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Preparatory Studies for Eco-design Requirements of EuPs

Lot 19: Domestic lighting
Part 1 - Non-Directional Light Sources

Draft final task reports
Task 1: Product Definition

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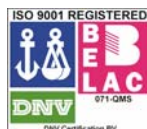


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This is an updated draft document intended for stakeholder communication.

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0 PREFACE

VITO and its partners are performing the preparatory study for the new upcoming eco-design directive for Energy Using Products (EuP) related to domestic lighting, on behalf of the European Commission (more info http://ec.europa.eu/enterprise/eco_design/index_en.htm).

The environmental impacts of Energy-using Products such as domestic lighting take various forms, including: energy consumption and the related negative contribution to climate change, consumption of materials and natural resources, waste generation and release of hazardous substances. Eco-design, which means the integration of environmental considerations at the design phase, is arguably the best way to improve the environmental performance of products.

The creation of a coherent framework for environmental product policy avoids the adoption of uncoordinated measures that could lead to an overall negative result; for example eliminating a toxic substance from a product, such as mercury from lamps, might lead to increased energy consumption, which could in total have a negative impact on the environment. A Community framework also ensures that divergent national or regional measures, which could hinder the free movement of products and reduce the competitiveness of businesses, are not taken. It is not the intention to decrease the quality of domestic lighting.

The objective of this interim draft document is to present preliminary data for discussion with stakeholders related to the EuP preparatory study for the lot 19.

You can follow the progress of our study and find general information related to lot 19 on the project website when you register as stakeholder: <http://www.eup4light.net>

Please, also consult the website for timing and organisation of the tasks.

1 PRODUCT DEFINITION

Scope: This task should define the product category and define the system boundaries of the ‘playing field’ for eco-design. It is important for a realistic definition of design options and improvement potential and it is also relevant in the context of technically defining any implementing legislation or voluntary measures (if any).

The objective of this task is to discuss definition and scope issues related to the EuP preparatory study for the lot 19. It consists of categorisation of products, description of product definitions, scope definition as well as identification of key parameters for the selection of relevant products to perform detailed analysis and assessment during the next steps of the study.

Further, the harmonised test standards and additional sector-specific procedures for product-testing are identified and discussed, covering the test protocols for:

- Primary and secondary functional performance parameters;
- Resource use (energy, etc.) during product-life;
- Safety (electricity, EMC, stability of the product, etc.);
- Other product specific test procedures.

Finally, it aims to identify existing legislations, voluntary agreements and labelling initiatives at the EU level, in the Member States and outside Europe.

1.1 Product category and performance assessment

1.1.1 System boundary and technical product definition

Proposed product definition, scope and system boundary:

The proposal is to use a product definition derived from existing European standards and the Prodcom classification.

A 'domestic lighting' product system can more generally be considered as 'lighting equipment' as defined in standard EN 12665 (Light and lighting - Basic terms and criteria for specifying lighting requirements) for domestic application, containing:

1. A “lamp” as “source made in order to produce an optical radiation, usually visible”;
2. A “luminaire” as “apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except the lamps themselves, all parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting the lamps to the electric supply”.

Furthermore it is proposed to exclude coloured lamps that are typically used for decorative purposes, therefore a definition of a white light source is included in [Annex 11.1.1](#).

It is important to note that the definition of domestic lighting in this eco-design study covers products with similar characteristics. Moreover, many so-called 'domestic lighting' products are also used in other areas (e.g. hotels, shops, offices). According to the MEEuP Methodology Report, these product groups that are functionally similar have to be envisaged. As a consequence all that products that are based on the same technology will be included in this study.

The 'domestic lighting' is not a lighting specifiers market, this means that the technical lighting requirements (e.g. illuminance levels) are not specified by the consumer before installation according to technical standards. Therefore the approach is different from the previous EuP studies for office and street lighting. In this study, a lamp technology based approach is proposed. This means a focus on the lighting technology that is most commonly used in the domestic market. The advantage of this approach is that the Prodcom classification according to lamp technology can directly be adopted and possible implementing measures can easily be followed up.

For luminaires it is proposed to exclude decorative elements because their functionality can not be quantified and moreover there are too many different versions on the market. The approach for luminaires will be elaborated in a second phase of the project. It is proposed to consider the minimum elements (e.g. sockets) and functional elements (e.g. dimming control, presence detector, control elements, ..). Also functional properties will be considered that enable energy efficient light sources or light use (lamp compartment properties, ..). For the found system-related improvement options (if any) environmental impact assessment and LCC impact assessment will be made in task 8 at product level.

1.1.2 Classification of domestic lamps and luminaires

Please note that in Eurostat's product-specific statistics for trade and production (the so-called Europroms¹-Prodcom² statistics) domestic lighting can be reported in two manners:

1. According to lamp technology.
2. According to function of the luminaire.

Prodcom is a valuable source of information in total number of sales and average price. This level of aggregation is rather raw. For the purpose of the eco-design analysis extra sub-categories will be therefore added.

1.1.2.1 Lamps applicable in domestic lighting

The PRODCOM segmentation for lamps related to domestic lighting is displayed in Table 1.1.

¹ Europroms is the name given to published Prodcom data. It differs from Prodcom in that it combines production data from Prodcom with import and export data from the Foreign Trade database.

² Prodcom originates from the French "PRODUCTION COMMUNAUTAIRE"

Table 1.1: Prodcom segmentation for lamps related to domestic lighting

31.50.12.93	Tungsten halogen filament lamps, for a voltage > 100V Excluding: - ultraviolet and infra-red lamps - for motorcycles and motor vehicles
31.50.12.95	Tungsten halogen filament lamps for a voltage ≤ 100V Excluding: - ultraviolet and infrared lamps - for motorcycles and motor vehicles
31.50.13.00	Filament lamps of a power ≤ 200W and for a voltage > 100V Including: - reflector lamps Excluding: - ultraviolet and infrared lamps - tungsten halogen filament lamps - sealed beam lamp units
31.50.15.10	Fluorescent hot cathode discharge lamps, with double ended cap Excluding: - ultraviolet lamps
31.50.15.30	Fluorescent hot cathode discharge lamps Excluding: - ultraviolet lamps - lamps with double ended cap
31.50.15.53	Mercury vapour discharge lamps Excluding: - ultraviolet lamps - dual lamps (Including : metal halide lamps)

As mentioned before, for the purpose of the eco-design analysis, extra sub- categories will be added; the complete list of lamp types is included in Table 1.2.

In this study directional light sources (DLS) or directional lamps (e.g. reflector lamps) and non-directional light sources (NDLS) or non-directional lamps will be discriminated, because the performance data provided by manufacturers are different for both lamp types and it allows to execute the study in two phases. Within directional light sources, further discrimination can be made according to light distribution or beam angle.

The base line proposal for defining these directional and non-directional light sources is based on the light distribution per solid angle. The unit for a solid angle is the steradian [sr]; a complete solid angle can e.g. be visualized as a sphere and counts 4π sr (see Figure 1.1).










