

Analytical Report

Faith Butler
Cree Inc.
4600 Silicon Dr.
Durham, NC 27703

September 09, 2021

SDG:

RE: RoHS/HF/PFOS/PFOA/HBCDD Testing

Dear Faith Butler:

Enclosed are the analytical reports for the EMT Work Order listed. Also included with this analytical report is a copy of the chain of custody associated with these samples. If you have any questions, please contact me.

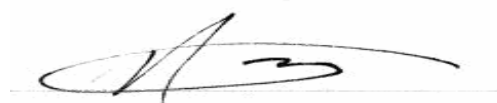
Sincerely,



Adam G. Chaffin
PE Project Manager
847.967.6666
achaffin@emt.com

Approved for release: 9/9/2021 11:10:50AM

Approved by,



Nathan Fey
Laboratory Operations Manager

The contents of this report apply to the sample(s) analyzed. No duplication is allowed except in its entirety. Reporting limits are adjusted for sample size used, dilutions and moisture content, if applicable.

ISO/IEC 17025, Accredited by PJLA, Cert No. L20-165

ISO 17025
ACCREDITED LABORATORY

Table of Contents

<i>Cover Letter</i>	<i>1</i>
<i>Sample Summary</i>	<i>3</i>
<i>Case Narrative</i>	<i>4</i>
<i>Client Sample Results</i>	<i>5</i>
<i>Dates Report</i>	<i>7</i>
<i>Qualifiers and Definitions</i>	<i>8</i>
<i>Certified Analyses</i>	<i>8</i>
<i>List of Certifications</i>	<i>9</i>
<i>Flow Chart</i>	<i>10</i>
<i>Pictures</i>	<i>12</i>
<i>Chain of Custody</i>	<i>13</i>
<i>Additional Documents</i>	<i>14</i>

Sample Summary

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
GaN HEMT Die	21H0464-01	Composite	08/11/21 00:00	08/11/21 13:02

Case Narrative

Client: Cree Inc.
Project: RoHS/HF/PFOS/PFOA/HBCDD Testing

Date: 09/09/2021

Work Order: 21H0464

All reported results are within defined laboratory quality control objectives unless listed below or otherwise qualified in this report.

Sample results only relate to the sample(s) received at the laboratory and analytes of interest tested.

Work Order: 21H0464

The samples were received on 8/11/21. The samples arrived in good condition.

Some of the analyses for this work order were subcontracted. Subcontract data, report, and receipt information is provided at end of report. Please also refer to subcontract lab narrative as needed.

Client Sample Results

Client: Cree Inc.
Project: RoHS/HF/PFOS/PFOA/HBCDD Testing

Client Sample ID: GaN HEMT Die
Report Date: 09/09/2021
Collection Date: 08/11/2021 00:00
Matrix: Composite
Lab ID: 21H0464-01

SDG:

Analyses	Result	EMT		Qual	Units	Reg Limit	Date/Time Analyzed	Batch	Analyst	Weight
		Reporting Limit	Limit							
Metals by ICP-AES										
Method: IEC 62321-5:2013										
Antimony	< 87.7	87.7			mg/Kg	1000	08/20/21 19:15	B1H0812	KJ1	< 2.64 mg
Beryllium	< 8.77	8.77			mg/Kg	1000	08/20/21 19:15	B1H0812	KJ1	< 0.26 mg
Cadmium	< 8.77	8.77			mg/Kg	100	08/20/21 19:15	B1H0812	KJ1	< 0.26 mg
Lead	< 87.7	87.7			mg/Kg	1000	08/20/21 19:15	B1H0812	KJ1	< 2.64 mg

Mercury by CVAA

Method: IEC 62321-4:2013

Mercury	< 104	104			mg/Kg	1000	08/27/21 12:28	B1H1075	TB2	< 3.13 mg
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Wet Chemistry

Method: EN 14582:2016, SW9056 / SW5050

Bromine	< 50.9	50.9			mg/Kg	1000	08/26/21 16:52	B1H1031	MM7	< 1.53 mg
Chlorine	< 50.9	50.9			mg/Kg	1000	08/26/21 16:52	B1H1031	MM7	< 1.53 mg

