



MODEL REGULATION GUIDELINES

MAY 2018

ENERGY EFFICIENCY AND FUNCTIONAL PERFORMANCE REQUIREMENTS FOR GENERAL SERVICE LAMPS



Endorsements

Please visit the United for Efficiency website to see the organisations that have endorsed this Model Regulation Guidelines for General Service Lamps. The endorsing organisations encourage governments who do not currently have up-to-date energy efficiency regulations for lighting to consider adopting these requirements in order to fast-track quality and performance requirements for these light sources in their economies.

<http://united4efficiency.org/>

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Foreword

This model regulation is a supplement to the UN Environment United for Efficiency (U4E) Lighting Policy Guide “Accelerating the Global Adoption of Energy-Efficient Lighting.”¹ It is intended for use by regulatory authorities in developing and emerging economies² that are considering a legislative framework³ to promote energy-efficient lamps, or those that have a legislative framework but have not yet developed regulations for energy-efficient lamps.

The model regulation includes means to regulate a transition for general service lamps for general illumination applications to more energy-efficient lamps. The model regulation covers conventional consumer light bulbs (the non-technical term for lamps), both non-directional and directional/spot light bulbs. It includes all the key elements that are needed: definitions, scope, performance requirements, information requirements, applicable test methods and compliance criteria.

This model regulation does not cover other light sources and equipment, such as linear lamps, outdoor street lighting, office and industrial lighting, and integrated LED luminaires. In the future, U4E intends to develop and publish similar guidance on model regulation documents for these and other lighting products and equipment.

Using this model regulation, countries can choose to leapfrog to a “higher energy efficiency” (Option A), or they can choose a gradual transition via a “medium / higher energy-efficiency” (Option B). Unlike Option A, Option B allows the on-going sales of compact fluorescent lamps (CFLs) which entails consideration of mercury contained in the lamps.

At the time of publication of this draft of the model regulation for developing and emerging economies, LED technology is continuing to evolve and improve as are the test methods and metrics used to assess the performance of these products. Thus, there are some aspects of the quality and performance criteria in the regulation which will require being added and updated from time to time, including for example non-visible flicker – (stroboscopic visibility measure - SVM). See Article 7 (Revisions) for a full list of items for review or revision in subsequent versions.

This model regulation is a supplement to the Lighting Policy Guide¹ which is one of a series of United for Efficiency reports along with room air conditioners, residential refrigerators, electric motors, and transformers. As is described further in the Lighting Policy Guide, United for Efficiency encourages countries to implement an integrated policy approach, which includes the following components:

- Standards and regulations;
- Supporting policies (e.g. communication campaigns);
- Finance and financial delivery mechanisms;
- Monitoring, verification and enforcement⁴; and
- Environmentally sound management.

Please visit <http://united4efficiency.org/> for more information about United for Efficiency.

¹ Please click [here](#) to view a copy of the United for Efficiency Lighting Policy Guide.

² This model regulation is not intended for governments that already have effective lighting regulations and policy processes for energy-efficient lighting products in their country or region (e.g. Australia and the European Union).

³ An effective legislation framework consists of regulatory requirements which can be verified and enforced. In this sense, it's recommended that the regulation include a collection of requirements which are based primarily on testing protocols and requirements set by the International Electrotechnical Commission (IEC), the International Commission on Illumination (CIE) or their national mirror standards. For some parameters, IEC and CIE standards may not be available and thus, regional standards may have to be used.

⁴ Please click [here](#) to view the en.lighten Monitoring, Verification and Enforcement Guidance Notes.

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Subject Matter and Structure

This model regulation addresses the following for general service lighting products:

- energy efficiency and functional performance requirements;
- product information reporting and labelling requirements;
- demonstrating compliance with the requirements; and
- market surveillance and enforcement of the requirements.

This model regulation does not include unique requirements on safety (including ultraviolet (UV) hazard, blue light and infrared radiation⁵), electromagnetic compatibility (EMC), hazardous substances (apart from mercury content in Option B), or warranty since these requirements are not primarily related to energy efficiency and functional performance, and are therefore typically incorporated in other parallel regulations on these same products. When developing these requirements, countries should investigate and confirm that these other requirements are covered in parallel regulations; if not they could be considered for inclusion in this regulation.

The model regulation applies to general service light bulbs (mains power lamps for general illumination applications) including those using incandescent, halogen, fluorescent or light emitting diode (LED) light sources. The model regulation includes two options, to facilitate use by governments when initiating their national consultative policy-making processes. Countries would choose either Option A or B:

- **Option A** offers a draft policy framework designed to leapfrog directly to higher energy-efficiency light-emitting diode (LED) lighting, removing incandescent, halogen and most integrally ballasted compact fluorescent lamps (CFLi) from the market.
- **Option B** offers a draft policy framework designed to remove incandescent and halogen lamps from the market, promoting more energy-efficient LEDs and CFLi's. It should be noted that CFLi's contain mercury, thus if this option is chosen, specific mercury waste management of the used lamps is required.

The U4E programme encourages countries to use Option A because it offers greater energy savings potential and avoids the use of mercury.

The policy guidance presented in this document is meant to be a starting point for policy-makers in developing and emerging economies, to encourage regional harmonisation where possible, lowering costs and removing barriers to trade. The work presented in this supplement represents the best available information at the time of publication, however the authors recognise that LED technology is rapidly evolving, as are the International Electrotechnical Commission (IEC) and International Commission on Illumination (CIE) standards that underpin the metrics and requirements set out in this report, thus countries are encouraged to investigate current requirements and standards at the time of adoption.

⁵ See the [U4E Lighting Policy Guide](#) (Page 91) for health and safety issue parameters including on UV. See IEC safety standards for photobiological safety on UV, blue light and infrared radiation.

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Article 1. Scope of Covered Products

1.1 SCOPE

This model regulation applies to all types (shapes and finishes) of general service lamps for general illumination purposes using incandescent, halogen, fluorescent, or light emitting diode (LED) light sources, and having:

- a) one or more input voltages of alternating current between 50 and 300 V and frequency of 50 Hz or 60 Hz, and;
- b) a lamp base which can be connected to one of the following general service lamp sockets:
 - Screw base types: E10, E11, E12, E14, E17, E26 or E27, or
 - Bayonet base types: B15d or B22d, or
 - Pin base types: GU10 or GZ10 base, or
 - Alternative base types which can be connected to the above lamp base sockets by using commercially available passive adaptors.

