

LightingEurope Position Paper LED Lighting Products in Harmonized System (HS) 2022

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INTRODUCTION

The lighting industry is currently undergoing a paradigm shift from conventional lighting to LED lighting and the development of new LED lighting products is continuously moving forward very rapidly. The clear distinction between lamps, luminaires, control-gear, etc. which was well-defined for conventional lighting (i.e. non-LED lighting) is not automatically applicable to LED lighting. In LED lighting, we have new types of components and products and the conventional boundaries between such products and components are dissolving, respectively need redefinition.

Due to the new LED lighting products and their configuration, customs classification has become less apparent and the existing revision of the Harmonized System where classification of lighting products was established around conventional lighting products seems no longer to provide sufficient guidance.

In fact, lighting companies as represented by LightingEurope are seriously concerned about inappropriate classification of LED lighting products resulting in certain cases in significant cost disadvantages and a non-level playing field in international competition. Therefore, LightingEurope suggests a thorough review of the current practice for customs classification of LED lighting products and further requests appropriate amendments of the relevant headings in the Harmonized System to better accommodate LED lighting products.

Due to the fact that the Harmonized System classification is also used as a basis for international trade statistics, industry and policy makers (such as energy efficiency, electrical safety and electro-magnetic compatibility regulators) will additionally benefit from the suggested amendments as these amendments will provide greater visibility of relevant LED market trends and scale.

Contact information can be found on the LightingEurope web page: http://www.lightingeurope.org/about-us

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1. Guiding Principles regarding the Classification of LED Lighting Products

This paper focuses on LED products for general lighting applications. As explained in detail in our earlier LightingEurope position paper (dated Feb. 2014), the current version HS-2012 of the Harmonized System does not provide satisfactory classification of such LED products. The forthcoming revision HS-2017 is expected to provide improvements specifically for LED lamps, but not for other LED products.

In order to harmonize classification practice of LED products in Europe, the EU Commission has published Regulation (EU) No 10372014 in Sept. 2014, specifically addressing basic LED components. In early 2015, the EU Commission has further adopted the WCO classification opinion regarding "certain bar-type LED assemblies" (see WCO Classification Rulings – HS Committee 54th Session) which provides further guidance for this type of products.

LightingEurope has very much welcome these steps taken by the EU Commission and would strongly support a worldwide adoption of similar classification practices based on proper amendments of the Harmonized System latest with the HS-2022 revision.

In view of these considerations, LightingEurope proposes the following general approach for the HS-2022 revision with regard to LED lighting products:

- LEDs (i.e. LED Chips and LED Packages as the basic LED components) should be covered under new/modified sub-headings of appropriately amended heading 85.41.
- LED Light Sources (i.e. LED Lamps and LED Modules) should be covered under new/modified sub-headings of appropriately amended heading 85.39.
- **LED Luminaires** should be covered under new/modified sub-headings of appropriately amended **heading 94.05**.

Of course, proper definitions of these different types of LED lighting products as well as additionally required explanations may be added as chapter notes or explanatory notes.

This classification approach follows the established value chain of the lighting industry and is also reflected by the terms and definitions used in international standardization. At the same time, this approach hopefully still offers sufficient flexibility to accommodate the development of new LED lighting products which is continuously moving forward.

Notes:

 Many of the ideas presented in this paper have already been discussed with representatives of EU Commission DG TAXUD and with members of other lighting organizations outside Europe, in particular NEMA (USA) and JLMA (Japan).

2. Basic LED Components: Proposal for Heading 85.41

Changes compared to (expected) revision HS-2017 are indicated in BLUE. Alternative wordings are separated by forward slashes: "*preferred wording / alternative wording*" Optional wording is shown in square brackets: "*[optional wording]*"

Biodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LEDs) whether or not assembled; mounted piezo-electric crystals:
Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LEDs) whether or not assembled in modules or made up into panels; light-emitting diodes (LEDs) whether or not assembled;
Light-emitting diodes (LEDs) whether or not assembled
Other

New (chapter) note to chapter 85:

(x) "<u>Light-emitting diodes (LEDs)</u>" are semiconductor components comprising one or more semiconductor chips [or tiles] which convert electrical energy into visible, infrared or ultra-violet rays, whether or not electrically connected among each other and whether or not combined with protective diodes, combined for all intents and purposes indivisibly.

Intended Coverage

The term "light-emitting diodes (LEDs)" in the amended heading and explicitly defined in the new chapter note should in particular cover the following types of LED products:

- Bare LED semiconductor chips and wafers
- Radial-type LEDs and SMD-type LEDs
- Multi-chip LED arrays

The term "whether or not assembled" in the amended heading should provide further coverage for "simple" LED assemblies, i.e. LED assemblies having the same basic function as the individual LEDs (which is the conversion of electricity into light), including the following:

- Single LED mounted on a printed circuit board (or similar mounting structure) which can serve as a heat sink and/or simplifies installation in other lighting devices;
- Arrangements of multiple LEDs on a printed circuit board (or similar mounting structure), combined to provide more light than a single LED.

Notes:

- While LEDs today are typically assembled on printed circuit boards, the exclusion of other (new) forms of assembly might be too restrictive for the future. Therefore, the type of assembly should not be specified in any more detail in the text of the heading.
- "Simple" assemblies to be covered under 85.41 would include the bar-type LED assemblies as described under item no. 13 in the WCO *Classification Rulings HS Committee 54th Session*.
- The word "*chip*" in the new chapter note is meant to describe a small single semiconductor unit and is typically used in the context of inorganic semiconductors. In the case of organic semiconductors, the word

"tile" instead of *"chip"* may be more appropriate. Accordingly, in order to also provide proper coverage of organic LEDs (OLEDs), the wording *"chips or tiles"* should be considered. The combination of LEDs with protective diodes is common practice since several years. In the future, we may also find other types of protective elements (i.e. not only protective diodes). Such developments should be covered by corresponding explanatory notes or classification rulings in due time. ٠

3. LED Light Sources: Proposal for Heading 85.39

Changes compared to (expected) revision HS-2017 are indicated in BLUE. Alternative wordings are separated by forward slashes: "*preferred wording / alternative wording*" Optional wording is shown in square brackets: "*[optional wording]*"

8539 Electric filament or discharge lamps, including sealed beam lamp units and ultraviolet or infra-red lamps; arc lamps; [light-emitting diode (LED) lamps and other] light-emitting diode (LED) light sources:
...
Light-emitting diode (LED) light sources
8539 51 - Light-emitting diode (LED) lamps
8539 52 - Other
...

New (explanatory) note to chapter 85:

- (x) For the purpose of heading 85.39, "light-emitting diode (LED) light sources" are electrical light sources based on light-emitting diodes (LEDs) possibly arranged in electrical circuits and containing further elements like electrical, mechanical, thermal or optical elements. [They may in particular contain discrete active elements, discrete passive elements, and/or articles of heading 8536 or 8542 for the purpose of providing power supply or power control.] In contrast to other light-emitting diode (LED) light sources, light-emitting diode (LED) lamps have a cap/base designed to allow easy installation or replacement in a luminaire by an ordinary person.
- (x) In this context, the cap/base (e.g. screw, bayonet or bi-pin type) is meant to be the installation interface of the light source designed to engage with a corresponding socket or lamp-holder as its counterpart in order to provide mechanical fixation and electrical contact in the luminaire.

Notes:

- The lighting industry typically distinguishes between "LED lamps" (with cap/base) and "LED modules" (without cap/base) as the two major types of LED light sources. "LED modules" are being installed in the luminaire by the luminaire maker and are pure B2B products, whereas LED lamps can be installed by the end consumer and are therefore also sold as B2C products. (See also APPENDIX I with corresponding IEC terms and definitions.)
- As defined under 85.41, LEDs emit visible, infra-red or ultra-violet rays. Accordingly, LED light sources (which are based on LEDs) would also emit visible, infra-red or ultraviolet radiation.

Intended Coverage

The term "light-emitting diodes (LED) lamps" in the amended (sub-) heading should in particular cover the following types of LED products:

- LED lamps with a cap that is also used for conventional (non-LED) lamps: LED lamps with such a cap can be used to replace corresponding conventional (non-LED) lamps and are therefore often called "LED retrofit lamps". Such LED retrofit lamps exist for many types of single-capped and double-capped conventional lamps.
- LED lamps with new LED-specific caps which are not used for conventional lamps: Most prominent are Zhaga compliant LED lamps with a LED-specific cap that has been developed and standardized by the Zhaga consortium.

The term "other light-emitting diodes (LED) light sources" which is added to the amended (sub-) heading should cover LED light sources having no cap/base, i.e. LED light sources which cannot be easily installed or replaced by the end user and which are typically denoted as "LED modules" by the lighting industry.

Such "LED modules" are intended to be used in a luminaire and typically comprise multiple LEDs mounted on a printed circuit board together with other components like:

- Electrical control gear (for power regulation or power control, etc.)
- Fixing elements
- Heat sink
- Lenses, diffusors or other optical components

4. LED Luminaires: Proposal for Heading 94.05

Changes compared to (expected) revision HS-2017 are indicated in BLUE. Alternative wordings are separated by forward slashes: "*preferred wording / alternative wording*" Optional wording is shown in square brackets: "*[optional wording]*"

9405	Lamps and lighting fittings Luminaires [and lighting fittings] including searchlights and spotlights and parts thereof, not elsewhere specified or included; illuminated signs, illuminated name-plates and the like, having a permanently fixed light source, and parts thereof not elsewhere specified or included.
9405-10	- Chandeliers and other electric ceiling or wall lighting fittings, excluding those of a kind used for lighting public open spaces or thoroughfares:
9405 11	Designed for use with light-emitting diode (LED) light sources only
9405 19	Other
9405-20	- Electric table, desk, bedside or floor-standing lamps
9405 21	Designed for use with light-emitting diode (LED) light sources only
9405 29	Other
9405-30	- Lighting sets of a kind used for Christmas trees
9405 31	Designed for use with light-emitting diode (LED) light sources only
9405 39	Other
9405-40	- Other electric lamps and lighting fittings-luminaires [and lighting fittings]
9405 41	Designed for use with light-emitting diode (LED) light sources only
9405 49	Other
9405 50	- Non-electrical lamps and lighting fittings luminaires [and lighting fittings]
9405-60	- Illuminated signs, illuminated nameplates and the like
9405 61	Designed for use with light-emitting diode (LED) light sources only
9405 69	Other

Notes:

- Corresponding amendments should also be made for headings 85.12 and 85.13.
- The word "*lamps*" is used in everyday language with different meanings: On the one hand, it is used to denominate the replaceable light sources (or "light bulbs"). On the other hand, the word "*lamps*" is also used as synonym for "*luminaires*", in particular for portable luminaires (like desk lamps or floor lamps) while stationary luminaires are rather called "light fittings" (UK English) or "light fixtures" (US English). (See definition of "light fixture" in Wikipedia: http://en.wikipedia.org/wiki/Light_fixture)
- In order to avoid any misunderstanding, the words "*lamps and lighting fittings*" in heading 94.05 should be replaced by the word "*luminaires*" which is recommended by the IEC and which automatically covers portable and stationary/fixed luminaires. (See also the French translation of the CN which uses the different words "*appareils d'éclairage*" and
- (See also the French translation of the CN which uses the different words "appareils d'eclairage" and "lampes" for a clear distinction between luminaires and lamps.)
- As fallback-alternative to changing the legal text of the heading, a corresponding explanatory note might already be sufficient to explain the wording and prevent misunderstandings.
- As an alternative to the wording "designed for use with light-emitting diode (LED) light sources only" proposed for the sub-headings, the simpler version "designed for use with light-emitting diodes (LEDs) only" may already be sufficient. A wording like "designed for use solely with light-emitting diode (LED) light sources" respectively "designed for use solely with light-emitting diodes (LEDs)" is considered to be equally appropriate.

Intended Coverage

"Luminaires" are end user devices for the creation of artificial light and include portable luminaires (like floor lamps, desk lamps, etc.) as well as stationary/fixed luminaires (like troffers, pendant luminaires and other ceiling/wall mounted luminaires, street lights, etc.).

Electrical luminaires use electrical light sources.

As distinction from conventional (i.e. non-LED) luminaires, *luminaires designed for use with LED light sources only* comprise the following:

- Integrated LED luminaires incorporating LED light sources which are not intended to be replaced by an ordinary person. The LED light sources are typically installed by the luminaire maker as part of the manufacturing process before the luminaire is sold to the end user.
- Luminaires for (replaceable) LED lamps with caps not used for conventional lamps. Such luminaires are equipped with lamp-holders that can engage with corresponding LED-only caps, but would not engage with conventional (non-LED) lamp caps.

5. Further Considerations & Explanations

LED Packages

LightingEurope considers it essential that LED Packages (LEDs) are being understood as basic semiconductor devices, regardless of the number of LED chips included in the package, regardless whether or not these LED chips are connected among each other, and regardless of the presence of any protective elements (e.g. Zener diodes). Accordingly, all such LED Packages (LEDs) should be classified under appropriately amended heading 85.41.

LED Assemblies / LED Modules

LEDs are typically assembled on a printed circuit board, possibly together with other active or passive elements like a.o. electrical, mechanical, optical or thermal components.

"Simple" LED assemblies have the same basic function as the individual LED, namely the conversion of electrical current into visible light. Such "simple" LED assemblies typically only comprise one or multiple LEDs on a printed circuit board without further components. The more LEDs are present, the higher the light output will be. In some cases, the printed circuit may already serve a heat sink which would further improve the efficiency of the LEDs.

Such "simple" LED assemblies which basically consist of (multiple) LEDs arranged on printed circuit board (or other mounting structure) having the same basic function as the individual LED, i.e. converting an electrical current in visible light, should be classified like the individual LED under heading 85.41.

More "complex" LED assemblies including further elements which provide additional function like power conversion or power control, beam forming, mechanical fixation, etc. should be considered as LED light sources and should be classified like all other electrical light sources under heading 85.39.

LED Lamps

LED lamps are also LED light sources which should be classified under heading 85.39. The distinctive feature compared to LED modules is the cap which allows an easy ("plug-and-play") installation and replacement into a corresponding lampholder in the luminaire.

Such caps are well-known from conventional (non-LED) lamps. LED lamps which are intended to replace conventional lamps have the same cap as the conventional lamps they are supposed to replace. Such LED lamps are called LED retrofit lamps. LED retrofit lamps are made available for ever more types of conventional lamps.

There are also LED lamps with new types of caps which have been designed specifically for these LED lamps and may offer the following benefits:

- Better heat transfer from the LED lamp to the luminaire, e.g. via a large contact surface between LED lamp (cap) and luminaire (lampholder);
- Restriction of the use of the luminaire with this specific type of LED lamp only. Unintentional replacement with other types of lamps which would not be suitable for this luminaire is prohibited.
- Additional electrical contacts that would be needed for multi-color control, color change or creation of other special lighting effects;
- New design options for shape and appearance of lamp and luminaire.

LED Luminaires

As described in Chapter 4 above, LightingEurope suggests distinct subheadings for luminaires *designed for use with LEDs <u>only</u>* and *other* luminaires which may be equipped with conventional (i.e. non-LED) light sources.

OLED Products

Organic LEDs (OLEDs) are based on organic semiconductor materials and include PLEDs (which are particularly based on polymer materials) and other types of organic LEDs.

For the time being, OLEDs and OLED products do not have any significant market share in general lighting applications. Therefore, it seems appropriate to simply continue classifying OLEDs and OLED products under the corresponding LED headings and not define any specific (sub-) headings for OLEDs.

APPENDIX I IEC Terms and Definitions

Technical Committee TC34 of the International Electrotechnical Commission (IEC) prepares international standards for lamps and other related equipment. Their work program includes a.o. the proper specification of the terms and definitions for LED product and related equipment used for general lighting applications as published in IEC 62504 Ed. 1, 2014-06.

Details of the corresponding work program can be found on the IEC web page at: http://www.iec.ch/dyn/www/f?p=103:38:0::::FSP_ORG_ID,FSP_LANG_ID:1235,25#top

In this standard, IEC distinguishes particularly among the following products:

According to these IEC definitions, LED Lamps and LED Modules are both considered being **LED Light Sources**. As the distinctive feature, **LED Lamps** have a cap which allows easy installation and replacement in a luminaire by an ordinary person, whereas **LED Modules** do not have such cap. LED Modules typically comprise LED packages mounted on a printed circuit board, possibly together with further electrical, optical, mechanical and thermal components, interfaces and control gear.

LightingEurope proposes that such LED light sources (i.e. LED lamps and LED modules) are covered under heading 85.39.

Furthermore, **LED luminaires** are defined as luminaires designed to be operated with LED light sources (i.e. with LED Lamps or LED Modules).

> LightingEurope proposes that **LED luminaires** are covered under heading **94.05**.

The IEC standards also provide definitions of **LEDs** and **LED packages** as the basic components used for the construction of LED modules and LED lamps. These components are not intended to be connected directly to the supply voltage.

- LightingEurope proposes to cover both, LEDs and LED packages, in the HS-2022 by the term "Light Emitting Diode (LED)" under heading 85.41.
- LightingEurope proposes that such LED light sources (i.e. LED lamps and LED modules) are covered under heading 85.39.

 LED Components

 LED Chip and LED Package

 Image: Strateging of the strateging

The following illustration shows the typical LED value chain (as also explained in IEC 62504):

LED dies/chips and LED packages are the basic components of a LED light source (i.e. LED Lamp or LED Module) for the conversion of electrical current into visible light. The LED lamps and LED modules are the light sources designed for integration into a LED luminaire.

LED lamps have (standardized) caps for easy installation in the luminaire and are therefore restricted in size and shape. LED modules without caps can offer additional design flexibility (in size, shape, thermal management), but require more sophisticated means for integration in the luminaire and cannot be installed or replaced easily by the end user.

APPENDIX II Basic LED Components – Examples & Technical Background

LED chips, LED packages and simple assemblies of LED packages as described below are considered to be the basic components of the LED lighting industry.

LED Chip and Wafer

LED chips are grown in wafers by epitaxy processes. After electrode formation, the wafers are cut into individual chips which can then be used for LED packages or for chip-on-board (COB) processing.



Wafer of LED chips at Pick&Place station

LED Packages

In the past, LED packages mostly came in the form of radial LEDs with the chip sitting on a lead frame, encapsulated by a plastic dome and with electrical leads suitable to mount the LED on a printed circuit board (PCB) via through-hole-technology (THT). Today, LED packages also come as surface mount devices (SMD). Here, the chip is also positioned on a suitable substrate/carrier and is encapsulated in a little plastic housing. The housing and the electrical contacts are suitable for further SMD processing allowing a higher degree of automation compared to traditional THT processing.



In order to increase the light output or to be able to generate different colors, LED packages (and here in particular the SMD packages and multi-chip LED arrays) often do not only contain a single chip, but contain multiple LED chips. These chips may be electrically connected among each other and are connected to external electrical contacts. Regardless of the number of chips, each LED package serves as only one light point; the (microscopic) inner structure is not visible during operation. Very often, these LED packages contain further electrical components in addition to the LED chips. In particular, the packages may contain Zener diodes, connected in parallel to the LED chips, to protect the LED chips against over-voltage or over-current. These extra components are not necessary for the normal operation of the LED chips, but rather serve as protection against damage via misuse like mis-wiring, over-supply of current or voltage, etc.

Radial-Type LEDs



SMD-Type LEDs

See also examples 1, 3 in Regulation (EU) No 10372014



Other Multi-Chip LEDs / **LED Arrays** See also example 4 in Regulation (EU) No 10372014







Single LED mounted on a Printed Circuit Board See also example 2 in Regulation (EU) No 10372014





Simple Assembly of Multiple LEDs on a Printed Circuit Board See also WCO classification opinion regarding "certain bar-type LED assemblies" as of March 2015



This simple LED assembly consists of multiple LEDs arranged on a printed circuit board without any further active or passive electronic components.

APPENDIX III LED Light Sources – Examples & Technical Background

LEDs (LED chips or LED packages) are not suitable for direct integration into a luminaire or direct connection to a commercial power supply. Instead, these LEDs have to be integrated into LED lamps or LED modules comprising additional electronics and thermal means to operate the LEDs. Appropriate heat dissipation away from the LEDs is a key requirement for proper operation of the LEDs.

LED Lamps and **LED Modules** are both LED light sources comprising one or several LEDs which are suitable for integration into a **LED Luminaire**. LED lamps have a (standardized) cap for easy installation in the luminaire, but are restricted in size and shape. LED modules offer additional design flexibility in size, shape and thermal management, but require more sophisticated means for integration in the luminaire.

LED Lamps with Conventional Caps

(i.e. caps which are also used for conventional lamps)



LED Lamps with new LED-Specific Caps

(i.e. caps which have been designed specifically for LED lamps and which are not being used for conventional lamps)



Pictures below show details of GH76p "Twist & Lock" Lampholder and LED Lamp:



LED Modules

LED modules come in a wide variety of shapes and geometries. They may have all or part of the electronics integrated which are required for power conversion and power control. They may come with optical elements like lenses, reflectors or diffusors. They may have simple or more sophisticated mechanical means for installation in a luminaire. They may comprise a heat sink as a separate element or integrated in a metal core printed circuit board.



LED modules may be designed for a specific luminaire only or as a standard product which can be integrated in different luminaires. They may be optimized for a specific application or intended to serve as a more generic light source. All these factors influence the specific appearance. Despite this vast variety, LED modules are always designed and intended to be installed as a LED light source in a corresponding LED luminaire.

APPENDIX IV LED Luminaires – Examples & Technical Background

The wide variety of LED luminaires is illustrated in the examples below.

Examples of 94.05 11: Chandeliers and other electric ceiling or wall lighting fittings – Designed for use with LED light sources only



Examples of 94.05 21: Electric table, desk, bedside or floor-standing lamps – Designed for use with LED light sources only



Examples of 94.05 41: Other electric luminaires – Designed for use with LED light sources only



Examples of 94.05 61: Illuminated signs, illuminated nameplates and the like – Designed for use with LED light sources only

