

**Email received on January 14, 2011 from Peter Tao.**

Dear EPA team,

Neo-Neon thanks the Environmental Protection Agency for the opportunity to submit comments on Final Draft Version 1.0 of the Energy Star luminaries specification.

We Neo-Neon is a large companies which manufactures LED chips and general lighting products. Our lighting products are promoted all over the world. Furthermore, we are very active in the standard making. For instance, we are a member of IEC committee and participate in the lighting standard making in China, Taiwan, and the international.

I have reviewed this final draft. Overall it' s very comprehensive detailed enough. There is only one point that I would like to comment.

This final draft only has brief definition about the LED Lumen Maintenance Life. It' s not as detailed as that of IEC standard. I have made a comparison between LM-80 life definitions and IEC document as below. The IEC document was abstracted from IEC 34D/977/DC. I have also attached the part of LED luminary life from 34D/977/DC which was updated in 2010-10-29. Please refer to the attachment. It' s suggested that EPA can absorb the merit of IEC standard and harmonize the standards between international and America.

[LM-80 life definition:](#)

**Lumen Maintenance:** The luminous flux output remaining (typically expressed as a percentage of the initial output) at any selected elapsed operating time. Lumen maintenance is the converse of lumen depreciation. (adapted from IES LM-80-08)

LM-80-08 :

**3.4 Lumen Maintenance Life**

The elapsed operating time at which the specified percentage of lumen depreciation or lumen maintenance is reached expressed in hours. Operating time does not include elapsed time when the light source is cycled off or periodically shut down.

**3.6 Rated Lumen Maintenance Life, ( $L_p$ )**

The elapsed operating time over which the LED light source will maintain the percentage,  $p$ , of its initial light output e.g.

$L_{70}$  (hours): Time to 70% lumen maintenance

$L_{50}$  (hours): Time to 50% lumen maintenance

IEC rated life definition abstracted from IEC 34D/977/DC:

### **3.6**

#### **rated life**

length of time during which a population of LED modules provides more than claimed percentage  $x$  of the initial luminous flux, published in combination with the failure fraction, as declared by the manufacturer or responsible vendor

NOTE 3 For explanation of the figure  $L_x F_y$  see Annex C.

### **3.7**

#### **life (of an individual LED module)**

##### **( $L_x$ )**

length of time during which a LED module provides more than claimed percentage  $x$  of the initial luminous flux, under standard conditions.

NOTE 1 A LED module has thus reached its end of life, when it no longer provides claimed percentage  $x$  of the initial luminous flux. Life is always published as combination of life ( $L_x$ ) at lumen maintenance  $x$  and failure fraction  $F_y$ , see NOTE 3 and Sub-clause 3.8.

NOTE 2 Any built-in electronic control gear, however, may show a sudden end of life failure. The definition under 3.7 implies that a LED module giving no light at all, due to an electronic 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 End of life is normally determined when  $y\%$  of the LED modules failed, indicated in combination with the chosen lumen maintenance value:  $L_x, F_y$ .

Thank you for the consideration of our comments. If you have any questions or comments, please do not hesitate to contact me as indicated below.

Peter Tao  
SENIOR MANAGER



For IEC use only

34D/977/DC

2010-10-29

**INTERNATIONAL ELECTROTECHNICAL COMMISSION**

**TECHNICAL COMMITTEE No. 34: LAMPS AND RELATED EQUIPMENT**

**SUB COMMITTEE SC 34D - LUMINAIRES**

**DRAFT IEC/PAS - LED LUMINAIRE PERFORMANCE**

IEC/SC 34D/WG 1 have asked that the attached proposal, to be incorporated in a PAS for vote, be circulated for comment:

This proposal also refers to two other proposals that are also being prepared and these are also attached:

- LUMEX(ADH)122F – Draft General Luminaire Performance PAS (Appendix 1)
- PRESCO(RTK)137G – Draft IEC LED Module PAS (Appendix 2)

National committees are requested to submit any comments on the proposal for consideration by WG 1 through the IEC electronic system by:

**Friday 17<sup>th</sup> December 2010**

# LED-LUMINAIRES FOR GENERAL LIGHTING

## Performance requirements

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## 4. Marking

Information on the parameters shown in Table 1 shall be provided by the manufacturer or responsible vendor and be located as described Table 1.

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

Parameters	Product	Product datasheets, leaflets or website
a) Luminaire power ( $W$ )	x	x
b) Photometric code	-	x <sup>2)</sup>
c) Rated luminous flux ( $lm$ ).	-	x <sup>3)</sup>
d) Rated life (h) and the related lumen maintenance factor ( $L_x$ )	-	x
e) Failure fraction ( $F_y$ ), corresponding to the rated life	-	x
f) Lumen maintenance category 1 to 3 <sup>4)</sup> including	-	x
Lifetime specification ( $L_xB_y$ ) for gradual light output degradation <sup>5)</sup>	-	on request
Lifetime specification ( $L_0C_v$ ) for abrupt light output degradation <sup>6)</sup>	-	on request

## 10. LED Luminaire Life

### 10.1 General

The provisions of Section 10.1 of IEC PAS 62XXX LED-modules for general lighting – Performance requirements are applied not to the LED-module but to the LED-luminaire.

