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ECOLOGY
State of Washington

Quality Assurance Project Plan

Flame Retardants and Metals in Children's Products and Consumer Goods

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Publication Information

Each study conducted by the Washington State Department of Ecology (Ecology) must have an approved Quality Assurance Project Plan. The plan describes the objectives of the study and the procedures to be followed to achieve those objectives. After completing the study, Ecology will post the final report of the study to the Internet.

The plan for this study is available on the Department of Ecology's website at www.ecy.wa.gov/biblio/1103105.html.

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Quality Assurance Project Plan

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March 2011

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Signatures are not available on the Internet version.
EAP: Environmental Assessment Program.
EIM: Environmental Information Management database.
W2R: Waste 2 Resources Program.

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Abstract

The Washington State Department of Ecology is conducting an initial study to evaluate screening methods for polybrominated diphenyl ethers (PBDEs) and 7 potentially hazardous metals in children's products and consumer goods. The study is being conducted in response to the state's ban on PBDEs and the reporting rule for the Children's Safe Product Act. Study objectives are to assess the usefulness of x-ray fluorescence (XRF) technology as a screening tool for PBDEs (bromine), the metals of interest required to be reported under the CSPA, and lead.

Background

Polybrominated diphenyl ethers (PBDEs) are chemicals added to consumer products in order to reduce their flammability and meet legislated flammability requirements. Historically, the largest amounts of PBDEs were added to plastics, upholstery fabrics, and foams in such common products as computers, TVs, furniture, and carpet pads (Rahman et al., 2001). Three types of commercial mixtures of PBDEs were produced (penta-BDE, octa-BDE, and deca-BDE), and consumer demand for PBDEs was highest in the US and Canada (Alaee et al., 2002).

Numerous studies have identified toxic compounds in products, including PBDEs, present in human tissues (e.g., CDC, 2009; She et al., 2002). Schreder (2006) found PBDEs, heavy metals, and phthalates, among other contaminants, in the hair, blood, and urine of Washington State residents. While contaminants can take several routes (e.g., air, food, water, skin absorption) to accumulate in humans, house dust is considered a major pathway, particularly for PBDEs (Jones-Otazo et al., 2005; Webster et al., 2005; Stapleton et al., 2005). Allen et al. (2008) found a link between household products containing bromine and PBDE levels in house dust.

Concern over adverse human health effects led the Washington state legislature to phase out PBDEs. Beginning in 2008, penta-BDE and octa-BDE flame retardants were banned in products manufactured, distributed, and sold in Washington State. Deca-BDE was also banned in mattresses in 2008. In 2011, Deca-BDE was banned in residential upholstered furniture and the electronic enclosures of televisions and computers. Transportation equipment, medical devices, and certain recycled materials were exempted from the ban. (PBDE Rule, Chapter 70.76 RCW).

The Children's Safe Product Act (CSPA) was passed by the Washington State legislature in 2008 (Children's Safe Product Act, 70.240 RCW) to reduce children's exposure to toxic chemicals and metals. The CSPA Reporting Rule is being finalized and will implement the reporting requirements of the CSPA. Under the rule, companies making children's products must begin reporting on a list of 67 toxic chemicals in spring 2011 (Appendix A). The list includes chemicals that were either found in children's products or documented as present in human tissues. Reporting requirements will begin with the largest manufacturers who make products intended for mouth or skin contact. Other manufacturers will begin reporting in a phased-in schedule included in the rule.

In response to Washington State's PBDE ban and the recent creation of the CSPA Reporting Rule, the Washington State Department of Ecology's (Ecology's) Environmental Assessment Program will begin analyzing children's products and consumer goods for PBDEs, 6 potentially toxic metals required to be reported under the CSPA (antimony, arsenic, cadmium, cobalt, molybdenum, and mercury), and lead. While lead is currently not required for reporting under the CSPA, it is included in this study because its content in certain products falls under Federal regulation (16 C.F.R. § 1303).

