

Assistance to the Commission on Technological Socio-Economic and Cost-Benefit Assessment Related to Exemptions from the Substance Restrictions in Electrical and Electronic Equipment:

Study to assess renewal requests for 29 RoHS 2 Annex III exemptions [no. 1(a to e -lighting purpose), no. 1(f - special purpose), no. 2(a), no. 2(b)(3), no. 2(b)(4), no. 3, no. 4(a), no. 4(b), no. 4(c), no. 4(e), no. 4(f), no. 5(b), no. 6(a), no. 6(b), no. 6(c), no. 7(a), no. 7(c) - I, no. 7(c) - II, no. 7(c) - IV, no. 8(b), no. 9, no. 15, no. 18b, no. 21, no. 24, no. 29, no. 32, no. 34, no. 37]

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Disclaimer:

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17.0 Exemption 5(b): "Lead in glass of fluorescent tubes not exceeding 0,2 % by weight"

Declaration

In the sections that precede the "Critical Review" the phrasings and wordings of stakeholders' explanations and arguments have been adopted from the documents provided by the stakeholders as far as required and reasonable in the context of the evaluation at hand. Formulations have been altered in cases where it was necessary to maintain the readability and comprehensibility of the text. These sections are based exclusively on information provided by applicants and stakeholders, unless otherwise stated.

Acronyms and Definitions

EEE	Electrical and Electronic Equipment
EoL	End of Life
LEU	LightingEurope
Pb	Lead
PbO	Lead oxide

17.1 Background

LightingEurope (LEU)⁴⁷⁴ has applied for the renewal of exemption 5(b) related to the presence of lead in the glass of discharge lamps. In the past, leaded glass used to contain ca. 20 % lead, added in the form of PbO for functional reasons in the production process. However lead is no longer added intentionally during lamp glass production. In principle lead in the glass of fluorescent tubes has successfully been phased out by the lighting industry several years ago. Nonetheless, recycled glass from end of life lamps is used

⁴⁷⁴ LEU (2015a), LightingEurope, Request to renew Exemption 5(b) under Annex III of the RoHS Directive 2011/65/EU Lead in glass of fluorescent tubes not exceeding 0.2 % by weight, submitted 15.1.2015, available under:
http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_Pack_9/Exemption_5_b_/5_b_LE_RoHS_Exemption_Reg_final.pdf

today in the manufacture of new glass tubes (e.g. discharge glass tubes). As this glass can contain differing amounts of lead, a maximum content of 0.2 % by weight lead may still be present in the glass of fluorescent lamps.

LEU thus requests the renewal of the exemption for use in lamps falling under Cat. 5, with the following wording formulation and for the maximum duration:

"Lead in glass of fluorescent tubes not exceeding 0.2 % by weight"

17.1.1 Amount of Lead Used under the Exemption

According to LEU⁴⁷⁵, the lead content in glass of fluorescent tubes can be up to 0.2% if recycling glass is used in the glass production process. The homogenous material is glass. Producers of lamp glass tubes are continuously monitoring the lead content in recycling glass. Regarding the amount of lead under the exemption, the applicant states:

"The amount of intentionally added substance entering the EU-28 market annually through application for which the exemption is requested: 0 tons. According to LightingEuropes' experience in average of all low pressure discharge lamps, the legal threshold of 0.1% wt in homogenous material glass is not exceeded.

Theoretically assuming a lead content of 500 ppm average, roughly estimated 25 tons of lead would enter the EU-28 market bound in lamp glass. Worst case would be 100 tons assuming an average content of 0.2%

*(Basis of the rough estimation: ca 680 Mio fluorescent lamps put on the EU-28 market per year (Eurostat data for 2013), average 0,1 kg weight per lamp; ca. 75% average glass per lamp = 50.000 tons; hereof 0.05/0.2% lead)"*⁴⁷⁶

17.2 Description of Requested Exemption

The exemption covers lamp glass of fluorescent tubes. Fluorescent lamps are low pressure discharge lamps in the scope of RoHS Directive, addressed in Annex I as category 5 (lighting equipment). The lamp glass used in low pressure discharge lamps is mainly soda-lime glass (soft glass). It can be understood that though lead was used in the manufacture of lamp tube glass in the past for functional reasons, it was successfully phased out years ago and is no longer intentionally added in manufacture. It is however present in the tube glass of new discharge lamps in light of its presence as an impurity in recycled glass, originating from end-of-life (EoL) lamps. Such glass is used as a raw material in the manufacture process of new lamp glass.⁴⁷⁷

