Exemption Request For Exemption 29 : Lead bound in crystal glass as defined in Directive 69/493/EEC

Date of submission: 16 January 2015

1. Name and contact details

1) Name and contact details of applicant:

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2) Name and contact details of responsible person for this application (if different from above):

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2. Reason for application: Please indicate where relevant:

☐ Request for new exemption in:

☐ Request for amendment of existing exemption in

X Request for extension of existing exemption in

☐ Request for deletion of existing exemption in:

☐ Provision of information referring to an existing specific exemption in:

X Annex III ☐ Annex IV

No. of exemption in Annex III or IV where applicable: 29

Proposed or existing wording: Lead bound in crystal glass as defined in Directive 69/493/EEC

Duration where applicable: 10 years

3. Summary of the exemption request / revocation request

Lead bound in crystal glass are used in EEE applications because their unique combinations of processing and optical/decorative properties and characteristics allow the manufacture of EEE articles which could not be produced otherwise. Substitutes were sought over the latest two decades without success. The performance of alternative materials is worse and does not allow the production of the same articles, notably because of the insufficient workability time made possible by the lead oxide component.

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4. Technical description of the exemption request / revocation request

(A) Description of the concerned application:

1. To which EEE is the exemption request/information relevant?

Name of applications or products:

Fixed/portable luminaires
Lamps
Electrified mirrors
Horology (clocks, watches etc.)
Display cases
Digital photo frames
Tablet and smart phone docking stations
Furniture and home décor items (carrousel, tables etc.)
Building materials (illuminated bricks)

a. List of relevant categories: (mark more than one where applicable)

☐ 1	☐ 7
☐ 2	☐ 8
☒ 3	☐ 9
X 4	☐ 10
X 5	X 11
☐ 6	

b. Please specify if application is in use in other categories to which the exemption request does not refer: No use in other categories

c. Please specify for equipment of category 8 and 9:

The requested exemption will be applied in

☐ monitoring and control instruments in industry
☐ in-vitro diagnostics

☐ other medical devices or other monitoring and control instruments than those in industry

2. Which of the six substances is in use in the application/product?

   (Indicate more than one where applicable)

   X Pb ☐ Cd ☐ Hg ☐ Cr-VI ☐ PBB ☐ PBDE

3. Function of the substance:

   Lead Oxides (PbO or Pb3O4), are used as an intermediate for the chemical synthesis of Lead Crystal Glass, as required by Council Directive 15 December 1969 on the approximation of the laws of the Member States relating to crystal glass (69/493/EEC). The amount of Lead in the Lead Crystal Glass has to be at minimum of 24% expressed as PbO for the glass to be called "crystal glass", and it must be stressed that it does not mean that there is PbO nor Pb as such in the articles. It is simply a convenient way to express the result of an elementary composition analysis. Under REACH Regulation, Crystal Glass is itself a substance of unknown or variable composition, which by convention is expressed as oxides of the constituent elements (SiO_2, Na_2O, K_2O, PbO, etc.)[1]. We reemphasize that articles made of Lead Crystal Glass actually contain no elemental Pb or PbO as such.

   The addition of lead oxide enables

   - A better energy efficiency. Measures demonstrate that from a same source (LED), the light flow transmitted through a crystal item is bigger by a factor of at least 10%, compared to the light flow transmitted by the same item in flint glass. The energy efficiency (lumen/watt) of crystal is therefore much better than in flint glass. In certain cases, the ranking IEE of an electric lighting device can jump to category A (with crystal) from category B (with flint glass). In other words, less energy is required for lighting.

   - The production of exceptional articles otherwise impossible to obtain, through the
     - increased working time with the glass, via excellent thermal and viscosity properties (melting and forming)
     - unique optical properties needed for
       - ⇨ High refractive index n_d > 1.56 (responsible for brilliance)

[1] REACH Regulation, Annex V and Guidance for Annex V, Entry 11, pp. .38-39.

