7th Adaptation to Scientific and Technical Progress of Exemptions 8(e), 8(f), 8(g), 8(h), 8(j) and 10(d) of Annex II to Directive 2000/53/EC (ELV)

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5.0 Exemption 8(f) "Lead in Compliant Pin Connector Systems"

Abbreviations and Definitions

CoPiCS	Compliant pin connector systems
ECU	Engine control unit
FMEA	Failure mode and effect analysis
OEM	Original equipment manufacturer
OSP	Organic surface protection
PCB	Printed circuit board
PTH	Plated through holes

Declaration

The phrasings and wordings of stakeholders' explanations and arguments have been adopted from the documents provided by the stakeholders as far as possible. Formulations have been altered in cases where it was necessary to maintain the readability and comprehensibility of the text.

5.1 Description of Requested Exemption

ACEA et al.[66] requests the continuation of Exemption 8(f) in Annex II of the ELV Directive, i.e. relating to:

Lead in compliant pin connector systems.

5.1.1 History of the Exemption

Annex II of the ELV Directive was reviewed in 2009. At that time it was assessed that lead-free solutions were not yet available for compliant pin connector systems (CoPiCS), even though the substitution of lead in CoPiCS had been proved to be viable in CoPiCS for applications in electrical and electronic equipment under the scope of

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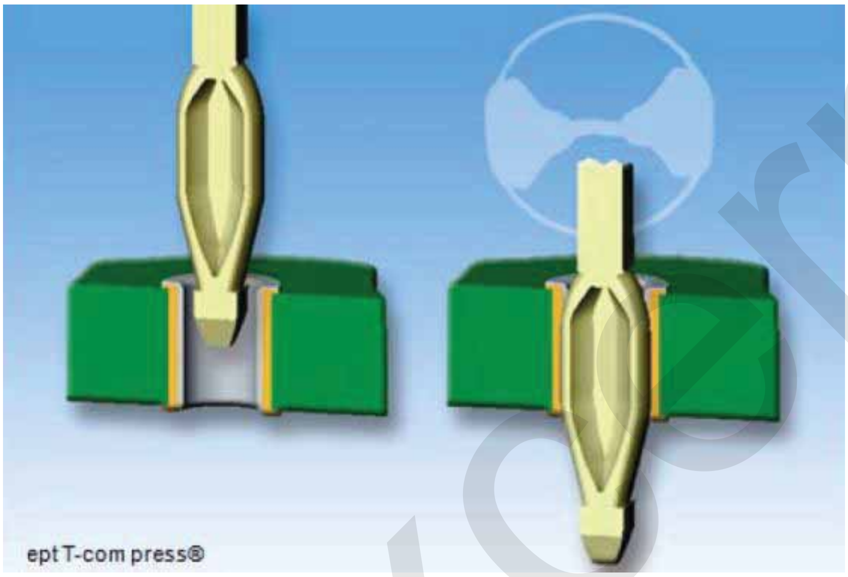
66 ACEA et al. (2013b) ACEA, CLEPA, JAMA, KAMA stakeholder document "acea_clepa_jama_kama_contribution_Ex_8f_20131104.pdf", submitted during the online stakeholder consultation, retrieved from http://elv.exemptions.oeko.info/fileadmin/user_upload/Consultation_2013_1/Exemption_8_f_/acea_clepa_jama_kama_contribution_Ex_8f_20131104.pdf; last accessed 27 December 2013

the Directive 2002/95/EC (RoHS 1)[67]. The main difference was that automotive CoPiCS use insertion forces in the range of 120 to 150 N, while for CoPiCS used in EEE in the scope of RoHS, 20 to 50 N are sufficient.[68] As the stakeholders stated in 2009 that lead-free alternatives were under development, the exemption was scheduled for review in 2014, to adapt it to the scientific and technical progress.

5.1.2 Technical Background

ACEA et al.[69] explains that compliant pin connector or press-fit connector systems provide a method of attachment and electrical contact between a connector and printed circuit board (PCB), which does not require a soldering operation. The pin contacts are inserted into 'plated through holes' (PTH) in the PCB (see Figure 5-1) and the mechanical design of the pin provides reliable electrical contact.

