This initial feedback is submitted on behalf of participants in the Umbrella Project ("UP")´s Exemption #6a technical Working Group ("WG") (hereafter referred to as "UP Exemption #6a WG Participants").

Clarification Questionnaire Exemption 6(a) & 6(a)-I

Exemption 6(a) for "Lead as an alloying element in steel for machining purposes and in galvanised steel containing up to 0,35 % lead by weight"

Exemption 6(a)-I for ''Lead as an alloying element in steel for machining purposes containing up to 0,35 % lead by weight and in batch hot dip galvanised steel components containing up to 0,2 % lead by weight"

Abbreviations and Definitions

EEE	Electrical and Electronic Equipment
Pb	Lead
REACH	Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), […]
RoHS	Directive 2011/65/EU on the Restriction of Hazardous Substances in Electrical and Electronic Equipment
UP	Umbrella Project (Applicant)

Background of this document

The Oeko-Institut has been appointed by the European Commission, within a framework contract[1], for the evaluation of applications for exemption from Directive 2011/65/EU (RoHS), to be listed in Annexes III and IV of the Directive.

Your organisations Röhm GmbH as well as the European Steel Association (EUROFER) and European General Galvanizers Association (EGGA) on behalf of the "RoHS Umbrella Industry Project" (hereafter referred to as "Umbrella Project" or UP) have submitted a request for the renewal of the above mentioned exemption, which has been subject to an initial evaluation. A summary of the main argumentation for justifying the request is provided below as a first basis to be used in the stakeholder consultation planned as part of this assessment.

Please review the summary of the argumentation provided to ensure that your line of argumentation has been understood correctly and provide answers to the questions that follow that are to address aspects requiring additional information and/or clarification.

1. Background of applications

The Umbrella Project (UP) applies for a renewal of exemption 6(a) and for exemption 6(a)-I with regards to EEE categories 1-10. The application covers both lead in steel for machining purposes and for lead in hot dip galvanised steel. The applicant refers to the wording of Ex. 6(a)-I as the

[1] The contract is implemented through Framework Contract No. ENV.B.3/FRA/2019/0017, led by Ramboll Deutschland GmbH.

requested wording and requests the maximum validity periods foreseen in the RoHS 2 Directive (which means 7 years for Cat. 8 and Cat. 9 EEE and 5 years for all other categories).

The Röhm GmbH applies for exemption 6(a). Given that this exemption is only applicable to EEE categories 8, 9 and 11, and that the relevant EEE indicated by the applicant are power tools, thus category 6, it is understood that the application relates to 6(a)-I with regards to lead in steel for machining purposes. It still needs to be clarified whether drill chucks are also applied in other EEE categories. The applicant has not provided any alternative wording for the exemption, however, lead in steel for hot dip galvanized steel is not in scope of the Röhm application. The requested duration of the exemption has not been specified.

Based on the input of the Umbrella Project, it is understood that 146 to 255 tons of lead are placed on the market through all types of leaded steel applications for machining purposes. Thereof, EEE (in addition to automotive applications) is only a part and the Umbrella Project cannot specify the share of steel used in EEE compared to other applications. For batch galvanised steel, it is assumed that less than 1 ton per annum is intentionally used, the amount of Pb in recycled zinc is not calculable.

2. Summary of argumentation of applicant on the justification of the exemption

2.1. Leaded steel for machining purposes

2.1.1. Technical description

According to the applications, lead in steel provides a lubricant effect to the host material that results in a good chip crack performance, stability and smooth surface. This allows a higher cutting speed, a higher stability (a lower spindle stress) and a longer tool life. The steel is used in a "*diverse range of final applications within EEE including finished products and fixed installation of which an exhaustive list is not feasible*", states the UP application.

