

Brussels, **XXX**
[...] (2017) **XXX** draft

COMMISSION REGULATION (EU) .../...

of XXX

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**

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(Text with EEA relevance)

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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,

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**and,
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(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products ⁽¹⁾, and in particular Article 15(1) thereof,

After consulting the Ecodesign Consultation Forum,

Whereas:

- (1) Directive 2009/125/EC requires the Commission to set ecodesign requirements for energy-related products representing significant volumes of sales and trade, having a significant environmental impact and presenting significant potential for improvement through design in terms of their environmental impact, without entailing excessive costs.
- (2) Article 16(2)(a) of Directive 2009/125/EC provides that in accordance with the procedure referred to in Article 19(3) and the criteria set out in Article 15(2), and after consulting the Ecodesign Consultation Forum, the Commission shall, as appropriate, introduce implementing measures starting with those products that offer a high potential for cost-effective reduction of greenhouse gas emissions, such as lighting.
- (3) The European Commission set ecodesign requirements for lighting products through three implementing measures: Commission Regulation (EC) No 244/2009 ⁽²⁾ and its

¹ OJ L 285, 31.10.2009, p. 10.

successive amendments ⁽³⁾, Commission Regulation (EC) No 245/2009 ⁽⁴⁾ and its successive amendments ⁽⁵⁾ and Commission Regulation (EU) No 1194/2012 ⁽⁶⁾ and its successive amendment ⁽⁷⁾. The three regulations require that the European Commission shall review them in light of technological progress.

- (4) The Commission carried out a review study to analyse the technical, environmental and economic aspects of lighting products. The study was developed together with stakeholders and interested parties from the Union and third countries and the results have been made publicly available.
- (5) The results of this study show the benefit of updating the requirements for lighting products. The review also shows the benefit of simplifying the requirements to be applied to lighting products, in particular by having one single regulation for this product group.
- (6) The unification of the three existing regulations is in line with the Commission's 'Better Regulation' policy with the main aim to decrease administrative burden for manufacturers and importers, and to facilitate verification by market surveillance authorities, inter alia by better defining the scope and exemptions, reducing the number of parameters for compliance testing and decreasing the time of some test procedures. Following the review, a uniform formula is set to calculate the energy efficiency for all the lighting products that are in the scope of the three existing regulations, including incandescent, halogen, fluorescent, high-intensity discharge and light-emitting diodes (both inorganic – LED – and organic – OLED). Light sources and their control gears as defined in Article 2 come within the subject of this Regulation resulting from the combination of the products in scope of the three existing regulations.
- (7) The environmental aspects that have been identified as significant for the purposes of this Regulation are energy consumption in the use phase along with mercury content and mercury emissions.
- (8) Ecodesign requirements for products subject to this Regulation should be set with a view to improving the environmental performance of the products concerned, contributing to the functioning of the internal market and to the Union objective of reducing energy consumption and promoting a circular economy.
- (9) In 2015, the EU-28 electricity consumption for lighting was 335 TWh/y, covering 12.4% of the overall EU-28 electricity use. This corresponds to greenhouse gas (GHG) emissions of 132 megatons of CO₂ equivalent per year (MtCO₂eq/y) to 2.8% of the overall EU-28 GHG-emission.
- (10) It is estimated that this Regulation will reduce the energy consumption for lighting by 40-60TWh/a in 2030 with respect to a Business-as-Usual scenario. This translates into around 20 MtCO₂eq/a savings of GHG emissions in 2030. It is estimated that this Regulation will reduce the total user expense for lighting by 11-15 billion euros per year in 2030 with respect to a BAU-scenario.

² OJ L 76, 24.3.2009, p. 3.

³ OJ L 247, 19.9.2009, p.3 and OJ L 244, 27.8.2015, p.1

⁴ OJ L 76, 24.3.2009, p. 17.

⁵ OJ L 104, 24.4.2010, p.20 and OJ L 244, 27.8.2015, p.1

⁶ OJ L 342, 14.12.2012, p. 1.

⁷ OJ L 244, 27.8.2015, p.1

- (11) Setting additional energy efficiency requirements for light sources should lead to a decrease in the overall mercury emissions. In addition, the mercury content of light sources is restricted by Directive 2011/65/EU of the European Parliament and of the Council (RoHS)⁸. Hence, no specific ecodesign requirements on mercury content should be set in this Regulation.
- (12) The electricity consumption of products subject to this Regulation could be lowered by applying existing non-proprietary cost-effective technologies, which lead to a reduction of the combined expenses for purchasing and operating the equipment.
- (13) The ecodesign requirements should not affect functionality from the user's perspective and should not negatively affect health, safety or the environment. In particular, the benefits of reducing the electricity consumption during the use phase should outweigh any potential additional environmental impact during the production phase of products subject to ecodesign requirements. In order to ensure consumer satisfaction with more energy efficient products, functional requirements should be set. Product information requirements should allow consumers to make informed choices.
- (14) Mandatory ecodesign requirements apply to products placed on the Union market wherever they are installed or used and should therefore not be made dependent on the application in which the product is used.
- (15) Exemptions from the requirements set out in this Regulation should be made for light sources with special technical features for use in specific applications, including those related to health and safety, and for which higher energy efficiency alternatives are not available or not cost-effective. Light sources that are currently allowed on the market to replace less efficient products, should remain available on the market to allow manufacturers and importers to benefit from the payback period of their investment.
- (16) Low-quality LED light sources on the market have potential flicker problems which can cause health issues. As LED light sources are among the high-efficiency lighting technologies emerging on the market, it is appropriate to set a functional requirement on flicker for LED and OLED light sources that can be operated directly on the mains electricity supply.
- (17) Measurements of the relevant product parameters should be performed through reliable, accurate and reproducible measurement methods, which take into account the recognised state-of-the-art measurement methods including, where available, harmonised standards adopted by the European standardisation bodies, as listed in Annex I to Directive 98/34/EC of the European Parliament and of the Council (⁹).
- (18) In accordance with Article 8 of Directive 2009/125/EC, this Regulation should specify the applicable conformity assessment procedures.
- (19) In order to facilitate compliance checks, manufacturers should provide information in the technical documentation referred to in Annexes V and VI to Directive 2009/125/EC in so far as that information relates to the requirements laid down in this Regulation.
- (20) Commission Regulation (EU) 2016/2282 (¹⁰) amends several ecodesign implementing measures with regard to the use of tolerances in verification procedures of the measured parameters by Member State authorities. However, it did not amend the

⁸ OJ L 174, 1.7.2011, p. 88, and amendments.

⁹ OJ L 204, 21.7.1998, p. 37.

¹⁰ OJ L 346, 20.12.2016, p. 51.

three regulations on lighting products, but clarified that the intended use of tolerances for lighting products would be reassessed in conjunction with the review of the three regulations. Hence this Regulation specifies tolerance values for lighting parameters and adopts the approach of declared values as laid down in Commission Regulation (EU) 2016/2282. The mandatory information on verification testing, including the model of the product tested and the results of the procedure, will minimise unnecessary double testing while reducing the number of non-compliant models on the Union market.

- (21) In addition to the legally binding requirements laid down in this Regulation, indicative benchmarks for best available technologies should be identified. This will help to ensure the wide availability and easy accessibility of information on the life cycle environmental performance of products subject to this Regulation, in particular for small and medium-sized enterprises, which will further facilitate the integration of best design technologies and the development of more energy- and resource efficient products.
- (22) A further review of this Regulation should assess the appropriateness and effectiveness of its provisions in achieving its goals, and also address some topics that could not be considered in this Regulation because of a current lack of an agreed metric, measurement method or acceptability limits, such as flicker, colour rendering and light output. The timing of the review should be sufficient for all provisions to be implemented and show an effect on the market.
- (23) This Regulation should apply from 1 September 2020, while allowing existing requirements from the three regulations repealed through this act to stay in force until that date. The application of the ecodesign requirements should provide sufficient time to manufacturers to re-design products subject to this Regulation. The timing should be such that any negative impact on functionalities of products on the market is avoided and that the cost impact for end-users and manufacturers, in particular small and medium-sized enterprises, is taken into account, while ensuring timely achievement of the objectives of this Regulation.
- (24) The measures provided for in this Regulation are in accordance with the opinion of the Committee established by Article 19(1) of Directive 2009/125/EC,

HAS ADOPTED THIS REGULATION:

Article 1

Subject matter and scope

1. In accordance with Article 15 of Directive 2009/125/EC, this Regulation establishes ecodesign requirements for placing on the market of light sources and separate control gear for light sources. The requirements also apply to light sources and separate control gear placed on the market in a containing product.
2. This Regulation shall not apply to light sources and separate control gears specified in Annex I points 1 and 2. Light sources and separate control gears specified in Annex I point 3 shall comply only with the requirements of Annex III point 3.5.

Article 2

Definitions

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

(1) '*light source*' means an electrically operated product intended to emit and/or be possibly tuned to emit light with all of the following optical characteristics:

(a) chromaticity coordinates x and y in the range

$$0,270 < x < 0,530 \text{ and}$$

$$-2,3172 x^2 + 2,3653 x - 0,2199 < y < -2,3172 x^2 + 2,3653 x - 0,1595;$$

(b) a luminous flux $< 1000 \text{ lm per mm}^2$ of projected light-emitting surface area as defined in Annex II;

(c) a luminous flux between 60 and 82 000 *lumen*;

(d) a colour rendering index $\text{CRI} > 0 \text{ Ra}$;

using incandescence, fluorescence, high-intensity discharge, light emitting diodes or their combinations as lighting technology.

High-pressure sodium light sources (HPS, as defined in Annex II) that do not fulfil condition (1)(a) are anyway considered light sources in the sense of this Regulation.

If a containing product is itself a light source, the light source to be considered for the purpose of this Regulation is the smallest physical unit that can be readily removed from the containing product without permanent mechanical damage and that meets the definition for light source.

(2) '*control gear*' means one or more devices, possibly integrated in a light source, intended to prepare the mains electricity supply for the electric format required by one or more specific light sources within boundary conditions set by electric safety and electromagnetic compatibility. It may include transforming the supply and starting voltage, limiting operational and preheating current, preventing cold starting, correcting the power factor and/or reducing radio interference.

The term does not include power supplies within the scope of Commission Regulation (EC) No 278/2009⁽¹¹⁾. The term does also not include lighting control parts and non-lighting parts (as defined in Annex II), although such parts may be physically integrated with a control gear or marketed together as a single product.

A Power over Ethernet (PoE) switch is not a control gear in the sense of this Regulation.

(3) '*separate control gear*', means a control gear that is not physically integrated with a light source and is placed on the market as a separate product or as a part of a containing product.

(4) '*containing product*' means a product containing one or more light sources and/or separate control gears in scope of this Regulation. Manufacturers or importers of containing products shall enable verification by market surveillance authorities of compliance of light source(s) and/or control gear(s) as set out in Annex IV.

¹¹ OJ L93, 7.4.2009, p.3.

