometric instruments, the parameter MP_O for the LED_MOD_O and the MP_D for the LED_MOD_D are measured.

In case of measurements made by a goniophotometer, for better reproducibility and to reduce possible measurement uncertainty due to variation in the LED module positioning, it is recommended to compare the total luminous flux.

C.4.2.3 Calculation of the derived parameters

The $K\Phi$ factor is calculated with the following formula:

$$K\Phi = \frac{MP_D}{MP_O}$$

The $K\Phi$ factor can be used to get the luminous flux Φ_D of the LED_MOD_D from the luminous flux Φ_O of the LED_MOD_O by the following formula.

$$\Phi_D = K\Phi \cdot \Phi_O$$

The $K\Phi$ factor can also be used to calculate the Φ_D of the LUM_D.

It is also recommended that the measurement be carried out on from three to five LED module samples, getting the mean values in order to reduce the production variation.

C.4.3 Procedure II for method 2 ($K\Phi$ for LED luminaires)

C.4.3.1 General

This procedure allows to calculate a $K\Phi$ factor for the luminous flux as described in method I but using the luminaires LUM_D and LUM_O instead of modules. The luminous flux of the LUM_D can be calculated by multiplying the luminous flux of the LUM_O by the $K\Phi$ factor.

NOTE This procedure is only relevant where the measured photometric parameter (for example luminous intensity) is proportional to the luminous flux, thereby determining $K\Phi$ so that Φ_D of the luminaire can be calculated.

C.4.3.2 Test procedure

Use the same test procedure as in C.4.2.2 but with luminaires instead of modules.

C.4.3.3 Calculation of the derived parameters

Use the same calculation method as in C.4.2.3 but with the measured photometric parameters, MP_D and MP_O from the luminaires, instead of modules.

C.4.4 Procedure III for method 2 ($K\Phi$ for LED packages)

C.4.4.1 General

This procedure allows the calculation of the $K\Phi$ factor by comparing the test results on the LED packages tested in accordance with CIE 235. The data of the LED packages used in LUM_O are compared with the same data of the LED packages used in LUM_D.

C.4.4.2 Test procedure

Use the same test procedure as in C.4.2.2 but with the measurements made in accordance with CIE 235.

C.4.4.3 Calculation of the derived parameters

Use the same calculation method as in C.4.2.3.

C.5 Method 3 – Use of a different LED controlgear or additional electrical components

C.5.1 General

This method is applicable when the LUM_D differs from the LUM_O for the LED controlgear or for the presence of additional electrical components. This method is applicable only where the LED module(s) of the LUM_O is(are) identical to the LED module(s) of the LUM_D and operates in the same operating conditions including LED drive current.

Procedure I of method 3 is applicable in the case where different controlgear are used; procedure II of method 3 is applicable in the case where additional electrical components are installed within the luminaire.

C.5.2 Use of a different LED controlgear

It is often necessary to change or to have the possibility to use alternative LED controlgear to supply the LED modules in a given luminaire.

It is clear that when changing the controlgear, even if the forward current to the LEDs is the same, the total input power of the luminaire can be different, thus P_D could be different from P_O . Therefore, the efficacy will also be different, but the relative luminous intensity distribution does not change and, provided that the acceptance conditions below are fulfilled, it can be granted that the total flux does not vary either.

It can be assumed that the total flux does not change if both of the following conditions are met:

- the driving current of the LED module in the derived luminaire is within $\pm 2,5$ % of the driving current of the LED module in the original luminaire;
- t_p of the LED module does not vary by more than 5 °C.

NOTE Both the above conditions will ensure that the different powers in the components inside the luminaire do not affect the LED module working condition and temperature.

The LUM_D input power is measured in accordance with the conditions indicated in Clause 7. All other parameters remain the same as in the LUM_O .

C.5.3 Additional electrical components installed in the luminaire (e.g. controlling device)

By adding an electrical component in the luminaire, the result is an increase of the luminaire input power, but the relative luminous intensity distribution does not change and, provided that the acceptance conditions below are fulfilled, it can be granted that the total flux does not vary either.

It can be assumed that the total flux does not change if both of the following conditions are met:

- the driving current of the LED module in the derived luminaire is within $\pm 2,5$ % of the driving current of the LED module in the original luminaire;
- t_p of the LED module does not vary by more than 5 °C.

NOTE Both the above conditions will ensure that the different power in the components inside the luminaire do not affect the LED module working condition and temperature.

The LUM_D input power is measured in accordance with the conditions indicated in Clause 7. All other parameters remain the same as in the LUM_O .

C.6 Application of methods 1, 2 and 3 to luminaires of the same family

Although methods 1, 2 and 3 are applicable in the conditions and with the limitation described in Clauses C.3, C.4 and C.5, the result of these methods, being comparative methods, can be extended to luminaires of the same family where different secondary optics are used to get different light distribution and consequently different luminous flux.

NOTE In principle, luminaires using different secondary optics have the same behaviour against the LED driving current.

As a consequence, the result of these methods can also be used to calculate the luminous flux and input power on different current settings (as described in method 1) or with different parameters (as described in methods 2 and 3) on luminaires with the following characteristics:

- identical case: heat sink and identical general characteristics (e.g. material, shape, design);
- t_p of the LED module that does not vary by more than 5 °C;
- different secondary optics.

In this case the input power, the luminous flux and the luminous intensity distribution for each luminaire with different optics, shall be measured as LUM_O and the derived flux Φ_D and P_D can be calculated by applying the above methods.

C.7 Overview of the methods in Annex C

See Table C.1