

**Environmental Technology
Verification Program
Advanced Monitoring
Systems Center**

Test/QA Plan for Verification of
Releasable Asbestos Field Sampler



Verification of Releasable Asbestos Field Sampler

August 2, 2010

Prepared by

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SECTION A
PROJECT MANAGEMENT

A1 VENDOR APPROVAL PAGE

ETV Advanced Monitoring Systems Center
Test/Quality Assurance Plan for Verification of
Releasable Asbestos Field Sampler

Version 1.0

August 2, 2010

APPROVAL:

Name _____

Environmental Quality Management, Inc. _____

Date _____

Notice

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A3 ACRONYMS AND 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
EQ	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

A4 DISTRIBUTION LIST

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Christina Leung, EPA Region 2,
Weedspport Site

A5 VERIFICATION TEST ORGANIZATION

The verification test will be conducted under the U.S. Environmental Protection Agency (EPA) Environmental Technology Verification (ETV) Program. It will be performed by Battelle, which is managing the ETV Advanced Monitoring Systems (AMS) Center through a cooperative agreement with EPA. The scope of the AMS Center covers verification of monitoring technologies for contaminants and natural species in air, water, and soil. This verification test will evaluate a field sampler that provides air samples for quantitative measurement of the releasability of asbestos from soil *in situ*.

The objective of the verification is to test the ability of the Releasable Asbestos Field Sampler (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). This will be accomplished by generating data for performance parameters that will 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). The performance parameters for this test are accuracy, reproducibility, comparability, variability/consistency, and a number of operational factors defined in Section B.

The performance of the RAFS will be based on comparison with measurements made through ABS, an EPA-designated reference sampling method for asbestos. For this test ABS will be conducted by the site representative, and results from the ABS will be compared to those from the RAFS technology. The ABS samples will be collected on the same day as the RAFS samples (or within 24 hours). ABS samples will be collected by the site representative. Filter samples from both the RAFS and ABS will be analyzed using International Organization for Standardization (ISO) Method 10312:1995 (ISO 10312), but conducted at different laboratories. Quality control (QC) samples will be submitted, and a performance evaluation (PE) audit will be conducted by Battelle at each laboratory as a QC check of the inter-laboratory variability, and to assess their QC procedures. Standard operating procedures (SOPs) will be obtained and reviewed from each laboratory.

The day to day operations of this verification test will be coordinated and supervised by Battelle, with the participation of the RAFS technology vendor. Laboratory testing of the RAFS technology will be conducted at Battelle in Columbus, Ohio. Field tests will be conducted at a site in Libby, Montana, (Asbestos Site Operable Unit 4 [Libby OU4]) and at a site in Weedsport, New York. The vendor will

provide Battelle with two replicate copies of the technology, and will train Battelle staff on its use. Battelle staff and the vendor will operate the technology during verification testing.

The organization chart in Figure 1 identifies the responsibilities of the organizations and individuals associated with the verification test. Roles and responsibilities are defined further below. Quality assurance (QA) oversight will be provided by the Battelle Quality Manager, the designated Battelle Quality Assurance Officer (QAO), and also by the EPA AMS Center Quality Manager, at her discretion.

A5.1 Battelle

Dr. Ramona Darlington is the AMS Center's Verification Test Coordinator (VTC) for this test. In this role, Dr. Darlington will have overall responsibility for ensuring that the technical, scheduling, and cost goals established for the verification test are met. Specifically, Dr. Darlington will:

- Prepare the draft test/QA plan (TQAP), verification report(s), and verification statement(s);
- Revise the draft TQAP, verification report(s), and verification statement(s) in response to reviewers' comments;
- Assemble a team of qualified technical staff to conduct the verification test;
- Establish a budget for the verification test and manage staff to ensure the budget is not exceeded;
- Coordinate with the vendor for provision of its technology for testing;
- Direct Battelle technical staff in the laboratory testing and coordinate with vendor personnel for performance of the field testing;
- Direct the team in performing the verification test in accordance with this TQAP;
- Hold a kick-off meeting approximately one week prior to the start of the verification test to review the critical logistical, technical, and administrative aspects of the verification test. Responsibility for each aspect of the verification test will be confirmed by the VTC;

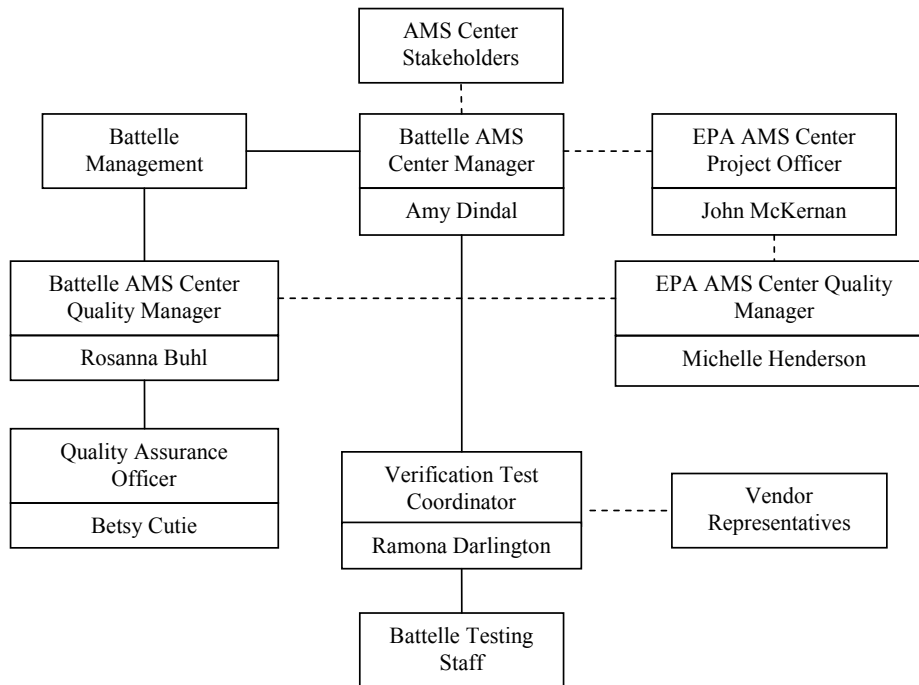


Figure 1. Organizational Chart

- Ensure that all quality procedures specified in this EPA Quality Level III test/QA plan¹ and in the AMS Center Quality Management Plan² (QMP) are followed;
- Serve as the primary point of contact with the vendor representative;
- Ensure that confidentiality of sensitive vendor information is maintained;
- Assist vendor as needed during verification testing;
- Become familiar with the operation of the technology through instruction by the vendor, if needed;
- Prepare a deviation report for any departure from the TQAP during the verification, obtain the requisite EPA approvals, and distribute the approved report as specified in the AMS Center QMP;
- Respond to any issues raised in assessment reports, audits, or from test staff observations, and institute corrective action as necessary; and
- Coordinate distribution of the final TQAP, verification reports, and verification statements.

¹ 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.

² 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.

Ms. Amy Dindal is Battelle's Manager for the AMS Center. As such, Ms. Dindal will oversee the various stages of verification testing. Ms. Dindal will:

- Review the draft and final TQAP;
- Attend the verification test kick-off meeting;
- Review the draft and final verification report(s) and verification statement(s);
- Ensure that necessary Battelle resources, including staff and facilities, are committed to the verification test;
- Maintain communication with EPA's technical and quality managers; and
- Issue a stop work order if Battelle or EPA QA staff discovers adverse findings that will compromise test results.

Technical staff from Battelle will support Dr. Darlington in planning and conducting the verification test. The responsibilities of the technical staff will be to:

- Assist in planning for the test, and making arrangements for the receipt of and training on the technology;
- Attend the verification test kick-off meeting if participating in testing (e.g., operating the vendor technology);
- Perform statistical calculations specified in this TQAP on the verification data as needed;
- Provide results of statistical calculations and associated discussion for the verification report(s) as needed; and
- Support Dr. Darlington in responding to any issues raised in assessment reports and audits related to statistics and data reduction as needed.

Ms. Rosanna Buhl is Battelle's QA Manager for the AMS Center. Ms. Buhl will:

- Review the draft and final TQAP;
- Assign a QAO for each verification test;
- Delegate to other Battelle quality staff any QAO responsibilities assigned below as needed to meet project schedules;
- Review any audit checklists prepared by the QAO for completeness and detail;
- Review draft audit reports prior to release to the VTC and/or EPA for clarity and appropriate assessment of findings;
- Review audit responses for appropriateness;

- Review and approve TQAPs, TQAP amendments, deviations and audit reports;
- Maintain real-time communication with the QAO on QA activities, audit results, and concerns;
- Work with the QAO, VTC, and Battelle's AMS Center Manager to resolve data quality concerns and disputes; and
- Recommend a stop work order if audits indicate that data quality or safety is being compromised.

Ms. Betsy Cutié is Battelle's QAO for this test. Ms. Cutié will:

- Attend the verification test kick-off meeting and lead the discussion of the QA elements of the kick-off meeting checklist;
- Prior to the start of verification testing, verify the presence of applicable training records, including any vendor training on test equipment;
- Conduct a technical systems audit at least once during the verification test;
- Conduct audits to verify data quality;
- Prepare and distribute an audit report for each audit;
- Verify that audit responses for each audit finding and observation are appropriate and that corrective action has been implemented effectively;
- Communicate to the VTC and/or technical staff the need for immediate corrective action if an audit identifies TQAP deviations or practices that threaten data quality;
- Provide a summary of the QA/QC activities and results for the verification reports;
- Review the draft and final verification report(s) and verification statement(s);
- Maintain real-time communication with the Battelle Quality Manager on QA activities, audit results, and concerns, including potential schedule and budget problems;
- Communicate data quality concerns to the VTC and/or Battelle's AMS Center QA Manager; and
- Recommend the need for a stop work order if audits indicate that data quality or safety is being compromised.

A5.2 Technology Vendor

The technology vendor is Environmental Quality Management, Inc. (EQ). Mr. John Kominsky is EQ's representative and point of contact. The responsibilities of the technology vendor are:

- Review and provide comments on the draft TQAP;
- Accept (by signature of a company representative) the final TQAP prior to test initiation;
- Participate in the kick-off meeting for the verification test;
- Initially provide two replicates of the technology to carry out comparative analysis during the verification test;
- Supply instructions on the use of the technology, and written consent for test staff to carry out verification testing; and
- Review and provide comments on the draft verification report and verification statement for their respective technology.

A5.3 EPA

EPA's responsibilities in the AMS Center are based on the requirements stated in the "Environmental Technology Verification Program Quality Management Plan" (EPA QMP). The roles of specific EPA staff are as follows:

Ms. Michelle Henderson is EPA's AMS Center Quality Manager. For the verification test, Ms. Henderson will:

- Review the draft TQAP;
- Perform one external technical systems audit during the verification test;
- Notify the EPA AMS Center Project Officer of the need for a stop work order if the external audit indicates that data quality is being compromised;
- Prepare and distribute an assessment report summarizing results of the external audit; and
- Review draft verification report(s) and verification statement(s).

Dr. John McKernan is EPA's Project Officer for the AMS Center. Dr. McKernan will:

- Review the draft TQAP;
- Approve the final TQAP;
- Review and approve deviations to the approved final TQAP;
- Appoint a delegate to review and approve deviations to the approved final TQAP in his absence, so that testing progress will not be delayed. Review the first day of data from the verification test and provide immediate comments if concerns are identified;
- Review the draft verification report(s) and verification statement(s);

- Oversee the EPA review process for the TQAP, verification reports, and verification statements; and
- Coordinate the submission of verification reports and verification statements for final EPA approval.

A5.4 Verification Test Stakeholders

This TQAP and the verification report(s) and verification statement(s) based on testing described in this document will be reviewed by experts in the fields related to asbestos sampling. The following experts have been providing input to this TQAP and have agreed to provide a peer review.

- Mark Follansbee, SRC, Inc.
- Patricia Billig, SRC, Inc.
- Jonathan Thornburg, Ph.D., Research Triangle Institute
- Dave Ferguson, EPA
- Bill Barrett, Ph.D., EPA
- Jim Konz, EPA

The responsibilities of verification test stakeholders and/or peer reviewers include:

- Participate in technical panel discussions (when available) to provide input to the test design;
- Review and provide input to the draft TQAP; and
- Review and provide input to the verification report(s)/verification statement(s).

In addition, this technology category was reviewed with the broader AMS Center Stakeholder Committees during the regular stakeholder teleconferences, including the June 2010 meetings, and input from the committees was solicited.

A5.5 Reference Laboratory

The reference laboratory, Forensic Analytical, is required to receive and analyze filters for asbestos from the vendor technology as well as soil samples. (Note that samples collected using the ABS reference method will be analyzed at a laboratory selected by the specific site. In such a case, both analytical laboratories will follow ISO Method 10312:1995, as well as the counting and stopping rules. Battelle will send a performance evaluation reference filter and soil samples to both laboratories for analysis to determine inter-laboratory variability). Secondly, 5% of the samples will be designated as PE samples

and distributed to both analytical laboratories. Five percent of the soil and filter samples analyzed by Forensic Analytical will be identified by the VTC as additional PE audit samples. These will be forwarded to the site laboratory for replicate analysis and verified counting. Mr. Jim Flores will be the contact person for Forensic Analytical. The responsibilities of the reference laboratory for this verification test include:

- Maintaining accreditation 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);
- Acknowledging receipt of filter samples and maintaining the chain-of-custody forms for the samples;
- Analyzing air filter and soil samples by TEM direct-transfer technique using ISO Method 10312:1995. The target analytical sensitivity is 0.005 (cc)^{-1} . The aspect ratio for analysis is 3:1. All structures 0.50 micrometer (micron or μm) or longer in length are to be quantified with the following breakdown according to ranges by length: ≥ 0.50 to $5.0 \mu\text{m}$; $\geq 5.0 \mu\text{m}$ to $10 \mu\text{m}$; and larger than $10 \mu\text{m}$;
- Providing analysis results within 30 days of receipt of samples;
- Providing documentation as requested (such as SOP) for an independent technical systems audit (TSA) of laboratory procedures; and
- Participating in a PE audit (see Section C1.1). Since this is an accredited laboratory, an on-site audit of the laboratory is not anticipated, provided the laboratory meets the acceptable criteria of the performance evaluation audit.

A6 BACKGROUND

A6.1 Technology Need

The ETV Program's AMS Center conducts third-party performance testing of commercially available technologies that detect or monitor natural species or contaminants in air, water, and soil. The purpose of ETV is to provide objective and quality assured performance data on environmental technologies so that users, developers, regulators, and consultants can make informed decisions about purchasing and applying these technologies. Stakeholder committees of buyers and users of such technologies recommend technology categories, and technologies within those categories, as priorities for testing. Among the technology categories recommended for testing are asbestos field samplers. In particular, the use of sampling technologies for the measurement of releasable asbestos fibers from soil *in situ* was identified as an area of interest for technology verification.

Asbestos becomes aerosolized or released when material and surfaces on which asbestos fibers are contained are disturbed by human activity or natural forces. The resultant health risk is due to inhalation of airborne asbestos fibers. Currently, EPA has established ABS as the preferred approach for measuring a person's inhalation exposure during surrogate activities such as lawn mowing, raking, jogging, or riding motorcycles/ATVs that can release asbestos from the soil. It is, however, an expensive and labor-intensive procedure and EPA has acknowledged that the surrogate activities may not adequately capture all personal exposures. ABS provides information on a single area under one set of environmental conditions with a choice of multiple exposure scenarios. Other methods available for determining asbestos aerosolization from soil are not suitable for field use. The methods require removal and transport of the soil, thereby potentially altering the physical characteristics of the matrix and subsequent aerosolization.

An alternative technology appropriate for field use is therefore needed that provides repeatable and representative asbestos aerosolization data from soil *in situ* with less labor and at a lower cost than ABS at comparative exposure scenarios.

A6.2 Technology Description

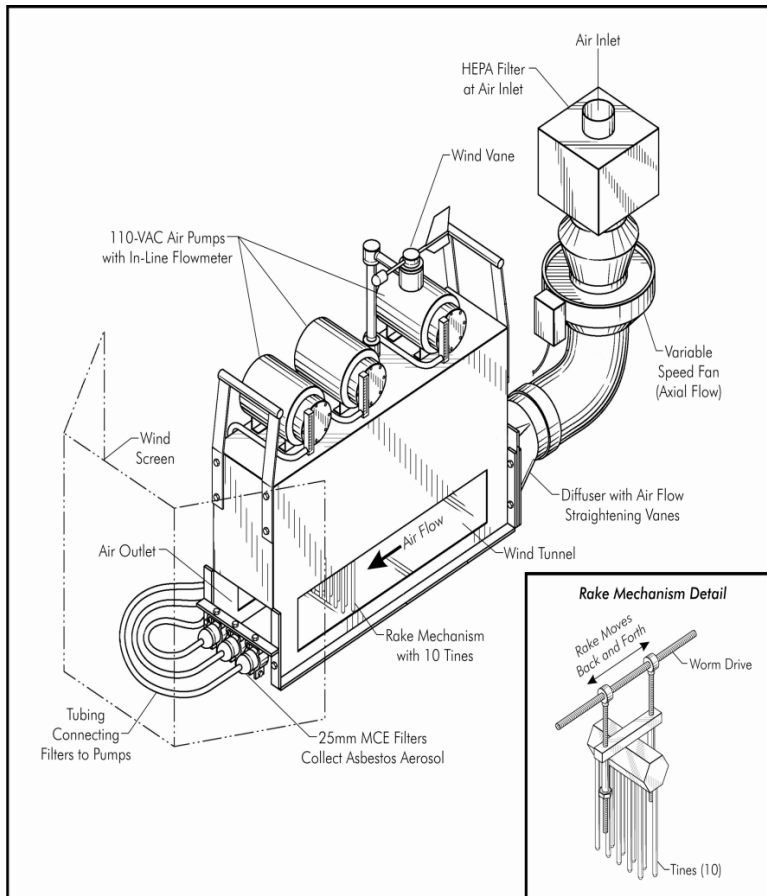
The following technology description was provided by the vendor. The RAFS, which is owned by EQ (U.S. Patent No. 7,758,813), is a field-portable system for determining the potential for exposure to asbestos fibers released from soils. The RAFS was designed to measure the emission rate (asbestos

structures/sec) and concentration (asbestos structures per cc of air) from soil. 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 2). 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 the 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. 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 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, smaller-sized particles are not collected in a representative manner.



**Figure 2. Schematic of RAFS with Rake Mechanism Detail
(U.S. Patent Number 7,758,813)**

A7 VERIFICATION TEST DESCRIPTION AND SCHEDULE

The purpose of the test is to generate performance data on a field technology for collecting air samples to determine the concentration of asbestos released from soil *in situ* during soil raking activities. The data generated from this verification test are intended to provide organizations and users interested in operating this sampling technology with information on the accuracy of measurements and comparability of the sampling technology to ABS utilizing activities that are most similar to the RAFS operations (e.g., soil raking).

A7.1 Verification Test Description

The purpose of this TQAP is to specify procedures for a verification test applicable to sampling and measuring asbestos releasability from soil. The primary evaluation is to compare releasability measured by the asbestos field sampler (RAFS) to those made by the EPA-preferred ABS method. In performing the verification test, Battelle will follow the technical and QA procedures specified in this TQAP, and will comply with the data quality requirements in the AMS Center QMP.²

Testing will be conducted in three phases over a two-month period (Table 1) by Battelle staff and the vendor. Each phase will involve approximately one week of testing. Field testing will be conducted in two phases, and laboratory testing will be conducted in one phase.

The RAFS samplers will be evaluated on the following performance parameters, described in detail in Section B:

- Comparability;
- Accuracy;
- Reproducibility;
- Variability/Consistency; and
- Operational factors (qualitative assessment).

The field testing will be done in two phases (Phases 1 and 3) with each phase involving a different site. Three of the performance parameters, comparability, reproducibility and operational factors will be tested in the field. The same tests will be performed at both sites. At least three areas (10 by 10 ft) at each site will be tested. Specific tests using the RAFS will be conducted at three sampling points within each area.

The sampling parameters such as fan speed, rake power (characterized by rake traverse cycles/minute) and sample volumetric flow rate will be approximately the same. The reproducibility of the sampler will be tested by comparing the asbestos concentration measured by the filters within the RAFS. RAFS and ABS sampling will be conducted within site areas known to contain concentrations of asbestos greater than 0.25% to assess the comparability of the sampler to ABS. Soil samples will be taken at each of the sampling points.

Table 1. Planned Verification Test Activities and Approximate Schedule

Tests	Phase	Expected Month of Completion	Location	Testing Activities
Field	1	August 2010	Libby, Montana	EPA approved ABS method by raking Reproducibility of the RAFS Operational parameters Technical systems audit Audit of data quality
	3	September 2010	Weedspport, NY	EPA approved ABS method by raking Reproducibility of the RAFS Operational parameters Audit of data quality
Laboratory	2	September 2010	Battelle Laboratories Columbus, OH	Accuracy of sampler in soil known to contain asbestos Variability and consistency between two replicate RAFS samplers Technical systems audit Audit of data quality

Operational parameters including ease of use, training and sustainability (sampling time, waste produced, and the amount of protective equipment required by the individual operating the instrument) will be evaluated by Battelle staff. More details on the test design are provided in Section B.1.3.

The laboratory testing will be done in one phase. Two of the performance parameters, accuracy and variability/consistency will be verified in the laboratory. The laboratory tests allow an evaluation of the accuracy of measurement by testing the instrument in soils spiked with asbestos fibers. A loose soil containing fine and coarse grained sand and organic matter will be used. Soil moisture content is critical when utilizing the RAFS that tests the releasability of asbestos from soil. By varying the soil moisture content, the ability of the RAFS sampler to determine asbestos concentration within its acceptable range of soil moisture contents (< 35% soil moisture content) will be tested.

Subsequent to verification testing, Battelle will prepare one verification report for the field and laboratory evaluations. The report will describe the RAFS performance on the verification parameters tested within each phase of the verification (as described in Section B.1.3). The report will be reviewed by the technology vendor and by peer reviewers, and revised and submitted to EPA for final approval. In performing the verification test, Battelle will follow the technical and QA procedures specified in this TQAP and will comply with the data quality requirements in the AMS Center QMP.

Quality procedures include a TSA and audit of data quality (ADQ). The Battelle QAO or her designee will perform the TSA. The first batch of data will be delivered within 30 days of test initiation. Unaudited data will include the disclaimer “has not been reviewed by Battelle QA Manager.” The first ADQ will review the first batch of data delivered. Subsequent ADQs will be performed for each phase of testing. Additional quality procedure details are provided in Section C.

A7.2 Verification Test Schedule

Table 1 shows the planned schedule of activities for the verification testing and data analysis and reporting. Both laboratory and field testing of the RAFS samplers will be initiated upon final EPA and vendor approval of this TQAP, and are planned to begin on or about August 1, 2010. Testing at the second field site is planned for September 2010. Laboratory and field testing will occur over approximately a two-month period.

A7.3 Verification Location

Laboratory testing will be conducted in the Environmental Laboratory at Battelle in Columbus, Ohio. Field testing will be conducted at two sites (Libby OU4, MT and Weedsport, NY).

A7.3.1 Environmental Laboratory. Battelle staff will conduct testing in laboratories that are fully equipped to handle asbestos-related activities and soils in a controlled environment. The Environmental Laboratory is located at the Battelle Columbus campus.

A7.3.2 Field Test Sites. Phase 1 of the verification test will be field testing at the Libby OU4 Montana Site. Libby is a community in northwestern Montana, located 7 miles southwest of an open pit vermiculite mine that operated from 1920 until 1990. Studies at the site revealed that the vermiculite from the mine contains amphibole-type asbestos (LA). EPA collected initial data beginning in 2005 to

evaluate human exposure to LA, and the efficacy of cleanup activities. Although the data varied widely, a discernable 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. At Libby, testing will be conducted in the yards of four Libby residents.

Phase 3 of the verification test will be field testing at the Weedsport, New York site. The former Zonolite Company/W.R. Grace facility located on Dunn Road in Brutus, New York, operated from 1963 until 1989. The facility was known as the "Weedsport facility" because of its close proximity to the Village of Weedsport. The Agency for Toxic Substances and Disease Registry (ATSDR³) and the New York State Department of Health (NYSDOH) are evaluating the plant because it processed vermiculite mined in Libby. The facility exfoliated ("popped" or expanded) vermiculite ore to manufacture insulation, building products, agricultural products, and fireproofing material (under the brand name Monokote[®]). This process released asbestos fibers from the ore into the air, where they could be inhaled. It also produced unpopped, waste vermiculite often known as stoner rock. The facility processed an estimated 148,485 tons of vermiculite from Libby. Before leaving the site in 1989, W.R. Grace cleaned the former exfoliating building and had a contractor collect air samples inside the structure. The results showed no asbestos. Recent EPA soil sampling at this site showed some asbestos in soil. Currently, the site is unoccupied.

³ Perkins, R.L and B.W. Harvey. 1993. Method for Determination of Asbestos in Bulk Building Materials. ISO Method 10312:1995 EPA/600/R-93/116.

A8 QUALITY OBJECTIVES

This verification test is designed to evaluate the performance of RAFS samplers in determining the releasability of asbestos from soil *in situ*. This verification will vary soil conditions in the laboratory and instrument parameters throughout the verification to include instrument challenges under controlled and repeatable test conditions. ABS samples will be analyzed for asbestos using the same analytical method (i.e., ISO 10312:1995). The quality indicators for this verification test lie in the performance parameters and the QC samples. Acceptance criteria for the QC samples are detailed in Tables 2 and 3.

Table 2. Sample Collection Quality Control Assessments During RAFS Verification

Type of Sample or Data	Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
RAFS Air Sample	Asbestos	Field Blank	1 per area	< 0.005 str/mm ²	Blank correct sample data
		Equipment Blank	1 per area	< 0.005 str/mm ²	Blank correct sample data
		Triplicate	See Table 7	20% RPD	Flag sample as potentially invalid. Investigate cause
	Met 1 Optical Particle Counter	Zero Check	1 per day per OPC	< 10 particles per L of air	Repeat until criteria achieved
RAFS Rake Speed	Speed	Replicate Measurements	2 per experiment	5% RPD	Repeat until criteria achieved
RAFS Air Speed	Speed	Replicate Measurements	2 per experiment	5% RPD	Repeat until criteria achieved
Soil	Asbestos	Replicate Samples	2 per location	n/a	n/a
Soil Moisture	% H ₂ O	Replicate Measurements	5 per location	5% RSD	Recalibrate and retest

Table 3. Sample Analysis Quality Control Assessments

Type of Analysis	Analytes	QC Check	Frequency	Acceptance Criteria	Corrective Action
TEM ISO Method 10312:1995	Asbestos (str)	Lot Blank	2 per Lot	< 10 str/mm ²	Reject filter lot
		Lab Blank	1 per batch of filters prepared	< 10 str/mm ²	Collect and analyze Clean Area Blank, re-prep sample.
		Clean Area Blank	When a Lab Blank does not meet acceptance criteria	< 10 str/mm ²	Identify and eliminate source of contamination
		Replicate Analysis	Not to exceed 5% of total number of samples	Replicate ^(a) = 1.96 Duplicate ^(a) = 2.24	Re-examine grids to determine cause of variation
		Verified Counting (intra-lab, inter-lab)	Not to exceed 5% of total number of samples	Replicate ^(a) = 1.96 Duplicate ^(a) = 2.24	Re-examine grids to determine cause of variation
		Duplicate Analysis	Not to exceed 5% of total number of samples	Replicate ^(a) = 1.96 Duplicate ^(a) = 2.24	Re-examine grids to determine cause of variation; re-prep sample
		Inter-laboratory Duplicate Analysis	Not to exceed 5% of total number of samples	Replicate ^(a) = 1.96 Duplicate ^(a) = 2.24	Re-examine grids to determine cause of variation; re-prep filter samples
PLM	Asbestos (points)	Replicate Analysis	Not to exceed 5% of total number of samples	Replicate ^(a) = 2.24 Duplicate ^(a) = 2.50	Re-examine sample to determine cause of variation; re-prep sample
		Duplicate Analysis	Not to exceed 5% of total number of samples	Replicate ^(a) = 2.24 Duplicate ^(a) = 2.50	Re-examine sample to determine cause of variation; re-prep sample

(a) Analytical Precision: This variability is the absolute value of the difference of the two analyses, divided by the square root of the sum, which is an estimate of the standard deviation of the difference based on a Poisson counting model. For replicate air samples, for which the simple Poisson model is most directly applicable, the value 1.96 is chosen so the criterion will flag approximately 1 replicate pair out of 20 for which the difference is due only to analytical variability, i.e., it has a “false positive” rate of 5%. For the other types of analyses, where greater natural variability is expected than indicated by a pure Poisson model, the criterion value has been increased from 1.96 in order to avoid flagging excess cases where the difference between the values is due only to normal variation, and not to issues with either analysis. The values 2.24 and 2.50 were selected as targeting false positive rates of 2.50% (1/40) and 1.13% (1/80) for the Poisson model.

$$\text{Analytical Precision} = \frac{(\text{Analysis A}) - (\text{Analysis B})}{\sqrt{\text{Analysis A} + \text{Analysis B}}}$$

Example: For replicate air samples where A = 0 fiber and B = 3 fibers, the variation is considered acceptable, while A = 0 and B = 4 would be flagged for further investigation. Likewise A = 1 and B = 6 is acceptable, while A = 1 and B = 7 is flagged. At higher levels, A = 20 and B = 34 is acceptable, but A = 10 and B = 24 is flagged.

A9 SPECIAL TRAINING/CERTIFICATION

Documentation of training related to technology testing, field testing, data analysis, and reporting is maintained for all Battelle technical staff in training files at their respective locations. The Battelle Quality Manager will verify the presence of appropriate training records prior to the start of testing. Battelle and EPA staff involved in this verification at the field sites will be specifically trained on the operation of the participating technology. Training in the use of the RAFS sampler will be based on the instructions provided in the vendor's user manual (Appendix G) and through hands-on training. Battelle will document this training with a consent form, signed and dated by the vendor, which states which Battelle technical staff have been trained to use the technology and can train other staff to do so as well. In the event that other staff members are required to use the technology, they will be trained by the operators that were trained by the vendors.

HAZWOPER training and respirator fit testing are required in order to work at the field sites, and at Battelle Columbus when using the asbestos-spiked soils. Health and safety plans at both the Battelle laboratory and field sites will be followed.

A10 DOCUMENTATION AND RECORDS

The documents for this verification test will include the TQAP, vendor instructions, reference methods, verification reports, verification statements, and audit reports. The project records will include laboratory record books (LRBs) and data collection forms, supporting laboratory records, training records, electronic files (both raw data and spreadsheets), and QA audit files. Section B10 summarizes data management for the test and the types of data to be recorded. Documentation of Battelle staff training by vendors and copies of other project specific training will also be included in the project files. All of these records will be maintained by the VTC during the test, and will be transferred to permanent storage at Battelle's Records Management Office (RMO) at the conclusion of the verification test. All Battelle LRBs are stored indefinitely with the project files by Battelle's RMO. Section B10 further details the data management practices and responsibilities.

All data generated during this project will be recorded directly, promptly, and legibly in ink. All data entries will be dated on the date of entry, and signed or initialed by the person entering the data. Any changes in entries will be made so as not to obscure the original entry, will be dated and signed or initialed at the time of the change and will indicate the reason for the change. Project-specific data forms will be developed prior to testing to ensure that all critical information is documented in real time. The draft forms will be provided to the Battelle QA Manager for review.

SECTION B

MEASUREMENT AND DATA ACQUISITION

B1 EXPERIMENTAL DESIGN

This TQAP addresses the verification of RAFS samplers through laboratory and field testing. Specifically, the RAFS sampler will be evaluated for the following performance parameters:

- Comparability;
- Accuracy;
- Reproducibility;
- Variability/Consistency; and
- Operational factors (including sustainability).

The verification test will be conducted over a period of two months. The field testing will be completed in two phases, with each phase being at a different site; laboratory testing will be completed at Battelle's laboratories in Columbus.

B1.1 Test Procedures

The following sections describe the test procedures that will be used to evaluate each of the performance parameters listed above. Accuracy and variability/consistency will be evaluated in the laboratory. Reproducibility, comparability and operational factors will be tested in the field. Cost information will be provided by the technology vendor (i.e., price of instrument, operation and maintenance cost). The performance parameters are defined in detail in Table 4.

B1.1.1 Field Testing. Field testing will be performed in a similar manner at each of the two field test sites. The site will be prepared by cordoning off at least three distinct areas. The areas could be 10 ft by 10 ft squares at an industrial site (Weedsport, NY) or the yard of a private residence (Libby, MT). To be consistent, similar sampling points around each home will be selected for sampling. Within each area, a minimum of three sampling points will be selected for RAFS operation. Ideally, each soil type, soil cover, and asbestos contamination level for the test areas will be as similar as possible, but the asbestos contamination level in the soil may be significantly different. A relatively flat testing area, approximately 1 ft wide and 4 ft long, will be selected for the RAFS. This will allow the RAFS to maintain solid contact with the soil. The sampler tunnel has a footprint of 6-inches wide by 24-inches long. An uneven surface

Table 4. Summary of Tests and Testing Frequency

Location	Phase	Performance Parameter	Objective	Variable	Comparison Based On	Testing Frequency	Minimum number of data points from asbestos filters	Number of data points from soil sampling
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 8 sites, equally divided between Libby, MT and Weedsport, NY	8	8
	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 will be applied at the same sampling point and the asbestos concentration obtained from each will be compared	The RAFS will be applied at three locations within one ABS sampling area	24	24
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 will be applied at three locations within the 4ft by 4ft wooden frame with soil	21	7
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 will be applied at three different sampling locations in soil known to contain asbestos. A second independent sampler will also be applied in the soil known to contain asbestos	18	6

beneath the tunnel walls will be evened to prevent the release of air beneath the walls. Small gaps between the sampler and the soil will be filled with extra soil.

The surface beneath the sampler tunnel walls will be leveled to ensure that the rake tines reach a depth of between $\frac{1}{4}$ to $\frac{3}{4}$ -inch into the soil. The rake tines will maintain consistent contact with the soil along the entire length of traverse during sample collection.

The sampling point soil will be kept free of rocks, twigs, roots, and other detritus larger than approximately $\frac{1}{2}$ -inch in any dimension to prevent the rake mechanism from stalling. As a general rule, the sampling point is acceptable if the bare soil to vegetation ratio is 1:1 with even coverage. Heavy vegetation, such as a lawn, will require removal of vegetation to achieve the 1:1 ratio. Extremely compacted soil may be gently loosened with a hand-held pickax if the rake tines are unable to penetrate the soil. These conditions will be applied to test areas for RAFS and ABS.

The rake will be mounted to a shaft, which is attached to a motorized screw-drive. The mounting connection allows for a moderate degree of lateral motion as the rake traverses the tunnel. The lateral motion of the rake increases the surface area of the soil that is mechanically disturbed. As the rake traverses the tunnel, grooves are created in the soil and the rake mechanism is lowered by its weight to accommodate the soil plane. Typically, the rake reaches a depth of approximately $\frac{1}{8}$ -inch in compacted soil, $\frac{1}{4}$ -inch in firm soil, and greater than $\frac{1}{2}$ -inch in sandy soil.

If precipitation is forecasted, the sampling points will be covered with approximately a six by six ft plastic tarp, held in place with tent stakes to maintain the soil moisture content. The soil moisture content will be measured at five locations around the sampler's footprint to obtain a representative value of the soil moisture content (i.e., measured at the four ordinal points and at the center of RAFS tunnel). Before the RAFS is used, the soil moisture content will be measured using a soil moisture meter. A MetOne (or equivalent) particle counter will be utilized to measure the releasability of particles from the soil surface to determine the period of time required for collecting each sample. Soil samples will be taken from each one by four ft area at the center of the RAFS and at the four cardinal points of the sampler, and composited into one soil sample to determine the asbestos concentration in the soil. Therefore, there will be one composite soil sample per RAFS sampling point. The SOP for soil sampling is provided in Appendix A. The asbestos content in these soil samples will be measured by 1,000 point count (0.1%) by PLM using EPA 600/R-93/116.

Determining sampling time- Sample collection is dependent on the generated aerosol concentration and sample volume (sampling flow rate x sampling time) of the RAFS sampler. Sample periods will be sufficiently long to collect an adequate amount of aerosol to achieve the specified direct-transfer TEM analytical detection limit (e.g., 0.005 [cc]⁻¹). The following methods will be used to determine the sampling time.

- a) A hand-held optical particle counter (e.g., MetOne GT-521) will be used to determine the particulate air concentration (i.e., number particles/cm³) or generation rate (number particles per second) from the RAFS. The MetOne particle counter manual is provided in Appendix E. Typically, the highest particle concentration and generation rate occur within the first five minutes of sample collection. Hence, the sample collection time for the first sample will be determined based on the air concentration or generation rate after the first five minutes. Table 5 provides guidance on determining sampling time for the first sample to obtain an acceptable filter loading for asbestos analysis using direct transfer specimen preparation for TEM analysis.

Table 5. Guidance to Determine Target Sampling Time Based on Generated Particulate Number, Generation Rate, or Concentration

Aerosol Concentration (number of particles/cm ³)	Sampling Time (mins)	Sample Volume (liters ^a)
>25	5 or less	< 68
~ 10	5 to 10	68 to 135
~ 5	10 to 20	135 to 270
~ 2	15 to 40	203 to 540
~ 1	30 to 75	400 to 1000
<1	45 to 110	600 to 1500

- b) After initiating the test sample, once the target sampling period is reached, all three sampling pumps (pumps within the RAFS that pull air over the soil and through the filters) will be paused and the filter cassette removed from location #1 for observation by visual examination by an unaided eye. Based on the visual examination of the filter particulate loading, sampling will either be terminated and the remaining two filter cassettes removed, or sampling will continue with the sampling on filter cassettes #2 and #3. If loading is insufficient on location

#1, the cassette will be reinserted for additional sample collection. Otherwise filter cassette #1 will be properly stored for potential subsequent TEM analysis in the laboratory.

Typically, the sampling period for the second filter cassette will extend five, 10, or 15 minutes (or even longer), depending on the visible particulate loading on the filter and the aerosol concentration being observed. After achieving the target sampling period, the two sampling pumps will be paused, and the filter cassette removed from location #2. Based on the visual examination of the filter particulate loading, either the sampling will be terminated and the third filter cassette removed, or sampling on filter cassette #3 will be continued. If loading is insufficient on location #2, the cassette will be reinserted for additional sample collection. Otherwise filter cassette #2 will be properly stored for potential subsequent TEM analysis in the laboratory.

- c) The sampling period for the third filter cassette will extend five, 10, or 15 minutes (or even longer) depending on the visible particulate loading on the filter and the aerosol concentration being observed. After achieving the target sampling period, the sampling pump will be paused, and the filter cassette removed from location #3. If loading is insufficient on location #3, the cassette will be reinserted for additional sample collection. The filter cassette will be properly stored for potential subsequent TEM analysis in the laboratory.
- d) The sample time for the sample with the largest air volume and acceptable particulate loading for TEM analysis using direct transfer specimen preparation will be selected and the corresponding sampling time will be used to collect all samples.

Determining soil moisture content – The vendor indicated that soil moisture content should be below 35% for proper release and aerosolization of asbestos from the soil. Soil moisture content will be measured by a soil moisture meter (e.g., FieldScout TDR 100 Soil Moisture Meter). The manual for the soil moisture meter is provided in Appendix D. Data quality indicators (DQIs) or quality parameters are presented in Table 2.

B1.1.2 Reproducibility. Reproducibility assessment will determine the precision of the asbestos concentrations measured by the RAFS. With each application of the RAFS, up to three independent filters are obtained. If the fan speed, rake power, volumetric flow rate, and sample time (Table 6) are kept

reasonably constant, the concentration of asbestos detected on the three filters contained each time the RAFS is applied should be similar. Similar concentrations indicate that the RAFS measurements are reproducible. To obtain sufficient data to conduct a statistical evaluation, asbestos concentration on the three filters will be compared for each sampling point. At the RAFS reproducibility, triplicate samples will be collected at a minimum of eight locations (four at Libby and four at Weedsport). Asbestos concentration on the three filters for each sampling point will be compared as described in Section B1.3.

Table 6. Vendor-Specified Operating Parameters

Item	Target Setting	Adjustment Location
Fan (air velocity)	280 - 380 fpm	RAFS control panel
Rake (traverse speed)	1 cyc/20 - 30 s	RAFS control panel
Sampling pump (flow rate)	13 - 14 lpm	Rotameter flow valve

B1.1.3 Comparability. Comparability refers to the ability of the RAFS sampler to monitor releasability of asbestos at the same or similar level to the EPA ABS method (considered the reference measurement). Use of the RAFS will follow the manual provided with the equipment, and ABS activities will be conducted as outlined in the SOP for Activity Based Sampling, SOP 2084 (Appendix C). At least eight 10 by 10 ft areas, or residences, will be selected for ABS/RAFS comparability measurements. Four areas will be located at the Weedsport, NY site and four residences will be sampled in Libby, MT. Within each area, at least three sampling points will be selected. At each sampling point, the RAFS will first be applied. ABS by raking will then be conducted in the same selected area. The asbestos concentrations obtained from a RAFS sample taken from within a given 10 by 10 ft area will be averaged for comparison with the ABS result from the same area. ABS samples will be taken by the EPA representative as outlined in the Libby OU4 Sampling and Analysis Plan. A composite sample of soil from the four cardinal points of the RAFS and at the center of the RAFS will be collected at each sampling point. Asbestos concentrations will be measured using the ISO 10312:1995 method for both the ABS and RAFS filters. A minimum of 24 soil samples (eight areas, three sampling points, five samples per point, combined into one composite sample) and 24 filters from the RAFS (eight areas, three sampling points, one filter per point) will be analyzed. Battelle will divide the sample quantities equally between Libby, MT and Weedsport, NY. Note that ISO Method 10312:1995 analysis of ABS samples will be performed

at the analytical laboratory specified by the EPA Regional Office. Table 4 outlines the number of samples to be taken.

B1.1.4 Operational Factors. The operational factors to be measured in the field include the training required to operate the RAFS sampler. The vendor will train one Battelle staff member on the use of the RAFS sampler. The Battelle staff member, as well as the vendor, will individually use the sampler during the field and laboratory tests. The Battelle staff member will then report on the ease of training and use of the RAFS. The RAFS will also be compared to the EPA approved ABS method in terms of its sustainability (i.e., the sampling time, waste produced, and the amount of protective equipment required) by the Battelle staff member. Examples of information to be recorded include vendor effort during training, ease of technology use, cost associated with maintenance of technology, overall convenience of the technology, safety issues of technology, number of samples that can be taken per day, and clarity of the vendor instructions and manual. Battelle will summarize these observations to aid in describing the operational factors for the technology in the verification report.

B1.2 Laboratory Test

The objectives of the laboratory tests are to assess the RAFS ability to release asbestos from soil as a function of environmental conditions, specifically asbestos concentration in soil and soil moisture content. The laboratory tests will be performed on topsoil in a temperature and humidity controlled laboratory. The soil used will be a mixture of fine and coarse sands with organic materials to control soil moisture. All laboratory tests will be performed in a four by four ft wooden frame holding approximately three inches of soil. Several four by four ft wooden frames will be used for the laboratory tests. The results of the laboratory tests are independent and will not be compared to the results of the field tests.

B1.2.1 Accuracy. The accuracy of the sampler will be verified by measuring the asbestos releasability from soil that is known to contain asbestos. Chrysotile "A" Rhodesian Asbestos 0.10 g will be mixed with soil and packed into a four by four ft wooden frame. Before addition of the asbestos to the soil, the moisture content of the soil in the wooden frame will be determined to ensure that soil moisture content is less than 35%. Soil samples taken at the four ordinal points around the RAFS and at the center of the RAFS will be combined into one composite soil sample. The RAFS will then be applied to the soil to determine the optimum sampling time using the procedure outlined in Section B.1.1.1. That sampling time will then be utilized to test the RAFS's ability to release and detect asbestos from the soil. The RAFS only needs to be applied at one sampling point since asbestos is known to be present. This yields

three filters and one composite soil sample. The fan speed, rake power, and sample volume will be recorded and held constant during this test (Table 6).

The aerosolization of asbestos by the RAFS will also be tested at varying soil moisture content within the acceptable range. Soil moisture content of 5% and 15% will be tested on the soil amended with asbestos starting with soil at 5% and increased by 10% by adding water before the test. The soil moisture content will be confirmed at the soil surface at least to a depth of one inch using the soil moisture meter. At each soil moisture content, the sampler will take three separate measurements. A total of 18 filters will be analyzed (two soil moisture conditions, three sampling points per moisture condition, three filters per RAFS application) and six soil samples (two soil moisture conditions, three sampling points per moisture condition, five samples per sampling point composited into one sample each).

B1.2.2 Variability/Consistency. In the laboratory, two RAFS will be used to measure the releasability of asbestos from soil known to contain asbestos. The ability of both samplers to measure the releasability of asbestos identically will be monitored by operating each sampler three times within the four by four ft wooden frame containing soil known to contain asbestos. The fan speed, rake power and sample volume collected will be recorded and remain constant for both samplers (Table 6). The length of time the samples are taken will be previously determined using the procedure described in Section B1.1.1. An average of the asbestos concentration obtained from the three filters within the RAFS will be calculated and compared to the same value for the second RAFS. A total of 18 filters will be analyzed (three per sampling event, three sampling events, for two RAFS), and six soil samples (two RAFS, three sampling events each, one composite soil sample per sampling event).

B1.3 Statistical Analysis

The analytical data obtained from the RAFS will be used to calculate the emission rate of the RAFS and the asbestos concentration released from the soil.

$$EmissionRate = \frac{AsbestosStructuresperfilter}{SamplingTime}$$

$$AsbestosConcentration = \frac{AsbestosStructuresperFilter}{SampleVolume}$$

The statistical methods and calculations used for evaluation of the quantitative performance parameters are described in the following sections.

B1.3.1 Reproducibility. The reproducibility of the data obtained from the three filters within the RAFS will be determined. The RAFS will be applied at three sampling points. At each sampling point, three filters, and therefore three data points, will be obtained and compared. This will be done at three sampling points yielding triplicate measurements. The relative percent standard deviation (RSD) between the measurements will be calculated.

$$\%RSD_i = \frac{s}{\bar{Y}_i} \times 100$$

Where \bar{Y}_i is the average sampler response i , and s the standard deviation of the sampler responses.

B1.3.2 Comparability. Comparability is the agreement between the measurements collected by two identical devices or measures (in this case, asbestos concentration obtained from the RAFS and by ABS). Comparability is reported as the relative percent difference (RPD) between multiple samples, measurements, or sample analyses. At each sample point, three filters and three asbestos concentrations will be obtained. An average of the asbestos concentration at each sampling point will be determined. At each area where ABS is applied, the RAFS is applied at four sampling points so there will be four data points to compare to each ABS result. An RPD (difference over mean) will be determined for each of the four RAFS sampling points to the ABS result.

$$\%RPD = \frac{RAFS - ABS}{(RAFS + ABS) / 2}$$

In addition, a one way ANOVA or t-test of the data will be conducted to compare the average asbestos concentration obtained from the RAFS and ABS methods.

$$t = \frac{uR - uA}{\sqrt{\frac{\text{var } R}{nT} + \frac{\text{var } A}{nA}}}$$

where u represents the average asbestos concentration for one sampling area, R represents the RAFS data, and A represents the ABS data. The variance of the data is var , and n is the number of samples.

B1.3.3 Accuracy. The accuracy of the sampler will be verified by measuring the asbestos releasability from soil that is known to contain asbestos. The details of the test are presented in Section B1.2.1.

When soil moisture concentration is found to be variable, a sampling point at each moisture concentration will be collected. From each sampling point, three asbestos concentrations will be obtained from the three filters within the RAFS. An average RAFS concentration will be obtained from the three filters. Soil moisture contents of 5% and 15% will be targeted for soils with known asbestos concentrations. The percent difference in releasability of asbestos at the different moisture conditions will be measured.

$$\%RPD = \frac{u1 - i}{(u1 + i)/2}$$

where $u1$ represents the average asbestos concentration obtained from the three filters at each RAFS sampling point, and i represents the concentration of asbestos obtained from the ABS measurement in that sampling area.

B1.3.4 Variability and Consistency. Variability and consistency is determined in a laboratory analysis by measuring the releasability of asbestos from two RAFS in soil known to contain asbestos. Each RAFS will be applied at three sampling points. From each sampling point, three asbestos concentrations are obtained from the three filters within the RAFS. An average RAFS concentration will be obtained from the three filters. This will be done three times for both RAFS. To compare the variability and consistency of the results, the RPD of the data will be determined.

$$\%RPD = \frac{u1 - u2}{(u1 + u2)/2}$$

where u_1 represents the average asbestos concentration obtained from one sampling point from the first RAFS, and u_2 represents the average asbestos concentration obtained from one sampling point for the second RAFS.

B2 SAMPLING METHOD REQUIREMENTS

Sampling will be performed according to the vendor provided instructions and training. ABS sampling will be performed by field staff at the site as part of each site's on-going characterization activities. RAFS sampling will be conducted according to the RAFS manual provided by the vendor (Appendix G). Manuals and SOPs for all instruments are provided in the appendices.

B3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Sample custody will be documented for the filter, soil, and ABS samples. A chain-of-custody (COC) form will include details about the sample, such as the time, date, location, and person collecting the sample. The COC form will track sample release from the sampling location to the testing laboratory. The COC form will be signed by the person relinquishing samples once that person has verified that the COC form is accurate. Upon arrival at the testing laboratory, COC forms will be signed by the person receiving the sample once that person has verified that all samples identified on the COC forms are present. Copies of all COC forms will be delivered to the VTC and maintained with the test records.

Section B3.2 describes the proper handling of the filter cassettes for subsequent TEM analysis. All samples will be transferred to the analytical laboratory using COC documentation.

The COC procedures emphasize careful documentation of constant secure custody of samples during the field, transport, and analytical stages of project. The sample custodian (and alternate) responsible for the proper COC during this project is:

- Person's/Name;
- Company Name/Address; and
- Phone number.

B3.1 Field Chain-of-Custody

Each sample will have a unique project identification number. This identification number will be recorded on a Sampling Data Form along with the other information specified on the form. After the labeled sample cassettes and containers are inspected, the sample custodian will complete an analysis request and COC record. This form will accompany the samples, and each person having custody of the samples will note receipt of the same and complete an appropriate section of the form. Samples will be sent to the appropriate laboratory via one or two day courier service.

B3.2 Sample Shipment

RAFS filter and soil samples will be securely packaged and shipped directly to the appropriate analytical laboratory. RAFS air filter samples will be packaged facing upwards and secured to minimize jostling, rattling, or other movement that may dislodge particles from the filter. Using the recommended procedure, the cassettes will be placed, wrapped in a paper towel, in the original egg-crate shipment box. The box will then be sealed and placed in a secondary container, such as a cooler, with appropriate packing material to minimize movement. Soil sample jars will be shipped in a separate cooler with sufficient packing material to prevent movement.

A COC sheet will accompany each shipment. At a minimum, the COC sheet will contain the site location name, sample identification number, sample type, approximate sample volume, shipper's initials, shipment date, receiver's initials, and receipt date.

B3.3 Sample Receipt

The laboratory's sample clerk will examine the shipping container and each sample cassette or sample container to verify sample numbers and check for any evidence of damage or tampering. The COC form is checked for completeness and signed and dated to document receipt. Any changes will be recorded on the original COC form and then the form will be forwarded to the VTC. The sample clerk will log in all samples and assign a unique laboratory sample identification number to each sample and sample set. COC procedures will be maintained in the analytical laboratory.

B4 ANALYTICAL METHOD REQUIREMENTS

All filters generated in the field and in the laboratory will be analyzed for asbestos by TEM direct-transfer technique using ISO Method 10312:1995. The target analytical sensitivity is 0.005 (cc)^{-1} , which is obtained by varying the number of grid openings and grid area during analysis of the filters. For example, 39 grid openings, a 0.01 mm^2 grid area, a filter area of 385 mm^2 , and an air volume of 200 liters would achieve an analytical sensitivity of 0.005 structures (str)/ cm^3 (i.e., the AS specified in the TQAP). The aspect ratio for analysis is 3:1. All structures $0.5 \text{ }\mu\text{m}$ or longer in length are to be quantified with the following breakdown according to ranges by length: ≥ 0.5 to $5.0 \text{ }\mu\text{m}$; $>5 \text{ }\mu\text{m}$ to $<10.0 \text{ }\mu\text{m}$; and $> 10 \text{ }\mu\text{m}$. Asbestos concentration in soil samples will be measured by 1000 point PLM method (EPA 600/R-93/116).

B5 QUALITY CONTROL REQUIREMENTS

QC measures are included to ensure quality data is provided by the verification test. This includes lot blanks, field blanks, equipment blanks, laboratory blanks, PE samples and duplicates/replicates. The QC procedures and acceptance criteria are presented in Table 2 and described in Appendix G.

B5.1 RAFS Lot Blank

Before air samples are collected, a minimum of 2% of unused filters from each filter lot of 100 filters will be analyzed to determine the mean asbestos structure count. The lot blanks will be analyzed for asbestos structures by using ISO 10312:1995. If the mean count for all types of asbestos structures is found to be more than 10 str/mm^2 , the filter lot will be rejected.

B5.2 RAFS Field Blank

B5.2.1 Open Field Blank. A field blank (25-mm dia., $0.8\text{-}\mu\text{m}$ pore size mixed cellulose ester [MCE] membrane filter with 50-mm extension cowl) is collected to check for accidental contamination of samples by the operator. An open field blank is taken by removing the filter cap and waving the filter in the ambient air for 30 seconds. One “open field blank” is collected for each sample set from each area.

B5.2.2 Closed Field Blank. A closed field blank is a QC sample (25-mm dia., 0.8- μ m pore size MCE membrane filter with 50-mm extension cowl) which is not opened. That is, it is transported to the field and sent to the laboratory without removing the plugs or caps. The closed field blank will be taken before the RAFS samples are taken. One closed field blank is collected per area.

B5.3 RAFS Equipment Blank

An equipment blank is a QC sample used to detect asbestos fibers introduced to samples during the measurement process (i.e., it determines the cleanliness and decontamination effectiveness of the RAFS). Immediately prior to collection of field samples, a vendor equipment blank sample will be collected to demonstrate the cleanliness of the vendor equipment. The RAFS unit is placed on a clean aluminum sheet, or equivalent non-porous surface. The equipment blank (open-face, 25-mm dia., 0.8- μ m pore size MCE filter with 50-mm extension cowl) is then collected using exactly the same procedure as used to collect a test sample. During the sampling period, the emission of any particles is determined using the optical particle counter. If the concentration on the optical particle counter exceeds 100 str/cm³, the unit is cleaned again, the filters replaced, and the test started again. One equipment blank is taken immediately prior to collection of samples on each area.

To collect an equipment blank, the clean RAFS will be placed on a clean non-porous surface. A 'blank' sample (open-face, 25-mm dia., 0.8- μ m pore size MCE membrane filter with 50-mm extension cowl) will be collected from the RAFS using the same procedures to collect a test sample, with the exception that the RAFS is positioned on a clean surface. The fan will be operated at the same speed as that utilized during testing. During the blank sampling period, the emission of any particles will be determined using an optical particle counter. If the concentration on the optical particle counter exceeds 100 str/cm³, the unit will be cleaned again, and testing restarted.

B5.4 Laboratory Blank

Laboratory blanks are unused filters that are prepared and analyzed in the same manner as the field samples to verify that reagents, tools, and equipment are free of the subject analyte and that contamination has not occurred during the analysis process. The laboratory will analyze one blank per prep series. Blanks are prepared and analyzed along with the other samples. If the blank control criteria are not met, the results for the samples prepared with the contaminated blank are suspect and will not be reported, or are reported and flagged accordingly. The preparation and analyses of samples will be stopped until the

source of contamination is found and eliminated. Before sample analysis is resumed, contamination-free conditions will be demonstrated by preparing and analyzing laboratory clean area blanks that meet the blank control criteria. Laboratory blank count sheets will be maintained in the project folder along with the sample results. A PE audit will be conducted on each laboratory that will analyze filter and soil samples for this project. Forensic Analytical will analyze the filters and soil; then the site laboratory will perform a replicate analysis and verified counting on 5% of the samples. The PE audit will be prepared by RTI International (RT). RTI is accredited to prepare PE audit samples.

B5.5 Performance Evaluation Samples

PE samples will be analyzed by each laboratory that will analyze soil and filter samples for this project as is described in Section C1.1.

B5.6 Duplicates

Replicate soil samples will be taken at each sampling area at the frequency outlined in Table 2. Replicate measurements of rake speed, airspeed and soil moisture will also be taken.

B6 INSTRUMENT/ EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

When Battelle staff operate and maintain the RAFS undergoing testing, those activities will be performed as directed by the vendor. Otherwise, operation and maintenance of the samplers will be the responsibility of the vendor. The manual for each piece of equipment used is provided in the appendices.

B7 INSTRUMENT CALIBRATION AND FREQUENCY

The RAFS does not require any calibration, but does require a performance check of its primary operating settings: fan speed and rake speed. The particle counter and moisture meter are calibrated once per year; see manuals in appendices.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All materials, supplies, and consumables will be ordered by the vendor.

B9 NON-DIRECT MEASUREMENTS

Data published previously in the scientific literature will not be used to evaluate the vendor's technology during this verification test.

B10 DATA MANAGEMENT

Various types of data will be acquired and recorded electronically or manually by Battelle and vendor staff during this verification test. Table 7 summarizes the types of data to be recorded. All maintenance activities, repairs, calibrations, and operator observations relevant to the operation of the sampling systems being tested will be documented by Battelle or vendor staff in the project-specific LRB or dedicated data collection forms. Report formats will include all necessary data to allow traceability from the raw data to final results. A dedicated shared folder within the ETV AMS Center SharePoint site will be established for all project records.

Records received by or generated by any Battelle or subcontractor staff during the verification test will be reviewed by a Battelle staff member within five days of receipt or generation, respectively, before the records are used to calculate, evaluate, or report verification results. If a Battelle staff member generated the record, this review will be performed by a Battelle technical staff member involved in the verification test, but not the staff member who originally received or generated the record. The review will be documented by the person performing the review by adding his/her initials and date to the hard copy of the record being reviewed. In addition, any calculations performed by Battelle will be spot-checked by Battelle technical staff to ensure that calculations are performed correctly. Some of the checks that will be performed include:

- QC samples and calibration standards were analyzed according to the TQAP and the acceptance criteria were met. Corrective action for exceedances was taken;
- 100% hand-entered and/or manually calculated data were checked for accuracy;
- Calculations performed by software were verified at a frequency sufficient to ensure that the formulas were correct, appropriate, and consistent;
- For each cut and paste function, the first and last data value was verified versus the source data;
- Data were reported in the units specified in the test/QA plan;

- Results of QC samples were reported; and
- All statistical calculations described in this TQAP were conducted.

Battelle will provide technology test data and associated reference data (including records; data sheets; notebook records) from the first day of testing within one day of receipt to EPA and the vendor for simultaneous review. The goal of this data delivery schedule is prompt identification and resolution of any data collection or recording issues. These data will be labeled as preliminary and will not have had a QA review before their release.

Table 7. Summary of Data Recording Process

Data to Be Recorded	Where Recorded	How Often Recorded	By Whom	Disposition of Data
Dates, times, and details of test events	ETV LRBs, field sampling records	Start/end of test event	Battelle staff	Used to organize/check test results; manually incorporated in data spreadsheets as necessary
Asbestos Sampler operating conditions, maintenance, down time, etc.	ETV LRBs, or electronically	When performed	Vendor and Battelle staff	Incorporated in verification report as necessary
Asbestos sampler settings	Recorded electronically by each monitor and then downloaded to computer daily	Recorded continuously by each monitoring system	Vendor staff for transfer to Battelle	Converted to spreadsheet for statistical analysis and comparisons
Asbestos concentration in soil	Obtained from laboratory	After each sampling event	Battelle Staff	Converted to spreadsheet for statistical analysis and comparisons
Soil moisture content	Read electronically from instrument and recorded in laboratory note book	Recorded from after each measurement	Vendor and Battelle staff	Converted to spreadsheet for statistical analysis and comparisons
Asbestos concentrations on filter	Obtained from laboratory	After each sampling event	Battelle staff	Converted to spreadsheets for statistical analysis and comparisons

SECTION C

ASSESSMENT AND OVERSIGHT

C1 ASSESSMENT AND RESPONSE ACTIONS

Every effort will be made in this verification test to anticipate and resolve potential problems before the quality of performance is compromised. One of the major objectives of this TQAP is to establish mechanisms necessary to ensure this. The procedures described in this TQAP, which is peer reviewed by a panel of outside experts, implemented by the technical staff and monitored by the VTC, will provide information on data quality on a day-to-day basis. The responsibility for interpreting the results of these checks and resolving any potential problems resides with the VTC. Technical staff has the responsibility to identify problems that could affect data quality or the ability to use the data. Any problems that are identified will be reported to the VTC, who will work with the Battelle Quality Manager to resolve any issues. Action will be taken to control the problem, identify a solution to the problem, minimize losses, and correct data, where possible. Independent of any EPA QA activities, Battelle will be responsible for ensuring that the audits described below are conducted as part of this verification test.

C1.1 Performance Evaluation Audit

Two types of PE audits will be conducted during this test. First, two PE audit samples, soil and filter, of known concentrations will be prepared by RTI and submitted to both laboratories. Results must fall within the PE sample acceptance range. Second, 5% of the samples will be designated as PE samples and distributed to both analytical laboratories. Five percent of the soil and filter samples analyzed by Forensic Analytical will be identified by the VTC as PE audit samples. These will be forwarded to the site laboratory for replicate analysis and verified counting. The results will assess comparability of multiple laboratories analyzing the same samples using the same methods (confirming that both laboratories can accurately perform the required analytical methods).

C1.2 Technical Systems Audits

The Battelle QAO or delegate will perform a TSA during performance of Battelle laboratory testing and one of the field-testing sites. The purpose of these audits is to ensure that the verification test is being performed in accordance with the AMS Center QMP and this TQAP. The reference laboratory is not expected to be assessed during a separate TSA, provided acceptable performance on the PE audit. The field TSA may be designated to an independent person by providing a checklist to be completed on site.

During the TSAs, the Battelle QAO or designee will compare actual test procedures to those specified or referenced in this plan and review data acquisition and handling procedures. The Battelle QAO will prepare a project-specific checklist based on the TQAP requirements to guide the TSA, which will include a review of the test location and general testing conditions; observe the testing activities; and review LRBs. The Battelle QAO will also check data acquisition procedures, and may confer with the vendor staff. The Battelle QAO will prepare an initial TSA report and submit the report to the EPA Quality Manager (with no corrective actions documented) and VTC within 10 business days after completion of the audit. A copy of each final TSA report (with corrective actions documented) will be provided to the EPA AMS Center Project Officer and Quality Manager within 20 business days after completion of the audit. At EPA's discretion, EPA QA staff may also conduct an independent on-site TSA during the verification test. The TSA findings will be communicated to technical staff at the time of the audit and will be documented in a TSA report.

C1.3 Data Quality Audits

The Battelle QAO, or designee, will audit at least 10% of the sample results data acquired in the verification test and 100% of the calibration and QC data versus the TQAP requirements. Four ADQs will be conducted for this project: the first batch of data will be audited within 10 business days of receipt and assessed using a project-specific checklist. Additional ADQs will be audited within 10 business days of receipt of all Phase 1, 2, and 3 data. During these audits, the Battelle QAO, or designee, will trace the data from initial acquisition through reduction and statistical comparisons, to final reporting. All calculations performed on the data undergoing the ADQ will be checked. Data must undergo a 100% validation and verification by technical staff (i.e., VTC, or designee) before it will be assessed as part of the data quality audit. All QC data and all calculations performed on the data undergoing the audit will be checked by the Battelle QAO. Results of each ADQ will be documented using the checklist and reported to the VTC and EPA within 10 business days after completion of the audit. These reports will not include documented corrective actions. The completed ADQs with corrective actions documented will be provided to EPA within 10 business days of receipt from the VTC. A final ADQ that assesses overall data quality, including accuracy and completeness of the technical report, will be prepared as a narrative and distributed to the VTC and EPA within 10 business days of completion of the audit.

C1.4 QA/QC Reporting

Each assessment and audit will be documented in accordance with Section 3.3.4 of the AMS Center QMP. The results of all audits will be submitted to EPA within 10 business days as noted above.

Assessment reports will include the following:

- Identification of any adverse findings or potential problems;
- Recommendations for resolving problems. (If the QA audit identifies a technical issue, the VTC or Battelle AMS Center Manager will be consulted to determine the appropriate corrective action);
- Response to adverse findings or potential problems;
- Confirmation that solutions have been implemented and are effective; and
- Citation of any noteworthy practices that may be of use to others.

C2 REPORTS TO MANAGEMENT

During the field and laboratory evaluation, any TQAP deviations will be reported immediately to EPA. The Battelle Quality Manager and/or VTC, during the course of any assessment or audit, will identify to the technical staff performing experimental activities any immediate corrective action that should be taken. A summary of the required assessments and audits, including a listing of responsibilities and reporting timeframes, is included in Table 8. If serious quality problems exist, the Battelle Quality Manager will notify the AMS Center Manager, who is authorized to stop work. Once the assessment reports have been prepared, the VTC will ensure that a response is provided for each adverse finding or potential problem and will implement any necessary follow-up corrective action. The Battelle Quality Manager will ensure that follow-up corrective action has been taken. The TQAP and final report are reviewed by the EPA AMS Center Quality Manager and the EPA AMS Center Project Officer. Upon final review and approval, both documents will then be posted on the ETV Web site (www.epa.gov/etv).

Table 8. Summary of Assessment Reports^(a)

Assessment	Prepared By	Report Submission Timeframe	Submitted To
Phase 1 (Field)TSA	Battelle or delegate	TSA response is due to QAO within 10 business days of receipt from QAO TSA responses will be verified by the QAO and provided within 20 business days	EPA ETV AMS Center
Phase 2 (Laboratory) TSA	Battelle	10 business days after TSA is complete	EPA ETV AMS Center
ADQ (Initial batch and Phases 1, 2, and 3)	Battelle	ADQ will be completed within 10 business days after receipt of the initial data batch and then after all data for a phase is submitted	EPA ETV AMS Center

(a) Any QA checklists prepared to guide audits will be provided with the audit report.

SECTION D

DATA VALIDATION AND USABILITY

D1 DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

The key data review and data verification requirements for this test are stated in Section B10 of this TQAP. In general, the data review requirements specify that data generated during this test will be reviewed by a Battelle technical staff member within five days of generation of the data. The reviewer will be familiar with the technical aspects of the verification test but will not be the person who generated the data. This process will serve both as the data review and the data verification, and will ensure that the data have been recorded, transmitted and processed properly. Furthermore, this process will ensure that the monitoring systems data were collected under appropriate testing.

