Exemption Evaluation under Directive 2000/53 EC

ACEA et al. Answers to Stakeholder Consultation Questionnaire

of Bio Innovation Service
and The United Nations Institute for Training & Research (UNITAR)
and Fraunhofer Institute for Reliability and Microintegration (IZM) dates 08.02.2024

Exemption 8(g) (ii) - Lead in solders to complete a viable electrical connection between the semiconductor die and the carrier within integrated circuit flip chip packages where that electrical connection consists of any of the following:

1) A semiconductor technology node of 90 nm or larger;
2) A single die of 300 mm^2 or larger in any semiconductor technology node;
3) Stacked die packages with dies of 300 mm^2 or larger, or silicon interposers of 300 mm^2 or larger.

Application for an extension of Annex II EU ELV exemption No. 8(g) (ii).

This application is supported by the following associations:

- ACEA, the European Automobile Manufacturers Association, Brussels (transparency registration ID number 0649790813-47)
- CLEPA, the European Association of Automotive Suppliers, Brussels (transparency registration ID number 91408765797-03)
- JAMA, the Japan Automobile Manufacturers Association, Tokyo / Brussels (transparency registration ID number 71898491009-84)
- JAPIA, the Japan Auto Parts Industries Association, Tokyo
- KAMA, the Korea Automobile Manufacturers Association, Seoul

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PART A Background and technical information

Acronyms and definitions

BGA	Ball Grid Array
COM	European Commission
CTE	Coefficient of Thermal Expansion
ECB	Electronic Circuit Board
EEE	Electrical and Electronic Equipment
FCOL	Flip Chip On Lead-frame
FCP	Flip Chip Package
HMP	High Melting Point
HMPS	High Melting Point Solder, i.e. solder with a Lead content of 85 % by weight or more
Lead-free	Not containing lead in the application in the scope of the exemption under review
Pb	Lead
RoHS	Directive 2011/65/EU on the Restriction of Hazardous Substances in Electrical and Electronic Equipment
Circuit modules	Sub-assemblies for electronic schematics of electronic circuits (respectively electronic circuit board assemblies)

1 Introduction to exemption 8(g)(ii)

1.1 Development of the exemption under ELV

The Commission decided with Commission Decision 2010/115/EU of 23 February 2010, to split the exemptions 8(a). *Solder in electronic circuit boards and other electrical applications except on glass* and 8(b). *Solder in electrical applications on glass,* prior defined in Commission decision 2008/689/EC of 1 August 2008.

The split was extended to 10 new defined entries. For the new introduced subentry 8(g)., *´Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages´* the Directive 2010/115/EU determined a first review in 2014.

With the Commission Directive (EU) 2016/774 of 18 May 2016 the Commission decided to continue exemption 8(g) and a review for the year 2019, as the applications covered by exemption 8(g) remains unavoidable as substitutes have not become available yet.

In May 2018, the Oeko Institute launched a stakeholder consultation for the review of several exemptions of Annex II including the review of exemption 8(g).

In their report [1] the consultants Oeko Institute and Fraunhofer IZM from October 2019 recommend (see fig. 1.1) to split the exemption 8(g) into the two subentries 8g(i) and 8(g)(ii).

1 Review in the light of scientific and technical progress of exemptions 8(e), 8(f)(b), 8(g) and 14 and re-evaluation of entry 8(j) of Annex II to Directive 2000/53/EC (ELV) (Pack 3) – Draft Final 02.10.2019

8(g)(i) shall cover the scope of the previous entry 8(g), but are only applicable for *´Vehicles type approved before 1 October 2022 and spare parts for these vehicles.´*

8(g)(ii) shall continue previous entry 8(g), but with narrowed scope and with a suggested review date in the year 2024.

