Consultation Questionnaire Exemption No. 34

Exemption for „Lead in cermet-based trimmer potentiometer elements“

Abbreviations and Definitions

EEE	Electrical and Electronic Equipment
Umbrella Project	RoHS Umbrella Industry Project
Pb	Lead
PbO	Lead Oxide
RoHS	Directive 2011/65/EU on the Restriction of Hazardous Substances in Electrical and Electronic Equipment

Background

The Oeko-Institut has been appointed by the European Commission, within a framework contract[1], for the evaluation of applications for exemption from Directive 2011/65/EU (RoHS), to be listed in Annexes III and IV of the Directive.

General Electric, on behalf of the RoHS Umbrella Industry Project, has submitted a request for the renewal of the above-mentioned exemption, which has been subject to an initial evaluation. A summary of the main argumentation for justifying the request is provided below. The applicant has been requested to answer additional questions and to provide additional information, available on the request webpage of the stakeholder consultation (http://rohs.exemptions.oeko.info/index.php?id=368).

For further details, please check the applicant’s exemption request under the link available above.

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 (RoHS 2), which can be found under:

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32011L0065:EN:NOT

If you intend to contribute to the stakeholder consultation, please read the summary of the argumentation provided and answer the questions that follow.

[1] The contract is implemented through Framework Contract No. ENV.B.3/FRA/2019/0017, led by Ramboll Deutschland GmbH.

1. Summary of argumentation of applicant on the justification of the exemption

1.1. Background

On behalf of the Umbrella Project General Electric applies for the renewal of Ex. 34 of Annex III of the RoHS Directive:

> *"Lead in cermet-based trimmer potentiometer elements"*

The Umbrella Project submitted two applications (RoHS Umbrella Industry Project 2020b; 2020a) for this purpose, one applying for the exemption for categories 1-10 and a second application applying for the exemption for category 11. It applies for the exemption for the maximum duration applicable to each category (5-7 years).

1.2. Volume of lead to be placed on the EU market through the exemption

The RoHS Umbrella Industry Project (2020b) specifies that the content of lead-oxide (PbO) in the homogenous material (glass) is 40-50%. As for the amount of Pb placed on the market through these articles, EEE are used in a wide range of final products and markets, and the Umbrella Project contends that it is impossible to provide a precise figure of the amount of lead included in glass and ceramic components in the EU for EEE.

In a later communication, the Umbrella Project (2021) provide a rough estimate that "*Less than 10 kg/yr of Pb element present into the glass frits and lead monoxide (both present in inks composition) for Sfernice Potentiometers & Trimmers department*".

1.3. Technical description

Lead is explained to be used in resistive inks in glass to obtain appropriate physical characteristics as a functional element in potentiometers. Potentiometers are electronic components the resistance of which can be varied manually by the user. These contain a resistive material (the cermet) and a sliding contact that is moved across the cermet surface to vary the component's electrical resistance. (RoHS Umbrella Industry Project 2020b)

1.4. Applicant's justification for the requested exemption

RoHS Umbrella Industry Project (2020b) specifies mechanical endurance and contact resistance variation as critical properties provided by lead in this application. Further characteristics are detailed for cermet potentiometers that contain lead:

- Long lifetime, typically up to 50,000 rotation cycles;
- Low temperature coefficient (TC) - 50 ppm/°C which is lower than other types of potentiometer;
- High level of heat dissipation;
- Wide operating temperature range, -55 °C to +125 °C;
- Higher wattage rating, e.g. 3 watts;
- Low reactance at high maximum frequency;
- Good resolution (resolution is the smallest possible change in resistance ratio);

- Low electrical noise when resistance is adjusted;
- Small size enabling use in high density microelectronic circuits.

According to Umbrella Project (2021) the main parameters demonstrating the quality of a potentiometer are:

- Total resistance drift percentage;
- Wiper-track contact resistance variation percentage;
- Percentage of the maximum wiper-track contact resistance.

with "*all of these three parameters to be measured during forthcoming tests. Among them: mechanical endurance, electrical endurance, thermal shock cycles*".

For replacement, the following issues also have to be taken into account, for cermet trimmers using lead: (RoHS Umbrella Industry Project 2020b)

- can be of a very small size, unlike all other types;
- are not sensitive to Electrostatic Discharge (ESD), unlike some other types[2];
- do not need reverse polarity or surge protection, unlike other types;
- can work at high temperature without Ohm-value drift.

1.4.1. Availability of alternatives (Substitution or Elimination, roadmap to substitution, reliability of substitutes)

RoHS Umbrella Industry Project (2020b) state that despite extensive research, no suitable substance for substituting Pb has been identified. Boron, phosphorus, zinc, tin, bismuth, etc., have been investigated as elements for substituting Pb as a constituent element of glass. However, these potential substitute materials, when compared with lead-containing glasses, give chemical stability and mechanical strength of the glasses that are both inferior and are insufficient to meet the required functionality. This inferior performance results in significantly shorter lifetimes, resulting in the equipment reaching end of life much sooner than is required for the end-use equipment. Tests also showed that substitute-types of lead-free glass resulted in the generation of electrical noise, which is unacceptable for most applications. The critical point is explained to be the surface roughness of the ink after firing, which quickly degrades the sliding contact (wiper) or creates unacceptable electrical noise.

According to RoHS Umbrella Industry Project (2020b), preliminary tests with lead-free inks seem to show that a lubricant shall be necessary. Even with a lubricant, the same performance is not expected to be reached with all ohmic values

As for technical alternatives, RoHS Umbrella Industry Project (2020b) explains that alternative types of potentiometer have different technical performance and are also larger, making them unsuitable in applications where cermet trimmer potentiometers are used. There are many types of potentiometers (variable resistors) on the market, but each type has a unique combination of performance criteria which determines when they are suitable. The application provides a table (pg. 10) comparing these properties for various potentiometer types (conductive plastic, carbon and wire

[2] In a later communication, Umbrella Project (2021) specified "potentiometers made with CerMet ink that are less ESD-sensitive than potentiometers made with a carcer ink" as other types, explaining that for the former, it has been shown that a couple of kilovolt can be applied without causing functional damage.

wound) to show how the combination of performance of cermet's is different to all other types of potentiometer and so one type cannot be substituted by another and achieve the same performance.

The cermet type provides a performance with no drift for hundreds of hours at 150°C. With Bakelite (carbon) inks for example, there are several %-points of drift for every 96 hours of testing at 125°C. Cermet is robust enough to withstand the force of the wiper. Particularly in miniature devices, accurate, repetitive determination of the force of the wiper is difficult. For cermet -based units, a wiper force from 10cN up to 150cN can be used. Bakelite pots are of a poorer quality than Cermet. The wear of the inks used on Bakelite is quicker than the Cermet ones. Cermet potentiometers can work up to 125°C and can work up to 210°C under defined circumstances.

Additional alternative technologies to cermet trimmer/ potentiometers are mentioned, however without giving more detail:

- Conductive plastic inks;
- Other technology (optic, magnetic, digital).

When asked to provide further detail as to the above alternative technologies, the Umbrella Project (2021) did not provide such detail but stated that "*Some fields such as aeronautics are rather conservative. To have in mind that if they show interest in a new technology, it would take them several years to start introducing it to their airplanes*."

1.4.2. Environmental and health arguments

Environmental arguments were not raised as the main justification for this exemption.

1.4.3. Socio economic aspects

RoHS Umbrella Industry Project (2020b) states that deletion of this exemption would prevent the sale of thousands of types of electrical equipment that rely on these into the EU. These types of equipment will include essential medical devices, test equipment, IT, telecoms, industrial controls etc., that are essential for health, environmental protection and manufacturing businesses in the EU.

2. Questions for stakeholders

1. The applicant specifies various parameters where lead-based potentiometers perform better than lead-free alternatives, however the required performance range has not been specified for most of these (See section 1.4 in this respect). Please provide data as to the relevant performance range that substitute candidates for lead based potentiometers must show in relation to various parameters to be considered as viable alternatives. Please furthermore explain whether all properties are required in all cases or only for specific application types.
2. The applicant has requested an exemption, proposing the following wording formulation:

   "Lead in cermet-based trimmer potentiometer elements"

   a. Do you agree with the scope of the exemption as proposed by the applicant?

   b. Please suggest an alternative wording and explain your proposal, if you do not agree with the proposed exemption wording.

c. Please explain why you either support the applicant's request or object to it. To support your views, please provide detailed technical argumentation / evidence in line with the criteria in Art. 5(1)(a) to support your statement.

3. Please provide information concerning possible substitutes or developments that may enable reduction, substitution or elimination, at present or in the future, of *"Lead in cermet-based trimmer potentiometer elements"*; In this respect, please provide additional data on "Conductive plastic inks"; and "Other technology (optic, magnetic, digital)" for which the applicant has not provided detail.

    a. In this regard, please provide information as to alternatives that may cover part or all of the applicability range of *"cermet-based trimmer potentiometer elements"*;

    b. Please provide quantitative data as to application specifications to support your view.

4. Please provide information as to research initiatives which are currently looking into the development of possible alternatives for some or all of the application range of *"cermet-based trimmer potentiometer elements"*.

    a. Please explain what part of the application range is of relevance for such initiatives (in what applications substitution may be possible in the future).

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

5. As part of the evaluation, socio-economic impacts shall also be compiled and evaluated. For this purpose, please provide details in respect of the following:

    a. Please estimate possible amounts of waste to be generated through a forced substitution should the exemption not be granted. In this respect, please clarify whether devices placed on the market before the 22 July 2021 could still be serviced through the spare parts provision stipulated in the Directive under Article 4.

    b. Please estimate possible impacts on employment in total, in the EU and outside the EU, should the exemption not be granted. Please detail the main sectors in which possible impacts are expected – manufacture, supply chain, retail, etc.

    c. Please estimate additional costs associated with a forced substitution should the exemption not be granted, and how this is divided between various sectors (e.g. private, public, industry: manufacturers, suppliers, retailers, end-users).

6. Please provide any further information and/or data that you think is of importance to substantiate your views.

In case parts of your contribution are confidential, please provide your contribution in two versions (public /confidential). Please also note, however, that requested exemptions cannot be granted based on confidential information!

Finally, please do not forget to provide your contact details (Name, Organisation, e-mail and phone number) so that Oeko-Institut can contact you in case there are questions concerning your contribution.

3. References

RoHS Umbrella Industry Project (ed.) (2020a): Umbrella Project. Exemption Request Form - Exemption #34 - Categories 11, 9 Oct 2020.

RoHS Umbrella Industry Project (ed.) (2020b): Umbrella Project. Exemption Request Form - Exemption #34 - Categories 1-10, 15 Jan 2020.

Umbrella Project (ed.) (2021): RoHS Umbrella Industry Project. Answer to clarification questions regarding Ex. 34 of Annex III, 10 Mar 2021.