PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN LIGHTING PRODUCTS – *Factsheet*

v250422

'The lighting industry's influence on PFAS emissions is indirect.'

GLOBAL
LIGHTING
ASSOCIATION

PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN LIGHTING PRODUCTS

Introduction

Lighting is a fundamental component of modern life, providing essential visibility that enhances safety and aesthetics across various environments. From hospitals and emergency services to homes, working environments and public spaces, effective lighting significantly contributes to daily activities and overall well-being.

As the demand for innovative lighting solutions grows, so does the complexity of the materials used in their production. Preliminary research has identified over 50 per- and polyfluoroalkyl substances (PFAS) commonly utilised in electronic components, many of which are integral to lighting products.

The Lighting industry is committed to substituting PFAS with viable alternatives as soon as they become available, and actively seek cooperative partnerships with suppliers and legislators to facilitate this process.

PFAS are synthetic chemicals known for their unique properties, including insulation, flame retardancy, mechanical strength, and resistance to water, dust, and chemicals. These characteristics make PFAS highly versatile, allowing them to meet diverse requirements across multiple applications and uses within the lighting industry.

However, while PFAS are prevalent in the manufacturing of electronic components, the lighting industry's influence on PFAS emissions is primarily indirect. The main source of PFAS release into the environment stems from the manufacturing processes of these substances rather than from the production- and use phase of lighting products themselves.

As regulatory scrutiny surrounding PFAS intensifies, the lighting industry faces challenges in identifying essential uses and developing direct replacements for these materials. The current lack of suitable alternatives means that suppliers and manufacturers may need a decade or more to reformulate materials or redesign products to mitigate environmental impact. This large change-over includes technical feasibility to assure long-life durability, recertification and electrical and fire safety, while on the other hand also assuring alternatives do not face the risk of being banned due to similar potential environmental and health issues, so called “regrettable substitutions” which might be subject to future bans.

This necessity for innovation highlights the ongoing evolution within the industry as it seeks sustainable solutions while maintaining safety and durability standards essential for effective lighting. Understanding the role of PFAS in lighting products is crucial for addressing both safety concerns and environmental responsibilities as we move towards a more sustainable future.

2. Lighting as an essential service

The lighting industry produces several types of luminaires for a wide range of applications (outdoor, commercial, automotive, decorative lighting, etc.).

- Lighting is essential for numerous aspects of modern life. It ensures adequate visibility, contributes to safety, and enhances aesthetics in both professional and consumer settings. From hospitals and emergency services to homes and public spaces, lighting plays a crucial role in daily life and well-being.
- The lighting market is diverse as well as innovative, with notably LED lamps and connected lighting systems representing examples of technologies currently increasingly deployed in regional markets.
- A variety of components are employed in luminaires and in control systems. PFAS are used in some of these components, often due to the durability gains which they bring or for fire and electrical safety reasons.

3. Challenges, Market Impact & Recertification

The lighting industry produces several types of luminaires for a wide range of applications (outdoor, commercial, automotive, decorative lighting, etc.).

The restriction of PFAS presents a significant challenge for the global lighting industry.

PFAS are integral to many electronic components and production processes, making them essential for the functionality and durability of lighting products.

Stricter regulations or bans on PFAS could lead to supply chain disruptions in the lighting industry, increased production costs, and potential delays in product development and manufacturing. These challenges could ultimately impact the availability and affordability of lighting solutions for consumers and businesses worldwide.

Preliminary research has identified a broad spectrum of over 50 PFAS compounds commonly used in generic electrical and electronic components for a wide range of electronic applications, many of which are also integrated into lighting products. PFAS offer a unique combination of properties, enabling them to fulfill multiple requirements in various applications.

For existing lighting products, the "repair as produced principle" is a crucial concept that ensures the continued maintenance and repair of lighting equipment that has already been installed in the past. In order to extend the lifespan of these products, original spare parts must be made available.