1.2 EXEMPTIONS

Any general service lamp in scope of this Regulation shall be exempt from the requirements of Article 3, with the exception of the information requirements set out in paragraph 3.3 point 5, if it has a specific technical design for its intended use in at least one of the following applications:

- a) solely emitting light outside the chromaticity coordinates x and y in the range

$$0,250 < x < 0,570 \text{ and } -2,3172 x^2 + 2,3653 x - 0,2400 < y < -2,3172 x^2 + 2,3653 x - 0,1400;$$
- b) solely emitting light with a luminous flux less than 60 or higher than 3300 lm;
- c) the primary purpose of the light is not general illumination and the product packaging is prominently marked as such, e.g. but not limited to:
 - I. emission of light as an agent in chemical or biological processes, e.g. but not limited to:
 - polymerization,
 - ultraviolet light used for curing/drying/hardening,
 - photodynamic therapy,
 - horticulture,
 - food service,
 - medical applications,
 - aquarium,
 - animal care, and
 - anti-insect products;
 - II. image capture and image projection, e.g. but not limited to:
 - camera flashlights,
 - photocopiers, and
 - video projectors;
 - III. signalling, e.g. but not limited to:
 - railway-signalling,
 - marine- signalling,

- road-signalling and traffic control, and
 - air traffic-signalling and airfield lamps.
- d) the spectral distribution of the light is adjusted to the specific needs of particular technical equipment, in addition to making the scene or object visible for humans, e.g. but not limited to:
- studio lighting,
 - performance special effects lighting, and
 - theatre lighting.
- e) the scene or object lit requires special protection from the negative effects of the light source, e.g. but not limited to:
- lighting with dedicated filtering for photosensitive patients, and
 - lighting with dedicated filtering for photosensitive museum exhibits.
- f) lighting is required only for emergency situations, e.g. but not limited to:
- emergency lighting luminaires.
- g) requiring ambient temperatures above 120°C and this exemption only applies to incandescent and halogen lamps with the following characteristics:
- a) an overall length of maximum 60 mm, and
 - b) a rated power of maximum 40W, and
 - c) a rated luminous flux less than or equal to 415 lumens.

ARTICLE 2. TERMS AND DEFINITIONS

- (a) *'arithmetic mean'* means the average of a set of numerical values, calculated by adding them together and dividing by the number of terms in the set.
- (b) *'beam angle'* of a directional lamp means the angle between two imaginary lines in a plane through the optical beam axis, such that these lines pass through the centre of the front face of the light source and through points at which the luminous intensity is 50 % of the centre beam intensity, where the centre beam intensity is the value of luminous intensity measured on the optical beam axis. Note 1. For lamps that have different beam angles in different planes, the largest beam angle shall be considered; Note 2. For lamps with user-controllable beam angle, the beam angle corresponding to the *'reference control setting'* shall be considered.
- (c) *'chromaticity'* means the property of a colour stimulus defined by its chromaticity coordinates (x and y).
- (d) *'colour rendering index'* (CRI) means the measure of the degree to which the psychophysical colour of an object illuminated by the test illuminant conforms to that of the same object illuminated by the reference illuminant, suitable allowance having been made for the state of chromatic adaptation. CRI is a measure of the ability of a light source to accurately reveal the colours of various objects in comparison with an ideal or natural light source.
- (e) *'colour-tuneable lamp'* (CTL) means a connected lamp (CL) using LED or OLED technology, that can be set to emit light with a large variation of colours outside the range defined in the scope, but can also be set to emit white light inside the range defined in in the scope, and with which the lamp is in the scope of this Regulation.

The term does not include tuneable-white lamps that can only be set to emit light, with different colour temperatures, within the range defined in the scope.

The term also does not include dim-to-warm lamps, that shift their white light output to lower colour temperature when dimmed, simulating the behaviour of incandescent light sources.

- (f) *'compliance'* means conforming to a rule, such as a law, policy, specification or standard. Also, fulfilment by countries/businesses/individuals of emission reduction and reporting commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.
- (g) *'Conformity Assessment Report'* (CAR) – means the documentation prepared by the manufacturer or importer of the lighting product which contains the compliance declaration, the evidence and the test reports to demonstrate that the product is fully compliant with all applicable regulatory requirements.
- (h) *'connected lamp'* (CL) means a general service lamp including data-connection parts that are physically integrated with the light emitting parts in a single inseparable housing, and where the data-connection parts cannot be disconnected, switched-off or their power consumption minimised.

- (i) *'correlated colour temperature'* (CCT) means the temperature of the Planckian radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions. Units: K Lamps with a high CCT, i.e. 5000K produce blueish-white light, whereas those with a CCT of 2700K produce light that is more yellowish-white.
- (j) *'data-connection parts'* means parts that perform one of the following functions:
 - reception or transmission of wired or wireless data signals and the processing thereof (either used to control the light emission function or otherwise),
 - sensing and processing of the sensed signals (either used to control the light emission function or otherwise),
 - actuation by audio control (including voice control),
 - a combination of these.
- (k) *'directional lamp'* (DL) means a lamp which has a beam angle (as defined in IEC 61341:1994 and measured in accordance with CIE S025:2015) of no more than 90 degrees in at least one plane and that being in at least one plane for an asymmetric beam lamp. These lamps are also known as reflector lamps and are commonly installed in recessed cans or track lighting.
- (l) *'endurance test'* (also called a supply switching test) is the rapid switching on and off of a solid state lighting product to simulate how a product will perform over its lifetime. The test is carried out to stress a solid state lighting product over a short period of time to help determine the failure rates of a product.
- (m) *'flicker'* means the perception of visual unsteadiness induced by a light stimulus the luminance or spectral distribution of which fluctuates with time, for a static observer in a static environment. The fluctuations can be periodic and non-periodic and may be induced by the light source itself, the power source or other influencing factors.
- (n) *'fluorescence'* or *'fluorescent light source'* (FL) means the phenomenon or a light source using an electric gas discharge of the low-pressure mercury type in which most of the light is emitted by one or more layers of phosphors excited by the ultraviolet radiation from the discharge. Fluorescent light sources may have one ('single-capped') or two ('double-capped') connections ('caps') to their electricity supply. For the purposes of this Regulation, magnetic induction light sources are also considered as fluorescent light sources.
- (o) *'fundamental power factor'* (also called displacement power factor) quantifies the displacement (phase-shift) between the fundamental current and voltage waveforms by calculating the cosine of the phase-shift angle. Fundamental power factor is a more detailed measure to quantify the displacement of the current and its effect on the power supply network.
- (p) *'gas discharge'* means a phenomenon where light is produced, directly or indirectly, by an electric discharge through a gas, plasma, metal vapour or mixture of gases and vapours.
- (q) *'general service lamp'* (GSL) includes general service incandescent and halogen lamps (GSILs), compact fluorescent lamps (CFLs), general service light-emitting diode (LED) lamps, organic light-emitting diode (OLED) lamps, and any other lamps that are used to satisfy lighting applications traditionally served by GSILs. GSLs are used in general lighting applications and can be operated directly on the mains electricity supply. GSLs account for the majority of installed lighting in the residential sector.

