

Test & Measurement Coalition

RoHS Directive Scope Review

Contribution to Öko-Institut study on RoHS current exemptions

1 April 2008

Introduction to T&M Coalition

The Test & Measurement Coalition represents an ad-hoc grouping of companies active in producing Category 9 type products. The Coalition includes six leading companies in the sector including Agilent Technologies, Anritsu, Fluke Corporation, Keithley Instruments, National Instruments, and Tektronix. We estimate the coalition membership represents roughly 60% of the global production of industrial Test and Measurement products and other Category 9 equipment including chemical analysers.

The Test & Measurement Coalition actively participated in the consultations organised by DG Environment and DG Enterprise regarding RoHS revisions. We have also submitted detailed information to ERA about the exemptions needed for our products. We are pleased now to contribute to the Öko-Institut consultation preparing the study on current RoHS exemptions.

Summary

Category 9 is currently not in the scope of RoHS. Bringing Category 9 into scope will require significant substitution and redesign of the large number of products due to extensive use of lead solder. Assuming that drop-in replacement, compliant components were available, which is not the case for many custom parts, compliance will require re-qualification of virtually all products after new designs are assembled with lead-free solder. Qualification testing alone will have a major impact on our industry and on our customers considering the large number of products we make, even without additional practical issues to solve.

The Coalition strongly emphasises the need to maintain the following exemptions when category 9 will be brought into the scope:

- a) Exemption #1 - Mercury in compact fluorescent lamps not exceeding 5mg per lamp.
- b) Exemption #5 - Lead in the glass of cathode ray tubes, electronic components and fluorescent tubes.

- c) Exemption #6 - Lead as an alloying element in steel containing up to 0.35% lead by weight, aluminum containing up to 0.4% lead by weight and as a copper alloy containing up to 4% lead by weight.
- d) Exemption #7
 - Lead in high melting temperature type solders (i.e. lead based alloys containing 85% by weight or more lead).
 - Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunication.
 - Lead in electronic ceramic parts (e.g. piezo-electronic devices).
- e) Exemption #8 Cadmium and its compounds in electrical contacts and cadmium plating except for applications banned under Directive 91/338/EEC (1) amending Directive 76/769/EEC (2)
- f) Exemption # 9 a Deca BDE in polymeric applications
- g) Exemption # 11 Lead used in compliant pin connector systems
- h) Exemption #13 Lead and cadmium in optical and filter glass
- i) Exemption #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.
- j) Exemption #15 - Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit Flip Chip packages.
- k) Exemption #23 - Lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with NiFe lead frames and lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with copper lead frames.
- l) Exemption #24 - Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors.
- m) Pending Exemption: Lead oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes

In addition, we assume no additional regulated materials are added to the EU RoHS Directive and that Maximum Concentration Values for existing RoHS substances are not reduced.

The reason for requesting the extension of the above mentioned exemptions is linked to the specific nature of our products, their design cycles and high reliability requirements:

- Redesign often presents significant technical challenges that take time to resolve – it can be 1-2 years before a new product can be released and 0.5-1 year for an enhancement. A significant amount of the time is required for environmental and safety testing of new designs.
- 15 - 20% of the components used in Test & Measurement products are custom designed for our instruments. As many of our members use around 100,000 different parts today this means redesign and testing of several thousand custom parts for each company.

- Where RoHS compliant components are available, they require extensive testing to verify their long-term reliability when used in Test & Measurements products.
- Test & Measurement products have a long product life (≈ 10 years on average) and frequent redesign is not common for the sector, further emphasizing the need for extended transition periods to achieve compliance with existing resources.
- Test & Measurement products are extremely complex and there are a limited number of highly qualified engineers available to work on redesign. This will divert significant resources from the development of new, innovative products.
- Material substitutes meeting our customers' reliability criteria are limited in some instances. For example a domestic household product with expected life of five years has more material options for anti-corrosion coating than a Test & Measurement product for outdoor use which customers expect to work reliably for ten years or more.
- Historically, material or component substitutions have been validated through a number of tests under extreme conditions. Testing programmes can last one or two years.
- Preliminary evaluation of several RoHS compliant substitutes in our critical applications has so far yielded less than satisfactory results.

