Assistance to the Commission on Technological Socio-Economic and Cost-Benefit Assessment Related to Exemptions from the Substance Restrictions in Electrical and Electronic Equipment (RoHS Directive)

Pack 3 - Final Report

Report for the European Commission DG Environment under Framework Contract No ENV.C.2/FRA/2011/0020

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Disclaimer

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1.0 Background and Objectives

The RoHS Directive 2011/65/EU entered into force on 21 July 2011 and effectively leads to the repeal of Directive 2002/95/EC on 3 January 2013. The Directive can be considered to have provided for two regimes under which exemptions could be considered, RoHS 1 (the old Directive) and RoHS 2 (the new Directive).

Under Framework Contract No. ENV.C.2/FRA/2011/0020, a consortium led by Eunomia Research & Consulting was requested by DG Environment of the European Commission to provide technical and scientific support for the evaluation of exemption requests under the new RoHS 2 regime. The work has been undertaken by the Oeko Institut with support from Franhofer Institut IZM, and has been peer reviewed by Eunomia Research & Consulting.

The approach to adjudicating on the case for exemptions has to take into account some new aspects under the RoHS 2 regime as compared to that of RoHS 1:

- The scope covered by the Directive is now broader as it covers all EEE (as referred to in Articles 2(1) and 3(a));
- The former list of exemptions has been transformed in to Annex III and may be valid for all product categories according to the limitations listed in article 5 (2) of the Directive. Annex IV has been added and lists exemptions specific to categories 8 and 9;
- The RoHS 2 Directive includes the provision that applications for exemptions have to be made in accordance with Annex V. However, even if a number of points are already listed therein, Article 5(8) provides that a harmonised format, as well as comprehensive guidance – taking the situation of SMEs into account – shall be adopted by the Commission; and
- The procedure and criteria for the adaptation to scientific and technical progress have changed and now include some additional conditions and points to be considered. These are detailed below.

The new Directive details the various criteria for the adaptation of its Annexes to scientific and technical progress. Article 5 (1) details the various criteria and issues that must be considered for justifying the addition of an exemption to annexes III and IV:

- The first criterion may be seen as a threshold criterion and cross refers to the REACH Ordinance (1907/2006/EC). An exemption may only be granted if it does not weaken the environmental and health protection afforded by REACH;
- Furthermore, a request for exemption must be found justifiable according to one of the following three conditions:
    - Substitution is scientifically or technically impracticable, meaning that a substitute material, or a substitute for the application in which the

restricted substance is used, is yet to be discovered, developed and, in some cases, approved for use in the specific application;

- The reliability of a substitute is not ensured, meaning that the probability that EEE using the substitute will perform the required function without failure for a period of time comparable to that of the application in which the original substance is included, is lower than for the application itself;
- The negative environmental, health and consumer safety impacts of substitution outweigh the benefits thereof.

- Once one of these conditions is fulfilled, the evaluation of exemptions, including an assessment of the duration needed, now has to consider the availability of substitutes and the socio-economic impact of substitution, as well as adverse impacts on innovation, and life cycle analysis concerning the overall impacts of the exemption; and
- A new aspect is that all exemptions now need to have an expiry date and that they can only be renewed upon submission of a new application.

Against this background, and taking into account that exemptions falling under the enlarged scope of RoHS 2 can be applied for upon its entry into force (21.7.2011), the consultants have undertaken evaluation of a range of exemptions in this work (new exemption requests, renewing existing exemptions, amending exemptions or revoking exemptions).

The report includes the following Sections:

Section 2.0: Project Set-up

Section 3.0: Scope

Section 4.0: Overview of the Evaluation Results

Section 5.0: Links from the Directive to the REACH Regulation

Sections 6.0 – 9.0: Evaluation of the requested exemptions handled in the course of this project.

2.0 Project Set-up

Assignment of project tasks to Oeko-Institut and Fraunhofer IZM started on the7th of December 2012. The overall project has been led by Carl-Otto Gensch. At Fraunhofer IZM the contact person is Otmar Deubzer. The project team at Oeko-Institut consists of the technical experts Yifaat Baron and Markus Blepp. Eunomia, represented by Dominic Hogg, have the role of ensuring quality management.

3.0 Scope

Three RoHS exemption requests have been revaluated. All three requests were part of the previous Project 1, however, due to lack of information from the applicants, during the official schedule of Project 1 it was not possible to come to a conclusive recommendation in the course of their evaluation. Further correspondence with the applicant concerning these requests resulted in new information, regarded as substantial in terms of defining the product scope of the requested exemptions. After coordination with the Commission it was thus concluded that a further stakeholder consultation would be necessary to allow review of changes to wording and new information submitted, allowing stakeholders a chance to provide further input concerning the justification of the exemptions, before revaluation of the requests could begin.

An overview of the exemption requests is given in Table 4-1 below.

In the course of the project, a stakeholder consultation was conducted. The stakeholder consultation was launched on the 21st of December 2012 and ran until 15 February 2013, covering the three requests.

A specific project website was also set up in order to keep stakeholders informed on the progress of work: http://rohs.exemptions.oeko.info. The consultation held during the project was carried out according to the principles and requirements of the European Commission. Stakeholders who had registered at the website were informed through mailings about new steps within the project.

Information concerning the consultation was provided on the project website, including a general guidance document, the applicant's documents for each exemption request, or results of earlier evaluations where relevant, a specific questionnaire and the link to the EU CIRCA website, where all non-confidential stakeholder comments submitted during the consultations were made available (EU CIRCA website).[1]

[1] EU CIRCA website (Browse categories > European Commission > Environment > RoHS 2012 Exemptions Review, at top left, click on "Library")

The evaluation of the stakeholder contributions led to further consultation including, *inter alia*, engaging with stakeholders in further discussion, further exchanges in order to clarify remaining questions, cross-checking with regard to the accuracy of technical arguments, and checks in respect of confidentiality issues. The requests were evaluated according to the various criteria (Cf. Section 1.0 for details). The evaluations appear in the following chapters. The information provided by the applicants and in some cases also by stakeholders is summarized for each request in the first sections. This includes a general description of the application and requested exemption, a summary of the arguments made for justifying an exemption, information provided concerning possible alternatives and additional aspects raised by the applicant and other stakeholders. In some cases, reference is also made to information submitted by applicants and stakeholders in previous evaluations, in cases where a similar request has been reviewed or where a renewal has been requested of a request reviewed in the past. The Critical Review follows these sections, in which the submitted information is discussed to clarify how the consultants evaluate the various information and what conclusions and recommendations have been made. For more detail, the general requirements for the evaluation of exemption requests may be found in the technical specifications of the project.[2]

[2] Cf. under: http://rohs.exemptions.oeko.info/index.php?id=174

4.0 Overview of the Evaluation Results

The exemption requests covered in this project and the applicants concerned, as well as the final recommendations and proposed expiry dates are summarized in Table 4-1. The reader is referred to the corresponding sections of this report for more details on the evaluation results.

The – not legally binding – recommendations for exemption requests no. 17a, 18a and 20a were submitted to the EU Commission by Oeko-Institut and Fraunhofer IZM and were published at the EU CIRCA website on the 19th of September 2013. So far, the Commission has not adopted any revision of the Annex to Directive 2011/65/EU based on these recommendations.

Table 4-1: Overview of the Exemption Requests, Associated Recommendations and Expiry Dates

No.	Wording	Applicant	Recommendation	Expiry date
17a	Lead in glass of electronic components and fluorescent tubes, or in electronic ceramic parts (including dielectric ceramic capacitors) used in industrial monitoring & control instruments (only subcategory 9 industrial), exemption to expire in 2024	Test and Measurement Coalition (TMC)	*Lead in dielectric ceramic in capacitors for a rated voltage of less than 125 V AC or 250 V DC for industrial monitoring and control instruments (cat. 9).*	*The exemption expires on 1 January 2021 (alternatively: 1 January 2023), and after that date may be used in spare parts for industrial monitoring and control instruments placed on the market before 1 January 2021 (alternatively 1 January 2023).*
18a	Lead used in compliant pin connector systems for use in industrial monitoring and control instruments (only sub-category 9 industrial), exemption to expire in 2024	TMC	*Lead used in other than C-press compliant pin connector systems for industrial monitoring and control instruments (cat. 9)*	*The exemption expires on 1 January 2021 (alternatively: 1 January 2024), and after that date may be used in spare parts for industrial monitoring and control instruments placed on the market before 1 January 2021 (alternatively 1 January 2024).*
20a	Mercury in cold cathode fluorescent lamps (CCFL) for back-lighting liquid crystal displays not exceeding 5 mg per lamp used in industrial monitoring and control instruments (only sub-category 9 industrial)	TMC	*"Mercury in cold cathode fluorescent lamps (CCFL) for back-lighting liquid crystal displays, not exceeding 5 mg per lamp, used in industrial monitoring and control instruments placed on the market before 22/07/2017"*	*Expires on 21/07/2024*

5.0 Links from the Directive to the REACH Regulation

Article 5 of the RoHS 2 Directive 2011/65/EU on "Adaptation of the Annexes to scientific and technical progress" provides for the:

> "*inclusion of materials and components of EEE for specific applications in the lists in Annexes III and IV, provided that such inclusion does not weaken the environmental and health protection afforded by Regulation (EC) No 1907/2006*".

RoHS 2 does not further elaborate the meaning of this clause.

Regulation (EC) No 1907/2006 regulates the safe use of chemical substances, and is commonly referred to as the REACH Regulation since it deals with **R**egistration, **E**valuation, **A**uthorisation and Restriction of **Ch**emical substances. REACH, for its part, addresses substances of concern through processes of authorisation and restriction:

- Substances that may have serious and often irreversible effects on human health and the environment can be added to the candidate list to be identified as Substances of Very High Concern (SVHCs). Following the identification as SVHC, a substance may be included in the Authorisation list, available under Annex XIV of the REACH Regulation: "List of Substances Subject to Authorisation". If a SVHC is placed on the Authorisation list, companies (manufacturers and importers) that wish to continue using it, or placing it on the market, must apply for an authorisation for a specified use. Article 22 of the REACH Regulation states that:
  "Authorisations for the placing on the market and use should be granted by the Commission only if the risks arising from their use are adequately controlled, where this is possible, or the use can be justified for socio-economic reasons and no suitable alternatives are available, which are economically and technically viable."
- If the use of a substance (or compound) in specific articles, or its placement on the market in a certain form, poses an unacceptable risk to human health and/or to the environment that is not adequately controlled, the European Chemical Agency (ECHA) may restrict its use, or placement on the market. These restrictions are laid down in Annex XVII of the REACH Regulation: "Restrictions on the Manufacture, Placing on the Market and Use of Certain Dangerous Substances, Mixtures and Articles". The provisions of the restriction may be made subject to total or partial bans, or other restrictions, based on an assessment of those risks.

The approach adopted in this report is that once a substance has been included into the regulation related to authorization or restriction of substances and articles under REACH, the environmental and health protection afforded by REACH may be weakened in cases where, an exemption would be granted for these uses under the provisions of RoHS. This is essentially the same approach as has already been adopted for the re-evaluation of some existing RoHS exemptions 7(c)-IV, 30, 31 and 40,[3] as well as for the evaluation of a range of requests assessed through previous projects in respect of RoHS 2.[4] Furthermore, substances for which an authorisation or restriction process is already underway are also reviewed, so that future developments may be considered where relevant.

When evaluating the exemption requests, then with regard to REACH compliance, we have checked whether the substance / or its substitutes are:

- on the list of substances proposed for the adoption to the Candidate List (the Registry of Intentions);
- on the list of substances of very high concern (SVHCs- the Candidate List);
- in the recommendations of substances for Annex XIV (recommended to be added to the Authorisation List);
- listed in REACH Annex XIV itself (The Authorization List); or
- listed in REACH Annex XVII (the List of Restrictions).

As the European Chemicals Agency (ECHA) is the driving force among regulatory authorities in implementing the EU's chemicals legislation, the ECHA website has been used as the reference point for the aforementioned lists, as well as for the exhaustive register of the Amendments to the REACH Legal Text.

Figure 5-1 shows the relationship between the two processes and categories. Substances included in the red areas may only be used when certain specifications and or conditions are fulfilled.

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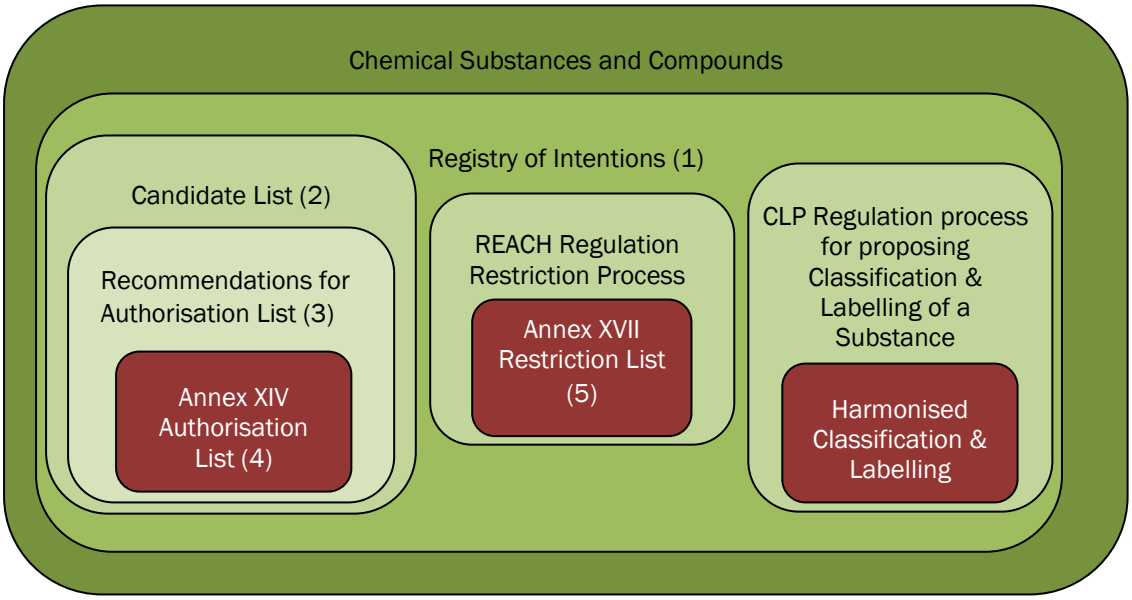
[3] See Zangl, S.; Blepp, M.; Deubzer, O. (2012) Adaptation to Scientific and Technical Progress under Directive 2011/65/EU - Transferability of previously reviewed exemptions to Annex III of Directive 2011/65/EU, Final Report, Oeko-Institut e.V. und Fraunhofer IZM, Freiburg, February 17, 2012, http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Re-evaluations_transfer_RoHS_I_RoHS_II_final.pdf

[4] Gensch, C., Baron, Y., Blepp, M., Deubzer, O., Manhart, A. & Moch, K. (2012) Assistance to the Commission on technological, socio-economic and cost-benefit assessment related to exemptions from the substance restrictions in electrical and electronic equipment (RoHS Directive), Final Report, Oeko-Institut e.V. und Fraunhofer IZM, Freiburg, 21.12.2012 http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/RoHS_V_Final_report_12_Dec_2012_final.pdf

Figure 5-1: Relation of REACH Categories and Lists to Other Chemical Substances



The following bullet points explain in detail the above mentioned lists and where they can be accessed:

- Member States Competent Authorities (MSCAs) / the European Chemicals Agency (ECHA), on request by the Commission, may prepare Annex XV dossiers for identification of Substances of Very High Concern (SVHC), Annex XV dossiers for proposing a harmonised Classification and Labelling, or Annex XV dossiers proposing restrictions. The aim of the public Registry of Intentions is to allow interested parties to be aware of the substances for which the authorities intend to submit Annex XV dossiers and, therefore, facilitates timely preparation of the interested parties for commenting later in the process. It is also important to avoid duplication of work and encourage co-operation between Member States when preparing dossiers. Note that the Registry of Intentions is divided into three separate sections: listing new intentions; intentions still subject to the decision making process; and withdrawn intentions. The registry of intentions is available at the ECHA website at: http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/registry-of-intentions;
- The identification of a substance as a Substance of Very High Concern and its inclusion in the Candidate List is the first step in the authorisation procedure. The Candidate List is available at the ECHA website at http://echa.europa.eu/web/guest/candidate-list-table;
- The last step of the procedure, prior to inclusion of a substance into Annex XIV (the Authorisation list), involves ECHA issuing a Recommendation of substances for Annex XIV. The ECHA recommendations for inclusion in the Authorisation List are available at the ECHA website at http://echa.europa.eu/web/guest/addressing-chemicals-of-

concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list;

- Once a decision is made, substances may be added to the Authorisation List available under Annex XIV of the REACH Regulation. The use of substances appearing on this list is prohibited unless an Authorisation for use in a specific application has been approved. The Annex can be found in the consolidated version of the REACH Legal Text (see below);
- In parallel, if a decision is made concerning the Restriction on the use of a substance in a specific article, or concerning the restriction of its provision on the European market, then a restriction is formulated to address the specific terms, and this shall be added to Annex XVII of the REACH Regulation. The Annex can be found in the consolidated version of the REACH Legal Text (see below); and
- As of the 22 of February, 2013, the last amendment of the REACH Legal Text was dated from 19 September 2012 (Commission Regulation (EU) No 494/2011) and so the updated consolidated version of the REACH Legal Text, dated 9 October 2012, was used to check Annex XIV and XVII: The consolidated version is presented at the ECHA website: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2006R1907:20120601:EN:PDF.

Table 5-1 lists those substances appearing in Annex XIV, subject to Authorisation, which are relevant to the RoHS substances dealt with in the requests evaluated in this project. As can be seen, at present, exemptions have not been granted for the use of these substances.

Table 5-1: Relevant Entries from Annex XIV: The List of Substances Subject to Authorization

Designation of the substance, of the group of substances or of the mixture	Transitional arrangements		Exempted (categories of) uses
	Latest application date (1)	Sunset date (2)	
10. **Lead chromate** EC No: 231-846-0 CAS No: 7758-97-6	21 November 2013	21 May 2015	-
11. **Lead sulfochromate yellow** (C.I. Pigment Yellow 34) EC No: 215-693-7 CAS No: 1344-37-2	21 November 2013	21 May 2015	-
12. **Lead chromate molybdate sulphate red** (C.I. Pigment Red 104) EC No: 235-759-9 CAS No: 12656-85-8	21 November 2013	21 May 2015	-

For cadmium, hexavalent chromium, lead, mercury and their compounds covered in the exemption requests that were evaluated in this project, we have found that some relevant entries are listed in Annex XVII. The conditions of restriction of hexavalent chromium, lead, mercury and their compounds are presented in Table 5-2 below. Additionally, some amendments have been decided upon, and are still to be included in the concise version. These may be seen in Table 5-3.

Table 5-2: Conditions of restriction in REACH Annex XVII for mercury, cadmium and its compounds, cadmium oxide and specific lead compounds.

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
8. **Polybromobiphenyls; Polybrominatedbiphenyls (PBB)** CAS No 59536-65-1	1. Shall not be used in textile articles, such as garments, undergarments and linen, intended to come into contact with the skin. 2. Articles not complying with paragraph 1 shall not be placed on the market.
16. **Lead carbonates**: (a) Neutral anhydrous carbonate (PbCO 3) CAS No 598-63-0 EC No 209-943-4 (b) Trilead-bis(carbonate)-dihydroxide 2Pb CO 3 - Pb(OH) 2 CAS No 1319-46-6 EC No 215-290-6	Shall not be placed on the market, or used, as substances or in mixtures, where the substance or mixture is intended for use as paint. However, Member States may, in accordance with the provisions of International Labour Organisation (ILO) Convention 13 on the use of white lead and sulphates of lead in paint, permit the use on their territory of the substance or mixture for the restoration and maintenance of works of art and historic buildings and their interiors.
17. **Lead sulphates:** (a) PbSO 4 CAS No 7446-14-2 EC No 231-198-9 (b) Pb x SO 4 CAS No 15739-80-7 EC No 239-831-0	Shall not be placed on the market, or used, as substances or in mixtures, where the substance or mixture is intended for use as paint. However, Member States may, in accordance with the provisions of ILO Convention 13 on the use of white lead and sulphates of lead in paint, permit the use on their territory of the substance or mixture for the restoration and maintenance of works of art and historic buildings and their interiors.
18. **Mercury compounds**	Shall not be placed on the market, or used, as substances or in mixtures where the substance or mixture is intended for use: (a) to prevent the fouling by micro-organisms, plants or animals of: — the hulls of boats, — cages, floats, nets and any other appliances or equipment used for fish or shellfish farming, — any totally or partly submerged appliances or equipment; (b) in the preservation of wood; (c) in the impregnation of heavy-duty industrial textiles and yarn intended for their manufacture; (d) in the treatment of industrial waters, irrespective of their use.
18a. **Mercury** CAS No 7439-97-6 EC No 231-106-7	1. Shall not be placed on the market: (a) in fever thermometers; (b) in other measuring devices intended for sale to the

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
	general public (such as manometers, barometers, sphygmomanometers, thermometers other than fever thermometers). 2. The restriction in paragraph 1 shall not apply to measuring devices that were in use in the Community before 3 April 2009. However Member States may restrict or prohibit the placing on the market of such measuring devices. 3. The restriction in paragraph 1(b) shall not apply to: (a) measuring devices more than 50 years old on 3 October 2007; (b) barometers (except barometers within point (a)) until 3 October 2009. 4. By 3 October 2009 the Commission shall carry out a review of the availability of reliable safer alternatives that are technically and economically feasible for mercury containing sphygmomanometers and other measuring devices in healthcare and in other professional and industrial uses. On the basis of this review or as soon as new information on reliable safer alternatives for sphygmomanometers and other measuring devices containing mercury becomes available, the Commission shall, if appropriate, present a legislative proposal to extend the restrictions in paragraph 1 to sphygmomanometers and other measuring devices in healthcare and in other professional and industrial uses, so that mercury in measuring devices is phased out whenever technically and economically feasible.
23. **Cadmium** and its compounds CAS No 7440-43-9 EC No 231-152-8	For the purpose of this entry, the codes and chapters indicated in square brackets are the codes and chapters of the tariff and statistical nomenclature of Common Customs Tariff as established by Council Regulation (EEC) No 2658/87 (*). 1. Shall not be used in mixtures and articles produced from synthetic organic polymers (hereafter referred to as plastic material) such as: — polymers or copolymers of vinyl chloride (PVC) [3904 10] [3904 21] — polyurethane (PUR) [3909 50] — low-density polyethylene (LDPE), with the exception of low-density polyethylene used for the production of coloured masterbatch [3901 10] — cellulose acetate (CA) [3912 11] — cellulose acetate butyrate (CAB) [3912 11] — epoxy resins [3907 30] — melamine-formaldehyde (MF) resins [3909 20] — urea-formaldehyde (UF) resins [3909 10] — unsaturated polyesters (UP) [3907 91] — polyethylene terephthalate (PET) [3907 60] — polybutylene terephthalate (PBT) — transparent/general-purpose polystyrene [3903 11] — acrylonitrile methylmethacrylate (AMMA) — cross-linked polyethylene (VPE) — high-impact polystyrene — polypropylene (PP) [3902 10] Mixtures and articles produced from plastic material shall not be placed on the market if the concentration of

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
	cadmium (expressed as Cd metal) is equal to or greater than 0,01% by weight of the plastic material. By way of derogation, the second subparagraph shall not apply to articles placed on the market before 10 December 2011. The first and second subparagraphs apply without prejudice to Council Directive 94/62/EC (**) and acts adopted on its basis. By 19 November 2012, in accordance with Article 69, the Commission shall ask the European Chemicals Agency to prepare a dossier conforming to the requirements of Annex XV in order to assess whether the use of cadmium and its compounds in plastic material, other than that listed in subparagraph 1, should be restricted. 2. Shall not be used in paints [3208] [3209]. For paints with a zinc content exceeding 10% by weight of the paint, the concentration of cadmium (expressed as Cd metal) shall not be equal to or greater than 0,1% by weight. Painted articles shall not be placed on the market if the concentration of cadmium (expressed as Cd metal) is equal to or greater than 0,1% by weight of the paint on the painted article. 3. By way of derogation, paragraphs 1 and 2 shall not apply to articles coloured with mixtures containing cadmium for safety reasons. 4. By way of derogation, paragraph 1, second subparagraph shall not apply to: — mixtures produced from PVC waste, hereinafter referred to as 'recovered PVC', — mixtures and articles containing recovered PVC if their concentration of cadmium (expressed as Cd metal) does not exceed 0,1% by weight of the plastic material in the following rigid PVC applications: (a) profiles and rigid sheets for building applications; (b) doors, windows, shutters, walls, blinds, fences, and roof gutters; (c) decks and terraces; (d) cable ducts; (e) pipes for non-drinking water if the recovered PVC is used in the middle layer of a multilayer pipe and is entirely covered with a layer of newly produced PVC in compliance with paragraph 1 above. Suppliers shall ensure, before the placing on the market of mixtures and articles containing recovered PVC for the first time, that these are visibly, legibly and indelibly marked as follows: '*Contains recovered PVC*' or with the following pictogram:  In accordance with Article 69 of this Regulation, the derogation granted in paragraph 4 will be reviewed, in particular with a view to reducing the limit value for cadmium and to reassess the derogation for the applications listed in points (a) to (e), by 31 December 2017.