        - ⇨ High dispersion $n_f - n_c > 0.01$, preferably 0.013 (responsible for the refraction and reflection performance)
        - ⇨ High light transmission ($L > 98$; $-0.5 < a < 0$; $-0.5 < b < 0.5$ (100 mm thickness immersion, light C, 2°, CIELAB)
        - ⇨ No ‚grey' but sharp colour transition
    - unique mechanical (cutting and polishing) process possibility
    - unique refinement (sustainable surface) process possibility
    - decorative aspects

Certain applications therefore display design, shapes, dimensions and optical/decorative aspects which are unique to lead bound in crystal glass.

4. Content of substance in homogeneous material (%weight):

The crystal glass directive 69/493/EEC defines crystal glass into four categories along three criteria, among them its composition expressed notably as lead oxide up to over 30% by weight.
Under the REACH Regulation, glass is considered as a UVCB substance (substance of unknown or variable composition, complex reaction products or

biological materials).[2] It is not a preparation and does not contain lead metal nor lead compounds as such.

5. Amount of substance entering the EU market annually through application for which the exemption is requested: about 46 tons/year
   We estimate that about 50 tons/year of Pb3O4 or PbO is used to produce lead bound in crystal glass for electric and electronic articles entering the EU market. NB. The former submission indicated 145 tons/year, most probably because there was a confusion between lead crystal glass electric/electronic applications and Pb oxides components.
   Please supply information and calculations to support stated figure.
   The combined declarations of the major EU manufacturers show that electric/electronic articles with lead bound in crystal glass amount to about 130 tonnes of lead crystal electric/electronic articles. To produce 100 kg of lead bound in crystal glass, an average of about 29.6kg of Pb3O4 or PbO are needed, which means a use by EU producers of 39.6 tonnes of Pb3O4 for 130 tonnes of lead crystal glass electric/electronic applications

   Euromonitor[3] indicates 197 producers or distributors of crystal electric appliances in Europe. Bearing in mind that the consortium which tables this exemption represents the major EU manufacturers, they have estimated their global EU market share to be of 80%. From their combined declarations, it can be estimated that they use 40 tons/year of Pb3O4 and PbO as an intermediate for EEE applications. For the total EU market, this would make about 50 tons/year of Pb3O4 and PbO.

   The Pb comprised in Pb3O4 and PbO can be calculated to amount to 46 tons

6. Name of material/component: Lead bound in crystal glass as defined in Annex I (categories 1, 2, 3 and 4) of Council Directive 69/493/EEC

7. Environmental Assessment: _____
   LCA: ☐ Yes
   X No

[2] The EU Commission and the Member States have come to a political compromise defining glass in the following way: “Glass is a state of a substance, rather than a substance as such”. On this basis, glass should be treated as a UVCB substance, which means a substance of “unknown or variable composition, complex reaction products or biological materials” - 4th Meeting of the Competent Authorities for the implementation of Regulation (EC) 1907/2006 (REACH) 16-17 June 2008

[3] http://glass.europages.co.uk/companies/Crystal%20lamps.html

(B) In which material and/or component is the RoHS-regulated substance used, for which you request the exemption or its revocation? What is the function of this material or component?

The lead oxide and lead tetroxide are used as raw materials to produce lead bound in crystal glass along the specifications of directive 69/493/EEC, which in turn is used to produce luminaires etc. (see question 4(A)1)

The crystal glass is a component of high quality lighting and decoration applications mentioned under section 4.1, and is used for the very production of these articles otherwise impossible to manufacture, for enhancing light distribution or transparency thereof and for specific decoration (shape and finishing).

The hazard represented by glass depends on the intrinsic properties of the substance glass and not on the intrinsic properties of the individual substances that went into the batch as intermediates for making the glass.

By definition, glass is an amorphous, inorganic solid material made by fusing silica with basic oxides. Glass is called amorphous because it is neither a solid not a liquid but exists in a vitreous (or glassy) state. From a chemical point of view, glass is both a unique material and a material state respectively. The chemical and physical material characteristics and behaviour cannot be derived from the properties of the raw materials (PbO or Pb3O4) used as intermediates. The melting process leads to a complete chemical transformation forming a new chemical compound : crystal glass

(C) What are the particular characteristics and functions of the RoHS-regulated substance that require its use in this material or component?