Figure 5-1: Assembly of a Press Fit Pin Connector into a Board Structure



Source: ACEA et al.[70]

[67] For details see pages 140 to 152: Oeko-Institut (2009) Gensch, C.; Zangl, S.; Groß, R.; Weber, A. (Oeko-Institut e.V.); Deubzer, O. (Fraunhofer IZM); Adaptation to scientific and technical progress under Directive 2002/95/EC, Final Report, February 2009, retrievable from http://ec.europa.eu/environment/waste/weee/pdf/final_reportl_rohs1_en.pdf; last accessed 20.11.2011

[68] For details see pages 109-118: Oeko-Institut (2010) Zangl, S.; Hendel, M.; Blepp, M.; Liu, R.; Gensch, C. (Oeko-Institut); Deubzer, O. (Fraunhofer Institute for Reliability and Microintegration IZM); Adaptation to scientific and technical progress of Annex II to Directive 2000/53/EC (ELV) and of the Annex to Directive 2002/95/EC (RoHS), revised version of the final report, Freiburg, 28 July 2010, retrievable from https://circabc.europa.eu/sd/d/a4bca0a9-b6de-401d-beff-6d15bf423915/Corr_Final%20report_ELV_RoHS_28_07_2010.pdf; last accessed 5.09.2013

[69] Op. cit. ACEA et al. (2013b)

[70] Op. cit. ACEA et al. (2013b)

According to ACEA et al.[71], the compliant pins must be sufficiently flexible to deform as they are inserted into the holes without an excessively high force that might damage the plating in the holes. The press fit technology thus saves solder material and energy.

The tin-lead plating on the pins contains about 5%-10% lead and is only about 0.25-1.5 microns thick. Tin-lead plating covers only the termination portion of the contact, which includes the compliant section, which is about 2-7 mm long. Such connectors are used on printed circuit board assemblies contained in most automotive applications.[72]

ACEA et al.[73] claims that the tin-lead plating is required to:

- Provide lubrication while the pins are inserted in order to reduce the insertion force, thus avoiding damage of the PTH, which ensures the required reliability of the contact;
- Ensure good electrical contact once the pin has been inserted;
- Prevent whisker growth;
- Additionally, ACEA et al.[74] highlights that CoPiCS are widely used in safety-related parts like anti-lock braking systems or airbag systems. In case of failure, human life is directly endangered.[75]

[71] Op. cit. ACEA et al. (2013b)

[72] Op. cit. ACEA et al. (2013b)

[73] Op. cit. ACEA et al. (2013b)

[74] Op. cit. ACEA et al. (2013b)

[75] For more details on the technical background see Oeko-Institut (2009), pages 140-152, and Oeko-Institut (2010), pages 109-118

5.1.3 Amount of Lead Used under the Exemption

ACEA et al.[76] bases an estimation of lead use under this exemption on the assumptions listed in Table 5-1.

Table 5-1: Basic Assumptions for the Calculation of Lead Use under Exemption 8(f)

Value	Unit	Description
3.2	mm	Circumference of pin
7.0	mm	Length of surface
0.8	µm	Thickness of layer
7%	Lead portion of layer	
0.0012544	mm^3	Volume of Pb per pin
0.011342	g/mm^3	Specific mass density of lead
14.2274	µg	Weight of lead per pin
100	Pin/ECU (engine control unit)	Number of pins per ECU
10	ECU/Car	Number of ECUs per Car
71,490,000	Cars	Cars worldwide*
13,430,000	Cars	Cars in Europe*

**Note: Given the context of the table in the original document, the consultants understand the data provided for the number of cars in the EU and worldwide to regard annual quantities of cars placed on the respective markets.*

Source: ACEA et al.[77]

[76] Op. cit. ACEA et al. (2013b)

[77] Op. cit. ACEA et al. (2013b)

Based on the above assumptions, ACEA et al.[78] calculates the total, worldwide amount of lead used in CoPiCS to be 1.0 t per annum of lead worldwide, and around 0.2 t per annum in Europe.

ACEA et al.[79] admits that this is much less than the 0.8 t per annum ACEA et al. had estimated for Europe in the 2009 review. ACEA et al.[80] attributes this to the lower amount of lead with thinner platings that have been introduced during the last years.

5.2 Stakeholders' Justification for Exemption

5.2.1 Elimination of Lead

In principle, CoPICS could be replaced by solder joints, which also provide mechanical and electrical contact between components and the printed circuit board. ACEA et al.[81] explains that technologically, pin compliant connectors avoid the difficulties encountered in soldering a large number of closely spaced pins. The total thermal mass can be so large that it is difficult to achieve the correct temperature throughout the connector for the solder to flow and wet the surfaces. The situation is even more difficult with lead-free solders due to their slower wetting and higher assembly temperature. As solder is not used, smaller pads can be used around each pin, so that they can be placed closer together. The thermal situation will be even more critical because of the miniaturization of pins and components. Miniaturization, however, is needed because of performance and resource issues.

Furthermore, ACEA et al.[82] remarks, high-current applications, which have a lot of copper on the PCB and on the contact element, will have difficulties if soldering is to be attempted. The additional copper will increase the thermal mass of the PCB and make it even more difficult to reach the soldering temperature, which is required to produce a reliable solder joint. The result will be bad hole filling, and connectivity and wettability problems.

5.2.2 Substitution of Lead

5.2.2.1 Differences to RoHS

CoPiCS are used also in electrical and electronic equipment (EEE) which falls under the scope of Directive 2011/65/EU (RoHS 2). Exemptions 11(a) and 11(b) in Annex III of RoHS 2, allowing the use of lead in CoPiCS in EEE, expired in 2010 and in January 2013 respectively.

[78] Op. cit. ACEA et al. (2013b)

[79] Op. cit. ACEA et al. (2013b)

[80] Op. cit. ACEA et al. (2013b)

[81] Op. cit. ACEA et al. (2013b)

[82] Op. cit. ACEA et al. (2013b)

ACEA et al.[83] quotes the reports of Oeko-Institut[84] from the former reviews of the CoPiCS exemptions in the RoHS and ELV Directive in 2009 and 2010 to explain the differences between CoPiCS and their use in RoHS- and ELV-related applications:

> *"Compliant pin connectors in most "RoHS" equipment, in particular on complex PCBs like in high end servers, are used among other reasons because pin connections can be repaired and replaced. For repair, rework and upgrade e.g. of servers, the compliant pin connectors must be removable and reinsertable without causing damages to the pins or the plated through holes, and still work reliable. Any bonding of the pins to the plated through hole (PTH) due to cold welding effects must be avoided in such uses under the scope of the RoHS Directive.*
>
> *This is a crucial difference between automotive and non-automotive press fit applications. While cold welding must be avoided in most RoHS equipment, it is the aspired effect in automotive press-fit applications. Cold welding of the pins to the PTH walls is necessary that the pin connector systems can reliably withstand the mechanical forces enacted onto them due to vibration and temperature changes, and the combination thereof. Pin movement in the holes would result in unreliable functionality. To achieve the cold welding effect, a higher pressure of the pin to the PTH wall is required. This higher pressure entails a higher force to insert the pins into the holes. ACEA et al.[85] claim that for pin connectors in telecom equipment typical insertion forces are 20 to 50 N/pin, while automotive pin connectors are inserted with forces up to 150 N/pin."*
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> Source: Oeko-Institut[86] referenced in ACEA et al.[87].

5.2.2.2 Growth of Whiskers

ACEA et al.[88] states that whisker problems appear if lead-free chemical tin finishes on the PCB and galvanized tin surfaces on the press-fit pins are combined together (see examples in Figure 5-2).

[83] Op. cit. ACEA et al. (2013b)

[84] Op. cit. Oeko-Institut (2009,2010)

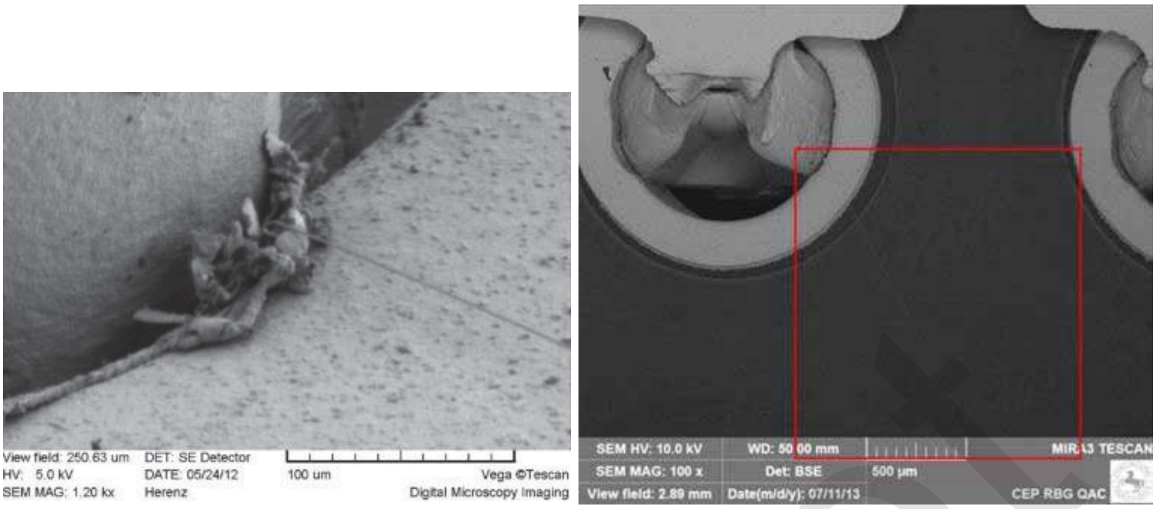
[85] Op. cit. ACEA et al. (2013b)