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
	5. For the purpose of this entry, 'cadmium plating' means any deposit or coating of metallic cadmium on a metallic surface. Shall not be used for cadmium plating metallic articles or components of the articles used in the following sectors/applications: (a) equipment and machinery for: — — food production [8210] [8417 20] [8419 81] [8421 11] [8421 22] [8422] [8435] [8437] [8438] [8476 11] — agriculture [8419 31] [8424 81] [8432] [8433] [8434] [8436] — cooling and freezing [8418] — printing and book-binding [8440] [8442] [8443] (b) equipment and machinery for the production of: — household goods [7321] [8421 12] [8450] [8509] [8516] — furniture [8465] [8466] [9401] [9402] [9403] [9404] — sanitary ware [7324] — central heating and air conditioning plant [7322] [8403] [8404] [8415] In any case, whatever their use or intended final purpose, the placing on the market of cadmium-plated articles or components of such articles used in the sectors/applications listed in points (a) and (b) above and of articles manufactured in the sectors listed in point (b) above is prohibited. 6. The provisions referred to in paragraph 5 shall also be applicable to cadmium-plated articles or components of such articles when used in the sectors/applications listed in points (a) and (b) below and to articles manufactured in the sectors listed in (b) below: (a) equipment and machinery for the production of: — paper and board [8419 32] [8439] [8441] textiles and clothing [8444] [8445] [8447] [8448] [8449] [8451] [8452] (b) equipment and machinery for the production of: — industrial handling equipment and machinery [8425] [8426] [8427] [8428] [8429] [8430] [8431] — road and agricultural vehicles [chapter 87] — rolling stock [chapter 86] — vessels [chapter 89] 7. However, the restrictions in paragraphs 5 and 6 shall not apply to: — articles and components of the articles used in the aeronautical, aerospace, mining, offshore and nuclear sectors whose applications require high safety standards and in safety devices in road and agricultural vehicles, rolling stock and vessels, — electrical contacts in any sector of use, where that is necessary to ensure the reliability required of the apparatus on which they are installed. 8. Shall not be used in brazing fillers in concentration equal to or greater than 0,01% by weight. Brazing fillers shall not be placed on the market if the concentration of cadmium (expressed as Cd metal) is equal to or greater than 0,01% by weight. For the purpose of this paragraph brazing shall mean a joining technique using alloys and under- taken at

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
	temperatures above 450 °C. 9. By way of derogation, paragraph 8 shall not apply to brazing fillers used in defence and aerospace applications and to brazing fillers used for safety reasons. 10. Shall not be used or placed on the market if the concentration is equal to or greater than 0,01% by weight of the metal in: (i) metal beads and other metal components for jewellery making; (ii) metal parts of jewellery and imitation jewellery articles and hair accessories, including: — bracelets, necklaces and rings, — piercing jewellery, — wrist-watches and wrist-wear, — brooches and cufflinks. 11. By way of derogation, paragraph 10 shall not apply to articles placed on the market before 10 December 2011 and jewellery more than 50 years old on 10 December 2011.
28 Carcinogen category 1A or 1B or carcinogen category 1 or 2 According to Appendices 1 and 2: **Cadmium oxide** **Cadmium chloride** **Cadmium fluoride** **Cadmium Sulphate** **Cadmium sulphide** **Cadmium (pyrophoric)** **Chromium (VI) trioxide** **Zinc chromates including zinc potassium chromate** **Nickel Chromate** **Nickel dichromate** **Potassium dichromate** **Ammonium dichromate** **Sodium dichromate** **Chromyl dichloride; chromic oxychloride** **Potassium chromate** **Calcium chromate** **Strontium chromate** **Chromium III chromate; chromic chromate** **Sodium chromate** **Lead Chromate** **Lead hydrogen arsenate** **Lead Nickel Salt** **Lead sulfochromate yellow; C.I. Pigment Yellow 34;** **Lead chromate molybdate sulfate red; C.I. Pigment Red 104;**	Without prejudice to the other parts of this Annex the following shall apply to entries 28 to 30: **1.** Shall not be placed on the market, or used, - as substances, - as constituents of other substances, or, - in mixtures, for supply to the general public when the individual concentration in the substance or mixture is equal to or greater than: - either the relevant specific concentration limit specified in Part 3 of Annex VI to Regulation (EC) No 1272/2008, or, - the relevant concentration specified in Directive 1999/45/EC. Without prejudice to the implementation of other Community provisions relating to the classification, packaging and labelling of substances and mixtures, suppliers shall ensure before the placing on the market that the packaging of such substances and mixtures is marked visibly, legibly and indelibly as follows: 'Restricted to professional users'. 2. By way of derogation, paragraph 1 shall not apply to: (a) medicinal or veterinary products as defined by Directive 2001/82/EC and Directive 2001/83/EC; (b) cosmetic products as defined by Directive 76/768/EEC; (c) the following fuels and oil products: - motor fuels which are covered by Directive 98/70/EC, - mineral oil products intended for use as fuel in mobile or fixed combustion plants, - fuels sold in closed systems (e.g. liquid gas bottles); (d) artists' paints covered by Directive 1999/45/EC. (e) the substances listed in Appendix 11, column 1, for the applications or uses listed in Appendix 11, column 2.
29 Mutagens: category 1B or category 2 According to Appendices 3 and 4: **Cadmium chloride**	

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
Cadmium fluoride **Cadmium Sulphate** **Chromium (VI) trioxide** **Potassium dichromate** **Ammonium dichromate** **Sodium dichromate** **Chromyl dichloride; chromic oxychloride** **Potassium chromate** **Sodium chromate**	Where a date is specified in column 2 of Appendix 11, the derogation shall apply until the said date.
30 Toxic to reproduction: category 1A or 1B or toxic to reproduction category 1 or 2 According to Appendices 5 and 6: **Cadmium chloride** **Cadmium fluoride** **Cadmium Sulphate** **Potassium dichromate** **Ammonium dichromate** **Sodium dichromate** **Sodium chromate** **Nickel dichromate** **Lead acetate** **Lead alkyls** **Lead azide** **Lead Chromate** **Lead di(acetate)** **Lead hydrogen arsenate** **Lead(II) methane- sulphonate** **Trilead bis- (orthophosphate)** **Lead hexa-fluorosilicate** **Lead nickel salt** **Lead 2,4,6-trinitroresorcinoxide, lead styphnate** **Mercury**	
43. **Azocolourants and Azodyes** Not allocated Component 1: CAS-No: 118685-33-9 C 39 H 23 ClCrN 7 O 12 S.2Na A mixture of: disodium (6-(4-anisidino)-3- sulfonato-2-(3,5-dinitro-2-oxidophenylazo)-1- naphtholato)(1-(5-chloro-2-oxidophenylazo)-2- naphtholato)chromate(1-); Component 2: C 46 H 30 CrN 10 O 20 S 2 .3Na trisodium bis(6-(4-anisidino)-3-sulfonato-2-(3,5- dinitro-2-oxidophenylazo)-1-naphtholato)chromate(1-)	1. Azodyes which, by reductive cleavage of one or more azo groups, may release one or more of the aromatic amines listed in Appendix 8, in detectable concentrations, i.e. above 30 mg/kg (0,003% by weight) in the articles or in the dyed parts thereof, according to the testing methods listed in Appendix 10, shall not be used, in textile and leather articles which may come into direct and prolonged contact with the human skin or oral cavity, such as: — clothing, bedding, towels, hairpieces, wigs, hats, nappies and other sanitary items, sleeping bags, — footwear, gloves, wristwatch straps, handbags, purses/wallets, briefcases, chair covers, purses worn round the neck, — textile or leather toys and toys which include textile or leather garments, — yarn and fabrics intended for use by the final consumer. 2. Furthermore, the textile and leather articles referred to in paragraph 1 shall not be placed on the market unless

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
	they conform to the requirements set out in that paragraph. 3. Azodyes, which are contained in Appendix 9, 'List of azodyes' shall not be placed on the market, or used, as substances, or in mixtures in concentrations greater than 0,1% by weight, where the substance or the mixture is intended for colouring textile and leather articles.
47. **Chromium VI** compounds	1. Cement and cement-containing mixtures shall not be placed on the market, or used, if they contain, when hydrated, more than 2 mg/kg (0,0002%) soluble chromium VI of the total dry weight of the cement. 2. If reducing agents are used, then without prejudice to the application of other Community provisions on the classification, packaging and labelling of substances and mixtures, suppliers shall ensure before the placing on the market that the packaging of cement or cement-containing mixtures is visibly, legibly and indelibly marked with information on the packing date, as well as on the storage conditions and the storage period appropriate to maintaining the activity of the reducing agent and to keeping the content of soluble chromium VI below the limit indicated in paragraph 1. 3. By way of derogation, paragraphs 1 and 2 shall not apply to the placing on the market for, and use in, controlled closed and totally automated processes in which cement and cement-containing mixtures are handled solely by machines and in which there is no possibility of contact with the skin.
63. **Lead** and its compounds CAS No 7439-92-1 EC No 231-100-4	1. Shall not be placed on the market or used in any individual part of jewellery articles if the concentration of lead (expressed as metal) in such a part is equal to or greater than 0,05% by weight. 2. For the purposes of paragraph 1: (i) 'jewellery articles' shall include jewellery and imitation jewellery articles and hair accessories, including: (a) bracelets, necklaces and rings; (b) piercing jewellery; (c) wrist watches and wrist-wear; (d) brooches and cufflinks; (ii) 'any individual part' shall include the materials from which the jewellery is made, as well as the individual components of the jewellery articles. 3. Paragraph 1 shall also apply to individual parts when placed on the market or used for jewellery-making. 4. By way of derogation, paragraph 1 shall not apply to: (a) crystal glass as defined in Annex I (categories 1, 2, 3 and 4) to Council Directive 69/493/EEC (**********); (b) internal components of watch timepieces inaccessible to consumers; (c) non-synthetic or reconstructed precious and semiprecious stones (CN code 7103, as established by Regulation (EEC) No 2658/87), unless they have been treated with lead or its compounds or mixtures containing these substances;

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
	(d) enamels, defined as vitrifiable mixtures resulting from the fusion, vitrification or sintering of minerals melted at a temperature of at least 500 °C. 5. By way of derogation, paragraph 1 shall not apply to jewellery articles placed on the market for the first time before 9 October 2013 and jewellery articles produced before 10 December 1961. 6. By 9 October 2017, the Commission shall re-evaluate this entry in the light of new scientific information, including the availability of alternatives and the migration of lead from the articles referred to in paragraph 1 and, if appropriate, modify this entry accordingly.

Table 5-3: Summary of relevant amendments to annexes that came into force after the last concise version of the REACH Regulation was finalized

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction	Amended Annex	Amendment date
Mercury	(1) paragraph 4 is deleted; (2) the following paragraphs 5 to 8 are added: 5. The following mercury-containing measuring devices intended for industrial and professional uses shall not be placed on the market after 10 April 2014: (a) barometers; (b) hygrometers; (c) manometers; (d) sphygmomanometers; (e) strain gauges to be used with plethysmographs; (f) tensiometers; (g) thermometers and other non-electrical thermometric applications. The restriction shall also apply to measuring devices under points (a) to (g) which are placed on the market empty if intended to be filled with mercury. 6. The restriction in paragraph 5 shall not apply to: (a) sphygmomanometers to be used: (i) in epidemiological studies which are ongoing on 10 October 2012; (ii) as reference standards in clinical validation studies of mercury-free sphygmomanometers; (b) thermometers exclusively intended to perform tests according to standards that require the use of mercury thermometers until 10 October 2017; (c) mercury triple point cells which are used for the calibration of platinum resistance thermometers. 7. The following mercury-using measuring devices intended for professional and industrial uses shall not be placed on the market after 10 April 2014: (a) mercury pycnometers; (b) mercury metering devices for determination of the softening point.	Annex XVII, entry 18a	20.09.2012

Designation of the substance, of the group of substances or of the mixture	Conditions of restriction	Amended Annex	Amendment date
	8. The restrictions in paragraphs 5 and 7 shall not apply to: (a) measuring devices more than 50 years old on 3 October 2007; (b) measuring devices which are to be displayed in public exhibitions for cultural and historical purposes.'		
Addition of **Entry 62** concerning: (a) **Phenylmercury acetate** EC No: 200-532-5 CAS No: 62-38-4 (b) **Phenylmercury propionate** EC No: 203-094-3 CAS No: 103-27-5 (c) **Phenylmercury 2-ethylhexanoate** EC No: 236-326-7 CAS No: 13302-00-6 (d) **Phenylmercury octanoate** EC No: - CAS No: 13864-38-5 (e) **Phenylmercury neodecanoate** EC No: 247-783-7 CAS No: 26545-49-3	1. Shall not be manufactured, placed on the market or used as substances or in mixtures after 10 October 2017 if the concentration of mercury in the mixtures is equal to or greater than 0,01% by weight. 2. Articles or any parts thereof containing one or more of these substances shall not be placed on the market after 10 October 2017 if the concentration of mercury in the articles or any part thereof is equal to or greater than 0,01% by weight.'	Annex XVII, entry 62	20.09.2012
Amendment of Entry 16 in Annex XIIV, regarding lead carbonates	in entry 16, column 2, the second paragraph is replaced by the following: 'However, Member States may, in accordance with the provisions of International Labour Organization (ILO) Convention 13, permit the use on their territory of the substance or mixture for the restoration and maintenance of works of art and historic buildings and their interiors, as well as the placing on the market for such use. Where a Member State makes use of this derogation, it shall inform the Commission thereof.';	Annex XVII, entry 16	13.2.2013
Amendment of Entry 16 in Annex XIIV, regarding lead sulphates	in entry 17, column 2, the second paragraph is replaced by the following: 'However, Member States may, in accordance with the provisions of International Labour Organization (ILO) Convention 13, permit the use on their territory of the substance or mixture for the restoration and maintenance of works of art and historic buildings and their interiors, as well as the placing on the market for such use. Where a Member State makes use of this derogation, it shall inform the Commission thereof.';	Annex XVII, entry 17	13.2.2013
Amendment of Entries 28, 29 and 30 in Annex XIIV, regarding various	in entries 28, 29 and 30, column 2, paragraph 1, the fifth indent of the first subparagraph is replaced by the following: '— the relevant concentration specified in Directive	Annex XVII, entries 28, 29 and 30	13.2.2013

<table>
<tr><th>Designation of the substance, of the group of substances or of the mixture</th><th colspan="3">Conditions of restriction</th><th>Amended Annex</th><th>Amendment date</th></tr>
<tr><td>substances</td><td colspan="3">1999/45/EC where no specific concentration limit is set out in Part 3 of Annex VI to Regulation (EC) No 1272/2008.';</td><td></td><td></td></tr>
<tr><td>Amendment of Entry 47 in Annex XIIV, regarding
Chromium VI compounds</td><td colspan="3">in entry 47, column 2, the following paragraph 4 is added:
'4. The standard adopted by the European Committee for Standardization (CEN) for testing the water-soluble chromium (VI) content of cement and cement-containing mixtures shall be used as the test method for demonstrating conformity with paragraph 1.';</td><td>Annex XVII, entry 47</td><td>13.2.2013</td></tr>
<tr><td rowspan="9">Addition of entries 16-22 (to Annex XIV</td><td>Entry No.: Substance</td><td>Latest Application Date</td><td>Sunset Date</td><td rowspan="9">Annex XIV</td><td rowspan="9">17.4.2013</td></tr>
<tr><td>16. Chromium trioxide EC No: 215-607-8 CAS No: 1333-82-0</td><td>21 March 2016</td><td>21 September 2017</td></tr>
<tr><td>17. Acids generated from chromium trioxide and their oligomers Group containing:
Chromic acid
EC No: 231-801-5
CAS No: 7738-94-5
Dichromic acid
EC No: 236-881-5
CAS No: 13530-68-2
Oligomers of chromic acid and dichromic acid
EC No: not yet assigned
CAS No: not yet assigned</td><td>21 March 2016</td><td>21 September 2017</td></tr>
<tr><td>18. Sodium dichromate EC No: 234-190-3
CAS No: 7789-12-0
10588-01-9</td><td>21 March 2016</td><td>21 September 2017</td></tr>
<tr><td>19. Potassium dichromate EC No: 231-906-6
CAS No: 7778-50-9</td><td>21 March 2016</td><td>21 September 2017</td></tr>
<tr><td>20. Ammonium dichromate EC No: 232-143-1
CAS No: 7789-09-5</td><td>21 March 2016</td><td>21 September 2017</td></tr>
<tr><td>21. Potassium chromate EC No: 232-140-5
CAS No: 7789-00-6</td><td>21 March 2016</td><td>21 September 2017</td></tr>
<tr><td>22. Sodium chromate EC No: 231-889-5
CAS No: 7775-11-3</td><td>21 March 2016</td><td>21 September 2017</td></tr>
</table>

As of the 01.3.2013, the Candidate list includes the following substances relevant for RoHS (i.e., proceedings concerning the addition of these substances to the Authorisation list (Annex XIV) have begun and shall be followed by the evaluation team to determine possible discrepancies with future requests of exemption from RoHS (new exemptions, renewals and revokals)[5]:

Table 5-4: Summary of Relevant Substances Currently on the Candidate List

Substance Name	EC Number	CAS Number	Date of Inclusion	Reason for inclusion
Pyrochlore, antimony lead yellow	232-382-1	8012-00-8	2012/12/19	Toxic for reproduction (Article 57 c)
Lead bis(tetrafluoroborate)	237-486-0	13814-96-5	2012/12/19	Toxic for reproduction (Article 57 c)
Lead dinitrate	233-245-9	10099-74-8	2012/12/19	Toxic for reproduction (Article 57 c)
Silicic acid, lead salt	234-363-3	11120-22-2	2012/12/19	Toxic for reproduction (Article 57 c)
Lead titanium zirconium oxide	235-727-4	12626-81-2	2012/12/19	Toxic for reproduction (Article 57 c)
Lead monoxide (lead oxide)	215-267-0	1317-36-8	2012/12/19	Toxic for reproduction (Article 57 c)
Silicic acid ($H_2Si_2O_5$), barium salt (1:1), lead-doped *[with lead (Pb) content above the applicable generic concentration limit for 'toxicity for reproduction' Repr. 1A (CLP) or category 1 (DSD); the substance is a member of the group entry of lead compounds, with index number 082-001-00-6 in Regulation (EC) No 1272/2008]*	272-271-5	68784-75-8	2012/12/19	Toxic for reproduction (Article 57 c)
Trilead bis(carbonate)dihydroxide	215-290-6	1319-46-6	2012/12/19	Toxic for reproduction (Article 57 c)
Lead oxide sulfate	234-853-7	12036-76-9	2012/12/19	Toxic for reproduction (Article 57 c)
Lead titanium trioxide	235-038-9	12060-00-3	2012/12/19	Toxic for reproduction (Article 57 c)
Acetic acid, lead salt, basic	257-175-3	51404-69-4	2012/12/19	Toxic for reproduction (Article 57 c)
[Phthalato(2-)]dioxotrilead	273-688-5	69011-06-9	2012/12/19	Toxic for reproduction (Article 57 c)
Tetralead trioxide sulphate	235-380-9	12202-17-4	2012/12/19	Toxic for reproduction (Article 57 c)
Dioxobis(stearato)trilead	235-702-8	12578-12-0	2012/12/19	Toxic for reproduction (Article 57 c)
Tetraethyllead	201-075-4	78-00-2	2012/12/19	Toxic for reproduction (Article 57 c)
Pentalead tetraoxide sulphate	235-067-7	12065-90-6	2012/12/19	Toxic for reproduction (Article 57 c)
Trilead dioxide phosphonate	235-252-2	12141-20-7	2012/12/19	Toxic for reproduction (Article 57 c)
Orange lead (lead tetroxide)	215-235-6	1314-41-6	2012/12/19	Toxic for reproduction (Article 57 c)
Sulfurous acid, lead salt, dibasic	263-467-1	62229-08-7	2012/12/19	Toxic for reproduction (Article 57 c)
Lead cyanamidate	244-073-9	20837-86-9	2012/12/19	Toxic for reproduction (Article 57 c)
Lead(II)	401-750-5	17570-76-2	2012/06/18	Toxic for reproduction (Article 57 c)

[5] Updated according to http://echa.europa.eu/web/guest/candidate-list-table

Substance Name	EC Number	CAS Number	Date of Inclusion	Reason for inclusion
bis(methanesulfonate)				
Lead diazide, Lead azide	236-542-1	13424-46-9	2011/12/19	Toxic for reproduction (article 57 c),
Lead dipicrate	229-335-2	6477-64-1	2011/12/19	Toxic for reproduction (article 57 c)
Dichromium tris(chromate)	246-356-2	24613-89-6	2011/12/19	Carcinogenic (article 57 a)
Pentazinc chromate octahydroxide	256-418-0	49663-84-5	2011/12/19	Carcinogenic (article 57 a)
Potassium hydroxyoctaoxodizincatedi chromate	234-329-8	11103-86-9	2011/12/19	Carcinogenic (article 57 a)
Lead styphnate	239-290-0	15245-44-0	2011/12/19	Toxic for reproduction (article 57 c)
Trilead diarsenate	222-979-5	3687-31-8	2011/12/19	Carcinogenic and toxic for reproduction (articles 57 a and 57 c)
Strontium chromate	232-142-6	7789-06-2	2011/06/20	Carcinogenic (article 57a)
Acids generated from chromium trioxide and their oligomers. Names of the acids and their oligomers: Chromic acid, Dichromic acid, Oligomers of chromic acid and dichromic acid.	231-801-5, 236-881-5	7738-94-5, 13530-68-2	2010/12/15	Carcinogenic (article 57a)
Chromium trioxide	215-607-8	1333-82-0	2010/12/15	Carcinogenic and mutagenic (articles 57 a and 57 b)
Potassium dichromate	231-906-6	7778-50-9	2010/06/18	Carcinogenic, mutagenic and toxic for reproduction (articles 57 a, 57 b and 57 c)
Ammonium dichromate	232-143-1	7789-09-5	2010/06/18	Carcinogenic, mutagenic and toxic for reproduction (articles 57 a, 57 b and 57 c)
Sodium chromate	231-889-5	7775-11-3	2010/06/18	Carcinogenic, mutagenic and toxic for reproduction (articles 57 a, 57 b and 57 c)
Potassium chromate	232-140-5	7789-00-6	2010/06/18	Carcinogenic and mutagenic (articles 57 a and 57 b).
Lead sulfochromate yellow (C.I. Pigment Yellow 34)	215-693-7	1344-37-2	2010/01/13	Carcinogenic and toxic for reproduction (articles 57 a and 57 c))
Lead chromate molybdate sulphate red (C.I. Pigment Red 104)	235-759-9	12656-85-8	2010/01/13	Carcinogenic and toxic for reproduction (articles 57 a and 57 c)
Lead chromate	231-846-0	7758-97-6	2010/01/13	Carcinogenic and toxic for reproduction (articles 57 a and 57 c)
Lead hydrogen arsenate	232-064-2	7784-40-9	2008/10/28	Carcinogenic and toxic for reproduction (articles 57 a and 57 c)
Sodium dichromate	234-190-3	7789-12-0, 10588-01-9	2008/10/28	Carcinogenic, mutagenic and toxic for reproduction (articles 57a, 57b and 57c)

Additionally, member states can register intentions to propose restrictions or to classify substances as SVHC. The first step is to announce such an intention. Once the respective dossier is submitted it is reviewed and it is decided if the restriction or authorisation process should be further pursued or if the intention should be withdrawn.

As at the time of writing (Spring 2013), it cannot yet be foreseen how these procedures will conclude. It is thus not yet possible to determine if the protection afforded by REACH Regulation would in these cases consequently be weakened by approving the exemption requests dealt with in this report. For this reason, the implications of these decisions have not been considered in the review of the exemption requests dealt with in this report. However for the sake of future reviews, process results shall be followed and carefully considered where relevant.[6]

Concerning registrations of intentions to propose substances for classification as SVHC, Sweden has registered an intention concerning *cadmium sulphide* as a CMR substance (Carcinogenic, Mutagenic or Reproduction toxic chemicals) on the 18th of April 2012 and intends to submit a dossier by August 2013.7

As for registries of intentions to propose restrictions, on the 18th of January 2013 the COM requested that an Annex XV restriction dossier be prepared concerning *cadmium and its compounds in plastics and paints*, to investigate whether entry 23 should cover additional plastic materials, and whether the existing restriction on the use of cadmium and cadmium compounds in paints with TARIC codes [3208] & [3209] should be extended to also cover the placing on the market of such paints containing cadmium.[8]

As for prior registrations of intention, dossiers have been submitted for the substances listed in Table 5-5.

[6] European Chemicals Agency (ECHA), Registry of intentions to propose restrictions: http://echa.europa.eu/registry-of-current-restriction-proposal-intentions/-/substance/1402/search/+/term (last accessed 22 August 2012)

[7] ECHA website, accesses 04.03.2013: http://echa.europa.eu/web/guest/registry-of-current-svhc-intentions

[8] ECHA website, accesses 04.03.2013: http://echa.europa.eu/registry-of-current-restriction-proposal-intentions/-/substance/3101/search/+/term

Table 5-5: Summary of Substances for which a Dossier has been Submitted, Following the Initial Registration of Intention

Concerning Restriction/ SVHC Classification	Substance Name	Submission Date	Submitted by	Comments
Restriction	Lead and lead compounds in articles intended for consumer use	18.01.2013	Sweden	Substances containing lead
	Phenylmercuric octanoate; Phenylmercury propionate; Phenylmercury 2-ethylhexanoate; Phenylmercury acetate; Phenylmercury	15.06.2010	Norway	Mercury compounds
	Mercury in measuring devices	15.06.2010	ECHA	Mercury compounds
	Lead and its compounds in jewellery	15.04.2010	France	Substances containing lead
SVHC Classification	Cadmium	04.02.2013	Sweden	CMR; other; Substances Containing Cd CMR; other; Substances Containing Cd
	Cadmium oxide	04.02.2013	Sweden	
	Trilead dioxide Phosphonate; Lead Monoxide (Lead Oxide); Trilead bis(carbonate)dihydroxide; Lead Dinitrate; Lead Oxide Sulphate; Acetic acid, lead salt, basic; Dioxobis(stearato)trilead; Lead bis(tetrafluoroborate); Tetraethyllead; Pentalead tetraoxide sulphate; Lead cyanamidate; Lead titanium trioxide; Silicic acid ($H_2Si_2O_5$), barium salt (1:1), lead-doped; Silicic acid, lead salt; Sulfurous acid, lead salt, dibasic; Tetralead trioxide sulphate; [Phthalato(2-)]dioxotrilead; Orange lead (lead tetroxide); Fatty acids, C16-18, lead salts; Lead titanium zirconium oxide;	30.08.2012	ECHA	CMR; substances Containing Lead
	Lead(II) bis(methanesulfonate)	30.01.2012	Netherlands	CMR; Amides
	Lead styphnate; Lead diazide; Lead azide; Lead dipicrate;	01.08.2011	ECHA	CMR; Substances containing lead

Concerning Restriction/ SVHC Classification	Substance Name	Submission Date	Submitted by	Comments
	Trilead diarsenate;			CMR; Arsenic compounds
	Strontium Chromate	24.01.2011	France	CMR; Substances containing chromate
	Acids generated from chromium trioxide and their oligomers: Chromic acid; Dichromic acid; Oligomers of chromic acid and dichromic acid;	27.08.2010	Germany	CMR; Substances containing chromate
	Chromium Trioxide	02.08.2010	Germany	CMR; Substances containing chromate
	Sodium chromate; Potassium chromate; Potassium Dichromate;	10.02.2010	France	CMR; Substances containing chromate
	Lead chromate molybdate sulfate red (C.I. Pigment Red 104); Lead sulfochromate yellow (C.I. Pigment Yellow 34);	03.08.2009	France	CMR; substances Containing Lead
Lead Chromate;	Lead Chromate;	03.08.2009	France	CMR; Substances containing chromate
Lead hydrogen arsenate	Lead hydrogen arsenate	27.06.2008	Norway	CMR; Arsenic compounds
Sodium dichromate	Sodium dichromate	26.06.2008	France	CMR; Substances containing chromate

Additionally, on 19 April 2012, Sweden registered the intention at ECHA[9] to propose the restriction (Annex XVII) of "Lead and lead compounds in articles intended for consumer use". The proposal for restriction must be submitted by 19 April 2013. This proposal stems from the recent findings deeming lead to be a toxic substance with no threshold below which it has no neurotoxic effects, particularly for children. As earlier decisions concerning restrictions on the use of lead were based on the belief that there is a threshold below which no effect occurs, Sweden considers there is a rationale for imposing restrictions on the use of lead in additional applications.

Since at present, it cannot be foreseen if, or when, new restrictions might be implemented as a result of this proposal; its implications have not been considered in the review of the exemption requests dealt with in this report. In future reviews, however, on-going research into processes and the results of on-going proceedings shall be followed and carefully considered where relevant.