- (5) '*light*' means electromagnetic radiation with a wavelength between 380 *nm* and 780 *nm*.
- (6) '*mains*' or '*mains voltage*' or '*mains electricity supply*' (MV) means the electricity supply of 230 ($\pm 10\%$) *Volt* of alternating current at 50 *Hz*.
- (7) '*chromaticity*' means the property of a colour stimulus defined by its chromaticity coordinates (x and y).
- (8) '*luminous flux*' or '*flux*' (Φ), expressed in lumen (*lm*), means the quantity derived from radiant flux (radiant power) by evaluating the electromagnetic radiation in accordance with the spectral sensitivity of the human eye. It refers to the total flux emitted by a light source in a solid angle of 4π *steradians* under conditions (e.g. current, voltage, temperature) specified in applicable standards. It refers to the initial flux for the undimmed light source after a short operating period, unless it is clearly specified that the flux in a dimmed condition or the flux after a given period of operation is intended. '*Luminous flux*' without further specification is the total luminous flux in a 360° sphere. For light sources that can be tuned to emit different light spectra and/or different maximum light intensities, it refers to the flux in the 'reference control settings' as defined in Annex II.
- (9) '*colour rendering index*' (CRI), expressed in *Ra*, means the effect of an illuminant on the colour appearance of objects by conscious or subconscious comparison with their colour appearance under the reference illuminant.
- (10) '*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.
- (11) '*halogen light source*' (HL) means an incandescent light source with a threadlike conductor made from tungsten surrounded by gas containing halogens or halogen compounds.
- (12) '*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.
- (13) '*high intensity discharge*' (HID) means an electric gas discharge in which the light-producing arc is stabilised by wall temperature and the arc has a bulb wall loading in excess of 3 *Watts per square centimetre*. For the purpose of this Regulation, HID light sources are limited to metal halide, high-pressure sodium and mercury vapour types as defined in Annex II.
- (14) '*fluorescence*' or '*fluorescent light source*' (FL) means the phenomenon or a light source using an electric gas discharge of the low-pressure mercury type in which most of the light is emitted by one or more layers of phosphors excited by the ultraviolet radiation from the discharge. Fluorescent light sources may have one ('single-capped') or two ('double-capped') connections ('caps') to their electricity supply. For the purposes of this Regulation, magnetic induction light sources are also considered as fluorescent light sources.
- (15) '*inorganic 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. The junction emits optical radiation when excited by an electric current.

- (16) ‘*organic light emitting diode*’ (OLED) means a technology in which light is produced from a solid state device embodying a p-n junction of organic material. The junction emits optical radiation when excited by an electric current.
- (17) ‘*Power-over-Ethernet switch*’ or ‘*PoE switch*’ means equipment for power-supply and data-handling that is installed between the mains and office equipment and/or light sources for the purpose of data transfer and power supply.
- (18) ‘*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.

Other definitions are set out in Annex II.

Article 3

Ecodesign requirements

Any product in scope of this Regulation shall meet the ecodesign requirements specified in Annex III of this Regulation, except when exempt according to Annex I points 1 and 2. Products specified in Annex I point 3 shall comply only with the requirements set out in Annex III point 3.4.

Ecodesign requirements shall apply from 1 September 2020.

Article 4

Removal of light sources and separate control gears

Manufacturers and importers shall ensure that light sources and separate control gears in scope of this Regulation can be readily removed without permanent mechanical damage by the end-user from any product containing them that is placed on the market. Where light sources and separate control gears in scope of this Regulation cannot be readily removed by the end-user, manufacturers and importers shall ensure that the containing product is designed in such a way that light sources and separate control gears in scope of this Regulation can be readily removed by qualified professionals. Containing products shall be accompanied by instructions on how light sources and separate control gears can be readily removed by either the end-user or by qualified professionals.

Article 5

Circumvention

The manufacturer or importer shall not place on the market products that have been designed so that a model’s performance is automatically altered in test conditions with the objective of reaching a more favourable level for any of the parameters declared by the manufacturer in

the technical documentation or included in any of the documentation provided with the product.

Where applicable, the power consumption of the product shall not increase after a software or firmware update when measured with the same test standard originally used for the declaration of conformity, except with explicit consent of the end-user.

Article 6

Conformity assessment

1. The conformity assessment procedure referred to in Article 8 of Directive 2009/125/EC shall be the internal design control set out in Annex IV to that Directive or the management system set out in Annex V to the same Directive.
2. For the purposes of conformity assessment pursuant to Article 8 of Directive 2009/125/EC, the technical documentation file shall:
 - (a) contain the product information specified in Annex III.3.4 of this Regulation;
 - (b) provide any other information required by this Regulation to be present in the technical documentation file.

Article 7

Verification procedure for market surveillance purposes

Member States shall apply the verification procedure described in Annex IV to this Regulation when performing the market surveillance checks referred to in Article 3(2) of Directive 2009/125/EC.

Article 8

Indicative benchmarks

The indicative benchmarks for the best-performing products and technologies available on the market at the time of adoption of this Regulation are set out in Annex V.

Article 9

Repeal

Commission Regulation (EC) No 244/2009, Commission Regulation (EC) No 245/2009 and Commission Regulation (EU) No 1194/2012 shall be repealed from 1 September 2020.

Article 10

Revision

The Commission shall review this Regulation in the light of technological progress and shall present the results of that review to the Ecodesign Consultation Forum no later than 1 September 2022. This review shall inter alia consider:

- setting more stringent energy efficiency requirements for all light source types, in particular for non-LED light source types, and for separate control gears;
- setting requirements on lighting control parts;
- exploring stroboscopic effects;
- setting requirements on dimming, including the interaction with flicker;
- substituting the CRI colour rendering metric by a more adequate metric;
- adequacy of lumen as a stand-alone metric for the quantity of visible light;
- setting additional resource efficiency requirements for products in accordance with the principles of the circular economy.

Article 11

Entry into force

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels,

For the Commission
Jean-Claude JUNCKER
The President

DRAFT ANNEXES

of

COMMISSION REGULATION (EU) .../...

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**implementing Directive 2009/125/EC of the European Parliament and of the Council
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ANNEX I - 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 ⁽¹⁾ of the European Parliament and of the Council;
 - (a) for emergency use as set out in Directive 2014/35/EU of the Council and the Parliament ⁽²⁾;
 - (b) in radiological and nuclear medicine installations, as defined in Article 3 of Directive 2009/71/EURATOM ⁽³⁾;
 - (c) 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;
 - (d) in or on motor vehicles, their trailers and systems, components and separate technical units intended as set out in Regulation No 661/2009 ⁽⁴⁾ , Regulation (EU) No 168/2013 ⁽⁵⁾ and their amendments;
 - (e) in or on civil aviation aircrafts as set out in Commission Regulation 748/2012 ⁽⁶⁾;
 - (f) in railway vehicle lighting as set out in Directive 2008/57/EC ⁽⁷⁾ and its amendments, as well as relevant Member State legislation;
 - (g) in marine equipment as set out in Council Directive 2014/90/EU ⁽⁸⁾ and its amendments or recasts;
 - (h) in medical devices as set out in Council Directive 93/42/EEC ⁽⁹⁾ and in vitro medical devices as set out in Directive 98/79/EC ⁽¹⁰⁾ and their amendments.

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

- 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
- 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

¹ OJ L 96, 29.3.2014, p. 309-356 (the 'ATEX Directive')

² OJ L 96, 29.3.2014, p. 357-. (the 'Low Voltage Directive')

³ OJ L 172, 2.7.2009, p. 18-

⁴ OJ L 200, 31.7.2009, p.1-24

⁵ OJ L60, 2.3.2013, p. 52

⁶ OJ L 224, 21.8.2012, p. 1-85

⁷ OJ L 191, 18.7.2008, p.1-45.

⁸ OJ L 257, 28.8.2014, p. 146–185

⁹ OJ L 169, 12.7.1993, p. 1

¹⁰ OJ L331, 7.12.1998, p.1

- is placed on the market specifically for the mentioned operating condition or application, as evidenced at least by the technical documentation, and possibly by information on the packaging and/or in publicity.
2. In addition, this Regulation shall not apply to:
 - (a) double capped fluorescent T5 light sources with power $P \leq 13 \text{ W}$;
 - (b) HID light sources with specific effective ultraviolet power $>2 \text{ mW/klm}$;
 - (c) HID light sources with colour temperature $T_c > 7000 \text{ K}$;
 - (d) light sources with a beam angle of less than 10° ;
 - (e) 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 ⁽¹¹⁾, Commission Decision (EU) 2015/1402 ⁽¹²⁾, Commission Regulation (EC) No 642/2009 ⁽¹³⁾, Commission Decision (EU) 2016/1756 ⁽¹⁴⁾, European Commission COM(2015)178 ⁽¹⁵⁾;
 - (f) light sources and separate control gears in portable 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;
 - (g) 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, photocopiers and video projectors);
 - (c) ambient temperatures below -30°C or above 120°C .

¹¹ OJ L 175, 27.6.2013, p. 13

¹² OJ L 217, 18.8.2015, p.9 (office equipment, computers)

¹³ OJ L 191, 23.7.2009, p.42 (televisions)

¹⁴ OJ L 268, 1.10.2016, p.90 (office equipment, displays)

¹⁵ COM(2015) 178 final, 22.4.2015 (related to self-regulatory initiative regarding game consoles)

ANNEX II – DEFINITIONS

In addition to the definitions in Article 2, the following definitions apply for the purposes of this Regulation:

- (1) ‘*mains light source (MLS)*’ means a light source that can be operated directly on the mains electricity supply.

Light sources that can operate both directly on the mains, and 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 but they are placed on the market without such control gear.

- (3) ‘*extra low voltage (ELV)*’ means an electricity supply of less than 120 V direct current, as further defined in relevant standards.

- (4) ‘*directional light source (DLS)*’ means a light source having at least 80% of total luminous flux within a solid angle of π sr (corresponding to a cone with angle of 120°)

- (5) ‘*non-directional light source (NDLS)*’ means a light source that is not a directional light source.

- (6) ‘*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.’. To maintain the reference control settings the data-connection parts cannot be disconnected, switched-off or their power consumption minimised.

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 as a single product.

- (7) ‘*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.

- (8) ‘*colour-tuneable light source (CTLS)*’ means a connected light source (CLS) using LED or OLED technology, that can be set to emit light with a large variation of colours outside the range defined in article 2 (1)(a), but can also be set to emit white light inside the range defined in article 2 (1)(a) 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 colour temperatures, within the range defined in article 2 (1)(a).

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

- (9) ‘*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, 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 1275/2008¹⁶.

- (10) '*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 connected 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)
- (11) '*useful luminous flux*' (Φ_{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 4π sr (corresponding to a 360° sphere).
 - For directional light sources with beam angle $\geq 90^\circ$ it is the flux emitted in a solid angle of π sr (corresponding to a cone with angle of 120°).
 - For directional light sources with beam angle $< 90^\circ$ it is the flux emitted in a solid angle of 0.586π sr (corresponding to a cone with angle of 90°).
- (12) '*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 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 considered.
- For light sources with user-controllable beam angle, the beam angle corresponding to the 'reference control setting' shall be considered.
- (13) '*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.
- (14) '*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 disconnected from light sources, and, if applicable, from data-connection parts, lighting control parts and non-lighting

¹⁶ OJ L 339, 18.12.2008, p. 45 and later amendments.

parts. If these parts cannot be disconnected, they shall be switched off or their power consumption shall be minimized following the manufacturer's instructions.

- (15) '*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 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.
- (16) '*networked standby mode*' means the condition of a connected light source (CLS) where it is connected to the power supply but the light source is intentionally not emitting light, and is awaiting a remotely initiated trigger 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.
- (17) '*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 lighting control signal can be internally generated or an external control signal 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.
- (18) '*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.
- (19) '*remotely initiated trigger*' means a signal that comes from outside the light source or separate control gear via a network.
- (20) '*network*' means a communication infrastructure with a topology of links, an architecture, including the physical components, organisational principles, communication procedures and formats (protocols).
- (21) '*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 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.

- (22) '*no-load power*' (P_{no}), expressed in Watts, is the electric power consumption of a separate control gear in no-load mode.
- (23) '*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.
- (24) '*networked standby power*' (P_{net}), expressed in Watts, is the electric power consumption of a connected light source in networked standby mode.
- (25) '*reference control settings*' 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, 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 Art.2(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.