Note:

LED Luminaire life relates primarily to the system reliability of the LED source and the other interacting luminaire components. A luminaire may reach the end of the whole luminaire life time before the "LED Luminaire life " in some severe environmental conditions.

### 10.2 Lumen maintenance

The provisions of Section 10.2 of IEC PAS 62XXX LED-modules for general lighting – Performance requirements are applied not to the LED-module but to the LED-luminaire.

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Appendix 2: PRESCO(RTK)137G at Milan, 17th September 2010

## **LED MODULES FOR GENERAL LIGHTING**

### **Performance requirements**

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### 3.6

#### rated life

length of time during which a population of LED modules provides more than claimed percentage  $x$  of the initial luminous flux, published in combination with the failure fraction, as declared by the manufacturer or responsible vendor

NOTE 1 For sample size see Clause 6.

NOTE 2 NOTE 2 and 3 of 3.7 apply.

NOTE 3 For explanation of the figure  $L_x F_y$  see Annex C.

### 3.7

#### life (of an individual LED module)

##### ( $L_x$ )

length of time during which a LED module provides more than claimed percentage  $x$  of the initial luminous flux, under standard conditions.

NOTE 1 A LED module has thus reached its end of life, when it no longer provides claimed percentage  $x$  of the initial luminous flux. Life is always published as combination of life ( $L_x$ ) at lumen maintenance  $x$  and failure fraction  $F_y$ , see NOTE 3 and Sub-clause 3.8.

NOTE 2 Any built-in electronic control gear, however, may show a sudden end of life failure. The definition under 3.7 implies that a LED module giving no light at all, due to an electronic 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 End of life is normally determined when  $y\%$  of the LED modules failed, indicated in combination with the chosen lumen maintenance value:  $L_x, F_y$ .

### 3.8

#### failure fraction

##### ( $F_y$ )

percentage  $y$  of a number of LED modules of the same type that at their rated live designates the percentage (fraction) of failures.

NOTE 1 This failure fraction expresses the combined effect of all components of a module including mechanical, as far as the light output is concerned. The effect of the LED could either be less light than claimed or no light at all.

NOTE 2 For LED modules normally a failure fraction of 10% or/and 50% are being applied, indicated as  $F_{10}$  and/or  $F_{50}$

### 3.9

#### 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.

### 3.10

#### 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.

## **8 10 LED module life**

### **8.1 10.1 General**

Life of a LED module (as defined in Clause 3.7) is the combined effect of gradual light output degradation, mostly caused by material degradation (see Clause 10.2) and abrupt light output degradation, mostly caused by electrical component failure (see Clause 10.3, endurance tests as an indication for reliability and life). Both elements are tested.

Reference is made to the definitions of 3.3 and 3.8, the latter describing the indicated fraction of tested modules of a total sample ( $F_y$ ) that may fail the requirements of the tests under Clause 10.2 and 10.3.

On request, reduction of luminous flux due to zero lumen output and due to degradation of the LED material in the measured sample shall be given separately. See also Table 1.e

### **8.2 10.2 Lumen maintenance**

As the typical life of a LED module is (very) long, it is within the scope of this PAS regarded unpractical and time consuming to measure the actual lumen reduction over life (e.g.  $L_{70}$ ).

For that reason this PAS relies on test results to determine the expected lumen maintenance category of any LED module.

NOTE 1 The actual LED behaviour 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.

NOTE 2 Other methods providing more advanced insight in lumen depreciation over LED module life are under consideration.

The lumen maintenance figure may vary depending on the application of the LED module. This PAS applies a value of 70%. Dedicated information on the chosen percentage should be provided by the manufacturer.

This PAS has opted for "lumen maintenance categories" (see Figure 2) that cover the initial decrease in lumen until 25% of rated life has elapsed with a maximum duration of 6 000 h. There are three categories of lumen maintenance compared to the initial lumen output at 0 h (see Table 6).

**Table 6: Categories of lumen maintenance after 25% of rated life time or maximum 6 000 h**

Lumen maintenance in % of 0 h value	Code
≥90	9
≥80	8
≥70	7

The initial luminous flux shall be measured. The measurement is repeated at 25% of rated 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 module life. The measured luminous flux value at 25% of rated life (with a maximum duration of 6 000 h) shall be expressed as maintained value (= percentage of the initial value).

NOTE 3 It is recommended to measure the lumen output values at 1 000 h intervals (expressed as a percentage of the initial value) for a total equal to 25% of rated life (with a maximum duration of 6 000 h).

