The following sample(s) was/were submitted and identified by/on behalf of the client as:

Sample Submitted By : HERAEUS MATERIALS SINGAPORE PTE LTD
Sample Description : Gold Flash Palladium Coated Copper Bonding Wire
Style/Item No. : PdFLASH
Color. : SILVER
Sample Receiving Date : 2019/04/24
Testing Period : 2019/04/24 to 2019/05/08

Test Requested : (1) As specified by client, with reference to RoHS 2011/65/EU Annex II and amending Directive (EU) 2015/863 to determine Cadmium, Lead, Mercury, Cr(VI), PBBs, PBDEs, DBP, BBP, DEHP, DIBP contents in the submitted sample(s).
(2) Please refer to next pages for the other item(s).

Test Result(s) : Please refer to next page(s).

Conclusion : (1) Based on the performed tests on submitted sample(s), the test results of Cadmium, Lead, Mercury, Cr(VI), PBBs, PBDEs, DBP, BBP, DEHP, DIBP comply with the limits as set by RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU.
Test Report
No. : KA/2019/42168 Date : 2019/05/08

HERAEUS MATERIALS SINGAPORE PTE LTD
BLK 5002 ANG MO KIO AVE 5, #04-05 TECHPLACE II, SINGAPORE 569871

Test Result(s)

PART NAME NO.1 : Gold Flash Palladium Coated Copper Bonding Wire

<table>
<thead>
<tr>
<th>Test Item (s)</th>
<th>Unit</th>
<th>Method</th>
<th>MDL</th>
<th>Result No.1</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium (Cd)</td>
<td>mg/kg</td>
<td>With reference to IEC 62321-5: 2013 and performed by ICP-AES.</td>
<td>2</td>
<td>n.d.</td>
<td>100</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>mg/kg</td>
<td>With reference to IEC 62321-5: 2013 and performed by ICP-AES.</td>
<td>2</td>
<td>n.d.</td>
<td>1000</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>mg/kg</td>
<td>With reference to IEC 62321-4:2013+ AMD1:2017 and performed by ICP-AES.</td>
<td>2</td>
<td>n.d.</td>
<td>1000</td>
</tr>
<tr>
<td>Hexavalent Chromium Cr(VI)(#2)</td>
<td>µg/cm²</td>
<td>With reference to IEC 62321-7-1:2015 and performed by UV-VIS.</td>
<td>0.10</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Hexavalent Chromium Cr(VI)</td>
<td>mg/kg</td>
<td>With reference to IEC 62321-7-2:2017 and performed by UV-VIS.</td>
<td>8</td>
<td>n.d.</td>
<td>1000</td>
</tr>
<tr>
<td>Hexavalent Chromium Cr(VI)</td>
<td>µg/cm²</td>
<td>With reference to BS EN ISO 3613.2010. Analysis was performed by UV-VIS Spectrometry.</td>
<td>0.02</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Hexavalent Chromium Cr(VI)</td>
<td>mg/kg</td>
<td>With reference to US EPA 3060A &amp; 7196A. Analysis was performed by UV-VIS Spectrometry.</td>
<td>2</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Sum of PBBs</td>
<td>mg/kg</td>
<td></td>
<td>-</td>
<td>n.d.</td>
<td>1000</td>
</tr>
<tr>
<td>Monobromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Dibromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Tribromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Tetrabromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Pentabromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Hexabromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Heptabromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Octabromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Nonabromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
<tr>
<td>Decabromobiphenyl</td>
<td>mg/kg</td>
<td></td>
<td>5</td>
<td>n.d.</td>
<td>-</td>
</tr>
</tbody>
</table>

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Tel: 886 (07) 3018121 Fax: 886 (07) 3018927 www.sgs.com.tw
Member of the SGS Group
## Test Item (s)    | Method                        | MDL  | Result No.1 | Limit  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sum of PBDEs</strong></td>
<td></td>
<td></td>
<td>n.d.</td>
<td>1000</td>
</tr>
<tr>
<td>Monobromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>Dibromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>Tribromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>Tetrabromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>Pentabromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>Hexabromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>Heptabromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>Octabromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>Nonabromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>Decabromodiphenyl ether</td>
<td>mg/kg With reference to IEC 62321-6:2015 and performed by GC/MS.</td>
<td>5</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>DIBP (Di-isobutyl phthalate) (CAS No.: 84-69-5)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td>1000</td>
</tr>
<tr>
<td>DBP (Dibutyl phthalate) (CAS No.: 84-74-2)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td>1000</td>
</tr>
<tr>
<td>BBP (Butyl Benzyl phthalate) (CAS No.: 85-68-7)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td>1000</td>
</tr>
<tr>
<td>DEHP (Di-(2-ethylhexyl) phthalate) (CAS No.: 117-81-7)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td>1000</td>
</tr>
<tr>
<td>DNOP (Di-n-octyl phthalate) (CAS No.: 117-84-0)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>DINP (Di-nonyl phthalate) (CAS No.: 28553-12-0, 68515-48-0)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>DIDP (Di-isodcetyl phthalate) (CAS No.: 26761-40-0, 68515-49-1)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>DMEP (Bis (2-methoxyethyl) phthalate) (CAS No.: 117-82-8)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>DNHP (Di-n-hexyl phthalate) (CAS No.: 84-75-3)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td></td>
</tr>
<tr>
<td>DNPP (Di-n-pentyl phthalate) (CAS No.: 131-18-0)</td>
<td>mg/kg With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.</td>
<td>50</td>
<td>n.d.</td>
<td></td>
</tr>
</tbody>
</table>
### Test Item (s) | Unit | Method | MDL | Result No.1 | Limit
--- | --- | --- | --- | --- | ---
Tetrabromobisphenol A (TBBP-A) (CAS No.: 79-94-7) | mg/kg | With reference to RSTS-E&E-121. Analysis was performed by LC/MS. | 10 | n.d. | -
Hexabromocyclododecane (HBCCD) and all major diastereoisomers identified (α-HBCCD, β-HBCCD, γ-HBCCD) (CAS No.: 25637-99-4 and 3194-55-6 (134237-51-7, 134237-50-6, 134237-52-8)) | mg/kg | With reference to IEC 62321: 2008. Analysis was performed by GC/MS. | 5 | n.d. | -

### Halogen

| Halogen-Fluorine (F) (CAS No.: 14762-94-8) | mg/kg | With reference to BS EN 14582:2016. Analysis was performed by IC. | 50 | n.d. | -
| Halogen-Chlorine (Cl) (CAS No.: 22537-15-1) | mg/kg | With reference to BS EN 14582:2016. Analysis was performed by IC. | 50 | n.d. | -
| Halogen-Bromine (Br) (CAS No.: 10097-32-2) | mg/kg | With reference to BS EN 14582:2016. Analysis was performed by IC. | 50 | n.d. | -
| Halogen-Iodine (I) (CAS No.: 14362-44-8) | mg/kg | With reference to BS EN 14582:2016. Analysis was performed by IC. | 50 | n.d. | -
| Perfluorooctane sulfonates (PFOS) | mg/kg | With reference to US EPA 3550C: 2007. Analysis was performed by LC/MS. | 10 | n.d. | -
| PFOA (CAS No.: 335-67-1) | mg/kg | With reference to US EPA 3550C: 2007. Analysis was performed by LC/MS. | 10 | n.d. | -
| Antimony (Sb) | mg/kg | With reference to US EPA 3052: 1996. Analysis was performed by ICP-AES. | 2 | n.d. | -

### Note:
1. mg/kg = ppm : 0.1wt% = 1000ppm
2. n.d. = Not Detected
3. MDL = Method Detection Limit
4. " - " = Not Regulated
5. (#2) =
   a. The sample is positive for Cr(VI) if the Cr(VI) concentration is greater than 0.13 µg/cm². The sample coating is considered to contain Cr(VI)
   b. The sample is negative for Cr(VI) if Cr(VI) is n.d. (concentration less than 0.10 µg/cm²). The coating is considered a non-Cr(VI) based coating
   c. The result between 0.10 µg/cm² and 0.13 µg/cm² is considered to be inconclusive - unavoidable coating variations may influence the determination.
Test Report

No. : KA/2019/42168 Date : 2019/05/08

HERAEUS MATERIALS SINGAPORE PTE LTD
BLK 5002 ANG MO KIO AVE 5, #04-05 TECHPLACE II, SINGAPORE 569871

PFOS Reference Information : POPs - (EU) 757/2010

Outlawing PFOS as substances or preparations in concentrations above 0.001% (10ppm), in semi-finished products or articles or parts at a level above 0.1%(1000ppm), in textiles or other coated materials above 1µg/m².

PFOS refer to Perfluorooctanesulfonic acid and its derivatives including Perfluorooctanesulfonic acid, Perfluorocane sulfonamide, N-Methylperfluorocane sulfonamide, N-Ethylperfluorocane sulfonamide, N-Methylperfluorocane sulfonamidoethanol and N-Ethylperfluorocane sulfonamidoethanol.
Analytical flow chart of Heavy Metal

These samples were dissolved totally by pre-conditioning method according to below flow chart. (Cr⁵⁺ test method excluded)

- Technician: Jony Liu
- Supervisor: Ray Chang

1. Cutting - Preparation
2. Sample Measurement
3. Pb/Cd/Hg
   - Microwave digestion / Hotplate digestion
   - Filtration
   - Solution
     - 1) Alkali fusion
     - 2) HCl to dissolve
   - Residue
4. Cr⁴⁺
   - Metal
   - Boiling water extraction
   - Cool, filter digestate through filter
   - Add diphenyl-carbazide for color development
   - Measure the absorbance at 540 nm by UV-VIS
5. Non-metal
   - ABS / PC / PVC
   - Others
6. Digesting at 150-160℃
   - Digesting at 80℃ by ultrasonication
   - Separating to get aqueous phase
   - Filtration
   - ICP-AES
   - pH adjustment
   - Add diphenyl-carbazide for color development
   - Measure the absorbance at 540 nm by UV-VIS
Test Report  No.: KA/2019/42168  Date: 2019/05/08
HERAEUS MATERIALS SINGAPORE PTE LTD
BLK 5002 ANG MO KIO AVE 5, #04-05 TECHPLACE II, SINGAPORE 569871

PBB/PBDE analytical FLOW CHART

- Technician: Dorothy Chen
- Supervisor: Ray Chang

1. Sample
2. Sample pretreatment
3. Sample extraction / Soxhlet method
4. Concentrate/Dilute Extracted solution
5. Filter
6. Analysis by GC/MS

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Analytical flow chart of phthalate content

- Technician: Dorothy Chen
- Supervisor: Ray Chang

[Test method: IEC 62321-8]

1. Sample pretreatment/separation
2. Sample dissolved/extracted by THF
3. Dilute Extracted solution
4. Analysis was performed by GC/MS
5. Data
TBBP-A analytical flow chart

- Technician: Ginny Huang
- Supervisor: Ray Chang

1. Sample pretreatment
2. Sample extraction by Ultrasonic extraction
3. Concentrate/Dilute Extracted solution
4. Analysis was performed by LC/MS
5. Data

*Any findings or observations are not to be considered as a complete or full report of the results.*

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HBCDD analytical flow chart

- Technician: Dorothy Chen
- Supervisor: Ray Chang

1. Sample pretreatment
2. Sample extraction / Ultrasonic method
3. Concentrate/Dilute Extracted solution
4. Filter
5. Analysis was performed by GC/MS
6. Data
Analytical flow chart of halogen content

- Technician: Jean Hung
- Supervisor: Ray Chang

1. Sample picture and report number
2. Sample pretreatment/separation
3. Weighting and putting sample in cell
4. Oxygen Bomb Combustion/Absorption
5. Dilution to fixed volume
6. Analysis was performed by IC
Analytical flow chart of PFOA/PFOS content

- Technician: Ginny Huang
- Supervisor: Ray Chang

1. Sample pretreatment
2. Sample extraction by ultrasonic method
3. Concentrate/Dilute Extracted solution
4. Analysis was performed by LC/MS
5. Data
Flow Chart of digestion for the elements analysis performed by ICP-AES

These samples were dissolved totally by pre-conditioning method according to below flow chart.

- Technician: Jony Liu
- Supervisor: Ray Chang

1. Cutting・Preparation
2. Sample Measurement
3. Acid digestion by suitable acid depended on different sample material (as below table)
   - Steel, copper, aluminum, solder: Aqua regia, HNO₃, HCl, HF, H₂O₂
   - Glass: HNO₃/HF
   - Gold, platinum, palladium, ceramic: Aqua regia
   - Silver: HNO₃
   - Plastic: H₂SO₄, H₂O₂, HNO₃, HCl
   - Others: Any acid to total digestion
4. Filtration
5. Solution
6. Residue
   - 1) Alkali Fusion
   - 2) HCl to dissolve

ICP-AES
* The tested sample / part is marked by an arrow if it’s shown on the photo. *

** End of Report **