Guidelines for Repairability of Luminaires

GLOBAL LIGHTING ASSOCIATION

GUIDELINES FOR REPAIRABILITY OF LUMINAIRES

Introduction

Across the globe, differences in customer preferences, codes, standards, regulations, and logistical complexities drive the procurement, installation, and end-of-life management of luminaires, resulting in the development of different models designed to minimise the environmental impacts. The lighting industry is increasingly focused on addressing this issue through thoughtful design and specification, including designing luminaires for component replaceability and product repairability.

It should be noted that there are consequences in this approach that could make it difficult or impossible to meet other performance, customer, and/or environmental sustainability objectives, so the decision to focus on repairability must be deliberate and carefully considered.

Purpose

The purpose of this paper is to highlight issues, concerns and opportunities concerning extending the lifetime of luminaires through effective upgrade and/or component replacement strategies, while balancing the interests of lighting product manufacturers, users and the environment. This document also aims to encourage environmentally sustainable practices.

1. What does “Repairability” in Luminaires mean?

The goal of extending a luminaire’s lifetime through component replacement, refurbishment or repair is often referred to in shorthand as “repairability” and will be used throughout this paper.

In lighting, “repairability” refers to the ability to restore non-functional luminaires to a functional state by exchanging or upgrading parts, including the replacement of components such as lamps, light sources, control gear (drivers), and other electronic components, which themselves cannot be repaired.

However, repairability covers only those luminaires that contain components that are designed to be replaceable, fully address safety requirements including testing and certification, and are allowed by codes, laws, and regulation to be repaired for continued usage. Additionally, regional wiring regulations can restrict installation of reconditioned (refurbished) products that are not recertified for safety.

It is also important to note that luminaires are considerably different from other items of consumer electronic and electrical equipment due to safety and design issues, and therefore luminaire "repairability" is not necessarily consistent with those other categories of products.

One of the main advantages of repairability is that it can substantially extend the useful lifetime of luminaires compared to non-repairable products, thereby reducing waste and supporting environmental sustainability efforts. Additionally, repairing rather than replacing entire luminaires can lead to cost savings over time and allows for easier upgrades as technology evolves.

2. Best Practice Considerations for Design

Lighting manufacturers increasingly design luminaires so that components such as control gear and light sources are easily replaceable. The development of these modular designs, standardisation of connectors, and availability of readily accessible replacement components are progressively becoming common practice. This trend responds to customer expectations and regulatory demands, driven by a growing awareness of environmental sustainability and the economic benefits of repairable products. Manufacturers also recognise that repairability can be a competitive advantage, attracting customers who value product longevity and reduced lifecycle costs.

Modular components allow for easy disassembly and replacement of individual components, such as interchangeable LED modules, without requiring the replacement of the entire luminaire.

Unlike conventional luminaires, which may have parts permanently sealed, glued, or otherwise difficult to separate, a truly modular design ensures that individual components—such as LED modules, control gear, or optical elements—can be accessed, removed, and replaced independently without specialised tools or risk of damaging the luminaire. This approach reduces downtime by enabling on-site service and eliminates the need to replace the entire luminaire, although consideration should be taken to ensure consistent quality and performance.

Modular designs also facilitate convenient upgrades, allowing users to replace outdated components with newer, more efficient or updated versions.

However, to facilitate repair, additional materials may be needed, such as spare parts, specialised tools, or hardware, which can increase resource use and add complexity to the process. Repairs often require skilled technicians, and in some cases, the cost or difficulty of sourcing replacement parts may outweigh the benefits. It is essential to note that spare parts or replacement parts are defined as any part that restores functionality, even if it is not an identical part. When manufacturers provide lists of approved replacement parts, the availability and compatibility of these parts can vary, and there may be a quality tradeoff with deviations from these guidelines.

Robust components with long lifetimes reduce the frequency of failures and decrease the need for repairs. However, even the most reliable components will eventually fail. Balancing the use of durable, long-lasting, resilient products and components with ease of repair ensures a longer product lifespan and reduces waste. For example, using high-quality LED modules rated with a long lifespan in conjunction with easily replaceable control gear can significantly extend the overall life of a luminaire.

3. Repairability Criteria

A luminaire's repairability comprises several criteria that determine how easily and effectively it can be restored to a functional state. These criteria include, but are not limited to, the degree to which the luminaire is capable of being repaired (including the safety, testing and certification requirements, regulations and codes and standards that allow for the repairability of the luminaire), the availability of spare parts and the clarity of information on part identification and compatibility.

3.1 Ability To Repair - It is crucial to differentiate between repairs that can be safely performed by end-users (e.g., replacing a standard light bulb) and those that require qualified technicians (e.g., replacing control gear within a complex lighting system). Upgrade and/or part replacement of components not designed for consumer action is not advisable for certain luminaires. Engaging in these practices may void safety certifications and manufacturer warranties and could violate building or energy codes. Attempts to repair lamps (i.e. light bulbs) are particularly dangerous as these devices are not designed to be opened and require specific expertise for safe handling. Clear communication and labelling are necessary to prevent unsafe repair practices.

3.2 Replacement Parts Availability - The availability of spare parts such as LED modules, drivers, connectors, and sealing components (if applicable) supports effective repair of luminaires. Having spare parts readily available for a reasonable period of time provides a longer timeframe for repairability. These may be available through direct sales, distributors, or partnerships with repair services. A lack of spare parts can render an otherwise repairable product prematurely obsolete, leading to unnecessary waste and increased costs for consumers.