Exemption	Initial Wording (2010/115/EU)	Recommended Wording (OEKO Institute et al)	Recommended expiry date and scope
8(g)	Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages	Expiry date for current exemption with new entry 8g(i) Introduction of new entry 8g(ii) with narrowed scope and split into 3 subentries	
		8(g)(I) Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages	In vehicles type-approved before 1 October 2022 and after that date as spare parts for these vehicles
		8(g)(II) Lead in solders to complete a viable electrical connection between the semiconductor die and the carrier within integrated circuit flip chip packages where one of the below criteria applies: a) A semiconductor technology node of 90 nm or larger b) A single die of 300 mm^2 or larger in any semiconductor technology node c) Stacked die packages with dies of 300 mm^2 or larger, or silicon interposers of 300 mm^2 or larger	Valid as of 1 October 2022 for vehicles type approved after 30 September 2022 Review in 2024

Figure 1.1 *: Excerpt from page 12 of ´Review in the light of scientific and technical progress of exemptions 8(e), 8(f)(b), 8(g) and 14 and re-evaluation of entry 8(j) of Annex II to Directive 2000/53/EC (ELV) (Pack 3) – Draft Final´*

With Commission delegated Directive (EU) 2020/363 [2] from 17. December 2019, the Commission followed the consultant recommendation and amended Annex II entry 8(g) accordingly, as there are currently no suitable alternatives to the use of Lead for the materials and components covered by this exemption. And date for a new review of the new exemption 8(g)(ii) was determined for the year 2024.

[2] 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 as regards certain exemptions for lead and lead compounds in components; OJ L 67/119, 5.3.2020

1.2 Development of exemption under the scope of RoHS

The above addressed exemption 8(g) is also listed in Annex III of Directive 2011/65/EU (RoHS Directive) as exemption no. 15.

For products in scope of WEEE and RoHS other use profiles may apply than for vehicles. E.g. demands to consumer electronics or smart phones are different from requirements to an engine controller in a vehicle.

Exemption 15 of RoHS was reviewed during the 2008/2009 review of RoHS Annex and a continuation of the exemption was granted by COM with review date 2016.

In 2015 exemption 15 of Annex III of RoHS Directive (2011) was reviewed, after industry had applied for its continuation beyond 2016 with a restricted scope reflecting the status of science and technology. The review resulted in the new wording as reflected in RoHS exemption 15(a):

Lead in solders to complete a viable electrical connection between the semiconductor die and the carrier within integrated circuit flip chip packages where one of the below criteria applies:

a) A semiconductor technology node of 90 nm or larger
b) A single die of 300 mm² or larger in any semiconductor technology node
c) Stacked die packages with dies of 300 mm² or larger, or silicon interposers of 300 mm² or larger

According to the specific rules of the RoHS legislation, the stakeholders applied to continue this exemption 15(a) with submissions of 16.01.2020 and to continue exemption 15 with submissions of 16.01.2020 for RoHS categories 8 and 9. As long as there is no COM decision to the submission, the exemption remains valid. Until today there is no valid COM decision.

2 FCP´s

2.1 FCP technology basics

Flip chip is a synonym for a technology for interconnecting dies such as semiconductor devices, IC chips, integrated passive devices and microelectromechanical systems (MEMS), to external circuitry with (solder) bumps that have been deposited onto the chip pads. FCP technology has in many cases substituted the wire bonding technology for electrical connections on semiconductors / IC´s.

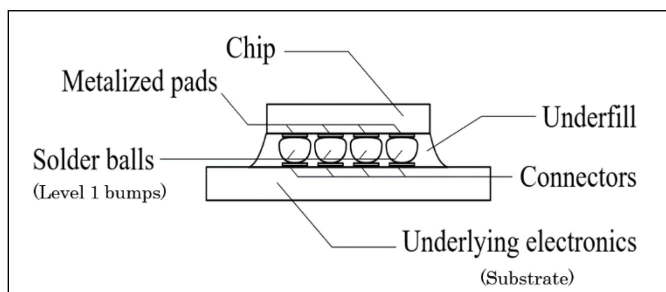

Figure 2.1 : *Schematic diagram of Flip chip*
(source: web Creative Commons CC0 License, Author Twisp, description in brackets added)

The advantages of Flip chips technologies are:

- Enabling high density packing of complex integrated circuits
- High speed of signal processing
- Input and output lines can be connected to all parts of the chip

Disadvantages:

- Sensitivity to thermomechanical stress

FCPs and their connections are sensitive to thermomechanical stress, as caused by CTE mismatch in all three dimensions (x/y/z) of different materials applied. By using Pb internal solder joint, fatigue resistance to thermal cycling is higher and resists cracking where Pb-free solutions currently fail. Underfills are used to reduce the thermomechanical stress between silicon die, solder and substrate. Additional mechanical stress by warping of the substrate stimulates failure of the connections to the silicon die.

In vehicles the temperature windows for electronics are specified for around up to 200 degrees Kelvin and additional harsh mechanical shocks can impact the long-term reliability of electronics. The requirements are more similar to military applications than to consumer electronics.

2.2 FCP Automotive Market

The market for FCP´s, validated for automotive applications, is a sub-segment of the FCP market and due to the elevated requirements e.g. like long-term availability, there are limitations in offered products.

Vehicle applications, as yet described in previous contributions, are

- 4G / 5G communication
- Electronic stability control systems
- Advanced emergency braking systems
- Distance control, assisted driving
- Lane departure warning systems
- Frontal projection systems
- Pedestrian protection
- Tire pressure monitoring systems to reduce rolling resistance and noise emissions
- Hydrogen and hybrid cars
- Vision systems
- Audio/multimedia/car radio/car infotainment
- Traffic sign recognition
- Navigation
- Telematic systems, emergency call (e-call)
- Head-up displays

3. Challenges of substitution

After a potential automotive suitable, Lead-free component is identified, usually a minimum of 6 years will be required to qualify (e.g. AEC-Q 100) it through the whole supply chain until release in volume scale car production. Based upon the current status of these special products, it is not possible to specify and hardly possible to estimate a real transition date. Product delivery for replacement and repair will need to continue for the life of type approved vehicles.

The solders used on *´level 1 bumps´* in the flip chip connections must be:

- Resistant to electro-migration failure at the extremely high current densities required;
- Able to create a solder hierarchy that allows staged assembly and rework of components in the manufacture process; and
- Have high ductility to reduce thermo-mechanical stress in under bump metallurgy structures in particular in larger dies.

Last but not least, a use of FCPs is linked to the board network design and the related control units and software installed in a vehicle.

4 Used quantities assessments

4.1 ACEA et al 2013

The flip chip products are used in selected few sockets within automotive applications. There are no metrics to identify the number of lead flip chip components within an average vehicle.

Assuming one to three flip chip components per vehicle, based upon the latest estimated 13.4 million registered units in the EU + EFTA, the total lead placed on the EU market is estimated at about 0.2 to 0.6 metric tons per year.

4.2 ACEA et al 2018

With15.7 million vehicles new registered in 2017 in the European Economic Area (EU28 +EFTA) the total Lead placed on the EU market making use of Exemption 8(g) is estimated with about 31kg to 548kg per year (2017)

Figure 10: Exemption 8(g) Lead in Vehicles Approximation

EU Vehicle Sales in 2017 [viii]						
ACEA Report						
Vehicle Type	2017 Totals (Mio units)		Minimum amount of Pb per vehicle (mg)	Maximum amount of Pb per vehicle (mg)	Minimum total Pb (kg)	Maximum total Pb (kg)
All	15,659		2	35	31	548

Additional remark for version made by ACEA:
With an average value of 17 mg/car and 15,7 Mio. vehicles put on EC market in 2017 we estimate a total Lead quantity of around 0,25 t/a for entry 8g applications.

[viii] Op. cit. OICA EU Statistics & sales figures EU28 (&EFTA) for 2017, (http://www.oica.net/category/sales-statistics/)

Table provided by JAPIA for 2 flip chip use cases

Use example of exemption 8(g) in JAPIA (2018.06.13)

Application	Component	Number of component per application	Mass of lead in component [mg]	Lead content in material [wt%]
Navigation	IC	1	2.48	37
Digital TV tuner	IC	1	5.34	36

4.3 ACEA/JAMA/JAPIA/CLEPA/KAMA 2024

Assuming, depending on the car model and its equipment, approx. 1 to 5 electronic systems (like Navigation or Digital TV tuner) of average 130 control devices per vehicle are equipped with FCPs.

With a mean value of around 12 mg (mass of lead per vehicle; based on mean value of around 4 mg (based on 3 FPCs per vehicle and on the mean value mass of lead per FPC) and 12,910,891 vehicles new placed (registered) on the EU market in the year 2022 (detail see frame document), we estimate a total Lead quantity of around 0,16 t/a in the scope of exemption 8(g)(ii).

PART B Answers to Questionnaire

Information from Consultant Consortium

Table 1: Current wording, scope and expiry date of the exemption 8(g)(ii)

No.	Exemption	Scope and dates of applicability
8(g)(ii)	Lead in solders to complete a viable electrical connection between the semiconductor die and the carrier within integrated circuit flip chip packages where that electrical connection consists of any of the following: (1) a semiconductor technology node of 90 nm or larger; (2) a single die of 300 mm^2 or larger in any semiconductor technology node; (3) stacked die packages with dies of 300 mm^2 or larger, or silicon interposers of 300mm^2 or larger.	Vehicles type-approved from 1 October 2022 and spare parts for these vehicles. This exemption shall be reviewed in 2024.

Figure B 1 : *Table 1 of consultant questionnaire*

Acronyms and Definitions

EEE	Electrical and electronic equipment
ELV	Directive 2000/53/EC on end-of-life vehicles
FCP	Flip chip package
Lead-free	Not containing lead in the application(s) in scope of the exemption to be reviewed
Pb	Lead
RoHS	Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment

Figure B 2: Acronyms and Definitions of consultant questionnaire

Consultant questionnaire text:

[ ] Footnotes of consultant questionnaire

1. Background

Bio Innovation Service, UNITAR and Fraunhofer IZM have been appointed [1] [3] by the European Commission for the evaluation of applications for new exemptions and the renewal/continuation of exemptions currently listed in Annex II of the ELV Directive 2000/53/EC.

[3] [1] It is implemented through the specific contract 070201/2020/832829/ENV.B.3 under the Framework contract ENV.B.3/FRA/2019/0017

This questionnaire has been prepared for the stakeholder consultation held as part of the evaluation. The objective of this consultation is to collect information and evidence for subsequent review to assess whether the exemption is still justified according to the criteria listed in Art. (4)(2)(b)(ii) of Directive 2000/53/EC (ELV Directive) [2], [4].

Additional background information can be found on the exemption review page accessible through the following link: www.elv.biois.eu

2. Main Observations in Previous Reviews

Exemption 8(g) was reviewed [3], [5] last time in 2018 under the ELV Directive [4] , resulting in the adoption of exemptions 8(g)(i) and 8(g)(ii) in place of exemption 8(g). At the time, the consultants concluded that granting an exemption with a more narrow scope, in alignment with exemption 15(a) of RoHS Annex III [4],[6], would be in line with Art. 4(2)(b)(ii) of the ELV Directive. To allow the automotive industry to transition to the scope changes, it was recommended that the existing exemption was to remain valid for a transition period as exemption 8(g)(i) and to introduce exemption 8(g)(ii) with a more narrow scope in alignment with exemption 15(a) of RoHS Annex III, as reproduced in Table 1.

The consultants noted that, at the time, ACEA et al. had claimed the need to include certain high current flip chips on lead frames into the scope of the exemption. In the absence of evidence and of clear technical information that and why the use of lead was unavoidable in these components for automotive uses, the consultants at the time concldduded that Art. 4(2)(b)(II) did not allow them to recommend including these components into the scope of the future exemption.

Exemption 15(a) on Annex III of Directive 2011/65/EU (RoHS) is the equivalent to exemption 8(g)(ii) on Annex II under the ELV Directive. Exemption 15(a) was last reviewed [5], [7] by Deubzer et al. (2022). At the time, the consultants concluded that the applicants did not provide substantiated evidence that would allow the consultants to recommend the exemption renewal in line with the conditions for exemptions laid out in RoHS Art. 5(1)(a), i.e. it could not be clarified whether and how far substitution or elimination of lead were still scientifically and technically impracticable. It remained unclear why larger node (≥ 90 nm) flip chip packages were still used and intended to be used another five or seven years in new EEE placed on the EU market while smaller node lead-free alternatives had been available since 2007. For the other clauses of exemption 15(a), the applicants did not clarify whether and how far the technological state of the art would allow restricting the scopes of these exemption clauses, i.e. whether, how far and under which conditions dies larger than 300 mm² could be produced without the use of lead solders. For the stacked die FCPs, no conclusion was feasible whether and under which conditions the use of organic/plastics interposers instead of silicon interposers could support the substitution of lead and thus allow restricting the scope of this part of the exemption. The concultants therefore did not recommend a renewal of exemption 15(a) but recommended a transition period of 12 months before its expiration. To date, the European Commission has not yet published a decision on the adoption of this recommendation.

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[4] [2] C.f. EUR-Lex, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0053

[5] [3] Gensch et al. (2019): Review in the light of scientific and technical progress of exemptions 8(e), 8(f)(b), 8(g) and 14 and re-evaluation of entry 8(j) of Annex II to Directive 2000/53/EC (ELV) (Pack 3). Available: https://data.europa.eu/doi/10.2779/98707

[6] [4] Exemption 15(a) on Annex III of Directive 2011/65/EU (RoHS): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02011L0065-20230901#tocId35

[7] [5] Deubzer et al. (2022): Study to assess requests for renewal of 12 exemptions to Annex III of Directive 2011/65/EU (Pack 23). Available: https://data.europa.eu/doi/10.2779/507661

3. (Consultant's) Questions

answers in blue color

Question 1:

Are FCPs in scope of exemption 8(g)(ii) still used today in newly designed electronic systems employed in vehicles in scope of the ELV Directive? In your response, please differentiate by the three sub-clauses of this exemption.

We noted the claims addressed in the application renewal for exemption 15(a) of RoHS Annex III and consider them justified.

FCPs in automotive grade are sourced based on their functions and technical parameters, not on production technology. Due to insufficient information on the production technologies used, it is regrettable to state, that it is currently unfeasible to allocate these components and their producers along the supply chain to the subentries within the given time constraints.

The automotive industry sector is a downstream user of electronics and relies on components provided by suppliers who are the value chain partner responsible for ELV Directive compliance and for making their products available to many industries using existing and established production processes and equipment.

The components subject to exemption 8(g)(ii) of ELV Annex II are being used less and less in the automotive industry sector. Simpler FCPs in particular have been phased out in recent years, and typically only a few complex FCP types are still in use, with long lived older IC technologies for which lead-free designs could not be reliably produced.

The automotive industry sector is not aware of new developments of FCPs in scope of exemption 8(g)(ii), newer variants due to minor adaptions are possible.

FCPs are used in circuit modules, which are sub-assemblies for electronic schematics of electronic circuits (respectively electronic circuit board assemblies).

In the context of vehicular systems, complex electronic components such as FCPs play a crucial role. These components are integral parts of control units or sensor systems that interact within a vehicle's board network, in conjunction with validated software.

A validated board network design, once established, can be utilized across different car models, thereby enhancing the efficiency of the design process and ensuring consistency in performance across various car models.

When it comes to changes in hardware and software, stringent and comprehensive procedures are implemented. These procedures are designed to ensure the reliability and safety of the vehicle, even if they may interfere with vehicle type approval demands.

Furthermore, changes in hardware and software can have significant implications due to the various vehicle type approvals and for maintenance and repair procedures. They can increase the complexity of service requirements, necessitating advanced technical skills and knowledge for effective vehicle servicing. Therefore, any changes made must be carefully considered, keeping in mind their potential impact on the overall lifecycle of the vehicle and the corresponding availability of components along the whole supply chain.

Some of the products with these electronic circuit board assemblies are themselves relevant for type approvals and/or are relevant for or influence the vehicle type approval.

The subsystem modules like for displays or radar signal processing are also made available to many car models by various automobile manufacturers. The complexity of these variants impacts vehicle type approvals and the phase-out period.

At our state of knowledge, FCPs in scope of exemption 8(g)(ii) have not been used for new circuit modules developments for years. If at all, we assume, circuit modules with these FCPs were only reused for variant products (of more complex objects).

