

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

Results previous evaluation
Exemption No. 23

“Lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with NiFe lead frames and lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with copper lead frames”

(Excerpt from Öko-Institut Report 2006; Annex 1 Monthly Report 4 and 9)

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Following this step all requests from set 2 available on 28 October 2005 have been checked with a view to determine the need for further clarification. Furthermore stakeholder comments were screened in order to attribute individual comments to the relating requests. Depending on the quality of the requests questions have been sent out to applicants and stakeholders were necessary. These questions can be found in the Annex 1 to this report.

It can be noted that in most instances data and information given in the requests do not meet the criteria set by the Commission on the consultation website. Nor are most of the requests justified in line with Article 5 (1) (b) of the RoHS Directive. It was therefore necessary to start an extensive clarification procedure with the applicants before going into detailed evaluation (e.g. in some requests it is not even clear what substance/application the exemption is requested for).

A detailed description of the requests ready for final recommendation is given in section 5 including the description of the request for exemption (substance, function, application, wording), the summary of the justification for exemption and a critical review of available data and information as well as the final recommendation by the contractor.

5 Status of remaining requests set 1 and requests set 2

The following section contains the status quo of the remaining request from set 1 for which no final recommendation can be given yet (request No. 21). Furthermore the following section contains final recommendations for requests from both set 1 and set 2.

5.1 Lead in finishes of fine pitch components – HP (set 1 request No. 1_b)

5.1.1 Description of requested exemption

- Substance: Lead in tin-lead finishes with typically less than 20 mass-% of lead
- Function: Prevention of whisker growth
- Specific application: Finishes on fine pitch components with a pitch of less than 0.65 mm
- Wording as requested by applicant: Lead in tin-lead finishes on fine pitch components with a pitch of 0.65 mm or less until 2010.
- The exemption would result in the use of 2 to 2000 metric tons of lead in the EU, based on the content of 0.1 to 1 mg of lead in a typical electronic component, around 1 mg to 1 g of lead per product and the shipment of EEE into the EU.

5.1.2 Summary of justification for exemption

Criteria for justification

- No long time experience on whisker formation from lead-free tin-based finishes.
- Great deal of uncertainty regarding environmental factors (e.g. high air humidity and high temperature) that might affect whisker growth.
- Whisker mitigation techniques applied by component manufacturers actually mitigate whisker growth, but cannot reliably prevent whiskers growing to a length that can be critical for fine pitch components.
- Discussions on whisker standard tests ongoing without a result yet due to these uncertainties. Hence, no standard test is available at the moment allowing reliable results on whiskering of tin-based lead-free finishes.
- Nickel-palladium (Ni/Pd) and nickel-palladium-gold (Ni/Pd/Au) are technically viable lead-free substitutes for components with copper lead¹-frames, but not available sufficiently to cope with the demand until July 2006. Component manufacturers focused their efforts on tin-based lead-free plating.
- No such whisker free alternative finishes available on nickel-iron lead-frames.

Critical review on data and information (given by applicant or other parties)

- The principle mechanisms of whisker growth are known, but currently failures resulting from whiskers from tin-based lead-free finishes in fine pitch components cannot be excluded reliably and generally.
- A general recommendation to use tin-based lead-free finishes cannot be given at the moment. Users of fine pitch components will have to decide on a case-to-case base.
- The applicant submitted a paper (Quist IPC San Jose Apr05 Cypress Customer Preferences.pdf²) where it is pointed out that there is a lack of production capacity and availability of fine pitch components with NiPdAu plating.
- The applicant argues that he cannot find all necessary fine pitch components with NiPd or NiPdAu finishes
- For NiFe-lead-frame components, NiPd and NiPdAu finishes technically are not a viable alternative. NiFe-lead-frames and Cu-lead-frames both have their technical indications of use (electrical and thermal conductivity, coefficient of thermal mismatch

¹ Technical remark: The word "lead" in "lead-frame" in this context does not refer to the chemical element lead (Pb), but means the chassis on which chips are attached in components.

² See Annex 2

between chip and lead-frame,...) and thus cannot generally be substituted with each other. Substitution of NiFe-components by copper-lead-frame components with NiPd or NiPdAu finishes therefore is no generally viable alternative.

