Clarification Questionnaire for Exemption 12 of Annex IV (renewal request with scope restriction)

Exemption for „*Lead in metallic bonds creating superconducting circuits in MRI (Magnetic Resonance Imaging) or NMR (Nuclear Magnetic Resonance)*"

Requested validity: 7 years

Abbreviations and Definitions

FTMS	Fourier Transform Mass Spectrometer
MRI	Magnet Resonance Imaging
NMR	Nuclear Magnetic Resonance
Pb	Lead
SQUID	Superconducting Quantum Interference Device

Background

The Oeko-Institut and Fraunhofer IZM have been appointed within a framework contract[1] 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.

JASTEC has submitted a request for the renewal of the above mentioned exemption, which has been subject to a first review. 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 the request at hand.

Questions

1. Exemption 12 currently covers the use of *"Lead and cadmium in metallic bonds creating superconducting magnetic circuits in MRI, SQUID, NMR (Nuclear Magnetic Resonance) or FTMS (Fourier Transform Mass Spectrometer) detectors"*. In your renewal request, you state that you do not longer need cadmium, and that the exemption is no longer required for SQUID and FTMS.

    a. We assume that lead- and cadmium-free solutions are available for SQUID and FTMS detectors. Please describe these solutions.

[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.

JASTEC) We do not know whether there are solutions for SQUID and FTMS detectors since we do not manufacture such systems.

b. Why can these solutions not be used for MRI and NMR devices as well? Please explain in detail why this is not viable.

JASTEC) We have no answer here .

c. In case you have no insights into the above-requested issues, could you please let us know which manufacturers produce SQUID and FTMS detectors?

JASTEC) We know following companies are producing SQUID, FTMS detectors.

There might be other companies.

SQUID: Quantum Design, Inc.

https://www.qdusa.com/products/laboratory_squids.html

FTMS : Bruker, Inc

https://www.bruker.com/products/mass-spectrometry-and-separations/mrms.html

2. JASTEC is not the only manufacturer of MRI and NMR devices:

a. Could you please let us know which other manufacturers produce such devices?

JASTEC) As far as we know, following companies are producing MRI and NMR

MRI

GE healthcare

https://www.gehealthcare.com/products/magnetic-resonance-imaging

Siemens healthcare

https://www.siemens-healthineers.com/magnetic-resonance-imaging

Philips Healthcare

https://www.philips.nl/healthcare/solutions/magnetische-resonantie

Hitachi

https://www.hitachi.com/businesses/healthcare/products-support/mr/index.

Canon Medical

https://ch.medical.canon/product-solutions/magnetic-resonance-imaging/

NMR

Bruker

https://www.bruker.com/products/mr/nmr.html

b. In case you have knowledge about this, could you please let us know whether other manufacturers have solved the problem of lead-free solder use in the applications in the scope of the exemption request?

JASTEC) We do not have the knowledge whether other companies have solved the problem or not. In general, the processes of metallic bonding in superconducting circuit are strict confidential technology for each company.

3. You say that substitutes must have a critical temperature higher than that of liquid helium (4.2 K) and high critical field strength to remain a superconductor in the presence of strong magnetic fields. We understand that materials lose their superconductivity at temperatures above their critical temperature. Can you please explain more about the critical field strength (Meissner effect?)?

JASTEC) Superconductor has not only critical temperature but also critical magnetic field. It is a physical nature of superconductivity defined by interaction energy.

Superconducting state is realized by the presence of Cooper pairs in which two electrons are virtually connected by interaction mediated by crystal lattice potential. Since this interactional energy is very small, superconducting state is realized only at very low temperatures where thermal energy is very small. If the temperature is too high, then the Cooper pair would be broken by the energy of thermal oscillation in the crystal lattice. This breakage also happens if Cooper pair is surrounded by certain magnetic field such that the interaction energy between electron and magnetic field becomes greater than the interaction energy that keeps Cooper pairs together. Under this condition, the Cooper pairs no longer exist. This is the reason that superconductor has its critical magnetic field.

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.