NOTE 4 This will give additional insight as to the reliability of the measured values, but assigning a category does not imply a prediction of achievable life time. Code "1" could be better or worse than Code "3".

For marking of the lumen maintenance ( $L_x$ ) and the lumen maintenance categories, see Table 1.

#### Compliance:

*An individual LED module is considered having passed the test when the following criteria have been met:*

*1. The measured flux value at 25% of rated life (with a maximum duration of 6 000 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.*

*2. The measured lumen maintenance shall correspond with the "lumen maintenance category" as defined and provided by the manufacturer or responsible vendor: 1 to 3.*

*Given a sample of n pieces (individuals) of LED modules according to Table 7 being subjected to the 6000 h (or 25% of rated life), it is deemed to having passed the test, if at the end of the test, the number of failed items is smaller or equal to the number claimed by the manufacturer. This PAS gives the following guide for calculation:*

*When  $F_{50}$  is specified, at least n-2 individual modules shall have passed;*

*when  $F_{10}$  is specified, at least n individual LED modules shall have passed.*

NOTE 5 Calculation, based on 25%\* of claimed failure fraction  $F_x$ :  
 Claimed failure fraction  $F_{50}$  gives  $25\% \times F_{50}$  (= 50%)  $\times n$  (= 20) = 2,5, rounded off to next lower integer gives 2 LED modules allowed to fail.

Claimed failure fraction  $F_{10}$  gives  $25\% \times F_{10}$  (= 10%)  $\times n$  (= 20) = 0,5, rounded off to next lower integer gives 0 LED modules allowed to fail

\*Assuming test time lower than the claimed life time, failure fraction at the end of the test is lower than the failure fraction at rated life. There is also no general relation between the failures at the end of the test in relation to the claimed failure fraction. In order to set a practical pass/fail criteria of reasonable quality this PAS has chosen for a linear relation of the claimed failure fraction with the specified test time, being 25% of rated life (with a maximum of 6 000 h).

## Annex C (informative)

### Explanation of recommended life time metrics

#### C.1 Introduction

Life time of LED modules 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 25% of rated life has elapsed with a maximum test duration of 6 000 h. Due to this limited test time the claimed life of a LED module cannot be confirmed nor rejected in most cases. The recommended metrics for specifying LED module life time is explained below and differs from the pass/fail criterion of the life time test as in clause 10.2.

#### C.2 Life time specification

It is recommended for LED modules to specify the lumen maintenance apart from the catastrophic failures in a standardised way giving more insight in light output behaviour (see marking).

#### C.3 Life time specification for gradual light output degradation

Example:  $L_{70}B_{50}$  is understood as the life time where light output is  $\geq 70\%$  for 50% of the population.

The failure fraction for  $B$  expresses only the gradual light output degradation, abrupt light output degradation is exempted. The light output threshold level for  $L$  and failure fraction for  $B$  is free to be chosen by the manufacturer. See Annex C.8 for recommended fraction values for  $B$ .

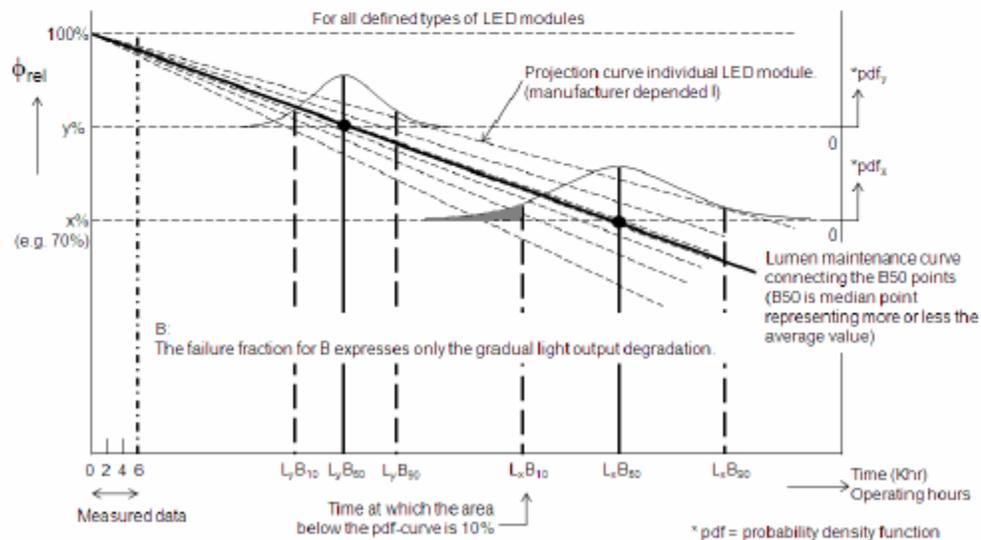


Figure C.1 Life time specification for gradual light output degradation