Please find below the input from European Aluminium on the Exemption 6(b)-II of RoHS Annex III – Lead as an alloying element in aluminium for machining purposes with a lead content up to 0,4 % by weight

European Aluminium represents the full aluminium value chain in Europe. Our 80+ members include primary aluminium producers; downstream manufacturers of extruded, rolled and cast aluminium; producers of recycled aluminium and national aluminium associations are representing more than 600 plants in 30 European countries. Aluminium products are used in a wide range of markets, including automotive, transport, high-tech engineering, building, construction and packaging.

FOREWORD:

Clarification of the exemptions of lead in aluminium in the RoHS Directive

In March 2018, legislators differentiated aluminium alloys where lead is not intentionally introduced and aluminium alloys where lead is added to obtain certain properties with two different wordings, respectively exemption 6(b)-I and exemption 6(b)-II, for categories 1 to 7 and 10. Legislators however kept the "old" not differentiated wording for categories 8, 9 and 10 in exemption 6(b).

Currently, the RoHS covers three exemptions for Lead in Aluminium Alloys:

• 6(b) Lead as an alloying element in aluminium containing up to 0,4 % lead by weight

• 6(b)-I Lead as an alloying element in aluminium containing up to 0,4 % lead by weight, provided it stems from lead-bearing aluminium scrap recycling

• 6(b)-II Lead as an alloying element in aluminium for machining purposes with a lead content up to 0,4 % by weight

In this context, it is important to know that, depending on the targeted manufacturing processes, two categories of Aluminium alloys are used in the electrical and electronic equipment industry, namely casting alloys and wrought alloys. Both categories of aluminium alloys differ in their raw material resources, production processes and required different percentages of alloying elements. This is to fulfil the required properties and functionality of the final product. It does not make sense to compare the alloy categories with each other. And it is crucial that exemptions 6(b)-I and exemption 6(b)-II are treated separately.

Main Aluminium alloy categories

1- Casting Aluminium alloys usually require a higher percentage of alloying elements when compared to wrought Aluminium alloys. Today, most of the end-of-life Aluminium scrap ends in casting alloys. Due to the longevity of aluminium products and higher lead limits in the past, different amount of lead is embedded in the scrap. In order to be able to continue to recycle end-of-life scrap and preserve the aluminium material loop in the most environmentally friendly way, it is important to allow to produce casting alloys with a certain level of Lead. This tolerated amount is 0,4% in the present RoHS Directive exemption 6(b)-I. It broadly reflects the global available material standards for recycled Aluminium. Nevertheless, there is a declining trend. The Aluminium industry has already reacted on this. The recent update of the standards EN 1676:2020 'Aluminium and Aluminium alloys. Alloyed ingots for remelting. Specifications' and EN 1706:2020 'Aluminium and Aluminium alloys - Castings - Chemical composition…'

will support that move since alloy compositions have been revised with a maximum lead content reduced to 0,29%.

So, the case of casting aluminium alloys is covered by exemption 6(b)-I, for which we applied for an extension with a more precise wording and maximum lead limit reduced to 0,3%.

For more details about this, please refer to our application for renewal and modification of exemption 6(b)-I, our answers to the clarification questions, and our separate answers to the public consultation on 6(b) & 6(b)-I.

2- Wrought aluminium alloys are used for rolled, extruded and forged parts (not for cast parts). Wrought aluminium alloys for machining purposes are mostly not manufactured using scrap deriving from end-of-life recycling aluminium, and when Lead is needed, it must be added intentionally. Lead has been used for technical reasons, mainly to give machinability properties to its alloys. Factories related to wrought aluminium alloys, in order to produce lead-containing alloys, are obliged to store and use pure lead metal, and the quantities are in the range of several hundred tons per year per factory. Pure lead metal causes health problems for the workers, according to latest research and studies[1].

It is our understanding that the case of wrought aluminium alloys is covered by exemption 6(b)-II, and European Aluminium has not applied for the extension of that exemption, as we consider the limit of 0.1% sufficient, and because not adding intentionally lead to new alloys will contribute to decrease of lead in the final products that are going back to recycling at the end of their life.

