Adaptation to scientific and technical progress under Directive 2002/95/EC

EXCERPT
of final report 2009

Final report

Freiburg, 20 February 2009

Öko-Institut e.V.

Dipl.-Ing. Carl-Otto Gensch

Dipl.-Ing. Stéphanie Zangl

Dipl.-Geoök. Rita Groß

Dipl.-Biol. Anna K. Weber

Fraunhofer IZM

Dr.-Ing. Otmar Deubzer

Öko-Institut e.V.
Freiburg Head Office
P.O. Box 50 02 40
79028 Freiburg, Germany
Street Address
Merzhauser Str. 173
79100 Freiburg, Germany
Tel. +49 (0) 761 – 4 52 95-0
Fax +49 (0) 761 – 4 52 95-88

Darmstadt Office
Rheinstr. 95
64295 Darmstadt, Deutschland
Tel. +49 (0) 6151 – 81 91-0
Fax +49 (0) 6151 – 81 91-33

Berlin Office
Novalisstr. 10
10115 Berlin, Deutschland
Tel. +49 (0) 30 – 28 04 86-80
Fax +49 (0) 30 – 28 04 86-88

EXCERPT
of final report 2009

4.20 Exemption No. 14

"Lead in solders consisting of more than two elements for the connection between the pins and the package of microprocessors with a lead content of more than 80% and less than 85% by weight"

The exemption was described and assessed in the 2004 ERA report [1]. The exemption is used in microprocessors of AMD. The competitor, Intel, claimed to have a lead-free solution available [2].

The exemption was granted without an explicit expiry date and now is subject to the general review of the RoHS Annex.

4.20.1 Description of exemption

Lead-solder is used in a microprocessor application with a high number of pins (i.e. microprocessors with a pin count of 630 pins and higher, e.g. a desktop microprocessor having more than 900 pins). The solder consists of 82% of lead, 10% of tin and 8% of antimony (Pb82Sn10Sb8).

This solder is specifically used to connect the pins to the package carrier providing both electrical connectivity and mechanical stability. The pins serve as interconnect between the microprocessor and the motherboard through a socket.

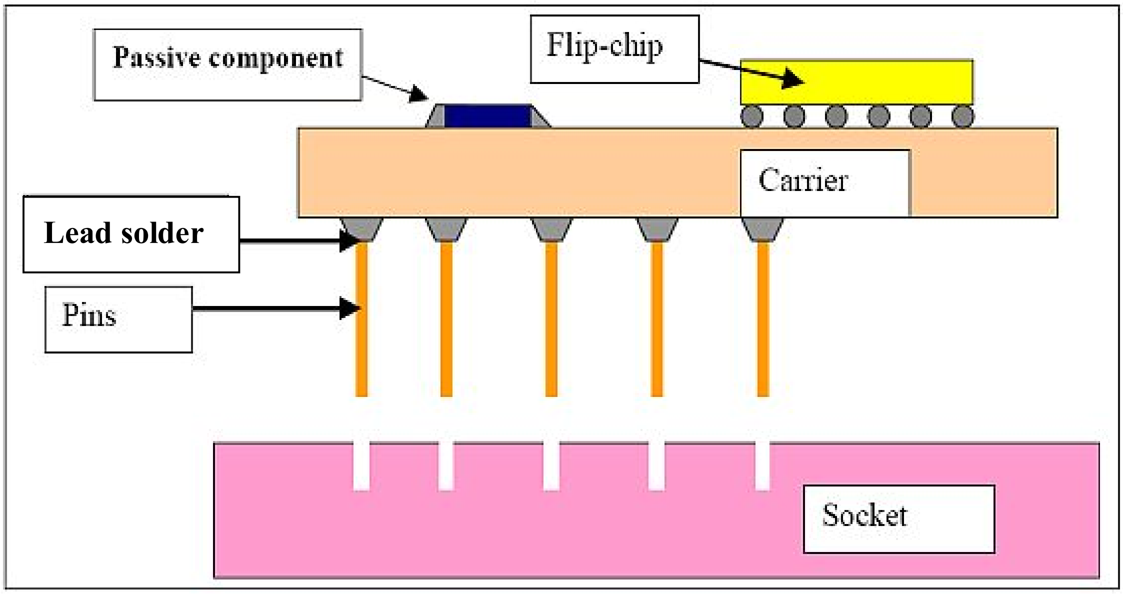

Figure 24 Schematic section of a pin grid array microprocessor package [1]

The large number of connections between the pin and the substrate requires very high reliability per individual connection, as the probability for package failure grows with the number of pins. As microprocessors will provide more functionalities, their packages will become larger and require an increased number of pins [4]. Lead-free solders, according to EICTA et al. [4], so far cannot provide the necessary product quality, yield and reliability in such high pin count applications.

Microprocessors are used in IT and communications equipment as well as in consumer equipment falling under the scope of the RoHS Directive: desktops, servers, embedded applications, mobile and handheld devices [4].

