Determination of Total and Soluble Concentrations of Regulated Elements in Electronic Consumer Products

California Department of Toxic Substances Control

Environmental Chemistry Laboratory, Berkeley

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Executive Summary

E-waste leachate from landfills can negatively impact drinking water sources. At the request of the Department of Toxic Substances Control (DTSC), Hazardous Waste Management Program (HWMP), and to assist regulatory action covering electronic waste (Electronic Waste Recycling Act of 2003: computers, screens, printed circuit boards, chargers, e.g.), the Environmental Chemistry Laboratory (ECL), Berkeley, tested selected electronic devices to determine the total and extractable concentrations of regulated elements for comparison with hazardous waste criteria. EPA Methods 3050 and 6010C, the California Waste Extraction Test (WET), and the Toxicity Characteristic Leaching Procedure (TCLP) were applied to extract and quantify total and extractable regulated elements. Sixteen electronic products were purchased and submitted to the Laboratory by HWMP for analysis. Devices were dismantled manually, and components were separated into material classes: plastic, glass, metal, and printed circuit boards. Any non-millable components (capacitors, batteries, metal frames, rods, e.g.) were removed. Printed circuit boards and liquid-crystal display (LCD) panels were ground and homogenized before collecting a subsample for downstream analysis. Analyses were performed following ECL Standard Operating Procedures (SOP) 03.0005 (sample homogenization), 03.3051 (microwave digestion), 03.3050 (acid digestion), 03.0025 (California Waste Extraction Test, WET), 03.1311 (Toxicity Characteristic Leaching Procedure, TCLP), and 03.6010 (Inductively Coupled Plasma-Optical Emission Spectroscopy, ICP-OES). Results were extrapolated to the entire device based on weight data, with the assumption that non-processed components did not significantly contribute any regulated elements. Because of this assumption, reported results should be considered minimum values.

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List of Abbreviations

DTSC	Department of Toxic Substances Control
ECL	Environmental Chemistry Laboratory
HWMP	Hazardous Waste Management Program
ICP-OES	Inductively Coupled Plasma-Optical Emission Spectroscopy
LCD	Liquid-Crystal Display
OLED	Organic Light-Emitting Diode
QL	Quantitation Limit
TCLP	Toxicity Characteristic Leaching Procedure
SOP	Standard Operating Procedure
WET	Waste Extraction Test (California)

Accompanying Files

1. 20210806 - ECL - Determination of Total and Soluble Concentrations of Regulated Elements in Electronic Consumer Products: This spreadsheet contains the tables presented in this report
2. 20210806 - Determination of Total and Soluble Concentrations of Regulated Elements in Electronic Consumer Products - ECL SOPs: This folder contains Standard Operating Procedures 03.0004, 03.0005, 03.0025, 03.1311, 03.3051, 03.3050, 03.6010 including details on method procedures and quality controls.
3. 20210806 - Determination of Total and Soluble Concentrations of Regulated Elements in Electronic Consumer Products - REPORTS: This folder contains reports released to HWMP under authorization numbers 20EC0050 through 20EC0055, including total and soluble concentrations of metals in electronic consumer products, detection limits and quantitation limits.

Introduction

The Electronic Waste Recycling Act of 2003 (SB 20/ SB 50, Sher) established a statewide program to promote and fund the collection and recycling of hazardous electronic devices beginning July 1, 2004. In 2004, the Department of Toxic Substances Control (DTSC) tested total and soluble concentrations of regulated elements in sixteen consumer electronic products to determine their regulatory status based on criteria in California Code of Regulations Title 22, Chapter 11, Article 3.

Between 2020 and 2021, the Hazardous Waste Management Program (HWMP), provided sixteen electronic devices to the Environmental Chemistry Laboratory (ECL), Berkeley, for testing in accordance with the 2003 Electronic Waste Recycling Act. Devices were manually dismantled and separated into components, digested, and analyzed

Data are reported as mass of element (mg) per unit of product weight (kg) for total metal analysis, and mg/L for TCLP and WET extraction analysis mass of element per unit leachate volume. Not detected is abbreviated as “ND”.