2.1.2. Applicant's justification for the requested exemption

With regards to substitution, the UP application outlines the efforts taken by the EU steel industry with regards to alternatives to lead as machinability enhancer in steels. Machinability enhancing additives (lead, bismuth, increased suflur, sulfuric tellurid, tin, phosphorus and calcium) were tested in three different steels in a project in the early 2000s. The findings are summarised with a focus on bismuth and are presented in aggregated form in the application. It is concluded that lead is preferred in regards to higher production rates, reduced cutting forces, lower tool wear rates, more finely broken chip morphology and improved surface finish; bismuth being the best available substitute so far does not show the same hot workability, which makes it only a theoretical substitute. The aspect of "hot workability" is most important according to the applicant.

Röhm GmbH provides information on two different steel alternatives (11SMn30 & 11SMn30-EM + C) that have been tested in 2019. On the former it was concluded that substitution would technically not be feasible with regards to the required characteristics for the application of drill chucks. The latter shows some technical difficulties in tests (chip fracture behaviour, machine stability, life time), but the main concerns remain with regards to availability and reliability given that the applicant claims to remain as last producer of the drill chucks in Europe: According to Röhm's input, in the market, there is only one supplier of this alternative lead-free steel, the market acceptance with regards to product quality and price is unclear.

Details on the reliability of bismuth and sulphur as alternative machinability enhancing additives are outlined by explaining the disadvantages of these two substances.

The UP application considers environmental implications of bismuth. The LCA provided by Nuss and Eckelmann (2014) comparing impacts at the life cycle stages mining, purification, and refining of different metals is provided to support the argumentation against bismuth and for lead. Furthermore, an LCA on environmental impacts of leaded and non-leaded low carbon free cutting steels including energy used during machining was provided with the application (Coleman et al. 2015). The system boundaries include raw material extraction and production, steel manufacturing, component machining and electricity production. The study concludes that "*for the part considered in the machining trials the global warming potential of the final part was ~9% lower for the leaded steel compared to a non-leaded steel*". Thus, in general, lead-free steels require less energy mainly in component machining, no quantified conclusions can be drawn for steel objects that have not been tested.

Please find the clarification questions with regards to this area of application in chapter 3 of this summary.

2.2. Hot dip galvanised steel

2.2.1. Technical description

The galvanization process results in a zinc coating on iron and steel products by immersion of the material in a bath of liquid zinc. According to the applicant (UP), components are batch galvanised for several reasons including highly durable corrosion protection, resistance to mechanical damage, increased durability allowing lighter steel sections and recyclability within existing steel recycling circuits. An exhaustive list of applications is not feasible; components include brackets, fixings, fasteners, ancillary items but also large structural steelwork of up to 25m length and "*lighting units that require high levels of durability in outdoor and aggressive environments*" (UP). A total of 7 million tonnes of steel is batch galvanized in Europe, the volume of components in the scope of RoHS and ELV "is extremely small" (UP).

Lead is present as an impurity related to the use of recycled material for the baths of liquid zinc for the galvanisation process. During the galvanising reaction, zinc-iron alloys are formed on the surface of galvanised products. Due to the low solubility of lead in the zinc-iron alloys, lead concentrations within the coating on the product are typically half as much as the lead present in the process bath. Lead has no beneficial (or adverse) effect on the coated product but influences the galvanisation as such: It has a positive effect on the drainage of coating material which is especially good in the case of complex geometries where adverse surface finishes can be avoided through a lead-mediated drainage. The lead content of a coating depends on the steel type's reactivity with molten zinc, on the technical features of the plant (related to the age of the plant) and the concrete galvanisation process.

At present, some plants intentionally add lead to the zinc bath for improvement of drainage of the coating of the galvanised product "*which is rapidly declining due to technical innovation*" (UP).

2.2.2. Applicant's justification for the requested exemption

The development of a one-to-one substance alternative for the substitution of lead in zinc originating from recycled zinc is not applicable. The applicant states that the intentional use of lead is now

limited to a narrow set of processes. Research on "*new zinc-based alloys for general galvanising*" is ongoing.