Project Description

Ecology's Environmental Assessment Program will conduct an initial study to measure PBDEs and metals (antimony, arsenic, cadmium, cobalt, lead, molybdenum, and mercury) in children's products and consumer goods. The objective of the study is to assess the usefulness of x-ray fluorescence (XRF) technology as a screening tool for PBDEs (bromine), the metals of interest required to be reported under the CSPA, and lead.

Products will be collected and analyzed with a handheld XRF gun during the spring of 2011. A portion of these products will be sent to Manchester Environmental Laboratory and RI Analytical Laboratories to assess the accuracy of the XRF screening results.

Sampling Process Design (Experimental Design)

Approximately 250 children's items and consumer products will be gathered from local stores and internet retailers for testing. Individual components of the item will be screened with a handheld XRF for the metals of concern to determine if laboratory validation is necessary. It is anticipated that approximately 75 - 85 products will be forwarded for laboratory analysis. Since XRF cannot detect PBDEs, bromine will be used as a surrogate to determine whether a product contains brominated compounds. Further testing will be required to determine if products with bromine contain PBDEs.

Items will be sent to the laboratory if they violate screening criteria (outlined below) during the XRF analysis or are selected for low level analysis. Laboratory analysis will be completed by inductively coupled plasma mass spectroscopy (ICP/MS) for metals, cold vapor atomic absorption (CVAA) for mercury, and gas chromatography electron capture detection (GC/ECD) for PBDEs.

Product Selection

Products selected for screening will focus on (1) the product tier approach outlined by the CSPA Reporting Rule and (2) historical presence of PBDEs (e.g., furniture foams, mattresses, electronic housings, adhesives).

Under the CSPA Reporting Rule tiered approach, products intended to be put into a child's mouth or applied to their skin, or intended for a child less than 3 must be reported first. Tier 2 includes products intended for prolonged direct skin contact, Tier 3 - short direct skin contact, Tier 4 - no intended skin contact. Product analysis will be weighted according to when the products are required to be reported, i.e., greater numbers of products falling under Tier 1 will be tested than Tier 4.

In addition to children's products, consumer goods that historically included PBDEs will be tested. In a study conducted on household items Allen et al. (2008) found a relationship between

the sum of PBDEs measured by gas chromatography mass spectrometry (GC/MS) and total bromine measured by a handheld XRF.

Product Screening

Products will be screened using a handheld XRF gun following the XRF manufacturer's recommendations and adaptations of ASTM method F 2617-08 *Standard Test Method for Identification and Quantification of Chromium, Bromine, Cadmium, Mercury, and Lead in Polymeric Material Using Energy Dispersive X-ray Spectrometry* (ASTM, 2008).

While ASTM method F 2617-08 is not intended for samples with surface coatings or non-polymeric materials, all samples will be screened following adaptations of the method for qualitative information.

Target Chemicals

Table 1 lists the target chemicals proposed for testing along with state and federal criteria.

Table 1. State and Federal Criteria for Analytes of Interest.

Analytes	Action level (ppm)
PBDE congeners: -28, -47, -99, -100, -153, -154, -183, -209	1000*
Antimony	60^
Arsenic	25^
Cadmium	75^
Cobalt	-
Lead	90†
Mercury	60^
Molybdenum	-

* Sum of congeners - De Minimus guidance regarding Chapter 70.76 RCW. www.ecy.wa.gov/programs/swfa/pbt/docs/DeMinimusPBDEGuidance.pdf.
^ ASTM F963-08 - Maximum allowable amounts in surface coatings of toys.
† 16 C.F.R. § 1303 restrictions in surface coatings of consumer goods and children's products. Non-soluble portions are limited to 300 ppm and 100 ppm in August 2011.

