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ANNEXES 1 to 6

## **ANNEXES**

**to the**

### **COMMISSION REGULATION**

**implementing Directive 2009/125/EC of the European Parliament and of the Council  
with regard to ecodesign requirements for light sources and separate control gears**

**repealing Regulation (EC) No 244/2009 with regard to ecodesign requirements for non-  
directional household lamps,**

**Regulation (EC) No 245/2009 with regard to ecodesign requirements for fluorescent  
lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and  
luminaires able to operate such  
lamps,**

**and Regulation (EU) No 1194/2012 with regard to ecodesign requirements for  
directional lamps, light emitting diode lamps and related equipment**

**ANNEX I**  
**Definitions applicable for the Annexes**

In addition to the definitions set out in Directive 2009/125/EC and the definitions set out in Article 2 of this Regulation, the following definitions shall apply:

- (1) ‘mains light source (MLS)’ means a light source that can be operated directly on the mains electricity supply. Light sources that operate directly on the mains, and can also operate indirectly on the mains using a separate control gear, shall be considered to be mains light sources;
- (2) ‘non-mains light source (NMLS)’, means a light source that is not a mains light source. These light sources require a separate control gear to operate on the mains;
- (3) ‘directional light source’ (DLS) means a light source having at least 80 % of total luminous flux within a solid angle of  $\pi$  sr (corresponding to a cone with angle of  $120^\circ$ );
- (4) ‘non-directional light source’ (NDLS) means a light source that is not a directional light source;
- (5) ‘connected light source’ (CLS) means a light source including data-connection parts that are physically or functionally inseparable from the light emitting parts to maintain the ‘reference control settings’;

The light source can have physically integrated data-connection parts in a single inseparable housing, or the light source can be combined with physically separate data-connection parts placed on the market together with the light source as a single product.

- (6) ‘connected separate control gear’ (CSCG) means a separate control gear including data-connection parts that are physically or functionally inseparable from the actual control gear parts to maintain the ‘reference control settings’;

The separate control gear can have physically integrated data-connection parts in a single inseparable housing, or the separate control gear can be combined with physically separate data-connection parts placed on the market together with the control gear as a single product;

- (7) ‘data-connection parts’ means parts that perform any one of the following functions:
  - (a) reception or transmission of wired or wireless data signals and the processing thereof (either used to control the light emission function or otherwise),
  - (b) sensing and processing of the sensed signals (either used to control the light emission function or otherwise),
  - (c) actuation by audio control (including voice control),
  - (d) a combination of these;
- (8) ‘colour-tuneable light source’ (CTL) means a light source that can be set to emit light with a large variation of colours outside the range defined in article 2(1) but can also be set to emit white light inside the range defined in article 2(1) for which the light source is in scope of this Regulation;

The term does not include tuneable-white light sources that can only be set to emit light, with different correlated colour temperatures, within the range defined in Article 2(1).

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

- (9) ‘colour purity index’: a percentage computed for a CTLS set to emit light of a certain colour, using a procedure further defined in standards, by drawing a straight line on an (x,y) colour space graph from a point with colour coordinates  $x=0.313$  and  $y=0.330$  (D65 reference point, point 1), going through the point representing the (x,y) colour coordinates of the light source (point 2), and ending on the outer border of the colour space (locus; point 3). The colour purity index is computed as the distance between points 1 and 2 divided by the distance between points 1 and 3. The full length of the line represents 100% colour purity (point on the locus). The D65 reference point represents 0% colour purity (white light);
- (10) ‘lighting control parts’ means parts that are integrated in a light source or in a separate control gear, or physically separated but marketed together with a light source or separate control gear as a single product, that are not strictly necessary for the light source to emit light at full-load, or for the separate control gear to supply the electric power that enables light source(s) to emit light at full-load, but that enable manual- or automatic-, direct- or remote-, control of luminous intensity, chromaticity, correlated colour temperature, light spectrum and/or beam angle. Dimmers shall also be considered as lighting control parts;

The term also includes data-connection parts, but the term does not include products within the scope of Commission Regulation (EC) No 1275/2008<sup>1</sup>;

- (11) ‘non-lighting parts’ means parts that are integrated in a light source or in a separate control gear, or physically separate but marketed together with a light source or separate control gear as a single product, that are not necessary for the light source to emit light at full-load, or for the separate control gear to supply the electric power that enables light source(s) to emit light at full-load, and that are not ‘lighting control parts’. Examples include, but are not limited to: speakers (audio), cameras, repeaters for communication signals to extend the range (e.g. WiFi), parts supporting grid balance (switching to own internal batteries when necessary), battery charging, visual notification of events (mail arriving, door bell ringing, alert), use of Light Fidelity (Li-Fi, a bidirectional, high-speed and fully networked wireless communication technology);
- (12) ‘useful luminous flux’ ( $\Phi_{\text{use}}$ ), means the part of the luminous flux of a light source that is considered when determining its energy efficiency:
- for non-directional light sources it is the total flux emitted in a solid angle of  $4\pi$  sr (corresponding to a  $360^\circ$  sphere).
  - for directional light sources with beam angle  $\geq 90^\circ$  it is the flux emitted in a solid angle of  $\pi$  sr (corresponding to a cone with angle of  $120^\circ$ ).
  - for directional light sources with beam angle  $< 90^\circ$  it is the flux emitted in a solid angle of  $0.586\pi$  sr (corresponding to a cone with angle of  $90^\circ$ ).
- (13) ‘beam angle’ of a directional light source 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

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<sup>1</sup> OJ L 339, 18.12.2008, p. 45 and later amendments.

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;

For light sources that have different beam angles in different planes, the largest beam angle shall be the one taken into account;

For light sources with user-controllable beam angle, the beam angle corresponding to the 'reference control setting' shall be the one taken into account;

