

2. Reason for application:

Please indicate where relevant:

- Request for new exemption in:
- Request for amendment of existing exemption in
- Request for extension of existing exemption in Annex III
- Request for deletion of existing exemption in:
- Provision of information referring to an existing specific exemption in:
 - Annex III
 - Annex IV

No. of exemption in Annex III or IV where applicable: 34

Proposed or existing wording: existing wording

Lead in cermet-based trimmer potentiometer elements

Duration where applicable:

We apply for renewal of this exemption for the categories marked in section 4 further below for the respective maximum validity periods foreseen in the RoHS2 Directive, as amended. For these categories, the validity of this exemption may be required beyond those timeframes. Although applications in this exemption renewal request may be relevant to other categories not marked in section 4 further below, this renewal request does not address those categories.

Other: _____

3. Summary of the exemption request / revocation request

We are requesting renewal for the exemption 34 for lead in cermet-based trimmer potentiometer elements. We suggest to keep the numbering and wording the same to avoid confusion and maintain the initial intention of scope of exemption 34.

This exemption follows the same justification criteria as exemption 7(c)-I "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".

Alternative technologies are evaluated but so far no substitution technology is available for resistive inks in glass which ensures the needed properties such as mechanical endurance and contact resistance variation. Alternative types of potentiometer have different technical performance and are also larger, making them unsuitable in applications where cermet trimmer potentiometers are used. Therefore we request renewal of the exemption.

4. Technical description of the exemption request / revocation request

(A) Description of the concerned application:

1. To which EEE is the exemption request/information relevant?

Name of applications or products: All types of electrical and electronic equipment (EEE).

a. List of relevant categories: (mark more than one where applicable)

- | | |
|---------------------------------------|--|
| <input checked="" type="checkbox"/> 1 | <input checked="" type="checkbox"/> 7 |
| <input checked="" type="checkbox"/> 2 | <input checked="" type="checkbox"/> 8 |
| <input checked="" type="checkbox"/> 3 | <input checked="" type="checkbox"/> 9 |
| <input checked="" type="checkbox"/> 4 | <input checked="" type="checkbox"/> 10 |
| <input checked="" type="checkbox"/> 5 | <input type="checkbox"/> 11 |
| <input checked="" type="checkbox"/> 6 | |

b. Please specify if application is in use in other categories to which the exemption request does not refer: Applications in this exemption renewal request may be relevant to categories not marked above

c. Please specify for equipment of category 8 and 9:

The requested exemption will be applied in

- monitoring and control instruments in industry
- in-vitro diagnostics
- other medical devices or other monitoring and control instruments than those in industry

2. Which of the six substances is in use in the application/product?

(Indicate more than one where applicable)

- Pb Cd Hg Cr-VI PBB PBDE

3. Function of the substance:

Lead is used to obtain appropriate physical characteristics as a functional element in potentiometers.

4. Content of substance in homogeneous material (%weight):

40-50% PbO in glass.

5. Amount of substance entering the EU market annually through application for which the exemption is requested:

Please supply information and calculations to support stated figure.

Electrical and electronic components are used in a wide range of final products and markets, it is impossible to provide a precise figure of the amount of lead included in glass and ceramic components in the EU for Electrical and Electronic Equipment [EEE].

Electronic equipment industry is engaged in the reduction of lead and environmental burdens within its powers, although it is impossible to completely cease the use of lead under the scope of exemption 34.

6. Name of material/component:

Lead (Pb) in Cermet based trimmer potentiometers

7. Environmental Assessment: not applicable, since there is no alternative to compare against.

LCA: Yes

No

(B) In which material and/or component is the RoHS-regulated substance used, for which you request the exemption or its revocation? What is the function of this material or component?

Lead in Cermet based trimmer potentiometers used as resistive inks. 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.

(C) What are the particular characteristics and functions of the RoHS-regulated substance that require its use in this material or component?

Glass containing lead as a constituent element is able to provide the high functionality required for electrical and electronic components. Such glass can fulfil the appropriate characteristics and satisfy the high reliability requirements over a wide range of applications.

Cermet potentiometers that contain lead have the following characteristics:

- Long lifetime, typically up to 50,000 rotation cycles (they are usually rated at 25,000 cycles)
- Low temperature coefficient (TC), which is a measurement of the resistance change relative to ambient temperature change and is expressed as parts per million (PPM) per degree centigrade change, or as a percentage. The TC for a typical Cermet potentiometer is 150 ppm/°C which is lower than other types of potentiometer
- High level of heat dissipation
- Wide operating temperature range, -55 °C to +125 °C is typical for cermet types.
- Higher wattage rating, e.g. 3 watts
- Low reactance at high maximum frequency¹
- 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
- Preliminary tests with LF inks seem to show that a lubricant shall be necessary.
- Even with a lubricant, the same performance will not be reached with all ohmic values

5. Information on Possible preparation for reuse or recycling of waste from EEE and on provisions for appropriate treatment of waste

1

https://www.bourns.com/docs/technical-documents/technical-library/trimmers/technical-articles/ap_proc.pdf?sfvrsn=7e552032_0

1) Please indicate if a closed loop system exist for EEE waste of application exists and provide information of its characteristics (method of collection to ensure closed loop, method of treatment, etc.)

