1st Questionnaire Exemption No. 6c (renewal request)

Exemption for „Copper alloy containing up to 4 % lead by weight“

Abbreviations and Definitions

Pb	Lead
LED	Light Emitting Diode
Hrs.	Hours

Background

The Oeko-Institut and Fraunhofer IZM have been appointed within a framework contract[1] for the evaluation of applications for the renewal of exemptions currently listed in Annexes III of the new RoHS Directive 2011/65/EU (RoHS 2) by the European Commission.[1]

LightingEurope has submitted a request for the renewal of the above mentioned exemption, which has been subject to a first evaluation. The information you have referred has been reviewed and as a result we have identified that there is some information missing and have formulated a few questions to clarify some aspects concerning your request.

Questions

1. Please clarify if lead based copper alloys are used for pin contacts in all lamp types, or only as specified in the application in TL fluorescent lamps, CFLni fluorescent lamps, starters for fluorescent lamps, GU10 reflector lamps and HID R-mini lamps. Where pin-contacts are not used, please clarify what contact components are used and what materials they are manufactured from.

***Answer LightingEurope**:* Lead containing copper alloys are used in the indicated lamps. In case of pins, the connection between the lamp leadwire and the contact pin is made by crimping/pinching technique thus requiring sufficient ductility of the pin material (As explained in the exemption request). If no pins are used for electrical connection another connection techniques are used like the well known screw base Edison screw fitting (e.g. E14, E27, E40) known from incandescent lamps. These are connected to the lead wires from the lamp by soldering or other techniques.

Some pin contact of lamps are made other than lead containing copper alloy where the shape does not require machining or the combination of length, diameter and mechanical stability requirements call for a different material. Typical but not exhaustive halogen incandescent examples are:

- G9 caps with molybdenum pins
- G4 caps with molybdenum or Fe/Ni pins
- GY6.35 caps with Fe/Ni pins

[1] Contract is implemented through Framework Contract No. ENV.C.2/FRA/2011/0020 led by Eunomia

2. Please specify the lead content of the copper alloys, respectively the copper alloy type, used for the contact-pins of the various lamps in which this application is used (specified as TL fluorescent lamps, CFLni fluorescent lamps, starters for fluorescent lamps, GU10 reflector lamps and HID R-mini lamps).

Answer LightingEurope: The lead content varies in type of applied alloy and manufacturer from 1% till 4 %. Some typical alloys are DIN CuZn39Pb2 or DIN CuZn39Pb3 [2].

3. You mention that lead is needed to ensure the ductility of the alloy, which is understood to be of importance for ensuring a reliable electric connection over the life time of the lamp. In this regard it is also mentioned that the lifetime of many products is high, up to 80,000 Hrs. However some of the lamps that have been mentioned as relevant for this request are expected to have much shorter lifetimes, especially where consumer products are concerned[3]. Please clarify if leaded copper alloys are used only for lamps with a long lifetime and specify the relevance of "long-lifetime" to products in which the connection pins are used.

Answer LightingEurope: The lead containing alloys are used in the indicated lamps under 1. to ensure during the whole lifetime a reliable connection to prevent safety issues so not only in „long-life"products. The ductile metal is needed in the manufacturing process to make the connection with the lead wire in a reliable way, independent of the lifetime of the lamp.

4. It is stated that "*An important function of lead in copper alloys is to improve the machinability of the alloy*". Machinability is often mentioned where the manufacture of small parts with complex details is needed.

    a. Please explain the relevance of this statement to pin connectors, which from the information provided are relatively simple in geometric form.

Answer LightingEurope: The form of the pins is illustrated in the exemption renewal request. Some pins have a more complex form than others. The more simply shaped pins however have a different manufacturing process where the lead has a different function than improving the machinability especially a localized large deformation is needed to make a reliable electrical connection with lead wires.

    b. Please specify which machining processes are applied (in the manufacture of the pins) and specify where the absence of lead would affect the efficiency of the machining process.

Answer LightingEurope: The techniques that are used to manufacture lead containing pins is deep drawing. The absence of lead will affect the drawing process (less yield, damage to the tools,..)

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[2] http://admin.copperalliance.eu/docs/librariesprovider5/pub-tn26---the-brasses-technical-data/copper-zinc-lead-alloys-(leaded-brasses)/cuzn39pb2-(cw612n)-datasheet-e7.pdf?sfvrsn=4

https://www.kupferinstitut.de/fileadmin/user_upload/kupferinstitut.de/de/Documents/Shop/Verlag/Downloads/Werkstoffe/Datenblaetter/Messing/CuZn39Pb3.pdf

[3] For example see Data sheet for Philips TL-D 36W/54-765 1SL quoting a Life to 50% failures EM of 13,000 hrs http://www.lighting.philips.com/main/prof/lamps/fluorescent-lamps-and-starters/tl-d/tl-d-standard-colours/928048505453_EU/product

5. Please specify if additional properties /qualities are enabled through the use of lead, which are of importance for this application.

Answer LightingEurope: There are other properties than mentioned under 3 and 4. For pins it is essential that the substitute alloy have high electrical conductivity, as well as comparable tensile strength, elongation % before breakage, and elasticity. Especially the higher ductility vs non-Pb brass is necessary during the lamp making process to establish a reliable connection between pin and lead-wire. However since the electrical contacts need to remain intact over a long lifetime additionally serious testing is needed to ensure that the contact within the lamp and the contact in the different lamp holders remain intact. For instance that they do not corrode.

6. You mention "*There is no evidence that lead-free materials cannot be used, but given the long life-time of lamps in combination with the mass scale application it also cannot be proven that lead-free contacts have the same performance regarding safety and reliability under all application conditions (current density, temperature, humidity etc). Below photos show lamps with safety issues caused by arcing and defect pins. Seen the severity of the potential problems the lighting industry needs to be very cautious in changing the material of the contact pins.*"

    a. Please confirm that the examples of safety issues presented relate to safety issues to have incurred with pin connectors manufactured of leaded copper alloys;

Answer LightingEurope: Confirms that these pins are manufactured of leaded copper alloys see the original renewal request clause 4.2.2.1.

Arcing occurs if the pin-leadwire connection is faulty, or if the lampholder contacts lose contact force. These safety issues can occur with lead containing pins also. It is critical to ensure that those failures do not occur more frequently with lead-free substitutions. It is emphasized that the ductility of the pin determines the quality of the electrical contact that is established during the lamp making process and its integrity over lifetime, and that the purpose of added Pb to brass is to increase the ductility.

The reason of inserting those pictures was to demonstrate that mechanical/geometrical properties of the pins are sentitive with respect to safety.

    b. Please clarify if efforts have been realised to test the suitability of lead free substitutes in pin contacts used for lamps (or in other contact components) and specify results.

Answer LightingEurope: Leadfree contact pins are tested but, seen the severity of the potentially safety related problems, the lighting industry is very cautious in changing pin material see the original renewal request clause 4.2.2.1.

    c. Please explain what testing methods are used and why it would not be possible to accelerate various affects in order to conclude as to the durability of substitutes over time?

Answer LightingEurope: Testing the lamps over their specified life time takes years. To determine the acceleration parameters and factor needs substantial parallel lifetesting.We did not find any method to accelarate testing which gives same results as burning the lamps over life. A lifetime of 30000 hours would take approximately 4 years of testing including in between measurements.

d. If alternative alloys have not been tested, please explain on what basis it is assumed that lead free alloys would not provide the needed performance required of pin connectors? Please provide data and information to support your views.

Answer LightingEurope: Tests were done but rejected because of safety issues. Brazing or welding are not technical options for small lamps with pins due to the very tight Standardized dimensional tolerances for fitup to the lampholder (GU6.5, G12, GX10 for HID).

7. It is stated that the "*The industry would need to expand their production capacity which would require investments in additional equipment and tooling. Given the changes that are on-going in the lighting industry it is expected that suppliers will be very reluctant to do investments*." Please clarify if this statement relates to lead-free copper alloys in general or to those in use for alternative lamp contact components.

Answer LightingEurope: As the conventional lighting industry is gradually moving to LED no significant investments will be made by the component manufacturers producing components for conventional lamps

8. It is understood, that there is a technically equivalent substitute available, which is however not sufficiently available on the market.

    a. You mention in the application that "*Only one supplier is known which can produce lead-free contact pins.*" Are you aware of any patent holdings of that supplier that could potentially prevent other suppliers of manufacturing the lead free pins?

Answer LightingEurope: We have no information about patent holdings on lead free contact pins.

Please estimate the expected trends in the availability of such substitutes over the next five years.

Answer LightingEurope We have no info about this

9. You note that "*Due to shortage of lead-free production companies it is not possible to purchase all the lead-free material that the lighting industry needs.*" On the other hand, you state that "*The long life-time of LED technology also enables the integration of LED modules in the luminaire and replacement of lamps is not required anymore. As a result the use of contact pins, and therefor also the use of lead will be reduced in the years to come.*"

    a. Please provide an estimation of how the expected reduction in demand for the contact-pins is to change over the next 10 years.

Answer LightingEurope The rate will depend on the lamp technology. The numbers for linear fluorescent are available are form the Vito study[4] (table 29 page 2-51) until 2020. They show a decrease in the number of lamps.

b. Please specify the respective estimated changes in production capacity of the lead free pin contacts so that the expected relation between the changing supply and demand can be understood.

Answer LightingEurope We have no information on this topic.

c. In both cases, if trends differ for various lamp types, please provide information according to lamp type so that differences are apparent.

Answer LightingEurope We have no information on this topic.

Please note that answers to these questions are to be published as part of the available information relevant for the stakeholder consultation to be carried out as part of the evaluation of this request. If your answers contain confidential information, please provide a version that can be made public along with a confidential version, in which proprietary information is clearly marked.

[4] Preparatory Study on Light Sources for Ecodesign and/or Energy Labelling Requirements ('Lot 8/9/19'). Draft Interim Report, Task 2 by Prepared by VHK, in cooperation with VITO and JeffCott Associates
Date: 19 November 2014, Table 29.