The data validation requirements for this test involve an assessment of the quality of the data relative to the DQI for this test referenced in Tables 2 and 3. Any deficiencies in these data will be flagged and excluded from any statistical comparisons to the RAFS being tested, unless these deviations are accompanied by descriptions of their potential impacts on the data quality.

D2 VERIFICATION AND VALIDATION METHODS

Data verification is conducted as part of the data review as described in Section B10 of this TQAP. A visual inspection of handwritten data will be conducted to ensure that all entries were properly recorded or transcribed, and that any erroneous entries were properly noted (i.e., single line through the entry, with an error code, such as “wn” for wrong number, and the initials of the recorder and date of entry).

Instrument parameters and laboratory data collected during the test will be inspected to ensure proper transfer from the datalogging system. All calculations used to transform the data will be reviewed to ensure the accuracy and the appropriateness of the calculations. Calculations performed manually will be reviewed and repeated using a handheld calculator or commercial software (e.g., Excel). Calculations performed using standard commercial office software (e.g., Excel) will be reviewed by inspection of the equations used for the calculations and verification of selected calculations by handheld calculator.

Calculations performed using specialized commercial software (i.e., for analytical instrumentation) will

be reviewed by inspection and, when feasible, verified by handheld calculator, or standard commercial office software.

To ensure that the data generated from this test meet the goals of the test, a number of data validation procedures will be performed. Sections B and C of this TQAP provided a description of the validation safeguards employed for this verification test. Data validation efforts include the completion of QC activities and the performance of a TSA as described in Section C. The data from this test will be evaluated relative to the measurement DQIs described in Section A8 of this TQAP. Data failing to meet these criteria will be flagged in the dataset and not used for evaluation of the RAFS, unless these deviations are accompanied by descriptions of their potential impacts on the data quality.

An ADQ will be conducted by the Battelle Quality Manager to ensure that data review, verification, and validation procedures were completed, and to ensure the overall quality of the data.

D3 RECONCILIATION WITH USER REQUIREMENTS

The purpose of this verification test is to evaluate the performance field samplers for asbestos detection. This evaluation will include a comparison to ABS. To meet the requirements of the user community, input on the tests described in this TQAP has been provided by external experts. Additional performance data regarding operational characteristics of the field RAFSs will be collected by verification test personnel. To meet the requirements of the user community, these data will include thorough documentation of the performance of the samplers during the verification test. The data review, verification, and validation procedures described above will ensure that data meeting these requirements are accurately presented in the verification reports generated from this test, and will ensure that data not meeting these requirements will be appropriately flagged and discussed in the verification reports.

APPENDIX A

**STANDARD OPERATING PROCEDURE FOR SOIL SAMPLE
COLLECTION DURING THE RELEASABLE ASBESTOS FIELD STUDY
(RAFS)**



Standard Operating Procedure
for
Soil Sample Collection
during the **Releasable Asbestos Field Study (RAFS)**

Prepared by: Cortina Johnson Date: 5/10/2010

Reviewed by: Andrew Dart Date: 5/10/2010

Approved by: _____ Date: _____

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List of Revisions

CAT Number	Revision Number	Changes	Date
600	0	Original, based on RAFS QAPP	05/2010

1. Background

This procedure provides a systematic approach for the collection of asbestos contaminated soil at multiple locations at a site. The collected soil samples are analyzed to determine asbestos soil loading. Trained field technicians use this method. Soil samples are collected in a manner that meets the requirements of this method and the needs of the investigator for whom the soil is being analyzed. The technician collects a composite soil sample at each location. A representative portion of the soil sample material is collected in a rigid, sealable, non-breakable container. The soil is shipped to a laboratory for PLM or TEM analysis.

2. Sampling Procedure

2.1. Equipment

- 2.1.1. *Template* – Cleanable plastic or metal template with a square central hold of size 15cm x 15cm x 1cm.
- 2.1.2. *Scoop* – A rigid metal or plastic scoop or trowel with a sharp edge.
- 2.1.3. *Sample Compositing Container* – Large area rigid, container of sufficient size to hold 1.5 L dry soil.
- 2.1.4. *Sample Containers* – Rigid, sealable, non-breakable containers of sufficient size to hold 1000 cm³ dry soil (1 container per composite).
- 2.1.5. *Tape* – To seal sample containers.
- 2.1.6. *Adhesive labels* – To label samples.
- 2.1.7. *Spray Bottle* – A plastic bottle filled with soapy water or other cleaning solution.
- 2.1.8. *Lint-free cloths* – Moistened with de-ionized water for cleaning sampling equipment before and after use.
- 2.1.9. *Paper Towels* – To dry equipment and for general use around sampling site.
- 2.1.10. *Shipping Container* – A rigid container of sufficient volume and structural integrity to hold sample containers for shipping.
- 2.1.11. *GPS Unit* – GPS unit to mark coordinates of the soil sample location.
- 2.1.12. *Marker Flags* – (Optional). Construction marker flags to physically indicate where soil samples were collected. These flags are useful if different personnel will return to the site for additional sample collection.

2.2. Cleaning

- 2.2.1. The materials listed above must be cleaned thoroughly before and after use to avoid cross contamination. Remove all extraneous material and debris by hand and wipe the equipment using the lint-free DI wipes. Allow sufficient time for

the equipment to dry before use (if necessary, manually dry the equipment with a clean un-used paper towel).

- 2.2.2. Disposal of waste in doubled garbage bag, taped closed, disposed in hazardous waste landfill or municipal trash, as specified in site protocols.

2.3. Soil Sample Collection Procedure for Outdoor RAFS

This section describes soil sample collection from a relatively flat horizontal surface.

- 2.3.1. *Sample Location Characteristics* – Try to select locations within minimal vegetation. If a location with minimal vegetation cannot be identified, the technician should use their judgment to select another location or remove excess vegetation by hand.
- 2.3.2. *Sample Point Selection* –
 - 2.3.2.1. Preliminary Site Evaluation Sample Collection: Collect soil using the template from five cardinal locations of a 3 m by 3 m square (or as close as possible). Cardinal locations correspond to the North, East, South, West, and Center points of the 3 m by 3 m square. Technician should use their best judgment when selecting sample locations. Record GPS coordinates of the “center” point on the COC sheet.
- 2.3.3. *Sample Collection* – If necessary, loosen the soil with a garden trowel or garden pick. Using the template to mask the area where soil will be collected, scoop soil from the masked area down to a depth of 1 cm and place it into the compositing container. Repeat for all 5 locations.
- 2.3.4. *Mixing* - After all 5 samples are collected; thoroughly mix the soil in the compositing container.
- 2.3.5. *Sample Distribution* – Distribute an aliquot of soil into the sample container.
- 2.3.6. *Labeling* – Label the sample containers and corresponding datasheet (See Table 1) using the code shown below. Note: COC sheet already completed with desired sample IDs.

Site-“SOIL”-Area#-Location#-Jar#.

Examples for Silver Strand Navy Site, San Diego, California:
SDCA-SOIL-A1-L1-1

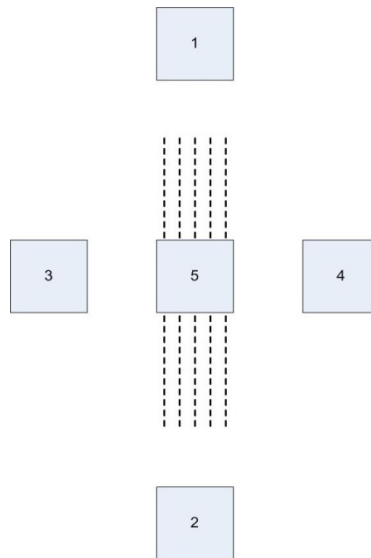


Figure 1. Five points to collect soil samples surrounding oRAFS footprint.

3. Shipment Preparation

- 3.1. *Sealing* – Once samples are collected and sealed, the jars shall be taped around the rim and loaded into the shipping container. All available space in cooler should be filled using foam or plastic wrap to prevent damage during transport.
- 3.2. *COC sheet* – See Forensic Analytical COC sheet. Complete the following COC cells as instructed below.
 - 3.2.1. Date (next to Sample ID)
 - 3.2.2. Sample Location/Description: Navy Area ID (A, B, G, etc) and GPS coordinates
 - 3.2.3. Sampled By/Date/Time
 - 3.2.4. Shipped Via
 - 3.2.5. Relinquished By

APPENDIX B

FIELD DATA SHEETS

ETV Test of Asbestos Sampling Tools AIR SAMPLING AND INSTRUMENT DATA COLLECTION FORM RELEASABLE ASBESTOS FIELD SAMPLER (RAFS) Site _____	Date: _____ Tech: _____ GPS: N _____ W _____ Altitude: _____ feet
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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):										Test Qualifier:	

Sample ID	RAFS Unit №	Rotometer, Pump №	Rotometer Reading		Agitator Data				Time		Comments	Filter ID
			Start (L/m)	Stop (L/m)	Start Count	Stop Count	Cycle Time (s)	Depth (inches)	Start	Stop		

MetOne GT 521 Filename	Start	Stop	Flow Rate (L/m)	Comments	Vane Anemometer
					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

APPENDIX C

STANDARD OPERATING PROCEDURES FOR ACTIVITY BASED SAMPLING

(Click on the title for a link to this appendix)

APPENDIX D

MANUAL FOR SOIL MOISTURE METER

(Click on the title for a link to this appendix)

APPENDIX E

MANUAL FOR OPTICAL PARTICLE COUNTER

(Click on the title for a link to this appendix)

APPENDIX F
CHAIN OF CUSTODY FORM

APPENDIX G

RAFS MANUAL

(Click on the title for a link to this appendix)