Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Fraunhofer Institut Zuverlässigkeit und Mikrointegration

Adaption to scientific and technical progress under Directive 2002/95/EC

Results previous evaluation
Exemption No. 24

"Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors"

(Excerpt from Öko-Institut Report 2006; Annex 1 Monthly Report 4 and Final Report)

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Summary of recommendations:

- Grant exemption for lead in finishes of NiFe-lead-frame components with the following wording:
  Lead in finishes of fine pitch components with a pitch of 0.65 mm or less with NiFe lead-frames until 2010.

- Grant exemption for lead in finishes of copper-lead-frame components with the following wording:
  Lead in finishes of fine pitch components with a pitch of 0.65 mm or less with copper lead-frames until 2008.

5.2 Solders containing lead for specific applications – Syfer (set 1 request No. 4_a)

5.2.1 Description of requested exemption

Solders containing lead for specific applications, namely:

Solders used for soldering to machined through hole discoidal and planar array ceramic multi layer capacitors.

Substance

Lead

Function of the Solder

Provide the combination of a suitable melting point and ductility of 50Pb/50In or 60In/40Pb solders. The ductility of this solder avoids cracking of the ceramic layer during and after soldering due to thermal mismatch.

Specific application

Solders used for soldering to machined through hole discoidal and planar array ceramic multi layer capacitors for EMC discrete filters, filter assemblies and filtered connectors.

The quantity of lead in the solder joints of each filter depends on the design. The applicant estimated by experiment that the quantity of lead is typically 5mg per joint. This approximates to 0.75% of the total filter weight maximum.

Filters assembled at the applicant's manufacturing sites during 2003 used approximately 4Kg of lead total in solder joints and approximately 3kg in 2004.

This request affects a small number of manufacturers, and for certain components the applicant claims to be the market leader. Therefore it is estimated that the total amount of

lead in such kind of components is in the same order of magnitude as stated by the applicant.

Precise wording

Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multi layer capacitors.

5.2.2 Summary of justification for exemption

According to the applicant, lead-free solders in connection with gold plated terminations cause cracking of the ceramic bodies after the soldering process due to thermal mismatch (CTE). As a main reason for the CTE is the copper alloy pin, alternative pin materials have been tested, but are not a viable substitute. The alternative materials do not provide suitable resistivity to allow sufficient current flow without excessive temperature rise.

Some companies may intend using PdAg terminations replacing gold together with lead-free solders. This avoids the cracking of the ceramic bodies. Tests, however, show that such devices show considerable deviations from the designed capacitance causing unacceptable losses of the filtering properties beyond the acceptable tolerances. The reason is the weaker – compared with gold terminations - adhesion between the ceramic and the AgPd plating causing lift-offs and/or the leaching of the PdAg layer, both in combination with lead-free solders. The problem does not exist with lead-containing solders. The loss of capacitance due to these failure modes affecting the filtering performance of the device may result in severe medium- and long-term reliability problems.

According to the applicant, in some applications, clips are an alternative to the use of solders. However, their use is principally limited to bigger through hole sizes as the clip needs space. Additionally, the use of clips may be limited due to required electrical parameters, which the clip affects. A general rule whether clips can be used as an alternative is therefore not at hand, but rather requires a case to case consideration.

The applicant reasons that the use of high-melting SnPb solders with more than 85 % of lead is a possible substitute. As this substitute would increase the amount of lead used in this application as well as the energy consumption and would require new soldering equipment, this alternative is not considered to be a viable and sound alternative. According to the applicant, alternatives therefore do not exist and an exemption is required for this use of lead.

5.2.3 Final recommendation

The presented arguments are plausible and supported by appropriate documentation. The use of high-melting solders with more than 85 % of lead, which are already exempted, could be a solution, but would even increase the use of lead and energy.

For some applications, the use of clips is an alternative, but must be considered on a case to case basis, according to the applicant. As a result, a generally appropriate substitute technically and scientifically is not at hand. It is therefore recommended to grant this exemption. The scientifically and technically accurate wording for this exemption, in line with Art. 5 (1) (b) of the RoHS Directive, should be

“Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multi layer capacitors”.

5.3 Special purposes Black Light Blue (BLB) lamps, containing lead in the glass envelope – ELCF (set 1 request No. 17)

5.3.1 Description of requested exemption

The European Lamp Companies Federation (ELCF) requests an exemption for PbO in the glass envelope of Black Light Blue (BLB) lamps. Typical applications of this kind of lamps are money checking, lamps for leak detectors, disco-lighting etc.

These lamps efficiently emit near ultraviolet rays at 315nm to 400nm which have strong photochemical and fluorescent effects. Through the usage of a special deep blue filter glass visible rays and transmits near ultraviolet rays are absorbed.

According to the applicant lead is essential for creating optimal optical properties: maximum transmission of UV light and minimum visible light transmission.