For screening purposes, products containing half or more of the action levels in Table 1 will be forwarded to the laboratory for validation, as allowed by the laboratory budget. Criteria falling under ASTM F963-08 and 16 C.F.R. § 1303 are designed for soluble portions of surface coatings. No criteria have been established for allowable limits of molybdenum and cobalt in products. Additionally, low levels of molybdenum cannot be detected in plastic materials using the XRF. Levels measured at 15 ppm or greater for cobalt (all matrices) and molybdenum (non-plastic matrices only) will be forwarded for validation.

All 7 metals will be analyzed in each sample forwarded to the laboratory if screening levels for a single metal are violated. PBDE analyses will not necessarily be conducted on all samples analyzed for metals. In addition to products violating the screening standards, multiple samples containing low levels will be forwarded to the laboratory for analysis. This will serve to determine the efficacy of the XRF screening at low levels and identify possible false negatives.

If bromine is not detected in appreciable amounts in the products tested, products manufactured prior to the PBDE ban will be examined to confirm the efficacy of the XRF screening method (in addition to low level samples). Older products manufactured prior to the PBDE ban will be obtained with permission from Ecology employees and electronics recycling facilities.

XRF vs. Laboratory Analysis

Major differences exist between XRF field measurements and traditional laboratory techniques; however, studies show good comparability between the two under the proper conditions (Allen et al., 2008; ASTM, 2008).

Some limitations of XRF handhelds include:

- A small area of the sample is measured (3-8 mm). This can cause variability if elements of interest are not equitably distributed across the product.
- Penetration depth of x-ray beams is a few microns to a quarter inch, depending on material.
- XRF handhelds are calibrated on a smooth flat disk with sufficient depth and area. Handheld analyses conducted on irregular surfaces, often encountered on consumer products, produce less accurate results.

Advantages of XRF handhelds include:

- Fast, reliable method allows for screening of a larger number of products than could be achieved with laboratory analysis.
- Analysis is non-destructive.
- Studies show the ability to accurately measure elements in plastics with excellent precision, provided the proper calibration and conditions.

A major difference between the methods is the amount of material analyzed. XRF handhelds measure a small area with shallow depth. It is particularly problematic to accurately measure elemental concentrations in non-homogeneous material and coated objects. In coated objects, x-ray beams may penetrate to the base material, resulting in skewed measurements (CPSC, 2007). Conversely, materials deeper than the x-ray beam penetration will go unmeasured. XRF measurements are specifically susceptible to error with thin layers covering metal substrates.

In an effort to reduce the amount of error between analysis techniques, samples selected for laboratory screening will be prepared for laboratory analysis one of two ways. Surface material from painted or glazed items will be removed (scraped off), and homogeneous materials

(e.g., non-painted polymers or foams) will be ground or cut into small pieces. Both painted shavings and ground/cut material will be reanalyzed with the XRF before laboratory validation.

Results for XRF surface screening, XRF analysis of sub-sampled material (shavings, ground, or cut material), and laboratory analysis will be compared to assess precision and bias of the XRF results.

Organization and Schedule

Table 2 lists the individuals involved in the project and Table 3 contains the schedule.

Table 2. Organization of Project Staff and Responsibilities.

Staff	Title	Responsibilities
Holly Davies W2R (360) 407-7398	EAP Client	Clarifies scopes of the project. Provides internal review of the QAPP.
John Williams W2R (360) 407-6940	EAP Client	Clarifies scopes of the project. Provides internal review of the QAPP and approves the final QAPP.
Chad Furl Toxics Studies Unit SCS, EAP (360) 407-6060	Project Manager	Writes the QAPP. Oversees field sampling and transportation of samples to the laboratory. Conducts QA review of data, analyzes and interprets data. Writes the draft report and final report.
Tanya Roberts Toxics Studies Unit SCS, EAP (360) 407-7392	Field Lead/ EIM Engineer	Helps collect samples, record field information, and enters data into EIM.
Dale Norton Toxics Studies Unit SCS, EAP (360) 407-6765	Unit Supervisor for the Project Manager	Provides internal review of the QAPP, approves the budget, and approves the final QAPP.
Will Kendra SCS, EAP (360) 407-6698	Section Manager for the Project Manager	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Stuart Magoon Manchester Environmental Laboratory, EAP 360-871-8801	Director	Approves the final QAPP. Assists in contract laboratory selection.
William R. Kammin EAP 360-407-6964	Ecology Quality Assurance Officer	Reviews the draft QAPP and approves the final QAPP.