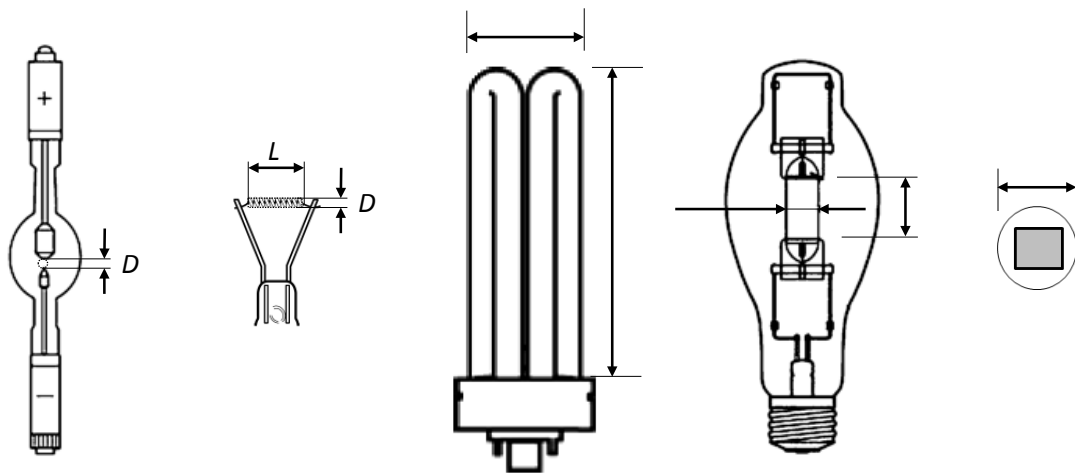
- (26) ‘*high-pressure mercury light source*’ means a high intensity discharge light source in which the major portion of light is produced, directly or indirectly, by radiation from predominantly vaporized mercury operating at a partial pressure in excess of 100 kilopascals.
- (27) ‘*high-pressure sodium light source*’ (HPS) means a high intensity discharge light source in which the light is produced mainly by radiation from sodium vapour operating at a partial pressure of the order of 10 kilopascals. HPS light sources may have one (‘single-ended’) or two (‘double-ended’) connectors to their electricity supply.
- (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) ‘*portable battery-operated product*’ means a containing product that is not permanently fixed to its surroundings, that is intended to be carried around or to be frequently moved, whose position can be changed by a simple manual pick-and-place operation, and that operates only on direct current (DC) with a voltage of less than 24 V supplied from a source contained in the same product, without being connected directly or indirectly to the mains electricity supply.
- (38) ‘*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.
- (39) ‘*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.
- (40) ‘*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.
- (41) ‘*control gear efficiency*’ is the output power divided by the input power of a separate control gear in conditions defined in measurement standards, with any lighting control parts and non-lighting parts disconnected, switched off or set to minimum power consumption according to manufacturer’s instructions.
- (42) ‘*functionality after accelerated endurance testing*’ means the functionality of a LED or OLED light source or of a separate control gear for LED or OLED light sources after accelerated endurance testing as defined in Annex V.
- (43) ‘*Pst LM*’ is the metric for flicker used in this Regulation 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.
- (44) ‘*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.
- (45) ‘*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.

- (46) '*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.
- (47) '*colour temperature*' (T_c [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.
- (48) '*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 (c_x and c_y) declared by the manufacturer or the importer, expressed as the size (in steps) of the MacAdam ellipse formed around the chromaticity centre point (c_x and c_y).
- (49) '*displacement factor* ($\cos \phi_1$)' means the cosine of the phase angle ϕ_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 manufacturer's instructions.
- (50) '*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.
- (51) '*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.
- (52) '*lifetime*' for LED and OLED light sources means the time in hours between the start of their use and the moment when 50% of a population of light sources have either abruptly failed (no light output anymore) or their light output has gradually degraded to a value below 70% of the initial luminous flux. This is also referred to as the $M_{70}F_{50}$ lifetime.
- (53) '*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.
- (54) '*end-user*' means a natural person buying or expected to buy a product for purposes which are outside his trade, business, craft or profession;
- (55) '*projected light-emitting surface area* (A)' is the surface area in mm^2 (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 smallest gross volume enveloping all emitters shall be taken as the light-emitting surface.



ANNEX III – ECODESIGN REQUIREMENTS

1. ENERGY EFFICIENCY REQUIREMENTS

1.1. Light sources

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 Φ_{use} (in lm) and the declared colour rendering index CRI (in Ra) as follows:

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

Where:

- The values for threshold efficacy (η in lm/W) and end loss factor (L in W) are specified in Table 1, depending on the light source type.
- 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 (η) and end loss factor (L)

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

* For connected light sources (CLS) a factor $L=2.0$ shall be applied.

Table 2: Correction factor C depending on light source characteristics

Light source type	Basic C value
Non-directional (NDLS) not operating on mains (NMLS)	1
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
Special light source feature	Bonus on C
FL or HID with $T_c > 5000 K$	C+0,1
FL with $CRI > 90 Ra$	C+0,1
HID with second envelope	C+0,1
MH NDLS $> 405 W$ with non-clear envelope	C+0,1
DLS with anti-glare shield	C+0,2
Colour-tuneable light source (CTLS)	C+0,1

Where applicable, bonuses on correction factor C are cumulative.

For CTLS (that in this Regulation per definition are CLS), the bonus on factor C applies together with the higher value for L.

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

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

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

1.2. Separate control gear

The minimum energy efficiency requirements given in Table 3 shall apply for separate control gear operating at full-load:

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

Declared output power of the control gear (P_{cg}) or declared power of the light source (P_{ls}) in W, as applicable	Minimum efficiency
<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>	

$P_{ls} \leq 30$	0,78
$30 < P_{ls} \leq 75$	0,85
$75 < P_{ls} \leq 105$	0,87
$105 < P_{ls} \leq 405$	0,90
$405 < P_{ls}$	0,92
<u>Control gear for LED or OLED light sources</u>	
$P_{cg} \leq 10$	0,70
$10 < P_{cg} \leq 25$	0,75
$25 < P_{cg} \leq 50$	0,83
$50 < P_{cg} \leq 100$	0,86
$100 < P_{cg} \leq 300$	0,88
$300 < P_{cg}$	0,90

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 of a separate control gear P_{no} shall not exceed 0.5 W.

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

2. FUNCTIONAL REQUIREMENTS

2.1. Light sources

The functional requirements specified in Table 4 shall apply for light sources.

Table 4: Functional requirements for light sources

Colour rendering	$CRI \geq 80$ Ra (except for HID with $\Phi_{use} > 4$ 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 for LED and OLED MLS	No limit at $P \leq 2W$, $DF \geq 0.4$ at $2W < P \leq 5W$, $DF \geq 0.7$ at $5W < P \leq 25W$ $DF \geq 0.9$ at $25W < P$
Functionality after accelerated endurance testing for LED and OLED	as specified 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	$Pst LM \leq 1.0$ at full-load

2.2. **Separate control gears**

There are no functional requirements for separate control gears.

3. **INFORMATION REQUIREMENTS FOR MANUFACTURERS AND IMPORTERS**

3.1. **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 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 colour temperature shall be provided. If there is room for only one value, the useful luminous flux shall be provided.

3.2. **Information to be visibly displayed on the packaging**

3.2.1. *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 V of Commission Delegated Regulation (EU) .../... .

3.2.2. *Separate control gears*

If a separate control gear is placed on the market in a packaging containing information to be visibly displayed to users, 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. 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) 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;

- (g) 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.

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.

3.3. Information to be visibly displayed on a free-access website

3.3.1. 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.

Manufacturers and importers are not refrained from setting other free-access websites.

3.3.2. Separate control gears

If a separate control gear 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 linked to a QR-code on the packaging:

- (a) the information specified in point 3.2.2;
- (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 (¹⁷).

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.

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.

¹⁷ OJ L 197, 24.7.2012, p. 38.

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.

3.4. 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 file drawn up for the purposes of conformity assessment pursuant to Article 8 of Directive 2009/125/EC shall contain the information set out in Annex V of Commission Delegated Regulation (EU) .../... in relation to the compliance part of the product database set out in Article 4 of Regulation (EU) 2017/1369 and the technical documentation pursuant to Article 3.3 of Regulation (EU) 2017/1369. The two technical documentations, for ecodesign and for energy labelling, can be combined in a single document.

3.5. 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 a clear indication that the light source is not intended for use in other applications.

The technical documentation file drawn up for the purposes of conformity assessment in accordance with Article 8 of Directive 2009/125/EC shall list the technical parameters that make the product design specific to qualify for the exemption.

ANNEX IV – VERIFICATION PROCEDURES FOR MARKET SURVEILLANCE AUTHORITIES

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, for the requirements referred to in this Annex, the market surveillance authorities of the Member States shall apply the following procedure:

- (1) The Member State authorities shall verify a single unit of the model.
- (2) The Member State authorities shall assess whether:
 - (a) the values given in the technical documentation pursuant to point 2 of Annex IV 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.
- (3) If the results referred to in point 2(a) or (b) are not achieved, the model and all equivalent models shall be considered not to comply with this Regulation.
- (4) If the results referred to in point 2(a) and (b) are achieved, the Member States authorities shall test 10 units of the model. 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.
- (5) The model and all equivalent models shall be considered to comply with the applicable requirements if the determined values of the applicable parameters comply with the respective verification tolerances as given in Table 6, and the functionality after accelerated endurance testing meets the requirements of Annex V, if applicable. The determined values are assessed as follows:
 - (a) for each unit measure the applicable parameters from Table 6;
 - (b) calculate the determined value of each applicable parameter as the arithmetical mean of the measured values of the 10 units for that parameter.
- (6) If the results referred to in point 5 are not achieved, the model and all equivalent models shall be considered not to comply with this Regulation.
- (7) 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 6.

Member State authorities shall use reliable, accurate and reproducible measurement procedures, which take into account the generally recognised state-of-the-art measurement methods, including methods set out in documents whose reference numbers have been published for that purpose in the *Official Journal of the European Union*.

The Member State authorities shall only apply the verification tolerances that are set out in Table 6 and shall only use the procedure described in points 1 to 7 for the requirements referred to in this Annex. No other tolerances, such as those set out in harmonised standards or in any other measurement method, shall be applied.

In case light sources and/or control gears are placed on the market as parts inside a containing product or supplied with the product, the manufacturer or importer of this containing product shall facilitate market surveillance authorities verifying compliance of the light sources and/or control gears with this Regulation by providing, on request, the identification of the contained light source(s) and control gear(s), and detailed instructions to the market surveillance authorities on how to dismount light source(s) and/or control gear(s) for inspection without permanent mechanical damage.

If the containing product contains multiple identical light sources connected to one control gear, possibly each individually emitting less than 60 lm but in total emitting more than 60 lm, verification testing of the market surveillance authorities may be limited to a representative subset of the individual light sources and the results can be extrapolated.

The verification tolerances defined in this Annex relate only to the verification of the declared parameters by Member State authorities and shall not be used by the manufacturer 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.

Table 6: Verification tolerances

Parameter	Sample size	Verification tolerances
Full-load on-mode power P_{on} [W]:		
$P_{on} \leq 5W$	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 %.
$5W < P_{on} < 100W$	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 %.
$P_{on} \geq 100W$	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 %.
Power factor [0-1]		
	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 %.
Useful luminous flux Φ_{use} [lm]		
	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 %.
No-load power P_{no}, Standby power P_{sb} and Networked standby power P_{net} [W]		
	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.
CRI [0-100]		
	3	The determined value shall not deviate from the declared value by more than 3.
	10	The determined value shall not deviate from the declared value by more than 2.

Flicker [<i>P_{st} LM</i>]	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 %.
Colour Consistency [<i>MacAdam ellips steps</i>]	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.
Control gear efficiency [%]		
$P_{out} \leq 5W$	10	The determined value shall not be less than 90% of the declared value.
$5W < P_{out} < 100W$	10	The determined value shall not be less than 95% of the declared value.
$P_{out} \geq 100W$	10	The determined value shall not be less than 97,5% of the declared value.
Luminous intensity [<i>cd</i>]	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 %.
Beam angle (<i>degrees</i>)	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 %.
Lumen Maintenance Factor (for FL and HID)	3	The determined value shall not be less than 90% of the declared value.
	10	The determined value shall not be less than 95% of the declared value.
Survival Factor (for FL and HID)	3	The determined value shall not be less than 0.65 (1 of 3 allowed to fail)
	10	The determined value shall not be less than 0.90 (1 of 10 allowed to fail).
M₇₀F₅₀ lifetime (for LED and OLED)	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%

ANNEX V - FUNCTIONALITY AFTER ACCELERATED ENDURANCE TESTING

1. LED AND OLED LIGHT SOURCES

Models of LED- and OLED- light sources shall undergo accelerated endurance testing to verify their lumen maintenance and survival factor. This accelerated endurance testing shall consist of three single tests as specified below. Member States authorities shall test 10 units of the model for each test. If the acquisition costs for 10 units would exceed 500 euros, Member State authorities have the option to reduce the sample size to 3 units for each test.