- (14) 'full-load' means:
- the condition of a light source, within the declared operating conditions, in which it emits the maximum (undimmed) initial luminous flux, or
  - the operating conditions and loads of the control gear under efficiency measurement as specified in the relevant standards;
- (15) 'no-load mode' means the condition of a separate control gear in which its input is connected to the mains power source and its output is intentionally disconnected from light sources, and, if applicable, from data-connection parts, lighting control parts and non-lighting parts. If these parts cannot be disconnected, they shall be switched off and their power consumption shall be minimized following the manufacturer's instructions;
- No-load mode only applies to separate control gear for which the manufacturer or importer has declared in the technical documentation that it has been designed for this mode;
- (16) 'standby mode' means the condition of a light source or of a separate control gear, where it is connected to the power supply but the light sources are intentionally not emitting light, and the light source or control gear is awaiting a control signal (from a source different from a network) to return to a state with light emission. Lighting control parts enabling the standby function shall be in their control mode. Non-lighting parts shall be disconnected or switched off or their power consumption shall be minimized following manufacturer's instructions;
- (17) 'networked standby mode' means the condition of a connected light source (CLS) or a connected separate control gear (CSCG) where it is connected to the power supply but the light source is intentionally not emitting light or the control gear does not supply the electric power that enables light source(s) to emit light, and is awaiting a remotely initiated trigger (from a network) to return to a state with light emission. Lighting control parts shall be in their control mode and data-connection parts shall be in a state enabling the networked standby function. Non-lighting parts shall be disconnected or switched off or their power consumption shall be minimized following manufacturer's instructions;
- (18) 'control mode' means the condition of lighting control parts where they are connected to the light source and/or to the separate control gear and performing their functions in such a way that a control signal can be internally generated or a remotely initiated trigger can be received, by wire or wireless, and processed to lead to a change in the light emission of the light source or to a corresponding desired change in the power supply by the separate control gear;
- (19) 'remotely initiated trigger' means a signal that comes from outside the light source via a network;

- (20) ‘control signal’ means an analogue or digital signal transmitted to light source or separate control gear wirelessly or wired either via voltage modulation in separate control cables or via a modulated signal in the supply voltage. The signal transmission is not through a network but e.g. from an internal source or from a remote control delivered with the product;
- (21) ‘network’ means a communication infrastructure with a topology of links, an architecture, including the physical components, organisational principles, communication procedures and formats (protocols);
- (22) ‘on-mode power’ ( $P_{on}$ ), expressed in Watt, is the electric power consumption of a light source in full-load with all lighting control parts and non-lighting parts disconnected. If these parts cannot be disconnected they shall be switched off or their power consumption shall be minimised following the manufacturer’s instructions;
- In case of a non-mains light source (NMLS) that requires a separate control gear to operate,  $P_{on}$  can be measured directly on the input to the light source, or  $P_{on}$  is determined using a control gear with known efficiency, whose electric power consumption is subsequently subtracted from the measured mains power input value;
- (23) ‘no-load power’ ( $P_{no}$ ), expressed in Watts, is the electric power consumption of a separate control gear in no-load mode;
- (24) ‘standby power’ ( $P_{sb}$ ), expressed in Watts, is the electric power consumption of a light source or of a separate control gear in standby mode;
- (25) ‘networked standby power’ ( $P_{net}$ ), expressed in Watts, is the electric power consumption of a connected light source (CLS) or of a connected separate control gear (CSCG) in networked standby mode;
- (26) ‘reference control settings’ (RCS) means a control setting or a 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, colour, correlated colour temperature, spectrum, and/or beam angle of the emitted light.

In principle, 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.

If the out-of-the-box value is deliberately set differently from the reference control setting (e.g. at low power for safety purposes), the manufacturer shall indicate in the technical documentation how to recall the reference control settings for compliance verification.

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

- the light source is in scope of this Regulation according to Art.1 and none of the conditions for exemption of Annex I applies (if this is not possible, the light source is out-of-scope or exempted);
- 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.

For light sources that allow the manufacturer of a containing product to make implementation choices that influence light source characteristics (e.g. definition of the operating current(s); thermal design), and that cannot be controlled by the end-user, the reference control settings need not be defined. In that case the test conditions defined in applicable standards apply;

- (27) ‘high-pressure mercury light source’ means a high intensity discharge light source in which the major portion of light is produced, directly or indirectly, by radiation from predominantly vaporized mercury operating at a partial pressure in excess of 100 kilopascals;
- (28) ‘metal halide light source’ (MH) means a high intensity discharge light source in which the light is produced by radiation from a mixture of metallic vapour, metal halides and the products of the dissociation of metal halides. MH light sources may have one (‘single-ended’) or two (‘double-ended’) connectors to their electricity supply. The material for the arc tube of MH light sources can be quartz (QMH) or ceramic (CMH);
- (29) ‘compact fluorescent light source’ (CFL) means a single-capped fluorescent light source with a bent-tube construction designed to fit in small spaces. CFLs may be primarily spiral-shaped (i.e. curly forms) or primarily shaped as connected multiple parallel tubes, with or without a second bulb-like envelope. CFLs are available with (CFLi) or without (CFLni) physically integrated control gear;
- (30) ‘T2’, ‘T5’, ‘T8’, ‘T9’ and ‘T12’ means a tubular light source with diameter of approximately 7, 16, 26, 29 and 38 mm respectively, as defined in harmonised standards. The tube can be straight (linear) or bent (e.g. U-shaped, circular);
- (31) ‘LFL T5-HE’ means a high-efficiency linear fluorescent T5 light source with driving current lower than 0.2 A;
- (32) ‘LFL T5-HO’ means a high-output linear fluorescent T5 light source with driving current higher than or equal to 0.2 A;
- (33) ‘LFL T8 2-foot’, ‘LFL T8 4-foot’ or ‘LFL T8 5-foot’ means a linear T8 fluorescent light source with a length of approximately 600 mm (2 feet), 1200 mm (4 feet) or 1500 mm (5 feet) respectively, as defined in standards;
- (34) ‘magnetic induction light source’ means a light source using fluorescent technology, where energy is transferred to the gas discharge by means of an induced high-frequency magnetic field, instead of using electrodes placed inside the gas discharge. The magnetic inductor can be external or internal to the shape of the discharge tube;
- (35) ‘G4’, ‘GY6.35’ and ‘G9’ means an electrical interface for a light source consisting of two small pins at distances of 4, 6.35 and 9 mm respectively, as defined in standards;
- (36) ‘HL R7s’ is a mains-voltage, double capped, linear halogen light source with a cap-diameter of 7 mm;
- (37) ‘G9.5’, ‘GX9.5’, ‘GY9.5’, ‘G9.5HPL’, ‘G16d’, ‘GX16d’, ‘GY16’, ‘G22’ and ‘G38’ means an electrical interface for a light source consisting of two pins at distances of 9.5, 16, 22 and 38 mm respectively, as defined in standards. ‘G9.5HPL’ includes a

heatsink of specific dimensions as used on High-Performance halogen lamps, and may include additional pins for grounding purposes;