[86] Op. cit. Oeko-Institut (2009,2010)

[87] Op. cit. ACEA et al. (2013b)

[88] Op. cit. ACEA et al. (2013b)

Figure 5-2: Whiskers Examples (see within the “line” in the right part of the left picture, and in the red rectangle on the right picture):



Source: ACEA et al.[89]

ACEA et al.[90] states that large deformations in the entrance area of the press-fit zone and tin abrasions from the pin surface adhering to the PCB-bushing surface increase the probability of whisker growth.

ACEA et al.[91] explains that CoPiCS are currently in use with both Sn and SnPb surface finishes. Since the last review in 2009 several cases of multiple customer returns of electronic devices caused by extensive whisker growth occurred when pure tin finishes had been used for pilot applications.

ACEA et al.[92] highlights from literature that stress gradients within the Sn surface is one of the driving forces for Sn whiskers. In all cases the insertion forces have been medium to high as described earlier. Due to the required reliability of automotive applications high retention forces are needed. High retention forces calls for high insertion forces which automatically results in high strain levels in the contact zone. This is the reason why at the border of the contact area between press-fit pin and plated through hole (PTH), high stress gradients are present which tend to generate whisker growth with high probability of electrical short circuit. Even CoPiCS with high insertion forces, which haven’t been estimated as highly prone to whisker growth due to their still moderate deformation shape, showed whisker returns recently. This leads ACEA et al.[93] to the conclusion that the occurrence of press-fit whiskers is not yet fully

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[89] Op. cit. ACEA et al. (2013b)

[90] Op. cit. ACEA et al. (2013b)

[91] Op. cit. ACEA et al. (2013b)

[92] Op. cit. ACEA et al. (2013b)

[93] Op. cit. ACEA et al. (2013b)

understood. This especially holds for the immersion tin layer production and resulting surface structures as well as the galvanic tin plating chemistry behaviour and the interplay of these factors.

ACEA et al.[94] says that the lack of knowledge led in all cases to a re-introduction of SnPb platings with a Pb-content of 5-10%, which immediately solved the whisker issue. In detail the mechanism of Pb preventing SnPb from generating long whiskers is not understood so far. Therefore, it is not possible yet to develop a substitute of Pb on a knowledge base with sufficient whisker suppression. Consequently mass production with an adequate substitute for Pb is not possible at the moment.

ACEA et al.[95] formulates three main requirements for an adequate substitute for Pb:

- Find a substitute of Pb in order to reach high reliability;
- Development of the bath chemistry and bringing it to high volume series production level worldwide and from different suppliers; and
- Proof of sufficient whisker suppression over the whole range of parameter scattering in the galvanic of the press-fit contacts and manufacturing process of the ECU with all interdependencies.

5.2.2.3 Compliance Activities in the Past Years

ACEA et al.[96] states that over the past few years an industry working group investigated the use of lead free CoPICS. In this working group a number of OEMs (original equipment manufacturers), Tier1s and Tier2s are working together to make lead avoidable as soon as possible. Information on the following potential approaches was provided:

2) <u>Geometrical change</u>

ACEA et al.[97] says that Oeko-Institut[98] had recommended making the pins smaller and the holes bigger. The automotive industry needs a cold welding effect for its connections. Cold welding effect needs high pressure between the pin and the PCB. If the geometry of the pins is changed, these pressures will not be present between the pin and the PCB.

3) <u>Thickness of tin-lead plating</u>

According to ACEA et al.[99], the thickness of the surface layers has been reduced in order to minimize the amount of lead in the compliant pin connector systems.

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[94] Op. cit. ACEA et al. (2013b)

[95] Op. cit. ACEA et al. (2013b)

[96] Op. cit. ACEA et al. (2013b)

[97] Op. cit. ACEA et al. (2013b)

[98] Op. cit. Oeko-Institut (2010)

[99] Op. cit. ACEA et al. (2013b)

4) <u>Protection with lacquer layer</u>

ACEA et al.[100] states that a lacquer layer can't stop whisker growth. Tests showed that lacquer also lead to contact problems. Furthermore, the use of lacquer would result in additional resources and a big environmental impact.