Removal of these exemptions will result in premature withdrawal of the affected products from the EU market when professional Category 9 equipment is brought into the scope of RoHS as redesign will in most cases not be economically viable.

Forced obsolescence will have a significant impact on EU industries using Test & Measurement equipment such as communication, defence, research & development, aerospace, electronic manufactures, industries involved in design manufacturing validation and testing of electrical and electronic components and systems, network equipment manufacturers and network providers, pharmaceuticals, etc. Service, installation and maintenance in thousands of heavy to light industries depend on the availability and reliability of Category 9 equipment.

With early retirement, customers will lose access to tailor-made specialty products which provide unique solution for a unique set of customers. This will have a negative impact on the reliability of these customers' products. Proven safe products will not be available for service, installation and maintenance application in industrial venues. Forced obsolescence will additionally have a major impact on companies who have invested in modular T&M systems, which can be continually upgraded and replaced.

Exemption 1: “Mercury in compact fluorescent lamps not exceeding 5 mg per lamp”

This exemption is currently in widespread use in the Test and Measurement sector to allow for the sale of products and systems incorporating LCD display technology. Due to the expectation for high reliability in Test and Measurement equipment, industrial display units are used. These display units generally incorporate one or two compact fluorescent lamps which do not exceed 5 mg mercury per lamp.

As downstream users of industrial display technology, test and measurement equipment producers are only able to incorporate the materials made available by display producers. At the current time, commercially viable industrial-grade LCD units using non-mercury LED backlighting are just starting to become available in some of the smaller sizes and form factors. It is expected that these substitutions will increase over the next three to five years, making available mercury-free displays for most if not all new designs.

It should be noted, however, that the Electromagnetic Compatibility performance of many Test and Measurement products is highly dependent on the particular display unit used. Should substitution in current designs be required, each replacement will require costly re-qualification of the product as a whole and potential scrap of any remaining stock of mercury-containing display units. This would not serve the goals of the Directive as units already on the market would be scrapped prematurely for a very minimal environmental return.

For further details, see our submission to ERA.

Exemption 5: “Lead in glass of cathode ray tubes, electronic components and fluorescent tubes”

We support the continuation of the exemption for lead in glass of electronic components as we are not aware of any alternatives for some components using these materials, e.g. surface-mount resistors, conformal coatings of semi-conductor dies, glass-bodied diodes, LCD frit seals and transformers. While many of these are common applications, some are very specialized. One custom use is in the glass capillary tube, composed of more than 20% Lead that helps deliver sample into a Mass Spectrometer (MS). The glass for this application needs to be electrically conductive to improve ion transfer into the MS. Non-lead glass would not work for this application.

Due to the unique nature of these components, the removal of the exemptions listed above would drive design changes to the individual component and potentially design changes to the application where the component is utilized.

For more details see our submission to ERA.

Exemption 6: “Lead as an alloying element in steel containing up to 0,35% lead by weight, aluminium containing up to 0,4% by weight and as a copper alloy containing up to 4% lead by weight”

Both steel and aluminium which contain lead are used to create machined chassis parts. Steel with lead is also used to create fine-pitch screws. We support the conclusions of the ELV assessment that there is currently no substitute for lead in steel and aluminum.

Copper alloys containing lead are also used for their improved machinability. Currently leaded copper alloys are used extensively in custom parts for Test and Measurement products, such as probes, for fine tolerance, high-reliability contact points. These alloys are also used to machine precision cavities. Substitution materials, if available, would need to work under potential size constraints due to RF-domain impedance concerns. Materials being marketed as potential substitutes (e.g., Ecobrass) do not claim machinability on par with higher-lead copper alloys, which makes it likely they would promote faster machine wear and have lower manufacturability (slower machining) characteristics. We support maintaining the current exemption for lead up to 4% in copper alloys.

For more details see our submission to ERA.

Exemption 7: “(a) Lead in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead), (b) lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunications, (c) lead in electronic ceramic parts (e.g., piezoelectronic devices)”

- (a) The Test and Measurement industry supports at least a limited continuation of the exemption for lead in high-melting type solders due to the unique nature of the design cycles employed in the industry. It is typical practice in the industry to have custom ICs produced to meet those design criteria that cannot be achieved using off-the-shelf parts. Due to the low volumes and long product and design lifetimes typical of the test and measurement industry, custom ICs are frequently built in a single run that constitutes a lifetime supply of parts for both production and service applications. Older IC designs were built up in this fashion with high melting temperature type solders and these parts will be required to continue producing the products designed to incorporate them. Removal of the exemption will result in premature withdrawal of the affected products from the EU market when professional Category 9 equipment is brought into the scope of RoHS as redesign of the ICs to extend product life will in most cases not be economically viable. The material is also used for ceramic ball grid array (CBGA) applications where the stand-off must be maintain to control stress introduced by CTE mismatch. Potential RoHS-compliant replacements relying on technical breakthrough developments are 6 or more years away according to industry sources.

- (b) Pb/In-based solders are used for soldering of high frequency connector pins to thick film gold traces in network management applications. Tests showed that tin-based solder are not suitable for this application due to the high gold dissolution rate, and there is no real replacement solder that would work in the common solder temperature range. Test and Measurement equipment manufacturers are also in some cases downstream users of servers and server storage arrays, as well as suppliers of equipment to the affected telecommunications network industry. The high reliability of a server platform or server array is an important criterion for their utility in test and measurement system designs. Though some years of lead-free solder reliability data have now been accumulated, it does not extend to the longer lifetimes needed in test and measurement applications. Until more data has been accumulated on the long-term reliability of lead-free solders in complex, “always-on” applications, we support a continuation of the exemption for lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunications.
- (c) This exemption is critical for the thick film technology that is central to the circuitry business. Suppliers of thick film pastes are just at the initial phase of introducing Pb-free compatible pastes, and in some cases, no suitable replacement material has been introduced.

Due to the unique nature of these components, the removal of the exemptions listed above would drive design changes to the individual component and potentially design changes to the application where the component is utilized.

For more details see our submission to ERA.

Exemption 8: “Cadmium and its compounds in electrical contacts and cadmium plating...”

There is no supplier for switches capable of currents above 10 Amps that does not use silver cadmium oxide contact plating material. AgCdO plating on switch contacts material prevents arcing leading to fire. This application requires the cadmium exemption to be maintained to meet safety standards.

For more details see our submission to ERA.

Exemption 9 a: “Deca BDE in polymeric applications (exemption until 2010)”

Deca BDE is used in some custom cables. Due to the unique nature of these components, the removal of the exemption would drive design changes to the individual component and potentially design changes to the application where the component is

utilized. Alternative flame retardant additives exist, though frequently less risk assessment data is available for these alternatives. Based on the outcome of the EU risk assessment deca BDE does not meet the criteria for restriction under RoHS so its continued use should be allowed via exemption.

Exemption 11: "Lead used in compliant pin connector systems"

This exemption is needed for making compliant pin connectors using alloys containing lead. In one case we have found a single source producer that has not found a feasible substitute to-date.

Exemption 13: "Lead and cadmium in optical and filter glass"

Gas Chromatograph Detectors and lasers use leaded Optical Filter glass as the glass must not shift color or optical quality from -40 to +450 C with very low optical interference and absorption. Trials were made last year to use filter glass of 5 different possible base materials. In all instances, either the temperature expansion capacity, opacity, or color retention to maintain the ability to filter and measure light levels that are at the minimum optical transmission were not able to perform with the same ability of leaded glass. The low level analysis of hydrogen flame color to measure amounts of Nitrogen, Sulfur, and Phosphorus in chemical matrix for raw oil, natural gas, etc. is the main use for this detector. If the leaded optical glass exemption is removed, the measurable base level of sulfur in oil & gasoline will no longer be capable of being measured to the level specified by the EU. GCs and lasers need the leaded glass for optical filters exemption if the standards for these & other applications are not impacted in the future. Leaded optical filter glass cannot be replaced in all precision optical applications including laser head lenses and beam-splitting interferometers especially where high refractive index glass is required. In applications requiring lower index, non-leaded glass is feasible and has been introduced. These precision optical components are incorporated into equipment for nanotechnology, integrated circuit fabrication and positioning systems.

For more details see our submission to ERA.

Exemption 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."

Test & Measurement Coalition members are down-stream users of microprocessors. Our suppliers have indicated that suitable lead-free solder connections are not available.

For more details see our submission to ERA.

Exemption 15: “Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit Flip Chip packages”

The Test and Measurement industry supports continuation of the exemption for lead in solders to connect die to carrier due to the unique nature of the design cycles employed in the industry. It is typical practice in the industry to have custom ICs produced to meet those design criteria that cannot be achieved using off-the-shelf parts. Due to the low volumes and long product and design lifetimes typical of the test and measurement industry, custom ICs are frequently built in a single run that constitutes a lifetime supply of parts for both production and service applications. Older IC designs were built up in this fashion with lead-containing solders and these parts will be required to continue producing the products designed to incorporate them.

There are a number of flip-chip BGA packages that require the high temperature melting solder connections to prevent against re-reflow of the solder joints during Pb-free solder assembling processes. Flip chip technology allows the entire die surface to be covered with an array of bonding pads. There are currently no available substitute components for use in high reliability applications, and few, if any, alternative components or technologies available for other applications. Substitution of lead-free solders has been shown to create unacceptable early life failures due to electro migration or dielectric damage in high reliability applications.

Removal of the exemption will result in premature withdrawal of the affected products from the EU market when professional Category 9 equipment is brought into the scope of RoHS as redesign of the IC Flip Chips to extend product life will in most cases not be economically viable.

For more details see our submission to ERA.

Exemption 23: “Lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with NiFe lead frames and lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with copper lead frames.

Current research did not come up with a conclusion as to when a suitable replacement will be available. Until the mechanisms for whisker production are fully understood and can be reliably and generally mitigated over an extended product lifetime, we support the maintenance of an exemption for lead in the finishes in the listed fine-pitch components.

For more details see our submission to ERA.

Exemption 24 – “Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors”

Pb in solders for installation of discoidal through hole multilayer ceramic capacitors affects capacitive DC feeds used in the fabrication of custom hybrid microcircuit package assemblies. The high temp solder alloy contains > 85% Pb and at this juncture, there is no RoHS compliant high temperature solder alternative that meets high reliability standards. Lower temp solders are not appropriate due to incompatible solder hierarchy for hybrid microcircuit package assembly. Additionally, suppliers of EMI filters constructed using these capacitors have reported the use of InPb solders in order to achieve thermal matching with the ceramic material and avoid cracking. As downstream users of these parts we support the extension of this exemption for the use of lead.

For more details see our submission to ERA.

Exemption: “Lead oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes” (Adopted October 07)

We need the exemption to be extended to cover seal frit for making assemblies for helium laser tubes. Unleaded glass frits have been tried but result in increased leakage of helium reducing the three year life of laser tubes using lead glass frit seals. As these tubes are replaced many times during the 20+ laser lifetime, the exemption could be withdrawn if the Commission defined "consumables" in respect of RoHS and provided binding ruling that laser tubes are consumables.