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Environmental Technology Verification Report

Releasable Asbestos Field Sampler

Prepared by

Battelle
The Business of Innovation

Under a cooperative agreement with

EPA **U.S. Environmental Protection Agency**

ETV ETV ETV

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Environmental Technology Verification Report

ETV Advanced Monitoring Systems Center

Releasable Asbestos Field Sampler

by

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Notice

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Foreword

The EPA is charged by Congress with protecting the nation's air, water, and land resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, the EPA's Office of Research and Development provides data and science support that can be used to solve environmental problems and to build the scientific knowledge base needed to manage our ecological resources wisely, to understand how pollutants affect our health, and to prevent or reduce environmental risks.

The Environmental Technology Verification (ETV) Program has been established by the EPA to verify the performance characteristics of innovative environmental technology across all media and to report this objective information to permit issuers, buyers, and users of the technology, thus substantially accelerating the entrance of new environmental technologies into the marketplace. Verification organizations oversee and report verification activities based on testing and quality assurance protocols developed with input from major stakeholders and customer groups associated with the technology area. ETV consists of six environmental technology centers. Information about each of these centers can be found on the Internet at http://www.epa.gov/etv/.

Effective verifications of monitoring technologies are needed to assess environmental quality and to supply cost and performance data to select the most appropriate technology for that assessment. Under a cooperative agreement, Battelle has received EPA funding to plan, coordinate, and conduct such verification tests for "Advanced Monitoring Systems for Air, Water, and Soil" and report the results to the community at large. Information concerning this specific environmental technology area can be found on the Internet at http://www.epa.gov/etv/centers/center1.html.

Acknowledgments

The authors wish to acknowledge the contribution of the many individuals, without whom, this verification testing would not have been possible. Quality assurance (QA) oversight was provided by Michelle Henderson, U.S. EPA and Rosanna Buhl and Betsy Cutie, Battelle. We gratefully acknowledge Dr. Mark Follansbee and Ms. Patricia Billig of SRC, Inc., Dr. Jonathan Thornburg, of the Research Triangle Institute and Mr. Dave Ferguson, Dr. Bill Barrett, and Mr. Jim Konz of EPA for being stakeholders and providing review of the test/QA plan and this verification report.

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List of Abbreviations

ABS	Activity based sampling
ADQ	Audit of data quality
AMS	Advanced monitoring systems
ATSDR	Agency for Toxic Substances and Disease Registry
cc	Cubic centimeter
COC	Chain-of-custody
DQI	Data quality indicators
EPA	U.S. Environmental Protection Agency
EQM	Environmental Quality Management, Inc.
ETV	Environmental technology verification
HAZWOPER	Hazardous waste operations and emergency response
ISO	International Organization for Standardization
LA	Libby amphibole asbestos
lpm	Liters per minute
LRB	Laboratory record book
MCE	Mixed cellulose ester
NIST	National Institute of Standards and Technology
NVLAP	National voluntary laboratory accreditation program
NYDOH	New York Department of Health
OU	Operable unit
PE	Performance evaluation
PLM	Polarized light microscopy
QA	Quality assurance
QC	Quality control
QAO	Quality assurance officer
QMP	Quality management plan
RAFS	Releasable asbestos field sampler
RMO	Records management office
RPD	Relative percent difference
RSD	Relative percent standard deviation
SOP	Standard operating procedure
TEM	Transmission electron microscopy

TQAP	Test/quality assurance plan
TSA	Technical systems audit
VTC	Verification test coordinator

Chapter 1
Background

The U.S. Environmental Protection Agency (EPA) supports the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized testing organizations, with stakeholder groups consisting of buyers, vendor organizations, and permit issuers, and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance (QA) protocols to ensure that data of known and adequate quality are generated and that the results are defensible. The definition of ETV verification is to establish or prove the truth of the performance of a technology under specific, pre-determined criteria or protocols and a strong quality management system. The highest-quality data are assured through implementation of the ETV Quality Management Plan. ETV does not endorse, certify, or approve technologies.

The EPA's National Risk Management Research Laboratory (NRMRL) and its verification organization partner, Battelle, operate the Advanced Monitoring Systems (AMS) Center under ETV. The AMS Center recently evaluated the performance of the Releasable Asbestos Field Sampler for field sampling of asbestos.

Chapter 2
Technology Description

This report provides results for the verification testing of the Releasable Asbestos Field Sampler (RAFS). The following is a description of the RAFS based on information provided by the vendor. The information provided below was not verified in this test.

The RAFS, owned by EQM (U.S. Patent No. 7,758,813), is a small, field portable system for determining the potential for exposure to asbestos fibers released from soils. The RAFS was designed to measure the emission rate of asbestos from soil (asbestos structures/sec) and concentration of asbestos in air when released (asbestos structures per cc of air). The RAFS operates *in situ* under actual soil conditions with representative moisture content and grain size. Thus, the possibility that soil conditions may change during handling, transport, and storage is eliminated.

The RAFS is a field instrument that provides an *in situ* measurement of asbestos releasability using mechanical agitation of the source material soil (Figure 1a). The RAFS consists of a variable speed, high efficiency particulate arrestor-filtered fan attached to a tunnel (6 inches by 6 inches by 24 inches) with an open bottom for exposure to the test matrix soil. The fan discharges air at the tunnel inlet through diffusers to evenly distribute the airflow. A variable speed motorized rake mechanism inside the tunnel provides consistent and reproducible agitation of the top ½ inch of soil. The rake mechanism has 10 tines that oscillate slightly as it traverses the tunnel back and forth to agitate the soil to aerosolize the asbestos fibers (Figure 1b). An attachment at the tunnel exit can support up to three 25-mm diameter mixed cellulose ester membrane filter cassettes with 50-mm extension cowls for asbestos collection and analysis using direct transfer TEM. This aspect of the RAFS design permits collection of concurrent samples for different sampling periods with resultant varied air volumes to obtain an acceptable particulate loading for analysis using direct transfer TEM. A typical sampling period ranges from 10 to 60 minutes, depending on the filter particulate loading. These filters are then tested for asbestos. Based on the amount of asbestos present on the filters, the likely exposure of individuals performing activities on the asbestos contaminated soil can be estimated. The person collecting the sample using the RAFS typically does not need to wear protective equipment such as a respirator.

Each filter assembly is attached with flexible tubing to an electric powered (110-volt alternating current) 1/10-horsepower vacuum pump operating at an airflow rate of approximately 13.5 liters per minute (lpm). Each pump is equipped with a flow control regulator and individually calibrated rotameter that maintains the initial flow rate of approximately 13.5 lpm.

The RAFS collects anisokinetic samples where the free stream velocity is greater than the sample velocity. Under these conditions, inertia effects are negligible and the free stream to sample concentration ratio is unity.

Figure 1. Releasable asbestos field sampler a) Instrument during sample collection b) Instrument rakes agitating the top soil
(U.S. Patent Number 7,758,813)

Chapter 3
Test Design and Procedures

3.1 Test Overview

This verification test was conducted according to procedures specified in the *Test/QA Plan for Verification of Releasable Asbestos Field Sampler* (TQAP) and adhered to the quality system defined in the ETV AMS Center Quality Management Plan (QMP). Battelle conducted this verification test with funding support from the EPA's National Risk Management Research Laboratory. As indicated in the QAPP, the testing conducted satisfied EPA QA Category III requirements. The QAPP and verification report were reviewed by the following stakeholders:

- Mark Follansbee, SRC, Inc.
- Patricia Billig, SRC, Inc.
- Dave Ferguson, EPA

This verification test evaluated the performance of the RAFS while conducting asbestos samples at field sites. The main objective of the verification was to test the ability of the RAFS to measure the emission rate from soil (asbestos structures/sec) and the asbestos concentration released from soil (asbestos structures per cubic centimeter [cc] of air). To accomplish the goal of this verification test, the experimental design included generating data for performance parameters to assess the ability of the asbestos sampler through laboratory testing with asbestos fortified soil samples and field testing for direct comparison with activity based sampling (ABS). Testing of the RAFS was done in two phases.

Phase 1 of this verification test was conducted in Libby, Montana from August 2 to 6, 2010 to evaluate the sampling performance of the RAFS. The resulting concentration data was used to assess the comparability of the RAFS to site specific ABS events (i.e. ABS during raking) and the reproducibility of the samples collected by the RAFS. Operational factors were also assessed in the field.

The ability of the RAFS to detect asbestos in soil samples where asbestos was added was evaluated during Phase 2 of this verification test, which was conducted at Battelle's Laboratory in Columbus, OH. The RAFS was tested in soil with low and high moisture content amended with chrysotile asbestos. The accuracy and variability/consistency was verified in the laboratory. Testing for Phase 2 was conducted from September 13 through September l5, 2010.

3.2 Test Site Descriptions

3.2.1 Libby, Montana

Phase 1 of the verification test was field testing at the Libby, Montana OU4 Site. Details of the Libby Montana testing are provided in the TQAP. The TQAP states that testing will be done in three phases with Phase 1 and Phase 3 being field testing and Phase 2 being laboratory testing. However field testing was only done at one location, therefore field testing was done in just one

phase. This was a deviation from the TQAP. A deviation was prepared stating that the second field site was changed from Weedsport, NY to BoRit in Ambler, PA however a second field test was not conducted due to financial constraints on the project. Testing at only one site reduced the amount of data available for comparison of the RAFS to the ABS but it was deemed that testing at numerous locations at one site would provide sufficient information for the comparison.

Libby is a community in northwestern Montana, located seven miles southwest of an open pit vermiculite mine that operated from the 1920s until 1990. At Libby, vermiculite containing asbestos was mined for several years. Studies at the site later revealed that the vermiculite from the mine contains Libby amphibole type asbestos (LA) including tremolite and winchite. As a result of mining activities, asbestos was inadvertently utilized in building materials etc. and also was deposited after transport through the air. At Libby, Montana, field testing was conducted at four homes (Table 1). Throughout the report the locations would be referred to by their location code. EPA collected initial data beginning in 1999 to evaluate human exposure to LA and the efficacy of cleanup activities. Although the data varied widely, a discernible correlation between elevated LA levels in soil (by the polarized light microscopy [PLM] visual area estimation method) and elevated levels of asbestos in air were determined. The level of PPE suggested by EPA was C or D based on the asbestos levels detected in the soil.

Table 1. Addresses in Libby, Montana

Location	Location Code
California Avenue, Libby, Montana	A31
Dakota Ave., Libby, Montana	A32
Conifer Ave., Libby, Montana	A34
Flower Creek Road, Libby, Montana	A35

At each location, the RAFS was applied at five randomly chosen sampling points around each home. One sampling point was utilized for comparability testing, and the additional four sampling points were utilized for reproducibility testing. At each test site ABS was conducted by a different contractor. ABS was conducted by raking for 20 minutes around each home using low flow sampling at 4.86 L/min in the same area as the RAFS application. The ABS data was used for comparability testing.

3.2.2 Laboratory Test

Details of the laboratory test are provided in the TQAP. [3] The laboratory test was conducted in a temperature and humidity controlled basement laboratory at Battelle in Columbus, Ohio. In the laboratory, a tent (Figure 2) was constructed with a vacuum pump with HEPA filter installed for air flow, a decontamination area, and transparent window for viewing. The tent was large enough to allow two 4 ft by 4 ft wooden frames to be placed in the working area. The tent was constructed such that all asbestos was contained within the tent for decontamination purposes. Once the experiment was completed the tent was sprayed with an encapsulant to seal the asbestos for tent disposal.

Figure 2. Tent for asbestos laboratory test showing, a) Working and decontamination area, and b) HEPA filter vacuum pump in wall of tent

3.3 Experimental Design – Field Test

Before field analysis, the verification test coordinator (VTC) was trained on the use of the instrument by the vendor. The training included cleaning the instrument, turning on the instrument sample pumps, blowers, and rakes, taking blank samples, and measuring air speeds. Two RAFS instruments were made available for the field test although only one was utilized. For each of the four locations, the same general procedures were followed once on site. The procedures are described below.

3.3.1 Prepare Instrument for Sample Collection

1) *Sanitize equipment* - Once onsite the instrument was sanitized using 409 All Purpose cleaner and lint free towels (Figure 3a).
2) *Equipment Blank* - An equipment blank sample was taken first for 10 minutes (Figure 3b). In order to take the equipment blank, the instrument was placed on a clean sheet of aluminum and an open filter placed in Position 2 (middle position) on the RAFS. The blower and sample pump at Position 2 remained on for the 10 minute duration. After 10 minutes, the filter was collected, covered, and stored.
3) *Record Air Speed within RAFS* - A Davis rotating wave anemometer was used to collect the wind speed in the tunnel of the RAFS after processing the equipment blank. In order to take the wind speed, the blower was left on for 1 minute while the anemometer recorded the air speed (Table 2). The rake was left off during this measurement. The target setting was between 280 and 380 ft/min.

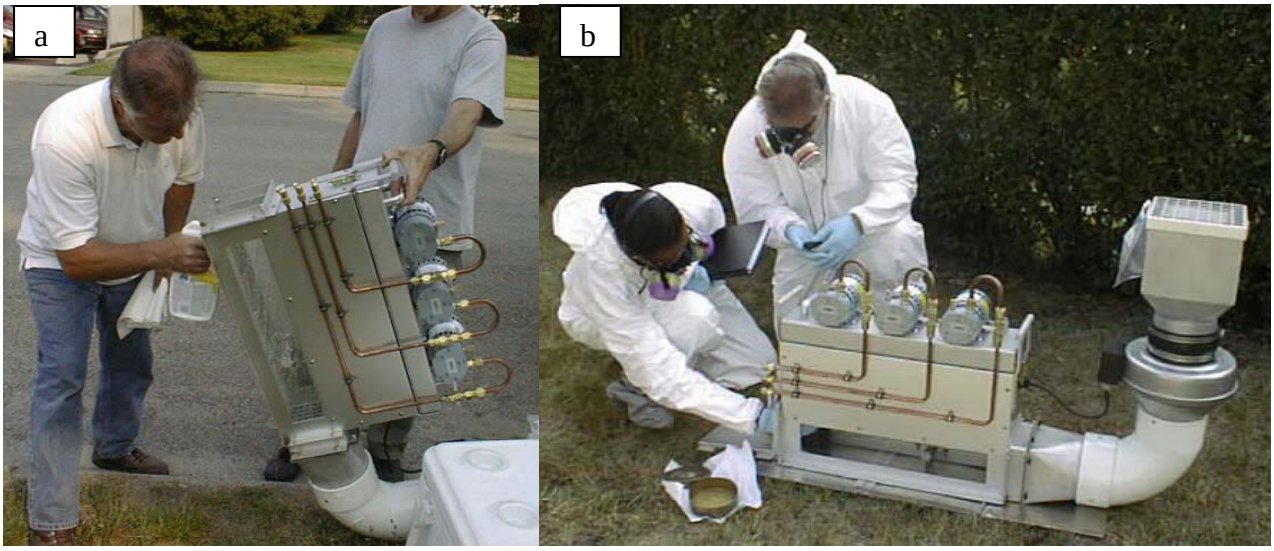

Figure 3. RAFS preparation, a) RAFS being sanitized, and b) Equipment blank being taken at a new location

3.3.2 Sample Collection

The general sample collection procedures are outlined in this section however the specific sampling conducted at each location is described later in the document.

1) *Measure flow at sampling pumps* – The RAFS holds three filters and can therefore collect triplicate samples during one application. Three individual sampling pumps are attached to each sampling point. Before samples are taken, the flow rate at each of the filter points is measured with a DryCal DC-Lite primary air flow meter and recorded. The target flow rate is 13 – 14 L/min. The flow meters on the sampling pumps can be adjusted to obtain an acceptable flow rate. The Dry Cal DC-Lite flow meter or rotameter calibration curve is provided in Figure 4. The duplicate rotameter readings were identical and therefore within the 5% RSD acceptance criteria of the test (Table 2).
2) *Load instrument and determine sampling time* – Three clean filters are loaded onto the RAFS, and the particle count flowing through the RAFS is determined using a Met One particle counter. The Met One particle counter reading is one of the variables used to determine the sampling time in addition to visible observation of the loading of the filter samples after a sample has been collected for the selected sampling time (Table 3).
3) *Blanks* – Open and closed field blanks were taken at each location (home). Open field blanks were taken by waving an open filter gently for 30 sec then closing and storing. Closed field blanks were taken by randomly choosing a filter from the filter lot and then labeling it as closed field blank.
4) *Rake Speed* – The rake speed was obtained by the counts of rake counter and the length of the sampling period. However the rake counter was not functional during the duration of the laboratory and field tests. This prevented the rake speed from being verified

however the actual rake speed setting remained the same for all test locations. The target rake setting is 1 cycle/20-30 sec.

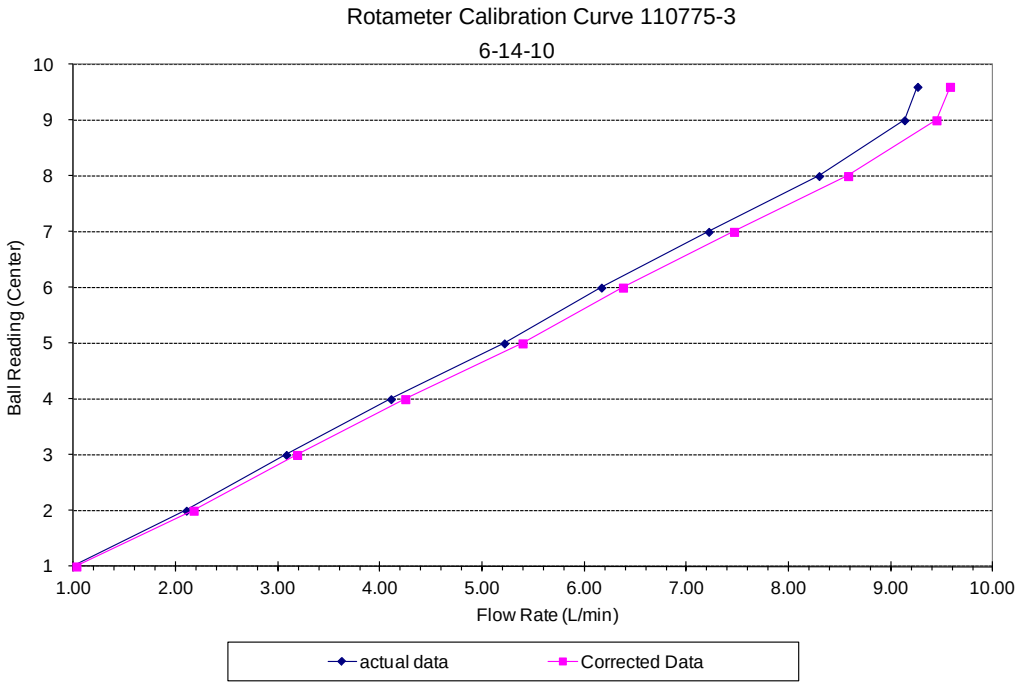

Figure 4. Air flow meter calibration curve

Table 2. Rotameter and anemometer measured blower speed during collection of equipment blank and samples

Sample	Rotameter reading (L/min)		Sampling time (min)	Anemometer measured fan speed ft/min
	13.61	13.61	10	281
Equipment blank	13.56	13.56	10	250
RAFS1-LOW- L1-1	13.98	13.98	8	323
RAFS1-LOW- L1-2	13.61	13.61	8	
RAFS1-LOW- L1-3	13.40	13.40	8	
RAFS1-LOW- L2-1	13.98	13.98	8	355
RAFS1-LOW- L2-2	13.61	13.61	8	
RAFS1-LOW- L2-3	13.40	13.40	8	
RAFS1-LOW- L3-1	13.98	13.98	8	316
RAFS1-LOW- L3-2	13.61	13.61	8	
RAFS1-LOW- L3-3	13.40	13.40	8	
RAFS2-LOW-L1-1	13.68	13.68	8	346
RAFS2-LOW-L1-2	13.56	13.56	8	
RAFS2-LOW-L1-3	13.34	13.34	8	
RAFS2-LOW- L2-1	13.68	13.68	8	322
RAFS2-LOW- L2-2	13.56	13.56	8	
RAFS2-LOW- L2-3	13.34	13.34	8	
RAFS2-LOW- L3-1	13.68	13.68	8	321
RAFS2-LOW- L3-2	13.56	13.56	8	
RAFS2-LOW- L3-3	13.34	13.34	8	
RAFS1-HIGH- L1-1	13.98	13.98	8	345
RAFS1-HIGH- L1-2	13.61	13.61	8	
RAFS1-HIGH- L1-3	13.40	13.40	8	
RAFS1-HIGH- L2-1	13.98	13.98	8	324
RAFS1-HIGH- L2-2	13.61	13.61	23	
RAFS1-HIGH- L2-3	13.40	13.40	23	
RAFS1-HIGH- L3-1	13.98	13.98	8	317
RAFS1-HIGH- L3-2	13.61	13.61	23	
RAFS1-HIGH- L3-3	13.40	13.40	23	

Rotameter Test Design Criteria 13 – 14 L/m
Anemometer Test Design Criteria 280 – 380 ft/min

3.3.3 Additional Measurements

1) *Weather Measurements* – At each location, wind speed, barometric pressure, and humidity were measured.
2) *Measure Soil Moisture* – Soil moisture readings were taken at five specific spots around each sampling point (Figure 5). The five spots were co-located at the four sides of the RAFS and the middle of the RAFS tunnel.

Figure 5. Collection of soil moisture readings

3.3.4 Experimental Design Specific to Location

Four locations in Libby Montana were selected for asbestos sampling.

Site A31

The first location where sampling was conducted was Site A31. The instrument was prepared for sampling as outlined in section 3.3.1. At the first sampling point (back yard), three clean filters were loaded onto the RAFS. The blower and rake were set to the highest setting with all sampling pumps on, and a sample was taken for 5 minutes. The Met One particle counter reading was > 10,000 indicating that the particle count through the RAFS chamber was very high. Upon visually observing the three filters, this was confirmed as they were found to be overloaded i.e. the filter was completely covered with a very dark layer of soil, so that sampling point was voided. A second sampling point was selected (other side of back yard), and samples were collected for the same period of time with the rake at half speed. Filters were again found to be overloaded, and the samples were voided. The third sampling point was selected at the front

left of the home. The dryness of the top soil indicated that the filters would again be overloaded. The soil moisture ranged from 2.2 to 2.8% at one of the sampling locations. Conversations with the EPA personnel, led to a deviation in the TQAP allowing for overloaded samples to be collected and analyzed by the indirect method vs. the direct method as stated in the TQAP. The laboratory analysis of overloaded samples is discussed in section 3.5.3.2. As a result three additional sampling points were selected with the first filter being removed after one minute of operating the instrument, and the remaining two filters removed after 10 minutes of operating the instrument (Table 3). The sampling times were determined by visually observing the filter after each sampling time and by checking the particle reading on the Met One particle counter. This sample collection time was conducted at four sampling points around the home for reproducibility testing while one additional sampling point was selected for the reproducibility parameter testing where the instrument sample collection time was 5 minutes for each of the three filters.

Additional measurements were collected as described in section 3.3.3. Soil samples collected in 1 L plastic bottles were taken from each sampling point. The soil samples were taken from the footprint of the RAFS at the sampling point about 1in to 2in depth. In summary, five soil samples were collected, and 18 RAFS filters were collected, the first three of which were voided.

Site A32

At the first sampling point, in the front yard of the residence, soil moisture content was very low ranging from 2.2% to 4.1% as experienced at the previous sampling location. The sampling time used was therefore the same with the first filter being removed after one minute and the two additional filters being pulled after the instrument had been run for 10 minutes. The reproducibility samples were again collected for a sampling time of 5 minutes (Table 3). Sample collection was attempted at 6 sampling points around the residence. One sampling point was voided because the particle count was too low (<10) leading to filters that were not well loaded. Five soil samples were collected at the five sampling points where the RAFS was successfully applied. A total of 18 filters was collected, three of which were voided due to low particle count. Additional field measurements were taken as outlined in section 3.3.3.

Site A34

At this location the yard of the residence was covered in grass so for each sampling point a 12” by 30” area was trimmed with shears, and a rake was used to loosen the soil before the RAFS was applied. While preparing the sampling points, visible vermiculite was observed in the top soil. Due to the high moisture content of the yard, once the sampling points were prepared the top layer was allowed to dry out before the RAFS was applied. The sampling points were located at the back, right side, and front of the house because the soil at the left of the house was water soaked and muddy. Soil moisture content at the sampling points ranged from 3.5% to 8.5% at one point and as high as 33.1% to 36% at another sampling point. When determining the sample time, the first filter was removed after 5 minutes of operating the RAFS, the second filter was removed after 10 minutes, and the third filter after 20 minutes. This was determined to be ideal sample collection time for this location due to the variable moisture content of the soil. The RAFS was applied at seven sampling points at this location, four of which were utilized for

comparability testing and one additional sampling point for reproducibility testing. The reproducibility samples were collected for five minutes as was done at the previous location. Soil samples were collected from each of the sampling points. Additional field measurements were taken as outlined in section 3.3.3.

Site A35

At the fourth location, the instrument was prepared for sample collection as outlined in section 3.3.1. The first sampling point was located in a horse shoe pit at the right side of the house where vermiculite was visible. Due to the low soil moisture content and the particle count, the sampling times selected were one minute for the first filter and 10 minutes sampling time for the two additional filters. The RAFS was applied at 5 locations around the house. At four of the locations comparability samples were collected, and in the additional location reproducibility samples were collected for a five minute sampling period. Additional field measurements were taken as outlined in section 3.3.3.

3.3.5 Activity Based Sampling (ABS)

ABS sampling was conducted by CDM, the contractor hired to conduct ABS throughout the Libby, Montana area. For each sampling location, a low flow personal sampling pump with a filter was attached to the individual conducting the ABS sampling. At each of the four locations ABS was done by raking for a total of 20 minutes at a specific sampling point around the home (Figure 6). When possible, the sampling point corresponded to a RAFS sampling point. There was a deviation from the TQAP in the ABS analysis. The TQAP stated that ABS should be conducted within 24 hours of the RAFS being applied at the home. However at one of the locations due to the rainy weather and subsequent high moisture content of the soil, ABS could not be conducted within 24 hrs of the RAFS. At this location, ABS was conducted nine days after the RAFS was applied. The effect of this is expected to be minimal.

Figure 6. ABS sampling

Table 3. RAFS sampling times used for each location and test parameter

Field Site	Sampling Objective	Sample collection time
Site A31	Comparability	Filter 01 - 5 min Filter 02 - 5 min Filter 03 - 5 min
	Reproducibility	Filter 01 - 1 min Filter 02 - 5 min Filter 03 - 5 min
Site A32	Comparability	Filter 01 - 5 min Filter 02 - 5 min Filter 03 - 5 min
	Reproducibility	Filter 01 - 1 min Filter 02 - 10 min Filter 03 - 10 min
Site A34	Comparability	Filter 01 - 5 min Filter 02 - 5 min Filter 03 - 5 min
	Reproducibility	Filter 01 - 5 min Filter 02 - 10 min Filter 03 - 20 min
Site A35	Comparability	Filter 01 - 5 min Filter 02 - 5 min Filter 03 - 5 min
	Reproducibility	Filter 01 - 1 min Filter 02 - 10 min Filter 03 - 10 min

3.4 Experimental Design – Laboratory Test

The purpose of the laboratory test was to measure the accuracy as well as variability/consistency of the RAFS. This was accomplished by assessing the RAFS ability to release asbestos from soil as a function of environmental conditions, specifically asbestos concentration in soil and soil moisture content. Two different soil moisture levels were used: low and high. For the laboratory test, two RAFS were used. A few minor deviations from the TQAP were implemented during the laboratory testing. The TQAP stated that Chrysotile "A" Rhodesian Asbestos (0.1 g) would be used to amend the soil but due to the unavailability of Chrysotile "A", a Chrysotile "B" laboratory standard was used (Appendix A). The TQAP suggested that the moisture content for the low moisture content soil would be 5% and for the high

moisture content soil would be 15%. However during testing, the low moisture content soil was found to be between 9% and 12% and the high moisture content soil was found to be between 14% and 18%.

3.4.1 Wooden Frame and Soil Preparation

Initially the experiment was designed to be conducted in two, 4 ft by 4 ft wooden frames but due to the limited availability of soil and sand and the realization that one 4 ft by 4 ft wooden frame could incorporate the RAFS footprint 6 times, the size of the additional wooden frame was reduced to 4 ft by 32 in. The reduction in size of the second wooden frame was a minor deviation from the TQAP. Figure 7 shows the footprint of the RAFS in each wooden box.