Method: IEC 62321-7-2:2017

Chromium, Hexavalent	< 1.3	1.3			mg/Kg	1000	08/27/21 15:08	B1H0871	JE1	< 0.04 mg
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Semivolatile Organic Compounds by GC/MS

Method: IEC 62321-6:2015

Monobromobiphenyls	< 18.5	18.5			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 0.56 mg
Dibromobiphenyls	< 18.5	18.5			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 0.56 mg
Tribromobiphenyls	< 37.0	37.0			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 1.11 mg
Tetrabromobiphenyls	< 37.0	37.0			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 1.11 mg
Pentabromobiphenyls	< 37.0	37.0			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 1.11 mg
Hexabromobiphenyls	< 37.0	37.0			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 1.11 mg
Heptabromobiphenyls	< 92.4	92.4			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 2.78 mg
Octabromobiphenyls	< 92.4	92.4			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 2.78 mg
Nonabromobiphenyls	< 92.4	92.4			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 2.78 mg
Decabromobiphenyl	< 92.4	92.4			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 2.78 mg
Total PBB's	< 92.4	92.4			mg/Kg	1000	09/04/21 13:46	B1H1150	LP	< 2.78 mg
Monobromodiphenyl ether	< 49.3	49.3			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 1.48 mg
Dibromodiphenyl ethers	< 49.3	49.3			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 1.48 mg
Tribromodiphenyl ethers	< 92.4	92.4			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 2.78 mg
Tetrabromodiphenyl ethers	< 92.4	92.4			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 2.78 mg
Pentabromodiphenyl ethers	< 92.4	92.4			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 2.78 mg
Hexabromodiphenyl ethers	< 92.4	92.4			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 2.78 mg
Heptabromodiphenyl ethers	< 92.4	92.4			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 2.78 mg
Octabromodiphenyl ethers	< 92.4	92.4			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 2.78 mg
Nonabromodiphenyl ethers	< 246	246			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 7.40 mg
Decabromodiphenyl ether	< 246	246			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 7.40 mg
Total PBDE's	< 246	246			mg/Kg	1000	09/04/21 00:59	B1H1150	LP	< 7.40 mg

Client Sample Results

(Continued)

Client: Cree Inc. **Client Sample ID:** GaN HEMT Die
Project: RoHS/HF/PFOS/PFOA/HBCDD Testing **Report Date:** 09/09/2021
SDG: **Collection Date:** 08/11/2021 00:00
Matrix: Composite
Lab ID: 21H0464-01 (Continued)

Analyses	Result	EMT Reporting Limit	Qual	Units	Reg Limit	Date/Time Analyzed	Batch	Analyst	Weight
Semivolatile Organic Compounds by GC/MS (Continued)									
Method: IEC 62321-8:2017									
BBP (Benzyl butyl phthalate)	< 255	255		mg/Kg	1000	09/03/21 19:19	B1I0063	LP	< 7.67 mg
DBP (Dibutyl phthalate)	< 175	175		mg/Kg	1000	09/03/21 19:19	B1I0063	LP	< 5.26 mg
DEHP (di-(2-ethylhexyl) phthalate)	< 259	259		mg/Kg	1000	09/03/21 19:19	B1I0063	LP	< 7.79 mg
DIBP (Diisobutyl phthalate)	< 170	170		mg/Kg	1000	09/03/21 19:19	B1I0063	LP	< 5.11 mg

