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**PremiumLight-Pro Procurement Criteria for Indoor Lighting**

**DRAFT Version 5**

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**Purpose of PremiumLight-Pro Procurement Criteria for Indoor Lighting within the service sector**

LED lighting technology development is ongoing at very high speed and models on the market are typically replaced within a year by new versions or new models. The quality of the products offered on the market is mixed. Procurement criteria for the energy efficiency and quality of LED lighting therefore need to be regularly revised to be in accordance with the current fast development of the technology. Many international measurement standards for LED are still under development. Besides technical product criteria, the overall lighting system design is also essential in order to support high quality energy efficient solutions are selected.

PremiumLight-Pro has set procurement criteria for white LED light sources and LED tuneable light sources including the white region[[1]](#footnote-1). The criteria are set to cover recent technology developments by the lighting industry, requirements in the demand side market and as far as possible all components within lighting systems used particular for the following areas within the service sector:

* Offices and education areas (offices, meeting rooms, schools and education sector etc.);
* Walking areas and halls in public and private service sector buildings;
* Presentation areas in the public and private service sector (museums, retail sector etc.);
* Walking areas and sickrooms in the health sector etc.

The procurement criteria are developed with consultation of experts from both the supply and demand side sector and considering recent international criteria:

* The IEA 4E SSL Annex Tiers, new update published Nov 2016 <http://ssl.iea-4e.org/product-performance/performance-tiers>
* The existing EU ecodesign regulation from 2009 and 2012: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009R0244>, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:076:0017:0044:EN:PDF>, [http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?­uri=OJ:L­:2012:342:0001:0022:EN:PDF](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:342:0001:0022:EN:PDF)
* EU Preparatory study on Light Sources (Lot 8/9/19) by VHK, 2015 [http://ecodesign-lightsources.eu/.](http://ecodesign-lightsources.eu/)
* Australia & New Zealand MEPS for LED, Draft Dec. 2016 <http://www.energyrating.gov.au/consultation/consultation-ris-lighting>
* Minergie and Toplicht (Switzerland) hhtp://minergie.ch/
* EU GPP (Green Public Procurement) Criteria for Indoor Lighting (2012): <http://ec.europa.eu/environment/gpp/pdf/criteria/indoor_lighting.pdf>

The PremiumLight-Pro procurement criteria includes recommended performance levels for the most important quality performance parameters trying to balance the demand side requirements with not complicating the procurement process more than necessary. This attempt to balance has resulted in non-inclusion of criteria as luminous intensity distribution, angular colour uniformity and colour beam luminous intensity.

# Table 1 – LED Requirements

| **Criteria** |  **Lamps** | **Integrated LED Luminaires** |
| --- | --- | --- |
| **Non-directional** | **Directional** | **Linear LED tubes** | **Small (< 2500 lm)** | **Large (2500 – 50000 lm) including planar, recessed, surface mount, high bay and low bay luminaires** |
| **Design of new building**  |
| The voluntary EU GPP[[2]](#footnote-2) for new lighting in the whole building sets maximum values for W/m2(see the table below with values for different consumer categories). These values for installed power include lamps, ballasts/drivers and control gear. For new lighting in a particular building space, the maximum values set are W/(m2\*(luminous flux/100 lux)) including lamps, ballasts/drivers and control gear. E.g. for an illumi­nance of 500 lux, the maximum power is divided by the floor area and by 5 (= 500 lux/100 lux). See the table below with values.  GPP indoor 1 GPP indoor 2 *New lighting in the whole building New lighting in a particular building space*  |
| **Energy Efficiency** |
| **Efficacy[[3]](#footnote-3)**  |  ≥90 lm/W ≥85 lm/W  | ≥ 110 lm/W  | ≥ 80 lm/W  | ≥ 105 lm/W  |
| **Replacement[[4]](#footnote-4)**Minimum Lumen output when claiming equivalence toHalogen or LFL CFLs without ballast are not included due to rather small lm/W differen­ce.  | [[5]](#footnote-5) | Percentage of halogen lamp non-directional equivalence required for the stated lamp shapes.[[6]](#footnote-6)

