



**MODEL REGULATION GUIDELINES**

**FEBRUARY 2021**

# ENERGY EFFICIENCY AND FUNCTIONAL PERFORMANCE REQUIREMENTS FOR GENERAL SERVICE LAMPS



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## Foreword

This model regulation guideline is a supplement to the UN Environment Programme’s (UNEP’s) United for Efficiency (U4E) Lighting Policy Guide “Accelerating the Global Adoption of Energy-Efficient Lighting.”<sup>1</sup> and is a revision of the first Model Regulation Guideline published in May 2018. It is intended for use by regulatory authorities in developing and emerging economies<sup>2</sup> that are considering a legislative framework<sup>3</sup> 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 guideline includes means to regulate a transition for general service lamps for general illumination applications to more energy-efficient lamps. The model regulation guideline 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 guideline does not cover other light sources and equipment, such as linear lighting, outdoor street lighting, office and industrial lighting, and integrated LED luminaires. Separately, U4E has developed similar guidance for linear lighting products, and the other categories will follow in the future.

As stated in the first edition of the model regulation guideline 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 have now been added and updated, including for example non-visible flicker (stroboscopic visibility measure – SVM).

The model regulation guideline is a supplement to the Lighting Policy Guide<sup>1</sup> which is one of a series of U4E guidance documents. Others in the series include, room air conditioners, residential refrigerators, electric motors, and transformers. As is described further in the Lighting Policy Guide, U4E encourages countries to implement an integrated policy approach, which includes five components – standards and regulations, supporting policies (e.g. communication campaigns), finance and financial delivery mechanisms, monitoring, verification and enforcement,<sup>4</sup> and environmentally sound management.

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<sup>1</sup> Accelerating The Global Adoption Of Energy-Efficient Lighting, available at <https://united4efficiency.org/resources/accelerating-global-adoption-energy-efficient-lighting>.

<sup>2</sup> This model regulation guideline 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).

<sup>3</sup> 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.

<sup>4</sup> Please click [here](#) to view the en.lighten monitoring, verification and enforcement guidance notes.

## Subject Matter and Structure

This model regulation guideline 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 guideline does not include unique requirements on safety (including ultraviolet (UV) hazard, blue light and infrared radiation,<sup>5</sup> electromagnetic compatibility (EMC), hazardous substances, 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 guideline 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 guidelines offers a draft policy framework designed to leapfrog directly to higher energy efficiency light emitting diode (LED) lighting, removing most incandescent, halogen and integrally ballasted compact fluorescent lamps (CFLi) from the market. It is for use by governments when initiating their national consultative policy-making processes.

Designated Authorities are encouraged to accelerate the adoption of higher efficiency LED general service lamps because they offer greater energy savings potential, as well as immediate energy savings, on existing installations and avoid the use of mercury. An energy rating system to support this is recommended as part of the model regulation guidelines. Monitoring, verification and enforcement is simplified with simple, baseline and affordable minimum energy performance standards (MEPS). No correction factors (for example, those typically given for lumen output, or for connected and colour tuneable lamps) are included to reduce loopholes to a minimum.

The policy guidance presented in this document is meant to be a starting point for policymakers 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 supplement, thus countries are encouraged to investigate current requirements and standards at the time of adoption.

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<sup>5</sup> 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 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 Clause 3.3 (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 lm.



## 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. The parameter used in this Regulation is the general colour rendering index known as CRI (R<sub>a</sub>).
- (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.

This 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.
  - 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 (Kelvin). 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. In addition, the field angle shall be no more than 120 degrees. 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 static 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. The metric for flicker used in this Regulation is the  $P_{st}^{LM}$ , where 'st' stands for short term and 'LM' for light flicker meter method, as defined in standards. A value  $P_{st}^{LM} = 1$  means that the average observer has a 50% probability of detecting flicker.
- (n) *'field angle'* using the same method as beam angle this is an angle defined at 10% of centre beam intensity.
- (o) *'fluorescence'* or *'fluorescent light source'* (FL) means the phenomenon of 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.