On the 3rd of September, ECHA launched a consultation for contributions concerning the proposal of 54 substances for the candidate list for Substances of Very High Concern (SVHC). This list refers among others to 21 lead compounds. Decisions

[9] European Chemicals Agency (ECHA), Registry of intentions to propose restrictions: http://echa.europa.eu/registry-of-current-restriction-proposal-intentions/-/substance/1402/search/+/term (last accessed 22 August 2012)

concerning these substances were anticipated to be reached towards the end of 2012. Based on the date of inclusion, it is understood that some of the substances appearing in Table 5-4 have been added to the candidate list as a result of this process. In any case, the process of inclusion of a substance in the candidate list is only one of the first steps in regulating the use of a substance through restriction or authorisation. As at the time of writing (August 2013), this procedure only addresses the inclusion of these substances in the candidate list of substances of very high concern (SVHC) and since it cannot yet be foreseen how this process will conclude, it is not possible at this time to determine if the protection afforded by REACH Regulation would consequently be weakened by approving the exemption requests dealt with in this report. For this reason, the implications of these decisions have not been considered in the review of the exemption requests dealt with in this report. However for the sake of future reviews, process results shall be followed and carefully considered where relevant.

6.0 General Issues Concerning Exemption Requests 17a and 18a

Abbreviations and Definitions

IMCI	Industrial monitoring and control instruments; monitoring and control instruments designed for exclusively industrial or professional use (source: RoHS 2)
RoHS 2	Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)
RoHS 1	Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

TMC requests exemptions 17a and 18a until 2024:

- Lead in glass of electronic components and fluorescent tubes, or in electronic ceramic parts in industrial monitoring and control instruments (17a)
- Lead used in compliant pin connector systems for use in industrial monitoring and control instruments (18a)

Besides information that is specific for each of the requested exemptions, TMC puts forward overarching arguments related to the general features of industrial monitoring and control instruments (IMCI) and the specific conditions of their manufacturers. These arguments are reflected in Section 6.0 here to avoid repeating them in the review of each individual exemption request.

6.1 The Test and Measurement Coalition (TMC)

TMC is an association representing several manufacturers of IMCI, which TMC lists[10]: Anritsu, Agilent, National Instruments and the Danaher group comprising of Tektronix, Fluke & Keithley.

[10] TMC (2012c), Test and Measurement Coalition (TMC) contribution concerning requests 1, 12, 13, 14, 15, 16, 17, 18, and 20, submitted 19.03.2012, available under: http://www.rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_1/TMC_contribution_request_1_12_13_14_15_16_17_18_20_submitted_19032012.pdf, retrieved on 3 August 2012

*Section 6 is heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

In addition TMC's[11] position is cross-communicated with Thermo Fisher Scientific and JEMIMA, the Japanese Electric Measurement Instruments Manufacturer's association[12].

With one exception, the TMC's members include all larger integrated companies that manufacture almost exclusively IMCI. Rohde-Schwarz, which is a large player in Europe is not a member. Thermo Fisher Scientific is not a member either but party to relevant positions although IMCI is not its main manufacturing area.[13]

For the rest there are hundreds if not thousands of companies,[14] larger and smaller ones that make one (generally) or more instruments – they are each taken individually minute compared to the TMC members although they could be large in other areas. Examples of such companies are Emerson Controls, LeCroy, Chauvin Arnoux, Kenwood, Hameg Instruments, Mueller Electric, Simpson, Tucker Electronics, Scientific Atlanta, Honeywell and GE Controls

TMC[15] estimates that TMC members represent 60% or more of the world market in IMCI. The vast majority of other manufacturers are very small companies producing one instrument, usually under contract manufacturing with companies such as Solectron. TMC[16] says that these companies therefore are not subject to similar constraints like the TMC members.

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[11] Op. Cit. (2012c)

[12] Member list of Jemima: http://www.jemima.or.jp/english_top/outline/members_list.html; TMC (2012 c) has only contact to Jemima itself, which is aware of what TMC does

[13] Op. Cit. (2012c)

[14] A simple search on a specialized site like dmoz.org will yield over 300 possible IMCI manufacturers on the global scale. Instrumentation makers – which would include some players that aren't really IMCI type companies, yields another thousand. These companies are on the whole not significant as the coalition represents the only large integrated manufacturers. Most instruments sold sell in very small quantities sometimes only one a year, a high volume piece of industrial equipment would sell in the low thousands per year. The market is highly specialized and quite unlike the consumer electronics market that has comparatively fewer different types of products but volumes that are several factors larger than the IMCI sector. (TMC (2012c))

[15] Op. Cit. (2012c)

[16] Op. Cit. (2012c)

6.2 Applicant's Arguments for Justification of the Requested Exemptions

6.2.1 Specific features and conditions of the category 9 sector and its products

TMC[17] claims that alternatives for the applications covered by the old exemptions have not been researched for their applicability to IMCI applications. If this process starts now, the TMC members need significant time before being able to confirm the suitability of the substitutes. TMC[18] explains that this is related to the specificity of the development of category 9 products:

1. A large percentage of products in category 9 are used to design and build cutting edge technological equipment and are themselves therefore one step more advanced and complex than any product developed or manufactured utilizing these Monitoring and Control instruments. This places extraordinary constraints as regards to reliability, performance and quality, quite unlike consumer equipment.
2. Category 9 producers do not benefit from anything like the efficiencies of scale such as manufacturers of mass-produced parts enjoy due to significantly smaller shipment quantities.
3. As Test & Measurement equipment, instruments need to undergo formal third-party qualification and / or certification. This process is lengthy and bureaucratic and requires additional review upon any material change. This equally applies to other category 9 producers.
4. Test & Measurement equipment have an average life span of 10 years with some products sold with guarantees to operate correctly for as long as 30 years.
5. Test & Measurement equipment, because of its longevity and complexity, goes through less frequent and slower redesign cycles than typical consumer electronics. Normally a full redesign isn't done for a minimum of 3 years, and 7 year redesign intervals are not unusual. Once undertaken, the time required to redesign and fully re-qualify a product can take two to three years. For a more limited enhancement of a product a year is not unusual for redesign and re-qualification. A ground-up development and design of a completely new product can take even longer, on the order of 3 - 5 years.
6. Test & Measurement instruments require highly technical engineers for their design and manufacture Category 9 producers have specialized and finite

[17] TMC (2012b), Answers to Clarification Questions, submitted by Test and Measurement Coalition (TMC) on December 2012, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/General_comments_to_Oeko_s_questions.docx retrieved on 3 August 2012

[18] Ob. cit. TMC (2012b)

*Section 6 is heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

resources available in line with existing business commitments, but would not be able to undertake unplanned rapid redesigns of existing equipment driven by unforeseen exemption withdrawals.

7. Category 9 producers market a huge quantity of different products in their portfolio unlike producers of consumer products in other categories. Agilent, the largest Test and Measurement manufacturer produces several thousand different instruments compared for example to mobile phone producers who have typically only tens of products subject to RoHS but ten times the number of engineers. The transition of Category 9 producers portfolio to become RoHS compliant is limited by the sheer scale and limited human, technical and financial resources available to make the transition, and not due to a lack of effort or willingness.
8. Test and Measurement instrument complexity is significantly greater than that of consumer products. As reflected in part count, several thousands of components are often required in a single instrument. This adds to the burden of developing appropriate materials compliance systems that provide reconcilable proof of compliance. Furthermore, many parts have multiple suppliers to assure production continuity. This multiplies the number of suppliers' declarations associated with exemptions that would need to be recollected following any changes.
9. Test and Measurement producers do not rely on continued availability of material on the market that utilize the exemptions requested. Material that is critical to a product's performance is frequently brought in quantities to cover projected production and support lifetime volumes (life time buy). The costs involved for purchase and management of this inventory can be economically justified against the cost and effort of product redesign and requalification. Redeploying resources to perform product design and requalification has a portfolio impact as planned new product introductions would be delayed; a material impact on customer satisfaction, market expectations and business performance.

TMC[19] sums up that, based on the received assurance that its category exemptions would remain available as detailed above, the Test and Measurement sector has invested millions of Euros in systems and data to support the development of RoHS compliant products with a view to meeting the intended compliance dates. Many products have already been introduced which have been designed to meet the substance restrictions. The investment in these product developments, the materials compliance systems and supporting component data is all thrown into question if the expected exemptions are changed.

[19] Ob. cit. TMC (2012b)

6.2.2 Lack of impact assessment of the old exemptions for category 9

TMC puts forward that the expiry dates of the old exemptions are applicable only to the old categories for which they were assessed. The old exemptions have not been assessed for category 9. Therefore, the expiry dates decided in 2009 were irrelevant for category 9 producers, as they were not yet in the scope of RoHS and their applications have not been assessed during the revision process. [20]

In parallel with the RoHS recast process, the old RoHS exemptions have been revised. This changed many substance restriction values, scope and expiry dates for many of the exemptions, some of them occurring already this year. The Annex listing the old RoHS exemptions was replaced by the Annex of the Commission Decision of 24 September 2010. Importantly, the new Annex did not specify that these expiry dates only apply to the old RoHS categories 1 to 7 and 10. Consequently, when now reading Art. 5 in combination with Annex III after transferring the Annex of the (RoHS Directive 2003) into Annex III of the (RoHS Directive 2011), there is no clarity about the application of the exemptions to category 8 and 9. It could be interpreted that the Annex exemptions expire for all categories in the timeframes published. [21]

However, TMC[22] claims that this does not reflect the legal scope of the Commission Decision of 24 Sept. 2010. This decision was the outcome of the revision of the exemption for their application only to categories 1 to 7 and 10. When Oeko Institute was preparing the study on the exemptions review, TMC's comments for the need to continue many of the exemptions for category 8 and 9 were noted but not officially included in their recommendations nor in the Commission decision. The justification provided at that time was that category 8 and 9 were not yet in the scope and the revision focused only on the categories that were currently in scope. [23]

Category 9 products have long life time of 10 years on average. Substitutes need to be tested to meet customers' expectations of long term reliability of products capable of consistently meeting published specifications. These requirements go substantially beyond those of consumer goods applications. Any forced change would require significant data collection from the supply chain, product review, redesign and requalification. This effort and cost would be disproportionate to the benefits of short-term substitution for the limited application of these parts in the monitoring and control sector. [24]

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[20] Ob. cit. TMC (2012b)

[21] Ob. cit. TMC (2012b)

[22] Ob. cit. TMC (2012b)

[23] Ob. cit. TMC (2012b)

[24] Ob. cit. TMC (2012b)

*Section 6 is heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

6.2.3 Environmental Arguments

TMC[25, 26] claim that category 9 products serve industrial monitoring applications and are produced in vastly smaller quantities compared to categories already in scope of RoHS. The entirety of Category 9 product volumes in total is representative of less than 0.25% of e-waste, of which industrial test and measurement is a subset. The amounts of lead involved are thus minimum, and the environmental benefit of earlier substitution thus disproportionate to the disadvantages for category 9 manufacturers.

The risks for environment and health are very low and efficiently managed as these products of up to 30 year lifetime are used in industrial or professional applications and collected in B2B schemes. Early forced redesign of the products goes against the objective of efficient use of resources and extended product lifetime (reuse). [27]

6.2.4 Socioeconomic impacts of not granting the exemptions

Due to the specific features and conditions described above, TMC[28] considers the key impact to be socio-economic. Category 9 producers have made the legitimate assumption that old RoHS exemptions will continue to apply for category 9 after its inclusion into the scope of the RoHS Directive. If during the current exemption process, it is not clarified that the old exemptions continue for Category 9, this would mean that all the redesign work has to restart again. This will not only seriously compromise the feasibility of meeting the 2017 deadline but will also penalise the producers who have already invested heavily in RoHS compliance versus those who are about to start conversions. Ultimately this will result in substantial costs and delays to many producers and availability to downstream users, without bringing any benefit to environment and health. [29]

If the exemption is not granted for category 9 monitoring and control equipment, the additional time needed for adaptation and redesign of the sector's portfolios would be considerable. Significant data collection from the supply chain would be required as well as product reviews, redesigns and requalifications of the products. This effort and cost would be disproportionate to the benefits of short-term substitution for the limited application of these parts in the monitoring and control sector. [30]

TMC[31] fears that the unavailability of this substance exemption would cause massive withdrawal of products from the EU market. This would have very serious

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[25] Ob. cit. TMC (2012b)

[26] Op. Cit. (2012c)

[27] Op. Cit. (2012c)

[28] TMC (2011), Original Application Request for Exemption, submitted 09.08.2011, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_17/17_Lead_in_Glass_of_Electronic_Components_2011-08-09.pdf, retrieved 10.09.2013

[29] Op. Cit. (2012c)

[30] Op. cit. TMC (2011)

[31] Op. cit. TMC (2011)

consequences, not only for category 9 producers, but also on client industries which are of key importance for the EU economy and competitiveness such as communication, defence, research & development, aerospace, electronic manufacture, etc.

The effort and costs required to recollect part data, review and redesign products is disproportionate compared to gains that can be obtained in other areas.

TMC[32] provides two key socio-economic impacts in the context of how the loss of expected exemptions (cf. section 6.2.6) is expected to affect the IMCI sector, due to rework of previously completed activities:

1. Compliance - IT Systems for data storage and product-level compliance analysis must be reviewed and potentially reconfigured to account for unexpected exemption withdrawals.
2. Renewal of supplier's declarations for any part relying on an expired exemption where there is no clear mapping or equivalent in the new exemption structure. Products developed and released to the market which were expected to meet the RoHS substance restrictions will have to be re-evaluated after new part compliance data has been obtained.

According to TMC[33], these impacts cannot be resolved simply by adding more engineering effort as this would take away existing resources from planned new product development activities. This effectively penalizes manufacturers who invested resources in developing RoHS compliant products in parallel to the regulations development to bring them into scope.

6.2.5 Qualification Procedures

IMCI need to prove their reliability in certain standards and qualification procedures, which TMC[34] separates into three types:

- Internal qualifications for quality assurance;
- External qualifications based on (para-) legal standards, both national and international ones, that need to be passed; and
- Customer-specific qualifications.

TMC highlights that these qualifications are absolutely essential to guarantee stated performance to specifications. Any uncertainty around it would prevent a manufacturer from marketing a product as the instruments' exactitude is key to the

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[32] TMC (2013b), General Clarifications submitted by the Test and Measurement Coalition (TMC) Concerning Requests 17, 18 and 20, submitted on 21.02.2013, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Clarification_General_Q_A_for_requests_17_18_20_ULM.docx; retrieved on 9 April 2013

[33] Op. cit.TMC (2013b)

[34] Op. cit.TMC (2013b)

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producers' reputation. One mistake could jeopardize the confidence in whole product ranges and can have catastrophic consequences due to the system critical applications that such instruments tend to be used for. [35]

6.2.5.1 Internal Qualification

According to TMC its' members' IMCI are warranted to perform measurements against published specifications. In order to assure these product specifications are correct, the equipment's performance is verified during design and formally calibrated within production to perform measurements that are traceable to National metrology standards. Measurements are related to stated references, either directly to one of the five independent unit measures: [36]

- Temperature interval;
- Linear distance;
- Electrical current;
- Frequency; and
- Mass.

Alternatively, units derived from the above units are measured, such as the electrical resistance Ohm.

TMC[37] says that not all published specifications are required to be measured and calibrated during production. Type testing to verify product design changes are necessary to revalidate the product design so it continues to meet published specifications. Recreating the test systems and associated test conditions, such as performing measurements over the specified operating temperature range, is a complex project. Measurements are performed within ISO 9001 or ISO 17025 management system requirements. TMC[38] references "Metrology In Short"[39] published by the National Physical Laboratory in the UK as a source from which to obtain additional information regarding metrological information, particularly in relation to measurement standards.

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[35] Op. cit.TMC (2013b)

[36] Op. cit.TMC (2013b)

[37] Op. cit.TMC (2013b)

[38] Op. cit.TMC (2013b)

[39] The National Physical Laboratory in the UK published "Metrology In Short 3rd Edition" which was "commissioned by the iMERA "Implementing Metrology in the European Research Area" project, contract number 16220, under the 6th Framework Programme and jointly financed by the European Commission and the participating institutes." Source referenced by TMC (2013c)

6.2.5.2 Technical Standards and Specifications

TMC[40] reminds that everyday people take for granted that products will connect together and operate as intended: mobile phones placing calls; BluRay players connecting to TVs through HDMI ports; Wi-Fi connectivity; etc. The reason these work so seamlessly is that all are based on International standards or industry specifications. IMCI allow their customers to develop and manufacture products compliant with these standards, measuring their product performance against the standard or specification. Each piece of IMCI equipment needs to assure it continues to meet any specified technical standard or specification when any change is introduced. There are thousands of such standards or specification, from multiple national and international bodies. A selection of such bodies provided by TMC is presented below: [41]

- CISPR
- 3GPP2 -TIA: http://www.3gpp2.org/
- Bluetooth SIG - Special Interest Group http://www.bluetooth.com/bluetooth/
- CCSA - China Communications Standards Association http://www.ccsa.org.cn
- CTIA - Cellular Telecommunications Industry Association http://www.ctia.org/
- ETSI - European Telecommunications Standards Institute http://www.etsi.org/WebSite/homepage.aspx
- IEEE
- IEC
- INCITS, InterNational Committee for Information Technology Standards
- JEDEC - Joint Electron Device Engineering Council

According to TMC[42], some kind of assessment needs to be made of the longevity of the new components as the specifications are guaranteed over long periods of use of the instrument in very variable conditions. Speeded aging, whilst efficient, takes time when it has to be done, and can never be rushed further than a compression factor of around 7. This is in itself a critical impediment to assuring full transition of thousands of different products.

6.2.5.3 External Standards

TMC[43] says that the most commonly known external standards are the old Weights & Measures[44] type of qualifications that have been in existence since medieval times.

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[40] Op. cit.TMC (2013b)

[41] Op. cit.TMC (2013b)

[42] Op. cit.TMC (2013b)

[43] TMC (2012d), New Information submitted by the Test and Measurement Coalition (TMC) for Stakeholder Consultation on 20.12.2012, available under:

In practice these are only a small part of what concerns IMCI makers today but the concept behind many of these qualifications is the same. IMCI must also adhere to safety and environmental standards. From a safety perspective IEC 61010 is one of the most notable, which leads to necessary certifications such as CE, UL, CSA, TUV, FM, Ex, FCC (and many other by country for products with wireless capability), C-Tick, and more[45]. Other typical standards would be 4G, GSM or IEEE issued ones where again because of the system critical nature of the IMCI **certainty** around meeting the standard is essential – not a best guess or '*it seems to be working' approach*. The IMCI manufacturers produce for a global market and must ensure that all national and international standards are met. IMCI manufacturers will often even go beyond the standards particularly regarding electromagnetic compatibility (EMC) properties.

TMC[46] concludes that it would be the subject of a dissertation to list all possible standards for all possible types of equipment, which is exactly the reason that it takes so long to transform to compliance outside of the normal 7-8 years redesign cycle that manufacturers have.

6.2.5.4 Customer Standards

TMC[47] claims that many IMCI are designed to meet military and commercial contractual standards or derivatives by country. Customer requirements; particularly those in the aerospace and the defence industry, involve assessments of specific products in order for them to be approved for purchase. These evaluations are customer or even deal specific, and impose restrictions on continued supply of the product *as evaluated* and obligations for design change notification. Change notifications can trigger the need for some or all of the assessments to be repeated, or simply to have the product approval dropped. Specific details of such assessments cannot be shared for confidentiality reasons but it is very normal for a manufacturer to have an obligation to notify any equipment change to the buyer. The latter will then have a contractual right to demand a retest and qualification and they are likely to do so in any situation where a large number of components are changed. That is one of the key problems with the ceramic capacitors that appear from low hundreds to sometimes thousands of times in a piece of equipment and whose substitution tends to trigger a customer driven retest and requalification.

TMC[48] puts forward that these requirements are in addition to the broadly understood need to comply with the EU's EMC[49] and Low Voltage[50] Directive, typically through

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http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_17a/TMC_submission_17_a_-_final.pdf; last accessed 9 April 2013

[44] In Germany this would be the Physikalisch-Technische Bundesanstalt (PTB) *www.ptb.de*; source as referenced by TMC (2013b)

[45] For some additional details this link is useful: ftp://ftp.ni.com/pub/devzone/EEpart1.pdf; source as referenced by TMC (2013b)

[46] Op. cit.TMC (2013b)

[47] Op. cit.TMC (2013b)

[48] Op. cit.TMC (2013b)

application of relevant Harmonized Standards[51,52]. Testing can either be performed in-house by a manufacturer or through an external third-party. Engagement with a third-party safety certification agency such as UL or CSA is normal practice.

6.2.6 Applicant's Arguments beyond the Consultants' Mandate

TMC on several occasions, e.g. in TMC[53], puts forward that it had assumed that already expired exemptions, or exemptions that will expire prior to 2017, when IMCI comes into the scope of the RoHS Directive, will remain available for category 9 equipment. TMC[54] claims "[...] the presumption that old exemptions will continue to apply and it was accepted as such by the Commission." According to TMC[55], "The ERA study [i.e. Goodman 2006; the reviewers] also stressed that "old" RoHS exemptions are critical for the timely transition of category 9 industrial products by the 2017 inclusion date. (References to existing exemptions used in categories 8&9 are on pages 6, 55, 56, 197, 199, 224, 241 & 243)."

The consultants wish to clarify the following:

- Any arguments based on TMC's interpretations and perceptions of the RoHS recast process or of the RoHS Directive itself with respect to the continued availability of "old" exemptions cannot be taken into account in this review process. Evaluating the political process leading to RoHS 2, as well as the applicant's interpretations of this process and the RoHS 2 Directive is beyond the consultants' mandate.
- The fact that the Commission accepts an exemption request for review neither means approval nor disapproval of the arguments the applicant puts forward to justify its exemption request.
- Contrary to the applicant's claim, the ERA-report of (Goodman 2006) does not mention that exemptions in the former Annex of RoHS 1, now Annex III of RoHS 2, would remain available for category 9 equipment in the status available to other categories before July 2011. Such an important pre-condition for the recommended time lines concerning the inclusion of IMCI into the scope of the RoHS Directive would have to be clearly stated in the ERA report. There is no such clause, however. Paul Goodman, the author of the

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[49] EMC Directive (EMCD) 2004/108/EC; sources as referenced by TMC (2012c)

[50] Low Voltage Directive (LVD) 2006/95/EC; sources as referenced by TMC (2012c)

[51] EMCD standards; sources as referenced by TMC (2012c)

[52] LVD standards; sources as referenced by TMC (2012c)

[53] TMC (2012b), Answers to Clarification Questions, submitted by Test and Measurement Coalition (TMC) on December 2012, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/General_comments_to_Oeko_s_questions.docx retrieved on 3 August 2012

[54] Op. cit. TMC (2012b)

[55] Op. cit. TMC (2012b)

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ERA-report, confirmed that the report was not prepared assuming the continued availability of the exemptions in Annex III for equipment of category 9.

The consultants cannot take into account the applicant's arguments based on any of the above issues for the evaluation of exemption requests 17a and 18a.

6.3 Stakeholders' Contributions Concerning Exemption Requests 17a and 18a

The Environmental Protection Agency of the Danish Ministry of the Environment (DMU) and the Japan Electronics Industry Business Council (JBCE) contributed to the stakeholder consultation.

6.3.1 Danish Ministry of Environment

Table 6-1 shows the contributions from DMU, together with the consultants' appraisal.

Table 6-1: Danish Ministry of the Environment (DMU) Consultation Contribution

DMU Contribution	Consultants' Appraisal
DMU[56] finds the requests somewhat confusing. It says that the requests on exemptions all address applications where alternatives have been developed for category 1,2,3,4,5,6,7 and 10. Thus, it is expected that alternatives are available or could relatively easily be developed also for category 8 and 9. To support this view no request for exemption on these applications has been made for category 8.	The consultants share this point of view. During the review, the consultants therefore focused on TMC's technical arguments to evaluate whether the requests are actually justified based on scientific and technical impracticability or the lack of reliability of the substitutes.
DMU[57] elaborates that the main reason put forward for the exemption seems to be not that there are no replacements available, but that the industry has assumed that there would be an exemption and has thus developed products in line with this assumption, and so changing to a new technology would be very costly at this point. DMU (2013) doubts that this is a valid argument. Anyway, the applicant should estimate the cost for replacement and it does not seem that they have done this.	As explained in section 6.2.6 above, the consultants will not take into account TMC's assumptions about the result of the RoHS recast concerning the continued availability of exemptions in the status before 2011. These arguments are beyond the mandate of this technical revision process.
DMC[58] wonders why TMC first applied for the whole category 9, then narrowed down its exemption	This was confusing for the consultants as well, and it took additional time to clarify what kind of category 9

[56] DMU (2013), Danish Ministry of the Environment: Environmental Protection Agency, Contribution to Stakeholders Consultation, submitted on 15.02.2013, available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/20130215_Contribution_to_RoHS_Ex_Re__17a_18a_20a_Danish_Ministry_of_Environment.pdf; retrieved on 19 May 2013

[57] Op. cit. DMU (2013)

[58] Op. cit. DMU (2013)

DMU Contribution	Consultants' Appraisal
request to only the industrial monitoring and control instruments (IMCI) in category 9 without explanation.	equipment actually is in the scope of TMC's exemption requests. It was learned that the exemption is only needed for IMCI, and it was therefore not further investigated why the exemption had first been requested for all equipment falling under category 9.
The applicant argues that it is a waste of money to qualify which type of equipment need an exemption, which in DMU's[59] understanding indicates that TMC does not know for sure, to what extent and, in worst case, if the exemptions are needed.	Low-voltage ceramic capacitors (LVCC, request 17a) are used in almost all equipment, and a restriction to specific devices therefore does not make sense. The use of compliant pin connector systems (CoPiCS, request 18a) is not as common as the LVCC. Due to time constraints it was, however, not possible to create a list of devices that use CoPiCS, which is, however, not relevant. It would not make sense for producers to use CoPiCS in IMCI which before had not used them in order to benefit from the exemption. The broader scope of exemption 18a therefore will not result in a broader use of CoPiCS.
DMU[60] is concerned because TMC further argues that the product development cycle takes seven to ten years, and that TMC would need until 2024 (11 years from now) to adjust. DMU[61] states that, according to Article 5, exemptions can only be granted for a period of up to seven years. Thus, according to the RoHS Directive it is not possible to grant an exemption that would run to 2024. The maximum exemption that can be granted in 2013 would run to 2020.	According to the Commission's interpretation of Art. 5(2), the validity periods of exemptions granted for equipment of cat. 8 and 9 under the regime of the new RoHS Directive start at the earliest from the time when the substance restrictions of Art. 4 start applying to such equipment. According to Art. 4(3), for industrial monitoring and control instruments the expiry date of all exemptions granted before July 2017 can thus be as late as July 2024.
Finally, DMU[62] puts forward, the producers of category 9 industrial equipment are already granted a transition period of six years from 2011 to 2017. DMU[63] thus finds it much too premature to support new exemptions for category 9. DMU[64] suggests that the Commission rejects the requests and recommends TMC to quantify and resubmit their applications in 2016.	The RoHS Directive stipulates that "It should be possible, from the date of entry into force of this Directive, to apply for exemptions for equipment, even before the actual inclusion of that equipment in the scope of this Directive."[65] Given the specific features of the industrial monitoring and control instruments branch and the complexity of the devices, it is understandable that manufacturers need long-time security about the legal situation, and it is also clear that considerable time and effort are required to achieve RoHS compliance. Nevertheless, the consultants agree that TMC must explain why six remaining years are not sufficient to cope with this task. In the review, TMC's timing of works and commitment of labour force was therefore critically reviewed and discussed in detail.