LEU⁴⁷⁸ explains that fluorescent lamps have long lifetimes and that since the use of lead in the glass of fluorescent tubes was allowed in the EU until 2010 and is still allowed in

⁴⁷⁵ Op. cit. LEU (2015a)

⁴⁷⁶ Op. cit. LEU (2015a)

⁴⁷⁷ Op. cit. LEU (2015a)

⁴⁷⁸ Op. cit. LEU (2015a)

most countries outside the EU, e.g. in China, that lead-containing recycled glass will be available for a foreseeable long term, probably decades. This is especially valid if the lamp glass is produced outside the EU. Lead in the glass is on the other hand safe as it will not leave the glass matrix under any circumstance. The requested maximum content of lead is only slightly above the RoHS threshold limit for lead in homogenous materials.

In a later communication, LEU details that under the first RoHS Directive, coming into effect in 2006, the use of Pb in glass for fluorescent lamps was exempted. In the second edition, this exemption was restricted to 0.2%. Thus a significant reduction was realized, leading to the current situation that glass for fluorescent lamps is still diluted with a small amount of Pb, sometimes slightly higher than the RoHS restriction of lead above 0.1% by weight. Hence in the long term, a declining trend of installed lamps with lead-containing glass is expected. On the other hand the market for fluorescent lamps is decreasing, which could lead to higher amounts of lamps or lamp glass produced outside the EU. The rejection of the exemption could lead to the limitation of the use of recycled glass (from lamps coming from the market) in lamp glass production.⁴⁷⁹

17.3 Applicant's Justification for Exemption

Lead has been added in fluorescent lamp glass production for decades in the form of PbO. Use of lead glass in lamps was for a long time standard technology. Adding lead to the glass in the past allowed better processability in all steps of glass smelting and glass soldering, leading to lower failure rates. Due to changes in the production processes lead in glass could be phased out in Europe during the last 4-8 years. However, lead can be found in the glass matrix of newly manufactured low pressure discharge lamps, if lead-contaminated recycling glass is used for glass production. In such cases the glass tubes can be contaminated with minimum amounts of lead, so that the general RoHS limit of 0.1% limit can slightly be exceeded, up to 0.2%. Depending on the levels of lead in the recycled material, the contents of lead in new discharge tube glass may vary. Thus, LEU explains that, despite internal measurements that show that most lamps do not exceed the threshold of 0.1% in the glass, the current threshold of 0.2% by weight is still considered to be necessary to ensure compliance where the 0.1% level is exceeded.

The use of recycled glass is explained to significantly reduce the energy consumption of glass production (-30% for the recycled glass amount according to experience of a LightingEurope member company).⁴⁸⁰

As it can be understood that the use of lead in the manufacture of lamp glass is not regulated in all countries outside the EU, LEU was asked, how it can be guaranteed that the presence of unintentional Pb in lamps manufactured with non-EU glass lamp

⁴⁷⁹ LEU (2015b), Lighting Europe, Answers to 1st Questionnaire Exemption No. 5(b) (renewal request), submitted 28.8.2015, available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_Pack_9/Exemption_5_b_/Ex_5_b_LightingEurope_1st_Clarification_LE_Answers_20150828.pdf

⁴⁸⁰ Op. cit. LEU (2015a)

recyclate (which may have higher lead levels) is similar to levels in glass tube manufactured with EU recyclate, or is at least within the allowances addressed in Ex. 5(b). LEU⁴⁸¹ explained in this regard that each manufacturer must ensure RoHS conformity of products by suitable measures e.g. according EN50581:2012. This includes the glass components. This requirement to ensure conformity applies evenly to different parts, different materials, different components, etc. LEU elaborated that glass coming from different glass furnaces may have differences in composition due to the specific mix of cullet and raw material, but not regarding the presence of lead. In general new produced lamp glass in Europe is lead-free (i.e. lead is not intentionally added - consultants comment). Fluorescent lamps put on the EU market since September 2010 have to be made of lead-free glass. No systematic differences could be recognized by LEU members regarding the origin of the glass.