Since the above facts about aluminium supply are valid for all EEEs, including categories 8, 9 and 11:
- our proposal for narrowing down the scope of exemption 6(b)-I to casting alloys and reducing the maximum lead limit to 0,3% is also valid for exemption 6(b)
- our opposition to the extension of exemption 6(b)-II applies to all EEE categories.

Further information for 6(b)-II is provided as answers to the questions below.

QUESTIONS:

1. The applicant has requested the renewal of an exemption currently listed in RoHS Annex III (see exemption specific page accessible through the links above):

a. Do you agree with the scope of the exemption as proposed by the applicant?

In our point of view, an extension of exemption 6(b)-II is not necessary.

b. Please suggest an alternative wording and explain your proposal, if you do not agree with the proposed exemption wording.

Not relevant.

c. Please explain why you either support the applicant's request or object to it. To support your views, please provide detailed technical argumentation / evidence in line with the criteria in Art. 5(1)(a) to support your statement.

We object to the applicant's request because lead-free wrought aluminium alloys for machining purposes are globally available and Aluminium producers have developed lead-free alternatives with properties compatible with lead-containing alloys in use for any kind of application. Aluminium extruders started back in 1996 to develop alloys with high machinability which could replace the lead-containing ones. Now, thanks to the big experience accumulated during

[1] https://echa.europa.eu/substance-information/-/substanceinfo/100.028.273

decades, there are in the market all possible lead-free alloys which could replace any kind of lead-containing alloy, for any end-use application, for all kind of families of alloys from 2000 series (Al-Cu based) to 6000 series (Al-Mg-Si series). These alloys have been tested and approved by all major industrial sectors, worldwide, in all applications, including electrical and electronic equipment such as medical equipment, valves, safety parts and components, whether used in high or low temperature environments, whether in contact with fluids, lubricants, coolants, whether anodized or not. All parts passed all the requirements also in terms of respecting tight tolerances, surface roughness, superficial aspect, anodizing response, mechanical properties. The aluminium industry is immediately able to supply any quantity needed of lead-free alloys. Roughness is even improved without Lead, as the absence of Lead avoids the eutectic with Bismuth and the alloys remains harder.

REACH Directive is taking into serious account to limit the quantity of Lead that any European Company can use and have in each factory. It is expected to have a final statement in the next years, where REACH will reduce the limit of Lead to a certain value that it will be impossible to produce aluminium alloys with lead content up to 0,40% for European Extruders or Rollers.

Indeed to protect the health of European workers has n.1 priority. Under this circumstance, European Companies will be obliged to respect REACH and will not be able to produce alloys with lead, but companies outside Europe will, resulting in unfair competition.

2. Please provide information concerning possible substitutes or elimination possibilities at present or in the future so that exemption could be restricted or revoked:

a. Please detail substitution and elimination possibilities and for which part of the applications in the scope of the requested exemption they are relevant.

Here is the list of all the alloys which include lead. In red all alloys which are already out of actual RoHS limit of 0,40% max and in black all alloys which are currently used.