Sample Weight as Received: 30.08 g
Total Weight of Compounds Analyzed: < 0.01 mg

Dates Report

Client: Cree Inc.
Project: RoHS/HF/PFOS/PFOA/HBCDD Testing

Report Date: 09/09/2021

Work Order: 21H0464

Sample ID	Client Sample ID	Collection	Matrix	Test Name	Physical Prep Date	Prep Date	Analysis Date	Batch ID	Sequence
21H0464-01	GaN HEMT Die	08/11/21	Composite	Antimony, Total by ICP	08/12/21 07:00	08/20/21 09:52	08/20/21 19:15	B1H0812	S1H0401
				Lead, Total by ICP	08/12/21 07:00	08/20/21 09:52	08/20/21 19:15		
				Cadmium, Total by ICP	08/12/21 07:00	08/20/21 09:52	08/20/21 19:15		
				Beryllium, Total by ICP	08/12/21 07:00	08/20/21 09:52	08/20/21 19:15		
				Hexavalent Chromium- Polymer & Electronics	08/12/21 07:00	08/23/21 07:27	08/27/21 15:08	B1H0871	S1H0505
				Chlorine by Ion Chromatography	08/12/21 07:00	08/26/21 09:30	08/26/21 16:52	B1H1031	S1H0495
				Bromine by Ion Chromatography	08/12/21 07:00	08/26/21 09:30	08/26/21 16:52		
				Mercury by CVAA	08/12/21 07:00	08/27/21 08:30	08/27/21 12:28	B1H1075	S1H0501
				PBDE Analysis by GC/MS	08/12/21 07:00	09/01/21 08:45	09/04/21 00:59	B1H1150	S110070
				PBB Analysis by GC/MS	08/12/21 07:00	09/01/21 08:45	09/04/21 13:46		S110075
				Phthalates by GC/MS	08/12/21 07:00	09/02/21 11:50	09/03/21 19:19	B110063	S110071

Qualifiers and Definitions

Item	Description
%Rec	Percent Recovery

Certified Analyses included in this Report

Analyte	CAS #	Certifications
EN 14582:2016, SW9056 in Composites		
Chlorine	7782-50-5	ISO
Bromine	7726-95-6	ISO
IEC 62321-4:2013 in Composites		
Mercury	7439-97-6	ISO
IEC 62321-5:2013 in Composites		
Beryllium	7440-41-7	ISO
Cadmium	7440-43-9	ISO
Lead	7439-92-1	ISO
Antimony	7440-36-0	ISO
IEC 62321-6:2015 in Composites		
Monobromobiphenyls		ISO
Nonabromobiphenyls		ISO
Octabromobiphenyls		ISO
Heptabromobiphenyls		ISO
Hexabromobiphenyls		ISO
Pentabromobiphenyls		ISO
Tetrabromobiphenyls		ISO
Dibromobiphenyls		ISO
Dibromodiphenyl ethers		ISO
Tribromobiphenyls		ISO
Monobromodiphenyl ether		ISO
Tribromodiphenyl ethers		ISO
Tetrabromodiphenyl ethers		ISO
Pentabromodiphenyl ethers		ISO
Hexabromodiphenyl ethers		ISO
Heptabromodiphenyl ethers		ISO
Octabromodiphenyl ethers		ISO
Nonabromodiphenyl ethers		ISO
Decabromodiphenyl ether	1163-19-5	ISO
Decabromobiphenyl		ISO
IEC 62321-7-2:2017 in Composites		
Chromium, Hexavalent	18540-29-9	ISO

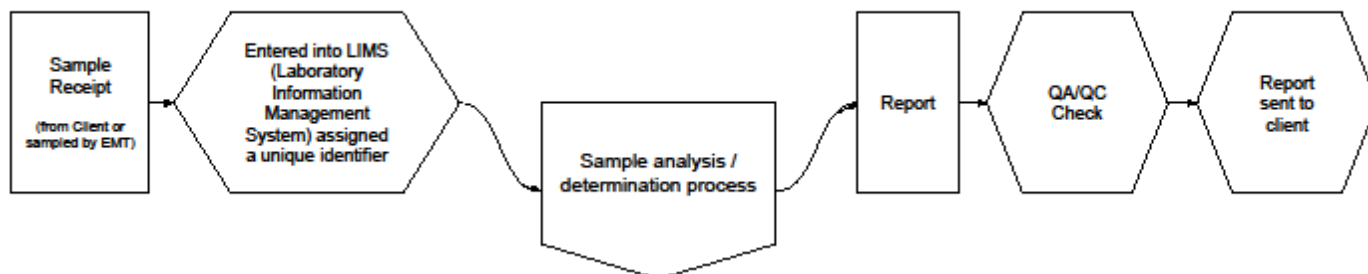
Certified Analyses included in this Report (Continued)