5.1.3 Final recommendation

Specific mitigation techniques can reduce tin whisker growth on tin-plated surfaces. However, whiskers still grow to a length that can become critical for fine pitch components. The whiskers on mitigated tin surfaces occur under specific testing conditions. It is contentious whether or not these testing conditions are relevant for the real life situation. This discussion is still ongoing in standardisation committees which are working on a standard whisker test. A final result of this discussion is not yet available and it cannot yet be foreseen when a final standard whisker test will be decided upon. It can therefore not be neglected that a certain risk may remain in using pure tin finishes on fine pitch components. .

Manufacturers must decide themselves whether and in which applications they use tin-based lead-free finishes. This means that, until more experience allows a clearer estimation of the risk, a viable other lead-free alternative needs to be available when compliance with RoHS is required. Manufacturers would thus not be forced to take the risk using fine pitch components with tin-based lead-free finishes if they consider it too risky for their application.

Nickel-palladium-gold and nickel-palladium are such other lead-free alternatives, which are already applied on a small number of components. However, they are only applicable on components with copper lead-frames. As the applicant states, on nickel-iron lead-frames, corrosion problems bar their use.

It is therefore recommended to grant an exemption for fine pitch components with NiFe lead-frames until 2010, as requested.

For fine pitch components on copper lead-frames, the availability of components with NiPdAu and NiPd finishes for the deadline July 2006 is still limited. The component manufacturers, according to the applicant, focused on tin-based lead-free finishes and thus neglected investing into alternatives. The documentation submitted makes this argumentation plausible, although exactly quantified data are not available as this information was not accessible for the applicant, if available at all.

It is therefore recommended to grant the exemption for fine pitch components on copper lead-frames for two years. Until then, the component manufacturers have time to react to the market demand.

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

equipment falling under category three of Directive 2002/96/EC (IT and telecommunications equipment) until 1 July 2007.”

The consultants would nevertheless like to stress that other industry sectors than ICT may have problems in complying with RoHS by 1 July 2006 (see section 6.1.1). The new proposed wording has not been subject to a stakeholder consultation thus not giving stakeholders the chance to comment on the now narrowed exemption request. The new wording is mainly the outcome of a late stakeholder comment by Electrolux and other manufacturers of household appliances and the subsequent response by the original applicant HP.

6.2 Corrigendum “Lead in finishes of fine pitch components – HP (set 1 request No. 1_b)”

The following recommendation has been adapted and corrected according to new conclusions drawn in the course of the evaluation work. Changes are highlighted in italic and bold letters. The proposed wording replaces the wording proposed in section 5.1 in the fourth monthly report.

6.2.1 Description of requested exemption

- Substance: Lead in tin-lead finishes with typically less than 20 mass-% of lead
- Function: Prevention of whisker growth
- Specific application: Finishes on fine pitch components with a pitch of less than 0.65 mm
- Wording as requested by applicant: Lead in tin-lead finishes on fine pitch components with a pitch of 0.65 mm or less until 2010.
- The exemption would result in the use of 2 to 2000 metric tons of lead in the EU, based on the content of 0.1 to 1 mg of lead in a typical electronic component, around 1 mg to 1 g of lead per product and the shipment of EEE into the EU.

6.2.2 Summary of justification for exemption

Criteria for justification

- No long time experience on whisker formation from lead-free tin-based finishes.
- Great deal of uncertainty regarding environmental factors (e.g. high air humidity and high temperature) that might affect whisker growth.

- Whisker mitigation techniques applied by component manufacturers actually mitigate whisker growth, but cannot reliably prevent whiskers growing to a length that can be critical for fine pitch components.
- Discussions on whisker standard tests ongoing without a result yet due to these uncertainties. Hence, no standard test is available at the moment allowing reliable results on whiskering of tin-based lead-free finishes.
- Nickel-palladium (Ni/Pd) and nickel-palladium-gold (Ni/Pd/Au) are technically viable lead-free substitutes for components with copper lead¹-frames, but not available sufficiently to cope with the demand until July 2006. Component manufacturers focused their efforts on tin-based lead-free plating.
- No such whisker free alternative finishes available on nickel-iron lead-frames.