- (38) ‘P28s’, ‘P40s’ and ‘PGJX50’ means an electrical interface for a light source that uses a flange contact to correctly position (pre-focus) the light source in a reflector, as defined in standards;
- (39) ‘QXL (Quick eXchange Lamp)’ means an electrical interface for a light source consisting, on the light source side, of two lateral tabs including the electrical contact surfaces and, on the opposite (rear) side, of a central protrusion allowing to grab the light source with two fingers. It has been specifically designed for use in a class of stage lighting luminaires, in which the light source is inserted from the rear of the luminaire using a ¼ turn rotation to fix or unfix it;
- (40) ‘battery-operated’ means a product that operates only on direct current (DC) supplied from a source contained in the same product, without being connected directly or indirectly to the mains electricity supply;
- (41) ‘second envelope’ means a second outer envelope on a HID light source that is not required for the production of light, such as an external sleeve for preventing mercury and glass release into the environment in case of lamp breakage. In determining the presence of a second envelope, the HID arc tubes shall not count as an envelope;
- (42) ‘non-clear envelope’ for a HID light source means a non-transparent outer envelope or outer tube in which the light producing arc tube is not visible;
- (43) ‘anti-glare shield’ means a mechanical or optical reflective or non-reflective impervious baffle designed to block direct visible radiation emitted from the light emitter in a directional light source, in order to avoid temporary partial blindness (disability glare) if viewed directly by an observer. It does not include surface coating of the light emitter in the directional light source;
- (44) ‘control gear efficiency’ is the output power divided by the input power of a separate control gear using the conditions and methods defined in measurement standards. Any lighting control parts and non-lighting parts are disconnected, switched off or set to minimum power consumption according to manufacturer’s instructions and subtracting this power consumption from the overall input power;
- (45) ‘functionality after endurance testing’ means the functionality of a LED or OLED light source after endurance testing as defined in Annex V;
- (46) ‘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.

The metric for flicker used in this Regulation is the ‘Pst LM’, where ‘st’ stands for short term and ‘LM’ for light flickermeter method, as defined in standards. A value Pst LM=1 means that the average observer has a 50% probability of detecting flicker;

- (47) ‘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. 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 the stroboscopic effect used in this Regulation is the ‘SVM’ (Stroboscopic Visibility Measure), as defined in standards. SVM=1 represents the visibility threshold for an average observer;

- (48) ‘declared value’ for a parameter means the value given by the manufacturer or importer in the technical documentation pursuant to point 2 of Annex IV to Directive 2009/125/EC;
- (49) ‘specific effective radiant ultraviolet power’ (mW/klm) means the effective power of the ultraviolet radiation of a light source weighted according to the spectral correction factors and related to its luminous flux;
- (50) ‘luminous intensity’ (candela or cd) means the quotient of the luminous flux leaving the source and propagated in the element of solid angle containing a given direction, by the element of solid angle;
- (51) ‘correlated colour temperature’ (CCT [K]) means the temperature of a Planckian (black body) radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions;
- (52) ‘colour consistency’ means the maximum deviation of the initial (after a short period of time), spatially averaged chromaticity coordinates (x and y) of a single light source from the chromaticity centre point (cx and cy) declared by the manufacturer or the importer, expressed as the size (in steps) of the MacAdam ellipse formed around the chromaticity centre point (cx and cy);
- (53) ‘displacement factor (cos  $\phi_1$ )’ means the cosine of the phase angle  $\phi_1$  between the fundamental harmonic of the mains supply voltage and the fundamental harmonic of the mains current. It is used for mains light sources using LED- or OLED-technology;

The displacement factor is measured at full-load, for the reference control settings where applicable, with any lighting control parts in control mode and non-lighting parts disconnected, switched off or set to minimum power consumption according to the manufacturer’s instructions;

- (54) ‘lumen maintenance factor’ (LMF) means the ratio of the luminous flux emitted by a light source at a given time in its life to the initial luminous flux;
- (55) ‘survival factor’ (SF) means the defined fraction of the total number of light sources that continue to operate at a given time under defined conditions and switching frequency;
- (56) ‘lifetime’ for LED and OLED light sources means the time in hours between the start of their use and the moment when for 50% of a population of light sources the light output has gradually degraded to a value below 70% of the initial luminous flux. This is also referred to as the  $L_{70}B_{50}$  lifetime;
- (57) ‘equivalent model’ means a model with the same relevant technical and performance characteristics as another model placed on the market under a different commercial code;
- (58) ‘end-user’ means a natural person buying or expected to buy a product for purposes which are outside his trade, business, craft or profession;
- (59) ‘photosensitive patients’ means people with a specific condition causing photosensitive symptoms and who experience adverse reactions to natural and/or certain forms of artificial lighting technology;

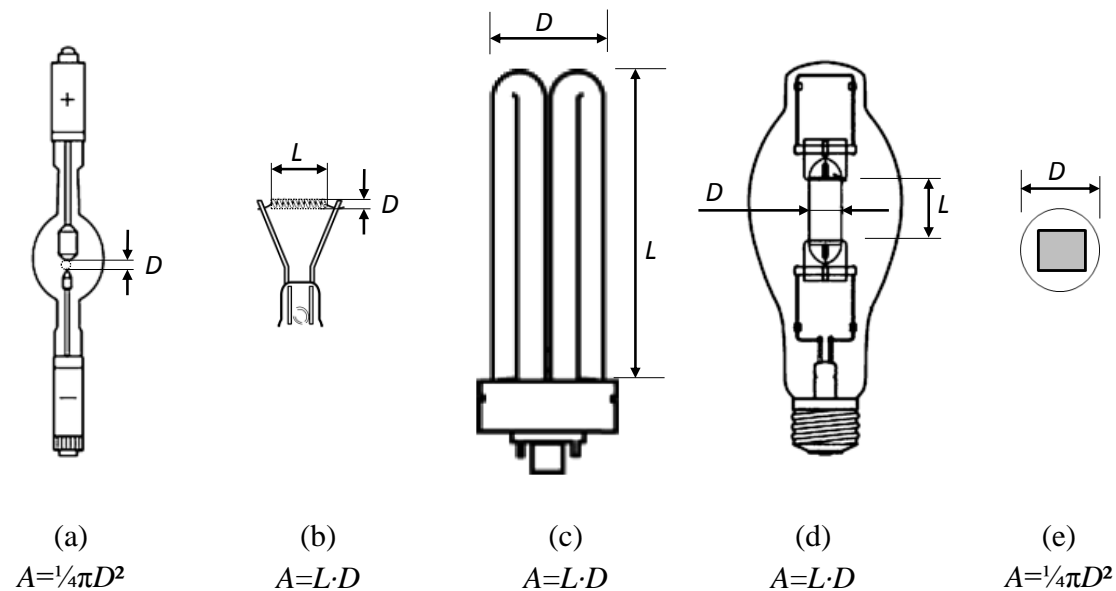


- (60) 'projected light-emitting surface area (A)' is the surface area in mm<sup>2</sup> (square millimetres) of the view in an orthographic projection of the light-emitting surface from the direction with the highest light intensity, where the light-emitting surface area is the surface area of the light source that emits light with the declared optical characteristics, such as the approximately spherical surface of an arc (a), cylindrical surface of a filament coil (b) or a gas discharge lamp (c, d), flat or semi-spherical envelope of a light-emitting diode (e).

For light sources with a non-clear envelope or with anti-glare shield, the light-emitting surface area is the entire area through which light leaves the light source.

For light sources containing more than one light emitter, the projection of the smallest gross volume enveloping all emitters shall be taken as the light-emitting surface.

For HID light sources definition (a) applies, unless the dimensions defined in (d) apply with  $L > D$ , where  $L$  is the distance between the electrode tips and  $D$  the inner diameter of the arc tube.



## ANNEX II

### Ecodesign requirements

For the purposes of compliance and verification of compliance with the requirements of this Regulation, measurements and calculations shall be made using harmonised standards the reference numbers of which have been published for this purpose in the *Official Journal of the European Union*, or other reliable, accurate and reproducible methods, which takes into account the generally recognised state-of-the-art.

#### 1. Energy efficiency requirements:

- (a) From 1 September 2021, the declared power consumption of a light source at full-load  $P_{on}$  shall not exceed the maximum allowed power  $P_{onmax}$  (in  $W$ ), defined in function of the declared useful luminous flux  $\Phi_{use}$  (in  $lm$ ) and the declared colour rendering index CRI (-) as follows:

$$P_{onmax} = C * (L + \Phi_{use} / (F * \eta)) * R$$

Where:

- The values for threshold efficacy ( $\eta$  in  $lm/W$ ) and end loss factor ( $L$  in  $W$ ) are specified in Table 1, depending on the light source type. They are constants used for computations and do not reflect true parameters of light sources. The threshold efficacy is not the minimum required efficacy; the latter can be computed by dividing the useful luminous flux by the computed maximum allowed power.
- Basic values for correction factor ( $C$ ) depending on light source type, and additions to  $C$  for special light source features are specified in Table 2.
- Efficacy factor ( $F$ ) is:
  - 1,00 for non-directional light sources (NDLS, using total flux)
  - 0,85 for directional light sources (DLS, using flux in a cone)
- CRI factor ( $R$ ) is:
  - 0,65 for  $CRI \leq 25$
  - $(CRI+80)/160$  for  $CRI > 25$

**Table 1 – Threshold efficacy ( $\eta$ ) and end loss factor (L)**

<b>Light source description</b>	<b><math>\eta</math></b>	<b>L</b>
	[lm/W]	[W]
LFL T5-HE	<b>98,8</b>	<b>1,9</b>
LFL T5-HO, $4000 \leq \Phi \leq 5000$ lm	<b>83,0</b>	<b>1,9</b>
LFL T5-HO, other lm output	<b>79,0</b>	<b>1,9</b>
FL T5 circular	<b>79,0</b>	<b>1,9</b>
FL T8 other than LFL 2-, 4- and 5-foot (incl. FL T8 U-shaped)	<b>89,7</b>	<b>4,5</b>
FL using magnetic induction, any length/flux	<b>70,2</b>	<b>2,3</b>
CFLni	<b>70,2</b>	<b>2,3</b>
FL T9 circular	<b>71,5</b>	<b>6,2</b>
HPS single-ended	<b>88,0</b>	<b>50,0</b>
HPS double-ended	<b>78,0</b>	<b>47,7</b>
MH $\leq 405$ W single-ended	<b>84,5</b>	<b>7,7</b>
MH $> 405$ W single-ended	<b>79,3</b>	<b>12,3</b>
MH ceramic double-ended	<b>84,5</b>	<b>7,7</b>
MH quartz double-ended	<b>79,3</b>	<b>12,3</b>
Organic light-emitting diode (OLED)	<b>65,0</b>	<b>1,5</b>
HL R7s $\leq 2700$ lm	<b>26,0</b>	<b>13,0</b>
Other light sources in scope not mentioned above	<b>120,0</b>	<b>1,5*</b>

\* For connected light sources (CLS) a factor L=2,0 shall be applied.

**Table 2 – Correction factor C depending on light source characteristics**

<b>Light source type</b>	<b>Basic C value</b>
Non-directional (NDLS) not operating on mains (NMLS)	1,00
Non-directional (NDLS) operating on mains (MLS)	1,08
Directional (DLS) not operating on mains (NMLS)	1,15
Directional (DLS) operating on mains (MLS)	1,23
<b>Special light source feature</b>	<b>Bonus on C</b>
FL or HID with CCT $> 5000$ K	+0,10
FL with CRI $> 90$	+0,10
HID with second envelope	+0,10
MH NDLS $> 405$ W with non-clear envelope	+0,10
DLS with anti-glare shield	+0,20
Colour-tuneable light source (CTLS)	+0,10

Where applicable, bonuses on correction factor C are cumulative.

Light sources 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 and/or correlated colour temperature (CCT), and/or changing the DLS/NDLS status, shall be evaluated using the reference control settings, at full-load.

The standby power  $P_{sb}$  of a light source shall not exceed 0.5 W.

The networked standby power  $P_{net}$  of a connected light source shall not exceed 0.5 W.

The allowable values for  $P_{sb}$  and  $P_{net}$  shall not be added together.

- (b) From 1 September 2021, the values set in Table 3 for the minimum energy efficiency requirements of separate control gear operating at full-load shall apply:

**Table 3 – Minimum efficiency for separate control gear at full-load**

<b>Declared output power of the control gear (<math>P_{cg}</math>) or declared power of the light source (<math>P_{ls}</math>) in W, as applicable</b>	<b>Minimum efficiency</b>
<u>Control gear for HL light sources</u> all wattages $P_{cg}$	0,91
<u>Control gear for FL light sources</u> $P_{ls} \leq 5$ $5 < P_{ls} \leq 100$ $100 < P_{ls}$	0,71 $P_{ls} / (2 * \sqrt{(P_{ls} / 36) + 38 / 36 * P_{ls} + 1})$ 0,91
<u>Control gear for HID light sources</u> $P_{ls} \leq 30$ $30 < P_{ls} \leq 75$ $75 < P_{ls} \leq 105$ $105 < P_{ls} \leq 405$ $405 < P_{ls}$	0,78 0,85 0,87 0,90 0,92
<u>Control gear for LED or OLED light sources</u> all wattages $P_{cg}$	$P_{cg}^{0,81} / (1,09 * P_{cg}^{0,81} + 2,10)$

Multi-wattage separate control gears shall comply with the requirements in Table 3 according to the maximum declared power on which they can operate.

The no-load power  $P_{no}$  of a separate control gear shall not exceed 0.5 W. This applies only to separate control gear for which the manufacturer or importer has declared in the technical documentation that it has been designed for no-load mode.

The standby power  $P_{sb}$  of a separate control gear shall not exceed 0.5W.

The networked standby power  $P_{net}$  of a connected separate control gear shall not exceed 0.5 W. The allowable values for  $P_{sb}$  and  $P_{net}$  shall not be summed.

2. Functional requirements:

- (a) From 1 September 2021, the functional requirements specified in Table 4 shall apply for light sources.

**Table 4 – Functional requirements for light sources**

Colour rendering	CRI $\geq 80$ (except for HID with $\Phi_{\text{use}} > 4 \text{ klm}$ and for light sources intended for use in outdoor applications, industrial applications or other applications where lighting standards allow a CRI $<80$ , when a clear indication to this effect is shown on the light source packaging and in all relevant printed and electronic documentation)
Displacement factor (DF, $\cos \phi_1$ ) at power input $P_{\text{on}}$ for LED and OLED MLS	No limit at $P_{\text{on}} \leq 5 \text{ W}$ , DF $\geq 0.5$ at $5 \text{ W} < P_{\text{on}} \leq 10 \text{ W}$ , DF $\geq 0.7$ at $10 \text{ W} < P_{\text{on}} \leq 25 \text{ W}$ DF $\geq 0.9$ at $25 \text{ W} < P_{\text{on}}$
Lumen maintenance factor (for LED and OLED)	The lumen maintenance factor $X_{\text{LMF}}\%$ after endurance testing according to Annex V shall be at least $X_{\text{LMF,MIN}}\%$ calculated as follows: $X_{\text{LMF,MIN}}\% = 100 * e^{\frac{(3000 * \ln(0.7))}{L_{70}}}$ where $L_{70}$ is the declared $L_{70}B_{50}$ lifetime (in hours) Upper limit for $X_{\text{LMF,MIN}}\%$ : the calculated required lumen maintenance of the sample shall not exceed 96.0% (i.e., $X_{\text{LMF,MIN}} \leq 96.0 \%$ )
Survival factor (for LED and OLED)	Light sources should be operational as specified in Annex IV Table 6, following the endurance testing given in Annex V.
Colour consistency for LED and OLED light sources	Variation of chromaticity coordinates within a six-step MacAdam ellipse or less.
Flicker for LED and OLED MLS	$P_{\text{st LM}} \leq 1.0$ at full-load
Stroboscopic effect for LED and OLED MLS	$SVM \leq 1.6$ at full-load

1. Information requirements:

(a) Information to be displayed on the light source itself.

For all light sources, except CTLS, LFL, CFLni, other FL, and HID, the value and physical unit of the useful luminous flux ( $lm$ ) and correlated colour temperature ( $K$ ) shall be displayed in a legible font on the surface if, after the inclusion of safety-related information, there is sufficient space available for it without unduly obstructing the light emission.

For directional light sources the beam angle ( $^\circ$ ) shall also be indicated.

If there is room for only two values, the useful luminous flux and the correlated colour temperature shall be displayed. If there is room for only one value, the useful luminous flux shall be displayed.

(b) Information to be visibly displayed on the packaging

(1) Light sources:

Light sources in scope of this Regulation are in scope of Commission Delegated Regulation (EU) .../... supplementing Regulation (EU) 2017/1369 with regard to energy labelling for light sources. As concerns the information to be visibly displayed on the packaging of light sources, manufacturers and importers shall apply the requirements set out in Annex **XXX** of Commission Delegated Regulation (EU) .../... .

(2) Separate control gears:

If a separate control gear is placed on the market as a stand-alone product and not as a part of a containing product, in a packaging containing information to be visibly displayed to potential buyers, prior to their purchase, the following information shall also be clearly and prominently displayed on the packaging:

- (a) the maximum output power of the control gear (for HL, LED and OLED) or the power of the light source for which the control gear is intended (for FL and HID);
- (b) the type of light source(s) for which it is intended;
- (c) the efficiency in full-load, expressed in percentage;
- (d) the no-load power ( $P_{no}$ ), expressed in W and rounded to the second decimal, or the indication that the gear is not intended to operate in no-load mode. If the value is zero, it may be omitted from the packaging but shall anyway be declared in the technical documentation and on websites;
- (e) the standby power ( $P_{sb}$ ), expressed in W and rounded to the second decimal. If the value is zero, it may be omitted from the packaging but shall anyway be declared in the technical documentation and on websites;
- (f) the networked standby power ( $P_{net}$ ), expressed in W and rounded to the second decimal. If the value is zero, it may be omitted from the packaging but shall anyway be declared in the technical documentation and on websites;
- (g) a warning if the control gear is not suitable for dimming of light sources, or can be used only with specific types of dimmable light sources or using specific wired or wireless dimming methods. In the latter cases, detailed information on the conditions in which the control gear can be used for dimming shall be provided on the manufacturer's or importer's website;
- (h) a QR-code redirecting to a website optimized for mobile devices, or the internet address for a website, where full information on the control gear can be found;
- (i) The information does not need to use the exact wording on the list above. In addition, it may be displayed in the form of graphs, drawings or symbols.

(c) Information to be visibly displayed on a free-access website

(1) Light sources:

Light sources in scope of this Regulation are in scope of Commission Delegated Regulation (EU) .../... supplementing Regulation (EU) 2017/1369 with regard to energy labelling for light sources. As concerns the information to be visibly displayed on a free-access website, manufacturers and importers shall apply the requirements set out in Annex V of Commission Delegated Regulation (EU) .../... in relation to the product database set out in Article 4 of Regulation (EU) 2017/1369.

(2) Separate control gears:

For any separate control gear that is placed on the market, the following information shall be displayed on at least one free-access website, including a website optimized for mobile devices. For separate control gears to which requirement 3.2.2(h) applies, the latter website shall be linked to a QR-code on the packaging:

- (a) the information specified in point 3.2.2, except 3.2.2(h);
- (b) the outer dimensions in mm;
- (c) the mass in grams of the control gear, without packaging, and without lighting control parts and non-lighting parts, if any and if they can be physically separated from the control gear;
- (d) instructions how to remove lighting control parts and non-lighting parts, if any, or how to switch them off or minimize their power consumption during control gear testing;
- (e) if it can be used with dimmable light sources, a list of minimum characteristics that the light sources should have to be fully compatible with the control gear during dimming, and possibly a list of compatible dimmable light sources;
- (f) recommendations on how to dispose of it at the end of its life for recycling in line with Directive 2012/19/EU<sup>2</sup>.

The information does not need to use the exact wording in the list above. In addition, it may be displayed in the form of graphs, drawings or symbols.

Information on separate control gears that are no longer in production or that are not or no longer intended for sale in the European Union should be clearly marked as such and/or moved to a separate section of the website.

The same information shall also be contained in the technical documentation file drawn up for the purposes of conformity assessment pursuant to Article 8 of Directive 2009/125/EC.

(d) Technical documentation

Light sources in scope of this Regulation are in scope of Commission Delegated Regulation (EU) .../... supplementing Regulation (EU) 2017/1369 with regard to energy labelling for light sources. The technical documentation for the purposes of conformity assessment pursuant to Article 5 shall include the information in the order and as set out in Table 6 of Regulation [*Please insert here references of the specific energy labelling regulation*]. For market surveillance purposes, manufacturers may refer to the technical documentation uploaded to the product

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<sup>2</sup> OJ L 197, 24.7.2012, p. 38.

database which contains the same information as per Regulation [*Please insert here references of the specific energy labelling regulation*].

(e) Information for products specified in Annex I point 3

For the light sources and separate control gears specified in Annex I point 3, the intended purpose shall be stated on all forms of packaging, product information and advertisement, together with an explicit indication that the light source is not intended for use in other applications.

In particular for light sources indicated in Annex I point 3 (p), it shall be stated: "This light source is only for use by photo sensitive patients. Use of this light source will lead to increased energy cost compared to an equivalent more energy efficient product."



### **ANNEX III**

#### **Exemptions**

1. This Regulation shall not apply to light sources and separate control gears specifically tested and approved to operate:
  - (a) in potentially explosive atmospheres as defined in Directive 2014/34/EU<sup>3</sup> of the European Parliament and of the Council;
  - (b) for emergency use as set out in Directive 2014/35/EU of the Council and the Parliament<sup>4</sup>;
  - (c) in radiological and nuclear medicine installations, as defined in Article 3 of Directive 2009/71/EURATOM<sup>5</sup>;
  - (d) in or on military or civil defence establishments, equipment, ground vehicles, marine equipment or aircraft as set out in Member States' Regulations or in documents issued by the European Defence Agency;
  - (e) in or on motor vehicles, their trailers and systems, components and separate technical units intended therefore, as set out in Regulation (EC) No 661/2009<sup>6</sup>, Regulation (EU) No 167/2013<sup>7</sup>, Regulation (EU) No 168/2013<sup>8</sup> and their amendments;
  - (f) in or on non-road mobile machinery intended as set out in Regulation (EU) 2016/1628/EU<sup>9</sup> and their amendments;
  - (g) in or on civil aviation aircrafts as set out in Commission Regulation (EU) No 748/2012<sup>10</sup>;
  - (h) in railway vehicle lighting as set out in Directive 2008/57/EC<sup>11</sup> and its amendments, as well as relevant Member State legislation;
  - (i) in marine equipment as set out in Council Directive 2014/90/EU<sup>12</sup> and its amendments or recasts;
  - (j) in medical devices as set out in Council Directive 93/42/EEC<sup>13</sup> and in vitro medical devices as set out in Directive 98/79/EC<sup>14</sup> and their amendments.

For the purpose of this point, 'specifically tested and approved' means that the light source or separate control gear:

- (1) has been specifically tested for the mentioned operating condition or application, according to the European legislation mentioned or related implementing acts, relevant Member State legislation, and/or relevant European or international standards, and

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<sup>3</sup> OJ L 96, 29.3.2014, p. 309-356 (the 'ATEX Directive')

<sup>4</sup> OJ L 96, 29.3.2014, p. 357-. (the 'Low Voltage Directive')

<sup>5</sup> OJ L 172, 2.7.2009, p. 18-.

<sup>6</sup> OJ L 200, 31.7.2009, p.1-24

<sup>7</sup> OJ L60, 2.3.2013, p. 1–51

<sup>8</sup> OJ L60, 2.3.2013, p. 52

<sup>9</sup> OJ L252, 16.9.2016, p. 53–117

<sup>10</sup> OJ L 224, 21.8.2012, p. 1-85

<sup>11</sup> OJ L 191, 18.7.2008, p.1-45.

<sup>12</sup> OJ L 257, 28.8.2014, p. 146–185

<sup>13</sup> OJ L 169, 12.7.1993, p. 1

<sup>14</sup> OJ L331, 7.12.1998, p.1

- (2) is accompanied by evidence, in the form of a certificate, a type approval mark, a test report or other documentation, that the product has been specifically approved for the mentioned operating condition or application, and
- (3) is placed on the market specifically for the mentioned operating condition or application, as evidenced at least by the technical documentation, information on the packaging and any advertising or marketing materials.

2. In addition, this Regulation shall not apply to:

- (a) double capped fluorescent T5 light sources with power  $P \leq 13 \text{ W}$ ;
- (b) electronic displays (e.g. televisions, computer monitors, notebooks, tablets, mobile phones, e-readers, game consoles), including but not limited to displays in scope of Commission Regulation (EU) No 617/2013<sup>15</sup>, Commission Decision (EU) 2015/1402<sup>16</sup>, Commission Regulation (EC) No 642/2009<sup>17</sup>, Commission Decision (EU) 2016/1756<sup>18</sup>, European Commission COM(2015)178<sup>19</sup>;
- (c) Range hoods in the scope of Commission Delegated Regulation (EU) No 65/2014;
- (d) light sources and separate control gears in battery-operated products, including but not limited to e.g. torches, mobile phones with integrated torch light, toys including light sources, desk lamps operating only on batteries, armband lamps for cyclists, solar-powered garden lamps;
- (e) light sources and separate control gears in bicycles and other non-motorized vehicles.

3. Any light source or separate control gear in scope of this Regulation shall be exempt from the requirements of Annex III, with the exception of the information requirements set out in Annex III point 3.5, if it has a specific technical design for its intended use in at least one of the following applications:

- (a) signalling (including, but not limited to, road-, railway-, marine- or air traffic-signalling, traffic control or airfield lamps);
- (b) image capture and image projection (including, but not limited to, photocopying, printing (directly or in pre-processing), lithography, film and video projection, holography);
- (c) light sources with specific effective ultraviolet power  $>2 \text{ mW/klm}$  and intended for use in applications requiring high UV-content;
- (d) light sources with a peak radiation around 253.7 nm and intended for germicidal use (destruction of DNA);
- (e) light sources emitting 5 % or more of total radiation power of the range 250-800 nm in the range of 250-315 nm and/or 20 % or more of total radiation

<sup>15</sup> OJ L 175, 27.6.2013, p. 13

<sup>16</sup> OJ L 217, 18.8.2015, p.9 (office equipment, computers)

<sup>17</sup> OJ L 191, 23.7.2009, p.42 (televisions)

<sup>18</sup> OJ L 268, 1.10.2016, p.90 (office equipment, displays)

<sup>19</sup> COM(2015) 178 final, 22.4.2015 (related to self-regulatory initiative regarding game consoles)

power of the range 250-800 nm in the range of 315-400 nm, and intended for disinfection or fly trapping;

- (f) light sources with the primary purpose of emitting radiation around 185.1 nm and intended to be used for the generation of ozone;
- (g) light sources emitting 40 % or more of total radiation power of the range 250-800 nm in the range of 400-480 nm, and intended for coral zooxanthellae symbioses;
- (h) FL light sources emitting 80 % or more of total radiation power of the range 250-800 nm in the range of 250-400 nm, and intended for sun-tanning;
- (i) HID light sources emitting 40 % or more of total radiation power of the range 250-800 nm in the range of 250-400 nm, and intended for sun-tanning;
- (j) light sources with a photosynthetic efficacy  $>1.2 \mu\text{mol/J}$ , and/or emitting 25 % or more of total radiation power of the range 250-800 nm in the range of 700-800 nm, and intended for use in horticulture;
- (k) HID light sources with correlated colour temperature  $\text{CCT} > 7000 \text{ K}$  and intended for use in applications requiring such a high CCT;
- (l) halogen light sources with a beam angle of less than  $10^\circ$  and intended for spot-lighting applications requiring a very narrow light beam;
- (m) halogen light sources with cap-type G9.5, GX9.5, GY9.5, GZ9.5, G9.5HPL, G16d, GX16, GX16d, GY16, G22, G38, GX38, GX38Q, P28s, P40s, PGJX50, QXL, designed and marketed specifically for scene-lighting use in film-studios, TV-studios, and photographic-studios, or for stage-lighting use in theatres, discos and during concerts or other entertainment events;
- (n) colour-tuneable light sources that can be set to at least the colours mentioned in table below and have for each of these colours, measured at the dominant wavelength, a minimum colour purity index according to table below, and intended for use in applications requiring high-quality coloured light:

Colour Dominant wave-length range Minimum colour purity index

Blue	440nm – 490nm	90 %
Green	520nm – 540nm	65 %
Red	610nm – 670nm	95 %

- (o) light sources accompanied by an individual calibration certificate detailing the exact radiometric flux and/or spectrum under specified conditions, and intended for use in photometric calibration (of e.g. wavelength, flux, colour temperature, colour rendering index), or for laboratory use during the evaluation of coloured surfaces and materials under standard viewing conditions (e.g. standard illuminants);
- (p) light sources provided specifically for use by photosensitive patients, to be sold in pharmacies and other authorised selling points like disability products suppliers on presentation of a medical prescription;
- (q) incandescent light sources (not including halogen light sources) fulfilling all of the following conditions: power  $\leq 40 \text{ W}$ , length  $\leq 60 \text{ mm}$ , diameter  $\leq 30 \text{ mm}$ , declared suitable for operation at ambient temperature  $\geq 300 \text{ }^\circ\text{C}$ , and intended for use in high temperature applications such as ovens;

- (r) halogen light sources fulfilling all of the following conditions: cap-type G4, GY6.35 or G9, power  $\leq 60$  W, declared suitable for operation at ambient temperature  $\geq 300$  °C, and intended for use in high temperature applications such as ovens;
- (s) light sources and separate control gears intended for operation at ambient temperatures below -30 °C.

## *ANNEX IV*

### **Verification procedure for market surveillance purposes**

The verification tolerances defined in this Annex relate only to the verification of the measured parameters by Member State authorities and shall not be used by the manufacturer or importer as an allowed tolerance to establish the values in the technical documentation or in interpreting these values with a view to achieving compliance or to communicate better performance by any means.

When verifying the compliance of a product model with the requirements laid down in this Regulation pursuant to Article 3(2) of Directive 2009/125/EC, the authorities of the Member States shall apply the following procedure:

1. The Member State authorities shall verify one single unit of the model for 2(a) and 2(b).

The Member State authorities shall verify 10 units of the light source model or 3 units of the separate control gear model for 2(c). For light sources, if the acquisition costs for the 10 units would exceed 500 euros, Member State authorities may reduce the sample size to 3 units. The verification tolerances are laid down in Table 6

2. The model shall be considered to comply with the applicable requirements if:
  - (a) the values given in the technical documentation pursuant to point 4 of Annex II to Directive 2009/125/EC (declared values), and, where applicable, the values used to calculate these values, are not more favourable for the manufacturer or importer than the results of the corresponding measurements carried out pursuant to paragraph (g) thereof; and
  - (b) the declared values meet any requirements laid down in this Regulation, and any required product information published by the manufacturer or importer does not contain values that are more favourable for the manufacturer or importer than the declared values; and
  - (c) when the Member State authorities test the units of the model, the determined values comply with the respective verification tolerances as given in Table 6, where 'determined value' means the arithmetical mean over the tested units of the measured values for a given parameter or the arithmetical mean of parameter values calculated from other measured values.
3. If the results referred to in point 2(a) or (b) are not achieved, the model and all models that have been listed as equivalent models in the manufacturer's or importer's technical documentation shall be considered not to comply with this Regulation.
4. If the result referred to in point 2(c) is not achieved, the model and all models that have been listed as equivalent models in the manufacturer's or the importer's technical documentation shall be considered not to comply with this Regulation.
5. The Member State authorities shall provide all relevant information to the authorities of the other Member States and to the Commission without delay after a decision being taken on the non-compliance of the model according to points 3 and 4.

The Member State authorities shall use the measurement and calculation methods set out in Annex II.

The Member State authorities shall only apply the verification tolerances that are set out in Table 6 and shall use only the procedure described in this Annex. No other tolerances, such as those set out in harmonised standards or in any other measurement method, shall be applied.