In case the coefficient of thermal expansion (CTE) did not fit and the use of lead-free solder caused unsolvable problems, a return to Leaded solder version was required to meet the production start date.

Since the long-term availability of the electronic elements contained in new circuit modules is already taken into account during their development, we see a high probability given that FCPs within the scope of exemption 8(g)(ii) have hardly been considered in new developments (of e.g., circuit modules and electronic schematics of electronic circuits (respectively electronic circuit board assemblies)) in the automotive industry sector for years.

Question 2:

In which types of electronic systems in vehicles are FCPs in scope of this exemption still used today? Please provide a list of relevant systems, their functionality, the functionality provided by the FCPs, and reasoning as to why lead-containing FCPs are still needed for each application, differentiated by the three sub-clauses of exemption 8(g)(ii).

In the automotive industry sector, FCPs in scope of exemption 8(g)(ii) are currently still used in various electronic systems of generations already in series production. Examples of applications used in vehicles are listed in chapter *´PART A Background and technical information / 2.2 FCP Automotive Market´*, but are not limited to these.

The main reason for using FCPs is the computing power and the processing speed of signals and large amounts of data, which are required in the applications mentioned and for which FCPs are then and now without alternative.

Among other things, the selection is oriented to reliable function in vehicles over service life and long-term availability of the FCPs.

The requirements for the various electronic systems and thus for the used FCPs are contingent upon their placement within the various vehicle models.

As outlined in the previous contributions, these requirements also depend on the production technology utilized by FCP producers.

Consequently, the use of Lead-based solder in FCPs may still be necessary for the applications mentioned.

In response to this question, we refer you to the answer to question No. 1, too.

Question 3:

Modern passenger cars are said to contain between 1,000 and 3,000 semiconductor chips . What share of those / how many of those are FCPs in scope of exemption 8(g)(ii), approximately? Which share of those make use of each sub-clause of ex. 8(g)(ii)?

In response to this question, we refer you to chapter *´PART A Background and technical information / 4 Used quantities assessments´* with quantity calculation information.

Question 4:

The exemption only covers flip chip packages. For what reasons does the automotive industry require this particular package type and does not opt for an alternative type that does not require leaded solder?

In the automotive industry sector, designs and technologies that are already established on the market in other sectors are used for complex chips in particular. And the automotive industry sector custom designed / adapted / optimized chip variants were then used in series production for 15…20 years or more, because these components have their own development lifecycle and period of use. For some time now, new generations of more complex objects without FCPs in scope of exemption 8(g)(ii) have been developed and industrialized in the automotive industry sector. This is why many FCPs in scope of exemption 8(g)(ii) have already been phased out in recent years and the remaining ones will phased out too.

Question 5:

Semiconductors fabricated with smaller than 90 nm technology nodes, that do not require lead in solders, have been available since at least 2007.

a. Are there any technical reasons why > 90 nm FCPs are still used electronic systems in vehicles despite newer, lead-free semiconductors < 90 nm being available?

   It cannot be confirmed in principle that lead-free semiconductors FCPs with smaller than 90 nm technology nodes are (automatically) qualified for automotive applications. Among other things, the selection is oriented to reliable function in vehicles over service life and long-term availability of the FCPs.

b. In your view, to which degree is this an economic issue more than a technical issue? Please substantiate your response with arguments

   In response to this question, we also refer you to the answer to question No. 1.

c. Please name the companies that still manufacture the semiconductors that are used in FCPs under sub-clause 1 of this exemption.

   FCPs in automotive grade are sourced based on their functions and technical parameters, not production technology. Due to insufficient information on the production technologies used, it is regrettable to state, that it is currently unfeasible to allocate these components and their producers along the supply chain to the sub-clauses within the given time constraints.

   Due to legal obligations and contractual agreements, the disclosure of information about subcontractors is strictly prohibited. In addition, such data is considered to be competitive sensitive, and sharing it violates our compliance policy.