- (r) *'halogen lamp'* gas-filled lamp containing halogens or halogen compounds, the filament being of tungsten.
- (s) *'illumination'* means the application of light to a scene, objects or their surroundings so that they may be seen.
- (t) *'incandescence'* means a phenomenon where light is produced from heat, in light sources typically produced through a threadlike conductor ('filament') which is heated by the passage of an electric current.
- (u) *'lamp'* means a light source made in order to produce an optical radiation, usually visible. Note: The term "lamps" is often referred to as a bulb or light bulb, and is also sometimes used to describe certain types of luminaires/lighting fixtures.
- (v) *'lamp cap'* means that part of a lamp which provides connection to the electrical supply by means of a lampholder or lamp connector and, in most cases, also serves to retain the lamp in the lampholder. Note 1. The term base is also used in both the United Kingdom and the US to denote an integral part of a lamp envelope which has been so shaped that it fulfils the function of a cap. It may engage either a holder or a connector, depending on other design features of the lamp- and holder system. Note 2. The cap of a lamp and its corresponding holder are generally identified by one or more letters followed by a number which indicates approximately the principal dimension (generally the diameter) of the cap in millimetres.
- (w) *'life'* (of a lamp) means the total time for which a lamp has been operated before it becomes useless, or is considered to be so according to specified criteria. Note: Lamp life is usually expressed in hours.
- (x) *'light emitting diode'* (LED) means a technology in which light is produced from a solid state device embodying a p-n junction of inorganic material or organic material. This latter case is also known as 'organic light emitting diode' (OLED). In both cases the junction emits optical radiation when excited by an electric current.
- (y) *'lumen'* (lm) is an SI unit of luminous flux which is emitted in unit solid angle (steradian) by a uniform point source having a luminous intensity of 1 candela. It indicates the amount of light the lamp provides.
- (z) *'luminaire'* means an apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply.
- (aa) *'luminous efficacy'* (η_v or Φ_v), expressed in lm/W, quotient of the luminous flux emitted by the power consumed by the source. It is an expression of how energy efficient a lamp (or bulb) is.
- (bb) *'luminous flux' or 'flux'* (Φ), expressed in lumen (lm), means the quantity derived from radiant flux (radiant power) by evaluating the electromagnetic radiation in accordance with the spectral sensitivity of the human eye. If not specified differently, it refers to the rated, maximum initial luminous flux of a light source, after a short operating period, and to the total flux emitted in a solid angle of 4π steradians (corresponding to a 360° sphere).
- (cc) *'non-directional lamp'* (NDL) means a general service lamp that is not a directional lamp.

- (dd) '*rated luminous flux*' (of a type of lamp) means the value of the initial luminous flux of a given type of lamp declared by the manufacturer or the responsible vendor, the lamp being operated under specified conditions. Unit: lm. Note 1: The initial luminous flux may be the luminous flux of a lamp after a short ageing period, as specified in the relevant lamp standard. Note 2: The rated luminous flux is sometimes marked on the lamp. (IEC)
- (ee) '*rated power*' (of a type of lamp) means the value of the power of a given type of lamp declared by the manufacturer or the responsible vendor, the lamp being operated under specified conditions. Unit: W. Note: The rated power is usually marked on the lamp. (IEC)
- (ff) '*rated voltage*' or '*rated voltage range*' means the nominal voltage/range of voltage at which a piece of electrical equipment is designed to operate.
- (gg) '*reference control setting*' means a control setting or combination of control settings that is used to verify compliance of a light source with this Model Regulation. These settings are relevant for light sources that allow the end-user to control, manually or automatically, directly or remotely, the luminous intensity, colour, colour temperature, spectrum, and/or beam angle of the emitted light.

The reference control settings shall be those predefined by the manufacturer as factory default values, and encountered by the user at first installation (out-of-the-box values). If the installation procedure foresees an automatic software update during first installation, or if the user has the option to perform such an update, the resulting change in settings (if any) shall be taken into account.

The light source manufacturer shall define the reference control settings such that:

- The light source is in scope of this Model Regulation according to Article 1.1 and none of the conditions for exemption of Article 1.2 applies (if this is not possible, the light source is out-of-scope or exempted);
 - The adjustable/selectable beam angle is the narrowest available;
 - The power consumption of lighting control parts and non-lighting parts is minimal (if these parts cannot be disconnected or switched-off);
 - The full-load condition is obtained (maximum initial luminous flux given the other chosen settings);
 - When the end-user opts to reset factory defaults, the reference control settings are obtained.
- (hh) '*stroboscopic effect*' means a change in motion perception induced by a light stimulus the luminance or spectral distribution of which fluctuates with time, for a static observer in a non-static environment.
- (ii) '*stroboscopic effect visibility*' means stroboscopic effect evaluated over a specified time interval of a relatively short duration. The duration is typically 1 second, in accordance with CIE TN 006.

OPTION A: HIGHER ENERGY-EFFICIENT LIGHTING

ARTICLE 3. REQUIREMENTS [OPTION A]

Lamps in the scope of this model regulation shall meet the energy efficiency requirements of clause 3.1, the functional performance requirements of clause 3.2 and the product information requirements of clause 3.3, and shall be assessed according to the compliance criteria and the referenced standards of clause 3.4.