Materials and Methods

HWMP submitted sixteen electronic products to ECL for analysis: two OLED televisions, two OLED computer monitors, three OLED laptops, two OLED tablets, four LCD tablets, and three LCD smart displays of different brands and models under six authorization numbers: 20EC0050 through 20EC0055. The following ECL Standard Operating Procedures (SOP) were followed to quantitate the concentration of total and extractable metals in device components and WET and TCLP extracts:

ECL SOP 03.0004, sample preparation: separation, identification, and preparation of electronic devices for metal analysis

ECL SOP 03.0005, sample grinding and homogenization: Screens and printed circuit boards were ground using a Fritsch Pulverisette 19 Universal cutting mill after removing plastics, glue and large components. The resulting material was a homogenous powder used for downstream analysis.

ECL SOP 03.3050, acid digestion of metallic samples: Based on EPA Method 3050B. A subsample is digested using acids to dissolve and recover metals.

ECL SOP 03.3051, microwave digestion: based on EPA Method 3051A for solids. A subsample is digested using microwaves and acid to dissolve and recover metals.

ECL SOP 03.0025, California Waste Extraction Test, WET: simulates leaching processes in landfills.

ECL SOP 03.1311, Toxicity Characteristic Leaching Procedure, TCLP: determines mobility of chemicals.

ECL SOP 03.6010, ICP-OES: Spectroscopy based identification of metals.

ECL SOP 03.7470, Mercury analysis by Flow Injection Mercury System (FIMS)

Briefly, electronic products were weighed, manually dismantled, and separated into components. When possible, large screens were separated into layers made of glass, plastic, and metal. Each layer was cut to pieces prior to grinding. Printed circuit boards were separated, components bigger than ~5mm in any dimension (batteries, capacitors, wiring, e.g.) and any visible plastic or glue were removed to allow grinding using a cutting mill. Screen materials and printed circuit boards were recovered, weighed, and homogenized. The homogenized material was used for total metal content analysis (ECL SOP 03.6010, ICP-OES), and to evaluate metal mobility following the Toxicity Characteristic Leaching Procedure (ECL SOP 03.1311, TCLP), and relevant leachate characteristics following California's Waste Extraction Test (ECL SOP 03.0025, WET).

Concentrations were converted to concentrations in the entire device using weight data, with the assumption that the removed components (batteries, capacitors, e.g.) do not contain regulated elements. Therefore, the reported results should be considered minimum values, which do not include any potential contribution from batteries and other large components in the products.

Remaining sample and product components are currently archived.

Quality Assurance

E- waste samples were processed and analyzed along with Quality Control (QC) samples. E-waste data were reviewed in conjunction with associated QC results. QC data for each analysis can be found in the respective Analytical Laboratory Report, which includes a summary of any deviation in the Comments section, page 2. When necessary, specific datapoints will include a Qualifier Flag that describe any potential QC deviation. Sample results are released after ECL reviewers confirm the data meet specific QC criteria:

Method Blank (MB) samples are evaluated to monitor background contamination and ensure a clean system. A MB sample consists of a solid sample free from the method analytes, processed following all method procedures. MB results must show analyte concentrations below 25% of the reporting limit, or below 10% of the lowest sample concentration.

Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS, LCSD) are prepared as MB samples but spiked with a known concentration of method analytes and processed following all method procedures. LCS/LCSD sample data is used to monitor method performance in a clean matrix, with minimal interference. LCS and LCSD sample results must be within 20% of the expected spiked concentration.

For MB and LCS/LCSD samples QC criteria is stringent, given that the material matrix used is free from method analytes. These QC samples evaluate the performance of the method in a clean, interference-free matrix.

Sample Duplicate is the analysis of an unknown sample in duplicate, prepared following all method procedures.

Matrix Spike and Matrix Spike Duplicate (MS, MSD) samples consist of two aliquots of a randomly selected sample, spiked with known analyte of known concentration, and processed following all

method procedures. MS and MSD sample results must consider results from the original sample to calculate expected concentrations.

Sample Duplicate and MS/MSD evaluate the performance of the method in a sample matrix. QC criteria for matrix-matched QC samples is used to evaluate potential interferences or any effects of the sample's heterogeneity.

Lower-Level Quality Control: method performance at concentrations close to the method's detection limit. LLQC samples are spiked at concentrations lower than the LCS samples and close to the method's detection limit.

Results

Weight information for consumer products and metal concentrations adjusted for the total weight of the device are presented in tables 1-6. Method Quantitation Limits (QL) for individual analysis can be found in the respective report (accompanying files: 20210806 - Determination of Total and Soluble Concentrations of Regulated Elements in Electronic Consumer Products – REPORTS).