Analyte	CAS #	Certifications
IEC 62321-8:2017 in Composites		
BBP (Benzyl butyl phthalate)	85-68-7	ISO
DBP (Dibutyl phthalate)	84-72-2	ISO
DEHP (di-(2-ethylhexyl) phthalate)	117-81-7	ISO
DIBP (Diisobutyl phthalate)	84-69-5	ISO

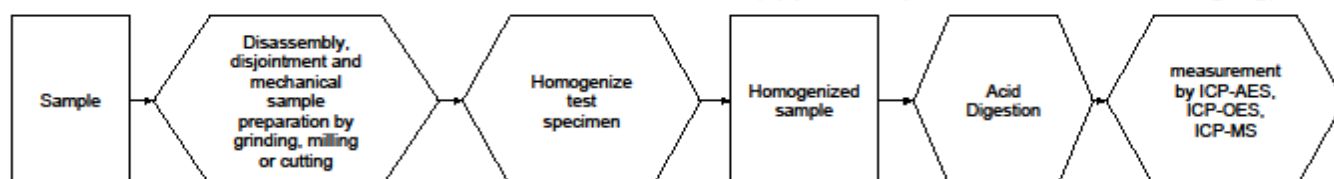
List of Certifications

Code	Description	Number	Expires
AKDEC	State of Alaska, Dept. Environmental Conservation	17-011	05/31/2022
CPSC	US Consumer Product Safety Commission, Accredited by PJLA Lab No. 1050	L18-184-R1	03/31/2022
DoD	Department of Defense, Accredited by PJLA	L20-164-R2	03/31/2022
ILEPA	State of Illinois, NELAP Accredited Lab No. 100256	1002562021-6	07/27/2022
ISO	ISO/IEC 17025, Accredited by PJLA	L20-165	03/31/2022
NEFAP	TNI National Environmental Field Activities Program	L20-166	03/31/2022
TX	Texas Commission of Environmental Quality	T104704554-20-5	10/31/2021
WA	Washington State Department of Ecology	C1057	01/05/2022
WDNR	State of Wisconsin Dept of Natural Resources	999888890	08/31/2022

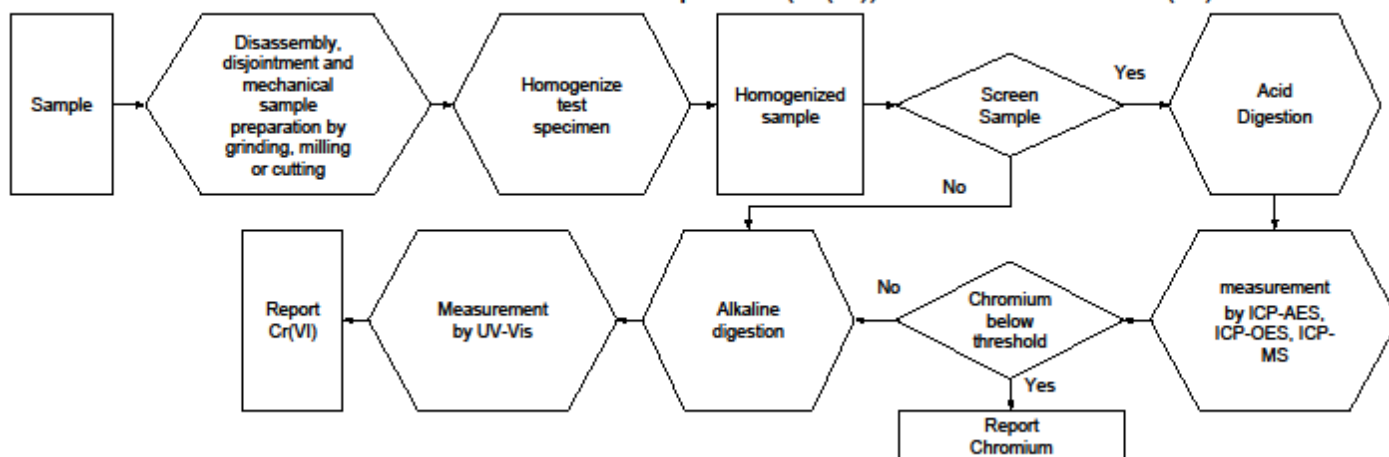
Sample flow through Environmental Monitoring and Technologies inc(EMT Inc.)



