



Proposed RoHS Additional Substances Consultation – Indium phosphide

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Background and issues caused by substitution

AEM is a US trade association representing manufacturers of industrial equipment including products in the construction and agricultural sectors. Some of AEM members' products are in scope of the RoHS directive although many are excluded as types of professional Non-Road Mobile Machinery (as defined by RoHS) or as equipment that is specifically designed to be installed in excluded types of equipment. Products that are in scope are believed to be mainly in RoHS category 11 with some in categories 6 and 9.

Most AEM members' products are complex products designed for long lifetimes and high reliability. They must comply with other legislation apart from RoHS, such as the Non-Road Mobile Machinery (NRMM) Emissions Regulation that necessitates gaining approval in the EU from a Notified Body after any changes are made to product design such as would result from new RoHS restrictions. The NRMM Regulation requires engines to meet strict emissions limits, have proven reliability and long lifetimes and manufacturers must test engines to obtain this data before approval can be granted.

Another issue for AEM's members is that most of their products have niche uses and are not made in large numbers. However many of the component parts used are obtained from suppliers whose main markets are types of products that are excluded from RoHS, such as in heavy goods vehicles. AEM members may buy less than 1% of the total sales of a type of part from a component supplier and so have no influence over if or when the supplier develops an alternative RoHS-compliant version without the newly restricted substance. Suppliers will be reluctant to make changes if most of their customers do not want changes made as they will not want to have to gain re-approval for their products. As a result, it can take AEM's members many years to identify substitute parts, assess them, test them in engines, test in finished equipment and finally apply for EU approval before these can be sold. This can take 10 years or longer if sourcing substitute parts is especially difficult. The use of less reliable or lower performance parts is not an option as EU NRMM Emissions Regulation approval would not be granted. This 10 year timescale assumes that no new restrictions are adopted part way through, because if so, new components would need to be identified and tested before finished equipment testing has to be re-started (this takes typically two years), which would extend the overall timescale required significantly.

Due to the considerable difficulties in achieving compliance, along with the uncertainties caused by the exemption request process (e.g. the time taken between submission and publication is now much longer than previously), some AEM members may consider withdrawing products from the EU market. If the next recast review results in the removal of some of the RoHS scope exclusions there could be more EU market withdrawal of products, especially if the list of RoHS restricted substances were to increase from the current 10. This would have a significant negative socio-economic impact on the EU.

The usage of RoHS substances in these products is limited to very small quantities comparing to the overall materials embedded in the finished product, which are nearly always collected for materials recycling or for refurbishment at end of life.

Supply chain RoHS data collection has been a significant challenge for our members due to the complexity of the impacted products and their supply chains. There can be up to 14 companies involved between raw material producer and AEM member manufacturer and this makes obtaining substance data difficult and time consuming. Some suppliers have been able to provide data on the proposed 7 additional RoHS substances, but most do not have this information and it will take some at least a year to obtain this information.

Some AEM members have identified needs for several RoHS exemptions for their products which have been requested in recent years via EUROMOT. Because of the safety, durability, and reliability requirement in our industry, alternative materials for restricted RoHS substances may not be available or feasible for machinery/equipment products that AEM members offer on the EU market. The restriction of one or more of the proposed 7 new substances under RoHS is likely to result in need for additional exemption requests from our members. Due to the sophisticated material technologies embedded in the products our members offer, it is likely to take several years to just confirm the need for exemption requests.

AEM members have pointed out that it would be very beneficial across the industrial equipment industry, if any future restrictions were to be application specific, as is the approach used for REACH Annex XVII restrictions, or to exclude types of equipment that are unlikely to enter the EU waste stream due to manufacturers operating within the circular economy and so collect end of life equipment and ensure that it is safely recycled or refurbished for reuse, as is the case with most industrial equipment.

Answers to questions.

1. Applications in which indium phosphide is in use

Some AEM members have surveyed their suppliers to ask if they use indium phosphide or if it occurs in parts that they supply. None have yet responded that the parts they supply contain this substance, but not all suppliers have replied to these requests yet.

AEM members understand that indium phosphide is primarily used in semiconductor devices (laser diodes, photodetectors, etc.) used for high speed and high frequency applications, such as for optical telecommunications. Single crystal indium phosphide devices are reported to be difficult to fabricate and so are more expensive than devices made with alternative semiconductors such as gallium arsenide or silicon, however indium phosphide can give faster optical telecommunications than other materials.

Occurrence in secondary materials that might be used

As indium phosphide is such an unusual material in electrical equipment, the extremely small quantities present in waste equipment and in recovered materials will be undetectable and cause no harm to workers, local people or the environment.

2. Quantities and ranges in which indium phosphide are in use

Quantity used: As far as we are aware, there is no indium phosphide in finished equipment made by AEM members

Substitution trends:

None that we are aware of.

3. Potential emissions in the waste stream

There are not likely to be detectable emissions as this is such an unusual and uncommon material.

4. Substitution

Which applications are substitution not practicable or reliable and why?

Indium phosphide devices are faster than can be achieved with all other semiconductors. As it is also the most expensive, it is only used if other types of semiconductor cannot be used. Therefore substitution for current uses is not possible.

Many of AEM members' products must have proven long term reliability to be permitted to be placed on the EU market. This is especially the situation with equipment that contains engines where EU emissions legislation is applicable. There are many types of professional equipment that is not excluded from RoHS (i.e. that is not a form of transport or professional non-road mobile machinery as defined by RoHS) which is also in scope of the Non-Road Mobile Machinery (NRMM) Regulation (this uses a different definition to that used by RoHS). The Non-Road Mobile Machinery Regulation requires that engines are extensively tested after any change is made, such as would occur if indium phosphide were to be restricted, to prove that substitution does not negatively affect lifetime or reliability of the equipment and also that the EU's emissions limits are still met. This type of redesign work and testing takes at least eight years after all substitute materials, parts and components have been identified and assessed for suitability. At present, AEM members do not know if components containing indium phosphide are used, but if they are, the reliability of substitutes, if any could be found with suitable performance, is not known.

Which alternatives are available?

None known.

Constraints on substitution

AEM members' equipment must be reliable and function correctly for the lifetime of the equipment which can be 25 – 40 years for some types of industrial equipment.

5. Socio economic impact of a possible restriction

If a restriction were to be adopted, even though we believe that this is unnecessary, it will be important to allow manufacturers sufficient time to identify, test and gain approvals for

substitutes. From past experience with phthalate substitution, this can take up to 10 years or longer if some substitute parts are not available from component suppliers. Note that many components are made primarily for sectors outside of the scope of RoHS and so manufacturers have no incentive to develop substitutes.

If research shows that no substitutes exist, AEM could apply for exemptions, but this would not be possible until the research had been completed with negative results available to justify the exemption. In addition, past experience has shown that it can take more than 3 years (>4 years in recent years) from submission of an exemption request to the exemption being published in the EU Official Journal. On this basis, a 10 year transition period appears reasonable.

If indium phosphide were to be restricted before fully RoHS compliant equipment can be tested and gain NRMM Regulation approval from a Notified Body, many types of equipment could not be sold in the EU. For example, EU hospitals could not buy emergency generators, with potentially disastrous implications, construction equipment would not be available so that new buildings could not be constructed, and some farm machinery will not be available in the EU therefore affecting food production.

6. Further information and comments

As indium phosphide is very unusual in electrical equipment and due to its high price, it is used only if alternatives do not exist. As a result, restriction is unnecessary because the high price of parts will always force manufacturers to use cheaper alternatives if this is technically possible.

An Internet search identified several research publications regarding novel uses of indium phosphide. Some future applications may allow energy savings, give improved healthcare, etc. and so any restriction of this uncommon substance would severely inhibit future innovations that might be developed.

There does not appear to be any need to restrict indium phosphide as there is no evidence that it causes harm. Indeed, in the longer term, a restriction may actually harm health and the environment as a result of limitations on potentially beneficial innovations.