3.3 Replacement Information - Clear information regarding compatible parts for replacements can include detailed specifications, part numbers, and any specific instructions needed to ensure proper installation and functionality. Compatibility information that is easily accessible through product documentation, online resources, and customer support channels, and clear guidance on compatible parts minimises the risk of incorrect replacements, which can damage the product or system, or compromise its safety.

4. Providing Documentation and Information

Comprehensive documentation and information are important for effectively facilitating appropriate repairs. This includes detailed documentation such as basic replacement instructions, compatible parts lists, and programming guides, user manuals, instructional materials, and online and customer support resources.

4.1 Required Documentation - The documentation should be appropriate for the required skill level of the person performing the repair. Instructions should be step-by-step, clearly illustrated and written in a language that is easily understood by the intended audience. Compatible parts lists should include all relevant specifications and part numbers, as well as information on where to source these parts. Programming guides are necessary for luminaires with programmable features, ensuring that replacement components can be properly configured.

Consumer education can empower individuals to make informed purchasing decisions. By providing materials on how to identify repairable products, where to find repair services, and how to properly treat replaced components at their end of life, consumers can be better informed about the benefits of choosing durable and repairable products.

4.2 User Manuals and Instructional Materials - Clear user manuals that include basic troubleshooting guides, instructions for simple repairs (e.g., replacing a lamp or LED module), and information on when to seek professional assistance, as well as instructional videos and other visual aids can be particularly helpful for demonstrating repair procedures and ensuring that users can safely and effectively perform repairs when appropriate. Warnings and labels communicate that certain repairs should not be performed.

4.3 Online Resources - Online support resources for end-users and those conducting repairs who seek assistance are particularly useful and important. This may include FAQs, troubleshooting guides, forums, and contact information for technical support. Online resources should be easily searchable and regularly updated to reflect new products and repair procedures. Providing robust online support can significantly reduce the burden on customer service channels.

5. Safety, Testing and Certification

5.1 Safety Standards, Electrical Codes and Certification - In some markets, applicable safety standards for repaired luminaires do not exist. Furthermore, many regions have concluded that certain products **should not be repaired**. Certain electrical safety standards specifically prohibit luminaire repair beyond simple component replacement. In many jurisdictions, wiring regulations and electrical codes restrict the installation of reconditioned (refurbished) products unless they are tested and recertified for safety.

Where these standards do exist, they can ensure that repaired products meet (or surpass) the same safety and performance requirements as new products. Certification of conformity with such standards may involve testing the repaired product to verify that it functions correctly and does not pose a safety hazard. Conformity and certification with standards is essential for electrical and thermal safety, maintaining consumer trust and ensuring the reliability of repaired luminaires.

5.2 Rating Programs - Various (but not all) regions have "Repairability Rating Programs" that include testing and certification procedures to evaluate the repairability of luminaires, ensuring that they meet safety and performance standards such as European Standard EN 45554 General methods for the assessment of the ability to repair, reuse and upgrade energy-related products.

These programs provide a standardised framework for evaluating the ease with which a product can be disassembled, repaired or upgraded, and reassembled. Repairability assessments, carried out only by qualified parties, may consider factors such as the number of steps required for repair, the tools needed and the availability of spare parts.

5.3 Steps Involved in Repair Testing - Repair testing involves simulating common failure scenarios and evaluating the effectiveness of repair procedures. This includes assessing the ease of disassembly, identifying potential challenges in accessing and replacing components, and verifying that repairs can be performed safely and reliably. The analysis of the repair process can identify areas for improvement in product design and documentation.

6. Minimising Waste

A focus on strategies that reduce waste during repair processes could include the following:

- designing products with durable materials
- minimising the use of hazardous substances
- providing clear instructions for proper recycling and end-of-life treatment of replaced components

In certain parts of the world, take-back programs for end-of-life products are available to consumers, ensuring that they are properly recycled. By minimising waste, repairability can significantly contribute to environmental sustainability.

7. Conclusion

The future of repairability in lighting is likely to be shaped by emerging technologies, evolving regulations and increasing consumer demand for environmentally sustainable products, as well as deliberate choice by manufacturers to design for repairability.

Emerging technologies that support repairability should be explored. This could include the use of 3D printing to produce spare parts on demand and the development of smart luminaires that can self-diagnose and predict failures.

When manufacturers design luminaires with repairability in mind, and provide necessary parts, support and documentation, they help contribute to a more environmentally sustainable and circular economy. Repairability not only extends the lifespan of luminaires, but it also reduces waste, lowers lifecycle costs, and promotes environmental sustainability. By prioritising repairability, manufacturers can meet the growing demand for durable and environmentally sustainable products.

ABOUT THE GLA

The Global Lighting Association (GLA) is the leading voice for the lighting industry worldwide, representing over 5,000 lighting manufacturers and generating $75 billion in annual sales. Through its network of 27 national and regional lighting associations, the GLA advocates for policies and practices that promote sustainable lighting solutions, energy efficiency, and human well-being. The GLA is committed to fostering a collaborative environment that supports innovation, fair competition, and the growth of the lighting industry on a global scale.

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