- (1) A temperature cycling test as specified in relevant standards. Where no standard is available, the duration of this test shall be 1000h. The temperature is varied from -10°C to $+40^{\circ}\text{C}$ over 4h periods. A 4h period consists of 1h holding time at each end temperature and 1h transfer time with a rate of temperature change of $1^{\circ}\text{C}/\text{min}$ until the end temperature is reached. During the test the model is switched on for 17min and off for 17min.

At the end of the test, all 3 models (if sample size used is 3) or 9 of 10 models (if sample size used is 10) shall operate and have a luminous flux that is not less than 70% of the initial luminous flux for a period of at least 15 min, and show no physical effects of temperature cycling such as cracks or delamination.

- (2) A supply switching test as specified in relevant standards. Where no standard is available, at test voltage, current or power, the model shall be switched on and off for 30 seconds each. The number of switching cycles shall be equal to half the model's declared lifetime with a maximum of 1000h.

At the end of the test, all 3 models (if sample size used is 3) or 9 of 10 models (if sample size used is 10) shall operate and have a luminous flux that is not less than 70% of the initial luminous flux for a period of at least 15 min.

- (3) An accelerated operation life test as specified in relevant standards. Where no standard is available, the duration of this test shall be 1000h. The model shall be operated continuously without switching at a temperature corresponding to 10°C above the maximum specified operating temperature if declared by the manufacturer. If there is no declared value or the value is below 40°C , then the test shall be performed at 50°C . Any thermal protecting devices that would switch off the model or reduce its performance shall be bypassed.

At the end of this test, and after cooling down to room temperature and being stabilized, all 3 models (if sample size used is 3) or 9 of 10 models (if sample size used is 10) shall operate and have a luminous flux that is not less than 80% of the initial luminous flux for a period of at least 15 min.

2. SEPARATE CONTROL GEARS FOR LED AND OLED LIGHT SOURCES

Models of separate control gear for LED- and OLED- light sources shall undergo accelerated endurance testing according to relevant standards to test their survival factor. Member States authorities shall test 10 units of the model for each test.

At the end of each test, 9 of 10 models shall operate normally for a period of at least 15 min.

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.

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

Energy efficiency

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

- Non-directional 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

The most efficient separate control gears have an energy efficiency of 95%.

Mercury content

The most efficient light sources and separate control gears do not have any mercury content.

Brussels, **XXX**
[...] (2017) **XXX** draft

COMMISSION DELEGATED REGULATION (EU) .../...

of **XXX**

**supplementing Regulation (EU) 2017/1369 of the European Parliament and of the
Council with regard to energy labelling of light sources**

repealing

**Regulation (EU) No 874/2012 with regard to energy labelling of electrical lamps and
luminaires**

(Text with EEA relevance)

This draft has not been adopted or endorsed by the European Commission. Any views expressed are the preliminary views of the Commission services and may not in any circumstances be regarded as stating an official position of the Commission. The information transmitted is intended only for the Member State or entity to which it is addressed for discussions and may contain confidential and/or privileged material.

1. CONTEXT OF THE DELEGATED ACT

Grounds for and objectives of the proposal

Regulation (EU) 2017/1369¹ establishes a framework for setting energy labelling regulations for energy-related products at EU level and repeals the previous framework set out in Directive 2010/30/EU. Energy labelling is a key EU policy instrument for informing consumers about the energy efficiency and other environmental performance aspects of energy-related products placed on the internal market.

The energy labelling measures applicable to lighting products are in:

- Commission Delegated Regulation (EU) No 874/2012² of 12 July 2012 with regard to energy labelling of electrical lamps and luminaires;
- as amended by Commission Delegated Regulation (EU) No 518/2014³ of 5 March 2014 with regard to labelling of energy-related products on the internet.

The revision of the energy labelling measure for lighting products follows Article 7 of Commission Delegated Regulation (EU) No. 874/2012. In particular, this review should assess verification tolerances.

Furthermore, according to article 11(5) of the new framework Regulation (EU) 2017/1369, a new delegated act for energy labelling of lighting products must be adopted at the latest by 2 November 2018 to rescale products from A to G (as of today, it applies A++ to E).

Moreover, there are new policies that force the revision to look beyond the strict scope mentioned in the review articles of the existing acts for lighting products: a renewed effort in carbon emission abatement through the Paris climate agreement⁴, the Commission's Circular Economy⁵, the Better Regulation policy aiming at more efficient and effective legislation⁶, the need to address possible circumvention of testing standards, etc.⁷

This act is developed in parallel with the proposed act for ecodesign of lighting products.

General context

In 2014, the Commission conducted an 'Omnibus' review⁸ of several product groups that indicated that there is still a large untapped saving potential for lighting products making the acts on ecodesign and energy labelling eligible for a revision. This was confirmed by the review study, concluded in October 2015⁹, for which consultants developed the 'Model for European Light Sources Analysis' MELISA.

¹ OJ L 198, 28.7.2017, p. 1–23.

² OJ L 258, 26.9.2012, p. 3

³ OJ L 147, 17.5.2014, p. 1–28

⁴ http://ec.europa.eu/clima/policies/international/negotiations/future/index_en.htm

⁵ Closing the loop - An EU action plan for the Circular Economy". COM(2015) 614 final, Brussels, 2.12.2015

⁶ http://ec.europa.eu/smart-regulation/better_regulation/key_docs_en.htm#_br

⁷ <http://www.europarl.europa.eu/committees/en/emis/home.html>

⁸ 'Omnibus' Review Study on Cold Appliances, Washing Machines, Dishwashers, Washer-Driers, Lighting, Set-top Boxes and Pumps, consortium of VHK, VITO, Viegand Maagøe, Wuppertal Institut für Klima, Umwelt, Energie for the European Commission, DG ENER-C3, Brussels/Delft, April 2014.

⁹ Preparatory Study on Light Sources for Ecodesign and/or Energy Labelling Requirements ('Lot 8/9/19'), Task reports 0-7, VHK for the European Commission, October 2015. <http://ecodesign-lightsources.eu/documents>.

In the Ecodesign Working Plan 2016-2019 of the European Commission¹⁰ the revision of the implementing acts for lighting products is mentioned as one of the major energy saving opportunities, with anticipated 125 TWh of primary energy savings per year in 2030 (combined effect of ecodesign and energy labelling).

In 2015, around 1.7 billion light sources were sold in EU-28, of which approximately 22% based on LED technology. In the same year, around 11.4 billion light sources were operating in EU-28, of which 6.5% LED. These light sources consumed a total of 335 TWh/a of electricity, covering 12.4% of the overall EU-28 electricity use. This corresponded to greenhouse gas (GHG) emissions of 132 megatons of CO₂ equivalent per year (MtCO₂eq/a), i.e. 2.8% of the overall EU-28 GHG-emission.

Following the growth in population and in economic activity, the total number of light sources operating in EU-28 will increase (projected 14.6 billion in 2030; 128% of the 2015 stock), but so will the share of LEDs in this stock (projected 81% in 2030). As these LEDs on average have higher energy efficiency than the light sources they replace, i.e. consume less electricity, the total EU-28 electricity consumption for lighting is expected to decrease to 275 TWh/a in 2030 (82% of the 2015 consumption), corresponding to 93 MtCO₂eq/a GHG-emissions.

Preliminary impact data from September 2016, based on the latest version of the MELISA model, estimates that this act on energy labelling of light sources will reduce the electricity consumption for lighting by 2030, reaching 20 TWh/y of electricity savings and 6 MtCO₂eq/y of GHG-emission savings in 2030, in addition to respectively 40 TWh/y and 14 MtCO₂eq/y from the ecodesign act. It is further estimated that the two acts will reduce the total user expense for lighting by 15 billion euros (4 billion euros thanks to energy labelling) per year in 2030 compared to a BAU-scenario without new measures.

The Commission will carry out an impact assessment of the measures under consideration, following the stakeholder consultation of December 2017 and the public consultation that will take place between November 2017 and January 2018.

2. CONSULTATIONS PRIOR TO THE ADOPTION OF THE ACT

Consultation of interested parties

Stakeholders (industry, Member States, NGOs) were consulted during the Lot 8/9/19 review study in two occasions. A 1st stakeholder meeting was held on 5 February 2015 on the MEERP (¹¹) Task 0, 1, 2 and 3 reports; a 2nd meeting was held on 17 June 2015 on the Task 4, 5 and 6 reports.

Study reports were updated to reflect stakeholders' comments. Importantly, the future projections for LED prices and LED efficiencies used in the analysis of the MELISA model were agreed with industry. Stakeholder comments were also taken into account when preparing the Commission Working Document (WD) for the Ecodesign Consultation Forum (ECF) of 7 December 2015.

The comments on the 2015 WD showed a lack of consensus among stakeholders on the general approach, the level of ambition and on many details. To resolve this situation following the 2015 ECF, between Spring 2016 and Spring 2017 further stakeholder meetings took place in an attempt to address the different comments. The MELISA model was extensively discussed with industry experts and adapted accordingly.

¹⁰ COM(2016) 773 final, Brussels, November 2016.

¹¹ MEERP is the methodology that the European Commission applies to make studies for ecodesign of energy-related products.

Furthermore, a second ECF is planned for December 2017 and a public consultation will be held between November 2017 and January 2018.

3. LEGAL ELEMENTS OF THE DELEGATED ACT

1. Scope

The scope of the measures is light sources. Light sources as defined by this act are always in scope, even when they are parts of ‘containing products’ such as e.g. luminaires, mirrors, fridges or shelves. However, the containing products themselves are not in scope of this act (but they may be in scope of other energy labelling acts). This means that this act eliminates the requirement of energy labelling of luminaires set out in Regulation (EU) 874/2012.

The scope covers all lighting technologies, including incandescent, halogen, fluorescent, high-intensity discharge and light-emitting diodes (both inorganic LED and organic OLED).

The definition of light sources is the same as that in the proposed act for ecodesign. However, fewer products are exempt under energy labelling than in the ecodesign act: while in the ecodesign regulation it is important to avoid the risk that light sources with special characteristics be unintentionally removed from the market, energy labelling of these light sources is useful, because the label will indicate the price to be paid, in terms of lower energy efficiency, to have the special characteristics. Thus, there will be light sources which are exempt from ecodesign requirements but not from the energy labelling.

2. Energy efficiency classes

The limits for the energy efficiency classes have been defined directly in terms of light source efficiency, as a result of the total light output of a light source (in lumen, *lm*) divided by the mains (230V) power input (in Watt, *W*) and expressed as *lm/W*. This is more straightforward and easier to understand than using the Energy Efficiency Index set out in the current regulation. This change implies that light sources with high light output do not need a higher efficiency than light sources with low light output to obtain a given energy efficiency class. This is reasonable considering that after 2020, when the measures start to apply, the label classes will mainly have to differentiate between LEDs with different efficiencies, and for LEDs the efficiency does not strongly depend on the amount of light output.

For directional light sources, where normally only the part of light output in a cone is taken into account, and for non-mains light sources (not taking 230 V as input), correction factors are applied to convert their efficacy to an efficacy comparable to the limits of the energy efficiency classes.

Class limits are proposed with 25 *lm/W* difference between consecutive classes: all light sources above 210 *lm/W* are class A. All light sources below 85 *lm/W* are class G.

