

## Test Report

No. : KA/2020/41390

Date : 2020/04/29

Page: 1 of 13

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

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 Bonding Wire  
Style/Item No. : AW1, AW6, AW7, AW8, AW9, AW13, AW14, AW21, AW22, AW23, AW24, AW25, AW28, AW29, AW66, AW66i, AW66X, AW99, AW99i, AW99X, AW99\_ATV, AW99X\_ATV, Formax, FP2, FP2\_ATV, HA3, HA6, HA6(H), HD2, HD5, RADIX, RADIXplus and RelMax  
Sample Receiving Date : 2020/04/17  
Testing Period : 2020/04/17 to 2020/04/29

=====  
**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.

  
**Ray Chang Ph.D. / Manager**  
Signed for and on behalf of  
**SGS Taiwan Limited**  
Chemical Laboratory-Kaonsiung  




PIN CODE: 12AA9BF9

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## Test Result(s)

PART NAME NO.1 : Gold Bonding Wire

Test Item (s)	Unit	Method	MDL	Result	Limit
				No.1	
Cadmium (Cd)	mg/kg	With reference to IEC 62321-5: 2013 and performed by ICP-OES.	2	n.d.	100
Lead (Pb)	mg/kg	With reference to IEC 62321-5: 2013 and performed by ICP-OES.	2	n.d.	1000
Mercury (Hg)	mg/kg	With reference to IEC 62321-4:2013+ AMD1:2017 and performed by ICP-OES.	2	n.d.	1000
Hexavalent Chromium Cr(VI)(#2)	µg/cm <sup>2</sup>	With reference to IEC 62321-7-1:2015 and performed by UV-VIS.	0.10	n.d.	-
Hexavalent Chromium Cr(VI)	mg/kg	With reference to IEC 62321-7-2:2017 and performed by UV-VIS.	8	n.d.	-
Hexavalent Chromium Cr(VI)	µg/cm <sup>2</sup>	With reference to BS EN ISO 3613:2010. Analysis was performed by UV-VIS Spectrometry.	0.02	n.d.	-
Hexavalent Chromium Cr(VI)	mg/kg	With reference to US EPA 3060A & 7196A. Analysis was performed by UV-Vis Spectrometry.	2	n.d.	-
<b>Sum of PBBs</b>	mg/kg	With reference to IEC 62321-6:2015 and performed by GC/MS.	-	n.d.	1000
Monobromobiphenyl	mg/kg		5	n.d.	-
Dibromobiphenyl	mg/kg		5	n.d.	-
Tribromobiphenyl	mg/kg		5	n.d.	-
Tetrabromobiphenyl	mg/kg		5	n.d.	-
Pentabromobiphenyl	mg/kg		5	n.d.	-
Hexabromobiphenyl	mg/kg		5	n.d.	-
Heptabromobiphenyl	mg/kg		5	n.d.	-
Octabromobiphenyl	mg/kg		5	n.d.	-
Nonabromobiphenyl	mg/kg		5	n.d.	-
Decabromobiphenyl	mg/kg		5	n.d.	-
<b>Sum of PBDEs</b>	mg/kg		-	n.d.	1000
Monobromodiphenyl ether	mg/kg		5	n.d.	-
Dibromodiphenyl ether	mg/kg		5	n.d.	-
Tribromodiphenyl ether	mg/kg		5	n.d.	-
Tetrabromodiphenyl ether	mg/kg		5	n.d.	-
Pentabromodiphenyl ether	mg/kg		5	n.d.	-
Hexabromodiphenyl ether	mg/kg		5	n.d.	-
Heptabromodiphenyl ether	mg/kg		5	n.d.	-
Octabromodiphenyl ether	mg/kg		5	n.d.	-
Nonabromodiphenyl ether	mg/kg		5	n.d.	-
Decabromodiphenyl ether	mg/kg		5	n.d.	-

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Test Item (s)	Unit	Method	MDL	Result	Limit
				No.1	
DIBP (Di-isobutyl phthalate) (CAS No.: 84-69-5)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	1000
DBP (Dibutyl phthalate) (CAS No.: 84-74-2)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	1000
BBP (Butyl Benzyl phthalate) (CAS No.: 85-68-7)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	1000
DEHP (Di- (2-ethylhexyl) phthalate) (CAS No.: 117-81-7)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	1000
DNOP (Di-n-octyl phthalate) (CAS No.: 117-84-0)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	-
DINP (Di-isononyl phthalate) (CAS No.: 28553-12-0, 68515-48-0)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	-
DIDP (Di-isodecyl phthalate) (CAS No.: 26761-40-0, 68515-49-1)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	-
DMEP (Bis (2-methoxyethyl) phthalate) (CAS No.: 117-82-8)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	-
DNHP (Di-n-hexyl phthalate) (CAS No.: 84-75-3)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	-
DNPP (Di-n-pentyl phthalate) (CAS No.: 131-18-0)	mg/kg	With reference to IEC 62321-8:2017. Analysis was performed by GC/MS.	50	n.d.	-
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 (HBCDD) and all major diastereoisomers identified ( $\alpha$ - HBCDD, $\beta$ - HBCDD, $\gamma$ - HBCDD) (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.	-

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Test Item (s)	Unit	Method	MDL	Result	Limit
				No.1	
<b>Halogen</b>					
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.	-
Antimony (Sb)	mg/kg	With reference to US EPA 3052: 1996. Analysis was performed by ICP-OES.	2	n.d.	-
PFOA (CAS No.: 335-67-1)	mg/kg	With reference to CEN/TS 15968 (2010). Analysis was performed by LC/MSMS.	0.01	n.d.	-
Perfluorooctane sulfonates (PFOS-Acid, Metal Salt, Amide)	mg/kg	With reference to CEN/TS 15968 (2010). Analysis was performed by LC/MSMS.	0.01	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/cm<sup>2</sup>. 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/cm<sup>2</sup>). The coating is considered a non-Cr(VI) based coating
  - c. The result between 0.10 µg/cm<sup>2</sup> and 0.13 µg/cm<sup>2</sup> is considered to be inconclusive - unavoidable coating variations may influence the determination.
6. Method Detection Limit = 0.02 µg/cm<sup>2</sup> .

**PFOS Reference Information : POPs - (EU) 2019/1021**

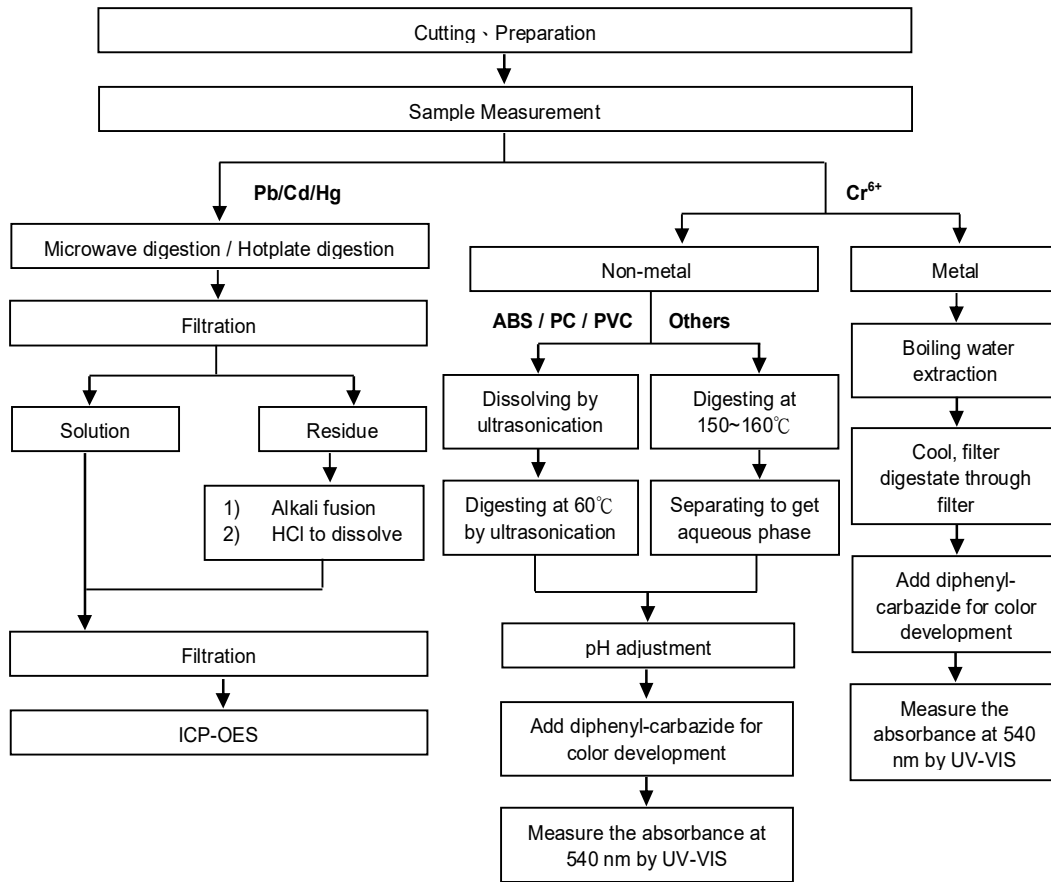
Outlawing PFOS as substances or preparations in concentrations above 0.001% (10ppm), in semi-finished products or articles or parts at a level above 0.1%(1000ppm), in textiles or other coated materials above 1µg/m<sup>2</sup>. PFOS refer to Perfluorooctanesulfonic acid and its derivatives including Perfluorooctanesulfonic acid, Perfluorooctane sulfonamide, N-Methylperfluorooctane sulfonamide, N-Ethylperfluorooctane sulfonamide, N-Methylperfluorooctane sulfonamidoethanol and N-Ethylperfluorooctane sulfonamidoethanol.

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### Analytical flow chart of Heavy Metal

These samples were dissolved totally by pre-conditioning method according to below flow chart. (Cr<sup>6+</sup> test method excluded)

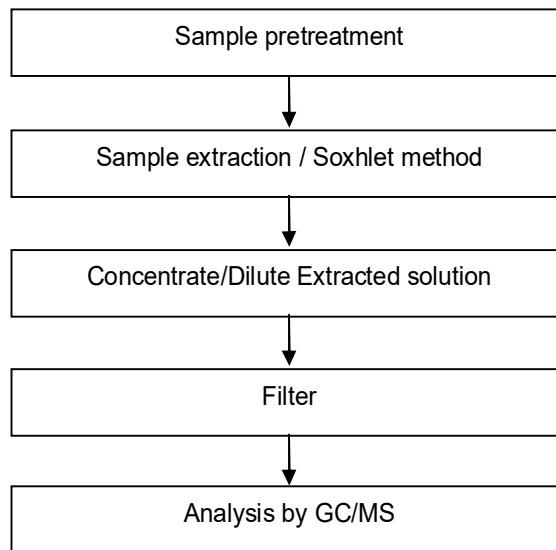


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### PBB/PBDE analytical FLOW CHART



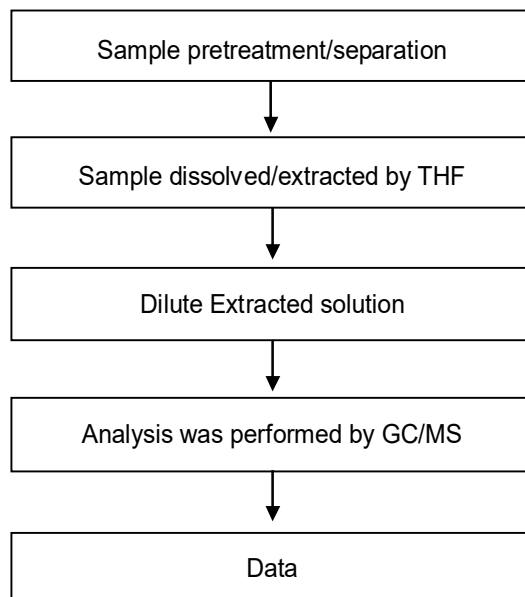
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BLK 5002 ANG MO KIO AVE 5, #04-05 TECHPLACE II, SINGAPORE 569871

### Analytical flow chart of phthalate content

#### 【Test method: IEC 62321-8】

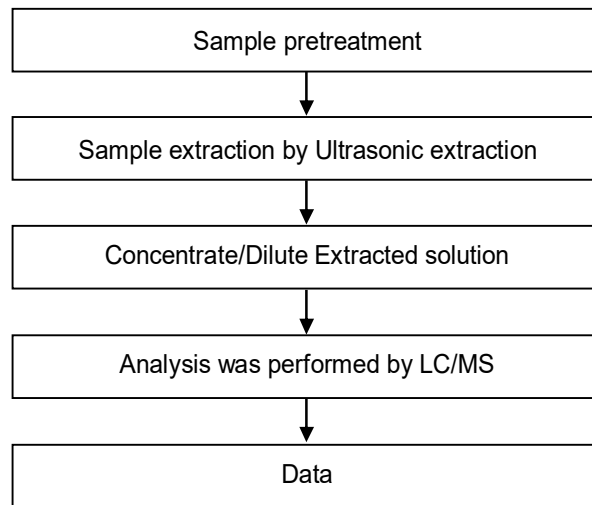


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### TBBP-A analytical flow chart



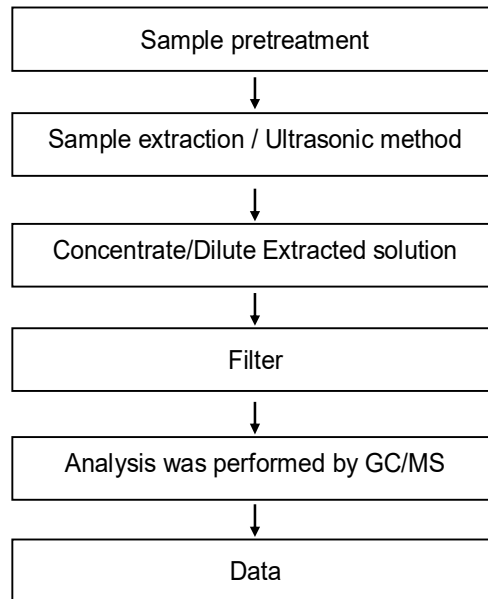
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### HBCDD analytical flow chart



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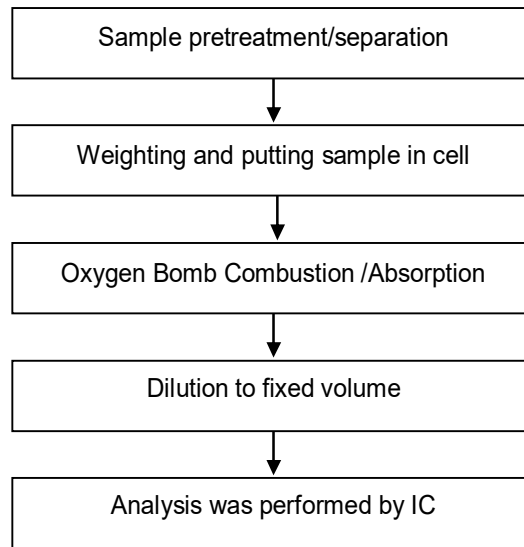
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## Analytical flow chart of Halogen

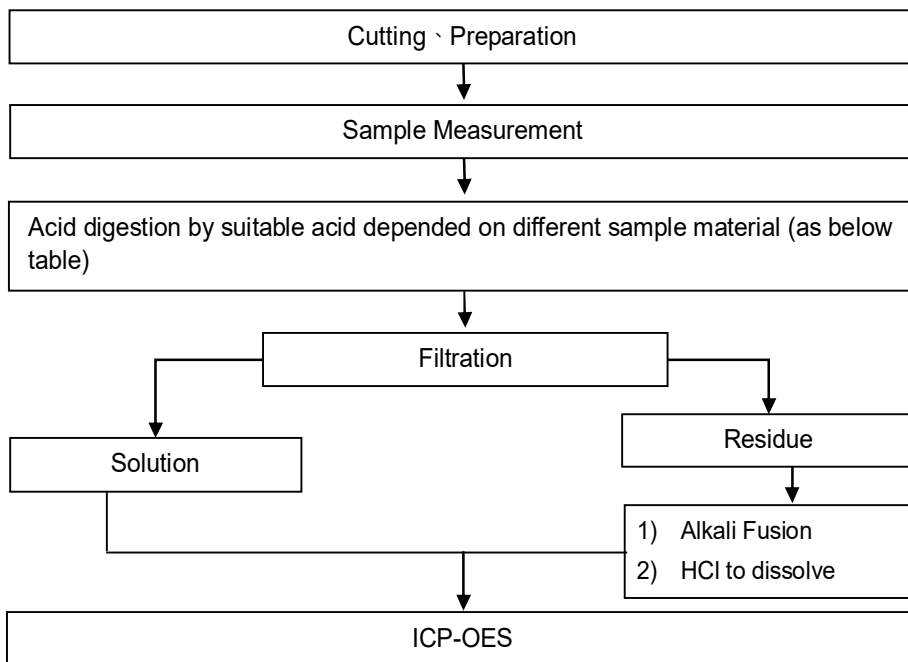


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### Flow Chart of digestion for the elements analysis performed by ICP-OES

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



	ICP-OES
Steel, copper, aluminum, solder	Aqua regia, HNO <sub>3</sub> , HCl, HF, H <sub>2</sub> O <sub>2</sub>
Glass	HNO <sub>3</sub> /HF
Gold, platinum, palladium, ceramic	Aqua regia
Silver	HNO <sub>3</sub>
Plastic	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O <sub>2</sub> , HNO <sub>3</sub> , HCl
Others	Any acid to total digestion

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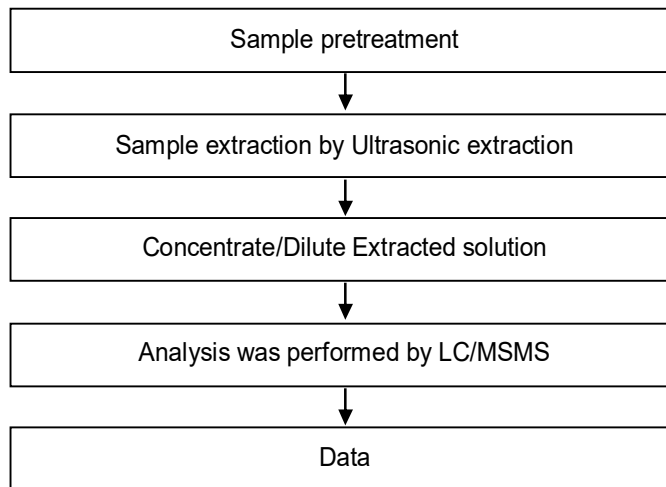
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## Analytical flow chart - PFOA/PFOS



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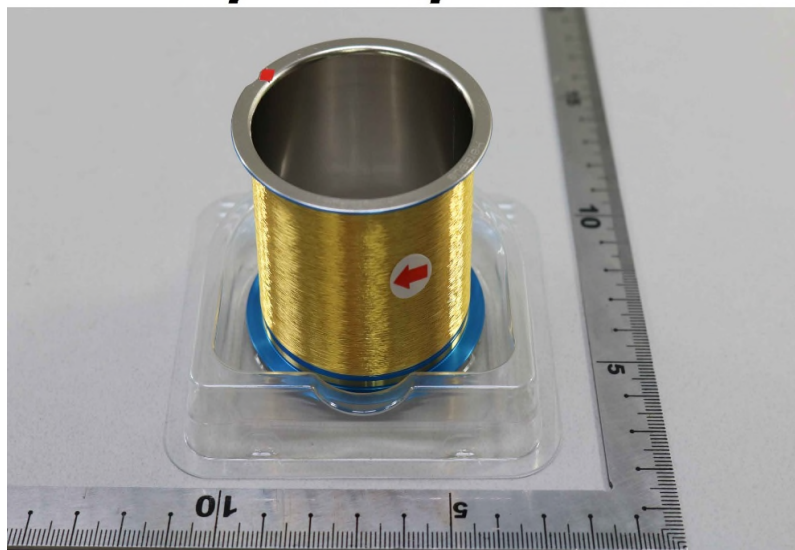
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\* The tested sample / part is marked by an arrow if it's shown on the photo. \*

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## Test Report

No. : KA/2020/41402

Date : 2020/04/29

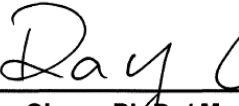
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HERAEUS MATERIALS SINGAPORE PTE LTD  
BLK 5002 ANG MO KIO AVE 5, #04-05 TECHPLACE II, SINGAPORE 569871

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 Bonding Wire  
Style/Item No. : AW1, AW6, AW21, AW24, AW99, AW99i, AW99X, Formax, FP2, HA6, RADIX and RelMax  
Sample Receiving Date : 2020/04/17  
Testing Period : 2020/04/17 to 2020/04/29

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

  
Ray Chang Ph.D. / Manager  
Signed for and on behalf of  
SGS Taiwan Limited  
Chemical Laboratory-Kaohsiung



PIN CODE: 1D5C43A3

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# Test Report

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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 Bonding Wire

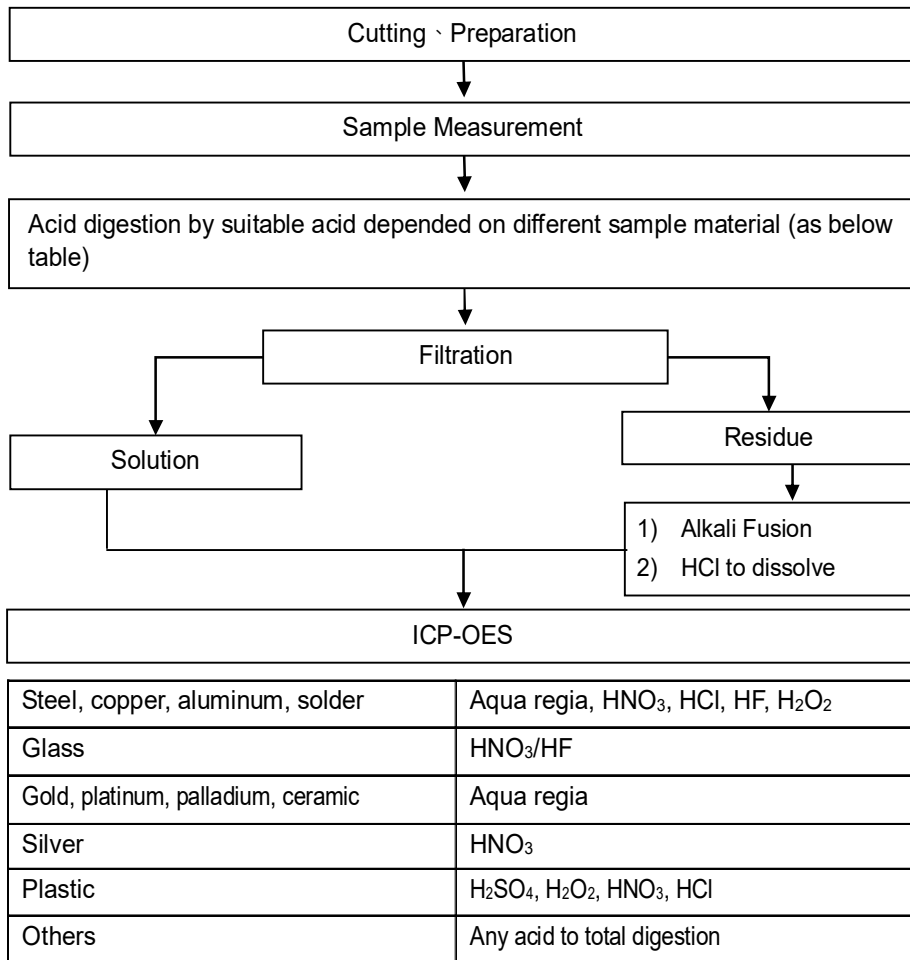
Test Item (s)	Unit	Method	MDL	Result
				No.1
Beryllium (Be)	mg/kg	With reference to US EPA 3052: 1996. Analysis was performed by ICP-OES.	2	n.d.

### Note :

1. mg/kg = ppm ; 0.1wt% = 1000ppm
2. n.d. = Not Detected
3. MDL = Method Detection Limit

## Flow Chart of digestion for the elements analysis performed by ICP-OES

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





## Test Report

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Date : 2020/04/29

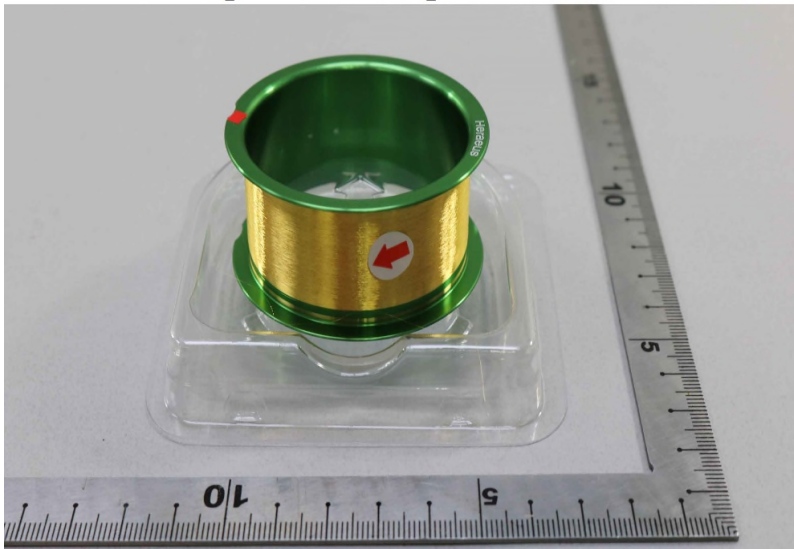
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BLK 5002 ANG MO KIO AVE 5, #04-05 TECHPLACE II, SINGAPORE 569871

\* The tested sample / part is marked by an arrow if it's shown on the photo. \*

## KA/2020/41402



\*\* End of Report \*\*