The tables below are available as file '20210806 - ECL - Determination of Total and Soluble Concentrations of Regulated Elements in Electronic Consumer Products', included in the data package.

QC deviations are detailed in tab 'flags' file '20210816 – ECL - Determination of Total and Soluble Concentrations of Regulated Elements in Electronic Consumer Products', included in the data package.

Table 1 – California Assessment Manual (CAM) list of metals

	method	element	symbol
1	ICP-OES	Antimony	Sb
2	ICP-OES	Arsenic	As
3	ICP-OES	Barium	Ba
4	ICP-OES	Berylium	Be
5	ICP-OES	Cadmium	Cd
6	ICP-OES	Chromium	Cr
7	ICP-OES	Cobalt	Co
8	ICP-OES	Copper	Cu
9	ICP-OES	Lead	Pb
10	FIMS	Mercury	Hg
11	ICP-OES	Molybdenum	Mo
12	ICP-OES	Nickel	Ni
13	ICP-OES	Selenium	Se
14	ICP-OES	Silver	Ag
15	ICP-OES	Thallium	Tl
16	ICP-OES	Vanadium	V
17	ICP-OES	Zinc	Zn

Table 2 – consumer products, weight data (PCB = Printed Circuit Board)

ARF #	ECL #	device	material	units	total weight (g)	sample weight (g)
20EC0050	BE01225	LG UHD C9PUA Series 55"	plastic	1	17800	165.4
20EC0050	BE01226	LG UHD C9PUA Series 55"	glass	1	17800	1037
20EC0050	BE01227	LG UHD C9PUA Series 55"	PCB	1	17800	531.4
20EC0050	BE01228	LG UHD C9PUA Series 55"	metal	1	17800	665.1
20EC0050	BE01229	SONY UHD A9G Master Series 55"	plastic	1	17600	71.38
20EC0050	BE01230	SONY UHD A9G Master Series 55"	glass	1	17600	1107
20EC0050	BE01231	SONY UHD A9G Master Series 55"	PCB	1	17600	764.9
20EC0050	BE01232	SONY UHD A9G Master Series 55"	metal	1	17600	688.3
20EC0050	BE01233	Remotes	PCB	2	219.9	38.93
20EC0051	BE01601	ASUS Proart 22"	PCB	1	1397	186
20EC0051	BE01602	ASUS Proart 22"	OLED panel	1	1397	419.9
20EC0051	BE01603	DELL Alienware OLED 55"	plastic	1	25500	163.1
20EC0051	BE01604	DELL Alienware OLED 55"	OLED glass	1	25500	1019
20EC0051	BE01605	DELL Alienware OLED 55"	metal	1	25500	611
20EC0051	BE01606	DELL Alienware OLED 55"	PCB	1	25500	700.4
20EC0052	BE01514	ASUS ZENBOOK PRO DUO 15.6"	LCD screen	1	2505	214.5
20EC0052	BE01515	ASUS ZENBOOK PRO DUO 15.6"	OLED screen	1	2505	325.1
20EC0052	BE01516	ASUS ZENBOOK PRO DUO 15.6"	PCB	1	2505	209.9
20EC0052	BE01517	DELL Alienware gaming laptop 15.6"	OLED screen	1	1961	256.9
20EC0052	BE01518	DELL Alienware gaming laptop 15.6"	PCB	1	1961	184.1
20EC0052	BE01519	HP Spectre x360 OLED 15.6"	OLED screen	1	1227	206.6
20EC0052	BE01520	HP Spectre x360 OLED 15.6"	PCB	1	1227	106.4
20EC0052	BE01521	ASUS/HP Chargers	PCB	2	833.6	68.22
20EC0053	BE01406	SAMSUNG Galaxy S6 10.5"	PCB	1	415.4	145.6
20EC0053	BE01407	SAMSUNG Galaxy S4 10.5"	PCB	1	403.3	135.2
20EC0053	BE01408	Chargers	PCB	2	81.01	7.101
20EC0054	BE01667	AMAZON Fire Tablet 7"	PCB	1	288.7	143.1
20EC0054	BE01668	IPAD Mini 7.9"	PCB	1	300.6	130.8
20EC0054	BE01669	IPAD 4	PCB	1	484.3	201.9
20EC0054	BE01670	SAMSUNG Tab A 8"	PCB	1	345.9	134.6
20EC0054	BE01671	Chargers	PCB	3	124.4	9.896
20EC0055	BE01277	GOOGLE Nest Hub 7"	PCB	1	488.2	116.4
20EC0055	BE01278	AMAZON Echo Show 8"	PCB	1	1054	198.2
20EC0055	BE01279	FACEBOOK Portal 10"	PCB	1	1025	214.9
20EC0055	BE01280	Chargers	PCB	3	454.6	22.39

