

Procurement criteria for LED indoor lighting in the service sector



The procurement criteria presented in this document are designed to support procurement processes for LED indoor lighting in the service sector. The set of criteria is complemented by an additional guidelines document for indoor lighting which addresses the topics lighting design, energy efficiency and life cycle cost, lighting control, procurement criteria and best practice for offices, schools, museums, retail and hospitals: www.premiumlightpro.eu/indoorguideline

The goal of the criteria is to support procurement projects including both installation of lighting in new buildings and retrofit of lighting in existing buildings. The criteria thus both include requirements at lighting system level and component level.

In the ongoing transition to use of LED lighting technology it is important to focus on both the large opportunities for energy efficiency as well as high quality lighting. The LED technology provides many possibilities for innovation e.g. through optimised luminaires, built-in lighting, flexible lighting control, colour temperature, mimicking of the outdoor lighting variation over the day, smart lighting and better use of daylight.

The basic parameters are included in the procurement criteria while more innovation aspects are addressed in the lighting design specification in the guidelines document. The procurement criteria include parameters as energy and power consumption, efficacy for light sources, standby, colour temperature, colour rendering, lifetime, compatibility, flicker, lighting control, life cycle cost and maintenance.

Evaluation of Tenders

Minimum criteria and requirements specified shall be fulfilled by any tender. Higher quality and efficiency beyond the minimum can be awarded and evaluated by a scoring scheme. Naturally, selection of award criteria and the weighting applied may depend on the type of project, type of building(s) or room types. An example for the weighting of award criteria is provided below.

PremiumLight-Pro is an EU H2020 project concerning implementation of energy efficient LED lighting systems (indoor and outdoor lighting) in the private and public service sector – for more information see www.premiumlightpro.eu.

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Criterion	Requirement	Mandatory requirement	Award criterion		
Energy Efficiency					
Power and energy consumption	Type of building and room		✓	✓	
	Art	Theater room			5.8
		Hall			5.8
		Exhibition hall			5.8
	Hospital	patient room			5.6
		Observation room			10.3
		Treatment room			10.3
	Hotel	Guest room			6.4
		Lobby			5.5
	Office	Single and Group room			10,3
large room		8,1			
Meeting room		10.3			
Hall		5.9			
Restaurant	Restaurant	4.9			
	Cafeteria	2.9			
	Kitchen in restaurant	15.5			
	Kitchen in Cafeteria	12.1			
Retail	Food sales	12.3			
	Shop	12.3			
	Furniture sales	9.9			
School	Class room	9.1			
	Teachers room	6.2			
	Library	4.9			
	Concert hall	8.1			
	Laboratories	9.1			
Sport	Gym	9.3			
	Fitness room	5.3			
	Swimming hall	6.0			
Parking area, Park house and others	Traffic area	2.9			
	Hospital traffic area	5.9			
	Stairwell	5.9			
	Outbuildings	2.5			
	Kitchen, Tea room	4.2			
	WC, Bath, Shower	5.0			
	WC	8.2			
	Wardrobe, shower	4.7			
	Car park	1.2			
	Wash and Dry room	7.0			
	Cooling room	2.3			
	Server room	2.8			
	Efficacy for light sources	<ul style="list-style-type: none"> • ≥ 90 lm/W for non-directional LED lamps that emit ≥ 100 lm. • ≥ 85 lm/W for directional LED lamps that emit ≥ 100 lm. • ≥ 100 lm/W for linear LED lamps nominal length of 550–1500 mm. • ≥ 90 lm/W for small integrated LED luminaires with remote control gear where the luminous flux ≥ 100 lm and $< 2,500$ lm. • ≥ 105 lm/W for large integrated LED luminaires with remote control gear where the luminous $\geq 2,500$ lm and $< 50,000$ lm. 	✓		

Criterion	Requirement	Mandatory requirement	Award criterion																																					
Standby power	<ul style="list-style-type: none"> Information about the size of all kind of standby power consumption (W). Information about if there is power supply of all driver components in the standby mode and how this will influence on the driver lifetime. Information about interoperability (use of open communication protocol). 	✓																																						
Lighting controls	<ul style="list-style-type: none"> The contracting authority has to inform the installer about the way the space is occupied and used, as well as all particular lighting control requirements including safety and security issues. To include contract performance clauses requiring that all lighting controls shall work properly. Provision of occupant guidelines ensuring that occupants can properly use the lighting control systems. Information for the maintenance staff to be used for adjustment of the lighting in case the use of the room changes. 	✓																																						
Lighting Quality and Design																																								
Illuminance level	EN 12464-1:2011	✓																																						
Use of daylight, lighting distribution, uniformity, contrast	Shall be addressed and described in the offer.	✓																																						
Colour temperature, tolerance and maintenance	<table border="1"> <thead> <tr> <th rowspan="2">Nominal CCT (K)</th> <th colspan="2">Centre Point of Circle</th> <th rowspan="2">Radius of Circle</th> </tr> <tr> <th>CCT (K)</th> <th>Duv</th> </tr> </thead> <tbody> <tr><td>2200</td><td>2238</td><td>0.0000</td></tr> <tr><td>2500</td><td>2460</td><td>0.0000</td></tr> <tr><td>2700</td><td>2725</td><td>0.0000</td></tr> <tr><td>3000</td><td>3045</td><td>0.0001</td></tr> <tr><td>3500</td><td>3465</td><td>0.0005</td></tr> <tr><td>4000</td><td>3985</td><td>0.0010</td></tr> <tr><td>4500</td><td>4503</td><td>0.0015</td></tr> <tr><td>5000</td><td>5029</td><td>0.0020</td></tr> <tr><td>5700</td><td>5667</td><td>0.0025</td></tr> <tr><td>6500</td><td>6532</td><td>0.0031</td></tr> </tbody> </table>	Nominal CCT (K)	Centre Point of Circle		Radius of Circle	CCT (K)	Duv	2200	2238	0.0000	2500	2460	0.0000	2700	2725	0.0000	3000	3045	0.0001	3500	3465	0.0005	4000	3985	0.0010	4500	4503	0.0015	5000	5029	0.0020	5700	5667	0.0025	6500	6532	0.0031	0.0044 in (u', v') diagram	✓	
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<p>The PremiumLight-Pro recommendation is to select one of the nominal CCTs in table consistent with the specified chromaticity quadrangles and Duv tolerances [1].</p> <p>The recommendation [1] concerning colour maintenance is to require a maximum shift in chromaticity co-ordinates after 6000 hours of operation:</p> <ul style="list-style-type: none"> $\Delta u',v' (6000 \text{ hours}) \leq 0.004$. <p>Compared to the MacAdam steps method, the ANSI requirements above are recommended as the requirements are specified for all nominal CCTs and the center points are specified.</p>																																								

¹ As per ANSI C78.377: 2015 Specifications for the Chromaticity of Solid State Lighting Products.

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	<p>Anyway, if some wants to specify by MacAdam steps, the recommendations are:</p> <p>LED colour tolerance requirements: ≤ 5 SDCM as minimum criterion in general ≤ 3 SDCM for work with visual task.</p> <p>LED colour maintenance requirements for 6000h: ≤ 7 SDCM as minimum criterion in general ≤ 5 SDCM for work with visual task.</p>																	
Colour rendering	<ul style="list-style-type: none"> • CRI ≥ 80 plus $R_a > 0$ as minimum criterion in general • CRI ≥ 90 plus $R_a > 0$ for work with visual tasks of high priority e. g. clinical areas in hospitals, other types of health care, museums, theatres, work with colour inspection/control/selection and some types of shops e. g. clothing selling. 	✓	✓															
Lifetime	<p>The PremiumLightPro requirements concerning minimum rated lifetimes are ($F_{80B_{50}}$ which is a little higher than tier 2 in [1]) and lumen maintenance at 6000 h [1]:</p> <table border="1"> <thead> <tr> <th>Lamp/luminaire</th> <th>Minimum rated lifetime $L_{80B_{50}}$</th> <th>Lumen maintenance, 6000 h</th> </tr> </thead> <tbody> <tr> <td>Non-directional and directional LED lamps</td> <td>20,000</td> <td>$\geq 93,5\%$ of initial flux</td> </tr> <tr> <td>Linear LED tubes</td> <td>35,000</td> <td>$\geq 96,2\%$ of initial flux</td> </tr> <tr> <td>Small integrated LED luminaires (< 2500 lm)</td> <td>40,000</td> <td>$\geq 96,7\%$ of initial flux</td> </tr> <tr> <td>Large integrated LED luminaires (2500 – 50,000 lm)</td> <td>50,000</td> <td>$\geq 97,4\%$ of initial flux</td> </tr> </tbody> </table> <p>The recommendation [1] concerning early failure rate is to require maximum 5% early failures at 6000 hours.</p> <p>It is also recommended to require documentation by test reports from the manufacturers (including extrapolation to reach the rated lifetime).</p>	Lamp/luminaire	Minimum rated lifetime $L_{80B_{50}}$	Lumen maintenance, 6000 h	Non-directional and directional LED lamps	20,000	$\geq 93,5\%$ of initial flux	Linear LED tubes	35,000	$\geq 96,2\%$ of initial flux	Small integrated LED luminaires (< 2500 lm)	40,000	$\geq 96,7\%$ of initial flux	Large integrated LED luminaires (2500 – 50,000 lm)	50,000	$\geq 97,4\%$ of initial flux	✓	✓
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Ambient temperature and driver type	<p>Depending on the application, PremiumLight-Pro recommendation is to consider to procure for an ambient temperature $t_a = 30\text{ °C}$ as this could be the ambient temperature in summer with still air around the ceiling.</p> <p>Concerning the longevity of the LED lighting system it is recommended to require inclusion of controls that ensure the operating temperature stays below the t_q limit.</p> <p>If the driver is replaceable, it is for maintenance recommended to require information about if the driver type is SELV (Safety Extra Low Voltage) or NON-SELV.</p>	✓																

Criterion	Requirement	Mandatory requirement	Award criterion	
Power factor and harmonic distortion	Non-directional and directional lamps: < 25 W: PF > 0.50 ≥ 25 W: PF > 0.90 Linear LED tubes (self-ballasted lamps): PF > 0.90 Small and large integrated LED luminaires: PF > 0.90 For harmonic distortion, for products with power > 25 W it is recommended to use the requirements for class C equipment in standard IEC 61000-3-2 [1] which are shown in table.	✓		
	Harmonic order (n)			Maximum possible harmonic current expressed as a percentage of the input current at the fundamental frequency (%)
	2			2
	3			30 – CPF (CPF is the circuit power factor)
	5			10
	7			7
	9			5
	11 ≤ n ≤ 39 (odd harmonics only)			3
Flicker	Based on IEA 4E SSL [1] and IEEE 1789:2015 PremiumLight-Pro recommendation is to require:	✓		
	f: Flicker frequency (Hz)			FM: Flicker modulation maximum (%)
	f ≤ 90Hz			FM ≤ (0.025 × f)
	90Hz ≤ f ≤ 1250Hz			FM ≤ (0.08 × f)
	f > 1250Hz			No FM requirement
Concerning dimming, it is recommended to require that no flicker appears for all important dimming levels (e. g. 50% and 25%).				
Glare and photo-biological safety	<ol style="list-style-type: none"> Concerning direct glare [standard EN_12464-1]: <ul style="list-style-type: none"> Specification of the minimum shielding angle in all directions depending on the lamp luminance. Specification of the discomfort glare by the UGR_L. Concerning avoidance of high angle luminance glare [1, 42]: <ul style="list-style-type: none"> When the gamma (γ) angle exceeds 60 degrees, the light source luminance shall be no more than 10,000 cd/m². Concerning photo-biological safety ensure that the human eye is not harmed by intensive bluelight radiation (blue light hazard) [1]: <ul style="list-style-type: none"> LED lamps and luminaires with RG0 or RG1 [see standard IEC 62471/CIE S009]. 	✓		
Dimmer and transformer compatibility	<p>Concerning dimmer compatibility it is recommended to require that the manufacturer shall:</p> <ul style="list-style-type: none"> Provide an address for a webpage that lists compatible dimmers For each compatible dimmer, list the range of luminous flux levels a given dimmer-luminaire combination can achieve. <p>Concerning dimmer operation it is recommended to require:</p> <ul style="list-style-type: none"> Smooth dimming down to 30% of total luminous flux with no observable flicker and no audible noise. When dimmer is set to 100%, the light output shall be ≥ 90% of luminous flux without dimmer. 	✓		

Criterion	Requirement	Mandatory requirement	Award criterion
Maintenance	<p>PremiumLight-Pro recommendation is to require:</p> <ul style="list-style-type: none"> • Lamp Lumen maintenance Factor (LLMF) • Luminaire maintenance Factor (LMF) • Maintenance Factor (MF) • Maintenance plan shall be provided including specified intervals for maintenance and cleaning. <p>It is recommended to consider the following requirements:</p> <ul style="list-style-type: none"> • Luminaires with constant luminous flux control for some applications • Closed LED luminaires for some applications that may encounter significant dirt. 	✓	
Cost criteria			
Life Cycle costs	<p>PremiumLight-Pro recommendation is to require:</p> <ul style="list-style-type: none"> • The lighting system solutions/alternatives shall be compared by LCC calculations and the LCC method specified by the procurer. 	✓	✓
Investment costs	Only to be provided in case it is impossible to calculate the life cycle costs.	✓	
Installation, Operation, Repair and Recycling			
Contractor experience and obligation	<p>The contractor shall ensure the following:</p> <p>Installation</p> <ul style="list-style-type: none"> • The lighting system is installed exactly as specified/required. • Delivery of a schedule for the lighting system installation with appended manufacturers' invoices or delivery notes. • Provision of information so that occupants know how to control the lighting and maintenance staff can make adjustments if necessary (e. g. when room layouts change). <p>Functionality</p> <ul style="list-style-type: none"> • The installed 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 in application. • Time switch control (physical and/or 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/recalibrate the systems. <p>Training</p> <ul style="list-style-type: none"> • The contract shall preferably include training of the users with focus on operation, lighting control and maintenance. <p>Evaluation of the performance</p> <ul style="list-style-type: none"> • The contract shall preferably include installation of a metering and measurement system for identification of failures and monitoring that energy consumption is as specified. <p>Product availability</p> <ul style="list-style-type: none"> • It is recommended to require that manufacturers of all procured LED products guarantee product availability over a designated time period. 	✓	✓

Criterion	Requirement	Mandatory requirement	Award criterion
	<p>Substances of Concern</p> <ul style="list-style-type: none"> It is recommended to require that manufacturers don't use substances of concern in their products. European Chemical Agency works together with the EC and the EU member States for the safety of human health and the environment by identifying the needs for regulatory risk management at an EU-wide level [39] including the REACH regulation. In connection to this, the Danish Environmental Protection Agency (EPA) [40] has made a "List Of Undesirable Substances" (LOUS) that include 40 substances. The LOUS list is aimed at Danish businesses and serves as a signal and guideline regarding substances that businesses should use less of in the long term or completely phase out. Some of the Danish municipalities require in their procurement that no substances at the LOUS list are included in the procured products. <p>Waste management</p> <ul style="list-style-type: none"> 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 Directive. Some Danish municipalities consider requiring all plastic and metal parts in the products to be suitably labelled so they can be recycled. 		

Prequalification

Prequalification of companies might include:

- Presentation of delivery of similar lighting systems in similar projects (of the same size and type) and the time of delivery etc.
- Measurements by a neutral laboratory to document the energy savings
- Presentation concerning how they will be able to integrate their luminaires in the actual buildings
- Presentation of their capability concerning maintenance of the lighting system.

PremiumLight-Pro award criteria – Weighting

Minimum criteria and requirements specified above shall be fulfilled by any tender. For the award criteria, higher quality and efficiency beyond the minimum can be awarded and evaluated by a scoring scheme with weight for each parameter as shown.

Naturally, selection of award criteria and the weighting applied depends on the type of project, type of building(s) and room types.

Award criterion	Weighting [%]
Cost	
Life Cycle Cost	30
Energy Efficiency	
Power and energy consumption	20
Lighting Quality and Design	
Colour rendering	10
Lifetime	15
Lighting control (depending on the amount extra control features included)	5
Installation, Operation, Maintenance, Repair, Recycling	
Contractor training (included or not included)	10
Warranty and spare part availability	10
Total	100

About PremiumLight-Pro

PremiumLight-Pro is an EU H2020 project (2016-19) concerning implementation of energy efficient LED lighting systems (indoor & outdoor lighting) in the private and public service sector by development of policy instruments designed in cooperation with stakeholders from the supply and demand side market including:

- Development of procurement criteria
- Development of guidelines for indoor and outdoor lighting
- Collection of Best Practice cases
- Establishment of an information platform
- Development of specific planning tools and a product database
- Execution of modular education courses for architects, installers, consultants etc.

PremiumLight-Pro will also support the ongoing development of EU regulation (ecodesign, labelling and EPBD) as well as national legislation policy instruments e.g. EPBD supportive tools, incentive schemes, white certificates and contracting models. See more at www.premiumlightpro.eu.

PremiumLight-Pro Consortium:



AUSTRIAN ENERGY AGENCY

Austria

Austrian Energy Agency
www.energyagency.at



Czech Republic

SEVEn, The Energy Efficiency Center
www.svn.cz



Denmark

Energy piano



UNIVERSIDADE DE COIMBRA

Portugal

Institute for Systems and Robotics,
University of Coimbra



United Kingdom

Energy Saving Trust
www.energysavingtrust.org.uk



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The Procurement Criteria were finalised in September 2017