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| --- | --- |
| MR11 | 80% |
| MR16 | 80% |
| AR-111 | 70% |
| R | 45% |
| PAR | 60% |
| R7s (forward) | 55% |

 | [[7]](#footnote-7)Only lamps with 360° emission along the length must be labelled as “Retrofit” as they matches the emission pattern and optical LFL performance. | When claiming equivalence to a specific lamp based fixture, the integrated LED luminaire must meet minimum lumen output provided by the lamps. |
| **Standby Power**[[8]](#footnote-8) |  < 0.5W and preferable < 0.3W  |
| **Colour** |
| **Colour Rendering** |  Ra ≥ 80. In a working situation where colour rendering is very important it is recommended to require Ra≥85 or Ra≥90 plus R9>0 [[9]](#footnote-9).  |
| **Colour Appearance****Maintenance** | Lamp must have one of the following nominal CCTs consistent with the 7-step chromaticity quadrangles and Duv tolerances below.[[10]](#footnote-10)Th 7-step chromaticity quadrangles range from 2200 to 6500 Kelvin The shift in chromaticity co-ordinates after 6000 hours of operation, Δ u’,v’ (6000 hours) ≤ 0.007 |
| **Life** |
| **Rated Lifetime[[11]](#footnote-11)**  | minimum 25,000 hours[[12]](#footnote-12) | minimum 35,000 hours[[13]](#footnote-13) | minimum 40,000h10 | minimum 45,000 hours[[14]](#footnote-14) |
| **Endurance** | The lamps must survive one switching cycle for every 2 hours of rated life. In case of buying lamps for frequent switching, the lamps are recommended to survive one switching cycle for every 0.5 hour of the rated life.  |
| **Lumen maintenance** | At 6000 h ≥ 86.7% of initial flux(based on L70B50 [[15]](#footnote-15)≥ 15,000h) | At 6,000h ≥ 91.8% of initial flux (based on L70B50 ≥ 25,000h) | At 6,000h ≥ 93.1% of initial flux(L70B50 ≥ 30,000h) | At 6,000h ≥ 95.4% of initial flux  (based on L70B50 ≥ 45,000h) |
| **Early failure**  | Maximum 5% early failures at 6000 hours |
| **Minimum Rated Life, F50[[16]](#footnote-16)** |  At 15,000 h < 50% have failed  |  At 25,000 h < 50% have failed  | At 30,000 h < 50% have failed | At 45,000 h < 50% have failed |
| **Operation** |
| **Power Supply** | There hast to be provided information about:1. Rated power supply voltage range,
2. Rated frequency range,
3. Rated power consumption FOR ON mode where the lamp is producing light in a default state without any dimming,
4. Rated Standby power consumption where the lamp is connected to a mains power source and standby due to smart function(s).
 |
| **Power Factor** |  < 25W: PF > 0.50 ≥ 25W: PF > 0.90 | PF > 0.90 for self-ballasted lamps | PF > 0.90 |
| **Harmonic distortion** | Products >25W within IEC 61000-3-2 (table 2) set limits for Class C equipment Maximum Permissable Harmonic Current For Products >25W for harmonic orders from N=2 For products 5W < P ≤ 25W: requirements are to be developed in pending amendment to 61000-3-2.  |
| **Dimmer operation** | Dim smoothly to 30% with no observable flicker and no audible noise. When dimmer is set to 100%, light output ≥ 90% of luminous flux without dimmer.  |
| **Dimmer compatibility[[17]](#footnote-17)** | For dimmable products, the manufacturer shall: (a) declare the conditions under which the luminaire will dim; (b) provide a web address for a webpage that lists compatible dimmers; and (c) for each compatible dimmer, the number of luminaires that can be dimmed and the range of luminous flux levels a given dimmer-luminaire combination can achieve.  |
| **Transformer compatibility** | For lamps operating on transformers, the manufac­turer shall provide a list of compatible transformers. | Not actual |
| **Ambient temperature control** | It should be informed if an automatic control of the operating current is included for control of the operating temperature stays at a level where that ensure the expected longevity of the LED. In case this kind of automatic control isn’t included, the recommended maximum ambient temperature should be informed.  |
| **Driver** | In case the driver is replaceable, the type of type of driver has to be informed (SELV (Safety Extra Low Voltage) or NON-SELV). |
| **Health** |
| **Photo-biolo­gical Safety** |  Blue Light & UV hazards shall be either RG0 or RG1 unlimited[[18]](#footnote-18) |
| **Flicker** |

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| --- | --- |
| **f: Flicker frequency (Hz)** | **FM: Flicker modulation maximum (%)**[[19]](#footnote-19) |
| f ≤ 90Hz | FM ≤ (0.025 × f) |
| 90Hz ≤ f ≤ 1250Hz | FM ≤ (0.08 × f) |
| f > 1250Hz | No FM requirement |