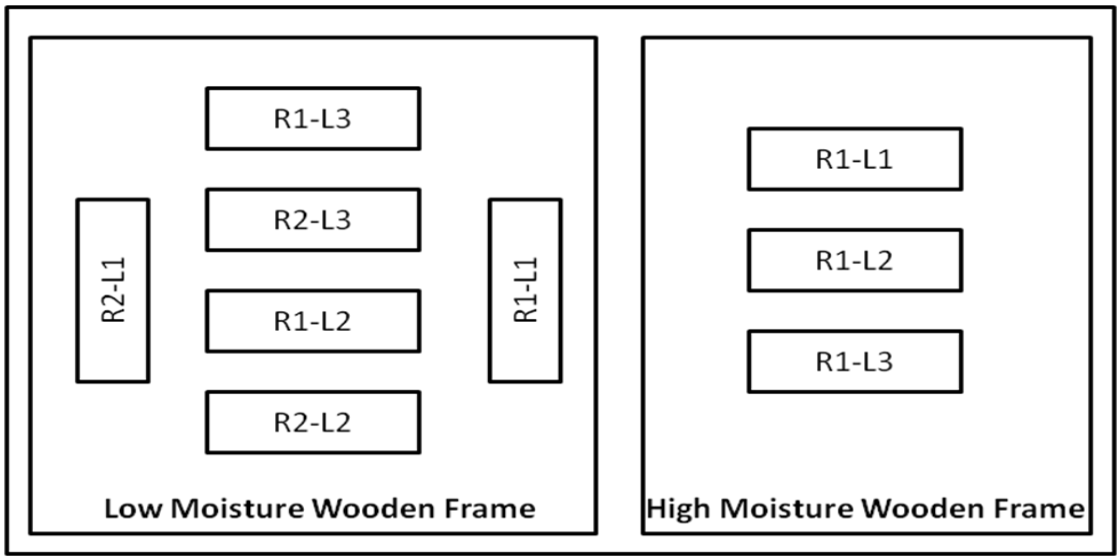

Figure 7. Locations of wooden frames and RAFS within tent (R1 and R2 = RAFS 1 and RAFS 2 and L1, L2 and L3 refers to the three sampling points at which the RAFS was applied)

Sand and soil in one part sand to two parts soil ratio was mixed in a cement mixer for 15 minutes until homogenized (Figure 8a). After mixing the soil and sand, the soil moisture of the mixture was measured at 8.1%. Three liters of water was added to the soil/sand mixture, and this was mixed for an additional l5 minutes resulting in a moisture content of 13.5%. An additional 3 L was added to the soil and sand mixture, and this was mixed for an additional 15 minutes resulting in a soil moisture reading of approximately 21.5 %. Each wooden frame was lined with a poly vinyl material for easy disposal of the asbestos containing soil after the experiment was complete and to prevent the wooden frames from becoming contaminated. The wooden frames were filled with the soil, and the soil was gently compressed until the surface was level (Figure 8b). Several impressions of the footprint of the RAFS were made in each wooden frame to indicate where the RAFS would be placed for each test. Figure 8c shows the soil being mixed, and the wooden frames being packed.

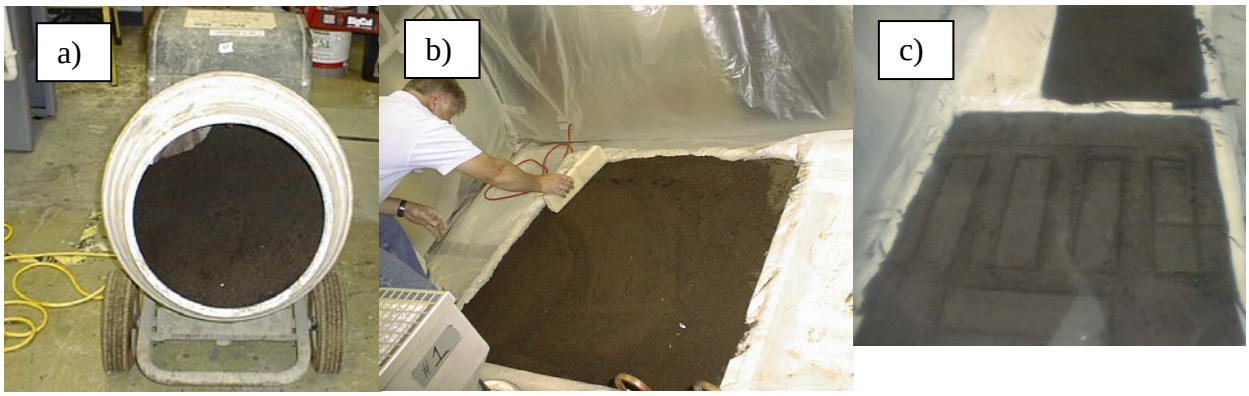

Figure 8. Soil and wooden frame preparation, a) Soil, sand and water being mixed, b) Wooden frame being packed and leveled, c) RAFS footprint impressions

3.4.2 Asbestos Preparation

Approximately 0.1 g of Chrysotile "A" Rhodesian Asbestos standard obtained from Forensic Analytical (Appendix A) was mixed into 200 mL of water in a volumetric flask and sonicated for 4 hours to separate and distribute the asbestos fibers throughout the water. Initially the asbestos fibers were lumped together in the flask but after sonicating, the mixture was milky white indicating that the asbestos fibers were distributed throughout the water. Figure 9 shows the asbestos fibers being sonicated. The 200 ml was divided into two 100 ml volumetric flasks to allow faster separation of the asbestos fibers. After sonicating, the asbestos fibers in water were transferred to a typical 0.5 um nozzle spray bottle for application to the soil. This was a deviation from the TQAP as the TQAP states the asbestos would be mixed with the soil. Spraying the surface of the soil allowed better distribution and increased the chances of the asbestos being detected in the soil. The asbestos solution was first sprayed onto a black surface to ensure that the nozzle would not become clogged.

Figure 9. Asbestos fibers distributed in water and sonicated

3.4.3 Accuracy Test

The accuracy of the sampler was verified by two methods

1) Measuring the asbestos releasability from soil using the RAFS in soil known to contain asbestos.
2) Measuring the ability of the RAFS to release asbestos from soil at two different moisture contents.

3.4.3.1 Varying Moisture Content

Two different moisture conditions were used for this test, low (5%) and high (15%). One wooden frame contained soil of low moisture content, and the second and smaller wooden frame contained soil of high moisture content. Where the RAFS was to be applied for this test, 25 mL of the asbestos in water mixture was sprayed on to the surface of the footprint and allowed to dry for approximately 30 minutes for the high moisture test and one hour for the low moisture test. After the drying time, the moisture content of the soil at each of the RAFS footprint was measured. The RAFS was prepared for collecting samples then loaded with three clean filters and applied for measurement. The fan speed, rake power, and air sample volume was recorded.

3.4.3.2 Measuring the Releasability in Soil Known to Contain Asbestos

For the measurement of accuracy, additional RAFS application was not taken because for each of the RAFS footprints and moisture contents, asbestos was added to the soil. Therefore the RAFS ability to sample asbestos from soil containing asbestos could be assessed from any of its applications.

3.4.4 Variability/Consistency

In the laboratory, two RAFS were used to measure the releasability of asbestos from soil known to contain asbestos in order to assess whether RAFS sampling ability was the same between instruments. Each sampler was applied three times within the 4 ft by 4 ft wooden frame containing soil known to contain asbestos. The low moisture content soil was utilized for this test. There were therefore six footprints on which the RAFS was applied for the variability/consistency test: three for one of the RAFS labeled RAFS 1 and three for the additional RAFS labeled RAFS 2. The RAFS was prepared for collecting samples as indicated in Section 3.3.1. The fan speed, rake power, and sample volume collected were recorded and remained constant for both samplers. Eight minutes was determined to be an ideal sampling time for the low moisture samples and 23 minutes for the high moisture samples.

The first two samples taken were RAFS1-LOW-L1 and RAFS2–LOW-L2 (Figure 7). RAFS1 and RAFS 2 represent the two different RAFS. LOW and HIGH represent the moisture level in the soil. The sampling point was labeled by L1, L2, or L3 since each RAFS was applied at three sampling points. For the first application, the two RAFS were applied on the two side footprints in the wooden frame containing the low moisture soil. These samples were used to determine the length of sampling time for samples taken from the low moisture wooden frames. After five minutes the filter at location 1 was removed and visually inspected. Due to low loading of the

filter, sampling was continued for an additional three minutes at which point the filter was sufficiently loaded. All additional low moisture samples were taken for 8 minutes.

3.5 Laboratory Methods

3.5.1 Soil Method

All field soil samples were analyzed by PLM 1000 method and the SRC Libby Method. This is a deviation from the TQAP. The TQAP stated that the asbestos in the soil would be determined by the PLM 1000 method. In addition to the PLM methods, the soil was also analyzed by the SRC Libby Method. This method has been modified from the EPA Test Method "Method for the Determination of Asbestos in Bulk Building Materials" (EPA/600/R-93/116) specifically for Libby asbestos. This was necessary because the PLM method yielded no detects for all soil samples. The soil samples from SiteA32 were analyzed at a second laboratory by the SRC Libby method due to the lack of detection of asbestos by the first laboratory.

At Reservoir Analytical, samples were analyzed by EPA/600/R-93/116 with additional preparation and methodology for soil samples according to SRCLIBBY- 03, Revision 2, "Analysis of Asbestos Fibers in Soil by Polarized Light Microscopy and SRC-LIBBY-01, Revision 2, "Qualitative Estimation of Asbestos in Coarse Soil by Visual Examination Using Stereomicroscopy and Polarized Light Microscopy." Samples were sieved to separate coarse and fine fractions. None of these samples contained a coarse fraction. The fine fraction was quartered and ground before PLM examination.

3.5.2 Filter Analysis Method

3.5.2.1 Direct Analysis

For direct analysis, quarter sections were excised from the sample filters collapsed in a solution of dimethylformamide (DMF), glacial acetic acid, and deionized water (35:15:50) on a slide warmer, etched in a low temperature plasma etcher for seven minutes, and evaporatively coated with carbon. Subsections of the coated filters were mounted on 200-mesh copper TEM grids in pure DMF in a modified Jaffe-wick apparatus for at least one hour followed by a brief acetone rinse. The prepared grids were stored in a number of grid boxes. A laboratory filter blank was prepared alongside the samples.

Analyses were conducted on a Philips CM12 TEM at 75-100 keV accelerating voltage and ~19,000x magnification. Ten grid openings were analyzed on each sample, leaving open the option for analyses of additions openings at a later date. Raw data were recorded on National Asbestos Data Entry Spreadsheets (NADES). The six regulated asbestos minerals are recorded including Libby Amphiboles, other amphiboles, and non-asbestos mineral fibers.

All filters generated in the field were analyzed for asbestos by TEM direct transfer technique using ISO Method 10312:1995. The target analytical sensitivity is 0.005 structure/cm^3. The aspect ratio for analysis is 3:1. All structures 0.5 µm or longer in length were quantified with the following breakdown according to ranges by length: from 0.5 to 5.0 µm, between 5 µm and 10.0 µm, and longer than 10 µm. Ten grid openings were analyzed.

3.5.3.2 Indirect Analysis

Analyzing samples by indirect analysis was a deviation from the TQAP. The TQAP stated that samples would be analyzed by direct TEM analysis. However due to the low moisture content of the soil at several homes during the field test, the filters were overloaded after only a short sample collection time. The indirect analysis method allowed these overloaded samples to be analyzed.

Each sample was prepared using the gravimetric technique. A representative subsample was weighed, ashed for eight hours, and reweighed to determine the proportion of the organic component. The ashed residue was ground in concentrated hydrochloric acid, dried, and reweighed to determine the acid soluble component weight percentage. The residual material was analyzed for asbestos using polarized light microscopy. Asbestos quantitation was performed using the semi quantitative Point Count method following the general guidelines in EPA Method 600/R-93/116. The analytical sensitivity for the method is calculated as the asbestos concentration that results from one point counted in the analysis adjusted using the residual weight of the sample. The limit of detection for this method was not determined.

Table 4. Summary of performance parameters and testing frequency

Location	Phase	Performance Parameter	Objective	Variable	Comparison Based On	Testing Frequency
Field	1 & 3	Reproducibility	Determine the reproducibility within the RAFS during application at a sampling point	Asbestos concentration on three filters within the RAFS	Asbestos concentration on the three filters produced at each sampling point.	Triplicate filters from at least 4 sites, at Libby, MT
	1 & 3	Comparability	Determine the ability of the RAFS to measure the releasability of asbestos from soil at the same accuracy as the EPA accepted method, ABS.	Asbestos concentration obtained by the average of the concentration on three filters within the RAFS. ABS filter asbestos concentration	Soil samples, ABS and the RAFS were applied at the same sampling point and the asbestos concentration obtained from each will be compared.	The RAFS was applied five sampling points at each home and ABS was applied at one of the sampling points corresponding to a RAFS sampling point at each home
Laboratory	2	Accuracy	Determine the ability of the RAFS to measure the releasability of asbestos from soil that is known to contain asbestos fibers.	Average asbestos concentration obtained from the three filters within the RAFS at different soil moisture contents	Whether or not asbestos is detected by the RAFS in soil known to contain asbestos. Asbestos concentration determined in soil known to contain asbestos at different soil moisture contents	The RAFS was applied at several locations within the 4ft by 4ft wooden frame with soil
Laboratory (Continued)	2	Variability and Consistency	Determine the consistency in data obtained between two different instruments	Average concentration of asbestos from three filters within the RAFS of two RAFS instruments.	Average asbestos concentration detected on the three filters produced at each sampling point from two independent samplers at the same location	The RAFS was applied at three different sampling locations in soil known to contain asbestos. A second independent sampler was also being applied in the soil known to contain asbestos.

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Chapter 4
Quality Assurance/Quality Control

QA/quality control (QC) procedures were performed in accordance with the QMP for the AMS Center and the TQAP for this verification test. During testing there were five deviations from the RAFS. The first deviation is discussed in section 3.6.3.2 and allowed overloaded filters to be analyzed by the indirect methods instead of being voided. The second deviation is discussed in section 3.3.5 and stated why ABS was not always conducted within 24 hrs of the RFAS being applied at the sampling location. Deviation 3 in section 3.2.1 discussed the change in location of the second field site; however a second field site was not tested during this ETV verification. Deviation 4 discussed in sections 3.5 and 3.5.1 was a collection of minor deviations conducted during the laboratory testing phase. The last deviation, outlined in section 3.5.1, discusses the additional analysis of the soil samples. The soil samples were analyzed by both the PLM 1000 method and the SRC Libby Method by one laboratory and five of the soil samples were analyzed by a different lab, Reservoir Analytical, with more experience in the SRC Libby Method.

4.1 Quality Control Samples

As part of the QC requirements for equipment blanks, open, or field blanks, and closed, or lot blanks (LB), were taken at each of the location (homes) and analyzed by the same method as the sample filters. Table 11 presents the analytical results of the blank samples showing that counts were always below the analytical sensitivity of the method.

Table 5. Blank sample results

Site A31						
Sample ID	**RAFS Port**	**Flow (Lpm)**	**Time (min)**	**Vol (L)**	**Type**	**Total Str/mm2**
LBMT-A31-L1-EB	2	13.3	10	133	EB	<3.8
LBMT-A31-L4-FB	-	-	30 sec	-	FB	<3.8
LBMT-A31-L6-LB	-	-	-	-	LB	<3.8
Site A32						
Sample ID	**RAFS Port**	**Flow (Lpm)**	**Time (min)**	**Vol (L)**	**Type**	**TOTAL**
LBMT-A32-L1-EB	2	13.4	10	134	EB	<7.7
LBMT-A32-L4-FB	-	-	-	-	FB	<7.7
LBMT-A32-L5-LB	-	-	-	-	LB	<7.7
Site A34 Category IV (visible vermiculite)						
Sample ID	**RAFS Port**	**Flow (Lpm)**	**Time (min)**	**Vol (L)**	**Type**	**TOTAL**
LBMT-A34-L1-EB	2	13.3	10	133	EB	<3.8
LBMT-A34-L4-FB	-	-	30 sec	-	FB	<3.8
LBMT-A34-L6-LB	-	-	NA	-	LB	<3.8
Site A35 Category IV (visible vermiculite)						
Sample ID	**RAFS Port**	**Flow (Lpm)**	**Time (min)**	**Vol (L)**	**Type**	**TOTAL**
LBMT-A35-L1-EB	2	13.3	10	133	EB	<3.8
LBMT-A35-L2-FB	-	-	30 sec	-	FB	<3.8
LBMT-A35-L5-LB	-	-	-	-	LB	<3.8

4.2 Audits

4.2.1 Performance Evaluation Audit

Battelle did not conduct a performance evaluation audit because the laboratory was accredited by the National Institute of Standards & Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP) for the performance of Airborne Asbestos Analysis by Transmission Electron Microscopy (TEM).

4.2.2 Technical Systems Audit

A Technical Systems Audit (TSA) was conducted on September 15 and 30, 2010. The purpose of the audit was to:

- Evaluate activities related to the verification testing of the asbestos sampler
- Review equipment calibration, materials, test setup, documentation and records associated with the verification testing
- Verify that laboratory operations and sampler operation at Battelle Columbus were compliant with TQAP requirements and that the required documentation was being completed in real time to ensure data traceability.

There were five findings and one observation determined through the TSA audit.

All finding were found to have documented responses in the deviation reports and the RAFS Manual.

4.2.3 Data Quality Audit

An Audit of Data Quality (ADQ) was conducted on September 20 and 21, 2011 for all phases of testing. The ADQ was conducted by Mr. Zachary Willenberg, Battelle AMS Center Quality Assurance Officer. A generic ADQ audit checklist was used to review the project requirements defined in the Test/QA Plan (TQAP), Version 1.0, for Verification of TSA for Verification of Releasable Asbestos Field Sampler dated August 2, 2010. The purpose of the audit was to:

- Evaluate activities related to the verification testing of the asbestos sampler
- Review documentation and records associated with the verification testing
- Verify that laboratory operations and sampler operation were compliant with TQAP requirements and that the required documentation was completed
- Verify that reported data for both laboratory and sampler operations were compliant with the TQAP requirements.

The data were submitted on September 20, 2011, and the ADQ was conducted on September 20-21, 2011, approximately one year after the data were collected. The audit consisted of a review of the TQAP to identify data quality requirements and review of raw and processed data. Raw data consisted of field data collection forms used to document testing

events and one spreadsheet (Tables for report.xlsx). Processed data consisted of worksheets, covering site information, soil moisture, field soil results, comparability, reproducibility, lab results and field blanks. The audit reviewed the following data quality elements: collection of reference method samples, quality control sample results, sample results, and documentation. One hundred percent (100%) of the sample collection and quality control (QC) data were reviewed; at least 10% of the data calculations were verified vs. the raw data.

Chapter 5
Test Results

The RAFS TQAP described several statistical methods including standard deviation, ANOVA and t-test that could be used to evaluate the reproducibility, comparability, variability and consistency of the RAFS. However, due to the lack of detection of asbestos in both the soil and filter samples statistical analysis of the data could not be completed.

5.1 Soil Results

At each of the sampling points in both the field (Table 6) and laboratory test (Table 7), soil moisture readings were taken. Soil moisture content is critical when utilizing the RAFS that tests the releasability of asbestos from soil within an acceptable range of < 35%. For all of the sampling points the soil moisture content was less than 35%. Although in most cases more than 5 moisture content readings were taken, the relative standard deviation was not within the 5% acceptance criteria set for the test. This was likely due to the heterogeneity of the soil causing soil moisture content to vary in samples within the footprint of the RAFS.

Table 6. Soil moisture readings at Libby, Montana sampling locations

Field Site	Sampling Point	Soil Moisture Readings							
		1	2	3	4	5	Avg	StDev	RSD
Site A31	L2	5.1	5.6	6.6	3.6	3.6	4.9	1.3	27%
	L3	2.7	1.7	1.7	4.6	2.2	2.6	1.2	46%
	L4	2.2	2.2	2.7	2.2	2.8	2.4	0.30	13%
	L5	3.6	6.1	5.1	2.7	1.7	3.8	1.8	47%
	L6	4.6	3.6	4.6	3.6	3.6	4.0	0.55	14%
Site A32	L1	2.7	2.7	2.2	4.1	2.7	2.9	0.72	25%
	L2	4.6	5.1	6.6	6.6	7.1	6.0	1.1	18%
	L3	7.6	8.1	9.0	11	11	9.1	1.3	15%
	L5	7.6	9.6	8.9	7.6	8.2	8.4	0.87	10%
	L6	3.3	2.6	2.7	3.3	4.3	3.2	0.68	21%
Site A34	L1	7.1	7.1	3.5	8.1	5.6	6.3	1.8	28%
	L2	20	21	18	22	19	20	1.5	7.4%
	L3	21	13	14	16	18	16	3.2	20%
	L4	31	32	24	31	31	30	3.4	11%
	L5	33	31	26	32	31	31	2.7	8.7%
Site A35	L1	4.6	12	16	15	6.1	11	5.2	48%
	L2	7.1	6.6	4.6	5.6	7.6	6.3	1.2	19%
	L3	8.5	19	22	9.0	10	14	6.3	46%
	L4	7.1	8.5	13	6.6	7.6	8.6	2.6	30%
	L5	9.0	9.0	11	10	9.0	9.5	0.71	7.4%

In the laboratory study the low moisture content soil ranged in moisture from 9.5% to 13% and the high moisture content ranged from 13.5 % to 20.8% (Table 6). Variability in soil moisture content occurred due to uneven drying of the soil after spraying with the asbestos fibers because of the natural heterogeneity of the soil. Although the laboratory test was conducted in a control setting with a soil created from a mixture of soil, sand and water the relative standard deviation of the moisture content at one RAFS footprint was greater than the acceptance criteria of 5%. However soil moisture content was always below the 35% threshold required for the RAFS.

Table 7. Soil moisture at each sampling point in laboratory study

Sample Location	Soil Moisture					Average	StDev	RSD
	1	2	3	4	5			
RAFS1-LOW- L1	11	9.0	9.5	9.0	11	9.8	0.91	9.3%
RAFS1-LOW- L2	13	12	13	11	12	12	0.61	5.1%
RAFS1-LOW- L3	12	8.5	11	9.5	10	10	1.1	11%
RAFS2-LOW-L1	11	12	13	10	11	11	1.3	11%
RAFS2-LOW- L2	13	12	12	11	12	12	0.74	6.2%
RAFS2-LOW- L3	8.1	11	9.5	9.0	12	9.8	1.5	15%
RAFS1-HIGH- L1	15	14	14	15	15	15	0.88	6.0%
RAFS1-HIGH- L2	21	18	19	18	17	19	1.5	8.2%
RAFS1-HIGH- L3	17	14	21	18	17	18	2.3	13%

Before measuring the asbestos count on the filters the asbestos count was determined in the soil samples from the field (Table 8) and laboratory samples (Table 9). If asbestos was detected in the soil then the filters were analyzed. If the asbestos count in the soil was not detectable (ND) or trace counts, the filters from the field samples were not analyzed.

Table 8. Field test soil asbestos results

Sample ID	Sample Description	Forensic Analysis				Method SRCLIBBY- 03		
		Method PLM 1000	Asbestos Type Detected	Analytical Sensitivity	Method SRCLIBBY- 03	*(LA)*	*(OA)*	*(Ch)*
Site A31								
LBMT-A31-L2-01-Soil	Composite Soil	<0.07%	Actinolite	0.07	ND	Not analyzed		
LBMT-A31-L3-01-Soil	Composite Soil	ND	ND	0.08	ND			
LBMT-A31-L4-01-Soil	Composite Soil	ND	ND	0.09	ND			
LBMT-A31-L5-01-Soil	Composite Soil	ND	ND	0.06	ND			
LBMT-A31-L6-01-Soil	Composite Soil	<0.08%	Actinolite	0.08	Trace actinolite			
Site A32								
LBMT-A32-L1-01-Soil	Composite Soil	ND	ND	0.08	ND	ND	ND	ND
LBMT-A32-L2-01-Soil	Composite Soil	ND	ND	0.08	ND	ND	ND	ND
LBMT-A32-L3-01-Soil	Composite Soil	ND	ND	0.08	ND	ND	ND	ND
LBMT-A32-L5-01-Soil	Composite Soil	ND	ND	0.06	ND	Tremolite	ND	ND
LBMT-A32-L6-01-Soil	Composite Soil	ND	ND	0.07	ND	Tremolite	ND	ND
Site A34 - Category IV (visible vermiculite)								
LBMT-A34-L1-01-Soil	Composite Soil	ND	ND	0.09	ND	Not analyzed		
LBMT-A34-L3-01-Soil	Composite Soil	ND	ND	0.08	ND			
LBMT-A34-L4-01-Soil	Composite Soil	ND	ND	0.07	ND			
LBMT-A34-L5-01-Soil	Composite Soil	ND	ND	0.08	Trace actinolite			
LBMT-A34-L6-01-Soil	Composite Soil	<0.07%	Actinolite	0.07	Trace actinolite			
Site A35- Category IV (visible vermiculite)								
LBMT-A35-L1-01-Soil	Composite Soil	ND	ND	0.06	ND	Not analyzed		
LBMT-A35-L2-01-Soil	Composite Soil	ND	ND	0.07	ND			
LBMT-A35-L3-01-Soil	Composite Soil	ND	ND	0.07	ND			
LBMT-A35-L4-01-Soil	Composite Soil	ND	ND	0.09	ND			
LBMT-A35-L5-01-Soil	Composite Soil	ND	ND	0.07	ND			
Notes								
LA = Libby Amphibole	OA = Other Amphibole		Ch = Chysolite	ND = None Detected				
SRCLIBBY- 03 = EPA/600/R-93/116 modified for Libby asbestos								

The laboratory soil samples were analyzed by both the PLM and Libby Method (Table 9) the results of which were all non detect or at the analytical sensitivity of the instrument. Due to the lack of detection of asbestos in the soil samples the filters were not analyzed for asbestos. Although the RAFS may provide a more sensitive method for detecting asbestos in soil, due to financial constraints on the project the corresponding filters were not analyzed.

Table 9. Laboratory study soil results

Location	PLM 1000	SRCLIBBY- 03	Analytical Sensitivity
RAFS1-HIGH-L1	ND	<0.06% crysotile	0.06
RAFS1-HIGH-L2	ND	<0.06% crysotile	0.06
RAFS1-HIGH-L3	ND	<0.06% crysotile	0.06
RAFS1-LOW-L1	ND	<0.05% crysotile	0.05
RAFS1-LOW-L2	ND	ND	0.05
RAFS1-LOW-L3	ND	ND	0.05
RAFS2-LOW-L1	ND	ND	0.05
RAFS2-LOW-L2	ND	ND	0.05
RAFS2-LOW-L3	ND	ND	0.05
LAB-BLK-HIGH-SOIL	ND	ND	0.07
LAB-BLK-LOW-SOIL	ND	ND	0.06

SRCLIBBY- 03 = EPA/600/R-93/116 modified for Libby asbestos

5.2 Comparability

The purpose of the comparability test was to compare the ability of the RAFS to detect asbestos in soil relative to the reference method of ABS. Although analysis of soil indicated only trace levels of asbestos, in a few samples the corresponding RAFS filters were analyzed for asbestos. For all filter samples except one, asbestos was not detected above the analytical sensitivity. The sample where asbestos was detected was as an ABS sample at the Site A32 at 0.32 f/cc.

5.3 Reproducibility

Reproducibility was evaluated by comparing the asbestos counts detected in each of the three filters obtained at each sampling point. For the reproducibility test only two filters were analyzed to reduce cost of the analysis. The results of the two filters were compared to determine if the RAFS sample ports were reproducible. Due to the fact that most of the data received were at or below the analytical sensitivity statistics could not be conducted on the data.

5.4 Variability/Consistency and Accuracy

These parameters were to be evaluated during the laboratory study. However since the filters were not analyzed these parameters could not be evaluated. The laboratory filter samples were not analyzed because soil sample analysis was not able to detect the Chrysotile A asbestos fibers. Although it may be possible for the RAFS to trap fibers on the filters that were not detected in

the soil, financial constraints on the project prevented the filters from being analyzed.

Table 10. Comparability test results from each of the locations and sampling points

Site A31								
Sample ID	**RAFS Port**	**Flow (Lpm)**	**Time (min)**	**Vol (L)**	**TOTAL (structures/cc)**	**>5 µm**	**Analytical Sensitivity**	**RPD**
LBMT-A31-L2-01	1	13.8	5	68.9	0.022	<0.022	0.022	
LBMT-A31-L2-02	2	13.3	5	66.7	0.022	0.022	0.022	
LBMT-A31-L2-03	3	13.5	5	67.4	<0.022	<0.022	0.022	
ABS	-	4.95	20	99.0	<0.015	<0.015	0.015	
Site A32								
LBMT-A32-L3-01	1	13.5	5	67.5	<0.058	<0.058	0.058	
LBMT-A32-L3-02	2	13.4	5	67.1	0.058	<0.058	0.058	
LBMT-A32-L3-03	3	13.6	5	67.8	<0.058	<0.058	0.058	
ABS	-	4.54	19	86.3	**0.316**	0.136	0.045	-138%
Site A34 - Category IV (visible vermiculite)								
LBMT-A34-L3-01	1	13.6	5	68.0	<0.022	<0.022	0.022	
LBMT-A34-L3-02	2	13.3	5	66.6	<0.022	<0.022	0.022	
LBMT-A34-L3-03	3	13.4	5	67.1	<0.022	<0.022	0.022	
ABS	-	4.04	20	80.8	<0.018	<0.018	0.018	
Site A35- Category IV (visible vermiculite)								
LBMT-A35-L5-01	1	13.6	5	68.2	<0.022	<0.022	0.022	
LBMT-A35-L5-02	2	13.3	5	66.5	<0.022	<0.022	0.022	
LBMT-A35-L5-03	3	13.8	5	69.1	<0.021	<0.021	0.021	
ABS	-	4.86	20	97.2	<0.015	<0.015	0.015	

Table 11. Results of reproducibility testing in the field

Site A31								
Sample ID	**RAFS Port**	**Flow (Lpm)**	**Time (min)**	**Vol (L)**	**Type**	**TOTAL**	**>5 µm**	**Analytical Sensitivity**
LBMT-A31-L3-01	1	13.8	1	13.8	S	<0.1075	<0.1075	0.1075
LBMT-A31-L3-02	2	13.3	10	133	S	<0.0111	<0.0111	0.0111
LBMT-A31-L4-01	1	13.8	1	13.8	S	<0.1075	<0.1075	0.1075
LBMT-A31-L4-02	2	13.3	10	133	S	<0.0111	<0.0111	0.0111
LBMT-A31-L5-01	1	13.8	1	13.8	S	<0.1075	<0.1075	0.1075
LBMT-A31-L5-02	2	13.3	10	133	S	<0.0111	<0.0111	0.0111
LBMT-A31-L6-01	1	13.8	1	13.8	S	<0.1075	<0.1075	0.1075
LBMT-A31-L6-02	2	13.3	10	133	S	0.1330	0.1000	0.0111
Site A32								
Sample ID	**RAFS Port**	**Flow (Lpm)**	**Time (min)**	**Vol (L)**	**Type**	**TOTAL**	**>5 µm**	**Analytical Sensitivity**
LBMT-A32-L1-01	1	13.5	1	13.5	S	<0.2193	<0.2193	0.2193
LBMT-A32-L1-02	2	13.4	10	161	S	<0.0908	<0.0908	0.0908
LBMT-A32-L1-03	3	13.6	10	163	S	-	-	-
LBMT-A32-L2-01	1	13.5	1	13.5	S	<0.2193	<0.2193	0.2193
LBMT-A32-L2-02	2	13.4	10	161	S	<0.0242	<0.0242	0.0242
LBMT-A32-L2-03	3	13.6	10	163	S	-	-	-
LBMT-A32-L5-01	1	13.5	1	13.5	S	<0.2193	<0.2193	0.2193
LBMT-A32-L5-02	2	13.4	10	148	S	<0.0264	<0.0264	0.0264
LBMT-A32-L5-03	3	13.6	10	149	S	-	-	-
LBMT-A32-L6-01	1	13.5	1	13.5	S	**0.2193**	0.2193	0.2193
LBMT-A32-L6-02	2	13.4	10	161	S	**0.0968**	0.0242	0.0240
LBMT-A32-L6-03	3	13.6	10	163	S	-	-	-
Site A34 - Category IV (visible vermiculite)								
Sample ID	**RAFS Port**	**Flow (Lpm)**	**Time (min)**	**Vol (L)**	**Type**	**TOTAL**	**>5 µm**	**Analytical Sensitivity**
LBMT-A34-L1-01	1	13.6	5	68.0	S	0.0220	0.0220	0.0220
LBMT-A34-L1-03	3	13.4	20	268	S	0.0055	0.0055	0.0055
LBMT-A34-L4-01	1	13.6	5	68.0	S	<0.0220	<0.0220	0.0220
LBMT-A34-L4-03	3	13.4	20	268	S	**0.0170**	0.0055	0.0055
LBMT-A34-L5-01	1	13.6	5	68.0	S	<0.0220	<0.0220	0.0220
LBMT-A34-L5-03	3	13.4	20	268	S	<0.0055	<0.0055	0.0055
LBMT-A34-L6-01	1	13.6	5	68.0	S	<0.0220	<0.0220	0.0220
LBMT-A34-L6-03	3	13.4	20	268	S	<0.0055	<0.0055	0.0055
Site A35- Category IV (visible vermiculite)								
Sample ID	**RAFS Port**	**Flow (Lpm)**	**Time (min)**	**Vol (L)**	**Type**	**TOTAL**	**>5 µm**	**Analytical Sensitivity**
LBMT-A35-L1-01	1	13.6	1	13.6	S	<0.110	<0.110	0.110
LBMT-A35-L1-02	2	13.3	10	133	S	<0.011	<0.011	0.011
LBMT-A35-L2-01	1	13.6	1	13.6	S	<0.110	<0.110	0.110
LBMT-A35-L2-02	2	13.3	10	133	S	<0.110	<0.011	0.011
LBMT-A35-L3-01	1	13.6	2	27.3	S	<0.054	<0.054	0.054
LBMT-A35-L3-02	2	13.3	10	133	S	<0.022	<0.022	0.011
LBMT-A35-L4-01	1	13.6	1	13.6	S	<0.110	<0.110	0.109
LBMT-A35-L4-02	2	13.3	10	133	S	<0.011	<0.011	0.011

5.5 Operational Factors

The operational factors analyzed were ease of use, training, and sustainability (sampling time, waste produced, and the amount of protective equipment required by the individual operating the instrument). The VTC found that the RAFS was easy to use. The VTC was trained in the field by John Kominsky of EQM to clean and use the RAFS. The RAFS was assembled in the field and powered on. To operate the RAFS a source of electricity was required. For this verification test a generator was taken to the field. The controls used to operate the RAFS were easy to use and read. Following a 30 minute training, the VTC was comfortable operating the RAFS. The RAFS was 4 feet long by 2 feet wide and 30 inches tall and could be carried by one person (Figure 10). Minimal waste was produced by using the RAFS. The main waste material was lint free paper towels used to clean the RAFS before use. Although PPE was not required when using the RAFS because of the EPA level of protection required, PPE was used at several of the locations due to the EPA requirements post EPA testing of the asbestos counts at the locations.

Figure 10. RAFS being transported from sampling point to sampling point by one individual

Chapter 6
Performance Summary

The performance of the RAFS was evaluated for its reproducibility, comparability, accuracy and variability/consistency. Verification tests were conducted in two phases, field and laboratory tests. During the field tests the performance parameters of reproducibility and comparability were tested. The field tests were conducted at one field site in Libby, Montana. The verification parameters accuracy and variability/consistency were tested during the second phase of testing in the laboratory. The reference method for this verification test was ABS.

Comparability

The comparability tests for the RAFS were conducted at four locations which corresponded to the yards of four homes in Libby Montana. The RAFS was applied at five sampling points around the home. At each sampling point three filters were used to obtain samples. The reference method ABS involved an individual raking for 20 minutes while wearing a personal sampling pump. The asbestos counts on the filters of the RAFS were compared to the asbestos counts in the filter from the ABS sampling. In most cases, the asbestos counts obtained from both the ABS and RAFS were below or at the analytical sensitivity of the method making it impossible to make a statistical comparison between the RAFS and ABS data. Since asbestos fibers were detected at 0.32 structures/cc from the ABS sample at Site A32 during a sampling time of 20 minutes while the RAFS filters reported non detects this may indicate that the ABS sampling had a higher sensitivity, However it must be taken into consideration that the ABS sampling was conducted over a much wider area than the footprint of the RAFS and involved raking which generated a large amount of dust particles to pass through the filter.

Reproducibility

A RAFS sampler is able to take triplicate samples. The reproducibility parameter was used to compare the results of the three filter samples taken during one application of the RAFS. Similar to the comparability test, the asbestos counts on the filters were below or at the analytical sensitivity of the method making it impossible to make a statistical comparison between the RAFS and ABS data.

Accuracy and Variability and Consistency

Laboratory tests were conducted to determine the accuracy and variability and consistency of the RAFS sampler. However due to the lack of detection of asbestos in the soil and financial constraints on the project the filters were not analyzed.

Operational Factors

The VTC found the RAFS easy to use and transport. The waste products generated while using the RAFS was minimal. Although PPE was not required to operate the RAFS, due to the EPA level of protection required for the sites being sampled PPE was used.

There are several improvements that could be made to the field and laboratory experimental design that would yield better results. These include:

1) Typically ABS is conducted for 60 to 120 minutes as recommended in the EPA SOP for ABS, however during this verification testing ABS was conducted for 20 minutes. At a

20 minute sampling adequate air may not have flowed through the filter to provide analytical sensitivity. A longer ABS sampling time may have yielded fewer none detects and results that could be statistically interpreted.

2) Preparation of the asbestos laboratory standard for soil application in the laboratory test involved sonication for 4 hours to suspend the asbestos fibers in the water. This agitation of the asbestos fibers may have broken the fibers into fragments that were too small to be detected by the TEM and PLM method. Although spraying asbestos suspended in water is a method used to apply asbestos to soil. The quantity did not result in high enough counts of asbestos to be detected in soil Asbestos at 0.1g was dissolved in 200 ml water and 25 ml sprayed onto the RAFS footprint 150 in^2. The sensitivity of the analysis method was 0.005 structures/cm^3. The amount of asbestos solution sprayed onto the RAFS footprint would not have provided the necessary asbestos structures to meet the analytical sensitivity.
3) The indirect TEM method (ISO 13794) instead of the indirect PLM method should have been used to analyze the overloaded samples for greater comparability with the direct TEM analysis of filters.
4) Counting more than 10 grids would provide a higher sensitivity but due to financial constraints on the project only 10 grids were sampled.

Chapter 7
References

U.S. EPA, Environmental Technology Verification Program Quality Management Plan, EPA Report No: 600/R-08/009 EPA/600/R-03/021, U.S. Environmental Protection Agency, Cincinnati, Ohio, January 2008.

Battelle, Quality Management Plan for the ETV Advanced Monitoring Systems Center, Version 7.0, U.S. EPA Environmental Technology Verification Program, prepared by Battelle, Columbus, Ohio, November 2008.

Battelle, Test/QA Plan for Verification of Releasable Asbestos Field Sampler U.S. Environmental Protection Agency, Cincinnati, Ohio, August 2010.

Appendix A
RAFS Field and Laboratory Data Sheets

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/4/10
Tech: JT, NB, JK, RN
GPS: N 48.40169
W 115.58776
Altitude: 2081 feet

Sampling Condition Parameters

Area: 34 Location: 4 RH: 41.4 % Temp: 84.4 °F Wind Vel: 2.4 miles/hr Bar Press: 27.92 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: E Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Trimmed grass, organic soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A34-L4-01	N1	1	13.60		0	7 3/4		1/4	1214	1219	5 min sample	—
LBMT A34L4 02	N1	2	13.31		6	15 1/2	-	1/4	1214	1225	10 min sample	—
LBMT A34 L4 03	N1	3	13.41		0	36 1/2		1/4	1214	1236	20 min sample	—
LBMT A34 L4 - FB	N1	—	—	—	—	—	—	JT 8/4 1/4	1213	1213	Field Blank	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A34 L4	1214	1236	3.154	Um+02	353 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
30.6	32.1	23.8	30.6	31.4

Additional Sample Period Comments

60 Conifer, Category 4
Rake moved slow thru heavy vegetation, about 2 inches near cassette

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A34-LM-01 Soil	
2	LBMT A34-L4-02 Soil	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/4/10
Tech: NB/JK/JT/RD
GPS: N 48.40153
W 115.58729
Altitude: feet

Sampling Condition Parameters

Area: 34 Location: 5 RH: 39.2 % Temp: 86.1 °F Wind Vel: 2.9 miles/hr Bar Press: 27.88 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: from East Dew Pt: 57.8 °F
Location Description (e.g. vegetation, soil consistency): Trimmed grass, organic soil, moist Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-A34-L5-01	N1	1	13.60		37	45 3/4		1/8	1329	1334	5 min sample	—
LBMT-A34-L5-02	N1	2	13.31		37	56.0		1/8	1329	1340	10 min sample	—
LBMT-A34-L5-03	N1	3	13.41		37	75 1/2		1/8	1329	1352	20 min sample	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT-A34-L5	1329	1352	3.134	Unit 02	~~2~~ 294 NB feet/minute

Soil Moisture Readings 33.1 31.1 26.2 32.1 34.6

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
~~30.6~~	~~32.1~~	~~29.8~~	~~30.6~~	~~31.6~~ NB
~~35.1~~	~~39.5~~	~~46.8~~	~~36.5~~	~~32.5~~ not Moved over, High moisture

Additional Sample Period Comments

60 Conifer, Category IV

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT-A34-L5-01-Soil	
2	LBMT-A34-L5-02-Soil	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/4/10
Tech: NB, JT, JK, ZD
GPS: N 48.40156
W 115.58748
Altitude: 2084 feet

Sampling Condition Parameters

Area: 34 Location: L6 RH: 35% Temp: 85.9 °F Wind Vel: 2.1 miles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: N Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Trimmed grass moist, organic soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A34 L6 01	N1	1	13.60		~~75~~ 77 ~~80~~		15		~~1401~~ JWT 8/4	1426	1431 Stop ~~Start~~ 5 min	—
LBMT A34 L6 02	N1	2	13.31		~~75~~ 77 ~~80~~		15		~~1401~~ JWT	1426	1430 Stop ~~Start~~ 10 min	—
LBMT A34 L6 03	N1	3	13.41		~~75~~ 77 ~~80~~ 8/4		15		~~1401~~ JWT	1426	1430 Stop ~~Start~~ 20 min	—
LBMT A34 L6 LB	N1	—	—	—	—	—	—	—	—	—	—	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A34 L6	1401	~~1426~~ 1426	3.134	Unit 2	303 feet/minute

Soil Moisture Readings

13.0 19.3 19.8 31.1 26.2 JWT 8/4

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
~~36.5~~	~~34.4~~	~~35.5~~	~~33~~ ~~38.1~~ JWT 8/4	~~47.9~~ 36.0

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A34 L6 01	Soil
2	LBMT A34 L6 02	Soil
3		
4		
5		

Additional Sample Period Comments 8/4

60 Conifer, Category 4
Stopped @ 30 sec → Timer catching on roots

Dug out soil and broke apart root balls. Replaced soil. Vermiculite visible

Counter broke

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

N 48. 40153
115. 58751

Date: 8/9/10
Tech: NB, JJ, JK, RD
GPS: N ~~48. 40##0~~ 40292
W ~~115. 62444~~ JT 8/4
Altitude: 1965 feet

Sampling Condition Parameters

Area: A34 Location: L7 RH: % Temp: °F Wind Vel: mles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Removed grass, broke apart soil, refilled Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A34-L7 01	N1	1	13.60	14.12	—	—	15		~~1502~~ 1510	1515	Five minute	—
LBMT A34 L7 02	N1	2	13.31	13.54	—	—	15		~~1502~~ 1510	1521	10 minute	—
LBMT A34 L7 03	N1	3	13.41	13.99	—	—	15		~~1502~~ 1510	1532	20 minute	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBAT A34 L7	~~1502~~ 1510	1532	3.134	Unit 02	312 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
19.2	19.3	9.0	15.9	18.9

Additional Sample Period Comments

60 Conifer, Category 4
Brake counter broken

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A34 L7 01 Soil	Visible Vermiculite
2	LBMT A34 ~~L7~~ L7 02 Soil	"
3	LBMT A34 L7 03 Soil	"
4	LBMT A34 L7 04 Soil	"
5		

23

Axles Terminal 406 756-1467 18 9

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/5/10
Tech: MB/SK/ST/RD
GPS: N 48.37354
W 115.56044
Altitude: 7301 feet

Sampling Condition Parameters

Area: 36 Location: L1 RH: 47.4 % Temp: 74.0 °F Wind Vel: Calm miles/hr Bar Press: 27.68 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: — Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Loose, Dry Soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-A35-L1-EB	1	02	13.30	13.51	0	0	—	8/5 ~~1/2~~ —	9:16	9:26	294 fpm	—
LBMT-A35-L1-01	1	1	13.63	13.55	0	~~1/2~~ 8/5 2		1/2	9:39	9:40	1 minute sample	—
LBMT-A35-L1-02	1	2	13.30	13.51	0	20		1/2	9:39	9:50	10 minute sample	—
LBMT-A35-L1-03	1	3	13.82	13.38	0	20		1/2	9:39	9:50	10 minute sample	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A35-L1-AC	9:10	9:26	3.012	Unit 02	308 feet/minute
LBMT A35 L1-	9:39	9:50	3.012	Unit 02	

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
4.6	12.0	15.9	15.4	6.1

Additional Sample Period Comments

603 Flower Creek Rd Category IV
Horse shoe pit

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT-A35-L1-01 Soil	
2	LBMT-A35-L1-02 Soil	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/5/10
Tech: NB, JK, JT, RD
GPS: N 48.37370
W 115.56052
Altitude: feet

Sampling Condition Parameters

Area: 35 Location: L2 RH: 59.3 % Temp: 68.8 °F Wind Vel: Calm miles/hr Bar Press: 27.67 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: — Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Raked grass, loose rocks, organic soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A35 L2 -01	N1	1	13.63	13.58	0.5	—		1/2	10:10	10:11	1 minute sample	—
LBMT A35 L2 02	N1	2	13.30	13.58	0.5	—		1/2	10:10	10:22	10 min Sample	—
LBMT A35 L2 03	N1	3	13.82	13.38	0.5	—		1/2	10:10	10:22	10 min Sample	—
LBMT A35 L2 FB	N1	—	—	—	—	—	—	—	—	—	Field Blank	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A35 L2	10:10	10:22	3.012	Unit 02	306 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
7.1	6.6	4.6	5.6	7.6

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A35 L2-01 Soil	
2	LBMT A35 L2-02 Soil	
3	LBMT A35 L2-03 Soil	
4	LBMT A35 L2-04 Soil	
5		

Additional Sample Period Comments

603 Flower Creek, Category 4
ABS Parking Area, behind Shed
Rake caught on grass
Rake Counter malfunction.

KARA - 406-291-7467

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/5/10
Tech: NB/JT/JK/RD
GPS: N 48.37367
W 115.56077
Altitude: 2267 feet

Sampling Condition Parameters

Area: A35 Location: L3 RH: 55.8 % Temp: 71.5 °F Wind Vel: Calm mles/hr Bar Press: 27.67 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: - Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Hard compacted, dry soil, some rocks Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-A35-L3-01	1	1	13.63	13.58	05	7	½	1/4	10:30	10:32	2 min Sample	—
LBMT-A35-L3-02	1	2	13.30	13.58	05	23 3/4		1/4	10:30	10:43	10 min Sample	—
LBMT-A35-L3-03	1	3	13.82	13.38	05	23 3/4		1/4	10:30	10:43	10 min sample	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT-A35-L3	10:30	1043	3.012	Unit 02	309 309 NO feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
8.5	19.3	21.8	9.0	10.0

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT-A35-L3-01	Soil
2	LBMT-A35-L3-02	Soil
3		
4		
5		

Additional Sample Period Comments

603 Flower Creek, Category IV
off back porch

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/5/10
Tech: NB, JT, JG, NB
GPS: N 48.37378
W 115.56071
Altitude: 2268 feet

Sampling Condition Parameters

Area: A35 Location: L4 RH: 49.9 % Temp: 77.1 °F Wind Vel: 2.0 miles/hr Bar Press: 27.66 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: E Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry, compacted, rocky soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A35 L4-01	N1	1	13.63	13.58	0	1		1/4	11:00	11:01	1 min sample	—
LBMT A35 L4-02	N1	2	13.80	13.58	0	19		1/4	11:00	1113	10 min Sample	—
LBMT A35 L4 03	N1	3	13.82	13.38	0	19		1/4	11.00	1113	10 min Sample	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A35 L4 -	11:00	11:13	3.012		309 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
7.1	8.5	13.0	6.6	7.6

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A35 L4-01 Soil	
2	LBMT A35 L4 02 Soil	
3		
4		
5		

Additional Sample Period Comments

603 Flower Creek, Category 4
Loosened soil & removed grass roots
Filter 01 came apart on removal.
Filter saved, valid sample

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 8/5/10
Tech: JT, NB, JK, RD
GPS: N 48.37358
W 115.56089
Altitude: 2285 feet

Sampling Condition Parameters

Area: A35 Location: L5 RH: 51.4 % Temp: 75.0 °F Wind Vel: 1 miles/hr Bar Press: 27.64 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: E Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Removed grass, Dry organic Soil Test Qualifier: Reproducibility

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A35 L5 01	N1	1	13.63	13.58	0	10		1/4	1129	1134	5 min	—
LBMT A35 L5 02	N1	2	13.30	13.58	0	10		1/4	1129	1134	5 min	—
LBMT A35 L503	N1	3	13.82	13.38	0	10		1/4	1129	1134	5 min	—
LBMT A35 L5-LB	N1	—	—	—	—	—	—	—	—	—	Closed Blank	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A35 L5	1129	1134	3.012	Unit 02	316 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
9.0	9.0	10.5	10.0	9.0

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A35 L5-01 Soil	
2	LBMT A35 L5-02 Soil	
3		
4		
5		

Additional Sample Period Comments

608 Flower Creek, Category 4
Removed grass
5 minute Triplicate

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 8/5/10
Tech: NB/SK/ST/RD
GPS: N 48.34700
W 115.51830
Altitude: ~~2229 m~~ 2233 feet

Sampling Condition Parameters

Area: 36 Location: L1 RH: 35.7 % Temp: 93.5 °F Wind Vel: L1 miles/hr Bar Press: 27.57 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry soil, vegetation, roots Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A36 L1-EB	N1	2	13.12		0			~~1/4~~ HS	13:35	13:45	304 fpm	—
LBMT-A36-L1-01	N1	1	13.78		04	6		1/4	~~13:57~~ 14:06	14:07	1 min Sample	—
LBMT-A36-L1-02	N1	2	13.12		04	16		1/4	~~13:57~~ 14:06	14:17	10 min Sample	—
LBMT-A36-L1-03	N1	3	13.26		04	16		1/4	~~13:57~~ 14:06	14:17	10 min Sample	—
LBMT-A36-L1-FB	N1	—	—	—	—	—	—	—	13:49	13:50	Field Blank	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A36 L1-QC	1330	1341	~~3.012~~ 2.962 AVG	Unit 02	299
LBMT-A36-L1	~~1354~~ 14:06	14:17	2.962	Rake moved to different location; Start at 14:06	~~304~~ 25 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
8.5	7.1	6.1	6.6	8.5

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT-A36-L1-01-Soil	
2	LBMT-A36-L1-02-Soil	
3		
4		
5		

Additional Sample Period Comments

36242 U.S. Hwy 2; Category IV
Rake got stuck in roots; moved to new location nearby.

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 8/5/10
Tech: JK, ST, NB, RD
GPS: N 48.34700
W 115.51834
Altitude: 2241 feet

Sampling Condition Parameters

Area: 36 Location: 2 RH: 46 % Temp: 86.5 °F Wind Vel: 2.5 miles/hr Bar Press: 27.56 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: E Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry organic soil, removed snow Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A36-L2-01	N1	1	13.24		0	1.5		1/4	1425	1426	1 min sample	—
LBMT A36-L2-02	N1	2	13.12		0	12.5		1/4	1425	1436	10 min sample	—
LBMT A36-L2-03	N1	3	13.26		0	12.5		1/4	1425	1436	10 min sample	—
LBMT A36 L2-BB	N1	—	—	—	—	—	—	—	—	—	Closed Blank	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A36 L2	1425	1436	2.962	Unit 02	~~29~~ 314 feet/minute
					50 815

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
2.7	8.1	4.1	6.1	2.7

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A36 L2 01 Soil	
2	LBMT A36-L2-02 Soil	
3		
4		
5		

Additional Sample Period Comments

36242 US Hwy 2, Category 4

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 8/5/10
Tech: IK, NB, JT, RD
GPS: N 48.34712
W 115.51841
Altitude: 2227 feet

Sampling Condition Parameters

Area: 36 Location: 3 RH: 37.5 % Temp: 91.1 °F Wind Vel: < 1 miles/hr Bar Press: 27.55 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dirt, dry, loose Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-A36-L3-01	N1	1	13.76		0.5	2.0		3/8	1450	1451	1 min sample	—
LBMT-A36-L3-02	N1	2	13.12		0.5	13		3/8	1450	1501	10 min sample	—
LBMT-A36-L3-03	N1	3	13.26		0.5	13		3/8	1450	1501	10 min sample	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A36-L3	1450 LBMT SF	1501	2.962	1 min 02	301 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
9.5	8.1	6.6	11.5	21.8

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A36-L3-01 Soil	
2	LBMT - A36 L3-02 Soil	
3	LBMT A36-L3-03	
4	LBMT A36-L3-04	
5		

Additional Sample Period Comments

36242 U.S Hwy 2, Category 4
Visible vermiculite

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 8/5/10
Tech: JT, JK, NB, RD
GPS: N 48.34709
W 115.51807
Altitude: 2238 feet

Sampling Condition Parameters

Area: 36 Location: L4 RH: % Temp: °F Wind Vel: miles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Removed grass, dry soil Test Qualifier: Reproducibility

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A36-L4 01	N1	1	13.78		0.5				VOID		5 min Sample	—
LBMT A36 L4 02	N1	2	13.12		0.5				VOID		5 min sample	—
LBMT A36 L4 03	N1	3	13.26		0.5				VOID		5 min sample	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A36-L4			2.962	Unit 02	feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A36 L4-01	Not Collected
2	LBMT A36-L4-02	Not Collected
3		
4		
5		

Additional Sample Period Comments

36242 US Hwy 2, Category 4

RAFS Malfunction - Race Drive broken. Voided Test

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 08/02/10
Tech: NB, JK, JT
GPS: N 48.38796
W 115.55656
Altitude: 2123 feet

Sampling Condition Parameters

Area: 31 Location: 1 RH: 40.8 % Temp: 84.0 °F Wind Vel: ~~292~~ 4.6 mph ~~ft/min~~ Bar Press: 27.76 inches of Hg

Weather Phenomena (e.g. rain, wind gusts): Partially Sunny Direction: Dew Pt: °F

Location Description (e.g. vegetation, soil consistency): Dry, loose organic soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-AJ-LI-EB	N1	02	13.34	13.34	0	0	0	0	14:40	14:50	292 ft/min	
LBMT-AJ-LI-01	N1	01	13.77		—	—	16		15:08	15:13	Rake Counter	
LBMT-AJ-LI-02	N1	02	13.34		—	—	16		15:08	15:13	Malfunction	
LBMT-AJ-LI-03	N1	03	13.48		—	—	16		15:08	15:13		

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT-AJ-LI-QC	14:40	14:45	2.70	~~Collocated~~ S/I + Blank check, Unit 02 Unit 03 malfunction, No collocation	feet/minute
LBMT-AJ-LI-01	15:08	15:13	2.70		

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
7.6	9.5	4.1	9.0	7.1

Additional Sample Period Comments

All samples voided. Filters overloaded
912 California Ave.

Soil Sample Tracking

Split #	Sample ID	Comments
1		No soil overloaded Filters
2		
3		
4		
5		

ABS: ORD

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 08/02/10
Tech: NB/JK/JT
GPS: N 48.38796
W 115.55656
Altitude: 2123 feet

Sampling Condition Parameters

Area: 31 Location: 2 RH: 40.8 % Temp: 84.0 °F Wind Vel: 4.6 mles/hr Bar Press: 27.76 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Partially Sunny Direction: SW Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry, loose soil w/grass Test Qualifier: Reproducibility

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading		Agitator Data				Time		Comments	RTI Filter ID
			Start (L/m)	Stop (L/m)	Start Count	Stop Count	Cycle Time (s)	Depth (inches)	Start	Stop		
LBMT-A31-L2-01	N1	1	13.77	13.77	—	—	15	1/4"	15:20	15:25	overloaded	
LBMT-A31-L2-02	N1	2	13.34	13.34	—	—	15	1/4"	15:20	15:25	Indirect Prep	
LBMT-A31-L2-03	N1	3	13.48	13.48	—	—	15	1/4"	15:20	15:25	H	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT-A31-L2-	15:20	15:25	2.70		288 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
5.1	5.6	6.6	3.6	3.6

Additional Sample Period Comments

Reproducibility Samples.

912 California Ave

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A31-L2-01-SOIL	
2	LBMT A31-L2-02 SOIL	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/2/10
Tech: NB, JT, JK
GPS: N 48.38771
W 115.55637
Altitude: 2116 feet

Sampling Condition Parameters

Area: A31 Location: 3 RH: 36.5 % Temp: 85.1 °F Wind Vel: ~~Calm~~ mles/hr Bar Press: 27.75 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Partly Cloudy Direction: NW Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry organic soil, dry grass Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
BMT A31-L3-01	N1	1	13.77	13.77	—	—	16	1/4	15:23	16:24	Direct	
BMT A31-L3-02	N1	2	13.34	13.34	—	—	16	1/4	15:23	16:37	10 min total	
BMT A31-L3-03	N1	3	13.48	13.34	—	—	16	1/4	15:23	16:37	10 min total	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
BMTA31-L3-01	15:23	16:37	2.70	1 min. time, stop, 9 min more	286 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
2.7	1.7	1.7	4.6	2.2

Soil Sample Tracking

Split #	Sample ID	Comments
1	BMTA31-L3-01-SOIL	
2	BMTA31-L3-02-SOIL	
3		
4		
5		

Additional Sample Period Comments

Pump 1 - Direct TEM
Pump 2, 3 - Indirect TEM
Cycle counter broken

912 California Ave

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/2/10
Tech: NB, JT, JK
GPS: N 48.38794
W 115.55646
Altitude: 2044 feet

Sampling Condition Parameters

Area: A31 Location: L4 RH: 41.2 % Temp: 85.4 °F Wind Vel: 3.2 miles/hr Bar Press: 27.74 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Partly Cloudy Direction: W Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry, organic soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A31-L4-01	N1	2	13.77	13.77	—	—	14	1/4	16:50	16:51	Direct Prep	
LBMT A31-L4-02	N1	2	13.34	13.34	—	—	14	1/4	16:50	17:02	Indirect	
LBMT A31-L4-03	N1	3	13.48	13.48	—	—	14	1/4	16:50	17:02	Indirect	
LBMT A31-L4-FB	—	—									Field Blank	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A31-L4-	16:50	17:02	2.70	1 min, stop, 9 minutes	289 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
2.2	2.2	2.1	2.2	2.8

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A31-L4-1-SOIL	
2	LBMT A31-L4-2-SOIL	
3		
4		
5		

Additional Sample Period Comments

Pump 1 : Direct Prep
Pump 2,3 : Indirect Prep
912 California Ave.

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/2/10

Tech: JT 8/2 ~~RD~~, JT, NB, JK

GPS: N 48.35746

W 115.56621

Altitude: 1996 feet

Sampling Condition Parameters

Area: A31 Location: L5 RH: 44.7 % Temp: 84.6 °F Wind Vel: ~~Calm~~ 1.4 JT 8/2 mles/hr Bar Press: 27.74 inches of Hg

Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: ~~W~~ W Dew Pt: °F

Location Description (e.g. vegetation, soil consistency): Organic soil, lots, Pine duff, detritus Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A31 L5-01	N1	1	13.72	13.77	—	—	16	~~JT 8/2~~ 1/2	17:17	17:15	1 min, Direct Term	
LBMT A31 L5 02	N1	2	13.34	13.34	—	—	16	1/2	17:17	17:29	~~test 8/2~~ 10 min	
LBMT A31 L5 03	N1	3	13.48	13.48	—	—	16	1/2	17:17	17:29	10 min	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A31-L5	~~17:17 2.70~~	17:29	2.70	1 min, Stop, + 9 min	270 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
36	6.1	5.1	2.7	1.7

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A31-L4-01-Soil	
2	LBMT-A31-L4-02 Soil	
3		
4		
5		

Additional Sample Period Comments

~~RD – lead experimentalist~~ JT 8/2

1 min, overloaded, Direct Term

Pump 2,3 10 min, Indirect Term

Rake Counter broken

912 California Ave

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/2/10
Tech: RD
GPS: N 48.38794
W 115.55669
Altitude: 2086 feet

Sampling Condition Parameters

Area: A31 Location: L6 RH: 45.1 % Temp: 86.0 °F Wind Vel: .9 miles/hr Bar Press: 27.74 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: W Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry, grass, organic soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A31 L6 01	N1	2	13.72	13.72	—	—	15	1/2 1/8	17:39	17:40	1 min	
LBMT A31 L6 02	N1	2	13.34	13.39	—	—	15	1/2 1/8	17:39	17:51	10 min total	
LBMT A31 L6 03	N1	3	13.48	13.55	—	—	15	1/2 1/8	17:39	17:51	10 min total	
LBMT A31 L6 LB	—	—	—	—	—	—		1/2	—	—	Closed blank	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A31-L6	17:39	17:51	2.70	Um=02, 1 minute, stop	268 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
4.6	3.6	4.6	3.6	3.6

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A31 L6 01 SOIL	
2	LBMT A31 L6 02 SOIL	
3	LBMT A31 L6 03 SOIL	
4	LBMT A31 L6 04 SOIL	
5		

Additional Sample Period Comments

Ramona Darlington - Lead
Rake Counter Broken
Pump 1 - 1 minute sample
Pump 2,3 → 10 minute samples

912 California Ave.

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/3/10
Tech: MB/JK/JT
GPS: N 48.38323
W 115.54990
Altitude: 2100 feet

Sampling Condition Parameters

Area: 32 Location: 1 RH: 62 % Temp: 69.9 °F Wind Vel: 1.0 miles/hr Bar Press: 27.90 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): clear, sunny, calm to mild breeze Direction: N Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry soil, dry grass Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-A32-L1-EB	N1	2	13.19	13.64	0	0	0	~~1/8~~ MB	9:02	9:12	312 fpm	—
LBMT-A32-L1-01	N1	1	13.49	13.52	—	—	16	1/8	9:32	9:33	Direct TEM	—
LBMT-A32-L1-02	N1	2	13.19	13.64	—	—	16	1/8	9:32	9:44	10 min, Indirect	—
LBMT-A32-L1-03	N1	3	13.34	13.76	—	—	16	1/8	9:32	9:44	10 min, Indirect	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments
LBMT A32-L1-QC	8:41	9:05	3.026	Unit 02
LBMT A32-L1-	9:32	9:44	3.026	Unit 02, 1 min, stop, +9 min

Vane Anemometer
~~VT 8/3~~ ~~328~~ 328
B ~~345~~ feet/minute
JT 8/3

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
2.7	2.7	2.2	4.1	2.7

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A32 L1-01 Soil	
2	LBMT A32 L1-02 Soil	
3		
4		
5		

Additional Sample Period Comments

1222 Dakota. Rake Counter Broken
Pump 1: Direct TEM
Pump 2,3: Indirect TEM
ABS = ORD 1

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/3/10
Tech: NB, JK, JT, RD
GPS: N 48.38313
W 115.54987
Altitude: 2102 feet

Sampling Condition Parameters

Area: A32 Location: L2 RH: 56.4 % Temp: 65.4 °F Wind Vel: 1.0 mles/hr Bar Press: 27.89 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: N Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): under pine tree, bare, loose soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A32 L2 01	N1	1	13.49	13.52	—	—	~~16~~ NB 15		9:56	9:57	Direct TEM	—
LBMT A32 L2 02	N1	2	13.19	13.64	—	—	15		9:56	10:08	10 min, Indirect	—
LBMT A32 L2 03	N1	3	13.34	13.76	—	—	15		9:56	10:08	10 min, Indirect	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A32 L2	9:56	10:08	3.026	Unit 02, 1 min stop + 9 min	329 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
4.6	5.1	6.6	6.6	7.1

Additional Sample Period Comments

1222 Dakota, Rake Counter Broken
Location on ABS (caking) location
Samp 1 – Direct TEM; Samp 2 & 3 – Indirect

Some observation Pump 2,3 filters
↳ built up soil

ARS = 0273

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT-A32-L2-01(Soil)	
2	LBMT-A32-L2-02(Soil)	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/3/10
Tech: MB, JK, JT, RD
GPS: N 48.38314
W 115.54990
Altitude: ~~1910~~ 2120 feet

Sampling Condition Parameters

Area: A32 Location: L3 RH: 58.5 % Temp: 74.6 °F Wind Vel: 4.1 miles/hr Bar Press: 27.89 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Under pine tree (North of L2), bare, loose soil Test Qualifier: Reproducibility

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-A32-L3-01	N1	1	13.49	13.52	—	—	16	1/4	10:17	10:22	5 min Sample	
LBMT-A32-L3-02	N1	2	13.19	13.64	—	—	16	1/4	10:17	10:22	↓	
LBMT-A32-L3-03	N1	3	13.34	13.74	—	—	16	1/4	10:17	10:22	↓	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT-A32-L3	10:17	10:22	3.026	Unit 02, 5 min Sample	390 378 feet/minute 390

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
7.6	8.1	9.0	10.5	10.5

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT-A32-L3-01	Soil
2	LBMT-A32-L3-02	Soil
3		
4		
5		

Additional Sample Period Comments

1222 Dakota, Rake counter broken
Location on ABS (raking) location
5 min Sample for 1, 2 & 3

ABS = GRD 1

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/3/10
Tech: NB, JK, JT, RD
GPS: N 48-38314
W 115.55013
Altitude: 2120 feet

Sampling Condition Parameters

Area: A32 Location: L4 RH: 57.7 % Temp: 75.2 °F Wind Vel: Calm mles/hr Bar Press: 27.88 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: — Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Compacted Topsoil, bare. Loosened soil w/ Rake Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A32 L4 01	N1	1	13.49	13.52	—	—			10:37	10:49 (1)	Stop @ 90 sec Direct TEM	—
LBMT A32 L4 02	N1	2	13.19	13.64	—	—			10:37	10:52 (2)	Start again @ 1043	—
LBMT A32 L4 03	N1	3	13.34	13.76	—	—			10:37	10:52 (2)	Start again @ 1045	—
LBMT A32 L4-FB	N1	—	—	—	—	—	—	—			Field Blank	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A32 L4	10:37	10:52	8.026	Stop @ 90 sec, + 1 min, stop, + 9 min	~~FE~~ NB feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
9.2	8.2	7.9	8.9	

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A32 L4 01	
2	LBMT A32 L4 02	
3		
4		
5		

Additional Sample Period Comments

Compacted soil. Stopped Test @ 90 sec.
Loosened soil w/ rake
ARS = 6RDM

(1) Total Time = 2½ min
(2) Total Time = 12½ min VOID Test, Not enough particles collected for indirect TEM in 10 min.

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/8/10
Tech: MB/JK/JT/RD
GPS: N 48.38319
W 115.55022
Altitude: 2111 feet

Sampling Condition Parameters

Area: A32 Location: L5 RH: 60.2 % Temp: 69.5 °F Wind Vel: 1.0 mles/hr Bar Press: 27.88 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: Southeast Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Compacted Topsoil, loosend soil w/ Rake Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-A32-L5-01	1	1	13.49	13.52	—		16	1/4	11:08	11:09	Direct TEM	—
LBMT-A32-L5-02	1	2	13.19	13.64	—		16	1/4	11:08	11:19	10 min, Indirect	—
LBMT-A32-L5-03	1	3	13.34	13.76	—		16	1/4	11:08	11:19	10 min, Indirect	—
LBMT-A32-L5-LB	—	—	—	—	—	—	—	—	—	—	Closed Field Blank	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT-A32-L5	11:08	11:19	3.026	Unit 03, 1 min Stop + 9 min	312 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
7.6	9.6	8.9	7.6	8.2

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT-A32-L5-01	Soil
2	LBMT-A32-L5-02	Soil
3		
4		
5		

Additional Sample Period Comments

1222 Dakota
Samp 1 - Direct TEM
Samp 2&3 - Indiret TEM

ABS: ORD 2

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/3/10
Tech: NB, JK, DT
GPS: N 48.38324
W 115.55008
Altitude: 2117 feet

Sampling Condition Parameters

Area: A32 Location: L6 RH: 53.4 % Temp: 73.6 °F Wind Vel: Calm mles/hr Bar Press: 27.89 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: — Dew Pt: — °F
Location Description (e.g. vegetation, soil consistency): Bare, loose soil, some grass Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A32 L6 01	N1	1	13.49	13.52	—	—	16	1/4	1130	1131	Direct	—
LBMT A32 L6 02	N1	2	13.19	13.64	—	—	16	1/4	1130	1142	Indirect, 10 min	—
LBMT A32 L6 03	N1	3	13.34	13.76	—	—	16	1/4	1130	1142	Indirect, 10 min	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A32 L6	1130	1142	3.026	Unit 02, 1 min, stop, +9 min	295 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
3.3	2.6	2.7	3.3	4.3

Additional Sample Period Comments

1222 Dakota Rate Counter Broken
Pump 1 : Direct TEM
Pump 2,3 : Indirect TEM

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A32 L6 01 Soil	
2	LBMT A32 L6 02 Soil	
3		
4		
5		

ABS : ORD 2

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/3/10
Tech: NB/JK/JT/RD
GPS: N 48.38708
W 115.55541
Altitude: 2126 feet

Sampling Condition Parameters

Area: A33 Location: L1 RH: 39.5 % Temp: 85.2 °F Wind Vel: 2.7 miles/hr Bar Press: 27.82 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: N Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry Soil, Dry grass Test Qualifier: Non. ETV

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading		Agitator Data				Time		Comments	RTI Filter ID
			Start (L/m)	Stop (L/m)	Start Count	Stop Count	Cycle Time (s)	Depth (inches)	Start	Stop		
LBMT A33-L1-EB	N1	2	13.31	13.73	0	0		1/8	2:55	3:05	305 fpm	—
LBMT A33-L1-01	N1	1	13.64	13.97	0	20 1/4		1/8	3:19	15:24		—
LBMT A33-L1-02	N1	2	13.31	13.73	0	20 1/4		1/8	3:19	15:29		—
LBMT A33-L1-03	N1	3	13.45	13.70	0	20 1/4		1/8	3:19	15:29		—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A33-L1-QC	14:41	14:51	3.021	Um102	258, 268, 296 274 feet/minute
LBMT A33-L1	15:19	15:29	3.021		

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
5.9	6.9	3.6	4.9	5.9

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT-A33-L1-01 Soil	
2	LBMT-A33-L1-02 Soil	
3		
4		
5		

Additional Sample Period Comments

1004 Mineral Ave ; Category 3
Non-ETV Area

GW 20/30

258 296

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/3/10
Tech: NB, JK, JT
GPS: N 48.38647
W 115.55534
Altitude: 2122 feet

Sampling Condition Parameters 8/5/10

Area: A33 Location: L2 RH: 37.7 % Temp: 85.9 °F Wind Vel: 7.4 miles/hr Bar Press: 27.81 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: N/NE Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry soil, Dry grass Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT A33 L2 01	N1	1	13.64	13.97 → 13.98	20 1/4	21 1/8		1/8	15:47	15:52	5min Sample	—
LBMT A33 L2 02	N1	2	13.31	13.73	20 1/4	21 1/8		1/8	15:47	15:59	10 min Direct	—
LBMT A33 L2 03	N1	3	13.45	13.70	20 1/4	21 1/8		1/8	15:47	15:59	10 min Direct	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A33 L2 ON	15:47	15:59	3.021	5 min Stop + 5 min for 2 & 3	289 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
2.6	3.9	2.6	3.3	1.9

Additional Sample Period Comments

1004 Mineral Avenue, Category II
Samp 1 - 5 min; Samp 2&3 - 10 min Direct

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A33 L2 - 01 Soil	
2	LBMT A33 L2 - 02 Soil	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 8/03/10
Tech: JK, NB, JT
GPS: N 48 38 6092
W 115.55546
Altitude: 2121 feet

Sampling Condition Parameters

Area: A33 Location: L3 RH: 38.6 % Temp: 84.1 °F Wind Vel: 3.4 mles/hr Bar Press: 27.80 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Mostly Cloudy Direction: N Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Dry grass over dry organic soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading		Agitator Data				Time		Comments	RTI Filter ID
			Start (L/m)	Stop (L/m)	Start Count	Stop Count	Cycle Time (s)	Depth (inches)	Start	Stop		
LBMT - A33 - L3 - 01	N1	1	13.64	13.97	21 1/4	27 1/2		1/8	16:08	16:13	Overloaded?	
LBMT A33 - L3 - 02	N1	2	13.31	13.73	21 1/4	27 1/2		1/8	16:08	16:13	Overloaded?	
LBMT A33 - L3 03	N1	3	13.45	13.70	21 1/4	27 1/2		1/8	16:08	16:13	Overloaded?	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A33 L3	16:08	16:13	3.021	Umpto 2	299 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
3.6	~~4.0~~ 4.3 NB	4.9	4.3	5.6

Additional Sample Period Comments

1004 Mineral Am. Category 3

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A33 L3 -01 Soil	
2	LBMT A33 L3 -02 Soil	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/4/10
Tech: NB/JK/JT/RD
GPS: N 48.40157
W 115.58748
Altitude: 2127 feet

Sampling Condition Parameters

Area: A34 Location: L1 RH: 50.5 % Temp: 76.2 °F Wind Vel: 1.6 miles/hr Bar Press: 27.96 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: East Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Grass, organic soil, Trimmed grass Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading		Agitator Data				Time		Comments	RTI Filter ID
			Start (L/m)	Stop (L/m)	Start Count	Stop Count	Cycle Time (s)	Depth (inches)	Start	Stop		
LBMT-A34-L1-EB	N1	2	13.31		—	—	—	—	935	945	268 ft/min	—
LBMT-A34-L1-01	N1	1	13.60		1/4	10 1/2		1/8	1038	10:47	5 min Sample	—
LBMT-A34-L1-02	N1	2	13.31		1/4	21 1/2		1/8	1038	10:53	10 min Sample	—
LBMT-A34-L1-03	N1	3	13.41		1/4	42 1/2		1/8	1038	11:05	20 min Sample	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT A34-L1-QC	938	9:43	3.134	Unit 2, #	308 feet/minute
LBMT A34-L1	1038	11:05	3.134	Unit 2, 1 min Stop + 4 min for Sample	

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
7.1	7.1	3.5	8.1	5.6

Additional Sample Period Comments

60 Conifer, Category 4
Samp 1 - 5 min; Samp 2 - 10 min; Samp 3 - 20 min

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A34-L1-01 Soil	
2	LBMT A34-L1-02 Soil	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/4/10
Tech: NB/JK/JT/KD
GPS: N 48.40169
W 115.58781
Altitude: 2058 feet

Sampling Condition Parameters

Area: A34 Location: L2 RH: 39.8 % Temp: 84.9 °F Wind Vel: 1.8 mles/hr Bar Press: 27.96 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: NE Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Grass, organic soil, Trimmed grass Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-A34-L2-01	N1	1	13.60		42 1/2	52 3/4		1/8	11:12	11:19	5 min Sample	—
LBMT-A34_L2-02	N1	2	13.31		42 1/2	60 1/4		1/8	11:12	11:24	10 min Sample	—
LBMT-A34_L2-03	N1	3	13.41		42 1/2	81 3/4		1/8	11:12	11:36	20 min Sample	—

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT-A34-L2	11:12	11:36	3.134	Unit 02, 1 min Stop + 4 min for Samp 1	304 263 8/4/10 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
20.3	20.8	18.4	22.3	19.3

Additional Sample Period Comments

60 Conifer, Category IV
Samp1-5 min; Samp2-10 min; Samp3-20 min

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT-A34-L2-01 Soil	
2	LBMT-A34-L2-02 Soil	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 8/4/10
Tech: MB/JK/JT/RD
GPS: N 48.40174
W 115.58770
Altitude: 2083 feet

Sampling Condition Parameters

Area: A34 Location: L3 RH: 42.1 % Temp: 80.2 °F Wind Vel: 2.7 miles/hr Bar Press: 27.93 inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Sunny Direction: E Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): grass, organic soil, trimmed grass Test Qualifier: Reproducibility

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
LBMT-A34_L3-01	N1	1	13.60		81 3/4	87 1/2		1/4	11:45	11:56	Restart 11:51	—
LBMT-A34_L3-02	N1	2	13.31		81 3/4	87 1/2		1/4	11:45	11:56	Stop at 11:45	—
LBMT-A34_L3-03	N1	3	13.41		81 3/4	87 1/2		1/4	11:45	11:56	Ran 47 second	—
											Subtract 3 cycle	
											Total Time: 5 min 47 sec	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
LBMT-A34_L3	11:45	11:56	3.134	Units 2	329, 329 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
28.2	30.1	14.4	15.9	17.9

Soil Sample Tracking

Split #	Sample ID	Comments
1	LBMT A34 L3 01 Soil	
2	LBMT A34 L3 02 Soil	
3		
4		
5		

Additional Sample Period Comments

60 conifer, Category IV
Fixed soil under RAFS, poor contact
Counter malfunction?

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

RTI INTERNATIONAL

Date: 9-14-2010
Tech:
GPS: N
W
Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: miles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading		Agitator Data				Time		Comments	RTI Filter ID
			Start (L/m)	Stop (L/m)	Start Count	Stop Count	Cycle Time (s)	Depth (inches)	Start	Stop		
	1	1	13.98									
	1	2	13.61									
	1	3	13.40									

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
ilm+01	3.495			10 Measurements	feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5

Soil Sample Tracking

Split #	Sample ID	Comments
1		
2		
3		
4		
5		

Additional Sample Period Comments

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 9-14-2010
Tech:
GPS: N
W
Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: miles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading		Agitator Data				Time		Comments	RTI Filter ID
			Start (L/m)	Stop (L/m)	Start Count	Stop Count	Cycle Time (s)	Depth (inches)	Start	Stop		
	2	1	13.68									
	2	2	13.56									
	2	3	13.34									

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
Unit 02	3.031			10 measurements	feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5

Soil Sample Tracking

Split #	Sample ID	Comments
1		
2		
3		
4		
5		

Additional Sample Period Comments

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 9/15/10
Tech: JWT, JK, RD
GPS: N —
W —
Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: miles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading		Agitator Data				Time		Comments	RTI Filter ID
			Start (L/m)	Stop (L/m)	Start Count	Stop Count	Cycle Time (s)	Depth (inches)	Start	Stop		
ETV-T1-2-EB	2	2	13.61	13.61	0	20		—	0	10 min	EB, 281 fpm	
ETV-T2-2-EB	2	2	13.56	13.56	0	20		—	0	10 min	EB, 250 fpm	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
Unit 01	8:31			1st batch - Collocation, 2nd : Blank	feet/minute
Unit 02	8:01			1st : collocation, 2nd : Blank	

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5

Soil Sample Tracking

Split #	Sample ID	Comments
1		
2		
3		
4		
5		

Additional Sample Period Comments

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 9/15/10
Tech: JK, JWT
GPS: N
W
Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: miles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Agricultually Loaded Soil Test Qualifier:

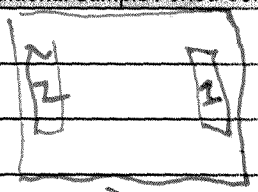
Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
RAFS 1 - Low-L1	1	1,2,3	See Cal sheet		0	15		1/2	0	8 min	Right, vertical	
RAFS 2 - Low-L2	2	1,2,3	See Cal sheet		0	15		1/2	0	8 min	Left vertical	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
Un.101				RAFS 1, Stop during run @ 5 min	R1 - 323 feet/minute
Un.102				RAFS 2 "	R2 - 346

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5	
11	9.0	9.5	9.0	10.5	R1
10.5	12.0	13.0	10.0	10.5	R2

Additional Sample Period Comments



Door

Stop @ 5 min - check
Stop @ 8 min - check
8 min Total time

@ 10:30 am start

Soil Sample Tracking

Split #	Sample ID	Comments
1	RAFS 1 - Low-L1	
2	RAFS 2 - Low-L1	
3		
4		
5		

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 9/15

Tech: JJ, JK

GPS: N

W

Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: miles/hr Bar Press: inches of Hg

Weather Phenomena (e.g. rain, wind gusts): Artificially Loaded 5:1 Direction: Dew Pt: °F

Location Description (e.g. vegetation, soil consistency): Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
RAFS 1-High-L1-1	1	1	13.98	13.98	0	15		½	0	8 min	check e 5min	
RAFS 1 High L1-2	1	2	13.61	13.61	0	15		½	0	8 min	check e 5min	
RAFS 1 High-L1-3	1	3	13.40	13.40	0	15		½	0	8 min	check e 5 min	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
High-L1-1	0	8 min		Unit 01, Stop RAFS e 5min	345 feet/minute

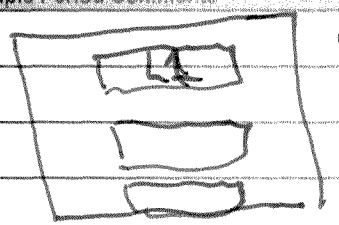
Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
15.4	13.5	13.9	14.9	15.4

Soil Sample Tracking

Split #	Sample ID	Comments
1	RAFS 1- High-L1	Too much soil collected
2		
3		
4		
5		

Additional Sample Period Comments



① Soil not compacted huge mounds, smoothed out e 5 min

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4; Libby, Montana

Date: 9/15/10
Tech: JT / JK / RD
GPS: N
W
Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: miles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Artificially Loaded Soil Test Qualifier:

Sample ID	RAFS Unit №	Rotameter Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
RAFS 1-Low-L2-1	1	1	13.98	13.98	0	15			0	8 min	Stop @ 5 min	
RAFS-Low-L2-2	1	2	13.61	13.61	0	15			0	8	"	
RAFS-Low-L2-3	1	3	13.40	13.40	0	15			0	8	"	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
RAFS 1-Low-L2	0	8 min		Unit #1, Stop @ 5 min	355 feet/minute

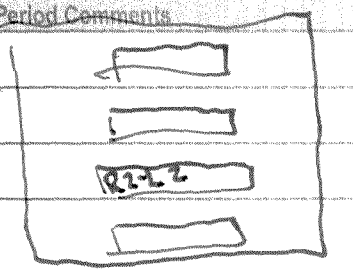
Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
12.5	12.0	12.5	11.0	12.0

Soil Sample Tracking

Split #	Sample ID	Comments
1		
2		
3		
4		
5		

Additional Sample Period Comments



RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby Operable Unit #4, Libby, Montana

Date: 9/15/10

Tech: JT/JK/RD

GPS: N

W

Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: miles/hr Bar Press: inches of Hg

Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F

Location Description (e.g. vegetation, soil consistency): Artificially Loaded Soil

Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
RAFS-Low-L2-1	2	1	13.68	13.68	0	15			0	8 min	Stop @ 5 min	
RAFS2-Low-L2-2	2	2	13.56	13.56	0	15			0	8 min	"	
RAFS2-Low-L2-3	2	3	13.34	13.34	0	15			0	8 min	"	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
RAFS2 Low L2	0	8 min		Used #2, Stop @ 5 min	322 feet/minute

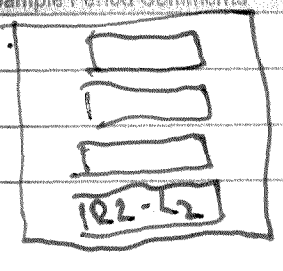
Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
13.0	12.0	11.5	11.0	12.0

Soil Sample Tracking

Split #	Sample ID	Comments
1		
2		
3		
4		
5		

Additional Sample Period Comments



RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 9/15/10
Tech: JT / JK
GPS: N
W
Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: miles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Artificially Loaded Soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
RAFS 1 - LOW - L3-1	1	1	13.98	13.98	0	15			0	8 min	Stop @ 5 min	
RAFS 1 - LOW - L3-2	1	2	13.61	13.61	0	15			0	8 min	"	
RAFS 1 - LOW - L3-3	1	3	13.40	13.40	0	15			0	8 min	"	
RAFS - LAB - FB - 0												
RAFS - LAB - FB - C												

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
RAFS 1 - LOW - L3	0	8 min		Unit 01, Stop @ 5 min	321 316 feet/minute
					JT 9/15

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
~~8.1~~ 11.5	~~10.5~~ 8.5	~~9.5~~ 10.5	~~9.0~~ 9.5	~~12.0~~ 10.0

JT 9/15

Soil Sample Tracking

Split #	Sample ID	Comments
1	RAFS 1 - LOW - L3	
2		
3		
4		
5		

Additional Sample Period Comments

B1-L3
"
"
"

Door

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 9/15/10
Tech: JT/JK
GPS: N
W
Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: mles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Artificially Loaded Soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
RAFS-Low-L3-1	2	1	13.68	13.68	~~0~~ 15	30			0	8 min	Stop @ 5 min	
Low-L3-2	2	2	13.56	13.56	~~0~~ 15	30			0	8 min	"	
RAFS2 Low-L3-3	2	3	13.34	13.34	~~0~~ 15	30			0	8 min	"	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
RAFS-Low-L3	0	8 min		Unit 2, Stop @ 5 min	321 feet/minute

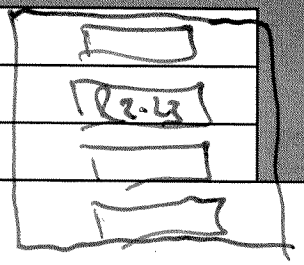
Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
8.1	10.5	9.5	9.0	12.0

Soil Sample Tracking

Split #	Sample ID	Comments
1	RAFS2-Low-L3	
2		
3		
4		
5		

Additional Sample Period Comments



RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 9/15/10
Tech: JT / JK
GPS: N
W
Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: mles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Artificially loaded Soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
RAFS 1 High L2-1	1	1	13.98	13.98	0	15		3/4	0	8 min		
RAFS 1 High L2-2	1	2	13.61	13.61	0	45		3/4	0	23 min	Stop @ 8 min, 13, 18	
RAFS 1 High L2-3	1	3	13.40	13.40	0	45		3/4	0	23 min	Stop @ 8 min	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
RAFS 1 - High - L2	0	23 min		Unit 01, Stop @ 8 min, 13, 18	321 324 feet/minute JT 9/15

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
20.8	17.6	19.3	18.4	16.9

Soil Sample Tracking

Split #	Sample ID	Comments
1	RAFS 1 - High - L2	Soil only collected from
2		piles at both ends
3		
4		
5		

Additional Sample Period Comments

RT1-L2

Door

RAFS Datasheet

AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM

RELEASABLE ASBESTOS FIELD SAMPLER (RAFS)

Libby, Montana

Date: 9/15/10
Tech: JT/JK
GPS: N
W
Altitude: feet

Sampling Condition Parameters

Area: Location: RH: % Temp: °F Wind Vel: mles/hr Bar Press: inches of Hg
Weather Phenomena (e.g. rain, wind gusts): Direction: Dew Pt: °F
Location Description (e.g. vegetation, soil consistency): Artificially Loaded Soil Test Qualifier:

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading Start (L/m)	Rotometer Reading Stop (L/m)	Agitator Data Start Count	Agitator Data Stop Count	Agitator Data Cycle Time (s)	Agitator Data Depth (inches)	Time Start	Time Stop	Comments	RTI Filter ID
RAFS1-High L3-1	1	1	13.98	13.98	0				0	8 min		
RAFS1 High L3-2	1	2	13.61	13.61	0				0	23 min	Stop @ 8 min	
RAFS1 High L3-3	1	3	13.40	13.40	0				0	23 min	Stop @ 8 min	

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
RAFS1-High L3	0	23 min		Unit #1, Stop @ 8 min	317 feet/minute

Soil Moisture Readings

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
16.9	14.4	20.8	18.4	~~15.9~~ 17.4

JT 9/15

Additional Sample Period Comments

[illegible]

Soil Sample Tracking

Split #	Sample ID	Comments
1	RAFS1-High-L3	
2		
3		
4		
5		

Door