[59] Op. cit. DMU (2013)

[60] Op. cit. DMU (2013)

[61] Op. cit. DMU (2013)

[62] Op. cit. DMU (2013)

[63] Op. cit. DMU (2013)

[64] Op. cit. DMU (2013)

[65] RoHS Directive memorandum (18)

*Section 6 is heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

6.3.2 Japan Electronics & Information Technology Industries Association et al.

The contributions from JBCE are shown in Table 6-2, together with the consultants' appraisal.

Table 6-2: Japan Electronics Industry Business Council (JBCE) Consultation Contribution

JBCE Contribution	Consultants' Appraisal
As exemption requests 17a and 18a refer to exemptions that are already listed in RoHS Annex III, JEITA et al. [66] is afraid it will be burdensome referring both to Annex III and Annex IV in case the exemptions will be granted and listed in RoHS Annex IV. JEITA et al.[67] are also afraid the overlap in scope and expiration of the exemptions may cause inconsistency or conflicts in the interpretation and enforcement of the legislation. JEITA et al. [68] recommend that exemptions which have already expired but which are necessary to be continued for category 9 should be assessed and, if needed, Annex III should be revised. For instance, exemptions 7(c)-III, 11(a) and 11(b) of Annex III have already expired for categories 1 to 7 and 10. If these exemptions are acknowledged to be applied to category 9, expiry dates for the category 9 should be newly set out in exemptions 7(c)-III, 11(a) and 11(b) in Annex III. JEITA et al. [69] justify their recommendation that, if the exemptions are granted and added to Annex IV, the applications for which the statement in RoHS Article 5(1)(b)[70] of RoHS is applicable could be acknowledged to be exempted again. JEITA et al. [71] propose the related existing exemptions in Annex III to be reviewed in 2016. JEITA et al. (2013) expect that the recommendation resulting from the assessment in this current consultation for the exemption requests should not affect the revision of the related existing exemptions to be subject for the updating process.	JEITA's comments are not of technical nature, but touch upon the system and architecture of the RoHS Directive, which are not in the consultants' competence. JEITA's arguments were therefore brought to the Commission's attention, and it was clarified that should the exemptions be granted, they will be adopted to Annex IV.

[66] JETIA et. al. (2013), JEITA (Japan Electronics & Information Technology Industries Association), CIAJ (Communications and Information Network Association of Japan), JBMIA (Japan Business Machine and Information System Industries Association), JEMA (Japan Electrical Manufacturers' Association), Contribution to Stakeholders Consultation, submitted on 15.02.2013, available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/20120215_Contribution_RoHS_Ex_Re_17a_18a_20a_JEITA_CIAJ_JEMA_JBMIA.pdf; retrieved on 19 May 2013

[67] Op. Cit. JEITA et. al. (2013)

[68] Op. Cit. JEITA et. al. (2013)

[69] Op. Cit. JEITA et. al. (2013)

[70] "deletion of materials and components of EEE from the lists in Annexes III and IV where the conditions set out in point (a) are no longer fulfilled." (Source as referenced in JEITA et al. (2013))

[71] Op. Cit. JEITA et. al. (2013)

6.4 References

DMU 2013 — Danish Ministry of the Environment: Environmental Protection Agency, Contribution to Stakeholders Consultation, submitted on 15.02.2013, available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/20130215_Contribution_to_RoHS_Ex_Re__17a_18a_20a_Danish_Ministry_of_Environment.pdf; retrieved on 19 May 2013

JEITA et al. 2013 — JEITA et. al. (2013), JEITA (Japan Electronics & Information Technology Industries Association), CIAJ (Communications and Information Network Association of Japan), JBMIA (Japan Business Machine and Information System Industries Association), JEMA (Japan Electrical Manufacturers' Association), Contribution to Stakeholders Consultation, submitted on 15.02.2013, available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/20120215_Contribution_RoHS_Ex_Re_17a_18a_20a_JEITA_CIAJ_JEMA_JBMIA.pdf; retrieved on 19 May 2013

TMC 2011 — TMC (2011), Original Application Request for Exemption, submitted 09.08.2011, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_17/17_Lead_in_Glass_of_Electronic_Components_2011-08-09.pdf, retrieved 10.09.2013

TMC 2013b — TMC (2013b), Specific Clarifications submitted by the Test and Measurement Coalition (TMC) Concerning Request 17, submitted on 21.02.2013, available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_17a/Exemption_Request_17_a_ULM.docx; retrieved on 9 April 2013

TMC 2013c — TMC (2013c), General Clarifications submitted by the Test and Measurement Coalition (TMC) Concerning Requests 17, 18 and 20, submitted on 21.02.2013, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Clarification_General_Q_A_for_requests_17_18_20_ULM.docx; retrieved on 9 April 2013

TMC 2012 b — TMC (2012b), Answers to Clarification Questions, submitted by Test and Measurement Coalition (TMC) on December 2012, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/General_comments_to_Oeko_s_questions.docx retrieved on 3 August 2012

TMC 2012 c — TMC (2012c), Test and Measurement Coalition (TMC) contribution concerning requests 1, 12, 13, 14, 15, 16, 17, 18, and 20, submitted 19.03.2012, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_1/TMC_contribution_request_1_12_13_14_15_16_17_18_20_submitted_19032012.pdf retrieved on 3 August 2012

TMC 2012d — TMC (2012d), New Information submitted by the Test and Measurement Coalition (TMC) for Stakeholder Consultation on 20.12.2012, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_17a/TMC_submission_17_a_-_final.pdf; last accessed 9 April 2013

*Section 6 is heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

7.0 Exemption Request 17a "Lead in glass of electronic components and fluorescent tubes, or in electronic ceramic parts in industrial monitoring & control instruments"

Abbreviations

EEE	Electrical and electronic equipment.
IMCI	Industrial monitoring and control instruments (cat.9).
LVCC	Low voltage ceramic capacitors (rated voltage of less than 125 V AC or < 250 V DC).
RoHS 1	Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
RoHS 2	Directive 2011/65/EC of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment; if not otherwise indicated in the text, the terms "RoHS" and "RoHS Directive" refer to RoHS 2.
TMC	Test and Measurement Coalition.

7.1 Description of Requested Exemption

Sections 7.1 and 7.2 are heavily based on information provided by the applicant and other stakeholders and do not necessarily reflect the views of the consultants.

The Test and Measurement Coalition (TMC) has applied for an exemption for

"Lead in glass of electronic components and fluorescent tubes, or in electronic ceramic parts (including dielectric ceramic capacitors) used in industrial monitoring & control instruments (only sub-category 9 industrial)."

TMC requests the exemption to expire in 2024.

During the review, TMC restricted its exemption request to lead-free ceramic capacitors maintaining the expiry of the exemption in 2024:

Lead in dielectric ceramic in capacitors for a rated voltage of less than 125 V AC or 250 V DC for industrial monitoring and control instruments in cat. 9

7.1.1 History of the Exemption

The exemption as requested by TMC is merged from exemptions 5 and 7(c) in the Annex of the RoHS Directive 2002/95/EC (RoHS 1) before the amendment in 2010 (cf. Table 7-1) and after the amendment in 2010 (cf. Table 7-2).

Table 7-1: Exemptions 5 and 7(c) in the Annex of the RoHS 1 prior to its 2010 amendment

Exemption		Scope and date of applicability
5	Lead in glass of cathode ray tubes, electronic components and fluorescent tubes	
7(c)	Lead in electronic ceramic parts (e.g. piezoelectronic devices)	

Gensch et al.[72] had recommended a rewording and restructuring of the above exemptions 5 and 7(c) in the 2008/2009 review of the exemptions. The Commission adopted the recommendation. The exemptions were transferred to Annex III of the RoHS 2 Directive[73] as illustrated in Table 7-2.

Table 7-2: Exemptions 5(a), 5(b) and 7(c) in Annex III of the RoHS Directive (2011)

Exemption		Scope and date of applicability
5(a)	Lead in glass of cathode ray tubes	
5(b)	Lead in glass of fluorescent tubes not exceeding 0.2% by weight	
7(c)-I	Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix compound	
7(c)-II	Lead in dielectric ceramic in capacitors for a rated voltage of 125 V AC or 250 V DC or higher	
7(c)-III	Lead in dielectric ceramic in capacitors for a rated voltage of less than 125 V AC or 250 V DC	Expires on 1 Jan 2013 and after that date may be used in spare parts for EEE placed on the market before 1 Jan 2013

TMC[74] had submitted a first exemption request (exemption request 17)[75] with the same wording as the current one, which aimed at reinstating the exemption in its

[72] Gensch et al. (2009), Gensch, C.; Zangl, S.; Groß, R.; Weber, A. K.; Deubzer, O.; Adaptation to scientific and technical progress under Directive 2002/95/EC; Final Report, Öko-Institut e.V. and Fraunhofer IZM, February 2009; http://ec.europa.eu/environment/waste/weee/pdf/report_2009.pdf

[73] Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast); http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32011L0065:EN:NOT

[74] TMC (2011a), Test and Measurement Coalition (TMC), original exemption request document concerning exemption request 17; available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_17/17_Lead_in_Glass_of_Electronic_Components_2011-08-09.pdf, retrieved on 8 April 2013

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

status before 2010 covering, according to TMC[76], not only industrial monitoring and control instruments but all equipment that falls under category 9, and a validity period until 2021.

In the subsequent review process following the online stakeholder consultation, it was not possible to arrive at a conclusion that this exemption would actually be justified according to RoHS Art. 5(1)(a). TMC submitted new information (the above exemption request 17a)[77], which made it necessary to start a new online stakeholder consultation. This time, TMC[78] restricted the scope of the requested exemption to industrial monitoring and control instruments (IMCI) in category 9 and requested the exemption to remain valid until 2024.

Actually, the current Annex III exemptions listed in the above table cover the same uses of lead as the exemption wording TMC proposes, with two differences:

- The lead content in fluorescent tubes is limited to 0.2% of weight in Annex III, while TMC requests the exemption without such a limitation;
- Exemption 7(c)-I of Annex III for low voltage ceramic capacitors expired on 1 January 2013 in Annex III, while TMC asks the continuation of this exemption until 2024 for industrial monitoring and control instruments.

7.1.2 Technical Background

A detailed technical description for the ceramic capacitors and of the "old" and the new exemptions 5 and 7(c)-I to 7(c)-III can be found in Gensch et al.[79].

TMC[80] puts forward typical examples of components using these materials:

- Surface-mount resistors;
- Conformal coatings of semi-conductor dies;
- Glass-bodied diodes; and
- LCD frit seals and transformers.

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[75] See online stakeholder consultation for exemption request 17: http://rohs.exemptions.oeko.info/index.php?id=123

[76] TMC (2011b), Test and Measurement Coalition (TMC) Answers to Questionnaire 1 concerning Exe-17, submitted during the first online stakeholder consultation; available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_17/Questionnaire-1_Exe-17_TMC.pdf; retrieved on 9 April 2013

[77] See online stakeholder consultation for exemption request 17a: http://rohs.exemptions.oeko.info/index.php?id=176

[78] TMC (2012d), New Information submitted by the Test and Measurement Coalition (TMC) for Stakeholder Consultation on 20.12.2012, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_17a/TMC_submission_17_a_-_final.pdf; last accessed 9 April 2013

[79] Op. cit. Gensch et al. (2009)

[80] Op. Cit. TMC (2011a)

According to TMC[81], its members identified examples of lead-glass or lead-ceramic containing components which are used in category 9 equipment:

- Atomic Force Microscope (AFM);
- Gas Chromatograph Capillary Tube;
- Glass Bodied Diodes (Schottky, switching, Zener, PIN);
- Glass Capacitors;
- Hermetic Seals on RF Modules;
- Hollow Cathode Lamps;
- Hybrid Circuit Encapsulation Material;
- Integrated Circuit Die Passivation;
- Micro-channel Plate Electron multipliers;
- pH electrodes;
- Photo-diodes;
- Photomultiplier tubes;
- Photo-transistors;
- Potentiometers;
- Specialty thick film resistors;
- UV-EPROMS.

7.1.3 Amount of Lead Used under the Requested Exemption

TMC[82] indicates the amount of lead for an average capacitor with 0. 017 mg. According to TMC[83], each product contains on average 100 capacitors, although this will vary depending on the amount of parts of the product in question (usually between 5,000 to 30,000 components). TMC[84] estimates a maximum of 240,000 IMCI with such capacitors being sold in the EU every year, representing 23% of global sales. This means that at most 400 grams of lead would be on the market annually through the maintenance of the exemption.

[81] Op. Cit. TMC (2011a)

[82] TMC (2013c), Test and Measurement Coalition (TMC) document "Questionnaire-2_Exe-17a_TMC-response.docx", received by the consultants on 18 April 2013

[83] Op. cit. TMC (2012a)

[84] Op. cit. TMC (2012a)

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

7.2 Stakeholders' Justification for Exemption

7.2.1 Substitution and Elimination of Lead

TMC[85] acknowledges that lead-free alternatives are offered on the market, but claims that their reliability is not assured for industrial monitoring and control instruments, and puts forward that this would be a recognized ground for granting an exemption according to the ROHS recast.

7.2.2 Reliability of Substitutes

TMC[86] highlights the need to test lead free dielectric ceramic capacitors due to the absence of 'drop-in' possibilities within the IMCI sector:

1) Test beyond manufacturers' specifications: Although the manufacturer specifications for a ROHS compliant part may be identical, in fact the IMCI manufacturers test beyond the specifications of the manufacturer. An identical supplier specification is therefore meaningless as the component would have been chosen on the basis of different specs that the IMCI manufacturer established after testing.
2) Manufacturers rarely, if ever, test capacitors at over 100 khz range – so that IMCI manufacturers whose equipment operates at > 1 GHz up to 1 THz are obliged to test the operational state of the capacitor at those frequencies themselves.
3) It has been shown that different temperature, humidity and pressure affect all of the background characteristics of the capacitors and these need to be assessed and normalized so that the signal testing is completely pure. One of the TMC manufacturers is even running a test for more than a year to study the effect on all the parameters of humidity and heat on the component. The oxidation – as minor as that can be – will affect some of the resistance and inductive properties and thereby affect the functioning of the equipment.
4) The capacitors also can have unexpected properties directly tied to their material composition, that cause unacceptable system deviation from specifications in a IMCI piece of equipment:
    a. Parasitic signals will be different for ROHS compliant and current non-compliant capacitors. The boards are set up with a series of capacitors, to filter out parasitics, and these need to be adapted for the new ROHS compliant parts.

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[85] Op. cit. TMC (2012d)

[86] TMC (2013f),Test and Measurement Coalition (TMC) document "Additional Clarification on exemption 17.doc", received by the consultants via e-mail on 12 June 2013

b. Microphonics and resonance effects will also be altered when a new composition component is introduced – this means that the board setup possibly needs to be changed to take that into account because the slightest variances are so critical.
c. EMC (electromagnetic compatibility) interference, likewise, will be altered by the simple fact that a component is of a different material – these rarely if ever show stoppers but they need to be identified and ironed out before a compliant machine can be put on the market.
d. Every component has its own internal resistance, induction and other properties that in IMCI actually make a difference where they are trivial for non IMCI equipment;

5) Use of capacitors as more than a simple capacitor - The ubiquity of dielectric capacitors in IMCI equipment is directly related to the fact that they are used to produce clean signals and sharp signal filters in much more sophisticated ways than any other piece of equipment needs to. The capacitors will also function with:
    a. Equivalent series resistance;
    b. Series inductance;
6) Capacitors are used in several cascades to produce specific signals and filtering of signals – this positioning is directly related to even the copper trace distance to the next component as each piece of copper trace will have its own resistance and inductance that needs to be accounted for when producing the signal or filter. Otherwise the equipment would be measuring its own noise level.

TMC[87] claims that the argument that the manufacturer must be able to provide the thousands of specification variations for their component does not work. The reason lays in the fact their specifications are primarily set by the major electronics firms, whose purchases run into the 1,000 billions of components, whereas the whole IMCI sector together will be in the low millions, if that high. This is apart from the fact that manufacturers rely on the IMCI manufacturers to assure the specifications in the first place.

As examples, TMC[88] included pictures of a board, of which there tend to be 5 to 20 in more complex pieces of equipment. TMC[89] claims that even to the naked eye it should be obvious that these are totally different from regular PC or equipment boards, containing a far greater number of capacitors and filtering circuits than any of those.

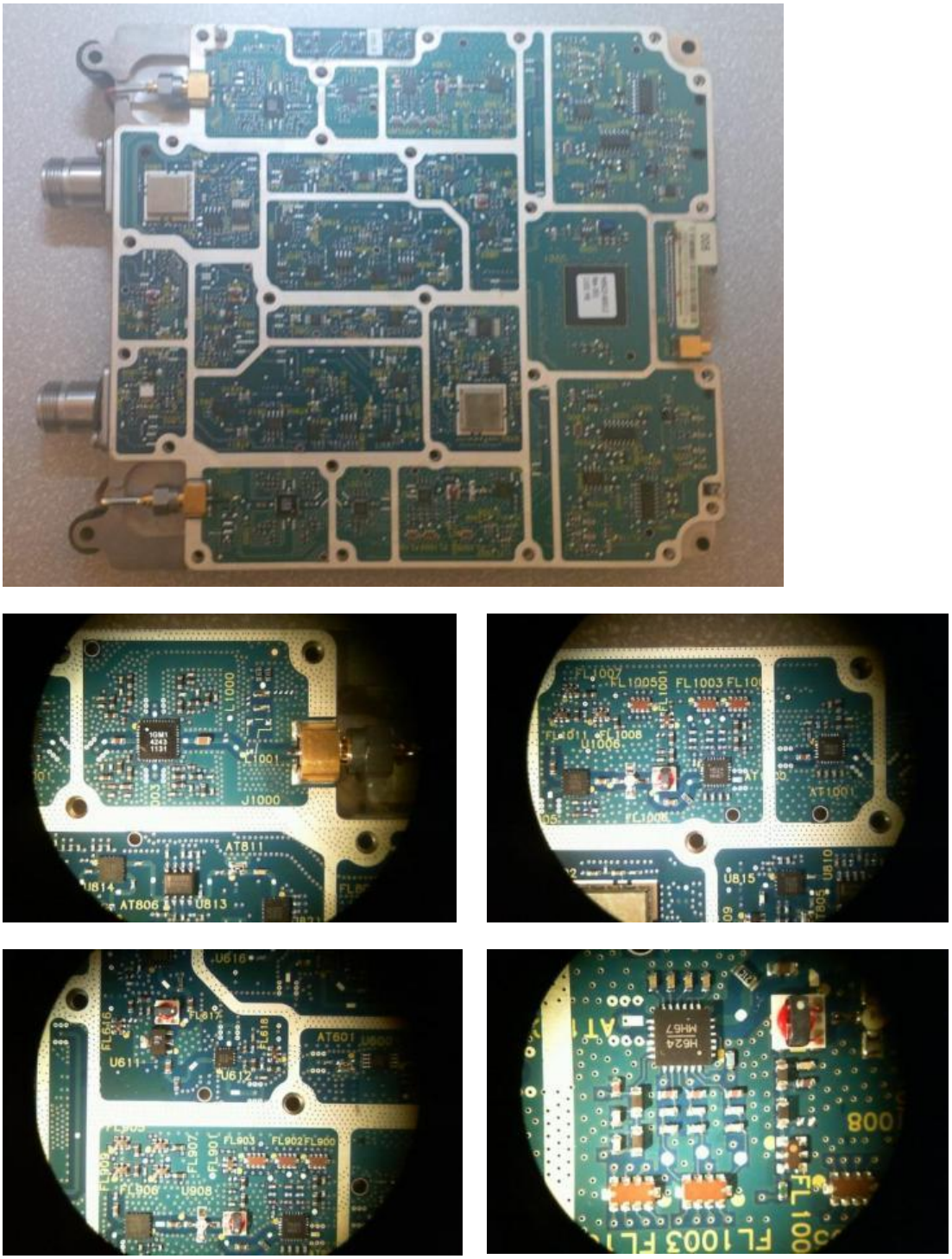
[87] Op. Cit. TMC (2013f)

[88] Op. Cit. TMC (2013f)

[89] Op. Cit. TMC (2013f)

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

Figure 7-1: Printed circuit board with capacitors (little brownish or dashed boxes)



Source: TMC (2013f)

TMC[90] claims that the mere existence of an alternative does not guarantee its functionality let alone allow one to assume it is a reliable one. So though TMC[91] hesitates to claim there are no substitutes neither is it reasonable to claim the opposite namely that these substitutes will be functional in all cases.

TMC[92] explains that from a metrology perspective, calibration is performed "*To establish the reliability of the instrument i.e. that it can be trusted*"[93]. Reliability in this context refers to the consistency of accurate results over consecutive measurements over time. The reliability of substitutes therefore is not ensured and the exemption is required.

7.2.3 Socioeconomic and Environmental Arguments

7.2.3.1 Limited Resources for Premature Redesign

TMC[94] references Agilent as an example, the largest manufacturer produces approximately 27,000 different types of instruments compared for example to Nokia, a well-known consumer goods manufacturer, who has no more than 30[95] different products subject to RoHS but ten times the number of engineers. The seeming slowness in transitioning by IMCI manufacturers is therefore not due to a lack of effort or willingness but simply by the sheer scale and limited human, technical and financial resources available to make the transition.

TMC[96] puts forward that LVCC are used in practically all IMCI, usually in large numbers. TMC's current low end estimate is that 80% (TMC 2011c) of products make use of LVCC.

TMC[97] claims that the total amount of different products[98] at Agilent is 5,000 (compared to around 20,000 in total for all TMC members), from which about 80%,

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[90] TMC (2013b), General Clarifications submitted by the Test and Measurement Coalition (TMC) Concerning Requests 17, 18 and 20, submitted on 21.02.2013, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Clarification_General_Q_A_for_requests_17_18_20_ULM.docx; retrieved on 9 April 2013

[91] Op. cit. TMC (2012d)

[92] Op. cit. TMC (2012d)

[93] "Metrology In Short" 3rd Edition, Page 17, Section 2.1.4 Calibration; source referenced by TMC (2013a)

[94] Op. cit. TMC (2012d)

[95] From Nokia's corporate website: http://investors.nokia.com/phoenix.zhtml?c=107224&p=irol-productPortfolio; source as referenced in TMC (2013a);

[96] TMC (2011c), Test and Measurement Coalition (TMC) document New Information Concerning Request 17", available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_17/Questionnaire-1_Exe-17_TMC.pdf; retrieved on 9 April 2013

[97] Op. cit. TMC (2011c)

[98] Footnote as cited from TMC (2011c): With different products we really mean different products i.e. something with a different function and purpose. This is not the same thing as a variant of the same

corresponding to 4,000 products, are known to contain LVCC. Assuming best, medium and worst case durations for the shift to lead-free LVCC including qualification (cf. Table 7-3), TMC (2012c) presents the following calculation:

- 5% worst case = 200 products @ 36 Months = 7,200 months
- 15% medium case = 600 products @ 18 Months = 10,800 months
- 80% best case = 3,200 products @ 3 months = 9,600 months

The result for Agilent would be 27,600 months for the portfolio of 5,000 products.

According to TMC,[99] Agilent has about 25 sites with 200 FTE (Full time equivalent engineers) who have the skill and knowledge to work on this and who can perform 2,400 working months in a year. According to the estimated work time calculated above it will take 11.5 years to complete the task.

TMC[100] considers the calculation made for Agilent as likely too optimistic as regards the other TMC members as they tend to have fewer engineers available. However in the given time span it wasn't possible to poll the other members in detail however TMC has a high degree of certainty they will not be able to do it faster if only for the simple reason they have even fewer engineers per piece of equipment than Agilent has available and due to smaller companies lower flexibility in diverting resources to address the issue.

7.2.3.2 Time Required for Supply Chain Management

TMC[101] says that IMCI are highly complex products. There can be several thousands of components in a single instrument. This adds to the burden of developing appropriate materials compliance systems that provide reconcilable proof of compliance. Furthermore, many parts have multiple suppliers to assure production. This multiplies the number of suppliers' declarations required.

According to TMC[102], exemption 17a is needed for virtually all equipment. Due to the changed scope of the revised exemption language used in Annex III of RoHS 2, it is not possible to map suppliers' data that has been previously collected for these components into the new exemption structure without the inclusion of the above exemption [103] in Annex IV. As a consequence, omission of this exemption would

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product: say a portable version of a test product but that is otherwise identical to a stationary version or a new upgraded product with extra features than another. We underline that quite unlike any other electronics manufacturing business test and measurement companies carry a vast array of dissimilar products with consequently far longer turnaround times than in classic electronics.

[99] Op. cit. TMC (2011c)

[100] Op. cit. TMC (2011c)

[101] Op. Cit. TMC (2012a)

[102] Op. Cit. TMC (2012a)

[103] *Lead in glass of electronic components and fluorescent tubes, or in electronic ceramic parts (including dielectric ceramic capacitors) used in industrial monitoring & control instruments (only sub-category 9 industrial)*

require the recollection of approximately 60% of all part data that utilizes any exemption that has been collected to date.

7.2.3.3 Key Socio-economic and Environmental Impacts

TMC[104] sums up the socio-economic and environmental impacts to the IMCI industry with the loss of expected exemptions due to rework of previously completed activities:

- Compliance IT Systems for data storage and product-level compliance analysis must be reviewed and potentially reconfigured to account for unexpected exemption withdrawals;
- Renewal of suppliers' declarations for any part relying on an expired exemption where there is no clear mapping or equivalent in the new exemption structure;
- Products developed and released to the market which were expected to meet the RoHS substance restrictions will have to be re-evaluated after new part compliance data has been obtained. The continued use of all capacitors that contain lead in dielectric ceramic in IMCI avoids the need to review and redesign products in development or already released to the market, which were expected to meet the RoHS substance restrictions utilizing the original exemptions;
- The effort and costs required to recollect part data, review and redesign products is disproportionate compared to gains that can be obtained in other areas;
- Exemption request 17a is particularly important as it is a foreseeable certainty that products will need to be withdrawn from the market prematurely without it. The amount of work involved would jeopardize the ability of the sector to meet the deadlines set in the directive for the coming into scope of the IMCI. Furthermore it requires the revision of about 25% of the product portfolio that has already been transitioned into RoHS compliance, taking away valuable resources to address the products not already transitioned;
- TMC[105] says that, given the very long lifetimes of IMCI and that they are only a tiny part of the total waste stream, and in turn contain very low amounts of lead (maximum around 400 g per year, cf. section 7.1.3), the environmental benefits that might be obtained are minimal whereas the economic and social negative effects of product withdrawal and the lack of access to IMCI for EU industries would be tremendous.

[104] Op. Cit. TMC (2012a)

[105] Op. Cit. TMC (2012a)

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

7.2.4 Roadmap to Substitution or Elimination of Lead

TMC[106,107] explains that qualification and testing for IMCI (cf. page 34 ff). TMC[108] indicates the times for supply chain assessment and qualification of IMCI as indicated in Table 7-3:

Table 7-3: Time required for achieving RoHS compliance per IMCI

Activity	Min. time (months)	Max. time (months)
Supply chain assessment	1	6
Product redesign	1	24
Product requalification	1	6
Total	3	36

TMC[109] says that each manufacturer is accountable for the metrology specifications of its own products and so, is the "qualifying body". Product requalification can take between one and six months, dependent on product complexity and the impact of the changes being evaluated. As qualification cannot start until near ready production samples are available, this is a challenge given the multitude of instruments that need to be brought into conformity.

For regulatory product certification as part of the requalification procedure, TMC[110] indicates the following time lines per product:

1) EMC – several weeks;
2) Safety evaluation – several weeks;
3) Third-party certifications – weeks to months depending on agency used.