- (p) '*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.
- (q) '*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.
- (r) '*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.
- (s) '*halogen lamp*' gas-filled lamp containing halogens or halogen compounds, the filament being of tungsten.
- (t) '*illumination*' means the application of light to a scene, objects or their surroundings so that they may be seen.
- (u) '*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.
- (v) '*lamp*' means a light source made in order to produce an optical radiation, usually visible. Note: The term "lamp" is often referred to as a bulb or light bulb, and is also sometimes used to describe certain types of luminaires/lighting fixtures.
- (w) '*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 United States 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.

- (x) *'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.
- (y) *'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.
- (z) *'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.
- (aa) *'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.
- (bb) *'luminous efficacy'* ( $\eta_v$  or  $\Phi_v$ ) quotient of the luminous flux emitted by the power consumed by the source. It is an indicator of how energy efficient a lamp (or bulb) is. Unit: lm/W (lumen/Watt).
- (cc) *'luminous flux'* or *'flux'* ( $\Phi$ ) 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  $4\pi$  steradians (corresponding to a  $360^\circ$  sphere). Unit: lm (lumen).
- (dd) *'non-directional lamp'* (NDL) means a general service lamp that is not a directional lamp.
- (ee) *'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 (lumen). 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)
- (ff) *'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 (Watts). Note: The rated power is usually marked on the lamp. (IEC)
- (gg) *'rated voltage'* or *'rated voltage range'* means the nominal voltage/range of voltage at which a piece of electrical equipment is designed to operate.

(hh) *'reference control setting'* means a control setting or combination of control settings that is used to verify compliance of a light source with this Regulation. These settings are relevant for light sources that allow the end-user to control, manually or automatically, directly or remotely, the luminous intensity, chromaticity, 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 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.

(ii) *'sensor'* means a device permanently connected to the electricity supply and integrated in a lamp or luminaire to sense environmental conditions and control the lamp in some way. For example a daylight sensor that switches the lamp or luminaire on at dusk or a presence detector that turns the lamp or luminaire off when nobody is there.

(jj) *'stroboscopic effect'* means a change in motion perception induced by a static light stimulus, the luminance or spectral distribution of which fluctuates with time, for a static observer in a non-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.

(kk) *'stroboscopic visibility measure or SVM'* is the metric for the stroboscopic effect used in this Regulation as defined in standards. SVM = 1 represents the visibility threshold for an average observer to have a 50% probability of detecting stroboscopic effects.

## Article 3. Requirements

Lamps in the scope of this 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	<b>Non-directional lm/W</b>	<b>Directional lm/W</b>	<b>Energy rating Level</b>
	≥80	≥70	MEPS – 0
	≥95	≥85	1
	≥110	≥100	2
	≥125	≥115	3
	≥140	≥130	4
	<p>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 (<math>R_a</math>) and/or colour temperature (<math>T_c</math>), and/or changing the DL/NDL status, shall be evaluated using the reference control settings.</p> <p>The MEPS level is a true baseline, no correction factors are allowed and test results for each of 10 lamps measured must comply with only one lamp out of 10 allowed below the baseline by up to 5%. Note: 11 lamps are sampled and 10 selected for test with one reserve. Only one catastrophic failure is allowed and must be substituted with the reserve. (see Clause 3.4)</p>		
Standby Power	<p>&lt; 500 mW</p> <p>Note: This requirement is only applicable to connected lamps</p>		
Fundamental Power Factor (also called Displacement Factor or $\cos \varphi_1$ )	<b>Rated Input Power P in W</b>		<b>Fundamental Power Factor</b>
	P ≤ 2W		Not applicable
	2W < P ≤ 5W		≥ 0.4
	5W < P ≤ 25W		≥ 0.7
	P > 25W		≥ 0.9