The lead content in the lead solder is more than 80% and less than 85%, or equal to around 0.5 g per microprocessor. The total amount of lead brought into the EU with applications using exemption No. 14 was nearly 6940 kg in 2007 [4].

4.20.2 Justification by stakeholders

According to EICTA et al. [4], alternative, lead-free solders and pin attach methodologies that exist today do not meet the necessary product quality, yield and reliability requirements for microprocessors with high pin counts and are therefore impracticable. AMD [3] uses higher pin counts of up to 940 pins for mass-produced PGA microprocessors compared to the maximum of 478 pins in Intel's mass production PGA microprocessors. The use of lead-free solders would translate to a double or even fourfold increase in pin movement and other associated quality and reliability issues in AMD products, as explained before already. Due to AMDs] significantly higher pin count, Intel's lead-free solution is not applicable to AMD's microprocessor technology [3]. Pin movement and other problems would lead to an increase in scrap, further burdening recycling and disposal systems in Europe. Also, pin positional tolerance is crucial to high manufacturing yields during board assembly. [3]

According to EICTA et al. [4], high pin counts result in increased tolerances and variations during pin mounting on the package and eventually lower the process margins in flip chip attach process. Pin counts have been increasing over time and will continue to do so. Microprocessors will provide more functionalities, their packages will become larger and require an increased number of pins.

The large number of connections between the pin and the substrate requires very high reliability per individual connection, as the probability for package failure grows with the number of pins. AMD states that it has shipped greater than 300 million microprocessor units using the Pb82Sn10Sb8 pin solder, without any quality or reliability failures related to the pin solder. [3]

Experiences with use of lead-free solders

EICTA et al. [4] state that AMD is actively pursuing development of lead-free solders as a substitute to the lead containing pin solder. However, studies have shown several constraints with the lead-free solders:

a) Pin movement

The pin moves from its desired, designed location. This compromises the socketing ability and thus affects the defect rate and mechanical reliability (see Figure 24). The applicant’s product test involves multiple socket insertions (as many as 30x) to ensure product performance, quality and reliability before a part is shipped to customers. In case there is partial pin movement observe, which might even pass this internal test, there is still a high potential for pins detaching from the package in the customers’ assembly process.

According to Master et el. [5], the probability of pin defects increases with the number of pins according to the formula

$P = 1-(1-p)n$

P: probability of a defective unit
p: probability of a defective pin
n: number of pins

With using lead-free solders, the probability p of a pin defect is higher compared to the use of the current PbSnSb solder, as explained above. To achieve the same level of reliability, the number of pins would have to be reduced. Vice versa, lead-free solders may yield sufficiently reliable products for pin grid arrays (PGA) with lower pin counts, but the probability of defects is too high for PGAs with higher pin counts in combination with lead-free solders. [5]

According to Master et al. [5], the socket may accommodate slight movement of a single pin, but is less forgiving with movement of multiple pins. Allowable movement of a single pin can be greater in magnitude than the allowable movement of multiple pins on a device. The threshold of allowable pin movement decreases when multiple pins move, because the movement is not constrained to the same direction. The effect of pin count on failing this tighter threshold can be calculated from the binomial distribution. In this calculation, it is assumed that a slight pin movement will not adversely affect socket insertion unless two or more pins move.

$$P = 1 - \sum_{r=0}^{1} \binom{n}{r} p^r (1-p)^{n-r}$$

Where r is the number of rejects (either 0 or 1 are allowed).
The device defective rate for the 940 package is approximately four times higher than the 478 pin package for the same pin defective rate. This ratio can be approximated by

$$\frac{P_{940}}{P_{478}} \sim \left(\frac{940}{478}\right) - 3.87 .$$

Under these circumstances, a 940 pin package would have nearly four times the reject rate as a 478 pin package. [5]
AMD [3] says that HP has found seemingly minor increases to the pin positional tolerance during the pin attach process resulting in significant increases in damaged pins during board assembly. This increases electronics scrap late in the manufacturing process, sometimes as high as 5%.

b) Solder climb
Lead-free solders climb up the pin (see Figure 24) and thus aggravate the insertion of the pins into the socket. Even if socketing is possible, the solder wears off and contaminates the contacts, as could be observed during the internal test with multiple socketing and desocketing actions. This may lead to arcing that consequently may damage the contacts or even the part itself.

c) Voiding
Increased tendency for voids in the lead-free pin solder joint affects pin strength and mechanical reliability.

d) Narrow soldering process window
The process window for the production of the pinned part is very small when using a lead-free solder. The melting points of the solder to attach the flip chip and that of the

pin solder must be sufficiently different. The pins and the flip chip are attached in subsequent solder processes to the carrier (see figure below). The pins must be attached first for logistical reasons. If the difference of the solder melting points is too small, the pin solder might melt when soldering the flip chip to the carrier. The pins may move away from their location, or even fall off.