TMC[111] says that the time and labour capacity problem is aggravated in the, hopefully, few cases that a replacement causes some kind of issue requiring a patch or further redesign. This would start the whole cycle over.

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[106] Op. cit. TMC (2012d)

[107] TMC (2013b), General Clarifications submitted by the Test and Measurement Coalition (TMC) Concerning Requests 17, 18 and 20, submitted on 21.02.2013, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Clarification_General_Q_A_for_requests_17_18_20_ULM.docx; retrieved on 9 April 2013

[108] Op. cit. TMC (2013b)

[109] Op. cit. TMC (2013b)

[110] Op. cit. TMC (2013b)

[111] TMC (2012c), Test and Measurement Coalition (TMC) General Answers to Clarification Questions Concerning Requests 17, 18 and 20, submitted during the stakeholder consultation, available under:

7.3 Critical Review

7.3.1 Rescoping and Rewording of the Exemption

TMC's[112] exemption request has a wide scope. In its justification, TMC mainly focuses on the use of low voltage ceramic capacitors (LVCC) and TMC[113] itself proposes that the exemption scope could be narrowed to the LVCC. TMC[114] sees its further needs for exemptions covered by other, still valid, exemptions in Annex III. As a result TMC[115] agreed to reword the proposed exemption to:

> *"Lead in dielectric ceramic in capacitors for a rated voltage of less than 125 V AC or 250 V DC for industrial monitoring and control instruments in cat. 9"*

TMC[116] requests that the validity of the exemption remains until 2024. With this rewording, TMC requests the continuation of the current exemption 7c(III) in RoHS Annex III for IMCI until 2024, which expired on 1 January 2013 for IMCI as well as for all other EEE in the scope of RoHS.

The critical review of exemption request 17a has therefore been limited to the LVCC.

7.3.2 REACH Compliance - Relation to the REACH Regulation

This exemption request concerns lead in the ceramics of low-voltage ceramic capacitors.

Entries 10, 11, and 12 of Annex XIV (for further details see Section 5.0 above) concern lead chromate, lead sulfochromate yellow and lead chromate molybdate sulphate red, respectively. These compounds can only be further used once a request for Authorization has been applied for and granted, concerning the application in which it should be allowed for use. As from the consultants' knowledge, these compounds are not in use as solder alloys, these entries have no further implications for this request.

Entries 16 and 17 in Annex XVII concern lead compounds applied in specific articles which are irrelevant in the context of this request for exemption (for further details Section 5.0 above).

Entry 30 in Annex XVII of the REACH Regulation, stipulates that lead and its compounds shall not be placed on the market, or used, as substances, constituents of other substances, or in mixtures for supply to the general public. A prerequisite to

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http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Clarification_General_Q_A_for_requests_17_18_20_ULM.docx; retrieved on 17 May 2013

[112] OP. cit. TMC (2012a)

[113] OP. cit. TMC (2012a)

[114] Op. cit. TMC (2013c)

[115] Op. cit. TMC (2013c)

[116] Op. cit. TMC (2013c)

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

granting the requested exemption would therefore be to establish whether the intended use of lead in this exemption request might weaken the environmental and health protection afforded by the REACH Regulation.

In the consultants' understanding, the restriction for substances under entry 30 of Annex XVII does not apply to the use of lead in this application. Putting lead in a LVCC used in an IMCI on the market, in the consultants' point of view is not a supply of lead and its compounds as a substance, mixture or constituent of other mixtures to the general public. Lead is part of an article and as such, entry 30 of Annex XVII would not apply. Additionally, IMCI are products that are not provided to the general public, but to other than private users, e.g. hospitals.

No other entries, relevant for the use of lead in the requested exemption, were identified in Annex XIV and Annex XVII (status June 2013).

Various processes that may result in future restrictions of the use of lead are detailed Section 5.0 above. In all these cases, it cannot yet be assumed if the processes shall result in a new restriction or in the addition of lead in certain compounds to the list of substances requiring an authorization. Therefore, at present these processes could not be assumed to have implications for this request for exemption in terms of ensuring the protection afforded by REACH.

Based on the current status of Annexes XIV and XVII of the REACH Regulation, the requested exemption would not weaken the environmental and health protection afforded by the REACH Regulation. An exemption could therefore be granted if other criteria of Art. 5(1)(a) apply.

7.3.3 Elimination and Substitution of Lead

Art. 5(1)(a) justifies an exemption if one or more of the following criteria are met:

1. the elimination or substitution of the restricted substance via design changes or materials and components, which do not require any of the regulated materials or substances is scientifically or technically impracticable;
2. the reliability of substitutes is not ensured; and
3. the total negative environmental, health and consumer safety impacts caused by substitution are likely to outweigh the total environmental, health and consumer safety benefits thereof.

TMC admits that the substitution of lead in low voltage ceramic capacitors (LVCC) is possible, as lead-free LVCC are available. The substitution of lead in LVCC thus is scientifically and environmentally practicable, and an exemption in line with Art. 5(1)(a) could only be justified if one of the other criteria are fulfilled.

TMC did not provide evidence that the total negative environmental, health and consumer safety impacts caused by substitution are likely to outweigh the total environmental, health and consumer safety benefits thereof. Therefore this criteria is also not fulfilled.

TMC claims, however, that the reliability and functionality of LVCC is not ensured for IMCI and hence justifies its exemption requests with Art. 5(1)(a)(2). TMC argues that

the exemption is required as IMCI need to be calibrated. TMC provided a definition stating that "calibration" is performed "*To establish the reliability of the instrument i.e. that it can be trusted*".[117]

The "reliability" in the above calibration definition cannot be the same type of reliability as the one addressed in Art. 5(1)(a)(2), which actually allows an exemption if "the reliability of substitutes is not ensured". For a capacitor, besides its mechanical stability, for example the exactness of the indicated capacity, the stability of this capacitance over time, its reproducibility across temperature and voltage ranges etc. are of importance in the context of reliability. TMC was asked to prove that, compared to their lead-containing counterparts, LVCC have deficiencies in any of the performance criteria that are essential for its proper functioning and for its usability in IMCI in particular. Any such weaknesses on component level may actually justify an exemption as in this case the reliability of the substitute would not be ensured. TMC[118] confirms that end stability of capacitance parameters including those listed above is indeed crucial to the operation of IMCI to meet their published specifications. TMC[119] does, however, not indicate any deficiencies in the reliability of lead-free LVCC but says that its statement on the non-ensured reliability of lead-free LVCC actually refers to the measurement reliability of instruments in terms of accuracy, resolution and repeatability of measurement over time.

Following TMC's argument would mean that all components in each IMCI produced must be considered as unreliable in the sense of Art. 5(1)(a) because each single IMCI produced must be calibrated individually before it is put on the market, regardless whether the IMCI was redesigned, whether it uses lead-free or lead-containing components, and regardless whether the design has been in use for 20 years already or is used for the first time. As a consequence, IMCI would have to be permanently exempted because not only the reliability of substitutes would not be ensured, but the reliability of each individual component used in IMCI would have to be doubted. The reliability addressed in Art. 5(1)(a) therefore cannot be the same as the reliability that has to be proven with the calibration.

TMC further justifies its request, by highlighting that LVCC in IMCI are operated beyond the component manufacturers' specifications, for example at much higher frequencies. According to TMC, this applies to both lead-containing as well as to the lead-free LVCC. TMC did not provide any argument to clarify why lead-free LVCC can be expected to be scientifically or technically impracticable, or why their reliability can be expected to be insufficient under these conditions compared to their lead-containing counterparts. Overall, there is no evidence that the substitution of the lead-containing LVCC with lead-free LVCC is technically or scientifically impracticable, or that the reliability of components themselves would not be ensured.

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[117] "Metrology In Short" 3rd Edition, Page 17, Section 2.1.4 Calibration; source referenced by TMC (2013a)

[118] Op. cit. TMC (2013c)

[119] Op. cit. TMC (2013c)

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

TMC[120] claims that component specifications are primarily set by the major electronics firms whose purchases run into the 1,000 billions of components whereas the whole IMCI sector together will be in the low millions at most. As almost all other manufacturers of EEE, in particular the major electronics firms, use lead-free LVCC due to the RoHS Directive, lead-containing LVCC must be assumed to be disappearing from the market. EPCOS[121] and TDK state that they have already stopped the production of lead-containing LVCC. Some customer-specific types are still produced, but, according to EPCOS,[122] will also be cancelled over time. It must therefore follow that most lead-containing LVCC will disappear from the market, or even that lead-free LVCC will be the only remaining types of LVCC in the market in a few years. Additionally, EPCOS[123] states that all types of LVCC on the market are available as lead-free versions.

In conclusion, lead-free substitutes are available for LVCC in sufficient quality and quantity. The 2008 review by Gensch et al.[124], confirmed that lead free LVCC substitutes were technically and scientifically practicable and reliable and the Commission therefore cancelled the exemption for LVCC from 2013 onwards. Lead-free LVCC have been available on the market for many years, thus allowing for the testing of their properties when applied in specific applications. Thus TMC would have been expected to start with LVCC testing for their products in case TMC had any doubts about their reliability in IMCI, at the latest from July 2011, when the RoHS 2 legal text was officially published.

TMC's argument that the lead-free LVCC may not be drop-in replacements for the lead-containing LVCC can, however, be followed. Therefore, the shift from lead-containing to lead-free LVCC will in many cases require a redesign of the printed circuit boards, which will need sufficient time for both the redesign itself, and for the testing and qualification of the new designs.

7.3.4 Testing and Qualification

7.3.4.1 Need for Testing and Qualification

The "reliability" TMC refers to[125] is part of the calibration and qualification procedures conducted.[126]

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[120] Op. cit. TMC (2013f)

[121] EPCOS (2013), Dr. Gerd Schulz, EPCOS AG/TDK-EPC Corporation, document „EPCOS 2013", submitted via e-mail on 15 April 2013

[122] Op. cit. EPCOS (2013)

[123] Op. cit. EPCOS (2013)

[124] Op. cit. Gensch et. al. (2009)

[125] See section 7.2.1 on page 19

[126] Cf. section "Internal Qualification" on page 10

Once reliable substitutes are available, it has been practice in the review of existing exemptions that manufacturers are granted the time to test and qualify printed wiring boards, modules etc., using the lead-free substitute in the various stages of the supply chain up to the final product according to their standard test and qualification procedures.[127] Even though Art. 5(1)(a) in RoHS 2 lists the reliability of the substitute as a new criterion for exemptions, the reliability of the substitute had been evaluated under RoHS 1 as well, as an unreliable substitute was considered as technically impracticable. There is thus no reason to deviate from the former review practice.

Once scientifically and technically practicable and reliable substitutes are available on the component level in sufficient quantities like in this case, an exemption can no longer be justified. An expiry date has to be set taking into account, however, the time needed for testing and qualifying new electrical and thermo-mechanical designs that have become necessary due to the use of lead-free LVCC in the higher levels of the supply chain above the component level. Manufacturers are responsible for the proper functioning of the product and therefore must make sure the product fulfils all necessary requirements, and IMCI manufacturers may also have to prove this to their customers.

The consultants conclude that technically practicable and reliable substitutes – the lead-free LVCC - are available. The time required for testing and qualifying new designs using lead-free LVCC on the printed wiring boards and at higher levels must, however, be taken into account to enable IMCI manufacturers to follow their customary testing and qualification procedures.

7.3.4.2 Start of RoHS Compliance Efforts

TMC says that that there is not enough time to achieve RoHS compliance by 2017. A main reason is that TMC had assumed the "old" exemptions listed in the Annex of RoHS 1 would remain valid for IMCI under RoHS 2. As explained earlier[128], the consultants will not take into account TMC's interpretations of the RoHS recast process and their expectations and interpretations concerning the new RoHS Directive. It has been clear since July 2011 at the latest, when RoHS 2 was officially published in the Official Journal of the European Union, that IMCI in cat. 9 will have to comply with the substance restrictions in RoHS Art. 4(1) from 2017 on, and that exemption 7c(III) will expire at the end of 2012 for all product categories in the scope of the RoHS Directive, including IMCI.

TMC can be expected to have started its RoHS compliance efforts, with regard to the understandings explained above, once the RoHS legal text came into force in July 2011. Exemption 7c-III expired at the end of 2012. Even though lead-free LVCC were already available in 2009, Gensch et al.[129] had recommended the expiry date at the end of 2012 to make sure lead-free LVCC are available in sufficient variety, quality

[127] For an example see review of exemption 22 on pages 202 ff in Gensch et al. (2009)

[128] Cf. section 6.2.6

[129] Op. cit. Gensch et. al. (2009)

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

and quantity, and to make sure manufacturers have sufficient time to test and qualify lead-free LVCC and new designs using lead-free LVCC above the component level up to the final products. Thus lead-free LVCC are understood to have been available in sufficient quantity and quality at the latest from January 2012 on, one year before the exemption expired, as other EEE, besides IMCI had to be redesigned and re-qualified in order to achieve RoHS compliance until the end of 2012. It thus would have been possible from July 2011 on, to test the basic properties of lead-free LVCC to ensure their reliability on the component level, or otherwise request specific exemptions for cases where no components were available for reliability testing.

TMC claims that the time until 2017 is not sufficient for IMCI manufacturers in the Test and Measurement Coalition, and justifies the additional time required until 2024 with socioeconomic arguments.

7.4 Socio-economic and Environmental Arguments

7.4.1.1 Additional Time Required Due to Limited Resources

TMC justifies the need for additional time until 2024 with the long redesign cycles and the limited resources for redesigning and qualifying IMCI for RoHS compliance. TMC provides details of Agilent's proceeding towards RoHS compliance as an example. According to TMC, Agilent needs 27,600 months for a portfolio of 4,000 products that contain LVCC. As only 200 full time equivalent engineers are available on Agilent's 25 sites, who have the skill and knowledge to work on the aspects of RoHS compliance, TMC calculates the time required for achieving RoHS compliance as 11.5 years.

While results of measurements or technical issues an applicant puts forward to justify an exemption request in principle can be checked and reproduced by parties other than the applicant, manufacturers' internal organization and number of employees qualified for certain tasks are inaccessible to such examination. TMC was therefore asked to substantiate the above figures taking into account the following issues:

- Agilent has 20,500 employees;[130]
- The tasks related to (re-) design and qualification to achieve RoHS-compliance in the consultants' understanding do not all require engineers, and can at least in part be performed by less qualified staff;
- The 11.5 years of time required to transfer Agilent's products containing LVCC to RoHS-compliance in the consultants' understanding is the total time required, which must not correspond to the labour time. Some tasks may, for example, take three months, but may require less than three months of labour. As TMC calculates the total time required based on the availability of

[130] Information from the Agilent webpage: http://www.agilent.de/about/companyinfo/index.html?cmpid=5012; last accessed 19 June 2013

qualified staff, the difference between total time and labour time influences the total time required.

In the following, the consultants quote the applicant's answers without further comments.

Concerning the difference between elapsed time and related working time, TMC[131] explains that:

> *"The duration times take into account availability of resources and facilities (both internal and external to IMCI producers) as well as the sequencing necessary to complete the transition. These must be taken into account as the capacity to develop, produce and qualify such changes is fundamentally limited.*
>
> *Ultimately, it is the elapsed time necessary to achieve products' RoHS compliance that is important to the Exemption request, and the TMC stands by our original estimates. During that time the labour force needs to be focused on the realization of the transition. The estimates are a model that reflects a reasonable average time; it is plausible there will be wide variations from much better – perhaps even instant solutions to some that will prove much more arduous than the estimate. The coalition has over 25,000 products to transition giving a sufficiently large sample to justify the approach we chose. For this reason the estimates are entirely plausible as an average and proxy for the labour time involved. Turning it around – even if we accept a margin of uncertainty of 50% on this, the best case scenario still takes us beyond the coming into scope of the sector. If the contention is that our estimates are more inaccurate than that – we would respectfully ask for some substantiation of why this is the case as they are based on decades of experience of the sector.*
>
> *The calculation made for Agilent is likely too optimistic as regards the other members of the coalition at large seeing as they tend to have fewer engineers available. … we have a high degree of certainty they will not be able to do it faster if only for the simple reason they have even fewer engineers per piece of equipment than Agilent has available and as smaller companies lower flexibility in diverting resources to address the issue".*[132]

TMC[133] further states that:

> "*Breaking down each and every job function as to the engineering content or otherwise has no bearing on the exemption request validity. The term "Engineers" was used for simplicity, as all of the tasks will require some engineering engagement. Clearly non-engineers will be engaged with the*

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[131] TMC (2013d), Test and Measurement Coalition (TMC) document "20130517_Questionnaire-3_Exe-17a_TMC Response Rev final.doc", received by the consultants via e-mail on 22 May 2013

[132] Op. cit. TMC (2013d)

[133] Op. cit. TMC (2013d)

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

process of bringing each product to RoHS compliance but this will never happen in isolation of engineering supervision and control."[134]

TMC[135] continues that:

"*Agilent clearly employs many other engineers, who have defined roles within each business. It is an extremely simplistic assumption that they can somehow be redeployed to reduce the timeframe of the estimates provided. It must also be taken into account that resources extend beyond simply headcount and are equally finite. Capacity both within and external to the industry must be considered when developing estimates of duration. All of this has the effect that great periods of time engineers must manage a large number of projects to assure safe transition, one cannot ramp up and simply say that as possibly some projects could run concurrently as they may have different outcomes at different points in time this will allow them to manage more in less total time. In reality that is a recipe for chaos as inevitably at some times all kinds of critical deadlines will fall at the same moment and the engineer would be incapable of managing them all at the same time. Regardless of whether a piece of equipment is undergoing a managed test cycle of a day, week, month or more in which more modest day to day supervision is necessary, the reality is the engineer cannot start a multitude of other projects simultaneously in that time frame. As much as we would desire the transition process to RoHS compliance to be trivial, painful experience has shown us it is not.*" [136]

TMC[137] puts the number of 200 persons (engineers and non-engineers) allocated to work on RoHS compliance into perspective of the 20,500 employees. "*Breaking down the number of Agilent employees by business group[138] also illustrates the marked reduction of staff collectively employed across all business functions:*

- Life Science: 4,000 employees
- Chemical Analysis: 4,000 employees
- Diagnostics and Genomics: 2,000 employees
- Electronic Measurement: 8,000 employees
- Global Infrastructure 2,750 employees
- Agilent Labs 250 employees

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[134] Op. cit. TMC (2013d)

[135] TMC (2013e),Test and Measurement Coalition (TMC) document "Questionnaire-4_Exe-17a_TMC Responses 4 June 13.docx"; received by the consultants via e-mail on 5 June 2013

[136] Op. cit. TMC (2013e)

[137] Op. cit. TMC (2013e)

[138] Agilent Technologies 2012 Annual Report, http://thomson.mobular.net/thomson/7/2494/4718/document_0/Agilent%20Annual%20Report%20(2012)%20-%20Final.pdf; source referenced in TMC (2013f)

The total number of employees in each business group is sized to deliver the New Product Introductions customers and the market expect for our businesses in addition to managing mature products and supporting customer needs. Each business could be further stratified to include: R&D; Marketing; NPI and Quality Engineering; Order fulfilment (including manufacturing and operations, supply chain management and Engineering); Sales; and Service (including periodic calibration.) However, this would require that confidential business secrets are divulged that bluntly have no direct relevance to the Exemption application. It should be understood that Research Laboratories; and Global Infrastructure, (including finance, legal, workplace services, human resources and information technology) are not engaged with product realization.

All employees engaged with the development, qualification, introduction, manufacture and support of the EEE products all play their role in the development and continued compliance of RoHS-compliant product through standard operating practices.

What is material to the Exemption requests is that the 200 employees worldwide quoted are incrementally available to retrospectively engage in the re-design, re-qualification and re-introduction of products that had been previously designed to be compliant with the substance restrictions on the understanding that the exemption requests would have been swiftly resolved. We also underline that 200 engineers represents 1% of the workforce which we would need to deploy to address just these specific exemption requests. The TMC sector is transitioning many dozens more technologies into ROHS compliance which was the basis of why we were out of scope in the first iteration of the directive. This exemption request is not made in a vacuum of other transition demands we would contend that assigning 1% of workforce is an extreme commitment [...]."

The consultants cannot evaluate whether the allocation of 1% of workforce represents the maximum commitment possible. It should be noted that in its earlier exemption request, TMC (2011a) requested the exemption until 2021 "aligned with typical product lifecycles and the first review of Exemptions for Category 9".[139]

This exemption had been requested for all monitoring and control instruments of cat. 9, even though TMC members almost exclusively produce IMCI. In the reformulation, the scope was limited to IMCI and the exemption was requested until 2024. No further explanation was provided as to why a longer period was requested to achieve RoHS compliance for IMCI

7.4.1.2 Environmental Arguments

TMC[140] says that, given the very long lifetimes of IMCI and that they are only a tiny part of the total waste stream, and in turn contain very low amounts of lead

[139] Op. cit. (2011a)

[140] Op. cit. TMC (2012a)

(maximum around 400 g per year, c.f. section 7.1.3), the environmental benefits that might be obtained are minimal whereas the economic and social negative effects of product withdrawal and the lack of access to IMCI for EU industries would be tremendous.

The RoHS Directive does not quantify a minimum amount of lead that would justify an exemption. There is no such stipulation in Art. 5(1)(a). TMC did not quantify the environmental and socioeconomic impacts. It is thus not clear whether the adverse impacts of substitution actually outweigh the benefits thereof. In the end, there is thus no proof as to the relation between the total negative environmental, health and consumer safety impacts caused by substitution and the total environmental, health and consumer safety benefits thereof.

Furthermore, there are producers of IMCI outside TMC. TMC in this review process only represents its members and some associated companies, but not all IMCI producers. No other IMCI manufacturers participated in the review process. It is thus not clear whether the other producers are able to provide RoHS-compliant IMCI even if the exemption is not granted.

7.5 Comments of the Danish Ministry of Environment (DMU)

DMU[141] finds the requested exemption 17a very broad and of general character[142]. According to Article 5 exemptions can be given for "specific applications". During the negotiations of the RoHS Directive this wording was specifically negotiated in order to assure that general and broad exemptions like the one proposed in e.g. request 17a would NOT be granted. Thus the applications in the current wordings, in the DMU's[143] understanding do not qualify for an exemption.

The consultants agree that the exemption originally requested under exemption request 17a was too broad.[144] Its scope was therefore narrowed during the review to the LVCC. A further restriction of the scope was not possible, as LVCC are standard components that are used in almost all equipment.

7.6 Summary and Conclusions

Based on the available information, the consultants conclude that the substitution of lead in LVCC is scientifically and technically practicable, but that there are questions over how long this will take due to the nature of the testing regimes for the equipment

[141] Op. cit. DMU (2013)

[142] For example, in 17a at some point the applicant narrows down the request to the wording in the current 7(c) III exemption, and in 18a a separation for C-press compliant pin connector systems and other systems could have been made. (Source: DMU 2013)

[143] Op. cit. TMC (2013d)

[144] Cf. section 7.1 on page 18

in question. TMC claimed that the reliability of the substitute is not ensured, but did not provide evidence even though there was time at least since 2011 to test the reliability of lead-free LVCC.

Even though reliable substitutes for lead-containing LVCC are available, IMCI manufacturers may have to redesign their IMCI or parts thereof, and requalify the new designs. The (re-)design and requalification of IMCI to achieve RoHS compliance is a complex task which requires more effort and time compared to most other equipment under the scope of RoHS. Goodman (2006) also confirmed this fact and suggested a long transition period for IMCI. The Commission accommodated the specific conditions of the IMCI sector with a transition period until July 2017, when the substance regulations of RoHS Art. 4(1) starts applying to IMCI.

TMC claims that the time remaining until 2017 is not sufficient for all tasks related to the redesign, testing and qualification of IMCI to achieve RoHS compliance and asks to extend the exemption until 2024 calculating around 11.5 years required to turn the IMCI product portfolio into RoHS compliant products. TMC justifies this long time with the limited workforce available for the transition of the complex IMCI with long redesign cycles to RoHS compliant products. TMC argues that its members cannot allocate sufficient staff to achieve RoHS compliance in time. The example of Agilent indicates that a maximum of 1% of the total staff is available for this task. The consultants are not in a position to verify this data. In its previous exemption request, TMC[145] had, however, indicated 2021 as expiry date for the exemption, and it has not been clarified why the initially requested timeframe changed. Likewise no information has been made available by other IMCI manufacturers outside TMC.

Taking into account all information submitted, and in the absence of further information from other manufacturers outside TMC, the consultants recommend granting the exemption until 2021 at least, or at the latest until the end of 2022, in case the Commission acknowledges the applicant's calculation that 11.5 years are required to achieve RoHS compliance (cf. page 49). TMC can be expected to have started its RoHS compliance efforts at the latest in July 2011, when it had become officially clear that cat. 9 equipment comes into the scope of the RoHS Directive.[146] This would leave TMC a total of 9.5 years to transfer its IMCI to RoHS compliance until 2021, or 11.5 years until the end of 2022.

In case the Commission acknowledges the applicant's socioeconomic arguments and decides to grant an exemption, the consultants recommend adopting the exemption to Annex IV as follows:

> *Lead in dielectric ceramic in capacitors for a rated voltage of less than 125 V AC or 250 V DC for industrial monitoring and control instruments in cat. 9.*

The exemption expires on 1 January 2021 (alternatively: 1 January 2023) for industrial monitoring and control instruments in category 9 of Annex I, and after that

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[145] Op. cit. TMC (2011a)

[146] Cf. section "Start of RoHS Compliance Efforts" on page 30

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

date may be used in spare parts for EEE placed on the market before 1 January 2021 (alternatively 1 January 2023).

7.7 Recommendation Exemption Request 17a

The applicant did not provide evidence that the substitution of lead in low voltage ceramic capacitors (LVCC) is scientifically and technically impracticable, or that the lead-free LVCC are unreliable.

IMCI manufacturers need time, however, to redesign IMCI or those parts thereof using lead-free IMCI, and to test and qualify the redesigned IMCI according to their customary state of the art qualification procedures. TMC claims that the time remaining until 2017 is too short to cope with all tasks related to RoHS compliance in the context with the shift to lead-free LVCC due to the specific nature of IMCI and the sector in combination with the workforce being too limited to achieve RoHS compliance in time. In the absence of official contrary information, it may well be the case that IMCI manufacturers need time beyond 2017 before RoHS compliant products can be made available on the market. Assuming the Commission views the applicant's socioeconomic arguments concerning additional time required to achieve RoHS compliance as reasonable, the consultants recommend granting the exemption at least until 2021 (the duration applied for in the original application) or alternatively until January 2023.

