

1st Questionnaire (Clarification Questionnaire)

Exemption for „Lead in solders of sensors, actuators and engine control units (ECUs) that are used to monitor and control engine systems including turbochargers and exhaust emission controls of internal combustion engines used in equipment that are not intended to be used solely by consumers. “ , requested for five years

Abbreviations and Definitions

ECU	engine control unit
EEE	electrical and electronic equipment
Pb	lead

Background

The Oeko-Institut and Fraunhofer IZM have been appointed within a framework contract¹ for the evaluation of applications for the renewal of exemptions currently listed in Annexes III and IV of the new RoHS Directive 2011/65/EU (RoHS 2) by the European Commission.

EUROMOT has submitted a request for a new exemption, which has been subject to a first evaluation. The information EUROMOT has referred has been reviewed and as a result we have identified that there is some information missing. Against this background, the questions below are intended to clarify some aspects concerning your request.

We ask you to kindly answer the below questions until 9 September latest.

Questions

1. The scope of your requested exemption is too broad and therefore needs to be specified.
 - a. Please provide a detailed list of electrical and electronic equipment (EEE) for private or professional end users for which the requested exemption would be relevant.

The exemption request is specific to components used for sensing, actuation and control, as described in our request, rather than a specific application of the engine on which they would be installed. The exemption request form already lists illustrative examples of professional only equipment in section 4(B). We are not repeating this list here. It is difficult to provide a complete list of types of equipment that are intended for use by professionals, and may be used by consumers.

¹ The contract is implemented through Framework Contract No. FWC ENV.A.2/FRA/2015/0008 of 27/03/2015, led by Oeko-Institut e.V.

We are able to provide only an illustrative list. In addition, the following types of equipment with engines are in scope of this exemption request:

- rotavators;
- vibrating plate for compacting hardcore, sand or gravel;
- shredders (of branches, logs, etc);
- brush cutters; and
- cement mixers.

b. Please detail the specific use conditions for each EEE listed in 1a, which justify the requested exemption for specific sensors, actuators, and ECUs.

We believe that this is answered by table 3 of the exemption request (re-pasted below). This table lists the extremes of environmental conditions under which the equipment must be designed to operate. All of the types of finished equipment which contain sensors, actuators and ECUs that require this exemption are designed to function under these conditions.

Parameters	Passenger road vehicles in scope of the ELV Directive	Engine applications as required by this exemption request
Temperature	Up to 150°C	Up to 150°C, exhaust sensors can be up to 600°C
Vibration	Up to 11.5 g RMS, but generally less severe than NRMM	Up to 12 g RMS. ECUs may be exposed to 95 – 105°C and at up to 12g RMS.
Fuel	Petrol or diesel	Diesel, natural gas and petrol. Some diesel engine exhausts are also dosed with diesel exhaust fluid (DEF) to reduce NOx emissions ²
Duty cycle	Private cars (UK) are used on average for only 4% of the time ³ .	30 – 70% are typically used for testing NRMM engines and is believed to be representative
Proportion of time at full load	Relatively small, no data but probably less than 5% of time when in use ⁴ .	Up to 100% (commonly required for generators)

² Most diesel engines made today which meet the most current NOx emissions limits utilize DEF fluid.

³ See Q5 from <http://www.racfoundation.org/motoring-faqs/mobility#a5> . Note that average UK passenger car miles per year in 2015 was 7,900 miles (source RAC), whereas the UK HGVs average was 33,000 miles per year (calculated from UK government statistics).

⁴ One study show fuel use in grams per second. Assume that peak load is when this is the highest values, such as in figure 15 of the paper, the peaks account for <10% of the total time with 5% appearing to be typical. https://www.repository.cam.ac.uk/bitstream/handle/1810/261082/Bishop_et_al-2016-Applied_Energy-VoR.pdf?sequence=1

ATEX compliance ⁵	Not required	May be required (this will limit the sensors and other components that can be used as they may need to be approved for ATEX compliance by a Notified Body)
Environment	Passenger cars are exposed to water and salt water spray, some dust, although engines, their sensors and control units tend to be shielded from these so only suffer from condensation and temperature fluctuations.	Many types of corrosive chemicals when used in factories, oil refineries, etc. Salt spray, high humidity, dust and dirt (e.g. in building sites, quarries, etc. so in much larger quantities than passenger cars) and frequent large temperature cycles

Notes on above table

- The duty cycle of passenger cars will be fairly varied. An average of 4% is equivalent to about 1 hour per day, but some cars are used for much longer periods (such as taxis and delivery vehicles), although only rarely more than 8 hours per day (33%)
- The proportion of time at full load has a very large impact on the operating temperature and level of vibration that the sensors and other electronics experience. These are both considerably more severe at full load than when idling.
- ATEX certified equipment must be constructed using ATEX approved electronic modules and sensors. The sensors and modules used in passenger vehicles do not need to be ATEX approved and so these cannot be used in types of engine equipment that require ATEX certification.

Although the maximum temperature and vibration experienced by passenger car engines and NRMM engines are similar, the proportion of time that NRMM engines experience high temperature and severe vibration will be considerably more than passenger car engines.

2. EUROMOT is an industry association and as such not a manufacturer of equipment subject of this exemption request.

- a. Please provide a list of manufacturers of the EEE listed under 1a in the EU and outside, as well as manufacturers of engines, sensors, actuators and ECUs that are used in such equipment, in the EU and outside.

Engine manufacturers include (but are not limited) to Agco, Caterpillar, Cummins, Daimler, Deere, Doosan, GE, GE (Waukesha), Generac, Kohler, Kubota, Mahindra, Rolls Royce, Volvo, and Yanmar. Pls refer to the EUROMOT website (www.euromot.eu) for a comprehensive list of engine manufacturers.

Manufacturers of equipment that use these engines include: Engine manufacturers' customer lists are confidential and cannot be disclosed. However, there are many manufacturers of the types of equipment described in the exemption request that advertise via their Internet websites. Examples

⁵ Equipment and protective systems intended for use in potentially explosive atmospheres Directive (ATEX) 94/9/EC

of these companies may include (but again are not limited to) companies like Bauer, Black and Decker, Case New Holland, Gorman-Rupp, Ingersoll-Rand, Kaeser.

3. Directive 2011/65/EU (RoHS 2) was enacted in 2011. Please explain which steps the manufacturers undertook since 2011 to achieve RoHS compliance, specifically for each EEE listed under 1a.

Engine manufacturers have been investigating the availability and suitability of lead-free substitutes and are testing these when they become available, but no definite results are available yet.

You have stated that some sensors relevant to your exemption request are currently available as RoHS compliant versions.

- a. Please provide a list with an indication on which type of sensor, actuator, and ECU is currently available as RoHS compliant version and which ones are not.

We assume RoHS compliant versions of certain components are available based on the fact that similar components are used in the automotive sector (light duty vehicles) which have to comply with the European ELV Directive.

Examples of sensors that are RoHS-compliant and have been designed for the automotive market are available at:

- Fluid temperature - <https://en.tdk.eu/tdk-en/373388/company/press-center/press-releases/press-releases/temperature-sensors--lightweight-all-plastic-media-sensor-for-automotive-fluids--tdk-epc-corporation-/165352>
- Pressure - http://www.bosch-semiconductors.de/media/automotive_electronics/product_information/smp480_productinfo_1110.pdf
- Speed (this is the IC only, not packaged for engine installation) - <http://www.allegromicro.com/en/Products/Magnetic-Speed-Sensor-ICs/Transmission-Sensor-ICs/ATS684.aspx>
- Various types - http://www.te.com/commerce/DocumentDelivery/DDEController?Action=srchtrv&DocNm=1308086-3_Sensor_Technologies&DocType=CS&DocLang=English

Examples of actuators:

Exhaust throttle control actuators, variable flow turbocharger flow control actuators and air throttle actuators.

Examples of ECUs:

- Components for ECUs – see <http://www.vishay.com/docs/48202/48202.pdf>
- Petrol vehicle ECU - <https://www.delphi.com/manufacturers/auto/powertrain/gas/ecm/mt9x>

4. Please describe which technological alternatives to the equipment using internal combustion engines relevant to your exemption request are available on the market. This may include equipment in which an electric engine replaces the internal combustion engine, and as such possibly avoids the use of lead in solders relevant to this exemption request.

Some equipment can use an electric motor as the power source. However, electric motors have advantages and disadvantages over internal combustion engines, which will determine which type of power source is appropriate. Important variables that prevent the use of electric motors include:

- The power / weight ratio of internal combustion engines can be much higher than equivalent size electric motors
- Running time with a tank of fuel is much longer than with a battery,
- Refilling a tank with fuel is much quicker than recharging batteries. Fuel powered engines can therefore be used continuously, whereas battery powered equipment has a typical running time of one or two hours before recharging is needed which will take several hours at least. Battery recharging is not possible at locations with no mains electricity.

Connection to a mains supply (for mains powered electric motors) is not possible at many locations, especially for mobile and emergency generators as these are needed where there is no electricity supply available.

For much of the equipment in the types covered by this equipment request, the features above may make it inappropriate to substitute an electric motor.

5. As part of the evaluation, socio-economic impacts shall also be compiled and evaluated. For this purpose, please provide details in respect of the following:
- a. Please estimate possible impacts on employment in total, in the EU and outside the EU, should the exemption not be granted. Please detail the main sectors for which impacts are expected, i.e. manufacturers, supply chain, retail, etc.
 - b. Please provide a list of manufacturers of your EEE for which you apply for the exemption in and outside the EU (see question 2);
 - c. Please quantify additional costs (money expenditure) through substitution of the restricted substance – or replacement of the EEE by other, RoHS-compliant EEE if feasible - divided into sectors (private, industry, public) if the exemption request is granted vs. its rejection;
 - d. Is there any generation of additional waste to be expected if the exemption is granted vs. its rejection;

For this exemption request, the exemption is needed because reliability cannot be assured and so at present there is no alternative designs that are proven to be reliable. Our exemption request is made, therefore, on the grounds of reliability, and not requested based on the socio-economic impact.

a Engines and equipment made with these engines would not be available in the EU without an exemption being granted because suppliers must guarantee reliability. For the types of equipment that are also in scope of the NRMM Emissions Regulation, these will need third-party approval to

be sold in the EU and this will not be granted without long term reliability data for RoHS-compliant engines.

b See Q1

c Determination of costs cannot be provided at this stage and will be based on the individual solutions and this will be passed down to the market.

d No

Please note that answers to these questions are to be published as part of the available information relevant for the stakeholder consultation to be carried out as part of the evaluation of this request. If your answers contain confidential information, please provide a version that can be made public along with a confidential version, in which proprietary information is clearly marked.