The total annual amount of lead in this application is about 50.000 kg p.a. (total EU market, 2004 figures). Compared to the usage of Pb respectively PbO in other discharge lamp applications (see monthly report 2, section 5.5 to 5.8) these figures are comparatively high.

5.3.2 Summary of justification for exemption

The applicant justifies the request for exemption based on technical criteria:

- Substitution is currently technically not feasible, no glass recipes are known that result in an acceptable transmission spectrum.
- Earlier efforts to substitute Pb have led to a published patent, WO 96/21629, published 18 July 1996, the implementation of which could not be realised up to now, due to a number of technical reasons.
- Earlier patented lead-free BLB glass appeared to yield a very large lamp emission reduction over time. This would result in an unacceptably short lamp life.

As reaction to additional questions by the consultants ELCF provided further information. According to the applicant in the mean time, substantial technical progress has been achieved, which makes it possible to decide on the technical feasibility in 2006.

6 Requests open for recommendation

The following section contains final recommendations for requests from set 2, set 3 and set 4 that were still open for recommendation. Furthermore it contains corrigenda of recommendations which have been subject to changes since their first publication in one of the monthly reports.

6.1 Add-on monthly report 3 section 5.6 - „Lead bound in glass, crystal glass, lead crystal or full lead crystal; Cr (VI) and Cd as colouring batch addition in glass, crystal glass, lead crystal or full lead crystal - CPIV/Swarovski (request No. 2 and No. 3)"

Upon request of the applicant, the consultant re-opened the dialogue on the recommendation given in monthly report n°3. It was agreed that the consultant would write an add-on to the existing text in report n°3 in order to better reflect the applicant's opposite view to the given recommendation.

In contrary to the consultant, the applicant argues that the functionality of a product (=electrical equipment) is NOT limited to the elementary technical function, e.g. the functionality of a chandelier is not only to spend light via the use of electricity but mainly to beautify and grace the room by the brilliancy of the crystals. Both aspects of functionality form an integral part of the product. Even if such an application could be realised with lead-, cadmium- and chromium-free alternatives, its whole functionality – according to the applicant – would not be given, since the quality of the application is directly linked to the optical and decorative properties of the crystal. The applicant states that substituting the crystals with RoHS-compliant ones would lead to a degradation in quality and thus not fulfil the needed requirements of a substitute.

A further example cited by the applicant is that a watch decorated with red crystals cannot be substituted with RoHS-compliant red crystals without crucial decrease in colour purity. This, he argues, does not fall under the term "substitution". Substitution implies equivalency.

Article 5 (1) (b) leaves room for interpretation concerning the definition of what exactly can be understood by "technically/scientifically practicable". The consultant and the applicant have diverging views on its interpretation.

6.2 Corrigendum "Solders containing lead for specific applications" – Syfer (set 1 request No. 4_a)

(Updating section 5.2 report 4 – proposed wording changed)

6.2.1 Description of requested exemption

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Substance

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Function of the Solder

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Specific application

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Precise wording

Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multi layer capacitors.

6.2.2 Summary of justification for exemption

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Some companies may intend using PdAg terminations replacing gold together with lead-free solders. This avoids the cracking of the ceramic bodies. Tests, however, show that such devices show considerable deviations from the designed capacitance causing unacceptable losses of the filtering properties beyond the acceptable tolerances. The reason is the weaker

– compared with gold terminations - adhesion between the ceramic and the AgPd plating causing lift-offs and/or the leaching of the PdAg layer, both in combination with lead-free solders. The problem does not exist with lead-containing solders. The loss of capacitance due to these failure modes affecting the filtering performance of the device may result in severe medium- and long-term reliability problems.

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6.2.3 Final recommendation

The presented arguments are plausible and supported by appropriate documentation. The use of high-melting solders with more than 85 % of lead, which are already exempted, could be a solution, but would even increase the use of lead and energy.

For some applications, the use of clips is an alternative, but must be considered on a case to case basis, according to the applicant. As a result, a generally appropriate substitute technically and scientifically is not at hand. It is therefore recommended to grant this exemption. The scientifically and technically accurate wording for this exemption, in line with Art. 5 (1) (b) of the RoHS Directive, should be

"*Lead in solders for the soldering to plated-through-holes in discoidal and planar array ceramic multilayer capacitors*".

6.3 Add-on "Hexavalent chromium (CR VI) passivation coatings – HP (set 1 request No. 5)

After publication of the final recommendation in monthly report 3 and the corrigendum in monthly report 9, a further clarification was requested concerning the word "and" in the recommended wording.

The "and" in the wording was added intentionally and does indeed mean that both conditions have to be fulfilled: i) corrosion protection AND ii) Electromagnetic Interference Shielding.

The reason is that after re-wording the exemption upon new information provided by the applicant, it was concluded that - concerning corrosion protection only - there did not seem to