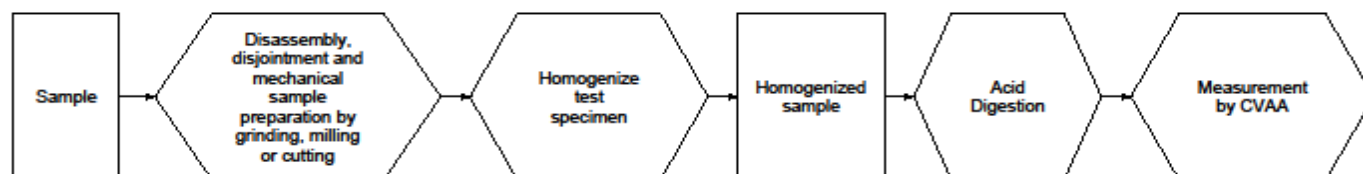
Determination of cadmium, lead, chromium or other metal(s) process (Cd, Pb, Cr, etc. excluding Hg)



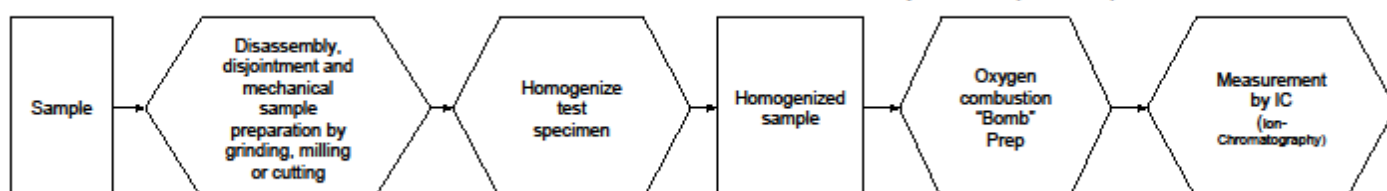
Determination of hexavalent chromium process (Cr(VI)) with chromium screen (Cr)



Determination of mercury process (Hg)



Determination of total bromine, chlorine and other ions process (Br & Cl)



Determination of polybrominated biphenyls and polybrominated diphenyl ethers process (PBBs & PBDEs)



Determination of phthalates process (DEHP, BBP, DBP, DIBP, etc.)







Environmental Monitoring & Technologies, Inc.

PRODUCT ECOLOGY CHAIN OF CUSTODY RECORD

Attn: EMT Product Ecology Log-In
 8100 North Austin Avenue
 Morton Grove, Illinois 60053-3203
 Phone: (800) 246-0663 FAX: (847) 967-6735
www.emt.com

RUSH _____ day turnaround
 STANDARD

Due Date: 9 / 9 / 21

CLIENT	Cree, Inc.	
ADDRESS	4600 Silicon Drive Durham, NC 27703	
PHONE	919.407.4758	FAX: 919.869.CREE
CONTACT	Faith Butler E-MAIL: fbutler@cree.com	

PURCHASE ORDER #	668299	QUOTE #	BID 08.02.21
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21H0464
 PM: Adam G. Chaffin
 Cree Inc.
 R0HS/HF/PFOS/PFOA/HBCDD Testing



Sample I.D.	Sample Description	Analysis	EMT WORKORDER #
GAN MMIC Die	GAN MMIC Die	RoHS10, Halogens, Antimony (Sb), and Beryllium (Be)	21H0463
GAN HEMT Die	GAN HEMT Die	RoHS10, Halogens, Antimony (Sb), and Beryllium (Be)	21H0464
HEMT 440161	CGHV14250P	RoHS10, Halogens, Antimony (Sb), and Beryllium (Be)	21H0465
HEMT 440206	CGHV35130P	RoHS10, Halogens, Antimony (Sb), and Beryllium (Be)	21H0466
		RoHS10, Halogens, Antimony (Sb), and Beryllium (Be)	
		RoHS10, Halogens, Antimony (Sb), and Beryllium (Be)	
		RoHS10, Halogens, Antimony (Sb), and Beryllium (Be)	
Relinquished By:	Faith Butler	Date: 08/10/2021	Client Code:
Relinquished By:		Date:	EMT Project ID.:
		Received By: Adam Chaffin	
		Date: 8-11-21	
		Date:	
		Time:	
		Time:	