17.3.1 Possible Alternatives for Substitution

LEU⁴⁸² states that there is no alternative. Lead in the glass of fluorescent tubes in amounts <0.2% has no intended or unintended function. It is a contaminant originating from the use of recycled glass as a raw material in glass production. There is no intended addition of lead or lead compounds other than in the form of recycled glass. However, manufacturers of lamp glass tubes use recycled glass in order to save resources and energy. The rejection of the exemption could lead to the limitation of the use of recycled glass for lamp glass production as well as to higher costs related to the use of resources and energy consumption. LEU also mentions that a limitation of the use of recycled glass in lamp glass production could result in an increase in the number of random conformity checks necessary, especially for lamps imported from outside the EU. If quality controls would reveal batches of lamps exceeding 0.1% lead, these lamps would not be allowed to be marketed in the EU-28. These non-conforming batches would then be exported out of the EU-28 or would need to be scrapped (recycled) directly before the lamps are used if export is not possible or too expensive (repackaging).

17.3.2 Environmental Arguments

According to one source a reduction of energy consumption of 2.5% per every 10% of recycled glass is achieved (lamp glass production of LightingEurope member OSRAM GmbH, Augsburg, Germany). Typically in the OSRAM GmbH, Augsburg glass production plant, 30 - 40 % recycling glass is used. Technically (theoretically) a recycled glass content of up to 80% is estimated to be possible, though such high amounts require that the recycled glass is nearly identical to the manufactured glass. The source of recycled glass is therefore mainly glass from lamp recycling. The content of lead (as well as mercury) is normally measured regularly in the above mentioned plant.⁴⁸³

⁴⁸¹ Op. cit. LEU (2015b)

⁴⁸² Op. cit. LEU (2015a)

⁴⁸³ Op. cit. LEU (2015a)

LEU⁴⁸⁴ further explains that lamps are in the scope of EU Directives 2002/96/EC - WEEE and 2012/19/EU– WEEE Recast. All lamps need to be collected and recycled, regardless of the levels of lead in lamp glass. Take back systems are installed in all EU Member States to facilitate the collection and the proper handling of lamps at end-of-life (further details in the exemption renewal application dossier, but are not detailed here as they concern lamps in general and do not provide specific details as to the fate of lead from the glass of lamps.

17.3.3 Socio-economic Impact of Substitution

According to the applicant there are no health impacts expected, irrespective of the lead content being below 0.2% (as requested) or below 0.1% (the RoHS threshold for Pb), as the lead is bound in glass. In parallel, as the use of recycled glass reduces the use of virgin resources and the consumption of energy, an increase in direct production costs could be expected should the exemption be revoked.⁴⁸⁵

17.4 Stakeholder Contributions

A single contribution was made during the stakeholder consultation regarding Ex. 5(b). The Test and Measurement Coalition (TMC)⁴⁸⁶ includes the seven leading companies in the sector representing roughly 60% of the global production of industrial test and measurement products. It is TMCs' understanding that according to the RoHS Directive, the exemptions listed in Annex III and Annex IV for which no expiry date has been specified, apply to sub-category 9 industrial with a validity period of 7 years, starting from 22 July 2017. This is also said to be explained in the RoHS FAQ, p. 26 http://ec.europa.eu/environment/waste/rohs_eee/pdf/faq.pdf. TMC, thus does not interpret the current exemption evaluation related to package 9 to concern category 9 industrial equipment, for which the exemptions evaluated in pack 9 are understood to remain valid, and has thus not provided exemption specific information.

17.5 Critical Review

17.5.1 REACH Compliance – Relation to the REACH Regulation

Appendix A.1.0 of this report lists Entry 30 in Annex XVII of the REACH Regulation, stipulating that lead compounds shall not be placed on the market, or used, as substances, constituents of other substances, or in mixtures for supply to the general public. A prerequisite to granting the requested exemption would therefore be to

⁴⁸⁴ Op. cit. LEU (2015a)

⁴⁸⁵ Op. cit. LEU (2015a)

⁴⁸⁶ TMC (2015), Test & Measurement Coalition, General comments related to RoHS exemption package 9, submitted 16.10.2015, available under

http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_Pack_9/Exemption_1_a-e/_General_Contribution_Test_Measurement_Coalition_package_9_exemptions_20151016.pdf

establish whether the intended use of lead in this exemption request might weaken the environmental and health protection afforded by the REACH regulation.