Table 3 – total metal concentration in e-waste (ICP-OES)

ECL #	ICP-OES (mg/Kg)															
	Sb	**As**	**Ba**	**Be**	**Cd**	**Cr**	**Co**	**Cu**	**Pb**	**Mo**	**Ni**	**Se**	**Ag**	**Tl**	**V**	**Zn**
BE01225	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BE01226	ND	ND	13.3	ND	ND	6.38	ND	132	ND	2.87	3.97	ND	ND	ND	ND	21.8
BE01227	79.3	ND	132	ND	ND	3.97	ND	5540	ND	ND	64.3	ND	6.12	ND	ND	47.6
BE01228	ND	ND	ND	ND	ND	5.48	76.8	15.3	ND	ND	10800	ND	ND	ND	ND	54.3
BE01229	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BE01230	ND	ND	10	ND	ND	3.65	ND	111	ND	2.2	2.24	ND	ND	ND	ND	11
BE01231	ND	ND	399	ND	ND	9.43	ND	10900	1.57	ND	224	ND	15.2	ND	ND	60.8
BE01232	ND	ND	ND	ND	ND	4.16	50.4	10.6	ND	ND	7880	ND	ND	ND	ND	39.5
BE01233	ND	ND	410	ND	ND	563	29.2	27600	ND	10.2	368	ND	59.2	ND	4.5	80.8
BE01601	ND	ND	1930	ND	ND	65.1	ND	49000	31.3	0	1050	ND	70.3	ND	ND	52.2
BE01602	ND	ND	ND	ND	ND	33.1	ND	27.1	ND	37.2	27.1	ND	12.5	ND	ND	13.6
BE01603	ND	ND	2.84	ND	ND	0.287	ND	4.89	ND	ND	2.26	ND	0.0766	ND	ND	0.393
BE01604	ND	ND	13.6	ND	ND	2.58	ND	74.2	ND	1.52	1.54	ND	ND	ND	ND	ND
BE01605	ND	ND	ND	ND	ND	3.42	38	8.35	ND	ND	7350	ND	ND	ND	ND	38.9
BE01606	ND	ND	205	ND	ND	3.6	ND	6290	28.2	ND	137	ND	10.5	ND	ND	26.9
BE01514	ND	ND	6.06	ND	ND	13.6	ND	1620	ND	2.91	33.1	ND	12.3	ND	ND	7.29
BE01515	ND	ND	ND	ND	ND	14.4	ND	4240	ND	38.7	12.1	ND	17.2	ND	ND	5.53
BE01516	ND	ND	395	ND	ND	39.2	ND	24100	28.4	2.67	261	ND	37.5	ND	ND	309
BE01517	ND	ND	6.65	ND	ND	86.4	ND	237	ND	ND	17.1	ND	2.62	ND	3.76	5.27
BE01518	2.52	ND	804	ND	ND	386	7.51	27500	50.9	3.15	995	ND	55.1	ND	3.02	194
BE01519	ND	ND	5.14	ND	ND	9.05	ND	8430	ND	88.4	21.3	ND	29.9	ND	ND	10.2
BE01520	ND	ND	814	ND	ND	28.1	6.57	36700	10.6	ND	945	ND	98.9	ND	ND	125
BE01521	ND	ND	255	ND	ND	12.7	ND	9800	6.89	ND	57.6	ND	11.8	ND	ND	33.1
BE01406	ND	ND	582	ND	ND	97	18.1	51000	ND	117	3920	ND	135	ND	ND	4220
BE01407	ND	ND	452	ND	ND	516	ND	25600	ND	112	786	ND	95.2	ND	ND	147
BE01408	ND	ND	294	ND	ND	135	2.18	10000	1880	ND	270	ND	51.8	ND	ND	214
BE01667	32.6	ND	706	ND	ND	3850	49.5	22700	ND	25.3	2650	ND	154	ND	14.7	70.1

ECL #	ICP-OES (mg/Kg)															
	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Mo	Ni	Se	Ag	Tl	V	Zn
BE01668	38.3	ND	940	ND	ND	1900	30.4	28400	ND	ND	3340	ND	131	ND	15.1	1760
BE01669	ND	ND	193	ND	ND	370	ND	6790	ND	26.9	748	ND	33.6	ND	ND	296
BE01670	ND	ND	192	ND	ND	56.2	ND	11100	ND	ND	978	ND	46.6	ND	ND	729
BE01671	52.7	ND	606	ND	ND	11	ND	9660	67.6	ND	487	ND	51.8	ND	ND	613
BE01277	ND	ND	402	ND	ND	105	ND	15500	ND	7.84	669	ND	44.9	ND	ND	342
BE01278	ND	ND	250	ND	ND	118	ND	18300	ND	5.32	564	ND	51.4	ND	ND	355
BE01279	6.92	ND	234	ND	ND	759	10.1	7030	ND	11.2	918	ND	26.8	ND	ND	401
BE01280	ND	ND	78.2	ND	ND	5.4	ND	6860	10.4	ND	143	ND	28	ND	ND	59.9

Table 3 – total metal concentration in e-waste (ICP-OES), continuation

Table 4 – TCLP

ECL #	TCLP (mg/L)						
	As	Ba	Cd	Cr	Pb	Se	Ag
BE01225	ND	ND	ND	ND	ND	ND	ND
BE01226	ND	ND	ND	ND	ND	ND	ND
BE01227	ND	0.106	ND	ND	ND	ND	ND
BE01228	ND	ND	ND	ND	ND	ND	ND
BE01229	ND	ND	ND	ND	ND	ND	ND
BE01230	ND	ND	ND	ND	ND	ND	ND
BE01231	ND	ND	ND	ND	ND	ND	ND
BE01232	ND	ND	ND	ND	ND	ND	ND
BE01233	ND	0.462	ND	ND	ND	ND	ND
BE01601	ND	0.884	ND	0.147	ND	ND	ND
BE01602	ND	ND	ND	ND	ND	ND	ND
BE01603	ND	ND	ND	ND	ND	ND	ND
BE01604	ND	ND	ND	ND	ND	ND	ND
BE01605	ND	ND	ND	ND	ND	ND	ND
BE01606	ND	0.124	ND	ND	ND	ND	ND
BE01514	ND	ND	ND	ND	ND	ND	ND
BE01515	ND	ND	ND	ND	ND	ND	ND
BE01516	ND	0.367	ND	ND	ND	ND	ND
BE01517	ND	ND	ND	ND	ND	ND	ND
BE01518	ND	0.390	ND	ND	ND	ND	ND
BE01519	ND	ND	ND	ND	ND	ND	ND
BE01520	ND	0.329	ND	ND	0.394	ND	ND
BE01521	ND	0.330	ND	ND	1.12	ND	ND
BE01406	ND	0.977	ND	ND	ND	ND	ND
BE01407	ND	0.920	ND	ND	0.502	ND	ND
BE01408	ND	ND	ND	ND	ND	ND	ND
BE01667	ND	ND	ND	ND	ND	ND	ND

ECL #	TCLP (mg/L)						
	As	Ba	Cd	Cr	Pb	Se	Ag
BE01668	ND	1.04	ND	ND	ND	ND	ND
BE01669	ND	ND	ND	ND	ND	ND	ND
BE01670	ND	0.814	ND	ND	0.526	ND	ND
BE01671	ND	ND	ND	ND	ND	ND	ND
BE01277	ND	0.409	ND	ND	ND	ND	ND
BE01278	ND	0.238	ND	ND	0.240	ND	ND
BE01279	ND	0.443	ND	ND	ND	ND	ND
BE01280	ND	ND	ND	ND	0.166	ND	ND

