



### Adaptation to scientific and technical progress under Directive 2002/95/EC

**Final Report** 

- final version -

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#### 1 Background and Objectives

Article 4 (1) of Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment provides "that from 1 July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, PBB or PBDE". The annex to the Directive lists a limited number of applications of lead, mercury, cadmium and hexavalent chromium, which are exempted from the requirements of Article 4 (1).

Article 5 (1) (b) of the Directive provides that materials and components can be exempted from the substance restrictions contained in Article 4 (1) if their elimination or substitution via design changes or materials and components which do not require any of the materials or substances referred to therein is technically or scientifically impracticable, or where the negative environmental, health and/or consumer safety impacts caused by substitution outweigh the environmental, health and/or consumer safety benefits thereof.

On the basis of this provision the European Commission has received (and is still receiving) from industry additional requests for applications to be exempted from the requirements of the directive. These requests need to be evaluated in order to assess whether the request for exemption fulfil the above mentioned requirements of Article 5 (1) (b). Where the requirements are fulfilled the Commission proposes a draft decision amending the RoHS Directive.

Against this background Öko-Institut e.V. and Fraunhofer Institute for Reliability and Microintegration IZM have been commissioned by the European Commission with technical assistance for the evaluation of requests for exemptions submitted according to Article 5 (1) (b). The main objective of this technical assistance consists in a clear assessment of whether the requests for exemptions are justified in line with the requirements listed in Article 5 (1) (b).



#### 2 General Procedure

For details on the general procedure of the evaluation of the requests for exemption please refer to the first monthly report.

#### 3 Scope

During the duration of the contract between July 2005 and July 2006 four sets of exemption requests were evaluated. These four sets were all subject to a public stakeholder consultation (corresponding to  $2^{nd} - 5^{th}$  consultation round). The following tables give an overview about the requests, the applicants and the recommendations given by the consultant.

Table 1: Overview requests set 1

No	Title of group	Applicant	Recommendation	Report
1	Lead in tin whisker resistant coatings for fine	1_a: FCI	Refuse	Report 3
	pitch applications	1_b: HP	Grant	Corrigendum in report 9 Report 4
		1_c: JBCE	Withdrawal	Report 3
		1_d: Sony	Refuse	Report 3
2	Lead bound in glass, crystal glass, lead crystal or full lead crystal in general	2_a: CPIV/Swarovski	Refuse	Report 3 + Add-on
	Lead and cadmium in enamels on borosilicate glass	2_b: ESGA/Schott Duran	Grant	Report 3
3	Chromium (also in oxidation state (VI)) and Cadmium as colouring batch addition each form up to a content of 2 % in glass, crystal glass, lead crystal or full lead crystal used as decorative and / or functional part of electric or electronic equipment	CPIV/Swarovski	Refuse	Report 3 + Add-on
4	Solders containing lead and/or cadmium for specific applications	4_a: Syfer	Grant	Corrigendum in final report Report 4
		4_b: Coherent	Grant (2 year moratorium)	Report 2
		4_c: JBCE	Withdrawal	Report 3
5	Hexavalent chromium (CR VI) passivation coatings	HP	Grant (1 year moratorium)	Corrigendum in report 9
				Report 3
6	Lead in lead oxide glass plasma display panels	JBCE/JEITA	Idem 19 set 2: Grant	Report 4
7	Lead in connectors, flexible printed circuits, flexible flat cables	JBCE	Withdrawal	Report 3
8	Lead oxide in lead glass, bonding materials of magnetic heads and magnetic heads	JEITA	Withdrawal	Report 3



No	Title of group	Applicant	Recommendation	Report
9	Cadmium as doping material in avalanche photodiodes (APDs) for the optical fiber communication systems	JBCE/JEITA	Withdrawal	Report 3
10	Lead in optical isolators	JEITA/Sumitomo	Grant	Corrigendum in final report Report 3
11	Lead in sheath heater of Microwaves	JBCE	Withdrawal	Report 3
12	Cadmium pigments except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to the restriction on the marketing and use of certain substances	ICdA	Refuse	Report 2
13	High Intensity Discharge (HID) lamps for professional U.V. applications, containing lead halide as radiant agent	ELCF	Grant	Report 2
14	Discharge lamps for special purposes containing lead as activator in the fluorescent powder (1% lead by weight or less)	ELCF	Grant	Report 2
15	Discharge lamps containing lead in the form of an amalgam	ELCF	Grant	Report 2
16	Mercury free flat panel lamp	ELCF	Idem 9 set 2: Grant	Corrigendum in report 4 Report 2
17	Special purposes Black Light Blue (BLB) lamps, containing lead in the glass envelope	ELCF	Grant	Report 4
18	Low melting point alloys containing lead	Cookson	Refuse	Report 2
19	Galvanised steel containing up to 0.35% lead by weight and aluminium with an unintended lead content up to 0.4% lead by weight in electrical and electronic equipment	Eurometeaux	Refuse	Report 2
20	Lead in solder and hexavalent chromium in surface treatment, in parts recovered from production printers and copying equipment, sold, rented or leased or otherwise returned from professional users other than private households, originally put on the market before 1 July 2006, and reused for the same purpose within the original manufacturer's closed loop system until 1 July 2011.	Xerox/Kodak/Océ	Grant	Report 2
21	Cadmium sulphide photocells	Perkin Elmer/Philips	Idem 10 set 2: Refuse	Report 5

Table 2: Overview requests set 2

No.	Title	Applicant	Recommendation	Report
1	Linear incandescent lamps	ELCF	Not applicable	-
2	Mercury in switches	Pickering	Refuse	Report 6
3	Special ICs having tin-lead solder plating on leads used in professional equipment	Thomson	Refuse	Final Report
4	Specific modular units including tin-lead solder being used in special professional equipment	Thomson	Refuse	Final Report



No.	Title	Applicant	Recommendation	Report
5	Solders containing lead and /or cadmium for specific applications where local temperature is higher than 150 deg C and which need to work properly more than 500 hours	Schlumberger	Withdrawal	Report 6
6	Lead in solder for printed circuit boards for emergency lighting products	LIF	Withdrawal	Report 5
7	Hexavalent chromium (Cr-VI) in chromate conversion coatings as surface treatment	Circuit Foil	Withdrawal	Report 9
8	Lead in gas sensors	Dräger	Refuse	Report 6
9	PbO (Lead in Seal Frit) used for making BLU (Back Light Unit Lamp) for LCD televisions	Samsung	Idem 16 set 1: Grant	Report 4
10	Cadmium in opto-electronic components	TESLA	Idem 21 set 1: Refuse	Report 5
11	Non-consumer mechanical power transmission systems including speed reducers and mechanical couplings which rely on electrical/electronic components for safe control and operation	FALK	Withdrawal	Report 6
12	Electrical and electronic components contained in heating ventilating and air conditioning building systems, commercial refrigeration systems and transport refrigeration systems	Carrier	Withdrawal	Report 5
13	Cadmium-bearing copper alloys	Symbol	Withdrawal	Report 6
14	Electrical/electronic components contained mobile and stationary air compressors and vacuum systems, compressed air contaminant removal systems and pneumatic contractor's air tools	Sullair	Withdrawal	Report 6
15	Electrical/electronic equipmentthat are: used in transport -aviation, aerospace, road, maritime, rail; installed in to the fabric of buildings – elevators, escalators, moving walks, dumb waiters, and heating, cooling and ventilation systems, and fire and security systems; used in the energy generation and transmission; used in mining and mineral processing; used for non-consumer mechanical power transmission systems; industrial process pumps and compressors; used in industrial refrigeration; and used in military applications	United Technologies	Withdrawal	Report 5
16	Lead alloys as electrical/mechanical solder for transducers used in high-powered professional and commercial loudspeakers	Meyer Sound	Grant	Report 7
17	Cadmium oxide	INMET	Refuse	Report 5
18	Solder tin of the thermo fuse with a defined low melting point	Friwo	Refuse	Report 9
19	Lead in lead oxide glass used in plasma display panel (PDP)	KEA	Idem 6 set 1: Grant	Report 4
20	Lead in solder on small PCB and tinned legs of primary components	e2v	Refuse	Report 5
21	Use of the not lead free component NEC V25 in the Memor 2000 $$	Datalogic	Refuse	Report 5



No.	Title	Applicant	Recommendation	Report
22	Lead used in shielding of radiation for Non Medical X-ray equipment	l3com	Withdrawal	Report 5
23	Lead based solders sealed or captured within heat- shrinkable components and devices.	SEIP	Refuse	Report 9

Table 3: Overview requests set 3

No.	Title	Applicant	Recommendation	Report
1	On-Semi MCR265-10 SCR	Helval Merca Ltd	Refuse	Final Report
2	Components NEC V55	CPG International	Refuse	Report 9
3	The use of lead in solder applications for electronic components of musical instruments having an average lifespan in excess of 10 years	Allan Organ Company represented by Bristows	Refuse	Report 9
4	Lead solder alloy in Surge protective devices (SPDs)	ZVEI	No recommendation possible	Final Report
5	Inventory of Special ICs having tin-lead solder on/in leads/balls, used in specialist/professional equipment	Calibre	Refuse	Report 9
6	Lead alloys as electrical/mechanical solder for transducers used in high-powered professional and commercial loudspeakers	Hosiden Besson Ltd	Grant	Final Report
7	Solder containing lead for applications where the local temperature exceeds 150 C and reliable operation for a minimum of 30,000 hours is required	ASCO	Grant	Final Report
8	Tin-lead solder in the manufacture of professional audio equipment	Lectrosonics Inc.	Refuse	Final Report
9	Specific modular units including tin-lead solder being used in special professional equipment	Avolites Ltd	Refuse	Final Report
10	Lead in electronic vacuum tubes	Kerp	Grant (qualified)	Final Report
11	Lead in aluminium used in gas valves for domestic cooking appliances	SABAF	Refuse	Final Report



No.	Title	Applicant	Recommendation	Report
12	"8. Cadmium and its compounds in electrical	NEC-SCHOTT	Grant	Corrigendum
	contacts except for applications of one-shot			in final report
	operation function such as thermal links and			Report 9
	cadmium plating except for the applications			
	banned under Directive 91/338/EEC amending			
	Directive 76/769/EEC relating to the restriction on			
	the marketing and use of certain dangerous			
	substances and preparations."			
13	Lead in solder of parts recovered from	BACTA	Grant	Final Report
	gaming/amusement machines put on the market			
	before 1/07/06 and reused for the same purpose			
	within a manufacturer's closed loop until July			
	2014			
14	Lead in solders in components and assemblies	AeA	Refuse	Final Report
	used in non-consumer products, provided that: -			
	such components and assemblies were			
	purchased or are subject to a proven last-time			
	buy contract placed before 1 July, 2006; and -			
	such components and assemblies are used in			
	models of EEE that were already available on the			
	market before 1 July 2006			
15	"8. Cadmium plating as defined in Directive	UMICORE	Grant	Corrigendum
	91/338/EEC except for applications banned			in final report
	under Directive 91/338/EEC amending Directive			Report 9
	76/769/EEC relating to restrictions on the			
	marketing and use of certain dangerous			
	substances and preparations."			

Table 4: Overview requests set 4

No.	Title	Applicant	Recommendation	Report
1	Cadmium and cadmium oxide in thick film pastes	Apex	Grant	Final
	used on beryllium oxide substrates until January 1,	Microtechnology		Report
	2008			
2	Gaskets of butyl rubber material vulcanised with	Evox Rifa	Refuse	Final
	chinondioxim and lead tetraoxide, for use in			Report
	Aluminium Electrolytic Capacitors			



No.	Title	Applicant	Recommendation	Report
3	Sharp LQ104X2LX11 (formerly Fujitsu FLC26XGC6R-01)	Mettenmeier GmbH	Withdrawal	Final Report
4	Quartz Crystal Resonator and in Fine Pitch Electronics Systems used in the Swiss Watch Indust	Swatch Group	Refuse	Final Report
5	Cadmium in opto- electronic components	Marshall Amplification	No recommendation possible	Final Report
6	Transducers used in professional loudspeaker systems, using tin-lead solder	Function One Research Ltd.	Withdrawal	Final Report
7	Tin-lead solder in the manufacture of professional audio equipment	MC2 Audio Ltd.	Refuse	Final Report
8	Components used in the manufacture of the Hog1000, Hog500, Event416, Event408, ESP2-24 and ESP2-48 lighting control consoles	JANDS	Refuse	Final Report
9	Specific modular units, including tin-lead solder, being used in special professional equipment	XTA Electronics Ltd.	Refuse	Final Report
10	Inventory of special ICS having tin-lead solder on/in leads/balls, used in specialist/professional equipment	INNOVASON	No recommendation possible	Final Report
11	Cadmium Mercury Telluride	SELEX	Refuse	Final Report
12	Lead contained in Babbit lined bearings	A.O.Smith	Refuse	Final Report
13	Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers	JBL Professional	Grant	Final Report
14	Thermal cutoff with a fusible element that contains lead (and possibly cadmium, mercury and hexavalent chromium) for applications where normal operating temperature exceeds 140 C and reliable, predictable, operation for a minimum of 30,000 hours is required	ASCO Valve Inc.	Refuse	Final Report
15	Mercury free flat panel lamp	OSRAM	Grant	Final Report



No.	Title	Applicant	Recommendation	Report
16	Electronic equipment where the reliability, durability and longevity of the equipment is paramount	Pulsar Light of Cambridge Ltd.	Refuse	Final Report
17	Semi Red Brass C84400, 81-3-7-9 or a similar Brass material. Used on radio frequency line sections	Bird Technologies Group	Refuse	Final Report
18	Lead is used as an alloy to the copper in 6 to 8 % by weight. Needed for casting and machinability characteristics	Bird Technologies Group	Not applicable – same as request 17	Final Report
19	Lead in solders for electronic equipments used for the monitoring, the protection and the safety of people in healthcare, telecare and emergency calls domains in professional and private sectors	Tele Alarm SA	Refuse	Final Report
20	FPGA devices manufactured by Xilinx (XC5202-6VQ100C, XC4003E-3VQ100C and XC4013E-3PQ240C) containing lead solder (Pb) used in the plating of the device terminations	H Pro	Refuse	Final Report
21	Lead oxide in seal frit used for making window assemblies for argon and krypton laser tubes	Coherent	Grant	Final Report
22	Smart card readers (product: GemSelf700-MS2, GCR700-3ZS, Vodafone D2, GCR760 and GemSelf750 SV)	GEMPLUS	No recommendation possible	Final Report
23	Use of mercury in Babcock's DC plasma displays and use of Lead Oxide (PbO) in Babcock's DC plasma displays frit seal	Babcock	Grant, wording to be clarified	Final Report



#### 4 Results

In total 88 requests were evaluated. 27 requests were recommended to be granted and 38 requests were recommended to be refused. 17 requests were withdrawn by the applicant. For 2 requests the evaluation procedure was not applicable. Due to lack of information for 4 requests a final recommendation was not possible during the duration of the contract.

The requests can be divided into the following thematic categories:

- 1. Solder Technology and Processes (25 requests)
- 2. Glass Technology (11 requests)
- 3. Metal coating / passivation (3 requests)
- 4. Electronic devices (12 requests)
- 5. Other / Miscellaneous (14 requests)
- 6. Lighting (6 requests)
- 7. Last Time Buy (17 requests)

Figure 1 below gives an overview on the thematic repartition of the requests over these categories.



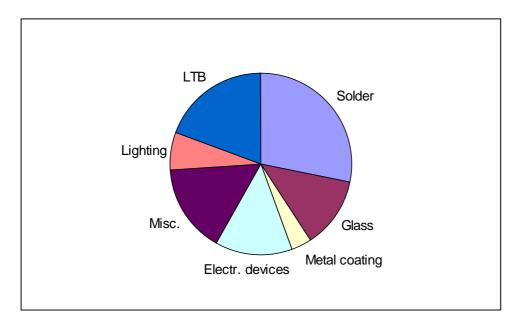


Figure 1: Thematic repartition of exemption requests

#### 5 General aspects - Cross Section Stakeholder Documents

#### 5.1 George-Massenburg-Labs (GML) stakeholder comment

The GML stakeholder document (060209.39%20RoHS%20stakeholder.pdf) gives comments on several exemption requests. Due to the cross sectional nature, the consultant's decided to separately take into consideration and comment this stakeholder document.

#### **Long-term Reliability Concerns**

The GML stakeholder comment (060209.39%20RoHS%20stakeholder.pdf) expresses concerns about the long-term reliability of lead-free solder joints.

- Solder Joint Structure
  - Lead-free solder joints are less homogeneous due to their tin-rich intermetallic regions throughout the lead-free solder joint. This awakes doubts about the longterm resistance in high-reliability applications. The intermetallics in SnPb solder joints are limited to the solder joint-pad and the solder joint-pin interface.
  - The predictability of the soldering process is limited, which affects the reliability of the solder joints. Lead-free alloys therefore are not acceptable for high-reliability applications.
  - The increased void formation of lead-free solder joints poses a reliability risk.



 Lead-free soldering increases the thermal mismatch between components, boards and solder joints, due to the different finishes on PWB and components, which before both had been of tin-lead type like the solder

#### Consultant's comment:

Companies of the automotive electronics industry with the highest reliability requirements and the harshest in-field use conditions have been applying lead-free solders (SAC) for years already (e. g. see <a href="www.ab-mikro.at">www.ab-mikro.at</a> — Aktuelles — Applikationsschrift Bleifreie Löttechnologie). The voiding problem is well-known, but can be mitigated or even avoided with the respective adaptations of design and in the soldering process. In general, it is necessary to differentiate between the symptoms and their possible impacts. Not every void, e. g., yields an increased reliability risk.

The argument that lead-free finishes increase the thermal mismatch has never been heard of and is not plausible. The finish is dissolved during the soldering process and thus cannot result in an additional CTE problem. Mechanical stress burdens the solder joints due to the thermal mismatch between the components and the substrate of the printed wiring board, not due to thermal mismatch within the solder.

- The conventional optical inspection criteria are not applicable for lead-free solder joints, as their characteristics is different from conventional solder joints. Consultant's comments:
  - Optical inspection tests need to be and can be adapted to the specific properties of lead-free solder joints.
- The PWB reliability generally decreases. Higher soldering temperatures cause additional stress due to thermal mismatch in the soldering. PWB delamination processes might also occur.
  - Consultant's comment:
  - Proper soldering process control, appropriate PWB design and material selection avoid these problems.
- No drop-in substitute is available for SnPb finishes on the PWBs. The different leadfree alternatives need more research for the use in high-reliability applications Consultant's comment:
  - It is a general issue in lead-free soldering that drop-in replacements for the SnPb-type solders and finishes are not available, but need to be selected specifically for each application.



There are no component finishes available complying with the strong requirements of high reliability applications. Gold is too expensive and its availability is limited, tin is not viable as it is prone to whiskering.

#### Consultant's comment:

Whiskering of tin finishes is not a general reliability problem, but may be an issue for some specific applications like fine pitch components, for which an exemption was recommended already. It is not comprehensible that there are no appropriate RoHS compliant finishes available.

The more inhomogeneous microstructure of lead-free solder joints due to more intermetallics in the joint can distort electronic signals in single solder joints, which then might result in signal distortions over the entire electronic circuit. This might cause problems in applications requiring high signal stability and quality.

#### Consultant's comments:

In case this kind of problem occurs and it cannot be solved technically, the affected company should submit an exemption request for this specific application to the Commission.

#### Summary

Most aspects mentioned may affect the reliability of solder joints. However, appropriate material selection and adapted processing avoids or mitigates most of these effects. In case this is not possible, the affected company should submit an exemption request for its specific application provided that it can prove that the observed effects seriously impact the reliability of the specific appliance to a degree that justify an exemption.

However, it must be stated that even in the automotive electronics industry with the toughest reliability requirements, lead-free solders, in particular tin-silver-copper (SAC) alloys have been applied successfully. It would be difficult to understand that professional audio and video equipment should be principally and generally exempted from the RoHS directive for reliability concerns, while the automotive industry has been using SAC solders and lead-free finishes on components and PWBS.

## 5.2 Stakeholder Comment John Burke on Environmental and Health Effects of Lead in Electronics/Solders

#### 5.2.1 EPA study "Solders in Electronics – A Life Cycle Assessment"

The stakeholder comment from John Burke (letter of support.pdf) for environmental reasons supports the use of lead in solders in general. He uses the EPA study "Solders in Electronics – A Life Cycle Assessment" (Geibig, Socolof, University of Tennessee) from August 2005 as a proof that the lead-free alternative solders have a higher environmental impact than the



lead-containing ones. However, the authors of the study themselves refrain from giving any recommendation for or against the use of lead-containing solders. They just show the various impacts of conventional and lead-free soldering in different environmental impact categories. In some impact categories the lead-free solders score better, in others the conventional ones. The authors of the study explicitly warn "Do not compare across impact categories". The stakeholder comment thus must expresses the stakeholder's conclusions after he had compared and weighted the different impact categories against the authors' intention. The cited study itself does not support the stakeholder's statement that lead-free soldering is environmentally more adverse then conventional soldering.

In the end, all LCA and similar environmental evaluations of lead-free vs. conventional soldering are based on a comparison and weighting of different environmental impact categories. This is in particular true if the result of studies is a single environmental score for lead-free and conventional soldering respectively, in favour or against lead-free soldering. In the end, the questions always are of the kind like how much additional energy and maybe resource impact balances the advantage from avoiding a certain amount of actual or potential lead toxicity.

For the work in this exemption request review process, the consultants must assume that the ban of lead was a political and societal decision as a result of a weighting process, which gave priority to the avoidance of potential toxic impacts from the use of lead to other, possibly adverse impacts of the ban of lead following the precautionary principle. The review of basic assumptions behind the ban of lead in the RoHS Directive would be an evaluation of a political decision and of the RoHS Directive itself, which is beyond the consultants' tasks and possibilities within this consultation process.

#### 5.2.2 John Burke Stakeholder Document

The same applies to the other document, which the stakeholder had submitted (EC\_check\_list.pdf) citing several studies and arguments as evidence that lead in electronics in general or from electronics solders in particular on landfills do not cause groundwater pollution or any other adverse environmental or health effects. He cites several studies and findings, which should prove that there is no toxic risk from lead on landfill sites. The stakeholder therefore demands that the use of lead in solders should be generally exempted from the ban of lead in the RoHS Directive.

Again, the review of basic assumptions behind the ban of lead in the RoHS Directive would be an evaluation of the RoHS Directive and the political decision behind it, which is beyond the consultant's tasks and possibilities within this consultation process. The consultants therefore refrain from commenting these studies and findings and did not take into account this stakeholder document during the evaluation of the respective exemption requests.



#### 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

Solders containing lead for specific applications, namely:



Solders used for soldering to machined through hole discoidal and planar array ceramic multilayer 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.

#### 6.2.2 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.

#### 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



be a substitution problem for CrVI in devices belonging to category 3 WEEE Directive. The problems - according to the applicant's information – did only relate to the combination of corrosion protection and EIS.

## 6.4 Corrigendum "Lead in optical isolators – JEITA/Sumitomo (set 1 request No. 10)"

(Updating section 5.15 of monthly report 3 and update of 21 June 2006)

#### 6.4.1 Requested exemption

JEITA (Japan Electronics & Infomation Technology Industries Association) on behalf of NEC Corporation and Murata Manufacturing Co., Ltd and SUMITOMO METAL MINING CO.,LTD. request an exemption for lead in optical isolators.

The function of optical isolators consists in the reduction of reflection noise in several optic communication systems (transceiver, transmitter and receiver, optical amplifier). For this purpose rare earth iron garnet (RIG) are used because of their magneto-optical effect.

The garnet crystal is grown by the so called LPE (liquid phase epitaxial) method which uses lead oxide as flux material. In doing so lead is slightly included in the crystal as an impurity.

The total annual quantity of RIG used for optical isolators in the EU is specified to be 6.000 g. Starting from a typical Pb content of 0,3 to 1,0 % the total amount of Pb in this applications accounts for less then 100 g per year. According to the applicant in a dissolution test using Dutch serial batch test Pb has not been detected. It is thus not expected that there are traceable impacts on the environment when entering the waste stream.

#### 6.4.2 Summary of justification for exemption

The applicants justify their request for exemption with technical reasons:

- There are several solution growth techniques for RIG available but only LPE technique leads to RIG with all the specification required for optical isolator.
- The specifications for RIG will not be achieved using alternative lead-free flux materials.

Furthermore the applicants discuss the application of VCSEL (Vertical Cavity Surface Emitting Laser) for fibre optic communication system because this system can be used without optical isolator. However, the transmission distances are restricted at 1.300 nm to 20 km (compared to transmission distances of more than 40 km using DFB laser with optical isolator).

Data and information mentioned above was brought forward and presented by JEITA and Sumitomo in September 2005. Taking this level of information into account the Consultants recommended to grant this request for exemption.



In November 2005 the Consultant received first references of garnet Faraday rotators equivalent to those described in the request for exemption. According to the manufacturer of these products (Integrated Photonics, Inc.) all of the bismuth rare-earth iron garnet Faraday rotator products have been third party certified to be compliant to all RoHS requirements and, in particular, all have less than 1.000 wt. ppm of lead. On inquiry Integrated Photonics, Inc. provided further information covering amongst others

- Technical specifications of the products
- Third party certification of compliance to the requirements of the RoHS Directive

As this information differed considerably from data and information given by JEITA/Sumitomo, both parties were asked to give comments on each contributions of the other party.

Integrated Photonics provided detailed information on test methods, product function and properties and market capabilities. Summarising all of the contributions and comments the Consultants conclude that RIG used for optical isolators compliant with the RoHS requirements are now available and thus changed its initial recommendation into the new recommendation not to grant an exemption on 21 June 2006.

Since more controversial information reached the Commission at the beginning of July 2006 the Consultant was asked to re-consider the newly brought forward arguments by all sides of industry (including the original applicant JEITA/ Sumitomo as well as Integrated Photonics and other stakeholders).

After having cross-checked the available documents the following conclusion can be drawn:

- This exemption requests does not represent an application which has a significant environmental impact. The lead content in the RIG Faraday rotator is very low and the probability that it will enter the environment is very low too. Thus, this exemption requests rather relates to the question of the rapidity of technological innovation in a very complex supply chain.
- A standard test procedure in order to determine RoHs compliance of such an application as the use of RIG Faraday rotators in optical isolators does not seem to exist. Hence, RoHS compliance is difficult to prove. Integrated Photonics has delivered third party certification of RoHS compliance. The original applicant has stated to have found lead above the 1.000 ppm Pb threshold in test material from Integrated Photonics (whereas it Is not clear how big the sample was and how many items were found not be RoHS compliant according to the applicant's test). Hence in this case no objective evaluation can take place. In view of the further evaluation a decision had to be taken: it was assumed that the RIG Faraday rotators produced by Integrated Photonics are RoHS compliant since they were tested by a third party laboratory including a description of the test procedure. Furthermore Integrated Photonics



declared to have shipped RoHS compliant products for some time already accepted as such by customers.

- Some of the comments received from industry do not refer to what was originally dealt with: the original request refers to lead impurities in RIG Faraday rotators<sup>1</sup>. The evaluation according to Article 5 (1) (b) thus has to analyse whether a lead-free alternative is scientifically and technically practicable. Arguments stating that long test procedures are needed until an optical isolator containing a RoHS compliant Faraday rotator can be regarded as reliable for the use in fibre optic communication systems<sup>2</sup> are not valid since they deal with subsequent problems in the supply chain and not with the Faraday rotator itself for which an exemption was requested.
- Nevertheless, it is indeed so that there might be problems at the end of the supply chain (i.e. manufacturers of optic fibre telecommunication systems) in being RoHS compliant. However, this question is not part of this evaluation and these problems are not related to whether a RoHS compliant RIG Faraday rotator can be put on the market or not. Concerning supply chain problems it would have to be evaluated why the manufacturers of fibre optic communication systems could not use RoHS compliant components on time for 1 July 2006 and why no such components are available from their suppliers<sup>3</sup>.
- There are arguments brought forward on lacking ability to cover market demand with RoHS compliant RIG Faraday rotators. This argumentation is not covered by the criteria in Article 5 (1) (b). When applying the article in a narrow sense, nothing is mentioned concerning market or supply chain availability<sup>4</sup>. Furthermore, Integrated Photonics has used comprehensive arguments that (at least European) market demand could be satisfied when corresponding purchase orders have been placed. The evaluation thus concluded that there is no valid argument in line with Article 5 (1) (b) justifying the need for an exemption<sup>5</sup>.
- Applying Article 5 (1) (b) the Consultant concluded that no justification is given to grant the requested exemption. Going beyond the criteria mentioned in Article 5 (1) (b) though, more investigation would be needed to evaluate fully whether the use of RoHS

<sup>&</sup>lt;sup>1</sup> And not to other kinds of Faraday rotators like e.g. YIG Faraday rotators.

<sup>&</sup>lt;sup>2</sup> A RIG Faraday rotator is used in optical isolators which undergo certain test procedures in order to be reliably used in passive optical components which are themselves part of fibre optic communications systems.

<sup>&</sup>lt;sup>3</sup> Since in this case there is contradictory information on the availability and reliability of those components.

<sup>&</sup>lt;sup>4</sup> A lot of controversial arguments are being used by both Integrated Photonics and other industry stakeholders.

<sup>&</sup>lt;sup>5</sup> Nevertheless market availability can also be considered as an argument in line with Article 5 (1) (b) when rather interpreted as technical impracticability. This is a question of interpretation. In this case is was concluded that market availability does not affect technical impracticability.



compliant RIG Faraday rotators is feasible with regard to supply chain problems and to reliability in communication systems.

#### 6.4.3 Final recommendation (update 05/07/06)

Against the background and regarding the criteria given in Article 5 (1) (b) there is no reason to grant this exemption request. Taking into account that the environmental impact of granting or not granting the exemption request is negligible the question behind any decision is more about competitiveness and innovation on the market.

# 6.5 Add-on to report 7 section 5.3 – "Lead alloys as electrical/mechanical solder for transducers used in high-powered professional and commercial loudspeakers" – Meyer Sound (set 2 request no. 16)

Clarification concerning the wording:

The term "several hours" was introduced to make a distinction between continuously operating loudspeaker systems (concert halls etc.) and e.g. emergency loudspeakers (as for this field of application no exemption was requested and seems not to be justified as the continuous operation - in conjunction with the high Sound Pressure Level (SPL) - is the critical point, which stresses the joints extremely).

