
Framo Morat GmbH & Co. KG - RoHS Exemption Request - Exemption 6(c)

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I. Contact details

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II. Summary of the exemption request - 02.12.2014

Framo Morat GmbH & Co. KG (Framo) is requesting a renewal for the exemption 6(c) out of annex III regarding copper alloys containing up to 4% lead by weight and the aimed limitation of annex II, which states a definition of a maximum of 0.1% lead by weight. This request demands, that there will be an extension of the proposed scope.

Framo is using a specific alloy to produce the soft partner of worm gears which is named CuZn37Mn3Al2PbSi. The calculation of load-carrying capacity is an essential part of the designing of a drive including worm gears. To ensure a realistic computation several material properties have to be known. These properties relating to CuZn37Mn3Al2PbSi cannot be found in common literature like "Niemann/Winter - Maschinenelemente 3" or "Dubbel - Taschenbuch für den Maschinenbau". Therefore the used properties base on decades of internal testing and recording. Framo is not able to perform any realistic and scientific approved calculation of load-carrying capacity, if CuZn37Mn3Al2PbSi will not be available for use anymore.

First tests with possible substitutes, for example ECOBRASS or other lead free (<0.1%) materials, were not satisfying. The substitutes did not reach the mechanical properties of the used one.

The effort to find an equal substitute, especially in connection with time and human resources, will be a huge task. Decades of testing and analyzing have to be done in a fractional part of time. The profitability in this short period of time is not given.

In summary it can be resumed, that at this time the limitation of lead in copper alloys to <0.1% by weight is technically and economically not suitable. Concerning this matter Framo proposes the retention of the limitation of up to 4% lead by weight like it is set in annex III.

III. Technical description of the application

Worm gears are placed in the technical group of helical gear systems and consist of a driving worm and a worm gear as typical output. The worm gear is the soft partner of the system and is usually made out of copper alloys.

The benefit of a soft partner is its individual run-in performance. Its run-in is necessary for the achieving of the best contact pattern and therefore the maximum bearing stress. Other materials compared to copper alloys do not have those excellent run-in performances.

Additionally considerable characteristics of worm gears are:

- shaft angle of 90°
- possibility of series connections of worms
- very compact in frame size regarding the transmission
- extremely loadable
- possibility of a self-locking effect
- lower noise level compared to spur gears

IV. Recycling of the applied material

The recycling process of CuZn37Mn3Al2PbSi is a defined and closed loop.

Framo gets the material as specific work pieces by a certified and long-term reliable partner in supply. After the manufacturing of the worm gears the remaining cuttings are collected by Framo and are, which is the first step of the recycling loop, stored for dripping of the left coolant.

As the second step a specialized recycling company picks up the cuttings and centrifuges the last leftovers of coolant out of it.

The last steps are sending the dry cuttings to the first named supplier and turning them back into new and usable work pieces.

This closed loop guarantees the most possible way of recycling the lead containing copper alloy.

V. Screening of possible substitutes

In the past Framo did some first tests with existing materials as substitutes. Those were cancelled after our specialists confirmed that the excellent mechanical properties of CuZn37Mn3Al2PbSi cannot be reached by any of them. Therefore the first attempt of changing the material at Framo failed in reflecting the specific material characteristics of the substitutes.

In the early 2010s Framo tried to generate some usable experiences in connection with new and high developed coatings like DLC or a particular shaped chrome layer. The first attempts had shown that there is a chance of potential in this technology to substitute CuZn37Mn3Al2PbSi. The continuation of this research would involve the generating of a non-assessable amount of costs and human resources. Anyway there are still future projects planned, which are connected to this technology.

In 2015 Framo decided to create a team made of specialists picked out of various sections of the company. It will contain purchasers, engineers, technologists and experts in technical calculation and process engineering.

The aim of this assembly is the screening and judgement of lead free materials and their mechanical and also economical characteristics.

One of the main obstacles will be to find a substitute which includes the great machinability of CuZn37Mn3Al2PbSi but excludes a comparable amount of lead by weight. The profitability of the used copper alloy concerning the costs and lifetime of tools has to be offset as well.

VI. Recapitulation of the request

The written request shows, that it is not possible to find a substitute material any time soon.

The mechanical and economical characteristics cannot be reached by any other vetted material or substitute system. The aims Framo set itself are attainable but the required time is today the big and unknown variable.

Regarding researches, up to now, all received test results were not positive, neither mechanically nor economically.

The retention of the given limitation (<4%) for several years is regarding to the given information above absolutely essential for Framo.

VII. Further information

The classification of the produced worm gear sets in just one or a few technical sectors is, regarding the strong international market position of Framo, impossible.

Framo sells more than a million worm gears to more than 275 customers all around the world placed in all branches.

There are two possibilities to order a worm gear set. First there are catalogue sets which can be ordered right away and are in stock. The other opportunity is to order customized worm gears which are designed in a specific way for every customer himself.

Considering the possibility of catalogue sets it is difficult to trace the final application, in which Framo worm gears can be found. One of the nameable examples is definitely the sector of geared motors and their affiliated surroundings.