As of October 2017 there are no light sources on the market that can meet the efficiency limits of classes A and B (but there are at laboratory level), so these classes would initially be empty as required by Regulation 2017/1369. The best LED light sources typically used by households today on the market would have new label class E; the best LED light sources for professional use today on the market would be class D. In 2020, when the new classes would start to apply, there might already be some class B light sources on the market, but class A is still expected to be empty.

In the highly dynamic light sources market, it is not an easy task to predict the share of models that will fall in class A around 2030, but it is unlikely that an update of the classes

would be necessary within 10 years of the introduction, thus meeting the requirements of Regulation 2017/1369. More data on the projected shares of light sources in the various energy efficiency classes in 2020 and 2030 will be supplied during the Ecodesign Consultation Forum of December 2017.

3. Energy label

The label is reviewed and updated following the instructions in the new framework Regulation (EU) 2017/1369. The general principle is that the label has to be displayed on the side of the packaging facing the potential buyer at the point of sale (visibility objective). Regulation (EU) 2017/1369, Article 16.3(e) sets out that delegated acts shall specify "the locations where the label shall be displayed (...) and the implications for customers, suppliers and dealers". Light source packages can be small, and there is also other information which must be displayed on the packaging. The tailor-made solution for small packages is to have the label on the rear of the packaging, with a coloured arrow with the energy efficiency class displayed on the front. This is in line with the outcome of the review study..

If the light source is sold inside a containing product (e.g. a luminaire) it would be confusing to attach a label for the light source to the packaging of the containing product. Hence, in this case, a label is not required, but the packaging of the containing product shall display a text declaring the energy efficiency class of the contained light source.

4. Implementation of product information requirements

The delegated act specifies the list of lighting parameters and other information:

- to be displayed on the packaging,
- to be entered in the public part of the product database established pursuant to Regulation 2017/1369 (this part can be printed as the product information sheet),
- to be entered in the compliance part of the product database established pursuant to Regulation 2017/1369 (this is a part of the technical documentation).

The list of parameters to be entered in the product database includes not only information strictly related to the energy label and its verification, but also all information useful for end-users and for market surveillance authorities to verify compliance with the ecodesign regulation on light sources, which is developed in parallel.

5. Verification procedure for market surveillance purposes

The procedure to be used by market surveillance authorities to verify the compliance of light sources with this Regulation is aligned to Commission Regulation (EU) 2016/2282¹², which is based on verification of parameter values declared by suppliers. In addition, the required number of samples has been reduced to 10 (3 for expensive products). This will facilitate market surveillance activities and remove some ambiguities.

As regards verification tolerances, the approach has been diversified, using different tolerances for different parameters and depending on the sample size, to better reflect reality.

6. Date of application

It is the intention of the Commission that this act starts to apply from the same date of application of the ecodesign act which is developed in parallel. The existing energy labelling regulation for lighting products (Commission Regulation (EC) No 874/2012) will be repealed from the day of application.

¹² OJ L 346, 20.12.2016, p.51.

COMMISSION DELEGATED REGULATION (EU) .../...

of XXX

**supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council with regard to energy labelling of light sources
repealing
Regulation (EU) No 874/2012 with regard to energy labelling of electrical lamps and luminaires**

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation 2017/1369 of the European Parliament and of the Council of 28 July 2017 setting a framework for energy labelling (¹³) repealing Directive 2010/30/EU, and in particular Articles 11 and 16 thereof,

Whereas:

- (1) Regulation 2017/1369 empowers the Commission to adopt delegated acts as regards the labelling or re-scaling of the labelling of product groups representing significant potential for energy savings and, where relevant, other resources.
- (2) Provisions on the energy labelling of lighting products, namely electrical lamps and luminaires, were established by Commission Delegated Regulation (EU) No 874/2012 of 12 July 2012 supplementing Directive 2010/30/EU (¹⁴) and its successive amendment (¹⁵).
- (3) Lighting products are among the product groups mentioned in Article 11(5)(b) of Regulation (EU) 2017/1369 for which the Commission should adopt a delegated act to introduce an A to G rescaled label.
- (4) Regulation (EU) No 874/2012 contains a review clause in Article 7 requiring the Commission to review the regulation in light of technological progress.
- (5) The Commission has reviewed Regulation (EU) No 874/2012 and analysed technical, environmental and economic aspects of as well as real-life user behaviour. The review was undertaken in close cooperation with stakeholders and interested parties from the Union and third countries. The results of the review were made public and presented to the Consultation Forum established by Article 14 of Regulation (EU) 2017/1369.
- (6) The review concluded that there was a need for the introduction of revised energy labelling requirements for lighting products, namely light sources.

¹³ OJ L 198, 28.07.2017, p. 1.

¹⁴ OJ L 314, 2010, p. 47

¹⁵ OJ L 147, 17.5.2014, p.1

- (7) The environmental aspect of light sources, identified as the most significant for the purposes of this Regulation, is electricity consumption in the use phase.
- (8) The electricity used by light sources accounts for a significant share of total household electricity demand in the Union. The review has shown that the electricity consumption of products subject to this Regulation can be further significantly reduced by implementing energy label measures.
- (9) The measures provided for in this Regulation were discussed by the Consultation Forum and the Member States' experts in accordance Articles 14 and 18 of Regulation (EU) 2017/1369.
- (10) Regulation 874/2012 should be repealed and new provisions should be laid down by this Regulation.

HAS ADOPTED THIS REGULATION:

Article 1

Subject matter and scope

This Regulation establishes requirements for the labelling of, and the provision of supplementary product information on, light sources, with or without integrated control gear. The requirements also apply to light sources placed on the market in a containing product.

This Regulation shall not apply to light sources specified in Annex I points 1 and 2. Light sources specified in Annex I point 3 shall only be subject to the requirements of Annex V point 5.

Article 2

Definitions

In addition to the definitions laid down in Article 2 of Regulation (EU) 2017/1369, the following definitions shall apply for the purposes of this Regulation:

- (1) '*light source*' means an electrically operated product intended to emit and/or be possibly tuned to emit light with the following optical characteristics:
 - (a) chromaticity coordinates x and y in the range
$$0,270 < x < 0,530 \text{ and}$$
$$- 2,3172 x^2 + 2,3653 x - 0,2199 < y < - 2,3172 x^2 + 2,3653 x - 0,1595;$$
 - (b) a luminous flux $< 1000 \text{ lm per mm}^2$ of projected light-emitting surface area as specified in Annex II;
 - (c) a luminous flux between 60 and 82 000 *lumen*;
 - (d) a colour rendering index $\text{CRI} > 0 \text{ Ra}$;

using incandescence, fluorescence, high-intensity discharge, light emitting diodes or their combinations as lighting technology.

High-pressure sodium light emitters (HPS, as defined in Annex II) that do not fulfil condition (1)(a) are anyway considered light sources in the sense of this Regulation.

If a containing product is itself a light source, the light source to be considered for the purpose of this Regulation is the smallest physical unit that can be readily removed from the containing product without permanent mechanical damage and that meets the definition for light source.

- (2) '*control gear*' means one or more devices, possibly integrated in a light source, intended to prepare the mains electricity supply for the electric format required by one or more specific light sources within boundary conditions set by electric safety and electromagnetic compatibility. It may include transforming the supply and starting voltage, limiting operational and preheating current, preventing cold starting, correcting the power factor and/or reducing radio interference.
- (3) '*containing product*' means a product containing one or more light sources in scope of this Regulation. Suppliers of containing products shall enable verification by market surveillance authorities of compliance of light source(s) as set out in Annex VI.
- (4) '*light*' means electromagnetic radiation with a wavelength between 380 *nm* and 780 *nm*.
- (5) '*mains*' or '*mains voltage*' or '*mains electricity supply*' (MV) means the electricity supply of 230 ($\pm 10\%$) *Volt* of alternating current at 50 *Hz*.
- (6) '*chromaticity*' means the property of a colour stimulus defined by its chromaticity coordinates (*x* and *y*).
- (7) '*luminous flux*' or '*flux*' (Φ), expressed in lumen (*lm*), means the quantity derived from radiant flux (radiant power) by evaluating the electromagnetic radiation in accordance with the spectral sensitivity of the human eye. It refers to the total flux emitted by a light source in a solid angle of 4π *steradians* under conditions (e.g. current, voltage, temperature) specified in applicable standards. It refers to the initial flux for the undimmed light source after a short operating period, unless it is clearly specified that the flux in a dimmed condition or the flux after a given period of operation is intended. '*Luminous flux*' without further specification is the total luminous flux in a 360° sphere. For light sources that can be tuned to emit different light spectra and/or different maximum light intensities, it refers to the flux in the 'reference control settings' as defined in Annex II.
- (8) '*colour rendering index*' (CRI), expressed in *Ra*, means the effect of an illuminant on the colour appearance of objects by conscious or subconscious comparison with their colour appearance under the reference illuminant. For the purposes of this Regulation it refers to the mean of colour rendering indices for a set of 8 test colour samples as specified in standards (*Ra8*).
- (9) '*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.
- (10) '*halogen light source*' (HL) means an incandescent light source with a threadlike conductor made from tungsten surrounded by gas containing halogens or halogen compounds.
- (11) '*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.

- (12) '*high intensity discharge*' (HID) means an electric gas discharge in which the light-producing arc is stabilised by wall temperature and the arc has a bulb wall loading in excess of 3 *Watts per square centimetre*. For the purpose of this Regulation, HID light sources are limited to metal halide, high pressure sodium and mercury vapour types as defined in Annex II.
- (13) '*fluorescence*' or '*fluorescent light source*' (FL) means the phenomenon or a light source using an electric gas discharge of the low-pressure mercury type in which most of the light is emitted by one or more layers of phosphors excited by the ultraviolet radiation from the discharge. Fluorescent light sources may have one ('single-capped') or two ('double-capped') connections ('caps') to their electricity supply. For the purposes of this Regulation, magnetic induction light sources are also considered as fluorescent light sources.
- (14) '*inorganic 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. The junction emits optical radiation when excited by an electric current.
- (15) '*organic light emitting diode*' (OLED) means a technology in which light is produced from a solid state device embodying a p-n junction of organic material. The junction emits optical radiation when excited by an electric current.
- (16) 'point of sale' means a physical location where the product is displayed or offered for sale, hire or hire-purchase to the end-user.
- (17) '*end-user*' means a natural person buying or expected to buy a product for purposes which are outside his trade, business, craft or profession.
- (18) '*final owner*' means the entity owning a product during the use phase of its life cycle, or any other entity acting on its behalf.

Other definitions are set out in Annex II.

Article 3

Obligations of suppliers

1. In addition to the obligations of suppliers laid down in Regulation (EU) 2017/1369, suppliers shall ensure that:
 - (a) each light source is supplied with a printed label in the format as set out in Annex III;
 - (b) the parameters of the product information sheet, as set out in Annex V, are entered into the product database established by Regulation (EU) 2017/1369;
 - (c) an electronic label in the format and containing the information as set out in Annex III shall be made available to dealers for each light source model;
 - (d) an electronic product information sheet shall be made available to dealers for each light source model;
 - (e) if requested by the dealer, the product information sheet shall be made available in printed form;
 - (f) the content of the technical documentation uploaded into the product database established by Regulation (EU) 2017/1369 is according to Annex V;

- (g) any visual advertisement for a specific model of light source, including on the internet, contains the energy efficiency class and the range of efficiency classes available on the label in accordance with Annex IX;
 - (h) any technical promotional material concerning a specific model of light source which describes its specific technical parameters, including on the internet, includes the energy efficiency class of that model and the range of efficiency classes available on the label, in accordance with Annex IX;
 - (i) the printed label to rescale products is a sticker, of the same size as the one which is already on the package;
 - (j) no products are placed on the market that have been designed so that a model's performance is automatically altered in test conditions with the objective of reaching a more favourable level for any of the parameters specified in this delegated act or included in the documentation provided for the product.
2. Suppliers of containing products placed on the market shall provide information on the contained light sources as specified in Annex V point 3.2.
 3. The energy efficiency class shall be calculated in accordance with Annex IV.

Article 4

Obligations of dealers

1. In addition to the obligations of dealers laid down in Regulation (EU) 2017/1369, dealers shall ensure that:
 - (a) each light source, at the point of sale, bears the label provided by suppliers in accordance with Article 3.1(a) displayed as indicated in Annex III, in such a way as to be clearly visible;
 - (b) the label and product information sheet are provided in the case of distance selling in accordance with Annexes VI and VII;
 - (c) any visual advertisement for a specific model of light source, including on the internet, contains the energy efficiency class and the range of efficiency classes available on the label, in accordance with Annex IX;
 - (d) any technical promotional material concerning a specific model of light source, including on the internet, which describes its specific technical parameters includes the energy efficiency class of that model and the range of efficiency classes available on the label, in accordance with Annex IX;
 - (e) existing labels on products on display at points of sale are replaced by the rescaled labels that need to be attached to the packages in such a way as to cover the existing label.

Article 5

Measurement methods

The information to be provided pursuant to Articles 3 and 4 shall be obtained by reliable, accurate and reproducible measurement and calculation methods, which take into account the

recognised state-of-the-art measurement and calculation methods, as set out in Annex IV and in Annex VIII.

Article 6

Verification procedure for market surveillance purposes

Member States shall apply the procedure laid down in Annex VIII when assessing the conformity of the declared energy efficiency class, the energy consumption and the information entered in the product database.

Article 7

Revision

The Commission shall review this Regulation in the light of technological progress and present the results of this review to the Consultation Forum no later than five years after its entry into force. The review shall in particular assess the energy efficiency classes and the possibility to introduce requirements on other environmental aspects in coherence with the objective to promote a circular economy.

In addition, the Commission shall review the label to rescale it when the requirements in Article 11 of Regulation (EU) 2017/1369 are met.

Article 8

Repeal

Regulation (EU) No 874/2012 is repealed as of the day of application of this Regulation as specified in Article 9.2.

Article 9

Entry into force and application

1. This Regulation shall enter into force on the 20th day following its publication in the Official Journal of the European Union.
2. It shall apply from **XXXX**.
3. The obligations in Article 3(1)(a) and (b) shall apply 4 months before **XXXX**.
4. The obligation in Article 4(1)(e) shall apply 30 days after the date of entry into force.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels,

For the Commission
Jean-Claude JUNCKER
The President

DRAFT

DRAFT OF
ANNEXES

COMMISSION DELEGATED REGULATION (EU) .../...
supplementing Regulation (EU) 2017/1369 of the European Parliament and of the
Council with regard to energy labelling of light sources

This draft has not been adopted or endorsed by the European Commission. Any views expressed are the preliminary views of the Commission services and may not in any circumstances be regarded as stating an official position of the Commission. The information transmitted is intended only for the Member State or entity to which it is addressed for discussions and may contain confidential and/or privileged material.

ANNEX I

Exemptions

1. This Regulation shall not apply to light sources specifically tested and approved to operate:
 - (a) in or on motor vehicles, their trailers and systems, components and separate technical units intended therefore as set out in Regulation No 661/2009¹, Regulation (EU) No 168/2013² and their amendments;
 - (b) in or on civil aviation aircrafts as set out in Commission Regulation 748/2012³;
 - (c) in railway vehicle lighting as set out in Directive 2008/57/EC⁴ and its amendments, as well as relevant Member State legislation;
 - (d) in marine equipment as set out in Council Directive 2014/90/EU⁵ and its amendments or recasts;
 - (e) in or on military or civil defence ground vehicles, marine equipment or aircraft as set out in Member States' Regulations or in documents issued by the European Defence Agency.

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

- 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
- 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
- is placed on the market specifically for the mentioned operating condition or application, as evidenced at least by the technical documentation, and possibly by information on the packaging and/or in publicity.

2. In addition, this Regulation shall not apply to:
 - (a) 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 617/2013⁶, Commission Decision (EU) 2015/1402⁷, Commission Regulation (EC) No 642/2009⁸, Commission Decision (EU) 2016/1756⁹, European Commission COM(2015)178¹⁰.

¹ OJ L 200, 31.7.2009, p.1-24

² OJ L60, 2.3.2013, p. 52

³ OJ L 224, 21.8.2012, p. 1-85

⁴ OJ L 191, 18.7.2008, p.1-45.

⁵ OJ L 257, 28.8.2014, p. 146–185

⁶ OJ L 175, 27.6.2013, p.13 (computers)

⁷ OJ L 217, 18.8.2015, p.9 (office equipment, computers)

⁸ OJ L 191, 23.7.2009, p.42 (televisions)

⁹ OJ L 268, 1.10.2016, p.90 (office equipment, displays)

¹⁰ COM(2015) 178 final, 22.4.2015 (related to self-regulatory initiative regarding game consoles)

- (b) light sources in portable battery-operated containing 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.
 - (c) light sources on bicycles and other non-motorized vehicles.
 - (d) light sources that do not comply with requirements becoming applicable in 2020 according to Regulations implementing Directive 2009/125/EC of the European Parliament and of the Council.
3. Any light source in scope of this Regulation shall be exempt from the requirements of Articles 3 and 4, with the exception of Annex V.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, photocopiers and video projectors).

For these products, the information requirements of Annex V.5 apply.

ANNEX II

Definitions

The following definitions apply in addition to those in Article 2 of the main text:

- (1) '*mains light source (MLS)*' means a light source that can be operated directly on the mains electricity supply. Examples include incandescent light sources designed to operate directly on the mains, light sources with physically integrated control gear.

Light sources that can operate both directly on the mains, and indirectly on the mains using a separate control gear, shall be considered to be mains light sources. E.g. tubular LED light sources intended to replace linear FL, by-passing or keeping the existing FL control gear.

- (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 but they are placed on the market without such control gear. Examples include extra-low-voltage light sources, light sources for operation on power-over-ethernet, and LED-, OLED-, HID- and FL- light sources placed on the market without control gear.
- (3) '*separate control gear*' means a control gear that is not physically integrated with a light source and is placed on the market as a separate product or as a part of a containing product.
- (4) '*directional light source*' (DLS) means a light source having at least 80% of total luminous flux within a solid angle of π sr (corresponding to a cone with angle of 120°)
- (5) '*non-directional light source*' (NDLS) means a light source that is not a directional light source.
- (6) '*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.' To maintain the reference control settings the data-connection parts cannot be disconnected, switched-off or their power consumption minimised.

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 as a single product.

- (7) '*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.
- (8) '*colour-tuneable light source*' (CTLS) means a connected light source (CLS) using LED- or OLED-technology, that can be set to emit light with a large variation of colours outside the range defined in article 2 (1)(a), but can also be set to emit white light inside the range defined in article 2 (1)(a) 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 colour temperatures, within the range defined in article 2 (1)(a).

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

- (9) '*lighting control parts*' means parts that are integrated in a light source, or physically separated but marketed together with a light source as a single product, that are not strictly necessary for the light source to emit light at full-load, but that enable manual or automatic, direct or remote, control of luminous intensity, chromaticity, 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 devices within the scope of Commission Regulation (EC) No 1275/2008¹¹.

- (10) '*non-lighting parts*' means parts that are integrated in a light source, or physically separate but marketed together with a light source as a single product, that are not necessary for the light source 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)

- (11) '*useful luminous flux*' (Φ_{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 4π sr (corresponding to a 360° sphere).
- For directional light sources with beam angle $\geq 90^\circ$ it is the flux emitted in a solid angle of π sr (corresponding to a cone with angle of 120°).
- For directional light sources with beam angle $< 90^\circ$ it is the flux emitted in a solid angle of 0.586π sr (corresponding to a cone with angle of 90°).

- (12) '*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 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 considered.

For light sources with user-controllable beam angle, the beam angle corresponding to the 'reference control setting' shall be considered.

- (13) '*full-load*' means:

- the condition of a light source, within the declared operating conditions, in which it is emitting 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.

¹¹ OJ L 339, 18.12.2008, p. 45 and later amendments.

- (14) '*standby mode*' means the condition of a light source, where it is connected to the power supply but the light sources are intentionally not emitting light, and the light source is awaiting a control signal 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.
- (15) '*networked standby mode*' means the condition of a connected light source (CLS) where it is connected to the power supply but the light source is intentionally not emitting light, and is awaiting a remotely initiated trigger 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.
- (16) '*control mode*' means the condition of lighting control parts where they are connected to the light source and performing their functions in such a way that a lighting control signal can be internally generated or an external control signal can be received, by wire or wireless, and processed to lead to a change in the light emission of the light source.
- (17) '*control signal*' means an analogue or digital signal transmitted to light source wirelessly or wired either via voltage modulation in separate control cables or via a modulated signal in the supply voltage.
- (18) '*remotely initiated trigger*' means a signal that comes from outside the light source via a network.
- (19) '*network*' means a communication infrastructure with a topology of links, an architecture, including the physical components, organisational principles, communication procedures and formats (protocols).
- (20) '*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 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.

- (21) '*standby power*' (P_{sb}), expressed in Watt, is the electric power consumption of a light source in standby mode.
- (22) '*networked standby power*' (P_{net}), expressed in Watt, is the electric power consumption of a connected light source in networked standby mode.
- (23) '*reference control settings*' 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, colour temperature, spectrum, and/or beam angle of the emitted light.

The reference control settings shall be those predefined by the supplier 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 supplier shall define the reference control settings such that:

- the light source is in scope of this Regulation according to Art.2(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.
- (24) '*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.
- (25) '*high-pressure sodium light source*' (HPS) means a high intensity discharge light source in which the light is produced mainly by radiation from sodium vapour operating at a partial pressure of the order of 10 kilopascals. HPS light sources may have one ('single-ended') or two ('double-ended') connectors to their electricity supply.
- (26) '*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).
- (27) '*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.
- (28) '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)
- (29) '*LFL T5-HE*' means a high-efficiency linear fluorescent T5 light source with driving current lower than 0.2 A.
- (30) '*LFL T5-HO*' means a high-output linear fluorescent T5 light source with driving current higher than or equal to 0.2 A.
- (31) '*HL R7s*' is a mains-voltage, double capped, linear halogen light source with a cap-diameter of 7 mm.
- (32) '*portable battery-operated*' means a containing product that is not fixed to the ambient, that is intended to be carried around by people or to be frequently moved, whose position can be changed by a simple manual pick-and-place operation, and that operates only on direct current (DC) with a voltage of less than 24 V supplied from a source

contained in the same product, without being connected directly or indirectly to the mains electricity supply.

- (33) '*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.
- (34) '*Non-clear envelope*' means a HID light source with a non-transparent outer envelope or outer tube in which the light producing arc tube is not visible.
- (35) '*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.
- (36) '*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.

- (37) '*declared value*' for a parameter means the value given by the manufacturer or importer in the technical documentation pursuant to Article 3(3) of Regulation 2017/1369.
- (38) '*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.
- (39) '*colour temperature*' (T_c [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.
- (40) '*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 (c_x and c_y) declared by the manufacturer or the importer, expressed as the size (in steps) of the MacAdam ellipse formed around the chromaticity centre point (c_x and c_y).
- (41) '*displacement factor* ($\cos \varphi_1$)' means the cosine of the phase angle φ_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.

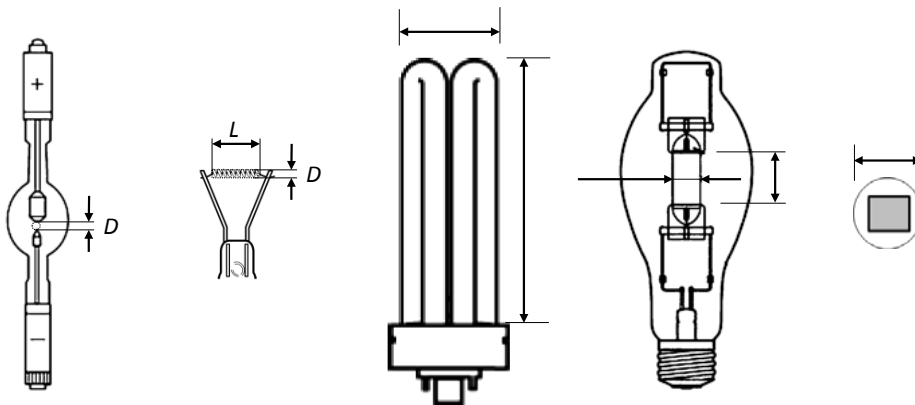
The displacement factor is measured at full-load, for the reference control settings where applicable, with any lighting control parts in control mode and non-lighting parts disconnected, switched off or set to minimum power consumption according to manufacturer's instructions.

- (42) '*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.
- (43) '*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.

- (44) 'lifetime' for LED and OLED light sources means the time in hours between the start of their use and the moment when 50% of a population of light sources have either abruptly failed (no light output anymore) or their light output has gradually degraded to a value below 70% of the initial luminous flux. This is also referred to as the $M_{70}F_{50}$ lifetime.
- (45) '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.
- (46) 'projected light-emitting surface area'(A), in mm^2 , is the surface area 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 non-clear envelope or with anti-glare shield, the light-emitting surface area is the entire area through which light is leaving the light source.

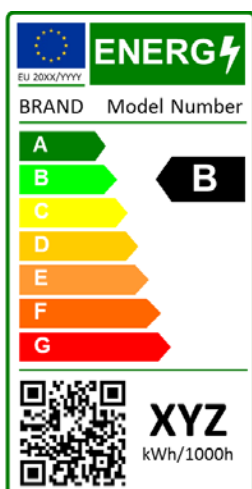
For light sources containing more than one light emitter, the smallest gross volume enveloping all emitters shall be taken as the light-emitting surface.



ANNEX III

Label for light sources

- (1) The label shall be as in the following illustration :



- (2) The following information shall be included in the label for light sources:
- I. trademark or supplier's name;
 - II. model identifier), meaning the code, usually alphanumeric, which distinguishes a light source model from other models with the same trade mark or supplier's name;
 - III. the energy efficiency class determined in accordance with Annex IV; the head of the arrow containing the energy efficiency class of the light source shall be placed at the same height as the head of the arrow of the relevant energy efficiency class;
 - IV. a quick response code (QR-code) redirecting to a website optimized for mobile devices where additional information on the light source can be found;
 - V. the energy consumption (XYZ), expressed in kWh of electricity consumption per 1000 hours of light source on-mode operation.
- (3) The label shall meet all the following requirements in its standard size. If the label is printed in a larger format, its content must nevertheless remain proportionate to the specifications for the standard size below:
- (XXX)
- (4) The following label application rules shall apply:
- (a) The label shall be placed on the side of the packaging that the end-user is intended to see first in a point of sale. Only if the label would significantly

distort or complicate the packaging (such as in some blister packages) can the label be placed on another side.

- (b) If the packaging is too small to accommodate the standard size label, a standard size or larger label shall be attached or placed in close proximity to the packaging, making it clear which product the label refers to.
- (c) If the label cannot be placed on the side of the packaging that the end-user is intended to see first in a point of sale as described in point (a), or if the packaging is too small to accommodate the minimum size label as described in point (b), a coloured arrow designating the energy efficiency class shall be placed on the side of the packaging that the end-user is intended to see first in a point of sale. The arrow shall follow the relevant design specifications as described in Annex IX, and have a minimum size of 33,4mm width and 21mm height.
- (d) If a model specimen is presented in a point of sale, a standard size label shall be attached or placed in close proximity to the specimen, making it clear which product the label refers to.
- (e) Nothing else placed or printed on, or attached to, the individual packaging or the model shall obscure the label, confuse its meaning or reduce its visibility, except if the model has been awarded an 'EU ecolabel' under Regulation (EC) No 66/2010. In this case a copy of the EU ecolabel may be added, but the energy label shall continue to be visible.
- (f) The label, and where applicable the coloured arrow under point (c), can be printed directly on the packaging, or can be a sticker firmly attached to the packaging, or can be a separate item inside the packaging provided it is clearly visible from the outside through e.g. a transparent part of the packaging, or any other solution, as long as it is clearly visible without opening the packaging and does not obstruct other information required to be present on the packaging according to Annex V.

ANNEX IV

Energy efficiency classes and calculation method

The energy efficiency class of light sources shall be determined on the basis of the efficacy values expressed in total mains efficacy η_{TM} , which is defined as the total initial luminous flux (in lm) divided by mains power input (in W) – (lm/W) – as set out in Table 1.

Table 1

Energy efficiency class	Total mains efficacy η_{TM} (lm / W)
A	$210 \leq \eta_{TM}$
B	$185 \leq \eta_{TM} < 210$
C	$160 \leq \eta_{TM} < 185$
D	$135 \leq \eta_{TM} < 160$
E	$110 \leq \eta_{TM} < 135$
F	$85 \leq \eta_{TM} < 110$
G	$85 \leq \eta_{TM}$

The total mains efficacy η_{TM} is calculated by dividing the declared useful luminous flux Φ_{use} (expressed in lm) by the declared on-mode power consumption P_{on} (expressed in W) and multiplying by the applicable factor F_{TM} of Table 2, i.e.:

$$\eta_{TM} = (\Phi_{use} / P_{on}) * F_{TM} (lm/W).$$

Table 2 Factors F_{TM} to be used for determination of $\eta_{TM} = (\Phi_{use} / P_{on}) * F_{TM} (lm/W)$

Light source type	Factor F_{TM}
Non-directional mains light source (NDLS, MLS)	1.000
Non-directional non-mains light source (NDLS, NMLS)	0.926
Directional mains light source (DLS, MLS)	1.176
Directional non-mains light source (DLS, NMLS)	1.089

ANNEX V

Product information

1. PRODUCT INFORMATION SHEET

The product information sheet to be provided by the supplier pursuant to Article 3(d) shall contain all the information entered in the public part of the product database established by Regulation (EU) 2017/1369, as specified in point 4.1 of this Annex.

2. TECHNICAL DOCUMENTATION

The technical documentation to be provided by the supplier pursuant to Article 3(f) shall include at least the information entered in the compliance part of the product database established by Regulation (EU) 2017/1369, as specified in point 4.2 of this Annex.

The information in the technical documentation shall be sufficient to enable market surveillance authorities to assess the accuracy of the energy label as specified in Annex III, of the product information sheet as specified in point 1 of this Annex and of the information entered in the product database as specified in point 4 of this Annex.

3. INFORMATION TO BE DISPLAYED ON THE PACKAGING

3.1. Light source as an independent product

If a light source is placed on the market in a packaging containing information to be visibly displayed to users prior to their purchase, the following information shall be clearly and prominently displayed on the packaging in addition to the energy label of Annex III:

- (a) the useful luminous flux (Φ_{use}) in a font at least twice as large as the display of the on-mode power (P_{on}), clearly indicating if it refers to the flux in a sphere (360°), in a wide cone (120°) or in a narrow cone (90°);
- (b) the colour temperature T_c in K, rounded to the nearest 100 K, also expressed graphically or in words, or the range of colour temperatures that can be set;
- (c) the beam angle in degrees (for directional lamps), or the range of beam angles that can be set;
- (d) electrical interface details, e.g. cap- or connector-type, type of power supply (e.g. 230 V AC 50 Hz, 12 V DC);
- (e) the $M_{70}F_{50}$ lifetime for LED and OLED light sources, in hours (not longer than the declared lifetime).
- (f) the on-mode power (P_{on}), expressed in W;
- (g) 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;
- (h) the networked standby power (P_{net}) for CLS, 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;

- (i) the colour rendering index CRI in Ra, rounded to the nearest integer, or the range of CRI-values that can be set;
- (j) if $\text{CRI} < 80$ Ra, and the light source is intended for use in outdoor applications, industrial applications or other applications where lighting standards allow a $\text{CRI} < 80$, a clear indication to this effect. For HID light sources with useful luminous flux > 4000 lm this indication is not mandatory;
- (k) if the light source is designed for optimum use in non-standard conditions (such as ambient temperature $T_a \neq 25$ °C or specific thermal management is necessary), information on those conditions;
- (l) a warning if the light source cannot be dimmed or can be dimmed only with specific dimmers or with specific wired or wireless dimming methods. In the latter cases a list of compatible dimmers and/or methods shall be provided on the manufacturer's website;
- (m) if it contains mercury, a warning about it including the mercury content in mg rounded to the first decimal place;
- (n) if it is in scope of Directive 2012/19/EU or contains mercury, a warning that it should not be disposed of in the general waste stream;
- (o) in addition to the QR-code included in the energy label of Annex III, the internet address for the website(s), where full information on the light source as set out in point 2.1 of this Annex can be found.

Items (a) to (d) shall be displayed on the packaging in the direction meant to face prospective buyers; for other items this is also recommended, if space permits.

For light sources that can be set to emit light with different characteristics, the information shall be reported for the reference control settings, or a range of obtainable values shall be indicated.

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.

If the packaging is too small to accommodate all required information, following Annex III.4(b), a standard size or larger label shall be attached or placed in close proximity to the packaging, and some of the information not required to face the prospective buyer may be displayed on the same physical carrier as the label instead of on the packaging.

3.2. Light source in a containing product

If a light source is placed on the market as a part in a containing product the following information requirements shall apply:

- (a) the technical documentation for the containing product shall clearly identify the contained light source(s), including the energy efficiency class according to Annex III;
- (b) the following text shall be displayed, clearly legible, on the outside of the containing product's packaging, in any advertisement, formal price quote or tender offer disclosing energy-related or price information on the containing product and in any technical promotional material for the containing product, which describes specific technical parameters:

'This product contains a light source of energy efficiency class <X> according to <replace by final indication of this Regulation>',

where <X> shall be replaced by the energy efficiency class of the contained light source according to Annex IV.

In case the product contains more than one light source, the sentence can be in plural, or repeated per light source, as suitable.

4. INFORMATION TO BE ENTERED IN THE PRODUCT DATABASE ESTABLISHED BY REGULATION (EU) 2017/1369

4.1. Public part of the product database

If a light source is placed on the market, including when it is a part in a containing product, the following information shall be entered in the public part of the product database:

- (a) supplier's name or trade mark, address, contact details and other legal identification of the supplier;
- (b) supplier's model identifier, meaning the code, usually alphanumeric, which distinguishes a specific light source model from other models with the same trade mark or supplier's name;
- (c) the energy label according to Annex III in electronic format;
- (d) the energy efficiency class according to Annex III;
- (e) the energy consumption expressed in kWh of electricity consumption per 1000 h of light source on-mode operation;
- (f) the lighting technology used, i.e. HL, LFL T5 HE, LFL T5 HO, CFLni, other FL, HPS, MH, other HID, LED, OLED, mixed, other;
- (g) if the light source is non-directional (NDLS) or directional (DLS) in the sense of this Regulation;
- (h) if the light source is a mains light source (MLS) or a non-mains light source (NMLS) in the sense of this Regulation;
- (i) if the light source is a connected light source (CLS) in the sense of this Regulation;
- (j) if the light source is a colour-tuneable light source (CTLS) in the sense of this Regulation;
- (k) if the light source has a second envelope, a non-clear envelope and/or an anti-glare shield in the sense of this Regulation;
- (l) the date (day, month, year) of last update of the information;
- (m) the date (month, year) of first production of the light source for the EU market;
- (n) if the light source is still in production for sale on the EU-market (yes/no);
- (o) if the light source is no longer in production for sale on the EU-market, the date (month, year) when production for the EU market stopped;
- (p) the information specified in point 1.1 of this Annex;

- (q) the outer dimensions in mm, without separate control gear, lighting control parts and non-lighting parts, if any;
- (r) the mass in grams of the light source, without packaging, and without separate control gear, lighting control parts and non-lighting parts, if any and if they can be physically separated from the light source;
- (s) the spectral power distribution in the range 250 nm to 800 nm, at full-load;
- (t) the displacement factor, $\cos(\phi_1)$, (for LED and OLED mains light sources);
- (u) the chromaticity coordinates (x,y);
- (v) the colour consistency in McAdam ellipses (for LED and OLED mains light sources);
- (w) the peak luminous intensity for directional light sources (in cd);
- (x) the lumen maintenance factor for FL and HID light sources at 2 000 h, 4 000 h, 6 000 h, 8 000 h, 12 000 h, 16 000 h and 20 000 h (up to 8 000 h only for new light sources on the market where no data is yet available), indicating which operation mode of the light source was used for the test if both 50 Hz and High Frequency operation are possible;
- (y) the survival factor for FL and HID light sources at 2 000 h, 4 000 h, 6 000 h, 8 000 h, 12 000 h, 16 000 h and 20 000 h (up to 8 000 h only for new light sources on the market where no data is yet available), indicating which operation mode of the light source was used for the test if both 50 Hz and High Frequency operation are possible;
- (z) the reference control settings, and instructions how they can be implemented, where applicable;
- (aa) instructions how to remove lighting control parts and/or non-lighting parts, if any, or how to switch them off or minimize their power consumption during light source testing;
- (bb) if it is dimmable, a list of dimmers it is compatible with, and the light source – dimmer compatibility standard(s) it is compliant with, if any;
- (cc) if it contains mercury, instructions on how to clean up the lamp debris in case of accidental breakage;
- (dd) recommendations on how to dispose of it at the end of its life for recycling in line with Directive 2012/19/EU.

For light sources that can be tuned to emit light at full-load with different characteristics, the values of parameters (including those of point 1.1 of this Annex) that vary with these characteristics shall at least be reported at the reference control settings.

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

4.2. Compliance part of the product database

If a light source is placed on the market, including when it is a part in a containing product, the following information shall be entered in the compliance part of the product database:

- (a) the name and address of the supplier;

- (b) supplier's model identifier, meaning the code, usually alphanumeric, which distinguishes a specific light source model from other models with the same trade mark or supplier's name;
- (c) the model identifier of all equivalent models already placed on the market;
- (d) the measured technical parameters of the model, including the declared values for:
 - (1) useful luminous flux (Φ_{use}) in *lm*;
 - (a) colour rendering index (CRI) in Ra;
 - (b) on-mode power (P_{on}) in W;
 - (c) beam angle in degrees, for directional light sources (DLS);
 - (d) colour temperature (T_c) in K, for FL and HID light sources;
 - (e) standby power (P_{sb}) in W, including when it is zero;
 - (f) networked standby power (P_{net}) in W, for connected light sources (CLS);
 - (g) displacement factor (DF, $\cos(\phi_1)$), for LED and OLED mains light sources;
 - (h) colour consistency in MacAdam ellipse steps, for LED and OLED light sources;
 - (i) flicker metric P_{stLM} , for LED and OLED light sources;
 - (j) other measurable parameters from the public part of the product database.
- (e) the calculations performed with the measured parameters, including the determination of the energy efficiency class according to Annex IV;
- (f) references to the harmonised standards applied or other measurements standards used;
- (g) testing conditions if not described sufficiently in point (d);
- (h) the reference control settings, and instructions how they can be implemented, where applicable;
- (i) instructions how to remove lighting control parts and/or non-lighting parts, if any, or how to switch them off or minimize their power consumption during light source testing;
- (j) specific precautions that shall be taken when the model is assembled, installed, maintained or tested.

5. INFORMATION FOR PRODUCTS SPECIFIED IN ANNEX I POINT 3

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

The technical documentation file drawn up for the purposes of conformity assessment in accordance with Article 3.3 of Regulation 2017/1369 shall list the technical parameters that make the product design specific to qualify for the exemption.

ANNEX VI

Information to be provided in the case of distance selling, except distance selling on the Internet

Any paper based distance selling must show the energy class and the range of available efficiency classes as following the example below, with the colour of the arrow matching the letter of the energy class:



It must be possible for the customer to access the full label and the product information sheet through a free access website, or to request a printed copy.

Telemarketing based distance selling must specifically inform the customer of the energy class of the product and the range of energy classes available on the label, and that they can access the full label and the product information sheet through a free access website, or by requesting a printed copy.

ANNEX VII

Information to be provided in the case of distance selling through the Internet

1. For the purpose of points 2 to 5 of this Annex the following definitions shall apply:
 - (a) ‘display mechanism’ means any screen, including tactile screen and visual technology used for displaying internet content to end-users;
 - (b) ‘nested display’ means visual interface where an image or data set is accessed by mouse click, mouse roll-over or tactile screen expansion of another image or data set;
 - (c) ‘tactile screen’ means a screen responding to touch, such as that of a tablet computer, slate computer or a smartphone;
 - (d) ‘alternative text’ means text provided as an alternative to a graphic allowing information to be presented in non-graphical form where display devices cannot render the graphic or as an aid to accessibility such as input to voice synthesis applications.
2. The appropriate label made available by suppliers in accordance with Article 3(1)(c) shall be shown on the display mechanism in proximity to the price of the product. The size shall be such that the label is clearly visible and legible and shall be proportionate to the size specified in Annex III. The label may be displayed using a nested display, in which case the image used for accessing the label shall comply with the specifications laid down in point 3 of this Annex. If nested display is applied, the label shall appear on the first mouse click, mouse roll-over or tactile screen expansion on the image.
3. The image used for accessing the label in the case of nested display shall:
 - (a) be an arrow in the colour corresponding to the energy efficiency class of the product on the label;
 - (b) indicate on the arrow energy efficiency class of the product in white in a font size equivalent to that of the price; and
 - (c) have the following format (specular image with the arrow pointing to the right is also possible):



4. In the case of nested display, the sequence of display of the label shall be as follows:
 - (a) the image referred to in point 3 of this Annex shall be shown on the display mechanism in proximity to the price of the product;
 - (b) the image shall link to the label;
 - (c) the label shall be displayed after a mouse click, mouse roll-over or tactile screen expansion on the image;
 - (d) the label shall be displayed by pop up, new tab, new page or inset screen display;
 - (e) for magnification of the label on tactile screens, the device conventions for tactile magnification shall apply;
 - (f) the label shall cease to be displayed by means of a close option or other standard closing mechanism;
 - (g) the alternative text for the graphic, to be displayed on failure to display the label, shall be the energy efficiency class of the product in a font size equivalent to that of the price.

The appropriate product information sheet made available by suppliers in accordance with Article 3(1)(d) shall be shown on the display mechanism in proximity to the price of the product. The size shall be such that the product information sheet is clearly visible and legible. The product information sheet may be displayed using a nested display, in which case the link used for accessing the product information sheet shall clearly and legibly indicate 'Product information sheet'. If nested display is used, the product information sheet shall appear on the first mouse click, mouse roll-over or tactile screen expansion on the link.

ANNEX VIII

Verification procedure for market surveillance purposes

The verification tolerances set out in this Annex relate only to the verification of the declared parameters by Member State authorities and shall not be used by the supplier as an allowed tolerance to establish the values in the technical documentation. The values and classes on the label or in the product information sheet shall not be more favourable for the supplier than the declared values reported in the technical documentation.

When verifying the compliance of a product model with the requirements laid down in this Delegated Regulation, for the requirements referred to in this Annex, the authorities of the Member States shall apply the following procedure:

- (1) The Member State authorities shall verify one single unit of the model.
- (2) The model shall be considered to comply with the applicable requirements if:
 - (a) the values given in the technical documentation pursuant to Article 3.3 of Regulation (EU) 2017/1369 (declared values), and, where applicable, the values used to calculate these values, are not more favourable for the supplier than the corresponding values given in the test reports; and
 - (b) the values published on the label and in the product information sheet are not more favourable for the supplier than the declared values, and the indicated energy efficiency class is not more favourable for the supplier than the class determined by the declared values,
- (3) If the results referred to in point 2(a) or (b) are not achieved, the model and all equivalent models shall be considered not to comply with this Regulation.
- (4) If the results referred to in point 2(a) and (b) are achieved, the Member States authorities shall test 10 units of the model. If the acquisition costs for the 10 units exceed 500 euros, Member State authorities will have the option to reduce the sample size to 3 units.
- (5) The model and all equivalent models shall be considered to comply with the applicable requirements if the determined values of the applicable parameters comply with the respective verification tolerances as given in Table 4. The determined values are assessed as follows:
 - (a) for each unit measure the applicable parameters from Table 4;
 - (b) calculate the determined value of each applicable parameter as the arithmetical mean of the measured values of the 10 (or 3) units for that parameter.
- (6) If the results referred to in point 5 are not achieved, the model and all equivalent models shall be considered not to comply with this Regulation.
- (7) 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 6.

The Member State authorities shall use reliable, accurate and reproducible measurement procedures, which take into account the generally recognised state-of-the-art measurement methods, including methods set out in documents whose reference numbers have been published for that purpose in the *Official Journal of the European Union*.

The Member State authorities shall only apply the verification tolerances that are set out in Table 4 and shall only use the procedure described in points 1 to 7 for the requirements referred to in this Annex. No other tolerances, such as those set out in harmonised standards or in any other measurement method, shall be applied.

In case light sources are placed on the market as parts inside a containing product or supplied with the product, the supplier of this containing product shall facilitate market surveillance authorities verifying compliance of the light sources with this Regulation by providing, on request, detailed instructions to the market surveillance authorities how to dismount light source(s) for inspection without permanent mechanical damage.

If the containing product contains multiple identical light sources, possibly each individually emitting less than 60 lm but in total emitting more than 60 lm, verification testing of the market surveillance authorities may be limited to a representative subset of the individual light sources and the results can be extrapolated.

Table 4: Verification tolerances

Parameter	Sample size	Verification tolerances
Full-load on-mode power P_{on} [W]:		
$P_{on} \leq 5W$	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 %.
$5W < P_{on} < 100W$	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 %.
$P_{on} \geq 100W$	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 %.
Power factor [0-1]		
	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 %.
Useful luminous flux Φ_{use} [lm]		
	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 %.
No-load power P_{no}, Standby power P_{sb} and Networked standby power P_{net} [W]		
	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.
CRI [0-100]		
	3	The determined value shall not deviate from the declared value by more than 3.
	10	The determined value shall not deviate from the declared value by more than 2.

Flicker [<i>P_{st} LM</i>]	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 %.
Colour Consistency [<i>MacAdam ellips steps</i>]	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.
Control gear efficiency [%]		
$P_{out} \leq 5W$	10	The determined value shall not be less than 90% of the declared value.
$5W < P_{out} < 100W$	10	The determined value shall not be less than 95% of the declared value.
$P_{out} \geq 100W$	10	The determined value shall not be less than 97,5% of the declared value.
Luminous intensity [<i>cd</i>]	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 %.
Beam angle (<i>degrees</i>)	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 %.
Lumen Maintenance Factor (for FL and HID)	3	The determined value shall not be less than 90% of the declared value.
	10	The determined value shall not be less than 95% of the declared value.
Survival Factor (for FL and HID)	3	The determined value shall not be less than 0.65 (1 of 3 allowed to fail)
	10	The determined value shall not be less than 0.90 (1 of 10 allowed to fail).
M₇₀F₅₀ lifetime (for LED and OLED)	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%

ANNEX IX

Displaying the energy class and the range of efficiency classes in visual advertisements and in promotional material

1. For the purposes of ensuring conformity with the requirements laid down in Article 3(1)(g) and Article 4(1)(c), the energy class and the range of efficiency classes available on the label shall be shown on visual advertisements as follows, with the colour of the arrow matching the letter of the energy class:



2. For the purposes of ensuring conformity with the requirements laid down in Article 3(1)(h) and Article 4(1)(d) the energy class and the range of efficiency classes available on the label shall be shown in promotional material as follows, with the colour of the arrow matching the letter of the energy class:

