



CLOSING THE LOOP

End of Life Management Document

FLEXI RANGE

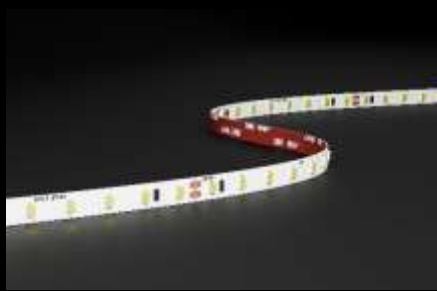
LEDFLEX

FLEXI RANGE

Flex Range is flexible linear LED lighting products for architectural applications. The range includes Nano Flex, Eco Flex, Lumen Line, Multi Line, Power Flex, Thermo Line, and Dynamic Flex. Although each variant is designed for different performance requirements, they share similar material characteristics and can be effectively managed through responsible end-of-life disassembly, material recovery, and recycling.



NANO FLEX



ECO FLEX



LUMEN LINE



MULTI LINE



POWER FLEX



THERMO LINE



DYNAMIC FLEX



1. Purpose and Scope

This document outlines the end-of-life (EOL) management process for LEDFlex Flexi Range luminaires. It covers all variants in the Flexi Range and is intended for customers, installers, facility managers, and waste handlers. The process ensures regulatory compliance, material recovery, and environmental protection through controlled collection, treatment, and disposal routes.

Flexi Range are constructed as multi-material assemblies, where each component contributes to performance but requires specific consideration at end-of-life for proper recovery and disposal. Due to the combination of electronic, metallic, and polymeric materials, effective separation and categorization of components at end-of-life is essential to enable recycling, material recovery, and to minimize environmental impact.

2. Regulatory framework and Compliance

At a global level, environmental protection and waste management practices are guided by a combination of international directives, national regulations, and local authority requirements. Frameworks such as the WEEE Directive in various regions promote the responsible collection, segregation, and recycling of electrical and electronic equipment. These frameworks require licensed electronic waste management providers, proper material recovery, and prohibition of uncontrolled disposal. Non-compliance risks fines and environmental harm.

Flexi Range aligns with ISO 14001 for environmental management and lighting-specific standards TM65 / TM66 for lifecycle assessment. These ensure impacts are evaluated from manufacturing through end-of-life treatment.

3. Material Composition and Environmental Impact

The Flexi Range consists of multiple material categories, each contributing to product performance while carrying specific environmental considerations at end-of-life.

- The primary structure is based on a flexible printed circuit board (PCB) integrated with LED chips and conductive copper pathways. The PCB is composed of fiberglass-reinforced resin, which is durable but not easily recyclable through conventional streams. If subjected to improper disposal methods such as open burning, it may release hazardous substances, making controlled recycling essential.
- Copper terminals and internal wiring provide electrical conductivity throughout the system. While copper is highly recyclable and valuable, its extraction is resource intensive. Recovering copper from end-of-life products significantly reduces environmental burden compared to primary production.
- Depending on the product variant, the Flex may include polymeric protective or encapsulation layers that provide mechanical protection and environmental resistance. These materials, while enhancing durability and lifespan, are typically non-biodegradable and may persist in landfill conditions if not properly processed.
- Additional components such as adhesive backing (e.g., VHB tape), plastic connectors, cable insulation, mounting clips, and optional rigid profiles introduce further material diversity. These elements are generally composed of mixed plastics and metals, which can complicate recycling if not effectively segregated. Improper disposal of such materials may contribute to microplastic pollution and long-term environmental degradation.
- The Flex system also interfaces with external electrical components such as power supply units, drivers, and controllers, which contain electronic circuitry and additional metals requiring specialized e-waste handling.

If these materials are not properly separated and treated at end-of-life, they may contribute to soil contamination, water pollution, and air quality issues. Therefore, appropriate dismantling, segregation, and recycling practices are essential to minimize environmental impact and support resource recovery.

4. LEDFlex EOL Principles

A well-planned EOL management hierarchy for all luminaires, designed to prioritise the retention of material and component value.

Reuse: Functional luminaires or major mechanical components are inspected and returned to service where performance standards are met. This avoids all processing costs and retains full product value.

Refurbish: Individual components drivers, connectors, profiles are tested, repaired, or replaced. Refurbished parts re-enter production, service spares, or lower-specification applications.

Repurpose: Mechanical components, mounting hardware, and cabling are redirected to fabrication, or other industrial uses. Copper components are sent to recycle and repurposed back into copper wires.

Recycle: All the E- Waste, scraps, the packaging waste from the production and warehouse are segregated and sent to proper recycling units based on the material characteristics.

Recover: The maximum quantity non-recyclable fractions possible (residual plastics, composites) go to waste to energy facilities. This captures thermal value while preventing landfill.

