

Consultation Questionnaire Exemption No. 4(f) of RoHS Annex III

Current wording of the exemption:

Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex

Requested validity period: Maximum (5 years and 7 years (cat. 8 and 9) respectively)

ACRONYMS AND DEFINITIONS

UV	Ultra Violet
LED	Light-Emitting-Diode
Hg	Mercury
LEU	LightingEurope

1. INTRODUCTION

1.1. Background

Bio Innovation Service, UNITAR and Fraunhofer IZM have been appointed¹ by the European Commission through for the evaluation of applications for the review of requests for new exemptions and the renewal of exemptions currently listed in Annexes III and IV of the RoHS Directive 2011/65/EU.

VDMA and Lighting Europe submitted requests² for the renewal of the above-mentioned exemption. The request has been subject to a first completeness and plausibility check. The applicant has been re-requested to answer additional questions and to provide additional information, available on the request webpage of the stakeholder consultation³.

The stakeholder consultation is part of the review process for the request at hand. The objective of this consultation and the review process is to collect and to evaluate information and evidence according to the criteria listed in Art. 5(1)(a) of Directive 2011/65/EU.⁴

To contribute to this stakeholder consultation, please answer the below questions until the 27th of May 2021.

¹ It is implemented through the specific contract 070201/2020/832829/ENV.B.3 under the Framework contract ENV.B.3/FRA/2019/0017

² Exemption request available at [RoHS Annex III exemption evaluation - Stakeholder consultation \(biois.eu\)](https://biois.eu/rohs-annex-iii-exemption-evaluation-stakeholder-consultation)

³ Clarification questionnaire available at [RoHS Annex III exemption evaluation - Stakeholder consultation \(biois.eu\)](https://biois.eu/rohs-annex-iii-exemption-evaluation-stakeholder-consultation)

⁴ Directive 2011/65/EU (RoHS) available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32011L0065:EN:NOT>

1.2. Summary of the Exemption Request

According to VDMA: “The application for prolongation of the existing exemption refers to mercury-containing UV discharge lamps which are used for curing (e.g. of layers of inks and coatings, adhesives and sealants), for disinfection (e.g. of water, surfaces and air) and for other industrial applications (surface modification, surface activation) The application includes the following lamp types:

- **UV medium-pressure discharge lamps (MPL) for curing, disinfection and other industrial applications** (internal operating pressure > 100 mbar). The UV medium-pressure lamps can be doped with iron, gallium or lead in addition to the mercury they contain.
- **UV low-pressure discharge lamps for special purposes in the high power range.** [...]

Typical applications to be covered by this application include curing, e.g. of inks and coatings, disinfection of water etc., and other industrial applications like surface activation and cleaning.

It is technically not possible to replace mercury in special UV lamps with other materials/chemicals in order to achieve the same widespread radiation distribution. LED-based technologies are increasingly being used, which in certain applications (e.g. curing) also offer many advantages over mercury-containing UV lamps. Nevertheless, LED technologies cannot be used as an equivalent replacement in many applications. ”

According to LightingEurope, “[...] The renewal application concerns lamps and UV light sources defined as:

- High Pressure Sodium (vapour) lamps (HPS) for horticulture lighting,
- Medium and high-pressure UV lamps for curing, disinfection of water and surfaces, day simulation for zoo animals, etc...
- Short-arc Hg lamps for projection, studio, stage lighting, microlithography for semiconductor production, etc...

Replacement of mercury and mercury containing lamps is impracticable:

- The lamps covered by exemption 4(f) must remain available on the EU market:
 - o For new equipment for certain applications where no functionally suitable alternatives are available
 - o As spare parts for in-use equipment as replacing end-of-life lamps avoids having equipment become electronic waste before due time”

General Statement

Founded in 1866, The Sherwin-Williams Company is a global leader in the manufacture, development, distribution, and sale of paints, coatings, and related products to professional, industrial, commercial, and retail customers. In Europe our footprint includes over 20 production locations and approximately 3800 direct employees. Sherwin-Williams is one of the largest companies supplying wood coatings to the wood products manufacturing industries. Our customers use mercury lamps for certain specific applications where alternative technologies are not yet fit for purpose. We welcome the opportunity to comment on the ban on mercury lamps for these industrial uses.

Use of mercury lamps for UV curing remains critical in the production of coated wood surfaces, flooring and some niche applications. Internally we use the lamps only at our Wood R&D facilities and for quality control (less than 50 units in EU), but our wood customers rely heavily on UV curing technology using

mercury lamps where the LED technology is not yet fit for purpose. In Europe, we estimate over 500 production lines that rely on mercury containing UV lamps to produce furniture and flooring

Recently, we engaged a study with the Uppsala University (Short wavelength UV-LED photoinitiated radical polymerization of acrylate-based coating systems – A comparison with conventional UV curing, Olof Torfgard, Uppsala University, 2021), to assess the viability of LED (UVB,UVC and UVA) curing in industrial settings compared to conventional the mercury arc lamp. While the authors observed some promising potential for LED curing technologies, the study concluded that the power output of the LEDs in the range of UVC and UVB are not sufficient to be applied in an industrial setting today.

