

This initial feedback is submitted on behalf of participants in the Umbrella Project (“UP”)’s Exemption # 7a technical Working Group (“WG”) (hereafter referred to as “UP Exemption # 7a WG Participants”).

Consultation Questionnaire Exemption 7(a)

Exemption for „Lead in high melting temperature type solders (i.e. lead-based alloys containing 85 % by weight or more lead)“

Abbreviations and Definitions

| | |
|------------------|--|
| BGA | Ball Grid Array |
| Bourns | Bourns Incorporated |
| DA5 | Die Attach 5, a consortium established to develop a Pb-free die-attach solution consisting of STMicroelectronics, NXP Semiconductors, Infineon Technologies, Bosch (Division Automotive Electronics), and Nexperia |
| EEE | Electrical and Electronic Equipment |
| ESD | Electro-Static Discharge |
| HMP | High melting point |
| HMPS | High melting point solders |
| LED | Light emitting diode |
| LHMPS | High melting point solders with a lead content of at least 85 % |
| Pb | Lead |
| RoHS | Directive 2011/65/EU on the Restriction of Hazardous Substances in Electrical and Electronic Equipment |
| SAC | Tin Silver Copper solder materials |
| Umbrella Project | A large number of company/business organizations/business associations that are participants in the RoHS Umbrella Industry Project |

1. Clarification Questions

General

1. Both applicants refer to various properties or functions that lead provides to LHMPS in its various application areas and for which alternatives must provide similar performance however in most cases, the minimum required performance is not specified. Please specify the range of performance required in relation to the properties in the table below or a threshold above or below which performance would be considered comparable. Furthermore, please indicate for which of the following application areas each of the properties is relevant (please refer to the annotation of the application areas in this respect or add additional application areas):
 - a) For combining elements integral to an electrical or electronic component:

- i) a functional element with a functional element; or,
- ii) a functional element with wire/terminal/heat sink/substrate, etc.;
- b) For mounting electronic components onto sub-assembled modules or sub-circuit boards;
- c) As a sealing material between a ceramic package or plug and a metal case; and
- d) For high power transducers (both low and high frequency in professional sound applications).

Umbrella Project (“UP”)’s proposal is to stay with the existing wording “Lead in high melting temperature type solders (i.e. Lead-based alloys containing 85 % by weight or more Lead)”.

LHMPS is only used where critical product characteristics cannot be achieved by other means. UP Exemption # 7a WG Participants have no evidence that industry is intentionally using this solution to circumvent the loss of other Pb exemptions. The best way to define the usage of LHMPS is keeping the RoHS exemption 7a wording found in the Commission Delegated Directive (EU) 2018/742 of 1 March 2018.

The proposed wording also aligns with the Exemption 8(e) wording included in the related Commission Delegated Directive (EU) 2020/363 of 17 December 2019 amending Annex II to Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles with reference to same exemptions for Lead and Lead compounds in components.

UP Exemption # 7a WG Participants have assessed the LHMPS material as being used in a huge variety of applications, this makes it impossible listing in detail all the applications separately.

The whole combination of required properties makes LHMPS a unique material, which cannot be replaced by substitutes currently available on the market without compromising the reliability of the semiconductor devices of which it is an integral component.

The usage of LHMPS is described in detail (chapter 4(A)1, 4(B)) in the “RoHS Exemption 7a Dossier for Renewal” send to the EU commission on 15 January 2020 (for category 1 to 10) and on 9 October 2020, for category 11.

The table reported in the next page is the attempt to summarize the details.

| | Required performance (threshold /range) | For combining elements integral to an electrical or electronic component | | For mounting electronic components onto sub-assembled modules or sub-circuit boards | As a sealing material between a ceramic package or plug and a metal case | For high power transducers (both low and high frequency in professional sound applications) |
|---|---|--|---|---|--|---|
| | | Functional element with a functional element | Functional element with wire/terminal/heat sink/substrate | | | |
| High melting point (liquidus line) | 200 - 300 C | X | X | X | X with specific, limited applications with 280-300°C | X |
| High softening temperature (solidus line) | not lower than 260 C | X | X | X | X | X |
| Strong thermal conductivity | | X | X | X | X | X |
| Good thermal fatigue resistance | | X | X | X | X | X |
| Good wettability | | X | X | X | X | X |
| Good ductility | | X | X | X | X | X |
| Corrosion-resistivity | | X | X | X | X | X |
| Appropriate oxidation nature | | X | X | X | X | X |
| Electrical conduction | | X | X | X | X | X |
| Stress relief | | X | X | X | X | X |
| Heatproof to reflow temperatures | reflow at 260 C | X | X | X | X | X |
| Moisture sensitivity | | X | X | X | X | X |
| Sustaining of heat dissipation | | X | X | X | X | X |
| Manufacturability | | X | X | X | X | X |
| High reliability | | X | X | X | X | X |

- The current exemption wording is understood to be relatively general and to leave room for misuse. To eliminate this possible loophole, past assessment efforts have tried specifying the exemption wording into various application areas, an effort that was discussed

controversy by stakeholders. Alternative approaches for specifying the exemption wording are:

- to specify application areas based on combinations of properties needed in the application and provided by lead; or
- to specify application areas where substitution was possible, excluding them from the exemption, for example: solder joints that can be exposed to temperatures below XX°C during assembly and/or operation.

Should these approaches show that the task is impractical in light of a wide range of differing application areas, provided information may support the justification of a wide range exemption. Please thus either provide a proposal as to possible application areas that can be excluded on the basis of function or properties or provide a proposal of property combinations for which the exemption is needed.

UP Exemption # 7a WG Participants firmly believe that the exemption wording cannot be modified to consider several application fields. The technical complexity to determine which sub-exemption applies to each homogeneous material and the lack of incremental environmental, health and consumer benefits resulting from this delineation since alternative Lead-free solutions are not available on the market, make the choice of splitting the wording impractical or impossible.

In case an exemption wording modification is applied to cover application areas it will become impractical not only for the industry but also for the authorities to verify compliance. UP Exemption # 7a WG Participants do not see any benefit since the applications mentioned above are used by component manufactures, impossible to link with end-use applications, also.

For the Umbrella Project

6 The Umbrella Project provides an estimation as to the total amount of Pb placed on the market as ranging between a few kg and 31 tonnes per annum. Though it is argued that substitution was applied where possible, the broad range suggests that the exemption may be applied also in applications where it is no longer needed. Please clarify on what basis you assume that such misuse does not take place or propose how this could be guaranteed through a reformulation of the exemption, addressing only application areas where substitutes do not exist.

UP Exemption # 7a WG Participants do not agree that there is any misuse of this exemption. LHMPs with >85% Lead will have a melting point of 255°C to about 300°C, which limits the applications where they can be used. They are used only for applications that can withstand these temperatures and so they cannot be used to make connections to printed circuit boards or in most types of plastic components as the high temperature would destroy the polymeric materials. Also, eutectic solders such as SAC (Tin Silver Copper) are always used in preference to LHMPs because they have superior wetting and spread properties, which makes soldering much easier and bonds are more reliable.

LHMPs are used in power semiconductors as die attach alloys only when alternatives cannot be used. Electrically/ thermally conducting adhesives are used as die attach materials in other semiconductor devices and will always be the first choice as the low bonding temperature avoids

thermal damage to the brittle silicon die and reduces mechanical stress. LHMPs are used only in applications where the electrical/ thermal conductivity of conductive adhesives is inadequate.

Metals must be used to make hermetic seals to metal and ceramic packages as adhesives degas and can be porous to air and moisture. Bonding with adhesives is always much easier than using LHMPs and so will always be used when this is possible. Lead-free high melting point alloys can be used only in some applications for hermetic seals, and even in these cases these are hard and brittle materials and so are susceptible to cracking, either of the bonding alloy or of the ceramic package if this is used, especially with large size devices.

In conclusion, in practice, LHMPs are used only when there is no suitable Lead-free alternative as discussed in chapter 7 and 9 in the “RoHS Exemption 7a Dossier for Renewal” sent to the EU commission on 15 January 2020 (for category 1 to 10) and on 9 October 2020, for category 11.

It is not evident that lead free alternative materials have lower environmental impact costs than LHMPs. Studies are ongoing and specifically for some metals, (<https://scientificarray.org/ijgt/ijgtv6a3/>) recent study acknowledges that lead-free HMPS have higher environmental impact costs than LHMPs.

7. The Umbrella Project argues that available substitutes do not provide the correct combination of properties that LHMPs do. Please clarify which combination of properties is needed for applications in which LHMPs are needed, referring also to quantitative performance levels needed. If this combination differs between application areas, please provide specific combinations for the application areas specified in general question 1 above and refer as needed to additional application areas.

The necessary properties of LHMPs are described in detail in chapter 4(C) in the “RoHS Exemption 7a Dossier for Renewal” sent to the EU commission on 15 January 2020 (for category 1 to 10) and on 9 October 2020, for category 11.

In case parts of your contribution are confidential, please provide your contribution in two versions (public /confidential). Please also note, however, that requested exemptions cannot be granted based on confidential information!

Finally, please do not forget to provide your contact details (Name, Organisation, e-mail and phone number) so that Oeko-Institut can contact you in case there are questions concerning your contribution.