The consultants propose adding the following exemption to Annex IV:

> *Lead in dielectric ceramic in capacitors for a rated voltage of less than 125 V AC or 250 V DC for industrial monitoring and control instruments (cat. 9).*
>
> *The exemption expires on 1 January 2021 (alternatively: 1 January 2023), and after that date may be used in spare parts for industrial monitoring and control instruments placed on the market before 1 January 2021 (alternatively 1 January 2023).*

7.8 References Exemption Request 17a

EPCOS 2013 — EPCOS (2013), Dr. Gerd Schulz, EPCOS AG/TDK-EPC Corporation, document „EPCOS 2013", submitted via e-mail on 15 April 2013

Gensch et al 2012 — Carl-Otto Gensch, Yifaat Baron, Markus Blepp, Andreas Manhart, Katja Moch, Öko-Institut; Otmar Deubzer, Fraunhofer IZM: Assistance to the Commission on technological, socio-economic and cost-benefit assessment related to exemptions from the substance restrictions in electrical and electronic equipment (RoHS Directive); final report 16 October 2012, retrieved from http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/RoHS_V_Recomendation_report_Part_1.pdf; last accessed 8 April 2013

Gensch et al. 2009 — Gensch et al. (2009), Gensch, C.; Zangl, S.; Groß, R.; Weber, A. K.; Deubzer, O.; Adaptation to scientific and technical progress under Directive 2002/95/EC; Final Report, Öko-Institut e.V. and Fraunhofer IZM, February 2009; http://ec.europa.eu/environment/waste/weee/pdf/report_2009.pdf

Goodman 2006	Goodman, Paul: Review of Directive 2002/95/EC (RoHS) categories 8 and 9 – Final Report. ERA Report 2006-0383, July 2006, amended September 2006, retrieved from http://ec.europa.eu/environment/waste/pdf/era_study_final_report.pdf; last accessed 9 November 2012
JEITA et al. 2013	JEITA et. al. (2013), JEITA (Japan Electronics & Information Technology Industries Association), CIAJ (Communications and Information Network Association of Japan), JBMIA (Japan Business Machine and Information System Industries Association), JEMA (Japan Electrical Manufacturers' Association), Contribution to Stakeholders Consultation, submitted on 15.02.2013, available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/20120215_Contribution_RoHS_Ex_Re_17a_18a_20a_JEITA_CIAJ_JEMA_JBMIA.pdf; retrieved on 19 May 2013
RoHS 2	Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast); http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32011L0065:EN:NOT
RoHS 1	Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0095:EN:NOT
TMC 2013a	TMC (2013b), Specific Clarifications submitted by the Test and Measurement Coalition (TMC) Concerning Request 17, submitted on 21.02.2013, available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_17a/Exemption_Request_17_a_ULM.docx; retrieved on 9 April 2013
TMC 2013b	TMC (2013b), General Clarifications submitted by the Test and Measurement Coalition (TMC) Concerning Requests 17, 18 and 20, submitted on 21.02.2013, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Clarification_General_Q_A_for_requests_17_18_20_ULM.docx; retrieved on 9 April 2013
TMC 2013c	TMC (2013c), Test and Measurement Coalition (TMC) document "Questionnaire-2_Exe-17a_TMC-response.docx", received by the consultants on 18 April 2013
TMC 2013d	TMC (2013d), Test and Measurement Coalition (TMC) document "20130517_Questionnaire-3_Exe-17a_TMC Response Rev final.doc", received by the consultants via e-mail on 22 May 2013
TMC 2013e	TMC (2013e),Test and Measurement Coalition (TMC) document "Questionnaire-4_Exe-17a_TMC Responses 4 June 13.docx"; received by the consultants via e-mail on 5 June 2013
TMC 2013f	TMC (2013f),Test and Measurement Coalition (TMC) document "Additional Clarification on exemption 17.doc", received by the consultants via e-mail on 12 June 2013

*Sections 7.1 through 7.2.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

TMC 2012d	TMC (2012d), New Information submitted by the Test and Measurement Coalition (TMC) for Stakeholder Consultation on 20.12.2012, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_17a/TMC_submission_17_a_-_final.pdf; last accessed 9 April 2013
TMC 2012c	TMC (2012c), Test and Measurement Coalition (TMC) General Answers to Clarification Questions Concerning Requests 17, 18 and 20, submitted during the stakeholder consultation, available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Clarification_General_Q_A_for_requests_17_18_20_ULM.docx; retrieved on 17 May 2013
TMC 2011a	TMC (2011a), Test and Measurement Coalition (TMC), original exemption request document concerning exemption request 17; available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_17/17_Lead_in_Glass_of_Electronic_Components_2011-08-09.pdf, retrieved on 8 April 2013
TMC 2011b	TMC (2011b), Test and Measurement Coalition (TMC) Answers to Questionnaire 1 concerning Exe-17, submitted during the first online stakeholder consultation; available under http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_17/Questionnaire-1_Exe-17_TMC.pdf; retrieved on 9 April 2013
TMC 2011c	TMC (2011c), Test and Measurement Coalition (TMC) document New Information Concerning Request 17", available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_17/Questionnaire-1_Exe-17_TMC.pdf; retrieved on 9 April 2013
TMC 2011d	TMC (2011d), Test and Measurement Coalition (TMC) General Comments to Oeko's Questions, last accessed 13 April 2013.

8.0 Exemption request no. 18a“Lead in compliant pin connector systems”

Abbreviations

CoPiCS	Compliant pin connector systems.
IMCI	Industrial monitoring and control instruments; monitoring and control instruments designed for exclusively industrial or professional use (source: RoHS 2).
RoHS 2, RoHS	Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast).
RoHS 1	Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment.

8.1 Description of the Exemption

Sections 8.1 to 8.3 are heavily based on information provided by the applicant and other stakeholders and do not necessarily reflect the views of the consultants.

The Test and Measurement Coalition (TMC) requests an exemption for “Lead used in compliant pin connector systems for use in industrial monitoring and control instruments (only sub-category 9 industrial)", and asks the exemption to remain valid until 2024.

TMC[147] states that, as it has been argued that the exemption as requested is too broadly worded, an alternative wording that would not materially cause harm to the industrial monitoring and control instrument (IMCI) sector would be:

> *Lead used in other than C-press compliant pin connector systems for Industrial Monitoring and Control Instruments, exemption to expire in 2024.*

According to TMC,[148] this wording would cover the needs of the coalition.

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[147] TMC (2012b), Test and Measurement Coalition (TMC) document “TMC_submission_18_a_final.pdf”, retrieved from http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_18a/TMC_submission_18_a_final.pdf; last accessed 20 June 2013

[148] Op. cit. TMC (2012b)

*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

8.1.1 Background and History of the Exemption

The requested exemption is closely related to an exemption, which was listed in the Annex of RoHS 1 as exemption no. 11 "Lead used in compliant pin connector systems". In the review of that exemption in 2008/2009, Gensch et al.[149] found that lead-free solutions will become available. The Commission followed the reviewers' recommendation to split the exemption and add expiry dates.

The exemption was adopted unchanged from the Annex of RoHS 1 to Annex III of RoHS 2. Table 8-1 shows the current wording of the exemption in Annex III.

Table 8-1: Wording and expiry dates of exemption 11 in Annex III of RoHS 2

Exemption No.	Exemption Wording	Scope and dates of applicability
11(a)	Lead used in C-press compliant pin connector systems	May be used in spare parts for EEE placed on the market before 24 September 2010
11(b)	Lead used in other than C-press compliant pin connector systems	Expires on 1 January 2013 and after that date may be used in spare parts for EEE placed on the market before 1 January 2013

The substance restrictions of RoHS Art. 4 (1) will apply to industrial monitoring and control instruments from 22nd July 2017 according to Art4(3).

In its first attempt, TMC[150] applied for the continuation of exemptions 11(a) and 11(b) for all category 9 equipment until 2021. In its recent submissions, TMC[151] asks for the extension of the two exemptions until 2024 instead of 2021, however it also restricts the scope of the request to industrial monitoring and control instruments in category 9. Without explanation, TMC[152] later further limited the request to the extension only of exemption 11(b) until 2024 to accommodate the needs of the IMCI sector.

8.1.2 Technical Description

The report of Gensch et al.[153] provides a detailed technical description of compliant pin connector systems from page 140 on.

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[149] Gensch et al. (2009), Gensch, C.; Zangl, S.; Groß, R.; Weber, A. K.; Deubzer, O.; Adaptation to scientific and technical progress under Directive 2002/95/EC; Final Report, Öko-Institut e.V. und Fraunhofer IZM, February 2009; http://ec.europa.eu/environment/waste/weee/pdf/report_2009.pdf

[150] TMC (2011a),Test and Measurement Coalition (TMC), original exemption request document "18_Lead_in_pin_connector_systems_2011-08-09.docx"; retrieved from http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_18/18_Lead_in_pin_connector_systems_2011-08-09.docx on 2 August 2012

[151] Op. cit. TMC (2013b)

[152] Op. cit. TMC (2013b)

[153] Op. cit. Gensch et al. (2009)

According to TMC,[154] the primary products that utilize this connection methodology include:

a. high speed digitizers
b. radiofrequency and wave signal sources
c. wireless test equipment

Figure 8-1: Product examples of a high speed digitizer (left), a wave signal source (middle) and wireless test equipment (right) (source: Agilent)

8.1.3 Amounts of Lead Used Under the Exemption

According to TMC,[155] typically 50 mg of lead are used per compliant pin connector of 100 pins. Sales in the EU are about 8300 devices, world-wide 36,000. This means there would be 450 grams of lead put on the EU market and 1.8 kg globally.

8.1.4 Socioeconomic and Environmental Arguments

TMC[156] claims that exemption request 18a concerns a very limited amount of lead used in specific high pin intensity arrays. It explains that the environmental cost associated with their continued use is truly minimal compared to the risk associated with the introduction of untested and possibly unreliable compliant pin connectors with lead free solutions. By analogy to the REACH model for socioeconomic monetization of health/environment TMC attempted to monetize the cost of the maintenance of the exemption for example for ground radar:

a. There are ca. 5 million flight movements in Europe each year;
b. Let's presume the chance that a fault develops due to a whisker is 1:100,000;

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[154] TMC (2012e), Test and Measurement Coalition (TMC) document "Exemption_Request_18a_ULM.docx", retrieved from http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_18a/Exemption_Request_18a_ULM.docx; last accessed 25 April 2013

[155] Op. cit. TMC (2013b)

[156] Op. cit. TMC (2012e)

*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

c. Let's presume furthermore that the chance the fault causes a fatal error is likewise 1:100,000.

TMC[157] presumes each such fatal fault might cause 150 fatalities; the cost of a fatality – based on European Commission norms – is ca. €1 million euros. This means that the cost would be ca. € 50,000 based merely on the direct costs attributable to individuals that are deceased. Even though this is a small amount for sure the potential environmental cost for exposure to a few grams of lead from the extremely rare piece of equipment that is not recycled cannot exceed this. It is therefore a socioeconomically unsound decision to withdraw this exemption until full certainty has been obtained regarding the reliability of the lead free alternatives. (TMC 2013a) Given that the products have very long lifetimes and are generally 100% recycled they comprise only a tiny part of the total waste stream, the environmental benefits that might be obtained are minimal whereas the economic and social effects of product withdrawal and the lack of access to IMCI for EU industries would be tremendous.[158]

8.2 Stakeholders' Justification for the Exemption

8.2.1 Applicant's Rationale for the Exemption Request

TMC[159] explains the rationale for exemption 18a with unique applications in IMCI:

1) Instruments are portable and have to survive use and transportation over a typical life of 10 years;
2) Products are specified to operate over a wide range of temperature and vibration environments (unlike ITE equipment);
3) Multi-pin data interfaces operating with very high speed data rates;
4) Compliant-pin connectors allow the maximum connectivity per unit area on printed circuit board, meeting the needs of improved signal density and integrity;
5) The long-term reliability of the compliant-pin connector to printed circuit board joint is a fundamental requirement: they are required to last the lifetime of the Instrument;
6) Compliant-pin connectors are not reworked or replaced in IMCI due to reliability issues with the subsequent compliant-pin to PCB joint;
7) It is not possible to solder alternative connectors reliably due to the pin density and subsequent heat-sinking thermal properties of the printed circuit board assembly;
8) The long-term reliability of lead-free alternatives remains in question;

[157] Op. cit. TMC (2012e)

[158] Op. cit. TMC (2012e)

[159] Op. cit. TMC (2013b)

Studies since the "substitution of lead in pin compliant connectors was found to be scientifically and technically practicable" continue to raise questions regarding the reliability of the substitute, particularly in relation to high reliability, long-life products such as IMCI;

9) "From these findings, tin finished press fit connectors should certainly be considered a failure risk. Literature does show that the addition of as little as 3 percent lead significantly mitigates the risk of long tin whisker formation that has been associated with electronic system failures." Michael Osterman, Ph.D. CALCE Operations Director, October 26, 2012);

10) Consequently, the reliability of substitutes is not ensured for products within IMCI of category 9, which is due cause for an extension to be granted while further investigations are undertaken;

11) The research by Calce and iNEMI show unacceptable reliability issues possibly connected with the compression force exerted in the connectors in the application;

12) Given the above, considerable life-time buys of tin-lead compliant pin connectors have been made to assure continued supply of these components for IMCI applications. These last time buys are kept in moisture proof bags together with a desiccant;

13) There remain a number of these connectors available on the market today. While many suppliers are transitioning to lead-free alternatives, the continued availability of leaded compliant pin connector systems depends on an appropriate exemption continuing to be available under the RoHS Directive;

14) Investigations into the long-term reliability of lead-free compliant-pin connectors in IMCI are only being initiated now;

15) Once the long term reliability has been established (something TMC says it can only hope for at this time) – a process that takes 3 years minimum due to the need for speeded aging tests – IMCI manufacturers can look at installing the new compliant connectors into the systems and testing after that, this is too close to the 2017 deadline in the best of cases;

16) The amount of lead involved is only around 450 grams of lead put on the EU market and 1.8 kg globally;

17) It has been suggested that there is still sufficient time before July 2017 for unproblematic technologies to be developed, however this bypasses the limitations that apply to the IMCI sector. The following aspects need to be considered, evaluated, and proven before completing substitution of parts within our products;

18) These reassessment and redesign activities can take weeks to many months to complete, particularly where printed circuit board changes are involved. Where there is a high business impact (resource and cost) product withdrawal from the market is a distinct possibility where there is a limited return on the investment forecast.

*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

TMC[160] explains that, to fulfil the functions described in Gensch et al.,[161] the use of lead is critical for compliant pin connectors in category 9 products, to guarantee high and long term reliability. The continued use of these components is necessary as the technology is proven, reliable and safe. The long-term reliability of all alternatives to compliant pin connector systems has not been fully evaluated for category 9 devices having long life time of 10 years on average. Therefore substitutes should be tested not only for meeting reliability requirements but also for long term performance, going substantially beyond the one of consumer goods. According to TMC,[162] the exemption is critical for such high reliability connectors. Since the alternatives are new, it has not yet been possible to put them through environment aging tests to ascertain long term reliability in all category 9 applications.

TMC[163] says that several potential substitutes are under investigation. However, the research and tests performed so far do not conclude that these are viable alternatives for Category 9 applications. According to TMC[164] there is widespread use of lead within compliant pin connector systems within IMCI, including many custom parts. The long-term reliability of IMCI alternatives had until 2012 not been evaluated for IMCI applications. In this year TMC had external and independent research done into the compliant pin connector substitutes which yielded alarming results in speeded aging tests. Products with nickel plated boards – meant to inhibit tin whisker growth – showed unacceptable and dangerous whiskers within an estimated 2 year span. The results of this test are too alarming to ignore the IMCI sector as the measurement and control instruments in question often manage system critical applications such as ground control radar and the like.

TMC[165] says that as the known alternatives are rather new, it has not yet been possible to put them through environment aging tests to ascertain long term reliability in IMCI applications. Unlike other types of equipment the pin connector systems are part of the core of the instrument and need to last the lifetime of the product. Many applications in different sectors like the automotive or card-based machines are more easily fixed by merely scheduling the replacement after an x number of years of the card with the pin-compliant connector. This is not the case for category 9 industrial. Any forced change to follow the revised exemption requirements would require significant data collection from the supply chain, product review, redesign and requalification.

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[160] Op. cit. TMC (2011a)

[161] Op. cit. Gensch et al.(2009)

[162] Op. cit. TMC (2011a)

[163] Op. cit. TMC (2011a)

[164] Op. cit. TMC (2013b)

[165] Op. cit. TMC (2013b)

8.2.2 Substitution and Elimination of Lead

8.2.2.1 Non-availability of reliable RoHS-compliant CoPiCS

TMC[166] claims that, although in 2004 several compliant pin connector manufacturers claimed that tin can replace tin/lead coatings, the tests performed did not come to a conclusive result, despite intensive research. The main concern with tin is the growth of tin whiskers, which occur on electroplated tin coatings. Tin whiskers have been shown to cause short circuits in electrical equipment, leading to either intermittent faults or complete, catastrophic failures.

TMC[167] rejects gold as a substitute for lead. Gold coatings are resistant against whisker growth, but the tests performed so far indicate that gold could not be a viable option for compliant pin connectors. The main reason is the required insertion force of gold press-fits which often results in unacceptable damage to the plated through holes (PTH).

TMC[168] states that to date, there is no single compliant pin system manufacturer able to supply a lead-free product. Despite intensive research, no alternatives were found so far for category 9 specific applications, which can guarantee high reliability.

To support the elimination of lead, the insertion force could be decreased by changing the design of the pin connectors. TMC[169] puts forward that tests have been performed to reduce the insertion force by increasing the PTH diameter or decreasing the pin thickness. The results however were not positive as these changes resulted in compromising the reliability of the connector.

8.2.2.2 Whisker Growth in Tests

Agilent[170] admits that the concerns with insertion and retention forces of pin connectors have been resolved with careful selection of printed circuit board (PCB) finishes and appropriate PCB thickness. For monitoring and control instruments, where long life is important, the risk of tin (Sn) whiskers from Sn-plating is of great concern. It is known that compression of the Sn contributes to tin whisker growth, and compliant pin connectors necessarily compress the plating as they are inserted into holes in the printed circuit board. The connector industry has already started to replace some tin-lead (SnPb) pin plating with pure Sn plating. Qualifications still show both success and failure of tin-plated pins, with tests performed at a reputable OEM as recently as January 2012, showing significant tin whisker formation. These

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[166] Op. cit. TMC (2011a)

[167] Op. cit. TMC (2011a)

[168] Op. cit. TMC (2011a)

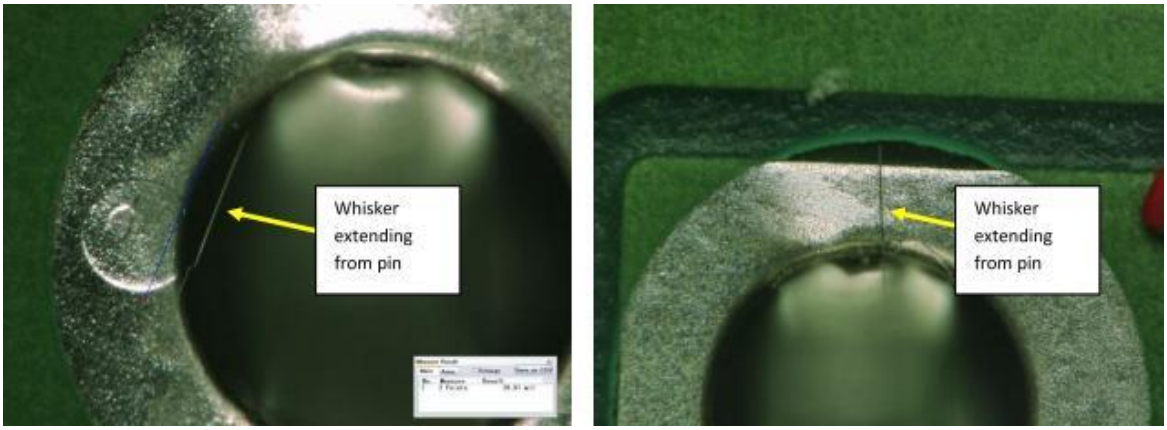
[169] Op. cit. TMC (2011a)

[170] Agilent (2012), Agilent Technologies stakeholder document „Agilent_contribution_request_18_submitted_19032012.pdf" available under: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_18/Agilent_contribution_request_18_submitted_19032012.pdf retrieved on 3 August 2012

*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

whiskers formed on both eye-of-needle and action-pin type compliant pins. The whiskers were not specific to a lot, manufacturer or pin type. Whiskers formed in 1,000 hours at ambient conditions, with a similar time-frame for samples at 85 °C and 85% relative humidity. Agilent shows pictures of field failures that motivated the testing.

Figure 8-2: Tin whiskers growing from compliant pin connector pins with Sn over Ni plating (Agilent 2012)



According to Agilent[171], the pin connectors shown in the figure above were assembled in April 2010, and failed in July 2011. The above photos were taken in October 2011. Agilent[172] concludes that the above evidence illustrates that the state of the art for lead-free compliant pin connectors cannot be considered immune from tin whisker growth. Consequently, the long-term reliability of these components is not assured.

TMC[173] concludes that no suitable alternatives for category 9 applications have been found so far, despite of intensive research. Even if new alternatives become available, they will require extensive testing to verify their long-term reliability when used in category 9 products. As material or component substitutions must be validated through a number of tests, under extreme conditions, testing programs can last one or two years.

8.2.2.3 Specific Features of CoPiCS Used in IMCI

According to TMC,[174] the use of CoPiCS is targeting cold-welding of the pins. TMC[175] explains that the compliant-pin connectors *are not* reworked or replaced in IMCI due to reliability issues with the subsequent compliant-pin to PCB joint. This is different

[171] Op. cit, Agilent (2012)

[172] Op. cit, Agilent (2012)

[173] Op. cit. TMC (2011a)

[174] TMC (2012c), Test and Measurement Coalition (TMC) document "Questionnaire-2_Exe-18a_TMC Responses 2-May-13.docx", received by the consultants via e-mail on 2 May 2013

[175] Op. cit. TMC (2013c)

from the use of CoPiCS in EEE of other categories, for example in information technology such as high-end servers, as the CoPiCS are generally used for enabling the later removal and reinsertion of components" during the active lifetime of their products for service and maintenance. Consequently, the active life of the connectors is expected to be considerably less than that of their products. Also EEE such as high-end servers spend their operating life in well-controlled environments, while IMCI applications of CoPiCS requires the connectors to last the expected lifetime of the equipment. IMCI not only have to operate in more severe operating environments subject to much broader operating temperature range. IMCI also have to withstand shock and vibration, the rigors of the storage and transportation environments associated with periods of inactivity and associated with being taken out of service for periodic calibration.

Additionally, TMC[176]puts forward that CoPiCS in IMCI are used with printed circuit boards (PCBs), having between four and thirty two layers, with eight and sixteen layer PCBs being most common. Therefore, unlike the IT industry, the application of CoPiCS is used across multiple board sizes and thicknesses.

8.2.3 Roadmap to Substitution of Lead in CoPiCS

TMC[177] indicates the times for supply chain assessment and qualification of CoPiCS in IMCI as indicated in Table 7-3:

Table 8-2: Time required for achieving RoHS compliance per IMCI

Activity	Min. time (months)	Max. time (months)
Supply chain assessment	No RoHS compliant substitutes known that meet long-term reliability needs; supply chain innovation required to make components available	
Product redesign	1	24
Product requalification	1	6
Total	unknown	unknown

Source: TMC (2012c)

TMC[178] explains that the following topics need to be considered, evaluated, and proven before completing substitution of parts in IMCI. It is not possible to "simply"

[176] TMC (2013d),Test and Measurement Coalition (TMC) document "Questionnaire-3_Exe-18a TMC Response 16 May 13 Draft.docx", received by the consultants on 16 May 2013

[177] TMC (2012d), Test and Measurement Coalition (TMC) document ""Oeko Feedback - Cat 9 Substitution Issues 20120622.docx"; received by the consultants via e-mail on 22 June 2012

[178] Op. cit. TMC (2012c)

*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

substitute components from a purchasing perspective and expect this change to roll through the value chain into each product. This extends beyond a simple form, fit and function evaluation. These reassessment and redesign activities can take months to years to complete, particularly where PCA changes are involved. Where there is a high business impact (resource and cost) product withdrawal from the market is a distinct possibility if there is a limited return on this investment forecast.

The following explanations are all taken from TMC.[179]

8.2.3.1 Product and Portfolio Assessment Elements

Product Complexity – product changes need to be considered from five key perspectives:

- Impact on published specifications;
- Impact on reliability;
- Impact on regulatory compliance (Safety, EMC, as well as Environment.):
  - Manufacturer's ability to self-certify;
  - Engagement with third-party certification bodies.
- Impact on customer acceptance/approvals;
- Impact on business performance:
  - Cost of scrapping old material – especially important if a "Life Time Buy" (LTB) has been made for material – potentially a many thousands of € impact;
  - Cost of re-design;
  - Cost of re-work;
  - Benefit of continued market access.

8.2.3.2 Supply Chain Assessment

Availability of substitute RoHS compliant components

- Identification of alternative parts available from existing suppliers
- Identification of alternative parts from a new supplier
  - Supplier assessment
  - Supplier acceptance and set-up
  - Supplier management

[179] Op. cit. TMC (2012c)

8.2.3.3 Product Redesign

Changes of components needed to address specific product attributes. This evaluation tends to be product specific although results for one product can be leveraged *for other applications where* the component is found to have direct form, fit, and function equivalence.

- Technical Equivalence – tight tolerance of key specifications are required to allow Category 9 equipment to continue to meet published specifications:
  - Electrical Performance;
  - Optical Performance (if applicable);
  - Range of operating and storage temperatures;
  - Tolerance to physical shock and vibration;
  - Specification for operating altitude;
  - Specification for operating and storage humidity;
  - Availability of appropriate third-party safety certifications (if safety critical);
  - MTBF.
- Physical Equivalence – physical size and pin layout must be equivalent to allow drop-in replacement for a specific component. Where this is not possible, the following two considerations also need to be taken into account:
  - Printed Circuit Assembly (PCA) complexity – the vast majority of printed circuit assemblies are highly complex with 8-16 layers widely utilized. Any change in a printed circuit board to accommodate a revised component footprint or layout is non-trivial from a layout perspective. Any change in a PCA requires a full re-qualification of the product;
  - Instrument layout – Any change in physical size of a component also needs to consider the available space above the component. In addition to the obvious issue of physically fitting in the available space, the following impacts need to be considered:
    - Product safety creepage and clearance distances;
    - Impact on airflow through the product and the resulting impact on cooling, and corresponding long-term reliability.

8.2.3.4 Product Requalification

Once changes have been implemented the following sequence of evaluations is required before the product can be reintroduced into the market:

- Compliance with published specifications. The Test and Measurement sector produces highly complex, multi-function products. Re-creating NPI-Qualification test systems that exercise and measure the products parameters is a highly skilled body of work. It should be noted that simply reusing or re-applying

production test and calibration systems is not an option as they test a limited set of the product's parameters:

- Even apparently simple substitutions need to have the relevant parameters associated to the circuit changes proven to meet published specifications.
- Testing per product – can range from weeks to months depending on complexity of product and scope of changes.

- Assure Reliability is not impacted. Run through an environmental test suite: weeks to months depending on product complexity;
- Long-term reliability of a specific application –life testing: months if accelerated testing is possible to years for critical applications where acceleration is not possible;
- Regulatory compliance evaluations:
  - EMC – weeks;
  - Safety evaluation – weeks;
  - Third-party certifications – weeks to months depending on Agency used.

8.3 Third-party Stakeholder Input on Exemption Request 18a

Continental[180, 181, 182] provided information supporting the applicant's exemption request. It is not clear from the information whether the experiments and findings relate to CoPiCS used in EEE under the scope of the RoHS Directive, or to CoPiCS used in automotive applications. As Continental is a supplier of the automotive industry, it is assumed that the submitted information refers to automotive CoPiCS.

