Quality Assurance Project Plan

Griffiss Former Parachute Shop
Griffiss Business and Technology Park
212 Hangar Road
Rome, New York

Mohawk Valley EDGE
584 Phoenix Drive
Rome, New York 13440

Prepared by:
BRS, Inc.
P.O. Box 2293
Medford Lakes, NJ 08055

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INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared by BRS, Inc. (BRS) for the Mohawk Valley EDGE. The proposed scope of work involves a site at the Griffiss Airforce Base Former Parachute Shop, located at 212 Hangar Road in Rome, New York where an Asbestos Survey and Lead Paint Survey of a former parachute building will be performed.

The United States Environmental Protection Agency (EPA) requires that all environmental monitoring and measurement efforts participate in a centrally managed quality assurance (QA) program. The team generating data under this QA program has the responsibility to implement minimum procedures to ensure that the precision, accuracy, completeness, and representativeness of its data are known and documented.

A site-specific QAPP includes specific methods for sampling and analysis to address the unique technical issues of performing a site assessment at that particular site. At this time the preferred environmental laboratory that will be used is AmeriSci, New York, NY. If a different laboratory is chosen to provide analytical testing services once vetted sites are proposed, the laboratory must be qualified to perform laboratory services in the State of New York and hold all necessary accreditations offered by the State for the project scope. All project reporting will be completed by BRS.

Griffiss Former Parachute Shop Quality Assurance Project Plan

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FIGURES

APPENDICES

Section 1 Griffiss Former Parachute Shop Brownfields QAPP Title and Approval Page

Title: Griffiss Former Parachute Shop Quality Assurance Project Plan (QAPP)
Property/Site Location: 212 Hangar Road, Building #212, Rome, New York
Revision Number: 1
Revision Date: July 25, 2025

Brownfields Cooperative Agreement Number(s): BF –96238700

Mohawk Valley EDGE
Brownfields Recipient

Alicia Flammia, Project Manager - Brownfield Redevelopment Solutions, Inc.
PO Box 2293, Medford Lakes, NJ 08055
856-964-6456 Ext. 6865 / AFlammia@BRSInc.com
Preparer's Name and Organizational Affiliation
Preparer's Address, Telephone Number, and E-mail Address

June 6, 2025
Preparation Date (Day/Month/Year)

BROWNFIELDS RECIPIENT PROGRAM MANAGER:

Signature

Marc Barraco, Mohawk Valley EDGE
Printed Name/Organization/Date

ENVIRONMENTAL CONSULTANT QUALITY ASSURANCE OFFICER: (QAO)

Signature

Alicia Flammia, BRS, Inc./ 9.15.25
Printed Name/Organization/Date

EPA REGION 2 BROWNFIELDS PROJECT OFFICER:

Signature

Patrick Peck, USEPA Region 2
Printed Name/Organization/Date

EPA REGION 2 BROWNFIELDS QUALITY ASSURANCE OFFICER:

Signature

Reginald St-Juste, USEPA Region 2
Printed Name/Organization/Date

U.S. EPA REGION 2 - QUALITY ASSURANCE PROJECT PLAN APPROVAL FORM

PROJECT INFORMATION

Quality Assurance Officer:	Reginald Saint-Juste
Project Officer:	Patrick Peck
Title of Quality Assurance Project Plan:	BRS Inc. : Griffiss Former Parachute Shop
Assistance Agreement or Contract #:	BF-96238700
QA File Number:	25-160

REGIONAL QA MANAGER OR DELEGATED APPROVER

Approved ☑ Conditionally Approved* ☐

*** Conditional Approval may be provided when there are unresolved comments that do not impact the data collection or the quality of the data and where the project has a small window of opportunity to collect such data. Conditional Approval expires 30 days from the signature date. If updated quality documentation (QD) is not provided by the expiration date or another due date is not agreed upon by EPA, then the QD will be considered delinquent.**

Comments:

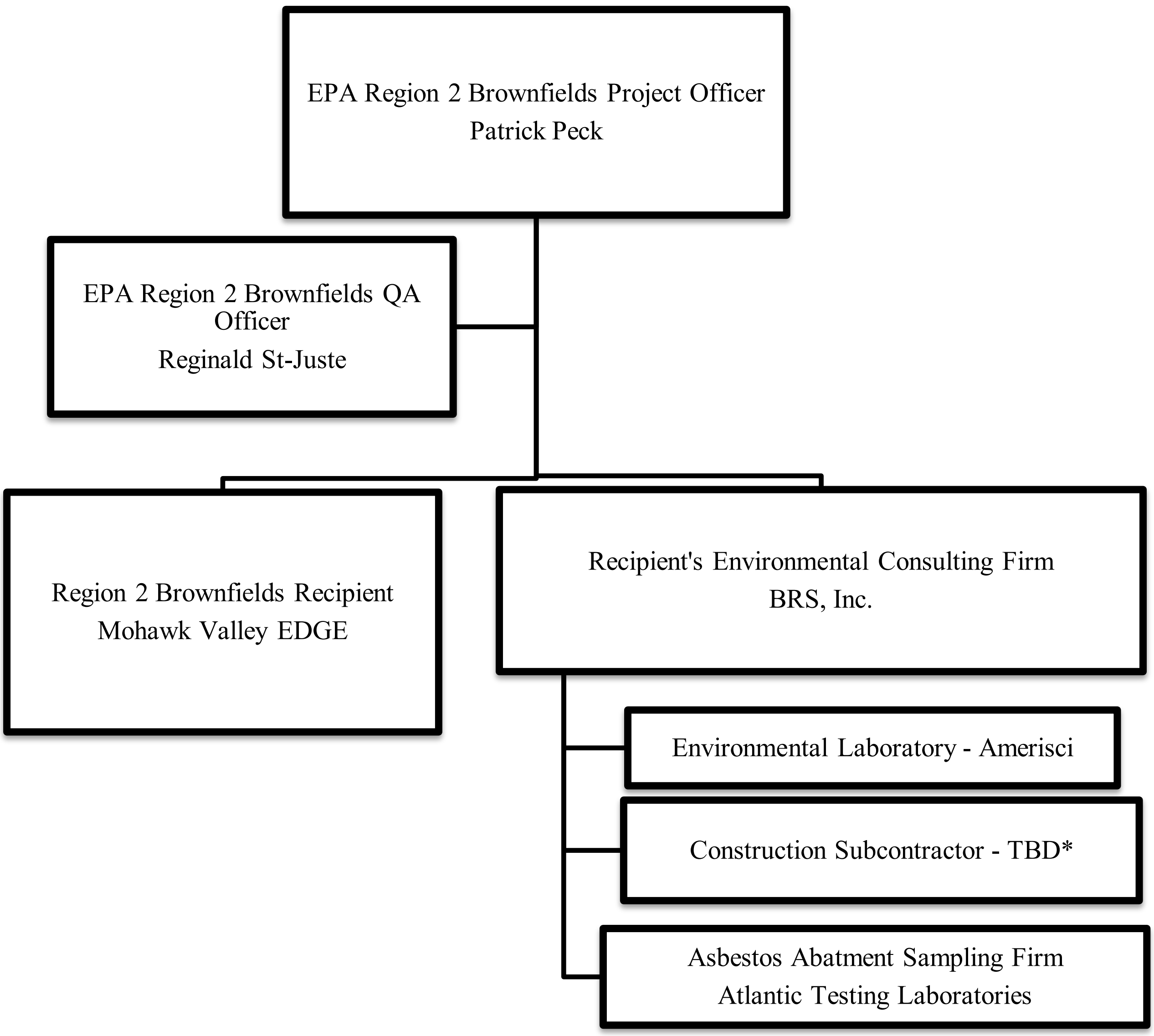
Signature EPA QA Officer

Signature EPA PO or Project lead

REVIEW SUMMARY:
A review was conducted on the above referenced Quality Assurance Project Plan. The subject QAPP was reviewed for conformance with the *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), EPA/240/B-01/003, March 2001; USEPA Region 2 Guidance for the Development of QAPPs for Environmental Monitoring Projects, April 2004 and other EPA QAPP guidance documents as appropriate.

This approval form documents EPA's decision of approval or conditional approval***** for the aforementioned QAPP. After the QAPP is approved by EPA via this approval form, obtain the required signatures from your organization on the QAPP Title/Signature page. Send the signed QAPP to the EPA Project Officer and others on the QAPP distribution list within the timeframe stipulated in the AA terms and conditions.

Section 2.1 Project Organizational Chart



*Work will be going out to bid.

Section 2.2 Personnel Responsibilities

Name	Title	Telephone Number/Email	Organizational Affiliation	Responsibilities[1]
Alicia Flammia	Project Manager	(856) 964-6456 Ext. 6865 AFlammia@BRSInc.com	BRS, Inc.	Qualified Environmental Professional and the Quality Assurance/ Quality Control manager
TBD staff from Atlantic Testing Laboratories	Project Monitor	Staff contact TBD	Atlantic Testing Laboratories	Collection of air monitoring samples
Marc Barraco	Chief of Staff/ Brownfields Recipient Program Manager	mbarraco@mvedge.org	Mohawk Valley EDGE	Project Management and Budget Oversight
Reginald St-Juste	EPA Brownfields QAO	(732) 321-6746 st-juste.reginald@epa.gov	EPA Region 2	Quality Assurance and Quality Control
Patrick Peck	EPA Brownfields Project Officer (BPO)	(212) 637-4421 Peck.patrick@epa.gov	EPA Region 2	Brownfields Project Oversight
Kelly Hale	NYSDEC Brownfields Contact	(315) 793-2554 Kelly.hale@dec.ny.gov	NYSDEC Region 6	Brownfields Project Oversight
Andrew Lee	Vice President	(212) 679-8600 alee@AmeriSci.com	AmeriSci New York	Laboratory analysis of environmental media samples
Maggie Perry	Third Party Data Validator	640-529-4061 MPerry@BRSinc.com	BRS, Inc.	Data validation of laboratory reports

[1] Resumes for staff of Atlantic Testing Laboratories (ATL) and BRS, Inc. (BRS) will be included as **Appendix A.**

The EPA BPO and the EPA QAO will approve this Site Specific QAPP. BRS, Inc. will perform all sampling, and as may be applicable will oversee collection of all environmental samples by other subcontractors. BRS, Inc. will be responsible for oversight of investigative tasks including surveying, drilling and disposal of investigation-derived waste, and site restoration performed by others.

This QAPP will govern the operation of the project at all times. Each responsible party listed in the above shall adhere to the procedural requirements of the QAPP and ensure that subordinate personnel do likewise. It is expected that from time to time modifications will need to be made to the project. Mohawk Valley EDGE shall be responsible for implementation of changes to the project and shall document the effective date of all changes made. Any significant changes made by the Mohawk Valley EDGE need to be approved by the EPA Project Officer before being implemented.

BRS, Inc.'s Quality Assurance Manager is responsible for determining that data are of adequate quality to support this project.

Distribution List

1. Marc Barraco – Chief of Staff, Mohawk Valley EDGE
2. Patrick Peck – EPA Region 2 (Project Officer)

Section 3.1 Problem Definition

To safely abate asbestos-containing materials (ACMs) and prepare the deteriorated structure for controlled demolition, Atlantic Testing Laboratories (ATL) will perform asbestos project monitoring and air sampling during the demolition of the subject property building. This Quality Assurance Project Plan (QAPP) provides general information related to Quality Assurance and Quality Control (QA/QC) procedures designed to achieve the data quality objectives of the air monitoring project to be performed during demolition of the Former Griffiss Parachute Shop. Descriptions of sample collection and field data acquisition associated with an analytical sampling program will be provided in this QAPP.

The Site is identified as the Former Griffiss Parachute Shop, Building #212, located in Rome, New York. The project includes the demolition of the current Site building, a one-story building totaling 13,904 square feet constructed circa 1958. A Site location map is provided as **Figure 1**.

This QAPP will outline the sampling and quality control procedures associated with the air monitoring program that will occur during building demolition. The air monitoring project will answer the following question:

- Is asbestos present in the air at concentrations which are above New York State Department of Labor 12 NYCRR Part 56-11.5 PCM clearance criteria?

The QA/QC procedures addressed herein are applicable to both the field sampling activities and the laboratory analyses of field samples. Laboratory analyses and QA/QC procedures will be performed in accordance with the United States National Institute of Occupational Safety and Health (NIOSH) methodologies and the most recent New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP). All work conducted will meet all federal, state and local regulatory requirements and can be used for the intended redevelopment purposes.

Section 3.2 Project Description

3.2.1 Site Location and Description

The Subject Property is located on a parcel of land within the former Griffiss Air Force Base complex and is improved with a single-story, 13,904-square-foot brick and metal structure, reportedly constructed circa 1958. Historically, the building operated as a Parachute Shop and was later used sporadically by the City of Rome for miscellaneous storage and bicycle collection following its closure around 1993 as part of the Base Realignment and Closure (BRAC) process. The remainder of the surrounding property consists of paved and unpaved areas with no additional structures or significant improvements. The Subject Building, #212, has been unoccupied for decades and is currently scheduled for environmental abatement activities related to the removal of ACMs.

No known structural repairs or modifications have been performed since the facility ceased full-time operations in the mid-1990s. Over time, the building has deteriorated significantly due to prolonged exposure to the elements and a lack of maintenance. A recent visual site inspection in April 2024 was conducted to assess the general structural integrity of the building prior to the abatement work. The structure was found to be in an advanced state of disrepair. Observed issues include widespread roof leaks, corrosion of steel roof framing members—particularly at bearing points—severe delamination of the roof deck, and failure or imminent failure of portions of the exterior brick veneer. Additional concerns include broken and missing windows, bowed or deflected exterior walls, and interior conditions suggesting compromised load-bearing capacity. Due to the visibly unsafe conditions, the inspection was limited to ground-level visual observations. Access to the roof was deemed too hazardous. The Subject Property is considered structurally unstable, and there is an immediate risk of partial building collapse.

3.2.2 Sampling and Analysis Plan

The sampling to be performed will be conducted by ATL and overseen by BRS, Inc. as the environmental consultant for the project. The project air sampling shall be conducted by an asbestos project monitor (ATL) who has been trained in the selected methodology of air sampling and who possesses an asbestos project air sampling technician certificate issued by the Department of Labor. A copy of asbestos handling licenses can be found in **Appendix C.**

Laboratory analysis of the air samples will be performed by AmeriSci New York, a New York State Department of Health Environmental Laboratory Approval Program (NYSDOH ELAP) accredited laboratory that meets the requirements of 12 NYCRR Subpart 56-4.2. See **Section 5.2** for further specifics on analytical methods and requirements. Samples will be analyzed by Polarized Light Microscopy (PLM)/ phase contrast microscopy (PCM). Laboratory analysis by PLM/PCM will be performed on a 24-hour or same-day turnaround time basis, as required, subsequent to receipt of the samples by the laboratory. Data validation will be performed by a third-party quality assurance officer to ensure quality of data. All field sampling and laboratory analysis will be performed according to standard operating procedures (SOPs) included in **Appendix B.** An estimated project schedule is summarized in **Section 4**.

Friable Asbestos-Containing Material (ACM) is defined as any material containing more than one percent (1%) asbestos as determined using the method specified in Appendix A, Subpart F, of 40 Code of Federal Regulations (CFR) Part 763, Section 1, Polarized Light Microscopy (PLM), that, when dry, can be crumbled, pulverized or reduced to powder by hand pressure. Nonfriable ACM is any material containing more than one percent (1%) asbestos as determined using the PLM method that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure. The USEPA further defines two categories of nonfriable ACM:

- Category I (Cat I) - Category I nonfriable ACM is any asbestos-containing packing, gasket, resilient floor covering or asphalt roofing product which contains more than one percent (1%) asbestos as determined using PLM, and
- Category II (Cat II) - Category II nonfriable ACM is any material, excluding Category I nonfriable ACM, containing more than one percent (1%) asbestos as determined using PLM that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Atlantic Testing Laboratories will provide services based upon the federal, state and local requirements for a full pre-renovation/demolition inspection. Inspection activities will be conducted in accordance with the following regulations: Occupational Safety and Health Administration (OSHA) regulations, 29 CFR 1926.1101, National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61, asbestos compliance issues for demolition and renovation, 40 CFR Part 763 Asbestos Hazardous Emergency Response Act (AHERA), NYSDEC's "DER-10 / Technical Guidance for Site Investigation and Remediation", NYSDEC regulations for hazardous and construction/demolition debris (6 NYCRR Parts 360 and 364). The asbestos project monitoring will be conducted by NYSDEC certified asbestos building inspectors. Certifications can be found in **Appendix C.**

All work conducted will meet all federal, state and local regulatory requirements and can be used for the intended redevelopment purposes. The full pre-renovation/demolition inspection is suitable for demolition and/or renovations per EPA NESHAP and NYSDEC regulations.

Section 3.3 Project Decision Statements

Data collected during air monitoring activities will be used to determine whether the air clearance samples are satisfactory to conclude that asbestos is not present in outdoor air above 0.01 fibers per cubic centimeter. If asbestos is present in air in excess of 0.01 fibers per cubic centimeter, then a corrective measure will be taken to reduce concentrations. The measure includes applying additional water to the demolition area.

3.3.1 Project Quality Objectives/Systematic Planning Process Statements

The objective of this sampling is to assess air quality for the potential to contain airborne asbestos to evaluate potential exposure risks to workers and the general public. The overall project objectives will be accomplished by completing the air sampling during the demolition of Building #212. Laboratory analytical results from the air samples will be evaluated against New York State Department of Labor (NYSDOL) Title 12 NYCRR Part 56-4.11 to make decisions regarding exposure risks to the public. NYSDOL Title 12 NYCRR Part 56-4.11 states that the PCM clearance air sample results shall be considered satisfactory when every clearance air sample demonstrates an airborne concentration of fibers of less than 0.01 fiber per cubic centimeter, or the established background level(s), whichever is greater.

Who will use the data?

Data will be used by the EPA Region 2 Brownfields Cooperative Agreement Recipient ("CAR", Mohawk Valley EDGE), BRS, and the property owner.

What will the data be used for?

The data will be used to assess the current levels of airborne fibers sitewide, determine if asbestos concentrations exceed regulatory action levels, and to guide decisions regarding mitigation measures and clearance related to the abatement of ACM and controlled demolition.

What types of data are needed?

- Asbestos Data:
  - Air samples will be analyzed by NIOSH Method 7400 PCM. Laboratory analytical results from the air samples will be evaluated against NYSDOL Title 12 NYCRR Part 56-4.11. Further discussion on analytical methods and requirements can be found in **Section 5.2**.
- Field screening
  - A Project Monitor certified by the New York State Department of Labor will be used to collect air samples in general accordance with 12 NYCRR Subpart 56-4, perform work area clearance in general accordance with 12 NYCRR Subpart 56-9.2, and ASTM E 1368: *"Standard Practice for Visual Inspection of Asbestos Abatement Projects,"* and monitor the asbestos abatement in accordance with the pertinent provisions of 12 NYCRR Part 56.
- Sampling techniques – per ATL SOP 107-001, included as **Appendix B**
  - Air samples will be collected using high-flow pumps with PCM cassettes set at a flow rate between 2 and 10 liters per minute (LPM). Each set of samples will have at least 2 Field blanks, or a number of field blanks equal to 10% of the samples that are opened just prior to sampling.

How "good" do the data need to be in order to support the environmental decision?

The quality of the data must meet criteria for precision, accuracy, representativeness, comparability, completeness, and sensitivity. Data validation will be performed to ensure that data quality objectives are met and data can be reliably evaluated against the standards set in NYSDOL Title 12 NYCRR Part 56-4.11.

The quality of data is determined by establishing criteria for performance measures that include precision, accuracy/bias, sensitivity (quantitation limit), data comparability, representativeness, and completeness. Specific analytical laboratory sensitivity and project criteria can be found in **Section 5.4.**

How much data is needed?

A minimum of 6 background samples, 5 inside the work area and 1 directly outside the work area, will be taken prior to demolition in accordance with NYCRR Part 56-6.2. During project work, a minimum of 8 samples shall be taken each day, with two of those samples or 10% of the total amount of samples being field blanks, in accordance with NYCRR Part 56-7.1 and OSHA requirements for Class I and II friable ACM asbestos projects. For final clearance, a minimum of 8 samples including 2 field blanks shall be collected.

Where, when, and how should the data be collected/generated?

A minimum of 6 background samples, 5 inside the work area and 1 directly outside the work area, will be taken prior to demolition. During project work, a minimum of 8 samples shall be taken each day, with two of those samples being field blanks. For final clearance, a minimum of 8 samples including 2 field blanks shall be collected.

Who will collect and generate the data?

ATL will collect samples under the oversight of BRS, Inc. Laboratory analysis and analytical data will be provided by AmeriSci New York, a NYSDOH ELAP accredited laboratory.

How will the data be reported?

BRS, Inc. will summarize and present the data as components of the final reports.

How will the data be archived?

BRS, Inc. will archive deliverables in its cloud-based company server for a minimum of five years.

Section 4 Project Schedule/Timeline

The anticipated start and completion dates are provided below.

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Preparation of QAPP	BRS, Inc. for Mohawk Valley EDGE	5/27/2025	6/6/2025	QAPP	TBD
Review of QAPP	Patrick Peck, EPA BPO and Reginald St-Juste, EPA QAO	Upon submission of QAPP	Up to 5 weeks after submission	Approved QAPP by EPA Region 2 BPO	TBD
Preparation of Health and Safety Plan	Contractor (TBD)	July 2025	July 2025	HASP	TBD
Procurement of Equipment	ATL	TBD	TBD	N/A	N/A
Laboratory Request	ATL	TBD	TBD	N/A	N/A
Field Reconnaissance/Access	ATL	Access will be gained prior to field activities	TBD	N/A	N/A
Collection of Field Samples	ATL with oversight by BRS, Inc.	At the commencement of demolition activities	Within the same day as activity initiation	Field Notes, Sample Logs	Within two weeks of completion of field activities
Laboratory Analysis	AmeriSci New York	Upon completion of Site sampling activity	Within 24-hour or same-day TAT	Unvalidated Data Package	3 weeks after activity start date
Validation of Laboratory Results	Third Party Data Validator	Within one week of receipt of laboratory analytical packages	Up to 2 weeks after receipt of data package	Validated data Packages	2 weeks after activity start date
Data Evaluation/ Preparation of Final Report	BRS, Inc. on behalf of Mohawk Valley EDGE	Within 2 weeks of receipt of laboratory analytical packages	Two weeks after activity initiation	Final Report	TBD

Section 5.1 Sampling Methods and Locations

Matrix	Sampling Location	Depth (ft)	Analytical Group	Number of Samples	Sampling SOP Reference	Rationale for Sampling Location
Air	Personal Decon	N/A	NIOSH 7400 PCM	6 background sample pre-abatement; Minimum of 8 samples per day (6 Site samples plus 2 field blanks), 8 samples to post-abatement (6 Site samples plus 2 field blanks)	ATL SOP 107-001: Asbestos Project Monitoring/ Air Sampling (see **Appendix B)**	To determine if there are asbestos fibers in the air over NYSDOL permissible limits
	Waste Decon					
	Inside Work Area					
	Outside Work Area					
	Field Blank					
	Critical Barriers					
	Neg. Air Exhaust					

Section 5.2 Analytical Methods and Requirements

Matrix	Analytical Group	Concentration Level	Analytical Preparation Method / SOP Reference	Sample Volume	Containers (number, size, type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Air	Fibers	Low	NIOSH 7400 / NMAM Asbestos and Other Fibers by PCM	400 L @ 0.1 fiber/ccc – MAX*: (NIOSH 7400 step 4, sampling) *Adjust to give 100 to 1300 fiber/mm^2	25mm, 3-piece cassette with 50-mm electrically conductive extension cowl with a mixed cellulose ester filter 0.45 to 1.2 µm pore size	None	60 days after preparation and analysis

Section 5.3 Reference Limits and Evaluation Table

<table>
<tr><td colspan="3">Matrix: Air</td></tr>
<tr><td colspan="3">Analytical Method: NIOSH 7400</td></tr>
<tr><th>Analyte</th><th colspan="2">CAS#</th><th>Analytical Method</th><th>Reporting Limit</th><th>MDL</th><th>NYSDOL Sample Results Criteria</th></tr>
<tr><td rowspan="7">Fibers (manual count)</td><td>*Actinolite</td><td>7756-66-4</td><td rowspan="7">NIOSH 7400</td><td rowspan="7">7 fibers/mm^2 of filter area</td><td rowspan="7">7 fibers/mm^2 of filter area</td><td rowspan="7">0.1 fibers/cc</td></tr>
<tr><td>*Amosite</td><td>12172-73-5</td></tr>
<tr><td>*Anthophyllite</td><td>77536-67-5</td></tr>
<tr><td>*Chrysotile</td><td>12001-29-5</td></tr>
<tr><td>*Amphibole</td><td>1332-21-4</td></tr>
<tr><td>*Tremolite</td><td>77536-68-6</td></tr>
<tr><td colspan="2">*Only NIOSH 7402 can ID the asbestos fiber types</td></tr>
</table>

Section 5.4 Analytical Laboratory Sensitivity and Project Criteria

Matrix: Air				
Analytical Group: Fibers				
Concentration Level: Low				
Analytical Method	**Data Quality Indicators**	**Performance Criteria (related to analytical method)**	**QC Sample Used to Assess Performance Criteria**	**QC Sample Assess Error for Sampling (S), Analytical (A), or both (S&A)**
NIOSH 7400	Accuracy/Bias	Quantitation within established limits	Reference Slides, Proficiency Test, Round Robin Exchange	A
	Accuracy/Bias Contamination	~LOD 7 fibers/mm^2 filter area	Field Blank	S&A
	Precision-Overall	10% Blind recounts, pair test cannot exceed 2.77 x S^1_r	QC re-analyses (Field)	S&A
	Sensitivity	LOD 5 fibers/mm^2 filter area	Laboratory Blank	A

Section 5.5 Secondary Data Criteria and Limitations Table

No secondary data for the project site is available.

Section 6 Project Specific Method and Standard Operating Procedures (SOPs) Reference Table

Analytical Method Reference
1a. NMAM Asbestos and Other Fibers by PCM, Method 7400, Issue 3, 14 June 2019
Analytical Laboratory SOPs
1b. Standard Operating Procedure for PCM and TEM Analysis of Asbestos in Air Samples (NIOSH Methods 7400 and 7402), 12/30/2024
Field Sampling SOPs
1c. ATL SOP 107-001: Asbestos Project Monitoring/Air Sampling, 2/10/2015

Section 7 Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Instrument	Calibration Activity	Maintenance Activity	Testing/Inspection Activity	Frequency	Acceptance Criteria	Corrective Action
Rotameter	Required Calibration using a Bios Defender 510-H	Daily prior to conducting work activity	Functional or not	Every 3 months	Functional	Switch meters
High volume air sampling pump	Calibration using same type of filter as used for sampling.	Daily prior to conducting work activity.	Check personal sampling pumps before use with 0.45-µm filters to ensure they can operate at the higher pressure drop.	Twice daily	Adequate pressure for filter	Switch pumps and/or filters

Section 8 Analytical Laboratory Instrument and Equipment Maintenance, Testing, and Inspection

AmeriSci Instruments Maintenance, Testing or Inspection						
Instrument/Equipment	**Maintenance Activity**	**Testing/Inspection Activity**	**Frequency**	**Corrective Action**	**Responsible Personnel**	**SOP Reference**
Polarized Light Microscopy (PLM)/ Phase contrast Light Microscope	Alignment	Cleaning and Maintenance	Annual/As needed	Removed from service. Call technician for maintenance	Supervisor/ Manager	SOP for PCM and TEM Analysis of Asbestos in Air Samples
Mechanical Tally Counter	Cleaned Verification	Monthly/As needed	Ensure 100 count sequence twice	Remove from service; replace tally counter	Supervisor/ Manager	

Section 8.1 Analytical Laboratory Instrument Calibration

AmeriSci Instrument Calibration						
Instrument	**Calibration Activity**	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action**	**Responsible Personnel**	**SOP Reference**
Phase contrast Light Microscope	Alignment	Daily/Next Use	Centering and focusing the objectives, condenser, stage, and lamp	Removed from service. Call technician for maintenance/repair	Supervisor/ Manager	Standard Operating Procedure for PCM and TEM Analysis of Asbestos in Air Samples (NIOSH Methods 7400 and 7402), 12/30/2024
Phase Centering Telescope	Alignment of microscope	Daily/Next use	Ensure phase ring is concentric	Remove from service. Call technician for replacement.	Supervisor/Manager	
HSL-NPL (phase-shift test slide)	Verify performance of microscope	Weekly/Next Use	Visibility band 5 fully visible and band 6 partially visible	Remove from service. Call technician for replacement.	Supervisor/Manager	
Walton-Beckett Graticule G22	Verify fibers longer than 5 microns	Monthly	100 µm at the stage	Remove from service. Call technician for replacement.	Supervisor/Manager	
Mechanical Tally Counter (hand clicker)	Fiber Counting	Monthly/As Needed	Ensure 100 count sequence twice	Remove from service; replace	Supervisor/Manager	
Klarmann Ruling, Stage Micrometer	Verify microscope eyepiece graticule	5 years	Tolerance range of 100 µm ±2	Remove from service. Call technician for replacement.	Supervisor/Manager	

Section 9 Sample Handling System

The following table presents the field and laboratory sample handling systems.

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): TBD, Atlantic Testing Laboratories
Sample Packaging (Personnel/Organization): TBD, Atlantic Testing Laboratories
Coordination of Shipment (Personnel/Organization): TBD, Atlantic Testing Laboratories
Type of Shipment/Carrier: Lab courier or Commercial Shipping Company
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): AmeriSci Receiving Department
Sample Custody and Storage (Personnel/Organization): AmeriSci Receiving Department
Sample Preparation (Personnel/Organization): AmeriSci Technician Department
Sample Determinative Analysis (Personnel/Organization): AmeriSci Analyst Department
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples to be shipped daily (upon completion of field sample collection)
Sample Extract/Digestate Storage (No. of days from extraction/digestion): As per analytical methodology; See Section 6.
SAMPLE DISPOSAL
Personnel/Organization: AmeriSci Warehouse Department
Number of Days from Analysis: 3 months from receipt (unless client requests extension, up to 180 days total)

Section 9.1 Sample Custody Requirements

The following presents an overview of the sample custody requirements.

Sample Identification Procedures: Sampling media will be identified by a letter/number code as follows: WT5001AA01-mm-dd-yyy (ATL Project number, sample number, date). Sample numbering will use consecutive numbering for the duration of the project. Following the sample number, the sample date will appear in mm-dd-yyyy format. Each sample will be labeled immediately following collection and recorded in chain-of-custody records.

Field Sample Custody/Tracking Procedures (sample collection, packaging, shipment, and delivery to laboratory: Samples submitted for laboratory analysis will be placed in laboratory provided sampling containers. All samples will be recorded and tracked under chain-of-custody protocols. In the field, each sample will be checked for proper labeling. A chain-of-custody form will be completed for each batch, as described below, and will be signed by the person who collected the samples, the person who relinquished the samples for shipment, and the person who received the samples at the laboratory.

Chain-of-Custody Procedures: A chain-of-custody form will be initiated with the sample collection. All samples will be traced from bottle preparation, sample collection, shipment, laboratory receipt, and laboratory custody. Labels will be affixed to sample containers with a minimum of the following information: ATL Project number, sample number, date, and name of sampler. Following sample collection, ATL personnel will transfer the samples to either a common courier or laboratory courier, who will deliver the samples to AmeriSci New York, where the samples will be transferred to laboratory custody following standard chain-of-custody procedure.

The chain-of-custody form is signed by all individuals responsible for sampling, sample transport and laboratory receipt. At a minimum, the chain-of-custody form must include: ATL Project number and name, sampler(s), sample number(s), date, time, sample location, and remarks. A sample chain-of-custody form is included in **Appendix D.** A copy of the fully signed chain of custody form is also kept with the project file by the ATL project manager, the laboratory manager, and attached to the data package to be maintained by BRS. The laboratory will be responsible for monitoring an internal chain-of-custody following receipt of the samples. Should it be required that the samples be shipped or delivered by a non-laboratory employed person (courier), the shipping container will be sealed with the chain-of-custody form inside using a chain-of-custody seal and tape prior to release by consultant personnel.

Section 10 Field and Analytical Laboratory Quality Control Summary

Field Quality Control Summary

Matrix			Air		
Analytical Group			Asbestos Fibers		
Concentration Level			Low/Medium – fibers per cubic centimeter		
Sampling SOP			ATL SOP 107-001 Asbestos Project Monitoring – Air Sampling		
Analytical Method			NIOSH 7400		
Field Sampling Organization			ATL		
Analytical Organization			AmeriSci		
No. of Sample Locations			TBD		
Quality Control Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**
Field Blank	2 samples per day or 10% of total sample number, whichever is greater	No constituent > CRQL	Flag outliers	Data validator	Accuracy

Section 11 Data Management and Documentation

The following table presents project related data management and documentation criteria.

Field Sample Collection Documents and Records	Analytical Laboratory Documents and Records	Data Assessment Documents and Records	Project File
• Air sampling logbooks • Daily field logbook • Applicable figures and tables for sampling location identification • Chain-of-Custody (COC) forms	• Sample receipt logs • Internal and external COC forms • Equipment calibration logs and data • Sample preparation worksheets/logs • Sample analysis worksheets/run logs • Telephone/email logs • Corrective action documentation • Narrative • Sample Data • Laboratory analytical data package	• Data validation reports • Field inspection checklist(s) • Laboratory Audit checklist (if performed) • Review forms for electronic entry of data into database • Corrective action documentation • Data Usability Summary Report	• Project files to be stored in BRS Inc.'s electronic project directory for a period of at least five years.

Section 11.1 Project Reports

The types of reports that will be routinely provided during the Brownfields project (e.g., status reports, final reports, etc.) are provided below.

Type of Report *	Frequency (Daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Status Report	Daily	1 day after daily field activities	ATL	Alicia Flammia, BRS, Inc.
Laboratory Analytical Data Package	One Time	Within 10 days of laboratory receipt of field samples	AmeriSci	Alicia Flammia, BRS, Inc. ATL
Data Validation Report	One Time	Within 5 weeks following receipt of analytical results	Third Party Validator, TBD	Alicia Flammia, BRS, Inc.
Demolition Air Monitoring Report	One Time	Within 3 months following receipt of data validation report	TBD	Patrick Peck, EPA Region 2 BPO Marc Barraco, Mohawk Valley EDGE

* Any other report related to the site investigation will be delivered within 30 days of the delivery date and will be sent to Mohawk Valley EDGE and the Project Officer.

Section 12 Planned Project Assessments Table

The following table identifies the type, frequency and responsible parties of planned assessment activities for the project.

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions (Title and Organizational Affiliation)
On-Site Field Inspection	Periodically	Internal	BRS, Inc.	Project Scientist, TBD	Project Manager, Alicia Flammia	Marc Barraco, Mohawk Valley EDGE	Marc Barraco, Mohawk Valley EDGE
Inspection of Field Logs	Periodically	Internal	TBD	Project Scientist, TBD	Project Manager, Alicia Flammia	Marc Barraco, Mohawk Valley EDGE	Marc Barraco, Mohawk Valley EDGE
Review of Laboratory Data Package	Upon receipt of data package	Internal and External	TBD	Project Scientist, TBD	Project Manager, Alicia Flammia	Marc Barraco, Mohawk Valley EDGE	Marc Barraco, Mohawk Valley EDGE

Section 12.1 Assessment Findings and Corrective Action Responses

Not applicable.

Section 13 Project Data Verification Process (Step I)

Verification Input	Description	Internal/External	Responsible for Verification
Site/Field Logbooks	Field notes will be prepared daily by ATL field staff and will be complete, appropriate, legible and pertinent. Upon completion of field work, logbooks will be place in project files.	Internal	TBD, BRS, Inc.
Chain-of-custody	COC forms will be reviewed against the samples packed in the shipping container prior to shipment. The reviewer will initial the form. An original COC will be sent with the samples to the laboratory. Copies will be retained for the project files.	Internal	TBD, BRS, Inc.
Laboratory Analytical Data Package	Data packages will be reviewed/verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Internal	Analytical Department, AmeriSci
	Data packages will be reviewed for content and sample information upon receipt by BRS and ATL project managers and the Third Party Data Validation Personnel.	Both	TBD, BRS, Inc. and TBD, ATL
Final Sample Report	The project data results will be compiled in a sample report for the project. Entries will be reviewed/verified against hardcopy information.	Internal	TBD, BRS, Inc.

Section 13.1 Project Data Validation Process (Steps IIa and IIb)

Step IIa[1]/IIb[2]	Validation Input	Description	Responsible for Validation
IIa	SOPs	Ensure that the sampling methods/procedures outlined in QAPP were followed, and that any deviations were noted/approved.	Alicia Flammia, BRS, Inc.
IIb	SOPs	Determine potential impacts from noted/approved deviations, in regard to PQOs.	Alicia Flammia, BRS, Inc.
IIa	Chain-of-custody	Examine COC forms against QAPP and laboratory contract requirements (e.g., analytical methods, sample identification, etc.).	Alicia Flammia, BRS, Inc.
IIa	Laboratory data package	Examine packages against QAPP and laboratory contract requirements, and against COC forms (e.g., holding times, sample handling, analytical methods, sample identification, data qualifiers, QC samples, etc.).	Alicia Flammia, BRS, Inc.
IIb	Laboratory data package	Determine potential impacts from noted/approved deviations, in regard to PQOs. Examples include PQLs and QC sample limits (precision/accuracy).	Alicia Flammia, BRS, Inc.

[1] Step IIa: Compliance with methods, procedures, and contracts
[2] Step IIb: Comparison with performance criteria in QAPP

Section 13.2 Project Matrix and Analytical Validation (Steps IIa and IIb)[1] Summary

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator
IIa / IIb	Air	Asbestos Fibers	Low/Medium	Comparison with performance and sampling criteria as outlined in the QAPP	Alicia Flammia, BRS, Inc.

[1] Step IIa: Compliance with methods, procedures, and contracts
Step IIb: Comparison with performance criteria in QAPP

Section 13.3 Usability Assessment (Step III)

Usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
Determine if any detectable amounts of asbestos are present. If no detectable amounts are indicated and all data are acceptable for the verification and validation, then the data is usable. If verification and validation are not acceptable then take corrective action (determine cause, data impact, evaluate the impact and document the rationale for resampling).

The evaluative procedures used to assess overall measurement error associated with the project:
Determine if the quality control data is within the performance criteria (precision, accuracy, etc.) through validation process IIb (Validation Activities).

Personnel responsible for performing the usability assessment:
Project Management Team: Alicia Flammia, Project Manager, BRS, Inc.

Documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:
The Usability Memo will describe the rationale for the data and the presentation of any data limitations. For example, if the performance criteria are not usable to address the regulatory requirements or support the project-decision, then the Memo should address how this problem will be resolved and discuss the alternative approach.

FIGURE 1

BRS inc
P.O. Box 2293
Medford Lakes, NJ 08055
T: 856-964-6456 | brsinc.com

Legend

Site Location

Scale 0 500 1,000 2,000 Feet

Figure Title **Site Location**

Client Mohawk EDGE

Address Griffiss Parachute Shop
212 Hangar Road
Rome, New York

Figure No. **1**

Print Date 5/27/2025

Document Path: M:\Data\BRS Portal\Mohawk EDGE\GIS\01_Aprx\GriffissLDParachuteShop\GriffissLDParachuteShop.aprx

Appendix A Resumes

Alicia Flammia

Environmental Division Director

Ms. Flammia assists clients to plan efficient brownfield assessment and remediation activities, communicate with regulatory agencies and project stakeholders, and select and oversee environmental contractors. Ms. Flammia manages all environmental aspects of environmental investigation and remediation work as well as performs research and analysis on community redevelopment where environmental concerns are present.

Environmental Assessment and Remediation: Managed hundreds of Phase I and Phase II Environmental Site Assessments (ESAs). Designed and managed soil, soil gas, and groundwater investigations and remediation; hazardous material/waste removal and disposal; and storage tank closure activities. Site remediation regulatory compliance and reporting in Massachusetts (310 CMR 40.0), New Jersey (N.J.A.C. 7:26E), New York, Vermont, Pennsylvania, and Utah.

Project Stakeholder Management: Experienced in managing complex cleanup and development projects requiring close coordination and clear communication with local, county, state and federal government officials and regulators; community–based organizations and citizen groups; private and non-profit developers; local police and fire departments and licensing and inspection units; utilities; neighboring property owners; non-profit organizations; insurance representatives, and bankers.

Construction and Demolition Project Management: Performed contract administration, coordination and management of consultants and contractors. Development and control of project budgets and schedules. Evaluation of contractor's submittals.

Environmental Review Records: Prepared review documents in accordance with 24 CFR Part 58 for activities funded through the U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG) and HOME programs.

National Environmental Policy Act Review: Prepared environmental review documents for wetland restoration and shoreline stabilization projects in accordance with 40 CFR Subchapter A Part 1500 to support the finding of no significant impact determination of projects in Tuckerton and Little Egg Harbor New Jersey.

Public Outreach Activities: Town of Walpole, NH Conservation Commission as Chair of the commission from 2016-2023. Outreach included public notification via online platforms and in local publications; preparing for and leading public presentations on topics including priorities for town-conserved lands, collaboration with large private landholders, and informational hikes and programming; and coordination with experts as part of public engagement programming.

BRS PROJECTS

EPA Region 3 Revolving Loan Fund, Brownfield Support, Lycoming County, PA
(2022-Present)
Ms. Flammia prepared EPA-approved Programmatic Quality Assurance Project Plan (QAPP) for county-wide assessment program.

Years of Professional Experience:

21

Education:

M.S. Resource Management and Administration, 2007
Antioch University New England

B.A. Culture, Ecology, and Sustainable Community, 2001
New College of California

A.A. Resource Management, 1997
Sterling College

Certifications:

OSHA 40-Hour HAZWOPER Course and Current 8-Hour Refresher Course

OSHA 8-Hour Supervisor Training

OSHA 10-Hour Construction Industry Outreach training

Regulatory IV: Wetland Id and Delineation, U.S. Army Corps of Engineers

Contact:

aflammia@brsinc.com

EPA Region 2 Revolving Loan Fund, Brownfield Support and Assessments, City of New York, Mayor's Office of Environmental Remediation (OER) (2016-Present)

Ms. Flammia provides support for multiple New York City Brownfield programs including the Brownfield Incentive Grant (BIG) program. As an On-Call pool contractor, Ms. Flammia prepared the programmatic QAPP used to govern sampling for all of OER's Phase II investigations and performs ASTM compliant Phase I and Phase II assessments for OER. Services include implementation of grant funded site work; technical liaison with state and EPA personnel; preparation of Analysis of Brownfield Cleanup Alternatives (ABCA); technical review of documents for BIG grant applications.

EPA Region 8 Brownfield Support, Land Use Analysis, Property Assessments, City of Orem, UT (2017-Present)

Ms. Flammia performed Brownfield Inventory and Land Use Analysis work as part of the EPA Brownfields Area Wide Planning grant received by the City of Orem. The Geneva Road Area is an important industrial, employment, and residential area for the City as well as Utah County since the 1940s. The area grew around the Geneva Steel plant, which was constructed by the United States government in 1912. As part of the City's first-in-Utah EPA Brownfields Community-Wide Assessment grant, Ms. Flammia prepared the programmatic QAPP used to govern sampling for all of the City's Phase II investigations and performs ASTM compliant Phase I and Phase II assessments for the City. Services include implementation of grant funded site work and technical liaison with state and EPA personnel.

EPA Region 2 Revolving Loan Fund, Brownfield Assessment and Remediation, Dominic Andujar Park, Camden Redevelopment Agency (2018-Present)

Ms. Flammia provides owner representative, contractor oversight, and technical review services for various legacy brownfield sites in the City of Camden including Dominic Andujar Park, the site of a former tannery operation. This park was closed in 2019 due to identified contamination and is being remediated for park upgrades and green infrastructure with involvement from Camden County, Trust for Public Land, Coopers Ferry Partnership and community stakeholders. Services include implementation of grant funded site work; technical liaison with LSRP, state and EPA personnel; preparation of Analysis of Brownfield Cleanup Alternatives (ABCA); Davis Bacon Act (DBA) compliance work.

ADDITIONAL PROJECT EXPERIENCE

Remediation of Retail Petroleum site, Greenfield, MA, Private Petroleum Retailer

Managed environmental response, remediation and site closure activities for a gasoline leak to soil and surface water at a site with a co-mingled chlorinated solvent plume. Oversaw the remediation of the co-mingled plume and managed the reimbursement of eligible petroleum costs under the state's cleanup fund. Successfully presented the case to the state that the chlorinated solvent impacts were not the responsibility of the client and assisted in relieving them of all financial and environmental liability for the chlorinated solvent impacts.

EPA Region 1 Regional Assessment for Emerging Contaminants, Bennington, VT, State of Vermont, Department of Environmental Conservation, Bureau of Site Remediation

Ms. Flammia managed the regional assessment of Perfluorooctanoic Acid (PFOA) contamination on behalf of the State in neighborhoods where private drinking water wells been contaminated with PFOA. Services included stakeholder and subcontractor management of potable water sampling, installation of alternative water supply and disposal of impacted water supply hardware; and technical liaison with landowners, federal, state and local officials.

EPA Region 1 Regional Brownfield Assessment for Waterline Installation, Springfield, VT, Engineering and Architectural Firm

Ms. Flammia managed site characterization activities and prepared technical specifications for a municipal water line installation project that traversed four Brownfield properties and three known hazardous waste sites. Services included stakeholder and subcontractor management of site work; and technical liaison with landowners, state and local officials.

Due Diligence Portfolio Management, New England, Private Petroleum Retailer

Managed the due diligence process for a property transaction of 50 retail petroleum sites for a large New England based petroleum retailer. Provided technical recommendations for portfolio cost allocations of escrow amounts related to environmental liability.

Emergency Response, Spill Prevention and Stormwater Facility Compliance

Preparation of state and federal compliance plans, quarterly reports and annual certifications. Bulk storage facility regulatory compliance and reporting in Massachusetts, Maine, Vermont and New York (6 NYCRR Parts 612-614).

EMPLOYMENT HISTORY

Brownfield Redevelopment Solutions, Inc. – Environmental Project Manager

(2016 to Present)

As Environmental Project Manager, Ms. Flammia assists clients to plan efficient brownfield assessment and remediation activities, communicate with regulatory agencies and project stakeholders, and select and oversee environmental contractors. Ms. Flammia manages all environmental aspects of environmental investigation and remediation work as well as performs research and analysis on community redevelopment and environmental concerns.

ATC Group Services, LLC (formerly known as ECS, Inc.), Brattleboro, VT – Branch Manager (2007 to 2016)

Branch Manager for environmental consulting firm. Managed hundreds of Due Diligence Environmental Site Assessments (ESAs) and performed senior and Environmental Professional review. Demonstrated experience with EPA-funded Brownfield redevelopment and "emerging contaminant" investigation projects. Served as lead on spill prevention and stormwater compliance projects and performed various regulatory compliance tasks for industrial clients.

Simple Solutions, LLC, Laytonville, CA – Proprietor (2003 to 2005)
Started and managed a property maintenance company specializing in drought tolerant landscape design.

Circuit Rider Productions, Windsor, CA – Staff (2000 to 2002)
Native Plant Restoration field staff and Nursery Operations staff.

UC Davis Bodega Marine Laboratory, Bodega Bay, CA – Staff (1999 to 2002)
Served as Invasive Species Management staff at the marine reserve.

OTHER

Member, Society of Women Environmental Professionals (SWEP)
Member, Brownfield Coalition of the Northeast (BCONE)
Member, Licensed Site Remediation Professional (LSRP) Association: NJ
Member, Conservation Commission, Walpole, NH
Board of Directors, Reservoir Woods Foundation

Appendix B

Atlantic Testing Laboratories, Limited (ATL)

Issue Date: May 30, 2014
Prepared By: Joe Grabowski
Reviewed By: Cheyenne Dashnaw
Revision Date: February 10, 2015

The purpose of this SOP is to promote quality through consistency of the procedure within the ATL organization, even through personnel changes, by documenting repetitive administrative and technical activities. The SOP is a step-by-step procedure presented in chronological order that can be followed in the same manner each time.

1. TABLE OF CONTENTS

2. POLICY STATEMENT

a. It is ATL's general policy to preserve the integrity of data, to ensure the precision and accuracy of results obtained in the testing process, and to provide clear documentation of results, supporting data, and conclusions.

3. PURPOSE/IMPACT

a. The purpose of this SOP is to provide standard guidelines for performing asbestos project monitoring and air sampling, to create consistency in sample collection, documentation, and enforcement, and to provide a basis for training and performance evaluations.

4. AREAS AFFECTED

a. All operating divisions of ATL performing Asbestos services.

5. IMPLEMENTATION

a. It is the responsibility of Division Management to ensure that the user is following the procedure(s) in accordance with the applicable SOP.

b. It is the responsibility of the direct supervisor to ensure the SOP is available to the user.

c. It is the responsibility of the user to use and adhere to the SOP.

6. CERTIFICATION REQUIREMENTS AND QUALIFICATION REQUIREMENTS

a. The technician must have completed a 40-hour training class from an accredited NYS training provider for certification as an Asbestos Project Monitor/Air Sampling Technician.

b. Attendance at the 2-day ATL Asbestos Project Monitor course.

c. Applicable non-expired NYS Department of Labor Asbestos Project Monitor (PM) Certificate (Hard card) or valid Department of Health Certificate of Asbestos Training for Asbestos Project Monitor/Air Sampling Technician within 45 days of issuance.

d. Training with a senior Asbestos Project Monitor or Asbestos Project Manager

7. EQUIPMENT REQUIRED

a. General Equipment

1) Narrow Beam Flashlight
2) Digital Camera
3) Tape Measure
4) Clipboard
5) High Volume Air Sampling Pumps and Stands
6) Applicable Air Sampling Cassettes (PCM and/or TEM)
7) Air Sample Chain-of-Custody Forms
8) Two Rotometers (calibrated within the last three months)
9) Extension Cords (12 Gauge)
10) GFCIs

11) Leaf Blower

12) 20” Fan(s)

b. Personal Protective Equipment

1) Nitrile Gloves
2) Safety Glasses/Goggles
3) Respirator equipped with HEPA filters
4) Safety Shoes
5) ATL Hard Hat
6) Swim Suit/Trunks for beneath Tyvek or Polypropylene Suits
7) Tyvek or Polypropylene Suits

c. Documents

1) Current copy of New York State Industrial Code Rule 56 (NYCRR)
2) Daily Project Log Book
3) Copy of ATL’s Current Asbestos License
4) Copy of Project Monitor/Air Technician Hard Card, Fit Test, Physical, and DOH-2832 Training Certificate
5) Asbestos Survey and/or Asbestos Project Design (supplied by building owner or representative)

8. REFERENCE DOCUMENTS

a. ASTM E 1368 – Standard Practice for Visual Inspection of Asbestos Abatement Projects

b. 12 NYCRR Part 56, Applicable Variances, and Guidance Document

c. Occupational Safety and Health Administration Code of Federal Regulations – Asbestos General Industry Standards (29 CFR 1910.1001)

d. Occupational Safety and Health Administration Code of Federal Regulations – Asbestos Construction Industry Standards (29 CFR 1926.1101)

e. U.S. Environmental Protection Agency's "Guidance for Controlling Asbestos-Containing Materials in Buildings″

f. U.S. Environmental Protection Agency - Asbestos Hazard Emergency Response Act of 1986 (EPA AHERA 40 CFR 763 Subpart E)

9. TERMS AND DEFINITIONS

Terms

12NYCRR 56: Part 56 of Title 12 of the Official Compilation of Codes, Rules, and Regulations of the State of New York (also referred to as Code Rule 56)

Terms (continued)

ACM:	Asbestos-Containing Material
ACBM:	Asbestos-Containing Building Material
AHERA:	Asbestos Hazard Emergency Response Act
ELAP:	Environmental Laboratory Approval Program
HEPA:	High Efficiency Particulate Air
HVAC:	Heating, Ventilating and Air Conditioning
IWA:	Inside Work Area
LPM:	Liters per Minute
MSDA:	Materials Safety Data Sheets
NESHAP:	National Emission Standard for Hazardous Air Pollutants
NIOSH:	National Institute for Occupational Safety and Health
NOB:	Non-organically Bound
NVLAP:	National Voluntary Laboratory Accreditation Program
OSHA:	Occupational Safety and Health Administration
OWA:	Outside Work Area
PACM:	Presumed Asbestos Containing Material
PCM:	Phase Contract Microscopy
PLM:	Polarized Light Microscopy
PPE:	Personal Protective Equipment
SDS:	Safety Data Sheets
TEM:	Transmission Electron Microscope
TSI:	Thermal System Insulation
VAT:	Vinyl Asbestos Tile

Definitions

Amended Water:	Water to which a surfactant (such as soap) has been added
Asbestos-Containing Material (ACM):	Materials that contain greater than one percent (1%) of asbestos
Authorized Person:	Person authorized by the employer and required by work duties to be present in regulated areas
Background Air Sampling:	Method used to determine airborne fiber concentrations in the area where abatement work is to be conducted, prior to starting Phase II A of the asbestos project

Definitions (continued)

Breeching:	Duct which transports combustion gases from a boiler or heater to a chimney or stack, also called a flue
Building / Facility Owner	The legal entity, including a lessee, which exercises control over management and record keeping functions relating to a building and/or facility in which activities covered by the NYCRR 56 standard take place
Category I Non-friable ACM:	Asbestos-containing packing, gaskets, resilient floor covering, and asphalt roofing products with more than 1% asbestos as determined using PLM
Category II Non-friable ACM:	Material (except Category I material) with more that 1% asbestos as determined using PLM that, when dry, cannot be crumbled, pulverized or reduced to power by hand pressure
Class I Asbestos Work:	OSHA term meaning activities involving the abatement of TSI and surfacing ACM and PACM
Class II Asbestos Work :	OSHA term meaning activities involving the abatement of ACM which is not TSI or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics
Clean Room:	Uncontaminated area or room, which is a part of the personal decontamination enclosure, with provisions for storage and changing of persons' street clothes and protective equipment
Clearance Air Sampling:	Accepted method of air sampling used upon completion of final cleaning, during Phase IIC of an asbestos project. This method consists of using aggressive air sampling techniques to dislodge and stir up remaining asbestos fibers, and then air samples are collected for appropriate analysis to determine representative airborne fiber concentrations
Competent Person:	Person capable of identifying existing asbestos hazards in the work place and whom has the authority to take corrective action
Containment:	Negative-pressurized enclosure within the restricted area, which establishes the regulated abatement work area and surrounds the location where the asbestos abatement is actually taking place
Critical Barrier:	Barriers that seal off all openings to or within the defined regulated abatement work area, including but not limited to operable windows and skylights, doorways, ducts, grills, diffusers, and any other penetrations to surfaces adjacent to or within the regulated abatement work area
Decontamination Enclosure:	Series of connected rooms, usually attached to the regulated abatement work area, for the decontamination of persons, materials and equipment

Definitions (continued)

Disturbance:	Any activities that disrupt the matrix of ACM or PACM, or generate debris, visible emissions or airborne asbestos fibers from ACM or PACM. This includes moving of friable asbestos containing material from one place to another
Equipment Room:	Contained area or room which is part of the personal decontamination system enclosure with provisions for the storage of contaminated clothing and equipment
Fixed Object:	Equipment, furniture or other item that is affixed, as a whole to a floor, ceiling, wall or other building structure system
Friable Asbestos-Containing Material:	Asbestos-containing material applied on ceilings, walls, structural members, piping, duct work, or any other part of a building which when dry may be crumbled, pulverized, or reduced to powder by hand pressure. The term includes non-friable asbestos-containing material after such previously non-friable material becomes damaged to the extent that when dry it may be crumbled, pulverized, or reduced to powder by hand pressure
Glovebag:	Manufacturers impervious bag-like enclosure constructed of at least six (6) mil transparent plastic, seamless at the bottom, with inward projecting long sleeve glove(s), which may also contain an inward-projecting water-wand sleeve, an internal tool pouch and an attached, labeled receptacle or portion, for asbestos waste
High-Efficiency Particulate Air (HEPA) Filter:	Filter capable of trapping and retaining at least 99.97 percent of 0.3 micrometer diameter mono-disperse particles
Incidental Disturbance:	The unintentional disturbance of ACM, PACM, or asbestos material
Incidental Disturbance Project:	The cleanup, repair or encapsulation of less than 10 square feet or less than 25 linear feet of incidentally disturbed ACM, PACM or asbestos material
Isolation Barrier:	Installed temporary hard wall barriers that complete the containment enclosure and establish the regulated abatement work area
Large Asbestos Project:	An asbestos project involving the removal, disturbance, enclosure, encapsulation, repair, or handling of 160 square feet or more of ACM, PACM, or asbestos material OR 260 linear feet of ACM, PACM, or asbestos material
Lockdown Encapsulant:	Thinned out bridging encapsulant used for lockdown purposes to assist with cleanup (typically sprayed on plastic sheeting)
Mastic:	Pasty material used as an adhesive (as seen under floor tiles)

Definitions (continued)

Minor Asbestos Project:	An asbestos project involving the removal, disturbance, enclosure, encapsulation, repair, or handling of 10 square feet or less of ACM, PACM, or asbestos material OR 25 linear feet or less of ACM, PACM, or asbestos material
Movable Object:	Equipment, furniture or other item that is not attached or affixed, in whole or in part, to a floor, ceiling, wall or other building structure or system or to a fixed object
Multiple Abatement:	The abatement of more than one type of asbestos within the same containment
Negative Air Pressure Equipment:	Local exhaust system, capable of maintaining air pressure within a containment at a lower pressure than the air pressure outside of such containment, and which provides for HEPA filtration of all air exhausted from the containment
Non-friable:	Material that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure, and is not capable of being released into the air by hand pressure
Non-friable Organically Bound (NOB):	Materials that are non-friable and that consist of fibers and other matter embedded in a solid matrix of asphalt, vinyl or other organic material
Personal Decontamination System Enclosure:	Area designated for controlled passage of all persons to and from the regulated abatement work area
Personal Protective Equipment (PPE):	Disposable work suits (Tyvek) or coveralls, head cover, eye protection, Safety footwear, gloves, and respiratory protection
Regulated Area:	Area established by the employer to demarcate areas where airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the permissible exposure limits
Remote Decontamination System:	Decontamination systems that are not attached to the regulated abatement work area but are within the work site
Removal:	Abatement, consisting of operations where ACM, PACM or asbestos material is removed or stripped from structures or substrates. This includes demolition operations
Repair (Asbestos):	Abatement, consisting of corrective action for a Minor Asbestos Project using required work practices to control fiber release from damaged ACM, PACM or asbestos material
Respiratory Protection:	NIOSH-approved respirators with appropriate NIOSH-approved filters

Definitions (continued)

Restricted Area:	Restricted area established and marked for the abatement portion of an asbestos project. This area shall include, but not be limited to asbestos project regulated abatement work areas and any contiguous decontamination facilities, adjoining staging areas where work materials, debris, or waste from such work may accumulate, remote decontamination areas, and waste storage areas
Sequential Abatement:	Abatement of different types of asbestos containing material within a common regulated abatement work area in a priority order
Shower Room:	Room between the clean room and the equipment room, in the personal decontamination enclosure, with hot and cold running water controllable at the tap and arranged for complete showering during decontamination
Small Asbestos Project:	An asbestos project involving the removal, encapsulation, enclosure, repair, disturbance, or handling of more than 10 and less than 160 square feet or more of ACM, PACM, or asbestos material OR more than 25 and less than 260 linear feet of ACM, PACM, or asbestos material
Surfacing Material:	Material that is sprayed on, troweled-on, or otherwise applied to surfaces (such as acoustical or finish plaster on ceilings and walls, and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes)
Tent:	Fire retardant polyethylene enclosure that includes walls, ceiling and a floor as required to remove ACM, PACM or asbestos material
Thermal System Insulation:	Insulation material applied to pipes, fittings, boilers, breeching, tanks, ducts, or other structural components to prevent heat gain or loss
Variance:	Relief in accordance with Section 30 of the Labor Law from specific sections of Industrial Code rule 56 for a specific project
Visible Emission:	Emission of particulate material that can be seen without the aid of instrumentation
Waste Decontamination System Enclosure:	Area consisting of a washroom and a holding area separate from each other by airlocks, designated for the controlled transfer of materials and equipment from the regulated abatement work area
Wet Cleaning:	Process of eliminating asbestos contamination from surfaces, equipment, or other objects by using cloths, mops, or other cleaning tools that have been saturated with amended water

10. TRAINING AND EVALUATION PROCEDURE

a. Use Training Checklist Nos. TRN-ENV-03 and TRN-ENV-04, and the Example Asbestos Logbook for training. The Training Checklists and the Example Asbestos Logbook are located at "P" Drive\Internal Quality\Training\Training and Evaluation Checklist\Training Checklists\Environmental.

b. Use Evaluation Checklist No. TRN-ENV-05 for evaluation. The Evaluation Checklist is located at "P" Drive\Internal Quality\Training\Training and Evaluation Checklist\Training Checklists\Environmental.

11. PROJECT MONITORING PROCEDURE

a. Pre-Monitoring Planning

1) Prior to project set-up, general project information must be obtained. Some of this information should be recorded on the cover and the first two pages of the Asbestos Project Logbook, for which the monitor is responsible for maintaining (reference section 11.d.14 on page 18 of this SOP). The following items are essential at the start a project and must be obtained before a project monitoring assignment can begin.

- An ATL Project Number, Name, Location, and ATL Office
- Directions to the Project Site
- Client Information (i.e., client company name, address, contact person, phone and fax numbers, and email address)
- Type of Services ATL is providing and Scope of Work being performed
- Available project plans and specifications
- Approved Site-Specific Variance(s) for the work, if applicable
- Establish what project-specific equipment will be needed for the location
- Establish an Asbestos Project Logbook
- Identify any chemicals that the abatement contractor is planning on using on the job site, and obtain the corresponding MSDS or SDS. Review the MSDS or SDS and consult with an ATL Health and Safety Manager to identify potential additional applicable requirements (i.e., use of combination organic cartridge / HEPA filter)

2) Prior to arriving on-site to commence work, the project monitor should review the project scope of work, related or associated documentation, project submittals and the Health and Safety Plan, in order to familiarize themselves with any specific requests the building/structure owner requires for monitoring and sampling or for the abatement contractor (i.e., the use of a specific product, keeping a set number of extra supplies on-site, etc.).

3) During project set-up, the project monitor shall start the Field Folder with pertinent information from items 1 and 2 above and the completed Project Management Set-up form ENV-032. Form ENV-032 is located at "P"\Forms\Environmental \Field Forms.

b. Associated Documentation

1) All associated documentation with the project must be filled out completely, accurately, legibly, and in black or blue ink.

2) Certifications – A copy of ATL's Asbestos Handling license and the Project Monitor/Air Sampling staffs hard card must be in possession on-site while performing project monitoring or air sampling duties, as applicable.

3) Project Submittals – These include all required worker documentation (hard card, training certificates, fit test results, and physical results), contractor's Asbestos Handling License, Waste Transport License, MSDS or SDS sheets, Design/Survey, site-specific variances, work plans, and EPA notifications. Often these are collected the first day of the project, but should be received prior to project start-up and reviewed, as applicable.

c. Health and Safety Plan

1) An assigned ATL project manager will review the Health and Safety Plan, if applicable. The Health and Safety plan identifies the potential hazards and associated applicable Job Safety Analyses to review. When unique health and safety issues are identified, consult with the Health and Safety Manager prior to the start of the job. Project personnel must continue to reassess the job-site conditions to identify any new or additional hazards that may require a revision to the Health and Safety Plan and the corresponding Job Safety Analyses.

d. On-site Project Monitoring

1) Health and Safety

i. Always adhere to the requirements of the site-specific safety plan, the Health and Safety Plan, ATL safety procedures, and the applicable Job Safety Analyses.

ii. Always wear required PPE, including Tyvek suits and respirators.

2) Pre-Abatement Work Area Set-up and Assessment

i. The first pages of the daily log should have listed the client, and all associated contractors for the project. Included in the contact list should be the addresses, phone numbers, and contact person for each business, including ATL's.

ii. Assemble the equipment and supplies, identified in section 7 of this SOP, that you will need on-site with you when you first arrive. Be sure all equipment works correctly, prior to leaving the office.

iii. Walk through the building/structure where abatement work is to be conducted to visually inspect the work area prior to area preparation and abatement and to see where removal will be performed. (The assistance of someone familiar with the building and scope of work will help familiarize yourself with the project).

iv. The project monitor should check to see that the building occupant notices have been properly posted and are accurate.

v. Upon the arrival of the abatement contractor and handlers, the monitor shall collect a copy of each individual's certificates and verify that they are all current and valid. Certificates include a copy of a fit test and a copy of a physical conducted within the last year and a copy of a valid hard card and DOH 2832 form. This information is required to be included in the project logbook.

vi. Once all certificates have been verified, the abatement contractor must hang asbestos warning signs and barrier tape in order to restrict access to the regulated abatement work area. These postings are required at all locations and approaches to locations where airborne concentrations of asbestos fibers may exceed ambient levels, as stated in 12 NYCRR 56-7.4 (c).

vii. Copies of the hard cards shall be obtained for the file and to be included in the final report.

viii. Once the area around the regulated work area has been properly posted construction of the personal decontamination system by the abatement contractor shall begin. Decontamination systems must be built in accordance with 12 NYCRR 56-7.5.

3) Personal Decontamination Enclosure: Large Projects

i. One layer of six mil fire retardant plastic sheeting shall be installed on the ceiling and walls of the enclosure

ii. Two layers of six mill fire-retardant reinforced plastic sheeting shall be used for flooring protection

iii. Attached Personal Decontamination Systems for a large project shall be constructed with rooms in the following order: A clean room (with a lockable doorway), followed by an airlock; next will be the shower, followed by another airlock; then the equipment room, followed by a curtained doorway (three overlapping sheets of poly) leading into the regulated work area. *See page 58 of 12 NYCRR 56 for examples*

iv. The shower, equipment room and each airlock shall be at a minimum three feet wide by six feet tall.

v. One shower for every six abatement workers, based on an eight hour shift, is required.

vi. Shower water shall be collected and filtered through a system with at least 5.0-micron particle size collection capability.

vii. The clean room shall be at a minimum thirty-two square feet of floor space for every six abatement workers. If there will be three or fewer workers, the size of the clean room may be reduced to twenty-four square feet.

viii. Lockers and hooks shall be provided for street clothes, as well as a shelf for respirators.

4) Personal Decontaminations Enclosure: Small Projects

i. For a small project, an attached personal decontamination system shall, at a minimum, consist of an equipment room, shower room and a clean room (with lockable doorway) separated from each other and the work area by three flapped doorways.

ii. One layer of six mil fire-retardant plastic sheeting shall be installed on the ceiling and walls of the enclosure

iii. Two layers of six mil fire-retardant reinforced plastic sheeting shall be used for flooring protection.

iv. One shower for every six full shift abatement workers, based on an eight hour shift, is required.

v. Water from the shower shall be collected and filtered through a system with at least 5.0-micron particle size collection capability.

5) Remote Personal Decontamination Enclosures

i. Allowed for projects meeting the criteria set forth in 12 NYCRR 56-11 **or** if a site-specific variance is obtained for the project.

ii. Procedures for using a remote decontamination unit are listed in 12 NYCRR 56-7.5 (d).

6) Waste Decontamination System Enclosure: Large and Small Projects

i. One waste decontamination enclosure shall be required for each abatement area and may share an exit from the work area through the equipment room.

ii. Waste decontamination enclosures shall be attached to the regulated work area, via an airlock. This airlock may be attached to the equipment room.

iii. Waste decontamination enclosures shall consist of a washroom and a holding area connected in series, and separated by an airlock with a lockable doorway.

iv. The waste decontamination shall be constructed with one layer of six mil fire-retardant plastic on the ceiling and walls, and two layers of reinforced plastic sheeting on the floor.

7) Regulated Work Area Pre-Cleaning

i. Areas where critical and/or isolation barriers are to be created shall be cleaned first using a HEPA Vacuum or wet wiping (no brooms). The barriers can then be installed.

ii. Critical barriers are openings and penetrations to the regulated work area (operable windows, skylights, doorways, ducts, grills diffusers, HVAC system seams or corridors not being used).

iii. As per 12 NYCRR 56-7.11, the critical barriers shall be constructed with **two** **independent** layers of six mil fire-retardant plastic sheeting and sealed with duct tape. The project monitor should be able to see each layer of duct tape clearly through the top layer of plastic sheeting.

iv. Isolation barriers are openings greater than thirty-two square feet, except where one dimension is one foot or less.

v. Isolation barriers are made of wood or metal framing and wood sheathing at least 3/8" thick. All seams shall be sealed air tight, using duct tape, caulk, or fire-retardant expandable foam. The barrier shall be covered with two layers of six-mil fire-retardant plastic sheeting with staggered joint and seams, sealed air tight with duct tape.

vi. Following the completion of the critical and/or isolation barriers the negative air machines shall be started, and kept in operation, until final air samples results are received and determined to be satisfactory.

vii. After the negative air machines are operating, the abatement contactor shall clean all removable objects with a HEPA vacuum and/or with wet wiping prior to removal from area.

viii. Upholstered objects, such as furniture and drapes and carpeting shall be HEPA vacuumed twice prior to removal.

ix. If carpet is to remain in place after the HEPA vacuuming has been finished a 3/8" piece of plywood shall be installed over the carpeting prior to plasticizing the floor.

x. Objects fixed in place shall be cleaned using HEPA vacuum or wet wiping and then covered in two layers of six-mil fire-retardant plastic sheeting.

xi. Once pre-cleaning has been finished, enclosure of the work area can begin. The common types of enclosures a project monitor will encounter on a project and the sequencing used to establish each regulated work area are described in this SOP (sections 11.d.8 and 11.d.9). The glovebag operations within a tent enclosure are described in this SOP (section 11.d.10).

8) Full Enclosures

i. Full enclosures plasticizing sequence

** The only areas to not be plasticized are those where asbestos is to be removed. For example, if the asbestos is on the floor, then the floor is not plasticized.*

1. First, the floor shall be covered in six mil fire-retardant plastic, with the edges extending up each wall at least twelve inches, and sealed air tight with duct tape.

2. Second, the walls shall be plasticized from ceiling to floor, with the edge of the plastic extending at least twelve inches onto the floor. The seams shall be sealed air tight with duct tape.

3. Next, the ceiling shall be plasticized overlapping the walls by at least twelve inches to form a secure airtight seal.

4. Last, repeat the process again in identical order to create the second layer.

ii. Plasticizing details

1. Seams within a layer shall be separated by a distance of at least six feet.

2. All seams between each layer shall be staggered by at least two feet.

3. All punctures (i.e. staples, holes) shall be covered with duct tape.

9) Tents

i. All tents must be adequately supported and reinforced to withstand local environmental conditions and the negative air used within them, as per 12 NYCRR 56-7.11 (c).

ii. Plastic need not be hung over those areas where ACM, PACM, or asbestos material is to be removed.

iii. Airlocks shall be constructed as stated in 12 NYCRR 56-7.5 (b) (11), at the entrance to all work areas, using a remote decontamination system.

iv. The airlock/tent shall be cordoned off twenty-five (25) feet from the perimeter, with proper signage.

v. Tents with greater than twenty (20) square feet of floor space, or that will be used for the gross removal of friable ACM, PACM, or asbestos material, must be constructed of two layers of six mil fire-retardant plastic sheeting, with double folded seams that are then sealed air tight and taped flush to the adjacent tent wall.

vi. Tents with less than twenty (20) square feet of floor space and no gross removal of friable ACM, shall require one layer of six mil fire-retardant plastic sheeting.

10) Glovebags

i. Glovebag operations must be done in a negative pressure tent enclosure, as stated in NYCRR 56-11.3. Tents must be at least one layer of six mil fire-retardant plastic sheeting.

ii. Glovebags may be used on pipe or duct insulation that does not exceed 150 degrees Fahrenheit.

iii. Glovebags must be commercially made of at least six mil, transparent plastic.

iv. Pipe or duct diameter may not exceed one half the length of the glovebag as stated in 12 NYCRR 56-8.4.

v. Duct tape should be placed securely around the area of abatement, in order to form a smooth seal to which the glovebag can be taped and sealed air tight.

vi. A HEPA vacuum and water hose should be inserted through slits into the glovebag and sealed air tight using duct tape.

vii. The abatement contractor shall test the seals of the glovebag by placing a bag under negative pressure, using a HEPA vacuum, and aspirate a smoke tube around the seals. If smoke enters the bag, those areas should be re-sealed using duct tape, and retested.

viii. The glovebag shall be collapsed using a HEPA vacuum and placed in an appropriately marked bag for asbestos waste that is sealed air tight.

11) Asbestos Abatement: Phase IIB

i. Small and large projects must observe at least a four hour waiting period, with the negative air running for all enclosures before abatement may begin, as stated in 12 NYCRR 56-8.2 (b).

ii. In order to perform multiple (sequential) types of abatement, the room must be prepped for the most stringent type of removal (see page 79 of 12 NYCRR 56 and the Guidance Document for additional details)

iii. Verify that workers entering/exiting the work area (including the project monitor) have signed the entry/exit log.

iv. When going into the work area, wear proper PPE.

v. Work areas should be inspected a minimum of twice daily. The first inspection should be performed early in the work shift, and the second or additional inspections should be conducted randomly, and at unannounced intervals.

vi. Large friable projects should be inspected more frequently, randomly throughout the work shift.

vii. Verify that there is no food, drink, or unauthorized equipment in the space.

viii. Verify that the decontamination system is clean and organized.

ix. Verify that all workers are wearing their PPE correctly.

x. Verify that no dry removal is being performed and that ACM is being thoroughly wetted with amended water.

xi. Verify that surfactant is being added to water.

xii. Look around in the work area enclosure to see if repairs are needed. If repairs are needed, then find someone inside the work area and ask that these be completed. Follow-up with the contractors' supervisor when repairs are not completed timely.

xiii. All bags of waste leaving the regulated area must have a generator label affixed to them. The outside of the bags must also be clean of debris.

xiv. Monitor the waste being removed from the waste out area. When waste is being removed frequently, this is an indication that a verification of proper removal methods should be performed.

xv. Verify that waste being removed has adequate amended water. The waste must be sufficiently wet, but no free liquids present.

xvi. Waste must be containerized as it is abated and not allowed to build up on work area floor/surfaces.

xvii. Stop work immediately if you observe any illegal or unsafe work practices in the work area, such as dry removal or waste water being dumped down a drain. Immediately call your project manager.

12) Final Cleaning and Clearance Procedures (Phase IIC)

i. Negative air machines shall be continuously running during this phase of work

ii. First Clean

1. All surfaces shall be first wet-cleaned, excess water may be collected with a HEPA filtered shop vacuum, which shall be emptied prior to leaving the regulated area, as stated in 12 NYCRR 56-9.1 (b).

2. Once the cleaning is finished, a thin coat of lock down encapsulant shall be applied to all surfaces where removal was not completed and the appropriate drying/settling period will be observed.

3. Once the settling period has elapsed, the top layer of plastic shall be removed and treated as asbestos waste, and the second clean can commence.

iii. Second Clean

1. After the top layer of plastic sheeting has been removed, all surfaces shall be HEPA vacuumed and then wet cleaned.

2. Appropriate drying/settling time shall be observed.

3. Once the settling period has elapsed the bottom layer of plastic sheeting shall be removed and disposed of as asbestos waste.

4. Critical barriers and isolation barrier shall remain in place.

iv. Third Clean

1. Once the bottom layer of plastic sheeting has been removed, all surfaces and objects shall be HEPA vacuumed and then wet cleaned.

2. Appropriate drying/settling time shall be observed.

3. Once the settling time has elapsed the final visual inspection shall be performed.

v. Exemption from multiple cleans:

1. When regulated area is not required to be plasticized one cleaning (HEPA-vacuumed AND then wet cleaned) is required followed by appropriate settling/drying time.

2. When a tent enclosure is used, one cleaning (HEPA-vacuumed and then wet cleaned) is required, followed by the appropriate settling/drying time.

13) Final Visual Clearance Procedures

i. ATL REQUIREMENT: for all large, friable asbestos projects the final visual clearance is to be conducted by two Project Monitors, one of which must be approved by ATL as a “Senior Project Monitor”.

ii. After the final cleaning is complete, final visual clearance shall not commence until the appropriate waiting/settling or drying time requirements have elapsed.

iii. The asbestos abatement contractor supervisor must complete a satisfactory visual inspection to confirm completeness of abatement and cleaning, prior to commencement of the Project Monitor visual inspection.

iv. Start by reviewing the scope of work that was scheduled to be completed.

v. Utilize a strong, narrow-beamed flashlight and clean cloths to test wipe surfaces. Hard to reach / hard to inspect areas may also be inspected using a leaf blower and strong flashlight to look for any dislodged debris.

vi. The project monitor is verifying the absence of visible residue, dust, and debris along with un-removed ACM. Dust and debris include ACM, as well as any dirt or other residue in the area, are all assumed to be contaminated. *(Refer to ASTM Standard E1368).*

vii. No area should be assumed to be clean. Inspect every surface.

viii. Get close enough to touch areas where removal has taken place in order to feel for debris or dust. Disturb these areas to see if you can create any dust.

ix. A competent person from the abatement contractor, equipped with cleaning materials, should follow the project monitor on the visual inspection so as to clean any areas deemed necessary.

x. Pay extra attention to hard to see areas and crevices, such as those found on elbows or spaces where pipes, beams or other materials touch each other tightly. ACM can adhere to these areas during cleaning.

xi. Look at all fixed or mounted objects not removed prior to abatement, to see if debris has adhered to any of these.

xii. Move the Negative Air Ventilation machine to visually inspect this area.

xiii. If residue is found and cannot be removed, the material must be encapsulated to prevent any future airborne release of fibers. Review project requirements and consult with your project manager when these areas exist.

xiv. Spaces that require special consideration:

1. Crawlspaces/Attics:

   a. For spaces with dirt floors, use a sharp or pointed tool along with a high powered light to inspect the dirt around the work area and be sure no debris remains. Extreme amounts of residue are an indication the area needs to be re-cleaned.

   b. The area should be as dry as practicable, with no airborne fibers visible (although this may occur simply by moving around in the area).

14) Project Monitor Daily Project Logs (Refer to Training Checklist Form TRN-ENV-04 located at "P"\Internal Quality\Training\Training and Evaluation Checklist\Training Checklists\Environmental

i. The first few pages of the daily log should have listed the client, and all associated contractors for the project. Included in the contact list should be the addresses, phone numbers and contact person for each business including ATL's.

ii. Document what time the project monitor and the other workers arrive on-site each day (also document the times at which lunch is taken and the time off-site for the day).

iii. List the names of all workers on-site for the day in the Contractor Employee List in the back of the log book, and assign each contractor employee a distinct number. Make sure you have all required paperwork for each person. Each day mark which worker is on-site and off-site, on the corresponding daily logbook page.

iv. Document start and end times for the various phases accomplished on each day (abatement of x, y, z finished at 1300, first clean started, etc.).

v. Document project milestones and relative amount of work completed.

vi. Document important or relevant conversations held with the site supervisor, project manager, building owner, or other project-related personnel.

vii. Document any injuries or incidences that occur each day and the time these occurred. For example, if you had to speak to workers regarding proper use of PPE, this should be documented.

viii. Document the number of waste containers and time being removed each day.

ix. Document the number of air samples obtained (including set-up and collection times).

x. Document when the final visual clearance occurred, as well as any deficiencies that had to be corrected.

15) Special Projects

i. Incidental Disturbances

1. Upon discovery, the affected area shall be cordoned off twenty-five feet from the outermost limits of the disturbance and signs posted.

2. Contact your project manager immediately.

3. Prior to starting abatement of an incidental disturbance project, permission must be given by the Department of Labor.

4. If the disturbance is an interior regulated abatement, then critical barriers must be established or a tent built in accordance with 12 NYCRR 56-7.11 (f) (1) around the disturbed material.

5. For exterior disturbances, all adjacent building openings within twenty-five feet of the outermost limit of the disturbance shall be sealed with two layers of six mil fire-retardant plastic sheeting.

6. A variance is required for all large and small projects.

ii. Tents-Minor Projects

1. Tents may be used for minor projects with or without the use of glovebags, in accordance with 12 NYCRR 56-11.3.

2. PPE shall be worn.

3. If a remote decontamination unit is used, workers shall wear two protective suits.

4. A negative air machine or HEPA-vacuum shall be used to ventilate the tent per 12 NYCRR 56-7.11 (f) (1).

5. The negative air machine or HEPA-vacuum shall run for twenty minutes after abatement work has ceased, then shall be shut off.

6. After the twenty minute wait period, final visual inspection can occur. If a minor size abatement work area is part of a large or small project, then final air samples are required.

iii. Exterior Removal of Non-friable Roofing, Siding, Caulking, Glazing compounds, Transite and other NOB ACM

1. The regulated work area is where active removal is taking place.

2. Regulated work area shall be cordoned off twenty-five feet from its perimeter and marked with signs.

3. If going from outside to inside the work area, then an airlock must be established at building entrance.

4. The personal and waste decontamination system can be remote, but must be within fifty feet of the entrance used by workers.

5. Roofs:

   a. All operable openings one floor below and one floor above the regulated area must be sealed with two layers of plastic sheeting.

   b. If contractor is not plasticizing the building to be worked on, a two layer plastic drape may be hung from the roof edge extending fifteen feet past the last operable opening within twenty-five feet of area.

   c. Non-operable windows within twenty-five feet shall have seams sealed with caulk or duct tape, no plastic.

   d. Vent openings that cannot be sealed shall be extended vertically eight feet.

   e. Operable openings on adjacent buildings within twenty-five feet of regulated work area shall be sealed with two layers of plastic sheeting.

6. Non-Friable Flooring/Mastic:

   a. Work areas shall be established accordance with 12 NYCRR 56-7.4

   b. 12 NYCRR 56-7.1 through 7-10 shall be followed accordingly.

   c. Six air changes per hour shall be required.

d. Critical and Isolation barriers shall be established according to 12 NYCRR 56-7.11 (a-b).

e. Walls, ceilings and floors do not need to be covered with plastic sheeting for manual or chemical removal methods.

f. Only one final cleaning of **<u>all</u>** exposed surfaces is required. Lockdown may not be used on surfaces where removal has been completed.

g. If a beadblaster or other abrasive method is to be used, full work area prep and attached decontamination system enclosure as well as multiple cleanings are required.

7. Typical Site-Specific Variances (not intended to be an all-inclusive list)

a. Contaminated Area/Space Cleanup Asbestos Projects

b. Crawlspaces with Soil Floors

c. Large Tent Enclosures with Friable ACM Gross Removals

d. Incidental Disturbance Cleanup-Greater than "Minor Size"

e. Dry Removals

f. Intact Component Removals

g. Floor Covering/Mastic Removal without Hard Wall Barriers

h. Decontamination Unit Size Reduction Due to Logistics

i. Exterior Friable ACM or Non-friable ACM Rendered Friable During Abatement

j. Controlled Demolition Asbestos Project for Structures not Identified as Unsound

k. No Plasticizing on Cleanable Surfaces

l. Elevated Abandoned Piping/Conduit Wrap & Cut/Glovebag Removals

12. AIR SAMPLING PROCEDURES

a. Health and Safety Warnings

1) Always wear PPE. Tyvek suits and respirators protect against possible exposure to asbestos fibers. Failing to wear this gear is harmful not only to you, but also to those who may subsequently come into contact with your potentially contaminated clothing.

b. Associated Documentation

1) Air Sample Chain-of Custody Form

i. This form must be filled out at the time the samples are collected and transported/submitted to the office or laboratory. The forms must be filled out completely and accurately. Arrows and “ditto” marks are unacceptable. Multiple samples may be recorded on a single chain-of-custody form as space allows.

c. Asbestos Air Sampling and Analysis

1) Determine ahead of time what air samples you will require and the number required (Background, Phase IIA, Phase IIB, Phase IIC)

2) Create drawings of the work area where samples will be set up (or use existing floor plans) and mark where you will place each of your samples with the correct corresponding sample numbers.

3) Complete an Asbestos Chain-of-Custody form with the following information

i. ATL Project Number

ii. ATL Project Name

iii. Project Location

iv. ATL Project Contact

v. Sample Date

vi. Turn-Around-Time

vii. Sample Type (PCM or TEM)

viii. Whom should results be sent to (Contact name, Office, email if required)

ix. Sample Number, using consecutive numbering for the duration of the project (for example if the last set ended with sample number 7, the next set will start with sample number 8)

1. Example Project Monitoring Sampling numbers shall look like WT5001AP01-mm-dd-yyyy.

2. Example Air Monitoring sampling numbers shall look like WT5001AA01-mm-dd-yyyy.

x. Sample Location Description

xi. Time Samples were taken/collected

xii. Name of Air Monitor

xiii. Project Phase (Background, Phase IIA, Phase IIB, Finals)

xiv. Start Time/End Time

xv. Average LPM

xvi. Total Volume Collected

xvii. Air Sampling Technician's signature, date and time collected

xviii. Air Sampling Technician's name, signature, date and time samples are relinquished for shipping.

xix. Name of commercial delivery service (e.g., UPS, Fed-Ex) used to transport the samples, if applicable

4) Air Sample Cassettes should be labeled with a minimum of

i. Sample Date

ii. Field Sample Number

iii. ATL Project Number

5) Air Sample Numbers and Locations

PCM AIR SAMPLE REQUIREMENTS

*IWA = Inside Work Area OWA = Outside the Work Area

Project Size	Phase 1 B Background Air Sampling	Phase 2 A Work Area preparation (5)	Phase 2 B Abatement (work in progress)	Phase 2 C Final Cleaning & Clearance Air Sampling
LARGE ASBESTOS PROJECTS (>160 square feet or >260 linear feet)	5 IWA (1) 5 OWA(1,2) 2 blanks	1 @ personal decon 1 @ waste decon 2 critical barriers 1 @ each neg. air exhaust 1 ambient air sample 2 Blanks <u>or</u> 10% total of samples		5 IWA (7) 5 OWA (2) 2 blanks
SMALL ASBESTOS PROJECTS (>10 square feet and <160 square feet & >25 linear feet and <260 linear feet)	3 IWA 3 OWA (2) 2 blanks	3 IWA 3 OWA 2 blanks	Not Required	3 IWA 3 OWA (2) 2 blanks
MINOR ASBESTOS PROJECTS (≤ 10 square feet or ≤ 25 linear feet)	Not Required	Not Required	Not Required	Required* (3,4) (typically 1 IWA & 1 OWA)

(1) For Sample Location and total number required, reference 12 NYCRR 56-6 through 56-9.
(2) 1 sample outside the building/structure if entire building/structure is regulated abatement work area.
(3) Required on glovebag failure or loss of integrity, or tent failure or loss of integrity
(4) Required for an Incidental Disturbance Project or if minor size regulated abatement work area is part of small or large asbestos project.
(5) Required for all OSHA Class I and Class II Friable ACM asbestos projects.
(6) During II C Final Cleaning Stage, air sampling as per Phase IIB is required.
(7) One additional inside sample shall be required for every 5,000 sq. ft. above 25,000 sq. ft. of floor space within the regulated abatement work area.

Each set of samples require a minimum 2 Field blanks **<u>or</u>** # of field blanks equal to total 10% of samples that are opened just prior to sampling.

6) PCM Air Samples

   i. Flow Rate must be between 2 LPM and 10 LPM

   ii. The minimum volume will be 1,200 liters for all background and clearance samples

   iii. 2 field blanks

iv. Final Clearance must be less than 0.01 fibers/cm^3 or the background level

v. Minimum of 400 liters to be valid

vi. Separate Chain-of-Custody for each work area

7) TEM Clearance

i. Large size projects: 5 IWA & 5 OWA w/ 3 Blanks (1 sealed & 2 opened for 30 sec.(1 in an ambient area & 1 at the work area entrance)

ii. Flow rate must be less than 10 l/m

iii. 9.5 LPM for 150 minutes =1425 Liters

iv. Passing Clearance must be less than 70 structures/mm^3 for the average of 5 inside samples

8) Aggressive Air Sampling for Clearance Samples

i. The exhaust of a leaf blower is directed toward all surfaces within the work area. This shall continue for at least five minutes per 1,000 ft^2 of work area floor space.

ii. At least one 20-inch fan shall be placed in the center of the work area and/or center of each room of the work area. One fan per 10,000 ft^3 of work area space shall be used. The fan(s) shall be operated on slow speed.

iii. When sampling has been completed; the sampling pumps shall be turned off prior to initiating the fan(s).

9) Reporting Air Sampling Results

i. Report failing or elevated air sample results to the NYSDOL, through ATL's Project Manager.

13. QC/QA

Internal quality system reviews will be performed to track or evaluate the effectiveness of the SOP, and management reviews will be performed to monitor its efficiency.

14. REVIEW

This SOP will be reviewed on an annual basis by the Technical Services Manager, as directed by Senior Management, or as driven by the SOP.

15. MANAGEMENT APPROVAL

The Executive Team will review and approve proposed changes submitted.

Scott M. McCasland **Vice President-Quality**	**Joseph D. Grabowski** **Senior Project Manager**

SECTION II
Standard Operating Procedure For PCM and TEM Analysis Of Asbestos In Air Samples (NIOSH METHODs 7400 and 7402)

Approved By Barry Browder Date 1/10/2025

Approved By Thomas R McKee, PhD Date 1/10/2025

Issued By Affiliate: America Science TEAM of New York

Affiliate Manager ______ Date 1/16/25

Affiliate QA Officer Tonya L Karsin Date 1/16/25

1. Principle and Application

1.1. Application

Asbestos has been widely used in building materials because of its strength and resistance to fire. Although asbestos makes a building resistant to the spread of fire, there are health hazards associated with loose fibers of asbestos in the environment. Because inhaled asbestos fibers are a hazard to containment and abatement workers, work areas and workers are monitored to control exposure to this health risk. Analysis of air cassette sample filters by PCM gives a quantitation of the concentration of fibers (assumed to be asbestos) per volume of air sampled. The following SOP details the methods established for monitoring laboratory and analyst precision, accuracy and quality. The quality control program is designed to evaluate both precision and accuracy of analyses performed by AmeriSci affiliates. The evaluation of quality control data validates the results produced at AmeriSci affiliates and therefore is a priority function of each employee's workday.

1.2. Principle and Method Summary

Air filter samples are collected in the field and submitted to AmeriSci affiliates in the original unopened cassette with appropriate descriptive paperwork which includes the sample time and pump flow rate for each cassette. For PCM analysis by Method 7400, a pie-shaped wedge (one-fourth of the filter) is cut from the filter and mounted on a glass microscope slide using the acetone/triacetin heating block method. The sample is analyzed using a prescribed counting technique to determine the number of fibers collected on the sample filter. Mathematical calculations using the analysis data allow comparison of sample data to regulatory limits. PCM analysis does not differentiate between asbestos and other fiber types, however this method (NIOSH 7400-PCM or OSHA PCM Reference Method) may be used in conjunction with NIOSH 7402-TEM for positive differentiation of asbestos fibers.

1.3. Sampling

AmeriSci affiliates does not provide field support services for PCM or TEM. In addition, sampling supplies are not provided by AmeriSci affiliates. Clients requesting information on sampling procedures will be referred to printed instructions in NIOSH 7400 and 7402 Methods.

2. Instrumentation and Equipment

All instrumentation and equipment used in the laboratory must be approved by the local QA officer, Corporate QA officer, Laboratory Manager and Chemical Hygiene officers. Any changes, alterations, repairs or substitutions must be tested and approved prior to use in analytical procedures.

2.1. Microscope, positive phase contrast, including: green filter, 10x eyepiece, and 40x phase objective; numerical aperture= 0.65 to 0.75; mechanical stage.

2.2. Glass microscope slides, pre-cleaned, 25 X 75 mm

2.3. Cover slips, 22 mm X 22 mm, No. 1 1/2

2.4. Two scalpels, #10 and #22 surgical steel curved blade

2.4.1. Label #10 scalpel “for cutting labels only”.

2.4.2. Label #22 scalpel “for cutting air filters only”.

2.5. Forceps

2.6. Acetone vaporizer (preferably with heating block accessory)

2.7. Syringe, 3 cc

2.8. Syringe, 1 cc

2.9. Telescope, ocular phase-ring centering

2.10. Permanent Marker (for labeling slides) - black and red extra fine tip

2.11. HEPA/Carbon filtered workstation hood

2.12. Replacement HEPA filter (particulate filter element)

2.13. Replacement Carbon filter (organic vapor filter element)

2.14. For NIOSH 7402 equipment see TEM Section V.2.

3. Reagents and Standards

All reagents and standards used in the laboratory must be approved by the local QA officer, Corporate QA officer, Laboratory Manager and Chemical Hygiene officers. Any changes in changes, alterations, repairs or substitutions must be tested and approved prior to use in analytical procedures.

3.1 Reagents

3.1.1. Acetone

3.1.2. Triacetin

3.2. Standards

3.2.1. Stage Micrometer Slide (0.01-mm divisions)

3.2.2. Phase contrast test slide with blocks of visible rules lines where at least one block is invisible under the microscope set up conditions specified in the method

3.2.3. Graticule, Walton-Beckett type G22 with 100 μm diameter circular field at the specimen plane (area - 0.00785 mm^2) (NIOSH acceptable limits 98-102 however AmeriSci only uses those with a diameter of 100 to reduce production errors)

4. Procedure

4.1. PCM Sample Identification

4.1.1. When logged into the AmeriSci affiliates database each sample is assigned a unique job/sample number. Each sample must be labeled with and thereafter referred to by the unique AmeriSci affiliates job/sample number.

4.2 PCM Sample Preparation and Analysis

4.2.1. Examine the Batch Traveler and client paperwork for necessary information regarding processing and reporting of the samples.

4.2.2. Examine the cassette for evidence of damage or tampering. Any such evidence observed should be noted on the Chain of Custody, Batch Traveler and Analysis Sheet. This condition should be reported as a footnote on the final report.

4.2.3. Check slides and cover slips, discarding any that are not clean. Do not use any new boxes of slides or cover ships that are questionable when opened, returning the rejected box to the QA Officer for supplier action. Label a new, clean slide with the AmeriSci affiliates job/sample number on the cassette.

4.2.4. Use appropriately labeled scalpel blades to slice the label at the cassette seam, then use the cassette opener to pry open the plastic cassette.

4.2.5. Inspect the cassette and filter for signs of Overloading. If there is an excess of unattached dust and debris note "Overloaded" on the Chain of Custody, Batch Traveler and Analysis Sheet. This condition should be reported as a footnote on the final report.

4.2.6. Inspect the filter for visible signs of Uneven Distribution or Bypass. If either is observed note "Uneven Distribution" or "Bypass Observed" on the Chain of Custody, Batch Traveler and Analysis Sheet. If the filter has been previously cut or obviously tampered with in any way, write a note on the Chain of Custody, Batch Traveler and Analysis Sheet. This condition should be reported as a footnote on the final report.

Note: The client should be notified prior to analysis of any condition which could void or invalidate the sample analysis results.

4.2.7. Handle the filter with forceps, by the edge only. Carefully place the filter, dust side up, on a clean, labeled slide. Cut a one-fourth wedge of filter with the appropriately labeled scalpel using a single rocking motion to prevent tearing (use a one-sixth wedge of filter for a 37mm diameter filter). Move the filter wedge to the proper location on the slide, being careful not to touch or disturb any area of the wedge which might be used for counting.

4.2.8. Return the remaining filter to the cassette for storage.

4.2.9. Insert the glass slide into the receiving slot at the base of the vaporizer. Place the tip of a syringe containing 3 cc of acetone into the inlet port on top of the vaporizer. Inject ≈0.25 cc acetone into the vaporization chamber with a slow, steady pressure. Wait 10 seconds for the filter to clear and remove the glass slide from the vaporizer port. Inject additional acetone if necessary for complete clearing. Place the slide on the heat block to assure that all acetone has been vaporized.

4.2.10. Using a 1 cc syringe, place ≈0.1 cc triacetin on the filter. Gently lower a clean cover slip down onto the filter at a slight angle to reduce the possibility of forming bubbles. The amount of triacetin necessary to form a good mount may vary depending on the amount and type of particulate on the filter.

4.2.11. If necessary return the completed slide to the heated block for approximately 15 minutes to insure complete clearing of the triacetin/filter combination.

4.2.12. If a permanent mount is desired, seal the edges of the cover slip to the glass using clear lacquer.

4.3. PCM Sample Analysis

4.3.1. Set up the microscope and fill out the instrument log (performed daily for each station). Refer to "SOP for Calibration and Maintenance ..." (Part IV SOP Manual).

4.3.2. Carefully inspect the slide for any signs of damage or unusual appearance. A questionable slide should be replaced. Do not in any case use more than one half of the filter without express permission of the client.

4.3.3. Place the slide on the mechanical stage of the microscope with the center of the filter under the objective lens. Focus the microscope on the plane of the filter. Continuously scan a range of focal planes with the fine focus in order to detect thin fibers when counting each graticule field.

4.3.4. Scan the entire filter observing the fiber and matrix distribution. If the distribution appears uneven, note "Uneven Distribution" on analyst's worksheet for that sample. This condition should be reported as a footnote on the final report.

4.3.5. <u>PCM Fiber Counting Rules</u> (previously called "A" rules)

4.3.5.1. Count only fibers **longer than 5 µm (>5 µm)**. Measure the length of curved fibers along the curve.

4.3.5.2. Count only fibers with a **length-to-width (aspect) ratio ≥ 3:1**.

4.3.5.3. For fibers which cross the boundary of the graticule field, do the following:

4.3.5.3.1. Count as **one fiber** any fiber longer than 5 µm which lies entirely within the graticule area.

4.3.5.3.2. Count as **½ fiber** any fiber with only one end lying within the graticule.

4.3.5.3.2. **Do not count** any fiber which crosses the graticule boundary more than once.

4.3.5.3.4. Reject and do not count all other fibers.

4.3.5.4. **Count bundles of fibers as one fiber** unless individual fibers can be identified by observing both ends of a fiber.

4.3.5.5. Count enough graticule fields to yield 100 fibers. Complete counting of the graticule field which contains the 100th fiber. Count a minimum of 20 fields. Stop at 100 fields regardless of fiber count.

4.3.6. Start counting from the center tip of the filter and progress along a radial line to the outer edge; shift either up or down on the filter, and continue in the reverse direction. Select fields randomly by looking away from the eyepiece briefly while advancing the stage. Continuously scan a range of focal planes with the fine focus in order to detect thin fibers when counting each graticule field. When an agglomerate covers 1/8 or more of the graticule field, reject the field and select another. Do not report rejected fields in the number of total fields counted.

4.3.7. Any sample with >50% of filter area covered with particulate or >1300 fiber/sq mm should be reported as "Overloaded" or "Uncountable". Insert a Footnote in the Report indicating "Overloaded" or "Uncountable" for any sample in which an excess of fields (>50%) have been rejected for counting as described in 4.3.6.

4.3.8. Read and record all indicated "blind recount" QC slides.

4.3.9. Perform the NIOSH blind recount acceptance test (NIOSH 7400, step 14) by entering each count pair (original and QC) into the "PCM Batch QC Test Worksheet". See computer "Pair Test" spreadsheet or its LIMS equivalent.

4.3.10. Recount any sample groups represented by any "rejected" count pairs and test the new against the original counts using the Pair Test (indicated by "N" after the sample number) as indicated in Section 5.1.9. Discard all rejected Pairs and recount. Note that both the rejected results and new results will remain in the QC report and records.

4.3.11. When all blind recount results have been accepted, the fiber count results may be used to generate a customer report using the LIMS package.

4.4. Sample Analysis Reporting

4.4.1. Enter date of analysis, microscope used, analyst, fiber count and field count into the appropriate LIMS worksheet for each sample (see SOP I - "LIMS System Operation").

4.4.2. Any sample specific comments on the worksheet should be addressed in a footnote for the respective sample. Note that samples are not normally corrected for blank counts by the LIMS package which is explained in a footnote on the summary report table.

4.4.3. Review and sign the computer generated report prior to issuing to a customer.

4.4.4. Analysis results may be calculated by the LIMS package or manually using the relationships shown in Section 4.5. Individual samples are not corrected for blank fiber counts by the LIMS package which is indicated in a summary table footnote. TWA calculations are normally the responsibility of the client since only they know the exact situation of interest. If TWA calculations are requested by a client, total time covered, assumed exposure for any time not represented by a sample and responsibility for all other relevant details must be assumed by the client.

4.5. Sample Calculations

4.5.1 Calculate and report fiber density on the filter. The normal procedure for AmeriSci affiliates reports is to calculate the fiber density without correction for the blank. In such cases the blank term in the following formula is set to zero. The calculation is performed as follows:

$$E = [(F/n_f)_{sample} - (F/n_f)_{blank}] \div A_f$$

Where: $(F/n_f)_{blank} = 0$ unless otherwise specified in an individual report
E = fiber density in fibers/mm^2
F = total fiber count
n_f = number of fields in fiber count
A_f = field area = π [(0.5) (field diameter in mm)]^2
Note: A_f = 0.00785 mm^2 for an acceptable Walton-Beckett graticule

4.5.2. Calculate the concentration as follows:

$$C = \frac{(E)(Ac)}{Vx10^3}$$

Where:

C = concentration in fibers/ml (or fibers/cc)
E = fiber density in fiber/mm^2 (normally uncorrected for blank)
Ac = collection area of the filter
385 mm^2 for 25 mm diameter filter
855 mm^2 for 37 mm diameter filter
V = air volume sampled (in liters)

4.5.3. **Time Weighted Average (TWA) -** Cumulative exposure data is given for employees who have worn more than one cassette through the course of a single work day. Cumulative exposures are calculated as follows:

4.5.3.1. Add the sample times in minutes together from individual samples to get Total Time.

4.5.3.2. For each cassette in the "Exposure Group", calculate the product (C)X(T) where C is fibers/ml actual exposure per cassette and T is the respective collection time in minutes per cassette.

4.5.3.3. Add the products for all of the filters of interest:

$$\Sigma C_i T_i = C_1 T_1 + C_2 T_2 + \ldots C_n T_n$$

Where: C = actual exposure per cassette in fibers/ml
T = respective collection time per cassette in minutes
n = number of samples or cassettes of interest

4.5.3.4. Actual Exposure may be calculated by dividing $\Sigma C_i T_i$ from step 4.5.3.3. by the Total Time from step 4.5.3.1. as follows:

$$\text{Actual Exposure} = (C_1 T_1 + C_2 T_2 + \ldots C_n T_n) / \text{Total Time}$$

4.5.3.5. Calculate the 8-hour TWA (if needed) by using 480 minutes as Total Time in the previous equation as follows. A decision must be made concerning any unrepresented portion of the 8-hour time period. Unless otherwise instructed a value of zero is used for the exposure of all time periods during the 8-hour shift, which are not represented by exposure data, in a fashion similar to the NIOSH TWA Guidelines for a government compliance officer. A Footnote to this effect should be included in the sample report.

$$\text{8-hour TWA} = (C_1 T_1 + C_2 T_2 + \ldots C_n T_n) / 480$$

4.5.3.6. Double check all figures, check the final report for necessary Footnotes.

4.5.4. The OSHA PEL is 0.1 fibers/mm^2 for an 8 Hr. TWA

4.6. Safety Considerations

Standard lab safety should be observed during all bench work procedures. Lab coats and gloves should be worn at all times. All mounting procedures should be conducted under an appropriate hood. More extensive safety guidelines can be found in the AmeriSci affiliates Health & Safety Manual and Chemical Hygiene Plan.

5. Intra- and Inter- Counter Quality Control

The intra-counter QC program provides an estimate of the variability of fiber density quantitation for each analyst. It provides information on the precision of an analyst's capability to provide reproducible fiber density quantitation.

5.1 Quality Control Procedure and Evaluation

5.1.1. Quality control analyses are performed at a minimum rate of 1 per 10 samples. The LIMS system identifies the samples in each job or batch selected for Intra-analyst quality control comparisons. The QC analyses will include both Duplicate and Replicate recounts (10% blind Intra-analyst "Duplicate" recounts by the same analyst (Intra-analyst) of the same slide) - RC and 1% Inter-analyst "Replicate" recounts by a second analyst (Inter-analyst, see section 6.1.6)).

5.1.2. Samples are prepared by taking a quarter-wedge from the circular filter and mounting it onto a microscope slide. When fibers are evenly distributed across the sample cassette's filter, this quarter-wedge is an accurate representation of the original sample.

5.1.3. The quality control "recount" (RC) slide is labeled with the LIMS QC job/sample number assigned to it. This blind QC job/sample slide evaluation protects the anonymous identity of the RC slide for the purpose of objective analysis of the sample.

5.1.4. RC samples are selected (10% for each job) using the RC Generation Worksheet by lab personnel other than the job analyst. Samples designated as RC slides are relabeled by other lab personnel for recounting by the original analyst.

5.1.5. The count for any RC slide is recorded in the normal sequence on the fiber count worksheet in the original count column of the Analysis/QC Sheet identified by the QC job/sample number to be later retrieved and evaluated.

5.1.6. Upon completion of a job or batch all RC samples are counted by the sample analyst and recorded in the appropriate "Duplicate" column of the Analysis/QC Sheet by the non-analyst lab personnel based on the identification from the RC Generation Worksheet. RC slides must be evaluated and accepted by the "PCM QC Pair Test" (available as an Excel worksheet) prior to release of data reports. The Pair Test is performed by entering each "count pair" consisting of the original or primary count (PC) and the recount (RC) into the "PCM QC Pair Test" available on each computer in the work area. The completed "PCM QC Pair Test" worksheet is printed out and left in the QC Officers Daily File for approval and incorporation into the PCM QC Results Notebook. This function is also available as an embedded QC function option of the LIMS package if a separate Pair Test Worksheet Control Chart is not desired.

5.1.7. The "PCM QC Pair Test Worksheet" evaluates each count pair for "acceptance" or "rejection" by calculating a "Test Value" which is compared to the "Control Limit" of 2.77 (step 13, NIOSH 7400).

$$\text{Test Value} = \frac{\text{Absolute Value}\left[\{(PC)^{0.5} - (RC)^{0.5}\}\right]}{\left[\{PCV/2\}\{(PC)^{0.5} + (RC)^{0.5}\} / 2\right]}$$

Where:
- PC = primary or original count
- RC = recounted (QC) count of same slide
- PCV = personal coefficient of variation (historical relative std dev)

5.1.8. If the Test Value does not exceed 2.77, the count pair is accepted, (see Section 5.1.10.).

5.1.9. If the Test Value exceeds 2.77, then the remaining samples in the job or batch must be recounted and tested against the original counts. All rejected count pairs remain on the Worksheet for comparison to the "new, accepted count pairs". Rejected counts are not used to produce client reports, but will be addressed in monthly QC reports by the local QC Officer.

5.1.10. After acceptance of the fiber count QC data the fiber count data is entered into the appropriate job in the LIMS system and a client report is generated. The client report is reviewed by the analyst prior to release.

5.1.11. The analyst's CVs in the LIMS system are updated on a semi-annual basis for experienced analysts. Analyst's CVs for analysts with less than one year of experience are updated on a monthly basis for each of the 3 loading ranges: low, medium and high. The appropriate intra-analyst CVs for the three ranges are printed on each customer report.

5.2. Personal Coefficient of Variation (Historical Relative Standard Deviation)

5.2.1. The data gathered for intra-counter QC purposes is divided into three fiber density ranges based on the average total fibers (per 100 field basis) counted for the original analysis:

1.	Low:	5 to 20 fibers (0.05 - 0.2 fib/fld)	or	[6.4 to 25.5 fib/mm2]
2.	Medium:	>20 to 50 fibers (0.2 - 0.5 fib/fld)	or	[>25.5 to 63.7 fib/mm2]
3.	High:	>50 to 100 fibers (0.5 - 1.0 fib/fld)	or	[>63.7 to 127.4 fib/mm2]

5.2.2. Evaluation of each "count pair" consisting of the original or primary count (PC) and the recount (RC) count pairs is accomplished using the Historical Relative Standard Deviation or Personal Coefficient of Variation (PCV) listed below.

5.2.2.1. Each analyst has a calculated PCV for each fiber density range. This PCV is a pooled intra-counter relative standard deviation on the square root scale. The PCV value provides a quantitation of the expected range of variability of an analysis within the designated fiber density range. The PCV is calculated as follows:

$$PCV = 0.5 \{ (\Sigma S_r 2) / n \}^{0.5} \qquad S_r = \frac{(0.707) \text{ Absolute Value } [X_{i1} - X_{i2}]}{0.5 (X_{i1} + X_{i2})}$$

where: X_{i1}, X_{i2} = the ith original count and recount for 1 analyst in (fibers/mm^2)
n = the number of data pairs in the calculation

5.2.2.2. The PCV is calculated using Reference Slide Count data and the following criteria:

5.2.2.3. If the total number of Reference Slide recounts for a range for an analyst is less than 15, no PCV is calculated and the analyst is assigned a value of 0.40 for that range.

5.2.2.4. If the total number of Reference recounts for a range for an analyst is between 15 and 50, all of those values are used in the calculation of the PCV.

5.2.2.5. If the total number of Reference recounts for a range for an analyst exceeds 50, only the most recent 50 pairs are used in the calculation.

5.2.2.6. PCV values are cumulative for quality control purposes regardless of the quarter.

5.2.2.7. Review of an analyst's PCV values allows comparison of current performance with past performance of a particular analyst. The expected pattern is for an analyst's PCV values to decrease as experience is gained, although other factors may cause it to do otherwise.

5.3. PCM Corrective Action Procedures for Pair Test Rejections

The comprehensive guidelines for Corrective Action procedures are outlined in the QA Manual, however specific guidelines are included here for those actions necessary in response to a "rejected" count pair analyzed by PCM.

5.3.1. If a count/recount pair is "rejected", by the "PCM QC Pair Test" corrective action must be taken immediately and a Corrective Action Report filed with the QA Officer.

5.3.2. If the Test Value generated by the "PCM QC Pair Test" exceeds the Control Limit of 2.77 then the remaining samples in the job or batch must be recounted and tested against the original counts. If a count pair is rejected a second time and is also noted as exhibiting an "uneven distribution", the condition will be mentioned in a report footnote and no further recounts will be necessary. All rejected count pairs remain on the Worksheet for comparison to the "new, accepted count pairs". Rejected counts are not used to produce client reports, but will be addressed in monthly QC reports by the local QC Officer.

5.3.3. The Shift Supervisor (or his/her designee) is asked to review the pair test results and the slides involved for assistance in resolving the source of the count pair rejection. If "uneven distribution" was noted on the analysis sheet then the condition will be mentioned in the client report as a footnote and no further investigation is necessary. In addition, "uneven distribution" is noted on the "PCM QC Pair Test" worksheet which is copied to serve as a QA irregularity report.

5.3.3.1. If an "uneven distribution" was not noted or found, data entry records are checked for possible errors.

5.3.4.1. If the analyst's repeat analyses of rejected slides pass the "PCM QC Pair Test", the Pair Test sheet with the failed and recounted sample indicated are included in a QA irregularity report to the QA Officer for inclusion in the monthly report.

5.3.4.2. Any repeat analyses not passing the "PCM QC Pair Test" will be counted by another analyst. A third analyst will count the count pair if necessary to establish the "outlier" of the previous analyses.

5.3.4.3. The total number of slides to be recounted is at the discretion of the shift supervisor, but must reflect a thorough investigation such that confidence may be placed in the data generated by an analyst. For example, if the job containing the rejected count pair had 10 samples, all 10 samples would be recounted to verify (or correct) the original results.

5.3.5. Client reports cannot be issued until the QC test has been resolved such that amended or re-issued reports are unnecessary. If amended reports are required for any other reason they must be approved by the Laboratory Director prior to being issued.

6. Intra-Laboratory Quality Control

The Intra-Laboratory QC program is in place to monitor the accuracy of data produced by analysts within the lab using "Duplicate" recounts by the same analyst and "Replicate" recounts by a different analyst. This QC measure gives confidence to reported results by assuring that the analyst's results reproduce (or could be reproduced by) those generated by another analyst within the same laboratory.

6.1. Quality Control Procedure and Evaluation

6.1.1. The Laboratory Supervisor maintains a pool of reference slides drawn from client and test slides. The reference slides cover the three ranges of fiber density concentrations and should represent the sample types normally observed by the laboratory. The slides are replaced as necessary.

6.1.2. Any microscopist who analyzes samples must first count a reference slide from a set designated by the Laboratory Supervisor for analysis that day.

6.1.3. After analysis of the Reference slide, but before analysis of client samples, the analyst records his/her data in the appropriate Reference Slide Worksheet on the computer in order to check that they are counting "in control". If unable to count "in control" the analyst may not analyze client samples until the source of the problem is resolved. The Shift supervisor may designate additional slides for evaluation after review of the analyst's condition and working environment.

6.1.4. The reference slides are filed in a separate storage area after being chosen so that they are removed from the pool of available reference slides until all Reference slides have been used. Then, all slides are replaced in the original slide box and the process repeated.

6.1.5. Data is recorded on the appropriate Reference Slide worksheet until at least 20 "in control" data points have been collected. At this time, the mean and standard deviation are re-calculated using all accumulated "in control" data.

6.1.6. At the beginning of a shift, 10% of the QC recounted slides from the previous shift are recounted by a second analyst. The different analyst recounts are entered in the "Replicate" column of the Analysis/QC Sheet. The Replicate counts must pass the "Pair Test" using the laboratory CV for each fiber density range. This is monitored by entering the data into an Intra-Laboratory (Inter-Analyst among a single lab site) "Pair Test" worksheet (to be replaced by an imbedded LIMS QC job designated for Replicate PCM QC analysis and evaluation which is under development).

6.2. Data Evaluation

6.2.1 Data points are evaluated by the analyst as each data point is entered into the Reference Slide computer worksheet. The worksheets are printed and reviewed by the Laboratory Supervisor on an ongoing basis. The warning limits of +2 standard deviations and the action limits of +3 standard deviations are automatically plotted on the computer worksheets for immediate evaluation by the analyst.

6.2.2. If a data point falls outside of the acceptable range of results, the analyst is considered "out of control" and must discontinue analysis until the source of the problem is resolved. The Shift Supervisor may designate additional slides for evaluation after review of the analyst's condition and working environment. The actual steps taken to remedy the problem are at the discretion of the Shift Supervisor, but in most cases will involve repeat analysis of the slide and subsequent analysis of other slides with supervision until the reasons for the discrepancy are determined.

6.2.3. Although daily analysis of the Reference Slides before analysis of client samples is an integral part of the QC program and should be observed by all analysts, it is of even greater importance for those analysts who perform analyses on an infrequent basis or those who have an analyst HRSD of 0.40 or greater. Any reference slide outliers for these analysts must be remedied immediately with no exceptions.

6.2.4. All analyst's data are plotted on the Reference Slide control chart with an identifying symbol. Any developing trends or bias of AmeriSci affiliates employee's counting ability will be readily apparent. The QC control charts are reviewed by the Quality Assurance Officer on an ongoing basis to evaluate this possibility.

6.3. Unauthorized Data Release - Corrective Action

6.3.1. The Intra-Laboratory QC program is operated to ensure that no client reports will be issued during an "out of control" period.

6.3.2. If for any reason, fiber count data are reported before reference slide counts are shown to be in control or an appropriate "Pair Test" has been performed, a random re-check of at least 10% of all the analyst's affected work must be performed immediately. In addition, the Walton-Beckett area must be verified. A Corrective Action report must be completed in order to prevent a reoccurrence of the unauthorized release of fiber count results.

6.3.3. Shifts, trends, or systematic bias as determined by evaluation of the control charts will be addressed as needed, through in-house training or other measures to assure that results from any AmeriSci affiliates analyst are as accurate as possible. Such situations will be documented by a Corrective Action report.

7. <u>Inter-Laboratory Quality Control</u>

The Inter-Laboratory QC program allows comparison of AmeriSci affiliates analysts' analyses with those of analysts from at least two other outside laboratories at least twice a year. Inter-Laboratory QC gives additional confidence to analyses by demonstrating that data generated from AmeriSci affiliates is comparable to that which would be generated by another experienced laboratory.

7.1. Proficiency Testing

7.1.1. AmeriSci affiliates participant in the AIHA Industrial Hygiene Proficiency Analytical Testing (IHPAT) (and New York State Department of Health Environmental Laboratory Accreditation Program (ELAP) programs for selected laboratories). The results of all analyses performed under these programs are maintained in Proficiency Round Files. Proficiency results will be submitted for each certified analyte twice per year.

7.1.2. Periodically AmeriSci affiliates receive proficiency test filters from AIHA and possibly NYS DOH ELAP (for those affiliate labs involved in this program). These samples are logged and handled in the same manner as client samples but are designated as QA jobs. Each analyst analyzes these samples after the blindly selected Submission Analyst submits results but prior to publication of the test round. The LIMS PCM worksheet which requires recording the individual counts for each field counted is utilized.

7.1.3. The data for each analyst is entered into the Proficiency Round Worksheet section marked "Analyst - 100 fld WS". The analyst Proficiency Results to be submitted for a particular Proficiency Round is rotated among all analysts (excluding analyst trainees). Once the "100 fld WS" results are compiled, the data for the analyst which was used for the previous submittal is removed from the available PT data pool and a submission data set is randomly selected and to represent the respective laboratory. The local QA Officer may use the random QA selection feature of the LIMS program or an alternative random method if desired.

7.1.4. Once the submission data set is chosen the samples may be analyzed twice more by each analyst on different days and entered into the Proficiency Round Worksheet in order to provide initial data for potential use in analyst evaluations and other QA characterizations within each laboratory.

7.1.5. When final results are received from AIHA or ELAP they are entered into the Proficiency Round Worksheets and used to prepare comparison control charts for each analyst and laboratory.

7.1.6. The graphed results are reviewed with each analyst. Initialed and dated review sheets are filed in each analyst's QA file. Copies of the laboratory graph should be posted in the PCM area after specific analyst identification has been removed.

7.2. Round Robin Participation

7.2.1. At least twice a year, AmeriSci affiliates participate in a Round Robin exchange program with at least two other accredited laboratories. The Round Robin program involves mounted air filter samples from the coordinating laboratory sample stream (may include filter sections to be mounted by each participating laboratory).

7.2.2. Each exchange set will consist of at least 5 samples with a range of fiber loadings. The set should include loadings in the low, medium and high ranges referenced in the NIOSH 7400 method. No more than one sample can be a blank.

7.2.3. Each laboratory should agree to return the samples within 2 weeks of receipt. Within 30 days of completion of the Round Robin the coordinating laboratory will provide a graphical evaluation of the analysis results utilizing comparisons to the mean and control limits of +/- 2 standard deviations.

7.2.4. The Laboratory Director/Supervisor and QA Coordinator will review the statistical summary when received. After verification of the removal of laboratory specific identification, the results will be posted in the asbestos work area for review by analysts. The round is discussed at the next Group meeting and reported in the appropriate monthly Quality Assurance Summary.

7.3. Intra and Inter-laboratory Comparability

7.3.1. Fiber counting samples with randomly distributed fibers at a single laboratory produces relative standard deviations (Sr) referred to as Intra-laboratory relative standard deviations. They depend on fiber type and on the inverse of the square root of the number of fibers counted.

$$\textbf{Intra-}S_r = 1 / (N)^{0.5}$$

7.3.1.1. AmeriSci affiliate PCM analysts utilize the local affiliate controlled document: PCM Personal Ref Slide CV (Sr) Worksheet (i.e. AMN-PLN-4128) in order to determine their Semi-Annual Personal Ref Slide CV (Sr) Values for Low, Medium and High Count Ranges

7.3.1.2. The Low, Medium and High Root Mean Square CV (Sr) for each analyst is maintained in the 4D LIMS data files and reported on affiliate PCM jobs which they analyze.

7.3.2. Additional relative standard deviations can be introduced by counting of the same sample by a different laboratory referred to as Inter-laboratory relative standard deviations. Ogden ((1982) found the component introduced by a different laboratory to be about 0.2 and found the estimated total Sr between different laboratories to be:

$$\textbf{Inter-}S_r = (N + (0.2 + N)^2)^{1/2} / N$$

7.3.3. It is suggested in NIOSH 7400 (Issue 3) that the total expanded uncertainty for a laboratory can be determined using the formula:

$$\textbf{Total Sr} = (N + (0.2N)^2)^{1/2} / N$$

7.3.3.1. AmeriSci affiliate PCM QA Officers utilize the local affiliate controlled document: PCM Lab-wide RMS CV (Sr) Summary Worksheet (i.e. AMN-PLN-4116) in order to determine the Inter-Laboratory Lab-Wide Sr (CV) for each local affiliate.

7.3.3.2. The Lab-Wide CV (Sr) for each affiliate location is maintained in the 4D LIMS data files and reported on affiliate PCM jobs.

8. Mobile Facilities (optional for national or regional emergency situations)

8.1. When operating from mobile facilities all standard laboratory practices and quality control procedures will be followed. The mobile facility will operate as an extension of a Parent Facility and will be under the direct control of the Microscopy Supervisor and QA Officer of the Parent Facility.

8.2. All slides and blanks prepared and analyzed at the Mobile Facility will be returned to the Parent Facility for validation, which will include a minimum of 10% recounted slides.

8.3. All Mobile Facility analysts will count daily control slides provided by the QA Officer of the Parent Facility.

8.4. All results produced by the Mobile Facility will be transmitted in a timely fashion such as by hand delivery, FAX or modem to the Parent Facility for daily evaluation and entry into the LIMS database. QC control charts, reports and necessary documents will be provided by the Parent Facility by a similar, timely means of communication.

9. Development of Analyst Specific PCM Demonstration of Capability

An initial Demonstration of Capability (iDOC) must be established for each new analyst or any experienced analyst using an established procedure which has undergone a significant modification. Once an iDOC has been established, continuing DOCs must be preformed on a regular basis at least semi-annually (frequency may be increased if there is an apparent need or requirement). The local DOC programs will be directed by the local AmeriSci affiliate Quality Assurance Officer and reviewed with the Laboratory Manager and other relevant Supervisors.

9.1. Initial DOC development

9.1.1 The minimum requirement for an iDOC will be successfully analyzing all PT samples analyzed by the laboratory during the previous 12 month period. The Quality Assurance Officer may require additional analyses with the approval of the Laboratory Manager and Compliance Officer.

9.2 Continuing DOC maintenance

9.2.1 Once the iDOC has been established, all analysts must successfully analyze all PT samples analyzed by the laboratory in order to maintain approval as an active analyst. If an analyst is absent from work during the time period that a set of PT samples were being analyzed they must successfully analyze the missed PT set in order to return to approved analyst status. Analysts transferring between AmeriSci affiliates may carry common PT analyses between AmeriSci affiliates operating under the AmeriSci QA Management Program. PT analyses from non-AmeriSci Laboratories shall not be used to establish a DOC at an AmeriSci affiliate.

9.3 Agency or Project Specific DOC (optional)

9.3.1 Any special initial or continuing DOCs will be established following the most recent required agency or project specifications which will be stated within the documentation for the DOC. When possible, the DOC development will utilize existing AmeriSci affiliate controlled documents in order to reduce unnecessary time and expense. AmeriSci affiliates controlled document may be modified as necessary for the project and will be identified by the addition of a suffix to the controlled document number.

9.3.2 NYSDOH-ELAP 231.1 Performance based PCM DOC (optional)

9.3.2.1 Assemble a DOC Reference Slide Set with a minimum of 15 characterized slides from the laboratory Reference Slide Set. Arrange the slides in repeating low, medium and high loading ranges. Relabel the new slide set in order to maintain the desired alternating range sequence.

9.3.2.2 Enter the new Slide Set in a 4D LIMS QA job for the current month (i.e. xQAyymmPC).

Enter the DOC identification in the "JobSite" field
Enter "Start Time ______"..."Stop Time_________" in the "Location" field for each sample

9.3.2.3 Print a set of Worksheets for each analyst

9.3.2.4 Instruct each PCM analyst to perform a timed analysis of the samples for a predetermined time period of 1 hour (complete any FOV being counted at the end of the 1 hour period). They should follow their normal routine for work/rest period rotation after they have started their normal workday routine including microscope setup and calibration procedures. During the analysis they should use a digital clock to record the start and stop times to the nearest minute for each slide analyzed (utilizing 24hr time nomenclature).

9.3.2.5 Return the DOC Reference Slide Set to its marked container and submit the completed worksheets to the local QA Officer.

9.3.2.6 The QA Officer will prepare a modified AmeriSci PCM Pair Test Worksheet for each analyst. The completed DOC data set for each PCM analyst will be entered into the Pair Test Worksheet and assemble a DOC Summary Report including the following information:

Total slides analyzed
Total analyzes passing the NIOSH Pair Test
Determination of the Percent Accuracy for each analyst
A laboratory (or shift) mean production rate and percent accuracy

9.3.2.7 After review and approval by the Laboratory Manager(s), Compliance Officer and QA Officer the DOC results summary will be posted in the Laboratory area. Any necessary follow-up with the analysts must be completed prior to the general posting. The DOC summary must be modified to remove analyst identification prior to posting.

9.3.2.8 The QA Officer will maintain the individual analyst's results in their personal QA file. A Corrective Action Plan will be implemented to address any problems evident from the analyses.

10. <u>Asbestos Fiber Differentiation by NIOSH 7402</u>

When necessary to differentiate asbestos fibers from other fiber types, the remainder of the original filter may be submitted for analysis by NIOSH 7402-TEM. The most current version of the NIOSH 7402 method is adopted by reference. For asbestos fiber differentiation the 7402 Method provides a fraction of the optically visible asbestos fibers on the original filter which is subsequently multiplied by the original PCM fiber count.

10.1. Preparation

10.1.1. The NIOSH 7402 preparation procedure follows Section V.3.1. with the exception that the Plasma Ashing Step detailed in Section V.3.1.8. is not performed on NIOSH 7402 samples in order to preserve any organic fibers present on the filter.

10.2. Calibration and Quality Control

10.2.1. The NIOSH 7402 calibration and quality control procedures are consistent with those performed for other TEM air analysis methods outlined in Section V and are therefore incorporated in the standard AmeriSci affiliates TEM Air SOP's with the stipulation that NIOSH 7402 sample quality control re-analyses are grouped together for selection and evaluation purposes on a monthly basis.

10.3. Transmission Electron Microscopy Analysis (TEM)

10.3.1. Rules for fiber measurement, counting, sizing and identification are adopted from NIOSH 7402 as specified by the method and spread over 3 TEM grids. Fibers are identified as "asbestos" by asbestos type or as "non-asbestos". If differential counting of fibers (such as fiberglass) is requested for PCM analysis the differential counting of fibers by TEM will also be provided if identification criteria of appropriate reference are available.

10.4. Calculation of Optically Visible Asbestos Fraction

10.4.1. The fraction of optically visible asbestos fibers on the filter or other samples identified by the client as represented by the TEM sample is calculated as provided in the 7402 method. The fraction is multiplied by the PCM fiber count to provide a "TEM corrected" fiber count reported in a 7402 Summary Table. The fraction is calculated as follows:

Asbestos Fraction = $(f_s - f_b) / (F_s - F_b)$

10.5. NIOSH 7402 Quality Control Procedures

10.5.1. Quality control procedures are incorporated into the standard AmeriSci affiliates Quality Assurance program since its requirements are consistent with those of other TEM air programs, with the exception of reanalysis evaluations. NIOSH 7402 quality control reanalyzes are grouped separately due to the different counting rules, but are evaluated by the same criteria in all other aspects.

11. <u>Monthly Summaries</u>

The Quality Control Coordinator at each facility will provide monthly summaries of QA analyses, including results from: blanks, duplicates, replicates, proficiency testing and inter-laboratory testing as available. The report will also include discussion of any deficiency corrections addressed during the month. Overall accuracy and precision for each analyst will be maintained in individual personnel folders and addressed in the monthly report.

12. References

Abell et al., November 1989, Applied Industrial Hygiene, "The Quality of Fiber Count Data", p. 273-285.

NIOSH 7400, Issue 3, 6/14/19, "Asbestos and Other Fibers by PCM", NIOSH Manual of Analytical Methods, 5th Edition, 2019, US Dept of Health and Human Services, Center for Disease Control and Prevention, NIOSH, Cincinnati, Ohio.

NIOSH 7402, Issue 2, 8/15/94, "Asbestos by TEM", NIOSH Manual of Analytical Methods, 4th Edition, 8/15/1994, US Dept of Health and Human Services, Center for Disease Control and Prevention, NIOSH, Cincinnati, Ohio.

Ogden, TL. 1982, Health and Safety Executive Research Paper 18: The Reproducibility of Fiber Counts. Sheffield, England: Health and Safety Laboratory, Health and Safety Executive.

OSHA Reference Method – Mandatory – 1920.1001 Appendix A

OSHA Reference Method – Non-Mandatory – 1910.1001 Appendix B

OSHA Letter of Recommendations (most recent issue)

ASBESTOS and OTHER FIBERS by PCM 7400

Formula: Various | MW: Various | CAS: Table 3 | RTECS: Various

METHOD: 7400, Issue 3

EVALUATION: FULL

Issue 1: 15 May 1989
Issue 3: 14 June 2019

OSHA: 0.1 asbestos fiber (>5 µm long and ≥3:1 aspect ratio)/cc; 1 f/cc, 30 min excursion; carcinogen
NIOSH: 0.1 fiber (>5 µm long and ≥3:1 aspect ratio)/cc, for a 400 L sample; carcinogen
MSHA: As OSHA

PROPERTIES: solid, fibrous, crystalline, anisotropic

SYNONYMS: actinolite or ferroactinolite; amosite; anthophyllite; chrysotile; crocidolite; tremolite; amphibole asbestos; refractory ceramic fibers; fibrous glass

SAMPLING

SAMPLER: FILTER (0. 45- to 1.2-µm mixed cellulose ester membrane, 25-mm; conductive cowl on cassette

FLOW RATE*: 0.5 to 16 L/min

VOL-MIN*: 400 L @ 0.1 fiber/cc
-MAX*: (step 4, Sampling)

*Adjust to give 100 to 1300 fiber/mm^2

SHIPMENT: routine (pack to reduce mechanical and static electrical shock) (step 6, Sampling)

SAMPLE STABILITY: stable

BLANKS: 2 to 10 field blanks per set

ACCURACY

RANGE STUDIED: 80 to 100 fibers counted

BIAS: see Evaluation of Method

OVERALL PRECISION ($\hat{S}_{rT}$): 0.115 to 0.13 [1]

ACCURACY: see Evaluation of Method

MEASUREMENT

TECHNIQUE: LIGHT MICROSCOPY, PHASE CONTRAST

ANALYTE: fibers (manual count)

SAMPLE PREPARATION: Treatment of filter by acetone or dimethylformamide (DMF)/acetic acid, followed by triacetin or Euparal mounting medium [2-4]

COUNTING RULES: Described in previous version of this method as "A" rules [1,5]

EQUIPMENT: 1. positive phase-contrast microscope; 2. graticule (100-µm field of view); 3. phase-shift test slide

CALIBRATION: Phase-shift test slide

RANGE: 100 to 1300 fibers/mm2 filter area
ESTIMATED LOD: 7 fibers/mm^2 filter area

PRECISION (S_r): 0.10 to 0.12 [1]; see Evaluation of Method

APPLICABILITY: The quantitative working range is 0.04 to 0.5 fiber/cc for a 1000-L air sample. The LOD depends on sample volume and quantity of interfering dust, and is <0.01 fiber/cc if free of interferences. The method gives an index of airborne fibers. This method can be used in conjunction with electron microscopy (e.g., Method 7402) for assistance in identification of fibers. For fibers with diameters >1 µm, polarizing light microscopy (as in NIOSH Method 7403) may be used to identify and eliminate interfering non-crystalline fibers [6]. Asbestos fibers thinner than about 0.05-0.15 µm diameter, depending on asbestos type, will not be detected by this method [7-10]. This method may be used for other materials with alternate counting rules.

INTERFERENCES: If the method is used to detect a specific type of fiber, any other fiber may interfere because all particles meeting the counting criteria are counted. Chain-like particles may appear fibrous. High levels of non-fibrous dust particles may obscure fibers in the field of view and increase the detection limit.

OTHER METHODS: This revision replaces Method 7400, issue 2 (dated 08/15/1994).

REAGENTS:

1. Acetone*, reagent grade.
   NOTE: Dimethylformamide (DMF)*, reagent grade/glacial acetic acid can be used as an alternative filter clearing reagent.
2. Triacetin (glycerol triacetate), reagent grade.
   NOTE: Euparal (synthetic Canada Balsam) can be used as an alternative mounting media.

*See SPECIAL PRECAUTIONS.

EQUIPMENT:

1. Sampler: Field monitor, 25-mm, 3-piece cassette with 50-mm electrically conductive extension cowl and mixed cellulose ester (MCE) filter, 0.45- to 1.2-µm pore size, and backup pad.
   NOTE 1: Analyze representative filters for fiber background before use to check for clarity and background. Discard the filter lot if mean is ≥ 5 fibers per 100 graticule fields. These are defined as laboratory blanks. Manufacturer-provided quality assurance checks on filter blanks are normally adequate as long as field blanks are analyzed as described below.
   NOTE 2: The electrically conductive extension cowl reduces electrostatic effects [11]. Ground the cowl when possible during sampling.
   NOTE 3: 0.8- µm pore size filters are commonly used for personal sampling. However, 0.45-µm filters are recommended for sampling when performing TEM analysis on the same samples. Check personal sampling pumps before use with 0.45-µm filters to ensure they can operate at the higher pressure drop. Perform calibration with same type of filter as used for sampling.
2. Sampling pump, battery or line-powered vacuum, of sufficient capacity to meet flow rate requirements and, for personal sampling pumps, applicable ISO Standard [12], with flexible connecting tubing.
   NOTE: See Step 4 in Sampling section for flow rate.
3. Wire, multi-stranded, 22-gauge; 1" hose clamp to attach wire to cassette for grounding, if needed.
4. Tape, shrink- or adhesive-, or cellulose bands.
5. Slides, glass, pre-cleaned, 25- x 75-mm.
6. Cover slips, 22- x 22-mm, No. 1 ½, unless otherwise specified by microscope manufacturer.
7. Cover slips, as above, imprinted with a relocatable grid, where required for quality assurance or training purposes.
8. Lacquer or nail polish.

9. Knife, #10 surgical steel, curved blade, or scissors.
10. Forceps (tweezers).
11. Flash vaporization system for clearing filters on glass slides using acetone. (See ref. [11] for specifications or see manufacturer's instructions for equivalent devices.). Use a drying oven or warming plate located in fume cabinet if using DMF/glacial acetic acid.
12. Micropipettes or microsyringes, 5-µL and 100- to 500-µL.
13. Microscope, positive phase (dark) contrast, with green or blue filter, adjustable field iris, 8x to 10x eyepiece, and 40x to 45x phase objective (total magnification ca. 400x); numerical aperture (NA) = 0.65 to 0.75.
14. Graticule, Walton-Beckett type (Type G22 and G24 are optimized for different counting rules per Appendix C.) with 100-µm projected diameter circular field (area = 0.00785 mm^2) at the specimen plane. Alternative graticules may be used where similar performance has been demonstrated; e.g., the RIB graticule.
    NOTE: The graticule is custom-made for each microscope. See APPENDIX A for the custom-ordering process.
15. Phase contrast test slide. A slide with blocks of visible ruled lines where at least one block of lines is certified as invisible under the microscope set up conditions given below.
16. Telescope, ocular phase-ring centering.
17. Stage micrometer (0.01-mm divisions).

SPECIAL PRECAUTIONS: Wear appropriate personal protection during sampling activities and analysis. It is essential that suitable gloves, eye protection, laboratory coat, etc., be used when working with the chemicals. Acetone is toxic at high exposures and is extremely flammable. Take precautions not to ignite it. Heating of acetone in volumes greater than 1 mL must be done in a ventilated laboratory fume hood using a flameless, spark-free heat source. DMF is toxic by inhalation; heating in a drying oven or warming plate located in an operating fume exhaust hood will reduce potential exposure. DMF is also toxic via absorption through the skin.

SAMPLING:

1. Calibrate each personal sampling pump with a representative sampler in line. Use a flow meter whose calibration is traceable to national or international standards.
   NOTE: See NMAM guidance chapters for discussion on sampling.
2. Cassette assemblies shall be tested to ensure they are not likely to fall apart during sampling. (This testing can be undertaken by the manufacturer.) A press may be useful in ensuring a tight fit, but shall not cause the filter to be cut. To reduce contamination, seal the crease between the cassette base and the cowl with a shrink band or light-colored adhesive tape. Commercial pre-assembled cassettes may already include a taped seal. For personal sampling, fasten the uncapped open-face cassette to the worker's lapel. The open face shall be oriented downward.

NOTE: Electrically grounding the cowl is highly recommended during area sampling, where possible, but especially under conditions of low relative humidity. Use a hose clamp to secure one end of the wire (Equipment, Item 3) to the monitor's cowl. Connect the other end to an earth ground (e.g., cold water pipe). It is recognized that circumstances do not always allow this procedure.

3. Submit at least two field blanks (or 10% of the total samples, whichever is greater) for each set of samples. Handle field blanks in a manner representative of actual handling of associated samples in the set. Open field blank cassettes at the same time as other cassettes just prior to sampling. Store top covers and cassettes in a clean area (e.g., a closed bag or box) with the top covers from the sampling cassettes during the sampling period.
4. Sample at 0.5 L/min or greater [13]. Adjust sampling flow rate, Q [L/min], and time, t (min), to produce a fiber density, *E*, of 100 to 1300 fibers/mm² (3.85×10^4 to 5×10^5 fibers per 25-mm filter with effective collection area $A_c = 385\ mm^2$) for optimum counting. These variables are related to the concentration of fibers in air, L (fibers/cc), of the fibrous aerosol being sampled by:

$$t = \frac{A_c * E}{Q * L * 10^3}$$

NOTE 1: The purpose of adjusting sampling times is to obtain optimum fiber loading on the filter. The collection efficiency does not appear to be a function of flow rate in the range of 0.5 to 16 L/min for asbestos fibers [14]. However, counting efficiency is a function of filter loading, with lower loadings typically resulting in higher proportional concentrations [14-16]. A sampling rate of 1 to 4 L/min for 8 h is appropriate in atmospheres containing about 0.1 fiber/cc in the absence of significant amounts of non-asbestos dust. Dusty atmospheres require smaller sample volumes (≤400 L) to obtain countable samples. In such cases take short, consecutive samples and average the results over the total collection time. For documenting episodic exposures, use high flow rates (7 to 16 L/min) over shorter sampling times. In relatively clean atmospheres, where targeted fiber concentrations are much less than 0.1 fiber/cc, use larger sample volumes (3000 to 10000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust. If ≥50% of the filter surface is covered with particles, the filter may be too overloaded to count and will bias the measured fiber concentration.

NOTE 2: OSHA regulations specify a minimum sampling volume of 48 L for an excursion measurement, and a maximum sampling rate of 2.5 L/min for all personal asbestos sampling [5].

5. At the end of sampling, shut off the pump, record the time, remove the cassette from the tube attaching it to the pump, and replace top cover and end plugs. Capping the cassette before shutting off the pump and removing the tubing will cause a vacuum within the cassette and damage to the filter.
6. Ship samples with conductive cowl attached in a rigid container with packing material to protect cassettes from jostling or damage.

NOTE: Do not use untreated polystyrene foam in shipping container because electrostatic forces may cause fiber loss from sample filter.

SAMPLE PREPARATION:

Two acceptable procedures for clarifying either a whole filter or a portion of a filter are described below. These procedures are the Acetone clearance procedure and the DMF/acetic acid clearance procedure. In either procedure, the filter material is placed on a glass microscope slide. It is then made transparent (clarified). Then, either triacetin or Euparal are placed on the clarified filter and a cover slip is placed on top.

NOTE 1: The object is to produce samples with a smooth (non-grainy) background in a medium with refractive index ≤ 1.46. An early method (P&CAM 239 in APPENDIX F) used dimethyl phthalate and diethyl oxalate [17]. This method may still be used as an alternative to those described below, but because the preparations are only stable for one to two days, the procedure is not further discussed.

NOTE 2: Other procedures use a technique for clearing the filter, either acetone (section A) or DMF/glacial acetic acid (section B), followed by mounting the cleared preparation (section C or D). Acetone collapses the filter into a gel, and has the advantage of being the fastest procedure to prepare the filter for the mounting medium. However, acetone can leave residual polymeric structures in the filter that may be counted as fibers. DMF/acetic acid dissolves the filter and does not leave residual structures to the same extent as acetone collapse.

NOTE 3: After the filter is clarified, either triacetin (section C) or Euparal (section D) are acceptable alternative mounting media. Triacetin provides reasonably permanent mounts when the amount used is restricted to ≤ 3.5 µL, otherwise fiber migration has been observed in slides made with larger quantities [4]. Euparal provides permanent mounts for long-term storage (> 5 years) regardless of the amount used. Either mounting medium can be used with either filter preparation procedure, and all combinations have been demonstrated to provide equivalent fiber counts [4].

7. Prepare samples in a clean area away from any bulk samples which might contaminate the samples. Ensure that the glass slides and cover slips are free of dust and fibers.
8. Determine and record the effective sample collection or filtration area and record the information referenced against the sample ID number.
9. Cut wedges of about 1/4 for a 25-mm diameter filter using a curved-blade surgical steel knife using a rocking motion to prevent tearing. Do not use a blade that was used to open the cassette. Scissors are an option for cutting the filter. The entire filter can be used instead of a wedge, but with the understanding that the whole sample is lost if there is a problem in preparation. Place the wedge or entire filter, dust side up, on slide using forceps. To prevent cross-contamination of samples, blades or scissors should be cleaned between samples.

NOTE 1: Filters can be cut while still in the base of the cassette, or removed and cut on a special cut-stand. If a cut-stand is used it shall be cleaned between filters to ensure no cross-contamination.

NOTE 2: Static electricity will usually keep the wedge on the slide.

A. ACETONE CLEARANCE PROCEDURE

NOTE 1: The aluminum “hot block” or similar flash vaporization techniques may be used outside the laboratory [2].

NOTE 2: Excessive water in the acetone may slow the clearing of the filter. Also, filters that have been exposed to high humidity or water prior to clearing may have a grainy background.

NOTE 3: Rest the “hot block” on a ceramic plate and isolate it from any surface susceptible to heat damage unless it is designed with appropriate safety features to prevent fire or damage.

A1. If the temperature can be varied, adjust the “hot block” to ca. 70 °C [2], otherwise switch on until ready.

A2. Mount a wedge cut from the sample filter on a clean glass slide. Insert slide with wedge into the receiving slot at base of the “hot block.” Immediately place the tip of a micropipette or microsyringe containing ca. 250 µL acetone (use the minimum volume needed to consistently clear the filter sections) into the inlet port of the PTFE cap on top of the “hot block” and inject the acetone into the vaporization chamber with a slow, steady pressure on the plunger button while holding the micropipette or microsyringe firmly in place. After waiting 3 to 5 seconds for the filter to clear, remove the micropipette or microsyringe and glass slide from their ports.

NOTE: Using excess acetone, or delivering it too fast into the “hot block” may cause material to be washed off the surface of the filter. Using insufficient acetone may cause the filter to curl.

CAUTION: Although the volume of acetone used is small, use safety precautions. Work in a well-ventilated area (e.g., laboratory fume hood). Take care not to ignite the acetone. Continuous use of this device in an unventilated space may produce unhealthful levels or even explosive acetone vapor concentrations.

B. DMF/ACETIC ACID CLEARANCE PROCEDURE

B1. Make a mixture of 1.4mL (35% volume) of DMF, 0.6mL (15% volume) of glacial acetic acid and 2mL (50% volume) of distilled water in a dark brown vial [3]. This should be done in a fume hood to minimize exposure to chemicals. This solution must be made at least once per week and the vial shall be stored in accordance with applicable laboratory safety procedures (e.g., kept in a vented chemical cabinet rated for flammable materials).

B2. Turn on the drying oven or warming plate (vented or located in a laboratory fume hood) and allow to come to working temperature. Place a cut filter wedge on a glass slide using forceps. Using 20 ± 5 µL DMF solution, place several drops along the edge of the wedge and allow the solution to wick onto the filter to avoid washing fibers off the filter. Warm the slide at 60 (+2/-5) °C for 30 minutes in the drying oven or on the warming plate.

C. TRIACETIN MOUNTS AFTER CLEARING AND COLLAPSE

C1. Using a 5-µL micropipette or microsyringe, immediately place 3.0 to 3.5 µL triacetin on the wedge. Gently lower a clean cover slip onto the wedge at a slight angle to reduce bubble formation. Avoid excess pressure and movement of the cover glass. Do not wait longer than 30 seconds before applying the coverslip.

NOTE: If too many bubbles form or the amount of triacetin is insufficient, the cover slip may become detached within a few hours. If excessive triacetin remains at the edge of the filter under the cover slip, fiber migration may occur [4].

C2. Mark the outline of the filter segment just inside the edge of the segment with a glass marking pen (such as a permanent ink marker) to aid in microscopic evaluation and to ensure the edge is avoided in the examination. Markings on the bottom of the slide are visible, but outside the depth of focus of fibers and this must be accounted for when positioning the microscope for counting. However, marking the bottom avoids any pressure on the coverslip. If marking the coverslip is preferred, it must be done very lightly and carefully.

C3. Glue the edges of the cover slip to the slide using lacquer or nail polish [18]. Counting may proceed immediately after clearing and mounting are completed.

NOTE: If clearing is slow, warm the slide on a hotplate (surface temperature 50 °C) for up to 15 min in order to hasten clearing. Heat carefully to prevent gas bubble formation.

D. EUPARAL MOUNTS AFTER CLEARING

D1. Add 1 drop of Euparal solution on the middle of the wedge and 1 drop to the center of a cover slip. In order to avoid trapping air bubbles, gently lower the cover slip onto the slide at a slight angle. Warm the slide at 60 (+2/-5) °C for 1 hour to polymerize the Euparal resin.

D2. Mark the outline of the filter segment just inside the edge of the segment with a glass-marking pen (such as a permanent ink marker) to aid in microscopic evaluation and to ensure the edge is avoided in the examination. Markings on the bottom of the slide are visible, but outside the depth of focus of fibers and this must be accounted for when positioning the microscope for counting. However, marking the bottom avoids any pressure on the coverslip. If marking the coverslip is preferred, it must be done very lightly and carefully.

D3. It is not necessary to seal the edges of the cover slip with nail polish if Euparal is used. Counting may proceed immediately after clearing and mounting are completed.

CALIBRATION AND QUALITY CONTROL:

10. Microscope adjustments. Follow the manufacturer's instructions for centering and focusing the objectives, condenser, stage, and lamp, if applicable. At least once daily, and preferably at regular intervals throughout the day, use a phase telescope ocular (or Bertrand lens, for some microscopes) to ensure that the phase rings (annular diaphragm and phase-shifting elements) are concentric. With each microscope, keep a paper or electronic logbook in which to record the dates of microscope cleanings and major servicing.
    a. Each time a sample is examined, do the following:
        i. Adjust the light source for even illumination across the field of view at the condenser iris. Use Köhler illumination, if available. With some microscopes, the illumination may have to be set up with bright field optics before aligning the phase contrast elements.
        ii. Focus on the particulate material to be examined (do not focus on the marking line).
        iii. Using the condenser focus, make sure that the field iris is in focus, centered on the sample, and open only enough to fully illuminate the field of view.
    b. Check the phase-shift detection limit of the microscope periodically for each microscopist/microscope combination:
        i. Center the certified phase-contrast test slide under the phase objective.
        ii. Bring the blocks of grooved lines into focus in the graticule area.

    NOTE: The slide contains seven blocks of grooves (ca. 20 grooves per block) in descending order of visibility. For asbestos counting, it is intended that some blocks of lines are completely visible and one or more are completely invisible when centered in the graticule area (blocks in between may be partially visible). The visibility of the blocks must match the statements in the accompanying certificate [19]. A microscope which fails to meet this requirement for a test slide has resolution either too low or too high for fiber counting.

        iii. If image quality deteriorates, clean the microscope optics. If the problem persists, consult the microscope manufacturer.
    c. Measure the projected diameter of the Walton-Beckett type graticule to assure that it is 100 µm ± 2 µm. Use the measured value to calculate the actual area of graticule. Check the measured value at the minimum and maximum interpupillary distance of the eyepieces. If the diameter changes, then the diameter may change any time a different microscopist uses the microscope and changes the interpupillary distance. If service is performed on the microscope, or components of the microscope are changed, measure the projected diameter again as changes may occur if the tube length or the location of the graticule in the eyepiece is changed.
        i. Center the stage micrometer under the 40X objective of the microscope.
        ii. Bring the scale into focus in the graticule area
        iii. The lines in the scale will appear wide. Using the mechanical stage of the microscope, manipulate the slide until the graticule is at one edge of a major line of the stage micrometer.
        iv. Estimate the diameter of the graticule using edges of the lines of the stage micrometer. Do not attempt to use the center of the micrometer lines.
        v. If the diameter is greater than 102 µm or less than 98 µm, determine if the inter-pupillary distance is correct for the analyst. If it is, then the microscope must be adjusted by someone qualified to service the microscope, or the graticule replaced by one meeting the projected diameter specification.
11. Determine a microscopist's ability to observe, measure, and count fibers.

    NOTE: Prior to examining samples, microscopists shall undergo training to observe, measure, and count fibers and the results of such training shall be available for inspection. A procedure for such training, which allows proficiency to be demonstrated quantitatively, may be found in Appendix B.
12. Document the laboratory's precision for each microscopist for replicate fiber counts.

a. Maintain as part of the laboratory quality assurance program a set of reference slides to be used on a daily basis [20]. These slides shall consist of filter preparations including a range of loadings and background dust levels from a variety of sources including both field and reference samples (e.g., PAT, AAR, or commercial samples). The Quality Assurance Officer shall maintain custody of the reference slides and shall supply each microscopist with a minimum of one reference slide per workday. Change the labels on the reference slides periodically so that the microscopist does not become familiar with the samples.
b. From blind repeat counts on reference slides, estimate the laboratory intra- and inter-microscopist precision. Obtain separate values of relative standard deviation (Sr) for each sample matrix analyzed in each of the following ranges: 5 to 20 fibers in 100 graticule fields, >20 to 50 fibers in 100 graticule fields, and >50 to 100 fibers in 100 graticule fields. Maintain control charts for each of these data files.
c. Alternatively, a laboratory may develop an analytical uncertainty model from intra- and inter-microscopist precision measurements (but, in practice, most laboratories will choose option b).
NOTE: Certain sample matrices (e.g., asbestos cement) have been shown to give poor precision [23].

13. Prepare and count field blanks along with the field samples. Report counts on each field blank.
NOTE 1: The identity of blank filters shall be unknown to the microscopist until all counts have been completed.
NOTE 2: If a field blank yields greater than 7 fibers per 100 graticule fields, report possible contamination of the samples.
14. Perform blind recounts by the same microscopist on 10% of filters counted (slides relabeled by a person other than the microscopist). Use the following test to determine whether a pair of counts by the same microscopist on the same filter shall be rejected because of possible bias: Discard the data if the absolute value of the difference between the square roots of the two counts (in fiber/mm^2) exceeds $2.77XS_r'$ where X is the average of the square roots of the two fiber counts (in fiber/mm^2) and $S_r' = (S_r/2)$ where S_r is the intra-microscopist relative standard deviation for the appropriate count range (in fibers) determined in step 12. For more complete discussions see reference [20].
NOTE 1: Fiber counting as the measurement of randomly placed fibers may be described by a Poisson distribution, so that a square root transformation of the fiber count data will result in approximately normally distributed data [20].
NOTE 2: If a pair of counts is rejected by this test, recount all other samples in the set and test the new counts against the first counts. Discard all rejected paired counts. It is not necessary to use this statistic on blank counts.
NOTE 3: Do not use an intra-microscopist variation calculated from standard relocatable test slides (Appendix B) for this test.
15. The microscopist is a critical part of this analytical procedure. Care must be taken to provide a non-stressful and comfortable environment for fiber counting. Use an ergonomically designed chair, with the microscope eyepiece situated at a comfortable height for viewing. Set external lighting at a similar level to the illumination level in the microscope to reduce eye fatigue. In addition, microscopists shall take 10- to 20-minute breaks from the microscope every one or two hours to limit fatigue [21]. During these breaks, eye and upper back, and neck exercises can be performed to relieve strain.
16. All laboratories engaged in asbestos counting shall participate in a proficiency testing program such as the AIHA Industrial Hygiene Proficiency Analytical Testing (IHPAT) Program for asbestos.
17. Each laboratory analyzing asbestos samples shall implement an interlaboratory quality assurance program that as a minimum includes participation of at least two other independent laboratories. Each laboratory shall participate in round robin testing at least once every 6 months with at least all the other laboratories in its interlaboratory quality assurance group. Each laboratory shall submit slides typical of its own work load for use in this program. The round robin shall be designed and results analyzed using appropriate statistical methodology.

MEASUREMENT:

18. Center the slide on the stage of the calibrated microscope under the objective lens. Focus the microscope on the sample-containing plane of the filter.
19. Adjust the microscope (Step 10).
20. Counting rules: (same as P&CAM 239 rules [1,17,22]: see examples in APPENDIX C).
    a. Count any fiber longer than 5 µm which lies entirely within the graticule area.
        i. Count only fibers longer than 5 µm.
        ii. Measure length of curved fibers along the curve. Count only fibers with a length-to-width ratio equal to or greater than 3:1.
    b. For fibers which cross the boundary of the graticule field:
        i. Count as 1/2 fiber any fiber with only one end lying within the graticule area, provided that the fiber meets the criteria of rule "a" above.
        ii. Do not count any fiber which crosses the graticule boundary more than once.
        iii. Reject and do not count all other fibers.
    c. Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of a fiber.
    d. Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields. Stop at 100 graticule fields regardless of count.
21. Start counting from the tip of the filter wedge and progress along a radial line to the outer edge. Shift up or down on the filter, and continue in the reverse direction. Select graticule fields randomly. Ensure that, as a minimum, each analysis covers one radial line from the filter center to the outer edge of the filter. When an agglomerate or bubble covers ca. 1/8 or more of the graticule field, reject the graticule field and select another. [35] Do not report rejected graticule fields in the total number counted.

    NOTE 1: When counting a graticule field, continuously scan a range of focal planes by moving the fine focus knob to detect very fine fibers which have become embedded in the filter. The small-diameter fibers will be very faint but are an important contribution to the total count. A minimum counting time of 15 s per field is appropriate for accurate counting.

    NOTE 2: Do not count at the outside edge of the filter, or at edges where the filter was cut, as the fiber distribution may be disturbed in these areas. Move in at least 1 mm from the edge (i.e., inside the marked line).

    NOTE 3: Under certain conditions, electrostatic charge may affect the sampling of fibers. These electrostatic effects are most likely to occur when the relative humidity is low (below 20%), and when sampling is performed near the source of aerosol. The result is that deposition of fibers on the filter is reduced, especially near the edge of the filter. If such a pattern is noted during fiber counting, choose fields as close to the center of the filter as possible [11].

    NOTE 4: Counts are to be recorded on a paper or electronic data sheet that provides, as a minimum, record of the counts for each field, filter identification number, analyst's name, date, total fibers counted, total fields counted, mean count, fiber density, and commentary. The average count is calculated by dividing the total fiber count by the number of fields observed. Fiber density (fibers/mm^2) is defined as the average count (fibers/field) divided by the field (graticule) area (mm^2/field).

CALCULATIONS AND REPORTING OF RESULTS:

22. Calculate and report fiber density on the filter, E (fibers/mm^2), by dividing the mean fiber count per graticule field, F/n_f, minus the mean field blank count per graticule field, B/n_b, by the graticule field area, A_f:

$$E = \frac{\left(\frac{F}{n_f}\right) - \left(\frac{B}{n_b}\right)}{A_f}, fibers/mm^2$$

NOTE 1: A_f=0.00785 mm^2 is the area for a graticule with a projected diameter of 100 µm. The actual area shall be calculated using the measured diameter of the graticule. The measured diameter shall be 100 ±2 µm at the proper magnification. The diameter of the graticule shall be re-measured whenever the microscope is serviced or if necessary if there is a change in measured size with inter-pupillary distance (e.g., between different microscopists).

NOTE 2: Fiber counts above 1300 fibers/mm^2 and fiber counts from samples with >50% of filter area covered with particulate shall be reported as "uncountable" or "probably biased." Fiber counts outside the 100–1300 fiber/mm^2 range shall be reported as having "greater than optimal variability" and as being "probably biased."

23. Calculate and report the concentration, (C) in fibers/cc, of fibers in the air volume sampled, (V) in liters, using the effective collection area of the filter, A_c (nominally 385 mm^2 for a 25-mm filter):

$$C = \frac{EA_c}{V * 10^3}$$

NOTE: The area varies according to the cassette inner diameter, where it contacts the filter, which could vary between manufacturers and even between production runs. For most accurate results the value of A_c may be checked and adjusted accordingly, but, in practice, the variation in this parameter is very small in comparison to other sources of uncertainty.

24. Report intra- and interlaboratory relative standard deviations with each set of results.

NOTE: Precision depends on the total number of fibers counted [1,24]. Relative standard deviation is documented in references [1,24-25] for fiber counts up to 100 fibers in 100 graticule fields. Comparability of interlaboratory results is discussed below. As a first approximation, use 213% above and 49% below the count as the upper and lower confidence limits for fiber counts greater than 20 (Figure 1).

EVALUATION OF METHOD:

Summary of Method Revisions:

Each revision or release clarified minor points of grammar and procedure as well as major changes. This summary lists the major changes only.

The initial US Public Health Service/NIOSH method for counting fibers was published in 1968 [26]. It was based upon the British Hygiene standard [27] and procedures developed by the British Asbestos Research Council. The procedure was published in the NIOSH Criteria for a Recommended Standard [28] Section VIII, Appendix I (1972).

An informal draft version was used until 1976 when NIOSH issued it as P & CAM 239. It was published in the NIOSH Manual of Analytical Methods, 2nd ed., Vol. 1, P&CAM 239, U.S. Department of Health, Education, and Welfare Pub. (NIOSH) 11-157-A (1977) [17].

NIOSH Method 7400 Issued 15 February 1984

In 1984, the NIOSH P&CAM 239 Fiber counting method was renamed Method 7400 and rewritten to be in the standard format for inclusion in the NIOSH Manual of Analytical Methods. This revision included changes in three areas:

1. Sampling: The change from a 37-mm to a 25-mm filter improved sensitivity for similar air volumes. The change in flow rates allowed for 2 m^3 full-shift samples to be collected, providing that the filter is not overloaded with non-fibrous particulates. The collection efficiency of the sampler is not a function of flow rate in the range 0.5 to 16 L/min [17].
2. Sample preparation technique: The acetone vapor-triacetin preparation technique was included as a faster, more permanent mounting technique than the dimethyl phthalate/diethyl oxalate method of

P&CAM 239 [2,7,17]. The aluminum "hot block" technique minimizes the amount of acetone needed to prepare each sample.

3. Measurement:
   a. The Walton-Beckett graticule standardizes the area observed [21,29-30].
   b. A phase shift test slide standardizes microscope optics [31].
   c. Because of past inaccuracies associated with low fiber counts, the minimum recommended loading was increased to 100 fibers/mm^2 filter area (a total of 78.5 fibers counted in 100 fields, each with field area = 0.00785 mm^2). Lower levels generally result in an overestimate of the fiber count when compared to results in the recommended analytical range [15]. The recommended loadings are expected to yield intra-microscopist S_r in the range of 0.10 to 0.17 [32, 36].
   d. An alternative set of counting rules (B rules) was introduced to improve precision of counting.

NIOSH Method 7400 Issued 15 February 1984, Revision #1 15 May 1985

Revision #1 included a discussion of interlaboratory variability and comparison of the A and B counting rules.

NIOSH Method 7400 Issued 02 February 1984, Revision #2 15 May 1986

Revision # 2 added an expanded discussion of interlaboratory variability and comparison of the A and B counting rules. It moved the "B" rules to an appendix as alternate counting rules (which should be used when counting man-made mineral fibers, e.g., fibrous glass, refractory ceramic fibers, etc.). It added three Appendices:

a. Appendix A: Calibration of the Walton Beckett Graticule
b. Appendix B: Examples of Counting Rules
c. Appendix C: Alternate Counting Rules

NIOSH Method 7400 Issued 02 February 1984, Issue 1: Revision #3 15 May 1989

Issue 1: Revision #3 corrected some technical issues and clarified the method language.

NIOSH Method 7400 Issued 02 February 1984, Issue 2: 15 August 1994

Issue 2 refined the method language, added some procedural notes and added an additional Appendix D

listing Equivalent Limits of Detection and Quantitation.

NIOSH Method 7400 Issued 02 February 1984, Issue 3: 29 April 2019

Issue 3 of this Method incorporates:

1. More accurate values for the minimum width limits for asbestos fiber detection. A value of 0.15 µm for chrysotile and 0.05 µm for amphibole asbestos is based on published research [7,8]. A recent user check confirms that these values are achievable [10]. However, not all microscopists can see finer chrysotile fibers between 0.15 µm and 0.2 µm without adequate training [33-34]. Note that PCM does not distinguish between asbestos types.
2. DMF/acetic acid as an alternative filter clearing procedure to acetone, and Euparal as an alternative mounting medium to triacetin. Either mounting medium is used with either clearing procedure. The DMF/acetic acid procedure does not leave undissolved residues from the filter medium, which may appear as fibers. Euparal produces permanent mounts regardless of the quantity of medium used [3]. These alternatives have been shown in a user-check to provide fiber counts that are not significantly different from counts in slides made from the original dimethyl phthalate/diethyl oxalate procedure [4]. This revision also allows the continued use of dimethyl phthalate/diethyl oxalate, if preferred.

3. A generic description of phase-shift test slides, since changes in the manufacture have led to confusion [19]. The description now only requires the slides to have a certificate stating that there are fully visible blocks and invisible blocks, so that the required phase-shift is bracketed. The microscopist is expected to be able to visualize a slide according to its certificate. Newer slides have been shown in a user-check to provide fiber counts that are not significantly different from counts in slides where the original version of the phase shift test slide was used for calibration [10].
4. Standard relocatable test slides as an additional non-mandatory quality assurance Appendix, and as documentation of inter- and intra-microscopist precision without the contribution from the selection of counting fields. Several user-checks have demonstrated increases in average analyst performance after training on these slides [33-34].
5. Guidance on the calculation of an expanded uncertainty budget. This guidance allows users to determine expanded uncertainty as required under international standards [35].
6. Re-numbering of appendices.

INTERLABORATORY COMPARABILITY

An international collaborative study involved 16 laboratories using prepared slides from the asbestos cement, milling, mining, textile, and friction material industries [23]. The relative standard deviations (S_r) varied with sample type and laboratory. The ranges were:

Rules	Intralaboratory S_r	Interlaboratory S_r	Overall S_r
AIA (NIOSH A Rules)*	0.12 to 0.40	0.27 to 0.85	0.46
Modified CRS (NIOSH B Rules)*	0.11 to 0.29	0.20 to 0.35	0.25

*Under AIA (Asbestos International Association) rules, only fibers having a diameter less than 3 µm are counted and fibers attached to particles larger than 3 µm are not counted. NIOSH A Rules are otherwise similar to the AIA rules.

A NIOSH study conducted using field samples of asbestos gave intralaboratory S_r in the range 0.17 to 0.25 and an interlaboratory S_r of 0.45 [20]. This agrees well with other recent studies [21,23-24,36].

At this time, there is no independent means for assessing the overall accuracy of this method. One measure of reliability is to estimate how well the count for a single sample agrees with the mean count from a large number of laboratories. The following discussion indicates how this estimation can be carried out based on measurements of the interlaboratory variability, as well as showing how the results of this method relate to the theoretically attainable counting precision and to measured intra- and interlaboratory S_r (NOTE: The following discussion does not include bias estimates and cannot be taken to indicate that lightly loaded samples are as accurate as properly loaded ones).

Theoretically, the process of counting randomly (Poisson) distributed fibers on a filter surface will give a S_r that depends on the number, N, of fibers counted: $S_r = \frac{1}{\sqrt{N}}$

Thus, S_r is 0.1 for 100 fibers and 0.32 for 10 fibers counted. The actual S_r found in a number of studies is greater than these theoretical numbers [15,25,30,36].

An additional component of variability comes primarily from subjective interlaboratory differences. In a study of ten microscopists in a continuing sample exchange program, Ogden [24] found this subjective component of intralaboratory S_r to be approximately 0.2 and estimated the overall S_r by the term: $\frac{\sqrt{N+(0.2+N)^2}}{N}$.

Ogden found that the 90% confidence interval of the individual intralaboratory counts in relation to the means were $+2\ S_r$ and $-1.5\ S_r$. In this program, one sample out of ten was a quality control sample. For laboratories not engaged in an intensive quality assurance program, the subjective component of variability can be higher.

In a study of field sample results in 46 laboratories, the Asbestos Information Association (AIA) also found that the variability had both a constant component and one that depended on the fiber count [18]. These results gave a subjective interlaboratory component of S_r (on the same basis as Ogden's) for field samples of ca. 0.45. A similar value was obtained for 12 laboratories analyzing a set of 24 field samples [36]. This value falls slightly above the range of S_r (0.25 to 0.42 for 1984–85) found for 80 reference laboratories in the NIOSH PAT program for laboratory-generated samples [25].

A number of factors influence intralaboratory S_r for a given laboratory, such as that laboratory's actual counting performance and the type of samples being analyzed. In the absence of other information, such as from an interlaboratory quality assurance program using field samples, the value for the subjective component of variability is chosen as 0.45. It is recommended that each laboratory establish an interlaboratory quality assurance program to improve their performance and thus reduce the intralaboratory S_r.

The above relative standard deviations apply when the population mean has been determined. It is more useful, however, for laboratories to estimate the 90% confidence for of the count distribution for both interlaboratory and intralaboratory results [24].

For example, if a sample yields a count of 24 fibers, Figure 1 indicates that the mean interlaboratory count will fall within the range of 227% above and 52% below that value 90% of the time. These percentages can be applied directly to the air concentrations as well. If, for instance, this sample (24 fibers counted) represented a 500-L volume, then the measured concentration is 0.02 fibers/cc (assuming 100 fields counted, 25-mm filter, 0.00785 mm^2 counting field area). If this same sample were counted by a group of laboratories, there is a 90% probability that the mean would fall between 0.01 and 0.08 fiber/cc. These limits are to be reported in any comparison of results between laboratories.

Note that the interlaboratory S_r of 0.45 used to derive Figure 1 is used as an estimate for a random group of laboratories. If several laboratories belonging to a quality assurance group can show that their interlaboratory S_r is smaller, then it is more correct to use that smaller S_r. However, the estimated interlaboratory S_r of 0.45 is to be used in the absence of such information. Note also that it has been found that interlaboratory S_r can be higher for certain types of samples, such as asbestos cement [23].

Quite often the estimated airborne concentration from an asbestos analysis is used to compare to a regulatory standard. For instance, if one is trying to show compliance with an 0.5 fiber/cc standard using a single sample on which 100 fibers have been counted, then Figure 1 indicates that the 0.5 fiber/cc standard must be 213% higher than the measured air concentration. This indicates that if one measures a fiber concentration of 0.16 fiber/cc (100 fibers counted), then the mean fiber count by a group of laboratories (of which the compliance laboratory might be one) has a 95% chance of being less than 0.5 fibers/cc; i.e., $0.16 + 2.13 \times 0.16 = 0.5$.

It can be seen from Figure 1 that the Poisson component of the variability is not very important unless the number of fibers counted is small. Therefore, a further approximation is to simply use +213% and -49% as the upper and lower confidence values of the mean for a 100-fiber count.

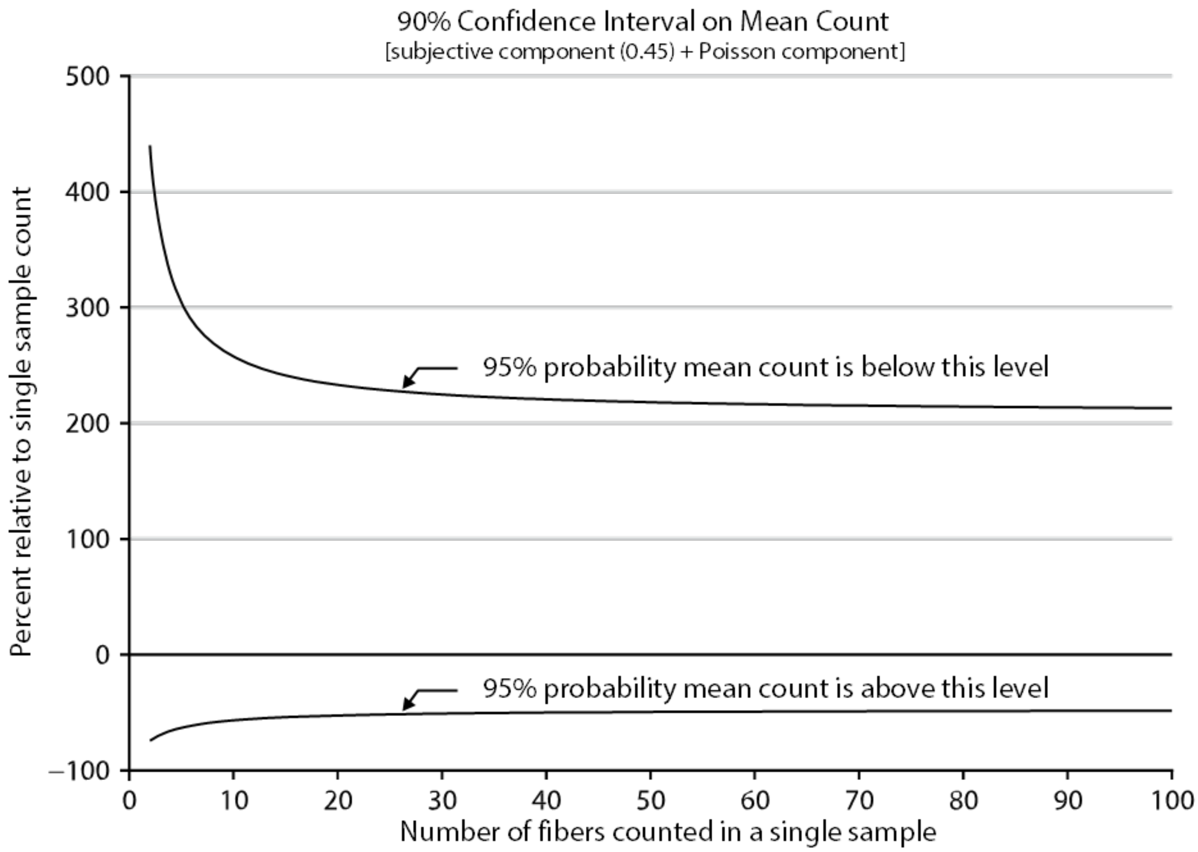


Figure 1. Interlaboratory precision of fiber counts

The curves in Figure 1 are defined by the following equations:

$$UCL = \frac{2X + 2.25 + \sqrt{(2.25 + 2X)^2 - 4(1 - 2.25S_r^2)X^2}}{2(1 - 2.25S_r^2)}$$

and

$$LCL = \frac{2X + 4 - \sqrt{((4 + 2x)^2 - 4(1 - 4S_r^2)X^2)}}{2(1 - 4{S_r}^2)}$$

where S_r = subjective interlaboratory relative standard deviation, which is close to the total interlaboratory S_r when approximately 100 fibers are counted, X = total fibers counted on sample, UCL = upper 95% confidence limit, and LCL = lower 95% confidence limit.

NOTE: The range between these two limits represents 90% of the total range.

It is also possible to use a similar approach to determining expanded uncertainty within a single laboratory.

The formula:

$$S_r = \frac{\sqrt{N + (0.2N)^2}}{N}$$

suggests that if *n* is the number of counts taken in a single reading, then the distribution of

$$\frac{n - N}{\sqrt{n + S_r^2 N^2}}$$

though unknown, depends only weakly on N, because the mean and variance are independent of N. In fact, from many readings by a number of microscopists, with N equal to the mean across the microscopists, confidence intervals were determined [24] as:

$$-1.8 \leq \frac{n - N}{\sqrt{N + S_r^2 N^2}} \leq +2.6$$

By solving the two quadratic equations at the two extreme limits for N in terms of n, confidence limits enclosing the consensus mean N, given single measurements n are easily obtained: $LCL[n] < N < UCL[n]$ (95% Confidence Limit), where LCL and UCL are given by:

$$LCL[n] = \frac{2n + 2.6^2 - \sqrt{(2.6^2 + 2n)^2 - 4(1 - 2.6^2 S_r^2)n^2}}{2(1 - 2.6^2 S_r^2)}$$

and

$$UCL[n] = \frac{2n + 1.8^2 + \sqrt{(1.8^2 + 2n)^2 - 4(1 - 1.8^2 S_r^2)n^2}}{2(1 - 1.8^2 S_r^2)}$$

NOTE: In these formulae the confidence level is expanded from 90% to 95%.

From these equations, the confidence limits accounting for both subjective microscopist and Poisson components for various fiber counts are calculated (Table 1) by taking $S_r = 0.2$. The intra- and inter-microscopist variability may be greater if quality control is poor.

Table 1. Intra-microscopist (S_r=0.2) 95% confidence interval bracketing the consensus mean for various numbers (n) of fibers in a single count

Number (n) for fibers	**Lower confidence limit (LCL)**	**Upper confidence limit (UCL)**	**Expanded uncertainty (%)**
5	1.6	13	(−68;160)
7	2.6	16	(−63;129)
10	4.2	21	(−58;110)
20	10	37	(−50;85)
50	29	85	(−42;70)
100	62	163	(−38;63)
200	127	319	(−36;60)

NOTE: Also shown is the confidence interval expressed as expanded uncertainty asymmetric around n and stated relative to n.

UNCERTAINTY BUDGET EXCLUDING COUNTING ERRORS

Various factors aside from counting errors can introduce random variation in measured values of asbestos concentrations [35]. Such factors are identified in Table 2.

Table 2. Example of an uncertainty budget for non-counting variable

Variable	Estimated uncertainty	Uncertainty squared
Sampling flowrate	0.03	0.0008
Sampling time	0.02	0.0004
Master stage micrometer	0.01	0.0001
Calibration of submaster	0.01	0.0001
Calibration of graticule	0.02	0.0004
Area of exposed filter	0.05	0.0025
Sum of squares	-	0.0043
Square root of sum of squares = Overall uncertainty	-	0.066
Expanded uncertainty (coverage factor k = 2)	-	0.13 or 13 %

The uncertainty in Table 2 contributes in quadrature to the expanded uncertainty. Therefore, as 13% is small relative to the values in Table 1, it may be reasonable to conclude that the contribution of non-counting errors to the total uncertainties is not significant in comparison to the Poisson and subjective errors.

NOTE 1: Non-counting errors are negligible only if consistently controlled.

NOTE 2: Inhomogeneous deposition of dust on the filter leads to gross errors, the magnitude of which cannot be estimated. Counting 20 or more fields ensures that minor divergence from randomness does not bias the result.

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Table 3. CAS numbers for analytes

Name	CAS No.
Actinolite	[77536-66-4]
Ferroactinolite	[15669-07-5]
Amosite	[12172-73-5]
Anthophyllite	[77536-67-5]
Chrysotile	[12001-29-5]
Crocidolite	[12001-28-4]
Tremolite	[77536-68-6]
Amphibole asbestos	[1332-21-4]
Refractory ceramic fibers	[142844-00-6]
Fibrous glass	[14808-60-7]

APPENDIX A: CALIBRATION OF THE GRATICULE

Before ordering any graticule, the following calibration must be done to obtain a counting area (D) 100 µm in diameter at the image plane. The diameter, d_c (mm), of the circular counting area and the disc diameter must be specified when ordering the graticule.

1. Insert any available graticule into the eyepiece and focus so that the graticule lines are sharp and clear.
2. Set the appropriate inter-pupillary distance and, if applicable, reset the binocular head adjustment so that the magnification remains constant.
3. Install the 40x to 45x phase objective.
4. Place a stage micrometer on the microscope object stage and focus the microscope on the graduated lines.
5. Measure the magnified grid length of the graticule, L_o (µm), using the stage micrometer.
6. Remove the graticule from the microscope and measure its actual grid length, L_a (mm). This can best be accomplished by using a stage fitted with verniers.
7. Calculate the circle diameter, d_c (mm), for the Walton-Beckett graticule: $d_c = \frac{L_a}{L_o} \times D$

   EXAMPLE: if L_o = 112 µm, L_a = 4.5 mm, and D = 100 µm, then d_c = 4.02 mm.
8. Check the field diameter, *D* (acceptable range 100 µm ± 2 µm) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine field area (acceptable range 0.00754 mm^2 to 0.00817 mm^2).

APPENDIX B: DETERMINATION OF A MICROSCOPIST'S ABILITY TO OBSERVE, MEASURE AND COUNT FIBERS USING RELOCATABLE GRIDDED COVERSLIPS (Non-mandatory)

1. Reference slides are commercially available, made from chrysotile or amosite proficiency test filters obtained from the Industrial Hygiene Proficiency Analytical Testing (IHPAT) scheme of the American Industrial Hygiene Association Proficiency Analytical Testing, LLC [37]. Each slide has been mounted

with a permanent Euparal medium and covered with a relocatable gridded cover slip. The fibers visible in each grid opening have been identified and their locations marked on a drawing of each opening. The identity, number and position of each fiber have been verified by a second microscopist. The accuracy of this verification has been shown to be within 3% of consensus values determined by multiple microscopists, separately and together [38]. Such slides are referred to in this method as standard relocatable test slides, and they are applied in various ways to improve and assess the quality of fiber counts.

NOTE: It is also possible to make standard relocatable test slides in the laboratory from PAT or field samples by using commercially available relocatable gridded cover slips. Either filter clearance or slide mounting procedure can be used with these cover-slips, but the DMF/acetic acid-Euparal procedure has been demonstrated to provide slides with long-term stability. The fibers in each grid are identified, marked and verified by at least two microscopists as above.

2. Count the fibers in each designated field and refer the counts to the accompanying slide descriptions. Calculate a score from the number of absolute discrepancies between the reported and verified fibers in each field as shown in:

$$Score = (1 - \left(\frac{number\ of\ discrepancies}{number\ of\ verified\ fibers}\right)) \times 100$$

3. Microscopists shall obtain a discrepancy score of more than 70 for a slide containing amosite fibers and more than 50 for a slide containing chrysotile fibers from the AIHA IHPAT scheme (or more than 70 for a slide prepared from chrysotile field samples) before proceeding. These scoring criteria are based on the results that have been achieved in round-robin studies and proficiency test programs. If these scores are not achieved, the Quality Assurance Officer is expected to work with the microscopist to review the slide descriptions to determine the cause and then attempt to rectify the situation by having the microscopist repeat the microscope set-up or by re-training.

NOTE: The number of absolute discrepancies has been shown to be linearly related to the sum of counting errors [37]. The positive discrepancies are mainly due to sizing extra fibers (especially amphiboles). The negative discrepancies are mainly due to oversight of fibers (especially chrysotile). Chrysotile filters from the AIHA IHPAT program contain a large number of fibers with narrow widths near the limit of detection and thus provide a very robust test of visual acuity and concentration. In theory, it should be possible for microscopists to obtain high discrepancy scores using slides made from chrysotile PAT samples, but a discrepancy score above 50 is sufficient to ensure the microscopist will be able to see the majority of the wider fibers typical of field samples.

4. The repeated fiber counts obtained from standard relocatable test slides can be used to document the laboratory's precision for each microscopist, per step 13. If repeated counts from specific fields are used, the resulting intra- and inter-microscopist precision will be improved because there will not be a contribution from the selection of field areas to be counted.

APPENDIX C: COMPARISON OF COUNTING RULES

Figure 2 shows a Walton-Beckett graticule as seen through the microscope. This is a Type G22 graticule with 3:1 ratios, providing optimal assistance for these counting rules. The rules will be discussed as they apply to the labeled objects in the figure.

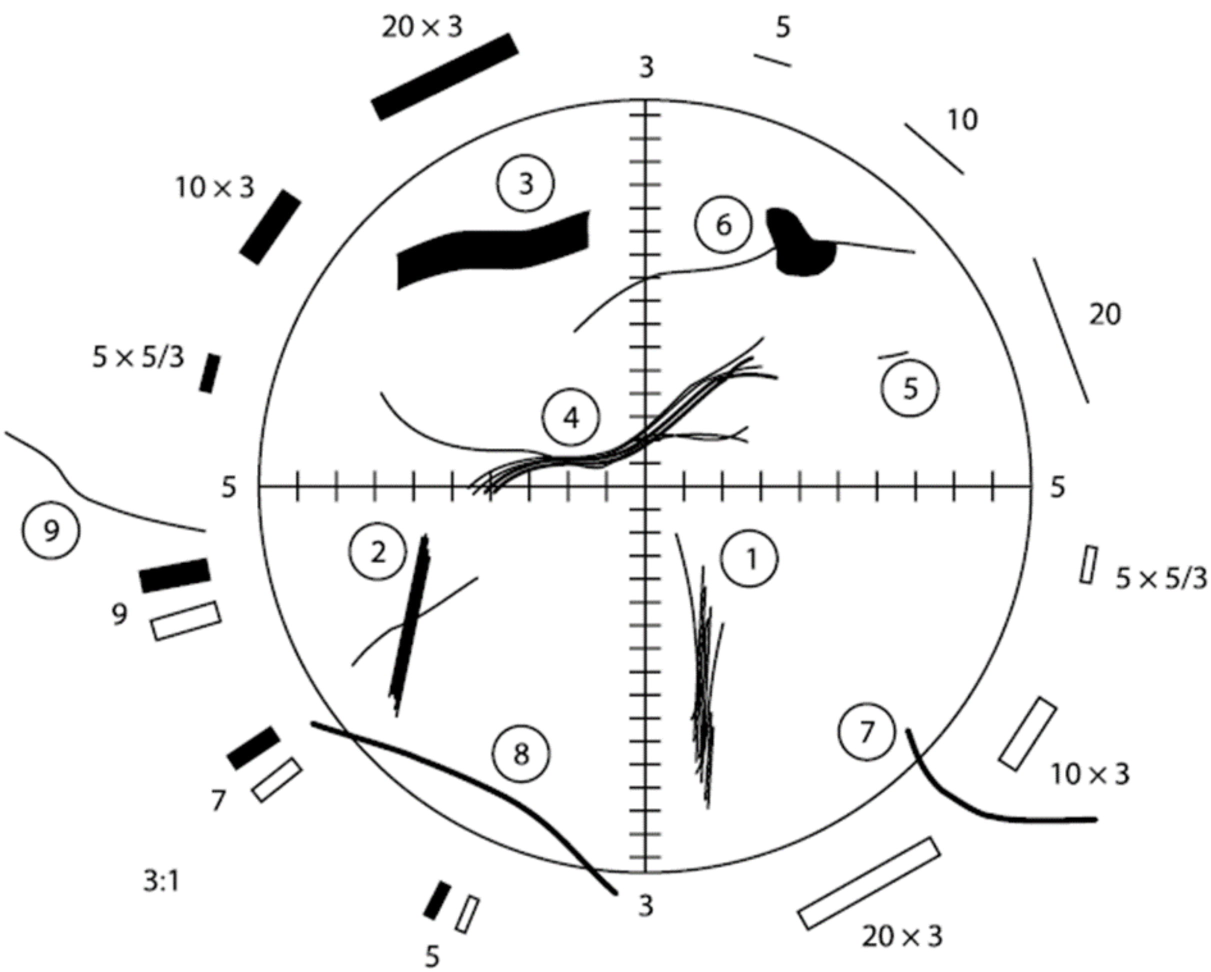

Figure 2 Walton-Beckett graticule with fibers

These rules are sometimes referred to as the "A" rules:

Object	Count	Discussion
1	1 fiber	Optically observable asbestos fibers are actually bundles of fine fibrils. If the fibrils seem to be from the same bundle, the object is counted as a single fiber. Note, however, that all objects meeting length and aspect ratio criteria are counted whether or not they appear to be asbestos.
2	2 fibers	If fibers meeting the length and aspect ratio criteria (length >5 µm and length-to-width ratio > 3 to 1) overlap, but do not seem to be part of the same bundle, they are counted as separate fibers.
3	1 fiber	Although the object has a relatively large diameter (>3 µm), it is counted as a fiber under the rules. There is no upper limit on the fiber diameter in the counting rules. Note that fiber width is measured at the widest compact section of the object.
4	1 fiber	Although long fine fibrils may extend from the body of a fiber, these fibrils are considered part of the fiber if they seem to have originally been part of the bundle.
5	Do not count	If the object is ≤ 5 µm long, it is not counted
6	1 fiber	A fiber partially obscured by a particle is counted as one fiber. If the fiber ends emanating from a particle do not seem to be from the same fiber and each end meets the length and aspect ratio criteria, they are counted as separate fibers.
7	½ fiber	A fiber which crosses into the graticule area one time is counted as ½ fiber.
8	Do not count	Ignore fibers that cross the graticule boundary more than once.
9	Do not count	Ignore fibers that lie outside the graticule boundary.

NOTE 1: OSHA Method ID-160 has slightly different counting rules, e.g. Rule 5: If the object is ≤ 5 µm, it is not counted, would become: If the object is < 5 µm, it is not counted. In practice, these minor differences would not likely modify calculated concentrations to the extent that decisions based on those concentrations would be affected, but this opinion has not been tested.

NOTE 2: Fibers wider than 3 µm are included in this method. Some other methods for counting asbestos fibers restrict the count to only those fibers of 3 µm width or less, as these are the fibers most likely to penetrate to the bronchial and lower airways. However, the inlet efficiency of the cowl has a similar effect in that it limits the maximum diameter of fibers entering the cassette, so the effect of this additional dimensional counting rule on the total fiber count is expected to be small. Any bias from not applying an upper width limit is also conservative (i.e. concentrations will be assessed higher).

APPENDIX D: ALTERNATE COUNTING RULES FOR NON-ASBESTOS FIBERS

Other counting rules may be more appropriate for measurement of specific non-asbestos fiber types, such as fibrous glass. These include the rules given below ("B" rules from NIOSH Method 7400, Revision #2, dated 08/15/1987), the World Health Organization reference method for man-made mineral fiber [39], and the NIOSH fibrous glass criteria document method [40]. The upper diameter limit in these methods prevents measurements of non-thoracic fibers. It is important to note that the aspect ratio limits included in these methods vary. Graticules designed for counting according to these rules are available (e.g. Walton-Beckett Type G24).

OSHA recommends using these alternate, or "B" counting rules as given below for all man-made vitreous fibers (MMVF). It is emphasized that hybridization of different sets of counting rules is not permitted. Report specifically which set of counting rules are used with the analytical results.

"B" Counting Rules

1. Count only *ends* of fibers. Each fiber must be longer than 5 µm and less than 3 µm diameter.
2. Count only ends of fibers with a length-to-width ratio equal to or greater than 5:1.
3. Count each fiber end which falls within the graticule area as one end, provided that the fiber meets rules 1 and 2 above. Add split ends to the count as appropriate if the split fiber segment also meets the criteria of rules 1 and 2 above.
4. Count visibly free ends which meet rules 1 and 2 above when the fiber appears to be attached to another particle, regardless of the size of the other particle. Count the end of a fiber obscured by another particle if the particle covering the fiber end is less than 3 µm in diameter.
5. Count free ends of fibers emanating from large clumps and bundles up to a maximum of 10 ends (5 fibers), provided that each segment meets rules 1 and 2 above.
6. Count enough graticule fields to yield 200 ends. Count a minimum of 20 graticule fields. Stop at 100 graticule fields, regardless of count.
7. Divide total end count by 2 to yield fiber count.

APPENDIX E: EQUIVALENT LIMITS OF DETECTION AND QUANTITATION

Fiber density on filter* (Fibers per 100 fields)	Fiber density on filter* (Fibers /mm²)	Fiber concentration in air, f/cc (400-L air sample)	Fiber concentration in air, f/cc (1000-L air sample)
200	255	0.25	0.10
100	127	0.125	0.05
LOQ 80	102	0.10	0.04
50	64	0.0625	0.025
25	32	0.03	0.0125
20	25	0.025	0.010
10	12.7	0.0125	0.005
8	10.2	0.010	0.004
LOD 5.5	7	0.00675	0.0027

*Assumes 385 mm² effective filter collection area, and field area = 0.00785 mm², for relatively "clean" (little particulate aside from fibers) filters

APPENDIX F: P&CAM 239 ASBESTOS FIBER IN AIR [17]

Analyte: Asbestos fibers

Matrix: Air

Procedure: Filter collection, microscopic count

Date Issued: 3/30/77

Method No.: P&CAM 239

Range: 0.1-60 fibers/cm³

Precision (CV_T): 0.24 to 0.38

Classification: D (Operational)

1. **Principle of the Method**
    1.1. This method describes the equipment and procedures for collecting, mounting, and counting asbestos fibers on cellulose ester membrane filters in the evaluation of personal samples of airborne asbestos fibers. The purpose of the method is to determine an employee's index of exposure to airborne asbestos fibers. The method is primarily a personal monitoring technique, but can be used for area monitoring.
    1.2. The sample is collected by drawing air through a membrane filter by means of a battery powered personal sampling pump. The filter is transformed from an opaque solid membrane to a transparent optically homogeneous gel. The fibers are sized and counted using a phase-contrast microscope at 400-450X magnification.
    1.3. Definitions. Asbestos fiber, for counting purposes, means a particulate which has a physical dimension longer than 5 micrometers and with a length to diameter ratio of 3 to 1 or greater. Asbestos includes chrysotile, cummingtonite-grunerite (amosite), crocidolite, fibrous tremolite, fibrous anthophyllite, and fibrous actinolite.
    1.4. Any laboratory attempting to use this procedure should have at least one counter attend a training course conducted by an experienced, proficient laboratory. Novice, untutored counters, using only published instructions, can easily obtain counts of half those performed by experienced, proficient counters. Large differences between laboratories can be caused by: 1) differences in technique and observing ability among counters and 2) small, but significant, differences between microscopes meeting the basic specifications of Section 6.2. The following procedures are recommended:

1.4.1. All microscopists who perform asbestos counting should meet together for an "asbestos counting workshop" at least quarterly.· This is best accomplished with counters from several laboratories using their own microscopes.

1.4.2. Each microscopist should count the same series of slides and with the results being compared.

1.4.3. Differences between counters should be resolved with side-by-side counting of the fields by the different counters.

1.4.4. Individuals who are found to be persistent outliers over several sessions should be encouraged to seek other tasks in their respective laboratories.

2. **Range and Sensitivity**

2.1. The usable range is primarily a function of sample volume, microscope count field area, and background airborne particulates. The influence of these variables is discussed in 8.1.3. For a microscope count field area of 0.003 mm^2 (see Figure 1) and a pump flow rate of 1.7 lpm, the optimal fiber densities would be produced over the range of 0.4 fiber/cm^3 (8-hour sample) to about 60 fibers/cm^3 (15-minute sample). For a field area of 0.006 mm^2 (see Figure 2) and a pump flow rate of 1.7 lpm, the optimal range is 0.2 fiber/cm^3 (8-hour sample) to about 30 fibers/cm^3 (15-minute sample). In each case, the optimal detection limits are inversely proportional to pump flow rate. The upper detection limit can be extended by using sample times less than 15 minutes or using lower flow rates. The lower detection limit can be extended by increasing the flow rate up to about 2.5 lpm. Filter surface fiber densities less than optimal (less than about 0.5 to 1.0 fiber per count field) are still adequate, but will lead to decreased precision for the method (increased coefficient of variation, see Section 4). The minimum total fiber count in 100 fields considered adequate for reliable quantitation is 10 fibers. Thus, the lower limit of reliable quantitation is 0.1 fiber/cm^3 (100,000 fibers/m^3). For this level, a flow rate of about 2.5 lpm is recommended. For a field area of 0.003 mm^2 , the minimum sample time would be about 2 hours. For a field area of 0.006 mm^2, the minimum sample time would be about 1 hour.

2.2. This method considers only fibers with a length to diameter ratio of 3 to 1 or greater and a length greater than 5 micrometers.

3. **Interferences**

In an atmosphere known to contain asbestos, all particulates with a length to diameter ratio of 3 to 1 or greater, and a length greater than 5 micrometers should, in the absence of other information, be considered to be asbestos fibers and counted as such.

4. **Precision and Accuracy**

4.1. In the past decade, there have appeared a number of articles examining sources of variation in the asbestos sampling and counting procedure. These include: Lynch et al. (11.1), Weidner and Ayer (11.2), Conway and Holland (11.3), Leidel and Busch (11.4), Beckett and Attfield (11.5), and Rajhans and Bragg (11.6). The sources of variation will be discussed by stages in the membrane filter evaluation procedure.

4.2. **Sources of Variation in the Sampling Process.** These include variations in pump flow rate, proximity of the filter to the employee's body, and filter location (left to right) in the employee's breathing zone.

4.2.1. Section 9.1 requires that the personal sampling pump be calibrated with sufficient accuracy such that the 95% confidence limits on the flow rate are ±10%. This is equivalent to a coefficient of variation (CV) of about 5%. However, this CV makes a negligible contribution to the total CV for the method due to the relatively large CV of the counting procedure.

4.2.2. Conway and Holland (11.3) concluded that positioning of the filter cassette on the wearer (regarding the angular portions of the filter and their proximity to the wearer) is not a significant factor in determining the fiber distribution on filters.

4.2.3. Weidner and Ayer (11.2) concluded that there is no appreciable difference between samples collected on either the right or left sides of a breathing zone or between samples collected side-by-side, especially for samples with concentrations less than 2.5 fibers/cm^3.

4.3. **Sources of Variation in the Counting Procedure**

4.3.1. Random variations exist in the fiber distribution on a filter wedge (intra-wedge variability). The industrial hygiene literature has seen considerable debate in the last 20 years concerning whether or not the distribution of mineral dust or asbestos fibers on a filter surface is adequately described by a Poisson distribution probability density function. Leidel and Busch (11.4) found excellent agreement between empirical error variance and theoretical variance calculated from the assumption of Poisson distributed true counts. They concluded that there was not excessive variation among count fields for a filter wedge and that clumping of fibers (non-random coalescence) did not occur.

4.3.2. Variations exist in the fiber distribution on the total filter surface (inter-wedge variability) due to the random or non-random distribution of fibers across the total surface of the filter. This type of variation is easily confused with intra-wedge variations. The count procedure does not require counting of multiple sectors of the filter. There may be significant differences between average counts for different wedges, or the fiber distribution variations for the total filter surface may be greater than the variations of the Poisson distribution. If either of these occur experimentally, one must use the experimental variations to estimate the minimum precision of the count procedure. The minimum precision is governed by the variations of the fiber distribution on the total surface of the filter.

Conway and Holhind (11.3) concluded the distribution of fibers on filters is not uniform and, the distribution of fiber counts is more disperse than Poisson. For their filters which had significant variations in fiber concentrations between sectors (as much as 50-60% of the total filter mean), they described the following relation for the standard deviation of the total number of fibers counted on a wedge (N)

$$empirical\ s(N) = 1.6(N)^{1/2}$$

where N is about 100. The Poisson standard deviation would be:

$$Poisson\ \sigma\ (N) = (N)^{1/2}$$

Rajhans and Bragg (11.6) in Series I of their study found significant variation between filter segments and rejected the Poisson distribution for the total filter surface. However, in Series II of their study, utilizing various experimental modifications, they found no significant variation between filter segments and no reason to reject the assumption of Poisson distributed fiber counts.

4.3.3. Systematic variations due to differences between microscopes were studied by Leidel and Busch (11.4). In their study using five different brands of microscopes, they found no significant differences among four, but the fifth gave counts approximately 45% higher on the average than the other four.

4.3.4. Variations due to differences between counters should be examined at three levels: experienced counters occasionally counting, experienced counters routinely counting, and inexperienced (new or untutored) counters. Leidel and Busch (11.4) studied five experienced counters, with one counting only occasionally. There were no significant differences among three of the counters, but a fourth was 16% lower than the first three. The fifth, who occasionally counted, averaged 27% higher than the first three. Conway and Holland (11.3) studied three experienced counters and three inexperienced counters. They found statistically significant differences between the means of both the experienced and inexperienced counters that typically were in the range plus or minus 5 to 15%. They concluded that experience as a fiber counter is not a significant parameter affecting intercounter variations.

Rajhans and Bragg (11.6) found no significant differences among means of five experienced counters in Series I of their study. But in their carefully controlled Series II, an analysis of variance showed significant variations between counters that were plus or minus 1 to 15%.

4.3.5. Variations between laboratories are most likely due to systematic biases and are not a significant additional source of random variations. Any additional variations are most likely due to differences in counting technique. Beckett and Attfield (11.5) observed that standard counters improved greatly after personal instruction; also new counters, after instruction, tended to overcompensate and get exceedingly high counts. Additionally, they found that counts from an experienced laboratory that had not had contact with other laboratories performing the same analysis were as far from the standard values as were the counts by new counters.

4.4. Sources of variations between samples taken at different times on one employee during one work shift can affect the exposure estimate for that employee. These are primarily due to a) differences in exposure concentrations during the day, b) differences in location of the employee within the plant, and c) differences in work operation performed by the employee during the day. These sources of variation can be controlled by proper choice of sampling strategy. Refer to Leidel and Busch (11.7) and Leidel, Busch, and Lynch (11.8) for an extended discussion of sampling strategies. Interday temporal variations can affect the exposure estimates obtained on different days. Refer to Leidel, Busch, and Crouse (11.9) for a discussion of this type of variation.

4.5. Until recently, the total coefficient of variation (CV_T) for the sampling and counting procedure was best estimated from the work of Conway and Holland (11.3). The conclusions of their study included:

4.5.1. The precision of their procedure for filters not containing an abundance of fine fibers can be estimated by a coefficient of variation of 16.2%. This value includes variation among counters and observed interaction effects.

4.5.2. The accuracy of the procedure for similar filters may be estimated for a 100-fiber count by a coefficient of variation of 21.4%. This assumes that the contribution of the overall variance from the nonuniform fiber distribution is additive.

4.5.3. A high percentage of very fine fibers on the filter can significantly affect the standard deviation and confidence limits for counts by different counters. After combining variations in fiber concentrations over the entire filter with those for different counters, it was concluded:

1. For filters with a low concentration of fine fibers, the coefficient of variation is estimated at 21% and the 95% confidence interval is ±43%.
2. For filters with a high concentration of fine fibers, the coefficient of variation is estimated at 25% and the 95% confidence interval is ±50%.

Lynch, Kronoveter, and Leidel (11.1) have also reported on variations of the method. Their intralaboratory study utilized the data from a large number of dust counts made by different methods by experienced counters over a period of years in an epidemiologic study of the asbestos products industry. They concluded that the standard deviation of counts of fibers longer than 5 micrometers on membrane filters could be estimated from the relation $\sigma=(N)^{0.591}$. Thus for counts of about 100 fibers, the coefficient of variation could be estimated at about 15.2% and the 95% confidence limits at ±30.4%.

These values are lower than the values reported by Conway and Holland (11.3). Recently, the Johns-Manville Corporation conducted an in-house investigation of the asbestos count method. (11.10). The study data contained total fiber counts for over 100 filters with each filter counted by two to five counters. From the Johns-Manville data, NIOSH calculated over 100 estimates of the count CV for the method (11.11). The NIOSH CV estimates included random intrafilter variations and intercounter variations, but did not include random pump flow rate variations. It was found that the count coefficient of variation (all random variations except for pump variations) was a function of the total fiber count. NIOSH then included a CV of 0.05 for random pump variations (see Section 9.1) in the CV-estimator equation to obtain a CV_T-estimator. The CV_T-estimator line is plotted on Figure 3 for total fiber counts in the range 10 to 100 fibers. Or the following equation can be used: $CV_T=[antilog_{10}(-0.215-0.203(log_{10}FB))+0.0025]^2$

where FB is total fiber count as discussed in Section 10.

Figure 3 demonstrates that for a total fiber count of 100, the best CV_T is attainable with the appropriate sampling times given in 8.1.3 and the count rules in 8.3.9. When making decisions regarding compliance with the OSHA asbestos exposure standards in 29 CFR 1910.1001, the statistical procedures given in Leidel et al. (11.11) should be followed. The procedures are based on statistical theory and assumptions given in References 11.12, 11.13.

Because of the possibility of systematic biases due to differences between microscopes, counters, and laboratories as discussed above, it is strongly recommended that any laboratory counting asbestos should participate in an interlaboratory quality control program that includes the counting of standard reference filters. These standard filters are available from NIOSH through the Proficiency Analytical Testing (PAT) Program. The PAT Program is used by the American Industrial Hygiene Association (AIHA) as part of its Laboratory Accreditation Program. Each laboratory's quality control program must include protocols for routinely adjusting, and calibrating sampling and counting equipment plus training and evaluation programs for counters.

5. **Advantages and Disadvantages of the Method**
   - 5.1. The method is intended to give an index of employee exposure to airborne asbestos fibers of specified dimensional characteristics.
   - 5.2. It is not meant to count all asbestos fibers in all size ranges or to differentiate asbestos from other fibrous particulates.

6. **Apparatus**
   - 6.1. Sampling Equipment

     The personal sampling equipment train consists of 1) personal sampling pump, 2) tubing, 3) clothing spring clip, 4) tubing-to-field monitor metal adaptor, and 5) field monitor (filter and holder).
     - 6.1.1. Personal Sampling Pump. The pump must be capable of sampling at 1.0 to 2.5 liters per minute (lpm) against a flow resistance of 7.5 inches of water (1.4 mm Hg) for 8 continuous hours on a fully charged battery.
     - 6.1.2. Tubing. Laboratory tubing such as rubber or plastic with 6-mm bore and about 100 cm length.
     - 6.1.3. Clothing Spring Clip. The clip attaches the rubber tubing to the lapel or shirt of the individual being monitored.
     - 6.1.4. Tubing-to-field Monitor Adaptor. A short metal adaptor with ridges on one end to grip the inside of the tubing. The other end is designed for a pressure fit into the field monitor.
     - 6.1.5. Field Monitor (Filter and Holder). The only field monitor currently considered acceptable by NIOSH is manufactured by the Millipore Corporation. The unit consists of 1) a three section styrene plastic case designated Millipore Aerosol Monitor Case, 2) a 37-mm diameter plain white cellulose ester membrane filter designated Millipore AA (pore size of 0.8 micrometer), 3) a support pad, and 4) two plastic sealing caps. If a large number of samples are to be taken, it may be less expensive to reuse the plastic cases. Great care must be taken in the cleaning and reassembly process. The outside mating surfaces of the field monitors may be covered with a "shrink-fit" band to provide proper sealing and a writing surface for filter identification.
   - 6.2. **Optical Equipment and Microscope Features**
     - 6.2.1. Microscope body with binocular head.
     - 6.2.2. 10X Huygenian eyepieces are recommended. Other eyepieces can be substituted if necessary. Wide field eyepieces can be used; however, wide field eyepieces may yield a count field area less than 0.003 mm^2 with the Porton reticle. This is not always desirable from the standpoint of obtaining optimum sampling times (see Section 8.1.3). If wide field eyepieces are used, it is preferable to use the Patterson Globe and Circle reticle to obtain a larger count field area.
     - 6.2.3. Koehler illumination (preferably built- in with provisions for adjusting light intensity).
     - 6.2.4. A Porton reticle is recommended. Others such as the Patterson Globe and Circle can be substituted.
     - 6.2.5. Mechanical stage.

6.2.6. Phase-Contrast condenser with a numerical aperture (N.A.) equal to or greater than the N.A. of the objective.
6.2.7. 40-45X phase contrast achromatic objective (N.A. 0.65 to 0.75).
6.2.8. Phase-ring centering telescope or Bertrand lens.
6.2.9. Green or blue filter, if recommended by microscope manufacturer.
6.2.10. Stage micrometer with 0.01 mm subdivisions.
6.2.11. For general guidance on phase contrast microscopy, consult Needham (11.12), Clark (11.15) and McCrone (11.14).

6.3. **Filter Mounting Equipment.** Experience has shown that certain equipment is useful for efficient sample mounting. The following items are recommended for extracting and mounting a portion of the filter for counting.

6.3.1. Microscope slides. 2.5 by 7.5 cm glass slides are most commonly used. Sample number, data, initials, etc., can be conveniently written on a frosted end slide.
6.3.2. Cover Slips. Cover slips are a necessary part of the slide mount and optical system. The shape should be appropriate for the size of the filter wedge. The appropriate cover slip depends upon the objective to be used. Ordinarily, objectives are optically corrected for a #1½ (0.17 millimeter) thickness cover slip. Improper cover glass thickness will detract from the final image quality.
6.3.3. Scalpel. A scalpel is needed to cut out a portion of the filter to be examined. A number-ten curved blade scalpel is recommended.
6.3.4. Tweezers. A pair of fine-tipped tweezers is used to remove the membrane filter slice from the field monitor and place it upon the slide.
6.3.5. Lens Tissue. To insure cleanliness, a lint-free tissue is recommended. This tissue should also be used for wiping mounting tools and for cleaning slides and cover slips.
6.3.6. Glass Rod. A fire-polished glass rod may be used to spread the mounting solution on the slide.
6.3.7. Wheaton Balsam Bottle. This special glass container has a glass top which prevents contamination of the mounting solution. A glass rod is included for dispensing the solution.

7. Reagents

Chemicals should be reagent grade, free from particles and color, conforming to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.

7.1. Dimethyl phthalate
7.2. Diethyl oxalate

Avoid getting the mounting solution on the skin. Wash skin promptly with soap and water if skin contact occurs.

8. Procedure

8.1. Sampling

8.1.1. General Information

Guidelines for the monitoring of employee exposures to industrial atmospheres are given in Reference 11.8. The Federal requirements for monitoring employee exposure to airborne asbestos are found in 29 CFR 1910.1001.

8.1.2. Mounting the Sampling Pump on the Worker

Fasten the sampling pump to the worker's belt and fasten the field monitor to the lapel or .shirt front (as close to the breathing zone as is practical). Remove the top cover of the plastic monitor, then invert the monitor making certain the exposed filter is facing downward. Turn the pump on and adjust to the calibrated flow rate (1.0 to 2.5 lpm). Record the following information in a logbook.

1. Filter number
2. Pump start time and date
3. Flow rate
4. Subject's name and job title

5. Type of operation or process
6. Ventilation controls and is the worker wearing a respirator approved for asbestos?

The pump should be checked periodically during the sampling period for proper operation and flow rate.

8.1.3. Optimum Sampling Times

The requirement for the minimum count of 100 fibers or 20 fields in 8. 3. 9 was determined to be the best compromise to achieve adequate precision for the airborne fiber estimate and reasonable counting times. An optimum fiber density of about 1 to 5 fibers per microscope count field is recommended. To estimate appropriate sampling times for feasible counting and optimal counting, one must consider the following constraints:

1. microscope count field area (generally 0.003 to 0.006 mm^2)
2. pump flow rate (typically 2.5 lpm maximum)
3. average airborne fiber concentrations
4. counting rule range of 20 to 100 fields
5. adequate fiber density to obtain a minimum count of 10 fibers in 100 fields, which is the least total fiber count that yields an acceptable count precision
6. background airborne particulate levels that can reduce the count precision due to an obscuring of fibers on the filter surface

The preceding constraints were considered in drawing Figures 1 and 2. These figures were developed from the following relationship:

$$sampling\ time = \frac{\left(\frac{FB}{FL}\right)\left(\frac{ECA}{MFA}\right)}{(FR)(AC)(1000)} minutes$$

where:

FB/FL = 1 to 5 fibers/field
ECA = effective collecting area of filters (855 mm^2 for 37-mm fiilter with effective diameter of 33 mm)
MFA = microscope field area (generally 0.003 to 0.006 mm^2)
FR = Pump flow rate (generally 1.0 to 2.5 lpm)
AC = Air concentration of fibers in fibers/cm^3 .

Figure 1 (microscope field area = 0.003 mm^2) and Figure 2 (microscope field area = 0.006 mm^2) show optimum and feasible sampling times for a pump flow rate of 1.7 lpm. Each individual responsible for sampling asbestos should prepare a similar chart for his particular pump flow rate and microscope field area before sampling is performed to aid in estimating proper sampling times. On Figures 1 and 2, the areas with solid shading lines are generally the optimum conditions for counting. The broken shading lines are for conditions very close to optimal.

However, feasible counting conditions may extend down to about 0.1 fiber/field and above 5 fibers/field. Recommended sampling times are most strongly influenced by background airborne particulate levels, once all the other constraints have been estimated. For heavy particulate levels, it may be necessary to limit each filter to about 60 to 180 minutes sampling duration. Each individual responsible for sampling should work closely with the microscopist to attain as high as possible filter surface fiber densities (up to about 5 fibers/field), while avoiding filter surface background particulate levels that create very difficult or impossible counting conditions. If one has very little idea of airborne fiber and particulate levels, the best procedure is to take several long samples (as. one 8-hour or two consecutive 4-hour samples) in conjunction with several short samples (as four consecutive 2-hour or eight consecutive 1-hour samples). If the longer samples prove very difficult to count, the microscopist will have the shorter samples to fall back on.

From Figures 1 and 2, it can be seen that there are certain sampling times which will yield optimum fiber densities on the filter for almost all airborne fiber concentrations from 1 to 10 fibers/cm^3. These optimum times have been calculated and are presented in Figure 4. Note that the optimum times given by Figure 4 are approximate and can be varied by as much as ±25%. The nomogram is intended as a guide to be used where no prior knowledge of the air concentration is available.

8.1.4. End of Sampling Period

Remove the field monitor, replace the plastic top cover and the small end caps, and store the monitor. Always shut off the pump when changing monitors to avoid contaminating or damaging the pump. Record the pump shutoff time and flow rate in the logbook.

8.1.5. Blanks

With each batch (25 to 50 filters) of samples sent for analysis, submit two unopened field monitors which have been subjected to the same treatment as the samples except that they were not exposed to the sampling environment. Label these as blanks. If the blanks yield fiber counts greater than 5 fibers/ 100 fields, then the entire sampling procedure should be examined carefully for the cause of contamination. The mounting solution of Section 8.2.1 should also be examined for contamination and/or crystal growth.

8.1.6. Shipping

The field monitors in which the samples are collected should be shipped in a rigid container with sufficient packing material to prevent crushing.

8.1.7. Numbers of Samples

When sampling for the Federal ceiling standard of 10 fibers (>5 µm)/cm^3, [29 CFR 1910-.1001(b)(3), effective July 7, 1972], only one sample (15 minutes maximum duration) is necessary, theoretically. However, several samples should be taken during expected periods of peak air concentrations to allow for detection of gross sampling or counting errors.

When sampling for determination of noncompliance with the Federal 8-hour TWA standard of 2 fibers (>5 µm)/cm^3, [29 CFR 1910.100l(b) (2)], one should continuously sample as large a portion of the work day as is feasible for airborne concentrations of about 2 to 10 fibers/cm^3. However, for a lower airborne concentration such as 0.5 fiber/cm^3, one sample might require 4 to 8 hours sampling time in order to get the proper filter fiber density (Section 8.1.3). For this situation, the 8-hour TWA exposure would be determined from one 8-hour or two 4-hour samples as appropriate.

8.2. Sample Preparation

8.2.1. Preparation of Mounting Solution

A very important part of the sample evaluation is the mounting process. This process involves a special mounting medium of prescribed viscosity. The proper viscosity is important in order to expedite filter dissolving and still minimize particle migration. After the sample has been mounted, an elapsed time of approximately sixty minutes is needed before the sample is ready for evaluation.

Combine the dimethyl phthalate and diethyl oxalate in a one to one ratio by volume and pour into a Wheaton balsam bottle. Add approximately 0.05 (±0.005) grams of new membrane filter per milliliter of solution to reach the necessary viscosity. The mixture must be stirred periodically until the-filters have dissolved and a homogeneous mixture is formed. The normal shelf life of the mounting solution is about three months. Twenty milliliters of mounting solution will prepare approximately 300 samples.

8.2.2. Sample Mounting

Cleanliness is important! A dirty working area may result in sample contamination and erroneous counts. The following steps should be followed when mounting a sample.

1. Clean the slides and cover slips with lens tissue. Lay each slide down on a clean surface with the frosted end up. It is a good practice to rest one edge of the cover slip on the slide and the other edge on the working surface. By doing this, you keep the bottom surface (the one which contacts the filter) from becoming contaminated.
2. Wipe all the mounting tools clean with lens tissue and place them on a clean surface (such as lens tissue). All tools should be wiped clean prior to mounting each sample.

3. Using the glass rod supplied with the Wheaton balsam bottle, apply a drop of mounting solution onto the center of the slide. It may be necessary to adjust the quantity of solution so that after the cover slip has been placed on top, the solution extends only slightly beyond the filter boundary. If the quantity is greater than this, particle migration may occur.
4. Using another glass rod, spread the mounting media into a triangular shape. The size of this triangle should coincide with the dimension of the filter wedge.
5. Separate the middle and bottom sections of the field monitor case to expose the filter. Cut a triangular wedge from the center to the edge of the filter using .the scalpel. The size of the wedge should approximate one-eighth of the filter surface. The filter can be very carefully removed from the cassette for cutting, but this should only be done with great care.
6. Grasp the filter wedge with the tweezers on the perimeter of the filter which was clamped between the monitor case sections. Do not touch the filter with your fingers. Place the wedge, **sample side up**, upon the mounting medium.
7. Pick up a clean cover slip with tweezers and carefully place it on the filter wedge. Once this contact has been made, **do not reposition the cover slip**.
8. Label the slide with the sample number and current date before proceeding to the next filter: On the bottom (backside) of the slide, trace the perimeter of the filter wedge with a felt tip marking pen. This will ·enable the counter, after the filter has become transparent, to stay within the filter perimeter when counting.
9. The sample should become transparent within fifteen minutes. If the filter appears cloudy, it may be necessary to press very lightly on the cover slip. This is rarely necessary; however, counting should not be started until an hour after the mounting. This allows the microscopic texture of the filter to become invisible to microscope viewing.
10. Discard the sample mount after two days if it has not been counted. Crystals appearing similar to asbestos fibers may begin to grow at the mounting media/air interfaces. They seldom present any problems if the slide is examined before two days. In any case, stay away from the filter's edges when counting and sizing.

8.3. Counting of Fibers

8.3.1. Place the slide on the mechanical stage of the microscope and position the center of the wedge under the objective lens and focus upon the sample. Start counting from one end of the wedge and progress along a radial line to the other end (count in either direction from perimeter to wedge tip). Random fields are selected, without looking into the eyepieces, by slightly advancing· the slide in one direction with the mechanical stage control.

8.3.2. It is essential to continually scan over a range of focal planes (generally the upper 10 to 15 micrometers of the filter surface) with the fine focus control during each field count. This is especially necessary for asbestos fibers due to their impaction into the filter matrix.

8.3.3. On most airborne samples, asbestos fibers will generally have fiber diameters less than one micrometer. Therefore, it is necessary to look carefully for faint fiber images.

8.3.4. Regularly check phase ring alignment.

8.3.5. When an agglomerate (mass of material) covers a significant portion of the field of view (approx 1/6 or greater)--reject the field and select another. (Do not include it in the number of fields counted.) However, report the fact as it may have meaning on other data collection.

8.3.6. Bundles of fibers are counted as one fiber unless both ends of the fiber can be clearly resolved.

8.3.7. Count only fibers with a length to width ratio greater than or equal to 3:1.

8.3.8. Count only fibers greater than 5 micrometers in length. (Be as accurate as possible in accepting fibers near this length.) Measure curved fibers along the curve to estimate the total length.

8.3.9. Count as many fields as necessary to yield a total count of at least 100 fibers. Exceptions: a) count at least 20 fields even if you count more than 100 fibers, and b) stop at 100 fields even if you haven't reached 100 fibers.

8.3.10. For fibers that cross either one or two sides of the counting field, the following procedure is used to obtain a representative count.
COUNT any fiber greater than 5 micrometers in length that lies entirely within the counting area. COUNT as "1/2 fiber" any fiber with only one end lying within the counting area. DO NOT COUNT any fiber crossing any two sides.
Reject and do not count all other fibers. Refer to Figures 5 through 10. Note that the fibers in Figures 5 through 10 **are not representative** of the appearance of most asbestos fibers. Most fibers have a very faint image.

9. **Calibration and Standards**

9.1. **Sampling Train Calibration**

The accurate calibration of the sampling pump is essential to the correct calculation of the air volume sampled. The frequency of calibration is dependent on the use, care, and handling to which the pump is subjected. Pumps must be recalibrated if they have just been repaired, misused, or received from the manufacturer. If the pump receives hard usage, more frequent calibration may be necessary. Ordinarily, pumps should be calibrated in the laboratory both before they are used in the field and after they have been used to collect a large number of field samples.

The accuracy of calibration is dependent upon the type of instrument used as a reference. The choice of a calibration instrument will depend largely on where the calibration is performed. For laboratory testing, a 1-liter buret used as a soap bubble flow meter or wet-test meter is recommended. Other standard calibrating instruments, such as a spirometer, Marriott's bottle, or dry gas meter can be used. The calibration should be of sufficient precision that the 95% confidence limits on the flow rate are ±10% (95% of the flow rates will fall within ±10% of the calibrated value). Instructions for calibration with the soap bubble flow meter follow. The sampling train used (pump, hose, filter cassette) in the pump calibration should be the same as the one used in the field.

9.1.1. Check the voltage of the pump battery with a voltmeter both with the pump off and while it is operating to assure adequate voltage for calibration. If necessary, charge the battery to manufacturer's specifications.

9.1.2. Fill a beaker with 10 ml of soap solution.

9.1.3. Connect the filter cassette inlet to the top of the buret with a length of hose.

9.1.4. Turn the pump on and moisten the inside of the soap bubble meter by immersing the open end of the buret into the soap solution and drawing bubbles up the inside of the buret. Perform this task until the bubbles are able to travel the entire length of the buret without breaking.

9.1.5. Adjust the pump rotameter to provide a flow between 1.5 to 2.5 lpm.

9.1.6. With a water manometer, check that the pressure drop across the filter is less than 13 inches of water (about 1 inch of mercury).

9.1.7. Start a soap bubble up the buret and measure the time it takes for the bubble to travel a minimum volume of 1 liter.

9.1.8. Repeat the procedure in 9 .1. 7 at least three times, average the results, and calculate the calibrated flowrate by dividing the volume traveled by the soap bubble by the elapsed time. If the range between the highest and lowest of the three flow rates is greater than about 0.33 lpm, then the calibration should be repeated since it is likely that the precision is not adequate.

9.1.9. Data required for the calibration include the volume measured, elapsed time, pressure drop, air temperature, atmospheric pressure (or elevation), pump serial number, date, and name of person performing the calibration.

9.1.10. Corrections to the flow rate for pumps with rotameters may be necessary if the pressure (elevation) or temperature where the samples are collected (actual flow rate) differs significantly from that where the calibration was performed (indicated flow rate). Actual flow rates at time of sampling may be calculated for a linear scale rotameter by using the following correction formula:

$$Q_{actual} = Q_{indicated}\sqrt{\left(\frac{P_{cal}}{P_{actual}}\right) * \left(\frac{T_{actual}}{T_{cal}}\right)}$$

where both pressure (P) and temperature (T) are in absolute units such as:

psia = psig + 14.7
deg Rankin = deg Fahrenheit + 460
deg Kelvin = deg Celsius + 273

9.2. Microscope Setup

9.2.1. Porton Reticle and the Counting Field

The asbestos fiber count procedure consists of comparing fiber length to the diameters of calibrated circles of a Porton reticle, and counting all fibers greater than 5 micrometers in length lying within a given counting field area. The Porton reticle is a glass plate inscribed with a series of circles and rectangles. The left half of the reticle is divided into six rectangles constituting the counting field. The counting field is illustrated in Figures 5 through 10.

9.2.2. Placement in Eyepiece

The Porton reticle is placed inside the Huygenian eyepiece where it rests on the field limiting diaphragm. If other types of eyepieces are used, it may be necessary to insert a counting collar for retaining the reticle. The reticle should always be kept clean, since dirt on the reticle is in focus and could complicate the counting and sizing process.

9.2.3. Stage Micrometer

The Porton reticle cannot be used for counting until it has been properly calibrated with a stage micrometer. Most stage micrometer scales are approximately two millimeters long and are divided into units of one-hundredth of a millimeter (ten micrometers).

9.2.4. Microscope Adjustment

When adjusting the microscope, follow the manufacturer's instructions while observing the following guidelines.

1. The light source image must be in focus and centered on the condenser iris or annular diaphragm.
2. The particulate material to be examined must be in focus.
3. The illuminator field iris must be in focus, centered on the sample, and opened only to the point where the field of view is illuminated.
4. The phase rings (annular diaphragm and phase-shifting elements) must be concentric.

9.2.5. Porton Reticle Calibration Procedure

Each eyepiece-objective-reticle combination on the microscope must be calibrated. Should any of the three be changed (disassembly, replacement, zoom adjustment, etc.), the combination must be recalibrated. Calibration may change if interpupillary distance is changed. For proper calibration, the following procedure should be followed closely.

With a 10X objective in place, place the stage micrometer on the mechanical stage, focus the millimeter scale, and center the image. Change to the 40-45X objective and adjust the first millimeter scale division to coincide with the left boundary of the Porton rectangle. Measure the distance between the left and extreme right boundaries of the Porton rectangle, estimating any portion of the final division. This measurement represents 200 L units. The rectangle is 100 L units on the short vertical dimension. The calculated "L" is inserted into the formula $D = L(2^N)^{1/2}$ where "N" is the circle number (indicated on the reticle) and "D" is the circle diameter. Since the circle diameters vary logarithmically, every other circle doubles in diameter. For example, circle number three is twice the diameter of number one; number four is twice the diameter of number two. When the circle sizes have been determined, the counting field area which consists of the left six smaller rectangles can be calculated from the relation 10,000 L^2. This completes the reticle calibration for this specific objective-eyepiece-reticle combination.

Example for Porton Reticle

The following calibration was obtained for a pair of 10X Huygenian eyepieces and a 43X objective:

200 L = 0.148 mm = 148 micrometers
100 L = 0.074 mm = 74 micrometers
One L-unit = 0.74 micrometers

Thus Circle #1 has a diameter $D = L(2^N)^{1/2} = 0.74(2^1)^{1/2} = 0.74\ (1.414) = 1.05$ micrometers.

Then our circle diameter calibration table looks like:

Diameter of Circle #1 = 1.05 micrometers
#2 = 1.48
#3 = 2.09
#4 = 2.96
#5 = 4.19
#6 = 5.92

Field area = (10,000) (L^2) = (100 L) (100 L) = (0.074) (0.074) = 0.0055 mm^2

Thus fibers with a length greater than a distance halfway between the diameters of the #5 and #6 circles would be counted.

If a Patterson Globe and Circle reticle is used, a different calculation procedure is required. The circle diameters are related as follows. The #25 circle diameter is (0.1) (reticle length).

The circle diameters are proportional to the ratio of their numbers. Thus the #20 circle diameter is (20/25) or 0.8 times the #25 circle diameter.

10. **Calculations**

10.1. The average airborne asbestos fiber concentration estimated by the filter sample may be calculated from the following formula:

$$AC = \frac{\left(\left(\frac{FB}{FL}\right) - \left(\frac{BFB}{BFL}\right)\right)(ECA)}{(1000)(FR)(T)(MFA)}$$

where:·

AC = Airborne fiber concentration in (fibers >5 µm)/cm^3.

BFB = Total number of fibers counted in the BFL fiels of the blank or control filters in fibers >5 µm.

BFL = Total number of fields counted on the blank or control filters.

ECA = Effective collecting area of filter (855 mm^2 for a 37-mm filter with effective diameter of 33 mm).

FR = Pump flow rate in liters/min (lpm).

FB = Total number of fibers counted in the FL fields in fibers >5 µm.

FL = Total number of fields counted on the filter.

MFA = Microscope count field area in mm^2 (generally 0.003 to 0.006).

T = Sample collection time in minutes.

10.2. Recount criteria. It is very desirable for a counter to conduct a "blind recount" for about 1 in every 10 filter wedges (slides) counted. Alternatively, a second counter could perform the blind recount. In training sessions for novice counters, the trainee should conduct a blind recount for filter wedges counted by an experienced, proficient counter. In all cases, we will observe differences between the first and second counts of the same filter wedge. Most of these differences will be due to chance alone, that is, due to the random variability (precision) of the count method. Statistical recount criteria enable us to decide whether observed differences can reasonably be explained due to chance alone or are probably due to systematic differences between counters or microscopes or due to some other biasing factor.

The following recount criterion is for a pair of counts that estimate some airborne fiber concentration (AC) in fibers/cm^3. The criterion is given at the type-1 error level. That is, there is a 5% maximum risk that we will reject a pair of counts for the reason that one might be biased, when the large observed difference is really due to chance.

Reject a pair of counts because one might be biased if:

$$(AC_2 - AC_1)\ exceeds\ 2.77(\overline{AC})(CV_{FB})$$

where:

AC_1 = lower estimated airborne fiber concentration

AC_2 = higher estimated airborne fiber concentration

$\overline{AC}$ = average of the two airborne concentration estimates

CV_{FB} = average CV for the two concentration estimates which are a function of the total fiber count (FB) in each case. Use the relation in Section 4 or Figure 3.

For a pair of counts on the same filter, reject the pair because one might be biased if:

$$(FB_2 - FB_1)\ exceeds\ 2.77(\overline{FB})(CV_{\overline{FB}})$$

where:

FB_1 = lower fiber count on the filter (total fibers)

FB_2 = higher fiber count on the filter (total fibers)

$\overline{FB}$ = average of the two total fiber counts

$CV_{\overline{FB}}$ = CV_T for the value FB. Use the relation in Section 4 or Figure 3.

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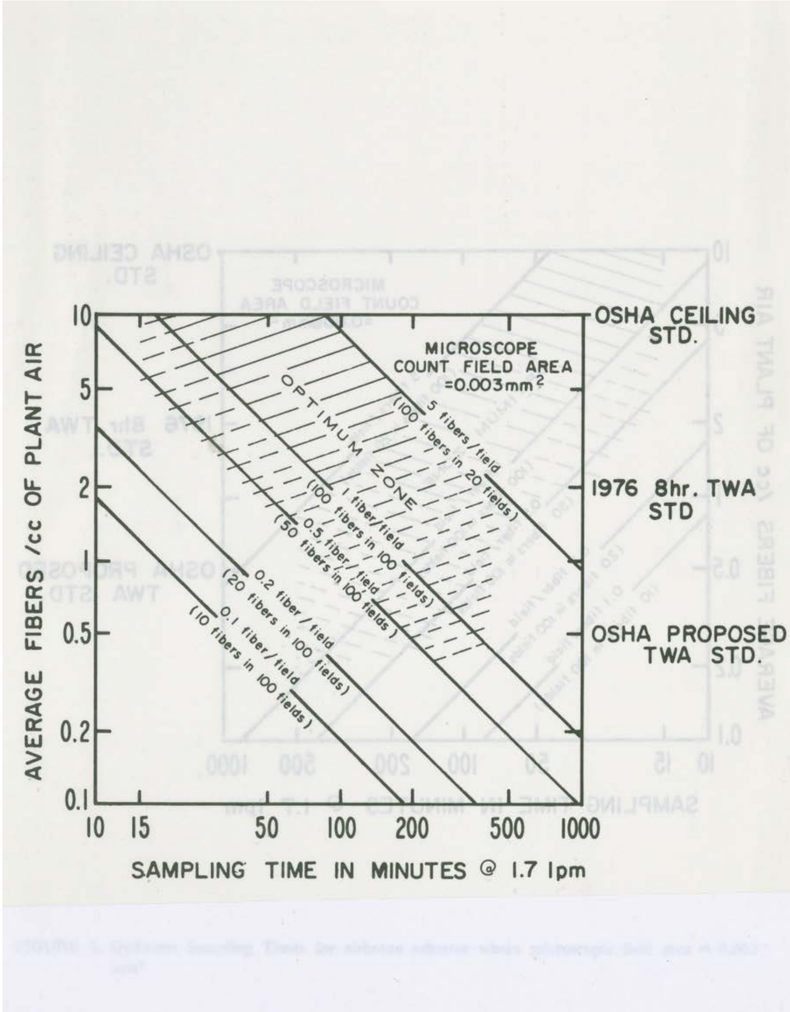

Figure 1 Optimum Sampling Times for airborne asbestos where microscopic field area = 0.003 mm²

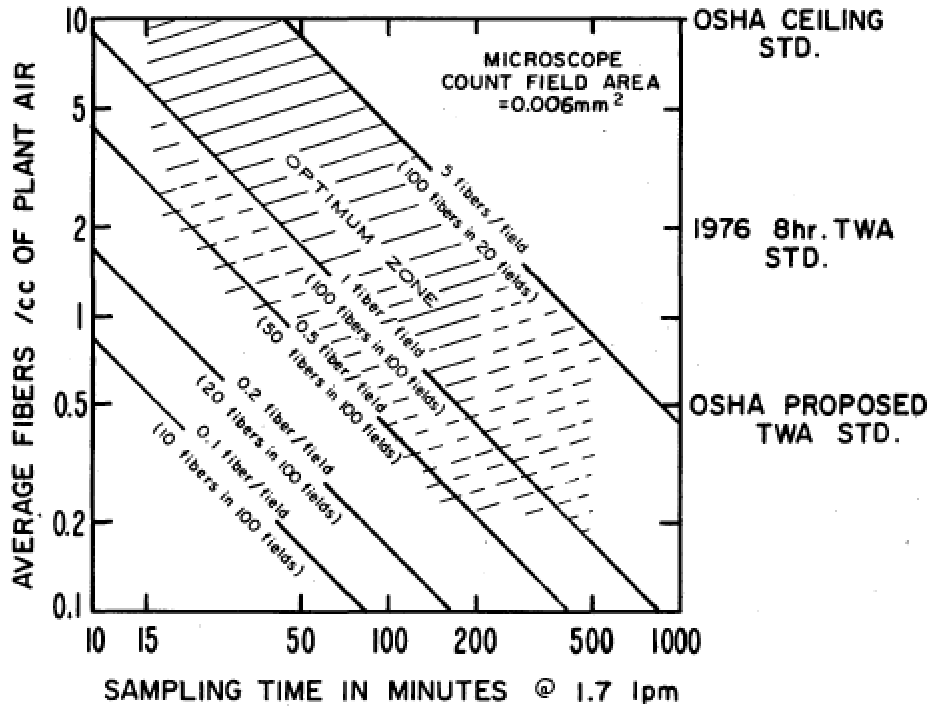

Figure 2 Optimum sampling times for airborne asbestos where microscopic field area = 0.006 mm²

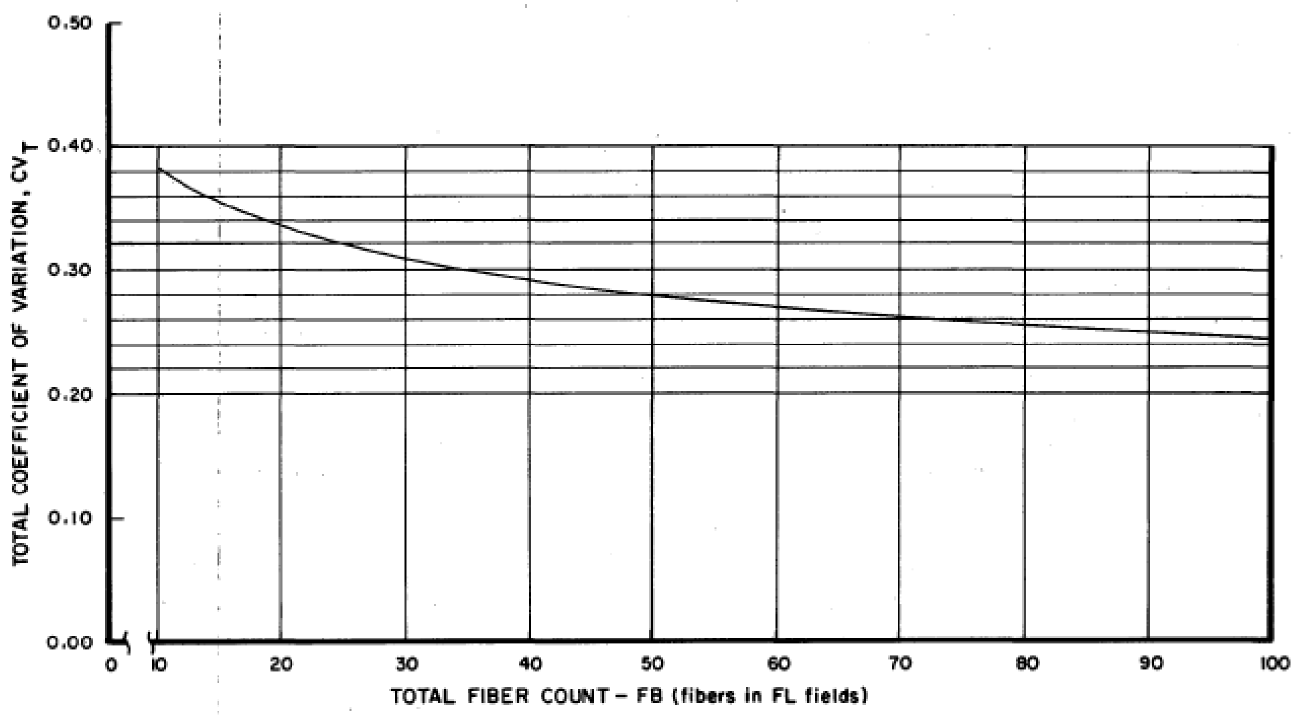

Figure 3 Total coefficient of variation as a function of total fiber count

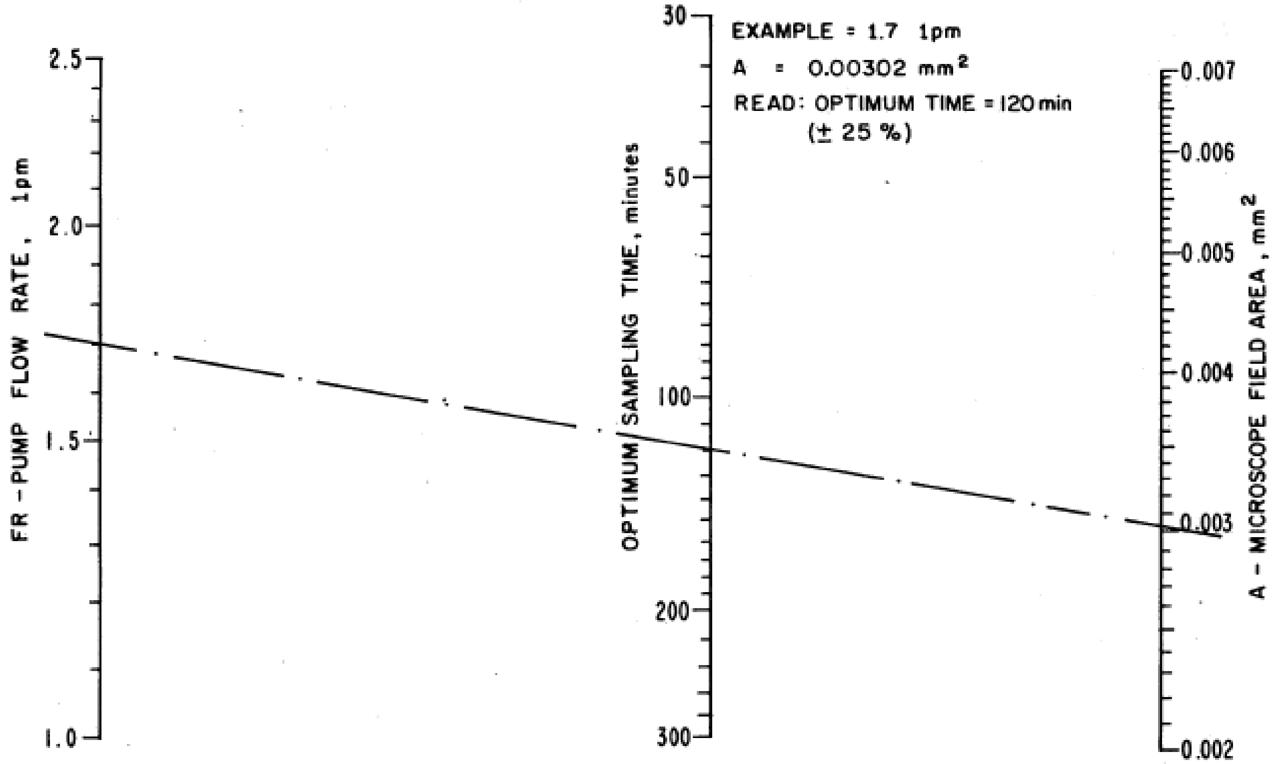

Figure 4 Nomogram of optimum sampling times for airborne asbestos fibers in concentrations of 1 to 10 fibers/cm³

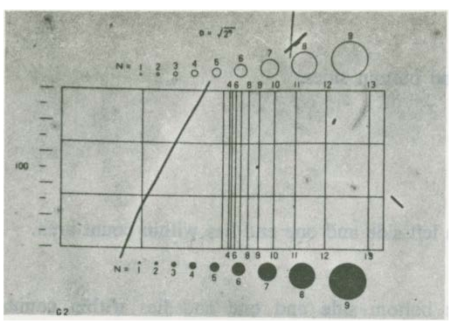

Figure 5 DO NOT COUNT. Fiber crosses top and bottom sides.

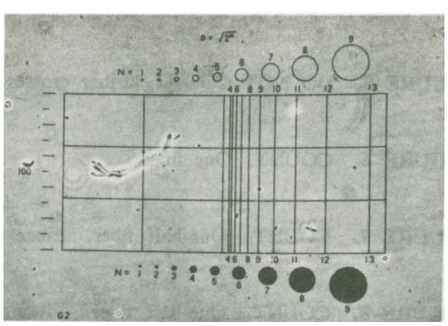

Figure 6 COUNT. One fiber.

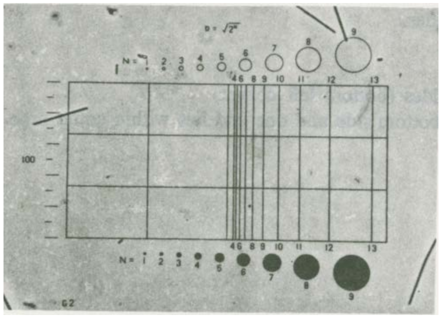

Figure 7 COUNT. One-half fiber. Fiber crosses left side and one end lies within the count area.

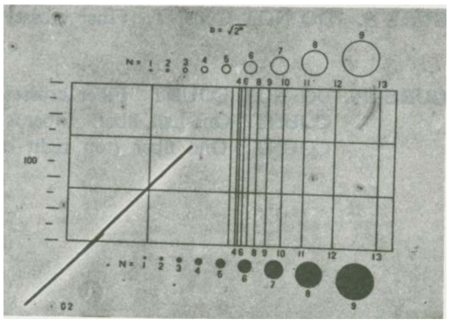

Figure 8 COUNT. One-half fiber. Fiber crosses bottom side and one end lies within count area.

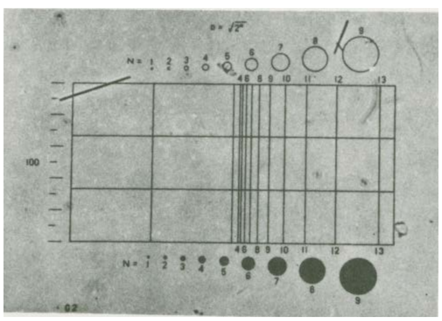

Figure 9 DO NOT COUNT. Fiber crosses two sides.

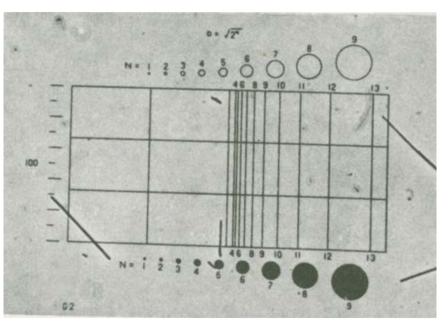

Figure 10 DO NOT COUNT. Fiber crosses two sides (bottom left corner). COUNT. One-half fiber. Fiber crosses bottom side and one end lies within count area. COUNT. One fiber (top right corner).

Appendix C Atlantic Testing Laboratories Asbestos Handling License

LAB ID: 11480

April 01, 2025

MS. KAROL H. LU
AMERICA SCIENCE TEAM NEW YORK, INC
117 EAST 30TH ST
NEW YORK, NY 10016

Certificate Expiration Date:
April 01, 2026

Dear Ms. Lu,

Enclosed are certificate(s) of approval issued to your environmental laboratory for the current permit year. The certificate(s) supersede(s) any previously issued one(s) and is(are) in effect through the expiration date listed. Please carefully examine the certificate(s) to insure that the categories, subcategories, analytes, and methods for which your laboratory is approved are correct. In addition, verify that your laboratory's name, address, lead technical director, and identification number are accurate.

Pursuant to NYCRR Subpart 55-2.2, original certificates must be posted conspicuously in the laboratory and copies shall be made available to any client of the laboratory upon request.

Pursuant to NYCRR Subpart 55-2.6, any misrepresentation of the fields of accreditation (category - method - analyte) for which your laboratory is approved may result in denial, suspension, or revocation of your certification. Any use of the Environmental Laboratory Approval Program (ELAP) or National Environmental Laboratory Accreditation Program (NELAP) name, reference to the laboratory's approval status, and/or using the NELAP logo in any catalogs, advertising, business solicitations, proposals, quotations, laboratory analytical reports, or other materials must include the laboratory's ELAP identification number and distinguish between testing for which the laboratory is approved and testing for which the laboratory is not approved.

If you have any questions, please contact us at the Environmental Laboratory Approval Program, Wadsworth Center, New York State Department of Health, Empire State Plaza, Albany NY, 12237; by phone at (518) 485-5570; by facsimile at (518) 485-5568; and by email at elap@health.ny.gov.

Sincerely,

Amy J. Steuerwald

Amy J. Steuerwald, Ph.D.
Director, Environmental Laboratory Approval Program

WE ARE YOUR DOL

NEW YORK STATE | Department of Labor

DIVISION OF SAFETY & HEALTH LICENSE AND CERTIFICATE UNIT, STATE OFFICE CAMPUS, BLDG. 12, ALBANY, NY 12226

ASBESTOS HANDLING LICENSE

Atlantic Testing Laboratories, Limited
P.O. Box 29, Canton, NY, 13617

License Number: 29276
License Class: RESTRICTED
Date of Issue: 10/01/2024
Expiration Date: 11/30/2025
Duly Authorized Representative: Marijean B Remington

This license has been issued in accordance with applicable provisions of Article 30 of the Labor Law of New York State and of the New York State Codes, Rules and Regulations (12 NYCRR Part 56). It is subject to suspension or revocation for a (1) serious violation of state, federal or local laws with regard to the conduct of an asbestos project, or (2) demonstrated lack of responsibility in the conduct of any job involving asbestos or asbestos material.

This license is valid only for the contractor named above and this license or a photocopy must be prominently displayed at the asbestos project worksite. This license verifies that all persons employed by the licensee on an asbestos project in New York State have been issued an Asbestos Certificate, appropriate for the type of work they perform, by the New York State Department of Labor.

Amy Phillips, Director
For the Commissioner of Labor

EXCELSIOR

Appendix D AmeriSci Certificates of Accreditation

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2026
Issued April 01, 2025

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. KAROL H. LU
AMERICA SCIENCE TEAM NEW YORK, INC
117 EAST 30TH ST
NEW YORK, NY 10016

NY Lab Id No: 11480

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved subcategories and/or analytes are listed below:

Miscellaneous

Asbestos in Friable Material	Item 198.1 of Manual
	EPA 600/M4/82/020
Asbestos in Non-Friable Material-PLM	Item 198.6 of Manual (NOB by PLM)
Asbestos in Non-Friable Material-TEM	Item 198.4 of Manual

Serial No.: 70488

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

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MS. KAROL H. LU
AMERICA SCIENCE TEAM NEW YORK, INC
117 EAST 30TH ST
NEW YORK, NY 10016

NY Lab Id No: 11480

is hereby APPROVED as an Environmental Laboratory for the category
ENVIRONMENTAL ANALYSES AIR AND EMISSIONS
All approved subcategories and/or analytes are listed below:

Miscellaneous

Asbestos	40 CFR 763 APX A No. III
	YAMATE,AGARWAL GIBB
	NIOSH 7402
Fibers	NIOSH 7400 A RULES

Serial No.: 70489

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2026
Issued April 01, 2025

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Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. KAROL H. LU
AMERICA SCIENCE TEAM NEW YORK, INC
117 EAST 30TH ST
NEW YORK, NY 10016

NY Lab Id No: 11480

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category
ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Miscellaneous

Asbestos	EPA 100.2

Serial No.: 70487

Property of the New York State Department of Health. Certificates are valid only at the address shown and must be conspicuously posted by the laboratory. Continued accreditation depends on the laboratory's successful ongoing participation in the Program. Consumers may verify a laboratory's accreditation status online at https://apps.health.ny.gov/pubdoh/applinks/wc/elappublicweb/, by phone (518) 485-5570 or by email to elap@health.ny.gov.