Test Report

No. HKTEC2104252902

Date: 03 Sep 2021

Page 1 of 5

ENVIRONMENTAL MONITORING & TECHNOLOGIES INC

509 N 3RD AVENUE
DES PLAINES, IL 60016
UNITED STATES

The following sample(s) was/were submitted and identified on behalf of the clients as : 21H0464-01

SGS Job No. : 4813618 - HK

Country of Destination : USA

Date of Sample Received : 26 Aug 2021

Testing Period : 26 Aug 2021 - 03 Sep 2021

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).

Conclusion : Based on the performed tests on submitted samples, the test results do not exceed the limit as set by the requirement of European Regulation POPs (EU) 2019/1021–Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified (α -HBCDD, β -HBCDD, γ -HBCDD).

Based on the performed tests on submitted sample(s), the test results do not exceed the limit as set by European Regulation POPs (EU) 2020/784 amending to Regulation (EU) 2019/1021 - PFOA and its salts, PFOA-Related Substances , PFOS and its derivatives.

Signed for and on behalf of
SGS Hong Kong Limited.

Wong Ka Ming, Polly
Chemist

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Test Report

No. HKTEC2104252902

Date: 03 Sep 2021

Page 2 of 5

Test Results :

Test Part Description :

Specimen No.	SGS Sample ID	Description
1	HKT21-042529.002	Golden crystal

Remarks :

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

European Regulation POPs (EU) 2019/1021 – Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified (α -HBCDD, β -HBCDD, γ -HBCDD)

Test Method : With reference to SGS inhouse method-CTS-SL-235-1, analysis was performed by GC-MS.
(Decision Rule: please refer to appendix 1: Category 1)

Test Item(s)	CAS NO	Limit	Unit	MDL	002
Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified (α -HBCDD, β -HBCDD, γ -HBCDD)	25637-99-4 / 3194-55-6	100	mg/kg	10	ND
Conclusion					PASS

European Regulation POPs (EU) 2020/784 amending to Regulation (EU) 2019/1021 - PFOA and its salts, PFOA-Related Substances , PFOS and its derivatives

Test Method : With reference to CEN/TS15968:2010, analysis was performed by LC-MS or LC-MS/MS and GC-MS. (Decision Rule: please refer to appendix 1: Category 1)

Test Item(s)	CAS NO	Limit	Unit	MDL	002
Perfluorooctanoic acid (PFOA) and its salts+	--	0.025	mg/kg	0.010	ND
PFOA-related substances	--	1	mg/kg	-	ND
1H,1H,2H,2H-Perfluoro-1-decanol (8:2 FTS)	39108-34-4	-	mg/kg	1	ND
Methyl perfluorooctanoate (Me-PFOA)	376-27-2	-	mg/kg	1	ND

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Test Report

No. HKTEC2104252902

Date: 03 Sep 2021

Page 3 of 5

<u>Test Item(s)</u>	<u>CAS NO</u>	<u>Limit</u>	<u>Unit</u>	<u>MDL</u>	<u>002</u>
Ethyl perfluorooctanoate (Et-PFOA)	3108-24-5	-	mg/kg	1	ND
1H,1H,2H,2H-Perfluoro-1-decanol (8:2 FTOH)	678-39-7	-	mg/kg	1	ND
1H,1H,2H,2H-Perfluorodecyl acrylate (8:2 FTA)	27905-45-9	-	mg/kg	1	ND
1H,1H,2H,2H-Perfluorodecyl methacrylate (8:2 FTMA)	1996-88-9	-	mg/kg	1	ND
Perfluoro-1-iodooctane (PFOI)	507-63-1	-	mg/kg	1	ND
Perfluorooctane sulfonates (PFOS) and its derivatives	--	1,000	mg/kg	-	ND
Perfluorooctane sulfonates (PFOS)^	1763-23-1	-	mg/kg	1	ND
N-ethylperfluoro-1-octanesulfonamide (EtFOSA)	4151-50-2	-	mg/kg	1	ND
N-methylperfluoro-1-octanesulfonamide (MeFOSA)	31506-32-8	-	mg/kg	1	ND
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol (EtFOSE)	1691-99-2	-	mg/kg	1	ND
2-(N-methylperfluoro-1-octanesulfonamido) -ethanol (MeFOSE)	24448-09-7	-	mg/kg	1	ND
Perfluorooctane sulfonamide (PFOSA)	754-91-6	-	mg/kg	1	ND