Lead oxide or tetroxide is added to achieve the following characteristics:

- Refractive index : ratio of the speed of the light in vacuum in a dimensionless number that describes how light propagates through a medium. The higher the refractive index, the more lighting effects (rainbow).
- Abbe number : Abbe number is a measure of the variation of refractive index with wavelength so that the refractive index of a glass with a low Abbe number varies across the visible spectrum less than a glass with a high Abbe number. Lead crystal glass has a low Abbe number which reduces chromatic aberration in parallel to displaying a high refractive index.
- Dispersion : phenomenon in which the phase velocity of a wave depends on its frequency The bigger the dispersion, the more visible spectrum of colours (rainbow)
- Cooling time : lapse of time between two viscosity states below and above which glass cannot be shaped. The more time is possible, the more specific

(longer, thinner, and complex) shapes can be designed. This specificity enhances the skills of the craftsman to elaborate high end products.

- Working range : range of temperature with the same purpose of the cooling time, expressed in °C, instead of time.
- Vickers' Hardness : measure of hardness of the material. The lower the hardness, the more possibilities for cutting and engraving complex artistic designs on exceptional and prestigious items which can only be achieved by handcrafting.
- Better energy efficiency because of less energy consumption together with a better lighting effect.

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5. Information on Possible preparation for reuse or recycling of waste from EEE and on provisions for appropriate treatment of waste

1) Please indicate if a closed loop system exist for EEE waste of application exists and provide information of its characteristics (method of collection to ensure closed loop, method of treatment, etc.)

Lead bound in crystal EEE applications are prestigious and expensive items which are kept, transferred, inherited or resold.

The repairing or replacement of the broken parts of these prestigious and expensive items (e.g. one branch or prism of a luminaire) prevent the discarding of the full EEE application.

Crystal manufacturers provide inherent assistance via an after-sales service by which they collect and replace the broken parts of EEE crystal items which have been brought back by the customer, sometimes via the distribution chain.

In addition, there are second-hand shops and specialized repair workshops, privately collecting, repairing and replacing spare parts of EEE applications made of lead bound in crystal glass.

2) Please indicate where relevant:

☐ Article is collected and sent without dismantling for recycling

☐ Article is collected and completely refurbished for reuse

X Article is collected and dismantled:

X The following parts are refurbished for use as spare parts:

Branches of fixed/portable luminaires, lamps, illuminated bricks, furniture and home decoration

☐ The following parts are subsequently recycled:

☐ Article cannot be recycled and is therefore:

☐ Sent for energy return

X Landfilled

3) Please provide information concerning the amount (weight) of RoHS substance present in EEE waste accumulates per annum:

☐ In articles which are refurbished N/A

☐ In articles which are recycled N/A

☐ In articles which are sent for energy return N/A

☐ In articles which are landfilled N/A

The number of discarded spare parts is negligible, given that EEE applications made of lead crystal glass are prestigious and expensive items which the consumer has all interest to keep and repair

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6. Analysis of possible alternative substances

(A) Please provide information if possible alternative applications or alternatives for use of RoHS substances in application exist. Please elaborate analysis on a life-cycle basis, including where available information about independent research, peer-review studies development activities undertaken

No substitute exists. Research has provided patterns achieving some of the Pb bound in crystal properties, but none of these patterns achieve all of the same essential properties, especially the main one : thermo-mechanical-optical properties to elaborate the product.

See 4(c)

Table comparison crystal and sodalime[4]

	lead crystal	lead free crystal 1	lead free crystal 2	lead free crystal 3	sodalime glass
Refractive Index	1,559	1,555	1,547	1,554	1,521
	discrepancy	0%	-1%	0%	-2%
Abbe Number	43,8	55,7	53,6	55,4	59,4
	discrepancy	27%	22%	26%	35%
Dispersion (656,27nm-768,2nm) (10E-3)	4,2	na	3,2	3,2	3,1
	discrepancy		-24%	-24%	-27%
Dispersion (589,3nm-656,27nm) (10E-3)	3,7	na	2,7	2,7	2,6
	discrepancy		-26%	-26%	-29%
Dispersion (435,84nm-486,13nm) (10E-3)	7,3	na	5,1	5,1	4,8
	discrepancy		-30%	-31%	-34%
Dispersion (404,66nm-435,84nm) (10E-3)	6,3	na	4,3	4,2	4,0
	discrepancy		-32%	-32%	-36%
Working Range (T Log4 - T Log 7,65) (°C)	333	271	290	254	298
	discrepancy	-19%	-13%	-24%	-10%
Cooling time (s)	130	106	113	104	100
	discrepancy	-19%	-13%	-20%	-23%
Vickers' Hardness (MPa)	4799	5319	5038	5431	5586
	discrepancy	11%	5%	13%	16%

[4] Lead free crystal 1&2 : formulations investigated during R&D works (thesis conducted by Baccarat until 2003, confidential, references upon request)

Lead free crystal 3 : US patent 2007/003237A1, Lead free is based on US Patent. Holder is Swarowski

Sodalime glass : commercial formulation used for tableware production

Lead free glass do not fit with the required combination of essential properties.

- Shorter cooling time/working range would not permit the production of complex items any more.
- Higher Vickers hardness will trigger musculo-skeletal disorders for the workers because the cutting difficulty will dramatically increase. In addition, quicker damage and need to replace industrial tools will drastically increase. It will become impossible to make very intricately engraved articles as employers are required to protect the health of their workers.
- The combination of optical properties (refractive index, Abbe number, dispersion) generated by the use of lead bound in crystal glass are unique and unmatched by other materials (the latter are unable to obtain the same low value of chromatic aberration).

After two decades of intensive research, all possible combinations of elements have been prepared and evaluated, and this has shown that for our applications, there are no alternatives to lead crystal glass. References are available upon request and upon confidentiality assurance.

(B) Please provide information and data to establish reliability of possible substitutes of application and of RoHS materials in application

There are no alternatives providing equivalent properties needed for the manufacture of these articles.

7. Proposed actions to develop possible substitutes

(A) Please provide information if actions have been taken to develop further possible alternatives for the application or alternatives for RoHS substances in the application.

Over the latest two decades, research has been launched to look for and develop alternatives but no viable solutions were established. The results obtained did not reach the same needed properties and displayed inferior thermal, mechanical and optical properties (cooling time, Vickers hardness, Abbe number) allowing the manufacture of the same applications.

(B) Please elaborate what stages are necessary for establishment of possible substitute and respective timeframe needed for completion of such stages.

There are a limited number of elements in the periodic table available that can be combined to form some kinds of crystal glass in EEE applications (BaO, ZnO, SrO, CaO, MgO). Moreover, those combinations that exist form glasses only within relatively small composition ranges. After two decades of research, all possible combinations of elements have been prepared and evaluated by some major lead crystal manufacturers and this has shown that for lead bound in crystal glass EEE applications, there are no alternatives to compositions that use lead as a component.

Research has been carried out and lead-free substitutes do not provide the same needed properties. Further research may never be successful due to the demanding combinations of essential characteristics. It is therefore not possible to predict how long this type of R&D would take or whether substitutes could be found for all the lead bound in crystal EEE applications. It is very likely that it will never be possible to replace lead bound in crystal EEE applications.

8. Justification according to Article 5(1)(a):

(A) Links to REACH: (substance + substitute)

1) Do any of the following provisions apply to the application described under (A) and (C)?

- ☐ Authorisation
  - ☐ SVHC
  - ☐ Candidate list
  - ☐ Proposal inclusion Annex XIV
  - ☐ Annex XIV
- ☐ Restriction
  - ☐ Annex XVII
  - ☐ Registry of intentions
- ☐ Registration

NB. Registration of glass is exempt (REACH, Annex V). Moreover, registration does not apply to articles. Chemicals used to make glass are transported intermediates and so are exempt from authorization.