Existing alternative LED or electron beam industrial curing technologies do not fulfil the requirements for sufficient crosslinking and surface properties, resulting in inadequate product performance. Also, there are limited photo initiators on the market that provide performance needs. Continued research to find alternatives is ongoing in close collaboration with our suppliers, but to date there are no viable alternatives available to support the alternative curing technologies in our applications. For example, the Electron beam curing units are extremely expensive (2.000.000 € compared 50.000 €) and require lead-shielding to contain dangerous radiation, and therefore is not a preferred technique to replace on existing production lines. As such, UV – mercury lamps are still needed until viable alternatives exists.

To avoid moving production of coated wood articles outside of EU, we urge for a derogation of UV mercury lamps until viable technology exists.

Specific Statements

Please state your opinion on as many questions stated below as possible. Provide specific and detailed information rather than general statements wherever possible.

If you don't feel qualified to answer the specific questions below, please give detailed arguments and reasons why you still support the renewal of the exemption as requested by VDMA and LightingEurope.

2. QUESTIONS

1. VDMA and LightingEurope² requested the renewal of the above exemption for the maximum validity periods with the same scope and wording for all EEE of cat. 3 and 5 (VDMA) and cat. 1-10 (LEU).
 - a. Please let us know whether you support or disagree with the wording, scope and requested duration of the exemption. To support your views, please provide detailed technical argumentation / evidence in line with the criteria⁴ in Art. 5(1)(a).

The wording should be retained, and an extension should be requested at least until 2026 and beyond. The reasons are:

- LED curing does not fulfil the needed performance on surface curing, resulting in non-performance in surface resistance, mechanical properties, etc. The available chemicals for coating formulation, curable with LED are limited as well.
- The Electron beam curing units are extremely expensive (2.000.000 € compared 50.000 €) and require lead-shielding to contain dangerous radiation.

- b. If applicable, please suggest an alternative wording and duration and explain your proposal.

From an industrial point of view, the shortening of the period of validity does not make sense, because effective alternative solutions (e.g., based on UV LEDs) are not available. Especially, the development for new applications in the UVC area is still facing major challenges such as lack of matching between the available LED lamp radiation wavelengths and the available photo-initiators light absorbance spectrum.

Also, at the time when viable alternatives become available a grace period will be needed to allow production lines to shift towards the new technology as generally large investments will be needed to make the overall change.

We request a derogation period of at least ten years to allow the whole value chain (photo – initiator supplier, coatings manufacturer and the applicator) to make the switch.

Furthermore, it can be assumed that not all specific UV applications are well known to VDMA and LightingEurope and have therefore been neglected (for example the wood

panel coating industry). This should be investigated and considered in detail. The previous wording of the exception: **“Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex” should therefore be retained unchanged.**

With regard to the following current and future developments/processes/products, and since there are no alternatives, the availability of UV lamps containing mercury is indispensable to the wood coatings and wood products industries in the EU and worldwide.

2. Please provide information concerning possible substitutes or elimination possibilities at present or in the future so that the requested exemption could be restricted or revoked.
 - a. Please explain substitution and elimination possibilities and for which part of the applications in the scope of the requested exemption they are relevant.

The periodic table of the elements offers no alternative to mercury in discharge lamps (i.e., an “alternative filling”) that would be an effective, compatible replacement. The physical properties of mercury make this material quite unique and ideally suited for discharge lamps (high vapor pressure, low boiling point, specific spectral lines in areas that are ideal for disinfection and photochemical reactions). Scientific and industrial approaches to compatibly replace mercury with an alternative substance - while maintaining the specific beneficial properties of mercury discharge lamps - have been ongoing for decades but have not yet met key performance and production needs.

There are other mercury-free types of discharge lamps and other light sources like UV-LEDs available, which can, to some extent, be used for similar processes. There are, however, some very severe limitations:

- Direct replacement (exchanging only the lamp) is in most cases technologically not possible
- Replacement of existing machines/processes with alternative light sources (if available) usually requires additional steps, which may include:
 - replacement of power supplies and peripheral electrical components
 - replacement or alteration of inks and varnishes
 - use of other substrates
 - necessity for (other) pre-treatment technology
 - necessity for inert production environments (expensive use of nitrogen or carbon dioxide)
 - change of UV measurement equipment (different spectral sensitivity)

- change of process speeds (usually substantial speed and productivity decrease)
- heavy redesign of machine equipment
- complications like cross-sensitivity to daylight and/or artificial lighting

- With respect to varnishes, replacement technologies based on LEDs can usually not provide the same degree of surface hardness, scratch resistance and product durability required for needed product performance (automobile, wood industry).

- b. Please provide information as to research to find alternatives that do not rely on the exemption under review (substitution or elimination), and which may cover part or all of the applications in the scope of the exemption request.

