Exemption Request Form

Date of submission: **20/01/2020**

1. Name and contact details

1) Name and contact details of applicant:

Company:	**Optical Fiber Packaging Ltd**	Tel.:	**+44(0)1440 766636**
Name:	**Mr Richard Durrant**	E-Mail:	**rdurrant@ofpgco.com**
Function:	**CEO**	Address:	**Hollands Road Ind. Estate, Haverhill, Suffolk, CB9 8PR, UK**

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

Company:	_____	Tel.:	_____
Name:	_____	E-Mail:	_____
Function:	_____	Address:	_____

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2. Reason for application:

Please indicate where relevant:

- ☐ Request for new exemption in:
- ☐ Request for amendment of existing exemption in
- ☒ Request for extension of existing exemption in
- ☐ Request for deletion of existing exemption in:
- ☐ Provision of information referring to an existing specific exemption in:
  - ☐ Annex III ☐ Annex IV

No. of exemption in Annex III or IV where applicable: **7c-I**

Proposed or existing wording: _____

Duration where applicable: **5 years**

- ☐ Other: _____

3. Summary of the exemption request / revocation request

Optical Fiber Packaging Ltd (OFP) are requesting an extension of the request for the following reasons.

There are no alternative materials or technologies available, commercially or otherwise to substitute for the current low melting point glass containing lead that OFP uses for hermetic sealing in its products for the applications.

The direct consequence of no extension being granted for the exemption would be catastrophic damage to OFP's core business with closure of the company's manufacturing and the loss of over 100 jobs. More than 90% of OFP's overall, products use the current low melting point glass.

The job losses would include all direct labour staff and skilled engineering employees at OFP. The job losses in Europe would be to the benefit of Chinese/Asian manufacturers not bounded by the same legislative restrictions. Without an extension, it would be an open growth opportunity for Asian companies and a strategic loss of a high technology capability within Europe to supply Western manufacturers of critical high technology fiber optic infrastructure communications equipment.

Whilst there are ongoing efforts to develop substitute materials and processing techniques, these efforts will not yield a commercially viable alternative within 3 years.

The nature of end application of OFP's products is such that very extensive reliability qualification has to be performed by OFP's customers and in turn OFP's customers 'end customers', and these qualifications typically take more than a year after a material change is notified by OFP.

OFP are seeking an extension of the exemption to have reasonable time to complete the development of alternative materials, have them qualified for use, and to retain sensitive strategic technology capabilities in Europe and further grow skilled employment.

With more than 20 years' experience in this field, OFP is probably the largest manufacturer of these hermetic seals using LMP glass in Europe and one of very few successful manufacturers in this field globally.

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4. Technical description of the exemption request / revocation request

The material OFP use for which the exemption extension is being requested is Low Melting Point glass (LMP glass). This contains some level of Lead oxide. OFP use the LMP glass to manufacture miniature hermetic seals to optical fibers contained within small metallic tubes. The small seal subassembly is then used to allow optical fibers to hermetically penetrate into a 'optical module' that contains typically a laser,

detector chip and other free space optical components that are highly sensitive to being exposed to atmosphere.

The same technology is also used to seal optical fibers into products where the end product is in a high-pressure differential environment, or a high-pressure environment and a high temperature resistance is required too.

The optical modules described are used in a very wide range of telecommunications, data networking, long haul submarine cabling systems, and military and medical applications.

They are also used in Oil and Gas exploration, production and field maintenance applications and submarine military applications.

OFP successfully service all these end markets with its hermetic seal products containing the LMP glass.

(A) Description of the concerned application:

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

Name of applications or products: List of relevant categories: (mark more than one where applicable)

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

a. Please specify if application is in use in other categories to which the exemption request does not refer: _____

b. 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)

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

3. Function of the substance:

Lead glass has been actively used since 17th century for decorative properties to produce crystal glassware (even the first lead-based glass was found used in Mesopotamia in 1700 BC). The glass had low melting temperature, low viscosity and high index of refraction.

In the 20th century those properties led to creating glass soldering technology. Glass solders are used to join glasses to other glasses, ceramics, metals, semiconductors, mica, and other materials, in a process called glass frit bonding. The glass solder has to flow and wet the soldered surfaces well below the temperature where deformation or degradation of either of the joined materials or nearby structures

Very low temperature melting glasses, fluid at 200–400 °C (390–750 °F), were developed for sealing applications for electronics. The bonding between the glass or metal and the glass solder can be either covalent, or, more often, van der Waals. The seal can be leak-tight; glass soldering is frequently used in many applications related to vacuum technology.

Lead is used in glass typically as lead oxide (PbO) to:

- Significantly reduce a melting point of the glass (from 1000 C to 270 C), allowing not too destroy optical fiber coating (typically acrylate)
- Significantly reduce viscosity of glass mix (by about 100 times), allowing melted glass to flow into very tight spaces required for reliable fiber optics glass seal
- Vary coefficient of thermal expansion of the glass to match those of metal and fiber optics glass
- Wet the metal surface to create proper physical bond and vacuum tight sealing

4. Content of substance in homogeneous material (%weight): **0.1%**

5. Amount of substance entering the EU market annually through application for which the exemption is requested: **50kg**

   Please supply information and calculations to support stated figure.