3.1 ENERGY EFFICIENCY REQUIREMENTS

Phenomena	Level																		
Luminous Efficacy	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th style="background-color: #d9ead3;">Rated Luminous Flux Φ in lm</th> <th style="background-color: #d9ead3;">Luminous Efficacy in lm/W</th> </tr> </thead> <tbody> <tr> <td>$60 \leq \Phi < 600$</td> <td>60</td> </tr> <tr> <td>$600 \leq \Phi < 1200$</td> <td>75</td> </tr> <tr> <td>$1200 \leq \Phi \leq 3300$</td> <td>80</td> </tr> </tbody> </table>	Rated Luminous Flux Φ in lm	Luminous Efficacy in lm/W	$60 \leq \Phi < 600$	60	$600 \leq \Phi < 1200$	75	$1200 \leq \Phi \leq 3300$	80										
	Rated Luminous Flux Φ in lm	Luminous Efficacy in lm/W																	
	$60 \leq \Phi < 600$	60																	
	$600 \leq \Phi < 1200$	75																	
	$1200 \leq \Phi \leq 3300$	80																	
	<p>Depending on the lamp characteristics, the required Luminous Efficacy values shall be decreased by the following correction factors (C):</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th style="background-color: #d9ead3;">Lamp Characteristics</th> <th style="background-color: #d9ead3;">C in %</th> </tr> </thead> <tbody> <tr> <td>Directional lamps</td> <td>-15</td> </tr> <tr> <td>Colour-tuneable lamps (CTL)</td> <td>-10</td> </tr> <tr> <td>Connected LED lamps with rated luminous flux Φ in lm:</td> <td></td> </tr> <tr> <td>$60 \text{ lm} \leq \Phi \leq 300 \text{ lm}$</td> <td>-15</td> </tr> <tr> <td>$300 \text{ lm} < \Phi \leq 650 \text{ lm}$</td> <td>-10</td> </tr> <tr> <td>$650 \text{ lm} < \Phi \leq 1200 \text{ lm}$</td> <td>-7.5</td> </tr> <tr> <td>$1200 \text{ lm} < \Phi \leq 2000 \text{ lm}$</td> <td>-5</td> </tr> <tr> <td>$2000 \text{ lm} < \Phi \leq 3300 \text{ lm}$</td> <td>-2.5</td> </tr> </tbody> </table>	Lamp Characteristics	C in %	Directional lamps	-15	Colour-tuneable lamps (CTL)	-10	Connected LED lamps with rated luminous flux Φ in lm:		$60 \text{ lm} \leq \Phi \leq 300 \text{ lm}$	-15	$300 \text{ lm} < \Phi \leq 650 \text{ lm}$	-10	$650 \text{ lm} < \Phi \leq 1200 \text{ lm}$	-7.5	$1200 \text{ lm} < \Phi \leq 2000 \text{ lm}$	-5	$2000 \text{ lm} < \Phi \leq 3300 \text{ lm}$	-2.5
	Lamp Characteristics	C in %																	
	Directional lamps	-15																	
	Colour-tuneable lamps (CTL)	-10																	
	Connected LED lamps with rated luminous flux Φ in lm:																		
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$1200 \text{ lm} < \Phi \leq 2000 \text{ lm}$	-5																		
$2000 \text{ lm} < \Phi \leq 3300 \text{ lm}$	-2.5																		
<p>The Conformity Assessment Report (CAR) shall provide evidence that substantiates the claimed correction factor (C).</p>																			
<p>Notes:</p> <ol style="list-style-type: none"> Where applicable, the correction factors are additive. For Colour-tuneable lamps (that in this Regulation per definition are Connected LED lamps), the correction factors are also additive. Lamps that allow the end-user to adapt the spectrum and/or the beam angle of the emitted light, thus changing the values for useful luminous flux, CRI-Ra and/or colour temperature (Tc), and/or changing the DL/NDL status, shall be evaluated using the reference control settings. 																			
Standby Power	<p>< 500 mW</p> <p>Note: This requirement is only applicable to Connected LED lamps</p>																		

Phenomena	Level	
Fundamental Power Factor (Also called Displacement Factor or $\cos \phi_1$)	Rated Input Power P in W	Fundamental Power Factor
	$P \leq 2W$	Not applicable
	$2W < P \leq 5W$	≥ 0.4
	$5W < P \leq 25W$	≥ 0.7
	$P > 25W$	≥ 0.9
Note: This requirement is only applicable to LED lamps		

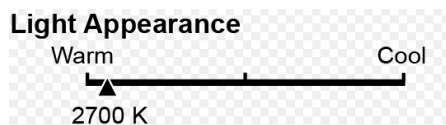
3.2 FUNCTIONAL PERFORMANCE REQUIREMENTS

Phenomena	Level
Colour Rendering Index (CRI)	≥ 80 Ra Note: 1. This requirements is not applicable for lamps designed, marketed and labelled exclusively for outdoor applications, industrial applications or other applications where a CRI- $R_a < 80$ is allowed.
1000 hour early failure test	Lamps must operate for 150 minutes on and 30 minutes off for 400 cycles at ambient conditions.
Short term flicker perceptibility (P_{st}^{LM})	≤ 1.0 at full load and a sinusoidal input voltage. Note: 1. This requirement only applies to LED lamps.
Mercury content	The lamp shall not contain any Mercury (0.0 mg Mercury)

3.3 PRODUCT INFORMATION REQUIREMENTS

The following information shall be clearly and prominently indicated on the packaging and in all other forms of product information:

- 1) Rated power in Watt
- 2) Rated initial luminous flux in lumen
- 3) Rated efficacy in lumens per Watt (lm/W)
- 4) Rated correlated colour temperature (CCT) in Kelvin (K) combined with a sliding scale:



Note: This information requirement is not applicable for incandescent or halogen lamps

- 5) Statement on Dimmability – clearly state whether dimmable or not dimmable. If yes, then information on dimmer compatibility, or web link to this information.
- 6) For general service lamps which are, according paragraph 1.2, exempted from the requirements of paragraph 3.1 and 3.2, the intended purpose shall be stated on all forms of packaging, product information and advertisement, together with a clear indication in large

font on the front of the package that the **Lamp is NOT Intended for General Illumination Purposes.**

Manufacturers are not required to provide a lifetime claim or incandescent equivalency claim (i.e. "This lamp is as bright as a 60W incandescent" or "10W = 60W"). However, if the manufacturer optionally decides to make a lamp lifetime or lumen equivalency claim on the packaging, or on the lamps and in all other forms of product information, then:

- Lifetime [hours] claim of LED lamps – manufacturers shall provide evidence to the regulator that substantiates the claim according the L70F50 definition of IEC 62612.
- Incandescent Wattage Equivalency [W] – shall be ranked according to the table below which depicts the minimum initial luminous flux that is required to claim a specific incandescent lamp wattage equivalency.

Table of incandescent wattage equivalencies for LED lamps

Incandescent Wattage Equivalency [W]	Minimum Initial Luminous Flux [lm]	
	230V Mains Power	120V Mains Power
15	120	150
25	200	250
40	400	450
60	700	800
75	950	1100
100	1400	1600
150	2200	2500
200	3000	3400

Note: The listed incandescent wattage equivalencies may be interpolated (e.g. 50 Watts) and extrapolated (e.g. 7 Watts) using the values in the given table.