EAP: Environmental Assessment Program.
EIM: Environmental Information Management database.
QAPP: Quality Assurance Project Plan.
SCS: Statewide Coordination Section.
W2R: Waste 2 Resources Program.

Table 3. Proposed Schedule for Completing Field and Laboratory Work, Data Entry into EIM, and Reports.

Field and laboratory work	Due date	Lead staff
Field work completed	May 2011	Chad Furl
Laboratory analyses completed	June 2011	
Final report		
Author lead / Support staff	Chad Furl	
Schedule		
Draft due to supervisor	September 2011	
Draft due to client/peer reviewer	October 2011	
Final (all reviews done) due to publications coordinator	November 2011	
Final report due on web	January 2012	

Sample Collection and Preparation

Items will be obtained in person or through Internet retailers by Ecology's Environmental Assessment Program or Waste 2 Resources Program staff. Upon collection, products will be removed from their original packaging, and individual subcomponents of the product will be screened separately. Items with different colors or base materials will be treated as subcomponents. Additionally, individual pieces of products intended to be disassembled will be treated as subcomponents. Subcomponents targeted for testing will be removed with stainless steel tools (e.g., scissors, pliers, saws) for further testing.

Non-coated homogeneous plastic items targeted for laboratory testing will be cryogenically ground into a fine powder by RI Analytical Labs. Non-plastic items such as foams, textiles, and metals will be reduced in size using a file, drill, dremel tool, or scissors. Coated items violating the screening standard will be processed by Environmental Assessment Program staff by scraping the surface material off, following ASTM F 963-08 guidelines. Scrapings will be further ground (if the material allows) by mortar and pestle. Sub-sampled materials (ground, cut, or scraped) will be reanalyzed by XRF prior to laboratory validation.

Figure 1 presents a schematic of the screening and preparation procedure.