To ensure compliance with the original safety certification requirements, original spare parts used in the production and certification of the lighting equipment must be allowed during the product's life cycle, sometimes up to 30 years. If this is not permitted, the service of existing lighting installations would not be allowed, as re-certification of spare parts for existing luminaires is in most cases, not possible. Moreover, these products will not be able to be refurbished or remanufactured, leaving disposal as the only viable option.

Recertification of all lighting products installed over the last few decades is not feasible, which is why the use of PFAS for existing spare parts should be permitted. This will enable the servicing and reuse of existing lighting equipment, as is the case with other examples of spare part exemptions in certain substance regulations, like for example the EU RoHS directive.

A preliminary survey with our GLA member organisations based on supplier data and available literature, indicated that PFAS are used in components for unique characteristics, listed in the table below. These unique characteristics are essential to provide safety, reliability and durability of lighting solutions, which are mandated by electrical and fire-safety standards issued by international standardisation bodies (e.g. ISO/IEC/EN/UL/CSA).

Examples of important IEC electrical safety standards for luminaires

- IEC 60598-1:2024 includes all relevant safety requirements on electrical safety and ‘resistance to heat, fire and tracking’.
- UL 1598 - North American safety standard for luminaires includes safety testing for temperature, shock and reliable mounting methods etc.

More information can be found via the link below to an annex listing Mandatory (International) Electrical Safety Standards Governing PFAS Use In Lighting Products.

Click here to link to ***Annex PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN LIGHTING PRODUCTS – Factsheet v250417***

To illustrate the critical role of PFAS in specific applications, we have identified key examples within the lighting industry and listed them in the annexes. Please refer to the list of PFAS uses in finished lighting products in Annex 1 and production processes in Annex 2.

Flame retardancy	Water and dust repellence
Dielectric strength	UV resistance
Chemical inertness and non-reactivity	Bonding properties
Low and high temperature and thermal resistance	Shatterproof/fragment retention protection
Flexibility	Minimisation of wear and tear for machinery and products

4. PFAS-free alternatives

Based on the survey results, GLA anticipates that direct replacements for PFAS used in the lighting industry will be rare, necessitating material reformulation or product redesign.

Furthermore, the use of Fluoropolymers is classified as 'low-concern' by the OECD and these polymers should be fully exempted from restrictions if alternatives do not exist. Due to limited knowledge within the material and plastic supply community about PFAS-free alternatives, there's a considerable risk that new materials will not meet stringent safety, fire, and durability standards required for lighting products. The assessment of PFAS applications and alternatives requires further investigation. Identifying suitable replacements is particularly challenging, as many current uses lack viable alternative options. Even when suitable substitutes emerge, extensive testing of new materials, components, and products will be necessary, placing substantial demands on industry resources.

Replacing the full range of PFAS substances in all used materials is extremely challenging as other polymer classes cannot withstand safety testing, high temperatures and exposure to aggressive media, typically resulting in a loss of performance and a significant reduction of service life. To ensure uninterrupted supply and product safety, temporary exemptions may be necessary while longer-term solutions are developed.

As regulatory scrutiny of PFAS intensifies, the lighting industry faces challenges in identifying essential uses and we call on plastic and component suppliers for action to develop direct replacements, where feasible.

5. Prevention and Reduction of PFAS Emissions and Exposure

The lighting industry's influence on PFAS emissions is indirect.

The manufacturing process of PFAS substances and materials themselves, rather than the production of lighting products, is the primary source of PFAS release into the environment. It is important to note that lighting manufacturers rely heavily on their suppliers and have limited influence over the use of PFAS substances which are managed by plastic, material and component suppliers upstream in the global supply chain.

Additionally, the degradation of lighting products at the end of their life cycle can lead to some PFAS release. However, as a general business principle, lighting stakeholders act to minimise the environmental impact of end-of-life lighting products. For instance, several of our members actively participate in extended producer responsibility programs which focus on the sustainable collection, treatment, and disposal of lighting products at end of life, thereby minimising the potential release of hazardous substances, including PFAS, into the environment. Through these 'take back' systems, the lighting industry demonstrates its commitment to responsible product lifecycle management and environmental protection.

