



EUROPEAN COMMISSION  
DIRECTORATE-GENERAL JRC  
JOINT RESEARCH CENTRE  
Institute for the Energy  
Renewable Energy Unit

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# EUROPEAN LED QUALITY CHARTER

An initiative promoted by  
the European Commission Joint Research Centre

## 1. INTRODUCTION

The European Commission together with several national governments, energy agencies, public and private organisations/industries is promoting the end-use energy efficiency in lighting through several instruments as a key component of the EU energy policy and the common goal of reducing climate change.

In EU, the total domestic lighting consumption is around 86 TWh and it is predicted to raise to 102 TWh by 2020 due to growing welfare especially in some countries and rapidly increasing number of lamps per home. LED lamps efficacy and luminous characteristics are improving very rapidly. In the future, LED lamps are expected to deliver substantial energy savings. LED lamps last 5-25 times as long as the traditional lamps.

GLS and some halogen lamps are about to be phased out due to EU regulation (Eco-design). In many cases, LED lamps are a valid retrofit solution. During this decade it is expected that LED lamps will cover nearly all types of lamps. At present, LED lamps are nearly not used for indoor lighting in the residential sector but the market penetration is starting.

The challenge is to retrofit incandescent lamps with LED lamps of good quality – alternatively users will install mainly new halogen lamps with only slightly lower energy consumption. The barriers for this development are actual high prices for LED lamps of good quality and the variation in performance of LED sources in the market is far too large. Many customers may have bad experience with use of LED lamps and that will threaten consumer confidence in LED lighting performance and savings. This might give a delay in market acceptance and a slowing down of the LED penetration rate.

The availability of good quality products is thus most essential along with information about the high energy efficiency and the savings for the consumer. Since the actual price of LED lamps of good quality is high, governments, municipalities and/or utilities may subsidise the LED lamps. A LED quality charter is needed in these activities, to assure public money is spent on lamps delivering real savings.

More than 20 years ago when the CFL product was introduced at the market the situation was quite similar. After buying the first CFLs many consumers were very dissatisfied and rejected the technology. It took many years and a lot of work to overcome the barriers created during the first years at the market. It is very important not to repeat these failures when the LED is introduced at the market.

Development of the market for LED lamps is thus very important to increase energy efficiency and reduce CO<sub>2</sub> emissions in the European Union. Standards and Eco-design regulation are coming within the next year. The role of the European LED Quality Charter is to set an important voluntary requirements for white LED lamps (not covering LED chips, modules or luminaires) that can be used now by governments, municipality, energy savings, utilities and other active parties to ensure the quality of LEDs on the market.

## 2. GOALS AND SCOPE

The European Quality Charter for LED is developed in 2010 on the initiative of the European Commission Joint Research Centre (JRC) to support the European initiatives for the Promotion of Efficient Lighting in the Residential Sector. It is a voluntary initiative.<sup>1</sup>

The scope of the present version LED Quality Charter is limited to **LED lamps intended primarily for use in the residential sector**. At this stage the European Quality Charter for LED does not include LED modules, luminaires and lamps specific for use in the commercial sectors. This limitation is due to the urgent need to publish a quality charter as soon as possible for support of customers replacing banned incandescent lamps (GLS and some halogen lamps), and other promotion programme at national or local level (e.g. white certificates).

The aim of the European LED Quality Charter is to offer a high quality voluntary standard to be used by European utilities, industries and other bodies for:

1. Manufacturing, marketing and/or sales of high quality LED lamps in the European Union
2. Raising consumer awareness and confidence in the LED, by assuring an acceptable quality and performance level are reached.
3. Supporting promotion and procurement campaigns providing quality, comfort, energy and money saving and decreasing the CO<sub>2</sub> emission.

The final goal of the European LED Quality Charter is thus to further increase the sales and penetration of high quality and efficient LEDs in the EU and thus contribute to the goals of the EU energy and environmental policies.

The European LED Quality Charter is a voluntary set of criteria established by the European Commission JRC in collaboration with a number of private and public organisations, including:

- Danish Energy Agency
- The Danish Energy Saving Trust
- NL Agency
- STEM

The European LED Quality Charter is open to all organisations who are willing to support and promote the present European LED Quality Charter in their recommendations to public and private organisations and when running promotion of LED lamps meeting the requirements of the European LED Quality Charter.

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<sup>1</sup> The background for the quality charter requirements is described in a EuropeanLED Quality Charter Background report.

### **3. PARTICIPATION**

The present European LED Quality Charter is a voluntary scheme open to:

- LED manufacturers, importers and retailers marketing in Europe LED lamps that meet the requirements of the European LED Quality Charter;
- Private and public organisations (electricity distribution companies, public authorities, housing associations, hotels etc.), that will use the requirements of the European LED Quality Charter for their LEDs promotion, procurement, and DSM campaigns.

Participating lamp manufacturers, LEDs importers and retailers agree to promote in the market LEDs, which meet all the requirements of the European LED Quality Charter. They may use the European LED Quality Charter logo<sup>2</sup> only to indicate that the company is participating in this scheme and in advertisement, information material only in connection with products that meet the criteria. The logo shall not be used on individual products or their packaging.

The Commission reserve the right to test, review or ask for additional information for any product that a participating manufacturer claims is meeting the European LED Quality Charter criteria.

For private and public organisations using the European LED Quality Charter for their promotion/procurement/DSM campaigns, it is recommended:

- to use the Quality Charter in promotion, procurement and DSM campaigns;
- to communicate to the end-users (where applicable) that this is a joint European initiative on quality end-use efficiency initiated by the European Commission Joint Research Centre and the other organisations;

Each organisation willing to participate is requested to send the attached registration form along with a list of LEDs fulfilling the Charter Requirements to:

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e-mail: [paolo.bertoldi@ec.europa.eu](mailto:paolo.bertoldi@ec.europa.eu)

With the permission of the participating company the Commission Joint Research Centre will disseminate the results of specific promotion/DSM campaign as “best practices” examples, acknowledging the contribution of the specific company.

### **4. ADDITIONAL INFORMATION**

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<sup>2</sup> As of 21 February the logo is not yet finalised. A new Annex with the logo will be distributed and posted on the web in March 2011

Additional information on the European LED Quality Charter including a list of participating manufacturers is available on the Internet at:

<http://energyefficiency.jrc.cec.eu.int/>

**EUROPEAN LED QUALITY CHARTER**  
**PARTNERSHIP COMMITMENT SUBMISSION FORM**

The company

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declares its willingness to:

- use the requirements of the European LED Quality Charter for their promotion, procurement, and DSM campaigns
- manufacturers, importers and retailers marketing in Europe LED lamps that meet the requirements of the European LED Quality Charter

Person responsible appointed by the company:

Name person: \_\_\_\_\_  
Managerial Function: \_\_\_\_\_  
Address: \_\_\_\_\_  
Tel. / Fax: \_\_\_\_\_ / \_\_\_\_\_  
e-mail/ internet: \_\_\_\_\_  
\_\_\_\_\_

Director or person authorised to sign for the organisation:

Name: \_\_\_\_\_  
Managerial Function: \_\_\_\_\_  
Address: \_\_\_\_\_  
Tel. / Fax: \_\_\_\_\_ / \_\_\_\_\_  
e-mail/ internet: \_\_\_\_\_  
Signature \_\_\_\_\_  
Date \_\_\_\_\_  
\_\_\_\_\_

*Please send the signed submission form by email, fax or post to :*

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## **5. WHAT ARE the MAIN PROBLEMS WITH LED QUALITY?**

The technology and performance of white LEDs are developing very fast. Actually, the availability of specific LED products at the market is very short as new and more efficient LEDs come on the market every six months. For customers buying LEDs one or two times a year, it is difficult if the products are different every time they visit the shop.