Figure 1.1: Visualization of a complete solid angle.



Discrimination of directional light sources will be made in the following categories:





- 'Non-Directional Light Source' or NDLS shall mean a light source having less than 80 % light output in a solid angle of π sr (corresponding with a cone with angle of 120°).
- "Directional Light Source" or DLS shall mean a light source having at least 80% light output within a solid angle of π sr (corresponding to a cone with angle of 120°). A DLS uses a reflector or an optical component (e.g. lens for LED) to align the luminous flux. All 'reflector lamps' are considered as DLS




Table 1.2: Overview of lamp types to be discussed in this study




PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
31.50.13.00 	Filament lamps of a power ≤ 200W and for a voltage > 100V Including: -reflector lamps Excluding: -ultraviolet and infrared lamps -tungsten halogen filament lamps -sealed beam lamp units	220-240	≤200	Low Frosted / silicated / coated	NDLS	E14 E27 B15d B22d	Domestic	Incandescent lamp or General Lighting Service lamp	GLS-F
						E10 BA.. etc.	In general, not used for domestic lighting	Incandescent lamp or General Lighting Service lamp	
31.50.13.00 	.			High Clear	NDLS	E14 E27 B22d B15d	Domestic	Incandescent lamp or General Lighting Service lamp	GLS-C
						E10 BA.. etc	In general, not used for domestic lighting	Incandescent lamp or General Lighting Service lamp	




PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
31.50.13.00 		230 - 240	5 - 60	High / Low Clear / Frosted	NDLS	E14 E27 B22d B15d	Decorative effects	Special decorative lamps	GLS-deco
31.50.13.00 			High / Low Clear / Frosted	NDLS	S14d S14s S19	Furniture lighting	Linear filament lamp	GLS-lin	
31.50.13.00 			15 - 60	NDLS	E14 E27 B15d B22d etc	Amenity lighting, demarcation lighting, etc. In general, not used for domestic lighting	Coloured lamp	GLS-colour	
31.50.13.00 			15-60	High and Low Clear and Frosted	NDLS	E14 E27 B15d B22d	Oven Refrigerator Sewing machines Cooker hood	Oven lamp Refrigerator lamp Sewing machines lamp Cooker hood lamp	GLS-special
31.50.13.00 			60 - 150	High Clear	NDLS	E27 B22 etc	Traffic lights Portable lamps. In general, not used for domestic lighting	Traffic sign lamp Reinforced filament lamp	GLS-signal




PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
31.50.14.93 	Filament lamps for a voltage > 100V Excluding: -ultraviolet and infrared lamps -tungsten halogen filament lamps -those of a power ≤ 200W -for motorcycles and motor vehicles -sealed beam lamp units	230-240	>200	High Clear	NDLS	E27 E40	In general, not used for domestic lighting (large surfaces)	Incandescent lamp or General Lighting Service lamp High Wattage	GLS-C-HW
31.50.14.95 	Filament lamps for a voltage ≤ 100V Excluding: -ultraviolet and infrared lamps -tungsten halogen filament lamps -for motorcycles and motor vehicles -sealed beam lamp units	≤100	15 - 100	High and Low Clear and Frosted	NDLS	E27 B22d etc.	Emergency lighting etc. In general, not used for domestic lighting	Incandescent lamp or General Lighting Service lamp Low Voltage	GLS-LV




PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
31.50.13.00 	Filament lamps of a power $\leq 200W$ and for a voltage $> 100V$ Including: -reflector lamps Excluding: -ultraviolet and infrared lamps -tungsten halogen filament lamps -sealed beam lamp units	230 - 240	≤ 200		DLS	E14 E27 B15d B22d		Incandescent reflector lamp or General Lighting Service reflector lamp	GLS-R
31.50.13.00 	.				DLS	E27 B22d	Amenity lighting, (disco bar, etc.) In general, not used for domestic lighting	Coloured incandescent reflector lamp	GLS-R-colour
31.50.14.93 	Filament lamps for a voltage $> 100V$ Excluding: -ultraviolet and infrared lamps -tungsten halogen filament lamps	230 - 240	> 200		DLS	E40	Floodlighting In general, not used for domestic lighting	Incandescent reflector lamp or General Lighting Service reflector lamp High Wattage	GLS-R-HW
31.50.14.93 	-those of a power $\leq 200W$ -for motorcycles and motor vehicles -sealed beam lamp units		300		DLS	MP GX16d	Traffic signalling flash lamp In general, not used for domestic lighting		GLS-R-special


PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
31.50.12.95 	Tungsten halogen filament lamps for a voltage ≤100V Excluding: -ultraviolet and infrared lamps -for motorcycles and motor vehicles	12	5 - 100	High Clear	NDLS	G4 G8,5 GY6,35		Halogen lamp	HL-LV
31.50.12.95 			15 - 100		DLS	GU4 GU5,3 G53 B15 Ba15d	In general, not used for domestic lighting	Halogen reflector lamp Halogen reflector lamp	HL-R-LV
31.50.12.93 	Tungsten halogen filament lamps, for a voltage > 100V Excluding: - ultraviolet and infrared lamps - for motorcycles and motor vehicles	230	25 - 2000	High (Low) Clear (Frosted)	NDLS	E14 E27 B15d B22d G9 R7s Fa4 E40 B35	General lighting Projector lamp etc. In general, not used for domestic lighting		HL-MV

PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
31.50.12.93 	Tungsten halogen filament lamps, for a voltage > 100V Excluding: - ultraviolet and infrared lamps - for motorcycles and motor vehicles	230	20 - 100		DLS	GU10 GZ10 E14 E27		Halogen reflector lamp	HL-R-MV
31.50.12.93 			20 - 100		DLS	GU10 GZ10 E14 E27	Amenity lighting, (disco bar, etc.) In general, not used for domestic lighting	Coloured Halogen Reflector lamp	HL-R-MV-colour
31.50.14.60 31.50.15.70	Automotive-, Bicycle- and Torch lamps Infrared lamps UV lamps			High Clear			Not used for domestic lighting		
31.50.15.10 	Fluorescent hot cathode discharge lamps, with double ended cap Excluding: ultraviolet lamps	----	15 - 58	Low Frosted	NDLS		General (domestic) lighting	Linear Fluorescent Lamp	LFL

PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
31.50.15.30 	Fluorescent hot cathode discharge lamps Excluding: -ultraviolet lamps -with double ended cap	230	3 - 30	Low Frosted	NDLS	E27 E14 B22d GX53	Domestic, retrofit for incandescent lamp	Compact Fluorescent Lamp with integrated ballast or 'energy saving lamp'	CFLi
31.50.15.30 	Fluorescent hot cathode discharge lamps Excluding: -ultraviolet lamps -with double ended cap	-----	5 - 120	Low Frosted	NDLS	G10q G23 GX24d-1-3 GX24q-1-6 GR8 GR10q 2G7 2G8-1 2G10 2G11 2GX13	Professional, Shop, Office, Industry, Hotel, Domestic	Compact Fluorescent lamp Compact Fluorescent lamp non integrated ballast Circular fluorescent lamp	CFLni
31.50.15.30 	Fluorescent hot cathode discharge lamps Excluding: -ultraviolet lamps -with double ended cap	230	9 11 15 20		DLS	E14 E27 GU10	Domestic, Hotel, etc., retrofit for incandescent or halogen reflector lamp	Compact Fluorescent Reflector Lamp with integrated ballast	CFLi-R

PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
(31.50.15.59 ?) 	Discharge lamps Excluding: -fluorescent hot cathode lamps -dual lamps -mercury or sodium vapour lamps -ultraviolet lamps (Fluorescent, electrodeless induction lamp)	230	20		NDLS	E27 B22d	Domestic (etc.) retrofit for incandescent and halogen lamp	Electrodeless induction lamp	CFLi-ind
(31.50.15.59 ?) 			23		DLS	E27 B22d	Domestic (etc.) retrofit for incandescent and halogen reflector lamp	Electrodeless induction reflector lamp	CFLi-R-ind
(31.50.15.59 ?) 		-----	55 - 165		NDLS	-----	Industry halls, tunnels, hardly accessible places	Induction lamp (Lifetime 60000h)	CFLni-ind

PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
31.50.15.53 	Mercury vapour discharge lamps Excluding: -ultraviolet lamps -dual lamps <i>(Including: metalhalide lamps)</i>	-----	20 - 150	High Clear	NDLS	G12 G8,5 PGJ5 RX7s		Metalhalide lamp	MH
31.50.15.53 			20 35 70		DLS	GU10 E27 B22d		Metalhalide reflector lamp	MH-R
	White Light Emitting Diode lamp White Light Emitting lamp with multicolour LED's	230	>0,5	Low	NDLS	E27 B22d E15 B15d		WLED Lamp White Light Solid State Lamp	WLED

PRODCOM Code	Definition Prodcom	Voltage [V]	Wattage [W]	Low luminance Frosted High luminance Clear	Directional / Non-Directional Light Source	Socket type	Application	Other names	Acronym in this study
No specific code (to be confirmed) 	White, Light Emitting Diode Reflector lamp	230	>0,5		DLS	GU10		WLED Reflector Lamp White Light Solid State Reflector Lamp	WLED-R

Remarks:

- External halogen transformers (power supplies) and lamp ballasts, non integrated in the lamp, will not be addressed in this study. They were already addressed in the finished EuP preparatory studies (lot 7 on External Power Supplies and lots 17 and 18 on Office and Street Lighting); the authors of this study are well informed. Although at system level, recommendations for halogen transformers will be given in chapter 8.
- The following lamps were also part of the previous EuP studies on Office and Street Lighting:
 - linear fluorescent lamps
 - CFLni (compact fluorescent lamps with non integrated ballast
 - HID lamps.Although they are not again part of all tasks in this study, they will be considered as BAT in task 6.
- HID lamps with high colour rendering index, especially MH-lamps, will be included in this study (task 6) because they form an energy efficient alternative for halogen lamps. MH-lamps are nowadays rarely or not used in domestic lighting (to be confirmed in task 2); they are mainly used in professional lighting applications (shops, sport fields, etc.). However they will be considered as BNAT or BAT (task 6) because of their potential to replace halogen lamps. Please also note that the Prodcom code 31.50.15.53 covers the complete group of mercury vapour discharge lamps. The Prodcom data are therefore not relevant for this study.
- Normal HPM lamps, included in the same Prodcom code 31.50.15.53 are not used in domestic lighting applications and phasing out was already proposed in the EuP preparatory study on street lighting.

1.1.2.2 *Luminaires applicable in domestic lighting*

Prodcom segmentation for domestic luminaires is represented in Table 1.3.

Table 1.3: Prodcom segmentation for domestic luminaires.

31.50.22.00	Electric table, desk, bedside or floor-standing lamps
31.50.25.30	Chandeliers and other electric ceiling or wall lighting fittings Excluding: - those used for lighting public open spaces or thoroughfares

To be developed in Part II of the planned work.

1.1.3 General lamp and luminaire performance specification parameters

1.1.3.1 General lamp performance specification parameters

Each lamp has its own specific characteristics; the important performance assessment parameters are (EN 12665(2002))³:

- Rated luminous flux Φ [lm]: quantity value of the initial luminous flux of the lamp, for specified operating conditions. The value and conditions are specified in the relevant standard, corresponding unit: lumen [lm];
- Nominal luminous flux Φ [lm]: a suitable approximate quantity value of the initial luminous flux of the lamp, corresponding unit: lumen [lm];
- Rated lamp power (P_{lamp} [W]): quantity value of the power consumed by the lamp for specified operating conditions. The value and conditions are specified in the relevant standard, corresponding unit: Watt [W];
- Nominal lamp power (P_{lamp} [W]): a suitable approximate quantity value of the power consumed by the lamp, corresponding unit: Watt [W];
- Lamp Survival Factor (LSF): fraction of the total number of lamps which continue to operate at a given time under defined conditions and switching frequency;
- Operational lifetime
- Lamp Lumen Maintenance Factor (LLMF): ratio of the luminous flux emitted by the lamp at a given time in its life to the initial luminous flux;
- Luminous efficacy of a lamp (η_{lamp}): quotient luminous flux emitted by the power consumed by the source, unit lumen per Watt [lm/W];
- Colour Rendering: the effect of an illuminant on the colour appearance of objects by conscious or subconscious comparison with their colour appearance under a reference illuminant.
- CIE general colour rendering index CRI [R_a]: mean of the CIE special colour rendering indices for a specific set of eight ($a = 8$) test colour samples. (If the colour rendering index is based on more colour samples, 'a' must be specified, e.g. R_{14} or R_{20} .) For a source like a low-pressure sodium vapour lamp, which is monochromatic, the R_a is nearly zero, but for a source like an incandescent light bulb, which emits essentially black body radiation, R_a is assumed to be one hundred. (see also CIE 13.3).
- Chromaticity coordinates (x, y): these are coordinates which characterise a colour stimulus (e.g. a lamp) by a ratio of each set of tristimulus values to their sum. Tristimulus values means the amounts of the three reference colour stimuli required to match the colour of the stimulus considered (e.g. a lamp). As the sum of three chromaticity coordinates equals 1, two of them are sufficient to define a chromaticity. The CIE defined different colour spaces with its own coordinates, for light sources the most common system is 'CIE xy' also known as 'CIE 1931 colour space'. The gamut of all visible chromaticities on the CIE plot is tongue-shaped or horseshoe-shaped shown in colour in Figure 1.2. In more general terms, a distance on the xy chromaticity diagram does not correspond to the 'degree' of 'perceived' difference between two colours. Other colour spaces (CIE Luv and CIE Lab in particular) have been designed

³ The definitions of 'nominal' and 'rated' value are not mentioned in this standard but in several other standards such as EN 60081 and EN 50294.

to reduce this problem but there is currently no single solution. Light with a flat energy spectrum (white) corresponds to the point $(x,y) = (0.33, 0.33)$.