5) <u>Gold surfaces</u>

ACEA et al.[101] states that Oeko-Institut[102] had recommended investigating gold surfaces. In the 2009 [RoHS] review, gold surfaces were rejected due to their insufficient cold welding properties. Despite the stakeholders in the RoHS Annex review having rejected gold surfaces, the automotive industry nevertheless investigated gold-combinations. These combinations showed minor reliability results in test series, increasing resistance after temperature changes and less retention forces after vibration due to loss of cold welding effects. The gold connections could be described as brittle, intermetallic connections.

6) <u>Alternative surface materials of pins and PCBs</u>

ACEA et al.[103] reports that on a generic level, there has been evaluation and investigation of alternative surfaces that might replace SnPb as well as Sn. Especially treated indium surfaces and certain SnAg compound surfaces might be candidates to partially replace surfaces used today. Both, SnAg and In (indium)-bath chemistries were developed together with a specialized galvanic plating supplier for each plating in 2009-2011 with great efforts and costs on both sides, suppliers and Tier1s.

According to ACEA et al.[104], a test program was set up in order to prove the long-term reliability by Design of Experiments, Process and Product-FMEA (Failure mode and effect analysis), process controls and whisker tests. Now, first experiences and results are available for SnAg in one pilot product field in series, since 2011 ongoing. For indium, first product validations are scheduled. Although the tests are running overall well, sometimes sudden unexpected peaks in the failure ratio appear. Further on, transfer to high volume production from galvanic side and experience with other automotive applications is missing. At last, this is a single source and just available in Germany. There is no solution worldwide available for SnAg and In galvanic.

Beside metallic surfaces, ACEA et al.[105] describes an extensive study investigating "press-fit at OSP (Organic Surface Protection)" as an alternative Sn-free PCB finish to avoid one possible source of whisker growth. The alternative PCB finish with

[100] Op. cit. ACEA et al. (2013b)

[101] Op. cit. ACEA et al. (2013b)

[102] Op. cit. Oeko-Institut (2010)

[103] Op. cit. ACEA et al. (2013b)

[104] Op. cit. ACEA et al. (2013b)

[105] Op. cit. ACEA et al. (2013b)

OSP in combination with Sn, SnAg, and In pin surfaces increase the number of alternative surface combinations. The evaluation of the results is not finished yet, but shows even higher insertion forces and PCB through hole deformation compared to immersion Sn PCBs. This indicates an increased risk for both manufacturability and reliability. Besides, the combination OSP on PCB and Sn on the pin still shows too high whisker growth.

ACEA et al.[106] sums up the assessment of working group "Press fit in OSP PCB" as follows:

- Press fit with OSP shows potential in future;
- Lower performance in comparison to state of the art;
- Shown weaknesses have to be ensured by:
    - Further investigations on PCBs and Pins;
    - Pilot projects between OEMs, Tier1s and Tier2s at both the component and vehicle levels.

5.2.3 Road Map for Substitution or Elimination

ACEA et al.[107] states that the industry consortium will perform further research in the next years. The pilot projects should mainly focus on Organic Surface Protection, change of basic printed circuit board materials and lead-free pins. Unfortunately, until now a lot of uncertainty and unknown topics occur during the development of surfaces of CoPiCS. The process is more research than development. So it is not ensured that the milestones can be reached.

ACEA et al.[108] lists the main development tasks:

<u>Task 1: Finish investigation</u>

A replacement of the wide range of SnPb applications cannot be reached in a short range time line. Generic investigations, e.g. at elevated temperatures, in miniaturized and high current applications are not finished or even started yet (time frame - 3 years).

<u>Task 2: Design and product validation</u>

Design and product validations need to be planned and performed and finally introduced on pilot projects to the field (time frame - 3 years).

<u>Task 3: Long-term reliability tests</u>

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[106] Op. cit. ACEA et al. (2013b)

[107] Op. cit. ACEA et al. (2013b)

[108] Op. cit. ACEA et al. (2013b)

It will take several years to gain enough field experience and roll-out the alternative plating to the diversity of applications in all presently known and future environments in light vehicles (time frame - 5 years).

Task 4: Ramp-up production of lead-free CoPiCS

In parallel, the production of the alternative plating must be ensured on a worldwide basis.

ACEA et al.[109] reports that one prototype line exists for each of the two mentioned alternative plating finishes, even though only for a relatively low amount of pins. The galvanic set-up needs to be transferred to the different economic regions (time frame - 3 years). A reasonable supplier portfolio needs to be built-up (time frame - 5 years).

Because of the uncertainty, ACEA et al.[110] requests the extension of Exemption 8(f) with a review date.

5.2.4 TE Connectivity's Arguments Against the Continuation of the Exemption

TE[111,112] claimed that there is no technical reason why Exemption 8(f) should be continued. TE[113] substantiates this statement saying that some action pin, multispring press in zones, in several versions, customized and as catalogue versions, are available. They are used for single pin insertion, assembled in connectors, as well as placed in overmoulded housings with more than several hundred part numbers. The hole diameters are 0.9, 1.0 and 1.5 mm.

5.2.4.1 Use of lead-free CoPiCS in Automotive Applications

In TE[114], TE Connectivity considers itself as market leader and has executed, with the release of the ELV Directive in 2003, a general change from tin-lead finishes to lead free finishes. All electroplating applications for use in automotive applications since 2003 conform with the ELV requirements (content of Pb in layer <0.1%), produced with lead free qualified electroplating baths.

TE[115] states that since 2003 over 10 billion compliant pins with ActionPin press-in zones in automotive airbag control units have been supplied. One example for the use of lead-free CoPiCS is an airbag ECU with millions of devices (every third car) delivered to the automotive market. There are much more applications with compliant

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109 Op. cit. ACEA et al. (2013b)

110 Op. cit. ACEA et al. (2013b)

111 TE (2013a) TE Connectivity document "TE Connectivity 2013a.pdf", sent via e-mail by Mr. Waldemar Stabroth to Mrs. Yifaat Baron, Oeko-Institut, on 30.10.2013

112 TE Connectivity are a designer and manufacturer of connection and communication components.

113 TE (2014a) TE Connectivity document "Questionnaire-1_TE_Exe-8f.pdf", sent via e-mail by Mr. Waldemar Stabroth to Mrs. Yifaat Baron, Oeko-Institut, on 17.01.2014

114 Ibid.

115 Ibid.

pins in the field, e.g. Multispring in ABS control units and other applications without any Pb content.

5.2.4.2 Prevention of Cold Welding During Insertion

TE[116] describes that, in order to prevent cold welding in the insertion process, during the insertion process the frictional behaviour of the press in system (pin and hole) should be optimized. This can be done by using well shaped round and smooth surfaces (optimizing of stamping process), a lubricant or a material combination, which is optimized to the used PCB technology. When using Sn as a surface layer the Sn thickness has to be optimized to the PCB. To prevent slivers and material wear, the tin thickness should be minimized to a stable press in process.

According to TE[117], the given minimum thickness depends on the press in zone type and the PCB hole/technology. When the Sn layer is too thin, stick slipping and cold welding effects cause a higher press in force and can have a negative impact on the quality. In worst cases the hole can be damaged. Cold welding after pressing in is a sign of a perfect electrical and mechanical connection and therefore an intended quality sign.

5.2.4.3 Prevention of Whisker Growth

TE[118] explains that Sn whisker growth requires as a precondition the presence of Sn and a mechanical stress gradient, which is applied onto the Sn. The more pure tin is present, the more and longer the whiskers are. SnPb is also a cause of whiskers, but reduced in amount and length, compared to pure Sn. To reduce the whisker growth in pure tin compliant pin applications, TE[119] reduces the amount of Sn (fodder for whiskers) to a minimum layer thickness (Sn flash) and shapes the compliant pin zone as smooth as possible during the manufacturing process.

5.3 Critical Review

5.3.1 Restriction of the Scope of Exemption 8(f)

ACEA et al. were asked to comment on TE's statements that lead-free CoPiCS are reliable and available for all applications. ACEA et al.[120] showed that lead-free CoPiCS using the TE lead-free technology were tested, but exceeded the applicable failure thresholds.

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116 Ibid.

117 Ibid.

118 Ibid.

119 Ibid.

120 ACEA et al. (2014b) ACEA, CLEPA, JAMA, KAMA stakeholder document "ACEA CLEPA JAMA KAMA Answers_Questionnaire-2_Exe-8f_20140221.pdf", received by Otmar Deubzer, Fraunhofer IZM, via e-mail from Peter Kunze, ACEA, on 21.02.2014

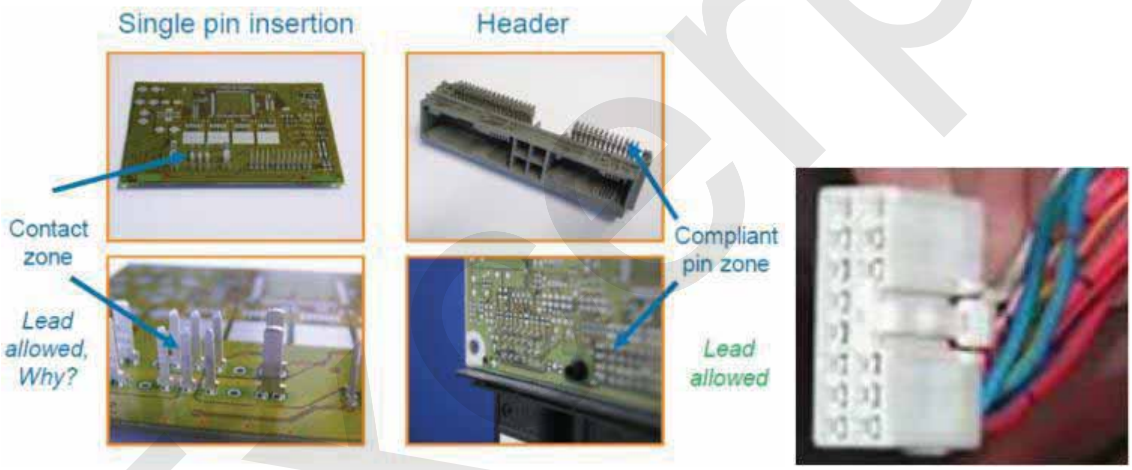
At the meeting on 9 May 2014 at Fraunhofer IZM in Berlin, it was agreed that ACEA et al. agree on a new wording of Exemption 8(f) that would reflect the current status of lead-free solutions for CoPiCS on the one hand, and on the other hand accommodate the still required use of lead. ACEA et al. and TE jointly worked out the below wording proposal for the future Exemption 8(f):

> *Lead in compliant pin connector systems other than the mating area of vehicle harness connectors*

ACEA et al.[121] explains that, based on the research of TE, the risk for whisker growth seems to be low on the mating area of a vehicle harness connector.

ACEA et al.[122] explains that mainly the CoPiCS in the below figures are used for electronic applications and call them “standard CoPiCS”. Standard CoPiCS are “vehicle harness connectors” as they always provide a 2-point connection where one side is the contact side/mating area connected via a harness to the customer applications and the second side is the connection to the printed circuit board by press fit technology. Figure 5-3 shows typical harness connectors.

Figure 5-3: Main Uses as Single Pin Insertion and Combination with a Header of Harness Connectors (left), and a Typical Harness Connector (right)



Source: TE Connectivity in ACEA et al.[123] (left), ACEA et al.[124] (right)

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[121] ACEA et al. (2014f) ACEA, CLEPA, JAMA, KAMA stakeholder document “General-Answers_Follow-up-Questionnaire_ACEA-et-al_20140528.pdf”, sent via e-mail to Yifaat Baron,Oeko-Institut, by Peter Kunze, ACEA, on 28.05.2014

[122] ACEA et al. (2014g) ACEA, CLEPA, JAMA, KAMA stakeholder document “ACEA-et-al._Final-Questions_Exe-8f_20140703.pdf”, sent via e-mail to Otmar Deubzer, Fraunhofer IZM, by Peter Kunze, ACEA, on 04.07.2014

[123] Ibid.

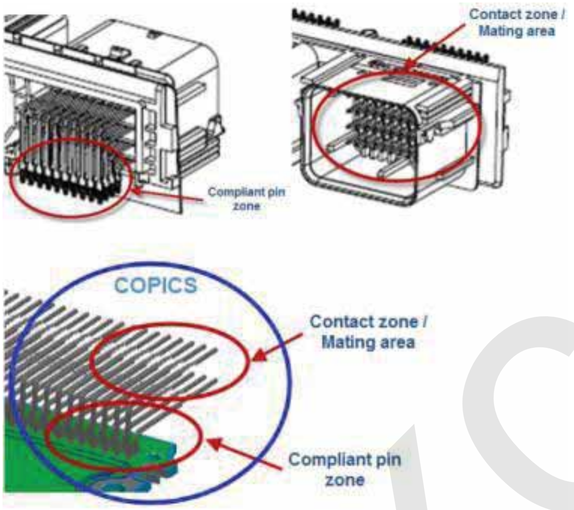
[124] Ibid.

ACEA et al.[125] differentiates between harness connectors (standard CoPiCS) and complex stamp grids. Unlike harness connectors, complex stamp grids, besides compliant pin zones, use other assembly and interconnection technologies like welding, “Schneid-Klemm,” etc. on the same stamp grid.

Typically, these stamp grids have no simple point-to-point connection but more the function of a printed circuit board combined with a complex three-dimensional form. For these kinds of complex parts, the surface needs to suffice the highest technical requirements of the interconnection technology. The application of different surfaces, for example lead and lead-free ones, is technically not feasible because of the complexity of the 3D-form. Therefore, if they use compliant pin zones, leaded tin could be used on the stamping grid.

ACEA et al.[126] defines the “mating area” as the “customer” side of the standard CoPiCS. The connection is here typically done with a harness connector. Figure 5-4 illustrates the situation.

Figure 5-4: Compliant Pin Zone and Contact Zone/Mating Area



Source: TE Connectivity in ACEA et al[127]

According to ACEA et al.[128], the definition “Lead in compliant pin connector systems other than the mating area of a vehicle harness connector” will reduce the use of lead for most of the CoPiCS, but keep the door open for the use of lead on complex stamp grids where it is still required.

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[125] Ibid.

[126] Ibid.

[127] Ibid.

[128] Ibid.

According to ACEA et al.[129], the wording proposal of ACEA et al.[130] and TE Connectivity would result in the following situation concerning the use of lead:

- Contact zone/mating zone:
  - Customer side;
  - Contact with a harness connector;
  - Lead free.
- Compliant pin zone:
  - Printed circuit board side;
  - Lead-containing surface permitted.

ACEA et al.[131] explains that the circumference of the contact zone and the compliant pin zone is not clearly defined. The area in between these zones is therefore dependent on the technical requirements of the plating line. Typically, the lead surface in the compliant pin zone will be kept as small as possible.

5.3.2 Conclusions

TE and ACEA et al. during the consultation had disagreed on the status of lead-free solutions for CoPiCS. The opponents finally agreed and proposed a new wording excluding the use of lead where lead-free solutions are available, and restricting it to those applications, where its use is still unavoidable. Art. 4(2)(b)(ii) would therefore justify the continuation of the exemption with the new wording

Lead in compliant pin connector systems other than the mating area of vehicle harness connectors

The above new wording restricts the scope of the exemption. In the above wording, the current exemption would be replaced by the revised one at the date of publication in the Official Journal of the European Union without a transition period. Adding to that, it would also apply to those vehicles that are already type approved and in series production. This would require redesigning and requalifying all currently used CoPiCS, which would exceed industry's labour capacity and would interrupt vehicle production for the EU market.[132]

By mistake, the transition period and the reference to the type approval were neglected in the previous report (dated 14/01/2015) and therefore have to be added to give industry a transition period to respond to the restricted exemption scope. A

[129] Ibid.

[130] Ibid.

[131] Ibid.

[132] Op. cit. Oeko-Institut (2010), p. 71 sqq.

new wording was therefore proposed and agreed with the stakeholders ACEA et al.[133] and TE Connectivity[134]:

i) *Lead in compliant pin connector systems for vehicles type-approved before 1 January 2017 and spare parts for these vehicles*

ii) *Lead in compliant pin connector systems other than the mating area of vehicle harness connectors for vehicles type-approved after 31 December 2016*

In the reviewers' opinion, the restriction of the revised exemption to new type approved vehicles as well as the transition period until end of December 2016 are appropriate. The transition period leaves sufficient time and is required to take into account the new situation in the development of vehicles that shall be type approved after December 2016.

5.4 Recommendation

Based on the available information, the consultants recommend the rewording of Exemption 8(f) to exclude the use of lead in compliant pin connector systems where lead-free solutions are available, and to restrict it to those areas where the use of lead is still unavoidable so that Art. 4(2)(b)(ii) justifies the continuation of the exemption.

In agreement with all involved stakeholders, the consultants recommend the following new wording of Exemption 8(f):

Materials and components	Scope and expiry date of the exemption
i) *Lead in compliant pin connector systems*	*For vehicles type-approved before 1 January 2017 and spare parts for these vehicles*
ii) *Lead in compliant pin connector systems other than the mating area of vehicle harness connectors*	*For vehicles type-approved after 31 December 2016* *Review in 2019*

To further adapt the exemption to the scientific and technical progress, it is recommended to review the exemption in 2019.

[133] ACEA et al. 2015: ACEA, CLEPA, JAMA, KAMA stakeholder document "ACEA CLEPA JAMA and KAMA Type Approval.pdf", sent via e-mail to Otmar Deubzer, Fraunhofer IZM, by Stefan Dully, ACEA, on 28.06.2015

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