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

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Monthly Report 9

- final -

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Content

1 Background and Objectives

Article 4 (1) of Directive 2002/95/EC on the restriction of the use of certain hazardous sub¬stances 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 Commission has received (and is still receiving) additional requests for applications to be exempted from the requirements of the Directive from industry. These requests need to be evaluated in order to assess whether they 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 contract consists in a clear assessment of whether the requests for exemptions are justified in line with the requirements listed in Article 5 (1) (b) and in a subsequent recommendation on whether or not to grant the exemption – including a precise wording. These recommendations as well as the description of the proceeding will be included in monthly reports between October 2006 and October 2007.

2 General Procedure

For details on the general procedure please refer to monthly report 1.

3 Scope

On 10 November 2006 the sixth stakeholder consultation round was launched by the Commission and closed on 10 January 2007 (set 6). A seventh stakeholder consultation round was launched on 15 June 2007 and will close on 10 August 2007 (set 7). The requests open for comments of these two consultation rounds represent the scope of this ninth monthly report and of the current and forthcoming evaluation.

Concerning set 6 some stakeholder comments have been posted on the consultation website concerning requests 1, 7, 15, 18, 22 and 23 as well as one general comment. Since for set 7 the consultation has been launched just before issuing this report, only two comments concerning requests nr. 3 and 4 have been posted on the consultation website.

Table 1 and Table 2 below give an overview over the corresponding sets of requests for exemption and their current status.

Table 1: Overview status of requests set 6

No.	Title	Applicant	Status
1a	Lead used for shielding of x-radiation emissions for CRT	VDC Display Systems	**WITHDRAWAL 11/12/06**
1b	Hazardous materials and lead in solders in components and assemblies used in non-consumer products	VDC Display Systems	**WITHDRAWAL 11/12/06**
1c	Electronic equipment where reliability, durability and longevity of the equipment is paramount	VDC Display Systems	**WITHDRAWAL 11/12/06**
2	Lead as soldering alloy in high performance communication electronic board and hexavalent chromium (Cr-VI)	Clarity SAS	**WITHDRAWAL 18/12/06**
3	GemCore 410 EMV	Gemplus	Recommendation given in monthly report 6.
4	SAVBIT solder	Roband Electronics PLC	Final clarification with applicant in progress.
5	Sn-Pb soldering used in Ground-based Aeronautical Communication Equipment Manufacturing	Telerad	Recommendation given in monthly report 8.
6	Transducers used in professional loudspeaker systems, using tin-lead solder	Gemini Sound products Corp.	Recommendation given in monthly report 5.

No.	Title	Applicant	Status
7	Tin-lead solder in the manufacture of professional audio equipment	Gemini Sound products Corp.	Recommendation given in monthly report 5.
8	Inventory of special ICS having tin-lead solder on/in leads/balls, used in specialist/professional equipment	Gemini Sound products Corp.	**WITHDRAWAL 02/01/07**
9	Crystal Stones within the battery operated watch	Zeon Ltd.	**WITHDRAWAL 10/01/07**
10	EEE used for the broadcast and homeland security sector	Tieline Technology	**WITHDRAWAL 26/2/07**
11a	AM186ES-V40 containing lead in used in the leads over plating and AM79C961AKC containing lead in used in the leads over plating	Digigram	Recommendation given in monthly report 6
11b	Audio board manufacturing process	Digigram	Recommendation possible (cf. section 5.1)
12	Cadmium sulphide or cadmium selenide in polymer based thin film transistor	Silk Displays Inc.	Recommendation possible (cf. section 5.2)
13	Lead used in the soldering for surface finishing at the electric pole terminal on the electronic parts	ICOM Incorporated	Recommendation given in monthly report 7.
14	Cadmium contained in the cadmium oxide of a thick film ceramic substrate	ICOM Incorporated	**WITHDRAWAL 15/06/07**
15	All electronics assemblies using lead in solder	RoHSUSA Inc	Recommendation given in monthly report 3.
16	Lead in electric overblankets for Hot Spot detection	Beurer / Especialidades Eléctricas Daga S.A.	Recommendation given in monthly report 5.
17	MPC10 used in automatic vending machines to achieve the payment by card	Sagem monetel	Recommendation given in monthly report 7
18	Hexavalent Chrome Cr-VI when used as a passivate	Amphenol Limited	Recommendation given in monthly report 7

No.	Title	Applicant	Status
19	Lead contained in circuit boards, obsolete and non-compliant Intel 80c188/86 EA\XL microprocessors, Analog Devices ADMC300 DSP, and NEC uPD7101 DART and hexavalent chromium	NBS Technologies Inc.	Recommendation possible (cf. section 5.3)
20	Component used in the manufacture of electric blankets and heating pads	Thermocable (Flexible Elements) Limited	Recommendation given in monthly report 5.
21	Request to delete exemption for "Lead as impurity in RIG (rare earth iron garnet) Faraday rotators used for fibre optic communications systems	Integrated Photonics	Recommendation given in monthly report 6
22	Lead in Trimmer Potentiometer elements	Tokyo Denshi Ltd.	Questions sent out 7/5/2007. Answers received 14/06/2007. Evaluation and further clarification in progress.
23	Cadmium in opto-electronic components	Marshall Amplification plc	Questions sent out 7/5/2007. Answers not yet received. Evaluation and clarification with stakeholders in progress. Overlapping with set 7 no. 4.

Table 2: Overview status of requests set 7

No.	Title	Applicant	Status	Overlapping
1a	Extension of Exemption #21 as listed in Annex 1 of 2002/95/EC	ELCF	No questions sent out yet	Overlapping with former request (set 1 no. 2b; cf. monthly report 3 of former contract)
1b	Lead in silver rings on the exterior lamp surface of induction-type fluorescent lamps	ELCF	No questions sent out yet	Overlapping with former requests (set 1 no. 13 – 17; cf. monthly report 2 and 4 of former contract)
2	Use of mercury in plasma displays	Babcock	No questions sent out yet	Overlapping with former request (set 4 no. 23) and exemption in force (entry no. 24)

No.	Title	Applicant	Status	Overlapping
3	Cadmium in photocells for accurate control of lighting equipment	Silonex	No questions sent out yet	Overlapping with former request (set 1 no. 21; cf. monthly report 5 of former contract)
4	3 year grace period on the use of cadmium-based photoresistors used in professional audio equipment, for the purpose of investigating suitable alternatives and redesigning audio products accordingly	Sound Devices	Evaluation in progress; in parallel with request no. 23 set 6	Overlapping with former requests (set 4 no. 5 and set 6 no. 23; cf. final report of former contract and forthcoming monthly report)
5	RELOCK FUSE, Model X-09, High Security Electronic lock	Kaba	No questions sent out yet	Overlapping with former request (set 3 no. 12; cf. monthly report 9 and final report of former contract)
6	Lead in glass housing of high voltage diodes	Vishay	No questions sent out yet	Overlapping with former request (set 1 no. 2b; cf. monthly report 3 of former contract)
7	Cadmium and cadmium oxide in thick film pastes used on beryllium oxide substrates	Apex	Recommendation possible (cf. section 5.4)	Overlapping with former request (set 4 no. 1; cf. final report of former contract)

4 Results

Questions have been sent out to all applicants of set 6. Due to sometimes complex technical issues, evaluation of three remaining open requests is not yet finalised: no. 23 is overlapping with request no. 4 of set 7. Evaluation of these two requests will be done in parallel in order to ensure a consistent recommendation. No. 4 and no. 22 require extensive e-mail and telephone exchange with the applicant, competitors and third party experts and will be finalised for the draft final report.

Concerning the newly launched consultation on set 7, no questions have been sent out to applicants yet. Requests have in a first step been analysed with regard to overlapping issues. As a result it came out, that most of the requests have a direct link to former requests and will thus be evaluated in that light. Exemption request no. 7 is already evaluated since no questions were needed for clarification. Exemption request no. 4 is already being evaluated since it is the direct continuation of request no. 23 of set 6.

5 Recommendations

5.1 Audio board manufacturing process – Digigram (set 6 request no. 11_b)

5.1.1 Description of requested exemption

Digigram requests an exemption for the audio board "MIXART 8" containing lead in one of its components. The audio board is used in applications belonging to category 3 WEEE Directive; more specifically in PCs used for e.g. radio broadcasting.

Due to technical problems in soldering the component (inter alia temperature, shock resistance) onto the audio board, Digigram used lead containing solders since the application of a similar RoHS compliant component created high failure rates of the audio board.

Since Digigram produces its audio board in low volumes, for specialised applications and since the MIXART 8 is an end-of-life product (it will run out of production and application within the next year, i.e. by mid 2008), Digigram cannot economically justify a complete re-design and would need an exemption to be able to market the remaining 200 – 600 boards with approximately 30 – 40 g of lead each (which would sum up to approximately 15 kg of lead) as RoHS compliant. The product's lifetime is of about 5 years (MIXART has been on the market since 2002 / 2003). The main market for Digigram's products is the US but a few customers of this highly specialised equipment remain in the EU and would like to purchase this board.

A new RoHS compliant product range to replace MIXART 8 is under development and will probably be finalised by mid – end 2008.

The applicant has not proposed any wording for an amendment of the Annex to the RoHS Directive.

5.1.2 Summary of justification for exemption

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

- A RoHS compliant component is available but creates too many technical problems. However, no written evidence / proof have been provided by the applicant. Non RoHS compliant production has thus been continued since production volumes are low, the product will run out of production by mid 2008 and market demand in the US is to be met. In order to satisfy market demand on the EU market, an exemption request is needed.

- Investigating in long and costly trials in order to replace the existing non RoHS compliant component on the MIXART 8 audio board is too costly for Digigram (same argumentation as above: small volumes, end-of-life product).
- Amount of lead concerned by a possible exemption is very low (approximately 15 kg) and presence on the EU market is limited to 5 years. After that audio board reaches end-of-life and will anyway be replaced.

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:

- Even upon several requests, the applicant did not provide any written evidence and information on:
  - More details on applications covered by the exemption request, their functionality and the functionality of the compound containing the restricted substance (e.g. performance criteria, circuit diagram, data sheet, …).
  - Wording of the requested exemption
  - Volumes and design cycles of the end-of-life components
  - Starting point of RoHS compliance activities
  - Re-design process (e.g. roadmap)
- The applicant has however well explained orally what his feasibility problems are and why an exemption is needed.
- Looking at the applicant's statement that the audio board has a remaining life time of approximately one year (until mid 2008) and assuming that the request for exemption would only be decided upon within EU institutions within a minimum of 9 months from the date of this report's submission to the Commission, the component would be phased-out within 3 more months thus making an exemption nearly obsolete by then.
- The exemption request is not well justified as regards technical and scientific impracticability of RoHS compliant solutions. It is thus not justified according to Article 5 (1) (b). However, it has to be noted that this request is similar to many other requests including the same problem with regard to highly specialised applications, produced in low volumes, containing low amounts of lead and reaching their end of life within a relatively short time span. Going beyond criteria of Article 5 (1) (b) an exemption limited in time would hence be appropriate.

5.1.2.1 Final recommendation

Since the applicant could not bring forward sufficient argumentation and evidence - in line with Art. 5 (1) (b) – concerning his exemption request and since it is assumed that the necessity of an exemption will not be maintained beyond mid 2008, it is recommended not to grant the exemption.

Nevertheless, the attention is drawn to the fact that this exemption request belongs to the lot of end-of-life products and that an evaluation sticking closely to Article 5 (1) (b) does not seem to be adequate. For many of the applicants the administrative costs and the costs associated with a redesign are not justifiable with regard to the low production volumes and the short remaining business life time of their products.

5.2 Cadmium sulphide or cadmium selenide in polymer based thin film transistor arrays used in AMLCD – Silk Displays (set 6 request no. 12)

5.2.1 Description of requested exemption

Silk Displays requests an exemption for the use of CdS or CdSe as semiconductor used in TFTs (Thin Film Transistor Arrays). These are used to produce flexible active matrix displays (AMLCD) and are fabricated onto a polymer material which gives the displays flexibility and ruggedness. At the time of the issue of the exemption request, there is no commercial availability of this product. Silk Displays projects its initial product introduction to take place in the fourth quarter of 2007. The flexible displays are then always to be part of another equipment set (e.g. in aerospace and mobile equipment markets or in home computers or laptops).

The intention of the use of polymer instead of glass (as done in current AMLCDs) as primary structural layer is to have advantages when displays are used in rugged environments and need shock absorbance (e.g. use in the field, in vehicles, industrial settings or in settings where display might be subject to abuse such as kiosks.

“The use of polymer in place of glass will require TFTs that can be fabricated by low temperature processes. TFTs can be fabricated from CdS and CdSe as the semiconductor material in temperature regimes compatible with polymers. Typically, a plastic super VGA (SVGA) display with a resolution of 1280 x 1024 pixels, screen size of 21 inches diagonal, will contain 1.65 milligrams of cadmium. The cadmium sulphide or cadmium selenide is bonded and sealed within the polymer structure of the display. This construction renders the cadmium sulphide or cadmium selenide inert. Using plastic as the substrate for TFT arrays further allows development of displays which can be curved or shaped to better fit the application. This cannot be done with glass based units.”[1]

The applicant did not provide information on the amount of Cd in the homogeneous material.

The wording proposed by the applicant is:

“Use of cadmium sulphide or cadmium selenide in polymer based thin film transistor arrays used in active matrix liquid crystal displays.”

[1] Extract from the applicant’s exemption request („RoHS Exemption Application 20060511.pdf” available at http://ec.europa.eu/environment/waste/rohs_6_consult.htm)

5.2.2 Summary of justification for exemption

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

- The applicant states that currently there are no commercially viable fabrication techniques which can produce TFT arrays on polymer substrates. Hence, Silk Display's upcoming technology using such TFT arrays on polymer substrates has no feasible substitutes according to the applicant.
- He furthermore argues that in certain applications, the weight of AMLCD will impose penalties and may be "aesthetically unacceptable". The applications given as example for this argument are: "Aircraft installations using hardened mountings will face increased weight, depending on the number of installations, and the consequent increase in fuel consumption. In portable units, the increased weight decreases the unit's portability and may, in many cases, be aesthetically unacceptable, such as installations in passenger transport vehicles. In the event of a significant impact, possibly from a vehicle collision, a heavy, hardened display may become an inadvertent projectile."
- Furthermore, the applicant argues that glass is not always an ideal structural element, particularly in rugged environments where a more shock absorbent material such as polymer would be more useful.
- In general it is stated that for applications needing a curved display, there are no glass based alternatives available.

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:

- From the applicant's exemption request it cannot be seen what proof / evidence exist with regard to impracticability of CdS / CdSe substitution. No stakeholder comments have been posted with regard to efforts made in such a direction. This may be due to the fact that Silk Displays appears to be developing a technological innovation that has not yet been subject to RoHS compliance efforts.
- The applicant does not mention any activities towards RoHS compliance of its new technology. It cannot be evaluated whether efforts have been undertaken with regard to substitution or whether the applicant regards the use of Cd-based semiconductor material the only technological solution for the development of flexible displays.
- Many of the examples for applications in which such flexible displays would be needed or be an obligatory prerequisite for functioning do not fall under the scope of the RoHS Directive. The applicant did not give precise examples on what RoHs-relevant applications would need such flexible displays. It can thus not be understood why an exemption is necessary and which RoHS application exactly is depending on the use of such flexible displays.

- In order to be able to evaluate a request for such a technological innovation properly with regard to substitution possibilities, efforts made and applications concerned, the applicant would need to reissue his request narrowing it a specific RoHS-relevant applications and providing more technical and scientific evidence.

5.2.2.1 Final recommendation

Since the applicant could not bring forward sufficient argumentation and evidence - in line with Art. 5 (1) (b) – concerning his exemption request and because no information is available on i) applications that are to be covered by an exemption, ii) the inclusion or exclusion of these applications into the scope of the RoHS Directive and iii) the concentration values of Cd in the application, the evaluation of the exemption request cannot be finalised. Especially the fact that this exemption request refers to a product that is not yet on the market and is a technological innovation makes it difficult to assess how RoHS has been incorporated into product development and whether there are substitution possibilities or not.

Therefore, in this case no recommendation is given.

5.3 Lead contained in circuit boards, obsolete and non-compliant Intel 80c188/86 EA\XL microprocessors, Analog Devices ADMC300 DSP, and NEC uPD7101 DUART and hexavalent chromium – NBS Technologies (set 6 request no. 19)

5.3.1 Description of requested exemption

NBS Technologies originally requested an exemption for the use of lead as well as the use of CrVI as passivation coating in certain circuit boards “Horizon / Evolution”, “Imagemaster series” and “advantage series”). These circuit boards are used in machines (“personalisation equipment”) for the credit card producing industry.

The products are “very low volume and highly specialized towards the Card Personalization industry”. NBS Technologies is “still building units covered by existing blanket orders that are due to expire late in 2007”. Its main source for revenue comes from service contracts related to maintaining this equipment. It has furthermore recently been outdated and according to the applicant most components are not available in RoHS compatible format.

NBS is currently undergoing development of a RoHS compliant new product platform which will inter alia replace the products for which an exemption is requested. “Those replacement products will be available beginning of 2008”[2].

[2] Cf. the applicant’s exemption request (“NBS RoHS extention letter_A.doc” available at http://ec.europa.eu/environment/waste/rohs_6_consult.htm)

However, by e-mail of 9 January 2007, upon questions sent for clarification by the contractor, the applicant withdraw his request for exemption for i) Imagemaster series ("which has now been re-designed to be fully RoHS compliant"), ii) CrVI ("as we have decided to strip and replate our non-compliance coatings of existing inventory") and iii) NEC uPD7101 DUART ("as this part has ben re-designed with a RoHs equivalent")[3].

The applicant asked for remaining with an exemption request for a 32 months period for the use of lead in its Evolution and Advantage product lines where certain integrated circuits contain lead that the applicant considers not to be suitable for substitution. However, the applicant himself stated in that very e-mail that he considered his products to be used as factory production equipment which would not fall under the scope of the RoHS Directive.

Against this background the contractor had started an extensive e-mail and telephone exchange with the applicant in order to clarify whether or not the remaining request would fall under the scope of the RoHS Directive and if not asking the applicant to formally withdraw his request (cf. e-mail exchange cited in section 5.3.4).

Even if the conclusion of this clarification exercise was that the applicant's products do not fall under the scope of the RoHS Directive due to their characteristic as fixed installation, the applicant did not formally withdraw his request even upon several e-mails and telephone calls by the contractor. This is why in the following the exemption request is formally evaluated although both the applicant and the contractor came to the conclusion that the equipment does not fall under the scope of the RoHS Directive.

The applicant has not proposed any wording for an amendment of the Annex to the RoHS Directive.

5.3.2 Summary of justification for exemption

The applicant justifies his exemption request according to the following technical and economical arguments[4]:

- "The manufacturers of some electronic components are not 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 NBS will be to redesign the system to replace the affected components which has consumed 50% of our engineering staff over the last 2 years and this same level of effort will be required till early 2008 before fully RoHS compliant designs are in place. Some of NBS' designs are "modular" with many circuit boards. Redesign will substantially increase risk to NBS' major customers in banking/financial markets that will require code port over of encryption and security algorithms to new RoHS compatible microprocessors and subsystems."

[3] Cf. full text of E-Mail below in section 5.3.4

[4] All arguments cited from the original applicant's exemption request (cf. footnote 2).

- "NBS needs additional time to complete the remaining code port over and circuit board re-designs to have its system fully RoHS compliant and minimize risk to EU financial/banking sectors."
- "There are no negative impacts caused by substitution other than scrapping NBS' current inventory which will pose an immediate environmental impact. If they are used, they will be in service typically between 10 and 15 years."

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:

- Even upon several requests, the applicant did not provide any written evidence and information on:
  - More precision on "personalization equipment for the credit card industry"
  - Exact wording for the request (e.g. lead in the solder of circuit boards used in credit card machines).
  - Design cycles of the components
  - Quantity of stocked components for each of the components and period during which these components would be present on the EU market
  - Specification when activities towards RoHS conformity have started for each of the concerned applications
  - Provision of specific documents/evidence clarifying the redesign process (e.g. roadmap)
  - Provision of written proof/confirmation of suppliers that the components are not available in a RoHS compliant form respectively were not available in a RoHS compliant form at time of the last time buy. In case of discontinued production, deliverance of according proof/evidence from suppliers
- The request can thus not be regarded as justified according to Article 5 (1) (b).
- Furthermore, as stated above, the contractor considers the equipment for which an exemption is requested not fall under the scope of the RoHS Directive since they are used in fixed installations.

5.3.3 Final recommendation

Since the applicant could not bring forward sufficient argumentation and evidence - in line with Art. 5 (1) (b) – concerning his exemption request it is recommended not to grant the exemption.

5.3.4 Supporting documentation

Applicant's e-mail of 9 January 2007

From:"Phil Roth" <proth@nbstech.com>
To: <rohs@oeko.de>
Subject: RE: Your RoHS exemption request No. 19 - Need for clarification
Date sent: Tue, 9 Jan 2007 17:13:09 -0500
Send reply to: proth@nbstech.com
Copies to: "Eliot Sobel" <esobel@nbstech.com>

Dear Sirs,
Thank you for your consideration. I would like to retract my exemption request for our Imagemaster product which has now been re-designed to be fully RoHS compliant.
I would also like to retract my exemption request for CrVI as we have decided to strip and replate our non-compliance coatings of existing inventory.
I would also like to retract my exemption request for the NeC uPD7101 DUART, as this part has been re-designed with a RoHS equivalent.

In response to your questions below:
What we desprately need is 32 month exemption for our Evolution and Advantage product lines. Critical components that are not RoHS compatable are:
Intel 80c188/86 16bit microprocessor used for data encryptiovolution n and processing for Credit Card personalization. Attached are datasheets.
ADMC300 Motion Control processor for motion control. Attached are datasheets.
All integrated circuits mentioned above contain Lead (Pb) and there are no RoHS equivalents.

I am having much deciding which WEEE category we belong in because our products are used as factory production equipment and they don't seem to fit any of the 10 categories.
If I must make a choice, it would be #3, IT and Telecommunications equipment.

Our annual production volumes into the EU for the 2 components mentioned above will be:
Intel 80c188/86 16bit microprocessor 300 pieces
ADMC300 Motion Control processor 300 pieces

Attached are Xcell spreadsheets explaining the costs and man/hours necessary to redesign these products for RoHS compliance.
We have already redesigned over 600 components that are now RoHs compliant and require an additional 32 months for full complaince.

Please let me know if you require further information.

Kind Regards

Philip M. Roth
Engineering Manager

Contractor's e-mail of 10 January 2007

From:RoHS Oeko-Institut <rohs@oeko.de>
To:proth@nbstech.com
Subject:RE: Your RoHS exemption request No. 19 - Need for clarification
Date sent:Wed, 10 Jan 2007 14:30:52 +0100

Dear Mr Roth,

thank you very much for the information. Due to your statement that your products are used as factory production equipment, I need to ask you for the following clarification: do these products fall under the scope of the RoHS Directive at all???

When checking on this point I would like you to take the following aspects under consideration taken out of the Commission's FAQ document on RoHS and WEEE Directives available at http://www.europa.eu.int/comm/environment/waste/weee_index.htm:

1) "Military equipment is excluded from the categories of Annex IA of the WEEE Directive, and therefore not covered by the RoHS Directive. [...] This does not, however, apply to products which are not intended for specifically military purposes."

2) "The opinion of the Commission is that excluded from the scope of the RoHS Directive is the equipment which part of another type of equipment that does not fall within the scope of this Directive. [...] Equipment which is part of another type of equipment is not to be considered a finished product. A finished product is any device or unit of equipment that has a direct function,its own enclosure and - if applicable - ports and connections intended for end users. "Direct function" is defined as any function of a component or a finished product which fulfils the intended use specified by the manufacturer in the instructions for use for an end-user. This function can be available without further adjustment or connections other than simple ones which can be performed by any person. If the "other type of equipment" is a fixed installation it will not fall under the scope of the WEEE Directive. "Fixed installation" in the broadest sense is defined as "a combination of several equipment, systems, finished products and/or components (hereinafter called "parts") assembled and/or erected by an assembler/installer at a given place to operate together in an expected environment to perform a specific task, but not intended to be placed on the market as a single functional or commercial unit".

3) "The onus to determine if a product falls within the scope of the two Directives is on the producer who is the person best placed to assess the characteristics of his product. In case of doubt, producers can check with the [EU] Member States authorities that are responsible for the enforcement of the national legislation implementing the provisions of the WEEE and RoHS Directives." Comment: since you are US based it would probably be best either to address EU Member States in which you will or are putting your product onto the market or to address your EU reprensentation (either the U.S. Mission to the European Union or e.g. AeA - American Electronics Association in Brussels).

4) "Exemptions are given for technical applications of the banned substances rather than for electrical or electronic products as such. [...] The request for exemption has to be precise and refer to a specific application of the substances of Article 4(1) of the RoHS Directive and can only be considered if strictly fulfilling the requirements of Article 5(1)(b) of the RoHS Directive. Submitters have to provide to the Commission all technical evidence supporting their request. Article 5(1)(b) of the RoHS Directive is the only criteria and guideline to be followed for arguing a request for exemption."

Please note that an exemption cannot be granted for an equipment that does not fall under the scope of the RoHS Directive. Therefore please first check on that matter and let us know what the outcome is. Should your product not fall under the scope of the RoHS Directive, we would kindly ask you to formally withdraw your request directly addressing the European Commission (env-rohs@ec.europa.eu) and CC to us.

Regards,
Stéphanie Zangl

Applicant's e-mail of 10 January 2007

From:"Phil Roth" <proth@nbstech.com>
To:<rohs@oeko.de>
Subject:RE: Your RoHS exemption request No. 19 - Need for clarification
Date sent: Wed, 10 Jan 2007 11:56:46 -0500

Dear Stephanie,
It is our opinion the Horizon/Evolution DOES NOT fall within the scope of the RoHS directive, but the explaination of exempt categories are very broad and vague. We do fall under the "fixed installation", but do not physically bolt or attach our equipment to the floor, as required in the exemption. Your mention below of a fixed installation is:

"Fixed installation" in the broadest sense is defined as "a combination of several equipment, systems, finished products and/or components (hereinafter called "parts") assembled and/or erected by an assembler/installer at a given place to operate together in an expected environment to perform a specific task, but not intended to be placed on the market as a single functional or commercial unit".

Because our machine is modular, it requires assembly by a factory qualified installer, BUT....the unit IS intended to be placed on the market as a single functional unit. You see, there is high risk for us to claim self exemption when there is no EXACT rule that excludes us.

It would very beneficial to our company if you and/or the TAC committee agree with us and would provide an opinion letter stating our Horizon/Evolution machine does not fall under the scope of the RoHs directive. This would help us in case we are questioned by individual EU member states. I have attached a marketing brochure of our product, which includes an optional Laser engraving station, that can be used for your evaluation.

If we can claim self-exemption, we would retract our exemption request for the Horizon/Evolution product and then be able to focus our engineering efforts on our Advantage product, which can be completed and RoHs capable within a shorter timeframe. We still would require exemption for use of lead (Pb) on the 2 devices originally mentioned for a period of 18-24 months. I will review the requirements of Article 5(1)(b) and provide appropriate criteria to the committee within 5 days.

Kind Regards
Philip M. Roth

Applicant's e-mail of 8 February 2007

From:"Phil Roth" <proth@nbstech.com>
To:<rohs@oeko.de>
Subject:RE: (Fwd) RE: Your RoHS exemption request No. 19 - Need for clarif
Date sent: Thu, 8 Feb 2007 06:49:57 -0500

Dear Stephanie:

Thank you for your reply and consolodated description.

This is exactly what I mean and why we think exclusion applies to our machines. I have read your explaination of "excluded equipment" many times before and glad you have summarized for me. Below is your explaination of exclusion for "Fixed installation" and comments about our equipment:

"Fixed installation" in the broadest sense is
defined as "a combination of several equipment, systems, finished products and/or components (hereinafter called "parts") assembled and/or erected by an assembler/installer at a given place to operate together in an expected environment to perform a specific task, but not intended to be placed on the market as a single functional or commercial unit".

Although we do not permanantly bolt our equipment to the floor, we fall under your description of "Fixed installation".

Our machines are custom ordered and can be configured and we have no single functional unit. All machines require custom configuration.
Our machines are installed and configured by a factory professional at a given place to operate.
Our machines incorporate several equipment, we may incorporate a custom laser, that is manufactured in Germany, and installed at the customer site.
Our machines may incorporate a mailing system to attach the credit cards to paper carriers and insert them into envelopes. This system is another machine that is assembled at the customer site.

[…]
Kind Regards

Phil Roth

5.4 Cadmium and cadmium oxide in thick film pastes used on beryllium oxide – Apex Microtechnology (set 7 request no. 7)

5.4.1 Description of requested exemption

The applicant had already submitted an exemption request on the same issue in the 5th stakeholder consultation asking to exempt cadmium and cadmium oxide in thickfilm pastes used on beryllium oxide until January 2008. The applicant at that time argued that RoHS compliant thickfilm pastes were available too late on the market to allow the necessary qualification and testing processes for his products to be finished by 1 July 2006.

The consultants had recommended granting the exemption with the following wording:

C*admium and cadmium oxide in thick film pastes used on beryllium oxide substrates until December 31, 2007* (see final report from 28 July 2006[5]).

Apex Microtechnology now has submitted a technically almost identical exemption request stating that the RoHS-compliant thickfilm pastes failed the long-term reliability tests and thus does not fulfil all necessary requirements.

The applicant describes the technical background of his recent exemption request as follows:

Thickfilm paste is used to produce hybrid circuit boards. 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 (also referred to as beryllia or BeO) 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.

The applicant further describes the situation with regard to his application in the following sense:

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, plasticisers).

[5] Available at http://ec.europa.eu/environment/waste/weee/studies_en.htm

According to Apex, two difficult but key requirements for thick film materials are

1) the ability to bond to the substrate and

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

One of the systems used to bond the thick film material to the substrate is metal oxides, where a heavy metal oxide such as PbO or CdO is used to create a bond to the substrate surface. 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.

Apex further describes the detailed technical requirements linked to its application as follows:

When materials are chosen for this particular application, the thickfilm circuitry, approximately 15 microns thick, must provide acceptable adhesion to the beryllium to withstand the rigorous conditions of ultrasonic aluminium 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 and 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. Such a reliability risk for hybrid customers is unacceptable unless a material with a similar performance and reliability can be qualified.

The applicant states 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, according to the applicant, have applications that fall into the "IT and telecommunications equipment" and "Lighting Equipment" categories, which need to be RoHS compliant.

The applicant says that currently there are no qualified RoHS-compliant formulations for use on beryllium oxide. The previous exemption, if granted, would expire in 31 December 2007.

The applicant therefore asks for an exemption until an appropriate RoHS compliant thickfilm paste is available.

Apex Microtech suggests the following wording for the requested exemption:

Cadmium and cadmium oxide in thick film pastes used on beryllium oxide substrates

According to the applicant, thick film formulations contain approximately 0.4% CdO by weight (0.004g 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% (0.005g CdO/g fired thick film) is achieved.

The applicant says that 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 as less than 2 pounds (900 grams) of cadmium per year.

5.4.2 Summary of justification for exemption

The applicant says that two cadmium-free thick film formulations have become available on the market in the latter half of 2005. Prior to these new formulations, no RoHS compliant alternatives were available for the use on beryllium based ceramic hybrids. Qualification and reliability testing of new formulations is a lengthy process. The applicant had begun his efforts once the compliant materials were made commercially available. One of the formulations failed in the pre-tests already, but the other one seemed to be promising. The applicant thus assumed that the second RoHS-compliant thickfilm paste may be an appropriate candidate for the use in his products and had asked for an exemption limited to December 2007 to have enough time to qualify this RoHS-compliant thickfilm paste for use.

In his recent exemption request, the applicant says that in tests this RoHS-compliant thickfilm substitute did not provide a viable long-term bond between the aluminium wire and the thickfilm material. After building up parts through a standard product build cycle, the parts to be evaluated along with a control group using the standard production gold thickfilm were placed into a long term bake at 155 °C. Wirebond pull strength values were evaluated after 1,000 hours and after 2,000 hours of bake. These tests are used to determine the strength and reliability of wirebonds and the thickfilm material they are bonded to. Table 3 and Table 4 show that the RoHS-compliant thickfilm pastes in the pull tests after a long-term bake have high failure rates compared to the non-RoHS-compliant pastes.

Table 3: Wirebond pull analysis after 1,000 hours long term bake at 155 °C

WireSize(mil)	1.25	1.25	2.0	2.0	5.0	5.0
Lot Number	6B199	6B200	6B199	6B200	6B199	6B200
Thickfilm Type*	RC	Control	RC	Control	RC	Control
Avg. Bond Strength**	5.3	5.9	17.8	21.0	95.9	106.8
Standard Deviation	1.7	1.3	6.4	4.5	20.7	15.3
Min. Pull Value (g)#	1.0	1.0	2.0	2.0	11.0	11.0
Exp'd Failure Rate (%)##	0.57	8.2E-07	1.3	5.0E-03	0.01	7.0E-07

Table 4: Wirebond pull analysis after 2,000 hours long term bake at 155 °C

WireSize(mil)	1.25	1.25	2.0	2.0	5.0	5.0
Lot Number	6B19	6B200	6B199	6B200	6B199	6B200
Thickfilm Type*	RC	Control	RC	Control	RC	Control
Avg. Bond Strength**	4.3	5.3	13.1	19.5	86.7	104.6
Standard Deviation	1.7	1.0	5.3	2.3	21.4	17.8
Min. Pull Value(g)#	1.0	1.0	2.0	2.0	11.0	11.0
Exp'd Failure Rate (%)##	2.61	8.5E-04	3.5	1.7E-10	0.09	1.0E-04

** - RC – RoHS Compliant Thickfilm Material; Control – Control parts (cadmium bearing thickfilm material currently used for this application)*

*** - Average Bond Strength (grams)*

 # - Harman, George. Wirebonding in Microelectronics: Materials, Processes, Reliability, and Yield. 2nd ed. New York: McGraw-Hill, 1996. Table T-4

- Expected Failure Rate – Percentage of total bonds expected to fall below minimum acceptable pull value. Assumes normal population. Number of wirebonds pulled for each reading above was approximately 100 for the 1.25 and 2.0 mil wires, 40 for 5.0 mil wire.

The applicant explains that the "Expected Failure Rate" figures are generated through the use of a statistical sampling of wirepulls on these specific parts. Based on statistical probabilities, this is the percentage of parts that would be expected to fail if a large enough population – larger than the around 100 wirebonds pulled for each reading - were to be tested. This is a common method of analysing wirebond pull strength in the hybrid industry.

With the RoHS-compliant thickfilm paste sample, the applicant experienced two actual failures (pull strengths below the minimum pull value) in the wirebond pull tests to generate the above statistical sampling. No failures were observed on the non-RoHS-compliant reference sample.

The above results indicate that a significant fraction of wirebonds placed on the RoHS compliant thickfilm material will begin to fail after an extended period. Most significantly, after 2.000 hours approximately 2,6% of the 1,25 mil wirebonds and 3,5% of the 2,0 mil wirebonds can be expected to fail (have bond strengths below the minimum pull strength value indicating imminent adhesion failure). The data indicates that significant failures can also be expected at 1.000 hours, where 0,6% of the 1,25 wires and 1,3% of the 2,0 mil wires are below the minimum pull values.

This is substantiated by the fact that a number of the 1,25 and 2,0 wirebonds were pulled below the minimum acceptable values in the course of deriving the above data. None of the wires placed on the control group thickfilm (non-RoHS-compliant) failed the minimum pull value nor did the 5,0 mil wires placed on the RoHS compliant thickfilm. This agrees with the calculated failure rate predictions.

According to the applicant, the above data indicate that the RoHS compliant thickfilm material is not acceptable for use in production and would be expected to lead to significant field failures with detrimental results to customers. The RoHS-compliant thickfilm material did not pass the qualification test.

The applicant further on explains that significant failure modes have been experienced in the field which had not appeared in initial testing and qualification. These failure modes specifically included wirebond reliability (adhesion to the thickfilm) and thick film adhesion to the substrate, resulting in a electrical failure of the device in the customer application. This necessitated an adaptation and intensification of tests towards the above long-term testing procedures to assure that the thick film materials and their associated properties do not degrade due to chemical, thermal, mechanical or electrical causes. Until testing shows that a thickfilm material provides sufficient long term adhesion of the aluminium wirebond to the thickfilm, these materials are not qualified for use in this application.

The applicant argues that furthermore, while vendors of RoHS-compliant thickfilm materials have conducted much of the above testing on alumina substrate materials, the beryllium based hybrid market is rather small and specialised. Cost is higher as well as the reliability requirements of power hybrids using beryllium ceramics. According to the applicant, thick film vendors have not conducted the above testing, nor do they guarantee their recently available candidate materials. Users of these materials in these applications must therefore conduct their own in-house testing.

According to the applicant, the testing time varies according to the material/process being evaluated. Thickfilm paste is a very complex and involved material on the hybrid, as it interacts with nearly all other components and materials. The qualification requirements are

extensive to exclude field failures. Testing includes the 1.000, 2.000 and 3.000 hr bakes at 150 °C followed by wirepull testing, as conducted in the recent tests of the RoHS-compliant substitute candidate.

Materials passing these tests would then be built into actual parts and put through a pilot lot qualification, which also includes the various bakes 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. Apex would review how these parts are functioning in the field. Assuming no problems are discovered, the new thickfilm materials would then be rolled out to all hybrid products. Apex has found that major qualification efforts such as this generally take a minimum of 1 year, assuming no significant problems are found. Once qualified, it takes another 6-12 months to get it fully to market as all of our models would need to be changed over to the new material and built. The overall duration of the qualification procedure thus is around 2 years.

The change from beryllium based to aluminium-nitride based or other ceramics in principle could be a way to achieve RoHS-compliance. RoHS-compliant thickfilm pastes for such applications are available. The applicant argues, however, that he has completed a variety of studies over the years investigating the possible use of aluminium-nitride (AlN) materials, as this would be cheaper. However, due to thermal limitations of such ceramics, CTE (constant of thermal expansion) mismatches and inability to procure and qualify materials with satisfactory adhesion, the applicant had decided that AlN did not present a feasible alternative for his products.

The applicant says that he will continue evaluating other RoHS-compliant candidate materials as they become available in order to find a suitable thickfilm paste for this application. The applicant currently cannot announce a deadline as the availability and long-term reliability of these candidate pastes is unknown.

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’s arguments are plausible and in line with the information provided in the previous exemption request from the 5th stakeholder consultation. At the time of the review of this exemption request, there was no information available that would have contradicted or put in doubt the applicant’s arguments.

The applicant shows that the failures rates of RoHS-compliant thickfilm pastes in this application are much higher in the qualification procedure. Based on the available information, the substitution of these thickfilm pastes currently is technically not practicable. The applicant’s arguments are in line with article 5 (1) (b) of the RoHS Directive and thus would justify an exemption. As the availability of alternative, RoHS-compliant thickfilms for the use on beryllium-based ceramics is unknown, the contractor does not recommend a limitation of the exemption before the regular review of exemptions.

5.4.3 Final recommendation

The applicant has undertaken efforts to achieve RoHS-compliance. The information provided shows that the substitution of cadmium-containing thickfilm pastes on beryllium-based ceramics currently is technically not practicable. The applicant's exemption request suffices the requirements of article 5 (1) (b) and it is therefore recommended to grant this exemption.

In accordance with the applicant, the wording of this exemption is suggested with:

Cadmium and cadmium oxide in thick film pastes used on aluminium bonded beryllium oxide substrates.

6 Further proceeding

The next step will be to finalise open requests of set 6. Furthermore, questions will be sent out to applicants of remaining open requests of set 7 and a first clarification and evaluation will take place.

The draft final report is scheduled for 24 August 2007.