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Better Brakes Enforcement Study 2017

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Better Brakes Enforcement Project 2017

Addendum to Quality Assurance Project Plan: Product Testing Program, Version 1.0

January 2017

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Department of Ecology

Hazardous Waste and Toxics Reduction Program

2.0 Abstract

As of 2013 manufacturers of brake friction materials have been reporting and certifying brake friction materials for sale in Washington State, under the Better Brakes Law, Chapter 70.285 Revised Code of Washington (RCW). The Better Brakes law prohibits the use of asbestos, cadmium, chromium, lead, and mercury and provides for a phase out of copper brake friction materials. To date Ecology has received data and certifications for over 5,000 of brake friction materials. This study will focus to identify manufacturers that have not yet certified their products for sale in Washington State and to conduct metals analyses on those identified brake friction materials. It will also serve to verify the accuracy of reported data submitted under the WA State Brake self-certification program. Drilled brake friction material will be tested for total cadmium, copper, and lead. The results will be used to assess compliance and for enforcement purposes.

3.0 Background

In 2010, Washington State passed the Better Brakes Law, Chapter 70.285 RCW. This law restricts the use of asbestos, cadmium, chromium, lead, and mercury and provides for a phase out of copper by 2025. The law established a self-certification program for brake friction materials sold in Washington State. To comply with the law, manufacturers are required to test each brake friction formulation in accordance with Society of Automotive Engineers (SAE) method SAEJ2975:2013 then submit summaries of this testing and signed self-certification documentation to the WA State Department of Ecology.

All brakes manufactured after January 1, 2015 must have the following packaging mark to indicate the level of compliance of the brake friction material. The more shaded the leaf, the more levels of compliance the brake friction material meets as shown in Figure 1.

	<p>Level A: limits levels of asbestos, chromium, lead, and mercury to less than 0.1% and cadmium to .01%</p>
	<p>Level B: includes all the requirements of Level A and copper levels must be less than five percent by weight.</p>
	<p>Level N: includes all requirements of Level A and copper levels must be less than 0.5 percent by weight.</p>

Figure 1. Package Markings Indicating Level of Compliance of Brake Friction Materials

Brakes must also have a marking on the product itself called an Edge Code. This marking is described in SAE J866 and in Ecology's publication, *Guidance for Marking Brake Friction Material*, <https://fortress.wa.gov/ecy/publications/documents/1304011.pdf>.

In general, the Better Brakes Law applies to brake friction materials intended for all vehicles that travel on the highway. Notable exemptions to the law include brakes intended for use on motorcycles, military combat vehicles, race cars, collector vehicles and internally enclosed braking systems that emit no debris under normal operating conditions. Brake friction material will not be tested from the exempted categories.

4.0 Study Description

Ecology's Product Testing Program regularly conducts studies on products to assess compliance with current regulations.

The objective of this project is to enforce the Better Brakes Law by identifying uncertified and inaccurately certified brake products (brake pads and shoes). This study will focus on determining the concentrations of total copper, cadmium, and lead in brake friction materials. Brake friction material samples consists of drilled brake pads and shoes.

The study will collect both "original equipment" and those considered "aftermarket parts" brake friction materials. Aftermarket parts are parts that are used in the upkeep or enhancement of a motor vehicle.

Brake friction materials will be purchased under three categories:

1. Passenger (sub categories are differentiated by vehicle weight and type)
2. Special use (bus, ambulance, police, garbage truck, and high-end sports cars)
3. Heavy duty / commercial vehicles

The study aims to purchase brake friction materials from many different manufacturers and cover a wide range of vehicle types. The study will target testing on uncertified brake friction materials still available for sale in Washington State. Additional testing will be performed on certified products to verify the accuracy of certification information submitted to Ecology's Better Brakes Program.

Any potential violations identified during this study will be referred to the Better Brake Enforcement Officer for compliance enforcement.

4.1 Study Goals

The data from this study will be provided to Ecology's enforcement officer to assess compliance to and for enforcement of the Better Brakes law.

4.6 Tasks Required

To meet study goals, Product Testing (PT) staff will carry out the following tasks:

- Research to identify uncertified brake friction materials by looking at data provided by CA, other brake friction material certification programs, and internet sources.
- Purchase 160 brake friction material products.

- Record product information in Ecology’s Product Testing Database (PTDB).
- Brake friction material to contract lab for drilling in accordance with SAE J2975:2013 (http://standards.sae.org/j2975_201312/).
- Drilled friction material samples sent from contract laboratory to Manchester Environmental Laboratory (MEL).
- MEL Analysis of total cadmium, copper, and lead.
- Evaluate and review study data.
- Document study findings.

5.0 Organization and Schedule

5.4 Project Schedule

Table 1. Schedule for the Better Brake Enforcement Project 2017

Product Collection, Processing, and Laboratory	Due date	Lead staff
Online purchases to purchasing	03/1/2017	Chrissy Wiseman/Jenna Rushing
Product collection completed	4/14/2017	Chrissy Wiseman
Product logging in completed	4/28/2017	Jenna Rushing
Samples sent to contract lab	05/5/2017	Chrissy Wiseman/Jenna Rushing
Samples from contract lab to MEL	5/31/2017	
Laboratory analyses completed	6/30/2017	
Data		
	Due date	Lead staff
Lab data QA reviewed	7/14/2017	Chrissy Wiseman
Lab data loaded into PTDB	7/21/2017	Chrissy Wiseman
Lab data to enforcement officer	7/28/2017	Chrissy Wiseman
Final report		
Author lead / Support staff	Chrissy Wiseman/Jenna Rushing	
Schedule		
Draft due to supervisor	9/28/2017	
Draft due to client/peer reviewer	9/28/2017	
Final (all reviews done) due to publications coordinator	10/20/2017	
Final report posted to the web	10/31/2017	

5.6 Budget and Funding

Table 2. Better Brakes Enforcement Study 2017 budget

Activity/Parameter	Number of Samples	QC Samples	Cost per Sample	Subtotal	
Product Collection	160	N/A	\$75	\$12,000	
Product Collection Total:				\$12,000	
Manchester Environmental Laboratory (MEL) Testing					
Metals Testing in Brake Friction Materials (triplicate analysis)	160	N/A	\$300	\$48,000	
Metals Testing in Blanks **	N/A	2	\$100	\$200	
Contract Laboratory					
Drilling	160	N/A	\$80	\$12,800	
Estimated Shipping Cost					\$1,000
				Laboratory Total:	\$61,000
				Project Total:	\$74,000

**At a minimum a 1 storage vial blank and 1 drill processing blank will be analyzed. If contamination in the blanks is above 500 ppb additional blanks will be analyzed or if method blanks the batch will be redigested.

6.0 Data Quality Objectives

6.2 Measurement Quality Objectives

Table 3. Better Brakes Enforcement Study 2017 MQO's

Analyte	Bias		Precision		Max Blank Contamination	Reporting Limit
	LCS (% recov.)	LCSD (% recov.)	Relative Percent Difference (RPD)	Lab Triplicates Rel. Stan. Dev. (RSD)	Drill, Storage, Method	
Metals*	85 - 115%	85-115%**	≤ 20%	≤ 20%***	500 ppb	5.0 ppm

*Metals includes: cadmium, copper, and lead.

**Matrix spikes and matrix spike duplicates will not be performed due to matrix.

*** Triplicate Sample Relative Standard Deviation (RSD) As per the SAE J2975 Version 2013

The drilling contract laboratory will collect three 50 milliliter (ml) DI water vial blanks which will be held as a storage blank and analyzed if necessary in addition to collecting processing drill blanks for each drilling batch of 50 or at the end of each drilling session. Storage blanks and drill processing blanks will be analyzed as determined by the MEL analyst when contamination is suspected.

Each drilled friction material sample will be digested in triplicate by EPA 3050B and then analyzed by EPA 6010D. The expected levels of the metals present in the samples will make it difficult to perform matrix spikes at an appropriate spike level, therefore matrix spike will not be performed on these samples.

Laboratory Control Sample (LCS), Laboratory Control Sample Duplicate (LCSD) and method blanks will be prepared and analyzed with each sample batch. Batches will consist of six drill friction material samples which consists of 18 individual MEL samples. Triplicate samples should not be split amongst batches.

Per the recommendation in SAE J2975 Version 2013 and because of the complex and heterogeneous nature of brake friction materials, the digestion and analysis for each brake friction material will be performed in triplicate and the average value be reported. Percent Relative Standard Deviation (standard deviation / measurements average *100) should be less than 20% for the triplicate measurements. Depending on the amount of specific components in the friction materials, additional dilutions during the analysis may be necessary.