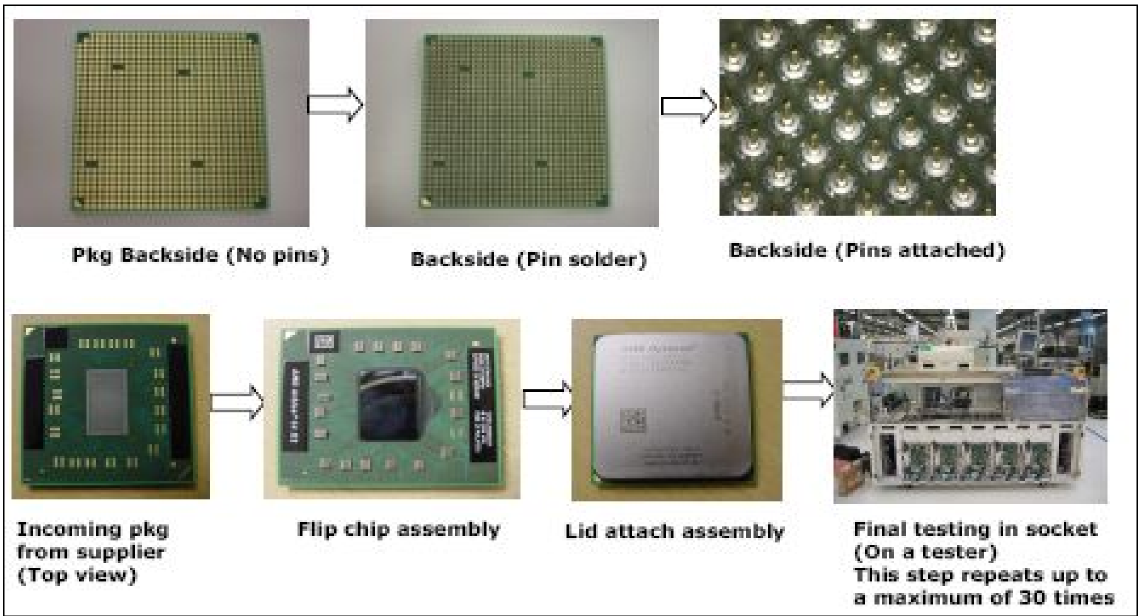

Figure 25 PGA assembly [3]

The applied lead-tin-antimony solder offers sufficient melting point difference to the flip chip solder in order to allow a proper flip chip attach without moving the pins from their correct position and alignment. Lead-free solders have a lower melting point compared to the PbSnSb solder. The process window to attach the flip chip to the package thus becomes smaller compared to the use of the PbSnSb solder. The end results of such issues are high yield loss in assembly and test, difficulty in scaling up to volume production and potential field failures at customers due to the loss of pin(s).

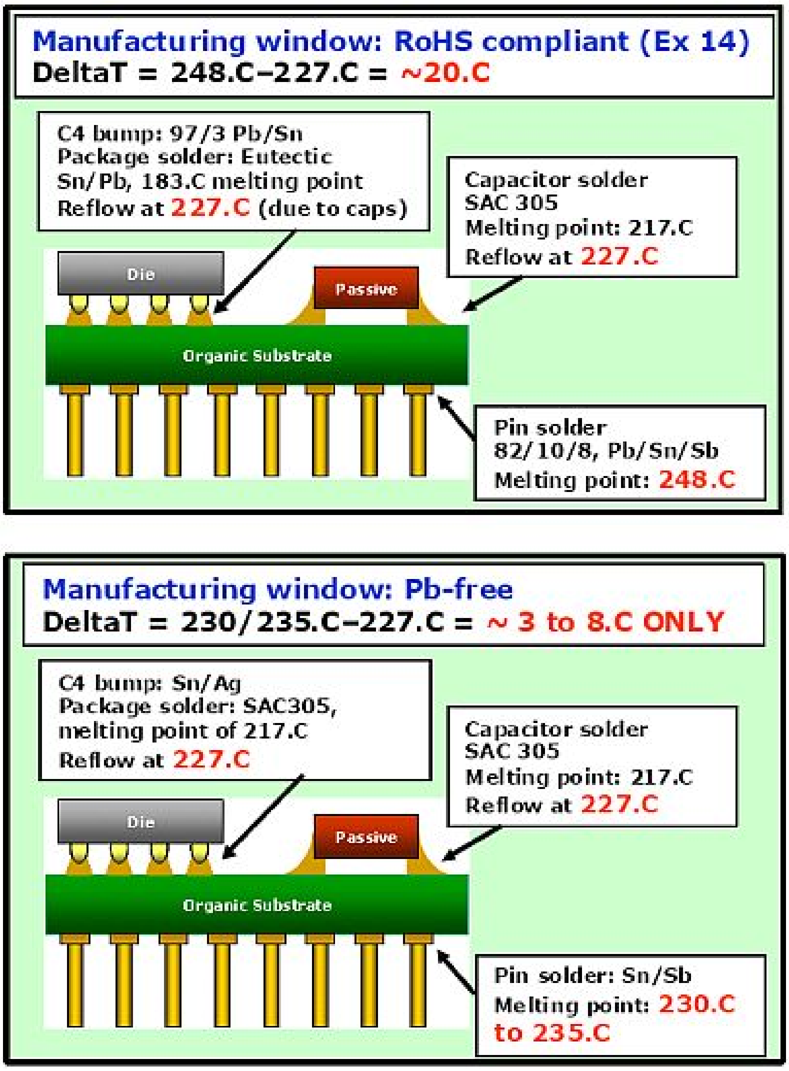

Figure 26 Narrowing of process windows with use of lead-free solders for pin attachment [8]

Manufacturing variations can induce temperature variations of about 10°C. Manufacturing variations include furnace-to-furnace variations, variations across the furnace belt, variations across the device when heated up in furnace (i.e. no uniform temperature from the C4 bumps to the pins when heated up in furnace) as well as other substrate and assembly variations.

Hence a manufacturing window of 3–8 deg C (as depicted above in the Pb-free scenario) leaves a minimal to negative margin to manufacture. In other words the use of Sn/Sb based pin solders is inconsistent with the assembly process window (229°C to 238°C) needed for the creation of proper SAC305 joints (capacitors and die). Pin movement would occur at the higher end of this temperature range, resulting in several quality and reliability issues [8].

e) Change of process order in pin and flip chip attachment
The pins are attached to the substrate before the flip chip is soldered on it. If the pins could be attached to substrate prior to the flip chip attach, the narrow process window with lead-free solder use could be overcome. The stakeholders explain, however, that the process in which pins are attached to the substrates MUST take place prior to flip chip attach.
The reasons for this are not just logistical, but also technical. The solder used to attach the pins to the substrates must have certain critical mechanical and thermal properties. The thermal property (melting point) has been discussed in detail. The mechanical properties (e.g. pin pull strength) are equally critical. The pin attachment needs to be sufficiently robust to withstand the various mechanical forces applied to it. These include the numerous insertions into various test sockets in AMD's test flow (at room, hot, cold temperatures), as well as multiple insertions/ removals of the package into motherboard sockets in OEM assembly or by the end-customer.
For the pin attach operation to be carried out on completion of AMD's assembly process, the pin solder would need to have a melting temperature in the 100°C to 125°C range. Anything higher than that would exceed the maximum temperature limit for epoxy degradation, and have severe negative consequences on the various epoxies used in the flip chip assembly process (underfill, thermal material, lid attach adhesive). Solders that melt in the 100°C to 125°C temperature range, and still provide the required mechanical robustness & chemical corrosion protection of the pin joints simply do not exist today, according to the stakeholders [8].

Further, the substrate manufacturer attaching the pins always 100% tests the organic PGA substrates prior to shipment to AMD. This is to screen out any as-manufactured defective substrates. This electrical test is a critical operation; not doing this test would result in additional yield loss after the die attach process in AMD's manufacturing flow. This is an unacceptable option because the microprocessor die would be lost by attaching it to a defective substrate, creating more waste. Thus, all the material and energy used to create the microprocessor would be wasted. The electrical test on organic PGA substrates is one of the last operations in the substrate manufacturer's process flow. It is always done after the pin attach process. The test setup contacts the PGA pins to carry out the electrical test.
If the pin attach operation were to be carried out by AMD on completion of the product assembly, the substrate manufacturer would need to carry out this electrical test (of bare substrates) by probing the sensitive pin attach land pads. Probing these pads would cause damage to the Ni/Au plating on the pads and potentially also some damage to the base Cu. This damage could have a serious negative impact on the integrity of the pin solder joint, since the mechanical robustness of the joint depends on the formation of a strong metallurgical bond at that interface with well defined intermetallics. Defects

at that interface could also create solder voids and result in poor wetting of the exposed Nickel to the solder material. Hence electrical testing of the substrates is not practical before shipment to AMD [8].

For the reasons mentioned above, pin attachment on organic PGA packages is always done by the substrate manufacturer. It is one of their core engineering competencies when it comes to organic PGA substrate manufacturing. There are no semiconductor manufacturers (neither AMD nor anyone else) who attaches pins to organic PGA packages on completion of product assembly. [8]

f) Use of low-melting solders for flip chip attachment

In order to improve the manufacturing process window, different flip chip low melting solders were investigated. Solders containing Sn, Ag, Bi, In, Cu were studied and found to be non manufacturable for high volume package fabrication. Experiments were conducted to optimize the pin geometry, solder composition, solder volume and assembly process. Results continue to show pin movement and solder climb that do not meet product requirements. In certain situations such as to repair defects, the flip chip attach process goes through multiple reflows which exacerbates the above stated issues. [4]

The applicant continues to work internally and with his partners on non-traditional ideas, novel pin attach techniques and other potential changes to the pin material and geometry. No substantial improvements could be achieved. [4]

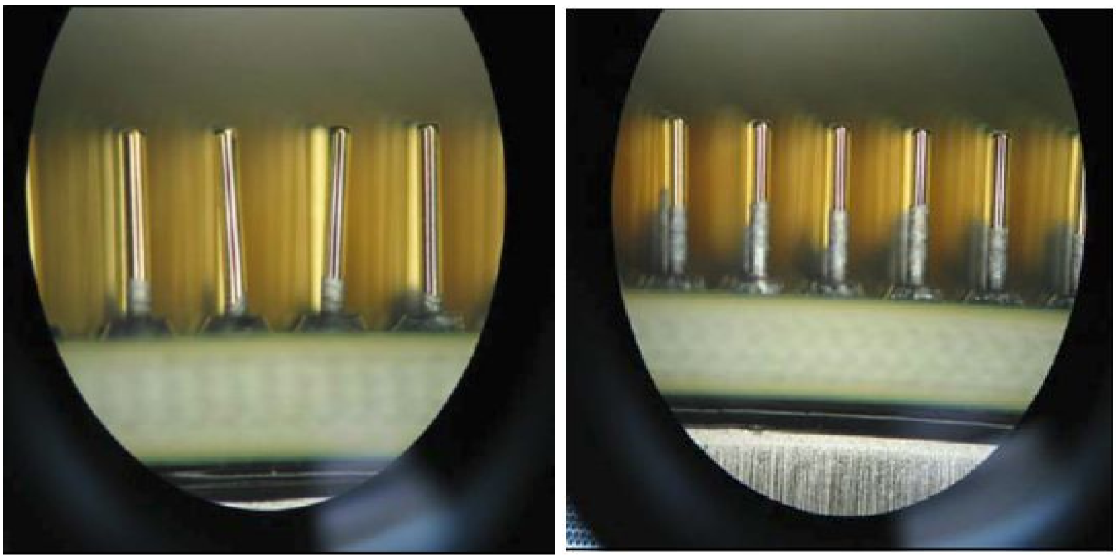

Figure 27 Moving pin (left) and solder climb under use of lead-free solders [4]

Alternative designs without pins

Ball grid arrays (BGA) and land grid arrays (LGA) in principle are alternative designs to the current pin grid array (PGA) design [4]. Currently, it is technically impracticable, especially for microprocessors with high pin counts, that consequently also require a high number of LGA interconnects. The high pin count PGA packages offer unmatched reliability advantages and flexibility compared to other packages at this high pin count. [8]

1. Land grid array (LGA) package microprocessors
   LGA is an interconnection technology that does not use pins any more and therefore does not need to use the pin solder for which this exemption is needed. However, based on customer feedback, transition to LGA is not possible for all products due to technical impracticability or lack of infrastructure in the customer application. Customers face significant challenges when they are forced to use products in LGA microprocessors. The motherboard sockets needed to house the LGA packages are more prone to damage and failure since they are inherently less robust than the sockets used to house PGA packages. LGA sockets are more complex in construction than the PGA sockets because they need to house the large number of spring-loaded pins needed to make proper electrical contacts with the LGA package pads. This complexity also results in a higher defect rate in the assembly of these LGA sockets onto the OEM motherboards.

   The stakeholders further on explain that a transition to LGA technically is not feasible for all products in the mobile product segment. For example, mobile applications require a lower profile for the socketed microprocessor on the motherboard. The LGA package form factor would require a socket that is significantly thicker than a PGA socket, due to the design of the interconnect required in the socket as well as the fact that a vertical clamping mechanism must be used to enable proper contact. PGA sockets do not need this vertical clamping mechanism. Hence an LGA processor in an LGA socket would have a significantly higher profile when compared to a PGA processor in a PGA socket. This higher profile is incompatible with typical mobile product (laptop etc.) case designs, where the overall profile height is a critical factor affecting the products ease-of-use and portability. [4], [8]

2. Ball grid array (BGA) microprocessors
   BGA microprocessor packages are another alternative, lead-free solution. Their use involves major infrastructure changes at the customer and also eliminates the flexibility of adding/removing the processor without affecting other components on the motherboard. BGA packages are not socketed onto the OEM motherboards. They are instead attached to the motherboard using a surface mount reflow operation. Once attached, it

places major restrictions on the manufacturing flexibility at the original equipment manufacturer (OEM) factory, since defective parts could result in the entire motherboard getting scrapped. A defective microprocessor would need to be removed by a thermal operation where all the BGA solder balls are heated up to melting temperature, and this process could result in adjacent components being damaged, thus creating a reliability issue. Also, if the components adjacent to the microprocessor are defective, reworking them could have a negative impact on the reliability of the sensitive microprocessor device. Using a BGA package also completely eliminates the flexibility enjoyed by the end-customer today to easily replace and/or upgrade the microprocessor. Using a PGA package does not have the above technical limitations. Since it is socketed onto the motherboard, it can be easily removed and replaced during motherboard assembly or by the end customer. [4], [8]

The stakeholders conclude that an alternative package design is not feasible for all products segments due to technical impracticability or lack of infrastructure in the customer application. They therefore want to continue pursuing a lead-free pin solder solution and ask that the necessary transition time is taken into account in determining an appropriate expiration date.

Future activities

EICTA et al. [4] state that research for lead-free substitutes and for alternative designs has been ongoing since 2001, but no solutions have been found so far that meet the applicant's product quality and reliability requirements for microprocessors with high pin count. The large number of connections between the pin and the substrate requires very high reliability per individual connection as the probability for package failure grows with the number of pins.

The PGA technology, according to EICTA et al. [4], could not yet be fully replaced by alternative designs like BGA or LGA.

The applicant provided a roadmap showing his past and future activities to achieve a lead-free solution.

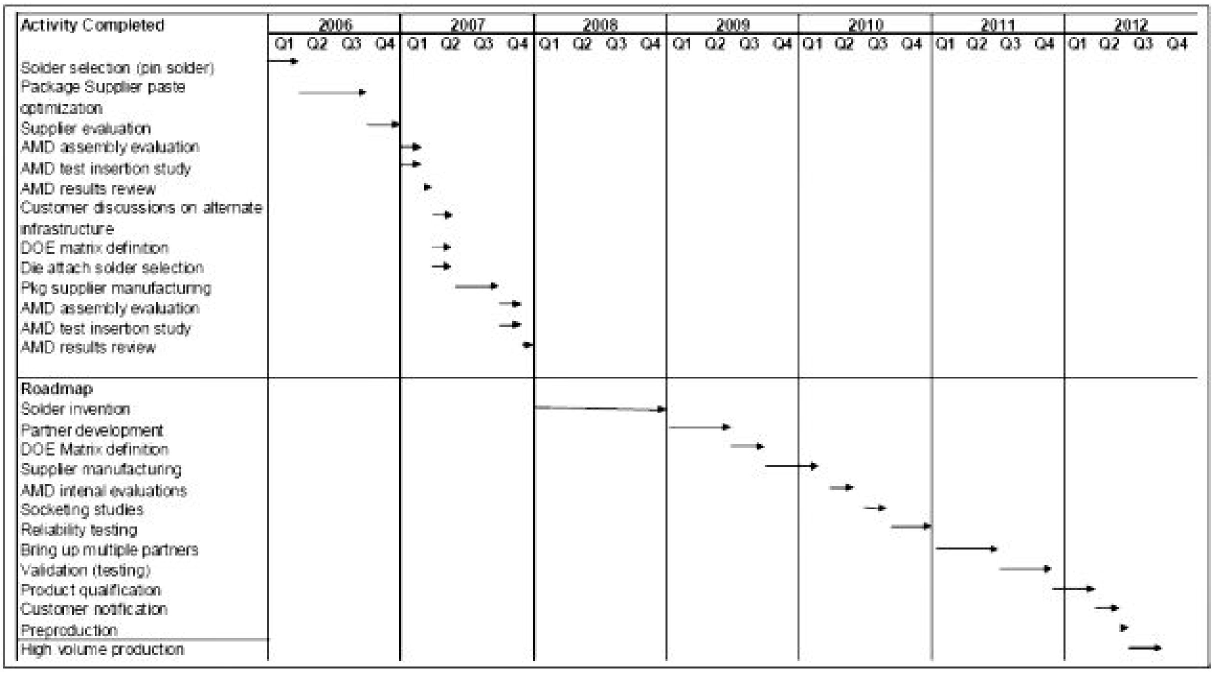

Figure 28 Roadmap towards the elimination of lead [4]

EICTA et al. [4] highlight that the roadmap relies on inventing a substitute solder in 2008. The roadmap is only valid if there is an invention done in 2008, which cannot be predicted with absolute certainty. If an invention could not be made within 2008, the roadmap will be subject to change.

Taking the optimistic view that an invention can be made in 2008 to eliminate lead in currently exempted pin solder, AMD asks that the pin solder exemption is extended until the end of 2012 or that at least an adequate transition time of 18–24 months is granted.

Support for continuation of exemption

EICTA, AeA Europe, EECA ESIA and ZVEI, support the continuation of the exemption [4]. They say that a manufacturable solution suitable for high volume production of microprocessors with high pin counts is not likely to be available by 2010. An expiration date for the exemption applicable to microprocessors with high pin counts is therefore not possible to name at this time.

Hewlett Packard [6] supports the continuation of the exemption stating that it is needed in order to continue shipping systems with certain processors from AMD. Without access to this exemption, HP would be forced to sell into the EU only systems using Intel processors.

Microprocessor architecture and high pin counts

AMD [3] states that there is no standard microprocessor that provides the "standard functionality" of a microprocessor. Significant differences exist in the architecture of microprocessors from different manufacturers. The effects of this are evident when looking at platform performance as well as platform energy efficiency or upgradability. The difference in pin counts reflects, among others, the different architecture. AMD has integrated more functionalities into the core microprocessor compared to other CPU manufacturers, which dictates a need to increase the electrical connections. Examples of functionalities additionally included in the core microprocessor are the integrated memory controller, which is an additional semiconductor part with Intel's technology, the Direct Connect Architecture, the size and arrangement of memory caches on the die, as well as number of power delivery planes to the different parts of the die of AMD processors as compared to Intel processors.

AMD [3] concludes that the overall withdrawal of exemption 14 could severely limit choice in an already monopolistic X86 microprocessor space as it might impact AMD's ability to supply reliable microprocessors.

Opposition of Intel to continuation of exemption 14

Intel opposes the continuation of the exemption stating that it uses tin-antimony (SnSb) lead-free pin attachment solder for pin grid array CPUs since 1999. [2] This solder, according to the stakeholder, proved to be the best solution. Intel says that this includes the 45 nm 100% lead-free CPU Penryn PGA and its earlier generation products that contained lead in first level interconnects. Currently, the Penryn PGA products with 478 pins are at ramp to high volume mass production [2], [7]. According to Intel [2], there is no high volume manufacturing issue.

Intel says it spent significant research and development efforts to enable lead-free PGA packaging, which comes together with Intel's lead-free die attachment process. Specific areas of work Intel achieved include advances in the solder metallurgy; optimization of geometries of the pin and solder; strengthening of interfaces and optimisation of all reflow parameters. Intel states to have PGA products in the market with up to 700 pins in lead-free pin attachment technology, and has announced lead-free soldered PGA microprocessors with close to 1.000 pins [7].

Summary of the case

AMD manufactures high pin count PGA microprocessors in mass production using a lead-containing solder for pin attachment. The competitor, Intel, has lead-free soldered PGA packages on the market. AMD [3], EICTA et al. [4] claim that lead-free solders might be a viable option to produce lower pin count PGA microprocessors like Intel's ones, but maintain lead-free solders not to yield reliable results in the pin attachment for high pin count PGA microprocessors manufactured in mass production [4], [10].

AMD, EICTA et al. say that AMD's and Intel's PGA microprocessors are different in architecture, and that Intel's PGA microprocessors therefore cannot replace the high pin count AMD PGA microprocessors. AMD additionally claims its high pin count microprocessor to be advantageous in energy efficiency, upgradability and performance without presenting further evidence for this claim.

BGA and LGA package microprocessors are an alternative to PGA ones. They do not use pins, and hence can be produced independently from exemption 14. They can partially replace the PGA microprocessors, but are more difficult to handle in manufacturing and are not a technically feasible alternative for all products, in particular not for mobile ones.

AMD, EICTA et al. therefore ask for the continuation of exemption 14 until 2012 stating that no adequate alternatives are available for the AMD high pin count PGA microprocessors using lead solder for the pin attachment.

Intel opposes these views and asks exemption 14 to be cancelled [2].

4.20.3 Critical review

As was already assessed in 2004 [1] and confirmed in the above stakeholder justification, there are lead-free soldered PGA microprocessors in the market. Additionally, BGA and LGA microprocessor packages are available, which do not have pins and thus do not depend on the use of solder with or without lead for pin attachment. The stakeholders explained that these BGA and LGA packages are not a full replacement of the PGA packages that offer unique advantages.

It must be clarified whether and how far the lead-free PGA microprocessors can replace the non-lead-free soldered PGA microprocessors. If they are a replacement, the avoidance of lead in this application is practicable.

Architectural differences and alternative packages

The AMD and the Intel PGA microprocessor architecture is different, as the stakeholders had explained. These architectural differences entail further differences, e. g. in the mother board sockets, to which the microprocessors need to be attached and the architecture of the motherboard that go beyond just adapting the number of pins.

The high pin-count and the lower pin count microprocessors cannot be simply exchanged, but require a redesign of the product, or parts thereof, into which they are installed, or even a change in the equipment manufacturing processes. The stakeholders claim that one microprocessor solution therefore cannot replace the other one and plead for the continuation of exemption 14.

According to Art. 5 (1) (b), an exemption is not possible if design changes – either on the supplier or the equipment manufacturer level or on both levels – eliminate the banned material. The users of microprocessors hence are expected to redesign their products to be able to apply lead-free soldered PGA microprocessors, or to shift to alternative packages like BGA or LGA microprocessors as far as technically viable. The architectural differences between the AMD and the Intel PGA microprocessors do not justify an exemption in line with Art. 5 (1) (b).

Functional equivalence

AMD claims that the high pin count solution has better platform performance as well as platform energy efficiency or upgradability. There is, however, no quantified information on this, and there is no evidence that this could outweigh the environmental advantages resulting from the substitution or elimination of lead, as Art. 5 (1) (b) would require to justify an exemption on energy efficiency or performance grounds.

Technologically, the AMD and the Intel microprocessors are different. Such differences are not relevant for this review process, however, as long as both microprocessor solutions have a certain level of functional equivalence. Even though there may be no standard microprocessor with a standard functionality, as AMD puts forward, it is still necessary to consider the functionality of a microprocessor under the specific aspects of Art. 5 (1) (b) in this review process. Despite of the architectural and technical differences the stakeholders put forward, the AMD as well as the Intel PGA microprocessor packages alone or with additional components technically can cover the functional requirements in all kinds of products in which microprocessors are used. This may require changes in product design and manufacturing processes to adapt the end product to the specific technical features, architectures and geometries of the respective microprocessor. Despite of the technical differences of the AMD and Intel microprocessor solutions, there is no proof that certain product groups could no longer be produced in case only one of the two PGA microprocessor solutions would be available on the market. No product groups would experience serious drawbacks for example in product performance, energy consumption or product features like weight and size of mobile products.

Lead-free soldered PGA microprocessors are on the market. Additionally, alternative packages like LGA and BGA microprocessors are available, although they cannot replace the PGA microprocessors in all applications, as the stakeholders had explained. The substitution of lead in the PGA packages of microprocessors or its elimination via design changes thus is technically practicable. The differences in technology and architecture between the AMD and Intel PGA microprocessors, and the limited applicability of alternative LGA and BGA microprocessor packages thus are no grounds to recommend an exemption in line with Art. 5 (1) (b).

Monopolistic market structures

AMD states that without exemption 14, choice in an already monopolistic microprocessor market will become smaller again, as AMD's ability to supply reliable microprocessors might be compromised [3]. Clearly, monopolies are of high concern in market economies whose proper function needs competition. In the context of this exemption review process, however, the reviewers cannot assess whether and how far the continuation or cancellation of an exemption weakens or strengthens monopolies. If the cancellation of exemption 14 results in monopolistic or more monopolistic market structures, it could have serious impacts, but the reviewers do not have the mandate to take this into account, as Art. 5 (1) (b) does not allow exemptions to prevent monopolies.

Conclusions

In the previous evaluation, the reviewer recommended exemption 14 to expire by 2010 [1]. In the stakeholder consultation, stakeholders applied to maintain the exemption beyond 2010 with mentioning 31 December 2012 as a potential date at which lead has been phased out in the currently exempted pin solder [10]. Given the situation as described above, the stakeholders' arguments do allow the continuation of exemption 14. The consultants hence recommend not to extend exemption 14 to suffice the requirements of Art. 5 (1) (b).

In the current version of the RoHS Annex, exemption 14 does not have an expiry date. Switching from one to another microprocessor with different architecture or a different package requires redesign and adaptations of the products in which these microprocessors are used, and changes in the production processes. Equipment manufacturers who so far applied the AMD PGA microprocessor packages need time to prepare their products and production processes for the use of microprocessors that are not produced using exemption 14. Assuming the official amendment of the RoHS Annex until end of 2009, exemption 14 is recommended to expire on 31 December 2010.

4.20.4 Recommendation

The substitution and elimination of lead for the attachment of pins in PGA microprocessor packages is technically practicable. The continuation of exemption 14 would therefore not be in line with Art. 5 (1) (b).

Exemption 14 is therefore recommended to expire on 31 December 2010 to enable equipment manufacturers preparing their products and their production for the use of microprocessors, which are not produced using exemption 14. It is further on recommended to facilitate the use of AMD PGA microprocessor packages with lead in the pin attachment solders for repair and reuse of equipment put on the market before the expiry date.

The new wording of exemption 14 is proposed as follows:

Lead in solders consisting of more than two elements for the connection between the pins and the package of microprocessors with a lead content of more than 80% and less than 85% by weight until 31 December 2010, and for the repair and reuse of products that were put on the market before 1 January 2011.

4.20.5 References

[1] Goodman et al. 2004, Technical adaptation under Directive 2002/95/EC (RoHS) – Investigation of exemptions, ERA 2004, document "era_technology_study_12_2004.pdf"

[2] Intel on ex. 14, Stakeholder document "Exemption-14_Intel_31_March_2008.pdf"

[3] AMD on ex. 14, Stakeholder document "Lead-free_Questions on Exemption 14_May21_2008_final.pdf"

[4] EICTA et al. on ex. 14, Stakeholder document "Exemption_14_EICTA_and-others_1_April_2008.pdf"

[5] Master et al., AMD, Stakeholder document "Effect of Pin Count on Device Defective Rate_May 21 08.pdf"

[6] Hewlett Packard; Stakeholder document "HP Letter to the Oeko Institut - Rev3.1.pdf"

[7] E-mails from Julian Lageard, Intel, received on 3 and on 10 October 2008 by Dr. Otmar Deubzer, Fraunhofer IZM

[8] EICTA stakeholder document "EICTA Position on Exemption 14 3rd Oct 2008.pdf"

[9] AMD stakeholder document "Letter to Dr Deubzer_IZM Oct 17 2008.pdf"

[10] EICTA stakeholder document "Letter to Dr Deubzer_IZM Oct 17 2008.pdf"