Exemption Request Form

Date of submission: 20 January 2023

1. Name and contact details

1) Name and contact details of applicant:

Company:	Test & Measurement Coalition	Tel.:	+32 2 735 82 30
Name:	Meglena Mihova	E-Mail:	meglena.mihova@eppa.com
Function:	TMC Secretariat	Address:	Place du Luxembourg 2, 1050 Brussels, Belgium

2) Name and contact details of responsible person for this application (if different from above):

Company:	_____	Tel.:	_____
Name:	_____	E-Mail:	_____
Function:	_____	Address:	_____

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2. Reason for application:

Please indicate where relevant:

- ☐ Request for new exemption in:
- ☐ Request for amendment of existing exemption in
- ☒ Request for extension of existing exemption in
- ☐ Request for deletion of existing exemption in:
- ☐ Provision of information referring to an existing specific exemption in:

☒ Annex III ☐ Annex IV

No. of exemption in Annex III or IV where applicable: 15

Proposed or existing wording: Existing.

"Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages."

Duration where applicable: Maximum validity period.

☐ Other: _____

3. Summary of the exemption request / revocation request

Exemption Annex III, 15 permits lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip-chip packages and is currently in force for Industrial Monitoring and Control equipment. Alternatives have entered the market in recent designs, a change to 15(a) restricting Pb-containing solder by die and node size has occurred, and some older components have been updated with these changes. However, there are still a significant number of suppliers that have not investigated or implemented these changes.

Given the intrinsic physical and technical characteristics of lead, solders containing Pb exhibits certain advantages that lead-free solders lack, including:

- Solders containing lead are more ductile and softer than Pb-free alternatives and can therefore better absorb stresses originating from mismatch in the coefficient of thermal expansion between semiconductor die and carrier. Subsequently, they are less prone to develop solder cracks.
- The die attach reflow temperature is reduced given the lower melting temperature of eutectic tin-lead solders. Consequently, the internal package stress during flip-chip die attach is reduced. Package failures, including package material interface delamination (the glue under the chip delaminates from the package substrate) are hence prevented.
- An additional failure mechanism for packages with flip-chip die is electro-migration. This mechanism causes solder joint failure when high current density (amps per square millimeter) causes atoms to migrate from one side of the joint to the other, depleting metal at the connection. Exemption 15(a) has been defined to address this; however, many suppliers have not yet investigated or implemented the effect of this change.

The T&M Coalition acknowledges that there are suitable alternatives available to substitute lead in solders for *new* components into newly designed instruments. Indeed, industry has demonstrated a strong commitment to developing lead-free flip-chip devices as new technologies become available.

However, while exemption 15 will be designed out over time as new lead-free components become available, a continuation of exemption 15 for category 9 industrial test and measurement instruments is still warranted as these lead-free components cannot be used for existing T&M products. Additionally, given the long lifetime of T&M instruments as well as the greater inventory of older parts used for the repair of products currently placed on the market, a discontinuation of exemption 15 for category 9 products would counter the logic of an increased circular economy and create avoidable EEE waste.

A thorough Socio-Economic Analysis was conducted in addition to the technical assessment and attached to this submission, further illustration the negative socio-economic impacts a non-renewal of exemption 15 would have. Overall, the analysis concludes that the **total impact of a non-renewal of this exemption is monetized in the range of 309 million EUR and 442 million EUR** (conservative lower bound estimate).

4. Technical description of the exemption request / revocation request

(A) Description of the concerned application:

1. To which EEE is the exemption request/information relevant?

Name of applications or products: _____

Industrial test and measurement instruments (category 9 – Industrial under the RoHS Directive) are very different from low mix, high-volume consumer products which are frequently re-designed to follow consumer trends and are placed on the market for a limited duration. Industrial test and measurement are high mix, low volume producers, managing portfolios of thousands of highly complex instruments. Each instrument is intentionally designed for high reliability and serviceability to support long useful lifespans, and are made available on the market for at least a decade. These instruments are designed: exclusively for professional and industrial use; to meet high performance requirements in critical applications; and last up to 40 years. Redesign is not frequent and happens every seven years on average (as compared to every 1.5 years or less for consumer products). Once test and measurement instruments are placed onto the market, they are typically accompanied with a long-term customer support arrangement to maintain reliability and calibration.

Product portfolios are widely diversified, with T&M Coalition members each having typically 2,000 to 3,000 products currently made available on the market. These are highly complex, sophisticated electronic instruments such as signal generators, power analysers, oscilloscopes, spectrum analysers, digital multi-meters, electron microscopes, chemical and biological analysers, complex chromatography systems and their detectors, each having many necessary options and accessories. Each instrument can have a minimum of 2,000 up to 40,000 parts; requiring a vast supply chain involving tens of thousands of suppliers and hundreds of thousands of unique components.

Considering the EU added-value, test and measurement equipment is manufactured and sold in relatively small volumes (per instrument design) and placed on the global market. There is an added value in community level action, which guarantees more coherent and consistent rules across Europe. But with the expansion of RoHS-like requirements beyond the EU, this creates a risk of discrepancies in RoHS-like national laws adopted in third countries.

The professional test and measurement products provide the tools for engineers to develop new solutions and businesses to bring them to market. These instruments are used in Research, Quality Control and Testing laboratories (including field testing) in Universities, Manufacturing and clinical facilities and by Governmental Agencies for conformance verification and environmental testing. They are essential to the good functioning of electronic communications networks, heavy industrial processes such as steel manufacturing, the testing of vehicles for compliance with emissions standards, and the monitoring of complex and critical systems of all types. The nature of the tests and measurements made by industrial equipment necessitates that the equipment itself is highly complex; with upwards of 40,000 components necessary to produce a single instrument. Even a relatively simple hand-held instrument incorporates significantly more components that a typical consumer product.

Historically, between 25 - 35% of the components used in test & measurement products are custom designed. The features of the TMC manufacturers' equipment necessitate the development and production of unique components that are not commercially made available on the open market and are typically made by sole, boutique suppliers. These components have their own development lifecycle and take years to bring into production. When these suppliers are unable to deliver compliant parts that meet current RoHS regulations, the product would be stopped from being sold into the EU.

Refer to the table below for a comprehensive list of the relevant product groupings and equipment types relevant to exemption 15.

Product Grouping	Equipment Types
Test and measurement upgrades and accessories	
Oscilloscopes, Analyzers & Meters	Oscilloscopes
	Spectrum Analyzers (Signal Analyzers)
	Network Analyzers
	Logic Analyzers
	Protocol Analyzers and Exercisers
	Bit Error Ratio Testers
	Noise Figure Analyzers and Noise Sources
	High-Speed Digitizers and Multichannel DAQ Solutions
	AC Power Analyzers
	DC Power Analyzers
	Materials Test Equipment
	Device Current Waveform Analyzers
	Parameter and Device Analyzers, Curve Tracers
	Digital Multimeters
	Phase Noise Measurement
	Power Meters and Power Sensors
	Counters
	LCR Meters and Impedance Measurement Products
	Picoammeters & Electrometers
Generators, Sources and Power	Signal Generators (Signal Sources)

	Waveform and Function Generators
	Arbitrary Waveform Generators
	Pulse Generator Products
	HEV/EV/Grid Emulators and Test Systems
	DC Power Supplies
	Source Measure Units
	DC Electronic Load
	AC Power Sources
Wireless	Wireless Network Emulators
	Channel Emulation Solutions
	Nemo Wireless Network Solutions
	5G OTA Chambers
	Wireless Analyzers
	IoT Regulatory Compliance Solutions
Modular Instruments	PXI Products
	AXIe Products
	Data Acquisition – DAQ
	USB Products
	VXI Products
	Reference Solutions
Network Test, Security & Network Visability	Protocol and Load Test
	Network Test Hardware
	Cloud Test
	Performance Monitoring
	5G NR Base Station Test
	Radio Access and Core Network Test
	Network Security
	Cyber Training Simulator
	Network Modelling
	Application and Threat Intelligence
	Network Packet Brokers
	Cloud Visibility
	Network Taps
	Bypass Switches
	Clock Synchronization
Application-Specific Test Systems and Components	
Photonic Test & Measurement Products	
Laser Interferometers and Calibration Systems	Monolithic Laser Combiners & Precision Optics
In-circuit Test Systems	
Used Equipment	
Probe	
Semiconductor Characterization System	
Other	Cell Analysis
	Liquid Chromatography
	Gas Chromatography
	Mass Spectroscopy

	Molecular Spectroscopy
	Vacuum Products
	Cell Analysis
	Liquid Chromatography
	Gas Chromatography

a. List of relevant categories: (mark more than one where applicable)

☐ 1	☐ 7
☐ 2	☐ 8
☐ 3	☒ 9
☐ 4	☐ 10
☐ 5	☐ 11
☐ 6	

b. Please specify if application is in use in other categories to which the exemption request does not refer: _____

c. Please specify for equipment of category 8 and 9:

The requested exemption will be applied in

☒ monitoring and control instruments in industry

☐ in-vitro diagnostics

☐ other medical devices or other monitoring and control instruments than those in industry

2. Which of the six substances is in use in the application/product?

(Indicate more than one where applicable)

☒ Pb ☐ Cd ☐ Hg ☐ Cr-VI ☐ PBB ☐ PBDE

Function of the substance: The function lead fulfills in the components relevant for T&M instruments as well as its intrinsic physical and technical characteristics are similar to those describe in a previous exemption renewal request submitted by the RoHS Umbrella Industry Project (Umbrella Project) [1] and the Öko-Institut report from 2016[2], which are further outlined in the sections below.

[1] Previous RoHS (renewal) exemption requests are publicly available and downloadable from the Commission webpages via https://environment.ec.europa.eu/topics/waste-and-recycling/rohs-directive/implementation-rohs-directive_en.

[2] Assistance to the Commission on Technological Socio-Economic and Cost-Benefit Assessment Related to Exemptions from the Substance restrictions in Electrical and Electronic Equipment: Study to assess renewal requests for 29 RoHS 2 Annex III exemptions [no. l(a to e -lighting purpose), no. l(f – special purpose), no. 2(a), no. 2(b)(3), no. 2(b)(4), no. 3, no. 4(a), no. 4(b), no. 4(c), no. 4(e), no. 4(f), no. 5(b), no. 6(a), no. 6(b), no. 6(c), no. 7(a), no. 7(c) - I, no. 7(c) - II, no. 7(c) - IV, no. 8(b), no. 9, no. 15, no. 18b, no. 21, no. 24, no. 29, no. 32, no.

Given the intrinsic physical and technical characteristics of lead, solders containing Pb exhibits certain advantages that lead-free solders lack. These include in particular:

- Solders containing lead are more ductile and softer than Pb-free alternatives and can therefore better absorb stresses originating from mismatch in the coefficient of thermal expansion between semiconductor die and carrier. Subsequently, they are less prone to develop solder cracks.
- The die attach reflow temperature is reduced given the lower melting temperature of eutectic tin-lead solders. Consequently, the internal package stress during flip-chip die attach is reduced. Package failures, including package material interface delamination (the glue under the chip delaminates from the package substrate) are hence prevented.
- An additional failure mechanism for packages with flip-chip die is electro-migration. This mechanism causes solder joint failure when high current density (amps per square millimeter) causes atoms to migrate from one side of the joint to the other, depleting metal at the connection. Exemption 15(a) has been defined to address this; however, many suppliers have not yet investigated or implemented the effect of this change.

Given the high reliability characteristics of lead, the composition of solders used in T&M relevant components have to remain unchanged to ensure that no product failure occurs during the lifetime of current T&M instruments.

3. Content of substance in homogeneous material (%weight): The quantity of lead utilized in the TMC's homogeneous materials varies based on the application. Therefore, the homogeneous materials can contain between 37% up to 97% lead by weight.

4. Amount of substance entering the EU market annually through application for which the exemption is requested: Approximately between 1.3 kg of lead.
Please supply information and calculations to support stated figure.
The amount of substance entering the EU market annually through application for which the exemption is requested is based on the replies provided by the TMC members (for the preparation of the Socio-Economic Analysis – see attached).

5. Name of material/component: integrated circuit flip chip packages.

34, no. 37]. Available at https://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_Pack_9/RoHS-Pack_9_Part_SOLDERS_06-2016.pdf.

6. Environmental Assessment: _____

LCA: ☐ Yes

☒ No

(B) In which material and/or component is the RoHS-regulated substance used, for which you request the exemption or its revocation? What is the function of this material or component?

Annex III, exemption 15 permits lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip-chip packages and is currently in force for Industrial Monitoring and Control equipment. Alternatives have entered the market in recent designs, a change to 15(a) restricting Pb-containing solder by die and node size has occurred, and some older components have been updated with these changes. However, there are still a significant number of suppliers that have not investigated or implemented these changes.

The function lead fulfills in the components relevant for T&M instruments as well as its intrinsic physical and technical characteristics are similar to those describe in a previous exemption renewal request submitted by the RoHS Umbrella Industry Project (Umbrella Project) 3 and the Öko-Institut report from 20164, which are further outlined in the sections below.

Given the intrinsic physical and technical characteristics of lead, solders containing Pb exhibits certain advantages that lead-free solders lack. These include in particular:

- Solders containing lead are more ductile and softer than Pb-free alternatives and can therefore better absorb stresses originating from mismatch in the coefficient of thermal expansion between semiconductor die and carrier. Subsequently, they are less prone to develop solder cracks.
- The die attach reflow temperature is reduced given the lower melting temperature of eutectic tin-lead solders. Consequently, the internal package stress during flip-chip die attach is reduced. Package failures, including package material interface delamination (the glue under the chip delaminates from the package substrate) are hence prevented.

[3] Previous RoHS (renewal) exemption requests are publicly available and downloadable from the Commission webpages via https://environment.ec.europa.eu/topics/waste-and-recycling/rohs-directive/implementation-rohs-directive_en.

[4] Assistance to the Commission on Technological Socio-Economic and Cost-Benefit Assessment Related to Exemptions from the Substance restrictions in Electrical and Electronic Equipment: Study to assess renewal requests for 29 RoHS 2 Annex III exemptions [no. l(a to e -lighting purpose), no. l(f – special purpose), no. 2(a), no. 2(b)(3), no. 2(b)(4), no. 3, no. 4(a), no. 4(b), no. 4(c), no. 4(e), no. 4(f), no. 5(b), no. 6(a), no. 6(b), no. 6(c), no. 7(a), no. 7(c) - I, no. 7(c) - II, no. 7(c) - IV, no. 8(b), no. 9, no. 15, no. 18b, no. 21, no. 24, no. 29, no. 32, no. 34, no. 37]. Available at https://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_Pack_9/RoHS-Pack_9_Part_SOLDERS_06-2016.pdf.

- An additional failure mechanism for packages with flip-chip die is electro-migration. This mechanism causes solder joint failure when high current density (amps per square millimeter) causes atoms to migrate from one side of the joint to the other, depleting metal at the connection. Exemption 15(a) has been defined to address this; however, many suppliers have not yet investigated or implemented the effect of this change. Given the high reliability characteristics of lead, the composition of solders used in T&M relevant components have to remain unchanged to ensure that no product failure occurs during the lifetime of current T&M instruments.

(C) What are the particular characteristics and functions of the RoHS-regulated substance that require its use in this material or component?

Please refer to point (B).

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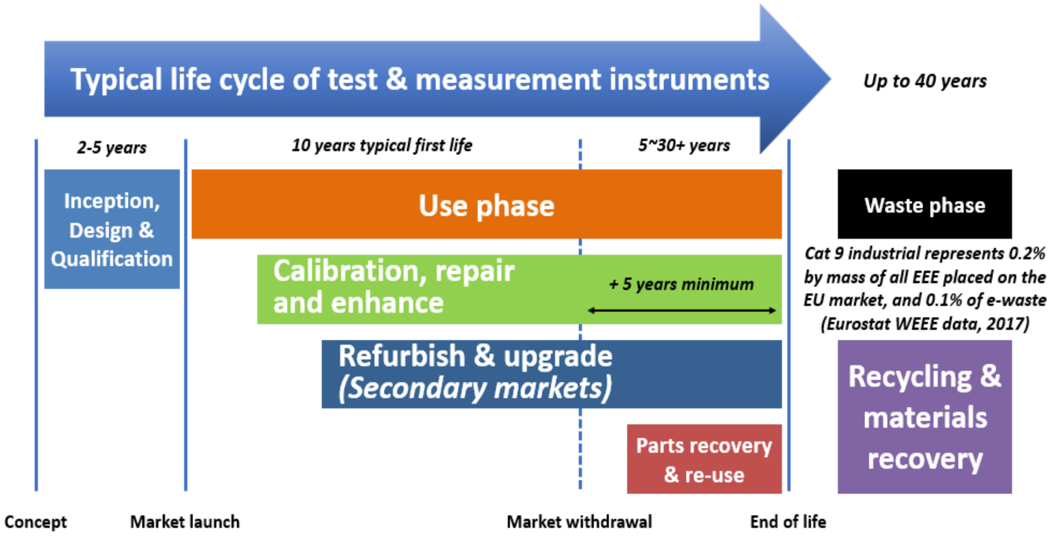
5. Information on Possible preparation for reuse or recycling of waste from EEE and on provisions for appropriate treatment of waste

1) Please indicate if a closed loop system exist for EEE waste of application exists and provide information of its characteristics (method of collection to ensure closed loop, method of treatment, etc.)

There is no specific closed loop system in place. Please find below some specific considerations on the typical End-to-Life Cycle of category 9 industrial Test and Measurement instruments:

The market sectors addressed by industrial test and measurement equipment can in some cases require that the instruments can be maintained in use for decades. The end-to-end lifecycle model below helps to illustrate how the members contribute to the circular economy by assuring the materials they consume to produce the equipment are kept in use for as long as possible.