Components in the scope of exemption 34 are incorporated into EEEs and at the end of life. Such WEEEs are collected and treated according to the WEEE directive. In general there is no, exclusive closed-loop system for such components due to the very large variety of final applications; just in some cases on an application basis related to specific sectors.

2) Please indicate where relevant:

- Article is collected and sent without dismantling for recycling
- Article is collected and completely refurbished for reuse
- Article is collected and dismantled:
 - The following parts are refurbished for use as spare parts: _____
 - The following parts are subsequently recycled: _____
- Article cannot be recycled and is therefore:
 - Sent for energy return
 - Landfilled

Note: Electrical and electronic equipment using components in the scope of exemption 34 as previously mentioned in general it is not separately collected or recycled from other types of electrical and electronic equipment and so it is recycled using the same procedures as for other WEEE.

3) Please provide information concerning the amount (weight) of RoHS substance present in EEE waste accumulates per annum:

- In articles which are refurbished _____
- In articles which are recycled _____
- In articles which are sent for energy return _____
- In articles which are landfilled _____

Note:

EU industry complies with all applicable waste legislation.

The industry refurbishes EEE where this is practical, recycles materials where possible and uses landfill only as a last resort. No data is available on the quantities of capacitors separately from whole EEE, which are refurbished, recycled or landfilled.

6. Analysis of possible alternative substances

- (A) Please provide information if possible alternative applications or alternatives for use of RoHS substances in application exist. Please elaborate analysis on a life-cycle basis, including where available information about independent research, peer-review studies development activities undertaken**

Despite extensive research, no suitable substance for substituting lead has been identified. Therefore such information and analysis are not applicable in this case. Boron, phosphorus, zinc, tin, bismuth, etc., have been investigated as elements for substituting lead 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.

Also as a result of this inferior performance, there are concerns regarding crucial failures in EEE incorporating electrical and electronic components composed of glass with lead substituted by these elements due to their decreased reliability and more rapid deterioration.

The analysis method used to assess substitute materials involved procurement of several different lead free cermet inks from a cross section of manufacturers. These were processed and their performances were measured by running qualification tests.

At present, no alternative solutions have similar (or acceptable) results compared to the leaded inks; especially in life tests. The critical point is the surface roughness of the ink after firing, which quickly degrades the sliding contact (wiper) or creates unacceptable electrical noise.

Based on these results, a continuation of the exemption is necessary to obtain the current performance of the products.

As of this time, no trimmer cermet potentiometer manufacturers have identified a workable alternative material. (see our comments on lubrication §4C)

There are many types of potentiometer (variable resistors) on the market, but each type has a unique combination of performance criteria which determine when they are suitable. As shown in the table below, the combination of performance of cermets is different to all other types of potentiometer and so one type cannot be substituted by another and achieve the same performance. In addition, trimmer cermet potentiometers are considerably smaller than other types and where space on high

component density circuits is limited, these are the only viable option.

Cermet potentiometer images (example):



Comparison of different types of potentiometers:

	Cermet	Conductive plastic	Carbon	Wire wound
Typical maximum power rating	3W	0.5W	1W	8W
Temperature Coefficient	±150 ppm	±500 – 1000 ppm	>±1000 ppm	±20 ppm
Maximum number of rotations	>50,000	>100,000	15,000 or less	>500,000
Typical maximum resistance	10MΩ	5MΩ	10kΩ	100kΩ
Maximum operating temperature	150°C, some can operate at up to 210°C	85°C	100°C	125 - 150°C
Limitations	Fewer rotations than other types, although used as presets (trimer potentiometers) so are infrequently adjusted	Limited power capability	Higher TC	Limited resolution* Much lower maximum frequency than cermet and other types (see reference 2)
Size	Cermet trimmers are very small size (e.g. 2.5 x 4.5 x 4.5mm ³) reference 3	Typical example e.g. 22.2mm diam reference4	Typical example e.g. 9.7 x 10 x 6.8mm Reference 5	Typical example e.g. 22.2mm diam Reference 6
Long term Stability of the ohm value (Humidity, ageing)	GOOD	POOR	POOR	GOOD

Note on above table

* Resolution is the smallest possible change in resistance ratio. Wire-wound resistors often have a lower resolution because the wire “turns” introduce discrete steps in resistance.

For replacement, the following issues also have to be taken into account, as cermet trimmers:

- 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

With cermet: no drift for hundreds hours at 150°C.
With Bakelite (carbon) inks: several %-points of drift for every 96 hours of testing at 125°C.

There are several ways alternative technologies to cermet trimmer/potentiometers for ex:

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

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.