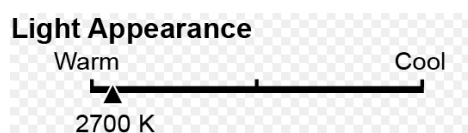
### 3.2 Functional performance requirements

Phenomena	Level
Colour Rendering Index (CRI (R <sub>a</sub> ))	≥ 80 Ra
Early Failure Test	After 3000 hours operation per the prescribed cycling rate of 150 minutes on and 30 minutes off in Appendix B the average lumen maintenance must be ≥ 90%
Short term flicker perceptibility (P <sub>st</sub> <sup>LM</sup> )	≤ 1.0 at full load and a sinusoidal line voltage input
Stroboscopic effect visibility (SVM)	≤0.4 at full load and a sinusoidal line voltage input <div style="border: 1px solid black; padding: 5px; margin-top: 5px;"> <p style="text-align: center; background-color: #c6e0b4; margin: 0;"><b>Context to Readers of the Model Regulation Guidelines</b></p> <p>The value 0.4 SVM was decided upon by reviewing policy trends, including:</p> <ul style="list-style-type: none"> <li>• International Energy Agency (IEA) – Energy Efficient End-use Equipment (4E) Solid State Lighting (SSL) Annex which has a value of 0.4.</li> <li>• European Commissions Ecodesign Directive – currently also has a value of 0.4 but it is under consideration for a transition value of 0.9.</li> </ul> <p>All are a more onerous level than legacy conventional fluorescent technology which achieves 1.3 to 1.6. Governments and stakeholders interested in implementing the Model Regulation Guidelines should research on the latest information and/or contact U4E for more information and the current status.</p> </div>
Mercury content	The lamp shall not contain any mercury (0.0 mg)

### 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. Items 1,2, 3 and 7 should also appear on the product label.

- 1) Rated power in Watt
- 2) Rated voltage in Volts
- 3) Rated initial luminous flux in lumen
- 4) Rated efficacy in lumens per Watt (lm/W)
- 5) Energy level as indicated by the conformity assessment report (see Article 5)
- 6) Rated correlated colour temperature (CCT) in Kelvin (K) combined with a sliding scale and indicated numerically on the product label.



- 7) Statement on control compatibility – clearly state whether dimmable or not dimmable. If yes, then information on dimmer compatibility, or web link to this information.
- 8) For general service lamps which are, according Clause 1.2, exempted from the requirements of Clause 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** or by adding the below pictogram to the packaging.



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).

#### Table of referenced test standards, compliance certification and surveillance testing (ref 3.4)

Phenomena	Measurement Standards	Surveillance Testing (for government)
Luminous Efficacy	Measured luminous flux/measured power See below	From a sample of 11 units, 10 are selected at random. The calculated luminous efficacy of each of the 10 units shall not be less than the required level with only one out of 10 allowed under the baseline by up to 5%. If one lamp fails catastrophically it is replaced with the reserve, if another fails then the product is non-compliant.
Luminous Flux in lm	IEC 62612 CIE S025	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.
Power in W	IEC 62612	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.
Standby Power (connected product only)	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.

Phenomena	Measurement Standards	Surveillance Testing (for government)
Fundamental Power Factor	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 (R <sub>a</sub> ))	IEC 62612 CIE S 025 CIE 13.3	Sample of 10 units. The arithmetical mean of the measured CRI (R <sub>a</sub> ) of the 10 units shall not be less than the required CRI (R <sub>a</sub> ) level minus 3.
Correlated Colour Temperature (CCT)	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.
Early Failure Test	See Appendix B	Sample of 10 units. After 1200 cycles of 150 minutes ON and 30 minutes OFF, at least nine lamps shall still be operational and the arithmetical mean of the luminous flux of the remaining units shall be at least 90% of initial luminous flux (lumen maintenance).
Flicker	IEC TR 61547-1	Sample of 10 units. The arithmetical mean of the measured P <sub>st</sub> <sup>LM</sup> of the 10 units shall not be more than the required level plus 10%.
Stroboscopic Effect	IEC TR 63158	Sample of 10 units. The arithmetical mean of the measured SVM of the 10 units shall not be more than the required level plus 10%.
Lifetime Claim	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.