Table 4 – TCLP, continuation

Table 5 – WET

ECL #	WET (mg/L)															
	Sb	**As**	**Ba**	**Be**	**Cd**	**Cr**	**Co**	**Cu**	**Pb**	**Mo**	**Ni**	**Se**	**Ag**	**Tl**	**V**	**Zn**
BE01225	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BE01226	ND	ND	ND	ND	ND	ND	ND	0.301	ND	ND	ND	ND	ND	ND	ND	0.417
BE01227	2.18	ND	0.807	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.748
BE01228	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.8	ND	ND	ND	ND	ND
BE01229	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00532
BE01230	ND	ND	ND	ND	ND	ND	ND	0.362	ND	ND	ND	ND	ND	ND	ND	0.499
BE01231	ND	ND	1.25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.84
BE01232	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.99	ND	ND	ND	ND	ND
BE01233	ND	ND	4.11	ND	ND	ND	ND	142	ND	ND	3.05	ND	ND	ND	ND	8.54
BE01601	ND	ND	3.46	ND	ND	0.134	ND	ND	ND	ND	0.16	ND	ND	ND	ND	0.645
BE01602	ND	ND	ND	ND	ND	ND	ND	0.372	ND	0.425	ND	ND	ND	ND	ND	0.547
BE01603	ND	ND	0.0118	ND	ND	ND	ND	0.0127	ND	ND	ND	ND	ND	ND	ND	0.0343
BE01604	ND	ND	0.0423	ND	ND	ND	ND	0.595	ND	ND	ND	ND	ND	ND	ND	ND
BE01605	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.68	ND	ND	ND	ND	ND
BE01606	ND	ND	0.709	ND	ND	ND	ND	ND	ND	ND	0	ND	ND	ND	ND	0.049
BE01514	ND	ND	0.265	ND	ND	ND	ND	0.645	0.161	ND	0.109	ND	ND	ND	ND	0.284
BE01515	ND	ND	ND	ND	ND	ND	ND	6.2	ND	ND	ND	ND	ND	ND	ND	0.221
BE01516	ND	ND	1.36	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.33
BE01517	ND	ND	0.219	ND	ND	ND	ND	0.148	ND	ND	ND	ND	ND	ND	ND	0.152
BE01518	ND	ND	2.56	ND	ND	ND	ND	ND	ND	ND	0.114	ND	ND	ND	ND	0.969
BE01519	ND	ND	0.239	ND	ND	ND	ND	8.29	ND	ND	ND	ND	ND	ND	0.171	0.279
BE01520	ND	ND	2.23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3
BE01521	ND	ND	2.19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.735
BE01406	ND	ND	3.21	ND	ND	0.471	ND	ND	ND	ND	1.12	ND	ND	ND	0.403	24.3
BE01407	ND	ND	2.41	ND	ND	ND	ND	ND	ND	ND	0.867	ND	ND	ND	0.395	34.1
BE01408	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BE01667	ND	ND	4.14	ND	ND	ND	ND	ND	ND	ND	1.04	ND	ND	ND	ND	0.779

ECL #	WET (mg/L)															
	Sb	**As**	**Ba**	**Be**	**Cd**	**Cr**	**Co**	**Cu**	**Pb**	**Mo**	**Ni**	**Se**	**Ag**	**Tl**	**V**	**Zn**
BE01668	ND	ND	1.97	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	1.93
BE01669	ND	ND	2.84	ND	ND	ND	ND	ND	ND	ND	3.97	ND	ND	ND	ND	1.31
BE01670	ND	ND	4.36	ND	ND	ND	ND	0.458	ND	ND	1.15	ND	ND	ND	ND	0.511
BE01671	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BE01277	ND	ND	3.74	ND	ND	ND	ND	ND	ND	ND	0.643	ND	ND	ND	ND	17.5
BE01278	ND	ND	2.43	ND	ND	ND	ND	ND	ND	ND	0.838	ND	ND	ND	ND	9.97
BE01279	ND	ND	1.98	ND	ND	ND	ND	4.46	ND	ND	1.08	ND	ND	ND	ND	17.5
BE01280	ND	ND	0.1	ND	ND	ND	ND	0.128	2.32	ND	0.0992	ND	ND	ND	ND	2.92