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[180] Continental (2013a), Continental AG stakeholder document "20130208_Continental_AG_Contribution_RoHS_exemption_request_18_a.pdf", retrieved from http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_18a/20130208_Continental_AG_Contribution_RoHS_exemption_request_18_a.pdf; last accessed 22 June 2013

[181] Continental (2013b), Hans-Peter Tranitz, Sebastian Dunker, Continental Automotive GmbH Regensburg and Conti Temic microelectronic GmbH, Nürnberg: Growth Mechanisms of Tin Whiskers at Press-in Technology; stakeholder document "20130215_Article_Continental_AG_Contribution_RoHS_exemption_request_18a.pdf", retrieved from http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_18a/20130215_Article_Continental_AG_Contribution_RoHS_exemption_request_18a.pdf; last accessed 22 June 2013

[182] Continental (2013c), Dr. Hans-Peter Tranitz, Continental Automotive GmbH: Pressure-Induced Whisker Growth in Press-in Connections of PCB Through-Holes; stakeholder document "20130215_Presentation_Continental_AG_Contribution_RoHS_exemption_request_18a.pdf", retrieved from http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_18a/20130215_Presentation_Continental_AG_Contribution_RoHS_exemption_request_18a.pdf; last accessed 22 June 2013

The information was therefore not further reviewed, as the automotive industry had informed Zangl et al.[183] during the last thorough review of Annex II of the ELV Directive that CoPiCS work with higher insertion forces and therefore are not the same technology as used in IMCI and in other EEE in the scope of the RoHS Directive. The differences and consequences are described in section 8.4.2 on page 80 regarding the use of cold-welding technique and the insertion forces relevant for the application of CoPiCs in the various industries.

8.4 Critical Review

8.4.1 REACH Compliance - Relation to the REACH Regulation

This exemption request concerns lead in CoPiCS.

Section 5.0 of this report lists various entries and proceedings concerning the restriction of lead in the REACH Regulation.

Entries 10, 11, and 12 of Annex XIV (for further details see Section 5.0) concern lead chromate, lead sulfochromate yellow and lead chromate molybdate sulphate red, respectively. These compounds can only be further used once a request for Authorization has been applied for and granted, concerning the application in which it should be allowed for use. As from the consultants' knowledge, these compounds are not in use as solder alloys, these entries have no further implications for this request.

Entries 16 and 17 in Annex XVII concern lead compounds applied in specific articles which are irrelevant in the context of this request for exemption (for further details see Section 5.0).

Entry 30 in Annex XVII of the REACH Regulation, stipulating that lead and its compounds shall not be placed on the market, or used, as substances, constituents of other substances, or in mixtures for supply to the general public. A prerequisite to granting the requested exemption would therefore be to establish whether the intended use of lead in this exemption request might weaken the environmental and health protection afforded by the REACH Regulation.

In the consultants' understanding, the restriction for substances under entry 30 of Annex XVII does not apply to the use of lead in this application. Putting lead in a COPICs used in an IMCI on the market, in the consultants' point of view is not a supply of lead and its compounds as a substance, mixture or constituent of other mixtures to the general public. Lead is part of an article and as such, entry 30 of Annex XVII would not apply. Additionally, IMCI are products that are not provided to the general public, but to other than private users.

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[183] Zangl et al. (2010), Zangl, S.; Hendel, M.; Blepp, M.; Liu, R.; Gensch, C.; Deubzer, O. Adaptation to scientific and technical process of Annex II to Directive 2000/53/EC (ELV) and of the Annex to Directive 2002/95/EC (RoHS); Final Report, Öko-Institut e.V. und Fraunhofer IZM, June 2010; http://circa.europa.eu/Public/irc/env/elv_4/library?l=/reports/final_rohs_2010pdf/_EN_1.0_&a=d

*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

No other entries relevant for the use of lead in the requested exemption could be identified in Annex XIV and Annex XVII (status June 2013).

Various processes that may result in future restrictions of the use of lead are detailed in Section 5.0. In all these cases, it cannot yet be assumed if the processes shall result in a new restriction or in the addition of lead in certain compounds to the list of substances requiring an authorization. Therefore, at present these processes could not be assumed to have implications for this request for exemption in terms of ensuring the protection afforded by REACH.

Based on the current status of Annexes XIV and XVII of the REACH Regulation, the requested exemption would therefore not weaken the environmental and health protection afforded by the REACH Regulation. An exemption could therefore be granted if other criteria of Art. 5(1)(a) apply.

8.4.2 Non-ensured Reliability of CoPiCS in IMCI

Gensch et al.[184] found that technically and scientifically, the substitution of lead in compliant pin connectors is practicable. Exemption 11 a in Annex III of the RoHS Directive (C-press compliant connectors) hence expired in September 2010, and exemption 11 b for all other pin connector types expired on 1 January 2013.

The need for highly reliable connectors in long-life safety-critical equipment is not unique to test and measurement equipment. Such connectors are used in high end servers with ten and more years of lifetime and high reliability requirements as well as in medical equipment with similar use times and high safety requirements. None of these industries has supported the applicant's exemption request. The consultants therefore asked the applicant to explain in more detail why and how the specific conditions of CoPiCS in IMCI render the use of the lead-free CoPiCS available on the market unreliable or technically impracticable so that an exemption can be justified in line with Art. 5(1)(a). This evidence is presented and reviewed in the subsections that follow.

8.4.2.1 Types of CoPiCS Used in IMCI

TMC[185] claims that the use of CoPiCS in IMCI targets the cold-welding of the pins in the holes of the CoPiCS. The types of CoPiCS used in IMCI could thus be similar or the same like those applied in vehicles. In the last review of exemption 8 (f) in Annex II of the ELV Directive in 2010, Zangl et al.[186] found that CoPiCS in vehicles use insertion forces of around 120 to 150 Newton per pin to achieve cold-welding after insertion. In comparison, CoPiCS in EEE, for example in information technologies, are inserted with insertion forces of 20 to 50 Newton per pin to avoid cold-welding and to enable the later exchange of components and modules connected via the CoPiCS to the printed

[184] Op. cit. Gensch et al. (2009)

[185] TMC (2012c), Test and Measurement Coalition (TMC) document "Questionnaire-2_Exe-18a_TMC Responses 2-May-13.docx", received by the consultants via e-mail on 2 May 2013

[186] Op. cit. Zangl et al. (2010)

circuit board. At the time of the review of ELV Annex II, in contrast to the use of CoPiCS in EEE, no lead-free alternatives could be identified that would have satisfied the reliability requirements of the automotive industry. In case IMCI manufacturers actually use CoPiCS targeting cold-welding, this might explain TMC's statement that no lead-free CoPiCS are available for IMCI.

TMC was therefore asked whether IMCI producers purchase specific, cold-welding CoPiCS and to specify the insertion forces of CoPiCS in IMCI. TMC[187] answered that IMCI manufacturers do not target cold-welding, and that CoPiCS in IMCI are not explicitly designed to achieve cold-welding but that IMCI manufacturers would accept the cold-welding in the CoPiCS in case it occurs, differently, for example, from producers of IT equipment. In a CoPiCS, which TMC[188] considers as representative,[189] the insertion force is 44.5 Newton per pin maximum average.[190] This is in the same range as those CoPiCS used in other categories of EEE in RoHS Annex I. TMC[191] confirms for the above representative CoPiCS that this lead-containing CoPiCS used in IMCI is the same as those that had been used in other EEE in the scope of the RoHS Directive prior to the expiry of exemption 11(a) and 11(b). TMC[192] also confirms that the substrates and fabrication technology for the multilayer PCBs in IMCI are physically incapable of withstanding the insertion forces required for cold-welding. Consequently, CoPICS for automotive applications are unsuitable for IMCI applications.

The type of CoPiCS used in IMCI, therefore, are the same as those used in other EEE in the scope of the RoHS Directive. They have nothing to do with those CoPICS applied in automotive applications, and the higher insertion forces of the automotive CoPiCS would even damage the printed wiring boards of IMCI. The applicant's above arguments therefore do not substantiate the applicant's claim that the CoPiCS used in IMCI are in principle different from those in other EEE. Consequently, the applicant's above arguments do not prove that the substitution of lead is scientifically or technically impracticable, or that lead-free CoPiCS would lack reliability in IMCI.

8.4.2.2 Specific Use Pattern of CoPiCS in IMCI

Even though IMCI producers used the same lead-containing CoPiCS as other producers of EEE, TMC insists that the use model of the CoPiCS is different, which

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[187] Op. cit. TMC (2013d),

[188] Op. cit. TMC (2013d),

[189] TE Connectivity product webpage for 1469025-1: http://www.te.com/catalog/pn/en/1469025-1?RQPN=1469025-1#features; source as referenced in TMC (2013f)

[190] Product Specification "Two, Three and Four Pair HM-Zd Connectors", http://www.te.com/commerce/DocumentDelivery/DDEController?Action=showdoc&DocId=Specification+Or+Standard%7F108-2055%7FC%7Fpdf%7FEnglish%7FENG_SS_108-2055_C.pdf%7F1469025-1; source as referenced by TMC (2013f)

[191] TMC (2013e), Test and Measurement Coalition (TMC) document "Questionnaire-4_Exe-18a_TMC Responses - Final 30-May-13.docx", received by the consultants on 30 May 2013

[192] Op. cit. TMC (2013e)

according to TMC[193, 194] shall explain why the lead-free CoPiCS used in other EEE are not appropriate for IMCI. TMC[195, 196] states that reworking CoPiCS does not meet IMCI producers' or customers' long term reliability needs and expectations. While removal of CoPiCS in IMCI is physically possible, IMCI producers scrap those which have defects with the CoPiCS rather than attempt any rework, even though this is not undertaken lightly since loaded PCBs cost multiple thousands of Euros. TMC[197, 198] concludes that consequently, the IMCI use model of CoPiCS differs from other products under the scope of the RoHS Directive (such as high-end servers) and automotive applications under the ELV and would be somewhere in between. Consequently, TMC[199, 200] states that the active life of the connectors is expected to be considerably less than that of IMCI products.

The applicant's above explanation is not plausible. First of all, in other applications of CoPiCS in EEE in the scope of the RoHS Directive, the CoPiCS are not reworked, but the components that are connected to the printed wiring board (PWB) using CoPiCs may be removed and reinserted in some cases. According to Gensch et al. (2009), some producers of EEE, e.g. of high end servers, avoid cold-welding of the CoPiCS for that reason. Hence TMC's conclusion is not correct that the CoPiCS would be exchanged because their life time is less than the products' life time, while only in IMCI the CoPiCS have to last the entire life time of the product. It would not make sense to use CoPiCS in servers to enable the exchange of components or modules, and then have to exchange the CoPiCS including the connected component or module, because the CoPiCS life time has come to a premature end of its life.

The need to exchange components or modules connected with CoPiCS to printed wiring boards even increases the reliability requirements, as each reinsertion increases the risk of damage to the layer of the pin hole, which in turn again increases the risk of whiskers. TMC itself claims not to rework or reinsert CoPiCS because of potential adverse reliability impacts. TMC's claim that only IMCI use CoPiCS across multiple board sizes and a variety of thicknesses is not plausible either. It is not clear whether and how the board size and thickness should affect the whisker risk, and other producers of IMCI use various multilayer printed wiring boards with 25 and more layers as well.

The "use model of CoPiCS" in IMCI thus does not plausibly explain that, different from other EEE under the scope of the RoHS Directive, the substitution of lead in CoPiCS

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193 Op. cit, TMC. (2013d)

194 Op. cit. TMC (2013e)

195 Op. cit, TMC. (2013d)

196 Op. cit. TMC (2013e)

197 Op. cit, TMC. (2013d)

198 Op. cit. TMC (2013e)

199 Op. cit, TMC. (2013d)

200 Op. cit. TMC (2013e)

for IMCI is scientifically and technically impracticable, or that the reliability of the substitute is not ensured. Granting an exemption based on these arguments would thus not be in line with Art. 5(1)(a).

8.4.2.3 Specific Use Conditions of IMCI

TMC[201] says that EEE such as high-end servers spend their operating life in well-controlled environments, while IMCI applications of CoPiCS require the connectors to last the expected lifetime of the equipment. IMCI have to operate in more severe operating environments subject to much broader operating temperature range. IMCI also have to withstand shock and vibration, the rigors of the storage and transportation environments associated with periods of inactivity and associated with being taken out of service for periodic calibration.

TMC[202] explains that IMCI are robust against the environmental stresses of storage, transportation *and end-use* across a large range of environments, including:

- For use in environments unsuitable for unprotected operating personnel;
- Intended for use outdoors; battery- or line-powered;
- For use in indoor facilities without air conditioning; hand carried outdoors;
- For use in indoor facilities without air conditioning (default);
- For use in indoor facilities with well controlled air conditioning; and
- For use in a very carefully controlled room environment.

According to TMC,[203] the primary products that utilize this connection methodology include:

- High speed digitizers:

  e.g. Agilent U1083A High-Speed 6U VME/VXS Generator.
- RF & uWave signal sources:

  e.g. Agilent N5183A MXG Microwave Analog Signal Generator.
- Wireless test equipment:

  e.g. Agilent E6607A EXT Wireless Communications Test Set.

Looking across these three examples, TMC[204] claims that the E6607A has the most restricted operating temperature range, yet this still is warranted to meet all published specifications in ambient temperatures ranging from +5 to +50 ^{o}C. It is also specified to survive non-operational temperatures of -40 to +65 ^{o}C. The shock and

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[201] TMC (2012c), Test and Measurement Coalition (TMC) document "Questionnaire-2_Exe-18a_TMC Responses 2-May-13.docx", received by the consultants via e-mail on 2 May 2013

[202] Op. cit. TMC (2013c)

[203] Op. cit. TMC (2013c)

[204] Op. cit. TMC (2013c)

*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

vibration values the Agilent products are verified against is proprietary information. However, they can be considered similar to MIL-PRF-28800F Class 3, which is more challenging to meet than Class 4 (for laboratory environment.)

TMC[205] further explains that products designed for bench top or field portable (installation test) use are subject to frequent shock and vibration incidents in their everyday use as well as when transported for Calibration to have their specifications verified. Even products designed to spend their operational life in production test racks have to be periodically removed from service and transported to a Calibration laboratory. The interval between calibrations is a function of the use model of the customer and their required measurement accuracy, and ranges from months to years. Such shock and vibration events introduce stresses which are known to promote tin-whisker growth.

According to TMC[206], in the case of portable instruments the situation is even more pronounced as they are frequently dropped from a small height to the floor. Even instruments of light weight will fall with >6-8 G force onto solid ground if their weight is over a few kilos or so. Similarly transportable equipment or moveable equipment will frequently be treated robustly during transportation, such as being shoved around on trucks, whereby considerable impacts are incurred. Where in the case of a robust tool this is unlikely to cause issues – the sensitive nature of the instruments makes it a problem to assure that they will remain compliant to their specifications over the longer term.

TMC[207] concludes that the above examples clearly illustrate the end-use environment for IMCI is much more severe than simply laboratory use. Transportation and storage environments also are relevant to the long-term reliability of IMCI in order to assure they continuously meet customer expectation throughout the typical 10-year life of these instruments. Agilent[208] provided information of whiskers in lead-free pin connectors.[209] This finding may support the above arguments. Other long life EEE, namely high end servers, indeed normally enjoy constant and stable conditions throughout their life time. Server rooms are conditioned and cooled to establish these stable conditions.

Gensch et al.[210] found that lead-free CoPiCS will become available and hence the Commission set expiry dates for lead in CoPiCS for exemptions 8(a) and 8(b) in 2010 and 2013. However, the information available at that time did not detail the specific conditions under which lead free CoPiCs are used in various categories and applications of categories 1-7 and 10. The reliability of lead-free CoPiCS available on

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[205] Op. cit. TMC (2013c)

[206] Op. cit. TMC (2013c)

[207] Op. cit. TMC (2013c)

[208] Op. cit. Agilent (2012)

[209] Cf. “Whisker Growth in Tests” on page 42

[210] Op. cit. Gensch et al. (2009)

the market may therefore not be ensured for IMCI, and Art. 5(1)(a) would justify an exemption.

8.4.3 Socioeconomic Impacts

TMC[211] put forward information to quantify the risk associated with the introduction of untested and possibly unreliable compliant pin connectors using lead free solders. It is explained that this assessment is based on the REACH model for socio-economic monetization of health/environmental impacts.

However the REACH socio-economic analysis (SEA) model regards the comparison of possible scenarios in terms of possible costs and benefits. The ECHA Guidance document concerning the use of SEA as part of an application for Authorisation[212] states that *"SEA is an approach used to describe and analyze all relevant impacts… In a SEA one needs to analyse and document whether the socio-economic benefits of continued use of the substance outweigh the risks of continued use for human health and the environment. (i.e. both positive and negative effects)"*

The information provided by the applicant only regards a possible health impact relevant for the scenario of introduction of untested and possibly unreliable compliant pin connectors using lead free solders. This establishes an impact in a specific area of application of such pin connectors (ground radar devices), but does not demonstrate all impacts attributed to this scenario and therefore does not suffice to understand the NET benefit of this scenario. Furthermore, information is not included to allow a comprehensive assessment and its monetization for an alternative scenario.

In this sense, the submitted information does not allow a comprehensive comparison, nor an understanding, from which it can be concluded how various scenarios would compare to each other. The consultants can therefore neither agree nor disagree with the applicant's conclusions.

8.4.4 Danish Ministry of Environment (DMU)

DMU[213] criticizes the broad scope of exemption request 18a and would have expected the applicant at least to differentiate the CoPiCS in C-press compliant pin connector systems and other systems following the current differentiation of exemption 11(a) and 11(b) in RoHS Annex I.

The consultants share this point of view. During the review process, the applicant limited its exemption request to other than C-type CoPiCS.

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[211] Op. cit. TMC (2012b)

[212] ECHA (2011), Guidance on the Preparation of Socio-Economic Analysis as part of an Application for Authorisation, European Chemicals Agency, Document ECHA-11-G-02-EN, retrieved from: http://www.echa.europa.eu/documents/10162/13637/sea_authorisation_en.pdf; last accessed 9.7.2013

[213] Op. cit. DMU (2013)

*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

8.5 Conclusions

Gensch et al. [214] found that lead-free CoPiCS will become available and hence the Commission set expiry dates for lead in CoPiCS for exemptions 8(a) and 8(b) in 2010 and 2013. However, the information available at that time did not detail the specific conditions under which lead free CoPiCs are used in various categories and applications of categories 1-7 and 10. TMC justifies its exemption request with the specific use conditions of IMCI. In lack of further information, the conditions TMC describes must be assumed to be different from the conditions relevant for the use of CoPiCS for example in high end servers, even though CoPiCS might be used in other equipment as well under conditions similar to those in IMCI.

TMC provide results of testing performed as late as 2012.[215] This regards the technical reliability of alternatives to provide the qualities needed for proper function in IMCI devices and to operate reliably throughout device service life.

Once the long term reliability is established *"a process that takes 3 years minimum due to the need for speeded aging tests – IMCI manufacturers can look at installing the new compliant connectors into the systems and testing".*[216] This statement regards further time needed for the redesign of alternative lead-free CoPiCS in to actual IMCI devices. After which a second round of reliability testing, aimed at establishing that the redesigned item provides an equivalent alternative to earlier non-compliant designs is performed. Only once reliability of a new design is ensured can devices be manufactured and subsequently placed on the market to replace IMCI which do not comply with the RoHS substance restrictions. An estimated time frame for these stages has not been provided.

As no information from IMCI manufacturers outside TMC was submitted during or after the stakeholder consultation, for due diligence the consultants contacted IMCI manufacturers outside TMC. No official confirmation could, however, be obtained that lead-free CoPICS have been used in IMCI for years already.

8.6 Recommendation

Based on the available information, and in the absence of contrary information, the consultants recommend granting the exemption. For the specific use conditions in combination with high reliability requirements of industrial monitoring and control instruments (as discussed in Section 8.4.2.3) the reliability of lead-free CoPiCS is not ensured. An exemption would therefore be in line with Art. 5(1)(a).

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[214] Op. cit. Gensch et al. (2009)

[215] Op. cit. Agilent (2012)

[216] Op. cit. TMC (2013b)

The applicant had initially requested the exemption until 2021. In its current exemption request, this deadline had been extended to 2024. The applicant has stated that three years are estimated for concluding the long term reliability of lead-free CoPiCS in IMCI. The consultants can follow that beyond these initial 3 years, further time shall be needed before devices complying with the RoHS substance restrictions can be placed on the market; however, it could not be established through the course of this evaluation that the exemption would indeed be needed until 2024. It is therefore recommended to grant the exemption at least until 2021.

As TMC proposed to restrict the exemption to other than C-press CoPiCS, it is recommended to adopt the scope limitation and add an exemption with the following wording to Annex IV of the RoHS 2 Directive:

> *Lead used in other than C-press compliant pin connector systems for industrial monitoring and control instruments (cat. 9)*
>
> *The exemption expires on 1 January 2021 (alternatively: 1 January 2024), and after that date may be used in spare parts for industrial monitoring and control instruments placed on the market before 1 January 2021 (alternatively 1 January 2024).*

8.7 References Exemption 18a

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*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

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*Sections 8.1 through 8.3 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

9.0 Exemption Request **No. 20a** "Mercury in cold cathode fluorescent lamps (CCFL) for back-lighting liquid crystal displays not exceeding 5 mg per lamp used in industrial monitoring and control instruments (only sub-category 9 industrial)"

Abbreviations

CCFF	Cold Cathode Fluorescent Lamps
IMCI	Industrial Monitoring and Control Instruments
LCD	Liquid crystal display
LED	Light Emitting Diode

9.1 Background

Sections 9.1 to 9.4 are heavily based on information provided by the applicant and other stakeholders and do not necessarily reflect the views of the consultants.

9.1.1 Background of the Evaluation Process

This request for exemption was submitted in 2011 by the Test and Measurement Coalition (TMC) as part of a previous evaluation in the course of the RoHS 2 Pack 1 Project).[217] Originally the requested exemption was formulated as follows:

> *"Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding 5 mg per lamp in lighting applications for monitoring and control instruments (Category 9)."*

This was the application that was subjected to stakeholder consultation. Following discussions with the applicant, the scope of the requested exemption was altered. The wording was reformulated as follows:

> *"Mercury in cold cathode fluorescent lamps (CCFL) for back-lighting liquid crystal displays not exceeding 5 mg per lamp used in industrial monitoring and control instruments (only sub-category 9 industrial)."*

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[217] TMC (2011a) Original exemption request no.20 (withdrawn), Submitted by Test and Measurement Coalition (TMC). http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_20/20_STZ_Mercury_in_lamps_exemption_2011-08-09.docx

In order to allow stakeholders to contribute to the changes of the wording and the new information submitted, the request has been included in the current service contract No. ENV/2012/637887/ETU/C2, implementing Framework Contract No. ENV.C.2/FRA/2011/0020 led by Eunomia.

9.1.2 Background Information Concerning CCFL Technology

The following background information on the technical aspects of CCFLs is based on information supplied by the applicant.

According to the applicant[218] CCFLs belong to the gas discharge lamp category and contain rare gases and a slight amount of mercury within the lamp tube to provide their function. Electrons are emitted from an electrode and collide with mercury atoms. As a result of this collision, energy is transferred to the atoms [in the form of electrons – consultants comment], which elevates them to an excited state. When these atoms fall back to their original status, they emit photons (packages of energy), normally not in the range of visible light. Ultraviolet photons excite the fluorescent powders, which coat the inside of the tube, with a high degree of efficiency. As a result these emit visible radiation in a range of colours.

The exemption request by TMC regards CCFLs as similar to the previous evaluation of the existing exemption no. (3a) listed in Annex III of Directive 2011/65/EU (RoHS 2). This exemption was evaluated and reviewed by Öko-Institut together with Fraunhofer IZM.[219]

As of May 2013, the RoHS Annex[220] includes exemption 3 for CCFLs as shown in Table 9-1.

Table 9-1: Overview on the current exemption 3 in the Annex III to Directive 20011/65/EU

Exemption		Scope and dates of applicability
3	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp):	
3(a)	Short length (≤ 500 mm)	No limitation of use until 31 December 2011; **3,5 mg** may be used per lamp after 31 December 2011
3(b)	Medium length (> 500 mm and ≤ 1 500 mm)	No limitation of use until 31 December 2011; **5 mg** may be used per lamp after 31 December 2011
3(c)	Long length (> 1 500 mm)	No limitation of use until 31 December 2011; **13 mg** may be used per lamp after 31 December 2011

[218] Op. cit. TMC (2011a)

[219] See Gensch et al. (2009) Gensch, C.; Zangl, S.; Groß, R.; Weber, A. K.; Deubzer, O.; Adaptation to scientific and technical progress under Directive 2002/95/EC; Final Report, Öko-Institut e.V. und Fraunhofer IZM, February 2009; http://ec.europa.eu/environment/waste/weee/pdf/report_2009.pdf

[220] RoHS Directive (2011) Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast), http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32011L0065:EN:NOT

*Sections 9.1 through 9.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

The exemption request in question proposes that CCFLs used in the backlighting of liquid crystal displays (LCD) in monitoring and control instruments which are shorter than 500mm may contain up to 5mg of Mercury. Therefore, in line with Exemption 3(a), the use of such lamps would no longer be exempted once the RoHS Directive substance restrictions apply.

9.2 Description of Requested Exemption

TMC, the applicant, represents over half of the world's industrial and professional test and measurement equipment manufacturers (coalition members), including Agilent, Anritsu, Fluke, Keithley, National Instruments and Tektronix. The products of these manufacturers are classified under RoHS as industrial monitoring and control instruments, which are designed exclusively for industrial or professional use.[221]

According to the applicant, backlit mercury displays are used to enable readability of equipment [displays – consultants comment] under all conditions (e.g. in bright, sunlight conditions etc.), and are solely supplied by third party vendors. The applicant argues that the use of mercury displays is essential and possibly lifesaving[222].

The applicant estimates that the annual market share of relevant products in the EU is less than 5000, and the total combined amount of mercury in these products is 24 grams or less. This amount is decreasing annually and will converge to zero by the mid-2020s.[223]

In subsequent correspondence[224] the applicant gave the following examples of products for which the request is relevant:

- Oscilloscopes;
- Logic analysers; and
- Waveform monitors.

The applicant has indicated that substitute materials using LED lamps have recently become available. However, the availability of LED displays for all industrial monitoring and control instruments (IMCI), which fall under the scope of this request for exemption (sub-category 9 industrial monitoring and control devices), has not

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[221] TMC (2013a) Answers to further clarification questions, following the consultation, Submitted by Test & Measurement Coalition (TMC), February 2013 http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Clarification_General_Q_A_for_requests_17_18_20_ULM.docx

[222] TMC (2012a) Introduction to the request for exemptions to apply to category 9, Submitted by Test & Measurement Coalition (TMC), December 2012 http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/Request_20a/TMC_submission_20a_final.pdf

[223] Op. cit. TMC (2012a)

[224] TMC (2013c), Information Concerning Wording Formulation and Product Service Life, provided by the applicant via Email on 10.5.2013

been fully established. TMC[225] further claims that substitution is not possible, as switching display units is generally not a "drop-in" replacement, especially when the type of display is changed (e.g. from CCFL to LED backlighting). TMC suggest that the display shape and size may force changes to the product enclosure and the change in control circuitry can demand board redesign.[226]

TMC states that the coalition members have converted about two-thirds (66%) of their displays to RoHS-conforming, new type displays lamps. This trend will continue and increase in pace even though TMC can already foresee it will not be possible to meet the 2017 deadline to transition all equipment. The aim is not product category specific because the substitution ability is partially related to how the fixed screen has been fitted into the equipment. The applicant's strategy for transition is that each redesign or redevelopment of affected products will involve the phase out of the lamps with a mercury content between 3.5mg and 5mg. [227]

The applicant[228] further elaborates that the IMCI in question have an average life span of 10 years with some products sold with guarantees to operate correctly for as long as 30 years. TMC have given the following examples:[229]

- Oscilloscopes ~ 10 years average
- Logic Analyzers ~ 10-15 years average
- Waveform Monitors ~ 15-20 years average

This means that displays [sold before 2017 – consultants comment] will be in circulation well beyond the July 2017 date.

TMC has therefore applied for the exemption, clarifying through the evaluation process[230], that it is required in order to enable the further use of products placed on the market before 22.7.2017. The following exemption formulation was therefore proposed to clarify the scope of this request:

> *"Mercury in cold cathode fluorescent lamps (CCFL) for back-lighting liquid crystal displays, not exceeding 5 mg per lamp, used in industrial monitoring and control instruments placed on the market before 22.7.2017"*

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[225] Op. cit. TMC (2012a)

[226] Op. cit. TMC (2012a)

[227] Op. cit. TMC (2012a)

[228] Op. cit. TMC (2012a)

[229] Op. cit. TMC (2013c)

[230] TMC (2013b) Answers to further clarification questions, following the consultation, and regarding exemption Request 20a, Submitted by Test & Measurement Coalition (TMC), February 2013

*Sections 9.1 through 9.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

9.3 Applicant's Justification for Exemption

The following justification for Exemption reflects the views of the applicant and does not necessarily reflect the views of the Consultants.

The basis of the justification is that the applicant claims that whilst it is likely that substitution of non-conforming CCFLs in new products will be complete by the 2017 deadline, there will be RoHS compliant products that will become non-compliant when the 2019 hard cut-off deadline passes.

The applicant explains that this will cause problems in a number of ways:

- Where working IMCI equipment requires a new lamp, if there is no "drop-in" LED substitute then the product will be redundant when it may be capable of many more years operation;
- Resale of working non-compliant units would be prohibited, despite them having been RoHS compliant prior to the changes and potentially capable of operation for many more years; and
- Rental and leasing organisations would be faced with having to replace a large amount of their IMCI equipment despite the fact that it is still operational.

The request for exemption, therefore, is to increase the longevity of products placed on the market prior to the applicability of the substance restrictions under the RoHS Recast

9.3.1 Substitution and elimination possibilities

As detailed in section 9.2, the applicant explains that substitutes have become available in the form of LEDs.[231] However LEDs do not offer a drop-in substitute in most cases, but rather require some redesign efforts or reliability testing to ensure that the substitute provides comparable performance over time. As the availability of LED displays for the products, which fall under this request for exemption, has not been fully established, a transition period is needed for the compliance of IMCI.

TMC explains[232] that:

> *"Some designs initialized or converted to RoHS compliance prior to the implementation of the reduced CCFL mercury allowance of 3.5 mg per lamp in January 2012 were produced with displays compliant to the 5 mg limit for upwards of five years prior to a transition to the lower limit or LED backlighting. This means that despite the fact that IMCI products are on pace to meet the RoHS Recast standard for mercury content prior to the mandatory date in 2017, there are products already in the customers' hands or still in production that have expected lifespans well past the 2019 hard cut-off date referred to in Article 2 (2)…*

[231] Op. cit. TMC (2013b)

[232] Op. cit. TMC (2013b)

TMC companies have been working towards RoHS conversion for about a decade, so early conversion projects did not have an opportunity to address such a substitution at the time, as displays with the desired characteristics (e.g. longevity, brightness, sunlight readability, form factor, compatibility of connections and/or room in enclosure to make necessary hardware additions) were not at that time available. For example, in some older design cases a display driver 'daughter' board must be designed to convert signals to drive an active versus passive display as the older passive type has not been converted due to display industry market forces. This sort of hardware addition can then cascade to require circuit board mounting hardware additions to the chassis as well as cabling changes. Even a simpler 'drop-in' type change will require safety evaluation, reliability testing and confirmation of continued electromagnetic compatibility, and will cost around 10,000 € and three months per program."

In this regard TMC[233] state that:

"the request for an exemption for the use in industrial monitoring and control instruments (IMCI) of mercury in CCFL display backlighting not exceeding 5 mg per lamp is intended to increase the longevity of products placed on the market prior to the applicability of the substance restrictions under the RoHS Recast. Due to the administrative details and final language of the RoHS Recast and prior exemption review, IMCI products intended to be RoHS compliant by design will lose this status prior to their functional end-of-life, and therefore will be rendered valueless prematurely if an exemption is not granted… IMCI have an average lifespan of upwards of 10 years, over which they retain significant value to the customer. There is a robust resale market and a very active test and measurement equipment rental and leasing sector that relies on the ability to continue to place the product on the market after the initial purchase from the manufacturer… we expect that the display transition will have occurred for all products in production at the time RoHS 2 requirements impact IMCI, but the true issue is related to products already in customer hands at that time. The exemption is requested only to ensure these earlier products may be made available throughout their useful life."

Additionally, the applicant further claims[234] that detailed technical information regarding the relevance of this request to the variable product range is not available at this stage. The reason this is the case is that the exemption [Annex III, (3a) – consultants comment] was presumed to be available for sub-category 9 industrial applications, and therefore no detailed assessment and investigation has been performed so far.

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[233] Op. Cit. TMC (2013b)

[234] TMC (2011b) Answers to first clarification questions no. 20 (withdrawn), Submitted by Test & Measurement Coalition (TMC), December 2011. thttp://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/Request_20/Questionnaire_Exe-20_TMC.pdf

*Sections 9.1 through 9.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

Due to the longevity and complexity of the equipment, the applicant indicates that there is a need to ensure the supply of replacements for existing screens in order to extend the support life of pre-RoHS equipment. Regarding the use of possible alternatives for replacement screens, the applicant claims that it is not that using a lamp with less mercury (3.5 mg instead of 5mg) will make a noticeable performance difference in the final display unit. It is merely that not all displays have drop-in substitutes made available by their vendors. This could be due to

- Consolidation of the supply stream;
- Suppliers going out of business; or
- Suppliers choosing to discontinue a product if redesign is not commercially viable. [235]

All new equipment is being developed on the basis of LED based backlighting and the problems mainly occur in a limited set of older equipment types with larger screen sizes. TMC estimates that the costs of replacement and redesign, testing and normalization of the remaining older-design equipment are disproportionate to the return in terms of environmental benefits.[236]

The primary issue preventing complete substitution in current production is the lengthy process involved in converting the entire portfolio of products to RoHS compliance.[237]

9.3.2 Socio-economic effects

According to the applicant,[238] the socio-economic effects associated with the requested exemption can be summarised as follows:

1. This request concerns a minimal amount of mercury, and due to the nature of displays as “fixed in place” parts of the instrument, the replacement is never a drop in replacement. It requires changes to the very structure of the instrument, with all the consequences that this entails, which is not economically and environmentally sound policy to implement, given the negligible amount of mercury involved.
2. The cost of redesign is excessive compared to the amount of product sold, as the change in the display has further reaching consequences in comparison with a drop in replacement. The critical assessment is whether the environmental/health benefit that is being pursued is reasonable compared to the cost incurred for compliance.

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[235] Op. cit. TMC (2013c)

[236] Op. cit. TMC (2012a)

[237] TMC (2011c), Additional Information Provided by the Applicant, submitted on 21.11.2011: http://rohs.exemptions.oeko.info/fileadmin/user_upload/Rohs_V/General_comments_to_Oeko_s_questions.docx

& Op. cit. TMC (2013b)

[238] Op. cit. TMC (2012a)

3. Given that the products have very long lifetimes and are generally repurposed or recycled, they comprise only a tiny part of the total waste stream, the environmental benefits that might be obtained are minimal whereas the economic and social effects of product withdrawal and the lack of access to ICMI equipment for EU industries would be tremendous.
4. The seeming slowness of transitioning by industrial category 9 is not based on a lack of effort or willingness but simply on sheer scale and limited human, technical and financial resources available to make the transition.
5. Granting the exemption will allow equipment already produced to retain its value and extend its working life. It will not cause additional mercury to be placed on the market as the industry is already committed to moving ahead with the conversion of existing products as fast as is practical

In the view of the applicant[239] the impacts mentioned above cannot be resolved simply by making more of an engineering effort, as this would consume the existing resources allocated to new product development activities. This effectively penalizes manufacturers who invested resources in developing RoHS compliant products in parallel to the regulations development to bring them into scope.

9.3.3 The Scope of the Exemption

The applicant argues that mercury use in CCFL for back lighting liquid crystal displays is the most suitable technology for supporting old-style instruments. This is because:

- While new products can clearly adopt the current LED-backlit displays, displays used in current production instruments do not have a direct equivalent which has the same physical dimensions, mounting locations or video interface specifications. In such cases, enclosure and/or video interface redesigns would be required to adopt the latest display technologies. Consequently, there is not a technological equivalent drop-in display available in each and every case[240]; and
- Due to the qualification process which is unique to an individual product design, the redesign to update a product display (or a complete RoHS conversion) is product specific, not by product type. Depending on its lifecycle state, one oscilloscope may have been completely redesigned since RoHS1 came into force while a different oscilloscope is still substantially the same, where its major hardware components are concerned. This is because various product lines are typically refreshed in parallel across a company's portfolio, but products within any single product line are generally refreshed in 'rotation' as expert resources for redesign activities are limited. Unfortunately there is no way to limit the request scope by product type.[241]

[239] Op. cit. TMC (2012a)

[240] Op. cit. TMC (2013b)

[241] Op. cit. TMC (2013b)

*Sections 9.1 through 9.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

9.3.4 Road Map for Substitution

Originally, the applicant supplied a number of roadmaps regarding the relevant timeframe of the requested exemption.[242] As these concerned the timeframes needed for the redesign of new products, these do not seem paramount to the evaluation of the request and have therefore not been detailed. TMC claims that the industry has been working towards RoHS compliance for about a decade.[243] As it had been assumed that exemptions previously listed in RoHS 1 would remain available for category 9, early conversion projects did not address CCFL substitution in displays at the time.

Finally, TMC provides an estimation of the time needed to complete the transfer of all remaining products relevant for this request[244]. The estimated time range is that display conversion should be completed between the end of 2015, and the end of 2017, with product withdrawals as necessary. As products have service lifetimes of 10-20 years (see details in section 9.2 above), an exemption to allow such products to remain in service throughout their expected lifetime duration is requested.

9.4 Stakeholders' Contributions

The Danish Ministry of Environment has submitted a contribution during the stakeholder's consultation[245]. It objects to the scope and wording of the exemption as proposed by the applicant for the following reasons:

- *"The request on this exemption addresses applications where alternatives have been developed for category 1,2,3,4,5,6,7 and 10. Thus, it is expected that alternatives are available or could relatively easily be developed also for category 8 and 9. To support this view no request for exemption on these applications has been made for category 8."*
- *"Furthermore, they first apply for the whole category 9, and then they narrow it down to only the industrial equipment without explanation."*
- *"The main reason put forward for the exemption thus seems to be, not that there are no replacements available, but that the industry has assumed that there would be an exemption and has thus developed products in line with this assumption, and so changing to a new technology would be very costly at this point. We* [the Danish Ministry of Environment – consultants comment] *doubt that this is a valid argument. Anyway, the applicant should estimate the cost for replacement and it does not seem to us that they have done this."*

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[242] All TMC

[243] Op. cit. TMC (2013b)

[244] Op. cit. TMC (2013b)

[245] Danish Ministry of Environment (2013) Stakeholder document submitted by Danish Ministry of Environment on 15 February 2013 within the consultation ; http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/20130215_Contribution_to_RoHS_Ex_Re__17a_18a_20a_Danish_Ministry_of_Environment.pdf

- The Danish Ministry of Environment suggests that the EU COM reject the requests and recommend to the TMC to quantify and resubmit their applications in 2016.

Another Stakeholder contribution was provided by a group of Japanese Industries - Association JEITA/CIAJ/JEMA/JBMIA.[246] Concerning exemptions that consist, to some degree, of a renewal or extension of exemptions that appear in Annex III, the association states that "If such exemptions are added to Annex IV, in which several items of the existing exemptions in Annex III are mixed, they could lead to misunderstanding that the total scope of these exemption items are exempted and may lead to the marketing of some products incompliant to RoHS." The association thus recommends that *"Exemptions only, which have already expired but which are necessary to be continued for Category 9, should be assessed and then, if needed, Annex III should be revised".*

9.5 Critical Review

9.5.1 REACH Compliance - Relation to the REACH Regulation

Section 5.0 in this report lists conditions stipulated in the REACH Regulation to specify if and how mercury may be used in the manufacture of applications; inter alia items 18 and 18a of the REACH regulation Annex XVII, state that mercury shall not be placed on the market when used as an anti-fouling agent or when used in measuring devices (such as manometers, barometers, sphygmoma-nometers, and thermometers other than fever thermometers).

As Sub-category 9 industrial products for which this exemption renewal has been requested are not considered to fall under the scope of applications mentioned in items 18 and 18a, the consultants believe that in the case an exemption is granted, the use of mercury in this application would not weaken the environmental protection afforded by the REACH Regulation.

Thus the consultants conclude that the use of mercury in these applications complies with the REACH Regulations.

9.5.2 Scientific and Technical Practicability

From the consultants' knowledge, worldwide, cold cathode fluorescent lamps (CCFLs) are used as a component in high technology products. Frequently, CCFLs are used as backlight lamps in displays of various devices.

Though the consultants are aware that substitution has been possible in other devices, either with lamps containing less mercury or with LED lamps, neither the

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[246] JEITA/CIAJ/JEMA/JBMIA (2013) Stakeholder document submitted by JEITA (Japan Electronics & Information Technology Industries Association), CIAJ (Communications and Information Network Association of Japan), JEMA (Japan Electrical Manufacturers' Association), JBMIA (Japan Business Machine and Information System Industries Association) on 15 February 2013 within the consultation ; http://rohs.exemptions.oeko.info/fileadmin/user_upload/RoHS_VIII/20120215_Contribution_RoHS_Ex_Re_17a_18a_20a_JEITA_CIAJ_JEMA_JBMIA.pdf

*Sections 9.1 through 9.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

applicant, nor other stakeholders, have comprehensively addressed the issue of substitution in sub-category 9 industrial products.

TMC explains that the display component is not manufactured by the device manufacturer but rather supplied from third parties, and drop-in substitutes are not made available for all devices by suppliers.[247] This being the case, as outlined in section 9.3.1, there may be limited availability of substitute replacements depending on the decisions of each vendor. To support this statement the applicant explains that "*Based on input from some manufacturers there will be a number of instruments withdrawn from the European market if this exemption is not granted*."[248]

Further information has not been provided, demonstrating the technical issues that inhibit "drop in" substitution, such as technical drawings and specifications. Nor has the range of applications for which this exemption is needed been demonstrated through specification of certain product groups or models. However it is understood that the product range is being reviewed in this regard, as part of the efforts towards redesign for RoHS compliance, and the consultants can follow that details have not been clarified at present for all devices. As information has not been submitted to suggest otherwise, and in light of possible technical differences between CFLs and LEDs in terms of dimensions and electric specifications, the consultant is led to understand that in some cases, without an exemption, compliant alternatives will not be made available for all devices as "drop-in" substitutes, making substitution (a retrofit replacement) impractical.

9.5.3 Roadmap for substitution

The time for which the applicant believes the exemption to be needed depends on when the product is to be placed on the market. After the product is placed on the market for the first time, the applicant assumes an average of 10 years of service life, throughout which the replacement of 5 mg mercury CCFLs might be needed. As the applicant estimates that it is likely that the transition to the production of RoHS 2 compliant products shall be accomplished by the end of 2015, this would still require that an exemption be available for the last products as late as 2025. In the case of products with longer service lifetimes, this timeframe may be further extended. Though it can be followed that the exemption may be needed throughout this timeframe, and in some cases, perhaps also beyond it, the RoHS Directive specifies a maximum duration of 7 years for new exemptions relevant for sub - category 9 products. Thus regardless of whether last non-compliant products shall come onto the market at the end of 2015 or during the first half of 2017, and whether lifetimes are regarded as 10 years or longer, an exemption could not be granted at present with a duration beyond July 2024.

[247] Op. cit. TMC (2011a) and TMC (2012a)

[248] Op, cit. TMC (2012b)

9.5.4 Aspects Concerning Components and Spare parts

Though TMC agrees that substitutes do exist, their argument is that the ability to drop-in replacement screens in products that are already in circulation, or that shall come into circulation before 2017, is not ensured. They elaborate that as the redesign of some products was completed before it became clear that exemption 3(a) would no longer allow the use of 5mg mercury CCFLs (components needed for the repair of non-compliant devices placed on the market before July 2017), without an exemption, such elements shall not be RoHS compliant after this date. This raises two issues:

- What is the status of the sub-category 9 devices in terms of coming into the scope of the RoHS Directive; and
- What implication does this status have on the possible use of non-compliant spare parts and components?

As it was established that this exemption is requested for products already on the market and which are to be placed on the EU market before the 21 July 2017, the status of relevant devices can be summarized as follows:

As Article 4(3) excludes industrial monitoring and control instruments placed on the market before 22 July 2017 from the Article 4(1) stipulation, non-compliant products from sub-category 9 industrial shall be in line with the Directive stipulations so long as they are placed on the market for the first time before 22.7.2017. Furthermore, as this article regards "placing on the market" and not "making available" on the market, it is understood that the continued circulation of these products after July 2017 is allowed (again, provided that they were first placed on the market before this date). As stated above, these products have a relatively long service life, and it can be assumed that repairs may be needed after July 2017 to enable a full service life, in part including the replacement of display units using 5mg mercury CCFLs [249]. If such replacement is not allowed, once a malfunction occurs in a relevant device, in cases where display substitutes are not drop-in, devices will not be repairable and thus shall have to be scrapped.

The possibility of using non-compliant spare parts and components can be summarized as follows:

Article 4(4)(e) provides an exclusion from the RoHS stipulations for cables and spare parts needed for repair, reuse, updating and upgrading of sub-category 9 industrial products placed on the market before July 2017. If the displays (containing the non-compliant CCFLs) can be considered to be spare parts, this exclusion would apply. However, it is unclear if components can be understood to be spare parts.

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[249] Article 3 of Directive 2011/65/EU (RoHS 2) Defines:

(11) 'making available on the market' means any supply of an EEE for distribution, consumption or use on the Union market in the course of a commercial activity, whether in return for payment or free of charge;

(12) 'placing on the market' means making available an EEE on the Union market for the first time

*Sections 9.1 through 9.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

Article 3(27) defines spare parts as:

> *"a separate part of an EEE that can replace a part of an EEE. The EEE cannot function as intended without that part of the EEE. The functionality of EEE is restored or is upgraded when the part is replaced by a spare part;"*

Components are not specifically defined in the Directive, though they are mentioned in the stipulations made concerning cases in which exemptions may be justified, in the context of obtaining an exemption for "materials and components of EEE".

The EU Commission RoHS FAQ Document[250] provides some further insight as to the definition and use of components. Components, can *"be separated and used as fully functional separate products" .* The relation between spare parts and components remains unclear, though the FAQ document also details when components need to be RoHS compliant and when not:

> *"Since equipment consists of different components, the EEE itself can only meet the substance requirements if all its components and parts meet the substance restriction requirements of RoHS 2… Therefore components being used in finished EEE or for repair or upgrade of used EEE, which is in the scope of RoHS 2 must meet the substance restrictions according to Art. 4 but do not need CE marking."*

However, the document also makes a distinction to this avail, between the use of non-compliant components in products already in the scope of RoHS and between products that are excluded from scope – whether per directive exclusion or per exemption:

> *"Components… if produced to be used in a product benefiting from an exclusion do not have to be CE marked and do not have to comply with the substance requirements."*

This clarifies, that if the 5mg mercury CCFL based displays are to be seen as components, they could be used in products benefiting from an exclusion, i.e., in sub-cat. 9 industrial products placed on the market before 22.7.2017. It is however unclear, if non-compliant components are further excluded for repair, reuse etc. in such products after this category comes into scope. To summarize:

- if the displays and the lamps fall under the definition of spare parts, their use benefits from a further exclusion, so that the exemption would not be needed;
- if they fall under the definition of components, it must be clarified:
  - whether components fall under the definition of spare parts, in which case an exemption is again not needed; or
  - if components are not covered by this exclusion, as it is unclear if non-compliant components can further be used for the repair of products placed on the market during the exclusion period, an exemption may be

[250] EU COM, 2012, ROHS 2 FAQ Guidance Document, updated 12.12.2012, Q7.1 & Q 7.3; available under http://ec.europa.eu/environment//waste/rohs_eee/pdf/faq.pdf, accessed 16.5.2013

needed. This would require the fulfilment of one of the Article 5(1)(a) criteria for justifying an exemption.

As it can be followed that drop-in alternative displays shall not be available for all devices placed on the market before 22.7.2017, it can be understood that in case of malfunction of the display the device shall become non-functional. In these cases existing substitutes would be regarded as impractical.

Furthermore, the premature disposal of devices is perceived as negative from an environmental standpoint. Though a comprehensive comparison has not been made, the consultants can follow that favouring the replacement of displays with non-compliant units with up to 5 mg mercury per CCFL, over replacement of the whole device, would be in-line with the RoHS Directive intentions. In particular when referring to Item 20 of the RoHS 2 legal text, which states that "…product reuse, refurbishment and extension of lifetime are beneficial…".[251]

9.5.5 Review of Stakeholder' Contributions

Both stakeholder contributions submitted during the stakeholder contribution address general issues that concern all requests handled within this project.

As it was only clarified after the consultation that the exemption is requested for prolonging the service life of articles placed on the market before the substance restrictions apply to IMCI, the consultants assume that the concerns raised by the Danish Ministry of Environment are to some degree alleviated.

Concerning the possibilities of substitution, the Danish Ministry of Environment anticipates that alternatives in use in categories 1-7 and 10 could also be applied in IMCI or easily adapted for this purpose. TMC indeed points out that the effort towards substitution is underway, however products placed on the market before 2017 are not required to comply with the substance restriction. As 2017 was set as a date for substance restrictions to apply to IMCI, it is understood that it was anticipated that the substitution process could take some time. The consultants assume that the Danish Ministry of Environment did not have products placed on the market before 2017 in mind in the context of this issue.

The Ministry also ponders the fact that the exemption was first requested for a wider range of products (category 9 and not the narrower industrial category 9 sub-group) and changed with no explanation. Though the request was originally made for all category 9 applications, TMC clarified[252] that it only represents its own members, which from further communication require the exemption only for IMCI. The RoHS Directive indicates that the scope of exemptions should be as narrow as possible. Furthermore, as stakeholders have not indicated that an exemption would be needed

[251] Op. Cit. RoHS 2 (2011), item (20)

[252] Op. cit. TMC (2011c)

*Sections 9.1 through 9.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

for non-industrial monitoring and control instruments, the consultants do not see the limitation of scope as an issue of concern.

The group of Japanese Industries - Association JEITA/CIAJ/JEMA/JBMIA recommend that, should an exemption be granted, it should be added to Annex III so as to avoid misunderstanding. However the applicability of exemptions listed in Annex IV is clearly stated in the first sentence of the Annex: "Applications exempted from the restriction in Article 4(1) specific to medical devices and monitoring and control instruments". The consultants therefore cannot follow why the addition of an exemption to Annex IV could be misinterpreted to apply to categories 1-7, 10 and 11. As it is proposed to further limit the scope of an exemption by adding "*used in industrial monitoring and control instruments"* to the wording, a misinterpretation by the medical industry is also not anticipated.

9.5.6 Conclusions

In the industrial monitoring and control sector, various devices are equipped with back-lighting liquid crystal displays, in which CCFL lamps with 5mg mercury are still in use. It is unclear if these components would fall under the definition of spare parts. It is therefore also unclear if they could further be used for the repair of devices placed on the market before the coming into scope of sub-category 9 industrial, as is possible with spare parts.

Assuming that components are covered by the Article 4(4)(e) exclusion, the requested exemption is not needed, as the repair of devices placed on the market prior to July 2017 is ensured.

However, if components do not fall under this exclusion, in the consultant's opinion, their use for prolonging the life of devices placed on the market prior to the coming into the scope of RoHS would be viewed as environmentally beneficial.

As the components shall enable the repair and prolonging of service life of devices, which is the intention behind the cables and spare part exclusion, we believe that an exemption is in line with the original intentions of the Directive.

Furthermore, it can be understood that in some cases, the compliant versions of displays may not be compatible (size, electronics…) with existing devices, making substitution unpractical and in case of malfunction, resulting in an early end-of-life of devices.

In this sense, not recommending an exemption would promote the early disposal of such devices before they have reached their full service potential, contributing to the production of more waste.

Therefore, on the balance of evidence the consultants conclude that:

- A retro-fit substitution is not always practical (not drop-in); and
- Substitution may be tied with negative environmental and health impacts (in light of premature end-of-life).

As a result, the consultants recommend that granting an exemption would be in line with the RoHS criteria.

9.6 Recommendation

As explained above, it is possible that the components for which this exemption has been requested fall under the cables and spare part exclusion stipulated in Article 4(4)(e) of the Directive. In this case, an exemption would be redundant and is hence not needed. If components are not regarded to fall under the definition of spare parts, their use in this request is still understood to be in line with the same intention; namely enabling the prolonged life of articles placed on the market in compliance with the requirements of the Directive. As it can be followed that substitutes shall not be readily available for all such devices, requiring early end-of-life, an exemption for products that are to be placed on the market before the relevant category comes into scope would be in-line with the criteria stipulated in Article 5(1)(a) and hence, an exemption would be justified.

In light of the average service life of the products in question, and as such products may legally be brought on the market until 21/07/2017, the consultant sees no reason not to grant an exemption for the maximum duration of 7 years.

The following wording was formulated, and is recommended to be added to Annex IV, along;

> *"Mercury in cold cathode fluorescent lamps (CCFL) for back-lighting liquid crystal displays, not exceeding 5 mg per lamp, used in industrial monitoring and control instruments placed on the market before 22/07/2017"*
>
> *Expires on 21/07/2024*

9.7 References

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*Sections 9.1 through 9.4 are heavily based on information provided by the applicant and other stakeholders. Alterations have been made mainly to ensure comprehension and to avoid repetition.

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APPENDICES

A.1.0 Appendix 1: List of small scale IMCI manufacturers

A simple search on a specialized site like dmoz.org will yield over 300 possible IMCI manufacturers on the global scale. Instrumentation makers – which would include some players that aren't really IMCI type companies, yields another thousand. These companies are on the whole not significant as the coalition represents the only large integrated manufacturers. Most instruments are sold in very small quantities sometimes only one a year, a high volume piece of industrial equipment would sell in the low thousands per year. The market is highly specialized and particular completely unlike the consumer electronics market that has comparatively fewer different types of products but volumes that are several factors larger than the IMCI sector. (TMC (2012c))

These companies are individually perceived as minute, compared to the TMC members although they could be large in other areas. Examples of such companies are listed below:

- Emerson Controls
- LeCroy
- Chauvin Arnoux
- Kenwood
- Hameg Instruments
- Mueller Electric
- Simpson
- Tucker Electronics
- Scientific Atlanta
- Honeywell
- GE Controls