The nature of industrial test and measurement instrument applications demand highly accurate and reproducible results throughout their life. With a typical first use of 10 years and a total life of up to 40 years, great care is taken during the design and qualification phases to ensure that the stringent performance and reliability requirements are met and must incorporate design for serviceability. This provides a continuous supply chain of equipment for refurbishment with extended life through resale providing great economic and environmental benefit. Whilst the instruments are designed for long-term reliability, failures do occur during such an extended period of use requiring ability to service and replace parts. After market withdrawal, equipment is normally supported for a minimum of five years. Moreover, refurbishing and reselling on the secondary market are crucial in this sector and often account for 4–5% of producer turnover for test and measurement manufacturers.

Due to the cost, reliability, and unique applications of T&M equipment, many customers do not dispose of the equipment, but instead keep it for use at a later date or place it on the secondary market. Therefore, Category 9 Industrial equipment’s contribution to the Waste Electrical and Electronic Equipment stream is very small (0.2% by weight of EU WEEE) with industrial WEEE being collected through B2B systems. Consequently, the environmental impact of industrial test and measurement products is negligible. Nevertheless, test and measurement equipment does enter the waste stream, typically many decades after it is placed on the EU market.

2) Please indicate where relevant:

☒ Article is collected and sent without dismantling for recycling

☒ Article is collected and completely refurbished for reuse

☒ Article is collected and dismantled:

☒ The following parts are refurbished for use as spare parts: PCAs, microcircuits

☒ The following parts are subsequently recycled: cables, metal

☐ Article cannot be recycled and is therefore:

☐ Sent for energy return

☐ Landfilled

3) Please provide information concerning the amount (weight) of RoHS substance present in EEE waste accumulates per annum:

No detailed data available.

☐ In articles which are refurbished ______

☐ In articles which are recycled ______

☐ In articles which are sent for energy return ______

☐ In articles which are landfilled ______

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6. Analysis of possible alternative substances

(A) Please provide information if possible alternative applications or alternatives for use of RoHS substances in application exist. Please elaborate analysis on a life-cycle basis, including where available information about independent research, peer-review studies development activities undertaken

The component suppliers of T&M instruments who are currently using exemption 15 are changing the solders to lead-free solders in new components. Additionally, the use of tin-lead (SnPb) solder in flip-chip component has declined as confidence has been increased with alternatives.

Exemption 15(a), which is the narrower definition for finer pitch components, works well for components designed in the last few years. However, T&M equipment is manufactured for many years with relatively long development cycles. Equipment designed 10 years ago still uses components designed 15 years and the technology internal to the flip-chip parts has not yet converted on many components.

Additionally, it should be noted that T&M companies also have higher inventories of older parts. It will therefore take time to consume these components and to allow for a low-waste transition to the modern Pb-free parts. While exemption 15(a) is therefore technically acceptable, the supply chain for T&M products will require more time to transition from exemption 15. A discontinuation of exemption 15 would thus unnecessarily increase EEE waste of components that are otherwise perfectly safe and suitable to use.

In terms of alternatives the T&M companies have noted that elimination of tin-lead solder in flipchip application has been the primary method to avoid the use of exemption 15. Manufacturers have converted to other alloys such as tin-silver-copper (SAC) solder in some applications. However, it should be noted that research has been done to evaluate the impact of current density when using different alloys. The research has shown that failures due to high current density in a flip-chip solder joint, which causes electromigration and thus leads to open or weak joints, have occurred. Electromigration occurs when the atoms in the solder joint diffuse from one side to the other due to high electron pressure, sometimes called “electron wind”[5] or “current-crowding”[6]. This then initiates void formation and coalescence on one side of the joint, resulting in a weak or open joint.[7] Different solder alloys are susceptible to this issue at different current densities. High Pb solder[8] and nickel-modified tin-copper (aka SN100C) have been shown to work well in some studies. As voids form in the joint, the joint gets effectively smaller and Joule heating from increased resistance accelerates void formation and coalescence. The electromigration effect can also result in consumption of the under-bump metallisation (UBM), whereas the severity varies with the UBM composition. Transition from the well-known eutectic SnPb has been carefully done to avoid issues. Exemption 15(a) has narrowed the exemption definition to allow Pb-based solders only in specific component types that are higher risk for this and other failure mechanisms.