No. [17]	Date	By	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ag	B	Bi	Ga	Li	Pb	Sn	V	Zr		Each	Total[3]	Al Min	(kg/m^3) x 10^3
2005	1983	ARGENTINA	0,8	0,7	3.5-5.0	1	0.20-1.0	0,10	0,20	0,5	0,20	…	…	0,20	…	…	1.0-2.0	…	…	…	…	0,05	0,15	Rem.	2,83
2007	1979	GERMANY	0,8	0,8	3.3-4.6	0.50-1.0	0.40-1.8	0,10	0,20	0,8	0,20	…	…	0,20	…	…	0.8-1.5	0,2	…	…	…	0,10	0,30	Rem.	2,82
2011 (*)	1954	USA	0,40	0,7	5.0-6.0	…	…	…	…	0,30	…	…	…	0.20-0.6	…	…	0.20-0.6	…	…	…	…	0,05	0,15	Rem.	2,83
2011A (*)	1982	SWITZERLAND	0,4	0,5	4.5-6.0	…	…	…	…	0,30	…	…	…	0.20-0.6	…	…	0.20-0.6	…	…	…	…	0,05	0,15	Rem.	2,82
2028	2005	GERMANY	0,8	0,8	3.3-4.6	0.50-1.0	0.40-1.8	0,10	0,20	0,80	0,20	…	…	0.10-1.0	…	…	1	0.10-1.0	…	…	…	0,10	0,30	Rem.	2,83
2028A	2006	SLOVENIA	0,80	0,7	3.3-4.5	0.20-1.0	0.50-1.3	0,1	0,1	0,50	0,2	…	…	0.50-0.7	…	…	0.20-0.40	…	…	…	…	0,05	0,15	Rem.	2,8
2028B	2006	SLOVENIA	0,8	0,8	3.3.-4.6	0.50-1.0	0.40-1.8	0,10	0,10	0,80	0,20	…	…	0.50-0.7	…	…	0.20-0.40	…	…	…	…	0,05	0,15	Rem.	2,81
2030	1972	EAA	0,8	0,7	3.3-4.5	0.20-1.0	0.50-1.3	0,10	…	0,5	0,20	…	…	0,2	…	…	0.8-1.5	…	…	…	…	0,10	0,30	Rem.	2,81
6012	1979	GERMANY	0.6-1.4	0,5	0,1	0.40-1.0	0.6-1.2	0,30	…	0,30	0,20	…	…	0,7	…	…	0.40-2.0	…	…	…	…	0,05	0,15	Rem.	2,74
6018	1991	SWITZERLAND	0.50-1.2	0,7	0.15-0.40	0.30-0.8	0.6-1.2	0,1	…	0,30	0,2	…	…	0.40-0.7	…	…	0.40-1.2	…	…	…	…	0,05	0,15	Rem.	2,74
6026	2004	ITALY	0.6-1.4	0,7	0.20-0.50	0.20-1.0	0.6-1.2	0,3	…	0,30	0,20	…	…	0.50-1.5	…	…	0,40	0,05	…	…	…	0,05	0,15	Rem.	2,74
6042	2006	USA	0.50-1.2	0,70	0.20-0.6	0,40	0.7-1.2	0.04-0.35	…	0,25	0,2	…	…	0.20-0.8	…	…	0.15-0.40	…	…	…	…	0,05	0,15	Rem.	2,72
6064	2006	SLOVENIA	0.40-0.8	0,70	0.15-0.40	0,15	0.8-1.2	0.05-0.14	…	0,25	0,15	…	…	0.50-0.7	…	…	0.20-0.40	…	…	…	…	0,05	0,15	Rem.	2,72
6064A	2007	SWITZERLAND	0.40-0.8	0,70	0.15-0.40	0,15	0.8-1.2	0.04-0.14	…	0,25	0,15	…	…	0.40-0.8	…	…	0.20-0.40	…	…	…	…	0,05	0,15	Rem.	2,72
6068	2009	SWITZERLAND	0.6-1.4	0,50	0,10	0.40-1.0	0.6-1.2	0,30	0,1	0,30	0,20	…	…	0.6-1.1	0	…	0.20-0.40	…	0	…	…	0,05	0,15	Rem.	2,73
6262	1960	USA	0.40-0.8	0,70	0.15-0.40	0,15	0.8-1.2	0.04-0.14	…	0,25	0,2	…	…	0.40-0.7	…	…	0.40-0.7	…	…	…	…	0,05	0,15	Rem.	2,72

Source: Teal sheets, available for free download from https://www.aluminum.org/standards

Here below is the list of ALL wrought aluminium alloys for machining purposes which do not have Lead, i.e. Pb ≤ 0,10%.