Table 5 – WET, continuation

Table 6 – total and WET mercury results in consumer product samples

ECL #	device	material	Hg
			mg/kg
BE01225	LG UHD C9PUA Series 55"	plastic	ND
BE01226		glass	ND
BE01227		PCB	ND
BE01228		metal	ND
BE01229	SONY UHD A9G Master Series 55"	plastic	ND
BE01230		glass	ND
BE01231		PCB	0.0038
BE01232		metal	ND
BE01233	Remotes	PCB	ND
BE01601	ASUS Proart 22"	PCB	ND
BE01602		OLED panel	ND
BE01603	DELL Alienware OLED 55"	OLED plastic	0.000136
BE01604		OLED glass	ND
BE01605		OLED metal	ND
BE01606		PCB	0.00235
BE01514	ASUS ZENBOOK PRO DUO 15.6"	LCD screen	ND
BE01515		OLED screen	ND
BE01516		PCB	ND
BE01517	DELL Alienware gaming laptop 15.6"	OLED screen	0.0626
BE01518		PCB	ND
BE01519	HP Spectre x360 OLED 15.6"	OLED screen	ND
BE01520		PCB	ND
BE01521	ASUS/HP Chargers	PCB	ND
BE01406	SAMSUNG Galaxy S6 10.5"	PCB	ND
BE01407	SAMSUNG Galaxy S4 10.5"	PCB	0.00984
BE01408	Chargers	PCB	0.00311
BE01667	AMAZON Fire Tablet 7"	PCB	ND
BE01668	IPAD Mini 7.9"	PCB	ND
BE01669	IPAD 4	PCB	0.0132
BE01670	SAMSUNG Tab A 8"	PCB	ND
BE01671	Chargers	PCB	0.00107
BE01277	GOOGLE Nest Hub 7"	PCB	ND
BE01278	AMAZON Echo Show 8"	PCB	ND
BE01279	FACEBOOK Portal 10"	PCB	ND
BE01280	Chargers	PCB	ND

Table 6 – total and WET mercury results in consumer product samples, continuation

ECL #	device	material	Hg WET
			mg/L
BE01225	LG UHD C9PUA Series 55"	plastic	ND
BE01226		glass	ND
BE01227		PCB	ND
BE01228		metal	ND
BE01229	SONY UHD A9G Master Series 55"	plastic	ND
BE01230		glass	ND
BE01231		PCB	ND
BE01232		metal	ND
BE01233	Remotes	PCB	ND
BE01601	ASUS Proart 22"	PCB	ND
BE01602		OLED panel	0.00528
BE01603	DELL Alienware OLED 55"	OLED plastic	ND
BE01604		OLED glass	ND
BE01605		OLED metal	0.000315
BE01606		PCB	ND
BE01514	ASUS ZENBOOK PRO DUO 15.6"	LCD screen	ND
BE01515		OLED screen	ND
BE01516		PCB	ND
BE01517	DELL Alienware gaming laptop 15.6"	OLED screen	ND
BE01518		PCB	ND
BE01519	HP Spectre x360 OLED 15.6"	OLED screen	ND
BE01520		PCB	ND
BE01521	ASUS/HP Chargers	PCB	ND
BE01406	SAMSUNG Galaxy S6 10.5"	PCB	ND
BE01407	SAMSUNG Galaxy S4 10.5"	PCB	ND
BE01408	Chargers	PCB	ND
BE01667	AMAZON Fire Tablet 7"	PCB	ND
BE01668	IPAD Mini 7.9"	PCB	ND
BE01669	IPAD 4	PCB	ND
BE01670	SAMSUNG Tab A 8"	PCB	ND
BE01671	Chargers	PCB	ND
BE01277	GOOGLE Nest Hub 7"	PCB	ND
BE01278	AMAZON Echo Show 8"	PCB	ND
BE01279	FACEBOOK Portal 10"	PCB	ND
BE01280	Chargers	PCB	ND

References

ECL Standard Operating Procedure 03.0004 “Preparation of Electronic Waste (E-Waste) for Metal Analysis”, June 30, 2020

ECL Standard Operating Procedure 03.0005 “Operation of the Fritsch Pulverisette 19 Universal Cutting Mill and attached Cyclone Separator”, June 30, 2020

ECL Standard Operating Procedure 03.0025 “California Waste Extraction Test (WET)”, June 30, 2020

ECL Standard Operating Procedure 03.1311 “Toxicity Characteristic Leaching Procedure (TCLP) – EPA 1311”, February 27, 2020

ECL Standard Operating Procedure 03.3051 “Microwave Assisted Digestion”, February 8, 2021

ECL Standard Operating Procedure 03.3050 “Acid Digestion of Sediments, Sludges, Soils and Metallic samples”, November 26, 2019

ECL Standard Operating Procedure 03.6010 “Standard Operating Procedure for EPA Method 6010C: Inductively Coupled Plasma-Optical Emission Spectroscopy”, October 23, 2019