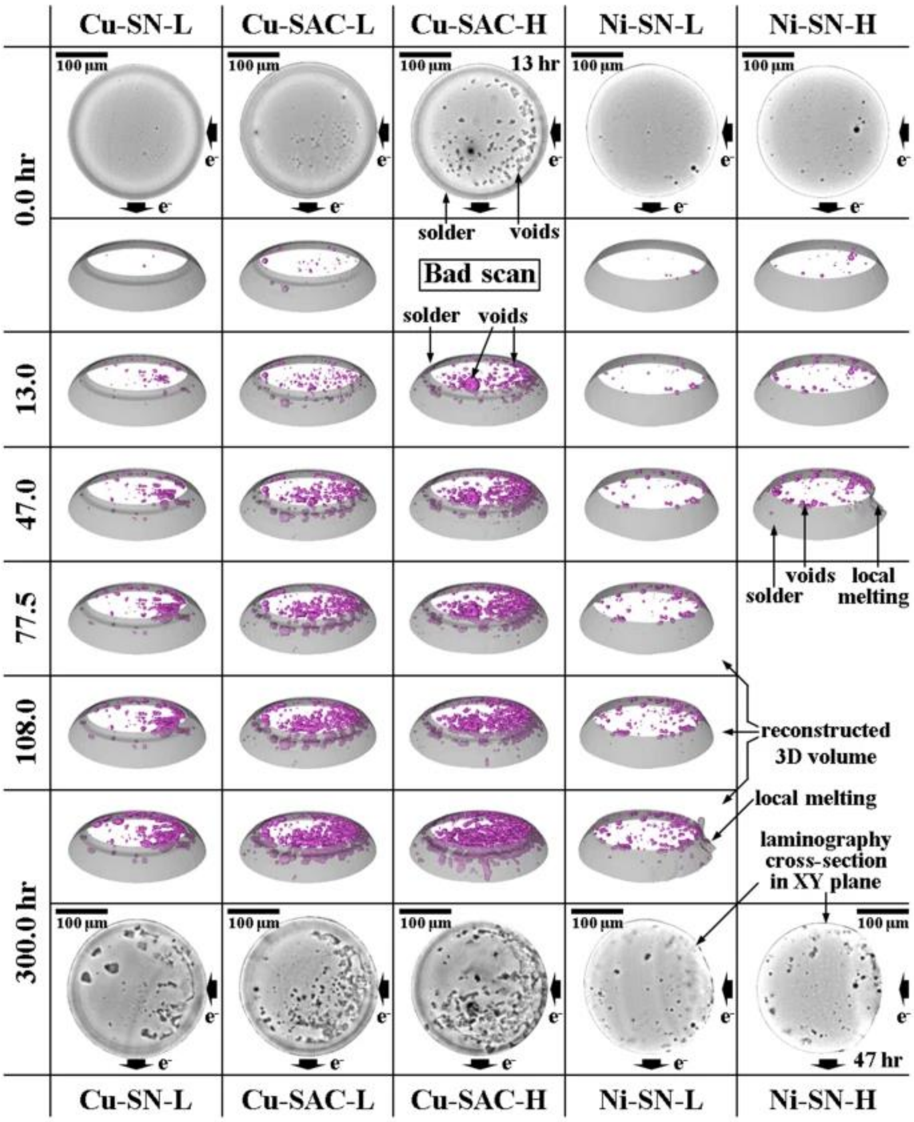
[5] Lienig, Jens, (2005), “Interconnect and current density stress – An introduction to electromigration-aware design. International Workshop on System Level Interconnect Prediction, SLIP. 81-88, source: https://doi.org/10.1145/1053355.1053374

[6] Chang, YW., Cheng, Y., Helfen, L., et al., “Electromigration Mechanism of Failure in Flip-Chip Solder Joints Based on Discrete Void Formation. Sci Rep 7, 17950 (2017). https://doi.org/10.1038/s41598-017-06250-8

[7] Ibid; Ahmed, M.T., Motalab, M. & Suhling, J.C., (2021), “Impact of Mechanical Property Degradation and Intermetallic Compound Formation on Electromigration-Oriented Failure of a Flip-Chip Solder Joint. J. Electron. Mater. 50, 233-248 https://doi.org/10.1007/s11664-020-08514-y

[8] J. D. Wu, P. J. Zheng, C. W. Lee, S. C. Hung and J. J. Lee, "A study in flip-chip UBM/bump reliability with effects of SnPb solder composition," 2003 IEEE International Reliability Physics Symposium Proceedings, 2003. 41st Annual., 2003, pp. 132-139, doi: https://doi.org/10.1109/RELPHY.2003.1197733

Figure 1



The reconstructed cross-sectional laminography images at the UBM/solder interface before (initial state) and after EM testing for 300 hours (on the top and the bottom, respectively). The solder material is visible in gray and the voids in black. In the middle: 3D rendition of the top portion of the solder joints, showing the evolution of discrete voids as a function of EM testing time; the solder outline is rendered in semi-transparent gray while the voids are in magenta.