6. Name of material/component: Lead compound – Lead (II) Oxide
7. Environmental Assessment: _____

   LCA: ☐ Yes

   ☒ No

(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?

Lead oxide at OFP is used in Low Melting Point Glass, which is used to creating fiber optics hermetic seals. Our customers use the seals to produce millions of fiber optics transceivers for high speed communication; to create high reliability optical seals for harsh environment applications in oil-and-gas; military and submarine telecom to survive extremely high pressures and temperatures in ocean depths and tens of kilometres under earth surface. Without those seals, world communication is impossible.

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

The main characteristics are – very low melting temperature, wetting properties, close CTE value to special alloys used in hermetics and low viscosity of PbO based glass mix.
To achieve tight hermetic seal, two properties must hold:
The molten glass must be capable of wetting the metal, in order to form a tight bond, and
The thermal expansion of the glass and metal must be closely matched so that the seal remains solid as the assembly cools.

The metal/glass contact can break if the CTEs (coefficient of thermal expansion) are not well aligned. For the case that the CTE of the metal is larger than the CTE of the glass, the sealing shows a high probability to break upon cooling. By lowering the temperature, the metal shrinks more than the glass does, leading to a strong tensile force on the glass, which finally lead to breakage. On the other hand, if the CTE of the glass is larger than the CTE of the metal, the seal will tighten upon cooling since compression force is applied on the glass.
Lead based glass allows to precisely match CTE of glass frit material to CTE of metal ferrule while still be not too far from CTE of glass used in optical fiber.
It also wets traditional metals used for hermetic feedthroughs, such as kovar, Inconel, stainless steel, etc. thus allowing water and gas tight sealing.
In addition to it, lead oxide addition to the glass mix significantly reduces melted glass viscosity allowing it to flow in very tight spaces between fiber and metal ferrule. For achieving a vacuum-tight seal, the seal must not contain bubbles. Low

viscosity of PbO based glass mix allows bubbles to escape before solidifying the glass.

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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.)

In Environmental legal terms none of the products produced by OFP inclusive of the lead material are finished 'EEE' (Electrical and Electronic Equipment). The products produced by OFP are sub-assemblies, requiring professional integration into other end EEE telecom equipment. this integration is done by OFP customers two supply levels above OFP, ready for end use in professional environments, such as telecom exchanges or datacentres. So OFP's sub-assemblies including any component parts are not in scope of WEEE regulations in their own right. Therefore OFP do not have closed loop recycling arrangements or registration into EU or other regions WEEE recycling schemes.

Our customers take care of applicable WEEE recycling scheme registrations, depending on which regulations apply in the regions they are importing their finished end equipment / EEE into.

Unless their end equipment is being installed into a large scale fixed installation in the EU, that is out of scope of EU WEEE, such as large telephone exchange also known as telecom central office or large scale datacentre. In those cases the telephone exchange owners / operators make their own arrangements for end of life EEE, such as sell parts for re-use or sell on for scrap / recycling, according to local applicable waste laws (as much of the end equipment in telecom exchanges can have a value for recovery at end of life).

2) Please indicate where relevant: Not applicable

☐ Article is collected and sent without dismantling for recycling

☐ Article is collected and completely refurbished for reuse

☐ Article is collected and dismantled:

☐ The following parts are refurbished for use as spare parts: _____

☐ The following parts are subsequently recycled: _____

☐ Article cannot be recycled and is therefore:

☐ Sent for energy return

☐ Landfilled

3) Please provide information concerning the amount (weight) of RoHS substance present in EEE waste accumulates per annum: Not applicable

☐ In articles which are refurbished _____

☐ In articles which are recycled _____

☐ In articles which are sent for energy return _____

☐ In articles which are landfilled _____

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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

Alternatives for the use of the RoHs substance (lead) do not currently exist. No material has is commercially available and has been qualified as a substitute. Development efforts have continued for many years to find either substitute technology or materials to account for the special requirements of hermetically sealing optical fibers for the same applications. Alternative processes and materials with the same physical properties to ensure high reliability sealing whilst maintaining the minimum requirements for performance and reliability of the optical transmission through the fiber at the same time, are not currently available and may not be for some years to come.

Over the course of the last 20+ years multiple attempts to create alternative low melting point glass mixes, such as β-eucryptite, zirconium vanadate (ZrV2C>7), and zirconium tungstate (ZrW208) or BaO(SrO,CaO)-B2O3-Bi2O3 systems, for example, have been made.