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| **Glare** |  N/A | When the gamma (ɣ) angle exceeds 60 degrees, the light source luminance shall be no more than 10,000 candela/m2 in C0, C45 and C90 planes (also used by IEA 4E SSL Annex and the Australia & New Zealand draft MEPS). |
| **Contract and Management** |
| **Competence of the design team****Competence of the installation team****Correct installation** | Execution of a minimum of 5 relevant lighting projects in the last 3 years – experience from 15 relevant projects is beneficial |
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| The contractor shall ensure: 1) The lighting system is installed exactly as specified/required. 2) Delivery of a schedule of the installed lighting systems with appended manufacturers’ invoices or delivery notes. |
| **Ensure the functionality** | The contractor shall ensure that new or renovated lighting systems are working properly and using no more energy than specified. Daylight linked controls shall be calibrated to ensure that they switch off the lighting when daylight is adequate. Occupancy sensors shall be verified to detect moving objects depending on the application. Time switches physical controls or time controls in software shall be set to appropriate switch off. If after the commissioning, parts of the lighting systems do not appear to meet all specifications and requirements, the contractor shall adjust and/or recalibrate the systems. |
| **Evaluation** | The contract shall preferably include installation of a metering and measurement system for identification of failures and monitoring of the energy consumption is as specified. |
| **Waste management** | During the installation of new or renovated lighting systems, waste is to be reduced and all parts are to be separated and recovered in accordance with the WEEE.  |

1. Technically specified by the chromaticity coordinates (x and y) range: 0,2 < x < 0,6 and –2,3172 x² + 2,3653 x – 0,28 < y < – 2,3172 x² + 2,3653 x– 0,1. [↑](#footnote-ref-1)
2. <http://ec.europa.eu/environment/gpp/pdf/criteria/indoor_lighting.pdf> is from 2012. It is considered to lower the values due to increase since then in LED efficacy. [↑](#footnote-ref-2)
3. The efficacy values are equal or very close to IEA 4E SSL tier 2 which are published 2016 as recommended requirements at the world scene based on the performance for the 20-30% best products at he market. [↑](#footnote-ref-3)
4. Dimensions of the lamp must comply with equivalent lamp’s requirements in the relevant IEC lamp performance specification Standard [↑](#footnote-ref-4)
5. The table is developed by the IEA 4E SSL Annex relating to GLS lamps. Compliance measurements show that non-directional halogen lamps are typically 15 % more efficient than GLS lamps but the wattage values are not lowered because the change is small, the table related to the directional lamps percentages, and this is guidance by rounded values. [↑](#footnote-ref-5)
6. This table origins from the Australia & New Zealand draft MEPS recommendations. [↑](#footnote-ref-6)
7. The table for LED tubes is for directional based on Design Lights Consortium requirements (also used by IEA SSL) and for retrofit based on major manufacturers catalogues. [↑](#footnote-ref-7)
8. For smart lamps with standby mode but not connectivity features. The requirements are equal to IEA SSL and Australian & New Zealand MEPS. Energy Star requires <0.5W. [↑](#footnote-ref-8)
9. R9 is a measurement of the Red saturated test colour and ability to accurately reproduce Red is a key for accurately rendering colours of displayed objects. [↑](#footnote-ref-9)
10. As per ANSI C78.377: 2015 Specifications for the Chromaticity of Solid State Lighting Products. [↑](#footnote-ref-10)
11. Lifetimes are chosen as a balance between long lifetime, market price and efficacy will increase considerably for replacement products within the near future. [↑](#footnote-ref-11)
12. Higher than 15-20.000 in IEA SSL and Australia &New Zealand because these criteria concern lamps for the professional market. [↑](#footnote-ref-12)
13. The same as in IEA 4E SSL Annex [↑](#footnote-ref-13)
14. IEA 4E SSL Annex 40,000 for high bay and low bay and 60,000 for planar luminaires. In Australia & New Zealand draft MEPS 45,000 h. [↑](#footnote-ref-14)
15. L70B50 ≥ 15,000h means that at least 50% of the lamps give 70% of the rated luminous flux until they are used 15,000 hours [↑](#footnote-ref-15)
16. Not to be applied until a practical test method becomes available. [↑](#footnote-ref-16)
17. This requirement is defined by IEA 4E SSL Annex [↑](#footnote-ref-17)
18. Based on IEC 62471/CIE S009. See also IEC/TR 62778:2014:Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires. [↑](#footnote-ref-18)
19. Based on IEEE 1789:2015. The priority here is on restricting the visible modulation of light (including flicker) at frequencies ≤ 90 Hz, as more research is required beyond 90 Hz (ie non-visible effects). There is a lack of a standard for the photometric measurement of modulated light. An updated shall be made when new guidance becomes available. [↑](#footnote-ref-19)