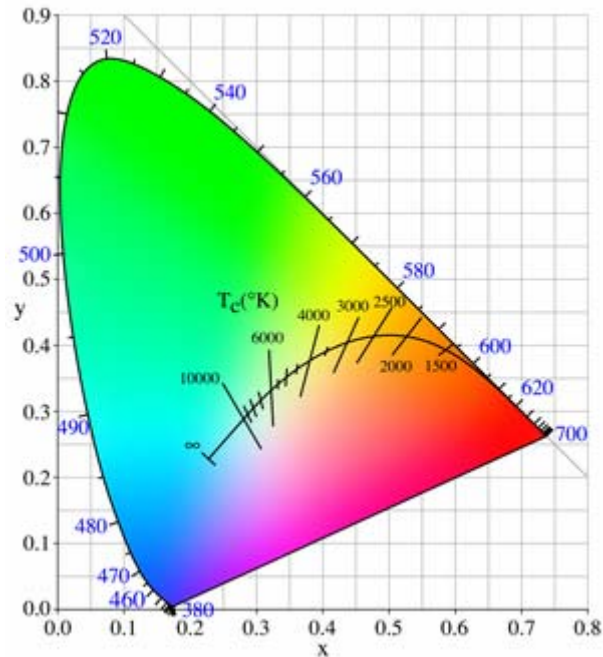


Figure 1.2 The CIE 1931 x,y chromaticity space, also showing the chromaticities of black-body light sources of various colour temperatures (T_c), and lines of constant correlated colour temperature (T_{cp}).

- Colour temperature T_c : temperature of a Planckian radiator whose radiation has the same chromaticity as that of a given stimulus, unit [K].
- Correlated colour temperature (T_{cp} [K]): temperature of a Planckian (black body) radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions. The recommended method for calculation is included in CIE publication 15⁴. Please note that a black body absorbs all electromagnetic radiation that falls onto it and the amount and wavelength (colour) of electromagnetic radiation they emit is directly related to their temperature (see also Figure 1.2). Incandescent lamps (non coloured) are Planckian (black body) radiators and are located exactly on the black body locus (see Figure 1.2). Other light sources can have coordinates that are not exactly located on the black body locus, therefore they have a 'correlated' colour temperature. Please note also that the chromaticity of these light sources (e.g. CFL) is therefore not identified by a single parameter such as correlated colour temperature, this means that for example CFL lamps can appear with different colour but have the same correlated colour temperature⁵.
- MacAdam Ellipses: MacAdam ellipse is the region on a chromaticity diagram which contains all colours which are indistinguishable, to the average human eye, from the colour at the centre of the ellipse. MacAdam ellipses are described as having 'steps' which really means 'standard deviations'. If a large sample of the population were used and if a trained observer could reliably repeat his observations, then the steps would

⁴ CIE 15: 2004 Colorimetry, 3rd ed.

⁵ Rensselaer (2003), 'Increasing market acceptance of compact fluorescent lamps (CFLs)', Mariana Figueiro et al., Project Report of Lighting Research Center, Rensselaer Polytechnic Institute, September 30, 2003.

translate to probabilities for the general population as follows: 1 sd = 68.26 % of the general, colour-normal population 2 sd = 95.44 % “3 sd = 99.44 %. Any point on the boundary of a '1-step' ellipse, drawn around a target, represents 1 standard deviation from the target. For a '3-step' ellipse, the boundary represents 3 standard deviations from the target, and so on. These MacAdam Ellipses are included in the standards for fluorescent lamps for describing acceptable colour deviation (EN 60901, EN 60081). Please note that LED lamps don't use these MacAdam Ellipses but defined zones of product groups in the CIE 1931 x,y chromaticity diagram. LEDs are binned for chromaticity in the manufacturing process. These bins, when superimposed on the CIE 1931 Chromaticity Diagram, take the form of quadrangles, as opposed to ellipses (standardisation work is under progress⁶).

Other performance parameters addressed in this study:

- dimmability;
- starting time: time needed for the lamp to start fully and remain alight, after the supply voltage is switched on;
- warm-up time: time needed for the lamp to reach 80% of its full luminous flux, after the supply voltage is switched on (in the ongoing revision of standard EN 60969 a change to limit the warm-up time to 60% is proposed);
- hot restrike capabilities (i.e. start-up after a short switch off time);
- power quality (power factor and harmonic currents e.g. third harmonic line current (%), fifth harmonic line current, current crest factor).
- unit purchase cost;
- a bright point source is defined as a light source that has only clear glass covers see [Annex 11.1.1](#).
(This is a clear GLS, clear halogen, clear HID lamp, not including frosted or silicated GLS, frosted or silicated halogen lamp, frosted or fluorescent HID, LPS, HPM, LFL, CFLi or CFLni lamps or other light sources with luminance above 25000 cd/m² for lamps below 2000 lm and above 100000 cd/m² for lamps with more lumen output.)
- a second lamp envelope: an additional lamp envelope that is not required for the normal functioning of the lamp (see second lamp envelope criterion in [Annex 11.1.5](#)).
- UV radiation content (% UV-A, % UV-B, % UV-C)
- the lamp dimensions and sockets, especially for more energy efficient lamp retrofit solutions.
- the light distribution, especially for more energy efficient lamp retrofit solutions and directional light sources ([part 2 of this study](#)).

Additional light distribution parameters for 'reflector lamps':

- beam angle: the angle between those points on opposite sides of the beam axis where the intensity drops to 50% of the maximum.
- peak intensity in candela [cd]: the maximum luminous intensity (normally in the centre of the beam angle).
- [Updated in part 2 of this study](#).

⁶ Energystar (2007), 'ENERGY STAR® Program Requirements for Solid State Lighting Luminaires Eligibility Criteria – Version 1.0 DRAFT' April 9, 2007.

1.1.3.2 Definition of a “white light source”:

A white light source contains all colours of the visible light spectrum and gives a natural appearance to all different colours. Visible light is the electromagnetic radiation with a wavelength between 380 nm (upper limit of UV) and 780 nm (lower limit of infrared) and all combinations of these wavelengths).

Currently there is no scientific definition nor for a white, neither for a coloured light source. Therefore a definition of a ‘white light source’ was developed for this study. This definition can be found in [Annex 11.1.1](#).

It must be noted that this white light definition is only used in this study to limit the scope of the lamps that will be considered because coloured lamps are excluded. It can never be used as a quality parameter for lamps.

1.1.3.3 General luminaire performance specification parameters:

The important performance assessment parameters for luminaires are (EN 12665(2002)):

- *light output ratio*: ratio of the total flux of the luminaire, measured under specified practical conditions with its own lamps and equipment, to the sum of the individual luminous fluxes of the same lamps when operated outside of the luminaire with the same equipment, under specified conditions;
- *light output ratio working*: ratio of the total flux of the luminaire, measured under specified practical conditions with its own lamps and equipment, to the sum of the individual luminous fluxes of the same lamps when operated outside of the luminaire with a reference ballast, under reference conditions.