However, such emergency loudspeaker cases at these SPL seem to be of a very minor market relevance (no data available for this market segment, but much more likely to be part of fixed installations anyhow). Unfortunately, there is no clear threshold value to define where "several hours" begins (we are not aware of any such investigations to figure out such a threshold value and the applicant with his products is obviously well beyond such threshold values anyway). From our understanding of the technology, 2 hours might be an appropriate duration, but even in this case it has to be noted, that the sound system in almost all cases does not work continuously at 125 dB and above, as there are usually breaks (between individual songs and variations within a piece of music). Therefore, also the term "...operating for at least two hours at acoustic power levels..." still would leave a grey area (CONTINUOUSLY operating above this level? Which in practice most likely never will be the case; or: IN TOTAL (adding up the times above 125 dB) operating above this level? Which would need a standardised test procedure). Deleting the term "several hours" would make the scope of the exemption much clearer, but might lead to a slightly broader scope indeed (but see also the fixed installation argument above). The term SPL (sound pressure level) is a well introduced and defined term and part of product specifications (as well as of product marketing) - therefore, SPL needs no further explanation / definition.



# 6.6 Continued use of tin-lead solder in the manufacturing of professional audio equipment until such time as it is practicable to convert to lead-free solder - Lectrosonics (request set 3 No. 8)

#### 6.6.1 Description of the requested exemption

The US-based company Lectrosonics applies for an exemption for the use of lead in solders of professional audio equipment. It is used in SnPb37 and SnPb40 solders with 37 % or 40 % of lead respectively. This solder is used to attach semiconductors and ICs to the printed wiring board in the assembly and soldering process in manufacturing of professional audio equipment. The applicant proposes the following wording for the exemption:

Continued use of tin-lead solder in the manufacturing of professional audio equipment until such time as it is practicable to convert to lead-free solder.

This solder is critical to the reliable operation of the equipment. It must withstand a wide range of operation temperatures, rough handling and physical shock as is common in the environments where they are normally used.

The total amount of lead involved in Lectrosonics' products currently is around 300 g per year in Europe. New products will increase this amount to around 1.700 g of lead in the applicant's products shipped into Europe.

The products include radio microphone and audio transmission equipment used in field, and audio signal processing equipment used in fixed installations. They serve specialized professional customers such as national television networks and broadcasters, commercial sound system installations in fixed locations such as governmental meeting rooms, corporate boardrooms and schools. They are also used in location television and outdoor motion picture production. The service life of the products reaches up to 20 years, often followed by another 10 years of service to a secondary user.

#### 6.6.2 Summary of justification for the exemption

#### Applicant's criteria for justification

The applicant estimates that his conversion to 100% RoHS compliant parts, solders and processes will not be completed until early 2010. The investment in additional Surface Mounted Devices (SMD) production equipment must be made first. New staff must be hired and trained to operate the equipment, followed by the testing and re-design of well over 200 different circuit board assemblies. The resources needed to make the conversion are considerable.



#### Minor amounts of lead

The applicant bases his request on the very small quantity of lead contained in the solder, and the professional nature of the products and customers.

The total shipments and amount of lead contained in finished assemblies is only up to 1.700 g. The products are used strictly in professional and commercial markets and enjoy long service lives, commonly up to 20 years. When products are retired from the first users, they typically move to a secondary market, which further extends the service life. The applicant says that when a product is retired and taken out of service it will disposed in accordance with WEEE Directive, or returned to the factory in the USA for disposal in accordance with applicable recycling applications.

#### **Processing issues**

According to the applicant, lead-free solders require higher temperatures to affix the components to the circuit boards. Several key components in each product are not available in RoHS-compliant versions yet. These are highly specialised IC and custom made components unique to the design of Lectrosonics products. These components are not qualified for the high lead-free soldering temperatures. When higher temperature substitutes become available and the products can be manufactured with lead-free solders, a conversion to lead-free will take place.

When all general semiconductors are readily available in lead-free versions, research will begin to develop substitutes for the key components that currently prevent a conversion to lead-free assemblies. Research and testing will take place on substitute solders as soon as these components are qualified for the higher soldering temperatures applied in lead-free soldering. Until this time, it will be necessary to use lead-containing solders on the entire printed wiring board (PWB).

The application of lead-free and lead-containing solders on the PWBs is not practicable. It is economically not feasible to use RoHS compliant components and solders applied in a SMT reflow process, followed by RoHS non-compliant components and SnPb type solders applied by hand soldering. The circuit boards are very small and most of the components are 0,02 x 0,04 inches in size, placed very close together. The interim conversion to RoHS compliant solders requires the adaptation of existing surface mounted technology (SMT) production equipment. The cost of the adaptation and the new equipment is greater than what the sales volume into EU member countries can support.



#### Impossibility of timely product redesign

According to the applicant, samples of the components listed above have been received only within the last 30 to 60 days (status May 16, 2006). New circuit board layouts could not be completed without the actual components on hand.

The circuit boards are very small and most of the components are 0,02 x 0,04 inches in size, placed very close together. In the radio equipment, the placement of the component on the circuit board is often critical, which imposes further limitations on design options.

Existing inventories of parts remain, most of which must be used before it is economically feasible to convert to a new design that does not use these components.

#### Critical review of data and information given by the applicant or stakeholders

#### Minor amounts of lead

Art. 5 (1) (b) of the RoHS Directive does not indicate minor amounts of a banned substance in a product as a reason for an exemption. The applicant's argumentation that his products only contain a maximum of 1.700 g of lead per year in the EU is not covered by the RoHS Directive.

#### Custom made, single source and last time buy component issue

The applicant says that some of the components, which he uses, are not qualified for higher soldering temperatures in the lead-free soldering processes. He therefore needs to use lead-containing solders to attach these components to the PWBs.

Some of these components are not RoHS compliant either. However, the applicant's exemption request only refers to tin-lead solders to attach components on the PWBs, but does not include any components. During the critical review of this exemption request, it was learned that meanwhile most of the respective components are available in a RoHS compliant version. The applicant, however, wants to use up the last-time-buy (LTB) contingents of these components nevertheless.

The applicant was informed that his exemption request does not include any components and that, after consultation with the Commission, he will have to submit another exemption request if he wants to use non-RoHS compliant components or if he wants to use up all his LTB components before switching to RoHS compliant versions.

#### Processing issues

The applicant says that some components do not tolerate the higher soldering temperatures in lead-free soldering. Selective or hand soldering as the standard solution for this kind of problem, according to the applicant, is not a viable option. The low volume production, ranging from sometimes only one up to six units, and the high variety of products make it economically impracticable to install and to adapt the necessary special tools in particular for



smaller components, where hand soldering is difficult. The applicant cites  $0.02 \times 0.04$  inches components (around  $1,02 \text{ mm} \times 0,51 \text{ mm}$ ) as an example for such components which are difficult or impossible for manual soldering without particular tools that need to be installed. The applicant, however, based his request to use lead-containing solders on general and other semiconductors, which are not capable of withstanding the high soldering temperatures. Components of the 0402 type, however, are not semiconductors, but chip capacitors and chip resistors in most cases, which can be processed in lead-free soldering and which are available in RoHS-compliant versions. The technical argument against hand soldering or selective soldering of temperature sensitive components thus is not plausible.

As the applicant produces only 12 of his products out of around 200 PWB assemblies for the European market, he does not want to install a lead-free soldering SMT line unless all products can be shifted to lead-free versions. Switching the existing lines or one of the lines from conventional production to lead-free soldering production and back is not viable either, as the setup and preparation time is too long. The cost involved would exceed the volume of the European business. These arguments are plausible and understandable, but they are economic ones and thus are not in line with the criteria of Article 5 (1) (b) of the RoHS Directive.

The GML stakeholder comment (060209.39%20RoHS%20stakeholder.pdf) additionally maintains that the moisture sensitivity level is a problem in the context with lead-free soldering. However, this problem is either solved for components that are qualified for lead-free soldering or a prebake of components or hand and selective soldering of those components classically can solve the problem. The fact that lead-free soldering processes require a stricter process control is not an argument against lead-free soldering. Many other companies show that they are able to adapt and control the processes adequately.

The arguments are technically not justified or are economic ones and thus are not in line with the requirements of article 5 (1) (b).

#### 6.6.3 Final recommendation

The exemption cannot be recommended for acceptance in line with article 5 (1) (b).

The applicant on one hand bases his request on the minor amount of lead, which he uses in his application, only around 1.700 g per year. Article 5 (1) (b) does not indicate a minimum limit for any of the banned substances that would allow an exemption.

On the other hand, the applicant generally wants to use tin-lead solder because of the temperature sensitivity of some components. The applicant justifies his request with economical arguments against the installation of a further SMT line only for lead-free soldering of the products for the European market. These arguments are plausible and understandable, but they are not in line with the criteria of article 5 (1) (b) justifying an exemption.



According to the criteria for an exemption given in article 5 (1) (b), the requested exemption thus cannot be recommended for acceptation.

## 6.7 Corrigendum "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 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations."

In order to better assess the requested changes in wording following general remarks are made:

■ The amendment of entry 8 through Commission Decision 2005/747/EC in October 2005 has been perceived by industry as a change in scope of the exemption



described in that entry<sup>6</sup>. Indeed, the new added wording "Cadmium and its compounds in electrical contacts" enlarged the existing exemption to the use of cadmium in non-metallic form in any application where a current flow is (or might be) interrupted. These devices are generally called switches or switchgear; the term includes relays, circuit breakers, contactors, cut-off protectors etc.

- The European Commission has neither carried out a stakeholder consultation nor an evaluation concerning the first amendment of entry 8 in October 2005 since it felt that the change in the wording was merely a clarification of the scope of the exemption and an alignment to the earlier Directive 91/338/EEC.
- The fact that the exemption is already part of the Annex to the RoHS Directive makes the requests evaluated different from usual requests brought forward. I.e. due to the existing exemption there is no incentive for industry to become RoHS compliant and to phase-out cadmium in electrical contacts and in cadmium plating within the next 4 years.
- Should the existing exemption be amended before the regular revision of the Directive's Annex by 2010, a transition period seems to be appropriate, since industry needs to prepare compliance. The extent of such a transition period is still to be determined.
- In general it has to be thought of a procedure in case a stakeholder comes up with an existing alternative or substitution possibility available on the market regarding an existing exemption within the 4 year period of the Annex' validity.
- The requested changes in wording are brought forward and commented by (i) suppliers of alternative materials to cadmium, (ii) suppliers of switches and relays using AgCdO as contact material and by (iii) suppliers of one-shot operation thermo fuses.

In the following sections the two proposed amendments to this wording will be discussed. This will include the results of an expert meeting that took place in Hanau, Germany on 3 May 2006. During this meeting both requests were discussed among applicants and stakeholders having commented on these requests in order to get a better understanding on the technical issues.

a surface coating / deposit of – in this case – metallic cadmium.

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<sup>&</sup>lt;sup>6</sup> Cadmium and its compounds in electrical contacts usually mean the use of AgCdO being an alloy / composite of non-metallic cadmium. This composite is prepared separately and attached to the support by mechanical or other means. "Compound" implies that it is homogeneous throughout the contact material. Cadmium plating as defined in Directive 91/338/EEC does thus not include the use of cadmium in such an alloy. Plating is only



# 6.7.1 Cd in electrical contacts – UMICORE (set 3 request no. 15)

The applicant requests a change in wording of the existing exemption on Cd in electrical contacts and platings (see list above). Being a supplier of cadmium-free contact materials, the applicant would like to have the existing wording amended in such a way that marketing of alternative materials is not hindered anymore.

# Summary of justification for exemption

The applicant justifies his exemption request according to the following technical and environmental arguments:

- For the contact material silver cadmium oxide (AgCdO) used in electrical contacts alternatives exist for all applications. The usual alternatives being silver nickel (AgNi) for low current and silver tin oxide (AgSnO) for higher current applications. Some changes might be necessary in the construction of the equipment.
- A general exemption of AgCdO in electrical contacts is rejected since according to the applicant AgCdO has been replaced in the majority of applications in Europe. Thus a general exemption for AgCdO in electrical contacts would be a significant competitive disadvantage for the majority of European manufacturers of E&E equipment having replaced AgCdO by cadmium-free materials.
- A clear signal within the Directive that the overall goal of substituting cadmium-containing materials in E&E equipment is not weakened by a general exemption for cadmium in electrical contacts is wished. Furthermore the applicant does not want the overall cadmium ban set by Directive 91/338/EEC<sup>7</sup> to be weakened either.

A critical review of the documents made available by other parties lead to the following observations and conclusions:

According to stakeholders electrical switches and automatic controls contain contact materials that need to have inter alia excellent electrical conductivity, durability and stability against welding. In particular those where the contact is used as the last step in the safety chain and no further mechanism is present to prevent fire hazards or electrical shocks to consumers (safety devices). Furthermore standards need to be met that require certain performance and endurance (e.g. some 10.000 operations), restricted thermal behaviour and no dysfunction or malfunction.

<sup>&</sup>lt;sup>7</sup> Directive 91/338/EEC refers to restriction on marketing and use of cadmium in certain applications. Exempted from the provisions of the Directive are: (i) safety applications and (ii) "electrical contacts in any sector of use, on account of the reliability required of the apparatus on which they are installed".



- Stakeholders have commented that cadmium in electrical contacts are used in a large variety of applications and that it can thus not be specified which of these fall under the scope of RoHS and which of the applications would have problems using cadmium-free alternatives. This is due to the fact that manufacturers of these applications do not know in which kind of applications their products are used and retailed by the last user (i.e. manufacturer of e.g. an E&E equipment).
- Following statement issued by a switch and relay manufacturer during the expert meeting on 3 May as an example for such a statement: "The applications of our customers are widely unknown to us. This means that even if we supply a product to our customers which is in the data sheet properties equal or superior to the existing product with AgCdO contacts, it might fail in the application. This we consider as a big safety risk."
- Furthermore suppliers state that the loads used by their costumers in E&E equipment are widely spread: the load might be capacitive, inductive, resistive and the current can vary from a few mA up to the maximum current. This is one of the reasons why purchasers of switches and relays opt for AgCdO contact materials since these have proven to be long-term reliable in the past and satisfy safety requirements.
- The advantage of cadmium in electrical contacts is according to stakeholders to allow high current ratings (10 to 50 A), voltage of about 50 to 400 V, different electrical loads and ambient temperature above room temperature. Since requirements during life time of switches and relays are unknown or changing, there is no possibility to substitute AgCdO on a general basis (1:1 substitution).
- The only possibility seen by manufacturers of switches and relays is to substitute cadmium in electrical contacts used in applications with narrow load ranges or for unique appliances. Most manufacturers were not able to give details on such load ranges for which substitution is feasible. It was rather claimed that both substitution and non-substitution exist for all load ranges of switches. One manufacturer defined narrow load ranges as "contacts to be exposed to one type of electrical load only (either resistive or inductive or capacitive load)" or "current load values that vary less than factor 2".
- Examples of applications for which no substitutes could be found yet: microswitch,
   45 A 250 V ac motor load, 20,000 cycles in a customer's application; microswitch,



A 13,5 V dc inrush current up to 80 A 50,000 cycles; general-purpose switch<sup>8</sup>; motor protectors (air conditioning and refrigeration systems); safety devices with working temperatures in excess of 100°C.

- Most important unsolved problems with substitutes based on AgSnO and AgZnO are: need initial surface material erosion to develop positive oxide characteristics and exhibit segregation effects under specific conditions which may cause safety risks by welding<sup>9</sup>.
- All suppliers agree that substitution is technically feasible but that a transition period
  is needed until all reliability problems of substitutes can be solved. Transition periods
  have been stated between 6 month and 4 years.
- Since stakeholders having commented on the requested change of the exemption are suppliers of applications using cadmium in electrical contacts (i.e. switches and relays), their statement are made from a view at the beginning of the supply chain not being the ones that need to be RoHS compliant in the first place. The problem is thus that it is not known to the consultants what difficulties such a user of switches and relays has with cadmium-free contact materials. Nothing has been reported from this user side since the exemption in force does not encourage public reactions on pros and cons of cadmium-free contact materials used in E&E equipment.
- Conclusion: alternatives do exist for the use of AgCdO leading to good results in tests and trials. However, manufacturers of switches and relays do not know what (safety) requirements the end application has in which these alternatives would be used. Hence, a 1:1 substitution is not practicable. Substitution needs to be done in accordance to the requirements of the end product the switch and relay is used in. Since the variety of these applications seems to be huge, substitution can only be realised when a limited number of substitute materials have been found for AgCdO than can satisfy the large majority of product requirements.
- Under Directive 91/338/EEC cadmium in electrical contacts is exempted from the general ban due to safety reasons. A restriction of use under RoHS should thus clearly identify those applications which do not create a safety problem when using cadmium-free materials in electrical contacts depending on load characteristics.

<sup>9</sup> Welding is being seen as a particular important issue regarding safety devices. One stakeholder commented that welding is seen early in the life time with Cd-free contacts.

<sup>&</sup>lt;sup>8</sup> A general purpose switch is used in a wide variety of applications and can only be defined in opposition to a special use switch. The special use switch is designed to be used only in a designated equipment, e.g. TV, theatre, coffeemaker etc.



### Final recommendation

The situation concerning possible substitution of cadmium and its compounds in electrical contacts is complicated. A general exemption does not seem to be justified since alternative materials do exist and are already in use (position agreed by applicant and stakeholders). Nevertheless, withdrawing the existing exemption immediately is not practicable since it can not be excluded that some of the alternative materials can lead to safety risks in certain applications falling under RoHS if the substitution is made without careful prior evaluation and testing.

Both parties – applicant and stakeholders – agreed that a transition period is needed to phase-out cadmium in existing applications.

Stakeholders are being asked to give more details on technical specifications of applications of cadmium in electrical contacts that can already be substitutes by cadmium-free alternatives. The exemption could thus be narrowed to those applications not fulfilling these specifications. Unfortunately it appeared not be practicable to give sufficient details on technical specifications in order to narrow the existing exemption.

The final recommendation is thus to withdraw the current exemption for cadmium and its compounds in electrical contacts within the next three years <sup>10</sup>. In order to allow industry to adapt production and product design this change in the Annex would though have to be announced immediately. The amended wording – coming into force on 1 July 2009 – would allow manufacturers of E&E equipment who have problems in using cadmium-free electrical contacts to bring forward exemption requests that would be of more specific nature. I.e. exemptions can than be granted for the use of cadmium-containing switches and relays in specific applications (that would then needed to be specified!) falling under the scope of RoHS. Thus avoiding a general exemption, giving an incentive on substitution of cadmium in electrical contacts and at the same time taking account of certain specific cases in which substitution is technically not feasible.

The proposed wording taking account of request 15 is to split the current wording in two:

8. (a) Cadmium and its compounds in electrical contacts until 1 July 2009 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.

AND

Three years is a proposition by the consultants based on a request for a four year transition period from stakeholders and a two year transition period seen as acceptable by the applicant. The general message though is to set a clear time limit for the exemption of cadmium in electrical contacts and to withdraw this exemption latest during the revision of the Annex in 2010.



8. (b) 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.

For the final wording proposed for both exemption requests, please refer to the final recommendation in section 6.7.2).

# 6.7.2 Cd in one-shot operations – NEC/Schott (set 3 request no. 12)

The applicant requests an explicit withdrawal of one-shot thermal cut-offs from the existing exemption of the use of cadmium in electrical contacts. Mechanical one-shot thermal cut-offs are considered to fall under the wording "cadmium and its compounds in electrical contacts"<sup>11</sup>. The proposed wording being:

Cadmium and its compounds in electrical contacts **except for applications of one-shot operation function such as thermal links** and Cadmium plaiting 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.

### Different types of thermal cut-offs

There are two types of thermal cut-offs (TCO): mechanical/pellet/contact type and alloy/eutectic/non-contact type (see

below). According to the applicant NEC/Schott only the pellet type would fall under existing exemption, since only this one contains cadmium in a contact material. NEC/Schott produces both pellet and alloy type TCOs. The stakeholder Thermodisc only produces pellet type TCOs. One stakeholder, A.O.Smith, produces alloy type TCOs.

Alloy type TCOs contain both cadmium and lead. Should these be excluded from the current exemption then alloy type TCOs would need to fulfil RoHS compliance by 1 July 2006. Apparently there is insecurity as to whether alloy type TCOs are covered by the existing exemption. The question that needs to be addressed here is whether the cadmium contained in the fusible alloy can be described as either contact material or as cadmium plating. A previous request brought forward by the JBCE during the second stakeholder consultation, has been withdrawn by the applicant (please refer to third monthly report).

In the following it is assumed that it is only the pellet type TCO that is covered by the existing exemption in entry 8 of the RoHS Annex. Nevertheless, the Commission should clarify this question.

<sup>11</sup> There are also so-called eutectic one-shot thermal cut-offs. It needs to be clarified whether these would not fall under the wording "cadmium and its compounds in electrical contacts". Please also see section "Different types of thermal cut-offs".



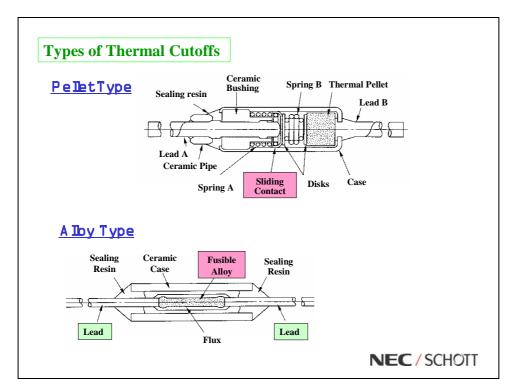


Figure 2: Different types of TCOs

### Summary of justification for exemption

The applicant justifies his exemption request according to the following technical and environmental arguments:

- NEC-Schott uses AgCuO as a substitute for AgCdO. This substitute has been registered as a patent. The applicant declares to be ready to discuss the use of this specific substitute according to common patent rules.
- According to the applicant competitors are also already putting cadmium-free mechanical one-shot thermal-cut-offs onto the market. Hence, substitution does not seem to be the problem for other market actors.
- All NEC-Schotts' customers have approved cadmium-free mechanical one-shot thermal-cut-offs. No claims have arisen until now and there is no knowledge on problems having appeared during use.
- Electrical properties as well as environment impacts such as temperature, vibration and humidity are not only of high relevance for the long-term reliability, durability and safety of AC voltage household appliances and customer electronics but even more in the field of DC voltage electric devices frequently applied in the automotive industry.



- Extensive testing, including accelerated life tests required by the automotive industry, have proven that the cadmium-free contacts are equal or even superior in performance to those containing cadmium.
- All relevant safety standards were approved (e.g. IEC safety standard). Customers (inter alia the automotive industry having very strict requirements) have done safety tests themselves that met the requirements.
- Cadmium-free mechanical one-shot thermal-cut-offs have been on the market since 2003. The market experience of those products thus being three years. RoHS relevant applications in which these cut-offs are used are e.g. home appliances, office equipment and electric components.
- The applicant delivered extensive evidence and data supporting the abovementioned statements.

A critical review of the documents made available by other parties lead to the following observations and conclusions:

- The issue does not seem to be RoHS compliant devices but rather long-term performance and field experience.
- RoHS compliant mechanical thermal cut-offs pass short-term standard (e.g. EN 60691) testing. Stakeholders though argue that from a customer perspective, short-term testing is not a substitute for long-term field experience.
- Other stakeholders argue that when putting an innovative (e.g. RoHS compliant) device on the market, they would market the device in a limited amount for a defined period of time (e.g. one year), see whether there are problems and claims and if not go into full marketing.
- Removing the exemption at this time would create confusion in the marketplace since customers opted not to change due to expected four year review of the Annex with existing exemption.
- Stakeholders arguing against a revision of the Annex before the four yearly review were not able to provide information on specific applications where substitution of cadmium is technically and scientifically impracticable and would thus justify an ongoing exemption.

#### Final recommendation

In this case the final recommendation is quite clear. The applicant has provided sound data and founded argumentation to support his request for withdrawing mechanical one-shot thermal cut-offs. It is therefore recommended to grant the request and thus limit the existing exemption to other applications of cadmium in electrical contacts. Because doing so immediately is not feasible since market actors need a transition period to switch to RoHS compliance it is proposed to allow a one year transition period.



The proposed new wording is thus (in line with the one proposed in section 6.7.1):

8. (a) Cadmium and its compounds in electrical contacts until 1 July 2009, except for mechanical pellet-type one-shot thermal cut-offs as from 1 July 2007 and 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.

### AND

- 8. (b) 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.
- 6.8 Lead in customer designed or single source integrated circuits (request set 2 No. 3) and in customer designed modular units (request set 2 No. 4) for use in professional broadcast equipment Thomson

The applicant had submitted two requests. They are evaluated together, as the applicant's argumentation line is almost identical for both requests.

### 6.8.1 Description of requested exemption

The applicant requests an exemption for lead used as constituent in finishes of application-specific custom designed or single source integrated circuits (ICs), and lead in *tin-lead solder* in custom designed modular units: power supplies, display modules less than 100 cm², non-standard connectors, in otherwise lead-free professional broadcast equipment.

The amount of lead involved in the ICs is around 1,4 kg worldwide and around 600 g in Europe. The amount of lead in the modular units is around 2,5 kg worldwide and less than 1 kg in Europe. The total amount of lead exempted would thus be around 4 kg worldwide, and less than 2 kg in Europe.



The wordings as proposed by the applicant in the original exemption request:

"Lead in tin-lead finish on leads (connecting elements) of custom designed or single source Integrated Circuits used in otherwise lead-free boards of professional broadcast equipment. The development of these ICs was completed before 19/8/05. The exemption is granted until 31/12/2009."

#### And

"Lead in tin-lead solder in custom designed modular units: power supplies, display modules less than 100 cm², non-standard connectors, in otherwise lead-free professional broadcast equipment. The development of these modular units was completed before 19/8/05. The exemption is granted until 31/12/2009."

The share of lead in these solders is around 40 %. The modular units comprise power supplies, display modules of less than 100 cm<sup>2</sup> size and either custom LCD or LED based, and non-standard connectors.

In both applications, the lead is a constituent of the tin-lead solder (~40% of Pb) and finishes. All these components and modules are used in professional broadcasting equipment like cameras and camcorder and accessories, routers and controllers etc. (see list attached in Annex II: Thomson product list).

### 6.8.2 Summary of justification for exemption

The applicant's arguments are complex. They are therefore summed up in different categories.

### Long product commercial life time

- Product development times can vary from 6 months to 3+ years, with an average of around 2 years.
- Once the physical product is in production, it is very common to continue development of new features by means of software enhancements for 5 10+ years. Example: Customers install professional TV broadcasting equipment with the expectation of being able to keep it in service for at least 10 and often up to 20 years. They also expect to be able to upgrade the system by means of new hardware or software for a large portion of the service life of the product.
- The re-design cycles of these products can last up to 5 years.



# Specific conditions of the supply chain

The majority of assemblies in products manufactured are lead-free, but a few modular components are not available lead-free. The manufacturer may use tin-lead for soldering components within these modular components. These modules must be purchased as a lifetime buy since there are no alternate manufacturers due to technology changes and low production volume. The only solution for the equipment integrator will be to redesign the system to replace the affected modular functions. The assemblies that include these modules will be otherwise totally lead-free (solder, finish, any). The modules will be added by hand using lead-free solder or other means of compliant connections. The modules themselves may include a small amount of Sn-Pb solder, typically 0,1 gram and no more than one gram. The display modules are typically custom designed LED segmented character displays or similar LCD units. Restarting the development with sub-contractors requires new tooling and set up of new production processes but is not viable due to the low volume of the production. The modules are customer specific and produced in small quantities, often in one production run. Some of the modules are no longer available after some years, making it impossible to shift them to lead-free versions. This forces users to buy big stocks at once for the supply of the coming years, and sometimes make a last-time-buy to sustain future production over the commercial product life time.

Products are sold in very low volume only, and few of the special ICs will be used: one or two in some of the boards. ICs are customer specific and produced in small quantities, often in one production run. Some of the ICs are no longer available after some years, making it impossible to shift them to lead-free versions. Users are forced to buy big stocks at once for the supply of the coming years, and sometimes make a last-time-buy to sustain future production over the commercial product life time. Over the year 2004, the applicant made a last order for the current generation of products that will provide continued supply of these components for the remaining commercial life of these products that should end by the end of 2007. Suppliers continue advising the applicant to make last order on additional components for which there is no technically viable replacement. The applicant has placed the last order by end of March 2006.

The redesign of non-compliant IC's suitable for use in a next generation product typically requires 24 – 36 months. Integration in a product typically requires 6 – 12 months after the availability of samples of the new IC. In 2003, the applicant started developing and initiate component classification for RoHS compliance. Many component manufacturers were not aware of the RoHS Directive and very few components were classified. Even in 2005, still manufacturers were encountered whose components are not compliant. In some cases lead-free components are not currently available, and until they are, prototyping or manufacturing is not possible. There are also components as referenced in this exemption request that will never be RoHS compliant so that this exemption is required. Fully RoHS compliant designs



are in process for the next generation of equipment due to be released within the next 2-4 years.

The applicant says that a major problem on the way to RoHS compliance has been that there was a lack of clarity in the directive. Until last year many component vendors (the applicant's suppliers) could not tell whether or not their parts were compliant or not, let alone announce plans for RoHS compliant replacement parts, or be able to provide sample parts to prove the transparency of these new parts when run through new lead free assembly processes. In other cases, manufacturers outside Europe were either not aware of the RoHS Directive, or misunderstood the requirements applying to their components. Once the requirements were clarified, the flow of information in the supply chain sped up significantly, but even today there are shortages of RoHS compliant parts to build fully compliant designs. For many of the applicant's suppliers the process has been extremely difficult, mainly due to the significant changes and verification required for each component.

# Legislative RoHS schedule versus long product life times

- There is a discrepancy between the way the RoHS legislation has been set and the long cycles of the specific professional products industries. By contrast, it's comparatively easy for consumer products using standard components in high volumes and having a commercial cycle of 6 to 12 months to manage their transition according to the timing imposed by RoHS, however it is quite unrealistic for special professional products.
- The discussions on important details of the RoHS Directive implementation made the situation difficult for a long-term business like the TV broadcasting equipment business.

# **Economic impacts**

- The existing resources for developing new products are inevitably limited and it's impossible to redesign all these products in a couple of years. This is even more critical considering the number of SMEs active in this field in EU.
- Re-design and re-engineering of the equipment just for RoHS compliance of these ICs is too expensive.

### **Environmental impacts**

- Discarding such ICs and modules will generate unnecessary waste as it will just happen sooner rather than later. It would generate more waste since a number of other components or assemblies involved in the same product will also be needed to be discarded.
- These types of very specific professional equipment are commonly offered for sale on the used equipment market after their first service life (often several times).



