Öko-Institut e.V.
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Institute for Applied Ecology

Fraunhofer Institut Zuverlässigkeit und Mikrointegration

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

Results previous evaluation
Exemption No. 8

"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"

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

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

Summary of recommendations:

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

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

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

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

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

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

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

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[3]. 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

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

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.

6.3.1 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[4] to be weakened either.

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

[4] 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”.

- 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.
- 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. Unfortunately 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.
- 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, 35 A 13,5 V dc inrush current up to 80 A 50,000 cycles; general-purpose switch; 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 enlarge risk of welding[5].
- 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.

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).

[5] Welding 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.

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[6]. 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

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 6.3.2).

[6] 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.

6.3.2 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"[7]. 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 Figure 1 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.

[7] 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".

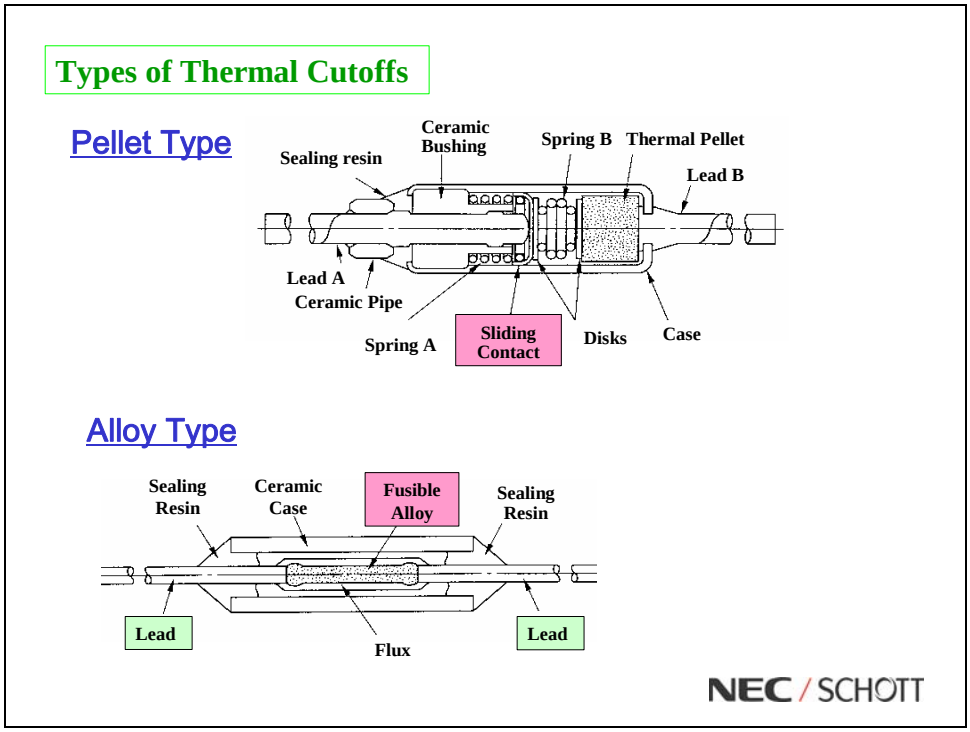

Figure 1: Different types of TCOs

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 above-mentioned 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 6.3.1):

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.

6.4 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 (set 3 request no. 3)

6.4.1 Description of requested exemption

The Allen Organ Company (represented by Bristows) asks for an exemption for the use of lead in solder applications for electronic components of musical instruments having an average lifespan in excess of 10 years. The specific musical instrument in question are digital electronic organs, which are installed into churches for use in the playing of church music. These products are specifically designed to reproduce the tone and sound of traditional pipe organs, which they often replace. According to the applicant the products are mainly sold to ecclesiastical for use in public religious ceremonies and acts of worship. Approximately 25% of sales are made to private individuals. Allen Organ Company sold in 2004 127 church organs and in 2005 128 church organs into the entire EU.

Lead is used as lead-containing solder in the manufacture of the organs' circuit boards. Assuming an average weight of 200 kg per digital church organ the total quantity of lead used in solder for all of the Allan Organ Companys' products amounts to ca. 5,2 kg per year.

6.4.2 Summary of justification for exemption

According to the applicant digital electronic church organs do not fall under the categories set out in Annex 1A to the WEEE Directive. The applicant justifies his position as follows:

- The only possible category into which these kind of products could fall was considered to be Category 4 Consumer Equipment where as an example `musical instruments´ are listed.
- However there are several hints why digital electronic church organs do not fall under this category:

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[6]. 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.

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

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[7] 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.

[7] 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, 35

A 13,5 V dc inrush current up to 80 A 50,000 cycles; general-purpose switch[8]; 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[9].
- 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.

[8] 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.

[9] 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.

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[10]. 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

[10] 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"[11]. 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.

[11] 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".

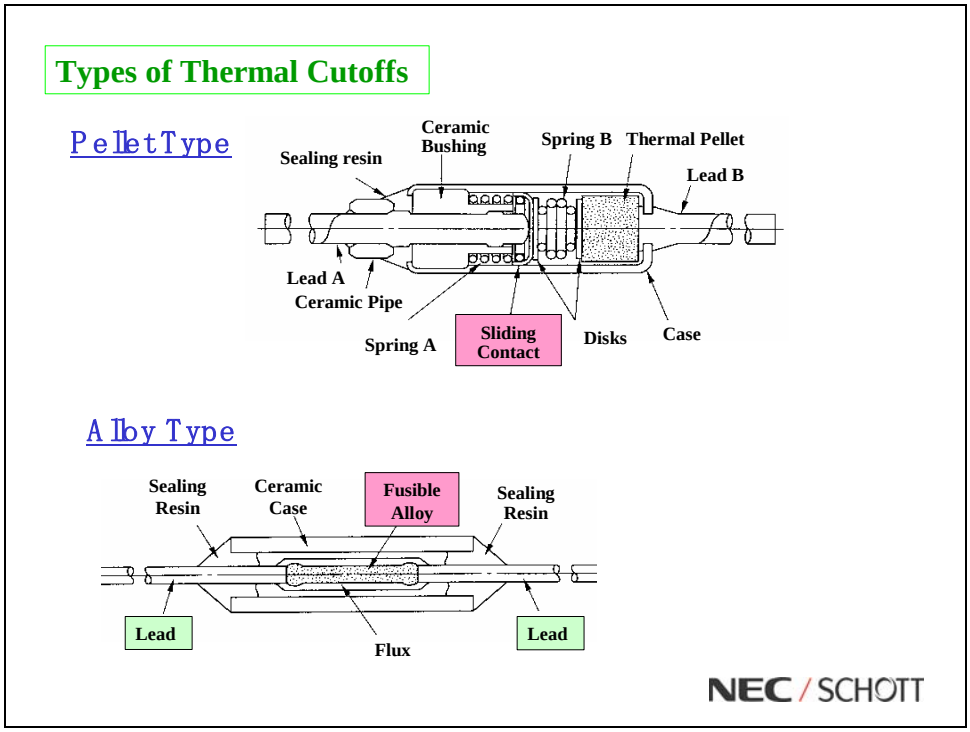

Figure 2: Different types of TCOs

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 above-mentioned 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.