To be [further developed in Part II](#) of the planned work.

1.1.4 Functional unit for domestic lighting

Knowing the functional product used in this study we now further explain what is called the “functional unit” for domestic lighting. In standard 14040 on life cycle assessment (LCA) the functional unit is defined as “the quantified performance of a product system for use as a reference unit in life cycle assessment study”. The primary purpose of the functional unit in this study is to provide a calculation reference to which environmental impacts (such as energy use), costs, etc. can be related and to allow for comparison between functionally equal domestic lighting products with and without options for improvement. Please note that further product segmentations will be introduced in this study in order to allow appropriate equal comparison.

The proposed functional parameter (FP) for domestic lighting in this study is:

“1 lumen provided by a light source during 1 hour of operation”.

(As defined in many standards, the measurement of the lumen output shall be performed after the lamp has burned for 100 hours.)

It is assumed that the performance of a domestic 'luminaire' is difficult to quantify.

1.2 Lighting test standards or guidelines

This paragraph identifies and shortly describes the 'test standards or guidelines' that are related to the functional unit, resource use (energy, materials, ..), safety and other lighting product specific standards.

A “test standard or guideline” is defined in the context of this study as a standard or guideline that sets out a test method, but that does not indicate what result is required when performing that test. Therefore, strictly speaking, a test standard can be different from a “technical standard”. Especially 'technical standards' that are a specification against which all others may be measured are not discussed hereafter (e.g. the measurement of power, luminous flux, ..). In addition to “official” test standards, there are other sector specific procedures for product testing that are compiled by industry associations or other stakeholders for specific purposes included in this section. Also ongoing work for the development of new standards or guidelines is discussed together with recommendations for new ones.

The following references are made to:

- EN, European standard ratified by either CEN (European Committee for Standardization) or CENELEC (European Committee for Electro-technical Standardization),
- IEC, International Electro-technical Commission,
- CIE, International Commission on Illumination.

1.2.1 Standards and guidelines related to the functional unit

- *EN 60064: 'Tungsten filament lamps for domestic and similar general lighting purposes - Performance requirements'*.

Scope:

This standard applies to tungsten filament incandescent lamps for general lighting services (GLS) which comply with the safety requirements in EN 60432-1.

- *EN 60357: 'Tungsten halogen lamps (non-vehicle) - Performance specifications'*.

Scope:

This standard specifies the performance requirements for single-capped and double-capped tungsten halogen lamps, having rated voltages of up to 250 V, used for the following applications:

- projection (including cinematograph and still projection)
- photographic (including studio)
- floodlighting
- special purpose
- general purpose
- stage lighting.

This third edition cancels and replaces the second edition published in 1982 and amendments.

- *EN 60969 : ‘Self-ballasted lamps for general lighting services - Performance requirements’.*

Scope:

This Standard specifies the performance requirements, together with the test methods and conditions, required to show compliance of tubular fluorescent and other gas-discharge lamps with integral means for controlling starting and stable operation (self-ballasted lamps) intended for domestic and similar general lighting purposes.

- *EN 60081 : ‘Double-capped fluorescent lamps - Performance specifications’.*

Scope:

This International Standard specifies the performance requirements for double-capped fluorescent lamps for general lighting service.

The requirements of this standard relate only to type testing. Conditions of compliance, including methods of statistical assessment, are under consideration.

The following lamp types and modes of operation are included:

- a) lamps having preheated cathodes, designed for operation on a.c. mains frequencies with the use of a starter, and additionally operating on high frequency;
- b) lamps having preheated high-resistance cathodes, designed for operation on a.c. mains frequencies without the use of a starter (starter less), and additionally operating on high frequency;
- c) lamps having preheated low-resistance cathodes, designed for operation on a.c. mains frequencies without the use of a starter (starter less), and additionally operating on high frequency;
- d) lamps having preheated cathodes, designed for operation on high frequency;
- e) lamps having non-preheated cathodes, designed for operation on a.c. mains frequencies;
- f) lamps having non-preheated cathodes, designed for operation on high frequency.

For some of the requirements given in this standard, reference is made to “the relevant lamp data sheet”. For some lamps these data sheets are contained in this standard. For other lamps, falling under the scope of this standard, the relevant data are supplied by the lamp manufacturer or responsible vendor.

- *EN 60901: ‘Single-capped fluorescent lamps – Performance specifications’.*

Scope:

This International Standard specifies the performance requirements for single-capped fluorescent lamps for general lighting service.

The requirements of this standard relate only to type testing. Conditions of compliance, including methods of statistical assessment, are under consideration.

The following lamp types and modes of operation with external ballasts are included:

- a) lamps operated with an internal means of starting, having preheated cathodes, for operation on a.c. mains frequencies;

- b) lamps operated with an external means of starting, having preheated cathodes, for operation on a.c. mains frequencies with the use of a starter, and additionally operating on high frequency;
 - c) lamps operated with an external means of starting, having preheated cathodes, for operation on a.c. mains frequencies without the use of a starter (starter less), and additionally operating on high frequency;
 - d) lamps operated with an external means of starting, having preheated cathodes, for operation on high frequency;
 - e) lamps operated with an external means of starting, having non-preheated cathodes, for operation on high frequency.
- *EN 50285: 'Energy efficiency of electric lamps for household use – Measurement methods'*.

Scope:

Specifies the test conditions and method of measurement of luminous flux, lamp wattage and lamp life as given on a label on the lamp packaging, together with a procedure for verification of the declared values. Only those parameters that are specific to Directive 92/75/EEC are included in this standard, all other parameters are defined in the relevant lamp performance standards.

- *EN 60921: 'Ballasts for tubular fluorescent lamps – Performance requirements'*.

Scope:

This standard specifies performance requirements for ballasts, excluding resistance types, for use on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz, associated with tubular fluorescent lamps with pre-heated cathodes operated with or without a starter or starting device and having rated wattages, dimensions and characteristics as specified in IEC 60081 and 60901. It applies to complete ballasts and their component parts such as resistors, transformers and capacitors. (It only applies to ferromagnetic ballasts; electronic ballasts are covered under IEC60929.)

- *EN 60929 : 'AC-supplied electronic ballasts for tubular fluorescent lamps – Performance requirements'*.

Scope :

This International Standard specifies performance requirements for electronic ballasts for use on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz with operating frequencies deviating from the supply frequency, associated with tubular fluorescent lamps as specified in IEC 60081 and IEC 60901 and other tubular fluorescent lamps for high frequency operation. (It only applies to electronic ballasts; ferromagnetic ballasts are covered under IEC60921.)