Critical review on data and information (given by applicant or other parties)

- The principle mechanisms of whisker growth are known, but currently failures resulting from whiskers from tin-based lead-free finishes in fine pitch components cannot be excluded reliably and generally.
- A general recommendation to use tin-based lead-free finishes cannot be given at the moment. Users of fine pitch components will have to decide on a case-to-case base.
- The applicant submitted a paper (Quist IPC San Jose Apr05 Cypress Customer Preferences.pdf²) where it is pointed out that there is a lack of production capacity and availability of fine pitch components with NiPdAu plating.
- The applicant argues that he cannot find all necessary fine pitch components with NiPd or NiPdAu finishes
- For NiFe-lead-frame components, NiPd and NiPdAu finishes technically are not a viable alternative. NiFe-lead-frames and Cu-lead-frames both have their technical indications of use (electrical and thermal conductivity, coefficient of thermal mismatch between chip and lead-frame,...) and thus cannot generally be substituted with each other. Substitution of NiFe-components by copper-lead-frame components with NiPd or NiPdAu finishes therefore is no generally viable alternative.
- ***Fine pitch connectors must be explicitly excluded from the scope of this exemption request. The whiskering mechanism is different, and the respective exemption requests referring to fine pitch connectors (second stakeholder***

¹ Technical remark: The word "lead" in "lead-frame" in this context does not refer to the chemical element lead (Pb), but means the chassis on which chips are attached in components.

² See Annex 2

consultation, lot 1) were recommended to be declined. One of the applicants had withdrawn his request as he accepted gold as an alternative, RoHS compliant coating (see report 3 from November 2005).

6.2.3 Final recommendation

Specific mitigation techniques can reduce tin whisker growth on tin-plated surfaces. However, whiskers still grow to a length that can become critical for fine pitch components. The whiskers on mitigated tin surfaces occur under specific testing conditions. It is contentious whether or not these testing conditions are relevant for the real life situation. This discussion is still ongoing in standardisation committees which are working on a standard whisker test. A final result of this discussion is not yet available and it cannot yet be foreseen when a final standard whisker test will be decided upon. It can therefore not be neglected that a certain risk may remain in using pure tin finishes on fine pitch components. .

Manufacturers must decide themselves whether and in which applications they use tin-based lead-free finishes. This means that, until more experience allows a clearer estimation of the risk, a viable other lead-free alternative needs to be available when compliance with RoHS is required. Manufacturers would thus not be forced to take the risk using fine pitch components with tin-based lead-free finishes if they consider it too risky for their application.

Nickel-palladium-gold and nickel-palladium are such other lead-free alternatives, which are already applied on a small number of components. However, they are only applicable on components with copper lead-frames. As the applicant states, on nickel-iron lead-frames, corrosion problems bar their use.

It is therefore recommended to grant an exemption for fine pitch components with NiFe lead-frames until 2010, as requested. ***To avoid misuse of this exemption, fine pitch connectors must be excluded from the scope of this exemption, as the respective exemption requests in lot 1 of the second stakeholder consultation were not recommended for an exemption.***

For fine pitch components on copper lead-frames, the availability of components with NiPdAu and NiPd finishes for the deadline July 2006 is still limited. The component manufacturers, according to the applicant, focused on tin-based lead-free finishes and thus neglected investing into alternatives. The documentation submitted makes this argumentation plausible, although exactly quantified data are not available as this information was not accessible for the applicant, if available at all.

It is therefore recommended to grant the exemption for fine pitch components on copper lead-frames for two years. Until then, the component manufacturers have time to react to the market demand. ***To avoid misuse of this exemption, fine pitch connectors must be***

excluded from the scope of this exemption, as the respective exemption requests in lot 1 of the second stakeholder consultation were not recommended for an exemption.

Summary of recommendations:

The following wording replaces the one in section 5.1 in the fourth monthly report! Changes are highlighted in bold and italic letters.

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

6.3 Changes in entry 8 of the RoHS Annex (set 3 request no. 12 and no. 15)

Within set 3 there are two exemption requests which deal with an amendment of the current wording of entry 8 of the RoHS Annex as amended by Commission Decision of 21 October 2005 (2005/747/EC).

The list below shows the evolution of the change in the wording concerning this entry.

- Original wording RoHS Directive: "**Cadmium plating** except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations."
- Amendment 10/2005: "**Cadmium and its compounds in electrical contacts and cadmium plating** except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations."
- Request Umicore: "**Cadmium plating as defined in Directive 91/338/EEC** except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations."
- Definition Cd plating in 91/338/EEC: "any **deposit or coating of metallic cadmium on a metallic surface**"
- Request NEC/Schott: "Cadmium and its compounds in electrical contacts **except for applications of one-shot operation function such as thermal links** and Cadmium plating except for applications banned under Directive 91/338/EEC amending Directive