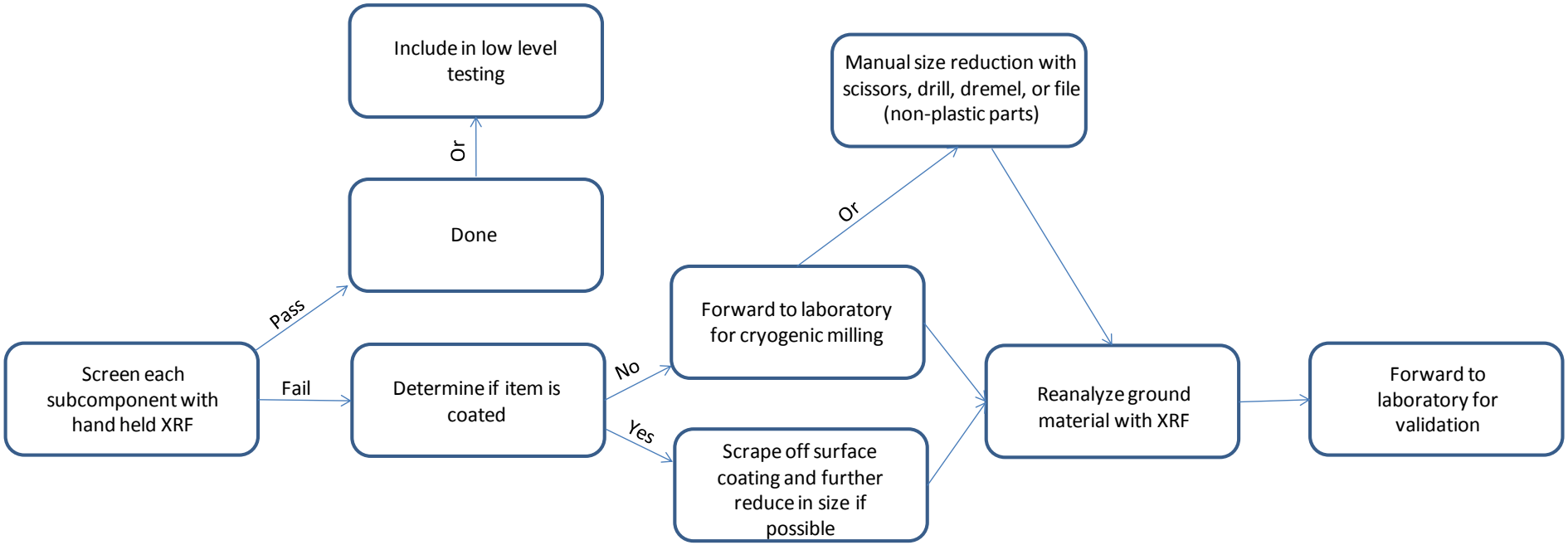

Figure 1. Screening and Sample Preparation Schematic.

Field staff will record photos and descriptive notes on each product screened. All field and laboratory staff handling the items will wear powder-free nitrile gloves. Stainless steel tools used to deconstruct the product will be cleaned by the following sequence: hot water scrub with Liquinox soap, 10% nitric acid rinse, deionized water rinse, acetone rinse, and hexane rinse.

The cryomill vessel will be cleaned between samples following consecutive washes with detergent, acetone, 3% nitric, and DI water.

Analytical Procedures

XRF Analysis

Individual subcomponents of products will be screened using a Niton XL3t handheld XRF gun (Figure 2) following the manufacturer recommendations and adaptations of ASTM method F 2617-08 *Standard Test Method for Identification and Quantification of Chromium, Bromine, Cadmium, Mercury, and Lead in Polymeric Material Using Energy Dispersive X-ray Spectrometry*. Subcomponents will be assigned a unique sample ID at the time of measurement that will correspond with XRF results.

For the initial screening, a reading will be taken for at least 30 seconds on a smooth (or near smooth) area of the product large enough to cover the spectrometer's window and at least 2 mm thick. If the item is less than 2 mm thick it may be folded on to itself until 2 mm depth has been reached (care will be taken to trap minimal air in between folds). Samples chosen for laboratory analysis will undergo a second, longer measurement (up to 180 seconds).

After a sample has been selected for further testing it will be processed (ground, cut, or scraped) and a second reading will be taken on the sub-sampled material in a similar manner using the stand provided by the manufacturer. For this measurement the processed material will be mounded on top of the spectrometer window to at least 2 mm and analyzed for 180 seconds. Both measurements will be taken using the appropriate XRF software package (based on sample material). Detection limits are shown in Table 4.

Figure 2. Niton Handheld XRF.

After XRF analyses are completed, the data will be reviewed and samples will be chosen for laboratory analysis. Samples forwarded to the lab will be placed in pre-cleaned I-chem jars.

Table 4. Niton Handheld XRF LOQs and Expected Range of Results.

Element	Expected Range of Results (ppm)	LOQ (ppm)†
Antimony	< LOQ - 300	25
Arsenic	< LOQ - 300	3
Bromine	< LOQ - 5000	3
Cadmium	< LOQ - 300	15
Cobalt	< LOQ - 300	*
Lead	< LOQ - 300	4
Mercury	< LOQ - 10	6
Molybdenum	< LOQ - 300	^

Ppm: parts per million.
LOQ: Limit of Quantitation.
† Polyethylene blank, 8 mm aperture, 180 second total analysis time.
* Detection limits are not specified by the manufacturer for cobalt.
^ Low levels of molybdenum cannot be detected by XRF.

All samples screened will be assigned a unique identifier and results from the XRF will be transferred to Microsoft Excel spreadsheets.

Laboratory

Table 5 describes digestion and analysis methods along with estimated LOQs. Metals samples will be prepared following EPA 3052 (microwave digestion) and measured using ICP/MS or CVAA (mercury) by Manchester Laboratory.

PBDEs will be measured by RI Analytical Labs using GC/ECD according to EPA 8082. Samples will be extracted by conventional soxhlet methodology following EPA SW-846 3540. When PBDEs are detected with GC/ECD a confirmatory analysis using GC/MS is performed.

Table 5. Laboratory Methods and Reporting Limits.

Analyte	Digestion Method/ Extraction	Analysis	Method	Reporting Limits (ppm)
Antimony	EPA 3052	ICP/MS	EPA 6020	4
Arsenic	EPA 3052	"	EPA 6020	2
Cadmium	EPA 3052	"	EPA 6020	2
Cobalt	EPA 3052	"	EPA 6020	2
Lead	EPA 3052	"	EPA 6020	2
Molybdenum	EPA 3052	"	EPA 6020	2
Mercury	EPA 245.5	CVAA	EPA 245.5	0.1
PBDEs	EPA 3540	GC/ECD	EPA 8082	1 - 5

ICP-MS: Inductively-coupled plasma/mass spectrometry.
CVAA: Cold vapor atomic absorption.
GC/ECD: Gas chromatography- electron capture detector.

Budget

Table 6 shows the project budget. The sample numbers are approximate and will be guided by the XRF screening.

Table 6. Project Budget.

Item	Number of samples	Cost per sample	Total
XRF rental			9000
Quality control review			2000
Sample collection			3000
Cryogrinding	100	45	4500
Metals	231	75	17,325
PBDEs	325	75	24,375
Quality control costs (10% of analysis)			4170
			64,370

Costs include 50% discount for Manchester Laboratory.

Quality Objectives

The quality objective for this project is to obtain data of sufficient quality so that uncertainties are minimized and results are comparable between product matrices. This objective will be achieved through careful attention to the sampling, sample processing, measurement, and quality control procedures described in this plan.

Measurement Quality Objectives

Duplicates and standards (provided by XRF manufacturer) measurements will be taken with the XRF every 25 samples. Since the XRF analysis is being used as a screening tool only, no measurement quality objectives (MQOs) are outlined. Performance of the handheld XRF will be based on how well results compare with the duplicates, standards, and laboratory analyses as discussed in the final report.

MQOs for laboratory analysis of metals and PBDEs are shown in Table 7. It is expected that Manchester Laboratory and RI Analytical Laboratory will meet these criteria. MQOs falling outside of the acceptance limits will be reviewed by the project manager for their usability.

Table 7. MQOs for Laboratory Analyses.

Analyte	Laboratory Control Samples	Matrix Spikes	Duplicates†	Method Blanks*	Surrogate Recovery
	(recovery)	(recovery)	(RPD)	(ppm)	(recovery)
Antimony	85 - 115%	75 - 125%	± 20%	4	
Arsenic	85 - 115%	75 - 125%	± 20%	2	
Cadmium	85 - 115%	75 - 125%	± 20%	2	
Cobalt	85 - 115%	75 - 125%	± 20%	2	
Lead	85 - 115%	75 - 125%	± 20%	2	
Mercury	85 - 115%	75 - 125%	± 20%	0.1	
Molybdenum	85 - 115%	75 - 125%	± 20%	2	
PBDEs	40 - 140%	40 - 140%	± 25%	1	30 - 150%

* Metals reporting limits were estimated by raising soil limits by a factor of 20.
† Matrix spike duplicates and split duplicates.
RPD: Relative percent difference.
ppm: parts per million.

Quality Control Procedures

Field

No field quality control procedures are anticipated for this project.

Laboratory

Table 8 shows laboratory quality control samples planned for the project. Split duplicate samples will be used to assess variability in the data due to sample preparation and laboratory procedures. Samples will be split before cryogenic grinding (or other size reduction method). Additionally, blank rinseate passed through the cryomill will be tested for metals and PBDEs once per every 10 samples milled.

Table 8. Quality Control Tests.

Laboratory Control Samples	Matrix Spikes	Matrix Spike Duplicates	Laboratory Duplicates	Split Duplicates†	Method Blanks	Surrogate Recovery*
1/batch	1/batch	1/batch	1/batch	1/batch	1/batch	every sample

† Dependent on amount of sample available.
* PBDEs only.

Data Management Procedures

XRF data from the screening portion of the project will be transferred to Microsoft Excel spreadsheets and stored with the project manager.

Data packages from Manchester Laboratory (including results of RI Analytical Labs) will include case narratives discussing any problems encountered with the analyses, corrective actions taken, changes to the referenced method, and an explanation of data qualifiers. The narrative should address condition of the samples on receipt, sample preparation, methods of analysis, instrument calibration, recovery data, and results on quality control samples. This information is needed to evaluate the accuracy of the data and to determine whether the MQOs were met.

All project data excluding XRF results will be entered into Ecology's Environmental Information Management System (EIM). Data entered into EIM follow a formal data review procedure where the data are reviewed by the project lead, the person entering the data, and an independent reviewer.

Audits

Manchester Laboratory participates in performance and system audits of their routine procedures. Results of these audits are available on request.

Report

A final report detailing the findings of the study will be completed. The final report will include:

- Categorical descriptions of the products screened with the XRF. (Brands, product names will not be included.)
- Statistical summaries of contaminant concentrations for all products screened with XRF including those not forwarded for validation.
- Results for XRF re-analysis on shavings and ground material along with laboratory results.
- Comparison of laboratory results with both XRF screenings.
- Assessment of handheld XRF's ability to provide accurate element concentrations on finished children's products and consumer goods.

Data Verification

Manchester Laboratory will conduct a review of all laboratory data generated, including RI Analytical Labs. Manchester will verify that methods and protocols specified in this Quality Assurance Project Plan were followed; that all calibrations, checks on quality control, and intermediate calculations were performed for all samples; and that the data are consistent, correct, and complete, with no errors or omissions. Evaluation criteria will include the acceptability of procedural blanks, calibration, matrix spike recoveries, labeled compound and internal standard recoveries, ion abundance ratios, duplicates, laboratory control samples, and appropriateness of data qualifiers assigned. Manchester Laboratory will prepare written data verification reports based on the results of their data review.

A case narrative will meet the requirements for a data verification report for Manchester's chemical data.

Data Quality (Usability) Assessment

The project lead will examine the data reviews, case narratives, and data packages to assess the usability of the data. To determine if project MQOs have been met, results for laboratory control samples, sample duplicates, matrix spikes, and labeled compound recoveries will be compared to quality control limits. The method blank results will be examined to verify there was no significant contamination of the samples. To evaluate whether the targets for reporting limits have been met, the results will be examined for "non-detects" and to determine if any values exceed the lowest concentration of interest. Based on these assessments, the data will be either accepted, accepted with appropriate qualifications, or rejected and re-analysis considered.

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Appendices

Appendix A. Chemicals Required by the CSPA Rule to be Reported in Children's Products

CAS	Chemical	CAS	Chemical
50-00-0	Formaldehyde	108-88-3	Toluene
62-53-3	Aniline	108-95-2	Phenol
62-75-9	N-Nitrosodimethylamine	109-86-4	2-Methoxyethanol
71-36-3	n-Butanol	110-80-5	Ethylene glycol monoethyl ester
71-43-2	Benzene	115-96-8	Tris(2-chloroethyl) phosphate
75-01-4	Vinyl chloride	117-81-7	Di-2-ethylhexyl phthalate (DEHP)
75-07-0	Acetaldehyde	117-84-0	di-n-octyl phthalate (DnOP)
75-09-2	Methylene chloride	118-74-1	Hexachlorobenzene
75-15-0	Carbon disulfide	119-93-7	3,3'-Dimethylbenzidine and Dyes Metabolized to 3,3'-Dimethylbenzidine
78-93-3	Methyl ethyl ketone	120-47-8	Ethyl paraben
79-34-5	1,1,2,2-Tetrachloroethane	123-91-1	1,4-Dioxane
79-94-7	Tetrabromobisphenol A	127-18-4	Perchloroethylene
80-05-7	Bisphenol A	131-55-5	Benzophenone-2 (Bp-2); 2,2',4,4'-Tetrahydroxybenzophenone
84-66-2	Diethyl phthalate	140-66-9	4-tert-Octylphenol; 1,1,3,3-Tetramethyl-4-butylphenol
84-74-2	Dibutyl phthalate (DBP)	140-67-0	Estragole
84-75-3	Di-n-Hexyl Phthalate	149-57-5	2-Ethylhexanoic Acid
85-44-9	Phthalic Anhydride	556-67-2	Octamethylcyclotetrasiloxane
85-68-7	Butyl Benzyl phthalate (BBP)	608-93-5	Benzene, pentachloro
86-30-6	N-Nitrosodiphenylamine	842-07-9	C.I. Solvent Yellow 14
87-68-3	Hexachlorobutadiene	872-50-4	N-Methylpyrrolidone
94-13-3	Propyl paraben	1163-19-5	2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether; BDE-209
94-26-8	Butyl paraben	1763-23-1	Perfluorooctanyl sulphonic acid and its salts; PFOS

CAS	Chemical	CAS	Chemical
95-53-4	2-Aminotoluene	1806-26-4	Phenol, 4-octyl-
95-80-7	2,4-Diaminotoluene	5466-77-3	2-Ethyl-hexyl-4-methoxycinnamate
99-76-3	Methyl paraben	7439-97-6	Mercury & mercury compounds including methyl mercury (22967-92-6)
99-96-7	p-Hydroxybenzoic acid	7439-98-7	Molybdenum & molybdenum compounds
100-41-4	Ethylbenzene	7440-36-0	Antimony & Antimony compounds
100-42-5	Styrene	7440-38-2	Arsenic & Arsenic compounds including arsenic trioxide (1327-53-3) & dimethyl arsenic (75-60-5)
104-40-5	4-Nonylphenol; 4-NP and its isomer mixtures including CAS 84852-15-3 and CAS 25154-52-3	7440-43-9	Cadmium & cadmium compounds
106-47-8	para-Chloroaniline	7440-48-4	Cobalt & cobalt compounds
107-13-1	Acrylonitrile	25013-16-5	Butylated hydroxyanisole; BHA
107-21-1	Ethylene glycol	25154-52-3	Nonylphenol
25637-99-4	Hexabromocyclododecane	28553-12-0	Diisononyl phthalate (DINP)
26761-40-0	Diisodecyl phthalate (DIDP)		

CAS: Chemical abstracts service

Appendix B. Glossary, acronyms, and abbreviations

Glossary

Blank rinseate: A contaminant-free rinse, usually deionized water or a solvent, which is analyzed to determine cross contamination between samples.

Acronyms and Abbreviations

ASTM	American Society for Testing and Materials
C.F.R.	Code of Federal Regulations
CSPA	Children's Safe Product Act
DI	Deionized
e.g.	For example
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
et al.	And others
i.e.	In other words
LOQ	Limit of Quantitation
MQO	Measurement quality objective
PBDE	Polybrominated diphenyl ethers
ppm	parts per million
RCW	Revised Code of Washington