Landfill: Permitted only for trace non-recoverable residues (<5% mass of total products manufactured by LEDFlex) after all higher routes fail.

EOL Overview for LEDFlex Luminaires		
Reuse	Up to 5%	Mechanical components are returned to service
Refurbish	5 – 10%	Modular components are repaired / reintegrated
Repurpose	10 - 15%	Silicone and PVC are repurposed
Recycle	Up to 75 %	Scraps and packaging waste from production is recycled
Recover	10 - 15%	Non-recyclables sent to waste to energy recovery facilities
Landfill	<5%	Only non-recoverable sent to landfill.



End of Life Management at LEDflex

1. EOL Guidance in installation manual

Comprehensive end-of-life (EOL) management guidance is provided to clients through all installation manuals to ensure responsible handling of products at the end of their service life. This includes clear disassembly instructions to enable safe and efficient separation of components, facilitating material-specific recycling and recovery processes.

The guidance also outlines recommended material-based recycling schemes, helping client's direct different components such as silicone, PVC, metals, and electronic parts into appropriate recycling streams. In addition, packaging EOL management is addressed, encouraging reuse and recycling of packaging materials in line with local regulations and best practices.

To further support compliance and sustainability, information on schemes such as Recolight and other applicable take-back programs is included in the installation manual. Clients are also guided towards the LEDflex-owned take-back scheme, which is supported by approved recycling partners, ensuring that products are processed through controlled and environmentally responsible channels.

2. LEDflex Take-Back Scheme

To support responsible end-of-life management, LEDflex Group implements a structured and compliant take-back scheme designed to facilitate the safe return, recycling, and recovery of products at the end of their service life.

Under this program, customers can return used or decommissioned products either directly to LEDflex or through its network of authorized collection and recycling partners. The scheme is aligned with applicable environmental regulations, including WEEE-related requirements where relevant, ensuring that all returned products are processed through certified waste treatment and recycling facilities.

Upon collection, products are subject to controlled handling processes, including dismantling, segregation, and material recovery. Key components such as metals, plastics, and electronic parts are separated and directed to appropriate recycling streams, maximizing resource recovery and minimizing environmental impact. Hazardous substances, if present, are managed in accordance with regulatory standards to prevent environmental contamination.

The take-back scheme is designed to simplify compliance obligations for customers by providing a clear and accessible route for responsible disposal. It also supports traceability and documentation, enabling proper reporting and verification of recycling outcomes where required.

Through this initiative, LEDflex actively contributes to circular economy principles by promoting reuse, recycling, and material recovery, thereby reducing reliance on virgin resources and preventing valuable materials from being lost to landfill.

3. Refurbishment, Repurposing of accessories

Following collection through the take-back scheme, returned products are assessed to determine their suitability for refurbishment, component recovery, or material recycling. Where feasible, LEDflex prioritizes refurbishment as a preferred strategy to extend product life and maximize resource efficiency.

Products designed with a modular architecture allow for efficient disassembly, enabling individual components, such as drivers, LED strips, connectors, and housing to be inspected, tested, and replaced independently. This modularity



reduces the need for full product disposal and supports targeted refurbishment, where only non-functional or degraded parts are substituted while retaining the remaining functional elements.

Recovered components that meet performance and safety criteria are refurbished and reintegrated either into the same product line or utilized as service parts. Accessories and sub-components that cannot be directly reused in their original configuration are evaluated for repurposing. These may be adapted for use in future product assemblies, prototyping, or lower-demand applications, thereby maintaining their value within the production cycle.

This approach minimizes waste generation, reduces demand for virgin materials, and enhances overall lifecycle efficiency. By embedding modular design principles and enabling repurposing pathways, LEDFlex strengthens its commitment to circular product development and sustainable resource management.

4. Recycling Copper in PCB

Copper recovery from PCB waste is a key end-of-life process that enables the extraction of valuable materials while reducing environmental impact and supporting circular resource use.

At end-of-life, PCBs are dismantled to remove non-metal components such as plastics, and adhesives, after which the boards are shredded into smaller fragments to expose embedded metal layers. The material is then crushed and ground into fine particles, allowing air classification and screening to separate lighter non-metal fractions from heavier metal-rich content. Further separation techniques are applied to isolate copper, including electrostatic methods based on conductivity differences and density-based processes that recover heavier copper particles. The concentrated copper fraction is then processed through metallurgical routes, either by high-temperature smelting to produce crude copper with impurities removed as slag, or through chemical leaching processes where copper is dissolved and recovered via electrowinning or precipitation.

Finally, the recovered copper undergoes electrorefining to achieve high purity levels of up to 99.9%, making it suitable for reuse in new electronic and industrial applications. This process ensures that valuable materials are retained within the production cycle, minimizing waste and contributing to a more circular and resource-efficient system. Through established recycling partnerships and specialized processing networks, recovered copper materials are directed to facilities equipped to carry out this treatment in accordance with environmental and safety standards. These collaborations ensure that the process is managed efficiently while maintaining compliance with applicable regulations.

This approach enables the retention of material value within the production cycle, reduces dependency on virgin copper resources, and supports circularity by transforming previously encapsulated materials into functional components for new product generations.

**Collection and sorting of the products**

Products are collected, inspected, and sorted to identify reusable components and recyclable material streams.

**Removal of Ancillary Components and Accessories**

Drivers, connectors, end caps, wiring, and other accessories are separated for individual recycling routes.

**Surface Preparation and Contaminant Removal**

Remaining LED strips are cleaned to remove dust, adhesives, coatings, and external contaminants prior to processing.

**Mechanical Dismantling and Size Reduction**

LED strips are mechanically dismantled and processed through controlled shredding to liberate embedded materials.

**Material Separation**

Shredded materials undergo mechanical separation using screening, magnetic separation, and density-based methods to isolate metals and non-metal fractions.

**Hydrometallurgical Copper Recovery**

Copper-containing fractions may undergo controlled chemical processing to dissolve and recover copper from electronic substrates.

**Electrochemical Copper Recovery**

Dissolved copper is recovered through electrowinning to produce high-purity copper deposits.

**Recovered Copper Feedstock**

Recovered copper is processed into secondary raw material suitable for reuse in industrial applications.

**Material Recovery and Industrial Reuse**

Recovered copper can be reintroduced into manufacturing supply chains, including electrical components, wiring, and PCB production after refinement.

6. End-of-life handling through Recolight

LEDflex works with Recolight to support the responsible end-of-life management of luminaires. Recolight manages the collection, transport, and onward treatment of lighting waste through an established WEEE compliance and recycling chain, so products are handled through a controlled and traceable process rather than being sent to unmanaged waste routes. Recolight also states that it prioritises reuse where possible, and otherwise routes products into approved recycling and recovery streams.

Customers can dispose of Luminaires in the Recolight collection points, which can be located by using the collection point locator Recycling Map, once luminaires are collected, they are transferred through Recolight's logistics network to approved treatment facilities. At that stage, the fittings are sorted and processed into material fractions such as metals, plastics, and other recoverable components, with the aim of maximizing recycling and recovery and minimizing landfill. Recolight's published process also emphasizes duty-of-care traceability, auditability, and compliance with WEEE requirements across the full chain.



For project and street-lighting collections, Recolight describes a streamlined process where customers can verify the source of the waste, after which collection is arranged, and the material enters the compliant recycling route. This creates a practical end-of-life pathway for installed luminaires, including those replaced during refurbishment or upgrade projects.

7. Landfill as a Last Resort

Landfill disposal is considered the least preferred option within LEDflex's end-of-life strategy and is only pursued when no viable reuse, refurbishment, repurposing, or recycling pathways are available.

Customers are strongly advised to select landfills only as a final option, and only in cases where appropriate recycling or recovery infrastructure is not accessible. LEDflex follows the same principle within its own operations, ensuring that all reasonable measures are taken to divert materials from landfill wherever possible.

Through the combination of take-back programs, modular refurbishment, material recovery, and advanced recycling processes, more than 95% of product materials are recoverable and directed toward reuse or recycling streams. The remaining fraction, typically less than 5% - may be sent to landfill, and only after undergoing proper segregation and treatment to ensure compliance with environmental regulations and responsible waste management practices.

This hierarchy-based approach reinforces LEDflex's commitment to minimizing environmental impact while maximizing resource efficiency across the product lifecycle.



8. Documentation and Traceability

LEDFlex maintains records of all end-of-life activities, including collection notes, transfer manifests, and material recovery reports.

Comprehensive records shall be maintained for all end-of-life processes, including collection notes, transfer manifests, treatment certificates, and material recovery reports. End-of-life materials are tracked through each stage of handling, from collection through to final recovery or recycling, ensuring clear visibility of material flow and processing outcomes. A dedicated reverse logistics team oversees and tracks the take-back scheme to ensure proper collection flow, partner coordination, and end-to-end material movement visibility.

Documentation evidencing proper handling, treatment, and recovery can be made available to customers upon request.

9. Conclusion

End-of-life management of the Flexi Range is a critical component of its overall sustainability profile. By following the guidance and processes outlined in this document, it can be ensured that the product is handled responsibly, in compliance with regulations, and in alignment with environmental best practices. Proper disassembly, segregation, recycling, and participation in LEDFlex take-back programs, along with material repurposing and recycling, contribute significantly to reducing environmental impact and supporting a circular economy.

This approach reinforces LEDFlex's commitment to sustainable product stewardship and responsible resource management.