3.4 REFERENCED TEST STANDARDS, COMPLIANCE CERTIFICATION AND SURVEILLANCE TESTING

The metrics, referenced standards, compliance certification, and surveillance testing criteria are set out in this section.

Note 1: The latest edition of the referenced measurement standards (including any amendments) applies.

Note 2: The same sample of lamps may be used for certain metrics as set out in the test sequence in Appendix A.

Note 3: For suppliers (i.e., importers and manufacturers), the required sample sizes and compliance criteria for compliance certification shall be the same as those set-out in the requirements of the referenced measurement standards.

Note 4: For governments (i.e., market surveillance authorities) the surveillance testing criteria for verification testing are less stringent than the criteria in the Measurement Standards to allow for measurement uncertainties and manufacturing tolerances.

Note 5: The surveillance testing criteria shall not be used by the suppliers to certify compliance with the regulation (see Note 3 above).

Phenomena	Lamp Type	Measurement Standards	Surveillance Testing (for government)
Luminous Efficacy	All	See below for (measured luminous flux / measured power)	Sample of 10 units. The arithmetical mean of the calculated luminous efficacy of the 10 units shall not be less than required level.
Luminous flux in [lm]	Incandescent / Halogen	IEC 60064 CIE 84	Sample of 10 units. The arithmetical mean of the measured luminous flux of the 10 units shall not be less than 90% of the rated luminous flux.
	LED	IEC 62612 CIE S025	
Power in [W]	Incandescent / Halogen	IEC 60064	Sample of 10 units. The arithmetical mean of the measured power of the 10 units shall not exceed 110% of the rated power, and the measured power of each individual lamp of the sample shall not exceed 115% of the rated power.
	LED	IEC 62612	
Standby Power	Connected LED lamp	IEC 63103	Sample of 10 units. The arithmetical mean of the measured standby power of the 10 units shall not exceed the required level by more than 100 mW.
Fundamental Power Factor	LED	IEC 62612	Sample of 10 units. The arithmetical mean of the measured displacement factor of the 10 units shall not be less than the required level minus 0.05.
Colour Rendering Index (CRI)	LED	IEC 62612 CIE S 025 CIE 13.3	Sample of 10 units. The arithmetical mean of the measured CRI of the 10 units shall not be less than the required CRI-R _a level minus 3.
Correlated colour temperature (CCT)	LED	IEC 62612 CIE S025 CIE 15	Sample of 10 units. The arithmetical mean of the measured CCT shall conform to the industry standard tolerances contained in the standards used for testing.
1000 hour early failure test	LED	See Appendix B	Sample of 10 units. After 400 cycles, all lamps shall still be operational and the arithmetical mean of the measured luminous flux of the 10 units shall be at least 90% of initial luminous flux.
Flicker	LED	IEC TR 61547-1	Sample of 10 units. The arithmetical mean of the measured P _{st} ^{LM} of the 10 units shall not be more than the required level plus 5%.
Lifetime claim	LED	L70F50 definition of IEC 62612	Suppliers must provide evidence (of a scientific or experimental nature) to the government regulator that substantiates the lifetime claim. Lifetime claim shall not exceed the value demonstrated by the evidence.
	Incandescent / Halogen	IEC 60064	

OPTION B: MEDIUM / HIGHER ENERGY-EFFICIENT LIGHTING

ARTICLE 3. REQUIREMENTS [OPTION B]

Lamps in the scope of this model regulation shall meet the energy efficiency requirements of clause 3.1, the functional performance requirements of clause 3.2 and the product information requirements of clause 3.3, and shall be assessed according to the compliance criteria and the referenced standards of clause 3.4.

3.1 ENERGY EFFICIENCY REQUIREMENTS

Phenomena	Level																							
Luminous Efficacy	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="background-color: #d9ead3;">Rated Luminous Flux Φ in lm</th> <th colspan="2" style="background-color: #d9ead3;">Luminous Efficacy in lm/W</th> </tr> <tr> <th style="background-color: #d9ead3;">Non-LED lamps</th> <th style="background-color: #d9ead3;">LED lamps</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">$60 \leq \Phi < 600$</td> <td style="text-align: center;">50</td> <td style="text-align: center;">60</td> </tr> <tr> <td style="text-align: center;">$600 \leq \Phi < 1200$</td> <td style="text-align: center;">55</td> <td style="text-align: center;">75</td> </tr> <tr> <td style="text-align: center;">$1200 \leq \Phi \leq 3300$</td> <td style="text-align: center;">60</td> <td style="text-align: center;">80</td> </tr> </tbody> </table>		Rated Luminous Flux Φ in lm	Luminous Efficacy in lm/W		Non-LED lamps	LED lamps	$60 \leq \Phi < 600$	50	60	$600 \leq \Phi < 1200$	55	75	$1200 \leq \Phi \leq 3300$	60	80								
	Rated Luminous Flux Φ in lm	Luminous Efficacy in lm/W																						
		Non-LED lamps	LED lamps																					
	$60 \leq \Phi < 600$	50	60																					
	$600 \leq \Phi < 1200$	55	75																					
	$1200 \leq \Phi \leq 3300$	60	80																					
	<p>Depending on the lamp characteristics, the required Luminous Efficacy values shall be decreased by the following correction factors (C):</p>																							
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #d9ead3;">Lamp Characteristics</th> <th style="background-color: #d9ead3;">C in %</th> </tr> </thead> <tbody> <tr> <td>Directional lamps</td> <td style="text-align: center;">-15</td> </tr> <tr> <td>Compact fluorescent lamps with a CCT > 5000 K</td> <td style="text-align: center;">-10</td> </tr> <tr> <td>Compact fluorescent lamps with a CRI > 90 Ra</td> <td style="text-align: center;">-10</td> </tr> <tr> <td>Colour-tuneable lamps (CTL)</td> <td style="text-align: center;">-10</td> </tr> <tr> <td>Connected LED lamps with rated luminous flux Φ in lm:</td> <td></td> </tr> <tr> <td style="text-align: center;">$60 \text{ lm} \leq \Phi \leq 300 \text{ lm}$</td> <td style="text-align: center;">-15</td> </tr> <tr> <td style="text-align: center;">$300 \text{ lm} < \Phi \leq 650 \text{ lm}$</td> <td style="text-align: center;">-10</td> </tr> <tr> <td style="text-align: center;">$650 \text{ lm} < \Phi \leq 1200 \text{ lm}$</td> <td style="text-align: center;">-7.5</td> </tr> <tr> <td style="text-align: center;">$1200 \text{ lm} < \Phi \leq 2000 \text{ lm}$</td> <td style="text-align: center;">-5</td> </tr> <tr> <td style="text-align: center;">$2000 \text{ lm} < \Phi \leq 3300 \text{ lm}$</td> <td style="text-align: center;">-2.5</td> </tr> </tbody> </table>		Lamp Characteristics	C in %	Directional lamps	-15	Compact fluorescent lamps with a CCT > 5000 K	-10	Compact fluorescent lamps with a CRI > 90 Ra	-10	Colour-tuneable lamps (CTL)	-10	Connected LED lamps with rated luminous flux Φ in lm:		$60 \text{ lm} \leq \Phi \leq 300 \text{ lm}$	-15	$300 \text{ lm} < \Phi \leq 650 \text{ lm}$	-10	$650 \text{ lm} < \Phi \leq 1200 \text{ lm}$	-7.5	$1200 \text{ lm} < \Phi \leq 2000 \text{ lm}$	-5	$2000 \text{ lm} < \Phi \leq 3300 \text{ lm}$	-2.5
	Lamp Characteristics	C in %																						
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$2000 \text{ lm} < \Phi \leq 3300 \text{ lm}$	-2.5																							
<p>The Conformity Assessment Report (CAR) shall provide evidence that substantiates the claimed correction factor (C).</p>																								
<p>Notes:</p> <ol style="list-style-type: none"> 1. Where applicable, the correction factors are additive. 2. For Colour-tuneable lamps (that in this Regulation per definition are Connected LED lamps), the correction factors are also additive. 3. Lamps that allow the end-user to adapt the spectrum and/or the beam angle of the emitted light, thus changing the values for useful luminous flux, CRI-Ra and/or colour temperature (Tc), and/or changing the DL/NDL status, shall be evaluated using the reference control settings. 																								

