

RoHS is being reviewed in the EU and it seems very likely that all exemptions for lead will soon be eliminated. Here is a link to the draft report:

[http://ec.europa.eu/enterprise/environment/reports\\_studies/studies/draft\\_rep\\_study\\_rohs\\_directive\\_dec07.pdf](http://ec.europa.eu/enterprise/environment/reports_studies/studies/draft_rep_study_rohs_directive_dec07.pdf)

Here are relevant excerpts of the EU draft study as regards reliability. [My comments are in brackets]

Robert J. Landman, Sr Member IEEE Power Engineering Society  
President, H&L Instruments, LLC  
[www.hlinstruments.com](http://www.hlinstruments.com)

=====

"the burden of RoHS is higher for smaller companies compared to large or multinational companies".

[RJL: How many times do we hear that small companies are the most innovative, provide the most jobs in the US economy? RoHS is crippling small companies, but who cares?]

"The total costs related to the number of employees: as much as €32,590 per employee." "Six of them [companies] provided a monetary estimate of the additional direct material costs that vary between € 10,000 - 500,000. On a global scale, corrected for recycling, the costs of lead-free solder would be € 660 million higher than for lead solder."

"The cost of solder approximately doubles. The costs of lead-free finishes are also expected to add significantly to the operational costs of substance phase-out (Deubzer, 2007)."

"Section 4.2.2.6 Insecurity of meeting the products' requirements: Category 8 and 9 products, currently still out of scope, concern specific high market value products and a large degree of customisation to meet the specific performance and reliability requirements of customers. They are produced in low volumes but with a wide range of applications and they have a long product life (up to 30 years). Unlike consumer goods, these products are not subject to fast-paced changes in market patterns, as they are in a slow moving market."

"Reliability is a key requirement of products with a long lifetime. The reliability requirement is one of the most fundamental drivers of its design and service activities. The redesign work necessary to be RoHS compliant will require retesting and re-qualification under a large number of conditions. Considerable time is needed to evaluate available substitutes against the demanding requirements as compared to consumer products."

"Even if all the parts are RoHS compliant, there is still a big question about the long-term reliability of nonlead solder assemblies. There have been no substantiated studies which allow predicting product reliability 8-12 years into the future, while there are studies that show the possibility of tin whisker growth well within that time (Test & Measurement Coalition, 2006)."

"The tin whisker growth was often mentioned during the stakeholder consultation. Lead-free finishes made from pure tin are not yet in all cases free of risks to build conductive fibres (tin whiskers), which can lead to electrical shortages. Those short circuits can cause failures of any equipment – exempt and non-exempt. The result of each failure is typically increased WEEE, which would be an unintended

consequence of RoHS."

[RJL: what they mean is that failures mean products must be junked and thus recycled and this adds to the waste stream.]

"The component market with the most common pure tin finish is not yet supplying a finish which is comparable free of risks from building shortage causing conductive whiskers. A particular issue of high risk are surface mounted components with fine pitch leads (0.65 mm distance from lead to lead or less). For this type of components, lead as part of alloy has still to be allowed as ever. Only lead as part of the finish alloy prevents the development of shortage causing tin whiskers. This exception of the lead ban should also be part of the RoHS review according to the Working group 'Lead-free Aviation Electronics'."

"At ball grid array components with ceramic packages e.g. for power processors with lead-free balls made from SAC alloy, the number of temperature cycles to failure is less than with balls made from the temporary used high lead containing alloy material." If one uses no-lead solder balls, "it is difficult to attach them to an assembly with tin-lead solder because the resulting connections are unable to withstand as many thermal cycles as are needed. Replacing the balls with tin-lead solder balls may reduce the reliability over what it would be had tin-lead solder balls been used in the first place, and voids the manufacturer's warranty. Until suitable alternatives are found, such components have to be allowed in a lead containing version according to a.o. the Working group 'Lead-free Aviation Electronics' (Arbeitskreis Bleifreie Luftfahrt Elektronik)."

[RJL: this next part relates to the products my company makes - 30 years is not an unrealistic time frame.]

"Perhaps the most sensitive product category is formed by Category 9 products: monitoring and control instrumentation. While medical, aerospace and military products are critical sectors with human life often depending on their equipment, these products are only as good as the testers verifying their performance and permitting them to leave the lab for the field."

"The monitoring and control instrumentation category sector covers a large range of different products (each company is producing 1,600 product types on average), which have a high market value (product prices range from €100 to €1,000,000, with an average price of €5,400) and a large degree of customisation to meet the specific performance and reliability requirements of customers."

"Unlike consumer goods, test & measurement equipment is not subject to fast-paced changes in market patterns, in a slow moving market. Quantities sold are minor (350 units on average per product per year in the EU total). Some systems are sold in very small quantities (2-10) whereas the highest volume products may reach 5,000-10,000 per year. Products are primarily sold to laboratories, universities, government and industry rather than to private consumers."

"The products placed on the market typically last for many years - between 7-30 years and 10 years on average. The lifetime of any given unit can often be extended through regular maintenance and servicing."

"The quantities and long lifetimes of test & measurement equipment are closely related to the design cycle. The products do not undergo frequent re-design, because there is little market demand for such changes. Whereas a television or mobile telephone's existence on the market may last for two or three

years, monitoring and control instrumentation are only redesigned every 5 to 15 years with an average of 7 years."

"In the ERA (2006) review of RoHS categories 8 and 9, it is stated that modification of more complex existing products to comply with RoHS add considerable large costs to the originally spent costs, hereby doubling costs during the lifetime of a product. Additional costs per product of modification could be as high as 20%, although most will be less and in the range from 1 to 10%."

"In the situation where these products have to comply with RoHS without a reasonable transition period, many older products will need to be obsoleted. This means that in many cases it will not be possible to get a return on investment from redesigning older products because of the resources involved. Forced obsolescence will have a significant impact on companies who have invested in modular T&M systems. A modular T&M system consists of individual products residing in a rack/chassis to create a modular system. A modular system can be continually upgraded as application needs change or as individual parts fail and need to be replaced. Because many older products will become obsolete, a customer will no longer be able to replace only the portion of his system that fails to meet new requirements. The entire system will need to be scrapped and a new system purchased causing two effects. First, more equipment than necessary will become waste having an environmental impact."

"Second, the customer will have a significant financial burden due to:

- The cost to replace an entire system which could easily exceed the cost of a single product by many times;"
- The additional testing time required to qualify an entirely new system;
- The impact of system downtime on research, development or production."

"Reliability is a key requirement of products with a long lifetime. The reliability requirement is one of the most fundamental drivers of its design and service activities. The market requires much more in-depth testing of the technology in order to ensure reliability. A new design in this type of industry frequently borrows heavily from core technology developed and proven over a long period of time. The redesign work necessary to be RoHS compliant will require retesting and re-qualification under a large number of conditions. Considerable time is needed to evaluate available substitutes against the demanding requirements as compared to consumer products. This has been limited by the non-availability of RoHS compliant critical components, and material processes."

"There are three categories of difficulty with regard to replacing non-compliant components:

- 60%-80% of purchased components are off the shelf and most suppliers are introducing RoHS compliant replacement versions. However, e.g. higher lead-free processing temperatures will reduce component lifetimes as well as cause drift in specifications making the design of precision instrumentation needing PPM (Parts per Million) performance difficult to achieve. Moreover, some of the off the shelf parts are difficult to find in a RoHS compliant version. This would require a complete redesign of the part. The parts that are not available include some of the most critical Integrated Circuits. Many instruments are designed around these components, so to use alternates would in essence mean redesigning the product from the beginning.

- 10%-20% are specialized custom parts where alternative compliant materials are known to be available for similar uses. These components are not normally validated by a component manufacturer with a very large client base. Cost and resources are involved to completely evaluate a new design before taking it to production.
- A final 10%-20% are custom parts where no alternatives are known with all the required properties.

Even if all the parts are RoHS compliant, there is still a big question about the long-term reliability of nonlead solder assemblies. There have been no substantiated studies which allow predicting product reliability 8-12 years into the future, while there are studies that show the possibility of tin whisker growth well within that time (Test & Measurement Coalition, 2006).”

“4.2.5.2 Arguments in favour of the view that innovation has been stifled by the RoHS Directive”

“A number of articles and company websites reviewed as part of this study revealed strong industry positions arguing that the pressure to comply with the RoHS Directive was putting pressure on their ability to develop innovative products.”

<http://www.sourceesb.com/configurable/article20060629.html>

“SourceESB, a company providing services for sourcing electronic components, products and services, in it’s article “RoHS Hampers Product Innovation”, June 29th 200618 argues that companies face an ongoing battle to deal with RoHS compliance for existing products, particularly as different regulations are being put in place in other parts of the world. The article quotes comments from a Director of a company providing tools to support the design process in the United States who argues that designers are having to design new products for compliance which involve more work and time since “as they spec each component, they have to see if it is compliant”. The article goes on to state:

“A further deterrent to new product development for design teams is the work they have to do to redesign existing products for compliance. Manufacturers have generally not hired new design engineers to cope with the task of revamping existing bills of materials (BOMs) to make sure they are compliant. Under these conditions, design teams have not been able to focus on new product design to the extent they have been able to in the past.”

“It is claimed that this situation exists under circumstance where design teams are smaller than they were some years ago. The article argues that many US manufacturers have been outsourcing design functions as a result and are sometimes using the services of outside design teams. The trend apparently began with low-end laptops and cell phones, but has expanded to include a wide range of consumer products and the article concludes that:

“The outsourced design trend affects innovation greatly, since it means that OEMs may be giving up their product knowledge as they give up their design work. While it is hard to judge whether RoHS had directly impacted new product design (we can’t count products that haven’t been created), it is also hard to imagine that the pressures from environmental compliance haven’t severely hampered innovation.”

A strong case from the side of industry is made by the trade website Global SMT and Packaging19:

“Adding insult to injury is the fact that true innovation has been purloined with a substantial percentage

of the global electronics manufacturing engineering talent having been diverted to solving the lead-free implementation problem.....Lead free has caused the electronics manufacturing industry to delay exploration, research and development of new interconnection concepts in favour of meeting the requirements of meaningless legislation. One highly negative result of RoHS is that manufacturing and process development engineers are sounding more and more like back room lawyers than scientists as they struggle with interpretations of the often vague and murky language of the promulgated legislation in an effort to make certain their company's products will comply”.

“ZVEI, the German Electrical and Electronic Manufacturers' Association, which represents the economic, technological and environmental policy interests of the German electrical and electronics industry at national, European and international levels, argues strongly that environmental regulations have a negative effect on innovation in one of its publications:

“Even in the electrical engineering and electronics industry over regulation and unnecessary rules hinder the growth of our companies and establishment of new businesses. Detailed regulations far away from practice prevent solutions achieved by the market and competition, quick reactions to market opportunities and competent people working on innovations. The current quickly growing flood of new taxing, inconsistent and restricting regulations are particularly critical, for example in the area of the protection of the environment and consumers. Detailed regulations at national and European level slow down innovation competition.”

[RJL: go to the document and read this entire section]

4.2.7 Impact of the RoHS Directive on Categories 8 & 9 of the WEEE Directive and equipment which is connected with the protection of the essential interests of the security of Member States, arms, munitions and war material