² Bourns potentiometer handbook, page 174, trimmer selection guide, downloaded from <https://www.bourns.com/pdfs/OnlinePotentiometerHandbook.pdf> . Also <https://www.radio-electronics.com/info/data/resistor/variable-adjustable-trimmer-resistor-potentiometer.php>

³ http://www.farnell.com/datasheets/2061255.pdf?_ga=2.187863976.1693350986.1553703746-1924281187.1530629915

⁴ http://www.farnell.com/datasheets/2237762.pdf?_ga=2.87267224.1693350986.1553703746-1924281187.1530629915

⁵ http://www.farnell.com/datasheets/2259384.pdf?_ga=2.108115714.1693350986.1553703746-1924281187.1530629915

⁶ http://www.farnell.com/datasheets/2237763.pdf?_ga=2.181065895.1693350986.1553703746-1924281187.1530629915

(B) Please provide information and data to establish reliability of possible substitutes of application and of RoHS materials in application

See 6 (A) above for comments on effect of substitution on lifetime, There is no suitable substance for substituting lead in cermet materials.

7. Proposed actions to develop possible substitutes

1. Please provide information if actions have been taken to develop further possible alternatives for the application or alternatives for RoHS substances in the application.

Research into alternative lead-free, thick-film materials is described in section 6. Since the last exemption renewal request was submitted in 2015, manufacturers have been looking for new potential alternative inks, however, none have become available that give satisfactory performance as illustrated by the recent analysis of lubricants.

2. Please elaborate what stages are necessary for establishment of possible substitute and respective timeframe needed for completion of such stages.

At present, research has indicated that there are no prospects concerning the technical scope of exemption 34 for a comprehensive substitution to “lead-free” trimmer potentiometers in the currently foreseeable future.

As indicated above, there are currently no prospects of alternative technology. If an alternative were found, which is not currently foreseen, a possible time frame would be at least 3 years: one for evaluation, one for internal qualification, one for qualification at customers especially for specific applications. Additional validation time would be required in categories 8 & 9 for integration into individual manufacturers’ products. Medical devices and many types of monitoring and control instruments cannot be placed on the market until approvals are granted. For medical devices this is by a Notified Body under the Medical Devices regulation. If a change is regarded as significant, which can be a change of component from one type to another, the reliability and functions of the modified device must be assessed to ensure that there is no decrease in performance, reliability or safety. For many applications, prolonged clinical trials may be required. Gaining approvals globally can take up to two years and so

the total timescale from evaluation by the potentiometer manufacturer to being able to make and sell modified medical devices can be as much as 10 years if complete redesign is needed; otherwise, a period of 5 – 6 years is considered reasonable.

8. Justification according to Article 5(1)(a):

Scientifically or technically impracticable, Reliability not ensured.

(A) Links to REACH: (substance + substitute)

1) Do any of the following provisions apply to the application described under (A) and (C)?

- Authorisation
 - SVHC
 - Candidate list
 - Proposal inclusion Annex XIV
 - Annex XIV
- Restriction
 - Annex XVII
 - Registry of intentions
- Registration

2) Provide REACH-relevant information received through the supply chain.
Name of document:

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. The requested exemption is therefore justified as other criteria of Art. 5(1)(a) apply.

(B) Elimination/substitution:

1. Can the substance named under 4.(A) 2 be eliminated?

- Yes. Consequences? _____
- No. Justification:

Please refer to Product Examples in Annex 1

2. Can the substance named under 4.(A) 2 be substituted?

Yes.

Design changes:

Other materials:

Other substance:

No.

Justification:

Please refer to Product Examples in Annex 1

As there are no substitutes, we are not able to provide reliability data and LCA data of substitutes in 3 and 4 below.

We are not able to evaluate availability and socio-economic impact in (C) and (D) below for the aforementioned reasons.

3. Give details on the reliability of substitutes (technical data + information):

4. Describe environmental assessment of substance from 4.(A) 2 and possible substitutes with regard to

1) Environmental impacts:

N/A

2) Health impacts: _____

N/A

3) Consumer safety impacts: _____ N/A

⇒ Do impacts of substitution outweigh benefits thereof?

Please provide third-party verified assessment on this: _____ N/A

(C) Availability of substitutes:

a) Describe supply sources for substitutes: none exist

b) Have you encountered problems with the availability? Describe: N/A

c) Do you consider the price of the substitute to be a problem for the availability?

Yes

No Price is currently undetermined as no substitution has been identified

d) What conditions need to be fulfilled to ensure the availability? N/A

(D) Socio-economic impact of substitution:

⇒ What kind of economic effects do you consider related to substitution?

Increase in direct production costs

Increase in fixed costs

Increase in overhead

Possible social impacts within the EU As no alternatives exist where these types of cermet are used, 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.

Possible social impacts external to the EU

Other: _____

⇒ Provide sufficient evidence (third-party verified) to support your statement:

9. Other relevant information

Please provide additional relevant information to further establish the necessity of your request:

All tests performed with LF inks utilising various wiper technologies across a range of contact forces did not offer the same product performance as with lead bearing inks.

10. Information that should be regarded as proprietary

Please state clearly whether any of the above information should be regarded to as proprietary information. If so, please provide verifiable justification:
