

This initial feedback is submitted on behalf of participants in the Umbrella Project (“UP”) Exemption #34 technical Working Group (“WG”) (hereafter referred to as “UP Exemption #34 WG Participants”).

Clarification 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 contract¹, for the evaluation of applications for exemption from Directive 2011/65/EU (RoHS), to be listed in Annexes III and IV of the Directive.

Your organisation (GE on behalf of the Umbrella 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 as a first basis to be used in the stakeholder consultation planned as part of this assessment.

Please read the summary of the argumentation provided to ensure that your line of argumentation has been understood correctly and provide answers to the questions that follow that address aspects requiring additional information and/or clarification.

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

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.

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.

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;
- 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 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).

1.4.2. **Environmental and health arguments** *(also LCA aspects)*

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. Clarification Questions

1. Though a precise estimation of the amount of Pb entering the EU market through this exemption is explained not to be possible, please provide as a minimum a rough range to clarify if the amounts range in a few kg, a few tonnes or more. **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.**
2. Are all the characteristics detailed under Section 1.3 above (or under pg. 10 of your application) of relevance to substitutes for this application? Please provide measurable parameters for these characteristics to clarify in relation to what minimum performance substitutes are to be measured for comparability. **The main parameters demonstrating the quality of a potentiometer are as follows :**
 - “total resistance drift percentage”;
 - “wiper-track contact resistance variation percentage”;
 - “percentage of the maximum wiper-track contact resistance”
 - => all of these three parameters to be measured during forthcoming tests. Among them: mechanical endurance, electrical endurance, thermal shock cycles.
3. You refer to lead based cermet trimmers not being sensitive to Electrostatic Discharge, “unlike some other types”. Please clarify what other components are referred to and how they perform in comparison with cermet trimmers. **Potentiometers made with CerMet ink that are less ESD-sensitive than potentiometers made with a carcer ink. It has been shown that a couple of kilovolt can be applied without causing functional damage.**
4. You refer to lead based cermet trimmers not needing reverse polarity or surge protection, “unlike some other types”. Please clarify what other components are referred to and how they perform in comparison with cermet trimmers. **Yes, “surtension” should be a peak (not long-term)**
5. Please provide illustrations of the comparative lifetimes and the comparative electrical noise of lead-based and lead-free articles.
6. Very little detail is provided on the alternative technologies: “Conductive plastic inks; Other technology (optic, magnetic, digital)” – please explain what the current status is of these in relation to potential substitution and why these technologies could not eliminate some or all of the cermet potentiometer application range. **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.**
7. Potentiometers are also mentioned in the application for Ex. 7(c)-I. This exemption excludes applications covered by Ex. 34 from its scope. Please explain if applications covered by this exemption could in theory be covered by Ex. 7(c)-I for “Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix compound” and why these exemptions should not be merged, with Ex. 34 appearing as a separate item of Ex. 7(c)-I.

Exemption N°34 was especially created a few years ago for cermet potentiometers and trimmers : "*Lead in cermet-based trimmer potentiometer elements*"

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.

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.