6. The socio-economic impact of a premature phase out of PFAS

A premature ban on PFAS without viable alternatives or exemptions would have severe repercussions for the lighting industry, consumers, and societies as a whole. It is imperative to adopt a balanced approach that considers the potential risks of PFAS while also recognising the critical role of lighting in modern life.

The phase-out of critical lighting components, necessitated by the absence of PFAS, would lead to a substantial reduction or even elimination of the current lighting product portfolio. This would inevitably result in widespread shortages of lighting products across various applications.

- The lighting industry, along with its extensive global supply chain, would face significant challenges, including widespread job losses, business closures, and decreased innovation.
- Moreover, the reliance on older, less efficient lighting technologies would lead to increased energy consumption and a corresponding rise in greenhouse gas emissions.
- A lack of lighting would have far-reaching implications in societies, such as, for public health care, safety, economic activity, leisure, sports and quality of life.

7. Required Transition Period and/or Derogations

Developing and implementing non-PFAS alternatives is a complex and time-consuming process. Even when suitable alternatives are identified, their integration into the supply chain typically requires up to a decade or more.

An estimated transition period of at least 12 years would be required for the lighting sector if PFAS were to be banned, considering the need to develop alternatives, from research and development to full-scale production and market adoption.

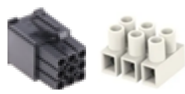
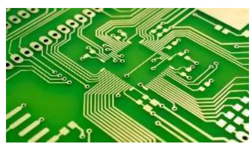
Specific derogations for essential PFAS without suitable alternatives should also be considered and subject to regular review exemptions linked to the research of suitable alternatives. Furthermore, to prevent waste and economic loss, existing stocks of PFAS-containing components and materials should be allowed for use beyond the implementation of any potential restrictions. This approach would ensure the efficient utilisation of existing inventories while providing the industry with sufficient time to transition to PFAS-free solutions.

The GLA advocates for policies and practices that promote sustainable lighting solutions, energy efficiency, and human well-being and will to this end actively collaborate through its members with lighting related supply chains to find a sustainable and timely solution to this challenge.

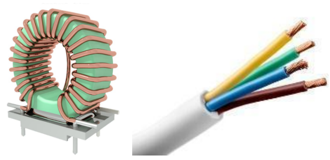
ANNEX 1: IDENTIFIED PFAS USES IN FINISHED LIGHTING PRODUCTS.

An estimated transition period of at least 12 years would be required for the lighting sector if PFAS were to be banned, considering the need to develop alternatives, from research and development to full-scale production and market adoption.

- **Anti-drip agent for flame-retardant plastics**

<table>
<tr><td colspan="2">PFAS substance / substance group:
• Polytetrafluoroethylene (PTFE)
• Potassium nonafluorobutane sulphonate
• Perfluorobutanesulphonate (PFBS)</td></tr>
<tr><td>PFAS-containing material / component:
Plastic (resin) in:
• Power supply unit plastic housing
• Luminaire housing
• Lamp base housing/module
• (Mini) Connectors
• PCB boards
• Housings of LEDs</td><td> 
 
 </td></tr>
<tr><td colspan="2">Reason for PFAS Use / Requirements Profile:
• Fire Safety (flame retardancy, anti-dripping)
• Meet flame retardancy requirements in international safety standards (e.g. ISO/IEC/EN/UL/CSA) and related regulations</td></tr>
</table>

- **Electrical insulation for wires**

<table>
<tr><td colspan="2">PFAS substance / substance group:
• Polytetrafluoroethylene (PTFE)
• Fluoroethylenepropylene (FEP)
• 1-Hexene, 3,3,4,4,5,5,6,6,6-nonafluoro-, polymer with ethene and 1,1,2,2-tetrafluoroethene (ETFE)
• Propane, 1,1,1,2,2,3,3-heptafluoro-3-[(1,2,2-trifluoroethenyl) oxy]-polymer with 1,1,2,2-tetrafluoroethene</td></tr>
<tr><td>PFAS-containing material / component:
Wire insulation in:
• Inductor and transformer
• Cables</td><td></td></tr>
<tr><td colspan="2">Reason for PFAS Use / Requirements Profile:
• Flexibility and crack avoidance (temperature and UV-resistance)
• Fire safety (flame retardancy)
• Electrical insulation (dielectric strength)</td></tr>
</table>

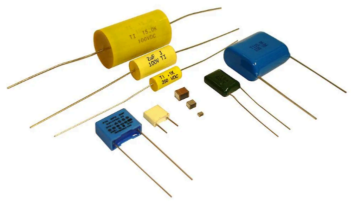
- **Durability of mechanical seals in lamps and luminaires:**

<table>
<tr><td colspan="2">PFAS substance / substance group:
• Homo-polymer of vinylidene fluoride (VDF)
• Hexafluoropropylene (HFP)</td></tr>
<tr><td>PFAS-containing material / component:
• Gasket
• O-ring</td><td></td></tr>
<tr><td colspan="2">Reason for PFAS Use / Requirements Profile:
• UV-resistance
• Chemical inertness
• Non-reactivity</td></tr>
</table>

- **Grease lubricant component to reduce wear and for water repellency reasons**

<table>
<tr><td colspan="2">PFAS substance / substance group:
Fluoropolymers</td></tr>
<tr><td>PFAS-containing material / component:
Grease Lubricant</td><td> </td></tr>
<tr><td colspan="2">Reason for PFAS Use / Requirements Profile:
Grease applied to components to extend product lifetime (minimisation of wear)
Water repellent for seals</td></tr>
</table>

- **Dielectric strength of film capacitors**

<table>
<tr><td colspan="2">PFAS substance / substance group:
Perfluoropolyether (PFPE)
Polytetrafluoroethylene (PTFE)
Polyvinylidene fluoride (PVDF)
1-Propene, 1,1,2,3,3,3-hexafluoro-, oxidized, polymerized</td></tr>
<tr><td>PFAS-containing material / component:
Film capacitor</td><td></td></tr>
<tr><td colspan="2">Reason for PFAS Use / Requirements Profile:
Reliability at high voltages (dielectric strength)</td></tr>
</table>

- **Lamp safety protection**

PFAS substance / substance group: • Fluoroethylenepropylene (FEP)	
PFAS-containing material / component: • Lamp protection - sleeve	
Reason for PFAS Use / Requirements Profile: • Customer safety (glass shattering protection) • UV Resistance	

- **Ink durability**

PFAS substance / substance group: • PFAS	
PFAS-containing material / component: • Ink	
Reason for PFAS Use / Requirements Profile: • Water repellence • High-temperature resistance • Chemical inertness and non-reactivity • UV resistance	

- **Paint durability**

PFAS substance / substance group: • Fluoroethylene vinyl ether (FEVE) • Polyvinylidene fluoride (PVDF) • Polytetrafluoroethylene (PTFE)	
PFAS-containing material / component: • Paint • Lacquer(s)	
Reason for PFAS Use / Requirements Profile: • Water repellence • High-temperature resistance • Chemical inertness • UV resistance • Non-reactivity	

- **Longevity of photovoltaic panels**

PFAS substance / substance group: • Ethylene tetrafluoroethylene (ETFE)	
PFAS-containing material / component: • Photovoltaic panel	
Reason for PFAS Use / Requirements Profile: • Efficiency and durability (water and dust repellence)	

- **Fire safety of electrical systems**

<table>
<tr><td colspan="2">PFAS substance / substance group:
Perfluorocarboxylic acids containing 9 to 14 carbon atoms
Perfluorooctanoic acid (PFOA) and its salts
Perfluorohexane-1-sulphonic acid (PFHxS)
Perfluorooctane sulfonate (PFOS)
Perfluoroheptanoic acid (PFHpA) and its salts</td></tr>
<tr><td>PFAS-containing material / component:
Switches
Sockets
Plugs
Safety breakers</td><td></td></tr>
<tr><td colspan="2">Reason for PFAS Use / Requirements Profile:
Fire safety (flame retardancy)</td></tr>
</table>

- **Thermal and electrical insulation of protective coverings**

<table>
<tr><td colspan="2">PFAS substance / substance group:
Polytetrafluoroethylene (PTFE)
Fluoroethylenepropylene (FEP)
1-Hexene, 3,3,4,4,5,5,6,6,6-nonafluoro-, polymer with ethene and 1,1,2,2-tetrafluoroethene (ETFE)
Propane, 1,1,1,2,2,3,3-heptafluoro-3-[(1,2,2-trifluoroethenyl) oxy]-polymer with 1,1,2,2-tetrafluoroethene</td></tr>
<tr><td>PFAS-containing material / component:
Insulation sleeves
Shrinking sleeves
Thermistors</td><td></td></tr>
<tr><td colspan="2">Reason for PFAS Use / Requirements Profile:
Fire safety (flame retardancy)</td></tr>
</table>

- Electrical safety (dielectric strength)
- Flexibility and crack avoidance (low/high temperatures and UV-resistance)

- **Binder in batteries' electrodes for improved performance and durability**

PFAS substance / substance group:

- Polyvinylidene fluoride (PVDF)
- Perfluoroalkoxyalkane (PFA)
- Polytetrafluoroethylene (PTFE)
- 1,1,2,2- Tetrafluoroethyl 2,2,3,3-tetrafluoropropyl ether

PFAS-containing material / component:

- Battery's electrodes

Reason for PFAS Use / Requirements Profile:

- Durability and efficiency (binder properties)

- **Barrier to protect internal components from external application of oil / water**

PFAS substance / substance group:

- Fluoropolymers

PFAS-containing material / component:

- Coating or tape

Reason for PFAS Use / Requirements Profile:

- Coating or tape applied to products as a barrier to protect from oil or water exposure and so extend product life (water and oil repellence)

- **Packaging material**

<table>
<tr><td colspan="2">PFAS substance / substance group:
PFAS</td></tr>
<tr><td>PFAS-containing material / component:
Coating
Material composition</td><td></td></tr>
<tr><td colspan="2">Reason for PFAS Use / Requirements Profile:
Potential water repellence or glossy finishing
Potential residue in recycled packaging material</td></tr>
</table>

ANNEX 2: IDENTIFIED PFAS USES IN MACHINERY AND SYSTEMS FOR PRODUCTION.

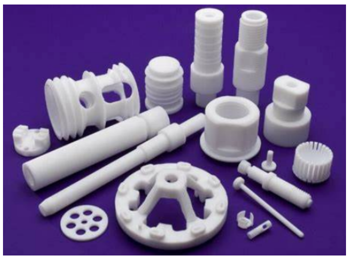
While some PFAS uses have been confirmed by our component suppliers and are indicated below, other applications remain under investigation. Please note that pictures have been added for illustrative purposes.

- **Durability of mechanical seals in machinery**

PFAS substance / substance group: • Homo-polymer of vinylidene fluoride (VDF) • Hexafluoropropylene (HFP)	
PFAS-containing material / component: • Gasket • O-ring	
Reason for PFAS Use / Requirements Profile: • UV-resistance • Chemical inertness • Non-reactivity	

- **Minimisation of machinery wear and tear and product scratching & breakage**

PFAS substance / substance group: • Polytetrafluoroethylene (PTFE) and other fluoropolymers	
PFAS-containing material / component: • Plastic resin • Grease and lubricants • Machinery parts (holders, conveyor rollers etc.)	


Reason for PFAS Use / Requirements Profile:

- Minimisation of machinery wear and tear
- Minimise scratching & breakage of products

- **Increased thermal resistance in manufacturing**

PFAS substance / substance group:

- Perfluoropolyether (PFPE)

PFAS-containing material / component:

- Grease and Lubricants


Reason for PFAS Use / Requirements Profile:

- Used in thermal shock testing
- Incorporated in lubricants and greases

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.

This document is designed to provide advice and guidance for relevant stakeholders. It is subject to change or update without prior notice. The content is compiled based on the best available knowledge of participating GLA members, who cannot be held liable for any inaccuracies, omissions, or misinterpretations.

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