## Article 4. Entry into Force

The product and information requirements set out in Article 3 shall take effect from one year after publication of the Regulation or 1 January 2023 whichever comes earliest.

## 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

### 6.1 Introduction

The designated authority implementing this Regulation shall develop a programme to check compliance with this standard and monitor the market for noncompliance. The programme should include details on sample size, laboratory accreditation requirements (ISO/IEC 17025 certified), and a challenge process that manufacturers can utilize if the initial testing of their product is found to be out of compliance.

[Agency name] will be responsible for enforcement activities that include potential assessment of fines and barring the ongoing sale of non-compliant products in the country. [Agency name] shall establish written policies that clearly spell out its authority, procedures, and penalty structure. All testing carried out for compliance and market surveillance testing purposes shall be in accordance with the measurement and calculation methods set out in this Regulation.

### 6.2 Outline procedure

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 samples of the same model from the same manufacturer, randomly selected in line with the table in Clause 3.4 and following the test sequence in Appendix A.

- (2) The model shall be considered to comply with the applicable requirements if:
- a. all measured parameters as defined in Clause 3.4 and the values calculated from these measurement(s) are within the respective verification tolerances,
  - b. the supplied technical documentation file provides sufficient evidence of the lifetime to substantiate the claim made by the manufacturer,
  - c. the product information meets the requirements of Clause 3.3 including:
    - i. the required statement on control compatibility and if compatibility is claimed then it is stated on the product label and packaging with further information provided qualifying this in instruction sheets or online.
- (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 to 4 inclusive. 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,
- substituting the CRI and CCT metrics by a more adequate metrics,
- setting requirements on dimming, including the interaction with flicker,
- combining this Regulation with other lighting-related Regulations,
- removing any apparent loopholes.