Phenomena	Level										
Standby Power	< 500 mW Note: This requirement is only applicable to Connected LED lamps										
Fundamental Power Factor (Also called Displacement Factor or Cos φ_1)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #d9ead3;">Rated Input Power P in W</th> <th style="background-color: #d9ead3;">Fundamental Power Factor</th> </tr> </thead> <tbody> <tr> <td>P ≤ 2W</td> <td>Not applicable</td> </tr> <tr> <td>2W < P ≤ 5W</td> <td>≥ 0.4</td> </tr> <tr> <td>5W < P ≤ 25W</td> <td>≥ 0.7</td> </tr> <tr> <td>P > 25W</td> <td>≥ 0.9</td> </tr> </tbody> </table> <p>Note: This requirement is only applicable to LED lamps</p>	Rated Input Power P in W	Fundamental Power Factor	P ≤ 2W	Not applicable	2W < P ≤ 5W	≥ 0.4	5W < P ≤ 25W	≥ 0.7	P > 25W	≥ 0.9
Rated Input Power P in W	Fundamental Power Factor										
P ≤ 2W	Not applicable										
2W < P ≤ 5W	≥ 0.4										
5W < P ≤ 25W	≥ 0.7										
P > 25W	≥ 0.9										

3.2 FUNCTIONAL PERFORMANCE REQUIREMENTS

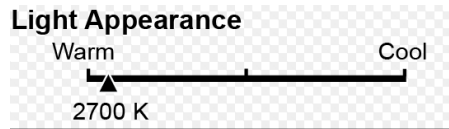
Phenomena	Level
Colour Rendering Index (CRI)	≥ 80 Ra Note: 1. This requirements is not applicable for lamps designed, marketed and labelled exclusively for outdoor applications, industrial applications or other applications where a CRI-R _a < 80 is allowed.
1000 hour early failure test	Lamps must operate for 150 minutes on and 30 minutes off for 400 cycles at ambient conditions.
Supply switching test	CFLi lamps must survive 3,000 switching cycles of 1 minute on and 3 minutes off. Note: 1. This requirement only applies to CFLi lamps.
Short term flicker perceptibility (P_{st}^{LM})	≤ 1.0 at full load and a sinusoidal input voltage. Note: 1. This requirement only applies to LED lamps.
Mercury content	Compact fluorescent lamps (CFLs) for general lighting purposes that are ≤30 watts should not exceed 5 mg per lamp burner. Note 1: The 5 mg requirement is based on the requirement of the UN Minamata Convention, however countries should consider if more stringent mercury content limits are appropriate for their national context, such as the European Restrictions of Hazardous Substances Directive (2011/65/EU) that puts a limit of 2.5 mg per lamp burner.

3.3 PRODUCT INFORMATION REQUIREMENTS

The following information shall be clearly and prominently indicated on the packaging and in all other forms of product information:

- 1) Rated power in Watt
- 2) Rated initial luminous flux in lumen.

- 3) Rated efficacy in lumens per Watt (lm/W).
- 4) Rated correlated colour temperature (CCT) in Kelvin (K) combined with a sliding scale:



Note: This information requirement is not applicable for incandescent or halogen light sources.

- 5) Statement on Dimmability – clearly state whether dimmable or not dimmable. If yes, then information on dimmer compatibility, or web link to this information.
- 6) For general service lamps which are, according paragraph 1.2, exempted from the requirements of paragraph 3.1 and 3.2, the intended purpose shall be stated on all forms of packaging, product information and advertisement, together with a clear indication in large font on the front of the package that the **Lamp is NOT Intended for General Illumination Purposes**.
- 7) For CFLi, the amount of mercury contained in the lamp in milligrams.

Manufacturers are not required to provide a lifetime claim or incandescent equivalency claim (i.e. "This lamp is as bright as a 60W incandescent" or "10W = 60W"). However, if the manufacturer optionally decides to make a lamp lifetime or lumen equivalency claim on the packaging, or on the lamps and in all other forms of product information, then:

- Lifetime [hours] claim of LED lamps – manufacturers shall provide evidence to the regulator that substantiates the claim according the L70F50 definition of IEC 62612.
- Lifetime [hours] claims of CFLi lamps - manufacturers shall provide evidence to the regulator that substantiates the claim according the lifetime definition of IEC 60969.
- Incandescent Wattage Equivalency [W] – shall be ranked according to the table below which depicts the minimum initial luminous flux that is required to claim a specific incandescent lamp wattage equivalency.

Table of incandescent wattage equivalencies for CFLi and LED lamps

Incandescent Wattage Equivalency [W]	Minimum Initial Luminous Flux [lm]	
	230V Mains Power	120V Mains Power
15	120	150
25	200	250
40	400	450
60	700	800
75	950	1100
100	1400	1600
150	2200	2500
200	3000	3400

Note: The listed incandescent wattage equivalencies may be interpolated (e.g. 50 Watts) and extrapolated (e.g. 7 Watts) using the values in the given table.