Question 6:

As was stated by the applicant during the review process of ex. 15(a) under RoHS [6], [8], “New products introduced into the market in the last several years are assembled with Pb-free bumps even though the die size is greater than 300 mm2”. In our view, this confirms that clause (2) and potentially clause (3) are no longer technically needed. Please share your view, substantiated with arguments.

In response to this question, we refer you to the answer to question No. 1.

Question 7:

For what reasons do stacked die packages use >300 mm2 silicon interposers – are there technical reasons why these are not fabricated using plastic / organic interposers which could facilitate the use of lead-free solders?

In response to this question, we refer you to the answer to question No. 1.

Question 8:

Please explain the efforts your organisation has undertaken to find and implement the use of lead-free alternatives for automotive uses. Please refer to alternatives, which at least reduce the amount of lead applied or eliminate its necessity altogether

For over two decades, the automotive industry is engaged for developing reliable lead-free electronic solutions under consideration of steadily increasing performance and environmental requirements. The transition from Lead-based soldering of electronic circuit board assemblies to lead-free soldering, which meets the automotive industry’s high-quality standards, took approximately 15 years. The use of Lead-based soldering for electrical / electronical components on EBC´s has become obsolete and has no more meaning; we limit the answer to these two examples and could add many more others.

Question 9:

What is the amount of lead in the scope of exemption 8(g)(ii) that would be contained in vehicles

a. placed on the EU market

b. worldwide

in case the exemption is continued? Please provide an approximate calculation or substantiated estimate.

The amount of Lead in FCPs placed on the EU market and worldwide has been reduced due to the phasing out in recent years and will decrease further.

From 2008 to 2019, the use of Leaded solder in Flip Chip Packages (FCPs) within the scope of RoHS exemption 15(a) saw a significant reduction, decreasing by 98.87% compared to the 2008 level. It has been estimated that due to these significant reductions approximately 85kg/year of ´RoHS exemption 15(a)´ - Lead´ has recently been entering annually the EU market.

(Source: https://rohs.biois.eu/15_15(a)_Exemption%20Request%20_16012020_final.pdf - Table 3: *´Estimated lead (Pb) containing devices and total Lead shipped to EU´*)

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[8] [6] E.g. https://polarsemi.com/blog/blog-semiconductor-chips-in-a-car/

We assume that this trend also applies to the automotive industry and that a reduction has continued in recent years (see *´PART A Background and technical information / 4 Used quantities assessments´*). We have no information on uses for military or aeronautical applications.

The Lead containing bumps are located at an internal interface of the ASIC package and are encapsulated by a chemically stable polymer (underfill), a release of lead and an impact on the environment after the component production / during the use phase of an article can almost be excluded.

In the automotive industry sector, a utilization with a rate of 95% has already been implemented. And the legally regulated and monitored recycling of electronic scrap for metal recovery ensures that this lead does not jeopardize the requirements of the circular economy, to promote the conservation of natural resources and ensure the protection of people and the environment.

Question 10:

Overall, please let us know whether you agree with the necessity to continue the exemption and your arguments for or against the continuation.

The automotive industry sector has the necessity to continue the exemption 8(g)(ii) for the purpose of an implementation and transition phase as there are more complex objects in the industrialisation and validation phase along the automotive industry sector supply chain.

After the gradual introduction along the supply chain with its finalization through a vehicle type approval, a subsequent expire date for exemption 8(g)(ii) is considered possible in the automotive industry sector.

The expire will be possible at the earliest 60 month after publication of the amending of Annex II to Directive 2000/53/EC in the Official Journal of the European Union due to its exemption 8(g)(ii) at the earliest *´Scope and expiry date of the exemption: Vehicles type-approved before 1 January 2030 and spare parts for these vehicles´*.

Question 11:

Is there any other information you would like to provide?

The information in this statement represents the sector-specific considerations of the automotive industry.

Considering the unique sector-specific legalities of the *´materials and components exempt´* tied to vehicle type approvals and spare parts for these vehicles, it is these legal circumstances, that it will be possible to phase out the exemption in the automotive industry sector (in addition to that FCPs within the scope of exemption 8(g)(ii) have not been considered and sidelined in new developments in the automotive industry sector for years).

Contact details:

Please see frame document.