## 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.

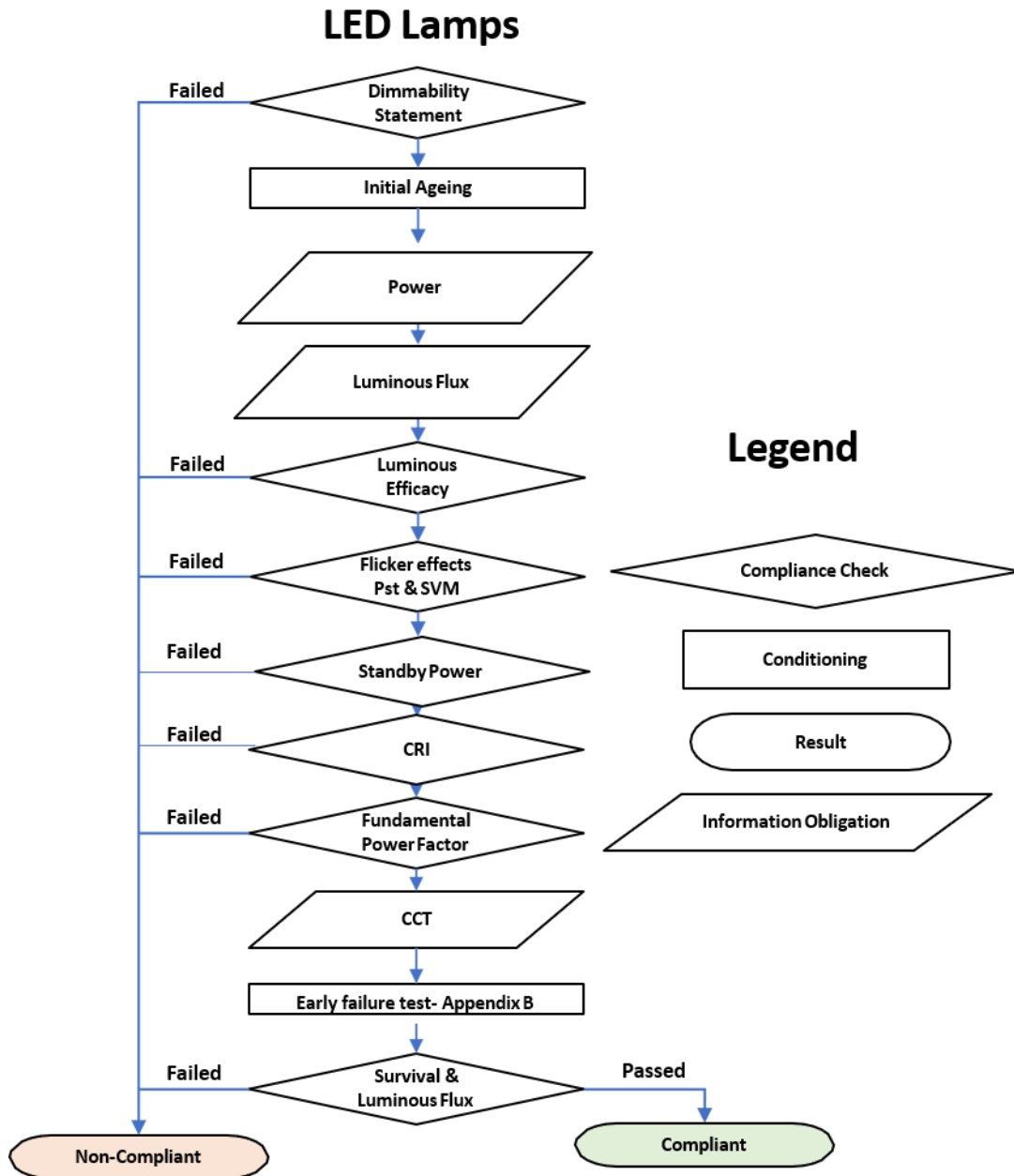
The most efficient light sources have an energy efficiency (based on useful luminous flux) of:

- Non-directional general service lamps: 140-160 lm/W
- Mains voltage directional lamps: 125-145 lm/W

Best available GSL lighting is all LED technology.

## Appendix A. Test Sequence

*Note: Mercury containing products such as fluorescent lamps cannot comply with the Regulation so this should be checked first.*



## Appendix B. Early Failure Test Including Lumen Maintenance

The combined test for LED GSL products shall be conducted using a sample of 10 units. If more than one lamp fails before the end of the test then both tests have failed and the tests can be stopped. If not, then the test continues until 3000 test hours is reached and at that point the arithmetical mean of the measured luminous flux of the remaining products shall be at least 90% of the arithmetical mean of their initial luminous flux. (i.e. lumen maintenance). The testing 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. blowing air from a fan or air conditioner directly onto the area where the testing racks and lamps are located),
- b) with the LED products operated in free air in a horizontal position,
- c) at the LED product's rated voltage and frequency if a single value is declared. If the rated voltage is a range, the LED product shall be tested at the mean voltage of that range. For dual-voltage LED products, 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 root mean square (RMS) 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 LED products operating for 1200 cycles. A cycle is defined as a repeatedly switching cycle of 150 minutes ON followed by 30 minutes OFF. The hours of operation recorded (i.e. 3000 hours) shall only include the periods of the cycle when the lamp was switched ON.

Note 1: Luminous flux of each LED product under test should be measured at time  $t=0$  (initial luminous flux prior to any cycling) and at the completion of 1200 cycles (150 minutes on, 30 minutes off).

Note 2: Linear LED products which can be connected directly to the electrical supply and to a magnetic control gear shall be tested as being connected to the electrical supply.

Note 3: Linear LED products that can only operate on control gear shall be tested using an inductive reference ballast in series.