In the consultants' understanding, the restriction for substances under Entry 30 of Annex XVII does not apply to the use of lead in this application. Pb present as an impurity in the glass of lamps manufactured with recycled glass from EoL lamps, in the consultants' point of view is not a supply of a lead compounds as a substance, mixture or constituent of other mixtures to the general public. Pb is part of an article and as such, Entry 30 of Annex XVII of the REACH Regulation would not apply.

Entry 63 of Annex XVII also restricts the use of lead and its compounds. Its restriction in jewellery would not apply in the case of this exemption. Paragraph 7 restricts the use of lead above certain concentrations in articles supplied to the general public, where these may be placed in the mouth by children during normal use. Paragraph 8(k) however excludes articles in scope of RoHS 2 from this restriction, which thus does not apply to this case.

No other entries, relevant for the use of lead in the requested exemption could be identified in Annex XIV and Annex XVII (status January 2015).

Based on the current status of Annexes XIV and XVII of the REACH Regulation, the requested exemption would not weaken the environmental and health protection afforded by the REACH Regulation. An exemption could therefore be granted if other criteria of Art. 5(1)(a) apply.

17.5.2 Scientific and Technical Practicability of Substitution, environmental arguments

From the available information it can be understood that the presence of lead in discharge lamp tube glass is a result of the use of recycled material originating from recycled lamps in the production of new lamp glass tubes. Lead is not added intentionally and in this sense a substitution does not require the provision of a specific function as such. Though discharge lamp tube glass could be manufactured without the use of recycled material (i.e., a possible form of substitution), this would result in a higher consumption of energy (as well as energy related emissions like greenhouse gas emissions) for the manufacture of the tube glass, as the manufacture of glass from primary material requires higher temperatures for the fusion of raw materials into glass. In this sense, it can be followed that revoking the exemption in favour of this potential substitute would result in a higher environmental impact. In parallel, it can be understood that impacts on health and or the environment related to the presence of lead in lamp tube glass would not be expected, as the lead is encapsulated in the glass and emissions leading to such impacts are not expected.

17.5.3 Stakeholder Contributions

The contribution submitted by TMC raises a legal question as to the availability of the current exemption to category 9 equipment. Regardless of TMCs claims as to the availability of Annex III exemptions to sub-category 9 industrial for 7 years starting in 22.7.2017, in the case of Ex. 5(b) the wording formulation limits its applicability to the

glass of fluorescent tubes. Fluorescent tubes are understood to be a product of the discharge lamp group, which can be used as a component in other equipment. As, stated by the applicant, this product is understood to fall under category 5 and not under Cat. 9. Thus from a practical perspective, in the consultants' opinion, sub-category 9 industrial equipment would not benefit from the exemption directly, though lamps benefiting from the exemption could be used in Cat. 9 equipment.

17.5.4 The Scope of the Exemption

In the consultants view the exemption could be limited to category 5. The applicant has stated that lamps benefiting from Ex. 5(b) fall under category 5 and in the consultants' view the exemption wording formulation excludes its availability to other EEE components when lamps are used in a specific EEE. Should discharge lamps be in use in equipment falling under categories other than category 5, they would still be understood to fall under Cat. 5 as a component of an EEE and would thus still benefit from the exemption as long as it would be valid. The reduction of the levels of Pb in lamp tube glass is a continuous process, affecting the glass of all lamps manufactured. The consultants thus expect this change to affect the glass of lamps evenly. In other words it is not expected that reduction in the level shall only affect lamps used in some EEE, but not others. Thus, differentiation between categories would not be relevant.

17.5.5 Conclusions

Article 5(1)(a) provides that an exemption can be justified if at least one of the following criteria is fulfilled:

- their **elimination or substitution** via design changes or materials and components which do not require any of the materials or substances listed in Annex II is scientifically or technically impracticable;
- the **reliability** of substitutes is not ensured;
- the total negative **environmental, health and consumer safety impacts** caused by substitution are likely to outweigh the total environmental, health and consumer safety benefits thereof.