Restriction

REACH restrictions applying to lead all carry an exemption for lead crystal.

- Lead in jewellery articles at a concentration level of 0.05% or above[5]. A derogation applies to lead bound in crystal glass.
- In December 2014, ECHA approved the following restriction proposal from Sweden: "Lead and its compounds shall not be (…) used in articles (…), which are supplied to the general public and which can be placed in the mouth by children, if the concentration of lead (…) is equal to or greater than 0.05% by weight". A derogation applies to crystal glass as defined in Annex I to Council Directive 69/493/EEC.

Authorization

PbO and Pb3O are transported iintermediates in the manufacture of glass and so are exempt from authorization.

2) Provide REACH-relevant information received through the supply chain.
Name of document: _____

5 Commission Regulation (EU) No 836/2012 of 18 September 2012 amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards lead, prohibits the placing on the market and the use of lead in jewellery articles at a concentration level of 0.05% or above

(B) Elimination/substitution:

1. Can the substance named under 4.(A)1 be eliminated?

   ☐ Yes. Consequences? _____

   X No. Justification: as stated above, it would be impossible to obtain all the same material properties leading to the production of the EEE articles at stake.

2. Can the substance named under 4.(A)1 be substituted?

   ☐ Yes.

   ☐ Design changes:
   ☐ Other materials:
   ☐ Other substance:

   X No.

   Justification: See answers 6-7

3. Give details on the reliability of substitutes (technical data + information):

   There are no industrial processible substitutes with comparable thermo-mechanical-optical properties enabling the manufacture of handmade high end articles. There is no single element or combination of elements known to substitute Pb in crystal glass in all its properties (workability, optical properties, chemical resistance, etc.). With combinations of elements such as Ti, B, Zn, Bi, Sb, Ba, Sr, Li it is only possible to reach some of the above-mentioned properties.

   Reference : *Properties of lead crystal versus unleaded glass formulations*, (IMC-RAP-04-12372/rie), June 2005, TNO (Dutch independent Institute)

4. Describe environmental assessment of substance from 4.(A)1 and possible substitutes with regard to

   Glass is a UVCB (substance of unknown or variable composition) and is exempted from registration[6].

   It has an own CAS number and might be classified an 'inorganic polymer' (with silicon and boron instead of carbon) with a stochastic far range order.

   Glass has its own characteristic chemical and physical properties which cannot and therefore must not be derived as a sum of the properties of its raw materials such as lead oxide or silicon dioxide (quartz). The glass matrix immobilizes all elements during the melting process (indeed it is a chemical reaction which transforms and combines the raw materials into a new chemical substance

   1) Environmental impacts:

   Lead bound in crystal glass waste is a non hazardous waste according to EC Decision 2003/33/EC.

[6] ECHA Guidance for Annex V : exemptions from the obligation to register, pp. 38-39

Release of metals on landfill

Release of metals during the disposal of glass in landfill is the only way that should be taken into consideration for all types of glass (end of life). Consistent with the position adopted by the Commission, the meeting of adequately and reliably set limits of a leaching test is an accepted methodology to demonstrate the non-availability of the constituents.

(…) Chapter 2.2.2 “Criteria for landfills for non-hazardous waste” in Council Decision 2003/33/EC (…) introduces criteria for acceptance of non-hazardous waste at landfills and leaching thresholds that have been set. The limit values for acceptance of a waste as non-hazardous material according to Council Decision 2003/33/EC (L/S = 10 l/kg) are given in Table 2 for the relevant elements used in a glass formulation and meeting the criteria for classification as dangerous in all their chemical forms according to Directive 67/548/EEC.

Table 2: leaching limit values according to Council Decision 2003/33/EC	**Leaching limit (mg/kg dry)**
Element	
Pb	10

Lead bound in crystal complies with the leaching values of the landfill directive and is classified as non-hazardous material in the Waste Directive.