- Finally, at the product's end-of-life it will be taken-back under the WEEE Directive. At that time it will be carefully disassembled, ICs and valuable components are recovered, tested and reused or recycled. So, in the end, no RoHS controlled substances are expected to enter the environment as waste.
- Another environmental aspect of the case is the fact the alternate solutions for soldering are not exempt of environmental problems. Comparative Life Cycle Analysis are showing the environmental benefit of the standard alternate solutions (like Sn-Ag-Cu) is not always obvious. This further reduces the relative impact of the expected exemption. The recovery approach as described above is a much more effective measure.

# Critical review of justification and arguments (as given by the applicant or stakeholders)

The critical review of documents and further information has lead to the following observations and conclusions:

The applicant, manufacturer of professional broadcasting equipment, requests this exemption in order to

- be able to <u>repair</u> equipment put on the market before the RoHS deadline July 2006 AND equipment put on the market after the deadline July 2006, if the exemption is granted. The use of non-RoHS-compliant components for the repair of equipment put on the market before July 1, 2006, is already exempted. However, this is not the case for equipment put on the market after the deadline.
- be able to <u>upgrade</u> customers' <u>exitisting</u> equipment with new modules and functions as long as they want to use this equipment. This requires software and also hardware upgrades. If these upgrades are impossible, the equipment will have to be scrapped, or customers and in consequence the manufacturers will have severe disadvantages. The applicant says that
  - the low volume of specific components makes a RoHS-compliant component redesign impracticable for existing products.
  - the long-term product re-design cycles of up to 3 years, the long commercial life time of 5 to 10 years and more make re-design not viable in order to be in line with the RoHS deadline for implementation.

According to the Commission's FAQ document (<a href="http://europa.eu.int/comm/environment/waste/pdf/faq\_weee.pdf">http://europa.eu.int/comm/environment/waste/pdf/faq\_weee.pdf</a>), the upgrade, like the repair, of equipment put on the market before July 2006 is possible with components that are not RoHS compliant: "The use of non-RoHS compliant material in electrical and electronic equipment (EEE) products put on the market before 1 July 2006 for the purposes of capacity expansion and/or upgrade is allowed in principle



provided that the EEE is not put on the market as a new product. If after the capacity expansion and/or upgrade the EEE is put on the market as a new product it should comply with the RoHS directive. However, if after capacity expansion and/or upgrade the EEE is put on the market as a reused product, the ROHS Directive does not apply."

The requested exemption is therefore not relevant regarding upgrade of products put on the market before July 1, 2006.

It should be allowed to put <u>new</u> non-RoHS compliant products on the market after the deadline July 2006. The aplicant claims that he has to make long-time- and last-buy-orders and now wants to use up all these components in production until the next generation of re-designed equipment is available for the market. Additionally, products are designed for long commercial life times of 5 to 10 years and more. Being RoHS-compliant would thus interrupt the commercial life of products designed for these long commercial lifes. In this sense, compliance is not a problem for consumer electronics with short re-design cycles according to the applicant.

Technically, the ICs in the focus can be produced so that their material composition is in line with the equirements of the RoHS Directive. Some of the component suppliers do not want to change the existing components in order to be RoHS compliant, according to the applicant. On the other hand, the applicant says that the component and module suppliers would produce RoHS compliant components, if he himself or his suppliers had redesigned the components for a new product generation. RoHS compliance thus becomes a question of a timely re-design of the components and modules considered in the exemption request.

The applicant, like for any other producer of EEE, must be expected to align and coordinate his component and product redesign in order to be ready for the deadline 1 July 2006. Underlying limited staff capacities for the product redesign, redesign times of customer specific ICs of up to 36 months and integration times into the printed wiring board of up to 12 months, and the total redesign time of up to 48 months hampers achieving RoHS compliance of such components. In 2002, component manufacturers could not yet offer RoHS compliant components. So there is an issue of technical impracticability of RoHS compliance for such components. The applicant says that he could not start the redesign in time due to the limited availability of RoHS compliant components, the lack of clear transition deadlines of components to RoHS conform versions, and the lacking awareness of component manufacturers outside the EU. The applicant was asked to explain how his own design activities interact with the component manufacturers' and suppliers' offers and RoHS transition deadlines. The applicant, however, did not provide such information.

 The applicant claims that details of the RoHS Directive, in particular the definition of the threshold value for the banned substances, has only be inserted into the legislation in



August and October 2005 (2005/618/EC, 2005/717/EC and 2005/747/EC). He claims that before he did not have enough legal security in order to start the re-design of the customer specific or single source ICs. The applicant mentions the consumer electronics industry with its short product and redesign cycles, that makes it easy to comply with the RoHS Directive, in opposite to his own business conditions. However, it must be severely doubted that the consumer electronics industry would have been able to comply if they had started the redesign of their products or complex parts thereof in August 2005. The argument with this deadline is therefore not valid.

Meanwhile, the applicant himself has reduced the deadline for his exemption requests to the end of 2007.

# **Environmental Aspects**

- If the exemption is not granted, they become waste prematurely causing environmental burdens. The characteristics of the professional equipment business require last time buys (LTB). The applicant's environmental arguments are therefore reasonable. However, as the components can be produced in line with the requirements of the RoHS Directive, the environmental reason cannot be the base to recommend an exemption based on Article 5 (1) (b).
- The applicant says that this equipment will be taken back at end-of-life and will be disassembled, re-used and recycled. If this happens, it certainly reduces the environmental impact of lead. It must be stated, however, that the RoHS Directive does not allow an exemption just because the possible impact of the banned substances is mitigated, but clearly makes provisions for the substitution as long as the substitutes themselves do not cause more adverse impacts than the materials or technologies, which they substitute. A reduced environmental impact of the RoHS-banned substances thus does not justify an exemption under the criteria of Article 5 (1) (b) of the RoHS Directive as long as it is not clear that the substitutes do not cause more adverse impacts than using the banned substances.
- At the time when this report was finalised, the applicant had not yet submitted the required list of all components and modules, which he would like to have exempted. It is therefore proposed that the applicant sends this information directly to the Commission, in case the Commission follows the consultant's proposal that applicants should register and escrow the component lists and component manufacturer certifications at the Commission (cf. final recommendation for the request of AeA Set 3 No. 14 and general procedural aspects concerning LTB requests described in monthly report 8 section 5).



### Recommendation

Summing up all the applicant's arguments, Article 5 (1) (b) does not give a base for a recommendation to grant this exemption. The applicant's arguments are logistical and economic ones, which are not in line with the requirements of Article 5 (1) (b). All the components and modules, which the applicant wants to have exempted, technically can be produced in compliance with the requirements of the RoHS Directive.

However, this exemption request is a typical last-time-buy exemption request. The applicant produces professional broadcasting equipment with product life cycles of ten and more years, low volumes of products manufactured, product redesign cycles of more than 3 years with limited redesign capacities, in particular in the small and medium sized enterprises involved, and only around 4 kg of lead involved. The characteristics of this business inevitably comprise LTBs in order to maintain the production over the intended life time of the product. In case, the applicant's requested exemption will not be granted, his business activities are affected and the LTB components and modules will have to be scrapped.

As explained in report 8 chapter 5 (LTB issues), the consultants do not have the possibilities to go into details of the product re-design processes in order to evaluate whether the applicant and his suppliers could have redesigned the products in time and ordered new, RoHS compliant components and modules.

The applicant was asked to explain how his own design activities interact with the with the component manufacturers and suppliers offers and RoHS transition deadlines. The applicant, however, did not provide such information.

### 6.8.3 Final recommendation

Applying the criteria of Article 5 (1) (b) it is recommended not to grant an exemption. However, as a typical LTB exemption request, the request should be subject to the Commission's decision about the LTB issue.

In case the Commission will allow exemptions for LTB components and modules, the consultants recommend the following wording:

Lead used as constituent in finishes of application-specific custom designed or single source integrated circuits (ICs), and lead in tin-lead solder in custom designed modular units, namely power supplies, display modules less than 100 cm², non-standard connectors, in otherwise lead-free professional broadcast equipment until 31 December 2007,

### provided that

- such components and assemblies were purchased or are subject to a proven lasttime buy contract placed before 1 July 2006; and
- such components and assemblies are used in models of EEE that were already available on the market before 1 July 2006."



# 6.9 On-Semi MCR265-10 SCR – Helval Merca (request set 3 No. 1)

# 6.9.1 Requested exemption

Helvar Merca Ltd. (Kent, England) manufactures ballast and lighting control electronics for key specialists involved in the lighting and luminaire industry. Extensive use of power switching devices is necessary in their light dimming products. The applicant requests an exemption for the use of a specific semiconductor "ON-Semi MCR265-10 SCT". This power switching device is used specifically in the phase control output stages of professional light dimming products.

The leads and tab of its TO220 package are coated with a small quantity of 80%/20% Sn/Pb plating, used for making the interface between the component leads and the lead-free solder join to the circuit board. Helvar Merca estimates 6,225mg of lead in the lead/tab coating per device. Taking the estimated usage into account the resulting annual amounts of lead are as follows:

2006 : 30.000 devices (est. 187 grams lead)2007 : 20.000 devices (est. 125 grams lead)2008 : 10.000 devices (est. 62 grams lead)

The applicant was notified in 2001 that the MCR265-10 was being discontinued. As no reliable alternative was found a large last-time buy took place.

The applicant suggests the wording for the exemption as follows:

"Lead as tin-lead plating of the MCR265-10 SCR, a device capable of withstanding very high current surge conditions, used specifically in the phase control output stages of professional (*b*2*b*) light dimming products which employ MCB breaker protection."

The applicant does not provide a time-frame for his exemption but mentions that a re-design needs up to 3 years to completion.

The applicant himself considers his products to fall under category 5 "Other lighting or equipment for the purpose of spreading or controlling light" of the WEEE Directive.

# 6.9.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical, supply chain, consumer safety and environmental arguments:

Products tested with alternative devices proved to be un-reliable, resulting in devices failing and a resultant on-going loss of light. Tests done on the similar devices (On-Semi 2N6509, Motorola 2N6509, Teccor S8055R, Transys MCR265-010 and Crydom CYNB55-800) all resulted in device failure with permanent damage to the devices. The MCR265-10 SCR device is technically superior in its surge handling capability, other



SCR manufacturers do not seem to be able to supply a suitable equivalent in this package type.

- As the lighting control products are used by lighting specialists in business, commercial and public environments, including office buildings, shopping centres and ships, changing to a less robust device would affect the reliability of these products and increase the likelihood of extended lighting failures, with a possible potential impact on public safety.
- The devices are already on stock from a last-time buy in 2001, if they were to be scrapped they would generate unnecessary additional waste.
- The applicant supplied samples to Retronix Ltd to investigate if the plating could be effectively removed and replaced. The applicant was informed that it extends under the plastic body and is not removable.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- Although there are some product-specific aspects the argumentation used by the applicant is similar to the one used by all requests belonging to the group of last time buys (cf. section 5 monthly report 8).
- It is a fact that the LTB issue is relevant for a number of companies and that in some cases substitution is not technically feasible. It is also a fact that scrapping components that could be used in equipment represents an unnecessary environmental burden.
- The applicant has provided extensive and comprehensible information on the component to be exempted, the stockpiled amount, the lead content, the phase-out duration as well as supplier information of the obsolete components.
- Taking this into account it is a matter of particular interest when the applicant started efforts for re-design of his products. In this context the applicant states that in August 2005 an engineer to assist with RoHS was employed and that they are making good progress towards compliance of the product range.
- Therefore taking the time period needed for new design into account the applicant would have been able to be RoHS conform if he had started his efforts in 2003. Consequently the conditions necessary for granting an exemption are not fulfilled.

### 6.9.3 Final recommendation

With regard to the above mentioned arguments it is recommended not to grant an exemption since the applicant failed to start the re-design process of his devices on time. Granting an exemption taking into account this specific background could create confusion and lack of understanding of competitors who started their efforts for re-design earlier.



# 6.10 Surge Protective Devices – ZVEI / Phoenix Contact (request Set 3 No. 4)

# 6.10.1 Requested exemption

The ZVEI on behalf of Phoenix Contact requests an exemption for lead in solders within thermal fuses used in Surge Protective Devices (SPDs). Phoenix Contact is a manufacturer of SPDs purchasing thermofuses. The thermal fuse is needed to prevent overheating in case of overload (e.g. switch off the varistor<sup>12</sup> if the SPD is heated up). It also has to withstand lightning surge current.

SPDs are mostly used in buildings as part of a fixed installation and are therefore not covered by the RoHS Directive. Some electrical and electronic equipment might though include SPDs like e.g. PCs. The SPD is then part of the equipment and thus falls under the scope of RoHS. The exemption is requested for these RoHS relevant applications. The annual amount of lead used in such SPDs is estimated to be about 200g.

The applicant has not provided any clear wording for the requested exemption. The exemption is described by the applicant as being requested for surge protective devices with lead solder alloy for the use in personal computers, printers, scanners, hubs, switches and modems.

# 6.10.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical and supply chain arguments:

- Thermal fuses used in SPDs have switching temperatures of 110°C, 108°C and 98°C with a tolerance of +0K to -10K. The applicant has carried out two test trials with lead free fuses testing the lightning surge capability at an amperage of 10.000 A. Both trials resulted in failing strength durability fuses were destroyed at a surge of 10kA. The applicant states that this has nothing to do with the response time of the fuse. The results of these trials have been provided by the applicant.
- The development of a lead free fuse with sufficient surge capability is expected to take place within the next 1 ½ years (end of 2007). Therefore an exemption until 2008 is requested.
- The applicant has requested lead-free fuses for the use in SPDs from its suppliers for the first time in March 2004. A letter showing such evidence has been provided by the applicant. In that letter it is made clear that the applicant is planning to be producing lead free SPDs by January 2005 and is thus requesting suppliers to provide lead-free components in time. Nevertheless the applicant says to have only received the first

<sup>&</sup>lt;sup>12</sup> A varistor is a voltage dependent resistor.



lead free fuses in February 2006. These fuses did not pass the tests on lightning surge capability as described above.

- The applicant states that no fuse with a higher melting temperature (this is the case when lead-free thermal fuses are used) can be used since there is otherwise danger of fire within the SPD. The function of the thermal fuse is to disconnect the SPD from the mains as early as possible. After disconnection the components can cool down and a risk of fire does not exist anymore.
- Upon request the applicant has stated that lead-free SPDs are indeed available on the market but that they can only be used in SPDs for electricity distribution (not being the application for which an exemption is requested). The reason why they cannot be used for SPDs in PCs etc, is that they require large surfaces respectively cross-sections. These large surfaces are needed to ensure stability which itself is needed for deviation of lightning surges. The compact design of PCs etc. does not allow the use of such "big" SPDs.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- The applicant has provided comprehensive information on the above mentioned arguments. Though, there is no information given on the availability of lead-free substitutes fulfilling the technical requirements outside the applicant's supply chain. The only statement made is that "competitors worldwide will have the same problem".
- An internet research gave evidence on market availability of lead-free SPDs. But as described above the applicant could counter-argue as to why these cannot be used as SPDs in the applications for which an exemption is requested.
- The argumentation on not being able to use fuses with higher melting temperatures would though need to be further looked at since it is not fully comprehensible. This could not be achieved due to time constraints since the applicant could only make additional information available at a late stage in the review process. Further investigation would be needed to give a sound recommendation.

### 6.10.3 Final recommendation

No recommendation can be given at this stage applying Article 5 (1) (b) since it could not be clarified completely as to why the specific melting temperatures are needed for the use of the thermal fuse in SPDs.

Going beyond criteria of Article 5 (1) (b) an exemption seems to be justified as regards general environmental issues since the amount of lead involved is very small and since the period of the exemption is limited to the end of 2007. The wording proposed in this case is:

"Lead in solders used in thermal fuses within surge protective devices in or on PCs, printers, scanners, hubs, switches and modems until 31 December 2007."



# 6.11 Lead alloys as electrical/mechanical solder for transducers used in highpowered professional and commercial loudspeakers - HBL (request set 3 No. 6)

# 6.11.1 Description of requested exemption

The applicant is requesting an exemption for the rocking armature capsule, which is used for its commercial and professional fire and security sounders designed for high power applications (generally 100dB SPL and above), and other sound applications such as military headsets and in handsets as telecommunications transducers at voice frequencies, but much lower outputs.



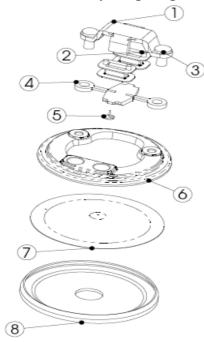
Figure 3: Rocking armature capsule and multi-tone sounder (source: HBL)

The unit is sold as a finished product and also used in fire alarm sounders. These parts have to comply with the EN54-3 standard. They are also used in other applications with an environmental test specification (see Env test 10595F.pdf). HBL thinks that this product falls under the category 3 (information and communication equipment) and 4 (consumer equipment) of the WEEE Directive, not into category 9 (monitoring equipment), which is currently outside the Directive.



The applicant uses Sn63Pb37 and Sn60Pb40 solder alloys with lead contents between 37 and 40% for joining together the 'con rod' and the 'double ended armature'.

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ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	818_lssue_T-1	YOKE AND MAGNET	1
2	40459_lssue_A	TRANSDUCER BOBBIN	2
3	40045_lssue_A-1	TERMINAL SCREW	2
4	40443_lssue_A-1	DOUBLE ENDED ARMATURE	1
5	40490_lssue_A	CONN ROD	1
6	40450_lssue_A-1	4T FRAME	1
7	40464_lssue_A-1	DIAPHRAGM	1
8	99-25_0069_lssue_A	FRONT COVER	1

Figure 4: Fire alarm sounder capsule with con rod (5) and double ended armature (4), which are joined together with lead-containing solder

The weight of the units varies due to type and due to the number of acoustic holes in the front cover, the terminals and back cover. The weight varies between 19.65 g and 33.8 g with the solder content for that joint being in the order of 0.015 g. This is a lead percentage of 0.02% of the total product weight. From the capsule with con rod drawing the applicant is not sure what would constitute a homogeneous part.

The applicant produces approximately some 350.000 capsules per annum. This would give a total annual lead use of some 2 to 3 kg worldwide in the applicant's products. With numbers relatively low and with long life cycles (that of buildings in the case of fire security sounders). The applicant does not give any indication on the total global amount of lead, which would be in use shoul the exemption be granted.

# 6.11.2 Summary of justification for the exemption

# Applicant's criteria for justification

Most professional or commercial transducers are designed to operate at high output levels in severe environments. At these high acoustic power levels, even though below 125db, the transducer's solder joints in the capsule are subjected to continuous mechanical and thermal stresses. These extreme stresses are often aggravated by the extreme temperature



environments to which fire and military use are frequently subjected. To the applicant's knowledge, lead-based alloys having less than 85% lead are the only proven solder alloys capable of withstanding the stresses produced in transducers used for high acoustic power applications. The units also have to meet the extreme environmental requirements of the EU standard EN54-3, which requires a durability of 100 hours at maximum volume, and the applicant's specification 10595F. In fire alarm situations, these are critical components to alert the public of a fire situation. When in operation, the diaphragm obviously vibrates at the specified frequency of between 500-3.800 Hz. The armature drives this diaphragm through the con rod to produce the diapragm vibration. Due to the construction of the product, there is very little access to the solder joint. The applicant says that he has tried numerous alternative lead free solders and glues but with all experienced failures on endurance testing, but due to the combination of the limited access and the required higher temperature, it was not possible to obtain a joint that will currently pass this 100 hour test.

Design changes in order to improve the accessibility of the solder joint, are not possible according to the applicant. The fundamental principle of operation relies on there being a firm but flexible joint created between the con rod (and diaphragm), and the armature. This is required to assist in the high efficiency of electro-acoustic conversion that the design produces. The exact motion of this joint is a complex 'figure of eight' movement, due to restraint of the diaphragm during oscillation, and the material used to clamp the con rod needs a combination of small plastic flow (that lead convey's] and mechanical bonding between the two parts, that the lead/tin alloy produces. Having just one property does not result in long life. Replacing Lead with any element or compound not having the plastic flow capability would result in much shorter life. The applicant has tried designs with the con rod integrated into the armature, and used cynoacrylate adhesive to secure the so formed con rod to the diaphragm, but the operating life was very short, a matters of a few hours, and the performance inconsistent during that time.

Funktion One Research Limited withdrew its exemption request (set 4, request 6) for the use of lead-tin solder in transducers for professional loudspeakers, which, among others, are used in loudspeakers of voice evacuation systems: "Funktion One has some track record built up of using lead free solder in our loudspeaker joints and so far we have seen very few failures." HBL says that the motion of speaker "tails" is much simpler than that described above, ie. it is linear, and that lead free solders may well 'work' for these applications.

The applicant says that he could not find an alternative. The negative environmental impacts from the use of lead do not outweigh the possible catastrophic effect of failure as an emergency device. The applicant nevertheless is currently looking for a substitute which will comply with the RoHS Directive.

With product numbers relatively low and with long life cycles (that of buildings in the case of fire security sounders), the total impact is small compared with toy or household use, according to the applicant.



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

The military use of the applicant's product is out of the scope of the RoHS Directive and thus does not require an exemption. The application of the sounders as parts of a smoke detector falls under category 9 of Annex I of the WEEE Directive (Monitoring and Control Instruments) and is currently exempted from the RoHS Directive. As pure emergency and alarm sounders and in handhelds, the applicant groups his products into category 3 (Information Technology) and 4 (Consumer Equipment).

The applicant's exemption request was reviewed assuming that the applicant's categorisation of his products is correct.

The applicant says that the sounders have to pass the EN54-3 standard requiring 100 h of sound at maximum volume of at least 100 dB (A). No lead-free solder alternative could be found so far that could pass this test. Design changes would negatively affect the sound efficiency of the product, which is crucial for the use in alarm equipment. The applicant's arguments are plausible and the applicant submitted all the necessary information upon the consultant's request. The applicant's arguments are in line with the requirements of Article 5 (1) (b).

The applicant wants to include into the exemption the loudspeakers used in handhelds etc., which do not have to comply with the EN54-3 standard, and which have sound pressure levels of far below 100 dB (A). The applicant could not prove that the substitution is technically not viable for loudspeakers that do not have to pass this test. The exemption must therefore be limited to the loudspeakers which have to pass this test. This part of the exemption request thus is not in line with Article 5 (1) (b).

There are no supporting or critical stakeholder documents available specifically on this topic.

The consultants made several efforts to obtain information from two other manufacturers on whether they can produce the sounders for which an exemption is requested in line with the requirements of the RoHS Directive. However, the consultants have not received any information. Due to time contraints and the consultant's mandate as by contract with the Commission, no further efforts could be undertaken to obtain such additional information.

The consultants' mandate is to review the exemption requests based on the information available from the applicant and stakeholders. The applicant has submitted all the requested information, and the consultants consider it plausible as to their best knowledge. It it therefore recommend granting an exemption with the following wording:

Lead in solders for transducers used in loudspeakers with sound pressure levels of 100 dB (A) and more for products that have to comply with the test requirements of the standard EN54-3.

Due to the short time period left between end of the stakeholder consultation and drafting of the final report, no further investigation could take place concerning this exemption request.



The consultants would like to annotate that a deeper investigation with other manufacturers of such sounders might have resulted in a different recommendation.

# 6.11.3 Final recommendation

With regard to the above mentioned arguments and based on the information available from the applicant, it is recommended granting an exemption with the following wording:

Lead in solders for transducers used in loudspeakers with sound pressure levels of 100 dB (A) and more for products that have to suffice the test requirements of the standard EN54-3

It can though not be excluded that an additional round of questions to other manufacturers would be necessary to further verify the justification given by the applicant. The time span necessary for this exceeds duration of the contract. Other manufacturers have been contacted but no reaction has been received.

The exemption request was recommended for acceptance in line with the consultant's mandate to review the exemption requests based on the information provided by the applicants and stakeholders.

# 6.12 Solder containing lead for applications where the local temperature exceeds 150 °C and reliable operation for a minimum of 30.000 hours is required – ASCO (request set 3 No. 7)

# 6.12.1 Description of requested exemption

ASCO manufactures solenoid valves for fluid control. Depending on the specific application requirements, the electrical coil operating these valves may have a Class F (155 °C), Class H (180 °C) or Class N (200 °C) insulation system. As required by Underwriters Laboratories, the coil must have a minimum thermal life of 30.000 hours at its class temperature.

Lead based solder is used to make the electrical connection between the magnet wire of the coil winding and the end termination means (flying leads, spade terminals, pin connector etc.).

Table 5: Types and quantities of solders used in different coils

Coil Class	F	H & N
Solder Type	60 Sn/40 Pb	PbAg1,5Sn1
Quantity of solder per coil [g]	0,04g	0,04g
% Lead by weight	40	97,5
Annual quantity of solder used [kg]	20	12
Annual quantity of lead used at ASCO	16	11,7
[kg]		



As the RoHS Directive already exempts the H & N class solder PbSn1Ag1,5, the requested exemption only covers the SnPb40 solder resulting in about 16 kg of total lead use per year. Around 4 kg would enter the European Union every year. The applicant says that he is not aware of the manufacturing techniques of other solenoid manufacturers and thus does not know how much additional use of lead the exemption might cause. In case the exemption is not granted, the use of lead would increase from around 16 to around 20 kg.

The next figure shows the coils, in which this solder is used.



Figure 5: Examples of typical ASCO solenoid valve coils. An encapsulation with a thermosetting epoxy or thermoplastic permanently seals leaded solder beads

Typical ASCO customers are in the petrochemical, medical/analytical, process and the automobile industries. ASCO valves are electro-mechanical components, not end items. As a part of a product, there will be cases where a solenoid valve is part of an OEM customer's product, which is within the scope of the RoHS Directive, e. g. in refrigerators and freezers, heaters, welding tools, dispenser (ice, beverage, coffee), printers, bathroom flushers, restaurant steamers, cookers etc. such as a household appliance (category 1) or a dispenser (category 10). In these cases, the OEM require the solenoid valve to be RoHS compliant.

ASCO says that it has a long history (> 100 years) of reliability for its coils manufactured with lead-based solders. Any alternate would have unknown reliability, equating to possible coil failure and subsequent potential risk to people's safety.

The applicant proposes the following wording for his exemption:



Solder connections containing 40% lead for solenoid coil terminations where the local temperature exceeds 150°C and reliable operation for a minimum of 30.000 hours is required. The solder connection is sealed by means of being encapsulated with a thermosetting epoxy or thermoplastic.

# 6.12.2 Summary of justification for the exemption

# Applicant's criteria for justification

# Reliability Concerns

Underwriters Laboratories (UL) requires, according to standard 1446 "Systems of Coil Insulation, General", that the coil must have a thermal life of 30.000 hours (around 3.5 years) at its class temperature (pertinent section 11.5 of UL 1446).

Although lead free solders do exist, the applicant says that he has no information regarding the reliability of such substitutes. Additionally, the use of a non-solder-based method (i.e. welding) for making the electrical connection does not readily lend itself to ASCO's current coil manufacturing process.

### Use of RoHS-exempted Solder with High Lead Content

The applicant would use the currently used H&N class PbAg1,5Sn1 solder with 97,5 % of lead content, which is exempted from the ban of lead in the RoHS Directive, as a substitute for the SnPb40 solder in the F class products as well, in case the Commission does not grant the requested exemption. This would increase the annual use of lead from nowadays 16 to around 26 kg of lead per year in this application.

The class F applications have been using the SnPb40 type solders due to ease of workability compared to PbAg1,5Sn1. The PbAgSn solder, with very few exceptions, could be used as a drop in replacement for the SnPb40 solder without changing the design of the product. The applicant also says that he has already qualified and obtained agency approval (Underwriter Laboratories) of both leaded soldering methods.

### **Economic Arguments**

The time required for ASCO to obtain Underwriter Laboratories (UL) approval of a lead-free alternate solder could exceed one year, with an estimated cost of \$50,000, and would adversely affect ASCO's ability to continue to provide products to the marketplace. Similarly, the capital expense required to implement a non-solder-based connection method (i.e. welding) could exceed \$250.000 and could not easily be amortised over the quantity of coils sold without adversely affecting selling price.



### **Environmental Arguments**

The lead-based solder in coils used in ASCO products is hermetically sealed as a result of the entire winding and winding/end connection means being encapsulated with a thermosetting epoxy or thermoplastic. The encapsulation prevents future exposure of the lead-based solder contained therein.

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

The applicant thus does not have any evidence that the use of lead-free solders or other solutions are technically or scientifically impracticable according to Article 5 (1) (b). He says that he has no information available. As an US company, ASCO was not fully aware of the EU RoHS Directive or any of its specific impacts until some time in the year 2005. The company did not track legislation in Europe.

According to the applicant, the official qualification of lead-free solders for the use in the solenoid valves is expensive, as well as the technical implementation of an alternative, lead-free interconnection technology. These economic arguments are not in line with the requirements of article 5 (1) (b) for an exemption.

The applicant says that he will use the exempted PbAg1,5Sn1 solder as a substitute for the SnPb40 solder, which would increase the amount of lead in the product. The applicant has already received the official approval of this soldering technique and the solenoids valves. With very few exceptions, he can use this solder without any design changes in his product. He can thus apply this solder without much additional expenses. This environmental reason could be an argument to allow the exemption. In this context, however, it would be useful to know how other manufacturers produce such coils for solenoid valves.

Despite of several efforts, the consultants could not obtain clear confirmation from other solenoid and solenoid valve manufacturers how they produce class F solenoid coils or valves. There are neither any other similar exemption requests, nor any stakeholder documents supporting or criticising the applicant's request. Due to the short time period left between the end of the stakeholder consultation and the drafting of the final report, no further investigation could take place concerning this exemption request. It was nevertheless tried to obtain information about products from other manufacturers. A decision will be taken on the grounds of the available documentation.

The applicant did not submit any evidence that lead-free solders are technically impracticable substitutes. This would not allow a recommendation to grant the exemption in line with Article 5 (1) (b). However, the applicant in this case will use a RoHS-exempted lead-silver-tin solder with more than 85 % of lead, which even increases the use of lead. The consultants assume that other manufacturers already did or will do the same. The exemption of tin-lead solder



with 40 % of lead would thus decrease the lead consumption, in the applicant's case from 26 to 16 kg per year.

For environmental reasons, the consultants therefore recommend to grant the exemption with the following wording:

Lead in solders with a content of lead up to 40 % for solenoid coils where the temperature exceeds 150 °C and reliable operation for a minimum of 30.000 hours is required for the electrical connection between the magnet wire of the coil winding and the end termination means in solenoid valves.

Given the unclear situation on which RoHS compliant solutions other manufacturers might have introduced, a limitation of this exemption should in principle be considered. However, as long as the RoHS Directive allows the use of PbSn alloys with more than 85 % of lead, it is not useful to set a time limit for the exemption. Regardless of any alternative solutions of other manufacturers, the option to use the exempted lead-tin type solders always remains open. For environmental reasons, the consultants therefore decided not to set a time limit.

### 6.12.3 Final recommendation

The consultants recommend granting the exemption with the following wording:

Lead in solders with a content of lead up to 40 % for solenoid coils where the temperature exceeds 150 °C and reliable operation for a minimum of 30.000 hours is required for the electrical connection between the magnet wire of the coil winding and the end termination means in solenoid valves

The RoHS Directive already contains an exemption for the use of lead in high melting temperature type solders (i.e. tin-lead solder alloys containing more than 85 % lead) in entry 7 of the Directive's Annex.

The applicant did not provide evidence that lead-free solders are a technically impracticable substitute. However, the use of the exempted lead-tin solder containing more than 85 % lead is an option for manufacturers. The use of tin-lead solders with up to 40 % of lead is thus the environmental more sound solution, as long as the above exemption for lead-tin solder alloys with more than 85 % of lead exists.



# 6.13 Continued use of tin-lead solder in the manufacturing of professional audio equipment until such time as it is practicable to convert to lead-free solder - Lectrosonics (request set 3 No. 8)

# 6.13.1 Description of the requested exemption

The US-based company Lectrosonics applies for an exemption for the use of lead in solders of professional audio equipment. It is used in SnPb37 and SnPb40 solders with 37 % or 40 % of lead respectively. This solder is used to attach semiconductors and ICs to the printed wiring board in the assembly and soldering process in manufacturing of professional audio equipment. The applicant proposes the following wording for the exemption:

Continued use of tin-lead solder in the manufacturing of professional audio equipment until such time as it is practicable to convert to lead-free solder.

This solder is critical to the reliable operation of the equipment. It must withstand a wide range of operation temperatures, rough handling and physical shock as is common in the environments where they are normally used.

The total amount of lead involved in Lectrosonics' products currently is around 300 g per year in Europe. New products will increase this amount to around 1.700 g of lead in the applicant's products shipped into Europe.

The products include radio microphone and audio transmission equipment used in field, and audio signal processing equipment used in fixed installations. They serve specialized professional customers such as national television networks and broadcasters, commercial sound system installations in fixed locations such as governmental meeting rooms, corporate boardrooms and schools. They are also used in location television and outdoor motion picture production. The service life of the products reaches up to 20 years, often followed by another 10 years of service to a secondary user.

# 6.13.2 Summary of justification for the exemption

# Aplicant's criteria for justification

The applicant estimates that his conversion to 100% RoHS compliant parts, solders and processes will not be completed until early 2010. The investment in additional Surface Mounted Devices (SMD) production equipment must be made first. New staff must be hired and trained to operate the equipment, followed by the testing and re-design of well over 200 different circuit board assemblies. The resources needed to make the conversion are considerable.



### Minor amounts of lead

The applicant bases his request on the very small quantity of lead contained in the solder, and the professional nature of the products and customers.

The total shipments and amount of lead contained in finished assemblies is only up to 1.700 g. The products are used strictly in professional and commercial markets and enjoy long service lives, commonly up to 20 years. When products are retired from the first users, they typically move to a secondary market, which further extends the service life. The applicant says that when a product is retired and taken out of service it will disposed in accordance with WEEE Directive, or returned to the factory in the USA for disposal in accordance with applicable recycling applications.

### Processing issues

According to the applicant, lead-free solders require higher temperatures to affix the components to the circuit boards. Several key components in each product are not available in RoHS-compliant versions yet. These are highly specialised IC and custom made components unique to the design of Lectrosonics products. These components are not qualified for the high lead-free soldering temperatures. When higher temperature substitutes become available and the products can be manufactured with lead-free solders, a conversion to lead-free will take place.

When all general semiconductors are readily available in lead-free versions, research will begin to develop substitutes for the key components that currently prevent a conversion to lead-free assemblies. Research and testing will take place on substitute solders as soon as these components are qualified for the higher soldering temperatures applied in lead-free soldering. Until this time, it will be necessary to use lead-containing solders on the entire printed wiring board (PWB).

The application of lead-free and lead-containing solders on the PWBs is not practicable. It is economically not feasible to use RoHS compliant components and solders applied in a SMT reflow process, followed by RoHS non-compliant components and SnPb type solders applied by hand soldering. The circuit boards are very small and most of the components are  $0.02 \times 0.04$  inches in size, placed very close together. The interim conversion to RoHS compliant solders requires the adaptation of existing surface mounted technology (SMT) production equipment. The cost of the adaptation and the new equipment is greater than what the sales volume into EU member countries can support.



### Impossibility of timely product redesign

According to the applicant, samples of the components listed above have been received only within the last 30 to 60 days (status May 16, 2006). New circuit board layouts could not be completed without the actual components on hand.

The circuit boards are very small and most of the components are 0,02 x 0,04 inches in size, placed very close together. In the radio equipment, the placement of the component on the circuit board is often critical, which imposes further limitations on design options.

Existing inventories of parts remain, most of which must be used before it is economically feasible to convert to a new design that does not use these components.

### Critical review of data and information given by the applicant or stakeholders

# Minor amounts of lead

Art. 5 (1) (b) of the RoHS Directive does not indicate minor amounts of a banned substance in a product as a reason for an exemption. The applicant's argumentation that his products only contain a maximum of 1.700 g of lead per year in the EU is not covered by the RoHS Directive.

### Custom made, single source and last time buy component issue

The applicant says that some of the components, which he uses, are not qualified for higher soldering temperatures in the lead-free soldering processes. He therefore needs to use lead-containing solders to attach these components to the PWBs.

Some of these components are not RoHS compliant either. However, the applicant's exemption request only refers to tin-lead solders to attach components on the PWBs, but does not include any components. During the critical review of this exemption request, it was learned that meanwhile most of the respective components are available in a RoHS compliant version. The applicant, however, wants to use up the last-time-buy (LTB) contingents of these components nevertheless.

The applicant was informed that his exemption request does not include any components and that, after consultation with the Commission, he will have to submit another exemption request if he wants to use non-RoHS compliant components or if he wants to use up all his LTB components before switching to RoHS compliant versions.

### Processing issues

The applicant says that some components do not tolerate the higher soldering temperatures in lead-free soldering. Selective or hand soldering as the standard solution for this kind of problem, according to the applicant, is not a viable option. The low volume production, ranging from sometimes only one up to six units, and the high variety of products make it economically impracticable to install and to adapt the necessary special tools in particular for



smaller components, where hand soldering is difficult. The applicant cites 0.02 x 0.04 inches components (around 1,02 mm x 0,51 mm) as an example for such components which are difficult or impossible for manual soldering without particular tools that need to be installed. The applicant, however, based his request to use lead-containing solders on general and other semiconductors, which are not capable of withstanding the high soldering temperatures. Components of the 0402 type, however, are not semiconductors, but chip capacitors and chip resistors in most cases, which can be processed in lead-free soldering and which are available in RoHS-compliant versions. The technical argument against hand soldering or selective soldering of temperature sensitive components thus is not plausible.

As the applicant produces only 12 of his products out of around 200 PWB assemblies for the European market, he does not want to install a lead-free soldering SMT line unless all products can be shifted to lead-free versions. Switching the existing lines or one of the lines from conventional production to lead-free soldering production and back is not viable either, as the setup and preparation time is too long. The cost involved would exceed the volume of the European business. These arguments are plausible and understandable, but they are economic ones and thus are not in line with the criteria of Article 5 (1) (b) of the RoHS Directive.

The GML stakeholder comment (060209.39%20RoHS%20stakeholder.pdf) additionally maintains that the moisture sensitivity level is a problem in the context with lead-free soldering. However, this problem is either solved for components that are qualified for lead-free soldering, or a prebake of components or hand and selective soldering of those components classically can solve the problem. The fact that lead-free soldering processes require a stricter process control is not an argument against lead-free soldering. Many other companies show that they are able to adapt and control the processes adequately.

The arguments are technically not justified or are economic ones and thus are not in line with the requirements of article 5 (1) (b).

### 6.13.3 Final recommendation

The exemption cannot be recommended for acceptance in line with article 5 (1) (b).

The applicant on one hand bases his request on the minor amount of lead, which he uses in his application, only around 1.700 g per year. Article 5 (1) (b) does not indicate a minimum limit for any of the banned substances that would allow an exemption.

On the other hand, the applicant generally wants to use tin-lead solder because of the temperature sensitivity of some components. The applicant justifies his request with economical arguments against the installation of a further SMT line only for lead-free soldering of the products for the European market. These arguments are plausible and understandable, but they are not in line with the criteria of article 5 (1) (b) justifying an exemption.



According to the criteria for an exemption given in article 5 (1) (b), the requested exemption thus cannot be recommended for acceptation.

# 6.14 Specific modular units including tin-lead solder being used in special professional equipment – Avolites Ltd. (request set 3 No. 9)

# 6.14.1 Requested exemption

Avolites Ltd. (London) requests an exemption for specific modular units including tin-lead solder being used in special professional equipment. On inquiry the request could be narrowed and clarified as follows:

One unit is a video control card based on the chip Cirus Logic-GD5428. The specific purpose of this unit is to display numeric data on a CRT screen:

- The unit is based on ISA bus technology which is no longer standard in Personal Computers.
- Because of minimum order quantities Avolites ordered this unit in quantities of 2.000 upwards, which represents between 2 and 4 years usage.
- The circuit board uses lead-containing solder (Sn60Pb40).
- The applicant denominates 5 products for which the unit is used: Pearl 2004, Azur Touch, Azure 2004 Shadow and Sapphire 200 and 2004

A second unit is based upon a microcontroller ST9R50:

This part is not made in a compliant form by its manufacturers AT Thomson. Avolites has therefore made a last time buy from their suppliers.

Both units are used to meet specific functions of professional theatrical lighting equipment.

The applicant estimates the total amount of lead within these units to be less than 1 kg over a 3 year period.

The applicant proposes the wording for the exemption as follows:

"Electronic components and circuit boards manufactured before 1 July 2006 can be used in manufacturing provided that no new lead is introduced into the manufacturing process after that date."

In the case that this proposed wording will not be possible the applicant suggests the following tighter wording:

"The use of Cirrus Logic based ISA modules and ST Thomson ST9R50 microcontrollers can be used in the Avolites 2000 series consoles and ART 2000 dimming systems for a maximum period of 4 years following 1 July 2006 providing these components were manufactured before 1 July 2006."



### 6.14.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical, supply chain and environmental arguments:

- The argumentation used by the applicant is similar to the one used by all requests belonging to the group of last time buys (cf. section 5 monthly report 8).
- In this case one particularity lies within the difficulties with the software developed for the micro controller unit: The firmware running on the ST9R50 is written in assembler and not portable. The last redesign of this unit took over 40 weeks from initiation to full production and even then required field modifications.
- The requested time frame for exemption is justified to allow sufficient time for redesign of the products and to allow the use of components already manufactured which would otherwise simply be discarded – this would be against the environmental goals being part of the RoHS Directive's intention.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- The request belongs to the group of LTB requests. The problematic inherent to those requests as well as the general evaluation procedure is described in section 5 of monthly report 8.
- It is a fact that the LTB issue is relevant for a number of companies and that in some cases substitution is not technically feasible. It is also a fact that scrapping components that could be used in equipment represents an unnecessary environmental burden.
- The applicant has provided extensive and comprehensible information on the components to be exempted (he provided an exhaustive list), their stockpiled amount, the lead content and the phase-out duration (he provided a roadmap).
- However, the applicant himself states that he has been working towards RoHS compliance since May 2005.
- Therefore taking the time period needed for new design into account the applicant would have been able to be RoHS conform if he had started his efforts in 2003. Consequently the conditions necessary for granting an exemption are not fulfilled.

### 6.14.3 Final recommendation

With regard to the above mentioned arguments it is recommended not to grant an exemption since the applicant failed to start the re-design process of his devices on time. Granting an exemption taking into account this specific background could create confusion and lack of understanding of competitors who started their efforts for re-design earlier.



# 6.15 Lead in electronic vacuum tubes – KERP (request set 3 No. 10)

# 6.15.1 Requested exemption

KERP (Center of Excellence for Electronic Scrap Recycling and Sustainable Design) submitted this request on behalf of AKG Acoustic, Austria. KERP requests the exemption of lead in electronic vacuum tubes which are used in high end audio equipment e.g. microphones and amplifiers<sup>13</sup>. According to the applicant lead is used in sealing elements between the glass bulb and the socket as well as in platings within the bulb. Therefore the applicant regards this request for exemption related to the request for lead in incandescent lamps (request no. 1 set 2 - not evaluated within this evaluation work) for which an exemption has already been granted and published in a Commission Decision (2006/310/EC; item 16 of the RoHS Annex).

The total amount of lead in vacuum tubes used for microphones from AKG is calculated to be 0,1 kg maximum p.a. (relating to about 1.000 vacuum tubes). There are no data available representing the annual amount of lead in all vacuum tubes put on the market in the EU. An expert estimates the overall turnover in the EU being 1 Million electronic vacuum tubes.

The applicant uses two specific types of vacuum tubes:

- General Electric 6072A (or equivalent types)
   This tube is not produced any more but available on the market due to stocks.
- ECC 83 (or equivalent types)

This type is produced by several manufacturers but the quality differs considerably concerning sound characteristics and inherent noise. The applicant therefore has to select charges operating extensive tests.

The applicant proposes a broad wording for the exemption being "Lead in electronic vacuum tubes".

# 6.15.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

The applicant states that there are no vacuum tubes as substitutes known which are compliant to the requirements of the RoHS Directive. According to a specialist cited by the applicant the lead containing plating is indispensable to fix the remaining oxygen

Unlike other electronic products where vacuum tubes were substituted through semiconductors since about 1960.



- after setting up the vacuum. Against this background the lead containing deposit at the inner layer of the vacuum tube is regarded to be inevitable by the applicant.
- Furthermore a substitution at system level would not be possible. At the level of the distortion factor amplifier based on semiconductors create harmonics perceived as disturbing and unmusical. In contrast amplifier based on vacuum tubes leads to alienation interpreted by listeners as warm and natural. Even identical types of electronic vacuum tubes from different manufacturers differ in their sound characteristics. This effect is used to tune the amplifier especially in the field of amplifier for guitars.
- Against this background microphone amplifier based on vacuum tubes are preferred by professional sound studios as well as broadcasting stations. About two-thirds of all records of solo parts and instruments are made using microphones with amplifier on vacuum tube technology because of their performance characteristic.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- The applicant was not able to specify the types of vacuum tubes for which an exemption is requested. In order to prevent misunderstandings and misuse of a possible exemption it would be inevitable to define an exhaustive list of those types.
- Upon inquiry a leading sound engineer from a well known broadcasting station confirms the specific advantages of amplifier based on vacuum tubes compared to those based on semiconductors.
- In the U.S. as well as in the EU most types of vacuum tubes are not produced any more. Therefore, manufacturers are mainly using stocks for their production of amplifiers and microphones. Some experts regard new tubes coming e.g. from Russia to be technically not a viable alternative because of the "bad sound".

After reconciliation with manufacturers in Russia and Slovakia a leading retailer of electronic vacuum tubes could provide more detailed information:

- Inside of new produced tubes no RoHS relevant substances are used. In former days filament and pins were connected using lead-containing solder.
- Some manufacturers plate the pins with lead-containing solder to prevent oxidation, while other manufacturers use silver.
- For some types of tubes the outer glass bulb is made of lead-containing glass. The main reason for the use of this kind of glass is to reduce resonance effects ("microphonie"). Especially in the case of audio amplifier it is inevitable to reduce such effects.
- Some types of electronic vacuum tubes have not been produced for about 30 years, although there is a demand on the market which is supplied by specialised retailer using their substantial stocks. This is mainly the case for power amplifier tubes.



Besides the lead-containing glass these tubes contain lead in the solder of the pins. Due to the marginal demand and the existing stocks a new RoHS compliant production is unlikely to take place for economic reasons.

#### 6.15.3 Final recommendation

With regard to the above mentioned arguments the recommendation is twofold:

- Against the background that "lead in glass of cathode ray tubes, electronic components and fluorescent tubes" is already exempted from the requirements of the RoHS Directive (entry 5 of the Annex) there is no need for an additional exemption regarding tubes of new production.
- Some specific types of electronic vacuum tubes are not produced any more. Tubes available from stock are not only used for repair but even for production of new amplifiers in specific applications. There are comprehensible arguments that substitution at a system level (semiconductor based devices) will not be possible due to the specific characteristics of these amplifiers. Against this background it is recommended to grant an exemption for those specific types on stock.
- In order to avoid misuse and misunderstandings it is necessary to set up an exhaustive list of those types of electronic vacuum tubes which are not available from new production. However, the applicant could not provide this kind of list on time before the evaluation was closed. Therefore it is impossible to propose a wording for the recommended exemption at this point of time. Should the applicant be able to provide such a list to the European Commission, an exemption could be granted on that basis.

# 6.16 Lead in gas valves for domestic cooking appliances – SABAF (request set 3 No. 11)

#### 6.16.1 Requested exemption

The Italian company SABAF requests an exemption for lead used in aluminium alloys to a content of up to 1,5% for the use in gas valves for domestic cooking appliances. The lead containing aluminium alloy is used for the body and plug of the valve. According to the applicant the lead is necessary to avoid the presence of long scraps during the machining phase: "broken" scrap is created that does not interfere with machining.

Gas valves are usually produced with either brass or aluminium. Brass valves contain up to 4% Pb. The use of lead as copper alloy containing up to 4% Pb by weight is already exempted from the restrictions of use under the RoHS Directive (Item 6 Annex RoHS). The use of lead in aluminium alloys is also exempted for a lead content up to 0,4% Pb. The exemption is thus requested for a higher content of lead in aluminium alloys (up to 1,5%).



The amount of lead contained is of 0,24 g per valve and 3,84 t of lead in the annual European valve production.

The applicant has not provided an exact wording for the requested exemption.

# 6.16.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical, economic and environmental arguments:

- According to the applicant the issue is not about the technical feasibility of producing gas valves containing up to 0,4% Pb. The issue raised with this exemption request is whether market forces drive towards the use of valves containing high (brass) or low (aluminium) amount of lead (currently most of the gas valve manufacturers in the EU use brass instead of aluminium).
- The argument used is price-related: gas valves containing only up to 0,4% Pb cannot be machined and processed in the same cost-effective way as those containing up to 1,5% Pb: the applicant states that only aluminium alloy containing up to 1,5% Pb creates "broken" scrap that does not interfere with the machining and does not create skeins that remain stuck on multiple cutting edge machining tools. The use of aluminium alloy with up to 0,4% Pb leads to frequent maintenance operations (e.g. due to overheating and very high variation of the dimensional quotes of the machined components that can affect the safety of the finished product) and energy-costly separate operations to brake the scrap.
- This would lead to a price increase of aluminium-based gas valves (the price being 15% lower than the corresponding brass valve when using 1,5% lead in the aluminium), thus not being competitive comparing to brass valves which might lead to a higher use of brass valves in domestic cooking appliances (the cost of an aluminium valve would then be 10% higher than the one of a brass valve).
- The applicant also uses environmental arguments:
  - Due to the higher need for maintenance operations and the need for operations to brake the scrap (in order to make it usable in machining tools), an increased energy consumption is needed for the production of gas valves containing 0,4% Pb in comparison to those containing 1,5% Pb (this statement is not backed up). The higher energy demand would itself generate additional emissions of inter alia lead.
  - The market domination towards brass valves would lead to a higher annual amount of lead used in the EU (8 times more respectively 30 t).
  - The use of 1,5% Pb aluminium for the production of gas valves also has other environmental advantages in comparison to the use of brass valves: a 28% reduction of the energy used for the production of each valve and lower transport energy costs



- due to the much lower specific gravity of aluminium (this statement is not backed up by more detailed data).
- Furthermore it is stated that the use of complex machines needed to brake the scrap when using 0,4% Pb aluminium compared to 1,5% Pb aluminium machines that have to be added to the standard machines would outweigh the environmental benefits of the reduction of the lead content.
- It is also referred to the ELV Directive which has exempted the use of lead in aluminium alloys for machining purposes with a lead content up to 1,5% Pb until 1 July 2008.
- According to the applicant an exemption for the use of aluminium alloy with 1,5% Pb until 1 July 2008 will create the conditions to increase the use of aluminium for the gas valve manufacturing. It will also allow the aluminium alloy industry to develop the necessary technology to produce aluminium alloys with 0,4% lead content having the same machining characteristics than the 1,5% Pb aluminium alloy. It is stated that such alloys are not yet available on the market.

- Electrolux has brought forward the comment that it is indeed economically and technically feasible to use aluminium alloys with a lead content up 0,4 % for the production of gas valves for the use in domestic cooking appliances. The stakeholder has delivered comprehensive evidence on that fact.
- The applicant has replied to this comment with the statement that those gas valves are purchased from a supplier having a machining process with very little automation that does not permit to fully appreciate the cost advantages of machining aluminium alloys instead of brass alloys (this statement is not backed-up).
- Electrolux again has replied to that statement with the information that their supplier of RoHS compliant aluminium gas valves has indeed a high degree of automation. Extensive research had to be undertaken in order to adopt his production process and the machines in order to be able to produce taps and valves with the new RoHS compliant alloy still keeping the same quality levels and the same production rate. As a result the production of RoHS compliant taps and valves could be started in November 2005 with all the regular production being switched to the RoHS compliant alloy in January 2006.
- In consequence it has to be concluded that it is not technically or scientifically impracticable to use aluminium with a content of up to 0,4 % lead in gas valves for domestic cooking appliances.
- Nevertheless Article 5 (1) (b) also provides the case where the environmental benefits
  of not substituting a substance outweigh those of substitution. The applicant has



- provided data on such a situation with regard to aluminium gas valves. The data is though not well-documented and not fully comprehensible.
- The overall market issue raised by the applicant concerning competitiveness of aluminium gas valves in comparison to brass valves having a higher lead content is rather comprehensible. Nevertheless the available documentation does not allow concluding on a situation where it is foreseeable that there will possibly be a market dominance for brass based gas valves leading to a higher consumption of lead within domestic cooking appliances.
- According to studies commissioned by the European Commission on the use of heavy metals in vehicles<sup>14</sup> (as a basis for the elaboration of Annex II ELV Directive), lead is "basically an impurity element in aluminium alloys": in secondary aluminium a certain amount of lead can be contained involuntarily (e.g. originating from ELV scrap) and tolerated as such. When entering the waste stream and shredder processes, lead contained in aluminium will mostly end up in the non-ferrous heavy fraction (lead cannot be eliminated during the separation process). Keeping lead impurities in the secondary aluminium cycle as low as possible is a key interest of the aluminium industry, since otherwise dilution with cleaner aluminium fractions becomes necessary (leading to a higher demand in energy due to the use of clean scrap or even primary aluminium and also leading to poorer product quality which is an undesirable effect). A maximum content of 0,4% lead in aluminium has been reported as sufficiently safe in order to avoid enrichment in the secondary aluminium cycle.
- According to the same studies it is agreed that for machining purposes a higher amount of lead might be necessary during a certain phase-out period. This is why the newest version of Annex II ELV Directive contains an exemption for aluminium for machining purposes with a lead content up to 1,5% by weight until 1 July 2008. However, machining lead-free aluminium was described as being technically possible: one option being the renunciation of lead without using substitutes (far reaching changes in production process needed) and another option being the substitution of lead by bismuth or tin (whereby raw material costs for substitutes are higher than costs for lead). The studies concludes that "... the major environmental benefit will be in the stage of production of aluminium for machinery rather than during the recycling phase<sup>15</sup>".

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<sup>&</sup>lt;sup>14</sup> Cf. "Heavy metals in vehicles", final report, March 2000, Ökopol GmbH and "heavy metals in vehicles II", final report, July 2001, Ökopol GmbH

<sup>15</sup> I.e. the benefits gained through a reduction of the lead content in the production of aluminium for machining purposes outweigh efforts made to enhance the recycling process with a view to obtaining "cleaner" aluminium scrap.



The fact that the ELV Directive exempts the use of 1,5% Pb aluminium for machining purposes does not necessarily lead to a need of harmonisation with the RoHS Directive since supply chain of lead containing aluminium alloy for the automotive industry can be considered a separate one than the one for the production of gas valves for domestic cooking appliances.

#### 6.16.3 Final recommendation

Applying Article 5 (1) (b) in a narrow sense no justification is given for an exemption. Nevertheless the hints given on a possibly negative environmental effect of not granting the exemption are worth being considered in more depth. However, documentation on that aspect was not provided in sufficient depth and comprehensibility. Furthermore the fact that an alternative is technically feasible and that the presence of high aluminium content in the waste stream is not desirable, also take away further grounds for an exemption. It is thus recommended not to grant this exemption.

# 6.17 Lead in solders for refurbished gaming & amusement machines – BACTA (request set 3 No. 13)

### 6.17.1 Requested exemption

BACTA (British Association of pay-to-play leisure machines) has requested an exemption for the use of lead in solders being part of refurbished gaming / amusement machines within manufacturers' closed loop systems. Lead is used for the purpose of soldering components in the construction of printed circuit boards for the machines. Even though the Commission has stated in its FAQ document that capacity expansion and / or upgrade of EEE put on the market as a re-used product does not fall under the scope of RoHS, BACTA does not consider this as being legally binding and thus applies for a formal exemption.

The refurbished machines are put as such on the market: a customer returns a gaming / amusement machine ("donor machine") to the manufacturer for refurbishment. In return, the customer will receive a credit and will be obliged to purchase the refurbished machine containing components from its donor machine. Consequently these refurbished machines will contain components that were manufactured before 1 July 2006 and are not RoHS compliant (they contain lead).



This practice seems to be typical for the UK only and is not encountered in other European Member States where the commercial lifetime of equivalent equipment is longer and used equipment is rather directly sold onto the second hand market<sup>16</sup>.

It is estimated that approximately 15.000 refurbished gaming /amusement machines are supplied each year in the UK and that there will be approximately 820 kg of lead in total in those machines. Each refurbished machine will contain one set of electrical and electronic components with 55 g lead each.

The phase-out period for those components is estimated to last until 2014 since the maximum life time is eight years and the exemption request only refers to components / machines put on the market before 1 July 2006. The exemption is thus requested until 2014.

The proposed wording by the applicant is:

"Lead in solder in parts recovered from waste or used gaming / amusement machines returned from business customers, originally put on the market before 1 July 2006, and traceably re-used for the same purpose within the original manufacturer's closed loop refurbishment system until 1 July 2014."

This exemption request overlaps with exemption request no. 20 set 1 ("Lead in solder and hexavalent chromium in surface treatment, in parts recovered from production printers and copying equipment, sold, rented or leased or otherwise returned from professional users other than private households, originally put on the market before 1 July 2006, and reused for the same purpose within the original manufacturer's closed loop system until 1 July 2011").

# 6.17.2 Summary of justification for exemption

The applicant justifies his request for exemption with environmental arguments:

- There is no technically feasible process for removing the lead from the printed circuit boards without destroying the integrity and functionality of the boards.
- By re-using electrical and electronic components in refurbished machines the need to manufacture new components would be significantly reduced. Therefore, the consumption of raw materials, energy, greenhouse gas emissions and other emissions to air and water associated with the manufacture of new components would be avoided in the short to medium term.

<sup>16</sup> According to the applicant this is due to the unique volatility of the gaming / amusement machine market in the UK and the constant demand by players and customers for new games, which is not commonly reflected to the same extent in other Member States.

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- If an exemption is not granted, still functioning electrical and electronic components / parts of gaming / amusement machines will have to be discarded. It is estimated that this would lead to approximately 1.320 t of potentially fully functional components entering the waste stream prematurely. The negative environmental impact generated through this action outweighs the environmental benefit of using new RoHS compliant components in refurbished equipment. The total amount of lead entering the wastre stream remains the same.
- The non-RoHS compliant components are used in a closed-loop refurbishment process: customers actively record and track these numbered components in their donor machines in order to ensure that the same components are used in the refurbished machine that they buy back from the manufacturer. In some cases the customers tag the components in their donor machines. When donor machines are returned to the manufacturer they are stored separately in order that the components are not mixed with other donor machines.

- The applicant has provided comprehensible documentation on the closed loop system for refurbished gaming & amusement machines. Nevertheless, there is no third party certification for that very system since it is currently self-audited. An external audit has not been considered necessary because manufacturers claim to have a commercial interest in a properly managed refurbishment process.
- Such a closed-loop system is considered to be reliable since no additional hazardous substances enter the material flow but rather the point of time of the entrance into the waste stream takes place at a later stage.
- Re-using components is clearly a general goal of environmental policy. This is also why the Commission has expressed its view that a re-use of non RoHS compliant components is not considered to fall under the scope of RoHS as long as the products are not marketed as new products. This is clearly the case here. Forcing an early disposal of such components cannot be considered in line with general goals of environmental policy.
- The positive environmental effects of re-use are consensus on a general environmental policy level and therefore do not need to be further justified or proven.
- Nevertheless, a similar exemption request has been positively recommended (cf. request no. 20 set 1). The difference though was that the applicant of that request had provided data on third party certification of the closed loop system as well as data on the environmental impacts and benefits of both options (re-use versus new components).



The time span requested here is quite large (8 years). Since the amount of non-RoHS compliant components will be reduced over time, a shorter time span of 4 years until the RoHS Directive is revised is considered as being sufficient.

#### 6.17.3 Final recommendation

With a view to the above mentioned argumentation it is recommended to grant the exemption. An exemption limited in time and restricted to a closed-loop system seems to be appropriate for the specific situation in the UK gaming & amusement machines sector. The wording proposed is thus:

"Lead in solder in parts recovered from waste or used gaming / amusement machines returned from business customers, originally put on the market before 1 July 2006, and traceably re-used for the same purpose within the original manufacturer's closed loop refurbishment system until 1 July 2010."

# 6.18 Lead in solders in components / assemblies subject to last time buy – AeA (request set 3 No. 14)

## 6.18.1 Requested exemption

AeA has requested an exemption referred to as the "general LTB exemption request" since the request is of very general nature. It is not related to a specific application and / or the use of a substance in such a specific application but refers to a wide range of possible applications. The request concerns the use of lead in solders within components and assemblies that were subject to a so-called last time buy (LTB) before 1 July 2006. The lead is mostly found as very finish plating on the contact pins of LTB components. The components and assemblies covered by this exemption request have the following characteristics in common:

- They have been subject to an LTB order
- They are scheduled to be used in applications and products put on the market after 1 July 2006.
- They are used in non-consumer products belonging to category 3 of the WEEE Directive.
- According to the applicant they are intended for use in products that are produced in very low volumes with long design cycles (compared to consumer products)

Examples of products might include:

- Specialised business data processing equipment
- Professional recording equipment
- Broadcast equipment



- Professional production printers and copying equipment
- Enterprise telecommunications equipment

The amount of lead in solders within components and assemblies is estimated to be less than 100 kg over the whole phase-out period until 2010.

The wording proposed by the applicant is:

"Lead in solders in components and assemblies used in non-consumer-products, provided that

- such components and assemblies were purchased or are subject to a proven lasttime buy contract placed before 1 July 2006; and
- such components and assemblies are used in models of EEE that were already available on the market before 1 July 2006."

# 6.18.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical and environmental arguments:

- Components are used in products that themselves are relatively close to being discontinued.
- Only a small proportion of components used in non-consumer EEE is affected by LTB and with that proportion only a small amount contains RoHS substances.
- In general a LTB contract is only considered for products for professional use that have long product lives and long periods between product generations.
- A LTB has to be issued when e.g. a component supplier announces that it will discontinue production of an electronic component. The LTB is issued because there is no alternative supplier for the component and a re-design of the equipment using other components is not feasible. In that case the equipment manufacturer orders a sufficient quantity of that component to accommodate foreseeable future production. This is only performed in those cases where equipment is sold in low volumes, or a design is time critical or technically impracticable due to the complexity of the LTB component.
- A LTB is, however, rarely the preferred option since future sales are hard to predict and stocking components for long periods is both burdensome and expensive.
- Without an exemption granted companies would have to scrap existing inventories of non-compliant components. This leads to unnecessary waste having a possible strain on the recycling systems that are just getting ramped up and wasting valuable resources. The total amount of LTB components in stock is estimated to be 10 t. Furthermore companies may also have to scrap inventories of compliant components that had been intended for use in equipment containing LTB components leading to additional generation of waste.



- Products put on the market after 1 July 2006 and containing non-compliant LTB components will be managed in an environmentally safe manner and will be recycled according to the WEEE Directive (this being due to the fact that the request refers to b2b products).
- SMEs are particularly vulnerable and affected by the LTB issue since they are the ones producing highly specialised EEE in small quantities for niche markets for which LTB is relevant due to long product lives and long design cycles. Furthermore SMEs have less influence on their component supplier than large manufacturers. Additionally SMEs also do not have the resources to re-design existing applications.
- LTB is a horizontal issue affecting potentially thousands of applications. Thus not each LTB relevant application can be justified separately. There is an analogy to the existing exemption on servers (exemption no. 8) which is also a horizontal issue being exempted.

- A large analysis of the LTB issue as such has been provided in section 5 of monthly report 8. In that section it is described how the evaluation is taking place for requests referring to LTBs.
- This exemption request has lead to a comparably large amount of stakeholder comments (24 companies and 4 professional trade associations). These comments mostly refer to examples of specific applications. These examples cannot be considered in detail since the request is made in general terms. However, they support the general need for an exemption request regarding the LTB problematic.
- It is a fact that the LTB issue is relevant for a number of companies and that in some cases substitution is not technically feasible. It is also a fact that scrapping components that could be used in equipment represents an unnecessary environmental burden.
- Nevertheless, applying Article 5 (1) (b) in a narrow sense there is no in-line justification available regarding this request since no evidence was provided on
  - the amount of components on stock for specific applications,
  - the duration of design cycles,
  - the volume of produced equipment containing LTB components,
  - starting point of efforts towards RoHS compliance (including e.g. evidence on end of production by suppliers, proof that components are not available in RoHS compliant version, efforts for re-design) and point of time of the LTB order and
  - technical specifications of the component.
  - This data and information is, however, needed for a proper evaluation of a potential justification of a request.



- Furthermore the wording provided by the applicant does not contain the restriction to category 3 of the WEEE Directive (IT and telecommunications equipment. This would have to be added in case of an exemption. Additionally the second part of the wording ("provided that such components and assemblies are used in models of EEE that were already available on the market before 1 July 2006.") is not applicable since this relates to repair or re-use of components which is already excluded from the RoHS Directive.
- The analogy to the existing server exemption is not given, since that exemption does indeed refer to specific applications even though this is actually done in a rather general / horizontal manner.
- A general exemption can only be granted when going beyond criteria of Article 5 (1) (b). In that case it is more the general environmental policy goals that speak in favour of the exemption. Furthermore the fact that specially SMEs have to face economic and financial difficulties related to LTBs could also be considered when thinking of an exemption. Nevertheless certain conditions would have to be set in order to prevent misuse and in order to guarantee a certain control and monitoring:
  - As a minimum an exhaustive list of potential applications linked to the LTB issue would have to be provided to authorities and implementing bodies.
  - The exemption should clearly be limited over time in order to ensure a controlled phase-out.
  - Companies wanting to fall under such an exemption could be asked to register separately in order to allow a minimum overview on the consequences of the exemption and lower the possibility of misuse. Part of the registration could be a dossier giving evidence and details on substitution and re-design efforts as well as information provided by the suppliers at the time of the last time buy. The argument "substitution not technically feasible" is often brought forward. However, re-design is often considered as being too costly and it could be assumed that this is rather the motivation for claiming technical impracticability.

### 6.18.3 Final recommendation

With a view to the above mentioned argumentation it is recommended not to grant the exemption since the justification is not in line with Article 5 (1) (b) even though the argumentation used by the applicant is comprehensible. Nevertheless, referring to the proposed way forward described in section 5 of monthly report 8, it is recommended to consider a possible "general ruling" on LTB issues / requests. This could include a slightly changed wording and the points described concerning measures taken in order to narrow misuse as well as to avoid a too general exemption.

The proposed wording in that case is:



"Lead in solder in components and assemblies used in non-consumer-products belonging to category three Annex IA of Directive 2002/96/EC until 1 July 2010, provided that

- such components and assemblies are subject to a proven last-time buy contract placed before 1 July 2006; and
- companies wishing to make use of this exemption have been registered at the competent authority; and
- the applications for which this exemption should be valid have been listed to the European Commission."

# 6.19 Cadmium and cadmium oxide in thick film pastes used on beryllium oxide substrates until January 1, 2008 - Apex Microtechnology (request set 4 No. 1)

# 6.19.1 Description of requested exemption

The applicant requests an exemption with the following wording:

Cadmium and cadmium oxide in thick film pastes used on beryllium oxide substrates until January 1, 2008.

Cadmium bearing thickfilm based hybrids are used in a wide variety of equipment and applications. While some of these fall into specific exemptions such as fixed installations, there are other applications such as amplifiers in sound equipment that fall under the scope of the RoHS Directive.

The applicant says that some customers, who purchase BeO hybrids from Apex, have inquired as to the RoHS status of these parts:

Alcon, Alstrom, Agilent, AME, Ampere, Ball Aerospace, Benchmark, Bombardier, Boran, Coherent, Harris, Hitachi, JEOL, KBK, Lockheed Martin, Mainsail, New Focus, Nykoping, Omicron, Orbotech, Panasonic, Peizo, Picosecond, Raytheon, Siemens, Solutec, Sunburst, Texas Instruments, Trimble, Tronico and Tyco.

A significant fraction of them have applications that fall into the "IT and telecommunications equipment" and "Lighting Equipment" RoHS categories.

Thick film formulations contain approximately 0.4% CdO by weight  $(0.004\ g\ CdO/g\ thick\ film$  as applied prior to drying and firing). Once the screened material has been dried, fired, and the vehicle removed (10-25% of the formulation by weight), a fired CdO concentration of approximately 0.5%  $(0.005\ g\ CdO/g\ fired\ thick\ film)$  is achieved.

The use of cadmium (as cadmium oxide) in thick film formulations on beryllium oxide is a limited market, with the worldwide total amount of cadmium used in this application being estimated at less than 1 kg of cadmium per year.



#### **Technical Background**

A hybrid is a device which incorporates a substrate onto which a number of thick and thin film elements, IC devices and discrete parts are placed into a circuit. The thick film elements are composed of a variety of formulated pastes that are screened and fired onto a ceramic substrate. The thick film materials are arranged into elements of a circuit and can provide functions such as conductors, resistors, capacitors and inductors. Hybrids using these elements allow the creation of devices of which there are few and in some cases no alternatives, including high frequency, microwave and high power circuits as well as circuits with other high thermal requirements. Where thermal considerations are especially significant, beryllium oxide is often the only choice of substrate due to its high thermal conductivity. Beryllium oxide is not used in other applications due to its relative cost disadvantage to alumina substrate materials, which are used in the large majority of thick film applications.

Thick film pastes have three primary components, these being

- 1) the functional element (metals, metal oxides, alloys, etc),
- 2) the binder (metal oxides or glass frit), and
- 3) a vehicle (organic solvents, plasticizers).

Two difficult but key requirements for thick film materials are

- 1) the ability to bond to the substrate and
- 2) the ability to bond to aluminum and gold wirebonds to make various electrical connections within the circuit.

Cadmium oxide is used as a bonding agent in some thick film formulations. Hybrid circuits are often used in environments subject to high thermal and mechanical stress conditions. A strong bond to the substrate is mandatory for these conditions. In addition, the material must be wirebondable. The cadmium oxide serves as the bonding agent between the thick film layer and the underlying substrate.

When materials are chosen for this particular application, the thick film circuitry, approximately 15 microns thick, must provide acceptable adhesion to the beryllia to withstand the rigorous conditions of ultrasonic aluminum wirebonding that connect the internal active and discrete components within the hybrid. The wire used to wirebond power hybrid devices generally ranges from 25 microns to 500 microns in diameter.

The ultrasonic wirebond process has a small process window as the thick film paste must exhibit excellent adhesion to the beryllia without peeling and detaching during the wirebond process, and must also maintain excellent "wirebondability" characteristics that allow the internal wirebonds to be robust and reliable, without themselves peeling or detaching from



the thick film. These two characteristics, adhesion to the beryllia <u>and</u> wirebondability to the bonding wire, are two of many sometimes opposing characteristics of an ideal thick film formulation for power hybrid devices. Adhesion cannot be sacrificed at the expense of wirebondability, or vice versa, or reliability problems will result.

# 6.19.2 Summary of justification for the exemption

### Applicant's criteria for justification

#### Late availability of qualified RoHS compliant materials

Only a limited number of formulations have been determined to form a satisfactory bond to beryllium oxide which can withstand the thermal, mechanical and electrical requirements of a hybrid circuit in applications requiring high levels of reliability. RoHS compliant thick film formulations, which were qualified for the use on beryllium oxide (BeO) had not been available for the use on beryllium oxide substrates (BeO) in time to be ready for the RoHS deadline July 1, 2006, according to the applicant.

The applicant now is testing these promising RoHS-compliant thickfilm pastes:

• Silver Paste: C4727-S from Heraeus

• Gold Paste: 8883-G from ESL

The applicant says that in September 2005 he became aware that the RoHS compliant, gold-containing paste was available, which had been on the market since June of 2005. The silver containing paste was available earlier. The qualification, however, was not possible as both materials are used on all the applicant's hybrid products. They are in contact with each other and interact with each other. Therefore, as part of the qualification, the contact resistance of the two materials (8883-G and C4727-S) needs to be examined as well, both initial and long-term. Qualification of the C4727-S alone, while helpful in examining other characteristics, would not have allowed the applicant to bring a cadmium free hybrid to the market.

Presently there are no known thick film suppliers who supply a qualified thick film paste for beryllia in power hybrid applications, with <u>proven</u> reliability for both fine (25 micron) and heavy (100-500 micron) wirebonding. As all reliability risks therefore fall onto the responsibility of the hybrid manufacturer, extensive testing is necessary.

# Alternatives to the Use of BeO Ceramics

The use of alternatives to BeO-ceramics are not possible. The applicant has completed a variety of studies over the years investigating the possible use of Aluminium-Nitride (AIN) materials. However, due to a number of factors, including thermal limitations of AIN, CTE mismatches and inability to procure and qualify materials with satisfactory adhesion, it was determined that AIN did not present a feasible alternative for the applicant's products.



### Long and extensive qualification procedure

The critical properties for high power hybrids are adhesion of the thickfilm to the beryllium oxide (BeO) substrate, initial bondability to wires (ranging in size from 25 microns to 500 microns), electrical conductivity, and the long term heat aged properties of all three of these initial properties. Thickfilm vendors often specify these properties for use on alumina substrates (Al203) but not for this application (BeO substrates). Qualification is therefore very specific to the materials and the process variables, which the hybrid vendor uses.

It is difficult therefore, to quantify the set of thermal, electrical and mechanical properties required for these products. Evaluation is normally conducted in side by side comparisons with existing known qualified materials. An example data sheet (C4727S from Heraeus) is supplied in Attachment B. However, the data is for alumina substrates and is not readily transferable to a property evaluation/comparison on beryllium oxide substrate material.

Users of these RoHS compliant materials in these applications must conduct their own inhouse testing. Qualification and reliability testing of new formulations is a lengthy process. This effort was begun once the compliant materials were made commercially available.

Testing time varies according to the material/process being evaluated. Thickfilm paste is the most complex material on the hybrid, as it interacts with virtually every other component and material. The applicant has experienced a significant thickfilm field failure episode in the past, even after a thorough initial qualification. The failures (wirebonds separating from the thickfilm) occurred after over a year in the field.

The qualification requirements for new thick film pastes therefore are much more extensive than what might be normally required. Several vendors' thickfilm products are initially chosen, and an initial screening was performed to check bondability, adhesion, conductivity and other parameters. These tests included a 3.000 hr (125 days) bake at 150 °C, followed by further tests for wirepull values. The best performing materials from this test were then built into actual parts and put through a pilot lot qualification, which also includes the 3.000 hr bake at 150 °C, followed by wirepull testing. Once fully qualified, a limited quantity of parts will be built with the new material and subjected to field experience. The applicant will then periodically review how these parts are functioning in the field. Assuming no problems are discovered, the new (cadmium-free) thickfilm materials will then be rolled out to all hybrid products.

Applying a strict timetable to the above is difficult. In his original exemption request, the applicant estimated that the qualification effort is expected to take at least through mid 2006, assuming no qualification failures occur. Meanwhile, it has become clear that the applicant is behind schedule with the qualification procedure as problems occurred.



#### Consumption of Remaining Stocks and Manufactured Products

The testing will take at least until mid 2006, if no failures occur. Once the new materials have been successfully qualified, it is estimated that it will take approximately six months to clear remaining stock from inventory at the hybrid vendors' facilities, and it is estimated to take another twelve months to clear remaining inventory from customer products. From these estimates, an exemption through January 1, 2008 is being requested.

#### **Environmental Arguments**

As noted above, total worldwide cadmium usage from all vendors in this application is estimated to be less than 1 kg. In addition to being present in very low quantities, the cadmium is in a form that is not easily exposed to the environment. Due to the bonding of the thick film material to the substrate, the thick film material would need to be ground or leached off the substrate in order to expose the cadmium. Leaching of these thick film materials would be difficult, as they are primarily composed of relatively inert materials (gold and silver). Further, hybrids are sealed to prevent exposure to the environment, the majority of which are in hermetically welded steel packages, as exposure to the atmosphere is generally catastrophic to the reliability and operation of the hybrid. Therefore, exposure of the cadmium to the environment from this application is extremely low.

The combination of low volumes of cadmium in this application and low exposure risk suggests that extending an exemption for cadmium in these products while the new alternative thick film materials are tested and qualified is extremely low and the exemption would be very unlikely to present any negative environmental, health and/or consumer safety impacts.

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

RoHS compliant thick film materials for use on BeO ceramics actually have not been available prior to mid 2005. A thickfilm manufacturer confirmed this upon the consultant's request.

The applicant's technical arguments are plausible, and a thick film manufacturer (Heraeus) confirmed that RoHS compliant thick film pastes for the use on BeO were not available before mid/end of 2005. The consultants therefore in principle recommend to grant this exemption.

The requested date for the exemption until January 2008, however, must be seen more critical. The applicant says that the qualification procedure for the RoHS compliant pastes should be finished until mid 2006 in case no unexpected failures occur. Meanwhile, it has become clear that problems occurred, which will delay the completion of the qualification procedure until fall 2006 at least.



The applicant requested another 6 months to use up the stocks of the non-RoHS compliant thick film pastes, and another year until the applicant's customers could sell off the cadmium-containing hybrids, as those are not end-products, but just part of other products.

The use of the non-RoHS compliant thick film paste is not in line with the requirements of article 5 (1) (b), as soon as a RoHS compliant paste is available and can be used in production. The other time limits seem reasonable to the consultants.

Acknowledging the fact that the qualification procedure is complex and has been delayed, the requested deadline until January 2008 should nevertheless be granted.

The consultants therefore recommend to grant an exemption with the following wording: Cadmium and cadmium oxide in thick film pastes used on beryllium oxide substrates until December 31, 2007.

#### 6.19.3 Final recommendation

The consultants recommend granting the requested exemption with the following wording: Cadmium and cadmium oxide in thick film pastes used on beryllium oxide substrates until December 31, 2007.

RoHS compliant thick film pastes were not available in time for the applicant to be ready for the RoHS deadline 1 July 2006. The applicant's technical arguments are plausible. The applicant himself had requested a deadline for the exemption until January 1, 2008 which would have enabled him to use up existing stocks of non-RoHS compliant thick film pastes. This is not in line with the requirements of Article 5 (1) (b). However, as the applicant experiences problems in the qualification procedure of the RoHS compliant thickfilm pastes, the requested deadline was adopted in the recommendation nevertheless.

# 6.20 Lead tetraoxide used in electrolytic capacitors – Evox Rifa (request set 4 No. 2)

#### 6.20.1 Requested exemption

The Swedish company Evox Rifa has requested the exemption for the use of lead tetraoxide  $(Pb_3O_4)$  in high voltage (>= 100V) customised full aluminium electrolytic capacitors (i.e. capacitors which also have an aluminium deck) used in lighting equipment. The lighting equipment is described as "industrial lighting equipment like fluorescent lamp (strip-light) fittings". Full aluminium electrolytic capacitors are necessary for applications like continuously turned on strip-light in underground, in underpass and in large industrial buildings.



The function of the capacitors is to smoothen the electronic ballast.  $Pb_3O_4$  is a fraction of butyl rubber gasket which is used for the sealing of the aluminium capacitors. The lead oxide is used as an accelerator for the vulcanisation of the rubber. The lead oxide has no function at all in the final application.

The lead content in an average rubber gasket is 1,8% (0,0054 g). The total annual amount used in the EU is estimated to be less then 10 kg for below 2 million of full alumium capacitors in total.

The wording provided by the applicant is:

"Aluminium electrolytic capacitors sealed with rubber gaskets vulcanised with lead tetraoxide, for use in lighting equipment.".

Since R&D efforts are already ongoing the exemption request is limited to one year (1 July 2007).

#### 6.20.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

- According to the applicant R&D for lead-free materials started in 2001. The applicant was ready to sign in a new material in November 2004. However, the applicant states that this project was stopped by the supplier because the producer could not deliver the required material (statement not backed-up). The applicant claims not to know the reason for this development.
- In January 2005 the applicant contacted several suppliers of rubber material and states that test for design that will eliminate the need for rubber gaskets are still ongoing and will need about another 10 months of development and testing to get ready for use. The exemption is therefore requested for 1 year until 1 July 2007.
- It is stated that despite the above mentioned 5 years of R&D efforts no substitute material could be found for permanent use. Only one type of lead-free butyl rubber can be temporarily used (the material which has been developed since 2001). However, this material has health risks during manufacturing and is thus not being produced anymore. The material on stock can still be used for the next ten months but does not fulfil all the requirements it reduces the need for lead containing rubber by 80%.
- Evox Rifa itself advertises RoHS compliant aluminium capacitors on its website and claims that all its production is RoHS compliant. Nevertheless "there will be a small rest of customised full aluminium capacitors" (not specified in more detail).
- Customised full aluminium capacitors require welded connections which can according to the applicant only be reached with a capacitor having an aluminium deck (i.e. full aluminium capacitor). The currently used temporary lead free solution (see above) is said to cover most of these requirements but "not quite 100%" (not specified further).



• The applicant assumes that the provided stakeholder comment stating that there are RoHS compliant alternatives refers to radial capacitors with rubber bungs (in comparison to the applicant's axial capacitors necessary for demanding applications).

- No exemption request is known from a lighting equipment manufacturer suggesting that it is possible to use RoHS compliant capacitors in these applications. The applicant states that its customers are waiting for him to find a solution. This may be possible since the exemption seems to refer to a very specialised field of application (nevertheless, a total of below 2 million full aluminium capacitors is estimated by the applicant to be produced within the next year).
- Some information could be found on the internet stating the availability of RoHS compliant aluminium electrolytic capacitors. However, the applicant claims that these are commodity products that do not need to fulfil the same requirements (e.g. long lifetime). The reasons (i.e. detailed technical specifications of the application) are not provided by the applicant in full detail and are not comprehensible from the available documentation. It is only stated that for high voltage, long life-time, low ESR (acronym not explained) and high ripple current there are no known alternatives to full aluminium electrolytic capacitors.
- It is stated that the capacitor for which an exemption is requested for saves energy in the lighting application. This is not further explained.
- An amended wording was proposed to the applicant while asking for a further specification of the application "lighting equipment": "Lead as Pb3O4 used as accelerator for vulcanisation of rubber for the use as butyl rubber gasket for the sealing of customised full aluminium electrolytic capacitors for use in lighting equipment (which was asked to be specified)." Upon answer of the applicant "lighting equipment" could be replaced by "continuously turned on strip-lights". However, the applicant did not comment on this proposed changed wording although explicitly asked to do so.
- The stakeholder having commented that RoHS compliant alternatives were available has been asked for more evidence and for comments on whether these alternatives are able to fulfil the requirements describe by the applicant. Comprehensible information was provided on RoHS compliance of aluminium electrolytic capacitors. However, at time of drafting of this recommendation it was not known whether these are also full aluminium capacitors and whether they can be used in the field of "continuously turned on strip-lights".
- Due to the short time period left between end of the stakeholder consultation and redaction of the final report, no further investigation could take place concerning this exemption request.



- Questions that could not be fully clarified are:
  - Detailed description of (technical specifications) of the application in which full aluminium capacitors are needed.
  - Agreement on amended wording.
  - Availability of such capacitors in RoHS compliant form.
  - Asking applicant for providing evidence on supplier problems and roadmap of R&D efforts.
  - Clarifying whether the applications for which an exemption is requested are fixed installations and thus do not fall under the scope of RoHS.

#### 6.20.3 Final recommendation

With regard to the above mentioned arguments no founded exemption can be given at this point. An additional round of questions to the applicant and stakeholders would be necessary to give a justifiable recommendation. The time span necessary for this exceeds duration of the contract.

Should a decision be taken on the grounds of the available documentation it is recommended not to grant the exemption due to the missing information – there is no founded justification in line with Article 5 (1) (b).

# 6.21 Sharp LQ104X2LX11 (formerly Fujitsu FLC26XGC6R-01) – Mettenmeier (request set 4 No. 3)

This exemption request has been withdrawn by the applicant by e-mail on 18 June 2006:

From: Boris.Redlich@mettenmeier.de

To: rohs@oeko.de

Subject: RoHs exemption request no. 3

Date sent: Thu, 8 Jun 2006 15:59:01 +0200

Send reply to: boris.redlich@mettenmeier.de

Hello,

yet we proved with help of a scientific laboratory in Hamburg that our procduct does not harm the ROHS directive.

So, we withdraw our application for extraordinary exemption.

Thank you for correspondence.

Mit freundlichen Grüßen/ Best regards



Boris Redlich Assistent der kfm. Geschäftsleitung Mettenmeier GmbH- Geoinformation, Services & Solutions Klingenderstr. 10-14, 33100 Paderborn

Tel.: +49(0) 5251-150-339; Fax: +49(0) 5251/150-333

mobil: +49(0)1732101433

mailto:Boris.Redlich@mettenmeier.de

http://www.mettenmeier.de

# 6.22 Use of up to 37% of lead in solder alloys for the electronic modules used in quartz movements and watches - Swatch Group (request set 4 No. 4)

# 6.22.1 Description of requested exemption

The request actually consists of two parts:

- Use of non-RoHS-compliant lead-containing alloy as a seal in quartz crystal resonators in quartz movements and watches to avoid whisker growth
- General use of non-RoHS-compliant lead-containing solders for the assembly of electronic modules used in watches in order to avoid whisker growth in fine pitch applications

The second part of the request is related to the HP request from the second stakeholder consultation to exempt lead in <u>finishes</u> of fine pitch components with a pitch of 0,65 mm or smaller in order to avoid reliability problems due to whiskers. By contrast, however, this exemption request focuses on the <u>solders</u> used to attach fine pitch components to the printed wiring board.

# Use of Lead-Containing Alloy in Quartz Crystal Resonators

The following figure shows the principle construction of a quartz crystal resonator.



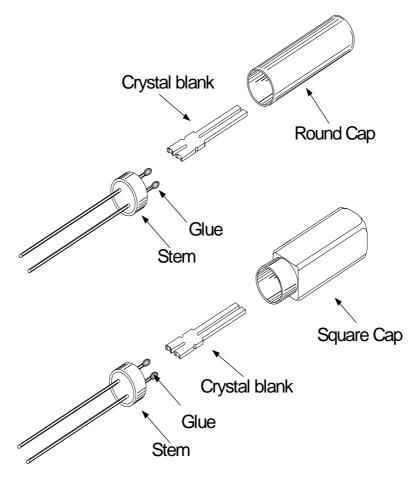


Figure 6: Quartz crystal resonator in metal packages

Quartz crystal resonators of this type are used in watches. They are mechanically resonating within a metal can (round cap or square cap) under sealed vacuum. In the past, the sealing material used for watch crystals in metal cans was Sn90Pb10. During the production process of these watch crystals, this galvanic deposited tin-lead alloy does not melt at any time. The sealing process is something like a cold-weld process and the Sn90Pb10 alloy acts as a soft, vacuum-tight cold-seal between the metal can and the metal ring of the crystal holder.

The Sn90Pb10 solder with 90 % of tin and 10 % of lead is a low melting alloy, which is not RoHS-compliant. Therefore, the applicant tried to replace the Sn90Pb10 coatings with Sn95Cu5. It was observed that this alloy tends to grow whiskers which can cause short circuits inside or outside of the crystal can.

The RoHS Directive already contains an exemption for the use of lead in high melting temperature type solders (i.e. tin-lead solder alloys containing more than 85 % lead) in entry 7 of the Directive's Annex. For the time being, the applicant uses the RoHS conform Sn5Pb95 alloy as a replacement for the Sn90Pb10.

In average, a resonator thus contains around 0.5 mg of lead resulting in an annual total lead



consumption of around 20 kg per year at Swatch. With the old Sn90Pb10 solder, it was around 2 kg. Other alloys than metallic alloys cannot be used as seals according to the applicant.

If the exemption for watch crystals would be granted, the global use of Pb for this application would be around 100 kg Pb / year, assuming a global production volume of 3 to 4 billion pieces, (3.000.000.000 – 4.000.000.000 pcs / year) with the Sn90Pb10 version. Without the exemption it should be around 1.000 kg per year.

# Use of Lead-Containing Solders on Printed Wiring Boards (PWB)

Additionally, the applicant says that he experienced a high risk of tin whiskers growing on fine pitch applications in his electronic modules without giving further specifications. To avoid the whisker risk, the applicant says that he would now use the RoHS conform PbSn-type solder with more than 85% of lead, which is currently exempted, in case his requested exemption will not be granted. This would push up the annual lead consumption from around 20 to 230 kg per year. The applicant therefore requests an exemption to continue the use of the previous SnPb-type solder with 10 to 37% of lead, which would then result in a total annual lead-consumption of around 90 kg in the applicant's products. The applicant therefore asks for an exemption for environmental reasons in order to reduce the use of lead in this application.

The wording of this exemption according to the applicant should be

Use of 10 to 37% of lead in solder alloys for the electronic modules used in quartz movements and watches.

#### 6.22.2 Summary of justification for exemption

# Applicant's criteria for justification

The applicant justifies his request with technical and environmental criteria.

## Use of Lead-containing Alloys as Sealing in Quartz Crystal Resonators

The applicant had tried lead-free alloys to replace the Sn90Pb10 solder alloy for vacuum-sealing the metal can: he used the RoHS-compliant SnCu alloy. Mechanical tensions, the absence of lead and the vacuum atmosphere generated tiny, monocrystalline tin whiskers up to several millimetres length. In up to 30 % of the quartz crystal oscillators whiskers grew within weeks already. Up to 5 % already created shortcuts.

Since SnAgCu alloys are more whisker resistant compared to SnCu alloys, the applicant tried this option too over the last three years. Unfortunately, SnAgCu alloy tends to be too hard to provide a vacuum-seal for push-in sealed watch crystals. It has no "smearing" effect during the push-in of the crystal assembly into the metal can. In addition, it was impossible to



obtain an even and homogenous galvanic plating of SnAgCu on the very small crystal package components.

# Use of Lead in Solder Alloys for the Assembly of the Electronic Modules

The applicant says that he experienced a high risk of tin whiskers growing from the solder joints of fine pitch applications with distances less than  $800 \, \mu m$  with the tin-copper solder paste, which he used. Using pitches with more than  $800 \, \mu m$  is not possible as the small dimensions of the watches require pitches of  $200 \, to \, 300 \, \mu m$ .

The use of tin-lead-alloys with up to 37 % of lead solves the problem, according to the applicant. If the exemption is not granted, the applicant will use RoHS-conform solders with 90 % of lead thus increasing the lead consumption, which the applicant would like to avoid for environmental reasons.

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

### General Use of Lead in Solder Alloys to Avoid Whiskers in Fine Pitch Components

The applicant said he would continue to use high-melting lead-tin solder alloys with more than 85 % of lead in case the Commission will not allow the general use of SnPb37 solder alloys for the applicant's application. This solder alloy would increase the use of lead, which for environmental reasons would not be favourable. After critical inquiry concerning the technical viability of this solution, the applicant admitted that this is not a viable option. The applicant had produced such modules for his watches with the RoHS conform Sn96.5Ag3Cu0.5 and the Sn95.5Ag3.8Cu0.7 solder and so far has not observed any whisker problems in fine pitch components. The SnAgCu solders are more whisker resistant than the SnCu solders, which - in his original exemption request – the applicant had claimed to use. The applicant says that the long-term reliability situation is uncertain and that he needs to have a secure alternative solution in case of emergency. The applicant does not present evidence that the SnAgCu solder is not a practicable substitute.

The consultants already reviewed HP's whisker-related exemption request from the second stakeholder consultation to use lead-containing finishes for fine pitch components with a pitch of 0,65 mm or less and gave a positive recommendation to the Commission. The applicant does not present evidence that beyond this recommended exemption, a general use of lead-containing solders is necessary to avoid reliability problems due to whiskers.

Based on the information which the applicant presented, the consultants do not see the necessity to restart the review process on whiskers in fine pitch components again. It is therefore recommended not to grant an exemption for the general use of lead in solders of electronic modules used for quartz movements and watches.



### RoHS Compliant and Lead-free Quartz Crystal Resonators

Alternative technical solutions to metal packages: ceramic packages

Crystal resonators can be designed as metal or as ceramic packages.

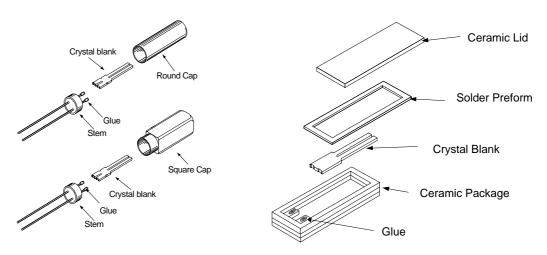


Figure 7: Quartz crystals in metal (left) and ceramic package (right)

While manufacturers of metal package crystal resonators use lead-containing alloys to vacuum-seal the metal can, manufacturers of ceramic package crystal resonators use a tingold alloy (solder preform) for the ceramic packages. The ceramic package thus offers a RoHS compliant solution, which technologically actually can replace the metal package in a range of applications. The ceramic packages are used in medical devices like pace makers. In this application, the noble metal sealing (gold) is thought to give better protection against corrosion. They are also used in devices like mobile phones of higher value. The ceramic packages can be produced as low height packages, which makes their use attractive whenever the height of the devices limits the design of the electronics module.

The technical disadvantage of the ceramic packages is that they require more area on the printed wiring boards compared to the metal packages, which is also obvious in the above figure. As the area is a limiting factor in watches, the watch movements would become too big and therefore would be harder to sell. They would not be appropriate for smaller watches, according to the applicant. The ceramic package technically is only a partial substitute for the metal package technology. Additionally, the ceramic package is about 15 times more expensive compared to the metal package. The cost of the metal package is around 0,05 to 0,06 Euro, the crystal in ceramic package costs 0,70 to 1,00 Euro.



Manufacturers thus have an option to produce RoHS compliant and lead-free quartz crystal resonators if they want to accept the higher price and if it is technically appropriate.

#### Lead-free metal package quartz crystal resonators

It could be excluded that the whiskers are growing from other materials than the RoHS-compliant SnCu solder. The version used currently has a pure Nickel (Ni) finish on the can. The can itself consists of a NiFe (alloy42) alloy. The whiskers grow from the sealing material, because the consistency of the observed whiskers is pure tin (Sn), and tin is only used in the seal-material. Also, the whiskers can grow before the crystals are mounted in watch modules.

Another cause for the whiskers could be thermal mismatch between the can, the solder, and the substrate, on the metal the can is soldered to. This could cause mechanical stress triggering the whisker growth. At the time after soldering, e. g., the mechanical stress could already be being frozen in the application after cooling and thus cause permanent mechanical stress. The thermal mismatch could also cause additional stress during the product life time.

The occurrence of the mentioned whiskers already takes place before the crystals are mounted into the watch movements. It can be assumed that the thermal mismatch of the different materials like printed circuit board (PCB) and mounting materials used during watch production are not the key factors of the whisker growth. However, the mechanical push-in seal of these watch crystals produces by nature a certain mechanical stress, which is even required and wanted to grant a proper vacuum-seal for the life span of a watch, which is probably several years or even decades. It was also tried to relieve this stress as much as possible to avoid the whisker growth. This was done by temperature cycling and baking-/annealing processes at elevated temperatures. This procedure could not avoid the growth of the whiskers.

The consultants could obtain information from another manufacturer of quartz crystal resonators in metal packages.. This manufacturer uses lead-free solders as a standard for the metal-type quartz crystal resonators. According to this manufacturer, the customer nevertheless can choose a lead-tin-type sealed metal quartz crystal resonator, but has to indicate this when ordering, as otherwise a lead-free version will be supplied. The attached document (see Annex III) shows this manufacturer's products and in which RoHS-compliant form they are available, either with lead-free or lead-tin type alloys.

It is thus obvious that quartz crystal resonators can be manufactured in line with the requirements of the RoHS Directive. The consultants thus cannot recommend granting this exemption based on article 5 (1) (b).



The applicant says that he will go on using the high melting lead-tin alloy with more than 85 % of lead instead of 10 %, which he had used previously. Although this is not desirable from the environmental point of view, the exemption cannot be recommended, as the lead-free manufacturing is technically not impracticable. It is thus left upon the applicant and each manufacturer to decide how environment-friendly he wants his products to be and whether he wants to rely on an exemption – the lead-tin-type solders - which is only temporary. Additionally, the quartz crystal resonators in ceramic packages offer a further possibility for a RoHS-compliant lead-free product.

#### 6.22.3 Final recommendation

#### General use of lead in solder alloys of electronics modules

The general exemption to use lead in solder alloys in the electronic modules of quartz movements of watches should not be granted. The consultants already reviewed Hewlett Packard's exemption request (second stakeholder consultation, lot 1) to use lead-containing finishes for fine pitch components with a pitch of 0,65 mm or less and gave a recommendation to the Commission. The applicant does not present new evidence that this pitch limit should be expanded or the use of RoHS compliant solders is technically or scientifically impracticable.

### Use of Lead for Vacuum-Sealings in Quartz Crystal Resonators in Metal Packages

The exemption should not be granted, as other manufacturers use lead-free solders in this application as a standard. Environmentally, it is not desirable that manufacturers use the RoHS-exempted lead-tin-type solder with more than 85 % of lead, as the applicant has announced in case the exemption is not granted. However, as the lead-free manufacturing of quartz crystal resonators in metal packages is technically practicable, the exemption cannot be recommended in line with article 5 (1) (b).

# 6.23 CdS in opto-electronic components – Marshall Amplification (request set 4 No. 5)

#### 6.23.1 Requested exemption

The applicant "Marshall Amplification" has requested an exemption for the use of cadmium in photo-resistors in their produced musical instruments amplifiers. The photo-resistor is used for optically controlling high-voltage AC signals with variable resistance.

Depending on the model different amounts of photo-resistors are used:

Model: - TSL100 9 in total

Model: - TSL122 9 in total

Model: - DSL100 1 in total



Model: - DSL50 1 in total

The applicant describes the application as follows:

"The photo-resistors used are combined in a single package, with an LED to form an Opto-coupler (or Opto-isolator). An Opto-coupler is any device which allows the passage of analog or digital signals between circuits using light. The use of light ensures that the sending and receiving circuits are electrically unconnected, "galvanic isolation".

Light from the LED strikes the surface of the photo-resistor, which is made of a high resistance semiconductor, Cadmium Sulphide. This semiconductor absorbs photons and changes its resistance according to its exposure. It does this by using the energy generated absorbing photons to give bound electrons enough energy to jump into the conduction band, where they (and the resulting hole partner), conduct and therefore lower resistance.

The semiconductor takes time to get to and recover from this higher conductivity state, meaning the resistance of the device falls and returns to high resistance over a matter of seconds. This gives the Opto-coupler device an important characteristic. The gradual change from one state to another, under a constant LED current, allows the device to switch audio signals gradually.

Using the photoresistor with a light source such as a light emitting diode (LED) allows a device (opto-coupler) to be created which can optically control a high voltage AC<sup>17</sup> (hundreds of volts) signal from a low level DC (5-24 volts) signal essential for the physical separation and safety isolation of high voltage circuits and low voltage circuits accessible to the user."

The applicant has neither provided a wording concerning the requested exemption nor given figures on the amount of Cd involved.

# 6.23.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

According to the applicant it is not possible to switch an audio signal gradually and distortion-free by the use of silicon-based photodiodes, "which is commonly recognised as the alternative to cadmium, due to the fact that a silicon device is photovoltaic and not resistive, so can not be used in AC circuits. As the conduction of the silicon-based photodiode is instant the moment the AC signal's amplitude is sufficient to exceed the photovoltaic voltage drop, the silicon device conducts, which causes completely un-

<sup>17 &</sup>quot;The high voltages are generated from the valve stages. Valves were used in the days before transistors in all audio amplifiers. The transistor did not require the same amount of supporting components to form an amplifier and became the preferred choice for devices like portable radios. Valves stayed in guitar amplifiers because of their unique transfer curve and distortion characteristics. Valve circuits run on high voltage, hundreds of volts. A factor of ten higher than most audio amplifiers that do not use valves."



acceptable deformation of the AC signal. This differs to the characteristics of a cadmium based device which can change the amplitude of the AC signal without deforming it."

- It is stated that other attenuator methods such as relays do not operate fast and consistently enough to switch an audio signal at the exact moment required. Other parts that are fats enough such as SSR (solid state relays) that were thought of by the applicant were considered as not being able for audio use.
- The applicant says that amplifiers for electric guitars such as the Marshall Amplification model TSL 100 do distort the signal (inherent characteristic of such an amplifier). But it is claimed that there is a difference between the wanted distortion from valve stages and unwanted distortion from other components (such as e.g. a photoresistor).
- As a summary the applicant states that the properties of CdS photoresistors which cannot be achieved by any other component are: delayed response to state change, passive element, high voltage, very low [unwanted] distortion. Daylight response which is an important characteristic of CdS photoresistors in other applications is not of importance in the mentioned audio applications.

- Many stakeholder comments have been received supporting the exemption request of Marshall Amplification. These documents as well as the additional information provided by the applicant have been submitted to a manufacturer of RoHS compliant photodiodes. This manufacturer has taken the following position regarding the possibility to use his RoHS compliant resistors in the described audio applications (amplifiers): he states that according to him there are no technical reasons hindering the use of a RoHS compliant photoresistor in amplifiers. Extensive argumentation and evidence has been provided to undermine that position.
- As an example for the argumentation used by this manufacturer the following paragraph is cited: "A special case of photo conductive mode is when a photodiode is connected between the positive and negative inputs of a dual supply operational amplifier (op-amp) with a feedback resistor between the op-amp output and its negative input. In this circuit there are no volts across the photo diode (except for the very small input offset voltage Vos of the op-amp. If light illumination is applied to the photodiode from the low voltage DC control circuit via an LED, the op-amp output voltage will vary linearly with respect to the GND of the output circuit. The output of the op-amp is electrically isolated from the DC input by the light beam. It would not be a difficult task for an experienced electronics engineer to use the isolated DC control voltage from the op-amp output to adjust the amplitude of a high voltage AC signal without introducing distortion."



- However, concerning the need for an opto-coupler incorporating a photoresistor, the manufacturer of RoHS compliant alternatives says that his device will shortly be available in opto-coupler configuration, meaning that it might not be available on the market by now.
- The same manufacturer again states that "relay-based switching can be implemented in an unobjectionable manner" when a gradual "cross-fade" nature of the switching provided by opto-couplers due to the slow response of the photo-resistor is required. "If the gradual "cross-fade" switching is a requirement, it is certainly possible to use a VCA [not further explained by the stakeholder]. This would provide smooth transitions, low distortion, and opens up other functional possibilities."
- In summary the manufacturer of RoHS compliant photoresistors issues the following statement as regards the need for an exemption for audio applications:
- "We believe that there are suitable ROHS compliant alternatives available for most requirements. The single argument that we have heard from the audio industry is the application where a specific genre of sound quality is attributed to the waveform arising from the use of CdS in an opto-coupler. We still believe that current state of the art digital signal processing would be capable of achieving a very similar attack and decay waveform to CdS given appropriate attention and development.
- The above mentioned amplifier argument is not applicable to channel switching which is not a discriminating audio application apart from the requirement to switch with the absence of popping noise.
- We feel that any exemption granted to the Audio Industry should be quite specific in terms of the application and for a very limited timeframe to encourage the audio industry to engage with companies like ourselves to develop environmentally friendly alternative technologies. We feel strongly that a general exemption covering general applications such as lighting and brightness control in TV, mobile phone, cameras etc should not be granted."
- In order to draft a sound recommendation these statements of the stakeholder have to be presented to the applicant. This is not possible due to time constraints in view of the contract ending at the end of July and last information exchange having taken place shortly before. It would furthermore have to be clarified what kind of restriction would need to be incorporated into a proposition for a recommended wording. Since in this case the question whether or not an exemption should be granted related to very special and specific technical issues it is recommended to bring the applicant and the manufacturer of the RoHS compliant photoresistor together in order to clarify the described open questions. This could not be done by the time of drafting this final report.



#### 6.23.3 Final recommendation

With regard to the above mentioned arguments no founded exemption can be given at this point. An additional round of questions to the applicant and stakeholders would be necessary to give a justifiable recommendation. The time span necessary for this exceeds duration of the contract.

Should a decision be taken on the grounds of the available documentation it is recommended not to grant the exemption due to the availability of alternatives and missing information on a possible technically detailed and exact wording restricting an exemption.

# 6.24 Transducers used in professional loudspeaker systems, using tin-lead solder – Function One Research (request set 4 No. 6)

This request has been withdrawn by the applicant by e-mail on 13 June 2006:

From: "Ann Andrews" <ann@funktion-one.com>

To: < rohs@oeko.de>

Subject: RoHS exemption request no.6
Date sent: Tue, 13 Jun 2006 16:25:19 +0100

Send reply to: ann@funktion-one.com

Dear Stephanie,

Many thanks for your email.

After careful consideration we have decided not to pursue our exemption request any further as we cannot provide the evidence you require in the time available.

Since our initial request for this exemption on the 6th February 2006, some 4 months ago, this is the first response we have had aside from acknowledgement of receipt. During this time there has been some track record built up of using lead free solder in our loudspeaker joints and so far we have seen very few failures. However, we are still concerned as some of our loudspeakers are used in voice evacuation systems which we consider to be as fundamental to public safety as medical and military equipment. We cannot help but wonder why medical and military have an automatic exemption if there were no long term reliability problems. Can you please comment on this seemingly preferential treatment afforded to these two particular industries.

Regards
Tony Andrews
Managing Director Funktion One Research Limited



# 6.25 Lead in professional audio equipment – MC2 Audio (request Set 4 No. 7)

### 6.25.1 Requested exemption

MC2 Audio has brought forward two different requests concerning the use of lead in amplifiers produced by the applicant: 1) "Specific modular units, including tin-lead solder, being used in special professional equipment" and 2) "Tin-lead solder in the manufacture of professional audio equipment". Both were published on the Commission's website for the fifth stakeholder consultation but within one item (no. 7). The evaluation will thus be twofold differentiating between the two requests.

# 6.25.2 Request 1 "Specific modular units, including tin-lead solder, being used in special professional equipment"

#### Requested exemption

The applicant has requested the exemption for the last time buy component "N-channel Mosfet – Samsung IRF549". This component is used in the amplifiers produced for professional users (24 per amplifier). Lead is contained in the solder which is present on the surface coating of the legs to ensure "wetting" when the part is soldered to the circuit board. It is estimated that the total annual amount of lead used through this application is of 200g (<0,008 g per device).

No exact wording has been provided by the applicant concerning the requested exemption.

# Summary of justification for exemption

The applicant justifies his request for exemption with technical, supply chain and environmental arguments:

- The professional audio sector is relatively small compared to high-turnover consumer audio market. Equipment for the professional audio market is thus produced in rather low volumes and the products have a comparably long lifetime (>10 years). The applicant argues that the component for which the exemption is requested will consequently not converted to lead-free. The manufacturer of the component has turned down production and offered a last time buy to the applicant (this statement is not backed up by supporting evidence).
- According to an oral communication by the applicant<sup>18</sup>, the stock of the LTB component will last for production until beginning of 2007.

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<sup>&</sup>lt;sup>18</sup> Telephone conversation on 17 July with Rob Bradshaw at MC2 Audio.



- The applicant argues that there is no replacement possible for the component (since production has been stopped and no equivalent could be found on the market) and that therefore a redesign will only be possible when a substitute has been found.
- As regards the environment, the applicant states that the quantities of lead involved are very small and that scrapping the components on stock would rather represent a negative environmental impact (wasting resources because scrapping new material and thus creating need for further new components).

- The request belongs to the group of LTB requests. The problematic inherent to those requests as well as the general evaluation procedure is described in section 5 of monthly report 8.
- It is a fact that the LTB issue is relevant for a number of companies and that in some cases substitution is not technically feasible. It is also a fact that scrapping components that could be used in equipment represents an unnecessary environmental burden.
- Nevertheless, applying Article 5 (1) (b) in a narrow sense there is no in-line justification available regarding this request since no evidence was provided on
  - the amount of components on stock for specific applications,
  - the duration of design cycles,
  - the volume of produced equipment containing LTB components,
  - starting point of efforts towards RoHS compliance (including e.g. evidence on end of production by suppliers, proof that components are not available in RoHS compliant version, efforts for re-design) and point of time of the LTB order and
  - technical specifications of the component.
  - This data and information is, however, needed for a proper evaluation of a potential justification of a request.
- An exemption can only be granted when going beyond criteria of Article 5 (1) (b). In that case it is more the general environmental policy goals that speak in favour of the exemption. Furthermore the fact that specially SMEs have to face economic and financial difficulties related to LTBs could also be considered when thinking of an exemption. Nevertheless certain conditions would have to be set in order to prevent misuse and in order to guarantee a certain control and monitoring:
  - The application would need to be described in detail.
  - The exemption should clearly be limited over time in order to ensure a controlled phase-out (in this case a limitation to February 2007 seems to be appropriate since the applicant has stated himself that the LTB component will last for production until beginning of 2007).



The relatively small amount of lead used during the short phase-out period would allow granting an exemption when looking at commensurability aspects (going beyond Article 5 (1) (b)).

#### Final recommendation

With regard to the above mentioned arguments it is recommended not to grant an exemption since there is no justification in line with Article 5 (1) (b). Should the Commission nevertheless wish to grant an exemption going beyond Article 5 (1) (b) taking into consideration that the component for which an exemption is requested is clearly identified as well as the application for which it is used and that the time frame during which the component will still be in use is limited to a short-term period. Furthermore the applicant is a SME probably facing difficulties in mobilising resources for changes towards RoHS compliance. Above mentioned conditions would need to be fulfilled beforehand though.

In that case the proposed wording is:

"Lead in solders used for soldering the component "N-channel Mosfet – Samsung IRF540" to the circuit board used in amplifiers for the professional audio market until 1 February 2007".

# 6.25.3 Request 2 "Tin-lead solder in the manufacture of professional audio equipment"

## Requested exemption

The applicant has requested a general exemption for the use of lead-containing solders for the attachment of electronic components to circuit boards within the produced amplifiers. He assumes that the total annual quantity of lead used is less than 35 kg (10 g - 15,5 g per device).

No exact wording has been provided by the applicant concerning the requested exemption.

#### Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

- The applicant is concerned about the long-term effects of lead-free soldering to the heavy components which come under strong physical and high temperature stress.
- Research on lead-free solders is being carried out but according to the applicant its reliability and safety is unproven.
- The applicant states that he is not aware of the use of substitutes for tin-lead solder by other manufacturers of professional audio amplifiers.
- One argument used is that lead-free soldering is an unproven technology.



- A general doubt on the long-term reliability of lead-free soldering is shared by many stakeholders. Nevertheless, lead-free soldering is considered as a viable technological alternative to lead-containing soldering by the scientific community and major parts of the industry (e.g. the automotive industry has very strong requirements concerning reliability and safety and is one industry sector currently using lead-free soldering). Please also refer to section 5 dealing with the general aspects on lead-free soldering. Furthermore it is an inherent characteristic of an innovative technology that there is no in-the-field long-term reliability experience.
- One stakeholder has brought forward a comment stating that he is able to produce RoHS compliant professional audio equipment and that he sees no justification for an exemption here.

#### Final recommendation

The general concerns on lead-free soldering are not an argument in line with Article 5 (1) (b). It is assumed that the RoHS Directive was set up with the view that lead-free soldering was a viable technological alternative in order to eliminate lead from electrical and electronic equipment.

It is therefore recommended not to grant the exemption.

# 6.26 Lead in components used in lighting control devices – JANDS (request Set 4 No. 8)

#### 6.26.1 Requested exemption

The applicant requests an exemption for the use of microprocessors and interface components used in lighting control devices containing lead within the plating of the component legs. These components are used to allow the use of personal computer type peripherals. Lighting control devices containing such components have particularly short lifecycles and rapid obsolence. JANDS currently holds 2.400 pieces of such components on stock since they have become obsolete and are not available in RoHS compliant form.

The exemption is requested for a period of two years, during which some of the stockpiled components would be used in new products until they reach their end of life and during which new RoHs compliant devices would be developed replacing the old non-RoHS compliant ones.

It is estimated that less than 20g of Pb will enter the market over the next two years should an exemption be granted.

The applicant himself considers his products to fall either under category 9 "monitoring and control instruments" of the WEEE Directive or under category 4 "consumer equipment". Upon request for further information the applicant has stated to be aware of the possibility for



its products to be exempted from the requirements of the RoHS Directive should they be considered to fall under category 9.

This exemption request overlaps with request no. 9 set 3 by Avolites ("Specific modular units including tin-lead solder being used in special professional equipment"").

# 6.26.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical, supply chain and environmental arguments:

The argumentation used by the applicant is similar to the one used by all requests belonging to the group of last time buys (cf. section 5 monthly report 8). In this case the particularity lies within the difficulties to generate compatible software for new RoHS compliant components. In the case of the applicant this represents a very large economic effort not considered feasible due to the small size of the company.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- The request belongs to the group of LTB requests. The problematic inherent to those requests as well as the general evaluation procedure is described in section 5 of monthly report 8.
- It is a fact that the LTB issue is relevant for a number of companies and that in some cases substitution is not technically feasible. It is also a fact that scrapping components that could be used in equipment represents an unnecessary environmental burden.
- The applicant has provided extensive and comprehensible information on the components to be exempted (he provided an extensive list), their stockpiled amount, the lead content, the phase-out duration as well as supplier information on some of the obsolete components.
- Consequently the conditions necessary for granting an exemption concerning a LTB request are nearly completely fulfilled. However, this request seems to be out of scope since the devices produced by the applicant are likely to fall under category 9 WEEE Directive.

#### 6.26.3 Final recommendation

With regard to the above mentioned arguments it is recommended not to grant an exemption since the devices "lighting control products" are considered to fall under category 9 WEEE Directive already being exempted. Grating an exemption for such an application could create confusion.

Should the Commission nevertheless consider the devices to fall under the scope of RoHS, the request would have to be looked at together with other LTB requests. The procedure to



follow is described in section 5 of monthly report 8 as well as in the recommendation given for request no. 14 set 3.

Questions that need to be clarified are:

- the duration of design cycles,
- the starting point of efforts towards RoHS compliance (including e.g. evidence on end of production by suppliers, proof that components are not available in RoHS compliant version, efforts for re-design) and point of time of the LTB order as well as
- the technical specification of the application for which the exemption is requested (detailed description of the "lighting control product").

In that case the proposed wording is:

"Lead in solders used for soldering the components to the circuit board used in lighting control products (to be specified in more detail) until 1 July 2008".

# 6.27 Lead in components used in professional audio equipment – XTA Electronics (request Set 4 No. 9)

### 6.27.1 Requested exemption

The applicant has requested an exemption for the use of lead as a solder for soldering components to the circuit board used in professional audio equipment. This equipment is not described in more detail. The lead is present as a tin-lead solder used on the component legs to ensure sufficient "wetting" when soldering. The exemption is requested for the following three components:

- The ST Microelectronics "68B50" ACIA comms controller (lead content < 0,1 g / device)
- The Texas Instruments "TMS57002" digital signal processor (lead content 0,4 g / device);
- The Hitachi "MT4C4M41ATG" 4Mbit x 4 DRAM (lead content < 0,0125 g / device).

These components have been subject to a last time buy. The total lead content in the EU is estimated to be less than 500 g for the forthcoming period of use (2-3 years), equivalent to 150 g/a.

The wording provided by the applicant is

"Specific modular units, including tin-lead solder, being used in special professional equipment".

# 6.27.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical, supply chain and environmental arguments:



- The market for professional "high-end" audio equipment is very small in comparison to the consumer audio market. A small number of components will thus not be converted to lead-free soldering to the low production volumes and the little remaining business life.
- These parts have become obsolete and the only solution for the applicant would be to redesign the affected products to incorporate newer lead-free alternatives. This is claimed not to be viable for the applicant due to the costs involved (low-volume products and highly specialised nature).
- A new product platform will be introduced by the applicant, using only RoHS compliant components and assembly processes. It is planned to utilise this new platform to phase out the older one over a 2-3 year period.
- The small amount of lead is brought forward as an argument in favour of a controlled phase-out period at the same time allowing continued use of the mentioned components instead of scrapping them (and thus wasting natural resources).
- The applicant claims that since the components have become obsolete there are no feasible substitutes available.
- Customer contracts and requirements are mentioned by the applicant to be one reason for continuing to use the listed components in the short-term.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- The request belongs to the group of LTB requests. The problematic inherent to those requests as well as the general evaluation procedure is described in section 5 of monthly report 8.
- It is a fact that the LTB issue is relevant for a number of companies and that in some cases substitution is not technically feasible. It is also a fact that scrapping components that could be used in equipment represents an unnecessary environmental burden.
- Nevertheless, applying Article 5 (1) (b) in a narrow sense there is no in-line justification available regarding this request since no evidence was provided on
  - the amount of components on stock for specific applications,
  - the duration of design cycles,
  - the volume of produced equipment containing LTB components,
  - starting point of efforts towards RoHS compliance (including e.g. evidence on end of production by suppliers, proof that components are not available in RoHS compliant version, efforts for re-design) and point of time of the LTB order for all components,
  - technical specifications of the application (application is not specified at all beyond "professional audio equipment") and
  - technical specification of the component.



- This data and information is, however, needed for a proper evaluation of a potential justification of a request.
- An exemption can only be granted when going beyond criteria of Article 5 (1) (b). In that case it is more the general environmental policy goals that speak in favour of the exemption. Furthermore the fact that specially SMEs have to face economic and financial difficulties related to LTBs could also be considered when thinking of an exemption. Nevertheless certain conditions would have to be set in order to prevent misuse and in order to guarantee a certain control and monitoring:
  - The application would need to be described in detail.
  - The exemption should clearly be limited over time in order to ensure a controlled phase-out (in this case a limitation to 1 July 2008 seems to be appropriate).
- The relatively small amount of lead used during the phase-out period would allow granting an exemption when looking at commensurability aspects (going beyond Article 5 (1) (b)).

#### 6.27.3 Final recommendation

With regard to the above mentioned arguments it is recommended not to grant an exemption. Should the Commission wish to grant an exemption going beyond Article 5 (1) (b) and taking the above mentioned points into consideration the proposed wording is:

"Lead in solders used for soldering the components to the circuit board used in professional audio equipment (to be specified in more detail) until 1 July 2008".

# 6.28 Inventory of special ICS having tin-lead solder on/in leads/balls, used in specialist/professional equipment – Innovason (request set 4 No. 10)

#### 6.28.1 Requested exemption

Innovason (Plougoumelen, France) requests an exemption for specific ICs. In the original request no further details were available. On inquiry it could be clarified that the request relates to integrated circuits as follows:

- AM 7968
- AM 7969

According to the applicant the leads of the IC are tinned with a small quantity of tin-lead solder, in the case of ball grid arrays the contact points contain a very small ball of solder. Following the applicant's argument some of he ICs are now unavailable und have been purchased as a "Last Time Buy".

In the original request no information was provided relating to the specific function of the ICs. After reconciliation with the applicant it could be clarified at least that the ICs are used in



units providing the transmission of a signal in theatres or concerts between stage and control panel. The applicant classifies this application to category 9 of the WEEE Directive (monitoring and control instruments).

The total amount of lead is less than 2 kg p.a.

# 6.28.2 Summary of justification for exemption

The applicant does not provide detailed information about the request for exemption. The request is justified with arguments belonging to the group of LTB requests. The problematic inherent to those requests as well as the general evaluation procedure is described in section 5 of monthly report 8.

It is a fact that the LTB issue is relevant for a number of companies and that in some cases substitution is not technically feasible. It is also a fact that scrapping components that could be used in equipment represents an unnecessary environmental burden. Nevertheless a minimum of information is required in order to do proper evaluation of this request.

A critical review of the documents made available by the applicant lead to the following observations and conclusions:

Applying Article 5 (1) (b) in a narrow sense there is no in-line justification available regarding this request since no evidence was provided on

- the amount of components on stock for the mentioned application,
- the duration of design cycles,
- the volume of produced equipment containing LTB components,
- starting point of efforts towards RoHS compliance (including e.g. evidence on end of production by suppliers, proof that components are not available in RoHS compliant version, efforts for re-design) and point of time of the LTB order and
- technical specifications of the integrated circuits in question...

This data and information is, however, needed for a proper evaluation of a potential justification of a request. An exemption could only be granted when going beyond criteria of Article 5 (1) (b). In that case it is more the general environmental policy goals that speak in favour of the exemption. Nevertheless certain conditions would have to be set in order to prevent misuse and in order to guarantee a certain control and monitoring:

- The application would need to be described in detail.
- The exemption should clearly be limited over time in order to ensure a controlled phase-out.

#### 6.28.3 Final recommendation

With regard to the above mentioned arguments no founded recommendation can be given at this point. An additional round of questions to the applicant would be necessary to give a



justifiable recommendation. The time span necessary for this exceeds duration of the contract.

Especially it could not be clarified whether this application could be really classified to category 9 of the WEEE Directive (monitoring and control instruments). Should a decision be taken on the grounds of the available documentation it is recommended not to grant the exemption due to the missing information – there is no founded justification in line with Article 5 (1) (b). It is assumed that even further investigations would not change the recommendation since the documents provided so far after a first round of questions are not at all comprehensible and complete.

# 6.29 Cadmium Mercury Telluride - Selex (request set 4 No. 11)

# 6.29.1 Requested exemption

The applicant SELEX has requested an exemption for the use of cadmium mercury telluride. Cadmium mercury telluride (CMT) is a ternary alloy semiconductor crystal that is used as the infrared-sensitive material in high performance infrared detectors. The CMT Crystal is a so called bandgap material which is particularly suited for the absorption of IR radiation. For this material to achieve infra-red detection, it has to be cooled at cryogenic temperatures between -40°C to -200°C. This requires a robust, normally high vacuumed encapsulation, or that the encapsulation is filled with an inert gas.

CMT has a wide range of military applications including thermal imaging (sometimes called night-vision), navigation, reconnaissance, missile and ammunition guidance, gun-sights, target identification, laser warning, and fusing. It also has civil applications for earth resource mapping from space, search and rescue, and scientific instruments such as infrared spectrometers.

Typical quantity per detector is 10 milligrams. Estimating the annual quantities of detectors to be 4.000 the total annual weight is about 40 grams. The content of cadmium is typically 7 – 11 weight -%, the content of mercury between 46 to 52 weight -%.

The total annual weight is estimated at 40 grams from this factory. There are 3 main manufacturers of this material in the EU. A total of 200 grams of manufacture is estimated within the EU.

The applicant adds that in all cases the infrared-sensitive element is contained within a robust, sealed package, of which the main part is metal. Advice is provided through handling instructions on the safe disposal of detectors at end-of-life.

The applicant suggests the following wording for the exemption:

"Crystal Cadmium Mercury Telluride - For use in the Infrared detection technology: no RoHS-compliant substitute is available with equivalent performance."



### 6.29.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

- There is no direct substitute material to CMT that can achieve the very high levels of performance demanded by thermal imaging community. The production of modern high performance infrared detectors, particularly in the important 8-12 micron wavelength interval in which the atmosphere is substantially transparent, dates from the development of cadmium mercury telluride material in the 1970's. To date no alternative material technologies that avoid mercury or cadmium have demonstrated a comparable performance envelope that includes sensitivity, wavelength coverage, and cooling requirements (high performance infrared detectors all require deep cooling, typically to liquid air temperature, around -195 °C).
- Alternative materials are being researched including quantum well structures, quantum dot structures, superlattices, and thermal detectors. They are unlikely to achieve the high performance levels required within the next 5-10 years.

Some substitute material currently exists as early research sample manufacture for evaluation purposes. For instance

- (1) PbSnTe: This material too would have problems with the lead content for RoHS compliancy
- (2) Superlattice materials made from InAs/GalnSb: Under development but Arsenic has restricted use under the Marketing and Use Directive of Certain Dangerous Substances Directive 76/769/EEC and the following amendments: 89/677/EEC, 2003/2/EC
- (3) Quantum Dot Arrays made from InAs & InGaAs. Restricted as (2) above.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- Some stakeholder comments have been received supporting the exemption request with the same arguments and similar information.
- The applicant himself provided comprehensive data and information on possible substitutes and technologies.
- Nevertheless it is still an open question whether the applications using CMT are covered by the requirements of the RoHS Directive or not. According to the applicant existing exemptions do not cover this particular application for use in commercial products. However, existing exemption currently do cover for use in military and monitoring/controlling applications.
- Following the proposed wording of the applicant the use pattern would be infrared detection technology. From the consultant's point of view applications related to that technology would be within the category monitoring / controlling applications.



#### 6.29.3 Final recommendation

With regard to the above mentioned arguments no founded exemption can be given at this point. Although the applicant provided comprehensive information on the availability of substitutes it is unclear whether the applications do fall under the scope of the RoHS Directive or whether the applications are already exempted. An additional round of questions to the applicant would be necessary to give a justifiable recommendation. The time span necessary for this exceeds duration of the contract.

Should a decision be taken on the grounds of the available documentation it is recommended to grant the exemption.

# 6.30 Lead contained in Babbit lined bearings - A.O.Smith (request set 4 No. 12)

# 6.30.1 Requested exemption

The applicant "A.O. Smith Electrical Products Company" has requested an exemption for the electric motor bearings lined with Babbitt metal. The Babbitt metal (as specified by the applicant) is a tin based alloy. Main alloying elements are antimony and copper, but it also contains lead. The presence of lead is due to impurity as a result of primary metal isolation. According to the applicant's conversation with manufacturers there is no commercially feasible method for removing lead from Babbitt metal.

The Babbitt lining form the load bearing surface of the bearing for the rotating shaft of the electric motor. According to A.O. Smith Babbitt metal is specifically used because it has a high load bearing ability compared to other metals.

The applicant's supplier of Babbitt lined bearings has advised that the lead content of the homogeneous Babbitt is a maximum of 0,5 % lead by weight, the typical range is between 0,3 to 0,4 % per weight. The total amount of lead contained in the bearing system is estimated to be worldwide around 38,6 kg p.a., the total of lead for all motors shipped to Europe is estimated to be less that 4 kg p.a.

The applicant did not provide an explicit wording according to the information given by the applicant the wording could be "electric motor bearings lined with Babbitt metal containing lead as impurity of the Babbitt metal up to 0,5% by weight."

# 6.30.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical and environmental arguments:

- Lead as an unwanted impurity in Babbitt material cannot be removed by commercial means.
- There are several requirements causing the need for Babbitt in the bearing system: low noise during operation, ability to operate under heavy loads through superior wear



resistance and the ability to withstand heavier loads than any other material in a bearing with the same size and shape.

- There are no substitutes available covering the performance of Babbitt in the bearing system: although ball bearings can support similar loads and have comparable durability ball bearings produce more noise than Babbitt lined sleeve bearings. Bronze bearings offer the benefit of quiet operation, but do not possess the durability of either ball bearings or Babbitt lined sleeve bearings.
- Use of bronze bearings would result in a shorter lifespan for electric motors which would be contrary to the purpose of RoHS.
- According to existing exemptions (use of lead in copper alloys, lead in bronze bearing bushings item 9b of the RoHS Annex) the applicant could switch to bronze bearings that could contain a much higher lead concentration than the 0,5 % maximum lead content of existing Babbitt lined bearings although this reaction would not be intended by the applicant.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- One industrial stakeholder a global manufacturer of electric motors, generators and power transmission equipment supports the request, however without a substantiated new argumentation.
- In contrast a leading sinter metal manufacturer confirms that there are lead-free bearings available. Since the beginning of the 1990s lead was replaced by other materials, especially through additions of graphite.

### 6.30.3 Final recommendation

With regard to the above mentioned arguments no founded exemption can be given at this point. An additional round of questions to the applicant and stakeholders would be necessary to give a justifiable recommendation. The time span necessary for this exceeds duration of the contract.

Should a decision be taken on the grounds of the available documentation it is recommended not to grant the exemption due to the availability of substitutes.



# 6.31 Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers - JBL (request set 4 No. 13)

### 6.31.1 Description of requested exemption

The applicant uses a multi-coil transducer design that allows transducers to be as little as 1/3 the weight and smaller in size than conventional transducers. This design, according to the applicant, thus offers significant performance advantages over his competitors. The dual coil allows the use of an extremely efficient and light motor magnet, because the magnetic return path is utilised by the second coil. For example, an 18 inch woofer of conventional design (2242 H) weighs 35 lbs (15.9 kg), but its dual coil equivalent (2258 H) weighs only 10,5 lbs (4.8 kg). Many auxiliary mounting, cabinet, packaging, and rigging parts can be reduced in size and weight because the woofer is so light, which results in a less expensive speaker system. Light weight is particularly important in portable or tour sound applications. There are other advantages, including reduced cost, size, and distortion.

The applicant has been granted multiple patents related to this multiple coil technology. He has been producing transducers of this type for over a decade and most of his products are now dependent upon this design.

The applicant's specific design requires a non-RoHS-compliant solder, which contains cadmium. The exemption would apply to cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers.

There are two general types of transducers which require the cadmium solder:

- 1) transducers where multiple voice coil windings are soldered together on the voice coil and
- 2) transducers where the voice coil windings are soldered to lead outs on the voice coil.

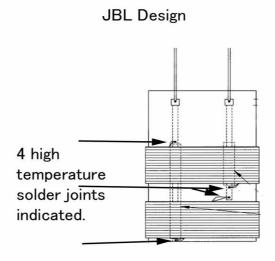
On cone transducers, the solder joints are used to interconnect the voice coil windings so the current flows in the correct direction in the windings. This makes both windings pull together to move the speaker cone. On compression drivers, the solder joints connect the moving voice coil winding to a fatigue resistant lead out for electrical connection to the driving signal. These applications have in common solder joints directly on the hot vibrating voice coil and are subjected to extreme temperatures of up to 250 °C and vibration.

The only solder known to work in this application contains 70-75% cadmium. From reference books, cadmium solder alloys have a solidus temperature of 265 °C. The voice coils in question are provided by an independent supplier outside the USA who considers the exact



alloy to be proprietary information. The supplier has only revealed that the solder contains 73% cadmium.

The transducers had been redesigned in order to reduce the amount of cadmium. Before the redesign, the typical dual coil required 4 solder joints between the voice coil windings and interconnecting copper strips.



Conventional designs have a single wind and no solder joints

Figure 8: JBL voice coil design

The quantity of solder averaged 0.56 grams per transducer. 73% or 0.409 grams of the solder were cadmium. The average transducer weight is 4.5 kg. The typical speaker system weight is 18 kg per transducer. A typical end sales product therefore contains .0023% cadmium. Estimating 75,000 transducers annually, around 31 kg of cadmium were used. The redesign reduces the solder joints in question from four to two and thus saves around 50 % of the cadmium. The actual amount of cadmium involved in this application at JBL thus is around 16 kg per year.

The applicant says that to his knowledge he is the only manufacturer using this kind of technology with cadmium alloys in the voice coils. Assuming that the applicant is right, the exemption would allow the use of 16 kg of cadmium worldwide.

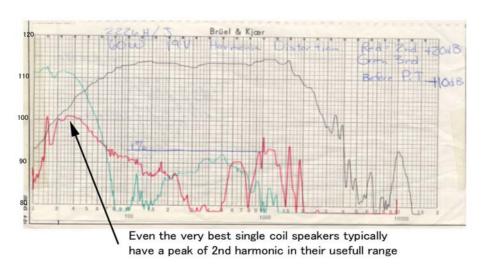


# 6.31.2 Summary of justification for the exemption

# Applicant's criteria for justification

The applicant says that his dual coil design reduces the distortion.

The next figure shows a distortion measurement diagram of a conventional and multi-coil loudspeaker in comparison.



JBL 2226H single coil vs, 2265H Dual coil

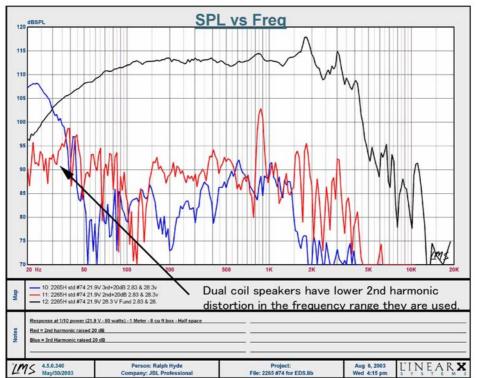




Figure 9: Single vs. dual coil loudspeaker comparison of distortion

The black lines are the frequency response. An ideal frequency response is flat and level from 20 Hz to 20 kHz, but a real response curve for a woofer has the characteristics seen here. These 15 inch Pro woofers are used from about 30 Hz to 300 Hz - and rarely higher. All the curves outside this frequency range can be ignored. Note that the output level around 100 -300 Hz is the same for the 2 speakers (113 dB) as it must be for a valid comparison.

Distortion is an unwanted and unpleasant noise generated in the transducer itself. Distortion consists primarily of harmonics. If a speaker is sent a pure tone of, for example, 100 Hz it would ideally only reproduce that tone, but in a real transducer it will also generate a small amount of 2nd harmonic at 200 Hz, 3rd harmonic at 300 Hz, and on up. JBL designs for minimum 2nd and 3rd harmonic distortion because minimising them will generally minimise all the harmonic distortions.

In the above figures, the blue line is the third harmonic and it can be ignored since it is not part of this discussion. The red lines are the distortion comparison. On the single coil speaker (upper curve), the 2nd harmonic averages about 100 dB between 30 and 45 Hz. On the dual coil speaker (lower curve) the second harmonic averages about 93 dB in the same frequency range. This 7 dB lower distortion is significant and it is due to the dual coil design of the 2265.

The mulit-coil motor for the applicant's loudspeakers is inherently symmetrical, and the resulting magnetic coupling to the voice coil is likewise symmetrical even as the coil is moving in the magnetic gap. This symmetrical motor design results in very low even order (2nd, 4th, etc) harmonic distortion. For single coil motor designs, it requires additional measures to approximate the symmetry which is inherent in the applicant's dual coil design.

The typical dual coil design required four, now two solder joints after the redesign, between the voice coil windings and interconnecting copper strips. The solder joints are directly on the moving voice coil and are subjected to extreme temperature and vibration. The only solder known to work in this application contains 70-75% cadmium.

Integral in the multi-coil transducer design are separate windings on a single coil form, but the windings must circulate electrical current in opposing directions. The only practical way the applicant knows to accomplish this is to solder the windings to interconnection strips on the voice coil itself in close proximity to the windings. JBL Pro has been unable to find a substitute solder due to the difficult nature of these solder connections:

- Most of the applicant's applications use aluminium windings, and aluminum is very difficult to solder. Only a very limited number of alloys are suitable.
- The solder connection must withstand operation approaching 300 degrees C, which is well over the melting point of most solders.



 The solder connections must function at full temperature on the moving voice coil with accelerations in thousands of Gs.

There are several tin/zinc alloys recommended for aluminum, but with a solidus temperature of only 200 C they are not applicable to the applicants speakers. The applicant tried one of these alloys, which confirmed that it does not work. It quickly melted and failed upon power testing. He also tried 95Zn/5Al with 382 C melting point, but it dissolved the very thin voice coil wire instantly while soldering. The applicant says that he tried the high lead, RoHS exempt solder as well, which is NOT recommended for aluminium. The high electromotive potential difference between lead and aluminum is expected to cause galvanic corrosion. The applicant considers it a stopgap fix only. In the testing, these coils are showing promise, but their reliability is questionable. The evaluation will only be complete after a full year of field usage confirms the reliability of the new voice coils. Transducers made with high lead RoHS exempt solder contain no cadmium. However, the applicant is afraid the exemption for high lead solder might expire. In the case that the lead-tin solder would prove to be a viable substitute, the amount of lead used at JBL for this application would be around 19 kg of lead replacing 16 kg of cadmium.

According to the applicant, there is a very remote possibility that other alloys might work and he intends to continue looking for a substitute. However, he says that there is no chance he will have an approved substitute by July 1, 2006.

A design change from aluminum to other voice coil materials like copper is not possible. The voice coil windings are required in the great majority of JBL Professional transducer applications to provide sufficient speaker efficiency to be competitive. Aluminum coil windings have conductivity to weight ratio two times that of copper. This is essential to achieve the high sound pressure levels required in professional use. With copper coils, the sensitivity and ultimate output level of the speaker suffers. Aluminium wire transducers yield aproximately 1,5 dB greater maximum output than copper coil drivers of the same basic design. Only limited applications, such as low sensitivity sub woofers, are competitive with a copper coil.

The use of copper clad aluminium coil wires in order to solve the contact problem, which only cadmium containing solders can solve sufficiently, is not a viable option. According to the applicant, copper clad aluminum wire is brittle and it breaks under the extreme usage these speakers must handle. This causes an unacceptable reliability problem. Even if copper or copper clad aluminum wire were to be used, a high temperature solder is still required. The only acceptable solder the applicant knows of for copper is the high temperature, high lead (>85%) solder, which is exempted from the RoHS Directive (entry 7 of the Annex).



The elimination of cadmium by a complete redesign of the transducers may be possible eventually, but not by July 1, 2006. The high temperature of up to 250 °C limits the number of possible solder alternatives. The applicant continues to work on design changes to the coils to eliminate high temperature solder joints or move them to lower temperature locations. Assuming that a potential alternative design or a substitute solder would be possible, it would require extensive qualification testing in many different transducer models. In order to discover infrequent failure levels as per the applicant's quality standards, very large quantities of transducers (hundreds to thousands) will have to be power tested. This test is destructive to the transducer and the applicant will have to bear the considerable cost of these expensive professional transducers. Even the most thorough test cycle will not give the same assurance of reliability in the field that the applicant has currently from its years of field experience with the existing solder. With the knowledge that any exemption will be temporary, the applicant says that he will continue investigating substitute solders and fundamental redesign of the voice coils to eliminate the need for cadmium.

The applicant says that he has more than a decade of transducer and system designs which would require redesign, test, and qualification. If an acceptable alternative design is found, minimum qualification cycles are months in length and at best he could only support a few simultaneously. A best case changeover by complete transducer redesign would be measured in years instead of weeks.

Reverting to a conventional design would eliminate the great majority of the applicant's products. The products would have to be redesigned to be heavier, less competitive, conventional designs. The applicant says that this would waste 10 years of design and development and destroy his competitive advantage. The applicant has a substantial business in professional and commercial speaker systems in Europe and China. An inability to sell in these markets would be devastating to the company.

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

The applicant uses a specific multi-coil technology for transducers offering technical advantages: high performance at less speaker volume and only around 1/3 of the weight compared to speakers produced with other technologies. The technical function itself – the function of a professional high-powered loudspeaker with sound pressure levels of more than 100 dB (A) – can be realised in compliance with the RoHS Directive, in opposition to the applicant's transducer technology. The mulit-coil motor for the applicant's loudspeakers is inherently symmetrical, and reduces the distortion, as the applicant showed with the provided distortion measurement diagram.

The PLASA (Professional Lighting and Sound Association) confirms that currently the applicant's technology cannot be produced in line with the RoHS Directive (stakeholder document "PLASA Harman.JBL response.pdf").



It must be acknowledged that the applicant has reduced the amount of cadmium to 50 % of the original need, and that he has been testing alternative solder alloys. The applicant only started his efforts in 2005, which is 2 years after the RoHS Directive had been enacted. So far, he has not yet found a possibility to produce his technology in line with the RoHS Directive. Once the applicant would have found an alternative product design offering similar advantages, it would take years, the applicant says, to implement this design in all products. Although the consultants do not have clear insight into the redesign processes and cycles, this argument is at least typical for a manufacturer of professional equipment with long product redesign cycles and limited redesign capacities.

The applicant himself did not put forward any environmental reasons to justify his exemption request. The reduced product weight and material use and a possibly lower energy consumption, could be environmentally advantageous and could have supported a recommendation to grant the exemption.

Based on article 5 (1) (b), the consultants can only recommend to grant the exemption if the applicant's technology itself – high performance at low volume and weight – is considered as the proper function, not just the function of a professional high-powered loudspeaker – generating sound in good quality and at sound pressure levels of 100 dB and more. While in the first case, the applicant currently does not have a technologically practicable and RoHS compliant solution, in the latter case the function can be provided in line with the requirements of the RoHS Directive.

The applicant says that the weight and volume are in particular important in portable or tour sound applications, additional to other advantages like distortion. The applicant did not prove that his technology is superior in terms of distortion. Nevertheless, the argument is plausible that weight and volume are crucial criteria for mobile use. The applicant says that he does not know of any other voice coil/motor technology that delivers equivalent performance at such low weight. Other manufacturers do not make high performance transducers with such a light weight, according to the applicant. The Professional Lighting and Sound Association (PLASA) supports this exemption request (PLASA Harman.JBL response.pdf). PLASA says that the applicant's patented multi-coil technology cannot be produced in line with the requirements of the RoHS Directive. The stakeholder therefore was asked to confirm that the JBL multi-coil technology currently is the only way to manufacture professional loudspeakers with such low volume and weight at high sound performance and reduced distortion. At the time when this review process was closed, there was no answer from PLASA. Other stakeholder comments were not available.

Within their mandate to review the exemption requests based on the applicants' and stakeholders' information, the consultants thus have to rely on the manufacturers information, which is plausible and complete, as the consultant had requested it. They must



assume that low weight and volume and high performance loudspeakers currently can only be produced with the applicant's patented multi-coil technology implying the use of cadmium.

The consultants do not know whether a further investigation, e. g. at other manufacturers, would have yielded different results. Time contraints limited further assessments.

The RoHS Directive already contains an exemption for the use of lead in high melting temperature type solders (i.e. lead-tin solder alloys containing more than 85 % lead) in entry 7 of the Directive's Annex. The applicant is therefore testing whether the use of such a lead-tin-type solder could be a viable option, but does not yet have a final result.

The consultants additionally doubt that the substitution of 16 kg of cadmium by 19 kg of lead, which would result from the the use of lead-tin solders with more than 85 % of lead, environmentally is a good strategy, the more as it is not clear whether the toxic potential and related risk would actually be lower.

The applicant could be more advanced with his research for a RoHS compliant solution, assuming that there is a reasonable one, if he had started his efforts not just less than one year before the RoHS deadline 1 July 2006. On the other hand, it should be acknowledged that the applicant has changed the transducer design reducing his use of cadmium from around 31 to 16 kg per year.

Taking into consideration all the facts, the consultants recommend granting the exemption with the following wording:

Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers with sound pressure levels of 100 dB (A) and more until 30 June 2010.

The limitation to 2010 is recommended because the applicant has started his efforts only in 2005, although the RoHS Directive had been enacted in 2003 already, as explained above. The applicant thus should be encouraged to boost his research for RoHS compliant alternatives, and he still should have enough time to find a reasonable and environmentally sound solution, which is in line with the requirements and the objectives of the RoHS Directive.

#### 6.31.3 Final recommendation

The consultants recommend granting the exemption with the following wording:

Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers with sound pressure levels of 100 dB (A) and more until 30 June 2010.



The applicant's transducer technology offers advantages – less product weight and volume at high performance - which currently cannot be substituted using a RoHS compliant technology, as to the consultant's knowledge, which they could obtain within their mandate and the available time. Currently, the applicant does not have a RoHS compliant solution for his technology, but he changed the design of his product and thus reduced the use of cadmium from around 31 to around 16 kg. The time limit of 2010 is recommended as the applicant started his efforts to be RoHS compliant late in 2005 only and thus could be more advanced with his research for a RoHS compliant solution.

# 6.32 Lead in thermal cutoffs for special applications – Asco (request Set 4 No. 14)

# 6.32.1 Requested exemption

The company ASCO Valve has requested an exemption for the use of lead<sup>19</sup> in a fusible element itself being part of a thermal cutoff. As such this request overlaps with request nr. 12 set 3 ("8. Cadmium and its compounds in electrical contacts except for applications of one-shot operation function such as thermal links and cadmium plating except for the applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to the restriction on the marketing and use of certain dangerous substances and preparations."). However, request nr. 12 set 3 related to the use of cadmium and not to lead as it is the case here. Furthermore, the applicant has specified his exemption request for applications where normal operating temperature exceeds 140°C and reliable, predictable operation for a minimum of 30.000 hours is required.

The function of lead has not been specified by the applicant but is assumed to be ensuring the desired melting temperature of the fuse. The applicant is not the manufacturer of the thermal cutoff but of solenoid valves for use in hazardous locations. A UL standard<sup>20</sup> requires the involved solenoid coil to have a minimum life of 30.000 hours and the necessity to have a means of limiting the surface temperature to defined safe values when subjected to fault conditions. The applicant states that a thermal cutoff with a lead-based fusible element provides this required functionality (the body temperature of the installed thermal cutoff exceeds 140°C when the solenoid valve is operated within normal limits (not further specified by the applicant).

<sup>&</sup>lt;sup>19</sup> The initial wording included the possibility of the presence of cadmium, mercury and/or hexavalent chromium. However, in the course of the evaluation procedure, the applicant provided a new wording only referring to lead.

<sup>&</sup>lt;sup>20</sup> UL1002: Standard for Electrically Operated Valves for Use in Hazardous (Classified) Locations.



The annual quantity of lead estimated to be put on the market in the EU with the mentioned application is of approximately 2 kg.

The applicant has not specified the RoHS relevant applications in which his solenoid valves are used. He only states that they are used "for hazardous locations in applications including but not limited to the petrochemical and process industry". Further information about the question whether these applications fall under the scope of the RoHS Directive is not available.

The wording proposed by the applicant is

"Thermal cutoff with a fusible element that contains lead for encapsulated solenoid coil applications where normal operating body/surface temperature exceeds 140°C and reliable, predictable, operation for a minimum of 30.000 hours is required."

#### 6.32.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

The applicant states that "there is no lead-free technical solution that provides reliable operation at body temperatures exceeding 140°C". This statement has not been backed-up by supporting evidence. The applicant has only provided evidence on the fact that thermal fuses by NEC/Schott are not intended for applications in safety-relevant equipment, have maximum body temperatures of 140°C and a limited life-time. These thermal fuses are stated to either open when operated at normal conditions or fail to open when operated at fault conditions at operating temperatures experienced by ASCO solenoid coils.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- The applicant has not specified what RoHS relevant applications are targeted with his exemption request and what their technical specifications are related to their use of thermal cutoffs. The only statement given is "there will be cases where a solenoid valve is part of an OEM customer's WEEE product." Furthermore it is stated that solenoid valves are often part of fixed installations. With the available documentation it cannot be assessed whether there any and if which RoHS relevant applications would be covered by this exemption.
- The unavailability of substitutes has not been proven by sufficient evidence. It is technically possible that some RoHS relevant applications may need the described kind of solenoid valves. But without detailed technical specification of those applications it cannot be assessed whether substitutes are available or not.
- The applicant has not provided any evidence on efforts made towards RoHS compliance. It can thus not be assessed whether efforts have been made at all and if so whether they have been made on time to comply with the RoHS Directive.



- Due to the short time period left between end of the stakeholder consultation and drafting of the final report, no further investigation could take place concerning this exemption request.
- Questions that could not be fully clarified are:
  - Detailed description of (technical specifications) of the application in which solenoid valves are needed and declaration whether these applications fall under the scope of the RoHS Directive.
  - Function of lead in this application
  - Proposal of new wording and agreement to it.
  - Availability of such valves in RoHS compliant form.
  - Asking applicant for providing evidence on supplier problems and roadmap of R&D efforts.

#### 6.32.3 Final recommendation

With regard to the above mentioned arguments no founded exemption can be given at this point. An additional round of questions to the applicant and stakeholders would be necessary to give a justifiable recommendation. The time span necessary for this exceeds duration of the contract.

Should a decision be taken on the grounds of the available documentation it is recommended not to grant the exemption due to the missing information – there is no founded justification in line with Article 5 (1) (b).

# 6.33 Mercury free flat panel lamp – Osram (request set 4 No. 15)

# 6.33.1 Requested exemption

Osram and the European Lamp Companies Federation (ELCF) request an exemption for mercury free flat panel lamps (type PLANON®). The lead containing glass solder is used to assemble the flat-panel glass envelope. The specific function of the glass solder is described by the applicant as follows:

"Since PLANON lamps do not use exhaust tubes, an especially designed pump-fill-process that takes place within a vacuum oven has to be used. This process includes the use of a variety of gas atmospheres and related partial gas pressures. The result is a complex interaction between the dielectric layers, the glass spacers and the glass solder/frit. During the pumping process at a certain temperature, the spacers must provide a sufficiently large gap between the bottom and the top glass of the lamp. When the temperature is increased, the top glass must sink toward the bottom glass in such a manner that ensures a good connection between top and bottom glass and simultaneously a tight connection between top



glass and the individual spacers. During this process, the dielectric layers must not build any foam. The temperature dependence of the viscosity of the three lead-containing glass solders/frits has to be such that it supports - for a given amount and form of spacers and thickness of the used sealing frit - the time, temperature, and pressure requirements of the sealing process. The temperature dependence of the three glass solders/frits needs to support the limitations that the sealing process imposes on the amount and thickness of the used frit materials."

The flat panel lamps are used as a light source for several products, e.g.

- LCD monitors
- Photo lighting equipment
- Design luminaire
- Equipment for inspection of radiographies

The total annual amount of lead in this application is about 60 kg (total EU market).

The ELCF suggests the wording for the exemption as follows: "Lead in soldering materials in mercury free flat fluorescent lamps (which e.g. are used for Liquid Crystal displays, design or industrial lighting)".

# 6.33.2 Summary of justification for exemption

The applicant justifies the request for exemption considering several criteria:

- Technically: Mercury free flat panels without lead are not available. At present no lead-free glass solders/frits is available which can meet the process requirements. Development of lead free flat panel lamps could possibly be finished within a 2 year time frame, but the outcome of the lead-free frit development is not predictable.
- Environment: The panels are the first generation of mercury free flat panels; in case of breakage or at end of life there is no impact of mercury like with usual flat panels. The lead used in glass solder and the solder itself are not available to the environment, because the system is closed and at end of life flat panels are recycled.

On inquiry the applicant could provide further information on advantages of mercury free flat panel lamps in comparison to conventional ones being the size (flat lamp), the absence of mercury and the very long lamp life time.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- Data and information given by the applicant are complete and comprehensible. Basically this exemption request should be granted as at the moment no substitutes are existent providing the functionality of the seal frit adequately.
- The requested exemption is similar to a former request (set 2 No. 16); due to not fully comprehensible and complete information the consultants at that time recommended to



grant the former exemption request but using a wording restricting the exemption to a specific application (backlight unit for LCD).

 Taking into account information now available the formerly recommended restricted wording is seen as obsolete.

#### 6.33.3 Final recommendation

With regard to the above mentioned arguments it is recommended to grant this request for exemption. According to the proposal of the applicant the following wording is considered as appropriate: "Lead in soldering materials in mercury free flat fluorescent lamps (which e.g. are used for liquid crystal displays, design or industrial lighting)".

# 6.34 Electronic equipment where the reliability, durability and longevity of the equipment is paramount – Pulsar Light of Cambridge (request set 4 No. 16)

### 6.34.1 Requested exemption

Pulsar Light of Cambridge Ltd. requests the exemption of Tin-Lead 60-40 solder. The applicant does not narrow his request to specific application(s) but states that this solder is used in every application.

The applicant states that 325.000 tons of lead is used annually in the UK by all industries but only 1% i.e. 3.250 tons of this lead is used in the electronic and electrical industries under RoHS, mainly in solder.

Even upon inquiry the applicant was not able to specify his request; the consultants interpret the request with a wording as follows: "Use of tin-lead solder for the production of electronic equipment where the reliability, durability and longevity of the equipment is paramount."

# 6.34.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical, health impacts, environmental and economic arguments:

- The replacement with lead-free solder does not work reliably, while existing tin-lead solder work exceedingly well.
- The replacement with lead-free solders would have no advantages and many defects which will damage the reliability of the applicant's products.
- Reduced reliability, durability and longevity of products would increase the amount of products scrapped and the amount of waste produced.
- Furthermore the applicant argues that there would not be a health issue to solve. Since red and white lead oxides were removed from paint and since lead has been



removed from petrol in the 70's, the level of lead intake in the UK (and presumably in Europe) has fallen to around 1/20th of the World Health Organisation's Provisional Tolerable Weekly Intake of 1,5 mg per person per week.

• Moreover the costs and efforts to mine and extract tin are tenfold higher compared to lead. Replacing abundant lead with more precious tin would not help to conserve and save our planet.

The arguments put forward by the applicant are quite similar to aspects which were discussed regarding other requests for exemption and in relation to a cross cutting stakeholder comment (see section 5). In summary the arguments by the applicant give no reason to grant this request for exemption. Even in applications where extremely strict reliability requirements are existent lead-free soldering was introduced (see section 5).

Furthermore, the applicant failed to define specific applications to be exempted. Therefore, it is not possible to evaluate this request in detail and to identify applications where the request could be justified.

#### 6.34.3 Final recommendation

The general concerns on lead-free soldering are not an argument in line with Article 5 (1) (b). It is assumed that the RoHS Directive was set up with the view that lead-free soldering was a viable technological alternative in order to eliminate lead from electrical and electronic equipment. Against this background and taken the above mentioned arguments into account it is recommended not to grant the exemption.

# 6.35 Lead in copper alloys used in RF applications – Bird Technologies Group (request Set 4 No. 17/18)

# 6.35.1 Requested exemption

Two different recommendations from Bird Technologies Group were posted on the internet (nr. 17 and 18 set 4). However, after reconciliation with the applicant, there is indeed only one exemption requested and one document provided. Since two different titles were used on the Commission's website, the applicant clarified which wording/title should be considered (see below).

The company Bird Technologies Group has requested an exemption for the use of lead as an alloying element for copper used in radio frequency (RF) applications.

According to the applicant radio frequency line sections are typically a copper alloy. Two different styles of parts use this brass:

- 1. Semi Red Brass C84400 and
- 2. 81-3-7-9 or a similar brass material



The first type is used for switching RF from one coaxial connector to another and the second one is used for RF power measurement in a coaxial line. These items are used in commercial equipment with long life. The applicant has not specified for what kind of RoHS relevant applications these kind of RF applications are used.

The applicant describes RF applications as follows:

Machined castings are used for RF applications. "The amount of lead aids in both the machining and casting process. When lower percentage lead is used for manufacturing these parts it results in leaving voids in the machined surfaces. This reduces the ground contact that is required for RF and can causes RF emissions. These are issues both regarding functionally and in meeting the EMC Directive."

RF applications are not finished products that are sometimes used in fixed installations (thus not falling under the RoHS Directive) but the applicant has the goal to state that it is compliant and not limit it to fixed installations. Some of the applicant's products that use the described brass material for RF power measurement are final products and belong to the category of monitoring and control instruments – thus excluded from the scope of RoHS. The applicant furthermore states that some of the products in which RF applications are used with are exempted telecommunications equipment (not further specified in documentation).

The brass parts can have a lead content of up to 8% and are thus not covered by the existing exemption allowing 4% of lead in copper alloys (item 6).

The wording proposed by the applicant is

"Lead as an alloying element for copper for machined cast parts that are used in RF applications, may be up to 8% lead by weight."

# 6.35.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

- The applicant states that reducing the amount of lead in the cast part leaves technically unacceptable finish (this statement is not backed-up by supporting evidence).
- Furthermore the applicant states that it is technically impracticable to use less copper in the machined cast parts since then voids appear and lead to inadequate grounding and shielding characteristics (this statement is not backed-up by supporting evidence).
- The applicant describes his R&D efforts to reduce the amount of lead as follows:
  - 1. "Compression molds with no lead. These work hardened when machining them, and we could not machine them within an acceptable tolerance. 4% lead as an alloy of copper had too much porosity.
  - 2. Other percentages of lead were also tested and found to be unacceptable. Going any lower caused the following issues:
    - Unacceptable microporosity in critical part surfaces.



- Inability to machine parts to the required specifications.
- Machining caused part temperatures to rise to unsafe levels."
- The applicant states to need a machinability rating of at least 90 (? Not explained in documentation) to obtain the tolerances and microporosity that is required for this part (no further technical details specified in documentation). This "high tolerance" is required due to the interchangeability of the RF sampling. The applicant states that this has to be very precise with regard to repeatability and accuracy, also to form a good RF shield and to be able to pass the EMC Directive.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- The applicant has not explained what RoHS relevant applications are targeted with his exemption request and what their technical specifications are related to their use of RF applications in sufficient detail. With the available documentation it cannot be assessed whether there are any and if which RoHS relevant applications would be covered by this exemption.
- The unavailability of substitutes has not been proven by sufficient evidence. It is technically possible that some RoHS relevant applications may need the described kind of RF shields. But without detailed technical specification of those applications it cannot be assessed whether substitutes are available or not.
- The applicant has not provided sufficient evidence on efforts made towards RoHS compliance. It can thus not be assessed whether efforts have been made on time to comply with the RoHS Directive.
- The applicant did not provide data on required production tolerance of the machined castings. Without that information further inquiries on substitutes are not possible.
- Due to the short time period left between end of the stakeholder consultation and drafting of the final report, no further investigation could take place concerning this exemption request.
- Questions that could not be fully clarified are:
  - Detailed description of (technical specifications) of the application in which RF applications are needed.
  - Required production tolerance
  - Proposal of new wording and agreement to it.
  - Availability of such RF applications in RoHS compliant form.
  - Asking applicant for providing evidence on roadmap of R&D efforts.



#### 6.35.3 Final recommendation

With regard to the above mentioned arguments no founded recommendation can be given at this point. An additional round of questions to the applicant and stakeholders would be necessary to give a justifiable recommendation. The time span necessary for this exceeds duration of the contract.

Should a decision be taken on the grounds of the available documentation it is recommended not to grant the exemption due to the missing information – there is no founded justification in line with Article 5 (1) (b). It is assumed that even further investigations would not change the recommendation since the documents provided so far after a first round of questions are not at all comprehensible and complete nor based on technical facts which are generally accepted as minimum for technical specifications.

# 6.36 Lead in solders for electronic equipments used for healthcare, telecare and emergency calls – Telealarm (request set 4 No. 19)

# 6.36.1 Description of requested exemption

The applicant produces devices for health-, telecare and emergency calls for the monitoring, protection and safety of people for private and professional use. He fears negative impacts on people's health and safety, because the long-term reliability of the lead-free soldering technology and the lead-free solder joints over ten years and more has not yet been proven.

The applicant currently uses SnPb36.5Ag1 (tin-lead-silver with 36.5% of lead and 1% of silver) solder and wants to continue its use.

### 6.36.2 Summary of justification for the exemption

#### Applicant's criteria for justification

The applicant maintains that the long-term reliability of equipment produced with lead-free solders is not known and <u>may be</u> inferior to the conventional soldering technology, which is not RoHS compliant. He does not give any evidence for that argumentation. The applicant believes that the absence of proof for the long-term reliability makes the use of RoHS compliant materials scientifically and technically impracticable.

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

Actually, no electric or electronic devices, which have been in the field for more than 10 years, so far has been using lead-free solders. Whether lead-free solders are inferior or not to the conventional solders in terms of reliability can thus not yet be shown based on real life experiences. Thermal cycle tests do not allow a clearer statement either (see ERA Report



2006-0134 - Interim Report about the Review of Directive 2002/95/EC, (RoHS) Categories 8 and 9).

Nevertheless, the automotive electronics industry has started using lead-free solders in smaller product segments or even in serial manufacturing. AB Mikroelektronik in Austria, e. g., uses tin-silver-copper alloys for engine control units in cars, and the company has produced 20 mio. Circuits for oil sensors based on tin-silver-copper alloys for the automobile market (status 2004, see <a href="www.ab-mikro.at">www.ab-mikro.at</a> under "Aktuelles", "Applikationsschrift Bleifreie Löttechnologie", only in German). The automotive industry has extremely strict reliability requirements, e. g. 150 °C operational temperature, 1,000 test cycles from -40 °C to +150 °C, longevity, as well as vibration and temperature shock stability (source: AB Mikroelektronik GmbH).

Parts of the applicant's products are currently out of scope, if they are monitoring and control instruments or medical devices. With this limitation in the scope of the RoHS Directive the legislators allowed for concerns about potential reliability constraints of lead-free solder joints at the time when the RoHS Directive was enacted in 2003. It is currently under review whether category 8 and 9 should be included into the scope.

The applicant therefore does not need an exemption for his products in category 8 and 9, as long as these products are out of the scope of the RoHS Directive. In case these products are included into the scope of the RoHS Directive, it must be assumed that the legislators consider the reliability of lead-free solder joints as adequate for these applications as well. The applicant's reasoning for his application would be obsolete, unless he provides evidence that for his products, unlike the other products in this category, an exemption would be justified. The applicant does not provide such information in his exemption request, but bases his request on the general lack of long-term experiences with lead-free solders.

Given the situation that even the automotive industry uses lead-free solders does not justify a general exemption for the applicant's products outside category 8 and 9. The requested exemption should therefore not be granted.

### 6.36.3 Final recommendation

The exemption should not be granted.

At least parts of the applicant's products are monitoring and control instruments or medical devices (category 8 and 9). As such, the applicant does not need an exemption. In case the category 8 and 9 products will be included into the scope of the RoHS Directive in future, the applicant will have to prove that his products, unlike other products of this category, require an exemption. The exemption request does not provide such evidence.

For the applicant's products outside category 8 and 9, the applicant's reasoning that the lead-free solders could be inferior to conventional ones in long-term reliability does not justify



an exemption. Other producers, e. g. of communication equipment, use lead-free solders, and even the automotive electronics industry with very high short-, medium- and long-term reliability requirements. A general exemption for his products, as the applicant intends, is therefore not justified.

# 6.37 Lead solders in FPGA devices – Harman Pro (request Set 4 No. 20)

# 6.37.1 Description of requested exemption

The company Harman Pro has requested an exemption for the use of lead in solders in specific devices:

- 1. XC5202-6VQ100C
- 2. XC4003E-3VQ100C
- 3. XC4013E-3PQ240C

These devices belong to the product family FPGA. The applicant has not explained what this acronym means and what applications is thereby referred to.

The lead solder is used in the plating of the devices legs for the device termination and solderability. The devices themselves do not fall under the scope of RoHS but are themselves part of an audio product. The applicant has not specified what kind of audio products these may be and under what WEEE category they would fall.

Devices number 1 and 2 contain 0,0089 g lead solder while device 3 contains 0,0678 g both used in the device lead plating. This equates to 5,6% and 8,1% respectively as percentage of the total lead frame alloy. Total annual amounts in the EU have not been provided – even after explicit request.

The applicant has not provided any wording for the exemption.

# 6.37.2 Summary of justification for the exemption

The applicant justifies his request for exemption with technical arguments:

- The applicant states that "the manufacturer (Xilinx) has made the decision not to manufacture these FPGA devices lead free". In the request it is said that no direct equivalent exists for the three devices and that the manufacturer has scheduled discontinuance of the devices in December 2005 (probably, because the applicant has written "2006") and has planned continued manufacture of 3 3V3 version (not further specified).
- The three above mentioned FPGA operate on 5 Volt as it is the case for "all of the other related logic devices" (not further explained / specified by the applicant). The applicant claims that "all logic devices that interface with the FPGAs must work on the same operating voltage". Therefore the devices would need an extensive redesign to



generate 3 Volt and replacement of all the interface logic. According to the applicant this is "technically impracticable" since it would require 1 man year of electronic design and 6 man months to incorporate the associated software changes required.

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- The applicant has not specified what RoHS relevant applications are targeted with his exemption request and what their technical specifications are related to their use of FPGA devices not even detailing what FPGA devices are and what they are needed for. With the available documentation it cannot be assessed whether there are any and if so, which RoHS relevant applications would be covered by this exemption.
- The unavailability of substitutes has not been proven by sufficient evidence. It is technically possible that some RoHS relevant applications may need the described kind of FPGA devices. But without detailed technical specification of those applications it cannot be assessed whether substitutes are available or not.
- The applicant has not provided any evidence on efforts made towards RoHS compliance. It can thus not be assessed whether efforts have been made at all and if so whether they have been made on time to comply with the RoHS Directive. The only evidence provided is a test report certifying that the three devices only contain lead as RoHS relevant substance.
- No wording has been provided by the applicant.
- Due to the short time period left between end of the stakeholder consultation and drafting of the final report, no further investigation could take place concerning this exemption request.
- Questions that could not be fully clarified are:
  - Detailed description of (technical specifications) of the application in which FPGA devices are needed.
  - Proposal for wording and agreement to it.
  - Availability of such devices in RoHS compliant form.
  - Asking applicant for providing evidence on supplier problems and roadmap of R&D efforts.
  - Clarifying whether the request belongs to the category of last time buys.
  - If so, the volume and design cycles of LTB components, the quantity of stocked components and time needed for phasing out these stocked components, evidence on the redesign process as well as request on written proof / confirmation of the suppliers.



#### 6.37.3 Final recommendation

With regard to the above mentioned arguments no founded exemption can be given at this point. An additional round of questions to the applicant and stakeholders would be necessary to give a justifiable recommendation. The time span necessary for this exceeds duration of the contract.

Should a decision be taken on the grounds of the available documentation it is recommended not to grant the exemption due to the missing information – there is no founded justification in line with Article 5 (1) (b). In this case there is not even the assumption that an additional round of questions would give enough evidence to justify an exemption. Probably only an intensive communication with the applicant would clarify what exactly is requested to be exempted and whether there is any justification available in line with Article 5 (1) (b) or maybe whether this request belongs to the category of LTB issues.

# 6.38 Lead oxide in seal frit used for making window assemblies for argon and krypton laser tubes – Coherent (request set 4 No. 21)

#### 6.38.1 Requested exemption

Coherent has requested an exemption for lead oxide in seal frit used for making window assemblies for argon and krypton laser tubes. Depending on the application, some of these laser tubes are already covered by existing exemptions (e.g. the use in a medical device to perform eye surgery) while the use of the laser as tool on a stand-alone basis or as a light source for scientific investigation is not explicitly exempted up to now.

Lead oxide is used as frit sealing, meaning bonding the front and rear crystalline quartz windows to crystalline quartz stems that are themselves vacuum sealed to the laser tube assembly using indium.

Typical quantity of lead per laser tube is about 10 to 20 milligram, the total amount in the applicant's annual shipment into the EU is less than 5 g (including both exempt and non-exempt applications).

The applicant suggests the following wording for the exemption:

"Lead oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes."

#### 6.38.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

 Despite years of ongoing development the applicant has no feasible substitute for the use of lead oxide. Due to intractable constraints on the manufacturing process' temperature and on the properties and composition of the window bonds it is



technically and scientifically impracticable to exclude lead-containing seal frit form the manufacture of their products.

- Lead-free frit materials (e.g. bismuth- or phosphorus-based glasses) are in the exploratory stage and not developed technically or commercially to be a viable alternative for the applicant.
- Optical contacting as an alternative approach was considered. Due to the high requirements (axial alignment of the window) it was not possible to achieve better than 50 % yield (compared to 97 % yield with the current frit process).

A critical review of the documents made available by the applicant and of further data and information given by other parties lead to the following observations and conclusions:

- The applicant provided comprehensive data and information on possible substitutes and technologies.
- There are obviously similarities to the use of lead oxide in other applications requested for exemption (set 1 No. 6, set 2, No. 9 and 19, set 4 No. 15). These requests were recommended to be granted against the background that currently no viable substitutes for lead oxide as seal frit are available.

#### 6.38.3 Final recommendation

With regard to the above mentioned arguments it is recommended to grant this exemption. From the consultant's point of view the wording suggested by the applicant seems to be appropriate:

"Lead oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes."

# 6.39 Smart card readers (product: GemSelf700-MS2, GCR700-3ZS, Vodafone D2, GCR760 and GemSelf750 SV) – GEMPLUS (request set 4 No. 22)

# 6.39.1 Requested exemption

Gemplus S.A. (France) requests an exemption for five types of special standalone smart card readers; product commercial names being:

- GemSelf700-MS2
- GCR700-3ZS
- Vodafone D2
- GCR760
- GemSelf750 SV



These products are used for healthcare and telecommunication (to copy content of SIM cards).

According to the applicant a small number of components and assemblies of these products will not be converted to lead-free solder by their manufacturers since they are custom designed and in many cases are now obsolete and have been stockpiled in a "Last Time Buy". The custom assemblies include specialised chip-set component, power supplies, small display and specialised connectors.

Lead is present in the tin-lead solder used on the component leads, or as part of some components. The corresponding weight of lead is about 9 g for the power supply and less than 1 g for the overall process assembly. The total quantity of lead p.a. is below 10 kg.

The applicant suggests the wording for the requested exemption as follows: "Temporary RoHS exemption for 18 months from the requirements of article 4(1) of Directive 2002/95/EC for specific application of lead on the five products listed hereunder, in accordance with Article 5 and 6 of Directive 2002/95/EC: Smart card readers (product: GemSelf700-MS2, GCR700-3ZS, Vodafone D2, GCR760 and GemSelf750 SV."

# 6.39.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical and economical arguments and the specific conditions of the supply chain:

- Substitute modules or components are not available due to their custom nature and the ability of the vendor or competitive vendors to provide suitable replacements.
- The sub-contractors, manufacturers of those custom modular components, are not all planning to convert to lead-free due to the low volume of business. Many of these devices are near the end of their business life. The only solution for the equipment integrator will be to redesign the system to replace the affected modular functions. To restart the development at sub-contractors requires new tooling and set up of new production processes but is not viable doe to the low volume of the production. Fully ROHS compliant designs are in process for the next generation of equipment due to be released end of 2007.
- It is not technically or economically feasible to develop substitute components. New products that are currently in development or on Product Roadmaps will ultimately replace products containing these components. Since these products will not all be in production by July 1, 2006, Customer contracts and requirements dictate continued manufacture of current products.

A critical review of the documents made available by the applicant lead to the following observations and conclusions:



The request is justified with arguments belonging to the group of LTB requests. The problematic inherent to those requests as well as the general evaluation procedure is described in section 5 of monthly report 8.

It is a fact that the LTB issue is relevant for a number of companies and that in some cases substitution is not technically feasible. It is also a fact that scrapping components that could be used in equipment represents an unnecessary environmental burden. Nevertheless a minimum of information is required in order to do proper evaluation of this request.

Applying Article 5 (1) (b) there is no in-line justification available regarding this request since no evidence was provided on

- the amount of components on stock for the mentioned application,
- the duration of design cycles,
- the volume of produced equipment containing LTB components,
- starting point of efforts towards RoHS compliance (including e.g. evidence on end of production by suppliers, proof that components are not available in RoHS compliant version, efforts for re-design) and point of time of the LTB order and
- technical specifications of the assemblies in question.

This data and information is, however, needed for a proper evaluation of a potential justification of a request.

#### 6.39.3 Final recommendation

With regard to the above mentioned arguments no founded recommendation can be given at this point. An additional round of questions to the applicant would be necessary to give a justifiable recommendation. The time span necessary for this exceeds duration of the contract.

Should a decision be taken on the grounds of the available documentation it is recommended not to grant the exemption due to the missing information – there is no founded justification in line with Article 5 (1) (b). It is assumed that even further investigations would not change the recommendation since the documents provided so far after a first round of questions are not at all comprehensible and complete.

# 6.40 Use of mercury in Babcock's DC plasma displays and use of Lead Oxide (PbO) in Babcock's DC plasma displays frit seal – Babcock (request set 4 No. 23)

# 6.40.1 Requested exemption

Babcock (La Mirada, U.S.) requests an exemption for

use of mercury in Babcock's DC plasma displays, and



use of Lead Oxide (PbO) in Babcock's DC plasma displays frit seal.

According to the applicant the functionality of the restricted substances can be summarised as follows:

- Mercury is hermetically sealed in the DC plasma display and is used to retard the cathode sputter onto the anode electrodes. Without the use of mercury in DC plasma display the sputtering of cathode will completely deplete the cathode material. The sputtered cathode materials deposited on the anode electrodes will also cover the pixel glow viewing and render the pixel non-viewable. DC plasma display life expectancy without the use of mercury is only a few hours as apposed to 20000 hours with the mercury inside.
- Lead Oxide (PbO) is used in frit sealing (glass sealant), cathode, anode, pad termination electrodes and dielectric thick film past in Babcock's plasma displays when mixed with other materials it exhibits excellent thermal properties. It's coefficient of thermal expansion is compatible for sintering thick film pastes at temperatures from 450-600°C. Lead oxide in the frit sealing makes the hermetic sealing of the DC plasma display possible.

The applicant's DC Plasma display has between 3,5 to 30 mg of mercury per unit. Amount of mercury is dependent on total cathode area. The displays can weight from 4 to 500 grams. Mercury percentage by weight range from 0,006 to 0,09 % in the DC plasma display. The total amount of mercury (Hg) in the applicant's DC plasma displays for use in the EU market is estimated to be less than 150 grams.

The applicant's DC plasma displays has between .3 to 13 grams of Lead Oxide (PbO) per unit. Assuming the total weight as mentioned above, lead oxide percentage by weight range from 2,6 to 7,5% in the DC plasma display. The total annual usage of Lead Oxide (PbO) in the applicant's DC plasma displays for use in the EU market is estimated to be less than 90 Kg.

The applicant suggests the wording for the requested exemption as follows:

"Exemption for lead to be use in DC plasma displays, maximum amount not to exceed 13 g per display."

"Exemption for mercury to be use in DC plasma displays, maximum amount not to exceed 30 mg per display."

# 6.40.2 Summary of justification for exemption

The applicant justifies his request for exemption with technical arguments:

 Substitution or elimination of mercury in DC plasma display is currently technically not available. The applicant has spent 2 years working with Dupont electronic division to develop mercury free DC plasma display and thus far no substitution was found that



enable the DC plasma operate more than few days versus typical 20,000 hours in a DC plasma display with mercury inside.

- Currently mercury alternative are not capable of inhibits sputtering of cathode onto the anode electrode in DC plasma displays.
- Substitution of elimination of Lead Oxide (PbO) in DC plasma display is currently technically not available. Substitute material have to be capable firing between 450-600°C and have expansion coefficient compatible with soda lime glass substrate. It must be chemically inactive to the electrode material during sintering. Phosphate based (P2O5) glass is a well know substitute for lead (lead oxide) but its poor water resistance and poor chemical stability make it poor material to use in DC plasma display. Bismuth oxide has been studied as substitutes for lead in the frit seal but bismuth has major limitation, as it crystallizes during firing and thereby significantly degrades the frit seal reliability.
- Therefore lead free alternatives do not satisfy the requirements as follows:
  - Capable of adjusting the softening temperature between 400-600°C
  - Having expansion coefficient matched to that of glass substrates.
  - Having chemical stability inactive to the conductor and dielectric materials during firing.

Furthermore the applicant states that there are overlapping aspects between this request for exemption and former requests concerning lead in PDP-panels.

A critical review of the documents made available by the applicant lead to the following observations and conclusions:

- The applicant has provided complete as well as comprehensible information about the use of the restricted substances and concerning the availability of substitutes.
- As result of an evaluation of former requests, the Consultant recommended the following exemption (cf. set 1 no. 6 and set 2 no. 19; monthly Report 4): Lead as lead oxide in plasma display panels (PDP) and surface conduction electron emitter displays (SED) used in structural elements; notably in the front and rear glass dielectric layer, the bus electrode, the black stripe, the address electrode, the barrier ribs, the seal frit and frit ring as well as in print pastes.
- This wording does not distinguish between AC and DC technology; therefore it is according to the consultant's point of view not necessary to add a new exemption to the recommended existing one.
- The only new exemption would be necessary concerning the use of mercury in the displays.



#### 6.40.3 Final recommendation

With view to argumentation mentioned above, basically it is recommended to grant the requested exemption. However, although the applicants has been asked to check and justify his request with already existing requests and / or exemptions the applicant has suggested an independent wording for his request concerning the use of lead. Against this background an additional round of questions to the applicant would be necessary in order to clarify the need for an independent wording. The time span necessary for this exceeds duration of the contract. Therefore it is impossible to propose an unambiguous wording for the recommended exemption at this point of time.

# 7 List of external experts

During the evaluation work, the consultants contacted a certain amount of external experts where this appeared to be necessary. However, most of the time applicants and stakeholders themselves are the experts in the field of an application for which an exemption is requested. Therefore, the external experts contacted often came from:

- competing companies
- suppliers advertising RoHS compliant components
- applicant's or stakeholder's suppliers

In addition experts belonging to neutral institutions were also contacted. They came from the following areas:

- universities (e.g. research on glass, minerals)
- governmental bodies and research institutes (e.g. the German Physikalische Technische Bundesanstalt was contacted)
- NGOs (e.g. EEB was contacted when it had to be dealt with mercury relevant issues)
- Internal resources (both Öko-Institut and Fraunhofer IZM can rely on a broad base of in-house experts not directly working within the RoHS exemption evaluation work but having extensive knowledge in fields like lead-free soldering and "green electronics" in general, toxicology, hazardous substances in the waste stream, chemistry, eco-design, home appliances, consumer electronic and lighting).

Experts are not listed here with their name and function as well as their institution / organisation since the information provided has often been a short-term oral communication which does not have the weight of a written piece of evidence. Therefore, experts want to be kept anonymous. This again reflects the fact that access to publicly available information is very difficult (cf. conclusions below in section 8) and that information can often only be obtained on a semi-confidential basis making its use within the evaluation work difficult. This why the consultants have mostly refrained from citing oral information given by external experts.



A general overview on the experts contacted is given here:

- Two European whisker experts from industry
- Expert on connectors from component industry
- Manufacturer of linear and switched mode power transformers
- Expert from component industry about availability and design of RoHS-compliant ASICs
- Expert on audio systems from industry
- Three experts on thick layer hybrids on (beryllium-oxide) ceramics from industry
- Thickfilm material supplier for use on beryllium-oxides
- Manufacturer of quartz crystal resonators in Japan and Germany
- Three experts on manufacturing of solenoids and solenoid valves
- Two manufacturers of sounders for use in emergency equipment
- Expert on galvanic processes from industry
- Expert on circuitry layout from industry

# 8 Overall conclusions

In this chapter the consultants would like to summarise a few points that have occurred during the evaluation work.

# 8.1 Procedural questions

In the course of the evaluation of request for exemption the following points were observed as being crucial or problematic concerning the process in itself. Possibilities for improvement are also mentioned.

- Applicants are often not aware of the "right" or the "best" way to bring forward an exemption request. The crucial questions for the evaluation such as a detailed technical description of the function of the substance as well as of the component in which the substance is used are often not answered. Other important points like providing evidence on R&D efforts made towards RoHS compliance, information on involvement of suppliers or reasons why RoHS compliant components of competitors cannot be used in a specific application are also often not mentioned.
- A possibility for improvement would be a better communication of what exactly makes a successful exemption request and what exactly the formal needs are that applicants have to fulfil. This appears particularly important as many applicants did not seem to understand the difference between bringing forward an exemption request and submitting a stakeholder comment.



- Stakeholder comments that are submitted during the public stakeholder consultations are not directly allocated to the corresponding request. The database set up by the Commission (Circa) makes it difficult to keep an overview on what comments refer to what request and where new documents are posted along the duration of the consultation as well as afterwards.
- Stakeholder commenting should thus be asked to clearly identify which request they are referring to. That way the comments can easily be associated to the respective requests. This is very much lowering efforts that need to be made before the evaluation can start.
- It seems that the public stakeholder consultations are not well enough known among relevant actors since in many cases competitors producing RoHS compliant alternatives have not brought forward comments in that sense. This, however, is crucial for a sound evaluation. The market itself bet knows where alternatives are feasible and where not.
- In the future publicity and enhanced communication of the possibility to comment on exemption requests should be used in order to gather more valuable information.
- It has appeared that the evaluation process itself is very lengthy and demanding: stakeholders and applicants need be contacted and addressed with need for clarification. Sometimes it is even necessary to organise meetings between all stakeholders since the questions looked at are of so specific nature that they can only be answered by the practical experts themselves.
- Initially, the Commission intended the review and evaluation work to be carried only on the basis of the documentation available from the applicant as well as from documents made available by stakeholders during the public stakeholder consultations. This has appeared to be impossible if a sound recommendation shall be given. It is therefore highly recommended to review the evaluation process with a view to integrate the need for massive additional efforts needed for research and gathering of additional information. If recommendations are to be given on the basis of the available information this may lead to significant misinterpretations and unqualified assessments due to a lack of information. The questions looked at are of such specific technical nature that a general assessment can not be done without prior analysis of the market situation, technical details as well as detailed inquiries of the applicant's situation regarding efforts made towards RoHS compliance.

# 8.2 Environmental impact of substances

Article 5 (1) (b) of the RoHS Directive includes the criteria of environmental impact as regards the hazardous substance that has to be substituted in comparison to possible alternatives. Even though this is in principle a sensible basis for an evaluation, it has



occurred that due to missing information on existing alternatives and their environmental impact it can often not be assessed which alternative is the "better" environmental choice.

For example, gold is a RoHS compliant alternative to lead when it comes to soldering issues. However, gold is said to have a more negative impact on the environment than lead. But there are no publicly available documents that can prove that statement. Therefore an evaluation sticking closely to Article 5 (1) (b) cannot take that argument into consideration. This is also the case when looking at substitute materials whose negative environmental impact is not fully experienced yet and thus not well documented.

# 8.3 Aspects beyond criteria Art. 5 (1) (b)

Technical feasibility of substitution and environmental impact of substances are criteria listed in Article 5 (1) (b). Even if these criteria appear to be sensible in view of the assessment of exemption requests, they leave a lot of room for interpretation. Furthermore they do not take into account that general environmental policy goals sometimes go beyond such narrowly defined criteria.

For example questions relating to a phase-out period of a substance in a certain application cannot be assessed when applying these criteria. Alternatives might be available on the market but not for an application that is itself running out of business life. Or the supply chain might not be willing to work towards RoHS compliance in close cooperation with the manufacturers.

Another aspect beyond the criteria of Article 5 (1) (b) is the question of economic impact for small and medium enterprises (SMEs). These are the ones that are particularly struggling with the requirements of the RoHS Directive. Especially in the field of highly specialised products sold in small amounts and with long design cycles, a re-design may signify bankruptcy for a SME. This is especially the case for requests belonging to the LTB category.

# 8.4 Future prospects

It is inherent to legislation like the RoHS Directive that not all special cases can be taken into account when drafting the legislation. Therefore, Article 5 (1) (b) did provide the possibility of requesting exemptions from the requirements of the Directive. Nevertheless, the field of electrical and electronic equipment is characterised through complex products in a huge variety of applications. All aspects that occur on the way to more efficient and less harmful products cannot be covered by the provision given in Article 5 (1) (b).

Should the RoHS Directive be reviewed it is thus recommended to adapt the criteria that should be applied for exemption requests. Otherwise the legislator should at least consider a practical procedure on how to implement the criteria of Article 5 (1) (b) in practice for the future evaluation work.





# Annex I: Monthly reports 1 – 9

See attached pdf files.

# **Annex II: Thomson product list**

See attached Word file "Annex II THGV\_Products\_6202.doc".

# Annex III: Swatch additional information

See attached pdf file "Annex III Working for pb-free.pdf"