According to our experience, also confirmed by a recent study ‘Short wavelength UV-LED photoinitiated radical polymerization of acrylate-based coating systems – A comparison with conventional UV curing’ (master thesis March 2021), replacement of existing UV lamp system with alternatives leads to a manifold of problems including quality issues, process downtime, productivity decrease, high investment costs, and higher overall operational costs.

The key issue is the performance of the ready surface during industrial application.

- c. Please provide a roadmap of such on-going substitution/elimination and research (phases that are to be carried out), detailing the current status as well as the estimated time needed for further stages.

We don't see the existence of a roadmap for the complete substitution/elimination of mercury-based discharge lamps in most fields of wood application. There are other



technologies available (see above point ...) which might justify investment into new technologies and which might gain market share with respect to conventional UV applications over time, but for numerous **existing** machines/processes/applications, there is no reasonable replacement available. We regularly engage in discussions with the suppliers of photo-initiators on developing new technologies, but despite their best efforts there are no such existing solutions.

3. Do you know of other manufacturers producing devices of comparable features and performance like the ones in the scope of this exemption request that do not depend on RoHS-restricted substances, or use smaller amounts of these substances compared to the applications in the scope of this exemption?

Since 100% replacement on **existing** installations is not possible, there is also no comparable product or device available with comparable features and performance.

Alternative products, when used with the alternative peripherals (other inks, varnishes, pre-treatment, ...), can have comparable features and performance in some applications (e.g., ink jet printing, general printing) but do not come close to meeting the performance needs for applications which rely on the specific spectrum of mercury for their performance.

Current technology and chemistry for UV curing wood coating products has not yet reached a point where a complete substitution of mercury lamps is possible.

4. As part of the evaluation, socio-economic impacts shall also be compiled and evaluated. For this purpose, if you have information on socioeconomic aspects, please provide details in respect of the following:
 - a. What are the volumes of EEE in the scope of the requested exemptions which are placed on the market per year?

The market is large, since most modern industrial wood manufacturing are at the using the conventional type (mercury content) of UV-technology, which includes furniture, flooring kitchen, interior doors and many more.

In fact, we see volumes in this technology increasing as generally UV-curing is seen as environmentally friendly, due to the decrease of VOC emissions.

- b. What are the volumes of additional waste to be generated should the requested ex-emption not be renewed or not be renewed for the requested duration?

Most existing machines on the market running with mercury discharge lamps would become obsolete and would have to be considered as additional waste requiring disposal. In many cases, it is economically and/or technologically infeasible to retrofit existing equipment with alternative light sources.

This would have the following effects for our customers: Most existing UV-lines would need a significant re-build or be scrapped. See response to Question 2(a), above.

- c. What are estimated impacts on employment in total, in the EU and outside the EU, should the requested exemption not be renewed or be renewed for less than the re-requested time period? Please detail the main sectors in which possible impacts are expected – manufacturers of equipment in the scope of the exemption, suppliers, re-tail, users of MRI devices, etc.

We don't have exact figures and can only state to the best of our knowledge that hundreds of companies exist in the EU that employ UV coating technologies based on mercury lamps. Some of them rely to up to 100% on the availability of mercury lamps (e.g., lamp manufacturers, power supply manufacturers, quartz suppliers, UV measuring device manufacturers, printers and coaters).

- d. Please estimate additional costs associated should the requested exemption not be renewed, and how this is divided between various sectors (e.g. private, public, industry: manufacturers, suppliers, retailers).

Heavy investment costs for companies into new machinery/equipment (e.g., costs for conversion to electron beam technologies).

Costs for disposal of obsolete machines and production equipment.

Loss of product diversity since no longer all products can be produced for technological and/or economic reasons.

5. Any additional information which you would like to provide?

We believe that the responsible authors of the pending mercury ban dramatically underestimate the global impact of a ban on industrial uses of mercury lamps on industries, products, markets, and lastly employment opportunities and end consumers.

The dramatic socio-economic outcome of a mercury lamp ban bears no meaningful relation to the comparatively very small amount of mercury that is in fact brought into the market by mercury-containing discharge lamps. Used lamps can be recycled and the mercury content can be reused for new lamps. If all participants in the market actively use the recycling opportunities, the mercury content for discharge lamps can be confined to closed-loop processes without damage or impact to the environment and personal health.

In addition to this we would like to draw attention to the likely damaging environmental impact of switching to alternative coating technologies.

Such as:

- Increasing VOC emissions
- Increased use of alternative crosslinking technologies that may require the use of hazardous raw materials
- Increased waste due to less efficient application methods.
- Increased energy demand connected to alternative production technologies.
- Transport increase needed due to lower solid content coatings, and higher application amounts of mentioned coating technologies.
- Loss of employment and production activity in the EU as wood product manufacturers shift production into areas of the world permitting the limited use of mercury in UV-cured wood coating operations.