LEU states that there is no substitute as such, however in the consultants view, manufacturing discharge lamp glass from primary materials comprises a valid substitute. According to the statements of LEU, there would also be no problem with the reliability of such glass, which is expected to have comparable performance to lamp glass with up to 0.2 % by weight lead.

However, the consultants can follow that discontinuing the use of recycled glass in the manufacture of lamp glass would create negative impacts in relation to the need to use more primary materials (where secondary ones are available) and more energy needed for smelting the glass. In this sense, the consultants conclude that though there may be alternatives in the form of manufacture from primary materials, such alternatives would create negative environmental impacts that arguably outweigh the benefits of this substitute.

17.6 Recommendation

It is understood that although substitutes may exist, their associated environmental costs would be higher than in the case where the exemption is renewed and a use of up to 0.2% by weight Pb in the glass of discharge lamp tubes is further allowed. In this sense, one of the Article 5(1)(a) criteria is understood to be fulfilled and the renewal of the exemption is thus understood to be justified.

It is further observed that the intention of the RoHS Directive restrictions is to reduce the contents of harmful substances in the waste stream and the impacts related thereto. This is evident for example from Recital 8 of the Directive, stating *“Restricting the use of those hazardous substances is likely to enhance the possibilities and economic profitability of recycling of waste EEE and decrease the negative impact on the health of workers in recycling plants”*. In the case of Pb in the glass of fluorescent tubes, its content, currently as an impurity resulting from the use of recycled lamp glass, is understood not to limit the recycling of such waste, nor the use of such recycled glass as a secondary resource.

As it can further be followed that the reduction of lead in recycled glass from EoL lamps is expected to occur only very gradually due to long product lifetimes, the consultants would further recommend extending the exemption for a further five years, in line with the duration limitations addressed in Article 5(2).

Though in light of Article 5(2), from a legal perspective, an exclusion of EEE falling under Cat. 8 and 9 from the scope of this exemption may not be possible, the consultants do not see an added benefit from the availability of the exemption to categories other than Cat. 5. In the consultants view, through its formulation, the exemption is already restricted to use in lamps, which fall solely under Cat. 5. Since lamps can be used as a component of other articles, restricting the exemption to this category should not create any disadvantage to manufacturers of products of other categories using discharge lamps as a component. In such cases the Cat. 5 exemption would still be applicable to such lamps used as a component in equipment other than Cat. 5. All the more so as the formulation of the exemption is not to change and it already limits its applicability to lamps which are understood to fall under Cat. 5. If this is acceptable from a legal perspective, the exemption could be limited to Cat. 5. If Cat. 8 and Cat. 9 cannot legally be excluded from these exemptions; duration periods for these categories have been specified in the exemption formulation below.

Exemption 5(b)	Duration*
<i>Lead in glass of fluorescent tubes not exceeding 0,2 % by weight</i>	For Cat. 5: 21 July 2021
	For Cat. 8 and Cat. 9: 21 July 2021
	For Sub-Cat. 8 in-vitro: 21 July 2023
	For Sub-Cat. 9 industrial: 21 July 2024

Note: As it can be understood that the exemption duration may vary for various categories on the basis of Article 5(2), expiration dates have been specified here for certain categories on the basis of the validity periods specified in Article 5(2) for categories, which are newly in scope.

17.7 References Exemption 5b

- LEU (2015a) LightingEurope, Request to renew Exemption 5(b) under Annex III of the RoHS Directive 2011/65/EU Lead in glass of fluorescent tubes not exceeding 0.2 % by weight, submitted 15.1.2015, available under:
http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_Pack_9/Exemption_5_b/5_b__LE_RoHS_Exemption_Req_final.pdf
- LEU (2015b) Lighting Europe, Answers to 1st Questionnaire Exemption No. 5(b) (renewal request), submitted 28.8.2015, available under
http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_Pack_9/Exemption_5_b/Ex_5_b__LightingEurope_1st_Clarification_LE_Answers_20150828.pdf
- TMC (2015) Test & Measurement Coalition, General comments related to RoHS exemption package 9, submitted 16.10.2015, available under
http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_Pack_9/Exemption_1_a-e_/General_Contribution_Test___Measurement_Coalition_package_9_exemptions_20151016.pdf