Conclusion

PASS

Notes :

- (1) + PFOA refer to its salts including PFOA-Na (CAS No.: 335-95-5), PFOA-K (CAS No.: 2395-00-8), PFOA-Ag (CAS No.: 335-93-3), PFOA-F (CAS No.: 335-66-0) and APFO (CAS No.: 3825-26-1);
- (2) ^ PFOS refer to its derivatives including PFOS-K (CAS No.: 2795-39-3), PFOS-Li (CAS No.: 29457-72-5), PFOS-NH₄ (CAS No.: 29081-56-9), PFOS-NH(OH)₂ (CAS No.: 70225-14-8), PFOS-N(C₂H₅)₄ (CAS No.: 56773-42-3), PFOS-DDA(CAS No.:251099-16-8) and POSF (CAS No.: 307-35-7)

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Appendix 1

Category	Decision Rule Statement
1	<p>The decision rule for conformity reporting is based on the non-binary statement with guard band (is equal to the expanded measurement uncertainty with a 95% coverage probability, $w = U95$) in ILAC-G8:09/2019 Clause 4.2.3.</p> <p>A. "Pass - the measured value is within (or below / above) the acceptance limit, where the acceptance limit is below / above to the guard band." or "Pass - The measured values were observed in tolerance at the points tested. The specific false accept risk is up to 2.5%."</p> <p>B. "Conditional Pass - The measured values were observed in tolerance at the points tested. However, a portion of the expanded measurement uncertainty intervals about one or more measured values exceeded / out of tolerance. When the measured result is close to the tolerance, the specific false accept risk is up to 50%."</p> <p>C. "Conditional Fail - One or more measured values were observed out of tolerance at the points tested. However, a portion of the expanded measurement uncertainty intervals about one or more measured values were in tolerance. When the measured result is close to the tolerance, the specific false reject risk is up to 50%."</p> <p>D. "Fail - the measured value is out of (or below / above) the tolerance limit added / subtracted to the guard band." or "Fail - One or more measured values were observed out of tolerance at the points tested". The specific false reject risk is up to 2.5%.</p>
2	The decision rule for conformity reporting is based on BS EN 1811:2011+A1:2015: Reference test method for release of nickel from all post assemblies which are inserted into pierced parts of the human body and articles intended to come into direct and prolonged contact with the skin in Section 9.2 interpretation of results.
3	The decision rule for conformity reporting is based on the general consideration of simple acceptance as stated in ISO/IEC Guide 98-3: "Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM 1995)", and more specifically for analytical measurements to the EURACHEM/CITAC Guide 2012 "Quantifying Uncertainty in Analytical Measurement".
4	The decision rule for conformity reporting is according to the IEC 62321-7-1 Edition 1.0 2015-09 Section 7: Table 1-(comparison to standard and interpretation of result)
5	The decision rule for conformity reporting is according to the IEC 62321-3-1 Edition 1.0 2013-06 Annex A.3 interpretation of result.
6	The decision rule for conformity reporting is according to the GB/T 26125-2011 Annex A to H
7	The decision rule for conformity reporting is according to the requested specification or standard (ASTM F963-17 section 4.3.5)
8	The decision rule for conformity reporting is according to the requested specification or standard (AS/NZS ISO 8124 Part 3 section 4.2)
Remark	If the decision rule is not feasible to be used and the uncertainty of the result is able to be provided, the uncertainty range of the result will be shown in the report. Otherwise, only result will be shown in the report.

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Test Report

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Page 5 of 5

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