The galvanisation sector is an important user of melts from recycled zinc e.g. from roofing applications with Pb-containing solders and galvanizers' ashes. However, "*costumer-driven requirement for lower lead levels in markets outside EEE/ELV and the occasionally higher price of lead than zinc (affecting intentional use)*" are factors reducing the lead in galvanised coating. On the long term, 30-50 years due to the lifetime of products going into recycling, lead in recycled zinc will be diluted.

The applicant states that the use of recycled / secondary zinc is more energy efficient than the use of primary zinc, and that there is no technique available to separate Pb in / from the zinc melt of recycled zinc, rather the applicant expects a dilution of Pb over time. Thus, no benefit was identified for changing the existing practice for galvanisation.

3. Clarification Questions

3.1. Clarification questions for leaded steel for machining purposes

To the Umbrella Project:

1. You refer on page 2 to the "*proposed or existing wording: Lead as an alloying element in steel for machining purposes containing up to 0,35 % lead by weight and in batch hot dip galvanised steel components containing up to 0,2 % lead by weight*". Please confirm that this wording is proposed for both exemptions, meaning that you propose that Cat. 8 and Cat. 9 EEE covered under Ex. 6(a) until July 2021 would be merged into Ex. 6(a)-I in the future, which would then be valid for Cat. 1-10.

   UP (Umbrella Project) Exemption #6a WG Participants' proposal is that all EEE Categories and subcategories covered under Ex. 6(a) (all Cat. 8, Cat. 9 and Cat 11 EEE Categories and subcategories under scope of Ex. 6(a)) would be merged into Ex. 6(a)-I in the future (which would then be valid for All EEE Categories and subcategories 1-11), with the following proposed wording for All EEE Categories and subcategories 1-11 "*Lead as an alloying element in steel for machining purposes containing up to 0,35 % lead by weight and in batch hot dip galvanised steel components containing up to 0,2 % lead by weight*".

2. Please provide information whether the lead-free alternative 11SMn30-EM + C may cover part or all of the application range of steel containing lead for machining purposes. What performance indicators speak for or against the use of 11SMn30-EM + C? Please differentiate where relevant between application areas that differ in terms of suitability and or in terms of performance.

   UP (Umbrella Project) Exemption #6a WG Participants do not have enough information on this alternative so far, so we cannot conclude if it can be used for all specific applications.

   However, we know that machining operations account for a large proportion of the cost breakdown of the manufacture of steel components for automobiles. For decades, low levels of lead (<0,35%) have been added to many free cutting steels and some heat treatable engineering steels to improve machinability. However, during the last years a

lot of efforts have been carried out in order to obtain an alternative to lead that is technically and commercially viable.

For free cutting steels and engineering steels requiring machinability improvement, some attempts at increasing the sulphur, calcium or tin contents and reducing the lead content have been performed; however, non-lead alternative grades have given poorer chip form and surface finish [1].

Between different alternatives, bismuth has been able to substitute for lead under certain conditions, although the reduced hot ductility and the increased cost of Bi addition may make it uneconomic, particularly for large scale application [1].

Since 2014, Bismuth is considered one of the 30 critical raw materials, whose sustainable supply is one of the pre-requisites to achieve climate neutrality, adopted by European Green Deal Communication in 2019. This is the main reason why bismuth can´t replace lead for the whole global production of free cutting steels and engineering steels with improved machinability [3, 4].

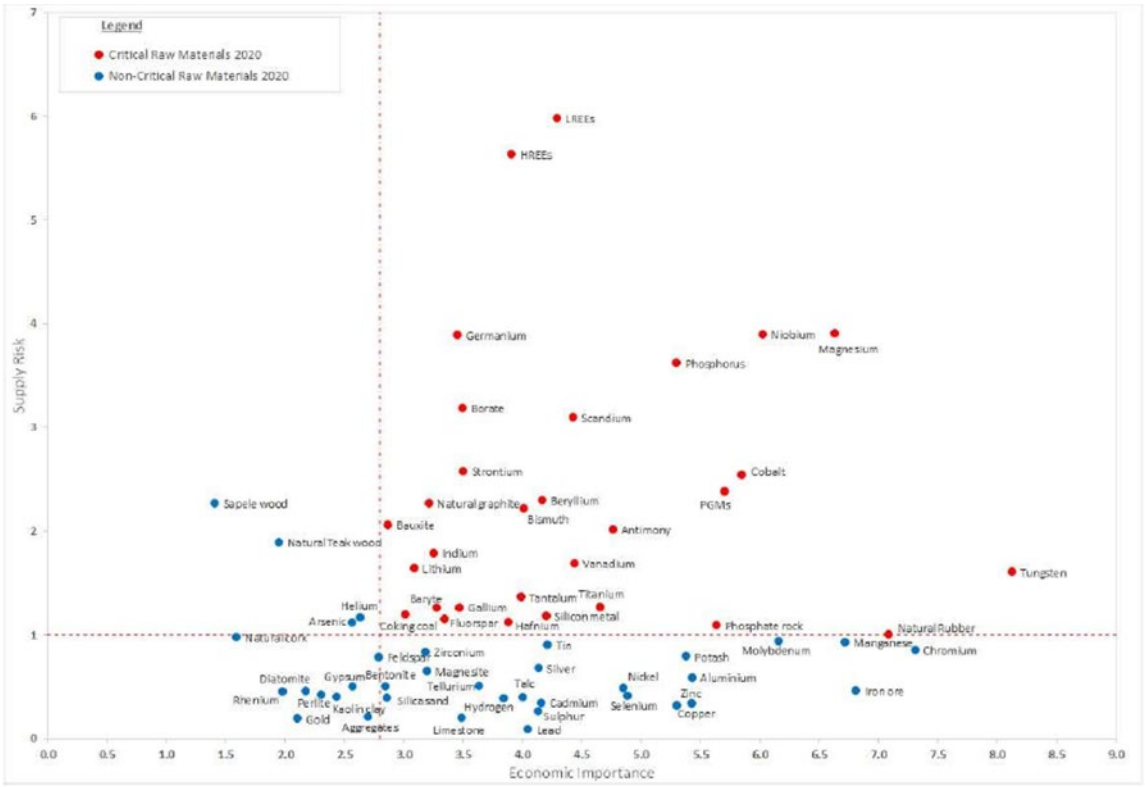

Figure 1. Economic importance and supply risk results of 2020 criticality assessment

3. On page 11 of your application, you mention a research project of the European Steel Industry and refer to the link http://cordis.europa.eu/project/rcn/66565_en.html for further information. This link does not provide additional information – please ensure the correct link has been specified or specify additional information that was meant to be referred to.

   (please also see questions 7 & 8)

UP (Umbrella Project) Exemption #6a WG Participants inform that the correct link to the EU funded research projects and its final report is https://op.europa.eu/en/publication-detail/-/publication/6b46dd1c-5944-48d7-8c4c-e009d62ca1ba . The report can be freely downloaded from the link above.

Aim of the study is to investigate technically and commercially viable alternatives to lead in free cutting and engineering steel grades.

Conclusion of the study states that ''This work has confirmed that leaded steels have generally shown the best performance in tests at lower cutting speeds with high-speed steel tools and in deep hole drilling. Non-leaded alternative grades generally gave poorer chip form and surface finish. It has been shown that, of the alternatives, bismuth is able to substitute for lead under certain conditions, although the cost of the addition may make it uneconomic, particularly for large-scale application. Calcium can also substitute in C45 steels for use at higher cutting speeds. Steels containing tin generally did not show good performance. The alternative grades generally showed equivalent fatigue performance to the leaded grades. ''

To Röhm GmbH:

4. It is explained that the drill chuck is used in power tools. Please clarify whether such power tools are expected to all fall under EEE Category 6 (electrical and electronic tools) or whether they are applied also in e.g. Category 8 (medical devices). Please note in this respect the definition under Article 3(21) and 3(22) of the Directive for medical devices:

   (21) 'medical device' means a medical device within the meaning of point (a) of Article 1(2) of Directive 93/42/EEC and which is also EEE;

   (22) 'in vitro diagnostic medical device' means an in vitro diagnostic medical device within the meaning of point (b) of Article 1(2) of Directive 98/79/EC;

5. How long do you request the exemption to be applicable? The maximum duration an exemption can be granted for is 7 years for Cat. 8 and Cat. 9 EEE and 5 years for all other categories.

6. From your input it is assumed that only the drill chuck body (as being one part of the complete drill chuck) will contain the type of steel where Pb is added for machinability reasons. Please elaborate, also in relation to the relevant type of steel (see question 7).

7. Question 4(A)5 of the application form asks in your case specifically for the amount of lead placed on the EU market through drill chucks sold by your companies (and/or your competitors). Please provide an estimation based on the amount of drill chucks you place on the market, the average amount of steel content per drill chuck and the average amount of lead content in the steel. Please as minimum provide an estimation for your own EU sales.

8. You state that there is only one supplier providing the type of lead-free steel which could be used as a substitute in drill chucks and that there will be market bottlenecks in availability. Please provide further (quantitative) information to substantiate this statement.

To both applicants:

9. The environmental impacts of leaded and non-leaded steel focus on low carbon free cutting steels, however, in the description of materials, components and applications, no more concrete definition on the type of steel (whether low carbon free cutting steel or any other) is addressed. Please refer to the kind of steel (free-cutting steel, steel for hardening and tempering, case hardening steel, other…) for which lead is necessary for machining purposes.

UP (Umbrella Project) Exemption #6a WG Participants believe that in regard to the steel types mentioned in the in the application the following distinctions may be helpful (example product standards are also referenced):

Low carbon free cutting steel (e.g. to EN 10087)

A steel where the primary property requirement is machinability (other properties, such as strength, although specified, are usually less important to the customer). These steels contain >0.1%S to enhance machining performance along with other elements such as oxygen, phosphorus and lead. They are typically used for the manufacture of machined parts where the amount of material removed is high or machined tolerance specifications are demanding and where service conditions do not result in the application of high levels of stress.

Variants of these steels (e.g. 10SPb30 or 38SMnPb28, a medium carbon free cutting steel) that are suitable for heat treatment (carburising or hardening) also exist but their mechanical property combinations are usually inferior to steels designed primarily for carburising or hardening as the high sulphur levels required for enhanced machining performance are detrimental to certain mechanical properties.

Steels for quenching and tempering (e.g. to EN 10083)

Steels where the primary property requirement is their ability to achieve a given combination of mechanical properties after heat treatment (e.g. strength, ductility, toughness). The manufacturing processes for these steels often require much less material to be removed by machining (compared to those for low carbon free cutting steels). Machinability is enhanced primarily through the additions of low levels of sulphur (<0.1%) and, in some grades, Ca, Bi or Pb. Typically, customers only require the highest levels of machinability (ie. leaded variants) where particularly demanding machining operations, such as high tolerance deep hole drilling, are undertaken.

Carburising steels (e.g. to EN 10084)

Steels where the primary requirement is the ability to carburise, quench and temper the steel to achieve a high toughness part with a very hard surface. As with steels for quenching and tempering, parts made from these steels often have much lower proportions of material removed by machining (compared to those of low carbon free cutting steels) and again machinability is enhanced primarily using low levels of sulphur (<0.1%) and in some grades Ca, Bi, Te or Pb. Most customers only use the highest machinability variants of these grades (i.e. leaded variants) where particularly demanding machining operations are undertaken.

Relative popularity of leaded variants for the different grade groups

Data from one European manufacturer of leaded steels has been supplied which demonstrates that the demand for leaded variants of low carbon free cutting steels was approximately 89% of their total supply of low carbon free cutting steels in 2018. Conversely for C35 (an example of a steel for quenching and tempering from EN10083) only around 12% of their supply comprised leaded variants of this grade. This percentage is thought to be higher than the overall proportion of leaded variants of this grade in the marketplace as a whole due to the fact that C35 without lead is produced by a large number of steelmakers who do not have the fume extraction facilities to manufacture leaded grades.

Generally speaking, since leaded steels are more expensive than their non-leaded counterparts, part manufacturers only utilise leaded steels where significant improvements in machining performance are required.

Translation of the above to environmental impact in terms of energy usage in the machining of different steel grades

Low carbon (and medium carbon) free cutting steels

Typically, large amounts of material are removed during machining and a high proportion of the demand for steels of this type is for leaded variants. Therefore this material was chosen for the environmental study as it reflects the most common use scenario for lead in steel and the overall impacts of lead in steel on global warming potential are best demonstrated using this grade.

Heat treatable and carburising steels

Typically, only a small proportion of these steel types are supplied as leaded variants. In addition, the amount of material removed by machining is usually lower than in parts made from low carbon free cutting steels. Since the energy reduction arising from the use of lead is proportional to the amount of material removed during machining the energy reduction per part from a lead addition is expected to be lower. The overall influence on global warming potential of lead additions in this group of steels is therefore much lower than in free cutting steels.

It should be noted that these steels are typically stronger than low carbon free cutting steels and therefore require more energy to machine a given component compared to a low carbon free cutting steel without lead.

10. If you think there is anything else that is relevant in addition to the questions above, please summarise it under this point.

UP (Umbrella Project) Exemption #6a WG Participants want to inform that New Life Cycle Assessment research was published in August 2020 (https://ijgtech.com/ijgtv6a3/) showing that 11S30Mn with Bi has on average 126 times higher environmental impact cost than 11S30Mn with Pb.

To download the full text in pdf, please use the below link:

https://www.researchgate.net/publication/343738708_Does_the_Restriction_of_Hazardous_Substances_RoHS_Directive_Help_Reduce_Environmental_Impacts

3.2. Clarification questions for hot dip galvanised steel

To the Umbrella Project (no other applicant for this area of the exemption):

1. You state that intentional use of lead in galvanisation processes is limited to a narrow set of processes. Please specify these processes.

   UP (Umbrella Project) Exemption #6a WG Participants can clarify the wording in the renewal request: "*Intentional use of lead is now limited to a narrow, but important, set of processes and products*". The wording was not intended to separate the 'processes' from the 'products'. The processes are those operated by galvanizing plants that would process, on a sub-contract basis, EEE products for which the technical features are required (eg complex parts requiring fluidity). These plants will not only be processing these EEE products and for trade and open competition reasons the processing of EEE should not be restricted to specific galvanizing plants. Hence, the separate processes are not identifiable as such.

2. Against the background that the Pb amount is diluted in recycled zinc, can the threshold provided for lead in the exemption formulation be lowered?

   UP (Umbrella Project) Exemption #6a WG Participants advises that, as the origin of the Pb content in recycled zinc is mainly originating from the scrap roofing zinc (that is contaminated with Pb solders) and that this material enters the recycling loops after many decades of service, such 'dilution' is not yet in evidence. Note that a lower proportion of recycled zinc has its origins in as by-products of the galvanizing process. However, since submission of the renewal application, information has become available that suggests that source separation in the European secondary zinc industry may be reducing the Pb levels in recycled zinc available to the batch galvanizing industry. The higher Pb-containing recycled zinc may be channelled to other sectors where the technical demand for Pb-containing zinc remains. The reductions compared to 2016 levels may as high as 25% although its impact on the exemption threshold is not directly transposed in the same proportions.

   Data on this new development is being collated and will be provided within a few weeks.

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.

References

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