Articles made of / or containing Pb bound in crystal glass (as defined in Directive 69/493) are prestigious and expensive items and are kept/stored/transmitted/inherited or sold. The amount of articles or parts of articles which might be discarded is therefore negligible.

When such articles are broken, consumers may return them to the supplier which will replace or repair them.(see point 5)

2) Health impacts: none
3) Consumer safety impacts: none

⇨ Do impacts of substitution outweigh benefits thereof?
Please provide third-party verified assessment on this:

There are no substitutes. The ban of lead crystal in electric and electronic equipment would lead to the disappearance of some mainly lead crystal manufacturing companies.

(C) Availability of substitutes: N/A

a) Describe supply sources for substitutes: _____

b) Have you encountered problems with the availability? Describe: _____

c) Do you consider the price of the substitute to be a problem for the availability?

☐ Yes ☐ No

d) What conditions need to be fulfilled to ensure the availability? _____

(D) Socio-economic impact of substitution: N/A

⇨ What kind of economic effects do you consider related to substitution?

☐ Increase in direct production costs

☐ Increase in fixed costs

☐ Increase in overhead

☐ Possible social impacts within the EU

☐ Possible social impacts external to the EU

☐ Other: _____

⇨ Provide sufficient evidence (third-party verified) to support your statement: _____

9. Other relevant information

Please provide additional relevant information to further establish the necessity of your request:

Articles made of lead bound in crystal are high end, prestigious and expensive products mostly stemming from artisanal work requiring unique and specific knowledge. Some European companies benefit from national recognition for this via a status of patrimonial knowledge. It requires the mastering of ancestral and rare craftsmanship.

The label 'Entreprise du Patrimoine Vivant'[7] is a mark of recognition by the French State, set up to distinguish French enterprises for their artisanal and industrial know-how of excellence. It is granted for five years to enterprises which are depository of an economic patrimoine, composed of a rare, famous or ancestral know-how, stemming from the mastering of traditional or high technologies. All French crystal manufacturers benefit from this label.

Most European crystal manufacturing companies were set up as early as the 18th century

REACH : it has to be stressed that glass and crystal are exempted from REACH registration. Moreover, Lead Crystal applications are the object of a derogation in lead restrictions under REACH (Com Reg 836/2012, lead in jewellery, and derogation for lead crystal in the EU restriction for Pb in articles which can be placed in children mouth).

[7] http://www.patrimoine-vivant.com/fr/a-state-label

The lead crystal glass industry is already under stress. EEE applications represent about one third of the turnover of some of them. Should the exemption not be renewed, it would mean :

- loss of economic and patrimonial wealth
- loss of ca. one third of turnover of related manufacturing companies and in the medium/long term, their disappearance.
- 1,000 direct jobs loss and 3,000 indirect jobs in Europe

In Europe there are many companies whose business is devoted entirely to the production and sale of lead crystal chandeliers and allied lighting products (UK approximately 10). A larger group of companies have lead crystal products as part of a wider range of products (UK approximately 25) and there are a number of specialist antique restoration companies that refurbish and restore lead crystal chandeliers and rely on the manufacture of spare parts made from the same quality of crystal glass (UK approximately 5).

Lead crystal has been used in high quality lighting for many years owing to the clarity and refraction which sets it aside from other forms of glass and provides a quality which is recognised the world over.

If lead crystal were to be banned in the EU the high quality market for chandeliers and other allied lighting products would be severely affected as the distinction between high quality chandeliers (some costing 10s of thousands of EUR) and poorer quality items will not exist. As a result the market for high quality crystal lighting will be damaged and some companies may be forced out of business with a resulting loss of jobs.

A similar damage will be done to the restoration and refurbishment market as lead crystal parts matching the originals would not be available rendering them as poor restorations (bearing in mind that refurbished lighting products need to comply with relevant regulations). If the market does not exist there would be no replacement part available.

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10. Information that should be regarded as proprietary

Please state clearly whether any of the above information should be regarded to as proprietary information. If so, please provide verifiable justification:
