

Test Report

No. TSNEC1501590501

Date: 02 Dec 2015

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JGD SEMICONDUCTOR CO., LTD.

NO.1659 ROAD KEYUAN, SUNCUN PARK, HI-NEW TECH DEVELOPMENT AREA, JINAN, SHANDONG, CHINA

The following sample(s) was/were submitted and identified on behalf of the clients as : KBP PACKAGE RECTIFIER

SGS Job No. : TP15-007463 - TJ

Client Ref. Info. : Other Model No.:

R-1/A-405/DO-41/DO-15/DO-201AD/DO-201AE/P600/SOD-923(F)/
SOD-723(F)/SOD-523(F)/SOD-323(F)/SOD-123(F)/SMAF/SMBF/
SMA(W)/GF1/SMA/SMB/SMC/LBF/LDF/ABS/MBS/MBF/DB/DBS/DF/
DFS/DBL/DBLS/SOT-23/SOT-323/
SOT-523/SOT-723/SOT-363/SOT-563/SOT-553/SOT-223/
SOT-143/SOT-89/TO-277/TO-277A/TO-277B/TO-263/TO-251/
TO-252/TO-220AB/TO-220AC/ITO-220AB/ITO-220AC/TO-126/
TO-162/TO-92/TO-92S/TO-92L/TO-3P/GBL/KBP/KBPM/GBPM/
D3K/GBU/WOB/RB-15/KBL/KBU/KBJ/GBJ/KBJL/GBJL/SOD-882/
DFN-10/DFN1006-2/FBP-02L/RA/SRA/0201/KBPC/
HV DIODES RECTIFIERS

Date of Sample Received : 24 Nov 2015

Testing Period : 24 Nov 2015 - 01 Dec 2015

Test Requested : Selected test(s) as requested by client.

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

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



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Signed for and on behalf of
SGS-CSTC Standards Technical Services (Tianjin) Co., Ltd.



Reabeca Zhou
Approved Signatory



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Test Results :

Test Part Description :

Specimen No.	SGS Sample ID	Description
SN1	TSN15-015905.001	black body part(mix all)
SN2	TSN15-015905.002	silvery metal plating
SN3	TSN15-015905.003	metal matrix(silvery plating excluded)
SN4	TSN15-015905.004	black plastic

Remarks :

- (1) 1 mg/kg = 0.0001%
- (2) MDL = Method Detection Limit
- (3) ND = Not Detected (< MDL)
- (4) "-" = Not Regulated

Cadmium, Lead, Mercury, Hexavalent Chromium, PBBs(Polybrominated biphenyls), PBDEs(PBDEs) (Polybrominated biphenyl ethers), Dibutyl phthalate (DBP), Butyl benzyl phthalate (BBP), Bis (2-ethylhexyl) phthalate (DEHP) and Diisobutyl Phthalates (DIBP)

- Test Method :
- (1) With reference to IEC 62321-5:2013, determination of Cadmium by ICP-OES.
 - (2) With reference to IEC 62321-5:2013, determination of Lead by ICP-OES.
 - (3) With reference to IEC 62321-4:2013, determination of Mercury by ICP-OES.
 - (4) With reference to IEC 62321:2008, determination of Hexavalent Chromium by Colorimetric Method using UV-Vis.
 - (5) With reference to IEC 62321-6:2015, determination of PBBs and PBDEs by GC-MS.
 - (6) With reference to EN 14372:2004, determination of phthalates by GC-MS.

Test Item(s)	Limit	Unit	MDL	001	004
Cadmium (Cd)	100	mg/kg	2	ND	
Lead (Pb)	1000	mg/kg	2	12347 [▲]	ND
Mercury (Hg)	1000	mg/kg	2	ND	
Hexavalent Chromium (Cr(VI))	1000	mg/kg	2	ND	
Sum of PBBs	1000	mg/kg	-	ND	
Monobromobiphenyl	-	mg/kg	5	ND	
Dibromobiphenyl	-	mg/kg	5	ND	
Tribromobiphenyl	-	mg/kg	5	ND	
Tetrabromobiphenyl	-	mg/kg	5	ND	
Pentabromobiphenyl	-	mg/kg	5	ND	
Hexabromobiphenyl	-	mg/kg	5	ND	
Heptabromobiphenyl	-	mg/kg	5	ND	



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<u>Test Item(s)</u>	<u>Limit</u>	<u>Unit</u>	<u>MDL</u>	<u>001</u>	<u>004</u>
Octabromobiphenyl	-	mg/kg	5	ND	
Nonabromobiphenyl	-	mg/kg	5	ND	
Decabromobiphenyl	-	mg/kg	5	ND	
Sum of PBDEs	1000	mg/kg	-	ND	
Monobromodiphenyl ether	-	mg/kg	5	ND	
Dibromodiphenyl ether	-	mg/kg	5	ND	
Tribromodiphenyl ether	-	mg/kg	5	ND	
Tetrabromodiphenyl ether	-	mg/kg	5	ND	
Pentabromodiphenyl ether	-	mg/kg	5	ND	
Hexabromodiphenyl ether	-	mg/kg	5	ND	
Heptabromodiphenyl ether	-	mg/kg	5	ND	
Octabromodiphenyl ether	-	mg/kg	5	ND	
Nonabromodiphenyl ether	-	mg/kg	5	ND	
Decabromodiphenyl ether	-	mg/kg	5	ND	
Dibutyl phthalate (DBP)	1000	mg/kg	30	ND	
Butyl benzyl phthalate (BBP)	1000	mg/kg	30	ND	
Bis (2-ethylhexyl) phthalate (DEHP)	1000	mg/kg	30	ND	
Diisobutyl Phthalates (DIBP)	1000	mg/kg	30	ND	

Notes :

(1) The maximum permissible limit is quoted from RoHS Directive (EU) 2015/863.

(2) ▲=According to the declaration from the client, Lead (Pb) in No.001 is exempted by EU RoHS directive 2011/65/EU based on [ANNEX III 7(a)]: Lead in high melting temperature type solders (i.e. lead-based alloys containing 85 % by weight or more lead).

▲=According to the declaration from the client, Lead (Pb) in No.001 is exempted by EU RoHS directive 2011/65/EU based on [ANNEX III 7(c)-I]: Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix compound.

RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU

- Test Method :**
- (1) With reference to IEC 62321-5:2013, determination of Cadmium by ICP-OES.
 - (2) With reference to IEC 62321-5:2013, determination of Lead by ICP-OES.
 - (3) With reference to IEC 62321-4:2013, determination of Mercury by ICP-OES.
 - (4) With reference to IEC 62321-7-1:2015, determination of Hexavalent Chromium by Colorimetric Method using UV-Vis.



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<u>Test Item(s)</u>	<u>Limit</u>	<u>Unit</u>	<u>MDL</u>	<u>003</u>
Cadmium (Cd)	100	mg/kg	2	ND
Lead (Pb)	1000	mg/kg	2	ND
Mercury (Hg)	1000	mg/kg	2	ND
Hexavalent Chromium (Cr(VI))▼	-	µg/cm ²	0.10	ND

Notes :

- (1) The maximum permissible limit is quoted from RoHS Directive (EU) 2015/863.
 - (2) ▼= a. The sample is positive for CrVI if the CrVI concentration is greater than 0.13 µg/cm². The sample coating is considered to contain CrVI
 - b. The sample is negative for CrVI if CrVI is ND (concentration less than 0.10 µg/cm²). The coating is considered a non-CrVI 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
- Information on storage conditions and production date of the tested sample is unavailable and thus Cr(VI) results represent status of the sample at the time of testing.
IEC 62321 series is equivalent to EN 62321 series
http://www.cenelec.eu/dyn/www/f?p=104:30:1742232870351101:::FSP_ORG_ID,FSP_LANG_ID:1258637,25

RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU

- Test Method :
- (1) Determination of Cadmium and Lead by ICP-OES after application of modified surface etching digestion based on IEC62321-5:2013.
 - (2) Determination of Mercury by ICP-OES after application of modified surface etching digestion based on IEC 62321-4:2013.
 - (3) With reference to IEC 62321-7-1:2015, determination of Hexavalent Chromium by Colorimetric Method using UV-Vis.

<u>Test Item(s)</u>	<u>Limit</u>	<u>Unit</u>	<u>MDL</u>	<u>002</u>
Cadmium (Cd)	100	mg/kg	10	ND
Lead (Pb)	1000	mg/kg	10	18
Mercury (Hg)	1000	mg/kg	10	ND
Hexavalent Chromium (Cr(VI))▼	-	µg/cm ²	0.10	ND

Notes :

- (1) The maximum permissible limit is quoted from RoHS Directive (EU) 2015/863.
- (2) ▼= a. The sample is positive for CrVI if the CrVI concentration is greater than 0.13 µg/cm². The sample coating is considered to contain CrVI
 - b. The sample is negative for CrVI if CrVI is ND (concentration less than 0.10 µg/cm²). The coating is considered a non-CrVI based coating
 - c. The result between 0.10 µg/cm² and 0.13 µg/cm² is considered to be inconclusive -



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unavoidable coating variations may influence the determination
 Information on storage conditions and production date of the tested sample is unavailable and thus Cr(VI) results represent status of the sample at the time of testing.
 IEC 62321 series is equivalent to EN 62321 series
http://www.cenelec.eu/dyn/www/f?p=104:30:1742232870351101:::FSP_ORG_ID,FSP_LANG_ID:1258637,25

Element(s)

Test Method : With reference to US EPA Method 3052:1996, analysis was performed by ICP-OES.

<u>Test Item(s)</u>	<u>Unit</u>	<u>MDL</u>	<u>001</u>
Beryllium (Be)	mg/kg	5	ND

Polychlorinated Naphthalenes (PCNs)

Test Method : With reference to US EPA 8081B: 2007, analysis was performed by GC-MS

<u>Test Item(s)</u>	<u>Unit</u>	<u>MDL</u>	<u>001</u>
1-Chlorinated Naphthalene	mg/kg	5	ND
2-Chlorinated Naphthalene	mg/kg	5	ND
1,4-Dichlorinated Naphthalene	mg/kg	5	ND
1,5-Dichlorinated Naphthalene	mg/kg	5	ND
1,2-Dichlorinated Naphthalene	mg/kg	5	ND
1,8-Dichlorinated Naphthalene	mg/kg	5	ND
1,2,3-Trichlorinated Naphthalene	mg/kg	5	ND
1,2,3,4-Tetrachlorinated Naphthalene	mg/kg	5	ND
1,2,3,4,6-Pentachlorinated Naphthalene	mg/kg	5	ND
Octa-chlorinated Naphthalene	mg/kg	5	ND

Perfluorooctane Sulfonates (PFOS) and Perfluorooctanoic Acid (PFOA) Content

Test Method : With reference to CEN/TS 15968:2010, analysis was performed by LC-MS.



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<u>Test Item(s)</u>	<u>Limit</u>	<u>Unit</u>	<u>MDL</u>	<u>001</u>
Perfluorooctane Sulfonates (PFOS)^	10	mg/kg	10	ND
Perfluorooctanoic Acid (PFOA)	-	mg/kg	10	ND

Notes :

- (1) Max. limit specified by commission regulation (EU) No. 757/2010 amending Regulation (EC) No 850/2004 (previously restricted under entry 53 of Regulation (EC) No 552/2009 amending Annex XVII of REACH Regulation (EC) No 1907/2006).
- (2) ^: 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.

Red Phosphor

Test Method : SGS in house method (SHTC-CHEM-SOP-342-T), Analysis was performed by ICP-OES and Pyrolysis-GC/MS

<u>Test Item(s)</u>	<u>Unit</u>	<u>MDL</u>	<u>001</u>
Red Phosphor	mg/kg	500	ND

Notes :

- (1) The test was subcontracted to SGS Shanghai chemical lab.

Hexabromocyclododecane (HBCDD)

Test Method : With reference to IEC 62321:2008, analysis was performed by GC-MS.

<u>Test Item(s)</u>	<u>Unit</u>	<u>MDL</u>	<u>001</u>
Hexabromocyclododecane (HBCDD)	mg/kg	10	ND

Short Chained Chlorinated Paraffin (SCCP)

Test Method : With reference to US EPA 3550C: 2007, analysis was performed by GC-ECD.

<u>Test Item(s)</u>	<u>Unit</u>	<u>MDL</u>	<u>001</u>
Short Chain Chlorinated Paraffin (SCCP) (C10-C13)	mg/kg	50	ND



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Polycyclic aromatic hydrocarbons (PAHs)

Test Method : With reference to AfPS GS 2014:01 PAK, analysis was performed by GC-MS.

<u>Test Item(s)</u>	<u>Unit</u>	<u>MDL</u>	<u>001</u>
Naphthalene(NAP)	mg/kg	0.1	ND
Acenaphthylene(ANY)	mg/kg	0.1	ND
Acenaphthene(ANA)	mg/kg	0.1	ND
Fluorene(FLU)	mg/kg	0.1	ND
Phenanthrene(PHE)	mg/kg	0.1	ND
Anthracene(ANT)	mg/kg	0.1	ND
Fluoranthene(FLT)	mg/kg	0.1	ND
Pyrene(PYR)	mg/kg	0.1	ND
Benzo(a)anthracene(BaA)	mg/kg	0.1	ND
Chrysene(CHR)	mg/kg	0.1	ND
Benzo(k)fluoranthene(BkF)	mg/kg	0.1	ND
Benzo(a)pyrene(BaP)	mg/kg	0.1	ND
Benzo(e)pyrene(BeP)	mg/kg	0.1	ND
Indeno(1,2,3-c,d)pyrene(IPY)	mg/kg	0.1	ND
Dibenzo(a,h)anthracene(DBA)	mg/kg	0.1	ND
Benzo(g,h,i)perylene(BPE)	mg/kg	0.1	ND
Benzo(b)fluoranthene(BbF) and Benzo(j)fluoranthene(BjF)	mg/kg	0.1	ND
Sum of Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Pyrene, Anthracene, Fluoranthene	mg/kg	-	ND
Sum of 18 PAHs	mg/kg	-	ND



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AfPS (German commission for Product Safety) : GS PAHs requirements

Parameter	Category 1	Category 2		Category 3	
		Toy under 2009/48/EC	Other products under ProdSG	Toy under 2009/48/EC	Other products under ProdSG
	Material indented to be put in the mouth or toys with intended skin contact (longer than 30 s).	Materials not falling under category 1 with foreseeable contact to skin for longer than 30 s (long-term skin or frequent contact).		Materials not falling under category 1 or 2 with foreseeable contact to skin for less than 30 s (short-term skin contact).	
Benzo(a)pyrene mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Benzo(e)pyrene Mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Benzo(a)anthracene mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Benzo(b)fluoranthene mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Benzo(j)fluoranthene mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Benzo(k)fluoranthene mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Chrysene mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Dibenzo(a,h)anthracene mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Benzo(g,h,i)perylene mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Indeno(1,2,3-cd)pyrene mg/kg	< 0.2	< 0.2	< 0.5	< 0.5	< 1
Acenaphthylene, Acenaphthene, fluorene, phenanthrene, pyrene, anthracene, fluoranthene, mg/kg	< 1 Sum	< 5 Sum	< 10 Sum	< 20 Sum	< 50 Sum
Naphthalene, mg/kg	< 1	< 2		< 10	
Sum of 18 PAHs	< 1	< 5	< 10	< 20	< 50

Remark:

The German committee on Product Safety (AfPS) adopted a new PAHs document on August 4, 2014, which is taken into account by the GS certification bodies for the certification process of the GS mark now. The transitional arrangements and deadlines contained therein shall determine the procedure for existing certificates and new certificates; also there are exceptions.



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Polychlorinated Biphenyls (PCBs)

Test Method : With reference to US EPA 8082A: 2007, analysis was performed by GC-MS

<u>Test Item(s)</u>	<u>CAS NO.</u>	<u>Unit</u>	<u>MDL</u>	<u>001</u>
2.4.4'-Trichlorobiphenyl (PCB 28)	7012-37-5	mg/kg	0.5	ND
2.2'.5.5'-Tetrachloro-biphenyl (PCB 52)	35693-99-3	mg/kg	0.5	ND
2.2'.4.5.5'-Pentachloro-biphenyl (PCB 101)	37680-73-2	mg/kg	0.5	ND
2.3'.4.4'.5-Pentachlorobiphenyl (PCB 118)	31508-00-6	mg/kg	0.5	ND
2.2'3.4.4'.5'-Hexachloro-biphenyl (PCB 138)	35065-28-2	mg/kg	0.5	ND
2.2'.4.4'.5.5'-Hexachloro-biphenyl (PCB 153)	35065-27-1	mg/kg	0.5	ND
2.2'.3.4.4'.5.5'-Heptachlorobiphenyl (PCB 180)	35065-29-3	mg/kg	0.5	ND

The sample(s) 001 was/were analyzed on behalf of the applicant as mixing sample in one testing. The above result(s) was/were only given as the informality value and only for reference.



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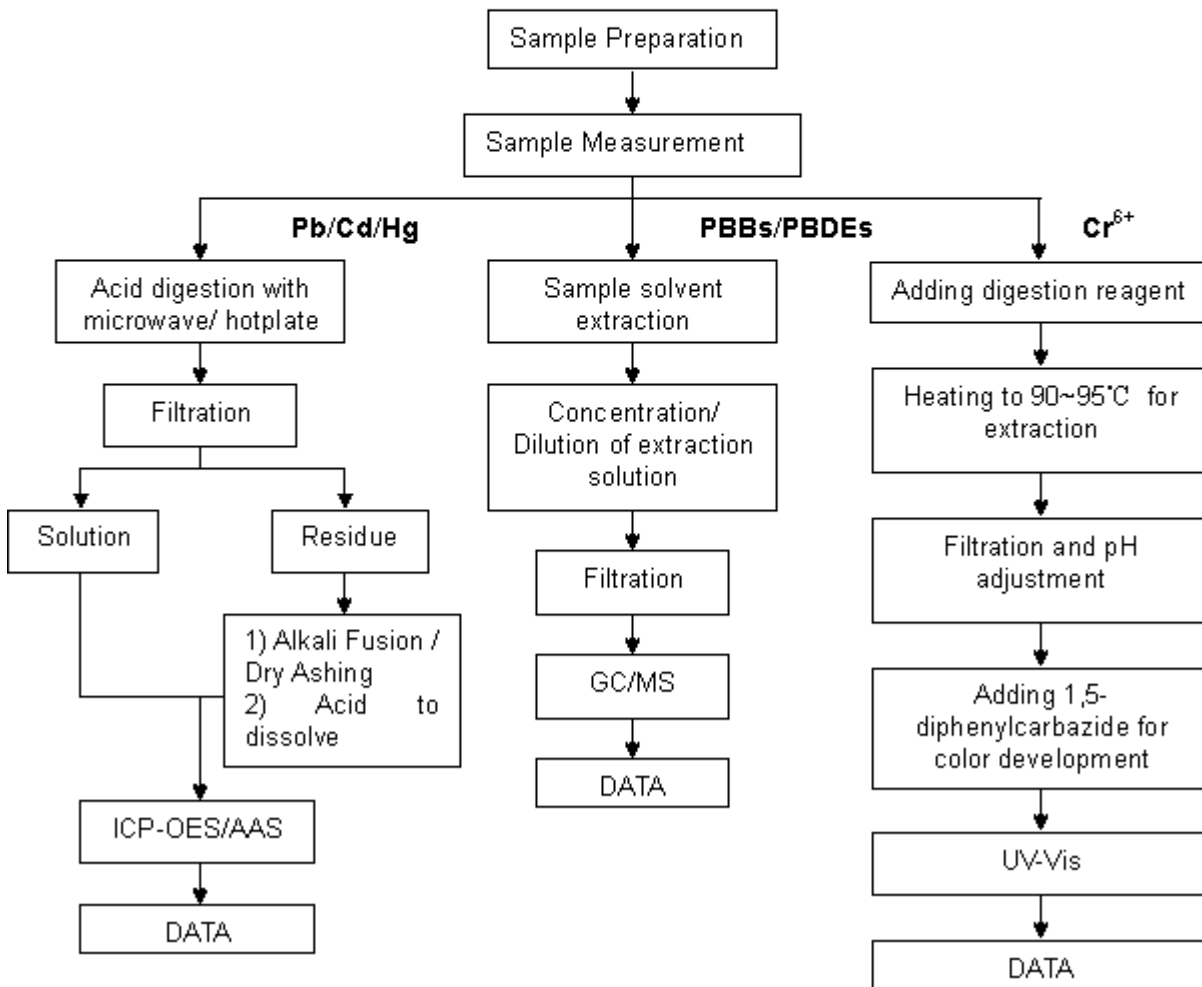
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Cd/Pb/Hg/Cr⁶⁺/PBBs&PBDEs Flow Chart

- 1) Name of the person who made testing: Teresa Wei/Ivy Hou/Carry Yao
- 2) Name of the person in charge of testing: Aaron Wang/Angell Yao/Rex Zhu
- 3) These samples were dissolved totally by pre-conditioning method according to below flow chart. (Cr⁶⁺ and PBBs/PBDEs test method excluded)



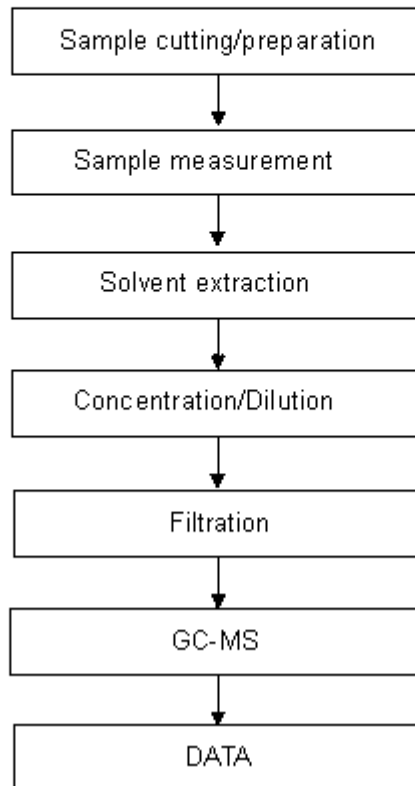
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Phthalate Testing Flow Chart

- 1) Name of the person who made testing: Cathy Cui
- 2) Name of the person in charge of testing: Rex Zhu



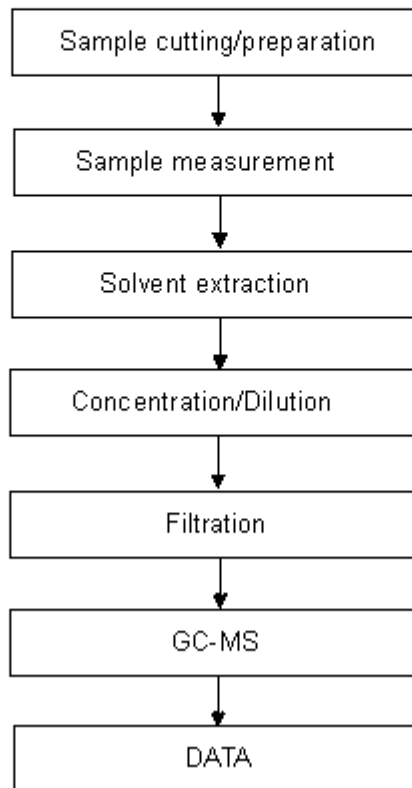
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HBCDD Testing Flow Chart

- 1) Name of the person who made testing: Carry Yao
- 2) Name of the person in charge of testing: Rex Zhu



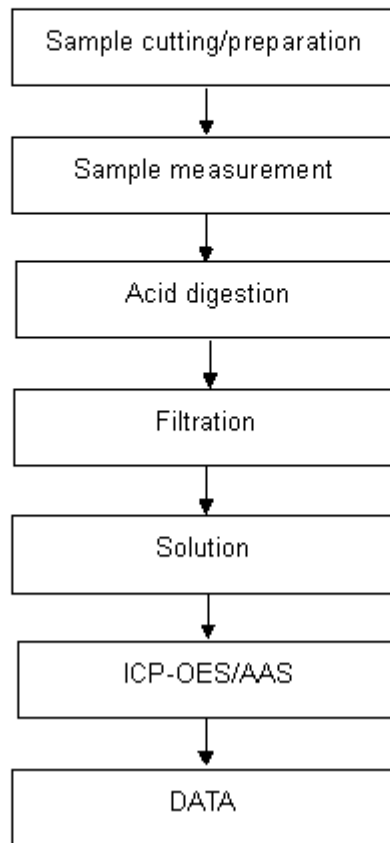
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Elementary Testing Flow Chart

- 1) Name of the person who made testing: Teresa Wei
- 2) Name of the person in charge of testing: Aaron Wang



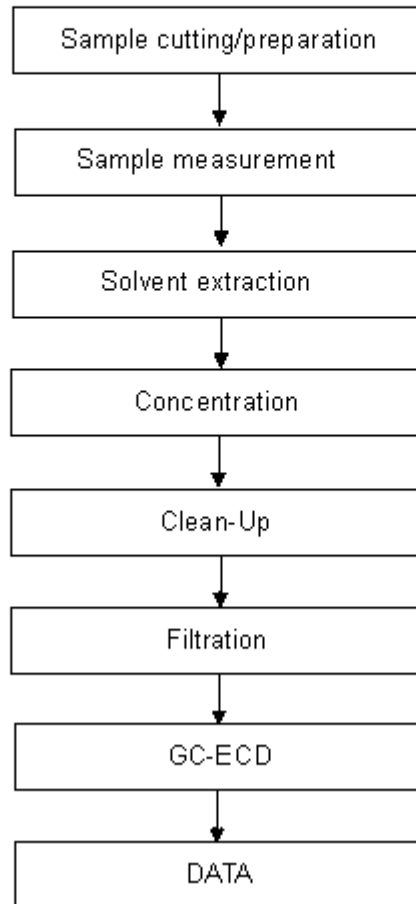
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SCCP Testing Flow Chart

- 1) Name of the person who made testing: Jin Wang
- 2) Name of the person in charge of testing: Rex Zhu



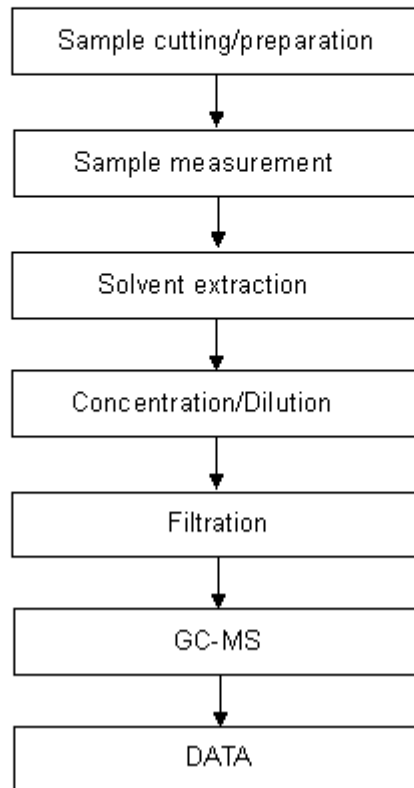
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PAHs Testing Flow Chart

- 1) Name of the person who made testing: Cathy Cui
- 2) Name of the person in charge of testing: Rex Zhu



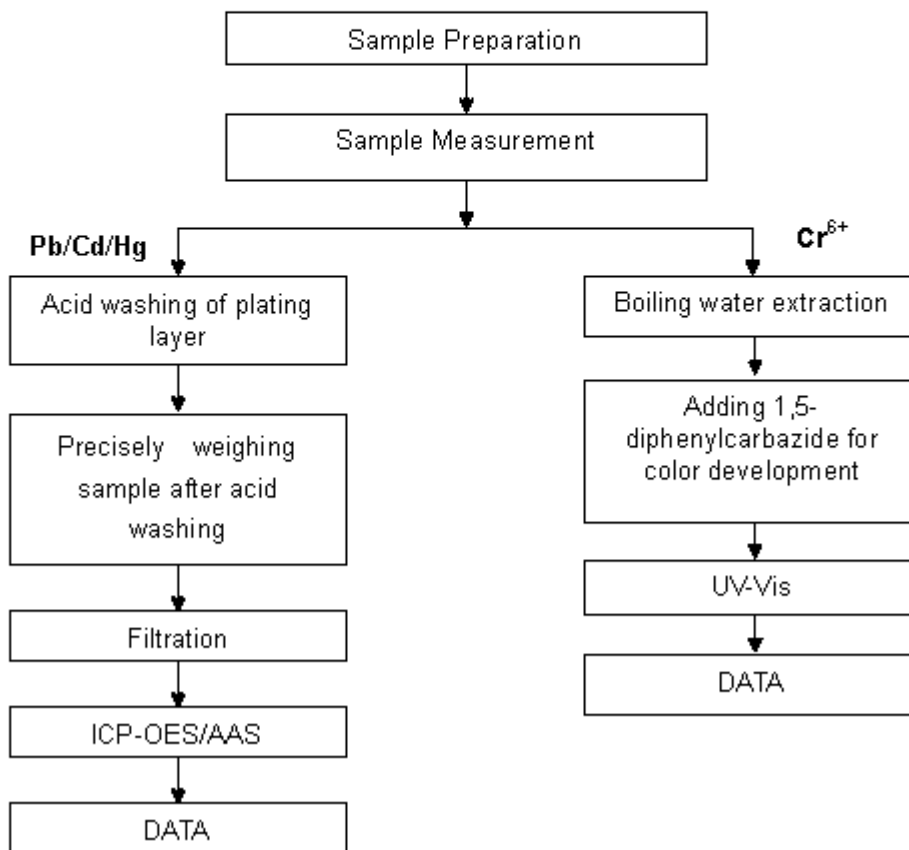
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Plating Pb/Cd/Hg/Cr⁶⁺ Testing Flow Chart

- 1) Name of the person who made testing: Teresa Wei
- 2) Name of the person in charge of testing: Aaron Wang



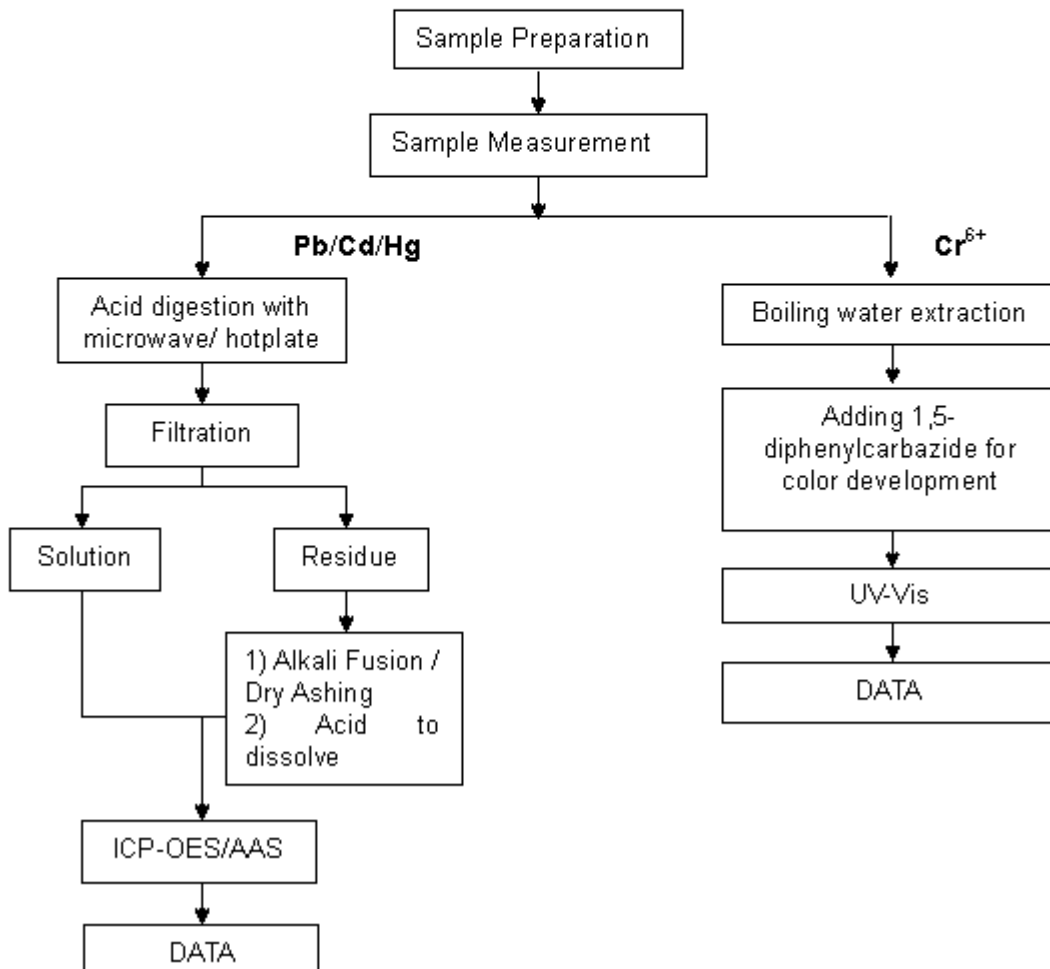
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Cd/Pb/Hg/Cr⁶⁺ Flow Chart

- 1) Name of the person who made testing: Teresa Wei/Ivy Hou
- 2) Name of the person in charge of testing: Aaron Wang/Angell Yao
- 3) These samples were dissolved totally by pre-conditioning method according to below flow chart. (Cr⁶⁺ test method excluded)



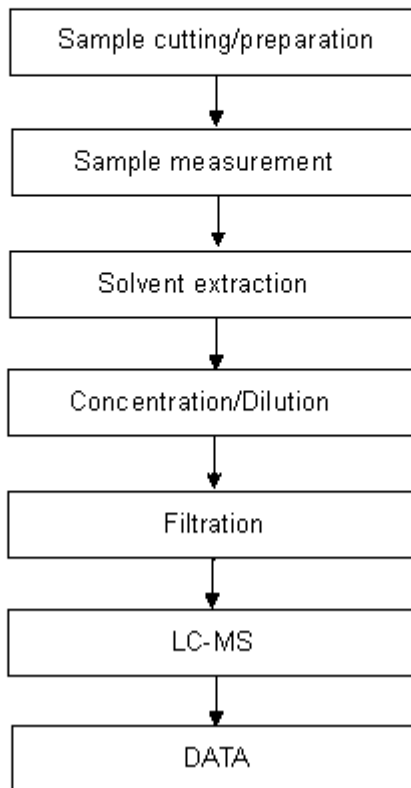
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PFOS/PFOA Testing Flow Chart

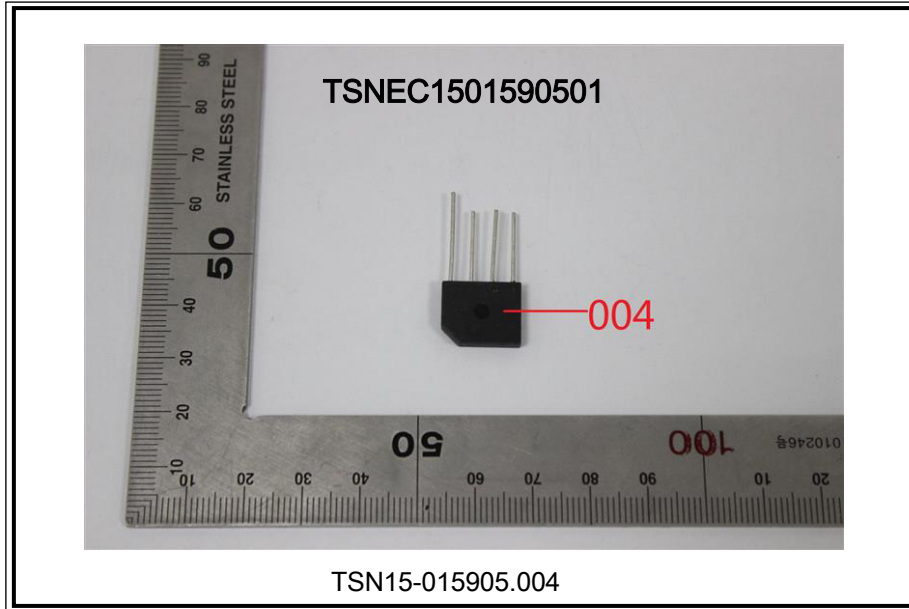
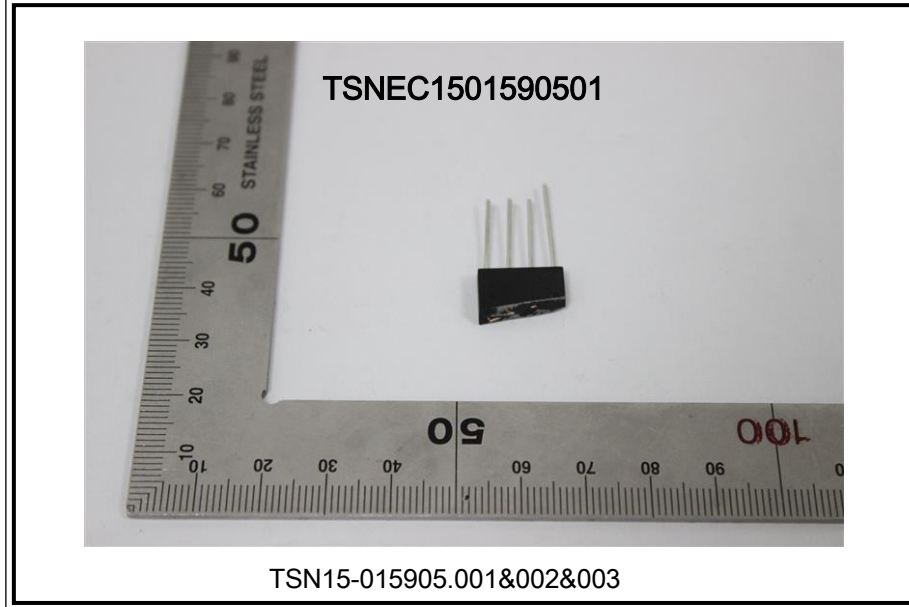
- 1) Name of the person who made testing: Jin Wang
- 2) Name of the person in charge of testing: Rex Zhu



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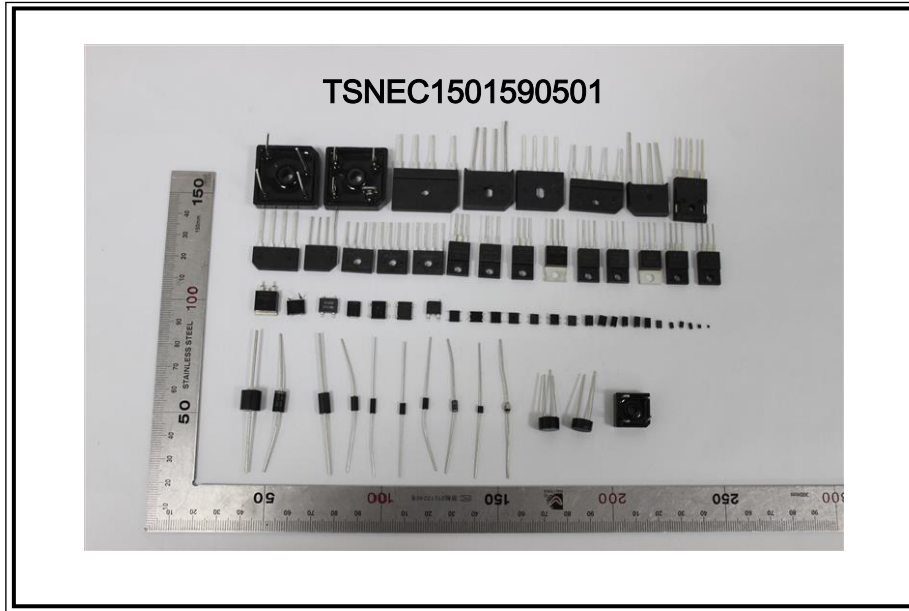
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