



# **Ministry of Electricity and Water**

## **Energy Efficiency Program**

### **LED Lighting Systems Specifications:**

A: Indoor

(Non – Residential Buildings)

**Jan. 2017**

Product Type	Panel	Tube	Down Light	Floodlight	LED Bulb (E27,E14)	MR16, GU10,11	High Bay	Other Systems
<b>Voltage Range (volts), and Frequency</b>	210+B2:I16-280V, 50 Hz	210-280V, 50 Hz	210-280V, 50 Hz	210-280V, 50 Hz	210-280V, 50 Hz	210-280V, 50 Hz	210-280V, 50 Hz	210-280V, 50 Hz
<b>System Efficacy, Lm/W</b>	≥ 125	≥ 125	≥ 125	≥ 125	≥ 100	≥ 100	≥ 125	≥ 125
<b>PF</b>	≥ 0.90	≥ 0.90	≥ 0.90	≥ 0.90	≥ 0.90	≥ 0.90	≥ 0.90	≥ 0.90
<b>CRI</b>	≥ 80	≥ 80	≥ 80	≥ 75	≥ 80	≥ 80	≥ 75	≥ 75
<b>Correlated Color Temp, CCT, (K)</b>	3500 - 4500	3500 - 4500	3500 - 4500	3500 - 5000	3500 - 4500	3500 - 4500	3500 - 5000	3500-4500
<b>Color Chromaticity , (MacAdams)</b>	≤ 4	≤ 4	≤ 4	≤ 5	≤ 4	≤ 4	≤ 5	≤ 5
<b>Median Useful Life - L<sub>80</sub>B<sub>50</sub>, LM-80 (Hrs)</b>	≥ 35,000	≥ 35,000	≥ 35,000	≥ 40,000	≥ 35,000	≥ 35,000	≥ 50,000	≥ 35,000
<b>Driver Failure Rate</b>	≤ 1.0 % Per 5000 Hours.	≤ 1.0 % Per 5000 Hours.	≤ 1.0 % Per 5000 Hours.	≤ 1.0 % Per 5000 Hours.	≤ 1.0 % Per 5000 Hours.	≤ 1.0 % Per 5000 Hours.	≤ 1.0 % Per 5000 Hours.	≤ 1.0 % Per 5000 Hours.
<b>Degree Of Protection</b>	IP20 / IK02	IP20 / IK02	IP20 / IK02	IP20 / IK02	IP20 / IK02	IP20 / IK02	IP20 / IK02	IP20 / IK02
<b>Chipset Type (*)</b>	C, E, G, L, P, O, N, S, Sy, T, Z	C, E, G, L, P, O, N, S, Sy, T, Z	C, E, G, L, P, O, N, S, Sy, T, Z	C, E, G, L, P, O, N, S, Sy, T, Z	C, E, G, L, P, O, N, S, Sy, T, Z	C, E, G, L, P, O, N, S, Sy, T, Z	C, E, G, L, P, O, N, S, Sy, T, Z	C, E, G, L, P, O, N, S, Sy, T, Z
<b>Working Temp., (°C)</b>	25 ± 10	25 ± 10	25 ± 10	-5 to +50	25 ± 10	25 ± 10	-5 to +50	25 ± 10
<b>Approval Standards (**)</b>	See note below	See note below	See note below	See note below	See note below	See note below	See note below	See note below

<b>Guarantee,</b> free replacement for non- compliant with Median useful life above	3 years	3 years	3 years	3 years	3 years	3 years	3 years	3 years
<b>Material</b>	Aluminum, or metallized steel body with PC or acrylic diffuser	Aluminum, or metallized steel body with PC or acrylic diffuser	Die-cast alum., PMMA collimator lenses as secondary optic of individual LED's and and protected by glass diffuser	Die-cast alum., PMMA collimator lenses as secondary optic of individual LED's and and protected by glass diffuser	Aluminum, or metallized steel body with PC or acrylic diffuser	Aluminum, or metallized steel body with PC or acrylic diffuser	Die-cast alum. alloy, PMMA collimator lenses as secondary optic of individual LED's and and protected by glass diffuser	Die-cast alum. alloy, PMMA collimator lenses as secondary optic of individual LED's and and protected by glass diffuser
<b>Eye Safety</b>	Risk-free (risk group 0) in accordance with EN62471:2008	Risk-free (risk group 0) in accordance with EN62471:2008	Risk-free (risk group 0) in accordance with EN62471:2008	Risk-free (risk group 0) in accordance with EN62471:2008	Risk-free (risk group 0) in accordance with EN62471:	Risk-free (risk group 0) in accordance with EN62471:	Risk-free (risk group 0) in accordance with EN62471	Risk-free (risk group 0) in accordance with EN62471

(\*) C = Cree, E= Epistar, G= GE, L=LG, P= Philips, O= Osram, N=Nichia, S=Samsung, Sy= Sylvania, T= Toshiba, Z= Zumtobel

(\*\*) **Standards Considered:** The following standards have to be adhered to when conducting different performance evaluation tests:

1. IESNA-LM-79 for photometric and electrical performance
2. IESNA –LM-80 for rated life
3. ANSI C78.377 for chromaticity
4. IEC 62834 for AC or DC supplied electronic control gear for LED modules.
5. IEC 62612 for self-balasted LED lamps > 50 V.
6. IEC62717 for LED modules for general lighting.
7. IEC 62722-2-1 for LED luminaires

## **GENERAL PERFORMANCE SPECIFICATIONS FOR LED LUMINAIRES**

LED Lighting Requirements:

Third Party (TP) test report or certification report by internationally reputed laboratory registered with MEW shall accompany ALL products. Quality LED lighting luminaires and solutions shall be put forward. The additional technical specification requirements for LED luminaires necessary to ensure quality solutions are proposed is detailed within this specification alongside the basic lighting specification and design requirements.

### **MANUFACTURER GENERAL**

- The Contractor shall furnish the complete LED-based lighting system as described in the architectural details.
- It shall be manufactured by a diversified technology company, focused on improving people's lives through meaningful innovation.
- All products associated with installation and control of the LED system, including peripheral devices and software, are to be provided by a single manufacturer.
- Manufacturer shall provide mechanical, electrical, network communication, and environmental specifications along with system wiring diagrams and installation instructions.
- Manufacturer shall provide the option of a factory-trained applications engineer for on-site supervision of start-up and/or programming and shall provide technical support.
- Manufacturer shall have at least ten years of experience designing, selling, and supporting intelligent LED systems, and shall be able provide a reference listing installations using its intelligent LED-based systems. LED luminaires must have a minimum 3 year manufacturer's warranty.
- Lamp and gear shall be from, and/or guaranteed by the luminaire manufacturer.
- Manufacturer shall be globally recognized to bring sustainability and shall be reflected on global rankings like the Dow Jones Sustainability Index and the Carbon Disclosure Project.

Manufacturer to use eco-design process focusing on the following Green Focal Areas to show the product's environmental performance

- Energy
- Weight
- Recycling
- Packaging
- Substances
- Reliability
- **LED LIGHT CHARACTERISTICS AND PHOTOMETRICS**
  - All LED packages used in the LED luminaire shall be high brightness and of proven quality from established and reputable LED manufacturers.

- Manufacturer shall utilize an advanced production LED binning process to deliver a common and repeatable color point to maintain color consistency from luminaire to luminaire and project to project over time, while ensuring a reliable supply of LED packages from the supplier.

## **QUALITY CRITERIA**

Both ‘initial performance’ and ‘performance over time’ shall be evaluated in order to give confidence about how a LED luminaire shall perform and how long LED packages shall sustain their rated characteristics over their years of operation.

Quality criteria to be considered when evaluating manufacturer’s ‘initial’ performance claims shall comply with the following documents:

- IEC/PAS 62722-1 Performance requirements for luminaires – General\*;
- IEC/PAS 62722-2-1 Performance requirements for LED luminaires\*;
- IEC/PAS 62717 Performance requirements for LED modules\*;

\* PAS stands for Public Available Specification and can be seen as a pre standard. The full standard is in preparation with expected publication second-half-2014.

Overtime performance claims be based on the Annex C Lifetime Metric for LED based products in IEC 62717 which is under progress.

- 1) Initial rated input power (in W);
- 2) Initial rated luminous flux (in lm);
- 3) Initial LED luminaire efficacy (in lm/W);
- 4) Luminous intensity distribution;
- 5) Initial Correlated Color Temperature (CCT in K);
- 6) Initial rated Color Rendering Index (CRI);
- 7) Initial rated chromaticity co-ordinate value and expected tolerance  $(x,y) < x$  SDCM;
- 8) Useful Life (corresponding to the gradual light output degradation (Median Useful Life: # hrs at L<sub>80</sub>B<sub>50</sub>))
- 9) Time to Abrupt Failure (corresponding to the abrupt light output degradation) of the LED based luminaire at rated life. (Driver failure rate at 2000hrs);
- 10) Rated ambient performance temperature (t<sub>q</sub>) for a luminaire.

A brief summary of the different quality criteria:

- 1) Initial Rated input power

The rated input power shows the amount of energy consumed by a luminaire, including its power supply. It is expressed in watts.

2) Initial Rated luminous flux

It corresponds to the light emitted by the luminaire which is expressed in lumen (unit of light output). For LED luminaires it is recommended that Absolute photometric values are used. Absolute photometry results in a LOR=1.

3) Initial LED luminaire efficacy

The measured initial luminous flux divided by the measured initial input power of the same individual LED luminaire. It is expressed in lumens per watt.

The minimum allowable luminous efficacy for an LED luminaire shall be as per product type mentioned in the table above.

4) Luminous intensity distribution

The spatial distribution of the luminous flux graphically depicted in a luminous intensity distribution curve, which is usually expressed in a polar coordinate diagram representing the light intensity as a function of angle about a light source. It is expressed in  $cd = lm \times sr^{-1}$ .

Size of MacAdam ellipse, centered on the rated colour target	Colour variation category	
	initial	maintained
3-step	3	3
5-step	5	5
7-step	7	7
>7-step ellipse	7+	7+

Manufacturer shall provide optical performance, polar diagrams, and photometric data in IES file format.

5) Initial Correlated Color Temperature (CCT)

The color temperature of a LED luminaire giving white light is determined by comparing the light emitted by the LED module with light of an ideal black-body radiator at the given temperature. It is expressed in Kelvin

6) Initial rated Color Rendering Index (CRI)

The color rendering of a LED luminaire giving white light is the effect on the color appearance of objects by conscious or subconscious comparison with their color appearance under a reference illuminant.

- 7) Initial rated chromaticity co-ordinate values both initial and maintained.  
Initial rated chromaticity co-ordinate value + expected tolerance (x,y) < x SDCM.  
The behavior of the chromaticity co-ordinates of a LED luminaire expressed in two measurement results of both initial and maintained chromaticity co-ordinates.

- 8) Useful Life (corresponding to the gradual light output degradation).

Median Useful Life - # hrs at  $L_{90}B_{50}$ ,  $L_{80}B_{50}$  and  $L_{70}B_{50}$

For example,  $L_{80}B_{30}$  at 50,000hrs means moment in time where;

- 30% of the luminaires provides < 80% of the initial light output
- or 70% of the luminaires provides  $\geq 80\%$  of initial light output.

- 9) Time to Abrupt Failure (corresponding to the abrupt light output degradation) of the LED based luminaire at rated life.

Abrupt Failures Value - At  $L_x$  values specified above (these values will – till further notice – not be published)

For example,  $L_0C_{10}$  at 30,000hrs means moment in time where;

- 10% of the luminaires give 0% (no) light due to abrupt failures.

Note 1: Tailored-made  $L_xB_y$  and  $L_0C_y$  calculations for specific projects shall be available upon request.

Note 2: Indoor luminaire over time life claims are specified at an ambient temperature of 25°C with 12 burning hours and 1 switch per day.

*Example*

- Median Useful Life  $L_{80}(B_{50}) = 50,000\text{hrs}$
- Abrupt Failure Value at 50,000hrs = 6%

- 10) Rated ambient performance temperature ( $t_q$ ) for a LED luminaire.

The highest ambient temperature around the LED luminaire related to a rated performance of the luminaire under normal operating conditions, both as declared by the manufacturer or responsible vendor Unit: °C.

Note 1: For a given life time, the  $t_q$  temperature is a fixed value, not a variable.

Note 2: There can be more than one  $t_q$  temperature, depending on the life time claim.