MEL triplicate samples that have an RSD exceedances of 20% will all be qualified “J”, an estimate.

6.2.1 Targets for Precision, Bias, and Sensitivity

6.2.1.1 Precision

If any RSD exceeds 20% these results will be noted in the case narrative and the summary report.

6.2.2 Targets for Comparability, Representativeness, and Completeness

6.2.2.2 Representativeness

Within each study’s boundaries Ecology Product Testing staff will purchase products representative of those available to Washington residents.

Products will be purchased for a wide variety of vehicle types, including different passenger vehicles, heavy-duty vehicles, and special use vehicles like police cars, school buses, and garbage trucks.

Care will be taken to assure that brakes are purchased from a wide variety of brake manufacturers and represent a variety of certification types.

7.0 Sampling Process Design (Experimental Design)

7.1 Study Design

Products will be selected based on data reported under the WA States Better Brakes certification program and through internet research. The study will prioritize testing brake friction material products that have not been certified. Additional products will be tested from certified brake friction materials to verify accuracy of reporting and to assess compliance.

The study will use the [National Highway Traffic Safety Administration](#) (NHTSA) Vehicle Classification sub-categories to divide and select the number of Original Equipment (OE) and the number of aftermarket brake friction materials.

Passenger vehicles will include sub categories determined by vehicle weight and type including, mini, light, compact, medium, heavy, sport utility, pickup trucks, and vans.

The study will also include special use vehicles, such as buses, ambulances, police vehicles, garbage trucks, and high-end sports cars and heavy duty/commercial vehicles (semi-trucks).

Table 4. Sample counts by vehicle category classifications

Primary Category	Sub-Category	Number of Products	Notes
Passenger Vehicles			
	Original Equipment	22	Purchase brakes for model year 2015 and newer
	Aftermarket	96	Purchase three brakes for Ecology vehicles off state contract
Special Use Vehicles			
	Bus	6	At least one off state contract, if available
	Ambulance	3	At least one off state contract, if available
	Police Car	5	At least one off state contract, if available
	Garbage Truck	3	At least one off state contract, if available
	High-end Sports Cars	3	Purchase brakes for model year 2015 and newer
Heavy Duty / Commercial Vehicles			
	Drum	20	
	Disk	2	
Total # of samples		160	

Table 5. Passenger car Sub-category sample counts

NHTSA classification	Sub-Category*	Number of OE**Products	Number of Aftermarket Products
Passenger cars: mini	1,500 to 1,999 lb. (680–907 kg)	2	3
Passenger cars: light	2,000 to 2,499 lb. (907–1,134 kg)	3	5
Passenger cars: compact	2,500 to 2,999 lb. (1,134–1,360 kg)	3	17
Passenger cars: medium	3,000 to 3,499 lb. (1,361–1,587 kg)	3	17
Passenger cars: heavy	3,500 lb. (1,588 kg) and over	3	17
Sport utility vehicles	–	3	17
Pickup trucks	–	3	17
Vans	–	2	3
Total		22	96

* lbs. = pounds and kg = kilograms

**OE = Original parts

Note: Each OE sample will be from a different brand of vehicle. Aftermarket parts will be selected from a variety of manufacturers.

7.1.3 Parameters to be Determined

Table 6. Table of Parameters (Analytes) with Chemical Abstract Service (CAS) numbers

Parameter	CAS Number
Cadmium	7440-43-9
Copper	7440-50-8
Lead	7439-92-1

8.0 Sampling Procedures

8.2 Containers, Preservation Methods, Holding Times

Ecology's PT program will acquire and ship all original brake friction materials packaged in zip-top bags to the contract drilling laboratory. Each bag containing the brake friction materials will be labeled by PT staff with the PT Component ID and the three associated MEL assigned numbers. Additional labels will be sent to the contract laboratory to affix on each 50 ml vials containing the final drilled friction material samples. All brake friction material products and drill friction material samples will be transported in Ecology supplied coolers. The drilled friction material samples are not required to be chilled or packed in ice.

The drilled brake friction material samples will be sent directly to MEL in 50 ml vials, provided by the drilling contractor. The drilling contract laboratory will dispose/recycle the drilled pads and shoes after observing the standard holding time.

The contract laboratory will use the MEL chain of custody for all samples throughout the process.

8.7 Field Log Requirements

In addition to the standard information outlined in the Sample Collection and Sample Processing SOP PTP001 (Wiseman et al., 2016), the information listed below will be recorded during this study for each product purchased, unless the information is unavailable. This information will be logged into the Product Testing Database when entering the products.

- The vehicle make, model and year that the brake is purchased for
- The brake edge code
- The environmental compliance code and the brake manufacture year to be determined from the edge code
- Notation that the product packaging **does not** have the Leaf Mark symbol
- Notation that the Leaf Mark symbol does not match the compliance code on the brake product

9.0 Measurement Methods

9.2 Laboratory Procedures Table

Table 7. Laboratory methods and reporting limits

Analyte	Samples (number/ arrival date)	Expected Range of Results	Matrix	RL (ppm)	Preparation Method	Analysis Method	Analysis Instrument
Metals*	160, 6/15/2017	< 5.0 – 400,000 ppm	Drilled Brake Friction Material dust	5.0	EPA 3050B	EPA 6010D	ICP-OES
Brake Drilling	160, 05/5/2017	N/A	Brake Friction Material	N/A	SAE J2975:2013	N/A	CNCDrill

*Metals includes: cadmium, copper, and lead.

** Computer Numerical Control (CNC)

MEL will use digestion method EPA 3050B and analysis method EPA 6010D by Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES). EPA 6010C method was used on the 2011 study.

9.3 Sample Preparation and Screening Method(s)

Brake friction materials will be sent to the contract laboratory to be drilled in accordance with SAE J2975:2013. Drilled samples will be sent from the contract laboratory to MEL for metals analysis.

9.4 Special method requirements

Three storage blanks will be prepared by filling three clean empty vials (same as used for the drilled brake friction material samples), with 50 ml deionized water prior to the beginning of any drilling by the contract drilling laboratory. The three storage blank vials will be sent to MEL along with the drilled brake friction material samples.

Drill processing blanks will be prepared by the contract laboratory for each batch of brake friction material drilled or at the end of a drilling session. Each blank will be prepared by opening a clean empty vials (same as used for the drilled brake friction material) filled with DI water and set next to the drill. At the end of each drilling batch the vial will be capped. The contract laboratory will define their meaning of a batch and what drill friction material samples are associated with each drill processing blank. The drill processing blanks will be sent to MEL along with the drilled friction material samples. MEL will use these blanks to assist in evaluating contamination on an as needed basis.

10.0 Quality Control Procedures

10.1 Table of Laboratory Quality Control Required

Table 8. Table of laboratory quality control required

Analyte	Method Blank	Laboratory Control Sample	Laboratory Control Sample Duplicate*	Drill Processing Blank	Storage Blanks
Metals	1/batch	1/batch	1/batch	as needed	as needed

Batch = analytical batch = (18 MEL samples).

*A laboratory control sample (LCS) will be performed in duplicate for each batch.

MEL will report a method blank, laboratory control spike, and a laboratory control spike duplicate with each batch of 6 drill friction material samples (18 MEL samples).

Storage blanks and drill processing blanks will be analyzed as determined by the MEL analyst when contamination is suspected. MEL will describe the criteria used upon deciding to perform the analysis on these samples in the case narrative.

RL should be five ppm for each cadmium, copper, and lead. If the sample is homogeneous then 20% RSD is reasonable.

14.0 Data Quality (Usability) Assessment

14.5 Document of Assessment

Data from triplicate analysis will be averaged and reported to the enforcement officer for regulatory Results will be averaged for assessments of compliance and for enforcement purposes.

15.0 References

Sekerak, S. 2016. [Quality Assurance Project Plan: Product Testing Program Version 1.0](#), Publication number 16-03-113, 52 pages.

Wesley, Ian 2013. [Guidance for Marking Brake Friction Material](#), publication number 13-04-011, 2 pages.

Wiseman, C., K. Inch, S. Sekerak, and S. van Bergen 2016. Product Testing Standard Operating Procedure: Sample Collection and Processing. Internal document No. PTP001.

SAE J2975 DEC2013. [Surface Vehicle Recommended Practice: Measurement of Copper and other Elements in Brake Friction Materials](#), 2013 specifically. <https://www.nhtsa.gov/>