Some testing programs<sup>3</sup> have also found that the performance within individual batches of identical sources varied as much as 40%. That indicates that the actual manufacturer has not performed a proper binning maybe caused by downward pressure on pricing increase the temptation for manufacturers to “cut corners”.

Some manufacturers overstate their LED performance and consumers unlucky enough to purchase low performing LEDs (not performing as claimed by the manufacturer) may be very dissatisfied and reject the technology, and the overall reputation of LED will suffer.

LED luminaires and replacement lamps available today often claim a long lifetime, e.g. 50,000 hours. These claims are based on the estimated lumen depreciation of the LED used in the product and often do not account for other components or failure modes. Lifetimes claimed by LED luminaire manufacturers should take into account the whole lighting system. Anyway in order to set requirements quickly in the actual emerging market, the present version of the European LED Quality Charter only sets requirements to the lifetime of the lamp.

LED's are often integrated permanently into the fixture/luminaire, making their replacement difficult or impossible – this may be could be all right if the lamp lifetime is 50,000 hours but it could be a problem if the lifetime is short. One of the key lessons learned from early market introduction of CFLi<sup>4</sup> is that long life claims need to be credible with appropriate manufacturer warranties.

A very long lifetime of 30-50,000 hours is somehow abstract as the lamps might rest at least 40-60 years pending on the yearly operation time. This means that the lamp might burn longer time than the luminaire is in use, the owner live in the home or live. A much shorter lifetime might be all right if the price of the LED is acceptable (i.e. relatively low) and the quality is preserved.

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3 “The Need for Independent Quality and Performance testing of Emerging Off-grid White-LED Illumination systems for Developing Countries”, Evan Mills, LBNL and Arne Jacobsen, Schatz Research Center, Technical report 1, The Lumina project, August 2007, <http://light.lbl.gov>.

4 US DOE. “Compact Fluorescent Lighting in America: Lessons Learned on the Way to Market”. 2006.

Both the correlated colour temperature (CCT) and the colour-rendering index (CRI) vary within large intervals. A new study of colour rendering of LED sources<sup>5</sup> with a paired comparison of halogen and fluorescent to seven different clusters of LED at 3000K (CCT). They found, that in general, that the colour rendering was found more attractive with some of the LEDs mixing than with standard light sources. In general, alternative scales for measuring the colour rendering are discussed. The investigation finds that neither of the alternative scales for measurement of colour rendering are optimal – they all have their weak and strong points: attractiveness (Gamut is the best scale), naturalness (CRI best) and colour difference (CIECAMO2 best).

The beam characteristics of LEDs are usually determined by discrete optical elements attached to the LED or LED board. The beam and field characteristics are different from a reflector optic with a single source and this might result in a non-circular beam pattern, colour variation across the beam (especially for single LED devices) and failure to achieve good beam definition at beam angles below 24 degrees<sup>6</sup>. For more detailed setting of requirements to LEDs, the rated lumen output of the LED luminaire is thus important. Requirements to the manufactures could be measurement of total luminous flux e.g. by use of photo-goniometer in order to characterize the light-distribution pattern.

Formalisation of product quality and a performance testing process is needed urgently. Independent testing has to start as soon as possible and the results have to reach the key audiences. The availability of standard test procedures can support manufacturers' product development efforts, evaluation of progress towards achieving higher quality (comparison to established benchmarks) and competitive analysis. This will be taken care of in the new IEA 4E SSL annex.

On the other hand, it is important to ensure the cost of testing is not overly burdensome to manufacturers. High-cost testing can be less successful than a more moderate approach because small firms might be unable to afford the entry cost to high-cost testing and some manufacturers might avoid markets where quality assurance is required. The testing become problematic as new methods has to adapt to that LED products have such long lives that lifetime testing and acquiring of real application data on long-term performance can versions of products might be available before current ones are fully tested.

An example of lamp performance measurements including LED lamps can be found at the Renewable Energy Olino web site<sup>7</sup> including use of different fittings.

UV/blue light radiation and high intensity glare are identified as a potential risk factors<sup>8</sup> and quality requirements plus care has to be taken<sup>9</sup>.

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5 "Colour Rendering of LED sources: Visual experiment on Difference, Fidelity and Preference", Jost-Boissard, Fontoyont and Blanc-Gonnet, Ecole Nationale Travaux Publics de l'Etat, CIE Light and Lighting Conference with emphasis on LED, 27-29 May 2009.

6 Comment from PLDA in the Eco-Design pre study concerning domestic lighting, lot 19, May 2009.

7 <http://www.olino.org/>

## 6. EU LED QUALITY CHARTER for LED lamps

### 1.1. SCOPE

The quality charter is a European voluntary set of requirements for LED lamps for use mainly in the residential sector as replacement for the phased-out incandescent lamps. The Quality Charter is not a label to be placed on the lamp or lamp package but a set of requirements that can be used to ensure high quality in LED manufacturing, marketing, consumer awareness and confidence.

The charter could also apply to use of the products in other sectors (e.g. hotels). The requirements address products from both European and non-European manufacturers.

Due to IEC/PAS 62612, point 3.1: A self-ballasted LED-lamp is a unit that cannot be dismantled without being permanently damaged, provided with a lamp cap conforming to IEC 60061-1 and incorporating a LED light source and any additional elements necessary for starting and stable operation of the light source.

A LED lamp typically includes one or more packaged LED chips, a thermal heat sink to cool the chips, a housing, and a lamp cap providing connection to the electricity supply. Often a circuit driver is included. Plastic lens or bulb might be used to shape the lamp's light distribution.

### 1.2. SAFETY

item	minimum requirement	measurement method
Safe in use, when installed and at the end of life	Lamps must meet the safety requirements and comply with relevant CE Marking legislation	IEC 60061 IEC 62031 (2008) IEC 62471 IEC 62560  IEC 62663-1

8 European Commission Health and Consumer DG, Committee SCENIHR: "Light Sensitivity" 26<sup>th</sup> Plenary 23/9 2008, and EU directive 2006/25/EC including photobiological hazard of visible radiation.

9 Health issues to be considered with lighting systems using LEDs (In French), ANSES, October 2010.

### 1.3. CONFORMITY OF PERFORMANCE

item	minimum requirement	measurement method
Conformity of Performance	The Manufacturer must provide a written conformity of performance from an approved Notified Body. If required, relevant test data must also be provided by the Body.	93/465/EEC Module A, Notified Bodies are defined in the Annex. Updated list of Notified Bodies is published in the Official Journal of the European Communities.

### 1.4. PERFORMANCE

item	minimum requirement	measurement method																																								
Efficacy (including ballast)		IES LM-79-2008																																								
	<table border="1"> <thead> <tr> <th></th> <th>CRI</th> <th>Min efficacy</th> <th>2011</th> <th>2012</th> <th>2013</th> <th>2014</th> <th>2015</th> </tr> </thead> <tbody> <tr> <td>NDLS</td> <td>&gt;80</td> <td>lm/W</td> <td>61</td> <td>65</td> <td>70</td> <td>75</td> <td>80</td> </tr> <tr> <td></td> <td>&gt;90</td> <td>lm/W</td> <td>52</td> <td>55</td> <td>60</td> <td>65</td> <td>70</td> </tr> <tr> <td>DLS</td> <td>&gt;80</td> <td>lm/W</td> <td>50</td> <td>55</td> <td>60</td> <td>65</td> <td>70</td> </tr> <tr> <td></td> <td>&gt;90</td> <td>lm/W</td> <td>40</td> <td>45</td> <td>50</td> <td>55</td> <td>60</td> </tr> </tbody> </table> <p>NDLS = Non Direct Lighting Sources DLS = Direct Lighting Sources</p> <p>In the future, 2012 to 2015 targets might be revised according to the development in LED efficacy. Any revision will be discussed and approved at least 6 month before the entry into force</p>		CRI	Min efficacy	2011	2012	2013	2014	2015	NDLS	>80	lm/W	61	65	70	75	80		>90	lm/W	52	55	60	65	70	DLS	>80	lm/W	50	55	60	65	70		>90	lm/W	40	45	50	55	60	
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Lumen maintenance	<p><math>L_{70F50} \geq 15,000</math> hours Maximum 50% lamps having lumen maintenance below 70% after 15,000 hours.</p> <p><math>L_{85F05} \geq 1000</math> hours Maximum 5% lamps having lumen maintenance below 85% after 1000 hours.</p>	<p>IEC/PAS 62612 Ed1 including a temperature cycling shock test and a supply voltage switching test with a number of cycles equal to half of the rated lamp life without any failure.</p> <p>IEC/PAS 62612 Ed1 testing after 1000 hours.</p> <p>The testing have to be performed under typical operating conditions e.g. operating in three different environments: open-air, semi-ventilated and enclosed.</p>																																								

Stabilised light output	<p>The starting time shall be less than 0.5 second.</p> <p>The time to 95% of stabilised rated lumen output after switch-on from cold, at normal room temperature, shall be less than 2 seconds.</p>	<p>IES LM-79-2008</p> <p>IES LM-80-2008</p>
Colour rendering	CRI > 80	CIE No. 13.3 – 1995
Colour temperature	<p>CCT shall be in the interval 2600 - 3500 K.</p> <p>The rated colour shall preferably be one of the three values:</p> <p>F2700 (2720K, X=0.463, Y=0.420)</p> <p>F3000 (2940K, X=0.440, Y=0.403)</p> <p>F3500 (3450K, X=0.409, Y=0.394)</p>	<p>IEC/PAS 62612 Ed.1.</p> <p>IEC 60081, Annex D.2, modified.</p> <p>A tolerance category of 7-step MacAdam ellipse size shall be assigned as maximum spread, that includes (circumscribes) the chromaticity co-ordinates of all LED lamps in the tested sample.</p>
Dimensions	Directional retrofit LED lamps shall be designed physically and functionally to replace GLS and halogen reflector lamps with reference to the maximum outline specified.	IEC 60630
Glare and blue light hazard	The visible radiation hazard class shall be 0 or 1.	IEC 62471-2
Flicker	<p>The frequency is required to be <math>\geq 100</math> Hz.</p> <p>No flicker must appear when the LED is dimmed covering all light output levels.</p>	IEC 61000-3-11
Power factor	The power factor shall at least be 0.5 for lamps of wattage 2-25W.	IEC 61000-3-2:2006

<b>1.5. INFORMATION ON PACKAGE</b>		
item	minimum requirement	measurement method
Lighting facts	Existing EU regulation already require to display energy class, lumen, estimated yearly energy cost, CCT, life time, wattage, warm-up time, beam angle (for directional lighting sources) and a warning if the lamp can't be dimmed.	EU 98/11/EC  EU 244/2009  New eco-design regulation for directional lamps coming in 2011.
Colour rendering	It is recommended that the CRI is displayed.	CIE No. 13.3 – 1995
Comparison LED/incandescent lamps	Where the packaging, or other literature claims that the rated luminous flux of the LED is equivalent to, or exceeds that, of an incandescent lamp the lamp rating must comply with existing EU regulation.	EU 244/2009 eco-design for non-directional lighting sources.  New EU eco-design regulation for directional lighting sources coming in 2011.

<b>1.6. GUARANTEE &amp; QUALITY</b>		
item	minimum requirement	measurement method
Guarantee to customer	EU regulation already provides the customer with 2 years guarantee in case of lamp failure.	EU 1999/44/EC
Quality of production	Lamps must be manufactured under a Quality Assurance System.	EN ISO 9002 or equivalent