**Table 6**

Parameter	Sample size	Verification tolerances
<b>Full-load on-mode power <math>P_{on}</math> [W]:</b>		
$P_{on} \leq 2W$	3	The determined value shall not exceed the declared value by more than 0.20 W
	10	The determined value shall not exceed the declared value by more than 0.20 W
$2W < P_{on} \leq 5W$	3	The determined value shall not exceed the declared value by more than 10 %
	10	The determined value shall not exceed the declared value by more than 10 %.
$5W < P_{on} \leq 25W$	3	The determined value shall not exceed the declared value by more than 10 %.
	10	The determined value shall not exceed the declared value by more than 5 %.
$25W < P_{on} \leq 100W$	3	The determined value shall not exceed the declared value by more than 7.5 %.
	10	The determined value shall not exceed the declared value by more than 5 %.
$100W < P_{on}$	3	The determined value shall not exceed the declared value by more than 5 %.
	10	The determined value shall not exceed the declared value by more than 2.5 %.
<b>Displacement factor [0-1]</b>	3	The determined value shall not be less than the declared value minus 0.1 units
	10	The determined value shall not be less than the declared value minus 0.1 units.
<b>Useful luminous flux <math>\Phi_{use}</math> [lm]</b>	3	The determined value shall not deviate from the declared by more than 10 %.
	10	The determined value shall not deviate from the declared by more than 5 %.
<b>No-load power <math>P_{no}</math>, Standby power <math>P_{sb}</math> and Networked standby power <math>P_{net}</math> [W]</b>	3	The determined value shall not exceed the declared value by more than 0.10 W.
	10	The determined value shall not exceed the declared value by more than 0.10 W.
<b>CRI [0-100]</b>	3	The determined value shall not be less than the declared value by more than 3,0 units.
	10	The determined value shall not be less than the declared value by more than 2,0 units.
<b>Flicker [<math>P_{st}</math> LM] and Stroboscopic effect [SVM]</b>	3	The determined value shall not exceed the declared value by more than 10 %.
	10	The determined value shall not exceed the declared value by more than 10 %.
<b>Colour Consistency [MacAdam ellips steps]</b>	3	The determined number of steps shall not exceed the declared number of steps.
	10	The determined number of steps shall not exceed the declared number of steps.
<b>Beam angle (degrees)</b>	3	The determined value shall not deviate from the declared value by more than 25 %
	10	The determined value shall not deviate from the declared value by more than 25 %.
<b>Control gear efficiency [0-1]</b>	3	The determined value shall not be less than the declared value minus 0,05 units.

	10	The determined value shall not be less than the declared value minus 0,025 units
<b>Efficacy [lm/W]</b>	3	The determined value (quotient) shall not be less than the declared value minus 10 %.
	10	The determined value (quotient) shall not be less than the declared value minus 5 %.
<b>L<sub>70</sub>B<sub>50</sub> lifetime (for LED and OLED)</b>	3	The determined value shall not be less than the declared value minus 20 %
	10	The determined value shall not be less than the declared value minus 10 %
<b>Lumen Maintenance Factor (for LED and OLED)</b>	3	The determined X <sub>LMF</sub> % of the sample following the test in Annex V shall not be less than X <sub>LMF, MIN</sub> %. <sup>20</sup>
	10	
<b>Survival Factor (for LED and OLED)</b>	3	All 3 light sources of the test sample must be operational after completing the endurance test in Annex V.
	10	At least 9 light sources of the test sample must be operational after completing the endurance test in Annex V.
<b>Colour Purity Index [%]</b>	3	The determined value shall not be less than the declared value minus 10 %
	10	The determined value shall not be less than the declared value minus 5 %
<b>Chromaticity coordinates (x,y) [-]</b>	3	The determined x and y values shall not deviate from the declared values by more than 0,01 units
	10	The determined x and y values shall not deviate from the declared values by more than 0,005 units
<b>Correlated Colour Temperature [K]</b>	3	The determined value shall not deviate from the declared value by more than 10 %
	10	The determined value shall not deviate from the declared value by more than 5 %

Following Article 4.1, manufacturers and importers of containing products shall ensure that light sources and separate control gears can be removed without being permanently damaged for verification purposes by market surveillance authorities and without permanent damage to the containing product. For containing products, instructions should be available on request on how light sources and separate control gears can be removed for verification without these being permanently damaged and without permanent damage to the containing product.

For light sources with linear geometry which are scalable but of very long length, such as LED strips or strings, verification testing of market surveillance authorities shall consider a length of 50 cm, or, if the light source is not scalable there, the nearest value to 50 cm. The light source manufacturer shall indicate which control gear is suitable for this length.

<sup>20</sup> There is no tolerance associated with this metric as it is a fixed requirement and it is up to the manufacturer to declare an L<sub>70</sub>B<sub>50</sub> value to meet it.

**ANNEX V**  
**Functionality after endurance testing**

Models of LED- and OLED- light sources shall undergo endurance testing to verify their lumen maintenance and survival factor. This endurance testing consists of the test method outlined below. Member State authorities shall test 10 units of the model for this test, however if the acquisition costs for 10 units would exceed EUR 500, Member State authorities have the option to reduce the sample size to 3 units.

The provisional endurance test for LED and OLED light sources shall be conducted as follows:

- (a) Ambient Conditions and Test Setup:
  - (i) The switching cycles are to be conducted in a room with an ambient temperature of  $25 \pm 10$  °C and an average air velocity of less than 0.2 m/s;
  - (ii) The switching cycles on the sample shall be conducted in free air in a vertical base-up position. However, if a supplier has declared the light source is suitable for use in a specific orientation only, then the sample shall be mounted in that orientation;
  - (iii) The applied voltage during the switching cycles shall have a tolerance within 2 %. The total harmonic content of the supply voltage shall not exceed 3 %. Standards provide guidance on the supply voltage source.
- (b) Provisional Endurance Test Method.
  - (i) Initial flux measurement: measure the luminous flux of the light source prior to starting the endurance test switching cycle;
  - (ii) Switching cycles: operate the light source for 1200 cycles of repeated, continuous switching cycles without interruption. One complete switching cycle consists of 150 minutes of the light source switched ON at full power followed by 30 minutes of the light source switched OFF. The hours of operation recorded (i.e., 3000 hours) include only the periods of the switching cycle when the light source was switched ON, i.e. the total test time is 3600 hours;
  - (iii) Final flux measurement: at the end of the 1200 switching cycles, note if any lamps have failed (see ‘Survival Factor’ requirements in Annex IV Table 6) and measure the luminous flux of the light sources that have not failed;
  - (iv) For each of the units in the sample which have not failed, divide the measured final flux by the measured initial flux. Average the resulting values over all the units that did not fail to compute the determined value for the lumen maintenance factor  $X_{LMF}\%$ .



## *ANNEX VI*

### **Benchmarks**

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.

At the time of entry into force of this Regulation, the best available technology on the market for light sources in terms of their efficacy based on useful luminous flux was identified as follows:

- Non-directional light sources: 120-140 lm/W
- Mains voltage directional light sources: 90-100 lm/W
- Extra low voltage directional light sources: 85- 95 lm/W
- Linear light sources (tubes): 140-160 lm/W

At the time of entry into force of this Regulation, the best available technology on the market for separate control gears have an energy efficiency of 95 %.

Features required in certain applications, e.g. a high colour rendering, might prevent products offering those features from achieving these benchmarks.

At the time of entry into force of this Regulation, the best available technology on the market for light sources and separate control gears do not have any mercury content.