Exemption Request Form

Date of submission: 10/01/2020

1. Name and contact details

1) Name and contact details of applicant:

Company: Knowles Precision Devices

Name: Stephen Hopwood

Function: Engineering Manager

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With support from :

Name WID Co.,Ltd	**Logo**	**Name** Expantech Co.,Ltd	**Logo**	**Name** Amphenol Canada Corp.	**Logo**
Name Amphenol Inc.	**Logo**	**Name** Glenair UK	**Logo**	**Name** Glenair Inc.	**Logo**
Filconn	**Logo**	Cordon Electronics Italia	**Logo**	Oxley Developments Co. Ltd	**Logo**

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: 24

Proposed or existing wording: Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors

Duration where applicable: We apply for renewal of this exemption for the categories marked in section 4 further below for the respective maximum validity periods foreseen in the RoHS2 Directive, as amended. For these categories, the validity of this exemption may be required beyond those timeframes. With regard to Category 11, we request that this application is not processed earlier than the applicable latest application date foreseen in RoHS2, as amended (i.e. 18 months before the respective maximum validity periods foreseen in RoHS2).

☐ Other: _____

3. Summary of the exemption request / revocation request

Discoidal and planar array capacitors are derivations of MLCC's with the opposing terminations made to the outside periphery and the inside diameter of holes drilled through the ceramic body. They are specialist capacitors used in EMI filters and EMI filtered connectors for high end applications, where the elimination of electrical interference is critical. Typical applications for assemblies incorporating these

components and covered by the RoHS directive include professional audio equipment, Maritime monitoring (coastguard radar) and CCTV systems

In application, signal carrying feedthrough pins are passed through the ceramic element and connected to the internal bore to make a mechanical and electrical connection. This connection must have low electrical resistance and inductance for optimum performance, as high resistance / inductance will inhibit the high frequency electrical path to ground through the filtering capacitor.

Traditionally this connection is made by solder, but when lead free solder is used to make the connection, the shrinkage of the solder and pin assembly within the bore exerts a tension force on the inside of the bore sufficient to form micro-cracks in the ceramic element. These cracks have a recognisable shape and form. If the crack propagates through the electrically active portion of the design, where electrodes of opposing polarities overlap each other, then the result can be a low resistance path or an electrical short circuit resulting in failure of the electrical system and potentially health and safety risks to operators.

Lead containing solders, often in conjunction with other metals such as Indium, imparts a degree of ductility to the solder joint, allowing stress release within the joint and absorbing the forces applied to the ceramic.

Alternative solder alloys, such as Sn based lead-free alloys and SnPb alloys, do not have sufficient ductility to prevent stress damage to the ceramic and can represent a reliability / safety risk during the operating life of the 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: EMI feedthrough filters and EMI filtered connectors

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

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

b. Please specify if application is in use in other categories to which the exemption request does not refer:
As a component supplier we are not aware of all applications where this product is used, but in general it is for high end applications where performance is more important than cost. They are not generally used in low cost consumer electronics.. We include category 11 to cover unknown applications.

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)
☒ Pb ☐ Cd ☐ Hg ☐ Cr-VI ☐ PBB ☐ PBDE

3. Function of the substance: To impart ductility to the solder joint

4. Content of substance in homogeneous material (%weight): Varies with filter design, but typically 5mg to 10mg per solder joint, equating to ~1.0% of the total component weight (maximum). More complex designs such as filter connectors will be proportionally less as a % of the total weight.

5. Amount of substance entering the EU market annually through application for which the exemption is requested: Estimated at ~ <250kg
Please supply information and calculations to support stated figure.

There is no accurate data available to indicate the amount of lead entering the EU in this type of application, however most applications of these components are not covered by the RoHS directive. Below we have attempted to estimate the volume of lead based on our knowledge of the market, our 2019 manufacturing data and typical solder volumes used.

There are 2 major players in the supply of planar arrays for EMI filtered connectors and we are informed by our customers that we currently account for ~70% of the market. Knowles current annual manufacturing output is ~34M capacitive holes, of which we estimate ~13M holes would use BeCu spring clips to make the contact, replacing solder. Considering Knowles projected market share, this would indicate the total market to be around 39M capacitive holes PA. The nature of these components is such that they are mainly used for high end applications such as aerospace and military where technical performance outweighs cost, although we are seeing a gradual increase in the number of applications requesting RoHS data. We estimate from feedback that only around 10% of parts are supplied into applications covered by the RoHS directive, meaning ~3.9M capacitive holes. Based on our earlier calculation that each hole takes up to 5mg to 10mg of lead in a typical solder joint, the total Lead from EMI filtered connectors entering RoHS applications PA is ~29kg.

With regard to EMI single line filters, we previously estimated the total weight of lead based the global market for EMI filters at ~19kg of lead maximum. We do not believe there has been any significant movement in the market from this position, but have taken the stance to increase the percentage of sales into RoHS applications to 10% in line with the trend seen in EMI connectors. This gives an estimate Lead from EMI single line filters of ~48kg for 2019

Since the last exemption review, HMP soldered EMI filters have been excluded from the scope of exemption 7(a) and included in the scope of exemption 24. We are unable to compile a definitive figure of solders used in these applications, as to do so would necessitate an understanding of all manufacturing processes and sales markets, but we estimate the total market to be similar to the EMI filter market using low lead (50%) solders. We have estimated this market will use ~47.5kg at a typical ratio of 50% lead. HMP solders are typically 92.5% lead, so we must recalculate the figure to allow for this, giving an estimated Lead from the HMP EMI filter market of ~88kg PA

Adding these 3 estimated quantities together gives the estimate Total Lead of 164kg PA supplied into applications covered by the RoHS directive, allowing for errors and assumptions, and applying the same ratio as previous exemption applications, we achieve a figure for total usage of <250kg

6. Name of material/component: Solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors such as are used in the manufacture of EMI Filters & EMI Filtered connectors

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?

Solder used to make electrical and mechanical contact between the internal contact face of the ceramic capacitor and the internal conductor pin of the finished component. The alloy used is usually InPb for mechanical mount applications, and PbSnAg for applications demanding secondary soldering operations by the end user.

Discoidal and planar array capacitors are used in the manufacture of EMI filters and EMI filtered connectors used to supress electromagnetic interference on signal lines.

By their nature, these devices are mainly used on high end applications – the majority being used in space / aerospace and military, but some applications exist within the remit of the RoHS directive

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

1. The solder must have good wetting action – it is not physically possible to apply the solder directly into the joint area, so the wetting action is vital for the solder to flow into the holes through capillary action.
2. The solder must have good ductility down to low temperatures – the Lead Indium compounds used are the only alloys in the ‘standard’ melting temperature range that have the required ductility.
3. Where secondary soldering operations are required (solder-mount filters) there is an additional requirement to maintain the ductility of the joint and have a high enough melting point alloy to allow the user to mount the filter by conventional reflow soldering techniques without the internal solder joint suffering secondary reflow The only other alloys having appropriate ductility and associated high melting points are lead containing HMP alloys. This has previously been

covered under exemption 7a, but is now within scope of exemption 24 following the rewording of 7a during the last exemption review cycle

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.)

Knowles provide the electronic components to OEM's & CEM's who incorporate them into their application / equipment. As a manufacturer of component level products, Knowles are not aware of the final disposition of EEE at EOL.

2) Please indicate where relevant:

☐ 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

Recycling is possible. Disposition is determined by the higher level manufacturer. Knowles cannot answer Question 2.

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

☐ In articles which are refurbished _____
☐ In articles which are recycled _____
☐ In articles which are sent for energy return _____
☐ In articles which are landfilled _____

Not known. The nature and cost of the component indicates a long lifecycle, so EOL equipment will be minimal. Disposition is determined by the higher level manufacturer. Knowles cannot answer Question 3.

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

As stated above, we currently process ~13M holes PA for applications which will use BeCu spring clips to make the electrical and mechanical contact. This is not possible on the majority of applications for several reasons:

- The BeCu clips takes up more space than a conventional solder joint (typical diameter of capacitive hole ~25% larger) due the mechanical requirements of the clip. This increase in hole diameter prevents use of spring clips in two ways:
    - It reduces the values of capacitance that can be achieved in the filter by restricting the available active electrode overlap area
    - It means that clips cannot be used on applications with a tight pin pitch, or small diameter, as there is no mechanical space available
    - Clips cannot be used with connectors that require a seal is made directly to the surface (for example epoxy encapsulation) as the liquid (epoxy) enters the clip 'fingers' and interferes with the electrical and mechanical contact
    - The technique does not provide a 100% grounding ring (a 100% electrical contact through 360º between the conductor pin and the capacitor, so it can reduce EMI performance and allow HF noise to pass through.

Note that BeCu is under consideration for inclusion in the RoHS directive as a restricted material, but there are no known alternatives with the appropriate combination of mechanical resilience and electrical conductivity to replace this.

Transient Phase Liquid Sintering is of interest for possible future applications and improvements in this field of 'soldering' are being monitored. TPLS theoretically allows reflow using lead free alloys to achieve a joint with a high secondary reflow temperature. To date, trials with TLPS alloy in these applications have not

identified an alloy with a suitable wetting characteristic to allow the jointing material to fill the joint area.

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

At present there are no known substitutes for lead containing solder alloys for this application.

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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.

We see no scope for replacing solder as the primary method of making electrical and mechanical connection between the capacitor and the through lead.

We continue to monitor the solder industry through web searches and in conjunction with our partner solder supplier Indium Corporation, but there are no viable alternatives to lead containing alloys at the present time.

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

N/A

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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:

Based on the current status of Annexes XIV and XVII of the REACH Regulation, the requested exemptions would not weaken the environmental and health protection afforded by the REACH Regulation. The requested exemptions are therefore justified as other criteria of Art. 5(1)(a) apply

(B) Elimination/substitution:

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

☐ Yes. Consequences? _____

☒ No. Justification: No known alternative providing the requisite joint characteristics.

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

☐ Yes.

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

☒ No.

Justification: No known alternative providing the requisite joint characteristics.

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

4. Describe environmental assessment of substance from 4.(A)1 and possible substitutes with regard to
    1) Environmental impacts: Not Applicable
    2) Health impacts: Not Applicable
    3) Consumer safety impacts: Not Applicable

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

(C) Availability of substitutes:

a) Describe supply sources for substitutes: None
b) Have you encountered problems with the availability? Describe: N/A
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? N/A

(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:

Technical report (application note) attached

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:

There is no information which should be regarded as proprietary information