No. [17]	Date	By	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ag	B	Bi	Ga	Li	Pb	Sn	V	Zr		Each	Total[3]	Al Min	(kg/m^3) x 10^3
2007A	2001	ITALY	0,8	0,8	3.3-4.6	0.20-1.0	0.40-1.8	0,10	0,20	0,8	0,20	…	…	0,20	…	…	0,05	0.8-1.5	…	…	…	0,10	0,30	Rem.	2,81
2007B	2006	SLOVENIA	0,8	0,7	3.3-4.6	0.50-1.0	0.40-1.8	0,10	0,10	0,8	0,20	…	…	0,10	…	…	0,10	0.40-1.9	…	…	…	0,05	0,15	Rem.	2,81
2012	1993	USA	0,40	0,7	4.0-5.5	…	…	…	…	0,30	…	…	…	0.20-0.7	…	…	…	0.20-0.6	…	…	…	0,05	0,15	Rem.	2,82
2028C	2006	BELGIUM	0,8	0,7	3.3-5.0	0.20-1.0	0.50-1.3	0,10	…	0,50	0,20	…	…	0.40-1.0	…	…	0,05	0.20-1.0	…	…	…	0,10	0,30	Rem.	2,82
2033	2017	ITALY	0.10-1.2	0,7	2.2-2.7	0.40-1.0	0.20-0.6	0,15	0,15	0,50	0,10	…	…	0.05-0.8	…	…	…	…	…	…	…	0,05	0,15	Rem.	2,77
2041	2006	SLOVENIA	0,40	0,7	5.0-6.0	…	…	…	…	0,30	…	…	…	0.50-0.7	…	…	0,05	0.50-0.7	…	…	…	0,05	0,15	Rem.	2,84
2044	2006	SLOVENIA	0,8	0,7	3.3-4.5	0.20-1.0	0.50-1.3	0,10	0,10	0,50	0,20	…	…	0.20-0.40	…	…	0,05	0.9-1.3	…	…	…	0,05	0,15	Rem.	2,81
2045	2006	SLOVENIA	0,8	0,8	3.3-4.6	0.50-1.0	0.40-1.8	0,10	0,10	0,8	0,20	…	…	0.20-0.40	…	…	0,05	0.9-1.3	…	…	…	0,05	0,15	Rem.	2,82
2077	2020	ITALY	0.40-1.0	0,7	4.0-5.0	0.60-1.2	0.60-1.2	0,20	0,20	0,25	0,15	0,15	…	0.20-0.90	…	0,15	…	…	…	0,15	…	0,05	0,15	Rem.	2,82
2111	1993	USA	0,40	0,7	5.0-6.0	…	…	…	…	0,30	…	…	…	0.20-0.8	…	…	…	0.10-0.50	…	…	…	0,05	0,15	Rem.	2,83
2111A	2001	ITALY	0,40	0,7	5.0-6.0	0,15	0,15	…	…	0,30	0,05	…	…	0.20-0.6	…	…	0,05	0.20-0.6	…	…	…	0,05	0,15	Rem.	2,83
2111B	2001	SWITZERLAND	0,30	0,50	4.6-6.0	0,05	0,05	…	…	…	…	…	…	0.30-0.6	…	…	…	0.30-0.7	…	…	…	0,05	0,15	Rem.	2,83
6012A	1999	ITALY	0.6-1.4	0,50	0,40	0.20-1.0	0.6-1.2	0,30	…	0,30	0,20	…	…	0,7	…	…	…	0.40-2.0	…	…	…	0,05	0,15	Rem.	2,74
6020	1995	USA	0.40-0.9	0,50	0.30-0.9	0,35	0.6-1.2	0,15	…	0,20	0,15	…	…	…	…	…	0,05	0.9-1.5	…	…	…	0,05	0,15	Rem.	2,73
6021	2000	GERMANY	0.6-1.5	0,40	0,20	0.40-1.0	0.8-1.5	0,25	…	0,20	0,10	…	…	…	…	…	…	0.6-1.5	…	…	…	0,05	0,15	Rem.	2,72
6023	2001	SWITZERLAND	0.6-1.4	0,50	0.20-0.50	0.20-0.6	0.40-0.9	…	…	…	…	…	…	0.30-0.8	…	…	…	0.6-1.2	…	…	…	0,05	0,15	Rem.	2,73
6026LF	2004	ITALY	0.6-1.4	0,7	0.20-0.50	0.20-1.0	0.6-1.2	0,30	…	0,30	0,20	…	…	0.50-1.5	…	…	0,05	0,05	…	…	…	0,05	0,15	Rem.	2,74
6028	2006	SLOVENIA	1.0-1.3	0,50	0.25-0.40	0.6-0.9	0.7-1.0	0.04-0.10	…	0,30	0,20	…	…	0.6-0.8	…	…	…	0.6-0.8	…	…	…	0,05	0,15	Rem.	2,74
6033	2002	USA	0.8-1.3	0,50	0.40-1.0	0,05	0.7-1.3	0,10	…	0.50-1.0	0,15	…	…	0.30-1.0	…	…	0,05	…	…	…	…	0,05	0,15	Rem.	2,73
6040	2002	USA	0.40-0.8	0,7	0.20-0.8	0,15	0.8-1.2	0,15	…	0,25	0,15	…	…	0.15-0.7	…	…	…	0.30-1.2	…	…	…	0,05	0,15	Rem.	2,73
6041	2006	USA	0.50-0.9	0.15-0.7	0.15-0.6	0.05-0.20	0.8-1.2	0.05-0.15	…	0,25	0,15	…	…	0.30-0.9	…	…	…	0.35-1.2	…	…	…	0,05	0,15	Rem.	2,73
6043	2006	CHINA	0.40-0.9	0,50	0.30-0.9	0,35	0.6-1.2	0,15	…	0,20	0,15	…	…	0.40-0.7	…	…	…	0.20-0.40	…	…	…	0,05	0,15	Rem.	2,72
6050	2016	USA	1.2-1.8	1.3-1.8	0.15-0.50	0.20-0.7	0.50-0.9	0.05-0.25	0,20-1.0	0.25	0.10	…	…	…	…	…	…	…	…	…	…	0,05	0,15	Rem.	2.74
6065	2005	BELGIUM	0.40-0.8	0,7	0.15-0.40	0,15	0.8-1.2	0,15	…	0,25	0,10	…	…	0.50-1.5	…	…	0,05	…	…	0,15	…	0,05	0,15	Rem.	2,72
6262A	2005	BELGIUM	0.40-0.8	0,7	0.15-0.40	0,15	0.8-1.2	0.04-0.14	…	0,25	0,10	…	…	0.40-0.9	…	…	…	0.40-1.0	…	…	…	0,05	0,15	Rem.	2,72

Source: Teal sheets, available for free download from https://www.aluminum.org/standards

It is evident that all actual alloys with Lead have Bismuth in combination too, in quantities between 0.2 and 1.5%.

Lead free alloys do not have Bismuth added compared to leaded alloys. This information need to be clearly understood, because the statement that Bismuth has been used as a replacement of Lead is false. Bismuth is present in leaded alloys in the same quantity than in lead free alloys. Therefore any consideration of the negative impact of Bismuth is meaningless, because if we would need to avoid Bismuth, we would need to avoid Lead as well, because today each and all alloys with Lead have Bismuth. Moreover ECHA stated that on Bismuth no hazards have been classified (https://echa.europa.eu/substance-information/-/substanceinfo/100.028.343), while we have to bear in mind that Lead is classified as Reprotoxic 1A with a hazard statement code of H360 (https://echa.europa.eu/substance-information/-/substanceinfo/100.028.273).

Tin is also used as replacement, both alone (6020) or in combination with Bismuth in tens of alloys. Tin cannot be used on higher temperature applications, but it is an excellent chip-forming element.

b. Please provide information on research to find lead-free alternatives (substitution or elimination) that may cover part or all of the applications in the scope of the exemption request at present or in the future.

Please refer to previous question.

c. Please provide a roadmap of such on-going substitution/elimination efforts and research (phases that are to be carried out), detailing the current status as well as the estimated time needed for further stages.

Many Companies have already completely switched their production into Lead-free wrought aluminium alloys. A complete replacement takes from 6 months to some years, depending on the quantity of components. As Lead-free alloys are now available worldwide, from suppliers in all Continents, the process of switching speeded up in the last years.

3. The Umbrella Project states that "*this renewal request is based on the fact that only a very low amount of leaded aluminium is still required for some niche applications*." In the answer to the clarification questions, the Umbrella Project specifies the following exact applications where leaded aluminium alloys are still needed (see the summary above for more details):

- **Cast and machined aluminium gear boxes from handheld tools;**
- **Charge holders for MEMS sensor applications;**
- **Stand-offs and spacers to electrically connect parts, such as heat sinks, in medical equipment.**

Would it be possible to narrow down the scope of the exemption to these three specific applications?

a. **Please explain why you either support or object the proposal to narrow the scope of the exemption to specific applications.**

There is absolutely no technical need for lead-containing wrought aluminium alloys. In Annex 1, all technical information to support this statement is provided.

b. **To support your views, please provide detailed technical argumentation / evidence in line with the criteria in Art. 5(1)(a) to support your statement.**

Please refer to previous question.

c. **If the list is not exhaustive, please specify additional applications for which this exemption is needed.**

No application needs lead-containing wrought aluminium alloys.

4. According to the Umbrella Project, the 3rd criterion of Art. 5(1) applies to the renewal request because the total negative environmental, health and consumer safety impacts caused by substitution with bismuth are likely to outweigh the total environmental, health and consumer safety benefits thereof.

a. Please explain why you either support or object the proposal to narrow the scope of the exemption to specific applications. [The above question seems to be a copy/paste mistake. The right question should probably be: **Do you support or object this argument?**]

We do not support this argument.

b. Please provide detailed information to support your statement.

As stated under question 2.a., new Bi-only alloys do not have more Bi than lead-containing alloys, so the total quantity of Bi between lead-free alloys and non-lead-free alloys remains the same.

5. Please provide any further information and/or data that you think is of importance to substantiate your views.

New Lead-free wrought aluminium alloys (i.e. max lead content of 0.1%) for machining purpose have been made globally available on the market since the last consultations, opening the path towards phasing out intentional additions of Lead in Aluminium, with first cases of successful substitution in the electrical and electronic equipment sector already happening. The aluminium industry is ready to give any support its customers need to replace the lead-containing wrought aluminium alloys.

Our experts are ready to supply any additional information that would be required.

See also Annex 1 on next page.

Annex 1

Functionality / Property /Performance Aspect	Performance indicator (basis for monitoring the performance and comparing between Al alloys with & without lead)	Performance (or performance range) enabled through the use of lead-based alloy in relevant applications	Comments - Interrelations
Corrosion resistance of manufactured articles	Lead reacts to form halides, therefore it is not suitable in applications when ions Cl-, Br-, I-, F-, At- are present	Bismuth does not react, to form halides, so it is suitable	
Surface finish of manufactured articles	Good surface finish	Lead free alloys has better surface finishing. Pb+Bi create eutectic alloy with melting point at 125°C. Without Pb, Bi melting point is 271°C, so the alloy is harder and grants better (lower) roughness on the surface.	
Longer life of manufacturing tools and less energy consumption during machining of parts		Some lead free can be machined at lower cutting speed, increasing life of manufacturing tools. Life tools is much higher using tools for steel, which are cheaper and last much more, granting the same final result.	
Cutting speeds of manufacturing tools		Using common tools for steel, we can use same speeds or even lower speeds to get the same final results. There is no need to use specific expensive tools as CVD or PVD for non-ferrous metals.	
Lubrication effect in manufactured articles		No changes	
Better chip fracturing in manufactured articles		Using common tools for steel, lead free alloys have much better attitude in drilling and milling, as well as machining and cutting.	
Temperature resistance		Bismuth-only based alloys (e.g. 6026LF and 2033) resist +146°C compared to Pb+Bi based alloys (e.g. 2011, 6262, 6012, 6042…)	
Electrochemical potential (of additive)	Pb2+ + 2e- <---> Pb = -0,13 Pb4+ + 2e- <---> Pb2++ = 1,67	Bi3+ + 3e- <---> Bi = +0,29 Sn2+ + 2e- <---> Sn = -0,1 Sn4+ + 2e- <---> Sn2+ = +0,15	Numbers in Volt, 25°C, 101KPa, 1M
Shrinking from liquid to solid phase (of additive)	Pb shrinks of 5,94%	Bi increases of 2,97% Sn increases of 3,93%	
Durability of part		No changes	

Eutectic point of alloy	Pb only melts at 327.5°C Pb+Bi melts at 124°C Pb+Sn melts at 183°C	Bi only melts at 271,5°C Sn only melts at 231,9 °C Sn+Bi eutectic melts at 139°C
Heat treatable strength		No changes
Heat treatment performance		No changes
Fatigue strength		No changes