3.4 REFERENCED TEST STANDARDS, COMPLIANCE CERTIFICATION AND SURVEILLANCE TESTING

The metrics, referenced standards, compliance certification, and surveillance testing criteria are set out in this section.

Note 1: The latest edition of the referenced measurement standards (including any amendments) applies.

Note 2: The same sample of lamps may be used for certain metrics as set out in the test sequence in Appendix A.

Note 3: For suppliers (i.e., importers and manufacturers), the required sample sizes and compliance criteria for compliance certification shall be the same as those set out in the requirements of the referenced measurement standards.

Note 4: For governments (i.e., market surveillance authorities) the surveillance testing criteria for verification testing are less stringent than the criteria in the Measurement Standards to allow for measurement uncertainties and manufacturing tolerances.

Note 5: The surveillance testing criteria shall not be used by the suppliers to certify compliance with the regulation (see Note 3 above).

Phenomena	Lamp Type	Measurement Standards	Surveillance Testing (for government)
Luminous Efficacy	All	(measured luminous flux / measured power)	Sample of 10 units. The arithmetical mean of the calculated luminous efficacy of the 10 units shall not be less than required level.
Luminous flux in [lm]	Incandescent / Halogen	IEC 60064 CIE 84	Sample of 10 units. The arithmetical mean of the measured luminous flux of the 10 units shall not be less than 90% of the rated luminous flux
	CFLi	IEC 60969 CIE 84	
	LED	IEC 62612 CIE S025	
Power in [W]	Incandescent / Halogen	IEC 60064	Sample of 10 units. The arithmetical mean of the measured power of the 10 units shall not exceed 110% of the rated power, and the measured power of each individual lamp of the sample shall not exceed 115% of the rated power.
	CFLi	IEC 60969	
	LED	IEC 62612	
Standby Power	Connected LED lamp	IEC 63103	Sample of 10 units. The arithmetical mean of the measured standby power of the 10 units shall not exceed the required level by more than 100 mW.
Fundamental Power Factor	LED	IEC 62612	Sample of 10 units. The arithmetical mean of the measured displacement factor of the 10 units shall not be less than the required level minus 0.05.
Power Factor	CFLi	IEC 60969	Sample of 10 units. The arithmetical mean of the measured power factor of the 10 units shall not be less than the required level minus 0.05.
Colour Rendering Index (CRI)	LED	IEC 62612 CIE S 025 CIE 13.3	Sample of 10 units. The arithmetical mean of the measured CRI of the 10 units shall not be less than the required CRI-R _a level minus 3.
	CFLi	IEC 60969 CIE 13.3	
Correlated colour	LED	IEC 62612 CIE S025 CIE 15	Sample of 10 units. The arithmetical mean of the measured CCT shall conform to the industry standard tolerances contained in the standards used for testing.

Phenomena	Lamp Type	Measurement Standards	Surveillance Testing (for government)
temperature (CCT)	CFLi	IEC 60969 CIE 15	
1000 hour early failure test	LED	See Appendix B	Sample of 10 units. After 400 cycles, all lamps shall still be operational and the arithmetical mean of the measured luminous flux of the 10 units shall be at least 90% of initial luminous flux.
Supply switching test	CFLi	IEC 60969 (switching cycle is 1 minute on and 3 minutes off)	Sample of 10 units. At the end of the test, at least 4 of the 10 lamps shall operate.
Flicker	LED	IEC TR 61547-1	Sample of 10 units. The arithmetical mean of the measured P_{st}^{LM} of the 10 units shall not be more than the required level plus 5%.
Lifetime claim	LED	L70F50 definition of IEC 62612	Suppliers must provide evidence (of a scientific or experimental nature) to the regulator that substantiates the lifetime claim. Lifetime claim shall not exceed the value demonstrated by the evidence.
	CFLi	IEC 60969	
	Incandescent / Halogen	IEC 60064	
Mercury Content	CFLi	Cold Vapor - Atomic Absorption Spectrometry (CV-AAS)" method according IEC62321-4, in combination with sample preparation of mercury in fluorescent lamps according IEC 62321-4	The supplier shall provide the evidence that the applied Mercury dosing unit (pill) does not exceed required level through a Supplier Declaration.
			Sample of 3 units. Only for lamps where evidence about the Mercury content of the applied Mercury dosing unit is not available, sample of 3 and the arithmetical mean of the measured Mercury content of those 3 units shall not be more than the required level plus 5%.

ARTICLE 4. ENTRY INTO FORCE

The product and information requirements set out in Article 3 shall take effect from 1 January 2020.

ARTICLE 5. DECLARATION OF CONFORMITY

Compliance with the requirements of Article 3 and any additional optional claims should be demonstrated in the Conformity Assessment Report (CAR).

The CAR shall:

- (1) demonstrate that the product model fulfils the requirements of of this Regulation;
- (2) provide any other information required to be present in the technical documentation file;
- (3) specify the reference setting and conditions in which the product complies with this Regulation.

ARTICLE 6. MARKET SURVEILLANCE

In the context of verifying compliance of a product model with the requirements laid down in this Regulation, the government authorities shall apply the following procedure:

- (1) The government authorities shall test a sample of the same model from the same manufacturer, randomly selected.
- (2) The model shall be considered to comply with the applicable requirements:
 - a. if the values in the Conformity Assessment Report, and where appropriate the values used to establish those values that are calculated, are not more favourable for the manufacturer or importer than the respective results of the measurements; and
 - b. if the values used to determine the compliance of the sample, and where appropriate the values used to establish those values that are calculated are not more favourable for the manufacturer or importer than the values in the technical documentation file, including in the test reports; and
 - c. if, when government authorities test the sample of models, all measured average parameters and the values calculated from these measurement(s) are within the respective verification tolerances.
- (3) If the results referred to in points 2(a), 2(b) and 2(c) are not achieved, the model shall be considered not to comply with this Regulation.
- (4) If a decision of non-compliance is taken according to point 2 against a manufacturer, the government authority may inform other government authorities in the region within one month of the decision being taken to help protect against the widespread sale of the same model.

Government authorities shall use the measurement and calculation methods set out in this Regulation.

Government authorities shall only apply those verification tolerances set out in Section 3 point 4 of this regulation, and the procedure described in this article (Article 6), points 1 through 4. No other tolerances, such as those set out in harmonised standards or in any other measurement method, shall be applied.

ARTICLE 7. REVISION

It is recommended that any subsequent review or revision to this Regulation will take into consideration the following topics:

- setting more stringent energy efficiency requirements for all light source types;
- substituting the CRI and CCT metrics by a more adequate metrics;
- setting requirements on stroboscopic effects;
- setting requirements on dimming, including the interaction with flicker;
- setting requirements on hazardous substance like Cd, Pb, Cr6+ and PBB / PBDE;
- combining this Regulation with other lighting-related Regulations.

ARTICLE 8. BENCHMARK MODELS (BEST AVAILABLE TECHNOLOGY)

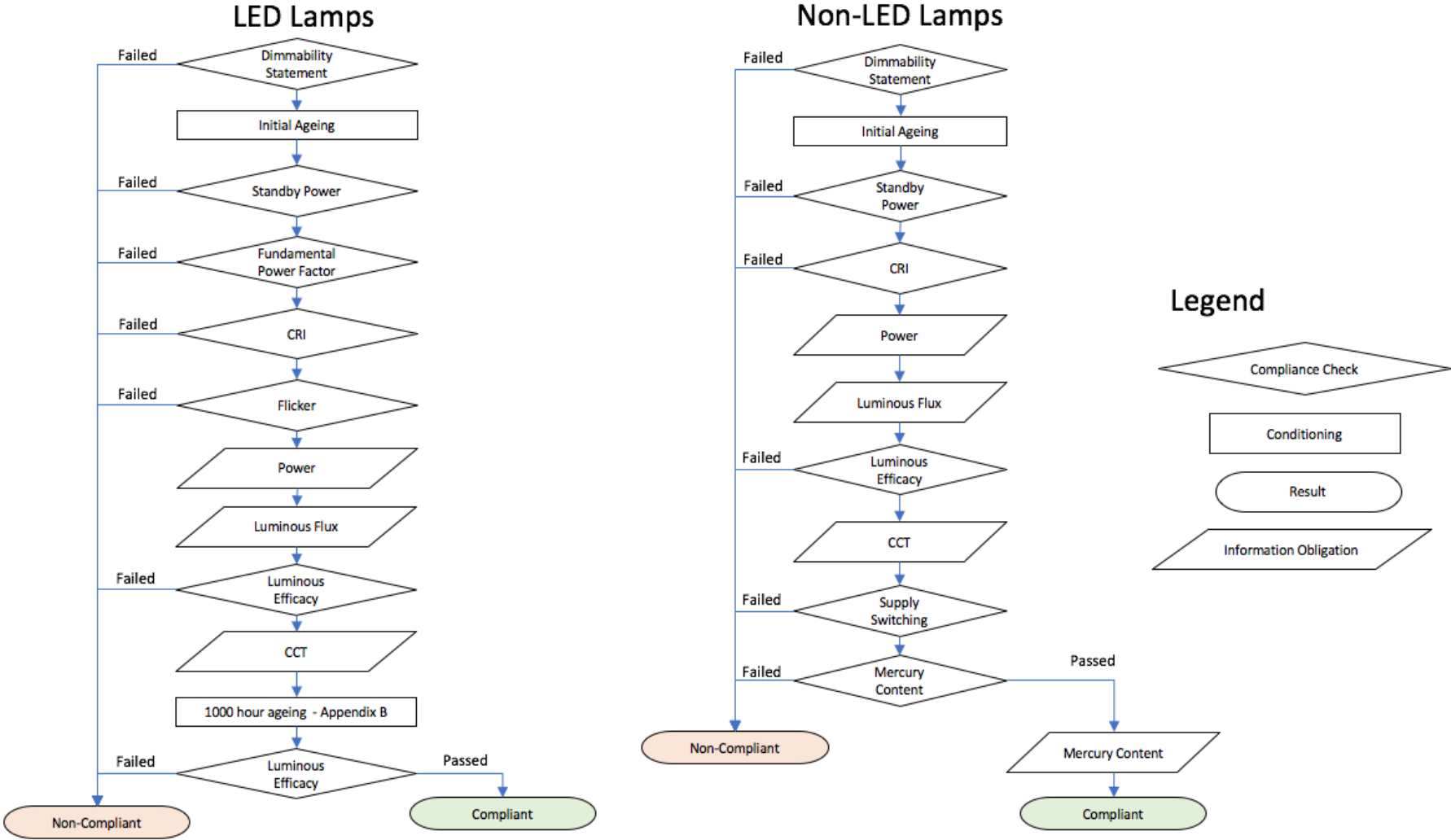
The best available technology on the market, at the time of entry into force of this Regulation, for the environmental aspects that were considered significant and are quantifiable, is indicated below. Features required in certain applications, e.g. a high CRI, might prevent products offering those features from achieving these benchmarks.

Energy efficiency: the most efficient light sources have an energy efficiency (based on useful luminous flux) of:

- | | |
|--|--------------|
| - Non-directional general service lamps: | 120-140 lm/W |
| - Mains voltage directional lamps: | 90-100 lm/W |

Mercury content: the most efficient light sources and separate control gears do not have any mercury content.

APPENDIX A. TEST SEQUENCE



APPENDIX B. 1000 HOUR EARLY FAILURE TEST (LED LAMPS ONLY)

The 1000 hour Early Failure test for LED lamps shall be conducted:

a) in a room with an ambient temperature in the range of 15°C to 40°C where vibration and shock are minimized and the lamps under test are not subject to supplemental ventilation or cooling (e.g may not blow air from a fan or air conditioner directly onto the area where the testing racks and lamps are located.)

b) with the lamps operated in free air in a vertical base-up position. If a supplier has declared the lamp is suitable for use in a specific orientation only, then the lamp shall be mounted in the declared orientation during all tests.

c) at the lamp's rated voltage and frequency if a single value is declared. If the rated voltage is a range, the lamp shall be tested at the mean voltage of that range. For dual-voltage lamps, for example those intended for operation at 110 V to 130 V and 220 V to 240 V, ageing and testing shall be conducted at the mean voltage of each voltage range. The test voltage supply shall have a tolerance within 2%. The total harmonic content of the supply voltage shall not exceed 3%. The harmonic content is defined as the R.M.S. summation of the individual harmonic components using the fundamental as 100%. IEC 61000-3-2, Annex A, provides guidance on the supply voltage source.

d) with the lamps operating for 400 cycles by a repeatedly switching cycle of 150 minutes ON followed by 30 minutes OFF. The hours of operation recorded (i.e., 1000 hours) shall only include the periods of the cycle when the lamp was switched ON.

Note: Luminous flux of each lamp under test should be measured at time $t=0$ (initial luminous flux prior to any cycling) and at the completion of 400 cycles (150 minutes on, 30 minutes off).