(B) Please provide information and data to establish reliability of possible substitutes of application and of RoHS materials in application

Please refer to point A.

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7. Proposed actions to develop possible substitutes

(A) Please provide information if actions have been taken to develop further possible alternatives for the application or alternatives for RoHS substances in the application.

The T&M Coalition acknowledges that there are suitable alternatives available to substitute lead in solders for *new* components into newly designed instruments. Indeed, industry has demonstrated a strong commitment to developing lead-free flip-chip devices as new technologies become available.

However, while exemption 15 will be designed out over time as new lead-free components become available, a continuation of exemption 15 for category 9 industrial test and measurement instruments is still warranted as these lead-free components cannot be used for existing T&M products. Additionally, given the long lifetime of T&M instruments as well as the greater inventory of older parts used for the repair of products currently placed on the market, a discontinuation of exemption 15 for category 9 products would counter the logic of an increased circular economy and create avoidable EEE waste.

(B) Please elaborate what stages are necessary for establishment of possible substitute and respective timeframe needed for completion of such stages.

As outlined above, while the Test & Measurement Coalition understands that new products can be designed to use lead-free components that utilize the restricted scope of exemption 15(a), the challenges of substitution are substantial for the vast majority of their portfolio that are in production but may have been designed while only exemption 15 was available.

Components which benefit from exemption 15 typically do not have form-fit-function drop-in replacements that are either lead-free or can benefit from exemption 15(a). Older product designs utilizing exemption 15 components would therefore need to be redesigned to match new component parameters, including a revised layout for PCB. Such changes require product-by-product projects to manage the change, including verification of each product against published performance specifications.

For products that will be newly designed, members of the Test & Measurement Coalition have pointed out that they mainly rely on their suppliers to find alternatives since most of the exemptions used in their products are not produced on-site by the company but bought off-the-shelf from suppliers. Therefore, meeting with suppliers to understand their (potential) alternatives, getting samples, measuring, and testing is the typical process to evaluate the suitability of potential alternatives which can take up to 4 years, as reported by the companies. The process would then be followed by the validation of the potential suitable alternatives accompanied by testing done by the manufacturers by the finished T&M equipment with the validation of the functionality and performance being their responsibility as well. However, the companies noted the impacts deriving from their suppliers as, depending on the complexity, there can be little to significant time and resources needed to validate alternatives.

The companies reported that the validation period alone would take a minimum of 6 months and up to a year after the delivery of suitable alternatives per product. It is significant to note that this validation period would only apply if the component were a fit, form, and function drop-in replacement. If any design changes to the exemption-free part of the product would be required to accommodate for the alternative, an additional validation period would be required for each redesigned product that used to utilize the component that relied on the exemption. Moreover, the validation would lead to the organizations incurring additional expenses. These include labour costs and costs arising from potential product resubmission requirements for testing to various notified bodies to ensure that substitution does not create any electrical and functional safety concerns.

Contrary to the statement of the Commission's external consultant BIOIS, made in the recent exemption assessment report (pack 23),[9] the Test and Measurement sector did not start incorporating lead-free components (much less in lead-free flipchip) in 2007. In fact, customers of T&M equipment demand continued sales of products designed before this sector's compliance date of 2017; this allows their manufacturing test processes to have consistent equipment and software. Re-design of these older products with new-technology components is not feasible or practical because of the number of products and relatively low volume and thus lower payback.

If a new substance free part is available, this part must be qualified for use by performing a variety of tasks, as described above. Due to the complexity and diversity of the applications, this must be done individually by each company for each product group. This process would divert resources from other projects and increase the cost to ensure continued availability of these products. This validation and testing process varies according to part complexity; which can be categorised as low, medium, and high:

- **Low complexity** parts are the off-the-shelf components or hardware parts that do not have a substantial performance impact. Replacement can be done based on supplier information, assuming a form/fit/function compliance, with standard manufacturing, testing, and validation processes. Based on process timescales reported by a T&M coalition company, the average time that it can take for these parts to be replaced ranges from **3 to 6 months**.

[9] European Commission, (2022), "Study to assess requests for renewal of 12 exemptions to Annex III of Directive 2011/65/EU. Available at https://rohs.biois.eu/RoHS_Pack-23_Report_Final_20221220.pdf.

- **Medium complexity** parts are more complex sub-assembly electronic parts, such as small motors which need additional validation for their performance. These parts are often commercial assemblies that are generally available to the electronic industry, and are utilised by the Test & Measurement coalition companies. Replacement of these assemblies, like-for-like, requires testing and validation prior to being integrated into the manufacturing process. The average time to find an alternative for medium complexity parts for production is reported to range from **6 to 12 months**.

- **High Complexity** parts are the complex sub-assemblies or parts that have a significant impact on performance of the company's products or play a critical role in overall safety of the products. These parts need to go through extensive validation for performance and/or compliances for varying regulations before the appropriate files can be updated and the proper competent authorities or regulatory bodies can be notified prior to purchase of parts for validation. The average time that it would take to find an alternative for high complexity parts for production is up to 1 year for additional testing. Where the exemption directly impacts the performance of that component (e.g., a centrifuge rotor) the evaluation of the replacement could take from **3 to 5 years**.

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8. Justification according to Article 5(1)(a):

(A) Links to REACH: (substance + substitute)

1) Do any of the following provisions apply to the application described under (A) and (C)?

   ☒ Authorisation

   - ☒ SVHC
   - ☒ Candidate list
   - ☒ Proposal inclusion Annex XIV
   - ☐ Annex XIV

   ☐ Restriction

   - ☐ Annex XVII
   - ☐ Registry of intentions

   ☒ Registration

2) Provide REACH-relevant information received through the supply chain.
   Name of document: _____

(B) Elimination/substitution:

1. Can the substance named under 4.(A)1 be eliminated?

   ☐ Yes. Consequences? _____

   ☒ No. Justification: for the time being technically not feasible, but over time alternative components will become available

2. Can the substance named under 4.(A)1 be substituted?

☐ Yes.

☐ Design changes:

☐ Other materials:

☐ Other substance:

☒ No.

Justification: For the time being technically not feasible, but over time alternative components will become available

3. Give details on the reliability of substitutes (technical data + information):______
4. Describe environmental assessment of substance from 4.(A)1 and possible substitutes with regard to
   1) Environmental impacts: _____
   2) Health impacts: _____
   3) Consumer safety impacts: _____

⇨ Do impacts of substitution outweigh benefits thereof?
Please provide third-party verified assessment on this: _____

(C) Availability of substitutes:

a) Describe supply sources for substitutes: Please refer to point 7 of the submission form.

b) Have you encountered problems with the availability? Describe: Please refer to point 7 of the submission form.

c) Do you consider the price of the substitute to be a problem for the availability?

☐ Yes ☐ No

d) What conditions need to be fulfilled to ensure the availability? _____

(D) Socio-economic impact of substitution:

⇨ What kind of economic effects do you consider related to substitution?

☐ Increase in direct production costs

☐ Increase in fixed costs

☐ Increase in overhead

☒ Possible social impacts within the EU

☒ Possible social impacts external to the EU

☒ Other: Possible economic impacts in the EU.

⇨ Provide sufficient evidence (third-party verified) to support your statement:
A thorough Socio-Economic Analysis has been performed by EPPA[10] at the request of Test & Measurement Coalition (TMC), in view of providing regulators with strong evidence-based findings on the expected social and economic impacts

[10] www.eppa.com

that are expected to occur should the use of lead (Pb) be impacted by the non-renewal of the RoHS exemption.

In line with the existing official guidance from ECHA on the preparation of the Socio-Economic Analysis,[11] the SEA therefore gathers technical and economic information to describe ex-ante in both qualitative and (if feasible) quantitative terms the (orders of magnitude of) socio-economic impacts TMC ell as the relevant EEA supply chain and society are expected to face from the non-renewal of the lead (Pb) exemption in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages, which would otherwise expire on 21 July 2024. Please see the respective SEA attached.

Overall, the main findings from the SEA conclude that, the total impact of a non-renewal is monetized in the range of 309 million EUR and 442 million EUR (conservative estimates in net losses; potential gains for suppliers of other components have been already taken into account), consisting of: economic impacts (EBIT loss); social impacts (i.e., unemployment in the EU-27); and substitution costs for test and measurement industrial type products' manufacturers.

9. Other relevant information

Please provide additional relevant information to further establish the necessity of your request:

See Socio-Economic Analysis report attached.

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10. Information that should be regarded as proprietary

Please state clearly whether any of the above information should be regarded to as proprietary information. If so, please provide verifiable justification:

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[11] The ECHA Guideline for the SEA preparation as a part of Application for Authorization is available at: https://echa.europa.eu/documents/10162/23036412/sea_authorisation_en.pdf/aadf96ec-fbfa-4bc7-9740-a3f6ceb68e6e ; The ECHA layout for an SEA to be used in Application for Authorization is available at: https://echa.europa.eu/documents/10162/13637/sea_format_with_instructions_v4_en.docx/0cbc5102-6ba2-2170-480a-0061d2798f55