1.2.2 Other test standards and guidelines not related to the functional unit

EN 12665 (2002): 'Light and lighting - Basic terms and criteria for specifying lighting requirements'

Scope:

This standard defines basic terms for use in all lighting applications; specialist terms with limited applications are given in individual standards. This standard also sets out a framework for the specification of lighting requirements, giving details of aspects which shall be considered when setting those requirements.

- *EN 60968 : 'Self-ballasted lamps for general lighting services - Safety requirements'*.

Scope:

This Standard specifies the safety and interchangeability requirements, together with the test methods and conditions, required to show compliance of tubular fluorescent and other gas-discharge lamps with integrated means for controlling starting and stable operation (self-ballasted lamps), intended for domestic and similar general lighting purposes, having: -a rated wattage up to 60 W; -a rated voltage of 100 V to 250 V; -Edison screw or bayonet caps.

- *EN 60630 : 'Maximum lamp outlines for incandescent lamps'*.

Scope:

This Standard specifies the maximum outlines for GLS-lamps in different shapes, with different caps etc.

- *EN 60669-2-1 : 'Electronic switches for households and similar use'*.

Scope :

Applies to electronic switches and to associated electronic extension units for household and similar fixed electrical installations either indoors or outdoors.

- *EN 61047 : 'D.C. or A.C. supplied electronic step-down converters for filament lamps. Performance requirements'*.

Scope :

Specifies performance requirements for electronic step-down converters for use on d.c. supplies up to 250 V and a.c. supplies up to 1000 V at 50 Hz or 60 Hz with operating frequencies deviating from the supply frequency, associated with tungsten halogen lamps as specified in IEC 60357 and other filament lamps.

- *EN 50294 : 'Measurement Method of Total Input Power of Ballast-Lamp Circuits'*.

Scope:

This Standard gives the measurement method of the total input power for ballast-lamp circuits when operating with their associated fluorescent lamp(s). This standard applies to electrical ballast-lamp circuits comprised solely of the ballast and of the

lamp(s). NOTE: Requirements for testing individual ballasts during production are not included. It specifies the measurement method for the total input power for all ballasts sold for domestic and normal commercial purposes operating with the following fluorescent lamps: linear lamps with power equal to or greater than 15 W; single ended (compact) lamps with power equal to or greater than 18 W; other general purpose lamps. This standard does not apply to: ballasts which form an integral part of the lamp; ballast-lamp circuits with capacitors connected in series; controllable wire-wound magnetic ballasts; luminaires which rely on additional optical performance aspects.

The standard mandates that a ballast lumen factor be declared by the manufacturer - this has to be in the range 0.925 to 1.0 for magnetic ballasts and between 0.925 and 1.075 for electronic ballasts.

The test method for ferromagnetic and electronic ballasts is quite different and each is described below:

For magnetic ballasts, the test ballast is operated with a reference lamp. In addition the reference lamp is operated with a reference ballast. The total input power and the lamp power are measured for each circuit in parallel. Finally, the total input power for the test ballast/lamp circuit is corrected for the ballast lumen factor (BLF), this correction is done by measurement of the lamp power compared to the reference lamp. Please note that for the reference ballast a normalized ballast lumen factor of 0.95 has been chosen (this suggests that manufacturers tend to under-run lamps on average on magnetic ballasts). A similar method exists for electronic ballasts, in this case a reference ballast lumen factor of 1 is chosen. The total input power for the test ballast/lamp circuit is corrected for the ballast lumen factor (BLF), this correction is done by measurement of the lamp luminous flux compared to the reference lamp. Please note that for T5 fluorescent lamps no magnetic reference ballast exists, therefore an electronic reference ballast with known BLF needs to be obtained (Klinger (2006)), e.g. from a lamp manufacturer.

It is important to realize that in this approach the losses of the lamp filament preheating are accounted as ballast losses, because magnetic ballasts have switch-off lamp filament preheating enforced by the principle and also the most advanced T5 ballasts that are used as reference ballast do so.

- *EN 60927: 'Specification for auxiliaries for lamps. Starting devices (other than glow starters). Performance requirements'.*

Scope:

Specifies performance requirements for starting devices (starters and igniters) for tubular fluorescent and other discharge lamps for use on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz which produce starting pulses not greater than 5 kV. Should be read in conjunction with IEC 60926.

- *EN 61048 : ‘Auxiliaries for Lamps - Capacitors for Use in Tubular Fluorescent and Other Discharge Lamp Circuits - General and Safety Requirements’.*

Scope :

This International Standard states the requirements for both self-healing and non-self-healing continuously rated a.c. capacitors of up to and including 2,5 kVAr, and not less than 0,1 μ F, having a rated voltage not exceeding 1 000 V, which are intended for use in discharge lamp circuits operating at 50 Hz or 60 Hz and at altitudes up to 3000m.

- *EN 61049 : ‘Capacitors for Use in Tubular Fluorescent and Other Discharge Lamp Circuits Performance Requirements’.*

Scope :

Specifies the requirements for both self-healing and non-self-healing continuously rated a.c. capacitors of up to and including 2,5 kVAr, and not less than 0,1 F, having a rated voltage not exceeding 1 000 V, which are intended for use in discharge lamp circuits operating at 50 Hz or 60 Hz and at altitudes up to 3 000 m. Does not cover radio-interference suppressor capacitors, the requirements for which are given in IEC 60384-14. This publication supersedes IEC 60566.

- *CIE 089 (1989) : ‘Measurement of luminous flux’ (technical report)*

Scope :

This technical report defines the terminology required for luminous flux measurements. It then deals with the principles of luminous flux measurements and describes methods for the evaluation of the illuminance distribution, the measurement of luminous flux by means of an integrating sphere photometer and the determination of luminous flux via luminance, luminous intensity and luminance measurements.

- *IEC/TS 61231 : ‘International lamp coding system (ILCOS)’.*

Scope :

This technical specification gives the rules for the international lamp coding system and covers all lamp categories, excluding vehicle lamps. Coding for the main lamp types is specified and, for the others, will follow by amendments to this technical specification as appropriate.

The object of the international lamp coding system is:

- to improve communication about the different types of lamps;
- to help in discussions concerning interchangeability and compatibility of products;
- to create a closer relationship between international standards and manufacturers’ literature (for example the code could be given in future in the relevant parts of a standard);
- to enable correct replacements of lamps;
- to be used as a complementary marking on the luminaire;
- to replace national and regional coding systems.

- *IEC 62471 (CIE S 009:2002): 'Photobiological safety of lamps and lamp systems'.*

Scope :

This international Standard gives guidance for evaluating the photobiological safety of lamps and lamp systems including luminaires. Specifically it specifies the exposure limits, reference measurement technique and classification scheme for the evaluation and control of photobiological hazards from all electrically powered incoherent broadband sources of optical radiation, including LED's but excluding lasers, in the wavelength range from 200 nm through 3000 nm.

1.3 Existing legislation

1.3.1 Legislation and Agreements at European Community level

1.3.1.1 Environmental Directives (RoHS, WEEE)

- *Directive 2002/95/EC on Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS)*

Scope:

The RoHS Directive stands for "the restriction of the use of certain hazardous substances in electrical and electronic equipment". This Directive bans the placing on the EU market, from 1 July 2006, of new electrical and electronic equipment containing lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) flame retardants.

Exemptions:

In annex, the exemptions from this requirements (a.o. for lamps) are listed:

- mercury in compact fluorescent lamps not exceeding 5mg per lamp
- mercury in straight fluorescent lamps for general purposes not exceeding

halophosphate	10mg
triphosphate with normal lifetime	5mg
triphosphate with long lifetime	8mg
- mercury in straight fluorescent lamps for special purposes
- mercury in other lamps not specifically mentioned in this annex
- lead in glass of fluorescent tubes.

There are no exemptions for luminaires and ballasts.

- *Directive 2002/96/EC on waste electrical and electronic equipment (WEEE)*

Scope:

The WEEE Directive aims to:

- reduce waste arising from electrical and electronic equipment (EEE);

- make producers of EEE responsible for the environmental impact of their products, especially when they become waste.
- encourage separate collection and subsequent treatment, reuse, recovery, recycling and sound environmental disposal of EEE .
- improve the environmental performance of all those involved during the lifecycle of EEE.

Exemptions:

In annex I A, all general categories of electric and electronic equipment concerned are mentioned; in annex I B, the subcategories with the exemptions are listed. In the subcategory of luminaires for fluorescent lamps, an exception is made for luminaires in households. Also filament bulbs (incandescent and halogen lamps) are exempted from this directive.

1.3.1.2 Efficiency Directives

- *Directive 2000/55/EC on energy efficiency requirements for ballasts for fluorescent lighting*

Scope:

The purpose of this Directive is to improve the efficiency of the systems by limiting the ballast losses. For this purpose, CELMA developed a classification system that takes both parts of the system into account, the lamp and the ballast and that is compliant with the directive. It constitutes an implementing measure within the meaning of article 15 of Directive 2005/32/EC.

- *Directive 98/11/EC of 27 January 1998 implementing Council Directive 92/75/EEC with regard to energy labelling of household lamps*

Scope:

This Directive, which was published on 10th March 1998, applies the energy labelling requirements for household electric lamps supplied directly from the mains (filament and integral compact fluorescent lamps) and to household fluorescent lamps (including linear and non-integral compact fluorescent lamps), even when marketed for non-household use.

In Annex I of the Directive, the design and content of the label is setted out, as well as the colours that may be used.

The label must include the following information:

- the energy efficiency class of the lamp;
- the luminous flux of the lamp in lumens;
- the input power (wattage) of the lamp;
- the average rated life of the lamp in hours.

The label shall be chosen from the following illustrations in Figure 1.3. Where the label is not printed on the packaging but a separate label is placed on or attached to the packaging, the colour version shall be used. If the 'black on white' version of the label is used, the printing and background may be in any colours that preserve the legibility of the label.

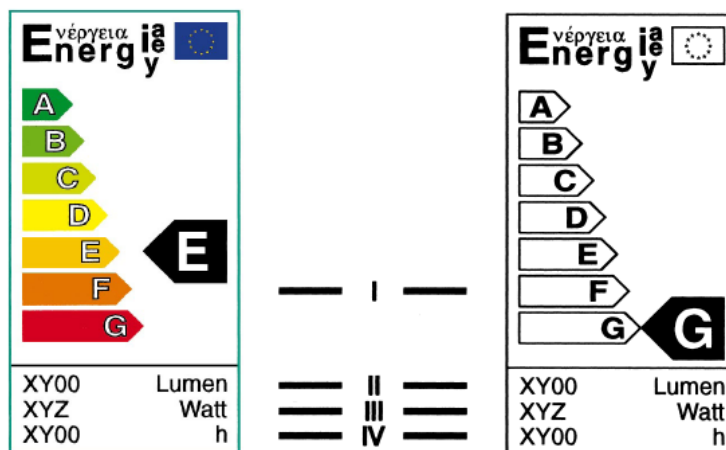


Figure 1.3: Energy efficiency label

The following notes define the information to be included:

- I. The energy efficiency class of the lamp, determined in accordance with Annex IV. This indicator letter shall be placed at the same level as the relevant arrow.
- II. The luminous flux of the lamp in lumens, measured in accordance with the test procedures of the harmonised standards referred to in Article 1(4).
- III. The input power (wattage) of the lamp, measured in accordance with the test procedures of the harmonised standards.
- IV. The average rated life of the lamp in hours, measured in accordance with the test procedures of the harmonised standards. Where no other information on the life of the lamp is included on the packaging, this may be omitted.

Where the information specified in II, III and, where applicable, IV is included elsewhere on the packaging of the lamp, it may be omitted from the label, as may the box that contains it.

Annex IV of the Directive specifies the calculation to determine the energy efficiency class of a lamp.

Identified gaps:

- The mention of the average rated life of the lamp is not strictly imposed.
 - The origin of the formulas in Annex IV is not clear.
 - Some much used lamps are excluded from the labelling e.g. reflector lamps (DLS) and lamps with an input power of less than 4W (e.g. LED's).
 - Also all lamps that are not directly supplied from the mains, e.g. the widespread low voltage halogen lamps (HL-LV) are not included in this Directive.
- *Commission Decision of 9 September 2002 establishing revised ecological criteria for the award of the Community eco-label to light bulbs and amending Decision 1999/568/EC*

Scope:

This Decision amends the Decision 1999/568/EC for the award of the Community eco-label. It sets specific criteria for light bulbs that aim in particular at promoting:

- the reduction of environmental damage or risks related to the use of energy (global warming, acidification, depletion of non-renewable resources) by reducing energy consumption,
- the reduction of environmental damage or risks related to the use of resources in both the manufacture and treatment/disposal of a light bulb by increasing its average lifetime,
- the reduction of environmental damage or risks related to the use of mercury by reducing the total emissions of mercury during the lifetime of a light bulb. to become this Community eco-label.

In annex also the test method is described to measure the mercury content.

- *There is a ' European Compact Fluorescent Lamps QUALITY CHARTER' see ' <http://re.jrc.cec.eu.int/energyefficiency/CFL/> '*

Scope:

This charter, that is in revision at this moment, is an initiative promoted by the European Commission in co-operation with the following organisations: EURELECTRIC, ELC, ADEME (France), NOVEM (The Netherlands), THE DANISH ELECTRICITY SAVING TRUST (Denmark) and THE UK ENERGY SAVING TRUST (UK).

The aim of the European CFL Quality Charter is to offer a high quality standard to be used by utilities and other bodies in their promotion and procurement campaigns. The ultimate goal of the European Quality Charter for CFL is to increase consumer confidence in this environmentally friendly technology, which save money and the environment. To achieve this, the charter promotes the manufacturing, marketing and sales of high quality CFLs in the European Union in order to offer residential customers a satisfying product from an energy, comfort and economic point of view. The requirements that are imposed by this charter are related to safety, performance, information, guarantee and information:

- Safety: standards EN 60968, EN 61199 and EN 60598 and comply with CE-marking legislation;
- Performance: luminous efficacy following energy label A (with a derating factor for lamps with an external casing 'bulb form') see Figure 1.4, lumen maintenance, running up time, number of ignitions (> lifetime in hr) and colour rendering ($R_a \geq 80$), with a written conformity certificate from an approved 'Notified Body'⁷;

⁷ Notified bodies as defined in the Annex to 93/465/EEC: Council Decision of 22 July 1993 concerning the modules for the various phases of the conformity assessment procedures and the rules for the affixing and use of the CE conformity marking, which are intended to be used in the technical harmonization directives.

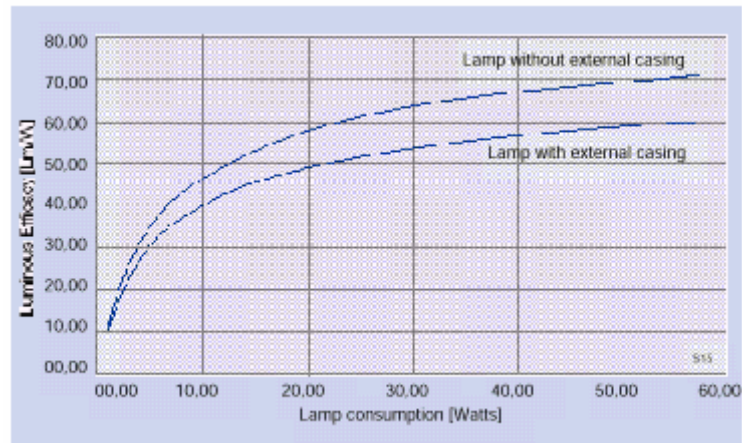


Figure 1.4: Luminous Efficacy limits for Integral Compact Fluorescent lamps

- Lifetime: minimum 6000hr and for ‘Long Life’ lamps minimum 1200hr;
- Information: lifetime and energy label A must be shown on the individual package of each lamp, mentioned equivalence with GLS filament lamp must comply with defined lumen output;
- Guarantee: 2 years on lamp failure;
- Quality of production: manufactured under a Quality Assurance System EN ISO 9002 or equivalent.

It is important to note that the charter is a voluntary set of criteria established by the European Commission in collaboration with the organisations mentioned above.

1.3.1.3 Other product related directives

- *Electromagnetic Compatibility (EMC) Directive 2004/108/EEC*

Scope:

The Council Directive 2004/108/EEC of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive) governs on the one hand the electromagnetic emissions of this equipment in order to ensure that, in its intended use, such equipment does not disturb radio and telecommunication as well as other equipment. In the other the Directive also governs the immunity of such equipment to interference and seeks to ensure that this equipment is not disturbed by radio emissions normally present used as intended.

- *Low Voltage Directive (LVD) 73/23/EEC*

Scope:

The Low Voltage Directive (LVD) 73/23/EEC seeks to ensure that electrical equipment within certain voltage limits both provides a high level of protection for European citizens and enjoys a Single Market in the European Union. The Directive covers electrical equipment designed for use with a voltage rating of between 50 and 1000 V for alternating current and between 75 and 1500 V for direct current. It should be noted that these voltage ratings refer to the voltage of the electrical input or output, not to voltages that may appear inside the equipment. For most electrical

equipment, the health aspects of emissions of Electromagnetic Fields are also under the domain of the Low Voltage Directive.

1.3.1.4 Voluntary agreements from industry on EU-level

The European Lamp Companies federation (ELC) has elaborated eco-design levels for certain lamp types the so-called ELC Eco-Profiles.

The following ecoprofiles can be found on their website

http://www.elcfed.org/2_resource_publications.html :

- *Eco-Profile for Self-ballasted Fluorescent Lamps*
- *Eco-Profile for Fluorescent Lamps*
- *Eco-Profile for Compact Fluorescent Lamps non-integrated*
- *Eco-Profile for HID Lamps.*

1.3.2 Legislation and Agreements at Member State level

Please note that this section will be updated in part 2 of this study, taking into account the results of the IEA study under preparation assessing GLS-phase-out policies around the world.

There are member states (a.o. in the UK by the Energy Saving Trust, in Sweden by the Swedish Energy Agency) that are preparing minimum performance specifications for (domestic) lamps. The specifications aim to enhance energy efficiency but also envisage colour rendering, colour temperature, lifetime, lumen maintenance, starting time, warm-up time, number of ignitions and guarantee period.

1.3.3 Third Country Legislation and Agreements

This section again deals with the subjects as above, but now for legislation and measures in Third Countries (extra-EU); some of them were indicated by stakeholders (NGO's, industry, consumers) as being relevant for the product group.

There are various minimum standards and labelling programs applied worldwide for compact fluorescent lamps (CFL) but only 4 countries have MEPS programmes that prohibit the sale of low efficiency CFL's⁸:

- China
- Mexico
- South Korea
- Japan.

The US have federal legislation with MEPS for Fluorescent Lamps (not for CFL's), for Incandescent Reflector Lamps and for Under-Cabinet Luminaires⁹.

California has the 'Energy Star Label' (a voluntary agreement) for CFL's and for Residential Light Fixtures (Luminaires)¹⁰.

⁸ Source : Report No :2005/12 from the (Australian) National Appliance and Equipment Energy Efficiency Program : Minimum Energy Performance Standards - Compact Fluorescent Lamps.

⁹ Source : Appliance – Efficiency Regulations, December 2006, CEC-400-2006-002-REV2, California

Australia and New Zealand are working on MEPS for compact fluorescent lamps¹¹. Japan has a 'Top Runner Programme' for the efficiency of Energy using Products. For lighting, this programme imposes burdens for fluorescent lighting (see: http://www.eccj.or.jp/top_runner/).

On the website www.apec-esis.org existing MEPS and labelling programmes worldwide at the moment of this study can be found. Due to accelerated efforts of several governments, the accuracy of this source can not be guaranteed.

In **Annex 11.3**, some current MEPS and quality parameters for CFLi's worldwide can be found.

¹⁰ Source : Energy Star Program Requirements for Residential Light Fixtures, Eligibility Criteria – Version 4.0 and Energy Star Program Requirements for CFL's – Partner Commitments Final Version

¹¹ <http://www.energyrating.gov.au/library/details200718-phaseout-incandescent-lamps.html>.

2 ECONOMIC AND MARKET ANALYSIS

**3 CONSUMER BEHAVIOUR AND LOCAL
INFRASTRUCTURE**

4 TECHNICAL ANALYSIS EXISTING PRODUCTS

5 DEFINITION OF THE BASE-CASE

6 TECHNICAL ANALYSIS BAT AND BNAT

7 IMPROVEMENT POTENTIAL

**8 SCENARIO- POLICY- IMPACT- AND SENSITIVITY
ANALYSIS**

For more info see website www.eup4light.net.