ZVEI:
Die Elektroindustrie

White Paper

The Replaceability of LED Light Sources

May 2017

German Electrical and Electronic Manufacturers' Association

Summary: Design Decides on Replaceability

The desire to exchange LED light sources stems from our experience of luminaires lasting much longer than lamps. However, this situation has changed with the rapid development of LED technology: in some applications, the service life of the LED light sources is by no means over when the luminaire is replaced.

The technical possibilities offered by LEDs have given rise to a variety of new lighting designs which can be matched better than ever to the needs of individual users and the respective application.

Depending on the design, LED luminaires come with replaceable or non-replaceable light sources. The following cases are distinguished between:

- Replaced by end user (without tools)
- Replaced by professional (on site)
- Replaced by manufacturer (at factory)
- No replacement

Luminaires with integrated LED light sources are designed as a complete system. High-quality products offer technically optimal operating conditions for long-lasting LED light sources and are designed for extended use. It makes little sense to replace the LED light sources in these kinds of luminaires after years of use, even taking the rapid technological development of LEDs into account. There are, however, luminaires with different designs and these can be replaced, depending on the application.

ZVEI: Diversity Yields Benefits for Consumers

The ZVEI Lighting Product Division takes the position that it will continue to be important to take the diverse requirements of modern lighting systems into account in the future. Optimal lighting solutions consider the needs of users and the respective fields of application. The resulting individual needs, such as the technical and optical design of luminaires (in professional and home applications), necessitate a wide range of different technical solutions.

This means that, for example, a legal requirement for the general replaceability of light sources would not be expedient; this would restrict the variety of application-specific solutions requested by users.

Preamble

This leaflet is intended to set out technically feasible designs for the exchange or replaceability of LED light sources in LED luminaires. In order to be replaceable, only suitable LED modules or LED lamps can be used to ensure that safety, lighting and EMC requirements and operational standards are still met.

Development of light sources

Traditional lamps generally have a base or cap. They are standardised. Luminaires include all the equipment required for their operation and for holding the lamp. Lamps can easily be replaced by the user. The high degree of standardisation means that the original lighting design specifications are still adhered to even following replacement.

This situation changed with the arrival of LED technology. Nowadays

- LED lamps have been developed as substitutes for conventional lamps,
- LED lamps have been developed with new caps, and
- LED modules have been developed for integration in luminaires.

LED modules have no lamp cap, but have dedicated thermal, mechanical and electrical interfaces. Good thermal coupling is imperative if LED modules are to have a long service life. Traditional lamp caps do not meet these requirements, and cannot replace thermally well-coupled LED modules. Lamp cap systems which are specially developed for LED lamps and ensure appropriate heat dissipation are an exception.

LED lamps which are used as replacements for incandescent, halogen and discharge lamps are known as retrofit lamps. They can be replaced like traditional lamps (e.g. fluorescent lamps).

In professional lighting, new luminaires are rarely designed for retrofit LED lamps because the construction and technical characteristics often do not meet the requirements.

Who can Replace What?

LEDs have given rise to new luminaire designs. While traditional lamps have to be replaced more frequently, the service life of LED lamps and LED modules can, in some applications, exceed the expected useful life of the luminaires.

The following cases are distinguished between when replacing light sources:

- **Replacement by user**
  (no tools needed, performed on-site)
  The end user replaces the existing lamp e.g. by a retrofit LED lamp, without tools and without any electrical changes to the luminaire.

- **Replacement by professionals**
  (performed on-site)
  LED modules can be replaced if this is intended by the luminaire manufacturer.
  The work is carried out by professionals, to:
  - ensure the safety of the persons involved (protection from electric shock)
  - protect the modules from improper handling and damage (e.g. ESD)
  - restore the mechanical and thermal coupling between the luminaire and the module.

  The operating characteristics of the luminaire and the photometric characteristics are preserved by being replaced professionally.

- **Replacement by manufacturer**
  (at factory)
  If the service is offered by the manufacturer, LED modules can be replaced in the factory. This ensures that all operational, safety and technical properties are preserved.

- **No replacement**
  No replacement is planned for LED modules which are integrated into luminaires; this is not mechanically possible. The service life of the luminaire corresponds to that of the LED module.

  This type of construction with non-replaceable modules is often chosen in professional lighting – and also makes sense in view of the rapid development of LED technology in many applications.

Exposition: The Right Luminaire Design for Each Application

Nevertheless, there are good reasons for making it possible to replace LED lamps and LED modules. Decisive here are the conditions of use and the estimated service life of the lamps in the respective application. Some examples:

- for luminaires with a high IP protection class, it can make sense to use a fully sealed closed luminaire construction. Examples: luminaires used in animal husbandry or in industrial environments with particular exposure to water, foreign objects or chemical influences.
- A shop that is open 14 hours a day, six days a week reaches nearly 4,400 hours of lighting operation every year. In the usual seven year renovation cycles this represents a total of just over 30,000 hours - a service life which is significantly exceeded by many LED light sources and LED luminaires.
- Luminaires in industrial buildings operating 24-hour shifts six days a week reach an operating time of roughly 52,500 hours after seven years. With a normal luminaire service life of more than ten years, replacement of the LED modules may be necessary in order to preserve the photometric parameters and thus the quality of the lighting.
- Luminaires intended for private use are identified by a corresponding label stating that the LED lamps are integrated and non-replaceable.

The examples show that ultimately it is up to the planners or the users themselves to decide which demands they wish to place on the performance of the lighting system. And so they decide in favour of replaceable or integrated LED modules or LED lamps based on the life cycle costs of the different variants.

Appendix

Product safety standards govern the replacement of LED lamps and LED modules. The harmonised European standards DIN EN 62031 (Safety of LED modules) and DIN EN 60598-1 (Safety of luminaires) include safety-related requirements for the replacement of light sources. The following terms are used:

- "non-replaceable light source",
- "replaceable light source" and
- "light source not replaceable by the user"

Definitions*

Light source – Lamp with lamp cap, module (LED) or other light source which generates visible optical radiation and can be used and/or built into a luminaire.

Replaceable light source – Lamp with lamp cap or other light source which is connected e.g. via terminals or connectors and can be replaced.

Non-replaceable light source – Long-lasting light source which is intended for long-term use and is an integral part of a luminaire or a module. It cannot be replaced without damaging the luminaire or module.

Light source not replaceable by the user – Light source which can only be replaced by the manufacturer, its service agent or a qualified electrician.

Built-in LED module – LED module that is installed in a luminaire or a housing and can usually be replaced.

Independent LED module – LED module that can be installed and operated independently of a luminaire or a separate housing. The type plate carries information on the respective safety class.

* From the standards DIN EN 60598-1 - "Luminaires: General requirements and tests" (2015-10) and DIN EN 62031 - "LED modules for general lighting – Safety specifications" (2015-09)

ZVEI:
Die Elektroindustrie

The replaceability of LED light sources

German Electrical and Electronic Manufacturers' Association
Lighting Division
Lyoner Strasse 9
60528 Frankfurt am Main, Germany

Contact: Wolfram Pajek
Phone: +49 69 6302-293
Fax: +49 69 6302-400
E-mail: licht@zvei.org
www.zvei.org

May 2017