Intensive studies of lead-free low melting systems have begun at the beginning of 90th of last century. However, the developed practical frit compositions do not meet these requirements. From our point of view, the main problem is the absence of new lead and alkali free low melting eutectics for low temperature hermetic sealing and the lack of proper phase diagrams. The same actual problem is the revealing of new stoichiometric compositions which may serve as a basis for the development of low melting crystallized frits and ceramic fillers for glass frits TEC reduction. So far, all attempts to create lead-free glass frits

produce mixes either not resistant to water attack or the ones which crystallize too much before fusing and flow of glass powders. OFP's founders had been involved into extensive study invested by TE Connectivity (Tyco) to attempt to find a lead-free mix to meet all needed criteria. Unfortunately, that investment proved to be unsuccessful.

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

Reliability information and engineering data is not currently available for alternative substitutions of the application nor substitutions for RoHS materials for the prevailing application. Substitutions for the application are not known as alternatives for the opto-electronic devices core to the end device use requiring hermetically sealing, do not exist nor are they under development.

Reliability data for substitute materials for the RoHS material for the current application will only be available when a technically viable substitute can be engineered.

Massive research for possible low melting lead free substitutes have been able to develop many lower melting point materials, which unfortunately produced either non-homogeneous or crystalized seals or did not wet to metals, thus not creating reliable seals or actually even vacuum tight seals.

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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.

OFP has been working for more than 5 years with several of its capable material suppliers to see if a substitute can be developed.

The work is focused on formulating a glass material without a lead content that can match or exceed the minimum physical properties required for the hermetic glass sealing of fiber optics application.

Development of such a material is challenged by the interest level of glass manufacturers to have any commercial incentive to support this work due to the very small amounts of the current glass formula used in this application and elsewhere for similar applications worldwide. Expertise at independent science

institutes such as Sheffield Halam University has also been employed to help the development efforts.

The complexity of formulating an alternative glass is considerable as many important parameters have to be met with a substitute. These include the melting point, flow characteristics, wetting characteristics and critically the CTE.

Efforts in recent years have been focussed on approximately 10 materials that can be formulated with glass as potential alternatives to lead. Significant focus has been on glass materials formulated with vanadium, bismuth and silver oxides. So far non of these formulations has delivered a substitute glass fomulation.Wetting ability and bond strengths have not yet met sutiable levels and melting points on experimental formulations have been substantially above what can be used in the application. Develeopment engineering contimues, however it is not known still if a substitute can actually be developed.

There are a number of patents filed by several research and commercial organization for glass frits containing dozens of different additives, for example CuO, C02O3 MnO, NiO, Cr203, PbF2; Nb2O5; Bi2O3; Fe2O3; ZnO; TiO2; Al2O3; B2O3; and CaO. Unfortunately, none of them were able to produce true hermetic seals.

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

Work has been continuous for 30+ years to create an alternative formulation of low melting point glass. It is OFP's guess that if this can be developed, 3 or more years work may still be required and this does not account for the qualification cycle for OFP's customers for the hermetic fiber seals. This time frame would have to include very detailed long cycle environmental and mechanical qualification regimes for the substitute glass material itself and the processing changes to use it. OFP have been working with a number of hermetic glass mix manufacturers in active attempt to find lead-free mixes with proper melting and glass transition temperatures, acceptable CTE and wetting properties.

Typically, due to the complexity of OFP's customers products into which the OFP hermetic seals are used and the available 're-qualification windows' for product changes, a minimum of a year is required for commercial acceptance of such an important change.

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

2) Provide REACH-relevant information received through the supply chain.
Name of document: **L3 2019 ROHS2 material safety and compliance datasheet (attached).**

(B) Elimination/substitution:

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

☐ Yes. Consequences? _____

☒ No. Justification: **There are no alternative technologies available for substitution for the application at this point.**

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

☐ Yes.

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

☒ No. Justification: **There are no materials available at this point that can be substituted and meet the technical requirements of the application**.

2. Give details on the reliability of substitutes (technical data + information):
Substitutes not yet available

3. Describe environmental assessment of substance from 4.(A)1 and possible substitutes with regard to
    1) Environmental impacts: **Substitutes not yet available**
    2) Health impacts: **Substitutes not yet available**
    3) Consumer safety impacts: **Substitutes not yet available**

⇨ Do impacts of substitution outweigh benefits thereof?

Please provide third-party verified assessment on this: **Substitutes not yet available therefore no third-party verified assessment possible.**

Availability of substitutes:

Describe supply sources for substitutes: **Substitutes not yet available**

Have you encountered problems with the availability? Describe: **Substitutes not yet available**

a) Do you consider the price of the substitute to be a problem for the availability? **Substitutes not yet available**

☐ Yes ☐ No

b) What conditions need to be fulfilled to ensure the availability? **Substitutes not yet available**

(C) Socio-economic impact of substitution:

⇨ What kind of economic effects do you consider related to substitution? **Substitutes not yet available**

☐ 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: **Substitutes not yet available**

9. Other relevant information

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

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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: