MOVE YOUR ENVIRONMENT FORWARD

SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN

Remington Site, Site E
14 Hoefler Avenue
Ilion, New York

Prepared For:

Mohawk Valley Economic Development District, Inc. (MVEDD)
Attn: Heather Devitt
Deputy Director
26 West Main Street
Mohawk, New York 13407

Prepared By:

HRP Associates, Inc.
1 Fairchild Square, Suite 110
Clifton Park, NY 12065

HRP Project Number: TUR3503.BA

Issued On: July 31, 2026

TABLE OF CONTENTS

Tables

Figures

Appendices

SECTION 1 TITLE AND APPROVAL PAGE

Template 1: Title and Approval Page

Quality Assurance Project Plan (QAPP): Remington Site, Site E

Property/Site Location: 14 Hoefler Avenue, Ilion, New York 13357

Revision Number: N/A

Revision Date: N/A

Brownfields Cooperative Agreement Number: 4B 96219500

MVEDD
Brownfields Recipient

Richard Cwiklowski, HRP Associates
Preparer's Name and Organizational Affiliation

1 Fairchild Square, Suite 110
Clifton Park, NY 12065
(314) 560-5882
Rick.cwiklowski@hrpassociates.com
Preparer's Address, Telephone Number, and Email Address

July 31, 2026
Preparation Date (Month/Day/Year)

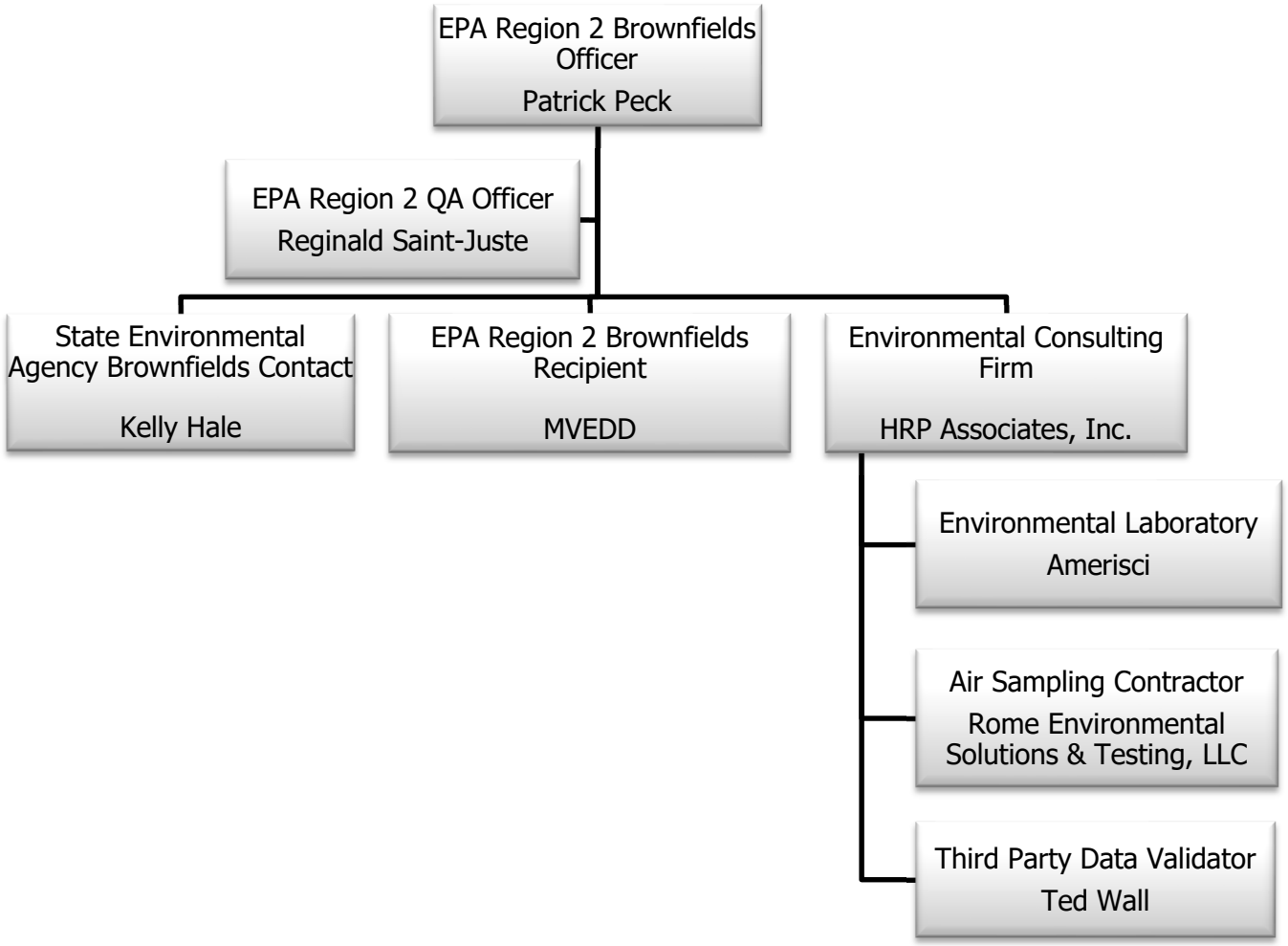
Brownfields Recipient Program Manager:
Heather Devitt
hdevitt@mvedd.org
MVEDD
Date: **Signature**

Environmental Consultant Quality Assurance Officer (QAO):
Ted Wall
Ted.Wall@hrpassociates.com
HRP Associates, Inc.
Date: 7/31/2026 **Signature**

EPA Region 2 Brownfields Project Officer:
Patrick Peck
peck.patrick@epa.gov
USEPA Region 2
Date: **Signature**

SECTION 2 PROJECT ORGANIZATION/RESPONSIBILITY

Template 2a: Project Organizational Chart



Template 2b: Personnel Responsibilities

Name	Title	Contact Information	Organizational Affiliation	Responsibilities
Heather Devitt	Deputy Director	(315) 866-4671 hdevitt@mvedd.org	MVEDD 26 W. Main Street Mohawk, NY 13407	Grantee Project Management and Budget Oversight
Patrick Peck	EPA Brownfields Project Officer (BPO)	(212) 637-4421 Peck.patrick@epa.gov	USEPA 290 Broadway, 25th Floor New York, NY 10007	Brownfields Project Oversight
Reginald Saint-Juste	EPA Brownfields QAO	(732) 321-6746 St-juste.reginald@epa.gov	USEPA 2890 Woodbridge Ave Edison, NJ 08837	Quality Assurance and Quality Control
Kelly Hale	NYSDEC Brownfields Contact	(315) 793-2554 Kelly.hale@dec.ny.gov	NYSDEC Region 6	Brownfields Project Oversight
Jesse Zahn	Regional Office Manager	(518) 978-2378 Jesse.zahn@hrpassociates.com	HRP Associates, Inc. 1 Fairchild Square, Suite 110 Clifton Park, NY 12065	Project Management
Ted Wall	Senior Database Manager	(720) 881-4994 x1190 Ted.Wall@hrpassociates.com	HRP Associates, Inc. 1 Fairchild Square #110 Clifton Park, NY 12065	Quality Assurance and Quality Control, Data Validation
Andrew Lee	Vice President	(212) 679-8600 alee@AmeriSci.com	AmeriSci New York 117 East 30th Street New York, NY 10016	Laboratory Analysis, Project Management
Eric Dousharm	Owner, Rome Environmental Solutions & Testing, LLC (REST)	315-794-7946 edousharm@romeenv.com	Rome Environmental Solutions & Testing, LLC 8041 River Road, Rome, NY 13440	Asbestos Air Monitoring, Project Management

SECTION 3 AREAS OF ENVIRONMENTAL CONCERN

Template 3a: Problem Definition/Project Description

3.1 Problem Definition

This Site-Specific 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 the abatement of asbestos containing materials (ACM) identified in Site buildings at the Remington Site ("Site") on behalf of MVEDD under the Environmental Protection Agency (EPA) Brownfields (BF) Cooperative Agreement (CA) 4B 96219500. Descriptions of sample collection and field data acquisition associated with an analytical sampling program will be provided in detail in this QAPP.

To be investigated under this QAPP is the Site identified as the Remington Site, Site E located in Ilion, New York. The project includes the abatement of ACM within Buildings 82, 83, 84, 85, and 86 at the former Remington Arms Plant (Remington Site E). This QAPP will outline the sampling and quality control procedures associated with the air monitoring program that will occur during building abatement. A Site location map is provided as **Figure 1.** The air monitoring project will answer the following question:

- Are asbestos containing materials present in the air at concentrations which contravene 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).

3.1.1 Site Location and Description

The Site consists of a portion of Tax Map/Parcel # 120.37-5-16. Improvements include Buildings 82, 83, 84, 85, and 86, which are interconnected industrial buildings

3.1.2 Physical Setting

The Site lies at an approximate elevation of 400-480 feet (ft) above mean sea level. The nearest surface water body is Steele Creek, located approximately 1,000 feet west of the Site. The Mohawk River is located approximately 2,000 feet north of the Site.

According to the United States Department of Agriculture Natural Conservation Service, soil at the Site is defined as Herkimer gravelly silt loam, 0 to 3 percent slopes (77%), and Hartland-Agawam complex, 8 to 15 percent slopes (23%). Herkimer gravelly silt loam consists of loamy old alluvium derived from dark, calcareous shale, and varying amounts of sandstone and limestone, well-drained. Hartland Agawam complex consists of silty eolian or glaciolacustrine deposits, well-drained.

Site investigations revealed the presence of fill materials at depths ranging from 0 to 35 feet below grade across Sites A-E. These materials are underlain by native fine to medium sands, silts, and clays.

According to the Surficial Geologic Map of New York, Hudson-Mohawk Sheet, surficial geology of the Site is classified as outwash sand and gravel. Materials are characterized as coarse to fine gravel with sand from proglacial fluvial deposition.

During Phase II investigations at the Site, a groundwater investigation was not conducted in Site E, although groundwater was encountered at depths ranging from 4-feet to 19-feet below ground surface at other areas of the Remington Arms facility.

3.1.3 Site History

Until March 2024, the larger Remington Arms facility was used by Remington Arms for the design, manufacture, testing, and distribution of Remington firearms. Site E was used for industrial manufacturing, primarily dedicated to firearms production as part of the larger Remington Arms facility.

The Remington Arms facility was originally developed as an armory in the early 1800s and has since been used for the manufacturing of numerous products including firearms, ammunition, agricultural equipment, bicycles, steam cars, typewriters, sewing machines, and cash registers.

3.1.4 Previous Environmental Investigations

A Phase I Environmental Site Assessment (ESA) and asbestos survey have been performed at the Site to-date.

Remington Arms Plant - 14 Hoefler Avenue, Ilion, New York - Phase I ESA
Prepared by HRP Associates, Inc. – March 28, 2025

HRP has completed a Phase I ESA in conformance with the scope and limitations of ASTM Practice E1527-21 of the Remington Arms Plant located at 14 Hoefler Avenue in the Village of Ilion, New York, the Site.

This assessment has revealed the following recognized environmental conditions (RECs) in connection with the Site:

- The 200-year history of manufacturing operations is considered a recognized environmental condition in connection with the Subject Property. Numerous current and historical areas of concern including various manufacturing operations, trench drains and dry sumps, oil/water separators, petroleum and chemical storage, coal storage, electrical transformers, gun powder houses, a railroad spur, and historic fill materials were identified, any of which may have impacted the Site with VOCs, SVOCs, and metals. A sitewide groundwater investigation was initiated in 1991 and completed in 2005, and a recent groundwater/soil characterization investigation specific to onsite areas of concern was conducted. Areas of concern with VOC, SVOC, and metals constituents in soil and/or groundwater were identified on-site during this investigation and are considered RECs.

If future development of the Site includes removal of site buildings and barrier surfaces, a soil management plan should be implemented to ensure that workers and the public are not exposed to dust from excavation or other handling and movement of soils. Encapsulation as a result of Site development through the use of paved surfaces, building coverage and other barrier surfaces could serve to maintain stability of contaminated fill/soil materials. If soil is to be removed from the Site and disposed, it should be characterized and re-used or disposed of at appropriate locations, based on the results of characterization and regulatory re-use requirements.

- The site contact identified the location of a water main break in the vicinity of Building 56 where cyanide was reportedly detected above state standards in soil. Soil analytical data was not provided and it is unknown if the contamination was delineated or excavated.

This assessment has revealed the following HRECs in connection with the Site:

- Based on the investigations conducted, regulatory closure, and the likelihood that the residual petroleum hydrocarbon impacts have since continued to naturally attenuate, previously documented petroleum spills are considered historical recognized environmental conditions (HRECs) for the Site.

Pre-Demolition Asbestos Survey for the Remington Site
Prepared by HRP Associates, Inc. – November 2022

Results of Asbestos Survey

A material is considered by the US EPA and NYS Department of Labor (DOL) to be asbestos containing if at least one sample collected from the homogenous area shows asbestos present in an amount greater than 1%. Based on a review of the laboratory results, two of the submitted friable and non-friable ACM samples analyzed contain asbestos. These materials are described below:

Remington Site Buildings 82, 83, 84, 85, and 86 - approximate quantities:

- 2,141 linear feet (LF) thermal system insulation (TSI)
- 1,152 ft^2 floor tile
- 770 ft^2 Transite
- 220 ft^2 tank insulation
- 90 ft^2 mechanical insulation
- 940 ft^2 duct tape, and
- 60 ft of gaskets

Based on the results of this survey, HRP recommends the following:

- Prior to any renovation or demolition activities, a copy of the asbestos survey should be provided to the renovation contractor and local asbestos control board.
- Maintain a copy of this asbestos survey with the property.
- If unassessed suspect ACM is identified during renovation or demolition activities, retain an asbestos building inspector to sample and test the material(s) following NYS requirements.

- One copy of this report must be immediately transmitted by the building owner, or their agent, to the local government entity charged with issuing a permit for such demolition, renovation, remodeling or repair work under applicable NY State or local laws.
- The completed asbestos survey for controlled demolition (as per Subpart 56-11.5) or pre-demolition asbestos abatement projects shall also be submitted to the appropriate Asbestos Control Bureau district office.

Integrated Site Assessment Report – The Remington Sites A-E
Prepared by HRP Associates, Inc. – November 2025

To support a more comprehensive environmental investigation of the former Remington Arms facility, a supplemental Phase II ESA was conducted in May 2025 by HGL under the technical oversight of HRP. The parcels assessed were labeled consistently with those evaluated during HRP's 2024 Phase II ESA. Subsurface investigation activities, including the advancement of soil borings, were conducted under the direction of HRP in coordination with HGL. While HRP provided oversight and technical guidance throughout the fieldwork, HGL was responsible for collecting and delivering the soil samples to the analytical laboratory for processing. This joint effort ensured adherence to the approved Quality Assurance Project Plan and maintained data integrity.

Site E exhibited fill materials to a depth of 16 ft bg, consistent in composition with other sites. Native soils were composed of fine to medium sand and silt with gravel. Indicators of contamination were observed in 10 of the 19 borings, suggesting more widespread impacts than at Sites C and D.

Analytical results from the Phase II investigation confirm that Site E meets the NYSDEC definition of a Brownfield site, with contaminants present at concentrations exceeding applicable CU SCOs established by the NYSDEC, based on the reasonably anticipated future use of the property. Contamination was observed across the Site. Three samples exceeded CU SCOs for metals, and three samples exceeded criteria for SVOCs. Arsenic was detected at concentrations ranging from 18 mg/kg to 83 mg/kg, exceeding CU SCOs. Lead and copper were also detected at concentrations exceeding CU SCOs. No VOCs were detected above applicable standards.

3.1.5 Areas of Concern

The area surrounding the Site buildings are identified as areas of concern due to the potential for release of ACM to the air during abatement activities. This area will be monitored and sampled for ACM during abatement activities. The area to be affected is depicted on **Figure 1.**

3.1.6 Contaminants of Concern

HRP identified asbestos as an airborne particle as the contaminant of concern (COC) to be monitored and sampled during abatement activities. Based on the results of the April 2025 Asbestos Survey ACM are present throughout the building interiors in TSI, floor tile, Transite, tank insulation, mechanical insulation, duct tape, and gaskets.

3.2 Project Description

3.2.1 Sampling and Analysis Plan

This QAPP has been designed to outline the procedures and quality control methods of monitoring the air quality of the Site during asbestos abatement activities. Activities will consist of the collection of air samples. No other environmental samples will be collected during this investigation. The sampling to be performed will be conducted by REST and overseen by HRP Associates, Inc. as the environmental consultant for the project. The project air sampling shall be conducted by an asbestos project air sampling technician (REST) who has been trained in the selected methodology of air sampling and who possesses an asbestos project air sampling technician certificate issued by the NYS DOL. Statements of Qualifications are included in **Appendix D**. Laboratory analysis of the air samples will be performed by AmeriSci. AmeriSci is a NYSDOH ELAP accredited laboratory. The Certificate of Accreditation for AmeriSci is included in **Appendix F**. 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) referenced in **Template 6** and included in **Appendix A**.

A Safe Work Permit (SWP) to be utilized by on-site workers during field activities is included as **Appendix B**.

The tasks to be completed are listed below in the order that they will be completed. An estimated project schedule/timeline is summarized in **Template 4**.

1. Air sampling during abatement activities, including collection of background samples
2. Post abatement visual survey and air samples in accordance with NYS DOL ICR 56
3. Post abatement report preparation

3.2.2 Air Monitoring

To determine if airborne fibers which may include asbestos fibers have been released, REST will collect air samples from various locations throughout the Site during abatement activities. Air samples will be collected using high-flow pumps with PCM cassettes (25 mm filter, Pore Size 0.8u (Micro). Pumps will be set to a minimum flow rate capacity of two liters per minute (LPM). Eight (8) air samples will be collected per day. Eight samples are specific to NYS State Code Rule 56which includes two field blank samples for quality control. Typically, an additional sample may be required based on having a site-specific variance that would include and inside the work area sample. A Site plan depicting the approximate sample locations is provided as **Figure 2.** Sampling will occur for the duration of the building abatement project. REST will collect and generate the data and will be overseen by HRP Associates. Samples will be collected and handled in accordance with REST SOP: #2 Air Sampling Protocols for interior Abatement of Asbestos Containing Materials (ACM). provided in **Appendix A**.

3.2.3 Air Sample Laboratory Analysis

Air samples will be collected daily and sent to AmeriSci for laboratory analysis. A total of 8 samples (6 samples and 2 QA/QC samples) will be collected per day during abatement activities. Sampling locations

are described in **Template 5a.** In addition to Site samples, QA/QC samples (field blanks [FB]) will be collected. Field blanks will be collected at a frequency of two samples per day. Air samples will be analyzed by NIOSH Method 7400 PCM.

3.2.4 Air Monitoring Report

An electronic copy of the final air sampling report will be distributed to MVEDD, addressed to Heather Devitt. The report will provide a description of the field activities, present data collected, a physical description of the Site, and provide an analysis and interpretation of the available data. The report will include laboratory analytical results and a comparison of data to New York State Department of Labor (DOL) Title 12 NYCRR Part 56.-4.11 criteria to determine whether the air clearance samples are satisfactory.

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. Decisions to be made with the data include:

1. 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 abatement area.

3.4 Project Quality Objectives

Template 3b: Project Quality Objectives/Systematic Planning Process Statements

3.4.1 Overall Project Objectives

The objective of this sampling event is to assess air quality for the potential to contain airborne asbestos to evaluate potential exposure risks to workers, occupants, and the general public and to determine if the abatement meets the NYS DOL requirements. The overall project objectives will be accomplished by completing the air sampling during the abatement of the Site buildings. 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 (see Project Decision Statements in **Template 3a**). 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.

3.4.2 Project Quality Objectives

The data will be used by MVEDD, HRP Associates, and relevant regulatory agencies to determine compliance with safety standards, assess environmental health risks, and make informed mitigation decisions. 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 after the demolition.

The quality of the data must meet criteria for precision, accuracy, representativeness, comparability, completeness, and sensitivity. Specific criteria for each category of PQO are discussed below. PQOs are assessed and data usability is determined through the project data review and verification process completed by the environmental consultant, laboratory, and third-party data validator through procedures outlined in **Template 13**.

Precision - Measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples and/or field samples. The most commonly used estimates of precision are the relative standard deviation (RSD) and, when only two samples are available, the relative percent difference (RPD). Precision related limits are presented for laboratory prepared QA/QC samples in **Template 5d** and for field QA/QC samples in **Template 10**.

Accuracy - Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. QC analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates. Accuracy related limits are presented for laboratory prepared QA/QC samples in **Template 5d** and for field QA/QC samples in **Template 10**.

Representativeness - Sample representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring the approved plans were followed during sampling and analysis. To ensure that the samples delivered to the laboratory for analysis are representative of the Site conditions, quality assurance procedures for sample collection and handling will be followed whenever samples are collected. The HRP Associates project manager has the responsibility of determining whether resampling and reanalysis is necessary to meet PQOs.

Comparability - Comparability expresses the degree of confidence with which one data set can be compared to another. The PQOs for comparability are to:

1. Demonstrate traceability of standards to National Institute of Standards and Technology (NIST) or USEPA sources.
2. Use standard methodology.
3. Report results from similar matrices in standard units.
4. Apply appropriate levels of quality control within the context of the laboratory QC program.
5. Participate in inter-laboratory studies to document laboratory performance.
6. Follow NYSDEC data validation process, which recommends the use of USEPA data validation guidelines.

Completeness - Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned. Although 100 percent project completeness is desired it is understood this may not be possible due to unforeseen field conditions, laboratory conditions, and analytical limitations (such as matrix interference or required dilution) that could result in unusable data. The minimum level for laboratory completeness is 95 percent for each analytical parameter. The minimum level of project completeness will be 90 percent. This is expected to be achieved by ensuring proper sample packaging and extraction procedures.

Sensitivity - Quantitation limits must detect asbestos fibers below the regulatory threshold (e.g., 0.01 fibers/cubic centimeter). Laboratory reporting limits are listed in **Template 5c**.

SECTION 4 PROJECT TIMELINE

Template 4: Project Schedule/Timeline

Activities	Organization	Dates (M/YYYY)		Deliverable	Deliverable Due Date
		Anticipated Date of Initiation	Anticipated Date of Completion		
Preparation of QAPP	HRP	7/2026	8/2026	QAPP	N/A
Preparation of Safe Work Permit	HRP	7/2026	8/2026	HASP	N/A
Review of QAPP	Patrick Peck, EPA BPO and Eric Best, EPA QAO	Upon submission of QAPP	Up to 5 weeks after submission	Approved QAPP by EPA Region 2 PO	N/A
Field Reconnaissance/Access	HRP	Access will be gained prior to field activities	N/A	N/A	N/A
Collection of Air Samples	REST	At the commencement of abatement activities	Within the same day as activity initiation	N/A	N/A
Laboratory Analysis	AmeriSci	Upon completion of Site sampling activity	Within the established laboratory TAT	Unvalidated data package	3 weeks after activity start date
Validation of Laboratory Results	HRP Associates	Within one week of receipt of laboratory analytical packages	N/A	Letter confirming the validity of the data	2 weeks after activity start date
Data Evaluation/ Preparation of Final Report	REST	Within two weeks of receipt of laboratory analytical results	2 weeks after initiation of report	Final Report	N/A

SECTION 5 SAMPLING AND ANALYTICAL REQUIREMENTS

Template 5a: Sampling Methods and Locations

Matrix	Sampling Location	Depth (ft)	Analytical Group	Number of Samples	Sampling SOP Reference	Rationale for Sampling Location
Air	Personal Decon Entrance	N/A	NIOSH 7400 PCM	8 samples per day (6 samples plus 2 field blanks)	SOP 2: Air Sampling Procedures for Abatement of Asbestos Containing Materials (ACM)	To determine if there are asbestos fibers in the outdoor air over NYSDOL permissible limits.
	Personal Decon Exit					
	Inside Work Area (Variance Only)					
	Adjacent #1 Critical Barrier					
	Adjacent #2 Critical Barrier					
	HEPA Exhaust – One per Negative Air Exhaust or Bank of 5 Exhausts					
	Ambient Air					
	Field Blank					
	Field Blank					

Template 5b: Analytical Methods and Requirements

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Air	Fibers	Low	NIOSH 7400 / ASB-SOP Sections II and IV	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

Template 5c: Reference Limits and Evaluation

Matrix: Air
Analytical Method: NIOSH 7400
Concentration level (if applicable):

Analyte	CAS#		Analytical Method	Reporting Limit (fibers/mm^2)	MDL	New York State Department of Labor Sample Results Criteria (fibers per cubic centimeter)
Fibers (manual count)	*Actinolite	77536-66-4	NIOSH 7400	7 fibers/mm^2 of filter area	7 fibers/mm^2 of filter area	0.01 fibers/cc
	*Amosite	12172-73-5				
	*Anthophyllite	77536-67-5				
	*Chrysotile	12001-29-5				
	*Tremolite	77536-68-6				
	*Amphibole	1332-21-4				
	*Only NIOSH 7402 can ID the asbestos fiber types					

Template 5d: Analytical Laboratory Sensitivity and Project Criteria

Matrix Air				
Analytical Group Fibers				
Concentration Level Low				
Analytical Method/SOP	**Data Quality Indicators**	**Performance Criteria (related to analytical method)**	**QC Sample such as Duplicate, Matrix Spike, Surrogates etc. Used to Assess Performance Criteria**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
NIOSH 7400/SOP Section II	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

Template 5e: Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Phase I Environmental Assessment (ESA)	HRP Associates, Inc., Phase I ESA, Remington Arms Plant, March 28, 2025	No data was generated by this report due to the nature of Phase I ESA	Presence of ACM was determined as a possibility, with recommendation to perform ACM Survey suggested.	Phase I ESAs do not generally provide original analytical data.
Asbestos Survey	HRP Associates, Inc, Asbestos Survey for the former Remington Arms Site, April 3, 2025	HRP Associates collected suspect ACM samples between December 13, 2024 and January 17, 2025	The data is used to determine that it is necessary to conduct air monitoring for asbestos during the building abatement activities	Asbestos conditions at a site may change over time due to environmental factors, renovations, or disturbance. Data from the survey only reflect conditions at the time of collection.
Integrated Site Assessment	HRP Associates, Inc., summary of Phase II sampling at the former Remington Arms Site, November 6. 2025	HRP and HGL collected soil and groundwater samples between August 26, 2024 and May 9, 2025	The data is used to confirm widespread environmental contamination across the site	The soil sampling was limited due to the presence of structures on the Site and, due to limited groundwater sampling, a site-wide understanding of groundwater impacts has not been achieved.

SECTION 6 PROJECT-SPECIFIC METHOD AND STANDARD OPERATING PROCEDURE REFERENCE

Template 6: Project-Specific Method and SOP Procedure 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. REST SOP 1: Air Sampling Procedures for Demolition with Regulated Asbestos Containing Materials (RACM) In-Place

SECTION 7 FIELD EQUIPMENT CALIBRATION/CORRECTIVE ACTION

Template 7: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Instrument	Calibration Activity	Maintenance Activity	Testing/ Inspection	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
Rotameter	Required	Calibration using a Bios Defender 510-H	N/A	Every 3 months	N/A	N/A	002 – Standard Equipment used for air sampling
Gillian BDX II Adjustable Flow 0.2–3 LPM	Required	Daily prior to conducting work activity and daily post work activity.	N/A	Twice Daily	N/A	N/A	002 – Standard Equipment used for air sampling
EMS ePro HD Adjustable Flow of 2–30 LPMy6	Required	Daily prior to conducting work activity and daily post work activity.	N/A	Twice Daily	N/A	N/A	002 – Standard Equipment used for air sampling
Super Vac	Required	Daily prior to conducting work activity and daily post work activity	N/A	Twice Daily	N/A	N/A	002 – Standard Equipment used for air sampling

SECTION 8 LABORATORY EQUIPMENT CALIBRATION/CORRECTIVE ACTION

Template 8a: Analytical Laboratory Instrument and Equipment Maintenance, Testing, and Inspection

AmeriSci Instruments Maintenance, Testing or Inspection							
Instrument/ Equipment	**Maintenance Activity**	**Testing/Inspection Activity**	**Frequency**	**Acceptance Criteria**	**Corrective Action**	**Responsible Person**	**SOP Reference**
Phase Contrast Light Microscope	Alignment	Cleaning and Maintenance	Annual/As Needed	Centering and focusing the objective, condenser, stage, and lamp	Removed from service. Call technician for maintenance	Supervisor/Manager	ASB-SOP IV-A.2
Mechanical Tally Counter (hand clicker)	Cleaned Verification	Visual inspection/function testing	Monthly/As Needed	Ensure 100 count sequence twice	Remove from service; replace tally counter	Supervisor/Manager	ASB-SOP IV-A.3

Template 8b: Analytical Laboratory Instrument Calibration

AmeriSci Laboratory Instrument Calibration						
Instrument	**Calibration Procedure/**	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**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	ASB-SOP II.4
Phase Centering Telescope	Alignment of microscope	Daily/Next use	Ensure phase ring is concentric	Remove from service. Call technician for replacement.	Supervisor/Manager	ASB-SOP IV-A.2
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	ASB-SOP IV-A.2
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	ASB-SOP IV-A.2
Mechanical Tally Counter (hand clicker)	Fiber Counting	Monthly/As Needed	Ensure 100 count sequence twice	Remove from service; replace tally counter	Supervisor/Manager	ASB-SOP IV-A.3

AmeriSci Laboratory Instrument Calibration						
Instrument	**Calibration Procedure/**	**Frequency of Calibration**	**Acceptance Criteria**	**Corrective Action (CA)**	**Person Responsible for CA**	**SOP Reference**
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	ASB-SOP IV-A.2

SECTION 9 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Template 9a: Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Eric Dousharm, REST
Sample Packaging (Personnel/Organization): Eric Dousharm, REST
Coordination of Shipment (Personnel/Organization): Eric Dousharm, REST
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 Template #5b.
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)

Template 9b: Sample Custody Requirements

9.1 Sample Labels

A sample label with a unique sample number will be attached to each cassette. An example of a sample label is provided in **Appendix C**. This unique number used for identification is part of a sample numbering system. This system will provide a tracking procedure to allow retrieval of information about a particular sample and will assure that each sample is uniquely numbered. The sample identification will consist of at two components:

- Number- a unique sequential number will be assigned to each sample
- Name- a name will be assigned to each sample corresponding to the location in which the sample was collected

An example of the sample numbering system is:

- 01- Personal Decon Entrance

Every sample label will clearly identify the sample and include the following information:

- Project number
- Sampler's initials
- Sample location
- Sample identification number
- Date/Time
- Sample Type
- Analyses to be performed

9.2 Project Identification

The project is identified with a three letter and four-digit code, followed by a letter and a digit. This project will be identified as TUR3503.BA.

9.3 Quality Assurance/Quality Control Samples

The samples will be labeled with the following suffixes:

FB Field Blank

A unique sequential number will be assigned to each sample and will precede the FB suffix.

9.4 Field Sample Custody/Tracking Procedures

The key element to every sampling program is the integrity of the samples collected. If the samples have been mishandled, misused, or incorrectly documented at any point of the investigation, the results from the investigation may be compromised. A chain-of-custody tracks a sample from collection to laboratory analysis. Along with a chain-of-custody, field logbooks, field datasheets, and sample labels record information such as personnel on-site, inspections, field activities, photographs collected, sample identification, sampling times and dates, and weather conditions.

All samples will be recorded and tracked under strict 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 sample batch. The form will be signed and dated by the person who collected the samples, the person the samples were relinquished to for transport to the laboratory, and the laboratory sample controller/custodian who receives the samples.

9.5 Laboratory Sample Custody/Tracking Procedures

AmeriSci sample custody/tracking procedures are described in detail in the Sampling Handling SOP included in **Appendix A** and identified in **Template 6** of this QAPP.

9.6 Chain of Custody Record

A chain-of-custody record is a printed form that accompanies a sample or group of samples as custody is transferred from person to person. A sample chain-of-custody form is included in **Appendix C.** It documents custody transfer from person to person and sample information recorded on sampling containers. A chain-of-custody record is a controlled document.

As soon as practical after sample collection, preferably after decontamination, the following information must be entered on the chain-of-custody form.

- HRP Project number
- Project name
- Sampler(s)
- Sample number
- Date
- Time
- Sample location
- Remarks

9.7 Sample Handling and Shipment

Air samples collected during the project will be collected via courier or shipped via carrier (e.g., UPS, Federal Express) to AmeriSci. All samples will be packed appropriately as to not undermine the integrity of the sample containers.

9.8 Transferring to Common Carrier or Courier

Instructions for REST shipper transferring custody of samples to a common carrier or courier are as follows:

- Sign, date, and enter time under "Relinquished by" entry.
- Enter name of courier or carrier (e.g., UPS, Federal Express) under "Received by."
- If using a carrier, enter bill-of-lading of air bill number under "Remarks."
- Place the original chain-of-custody form in the appropriate sample shipping package. Retain a copy with field records.
- Fold the custody seal over on itself so that it sticks together.
- Complete other carrier-required shipping papers, if applicable.

Common carriers will usually not accept responsibility for handling chain-of-custody forms; this necessitates packing the record in the sample package.

SECTION 10 FIELD/ANALYTICAL LABORATORY QUALITY CONTROL SUMMARY

Template 10: Field Quality Control Summary

Matrix	Air
Analytical Group	Asbestos
Concentration Level	Low/Medium – fibers/cubic centimeter
Sampling SOP(s)	SOP 1: Air Sampling Procedures for Abatement of Regulated Asbestos Containing Materials (RACM)
Analytical Method/SOP Reference	NIOSH 7400
Sampler's Name	To be determined
Field Sampling Organization	REST
Analytical Organization	AmeriSci
No. of Sample Locations	11

Quality Control (QC) 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	No constituent > CRQL	Flag outliers	Data Validator	Accuracy

SECTION 11 DATA MANAGEMENT AND DOCUMENTATION/PROJECT REPORTS

Template 11a: Data Management and Documentation

Field Sample Collection Documents and Records	Analytical Laboratory Documents and Records	Data Assessment Documents and Records	Project File
• Air Sampling logs • Daily field log	• Sample receipt logs • Internal and external COC forms • Equipment calibration logs • Sample preparation worksheets/logs • Sample analysis worksheets/run logs • Telephone/email logs • Corrective action documentation • Laboratory analytical data package	• Data validation reports • Field inspection checklist(s) • Review forms for electronic entry of data into database • Corrective action documentation	• HRP will retain copies of all field reports, laboratory reports or other generated documents, sampling logs, and data validation reports for a period of at least five years. Electronic copies of all forms will be generated upon completion and stored on HRP's electronic network.

Template 11b: Project Reports

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Daily Field Report	Daily	1 day after daily field activities	REST	Rick Cwiklowski, HRP Associates, Inc.
Laboratory Analytical Report	Once	Approximately 48hours after samples are submitted to the laboratory	Analytical, Andrew Lee-AmeriSci	Rick Cwiklowski, HRP Associates, Inc. Eric Dousharm, REST
Data Validation Letter	Once	Approximately 5 weeks after receipt of analytical results	Ted Wall, HRP Associates, Inc.	Jesse Zahn- HRP Associates, Inc. Eric Dousharm, REST
Abatement Air Monitoring Report	Once	Approximately 1-3 months following receipt of the data validation report	Eric Dousharm, REST	Patrick Peck, USEPA PO Heather Devitt, MVEDD

SECTION 12 ASSESSMENT/OVERSIGHT

Template 12a/12b: Planned Project Assessments/Assessment Findings/Corrective Action Responses

Planned project assessments are not included in the air monitoring sampling and analysis plan and are not applicable to this project. Therefore, Brownfields QAPP Templates #12a and #12b have not been utilized. Daily Field Reports may be generated by REST's field project manager during sampling activities and may be provided to HRP's Quality Assurance officer and/or Project Manager at the end of each workday. Daily field reports will document any pertinent field observations, deviations from the work plan, and weather conditions and any corrective actions taken in the field or by the laboratory.

SECTION 13 DATA REVIEW

Template 13a: Project Data Verification Process (Step I)[1]

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Site/Field Logbooks	Field notes will be prepared daily by the HRP and REST field staff and will be complete, appropriate, legible and pertinent. Upon completion of field work, logbooks will be placed in the project files.	I	Rick Cwiklowski, HRP Associates, Inc.
Chains of custody	COC forms will be reviewed against the samples packed in the specific container prior to shipment. The reviewer will initial the form. An original COC will be sent with the samples to the laboratory, while copies are retained for the project files.	I	Rick Cwiklowski, HRP Associates, 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.	I	Analytical, Andrew Lee-AmeriSci
Laboratory analytical data package	Data packages will be reviewed as to content and sample information upon receipt by the HRP and REST project managers and the Third Party Data Validation Personnel.	I/E	Jesse Zahn and Rick Cwiklowski, HRP Associates, Inc. and Eric Dousharm, REST
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.	I	Rick Cwiklowski, HRP Associates, Inc.

Template 13b: Project Data Verification Process (Step IIa and IIb)[1]

Step IIa[1]/IIb[1]	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure that the sampling methods/procedures outlined in QAPP were followed, and that any deviations were noted/approved.	Ted Wall, HRP Associates, Inc.
IIb	SOPs	Determine potential impacts from noted/approved deviations, in regard to PQOs.	Ted Wall, HRP Associates, Inc.
IIa	Chains of custody	Examine COC forms against QAPP and laboratory contract requirements (e.g., analytical methods, sample identification, etc.).	Ted Wall, HRP Associates, 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.).	Ted Wall, HRP Associates, 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).	Ted Wall, HRP Associates, Inc.

[1]Step IIa – Compliance with Methods, Procedures, and Contracts

[1]Step IIb – Comparison with Performance Criteria in QAPP

Template 13c: Project Matrix and Analytical Validation (Steps IIa and IIb)[1]

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa / IIb	Air	Asbestos	Low/Medium	Comparison with performance and sampling criteria as outlined in the QAPP	Ted Wall, Senior Database Manager, HRP Associates, Inc.

[1]Step IIa – Compliance with Methods, Procedures, and Contracts
[1]Step IIb – Comparison with Performance Criteria in QAPP

Template 13d: Usability Assessment (Step III)[1]

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: Rick Cwiklowski, Senior Project Manager, HRP Associates

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.

TABLES

Table 1 – Data Elements for Data Review Process				
Item	Step I - Data Verification	Step IIa - Data Validation Compliance	Step IIb - Data Validation Comparison	Step III -Data Usability
Planning Documents				
Evidence of approval of QAPP	X			Use outputs from previous steps
Identification of personnel	X			
Laboratory name	X			
Methods (sampling & analytical)	X	X	X	
Performance requirements (including QC criteria)	X	X		
Project quality objectives	X		X	
Reporting forms	X	X		
Sampling plans – locations, maps grids, sample ID numbers	X	X		
Site identification	X			
SOPs (sampling & analytical)	X	X		
Staff training & certification	X			
List of project-specific analytes	X	X		
Analytical Data Package				
Case narrative	X	X	X	Use outputs from previous steps
Internal lab chain of custody	X	X		
Sample condition upon receipt, & storage records	X	X		
Sample chronology (time of receipt, extraction/digestion, analysis)	X	X		
Identification of QC samples (sampling /lab)	X	X		
Associated PE sample results	X	X	X	
Communication Logs	X	X		
Copies of lab notebook, records, prep sheets	X	X		
Corrective action reports	X	X		
Definition of laboratory qualifiers	X	X	X	
Documentation of corrective action results	X	X	X	
Documentation of individual QC results (e.g., spike, duplicate, LCS)	X	X	X	
Documentation of laboratory method deviations	X	X	X	
Electronic data deliverables	X	X		
Instrument calibration reports	X	X	X	
Laboratory name	X	X		
Laboratory sample identification no.	X	X		
QC sample raw data	X	X	X	

QC summary report	X	X	X	

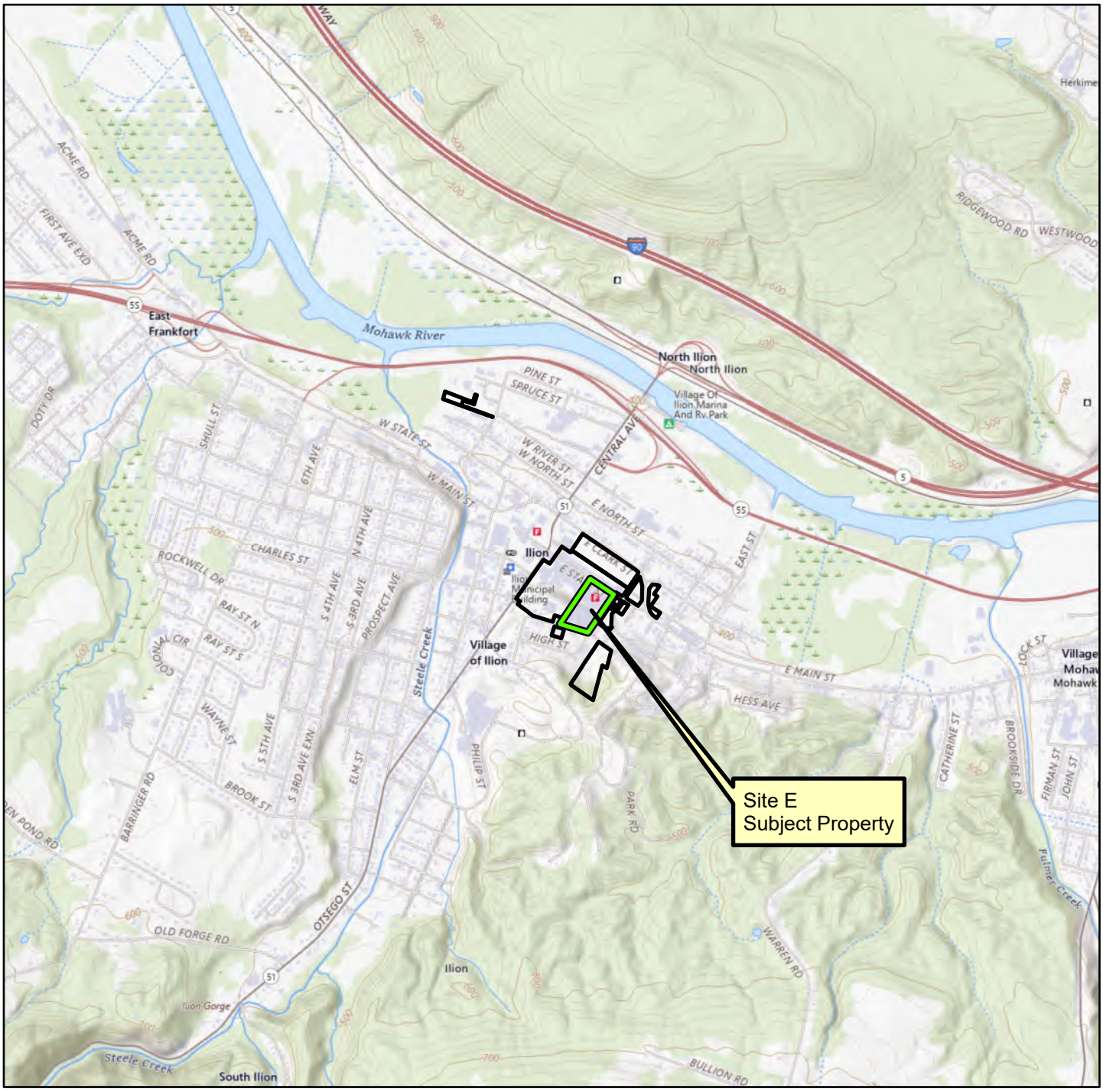
Data Elements for Data Review Process				
Raw data	X	X	X	Use outputs from previous steps
Reporting forms, completed with actual results	X	X	X	
Signatures for laboratory sign-off (e.g., laboratory QA manager)	X	X		
Standards traceability records (to trace standard source form NIST, for example)	X	X	X	
Sampling Documents				
Chain of custody	X	X		Use outputs from previous steps
Communication logs	X	X		
Corrective action reports	X	X	X	
Documentation of corrective action results	X	X	X	
Documentation of deviation from methods	X	X	X	
Documentation of internal QA review	X	X	X	
Electronic data deliverables	X	X		
Identification of QC samples	X	X	X	
Meteorological data from field (e.g., wind, temperature)	X	X	X	
Sampling instrument decontamination records	X	X		
Sampling instrument calibration logs	X	X		
Sampling location and plan	X	X	X	
Sampling notes	X	X	X	
Sampling report (from field team leader to project manager describing sampling activities)	X	X	X	
External Reports				
External audit report	X	X	X	Use outputs from previous steps
External PT sample results	X	X		
Laboratory assessment	X	X		
Laboratory QA plan	X	X		
MDL study information	X	X	X	
NELAP accreditation	X	X		

Table 2
ASBESTOS PROJECT AIR SAMPLING REQUIREMENTS

Air Sampling Requirements by Asbestos Project & Regulated Abatement Work Area Size	Phase I B Background Air Sampling	Phase II A Work Area Preparation Air Sampling	Phase II B Asbestos Handling Air Sampling	Phase II C Final Cleaning & Clearance Air Sampling
LARGE ASBESTOS PROJECT OR LARGE SIZE REGULATED ABATEMENT WORK AREA	Required	Required(5)	Required	Required(6)
Minimum Samples Required (1)	5 Inside Regulated Abatement Work Area & 5 Outside Regulated Abatement Work Area in Building/Structure (2)	1 per decontamination entrance/exit 1 per negative air exhaust or per bank of 5 exhausts 2 at critical barriers 1 outside the building/structure		5 Inside Regulated Abatement Work Area (7) & 5 Outside Regulated Abatement Work Area in Building/Structure (2)
SMALL ASBESTOS PROJECT OR SMALL SIZE REGULATED ABATEMENT WORK AREA	Required	Not Required		Required(6)
Minimum Samples Required (1)	3 Inside Regulated Abatement Work Area & 3 Outside Regulated Abatement Work Area in Building/Structure (2)	0		3 Inside Regulated Abatement Work Area & 3 Outside Regulated Abatement Work Area in Building/Structure (2)
MINOR ASBESTOS PROJECT OR MINOR SIZE REGULATED ABATEMENT WORK AREA	Not Required	Not Required		Required(3, 4)
Minimum Samples Required (1)	0	0		1 Inside Regulated Abatement Work Area & 1 Outside Regulated Abatement Work Area

Notes:
(1) For sample location and total number required, see Subparts 56-6 through 56-9.
(2) 1 sample outside the building/structure if entire building/structure is regulated abatement work area.
(3) Required on glove bag 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 IIC 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.

FIGURES



0 1,000 2,000 4,000 6,000 8,000

Feet

1:24,000

N

Legend

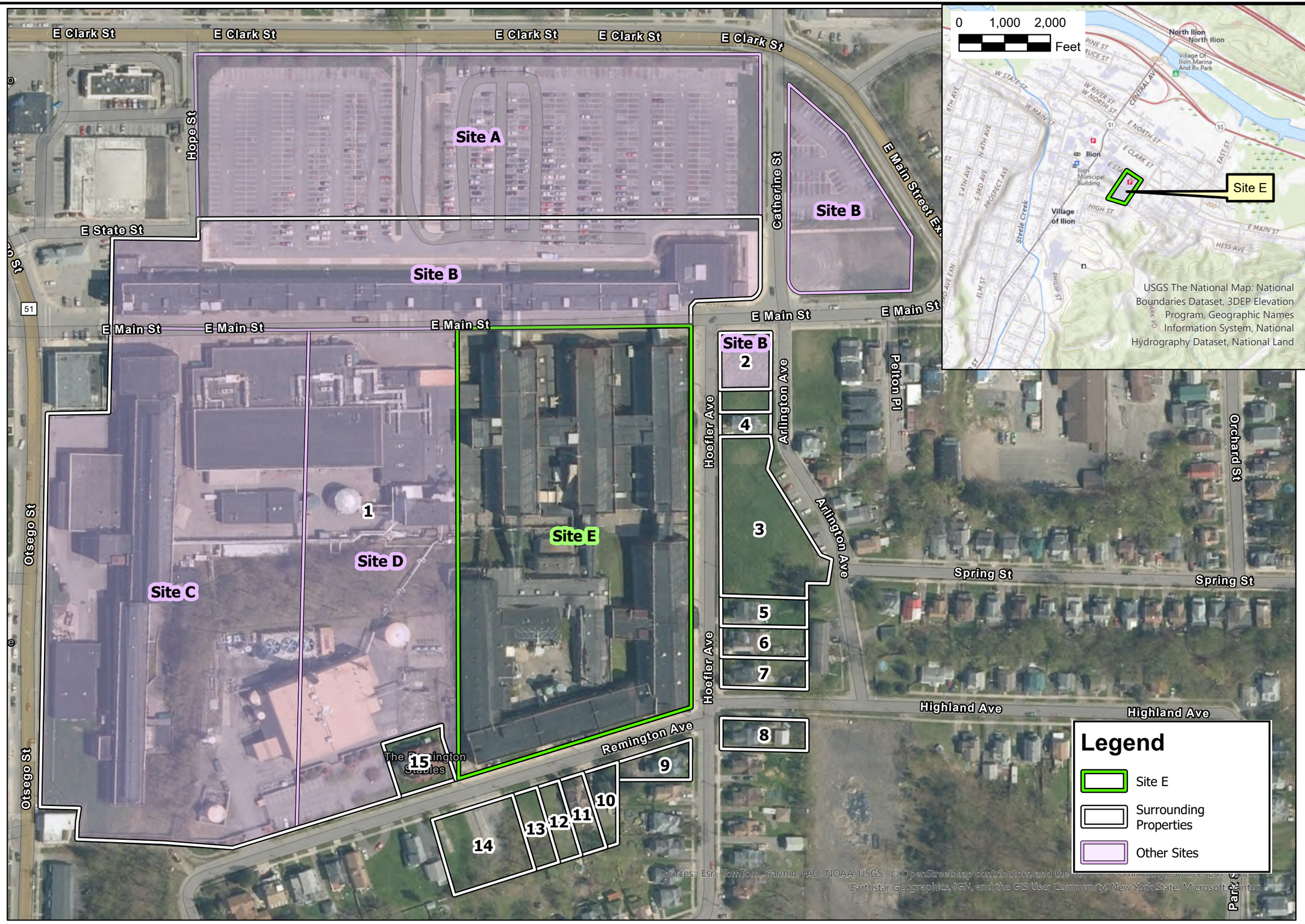
- Site E
- Parcel Boundaries

USGS Quadrangle Information
Quad ID: 43075-A1
Quad Name: Ilion, New York

Figure 1
Subject Property Location Map
Remington Arms
Site E
Ilion, New York
HRP # TUR3503.BA
Scale 1" = 2,000'

HRP
MOVE YOUR ENVIRONMENT FORWARD
ONE FAIRCHILD SQUARE
SUITE 110
CLIFTON PARK, NY 12065
(518) 877-7101
HRPASSOCIATES.COM

Path: S:\Data\TTURMG - TURIN MANAGEMENT LLC\14 HOEFLER AVENUE, ILION, NEW YORK\TUR3503BA - Site E RFL QAPP Rem Arms\GIS\Figures.aprx



HRP
MOVE YOUR ENVIRONMENT FORWARD
197 SCOTT SWAMP ROAD
FARMINGTON, CT 06032
(860) 674-9570
HRPASSOCIATES.COM

North

0 75 150
Feet

Revisions					
No.					
Date					

Designed By:	Drawn By:	Reviewed By:
CLT	BOB	RC

Issue Date:	Project No:	Sheet Size:
07/31/2026	TUR3503.BA	11x17

Site E Site Plan

The Remington Site E
14 Hoefler Avenue
Ilion, New York

Figure No.

2

Path: S:\Data\TUTURMG - TURIN MANAGEMENT LLC\14 HOEFLER AVENUE, ILION, NEW YORK\TUR3503BA - Site E RFI QAPP Rem Arms\GIS\Figures.aprx

APPENDIX A
Standard Operating Procedures

APPENDIX A-1

NMAM Standard Operating Procedures

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/mm^2 (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):

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

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.

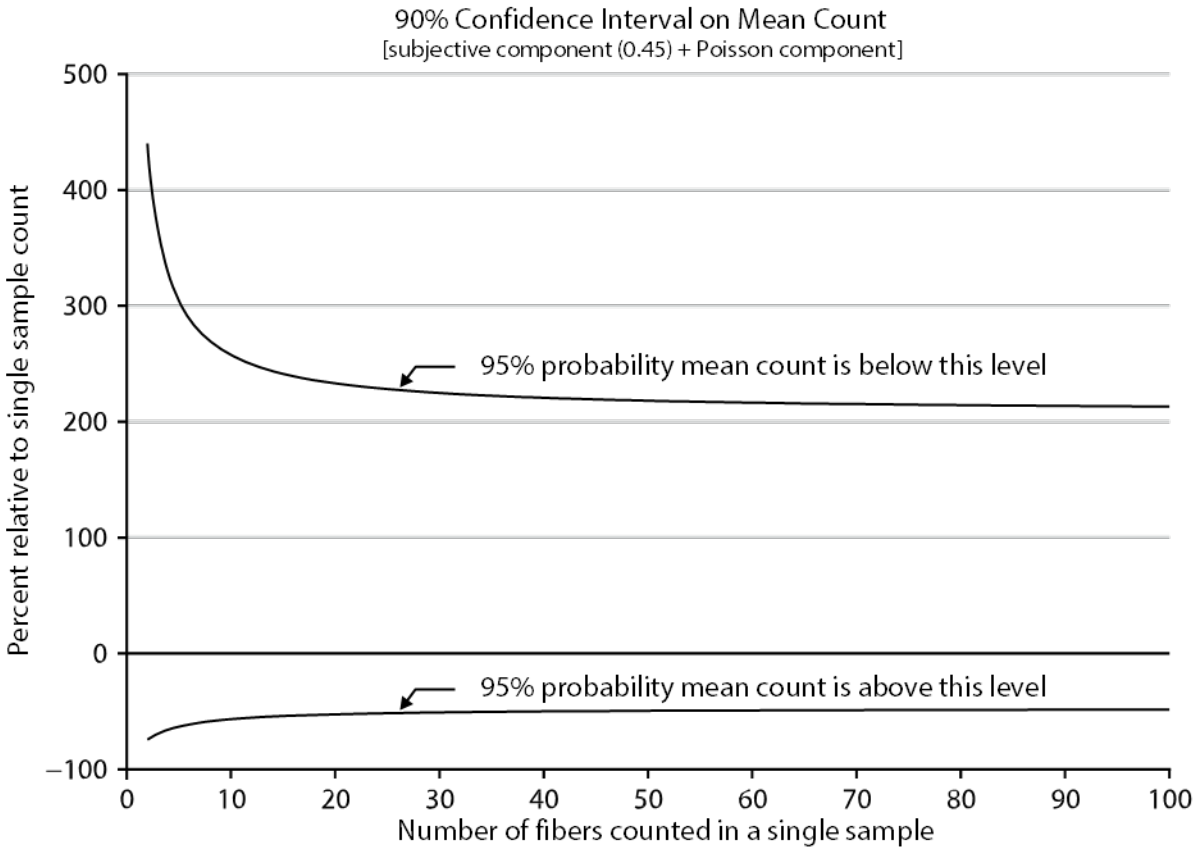


Figure 1. Interlaboratory precision of fiber counts

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

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

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

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

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:

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

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:

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

and

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

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.

REFERENCES:

[1] NIOSH [1979]. USPHS/NIOSH Membrane Filter Method for Evaluating Airborne Asbestos Fibers. By Leidel NA, Bayer SG, Zumwalde RD, Busch KA. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 79-127.

[2] Baron P, Pickford PA, Pickford GC [1986]. An asbestos sample filter clearing procedure. Appl Ind Hyg *1*:169–171, 199.

[3] LeGuen JMM, Galvin S [1981]. Clearing and mounting techniques for the evaluation of asbestos fibers by the membrane filter method. Ann Occup Hyg *24*:273–280.

[4] Lee EG, Pang TWS, Nelson J, Andrew M, Harper M [2011]. Comparison of mounting methods for the evaluation of fibers by phase contrast microscopy. Ann Occup Hyg *55*:644-657.

[5] OSHA [1994]. 29 CFR Part 1910.1001 Occupational Exposure to Asbestos. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.

[6] McCrone W, McCrone L, Delly J [1978]. Polarized light microscopy. Ann Arbor, MI: Ann Arbor Science.

[7] Rooker SJ, Vaughn NP, LeGuen JM [1982]. On the visibility of fibers by phase contrast microscopy. Am Ind Hyg Assoc J *43*:505–515.

[8] Kenney LC, Rood AP, Blight BJN [1987]. A direct measurement of the visibility of amosite asbestos fibres by phase contrast optical microscope. Ann Occup Hyg *33*:261–264.

[9] Harper M, Lee EG, Doorn SS, Hammond O [2008]. Differentiating non-asbestiform amphibole and amphibole asbestos by size characteristics. J Occup Envir Hyg *5*:761–770.

[10] Lee EG, Nelson J, Kashon M, Harper M [2015]. Evaluation of the dark-medium objective lens in counting asbestos fibers by phase-contrast microscopy. Ann Occup Hyg *59*:616–628.

[11] Baron P, Deye G [1990]. Electrostatic effects in asbestos sampling: parts I and II. Am Ind Hyg Assoc J *51*:51–69.

[12] ISO [2013]. ISO 13137-13 Workplace atmospheres -- Pumps for personal sampling of chemical and biological agents -- Requirements and test methods. Geneva, Switzerland: International Organization for Standardisation.

[13] Johnston AM, Jones AD, Vincent JH [1982]. The influence of external aerodynamic factors on the measurement of the airborne concentration of asbestos fibers by the membrane filter method. Ann Occup Hyg *25*:309–316.

[14] Beckett ST [1980]. The effects of sampling practice on the measured concentration of airborne asbestos. Ann Occup Hyg *23*:259–272.

[15] Cherrie J, Jones AD, Johnston AM [1986]. The influence of fiber density on the assessment of fiber concentration using the membrane filter method. Am Ind Hyg Assoc J *47*(8):465–474.

[16] Lee EG, Nelson J, Hintz PJ, Joy G, Andrew ME, Harper M [2010]. Field performance of the CATHIA-T sampler and two cyclones against the standard cowled sampler for thoracic fiber concentrations. Ann Occup Hyg *54*:545-556.

[17] NIOSH [1977]. P&CAM 239. In: Taylor DG, ed. NIOSH manual of analytical methods, 2nd ed. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW(NIOSH) Publication No. 77-157-A.

[18] AIA [1979]. AIA Health and Safety Recommended Technical Method #1: airborne asbestos fiber concentrations at workplaces by light microscopy. London, England: Asbestos International Association.

[19] Crane D, Harper M [2011]. The phase-shift test slide. https://www.aiha.org/Registries/aar/Documents/Phase%20Shift%20Interpretation%20OSHA%20NIOSH_2011_04_11.pdf.

[20] Abell MS, Shulman SA, Baron P [1989]. The quality of fiber count data. Appl Ind Hyg *4*:273–285.

[21] AIA [1983]. A study of the empirical precision of airborne asbestos concentration measurements in the workplace by the membrane filter method. Arlington, VA: Asbestos Information Association, Air Monitoring Committee.

[22] NIOSH [1976]. Revised Recommended Asbestos Standard. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Center for Disease Control, National Institute for Occupational Safety and Health DHEW (NIOSH) Publication No. 77-169.

[23] IOM [1982]. A comparison of the effects of different counting rules and aspect ratios on the level and reproducibility of asbestos fiber counts. Part I: effects on level and Part II: effects on reproducibility. By Crawford NP, Thorpe HL, Alexander W. Edinburgh, Scotland: Institute of Occupational Medicine.

[24] HSE [1982]. Health and Safety Executive research paper 18: the reproducibility of fiber counts. By Ogden TL. Sheffield, England: Health and Safety Laboratory, Health and Safety Executive.

[25] Schlecht PC, Schulman SA [1986]. Performance of asbestos fiber counting laboratories in the NIOSH Proficiency Analytical Testing (PAT) Program. Am Ind Hyg Assoc J *47*:259–266.

[26] Edwards GH, Lynch JR [1968]. The method used by the Public Health Service, for enumeration of asbestos dust on membrane filters. Ann Occup Hyg *11*:1-6.

[27] Lane RE, Barnes JM, Roach SA, Smith S, Addingley CG, Holmes S, Hunt R, Knox JF, King E [1968]. Hygiene standard for chrysotile asbestos dust. Ann Occup Hyg *11*:47 -49.

[28] NIOSH [1972]. NIOSH criteria for a recommended standard: occupational exposure to asbestos. Cincinnati, OH: U.S. Department of Health Education and Welfare, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 72-10267.

[29] Royal Commission on Matters of Health and Safety Arising from the Use of Asbestos in Ontario. Measurement of asbestos fiber concentrations in workplace atmospheres: Study No. 9. By Chatfield, EJ. Toronto, Ontario.

[30] Walton WH [1982]. The nature, hazards, and assessment of occupational exposure to airborne asbestos dust: a review. Ann Occup Hyg *25*:115–247.

[31] LeGuen JMM, Ogden TL, Shenton-Taylor T [1984]. The phase-shift test slide. Ann Occup Hyg *28*:237-247.

[32] Taylor DG, Baron PA, Shulman SA, Carter JW [1984]. Identification and counting of asbestos fibers. Am Ind Hyg Assoc J *45*:84–88.

[33] Pang TWS, Harper M [2008]. The quality of fiber counts using improved slides with relocatable fields. J Environ Monit *10*:89-95.

[34] Harper M, Slaven JE, Pang TWS [2009]. Continued participation in an asbestos fiber counting proficiency test with relocatable grid slides. J Environ Monit *11*:434-438.

[35] ISO [2014]. ISO 8672-14[E] Air quality — determination of the number concentration of airborne inorganic fibres by phase contrast optical microscopy — membrane filter method. Geneva, Switzerland: International Organization for Standardisation.

[36] Baron PA, Shulman SA [1987]. Evaluation of the Magiscan image analyzer for asbestos fiber counting. Am Ind Hyg Assoc J *48*:39-46.

[37] Pang TWS [2000]. Precision and accuracy of asbestos fiber counting by phase contrast microscopy. Am Ind Hyg Assoc J *61*:529–538.

[38] Harper M, Bartolucci A [2003]. Preparation and examination of proposed consensus reference standards for fiber-counting. Am Ind Hyg Assoc J *64*:283-287.

[39] WHO [1985]. Reference methods for measuring airborne man-made mineral fibers (MMMF). By: The WHO/EURO Technical Committee for Monitoring an Evaluating Airborne MMMF. Copenhagen, Denmark: World Health Organization.

[40] NIOSH [1977]. NIOSH criteria for a recommended standard: occupational exposure to fibrous glass. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77-152.

METHOD WRITTEN BY:

Paul A. Baron, PhD, NIOSH; Revised by Martin Harper, PhD, CIH, FAIHA, CChem, FRSC, NIOSH (retired) and Rosa Key-Schwartz, PhD, NIOSH.

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.

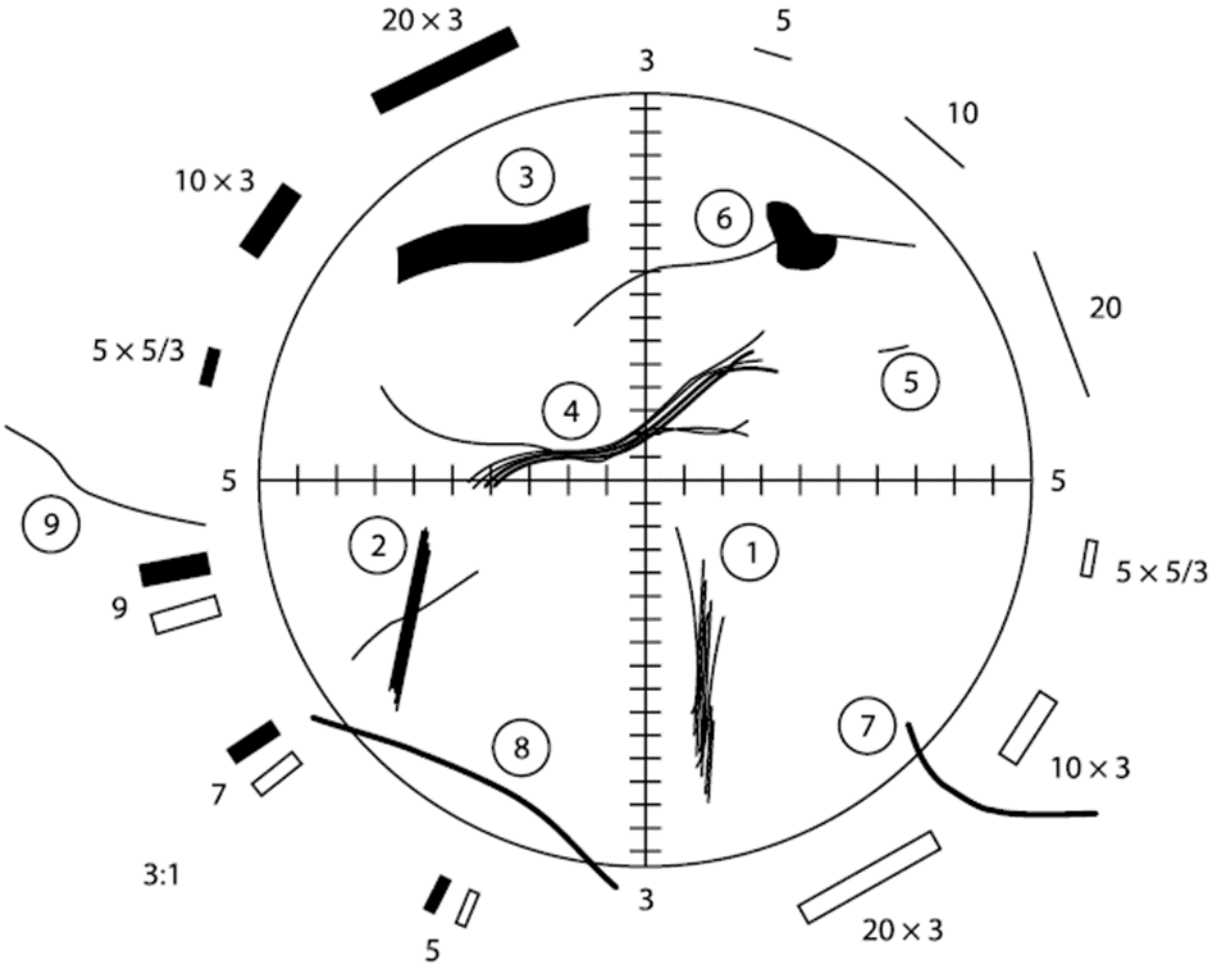


Figure 2 Walton-Beckett graticule with fibers

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 /mm^2)	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 mm^2 effective filter collection area, and field area = 0.00785 mm^2, 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/cm^3

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.

11. **References**

11.1. Lynch, J. R., K. J. Kronoveter, and N. A. Leidel, "Validity of the Poisson Distribution in Dust Counting", unpublished.

11.2. Weidner, R. B. and H. E. Ayer, "Dust Exposure in Asbestos Processing", Transactions of the American Conference of Governmental Industrial Hygienists, May 1972, pp. 103-121, San Francisco, California.

11.3. Conway, R. E. and W. D. Holland, "Statistical Evaluation of the Procedure for Counting Asbestos Fibers on Membrane Filters", LFE Corporation, Richmond, California. Prepared for the Asbestos on Membrane Assoc/North America, New York, 1973.

11.4. Leidel, N. A. and K. A. Busch, "An Evaluation of Phase Contrast Microscopes for Asbestos Counting", presented at the 1974 American Industrial Hygiene Conference, Miami Beach, Florida, May 18, 1974, unpublished.

11.5. Beckett, S.T. and M.D. Attfield, "Inter-Laboratory Comparison of the Counting of Asbestos Fibers Sampled on Membrane Filters", Ann Occup Hyg 17:85-96, 1974.

11.6. Rajhans, G. S. and G. M. Bragg, "A Statistical Analysis of Asbestos Fiber Counting in the Laboratory and Industrial Environment", Am Ind Hyg Assoc J 36(12):909-915, 1975.

11.7. Leidel, N. A. and K. A. Busch, "Statistical Methods for the Determination of Noncompliance with Occupational Health Standards", NIOSH Technical Publication 75-159, 1975.

11.8. Leidel, N. A., K. A. Busch, and J. R. Lynch, "Occupational Exposure Sampling Strategy Manual", NIOSH Technical Publication 77-173, 1977.

11.9. Leidel, N. A.; K. A. Busch, and W. E. Crouse, "Exposure Measurement Action Level and Occupational Environmental Variability", NIOSH Technical Publication 76-131, 1975.

11.10. Comments of the Johns-Manville Corporation with Respect to the Notice of Proposed Rulemaking: Occupational Exposure to Asbestos, Federal Register, October 9, 1975. Submitted to the public record at the U. S. Department of Labor, Occupational Safety and Health Administration, April 1976.

11.11. Leidel, N. A., S. G. Bayer, R. D. Zumwalde, and K. A. Busch, USPHS/NIOSH Membrane Filter Method for Evaluating Airborne Asbestos Fibers, to be published by NIOSH in 1977.

11.12. Needham, G. H., The Practical Use of the Microscope, Charles C. Thomas Publishing Corporation, Springfield, Illinois, 1958.

11.13. Clark, G. L., The Encyclopedia of Microscopy, Rheinhold Publishing Corporation, New York, 1961.

11.14. McCrone, W. C. and J. G. Delly, I. The Particle Atlas, Edition Two, Ann Arbor Science Publishers, Inc., Ann Arbor, Michigan, 1973.

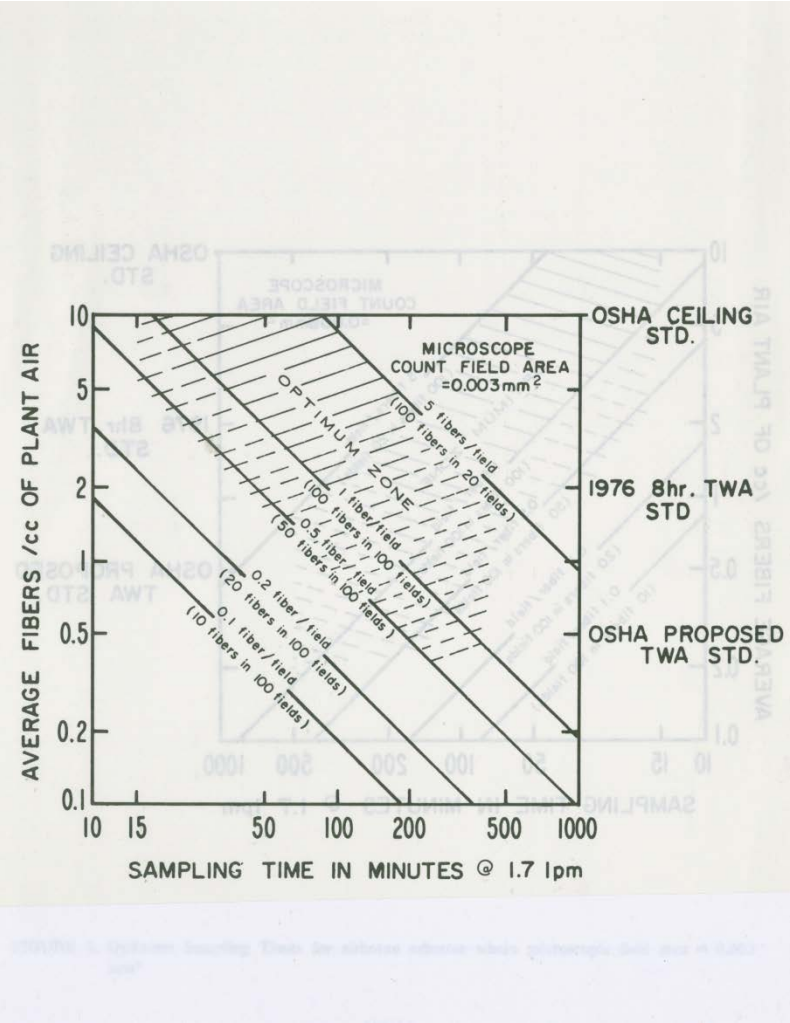


Figure 1 Optimum Sampling Times for airborne asbestos where microscopic field area = 0.003 mm²

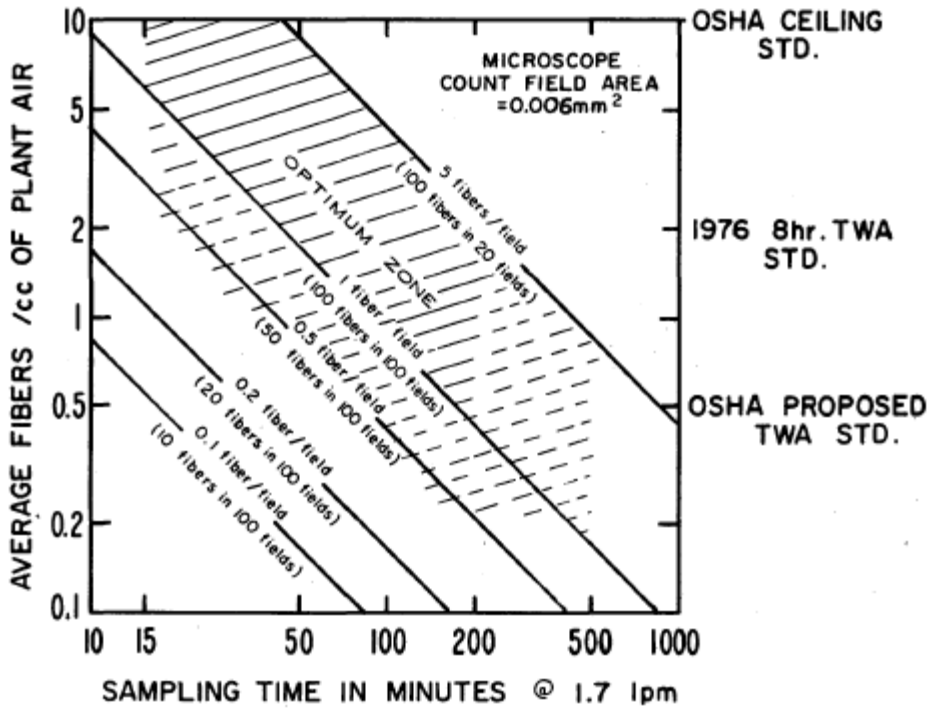


Figure 2 Optimum sampling times for airborne asbestos where microscopic field area = 0.006 mm²

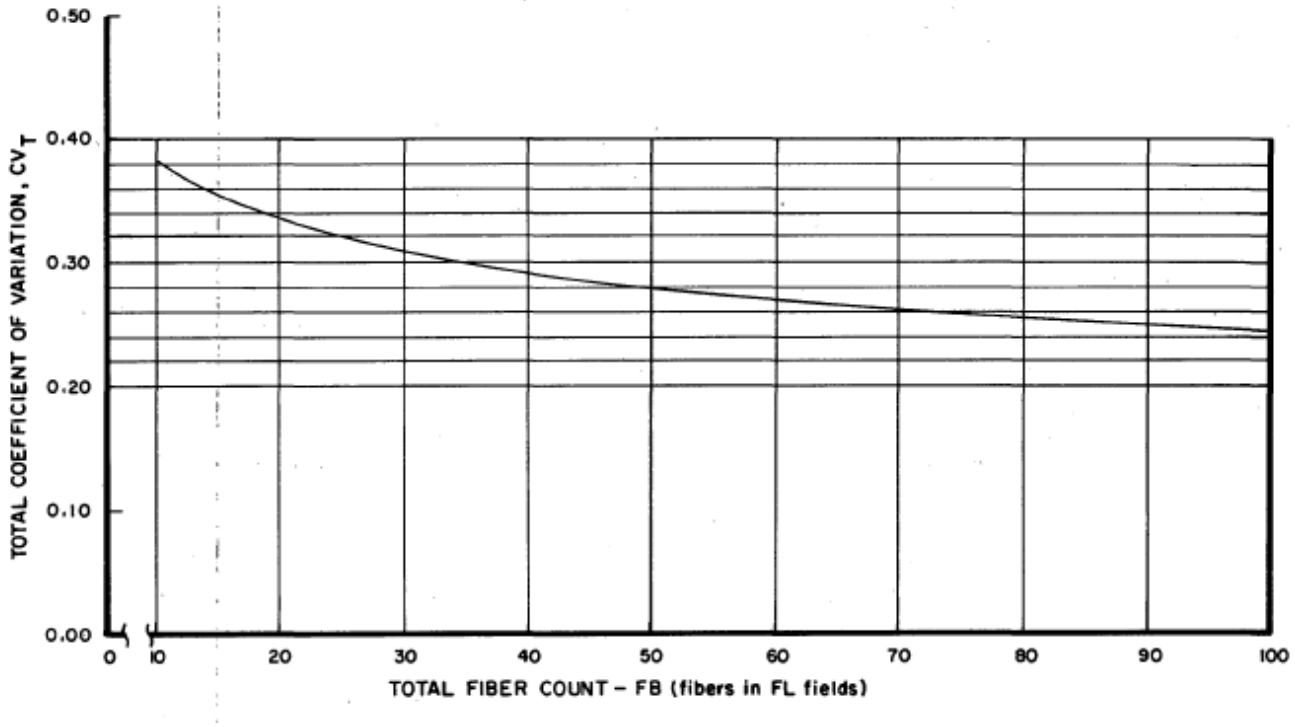


Figure 3 Total coefficient of variation as a function of total fiber count

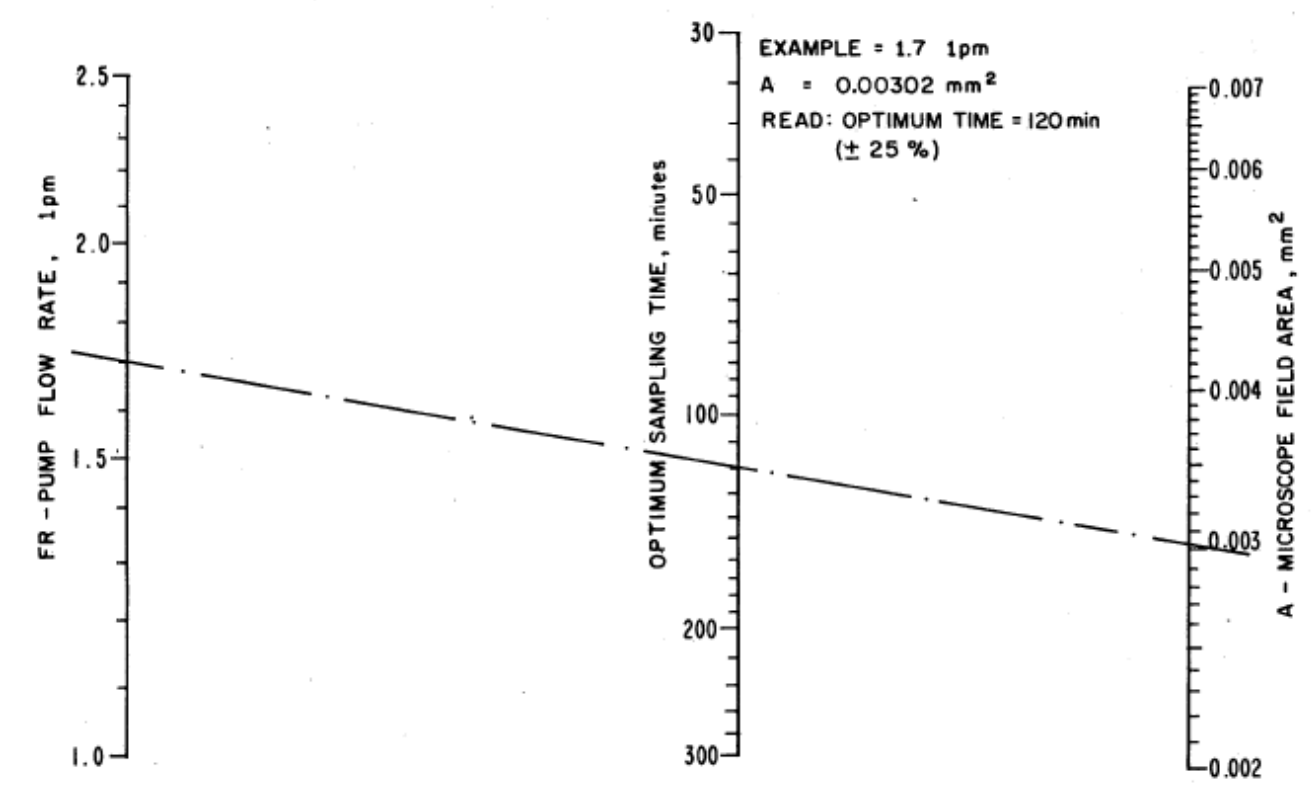


Figure 4 Nomogram of optimum sampling times for airborne asbestos fibers in concentrations of 1 to 10 fibers/cm³

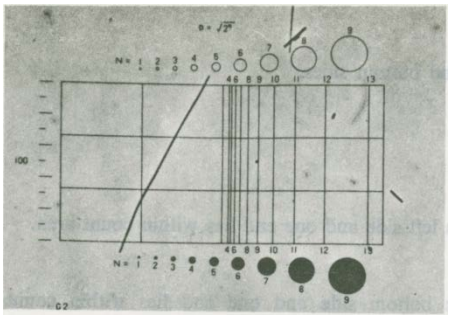


Figure 5 DO NOT COUNT. Fiber crosses top and bottom sides.

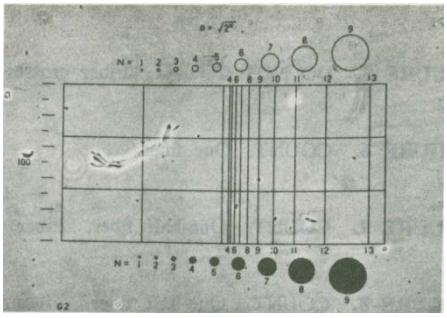


Figure 6 COUNT. One fiber.

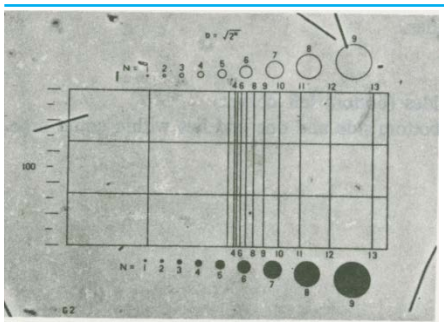


Figure 7 COUNT. One-half fiber. Fiber crosses left side and one end lies within the count area.

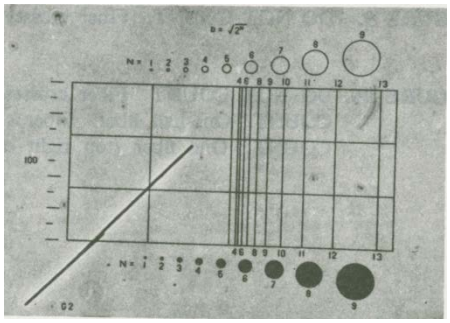


Figure 8 COUNT. One-half fiber. Fiber crosses bottom side and one end lies within count area.

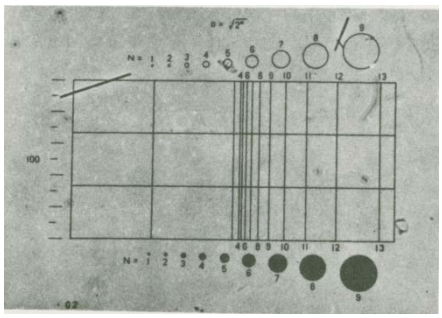


Figure 9 DO NOT COUNT. Fiber crosses two sides.

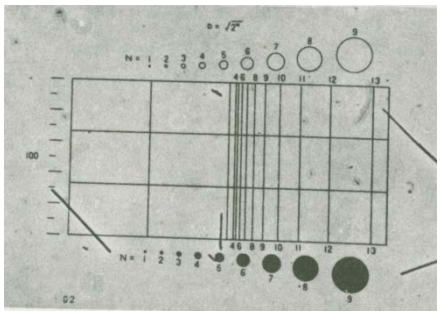


Figure 10 DO NOT COUNT. Fiber crosses two sides (bottom left corner). COUNT. One-half fiber. Fiber crosses bottom side and one end lies within count area. COUNT. One fiber (top right corner).

APPENDIX A-2

REST Standard Operating Procedures

ROME ENVIRONMENTAL SOLUTIONS & TESTING, LLC

Standard Operating Procedure #2

Title	Air Sampling Protocols for Interior Abatement of Asbestos Containing Materials (ACM)
Description	This Standard Operating Procedure (SOP) outlines how REST, LLC, will meet the New York State Department of Labor (NYS DOL) requirements for all asbestos projects performed in New York state which are subject to Part 56 Title 12 of the Official Compilation of Codes, Rules and Regulations of the State of New York (Cited as 12 NYCRR Part 56)
Link to NYS DOL code rule:	https://dol.ny.gov/system/files/documents/2023/12/icr56.pdf;
Effective Date / Updated	January 31, 2019
Cancellation Date	N/A
Replaced by P&P #	N/A
Qualifications of Air Sampling Personnel	REST Project Monitors/Air Sampling technicians are trained and certified yearly by NYS Department of Health (NYS DOH).
Sample Analysis Method	The NIOSH 7400 Method is the standard used for measuring the concentration of asbestos and other fibers in the air. It uses Phase Contrast Microscopy (PCM) to analyze samples collected on approved cassettes and shall be used at all phases of an asbestos project which require air sampling and analysis.
Laboratory Accreditation	All laboratories used by REST for sample analysis shall be accredited by both the National Voluntary Laboratory Accreditation Program (NVLAP) and the New York State Department of Health Environmental Laboratory Accreditation Program (ELAP)
Duration, Flow Rate and Calibration	For interior abatement air sampling, the samples shall be collected for the entire work shift, with a minimum flow rate capacity of two (2) liters per minute (LPM) and a maximum flow rate consistent with the applicable accepted air sampling and analysis methodology. The flow rate for each air sample shall be pre-calibrated and post-calibrated at the beginning and end of each work shift.
Standard Placement of Air Samples	NYS DOL has minimum requirements. Air sampling equipment shall be in place prior to the start of work activities and located as follows: • Personal Decontamination Unit Entrance • Personal Decontamination Unit Exit (Remote Decon Only) • HEPA Exhaust – one per negative air exhaust or bank of 5 exhausts. • Adjacent #1 critical barrier • Adjacent #2 critical barrier • Ambient Air • Two Field Blanks It is important to note that a site-specific variance can impact the actual number of samples that are required. REST will make appropriate adjustments as needed based on the site-specific variance.
Standard Sample labeling	Per project REST will utilize a sequential number scheme starting with 01.

Qualification of Air Sampling personnel	All project air sampling shall be conducted by an asbestos project monitor/air sampling technician who has been trained in the selected methodology of air sampling and who possesses an asbestos project air sampling technician certificate issued by NYS DOH. All of REST Project Monitors/Air Sampling Technicians are trained and certified annually by NYS DOH.
Equipment used for air sampling	• PCM Air Cassettes 25 mm filter, Pore Size 0.8u (Micro) • Battery air pump – Gillian BDX II; Adjustable Flow 0.2–3 Liters Per Minute (LPM) • High Volume battery air pump – Super Vac; Adjustable Flow 2.0 – 12.0 LPM • Electric air pump – EMS ePro HD; Adjustable Flow of 2–30 LPM • All air pumps are calibrated at the start of the sample period and at the end of the sample period using a rotameter. • GFCI Ext Cord 2 'with 3-way plug; UL rainproof rated for outdoor use. Complies with all OSHA regulations. • 5/16-inch O.D. polyethylene tubing • Telescopic Air Sampling Stands • Environmental Monitoring System (ems) Rotameter – 1-20 LPM; Calibrated every 3 months

Standard Protocol	
	REST will have the air sampling technician on-site to observe and maintain air sampling equipment for the duration of air sample collection.
	• At the start of the shift the project monitor/air technician will fill out an air sample analysis sheet/chain of custody (sample log) that includes the client/job information, the project monitor/air technician information and the Rotameter number/calibration date. • The air sample cassette is numbered with a Sharpie non erasable marker and placed on a 4-foot-tall stand at a 45-degree angle. • Each air sample shall be placed in accordance with the above standard placement of air samples and/or the Site-Specific Variance. • At the beginning of each shift, each sample will be pre-calibrated by attaching the PCM Cassette to a calibrated rotameter and adjusted for the appropriate flow rate and documented on the sample log. • If an electric air sampling pump is utilized it is to be plugged into an OSHA approved GFCI extension cord. • The air sample will be run the entire time that the controlled demolition site has active work being performed. • At the end of the shift, the sample will be attached to the same rotameter and the post-calibrated flow rate will be documented on the sample log. The average of the two readings shall be used in calculating the total liters of air collected. • The sample will be capped and placed in a large plastic sealable bag with the completed and signed air sample analysis chain of custody document. • The plastic bag is placed in a shipping bag and sent overnight to an approved NVLAP/ELAP laboratory. • The laboratory will sign the chain of custody and email the results back to REST within 48 hours of sample collection. • REST will provide hard copies of the air sample results on site and also will be available electronically.

APPENDIX A-3

AmeriSci Analytical Laboratories Standard Operating Procedures

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 [signature] Date 1/16/25

Affiliate QA Officer Tonya L Karsom 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. PCM Fiber Counting Rules (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:

$$\Sigma C_iT_i = C_1T_1 + C_2T_2 + ...C_nT_n$$

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 ΣC_iT_i from step 4.5.3.3. by the Total Time from step 4.5.3.1. as follows:

$$\text{Actual Exposure} = (C_1T_1 + C_2T_2 + ... C_nT_n) / \text{Total Time}$$

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.

$$\text{8-hour TWA} = (C_1T_1 + C_2T_2 + ... C_nT_n) / 480$$

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).

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

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. Inter-Laboratory Quality Control

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. Asbestos Fiber Differentiation by NIOSH 7402

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. Monthly Summaries

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)

APPENDIX B

Safe Work Permit

HRP

SAFE WORK PERMIT

PROJECT INFORMATION	
PROJECT NUMBER	**PROJECT ADDRESS**
TUR3502.BA	14 Hoefler Avenue, Ilion, New York

CLIENT INFORMATION	
CLIENT'S CONTACT NAME	**CONTACT NUMBER**
Kristen O'Neill	(914) 552-3316

CONTRACTOR INFORMATION	
Will a subcontractor be involved with the stated scope of work for this project?	☐ YES ☑ NO
If YES, proceed to answering the contractor's information below. If NO, this section is not applicable.	
CONTRACTOR'S CONTACT NAME	**CONTACT NUMBER**
Does contractor require HRP Health & Safety Orientation? If so, ensure this has been completed prior to performing job task(s).	☐ YES ☐ NO

Modify the General Information section as needed and include changes in the "Modifications of the Safe Work Permit Log."

PURPOSE AND SCOPE OF WORK

Provide oversight and reporting for abatement of former Remington Arms facility

SITE-SPECIFIC REQUIREMENTS

List any required training, site-specific requirements, and/or procedures that are or may be required to complete job task(s). If the client requires orientation to be completed prior to performing job task(s), be sure to list below and complete the orientation (ensure contractors also receive client orientation if needed). Before going on-site, verify with the client if there are any site security and/or visitor protocols that should be known (including cell phone usage).

Contractor oversight of ACM abatement

ACKNOWLEDGEMENT OF SAFE WORK PERMIT

The affected HRP's employee shall review this Safe Work Permit and acknowledge below that they understand the job task(s) being performed, the requirements, the potential hazards, and the control measures that are listed within this permit.

EMPLOYEE'S NAME	SIGNATURE	DATE
TBD		

PROJECT MANAGEMENT ACKNOWLEDGEMENT

Prior to the work being performed, this Safe Work Permit is required to be acknowledged by the Project Manager of the stated scope of work.

PROJECT MANAGER	SIGNATURE	DATE
Richard Cwiklowski		7/31/2026

PROJECT ASSESSMENT

Due to the nature of services that are provided, the activities listed below can lead to potential health and safety risks if the appropriate measures are not taken. Check the tasks or activities that are ONLY relevant to the work that will be performed by either the HRP employee and/or subcontractor. By acknowledging this Safe Work Permit, you are agreeing that you and/or the subcontractor have completed the Control Measures below that are listed by its task.

Activities Involved with Project	Control Measures to be Completed
☑ Working and/or traveling alone	Notify manager prior to working alone and/or traveling. Stay in communication with manager during work, such as, expectations of when to return, once arrive to designation, once work is complete, and when returned. Include emergency contacts in the appropriate section of this Safe Work Permit.
☐ Hot Work (Welding, Grinding, etc.)	Hot Work Permit Issued – Fire Watch Required
☐ Electrical Work	LOTO, confirm zero energy, training
☐ Rigging or Heavy Lifting	Load Ratings, Employee Certification, training
☐ Usage of Scaffold(s)	Competent Person Inspection Required
☐ Confined Space Entry	Permit Required, training
☐ Handling Hazardous Chemicals	Chemical list and SDS review with Employees, training, PPE
☐ Usage of Ladders / Stairways	Proper Rating, No Metal Ladders, Current Inspection
☐ Working at Heights	Training, PPE, Approved Anchor Points or Fall Protection
☐ Lockout Tagout	Verify proper lockout/tagout, Training
☐ Excavation / Ground Disturbance	Call Before You Dig, Training
☐ Roof Work	Awareness of working at heights, Fall protection if needed
☑ Walking Working Surfaces (Uneven)	Inspect area, Awareness on working at heights, guards/coverage
☐ Usage of Hand and Power Tools	Inspect prior to use, training of tool, ergonomics best practice
☐ Fire Systems (Impairment)	Post Fire Watch
☐ Locked Gates	Post signs and alternate exits, secure access arrangement
☐ Demolition at Construction Site	Inspect area, training
☑ Hazardous Materials (Abatement/Inspection)	Training, PPE
☐ Roadway Traffic	Training, PPE, High-Visibility Vest, Be alert, May use barriers/signs/cones
☐ Ergonomics	Training on specific stretches, proper techniques
☐ International Work	Review State Department website for any travel restrictions/notices, register travel with State Department, stay in touch with manager, utilize travel agency
☐ Construction Site/Utility Inspections	Awareness of Surroundings, Review of hazards, PPE
☐ Extreme environment temperatures	Heat/Cold Stress training, appropriate gear/clothing, know weather conditions prior to starting work
☐ Manual Handling	Training (Ergonomics), stretches, use of appropriate equipment
☐ Working Over/Near Water	Training, life jacket/buoyant work vest, ring buoys
☐ Other (List):	

NOTE: When working at a job site, be sure toilet and washing facilities are available either on-site or you know nearest location of facilities easily. Be sure hand sanitizer is available.

HAZARDS (OR PERSONAL SAFETY CONSIDERATIONS)

☐ Chemicals	☐ Fire/Heat/Explosions	☑ Temp Extreme Cold/Hot	☐ Tight/Crowded Area
☐ Laceration/Abrasion	☐ Struck By/Against	☐ Allergies	☐ Uneven floors/Surfaces
☐ Falling Objects/Loads	☐ Flying Debris	☐ Obstruction Exits/Paths	☑ Inclement Weather
☑ Slip / Trip / Fall	☐ High Pressure	☐ Compressed Air	☐ Excessive/Loud Noise
☐ Auto Equipment	☐ Mobile Equipment	☐ Animal Feces	☐ Toxic Plants
☐ Exposed Movement	☐ Poor Lighting/Visibility	☐ Caught In/On	☐ Conveyors
☐ Confined Space	☐ Drowning/Flooding	☐ Improper Machine Guards	☐ Poor Housekeeping
☐ Traffic	☐ Atmosphere	☐ Homeless Encampments	☐ Unnecessary Behavior
☐ Mold / Bacteria	☐ Unsafe Structure/Ceiling	☐ Dust / Silica	☐ Insects
☐ Electricity	☐ Animals/Birds	☐ Poor Cell Reception	☐ Remote Setting
☐ Radiation	☐ Potential for Unwanted Persons	☐ Poor/None Sanitation Facilities	☐ Security Issues/Concerns

Ergonomics: ☐ Repetitive Motion ☐ Vibration ☐ Poor Posture ☐ Poor design/workflow ☐ Other (Specify):	Hazardous Materials: ☐ Lead ☐ PCB ☑ Asbestos ☐ Benzene ☐ RCS ☐ Other (Specify):	☐ Other (Specify): _____ _____

REQUIRED PERMITS		
☐ None	☐ Hot Work	☐ Call Before You Dig
☐ Scaffold Inspection	☐ Confined Space	☐ Street Opening/Closing
☐ Electrical	☐ Working at Heights	☐ Encroachment
☐ Other (List)		

REQUIRED INSPECTIONS			
At times, an employee may need to inspect some type of equipment, material, tool, etc. (ladder, scaffold, fall harness, etc.) prior to use or before performing job task(s) at other job sites. Vehicle and PPE inspections are exempt from this section.			
1		4	
2		5	

PERSONAL PROTECTIVE EQUIPMENT (PPE)			
☑ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☐ Hardhats
☑ Steel Toe Shoes	☐ Over Boots	☐ Other Type of Safety Shoe (List):	
☐ Harness	☐ Lifebelt/Lanyard	☐ Reflective Vests	☐ Hearing Protection
☐ Cut Resistant Gloves	☐ Chemical Resistant Gloves	☐ Other Type of gloves/sleeves (List):	
☐ Respirator (Check the type below) ☐ Air Purifying Respirator - Cartridge Type: ☐ Face Mask ☐ Dust Mask ☐ N95 Respirator *Consult with OHSM prior to using respiratory protection.		☐ Protective Clothing (Check the type below) ☐ Tyvek ☐ Chemical ☐ Biological ☐ Radiological ☐ Other (List):	
☐ Other Type of PPE (Specify)			

PROCEDURES
List HRP's Health & Safety procedures that are related to the job task(s) being performed. Procedures may be attached to this completed Safe Work Permit. Include emergency procedures that are relevant to the job task(s) and work site, if applicable. HRP's HS procedures may be found at the following link: Standard Operating Procedures (SOPs) - Hike (hrpassociates.com). By acknowledging this Safe Work Permit, you are acknowledging that you have read and understand the applicable SOPs that are listed below.
Cold Stress Control, Heat Stress Control, Personal Protective Equipment, Rain-Electrical Storms-Snow-Ice

Only fill in the information that is needed to perform a project. Not all contact information may be needed for the job. If working alone, be sure to fill out the appropriate contact information. In case of any type of emergency regarding fires, need of ambulance, or immediate assistance from police, contact 9-1-1.

EMERGENCY CONTACT INFORMATION		
EMERGENCY CONTACT		**CONTACT NUMBER**
Police Department	Village of Ilion	911
Fire Department	Ilion Fire Department	911
Hospital	Wynn Hospital, 111 Hospital Dr., Utica NY	315-917-9966
Poison Center	New York Regional Poison Control Center	800-222-1222
Oil/Chemical Spill Emergency Response	National Response Center	1-800-424-8802
Chemical/Oil Spill Agency	NYS Spill Hotline	1-800-457-7362

MODIFICATIONS OF THE SAFE WORK PERMIT LOG

Each time the entered information of the Safe Work Permit is to be modified, updated, and/or reviewed, shall be documented below.

REVISION DATE	MODIFICATION/UPDATED CONTACTED	REVISED BY	REVIEWED BY
7/29/2026	Site Specific information	CLT	

REVISION LOG (DOCUMENT CONTROL PURPOSES)

Each time a revision of this template is made, the revision information must be listed in the Revision Log below.

REVISION DATE	REVISION CONTENT	REVISED BY	APPROVED BY
1.20.2021	Initiated form, Original Release. Document developed to provide a new hazard assessment "checklist" process for Non-HAZWOPER project sites. Replaces the use of former Site HASP document.	SF	TAG
12.15.2022	new hazard checks with associated criteria to improve the hazard assessment and other project planning details to the form e.g., project number, emergency contact table, worker review for signoff, and SOPs to be referenced.	SF	TAG
8.8.2024	-Updated format -Moved certain boxes around to make user friendly and makes more sense, Add instructions, added PPE/Hazards, added to Permits -Updated revisions section to "Modifications of the Safe Work Permit Log & Revision Log for document control purposes only -Eliminated items from Emergency Contact Info section – added statement	JLE	TAG
9.16.24	- Added hazards – to fit more for EHS/Compliance - Replaced SOP with the term procedures – added hyperlink - Added item to Project Assmt - Construction Site/Utility Inspections - Removed Visit Protocols/Security item from Project Assmt, added to the instructions - Replaced Creation Acknowledgement section with PM - Added more info / questions to contractor section	JLE	**TAG**
5.20.2025	- Modified formatting under contractor and client section - Removed "initial" column from the Proj Asstmt, added extreme temps - Added line items for toilet and washing facilities to Proj Asstmt line items - Added acknowledgement statement to Procedure section - Added emergency contacts to be listed under Lone Traveling line item under Proj Asstmt, Added CBYD to Permit section - Added note regarding toilet & washing facilities in Proj Asstmt - Replaced Lone Worker/Traveler with Working Alone and/or Traveling	JLR	**TAG**

APPENDIX C
Blank Sample Handling Forms

Rome Environmental Solutions Testing, LLC
8041 River Road, Rome, New York 13440 Phone: 315-794-7946 Email: edousharm@romeenv.com

AIR SAMPLE ANALYSIS ASBESTOS

Log No: _____ of _____

Date:	Phase: ☐ Background IB ☐ Prep IIA
Day of the Week: Su M Tu W Th F Sa	☐ Daily ☐ Clearance IIC
Client:	Analysis ☐ TEM AHERA
Project #	☐ NIOSH 7400 (PCM)
Project Name:	☐ Other: _____
Project Location:	Turnaround Time: ☐ Rush ☐ 24 Hour ☐ Other: ____
	Rotometer ID #:
Work Area:	Rotometer Calibration Exp Date:

REST ROLE:
☐ Air Sample Tech ☐ Project Monitor

☐ Brenda Card 26-6ZVEL-SHAB ☐ Elizabeth Dousharm 26-6AKDS-SHAB ☐ M. Eric Dousharm 26-6L8PO-SHAB ☐ **Patrick Baker 25-6IJ6Q-SHAB**

SAMPLE	LOCATION/DESCRIPTION	Start Time	Stop Time	Total Mins	L/min (Pre)	L/min (Post)	Volume Liters
Start next sample #:							

Remitted by	**Received by:**	
Printed Name:	Signature	Date
Signature:		
Company: Rome Enviornmental Solutions & Testing LLC		
Date:		
# of Samples:		

Please Email Results to: edousharm@romeenv.com Attn: M Eric Dousharm
CC if checked ☐ brendacard14@gmail.com

_____
Signature

APPENDIX D
Statement of Qualifications

APPENDIX D-1

AmeriSci Statement of Qualifications

AMERISCI GROUP

ASBESTOS LABORATORIES

STATEMENT OF QUALIFICATIONS

Who We Are:

AmeriSci is a group of service-oriented laboratories specializing in asbestos, microbial, and environmental testing. Our founding principle was to provide the best customer service to the laboratory industry while emphasizing quality, responsiveness, and competitive pricing all on a 24 hour a day/seven day a week schedule. Maintaining this principle, we now operate four locations nationwide that support each other by providing an internal support network for various inter-company needs including production, technical insight, and quality assurance programs. Our current operations include: Greater Richmond, VA; New York, NY; Greater Boston, MA; and Greater Los Angeles, CA.

Our steady and continued growth during the past decade has given us the insight and experience necessary to achieve our company goal of profitable growth because we are:

- Efficient With Our Lab Systems And Programs
- Knowledgeable In The Business of Science & The Science of Business
- Committed To Our Loyal, Long Term Business Partners-Our Customers

Our laboratory facilities include a significant amount of quality instrumentation and computer management systems that empower us with an efficient means to comply with the methods and protocols of the Environmental Protection Agency (EPA), American Public Health Association (APHA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), National Environmental Laboratory Accreditation Program (NELAP), American Industrial Hygiene Association (AIHA), National Institute for Occupational Safety and Health (NIOSH), American Society for Testing and Materials (ASTM), United States Department of Agriculture (USDA), Food and Drug Administration (FDA), and various other applicable Federal, State, and Local programs, guidelines, and regulations.

Our knowledgeable and experienced technical staff consists of geologists, geochemists, mineralogists, chemists, biologists, microbiologists and environmental scientists with specialized training and experience in the analyses we provide to our customers. Our staff recognizes the importance of our clients and the need to always provide high quality service in a responsive and professional manner.

Our Commitment and high regard for our customers is an attitude understood and practiced by all employees in AmeriSci. Our entire staff is empowered with the resources, instrumentation and training that allows us to always put the customers' needs first so we can continue to strive towards providing the best customer service in the industry.

A Service Philosophy:

Our high regard for and emphasis on customer service is an attitude understood and practiced by all employees in the AmeriSci network. Our entire staff is empowered with the resources, instrumentation and training that allows us to always put the customers' needs first so we can continue to provide what many have said, is the best customer service in the industry. We believe that we are in the service business as much as we are in the laboratory business. Our customer service commitment stems from our basic core belief and attitude best summarized as follows:

THE AmeriSci DEFINITION OF A CUSTOMER

The AmeriSci Customer is the most important person in our business.

The AmeriSci Customer is our partner - we succeed when they succeed.

The AmeriSci Customer does us a favor when they call - we are not merely doing them a favor by serving them.

The AmeriSci Customer is a part of our business - not an outsider.

The AmeriSci Customer is not someone to complain about or argue with, no matter how difficult the situation or the tasks at hand.

The AmeriSci Customer is a person who brings us their wants - it is our job to fill those wants.

The AmeriSci Customer is deserving of the most courteous and attentive treatment we can give them.

The AmeriSci Customer is the life-blood of our business.

Dedicated To Quality:

It is our goal and policy to produce analytical data of known quality through exact adherence to specifications of the methods employed, AmeriSci Manuals detailing standard Operating Procedures as well as AmeriSci Quality Assurance Program Plans. All employees are charged to take personal responsibility for conformance to those specifications or to cause those specifications to be changed, in an authorized and documented fashion.

AmeriSci recognizes the need to constantly examine its performance in order to ensure the technical quality of the data generated in the laboratory. In order to accomplish this objective, a quality control and quality assurance program has been established. The general provisions of our quality assurance programs includes the following items:

1. The employment of a full time Quality Assurance Officer with the authority to set specifications, review and audit performance to specifications and initiate corrective actions.
2. The establishment of detailed documentation of methods, procedures and quality assurance requirements.
3. Detailed training of all personnel in the execution of methods, procedures and quality assurance requirements.
4. The maintenance of control charts for precision and accuracy for all measurement parameters.
5. Utilization of quality instrumentation and standardized laboratory measurement equipment and lab grade supplies.
6. The usage and tracking of Routine and non-routine quality control checks.
7. Mechanisms for Document Control and Data Security.

AmeriSci's management organization is structured so as to provide an efficient means of providing analytical services and to assure that the data generated and reported is of high quality as described in the AmeriSci Quality Assurance Policy Manual. Technical staff are organized in such a fashion as to provide oversight of analytical activities by individuals who are experienced professionals in their respective areas. Staff members are thoroughly trained in analytical procedures and safety procedures as well as the Provisions of our Quality Assurance Programs.

Where We Are:

New York City
AmeriSci New York
117 E. 30Th Street
New York, NY 10016
(212) 679-8600

Greater Boston
AmeriSci Boston * Temp Closed
8 School Street
Weymouth, MA 02189
(781) 337-9334

Greater Los Angeles
AmeriSci California
24416 South Main Street, Suite 308
Carson, CA 90745
(310) 834-4868

Greater Richmond
AmeriSci Viginia
13635 Genito Road
Midlothian, VA 23112
(804) 763-1200

Accreditations:

AmeriSci maintains many accreditations and state certifications, which allow us to offer our clients national service for projects at various sites throughout the country.

Agency	AmeriSci VA	AmeriSci NY	AmeriSci MA	AmeriSci CA
Microscopy Asbestos Division				
AIHA				
NELAC (ELAP)	✓	✓		✓
NVLAP	✓	✓	✓	✓
California	✓			✓
Connecticut		✓		
Florida	✓			
Hawaii				✓
New Jersey		✓		
Massachusetts	✓	✓	✓	
New York	✓	✓		
North Carolina	✓			
Philadelphia	✓			
Rhode Island				
South Carolina	✓			
Tennessee	✓			
Texas	✓			
Vermont				
Virginia	✓			
West Virginia	✓			

Agency	AmeriSci VA	AmeriSci NY	AmeriSci MA	AmeriSci CA
IAQ Environmental Microbiology Division				
AIHA EMPAT				
Environmental Chemistry Division				
AIHA ELLAP				
NELAP				
California				
Connecticut				
Maine				
Massachusetts				
New Jersey				
New York				

Asbestos Microscopy Accreditations

AmeriSci maintains many state certificates, which allows us to offer our clients national service for projects at various sites throughout the country. In order to sustains these multiple certifications, AmeriSci participates in a number of single-blind performance evaluation (PE) sample programs and undergoes audits from regulatory representatives at a frequency of several times per year.

When additional state certifications are required by a specific client AmeriSci makes every effort to obtain this certification.

Agency	AmeriSci VA	AmeriSci NY	AmeriSci MA	AmeriSci CA
Microscopy Asbestos Accreditations				
AIHA				
NELAP	VA00911			
NVLAP	101904-0	200546-0		200346-0
USDA	S-44170			
California	2508			2322
Connecticut		PH-0186		
Florida	E87891			
Hawaii				L-01-028
New Jersey		NY031		
Massachusetts		AA00054	AA000162	
New York	10984	11480		
North Carolina	51702			
Philadelphia	216			
Rhode Island				
South Carolina	93004			
Tennessee	02841			
Texas	30-0328			
Vermont				
Virginia	3333000266 00303			
West Virginia	LT000217			

Please see certification for parameter list.

Our Commitment:

AmeriSci has dedicated its business efforts to our customer's laboratory needs and quality of service for over a decade nationwide. Our steady growth and significant successes are primarily due to our belief that we are here solely and exclusively for our clients. Our growth and success as a company is a result of the growth and success of our business partners - Our Clients.

Our Promise

Our clients are our partners. We succeed because we are loyal and committed, individually and collectively to our partners. Focused towards both our clients and our ability to serve our clients, we promise to always be:

- Scientifically Proficient In The Laboratory Work We Provide
- Streamlined And Efficient With All Our Laboratory Operations And Activities
- Understanding Of Your Needs and Strive To Exceed Your Expectations

Asbestos Microscopy Capabilities:

AmeriSci's asbestos laboratories provide a full range of light and electron microscopy services, with rush/immediate to 5-day response times. The following represents those services:

ANALYSIS BY	METHOD
Asbestos Identification in Air	
Phase Contrast Microscopy(PCM)	• NIOSH 7400
Transmission Electron Microscopy(TEM)	• AHERA Air Protocol (NVLAP Air) • NIOSH 7402 • EPA Level II • ASTM D6281-98 • ISO 10312
Asbestos Identification in Bulk Material	
Polarized Light Microscopy(PLM)	• EPA 600/M4-82-020 (NVLAP Bulk) • EPA/600/R-93/116 - Point Counting-EPA 400 Point Count

	• NYSDOH ELAP PLM 198.1 – Stratified Point Counting • NYSDOH ELAP PLM NOB 198.6 • NIOSH 9002
Transmission Electron Microscopy(TEM)	• EPA 600/R-93-116 (Chatfield: Semi-Quantitative) • EPA 600/R-93-116 (Quantitative) • NYSDOH ELAP TEM 198.4
Asbestos Identification in Dust	
Transmission Electron Microscopy(TEM)	• ASTM D5755 (Microvac) • ASTM D6480 (Wipe) • EPA/600/J-93/167 (Microvac, carpet, fabric)
Asbestos Identification in Soil	
Polarized Light Microscopy (PLM) & Transmission Electron Microscopy (TEM)	• EPA 600/R-93/116 -Quantitative -Modified (Qualitative) • EPA Region 1 Screening Protocol
Asbestos Identification in Water	
Transmission Electron Microscopy(TEM)	• EPA 100.2 Drinking Water (>10 um regulated fibers) (EPA-NELAC Water) (EPA 600R-94/134) • EPA 600/4-80-005 High Organic Waste Water

Asbestos Microscopy Procedures/Quality Assurance

Written Standard Operating Procedures Manual and a Quality Assurance Program Manual are in place in each laboratory with update revisions and enforcement chaired by Dr. Tom McKee, National Compliance Officer. These documents describe the means by which AmeriSci produces analytical data of known and verifiable quality.

Monitoring the operations in a light and electron microscopy laboratory is crucial to produce accurate and consistent analytical results. Maintaining chain of custody, sample integrity, and accurate analysis and reporting is of highest priority at AmeriSci. The following represents a highlight of some of the key steps of the analytical process dictated by our written Standard Operating Procedures and written Quality Assurance Manual:

RECEIPT OF SAMPLES

Samples are received, wiped down, examined for damage, and logged in. Each sample is cross-referenced by the Client's sample designation and a simple internal code, to assure proper, consistent handling through the chain of custody. This AmeriSci sample designation code accompanies the sample from entry to final report. In addition to registering the sample in a master file, each sample is "tracked" throughout the course of our analytical program by computer. When requested, samples are returned to the client after analysis.

The bulk and air samples are brought into separate laboratory locations to eliminate any possible cross-contamination between samples. Each sample is handled, prepared, and stored in the respective laboratory that has been constructed especially for asbestos preparation. The bulk decontamination hood is provided to clean sample containers before handling and assigning a laboratory-designated number. Only then are the samples brought into the "clean areas" of the laboratory. One HEPA filtered clean bench is used in the bulk decontamination area to allow the preparation of bulk samples. The "clean room" facility is used exclusively for the preparation of trace level asbestos samples (i.e., air and water).

SAMPLE PREPARATION

Individual preparation methodologies have been compiled in our Standard Operating Procedures Manual (SOP), which documents the detailed preparation steps utilized in all AmeriSci locations. After preparation, samples are stored in individualized identified sample containers while awaiting analysis.

SAMPLE ANALYSIS

A typical sample analysis might include identification, measurement, and quantification of a sample. The identification is accomplished by a combination of crystal morphology, chemical composition, and selected area electron diffraction (SAED) patterns. When applicable, SAED patterns are photographed and EDS printouts/spectrographs are filed, to assure proper identification. A reference scale that has been set during calibration accomplishes accurate size measurements.

DATA MANAGEMENT AND REPORTING OF RESULTS

All data is accumulated, calculated, reported, and archived using our custom designed and programmed Laboratory Information Management System (LIMS). The LIMS data is backed up on a daily basis as a safety precaution. All analytical report summaries are transmitted by fax directly to the customer upon completion of the analysis and review process. The reports are reviewed and signed by the analyst and the lab director prior to issuance of the final report which is sent by mail.

SAMPLE STORAGE AND DISPOSAL

Asbestos samples are stored for 90 days unless otherwise instructed for a particular project. Samples are then packaged (double bagged with properly labeled bags) and sent via licensed "hauler" with properly completed manifest, to an EPA approved asbestos waste landfill. Final completed disposal records/manifest are kept at each individual office with copy to the national compliance officer.

COMPUTER SYSTEMS

The client, analytical and financial functions are incorporated into an IBM based local area network at each laboratory facility. They are custom programmed in 4th Dimension (trademark of ACIUS, Inc. and ACI). Custom menus and input screens are created for each necessary application. A single fileserver database at each facility is accessed by multiple work stations such that analysis data, final reports, and job invoices are all generated simultaneously by the analyst upon completion of the job. Each facility LIMS may be password accessed, evaluated and controlled remotely from another AmeriSci facility. Facility client and financial information is routinely downloaded once per week to a central database.

Asbestos Microscopy Instrumentation

AmeriSci VA

Electron Microscopy
(2) Electron Microscopes: JEOL 100 CX (TEM)
(2) EDS: TN-DTSA, IXRF
Optical Microscopy
(6) PLM/DS Microscopes: Olympus
(3) PCM Microscopes: Olympus, Zeiss and Unitron
(6) Stereomicroscopes: Olympus, AO and B&L,

AmeriSci NY

Electron Microscopy
(3) Electron Microscopes: Hitachi 7000, 600 (TEM)
(2) EDS: IXRF
Optical Microscopy
(2) PLM/DS Microscopes: Nikon, (3) PLM/DS Microscopes: Olympus, (1) PLM/DS Microscope: Leica
(3) PCM Microscopes: Olympus BH-2 & CH-2
(5) Stereomicroscopes: Unitron, Zeiss, Olympus, Monolux & Bausch & Lomb

AmeriSci CA

Electron Microscopy
(2) Electron Microscopes: Hitachi 7000,
(2) EDS: EDAX, EVEX
Optical Microscopy
(3) PLM/DS Microscopes: Nikon
(2) PCM Microscopes: Olympus and B&L
(4) Stereomicroscopes: Olympus and B&L

Revised

APPENDIX D-2

HRP Statement of Qualifications

OUR DUE DILIGENCE SERVICES

HRP is a full service engineering consulting firm that specializes in providing quality, cost effective, Environmental Due Diligence services for commercial, industrial, residential, and agricultural real estate transactions. Upon our inception in 1982, we serviced the local metal finishing and real estate industries.

Fourty years later, we have expanded into a nationwide office network to manage our client's needs. We have provided due diligence services to firms ranging from the small business entrepreneur and local attorneys to Fortune 500 industrial clients and the largest financial institutions in the country.

HRP's qualified staff of environmental professionals have the technical abilities and business experience to quantify risks and provide "real world" solutions to identified environmental concerns. Our professionals are trained to understand the unique goals of each individual client and project at hand, and to provide practical solutions that are cost effective, timely, and responsive to your specific business situation. HRP will provide you with the tools vital to quantify environmental risks and necessary in making informed business decisions. We believe that the key to building enduring client relationships is to place our clients first and respond to their needs in a timely manner. This combination of technical expertise and customer service is paramount for a solid business relationship. Our services include:

ENVIRONMENTAL DUE DILIGENCE

- Phase I Environmental Site Assessments
- Real Estate Transaction Screens
- Desktop Risk Assessments
- Phase II/III Environmental Site Assessments
- Site Investigation and Remediation

BUSINESS ENVIRONMENTAL RISKS

- Asbestos Surveys and Abatement
- Lead-Based Paint Surveys and Abatement
- Tank Compliance Assistance
- Vapor Encroachment/Intrusion Assessments
- Abandoned or Obsolete Chemical Disposal
- Water Intrusion/Mold/IAQ Surveys and Abatement
- PCBs
- Wetland Assessment and Delineation
- Radon Assessments and Mitigation

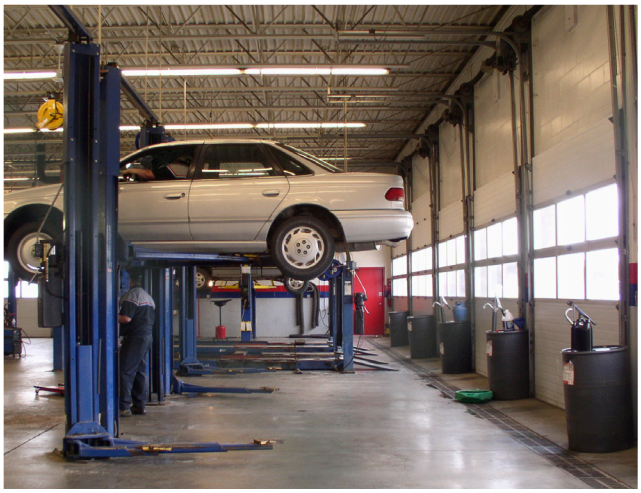
ADDITIONAL SERVICES

- Property Condition Assessments
- Construction Draw Assessments
- Civil Engineering
- Energy Management
- Environmental Health and Safety Compliance
- Environmental Liability Reserve Planning

OUR EXPERIENCE

ENVIRONMENTAL SITE ASSESSMENT PROPERTY CONDITION ASSESSMENT, INVESTMENT COMPANY, VARIOUS LOCATIONS, US

HRP was retained to perform a Property Condition Assessment (PCA) in conjunction with a Phase I ESA of six (6) parcels containing a retail shopping center with multiple tenants including restaurants, a bank and a theater. The seven (7) single-story buildings collectively totaled approximately 229,505 square feet of building area on 33.4 acres of land. The structures occupied all areas of the parcel with a centrally located main parking area. No recognized environmental conditions (RECs) were identified at the Site and no further investigation was recommended as part of the Phase I. HRP also inspected the buildings for water intrusion, mold and asbestos containing materials (ACM). Areas of water intrusion and potential mold growth were observed within the theater building and a former kitchen of a restaurant.



ENVIRONMENTAL SITE ASSESSMENT, LENDING INSTITUTION, FAIRFIELD, CT

HRP performed a series of environmental investigations, a tank removal, and soil remediation at an automotive transmission repair shop in Fairfield, CT. The project opportunity arose when The Bank of Fairfield contacted HRP to perform a due diligence Phase I Environmental Site Assessment to evaluate potential environmental liabilities associated with lending on the property. HRP completed the Phase I for the property and identified several features that could release petroleum to the environment, including an aged outdoor aboveground waste oil tank and several abandoned in-ground hydraulic vehicle lifts. HRP recommended a subsurface investigation to determine if the tank and cylinders had leaked. Ultimately, the Bank was satisfied with the risk reduction efforts and issued the loan to the business owner.

ENVIRONMENTAL SITE ASSESSMENT, LENDING INSTITUTION, BRISTOL, CT

HRP was contracted by a lending institution for environmental consulting services at a manufacturing facility in Bristol, CT, for which the bank had issued a commercial loan. HRP initially performed a due diligence Phase I Environmental Site Assessment to assist the bank in evaluating potential environmental liabilities associated with the property. HRP identified several environmental Areas of Concern (AOCs) and provided the opinion that the property would be subject to the Connecticut Transfer Act because of historical hazardous waste generation. Ultimately, the property owner was able to sell the property, satisfy his financial obligations to the bank, and avoid foreclosure. The property owner utilized HRP's findings in negotiating the terms of the sale which included Transfer Act responsibilities.

OUR EXPERTS

RICHARD R. CHANDLER, LEP, CPG

Mr. Chandler has more than 15 years of experience in performing a myriad of environmental services ranging from Phase I/II/III site assessments to remediation and post-remediation groundwater monitoring. Rich is also well-versed in all phases of environmental field work. His notable professional experience includes management of environmental efforts at a site in Fairfield, CT where he managed the remediation of 37,000 tons of polluted soil, analysis of over 2,000 sediment samples within the Mill River, and implementation of Connecticut's largest environmental dredging project.

JASON A. BEACH, CPG, LEP

Mr. Beach has more than 20 years of progressive experience in management of environmental due diligence, remediation, TSCA, corrective action, and natural resources projects. His environmental/geological service projects include an array of public utility, municipal, state, commercial, and educational development, as well as countless due diligence and investigation assignments. Mr. Beach's strong expertise lies in Brownfield redevelopment, and investigation and remediation of distressed sites to facilitate a higher and better end use.

NAME

Ms. Hendrickson is a Certified Hazardous Materials Manager with more than 20 years of project management on over 700 ESAs for a diverse client base. Project scopes included Phase I and II ESAs, Regulatory File Review, NEPA Compliance, Peer Review of Previous Environmental Assessment Reports, and Lead-Based Paint, Asbestos, and Limited Mold Surveys. Ms. Hendrickson also served as Project Manager for a municipal on-call contract that addressed the development and redevelopment issues of commercial, residential, industrial municipal properties in a densely populated urban area.

NAME

Mr. Feinson has over 15 years of experience in geotechnical and environmental assessment, site investigation, and remediation. David has performed multiple Phase I Environmental Site Assessments (ESAs) following the relevant ASTM standards and Connecticut's Site Characterization Guidance Document (SCGD) to identify recognized environmental conditions (RECs), potential release areas (PRAs), and areas of concern (AOCs). Following the Phase I ESA, David has coordinated and performed Phase II and Phase III ESAs in order to determine the presence or absence of contamination due to releases of hazardous materials and the extent of impact to soils and groundwater.

APPENDIX D-3

REST Statement of Qualifications

Statement of Qualifications

Overview

Rome Environmental Solutions & Testing, LLC (REST) is pleased to provide you with our qualifications to perform Environmental Consulting Services including Project Monitoring and Air Sampling Services for the project.

REST is an Environmental Consulting Firm that specializes in Hazardous Materials Testing, Abatement Design, Consulting, Management and Project Oversite including Air Monitoring. REST was established in 2019, however as the owner, I have over 30 + years of experience providing professional environmental services to the private and public sector clientele.

General Information

1. Name and Address of Firm: Rome Environmental Solutions & Testing, LLC
   8041 River Road, Rome NY 13440
2. Telephone No.: (315) 794-7946, No Fax Number
   Email – edousharm@romeenv.com
3. Head Quarters are same as above
4. Company Founded 2019 – See Resume for Additional Experience
5. Website – www.romeenvllc.com

Experience:

REST has performed a wide variety for both residential and commercial entities in both the private and public sector throughout Herkimer and Oneida County and its surrounding areas. References can be provided upon request.

Project Staff

REST employs two individuals to provide assistance with Surveys, Project Monitoring and Air Sampling. Below is a list along with NYS Disciplines:

M. Eric Dousharm (Owner) – Project Designer, Inspector, Project Monitor and Air Sampler – 30+ Years of Experience.
Brenda R Card – Inspector, Project Monitor and Air Sampler – 25 Years of Experience.
John A. Rehbein – Inspector, Project Monitor, OSHA 30 Hour – 5 Years of Experience.
Jessica Kent - Administrative

Insurance Requirements

REST is currently insured for General Liability, Contractual Liability, Professional Liability and Contractors Pollution Insurance in the amount of $1,000,000/$2,000,000 single occurrence/aggregate. REST carries an Excess Liability and Umbrella Policy in the amount of 1,000,000/1,000,000 single occurance/aggregate. REST carries workers compensation coverage.

REST has had no litigation involving the firm since its inception and the firm, under its current name has never declared bankruptcy.

Attached are any supporting documents mentioned above. I will be the primary contact for the project if selected. I can be contacted @ (315) 794-7946 or by e-mail: edousharm@romeenv.com

APPENDIX E
Qualifications of Assessors

APPENDIX E-1

REST Qualifications of the Assessors

M. ERIC DOUSHARM
8041 River Road
Rome NY 13440
(315) 794-7946

Business Objective:
Rome Environmental was established in January of 2019. As the owner of Rome Environmental Solutions & Testing, LLC, I continue to apply my previous experience of 26 years in the environmental consulting services by providing environmental consultation and testing services to customers based on my expertise in environmental services, construction administration and project management for now over 30 years. I will continue to work in a unified and structured environment that will allow for continued growth and development opportunities.

Work Experience:
Rome Environmental Solutions & Testing, LLC – January 2019 – Present
Owner/President.

REST is an Environmental Consulting Firm that specializes in Hazardous Materials Testing, Abatement Design, Consulting, Management and Project Oversite including Air Monitoring. REST was established in 2019, however as the owner, I have over 30 years of experience providing professional environmental services to the private and public sector clientele.

Eisenbach & Ruhnke Engineering, P.C. – May 1993 – January 2019
Senior Project Manager: May 2007 to January 2019
Project Manager: 1997 – 2007
Project Monitor/Field Technician: 1993 - 1997

Areas of Specialization include but are not limited to: Project Management experience includes: (project design, project management, project monitoring, environmental building surveys [asbestos, lead, mold, PCB's], supervision, construction materials testing and construction management), Project Construction Materials and Management, Energy Performance Contracts, Asbestos Project Monitoring, Asbestos Building Inspector, Asbestos Air Sampling, Lead Risk Assessor/Inspector, Mold Assessment and Remediation, Environmental Field Sampling, and assisting with Phase I, Phase II, Phase III Environmental Assessments, Occupational Health and Safety (OSHA) Regulations and Code Compliance.

Atlantic Testing Laboratories Incorporated
Lab and Field Technician: October 1989 to January 1993

Responsibilities included:
Quality control testing and design of construction building materials to ensure specification compliance (ASTM, ACI, AWS, NYSDOT) was met. I worked on road projects, construction sites, sanitary landfill designs and subsurface explorations. I developed bituminous mix designs for projects such as the New York Interstate 81 and Hancock International Airport. I am Disciplined in the American Concrete Institute Levels I & II for Concrete Testing, Soils Engineering and Testing, FAA Bituminous Inspections and Welding Inspections (Structural Steel and Tanks).

EDUCATION

Graduated from Whitesboro Sr. High School 1982
Civil Engineering and Technology - Mohawk Valley Community College

REGISTRATIONS AND AFFILIATIONS

OSHA 40-Hour Supervisor (HAZWOPER)-including First Aid/CPR, OSHA Confined Space, Lead Risk Assessor New York, Lead Risk Assessor Region 2 Tribal Lands, New York State Certified Project Designer, AHERA Building Inspector and Asbestos Project Monitor/Air Sampling Technician, NIOSH 582 (Phase Contract Microscopy Analysis), American Concrete Institute, Professional Asbestos Contractors of Central New York (PACNY), American Concrete Institute Levels I & II for Concrete Testing, American Standards for Testing and Materials (ASTM) Soils Engineering and Testing, Federal Aviation Administration Bituminous Inspections, and American Welding Society, Welding Inspections and Testing.

NEW YORK STATE | Department of Labor

WORKING FOR YOU

DIVISION OF SAFETY & HEALTH LICENSE AND CERTIFICATE UNIT, STATE OFFICE CAMPUS, BLDG. 12, ALBANY, NY 12226

ASBESTOS HANDLING LICENSE

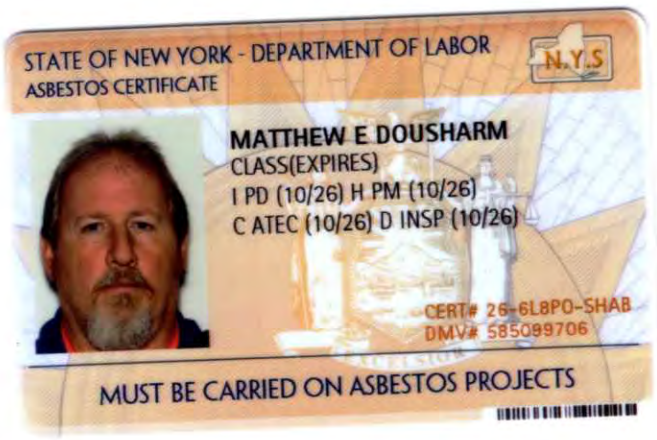
Rome Environmental Solutions & Testing, LLC
8041 River Road, Rome, NY 13440

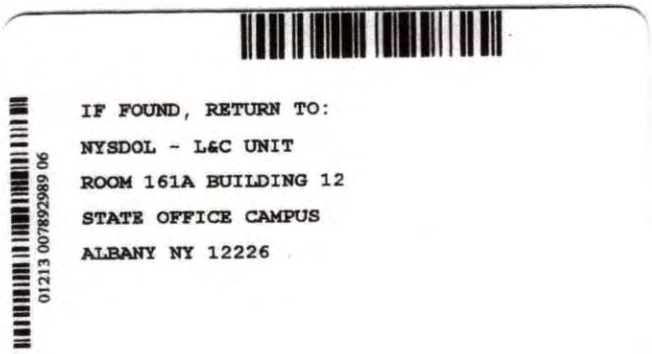
License Number: 137256
License Class: RESTRICTED
Date of Issue: 04/22/2026
Expiration Date: 04/30/2027
Duly Authorized Representative: Matthew Dousharm

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.

Vicki Mockler, Director
For the Commissioner of Labor


STATE OF NEW YORK - DEPARTMENT OF LABOR
ASBESTOS CERTIFICATE
N.Y.S
MATTHEW E DOUSHARM
CLASS(EXPIRES)
I PD (10/26) H PM (10/26)
C ATEC (10/26) D INSP (10/26)
CERT# 26-6L8PO-SHAB
DMV# 585099706
MUST BE CARRIED ON ASBESTOS PROJECTS


01213 007892989 06
IF FOUND, RETURN TO:
NYSDOL - L&C UNIT
ROOM 161A BUILDING 12
STATE OFFICE CAMPUS
ALBANY NY 12226

BRENDA CARD
ENVIRONMENTAL TECHNICIAN

AREAS OF SPECIALIZATION

Asbestos Air Sampling, Asbestos Project Monitoring, Asbestos Building Inspector, Data Entry and Report Preparation, and Training Program Support

EXPERIENCE

Project Monitor / Air Sampling Technician
Eighteen years experience air sampling and project monitoring at public and private schools, public facilities and housing, industrial, and medical locations in New York State
Field supervision of contractors to ensure regulatory compliance during abatement, and enforcement of contract specifications

Report writer
Compiles documentation from various sources, writes and edits reports, and delivers them to our clients in a timely fashion

Training program
Maintains supplies, coordinates teachers and class locations, teaches hands-on exercises, updates training materials and notifies NYSDOH for classes. Assisted with establishing a new training program

Surveys
Asbestos building surveys, lead in drinking water surveys and mold sampling.

EDUCATION

B.A. Biology - 1990
Houghton College
Houghton, New York

REGISTRATIONS AND AFFILIATIONS

Certified New York State Air Sampling Technician – CS3, Utica, New York
Certified New York State Project Monitor - CS3, Utica, New York
Certified New York State Building Inspector - CS3, Utica, New York
Certified Connecticut State Asbestos Consultant - Project Monitor
Certified Connecticut State Asbestos Consultant - Inspector

John Rehbein

Taberg, NY 13471
jrehbein1@twcny.rr.com
+1 315 709 9363

Authorized to work in the US for any employer

Work Experience

Asbestos Project Monitor

Adirondack Operations - New York, NY
April 2018 to Present

Project monitoring on Asbestos Abatement Projects
Collection of air samples and documentation
Ensuring adherence to Code Rule 56 ICR-56

Air Sampling Technician

GYMO Environmental Services - Watertown, NY
August 2017 to December 2017

Collection of air samples on Asbestos Abatement Projects

Fiber Instrument Sales

Assembly of Light Source and Power Meters - Oriskany, NY
October 2013 to April 2016

Testing fiber optic cables
Soldering circuit boards for test equipment
Arc Splicing of Fiber Optic Cables
Packaging products for shipping

Cable Assembler

R- tronics Inc - Rome, NY
August 2006 to October 2013

Assembly of multiple types of electrical cables
Soldering (IPC J-STD-001)
Preparing product for shipping
Training new employees

Service Advisor

Davidson Automotive Group Inc - Rome, NY
April 2005 to June 2006

Writing repair orders
Working between customers and technicians to facilitate repairs
Data entry of repair orders for invoicing

Field Service Technician

The Computer Specialists Inc - Whitesboro, NY
August 1999 to February 2005

Support for Multiple Networks statewide
PC Sales, Service and Repair of peripherals
Installation and configuration of computer hardware

Education

Diploma in PC Diagnostics and Repair

International Correspondence School - Home
June 1996 to July 1997

Regents Diploma

Camden High School - Camden, NY
September 1980 to June 1984

Skills

- Forklift Operator
- Computer Skills
- Field Service
- Computer Hardware
- Network Support
- Service Technician Experience
- IPC 610
- Surface Mount Technology
- Technical Support
- Quality Inspection

APPENDIX E-2

HRP Qualifications of Assessors

Jesse Zahn, CHMM, PG

PRINCIPAL, ACM ABATEMENT AND DEMOLISHION PLANNING

Mr. Zahn has over 30 years of experience assisting a broad spectrum of private and public clientele navigate and manage environmental compliance challenges as well as optimize existing management systems. His experience allows him to understand the regulatory landscape and its impact on client operations to develop and implement practical and effective strategies.

His experience includes scoping, managing, and completing technical deliverables for demolition of structures with engineering, public safety, and asbestos contamination concernsMr. Zahn has over 20 years of ACM survey experience and supporting communities with developing bid documents for demolition, clean up and site restoration of structurally unsound municipal, institutional and residential structures. He works with clients and their stakeholders such as communities to understand their needs and develops contract documents that include client contract terms, bonding requirements, developing site specific topographic surveys, technical specifications, and reporting to ensure they achieve their goal and comply with grant requirements. Mr. Zahn's role in this contract would be Principal for asbestos and demolition planning and management.

EDUCATION

MS, Environmental Science, New Jersey Institute of Technology/Newark College of Engineering, 1993

BA, Environmental Science, SUNY at Plattsburgh, 1991

BA, Environmental Geology, SUNY at Plattsburgh, 1991

PROFESSIONAL REGISTRATIONS/CERTIFICATIONS

- Certified Hazardous Materials Manager (CHMM), #10275 - Current
- New York State Professional Geologist, #001041-01 - Current

TRAININGS

- OSHA 40HR HAZWOPER

PRESENTATIONS

Reciprocating Internal Combustion Engines – "RICE," AHMP 2013 National Conference, Orlando Florida

Executive Order 13650, Improving Chemical Facility Safety and Security, AHMP 2015 National Conference Scottsdale, AZ.

GHG Reporting and Subpart OOOO Requirements for Oil & Gas Industry, IOGA OF NY, 2014 Annual Meeting

Carbon Dioxide Environmental, Health and Safety Concerns Subject Matter Expert Conference on CO2 Refrigeration, Confidential Food Retail Service Center, PA; Pottsville, PA, 2014

Don't Get Trapped by Air Toxics, AHMP 2019 and 2021 National Conferences

CITY OF GLOVERSVILLE, RESIDENTIAL DEMOLITION

Mr. Zahn was the Contract and Project Manager for the City of Gloversville for two demolition contracts for former industrial tanning sites and residential structures. He completed contract document preparation, bid solicitation, bid review, contractor management, payment application review and approval, site inspections, client interaction, and reporting. These two contracts included demolition, disposal and site restoration for 15 sites for approximately $400,000. The work included characterizing waste streams and gaining approval from permitted landfills to accept building debris from industrial sites.

CITY OF ROME, FORMER COLUMBUS SCHOOL

Mr. Zahn assisted Rome with contract document preparation, bid solicitation, bid review, contractor management, payment application review and approval, site inspections, client interaction, and reporting. This

contract included the demolition, disposal and site restoration for a former school contaminated with asbestos with a contract value of $1.7M

CHIPS

Mr. Zahn is completing contract documents, including technical specifications for an abandoned gasoline station in Frankfort, New York. Mr. Zahn is working with the County IDA to help them address an environmental and safety concern to a parcel used to support access to New York State's Empire State Trail for bicycles. The project is in progress and has a contract value of $100,000.

FORMER DUOFOLD SITE, ILION, NEW YORK

Mr. Zahn is the Manager for this project involving the salvage, stabilization, and partial demolition of a multiparcel building located on Main Street in Gloversville, New York. The budlings were initially constructed by 1907 consisting of three buildings totaling approximately 134,500 square feet: a main manufacturing/office building with steel and wood construction (124,000 square feet), boiler house (4,500 square feet), and a former storage building (6,000 square feet). Each building presents challenges with respect to water damage, asbestos contamination, and structural stability and ability to be stabilized and potentially redeveloped. In addition to hazardous material surveys, Mr. Zahn completed structural evaluations to assist in the development of management options. Additionally, HRP is working closely with the IDA to secure Federal funding to assist with project completion.

We are currently working very closely with the IDA in developing several approaches to match the site's use with the best development reuse to save costs and facilitate redevelopment.

12-18TH STREET, GLOVERSVILLE, NEW YORK

Mr. Zahn is the project manager for this project involving the demolition of a multiparcel building located on Main Street in Gloversville, New York. The structure is unoccupied, has partial roof and wall failure and is adjacent to residential and retail structures. HRP assisted the City with several options including evaluation of partial demolition and stabilization, facade stabilization, and complete demolition and site restoration. HRP completed hazardous materials surveys, developed specifications to obtain the lowest cost demolition and construction contractor(s). HRP included engineering controls and reinforcement to ensure safe demolition. Mr. Zahn is also assisting with access agreements, public meetings and other support as needed by the City. Site restoration will include adjacent roof parapet repairs, waterproofing newly exposed brick exterior walls, structure reinforcement and back fill of the below grade basement and proper drainage to protect the neighboring structures.

VILLAGE OF CAMBRIDGE, NEW YORK

Mr. Zahn was the Clerk of the Works for the project involving the demolition of the former Ackley Building in the Village of Cambridge. The structure was abandoned, had limited fire damage, asbestos and lead contamination, was structurally unsound (leaning) and was adjacent to a residential structure and pharmacy, and across a narrow alley to a public structure. HRP completed hazardous materials surveys, developed specifications to obtain the lowest cost demolition and construction contractor(s). HRP included engineering controls and reinforcement to ensure safe demolition. Mr. Zahn also assisted with access agreements, public meetings and other support as needed by the Village. Site restoration includes waterproofing newly exposed brick exterior walls, structure reinforcement and back fill of the below grade basement and proper drainage to protect the neighboring structures.

VILLAGE OF GREENWICH, NEW YORK

Mr. Zahn was the Project Manager for the project involving the demolition of the former Shirt Factory in the Village of Greenwich. The structure was abandoned, asbestos and lead contamination, was structurally unsound and was located in and adjacent to several residential structures. The building stored significant quantities of building materials and other contents including cars and a boiler; some materials were leaving the site and causing potential contamination issues. HRP completed hazardous materials surveys, developed specifications to obtain the lowest cost demolition contractor. The specific challenge for this project involved the significant about of concrete and materials inside the building potentially subject to transport and disposal costs. HRP was

SENIOR PROJECT MANAGER/HAZMAT CONSTRUCTION MANAGER

RICHARD "RICK" CWIKLOWSKI, PE

Mr. Cwiklowski has over 30 years of experience in project management services with regards to inspections, investigations and remedial activities for asbestos, mold, lead-based paint and numerous other environmental contaminants at a wide variety of facilities. Mr. Cwiklowski's experience includes conducting asbestos abatement, mold remediation and consulting services, project planning, estimating, preparation of technical specifications and bid documents, contract and contractor management facility surveys, Phase I ESAs, project management, oversight, air monitoring, and preparation and implementation of O&M programs. Mr. Cwiklowski also has extensive construction management and oversight experience for demolition projects.

EXPERIENCE

Former St. Joseph's Hospital, Kirkwood, MO
Responsible for abatement scope development including review of existing data from previous inspections and abatement activities. Conducted a complete environmental survey of the facility including asbestos, lead-based paint and miscellaneous/universal wastes. Developed an abatement scope of work based on the demolition plan for the facility including abatement of all asbestos-containing materials and miscellaneous/universal wastes identified. Prepared bid specifications for the abatement services and assisted with bid submission, review and contract award. Conducted abatement and demolition of the hospital complex, which included 2 and 3-story medical office buildings and a 5-story hospital tower, approximately 500,000 square feet.

Ralph H. Johnson VA Medical Center, Charleston, SC
Served as Project Manager for the Annual support for industrial hygiene services at the Ralph H. Johnson VA Medical Center. Responsibilities included pre project planning, meeting with clients and design team, conducting onsite inspections and investigations, preparing reports of findings and providing bid specifications, documents and drawings to client, as well as management and oversight of the abatement and remediation. Services are currently ongoing.

Hillvale Apartments, St. Louis, MO
Served as Project Manager for the IAQ and microbial consulting services associated with the renovation activities at Hillvale Apartments. Responsibilities included pre project planning, meeting with clients and design team, conducting onsite inspections and investigations, preparing reports of findings and providing bid specifications, documents and drawings to client, as well as management and oversight of the abatement and remediation. Services are currently ongoing.

Former Solutia Queeny Plant, St. Louis, MO
Responsible for abatement scope development including review of existing data from previous inspections and abatement activities. Conducted a complete environmental survey of the buildings and structures throughout the 33-acre plant including asbestos and miscellaneous/universal wastes. Developed an abatement scope of work including abatement of all asbestos-containing materials and miscellaneous/universal wastes identified. Conducted abatement and demolition of buildings and structures, including tanks and pipe racks throughout the industrial complex.

EDUCATION

- BS, Mechanical Engineering, University of Missouri-Rolla, 1989

PROFESSIONAL REGISTRATIONS/ CERTIFICATIONS

- Licensed Professional Engineer, Missouri and Illinois
- Asbestos Project Designer
- Asbestos Building Inspector
- Asbestos Contractor Supervisor
- Asbestos Air Sampling Professional
- Mold Remediation Specialist
- Lead Renovator

TRAININGS

- 40-hour HAZWOPER
- 10-Hour OSHA

SENIOR DATABASE MANAGER

THEODORE "TED" WALL

Mr. Wall is currently the Earth Soft EQuIS database manager at HRP Associates. He has more than 16 years of experience using the EQuIS database platform. He provides support included loading analytical data via electronic data deliverables (EDD) and creating report ready tables and chart to project teams. Mr. Wall also has several years of experience as a project chemist providing analytical data support to project staff. Mr. Wall also has several years experience using Microsoft Access and can tailor non-analytical data database to meet the needs of a project team.

EXPERIENCE

HRP Projects
Currently, there are over one thousand seven hundred (1700) facilities in EQuIS with over thirty (30) still current.

Serving as the database manager, load new analytical data into EQuIS using an Access based quality assurance checker and EDP. Provide project teams with options to report data using EQuIS Professional or EQuIS Enterprise and using the SQL Server Reporting Studio and Report Builder. Maintain database integrity for all sites. Provide the project teams with field-based solutions, Collect, to streamline the sampling process. Work with laboratories to provide HRP with the correct EDDs and assist project teams in method selection.

United States Army Engineering Command
Served as the database manager and conducted preliminary investigations of PFAS contaminated soil, sediment, surface water and groundwater. The primary task was to create and maintain EQuIS database platform facilities to input location, coordinate, AOC, and PFAS analytical data into the database. Create several report ready tables detailing analytical data and highlighting any exceedance of Department of Defense screening levels of specific PFAS compounds. These tables were produces using Microsoft Report Builder and the SQL Server Reporting Studio (SSRS) server to create reports accessible by the project staff.

Confidential Client, Wisconsin
Site contained several PFAS compounds impacting the drinking water of several nearby residences. The primary task was to continue loading analytical data into EQuIS database. Create and run specific report logs for distribution to homeowners with PFAS concentrations and sampling details. Create biweekly back up file (.bak) of the EQuIS database to deliver to client. Create several SSRS reports for project staff to add to biweekly reports to client.

HRP EQuIS Database
As senior database manager at HRP Associates, performed several quality control and database integrity check on entire EQuIS database to ensure current data were usable for reporting. Updated several CAS registry numbers and chemical name to eliminate synonyms. Updated several sample type and matrix related issues. Created Microsoft Access databases to perform preliminary QC checks for incoming analytical data EDD for standardizing data loading into the EQuIS database. Created standard practice and workflow documents to assist in the data load and reporting process. Continue to work with Earth Soft to maintain the optimal database platform to ensure continuity and consistency for all HRP projects.

EDUCATION

- BS, Chemistry, Colorado State University-Fort Collins, 1984

APPENDIX F

AmeriSci Certificate of Accreditation

NEW YORK STATE OF OPPORTUNITY. Department of Health

KATHY HOCHUL
Governor

JAMES V. McDONALD, M.D., M.P.H.
Commissioner

JOHANNE E. MORNE, M.S.
Executive Deputy Commissioner

LAB ID: 11480

April 01, 2026

MS. KAROL H. LU
AMERICA SCIENCE TEAM NEW YORK, INC
117 EAST 30TH ST
NEW YORK, NY 10016

Certificate Expiration Date:
April 01, 2027

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

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2027
Issued April 01, 2026

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 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.: 72133

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2027
Issued April 01, 2026

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.: 72134

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2027
Issued April 01, 2026

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 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.: 72135

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200546-0

AmeriSci New York

New York, NY

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Asbestos Fiber Analysis

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique on ISO/IEC 17025).

2026-07-01 through 2027-06-30

Effective Dates

For the National Voluntary Laboratory Accreditation Program

APPENDIX G

AmeriSci Laboratory Quality Assurance Manual

QUALITY ASSURANCE MANUAL

FOR

ASBESTOS ANALYSIS

AmeriSci Boston (Asbestos NVLAP Lab Code 102079-0)

8 School Street

Weymouth, MA 02189

781-337-9334

AmeriSci Los Angeles (Asbestos NVLAP Lab Code 200346-0)

24416 S. Main St., Suite 308

Carson, CA 90745

(310) 834-4868

AmeriSci New York

(Asbestos - NVLAP Lab Code 200546-0, NY ELAP Lab Code 11480)

117 East 30th Street

New York City, New York 10016

(212) 679-8600

AmeriSci Richmond

(Asbestos - NVLAP Lab Code 101904-0, NY ELAP lab Code 10984)

13635 Genito Road

Midlothian, VA 23112

(804) 763-1200

5th Edition, Rev 10

Last Review completed December 31, 2022

(compliant with ISO/IEC 17025 and ISO 9002)

A NOTE FROM THE AUTHORS:

ACCREDITATION: 1) to consider or recognize as outstanding; 2) to give official authorization to or approval of: a. to provide with credentials; esp. to send (an envoy) with letters of authorization; b. to recognize or vouch for as conforming with a standard. - Webster

NVLAP Accreditation signifies recognition of a Testing Laboratory's competence to perform specific test methods in specified fields of testing - NIST

This document signifies AmeriSci Group (AG) and AmeriSci affiliated laboratories' commitment to compliance with NIST Handbook 150 (Feb 2006 edition), ISO/IEC 17025:2017, and NELAC guidelines as means to assure quality, confidentiality, organization and documentation in the laboratory. It is also designed to combine a well-trained staff with dedicated equipment and protocols to produce a quality (precise and accurate) analytical product.

The methods and procedures contained in this document are specifically required of all employees in all phases of their jobs. They form a proactive program for the detection of and response to improper, unethical or illegal actions. Interactions of all personnel with customers shall be conducted within the specific guidelines set forth in this document and the AmeriSci affiliates Code Of Ethics. Failure to comply with the provisions of this manual is grounds for disciplinary or legal action including possible termination of employment. Illegal actions may result in referral for prosecution. Any changes made to this document must be approved by the QA/QC Director-Compliance Officer, Chief Technical Officer and QA Supervisors/Managers.

Barry L. Browder, AG Chief Technical Officer

Thomas R. McKee, Ph.D., AG Compliance Officer 12/31/2022

Lab Manager, (Boston) (Los Angeles) (New York) (Richmond) Date 1/10/23

QA Manager, (Boston) (Los Angeles) (New York) (Richmond) Date 1/10/23

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

I. SCOPE AND PURPOSE OF THE QUALITY MANAGEMENT PROGRAM

The **AmeriSci** affiliated laboratories' Quality Management Program objectives, procedures and management policies for achieving those objectives are documented in this Manual. The policies presented here attest to management's commitment to provide good professional practice, the highest possible quality of testing and exemplary service to all customers equally. The objectives, goals and procedures represented here provide guidelines for obtaining impartial, unbiased, accurate and precise analytical data. This manual signifies a commitment to quality, confidentiality, organization and documentation in the laboratory. It is recognized that a relationship which threatens the impartiality of the laboratory can be based on ownership, governance, management, personnel, shared resources, finances, contracts, marketing (including branding), and payment of a sales commission or other inducement for the referral of new customers, etc.

The methods and procedures contained in this document are specifically required of all employees in all phases of their jobs to ensure that all impartial, analytical service conforms to necessary technical and quality requirements. This document forms the basis of a dedicated proactive program for the detection of and response to improper, unethical, partial or illegal actions. Interactions of all personnel with customers shall be conducted within the specific guidelines set forth in this document and the AmeriSci affiliates' Code Of Ethics. The Code of Ethics in conjunction with this document ensures that all employees are free from any commercial, financial or other undue pressure or influence of any nature which might adversely affect the quality of or introduce a bias into their work. All employees acknowledge reading and understanding this information when signing relevant sections of the Training Checklists and Employee Policy Manual Acknowledgement Statements.

Both a Quality Management Review and Quality System Audit are performed at least once a year by the Compliance Officer or a qualified designee to assure management that the Quality Management Program and Quality Assurance Manual are continuing to provide significant guidance in all necessary aspects of both general and specific technical quality criteria.

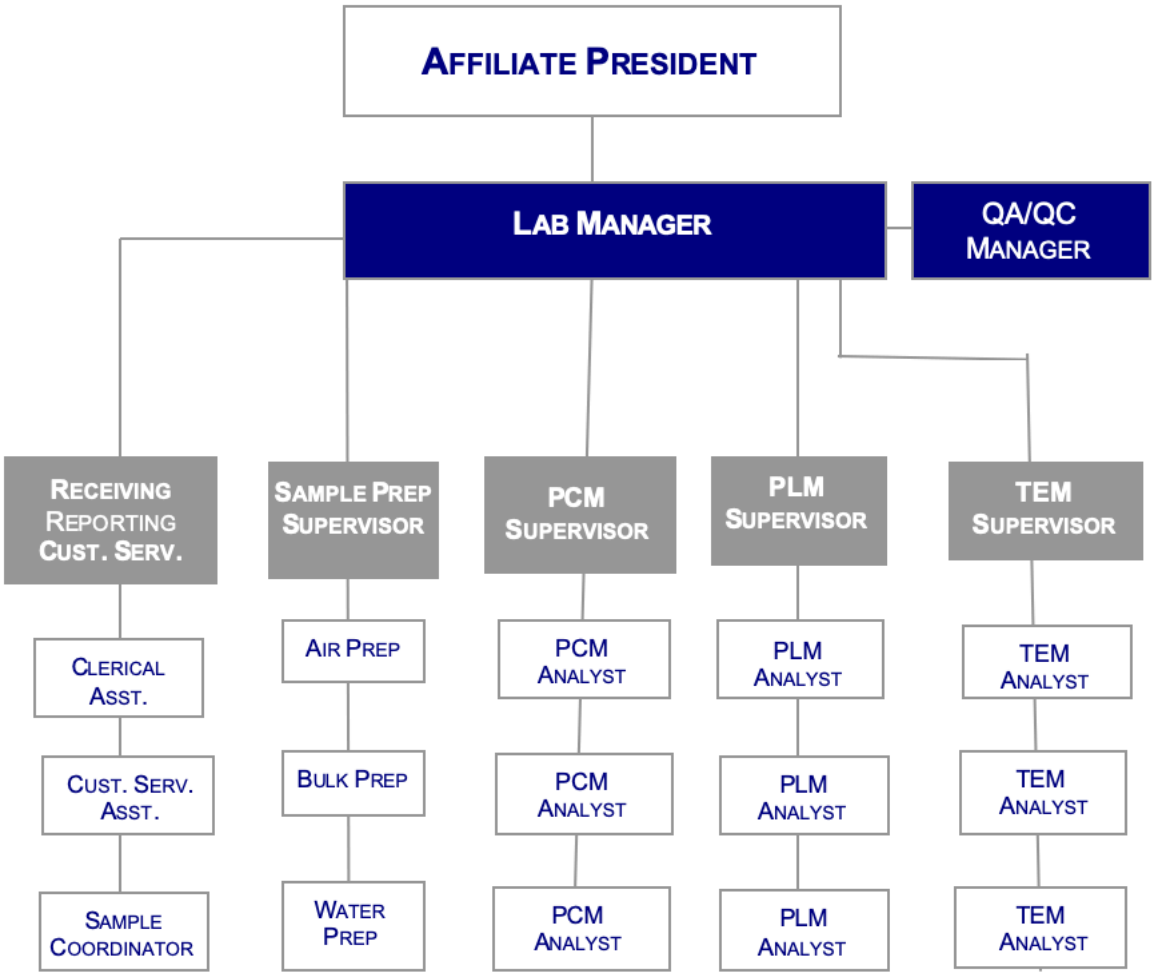
II. PROJECT DESCRIPTION OF AMERISCI ASBESTOS AFFILIATES

An **AmeriSci** affiliated laboratory provides analytical services using Light Microscopy (PCM and PLM) and Analytical Transmission Electron Microscopy (ATEM - TEM/EDS) for the Environmental Industry. All new work requests and contracts undergo a formal, documented review prior to acceptance in order to ensure that appropriate methods, SOP's, facilities, equipment, experience and trained personnel are available to perform the requested analyses. Requests for analyses not supported by established methods and SOP's are rejected for routine analysis. All customer discussions, correspondence and analysis results are considered both confidential and proprietary and are not released to or discussed with third parties without the written permission of the customer. All customers are served with utmost integrity and complete impartiality. Clients are allowed to tour AmeriSci facilities under escort and supervision with approval of the local Laboratory Director in order to monitor the lab's performance of the client's work. Such visits will only be allowed if confidentiality of all other clients' information and data can be maintained in a confidential manner during the visit.

This QA Manual deals directly with the QA/QC activities related to each of the analysis methods (Asbestos - PCM, PLM and TEM) and their associated intra- and inter-laboratory programs. An **AmeriSci** affiliated laboratory's performance is monitored through the use of on-site visits and proficiency testing programs by the American Industrial Hygiene Association and National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NIST/NVLAP-asbestos) for projects on a national level. On a state level the California and New York State Departments of Health, Environmental Laboratory Approval Programs (ELAP) and various other state and local certifications and licenses are maintained as necessary in order to serve customer needs. In addition, an **AmeriSci** affiliated laboratory conforms to other international, national, state and locality registration, certification or licensing procedures as required. A current listing of such items is available in an **AmeriSci** affiliated laboratory's **Statement of Qualifications** (SOQ).

II. PROJECT DESCRIPTION OF AMERISCI ASBESTOS AFFILIATES (CONTINUED)

A. TYPICAL AFFILIATE ORGANIZATION CHART



III. SUPERVISION OF THE QUALITY MANAGEMENT PROGRAM AND POLICIES

Controlled electronic copies of the current Quality Management Manuals are located in the Common Share Folder on the Server of each laboratory location. Approval of the documents at each location is indicated by the signatures of the local Directors.

The ultimate responsibility for the review and approval of the Quality Management Program and Quality Assurance Manual rests with the Compliance Officer. The advisors for supervision of the Systems and Manuals are the Chief Technological Officer and individual Managers of AmeriSci affiliates. The methods and procedures contained in the Manuals are specifically required for all relevant asbestos analyses. Analyses not supported by the Manuals and associated Standard Operating Procedures are not to be performed by Laboratory personnel. Failure to comply with the provisions of the Manuals is grounds for disciplinary action including possible dismissal. All employees acknowledge reading and understanding this information when signing that section of the relevant Training Checklist.

The Annual Review of the Quality Management System which includes as a minimum the Quality Assurance (QA) Manual, the Standard Operational Procedure (SOP) Manual and the Chemical Hygiene Plan/Safety (CHP/S) Manual will be initiated annually by the Compliance Officer on the first workday of the 4th Quarter. Special circumstances including situations discovered through ongoing QC programs or customer complaints may require more frequent revisions. The procedure involves (1) a checklist review of the effective operation of the Quality Management System and (2) a review of the written documents, followed by meetings with staff members to identify areas needing possible amendment or improvement. These topics are subsequently discussed with the Chief Technological Officer, District QA Supervisors/Managers and District Operations Managers/Laboratory Supervisors.

In order to implement an amendment to any document in the Quality System the Compliance Officer is required to provide a “draft” copy of the amended procedure to be reviewed by the Chief Technological Officer, District QA and Chemical Hygiene Supervisors. Once the amendment is edited by these staff members, approval of the Compliance Officer, Chief Technological Officer and affiliate Managers is required to address any final discussions on the modified or newly formulated “draft” procedure prior to implementation. A conference call is an approved method by which to hold the final discussion. Once agreed upon, the “draft” copy is published as an amended section of the appropriate Manual or document. The approved, revised document is published as an electronic image file, replacing the previous image file on each location's Common Share Folder. The most recent version of each document will be the only version allowed in use.

IV. QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION

A. QUALITY MANAGEMENT PROGRAM - Comprehensive Continuous Improvement

The goal and a major objective of the Quality Management Program is to achieve continuous improvement in all aspects of analytical customer services. This shall be accomplished by attention to Customer Feedback, Internal and External Audits, QA data analysis, Corrective Actions, Preventive Actions, and employee self-improvement and eva,luation reviewed on an annual basis. The Annual Quality Management Review implements improvements.

AmeriSci affiliates shall have managerial and technical personnel who, irrespective of other responsibilities, have the authority and resources needed to carry out their duties, including the implementation, maintenance and improvement of the management system, and to identify the occurrence of departures of the management system or from the procedures for performing tests and/or calibrations, and to initiate actions to prevent or minimize such departures. They shall ensure employee competence to operate specific equipment, perform analyses, evaluate results, and approve analysis reports. The qualifications shall be judged on the basis of appropriate education, training, experience, and demonstrated skills.

B. QUALITY MANAGEMENT – CONTROLLED DOCUMENTS

The Quality Management Program is documented in a series of controlled documents that include both internal AmeriSci generated documents and external reference documents available on the Common Share File Server at each AmeriSci location. All controlled AmeriSci internal document names end with the location and most current revision date (_NY-12-08). A Master List of all internal documents is maintained at each location. The version and revision status of internal documents is shown in the document control header and footer on each page. Controlled internal documents include the Quality Assurance (QA) Manual, the Standard Operating Procedures (SOP) Manual, Chemical Hygiene Plan/Safety (CHP/SM) Manual, the Employee Handbook, the Data Integrity and Ethics Plan, AmeriSci Forms and other location specific occasional laboratory operating documents and reports. Paper copies of Controlled Documents are printed on gray paper.

External Reference documents are maintained in a Common Share Reference File. Records of Customer Contact and Feedback maintained as part of the Quality Management System are a means to insure continuous improvement in relevant service to customers. All Quality Management Documents are archived for a minimum of 5 years after their generation.

C. QUALITY MANAGEMENT REVIEW AND APPROVAL OF CONTRACT PROPOSALS

1. Contract Review - All new work requests, tenders or contracts are reviewed by all levels of contract management prior to approval in order to ensure that the requests are adequately defined, that the laboratory possesses the necessary skills and resources, and that the laboratory has or can obtain the necessary certifications or licenses required. Trained personnel, required equipment, and relevant SOP's must be in place to perform the requested analyses. Requests for analyses not supported by established SOP's are rejected.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

C. QUALITY MANAGEMENT REVIEW AND APPROVAL OF CONTRACT PROPOSALS (cont'd)

2. Contract Review Procedure- Contracts must be reviewed and approved by all levels of relevant management including: Administrative, Financial, Marketing, Technical and Quality Assurance. The review and approval process is documented using a Contract/Work Request Evaluation Form as follows:

   a. Specifically, the relevant Technical Laboratory Manager and QA Manager must first perform a technical review in order to ensure that trained personnel, equipment, and SOP's are in place to perform the requested analyses. Any necessary subcontractors must be identified and approved by the Technical Managers.

   b. The Sales/Marketing Management reviews the pricing structure and marketing related issues.

   c. The Administrative Manager reviews the contract taking into consideration the recommendations of the technical and sales managers. The Administrative Manager, in conjunction with the CFO evaluate the terms and conditions of the contract in order to resolve any necessary issues or suggested amendments prior to final approval. The final document must be acceptable to both the laboratory and the customer. All contracts are signed by the CFO and submitted for final approval by the customer.

3. Contract Modifications or Deviations – The customer and all parties involved must be notified of any necessary amendments to the approved contract. The customer will be notified of any deviations from the approved contract. All amendments must follow the same approval process as the original contract.

4. Laboratory Ownership Change or Closure - In the event of any change in ownership or operating status of the laboratory such as transfer, closure or bankruptcy all records will be maintained for a period of five years (10 years for water analyses) as agreed in approved contracts. Records will be transferred according to the customer's instructions if specified

.

D. CUSTOMER COMPLAINTS - DOCUMENTATION AND REVIEW

Complaints received from customers shall be documented as discussed in QAM section X.D., reviewed in the monthly QA Report and archived as directed in SOP I-C. The reviews in the QA Report shall utilize the Amended Job Report Summary available from the LIMS Special Reports menu to evaluate the sources of the Amended Report Error Rate. The results of the reviews shall be reflected in Preventive Action Reports or Corrective Action Reports as appropriate.

Customer Complaints concerning an analysis result should be resolved to the customer's satisfaction, within regulatory and ethical constraints.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

E. MANAGEMENT STAFF ORGANIZATION

The Management responsibilities for AmeriSci Group (AG) and the AmeriSci affiliated laboratory operations at publication, include the following individuals:

Barry L. Browder, BS	Chief Technological Officer, AG
Thomas R. McKee, PhD	Compliance Officer - QA/QC Director, AG
Bryan H. Clark, MS	Asbestos Lab Director - AmeriSci Boston
Glenn F. Massey BS	Laboratory Director - AmeriSci Los Angeles
John P. Koubiadis	Asbestos Lab Director - AmeriSci New York
Cory M. Parnell, BS	Asbestos Lab Director - AmeriSci Richmond

Department Supervisors serve as Deputy Directors for their Departments during the Directors absence.

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES

The following is a summary of AmeriSci affiliates. JOB TITLES AND DESCRIPTIONS. (Employees may fill more than one position.) A Deputy may be appointed for a Director/Manager/Supervisor who will report to that individual and assume their duties during the Director/Manager/Supervisor's absence.

1. *LABORATORY DIRECTOR/MANAGER* (NVLAP Approved Signatory)
This position at an AmeriSci affiliated laboratory represents the ultimate responsibility at each location for implementation of all company polices and ensuring that all personnel are free from any commercial, financial or other undue pressure which might adversely affect the quality of their work. The Laboratory Director's qualifications and duties include:

   a. *QUALIFICATIONS*
      1) A minimum of a BA or BS degree or equivalent experience in one of the major science fields (i.e. biology, chemistry, geology or physics), material science or engineering preferred.
      2) Five years of experience with an AmeriSci affiliated laboratory analytical procedures or equivalent experience.

   b. *RESPONSIBILITIES*
      1) Assures conformance of all work
      2) Technical direction of the laboratory
      3) Approval of all analytical and technical service reports
      4) Approval of all departures from established procedures
      5) Reviews all new work requests and contracts for acceptance
      6) Establishes a quality work atmosphere where all personnel are free from any commercial, financial or other undue pressure, which might adversely affect the quality of their work.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F STAFF.JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

2. *COMPLIANCE OFFICER-QA/QC DIRECTOR*
(NVLAP Approved Signatory)

a. *QUALIFICATIONS*

1) A minimum of a BA or BS degree or equivalent experience in one of the major science fields (i.e. biology, chemistry, geology or physics), material science or engineering preferred.

2) Five years experience with an AmeriSci affiliated laboratory analytical procedures or equivalent experience.

b. *RESPONSIBILITIES*

1) Supervising all QA/QC Compliance company-wide by directing/working with the QA Supervisors from each lab location, thereby assuring conformance with all Federal, State, Certification Agency and customer requirements.

2) Monitoring the use of, revision of, and amendment of the QA Manual company-wide. As new employees are added to the staff at any office, he/she is responsible to assure that the Manual is reviewed with each individual.

3) Monitoring the company-wide Quality System through the use of annual system audits, performance audits and site visits of each laboratory location.

4) Implementing the Inter- Laboratory Quality Control Round Robins - General Laboratory Characterization of all Intra- and Inter-laboratory Round Robins.

5) Implementing the Intra-Laboratory Quality Control (includes round robin and verified asbestos analysis) - Internal Analyst Characterization including appropriate equipment calibrations, and analysis of all Intra- and Inter-laboratory PLM/PCM/TEM round robins for their office.

6) Implementing the completion of periodic Proficiency Rounds twice a year for each certified analyte per matrix per program. This includes coordinating the sample log-in, sample preparation (if applicable), analysis, & data entry by Company personnel on a set schedule.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

2. *COMPLIANCE OFFICER-QA/QC DIRECTOR (continued)*

7) Documenting and evaluating the QA programs associated with the individual laboratories of the Company. Perform monitoring visits to sub-facilities on a quarterly basis unless needed more often due to special circumstances.

8) Compilation and generation of all Control Charts documenting, by graphics: calibrations, quality check, intra/interlaboratory round robins and all results related to the QA system, through a monthly time-line.

9) Reviews Customer Service, Marketing and Laboratory Staff actions to assure that laboratory personnel are free from any commercial, financial or other influence or pressure, which might adversely affect the quality of their work.

10) In conjunction with the Laboratory Director reviews requests for new work, departures from documented policies and procedures prior to acceptance in order to assure that the appropriate facilities, resources and certifications are available.

11) Evaluates the significance of any non-conforming work and takes appropriate action which may include halting of work, withholding of reports, customer notification, issue of amended reports, corrective action or report recall.

3. *OPERATIONS MANAGER / LABORATORY SUPERVISOR*
(NVLAP Approved Signatory)

The Operations Manager / Laboratory Supervisor position at an AmeriSci affiliated laboratory overlaps many of the responsibilities of the Laboratory Manager. The Operations Manager/Laboratory Supervisor may cover only a portion of the analysis methods used at a facility depending upon his/her experience and qualifications. More than one Supervisor may be named for a facility in order to cover different areas of analysis. The Operations Manager assumes the administrative and technical responsibilities of the Laboratory Manager during his/her absence. The Laboratory Supervisor assumes the technical responsibilities, but not the administrative/report tasks taken on by the Operations Manager.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

a. *QUALIFICATIONS*

1) A minimum of a BA or BS degree in one of the major science fields (i.e. biology, chemistry, geology or physics), material science or engineering preferred.

2) Two years experience with an AmeriSci affiliated laboratory analytical procedures or equivalent experience.

b. *RESPONSIBILITIES*

1) Supervision of Analysts (PCM, PLM, TEM, etc.) and Laboratory Technologists (sample preparation).

2) Ultimately responsible for proper chain-of-custody - Ideal Sample Flow.

3) Generating and reviewing (Operations Director) technical service reports.

4) Responsible for the maintenance of equipment.

5) Responsible for all equipment and training, which includes training and evaluation of each analyst (To be done with the aid of the location's QA/QC Director/ Supervisor.)

6) Reviews all requests for new work and departures from policies or procedures prior to acceptance in order to assure that the appropriate facilities, resources and certifications are available.

7) Review of customer job and sample information entered by other employees into the LIMS during Log In, Preparation and Analysis.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

4. *ASBESTOS QUALITY ASSURANCE MANAGER/SUPERVISOR* (NVLAP Approved Signatory)

a. *QUALIFICATIONS*

1) A minimum of a BA or BS degree in one of the major science fields (i.e., biology, chemistry, geology or physics), material science or engineering preferred.

2) Two years experience with an AmeriSci affiliated laboratory analytical procedures or equivalent experience.

b. *RESPONSIBILITIES*

1) Working with the Compliance Officer to organize and maintain the QC Program at an office location such that the office will be prepared at all times for a certifying agency site visit.

2) Monitoring the use of the QA Manual at their location. As new employees are added to the staff, he/she is responsible to review the Manual with each person.

3) Implementing the Inter-Laboratory Quality Control Round Robins required by Federal and/or State Agencies not handled by the Compliance Officer nationally.

4) Implementing Intra-Laboratory Quality Control (round robin and verified asbestos analysis) - Intra-lab Analyst Characterization, equipment calibrations, and analysis of all Intra- and Inter- laboratory PCM/PLM/TEM round robins.

5) Implementing the completion of periodic Federal and State Agency Proficiency Rounds at least twice a year for each certified analyte per matrix per program. This includes coordinating the sample log-in, sample preparation (if applicable), analysis, & data entry by Company personnel on a set schedule.

6) Assuring compilation and generation of all Control Charts, documenting, by graphics: calibrations, quality check, intra/interlaboratory round robins and all results related to the QA system, through a monthly time-line.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

4. *ASBESTOS QUALITY ASSURANCE SUPERVISOR/MANAGER (continued)*

7) Organizing periodic weekend Production work with the Operations Manager/Laboratory Supervisor (1-2 times per month depending on the number of existing available staff). Different from the Compliance Officer, who has additional duties, the QA Supervisor may also take on weekday production lab analysis as a function of analytical skills, work schedules, and daily needs.

8) Ensure that each employee is aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system. These relationships should be highlighted during training using the individual discussions on the final page of the training checklist. After the initial training is completed continuing education items such as customer feedback, corrective action reports, error rates, audit results or any other relevant records should be used as examples to illustrate these relationships.

9) Review of customer job and sample information entered by other employees into the LIMS during Log In, Preparation and Analysis

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

5. *TRANSMISSION ELECTRON MICROSCOPY ANALYST*

The TEM Analyst occupies a central position in the TEM Laboratory, due to the requirement of his/her understanding of and implementing in all scientific areas of the TEM organization. The minimum required qualifications, (a) and associated responsibilities of an independent analyst, (b) follow below:

a. *QUALIFICATIONS*

1) A minimum of BA or BS degree in one of the major science fields (i.e., biology, chemistry, geology or physics), material science or engineering preferred.

2) Proficient in the operation of an ATEM and EDS. Can accurately analyze fibrous materials using SAED and EDS.

3) Has an average accuracy of better than 80% True Positives (≤20% False Negatives) and less than 10% False Positives.

4) Willingness to follow all procedures outlined in the QA Manual. Knows when and where to seek help.

b. *RESPONSIBILITIES*

1) TEM evaluation of asbestos samples including air, bulk, dust and water during his/her shift. Communicate results to customers by FAX (or verbally). Compile all existing data for the Laboratory Manager prior to a formal report preparation.

2) To ensure a proficient laboratory quality assurance program, the TEM Analyst is required to perform the following duties:

a) ll required TEM and EDS calibrations described in the Equipment Calibration section of the SOP Manual.

b) Evaluation of the quality of grid preparation.

c) Evaluation of contamination check samples.

d) Analyze all Intra/Inter-laboratory samples supplied by the QA Supervisor.

e) Review of customer job and sample information entered by other employees into the LIMS during Log In.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

6. *ASBESTOS LABORATORY TECHNOLOGIST - ALT (Sample Preparation)*

The Laboratory Technologist is responsible for sample receipt and sample preparation for all air methods (PCM – NIOSH 7400 & 7402, AHERA and – Yamate - EPA Level II), bulk (PLM, Digestion Method - Chatfield), water, dust and soil samples received at an AmeriSci affiliated laboratory. Therefore, the ALT is responsible and required to follow sample custody from laboratory entry to the PCM, PLM or ATEM analysis. One ALT may be designated the Laboratory Sample Coordinator to assure proper chain-of-custody, sample preparation and final storage of the prepared grids and raw, unprepared sample materials.

The following represents a list of Quality Assurance responsibilities to be addressed by the Asbestos Laboratory Technologist:

a) Sampling and preparation of the contamination check samples in the Air and Bulk Laboratories (described in Section XI - Contamination Checks & Controls).

b) Preparation of redo's to be incorporated into the QC Program on a daily basis for each sample set.

c) Re-analysis of actual samples (preparation of samples).

d) Review of customer job and sample information entered by other employees into the LIMS during Log In.

7. *POLARIZED LIGHT MICROSCOPY ANALYST*

The PLM Analyst occupies a central position in the PLM Laboratory, due to the requirement for his/her understanding of and implementing in all scientific areas of the Optical Laboratory. For that reason, listed below are the required qualifications (a) to become an independent analyst as well as the associated responsibilities (b).

a. *QUALIFICATIONS*

1) A minimum of a BA or BS degree in one of the major science fields (i.e., biology, chemistry, geology or physics), material science or engineering. Equivalent experience may be substituted.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

2) Proficient in the operation of PL microscopes.

3) Knowledgeable in sample preparation and chain-of-custody, etc.

4) Knows when and where to seek help.

b. *RESPONSIBILITIES*

1) PLM evaluation of asbestos samples during his/her shift. The analyst is required, of course, to follow the procedures stated in the QA and SOP MANUALS.

2) To ensure a proficient laboratory quality assurance program, the PLM Analyst is required to perform the following duties:

a) All required PLM and RI calibrations described in the Calibration section of the SOP Manual.

b) Evaluation of the quality of sample preparations.

c) Evaluation of contamination check samples.

d) Analyze all Intra/Inter-laboratory samples supplied by the QA Supervisor.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED))

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

8. *PHASE CONTRAST LIGHT MICROSCOPY ANALYST*

The PCM Analyst occupies a central position in the PCM Laboratory, due to the requirement for his/her understanding of and involvement in all areas of the Optical Laboratory. Therefore, the required qualifications (a) to become an independent analyst as well as the associated responsibilities (b) include:

a. *QUALIFICATIONS*

1) A minimum NIOSH 582 or equivalent course completion with 1 year experience preferred.

2) Proficient in the operation of Phase Contrast Microscopes.

3) Knowledgeable in sample preparation, chain-of-custody, etc.

4) Knows when and where to seek help.

b. *RESPONSIBILITIES*

1) PCM evaluation of air filter samples during his/her shift. The analyst is required, of course, to follow the procedures stated in the QA and SOP MANUALS.

2) To ensure a proficient laboratory quality assurance program, the PCM Analyst is required to perform the following duties:

a) <u>All</u> required PCM calibrations described in the Calibration section of the SOP Manual including: microscope alignment, W-B graticule diameter measurement, phase contrast resolution determination, daily analysis of reference slides and preparation blanks.

b) Evaluation of the quality of sample preparations.

c) Evaluation of contamination check samples.

d) Evaluation of blind recounts Pair Test prior to release.

e) Analyze all Intra/Inter laboratory samples assigned by the shift manager and QA Supervisor

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

9. *LABORATORY SAMPLE COORDINATOR*

One LABORATORY TECHNOLOGIST is assigned this position. The SAMPLE COORDINATOR is responsible for:

a) Supervising sample receipt, acceptance and log-in.

b) Supervising sample custody and integrity.

c) Supervising sample delivery to the appropriate preparation area.

d) Supervising sample handling throughout the laboratory in order to assure that samples are not damaged in any way.

e) Supervising proper storage and disposal of all sample material received at customer contacts concerning such items.

10. *LABORATORY CLERICAL ASSISTANT*

The Laboratory Clerical Assistant (LCA) is responsible for sample receipt in such a manner as to maintain a strict Chain of Custody for all materials entering or leaving the Laboratory. During their daily tasks the LCA is responsible for the following duties as specified by their supervisor:

a) Serving customers visiting or contacting the laboratory while maintaining security of the facility, customer and company information.

b) Documenting customer requests or complaints for action by the appropriate company representative.

c) Logging customer samples into the Laboratory Information Management System (LIMS) in an efficient and correct fashion.

d) Review of customer job and sample information entered by themselves and others into the LIMS during Log In or Reporting and resolving any uncertainties observed in the Chain of Custody analysis request.

e) Attaching a unique sample identification code generated by the LIMS to each sealed customer sample container before transporting each job to the appropriate analysis section of the laboratory.

f) Transmitting approved reports or communications to customers by

secure, company approved methods.

IV QUALITY MANAGEMENT PROGRAM AND STAFF ORGANIZATION (CONTINUED)

F. STAFF JOB TITLES, DESCRIPTIONS AND RESPONSIBILITIES (continued)

g) Maintaining sufficient supplies and services to perform their duties.

h) Maintaining and continuously improving the skills necessary to perform their job responsibilities.

i) Maintaining a commitment to organization, punctuality and a professional demeanor in the laboratory.

j) Other temporary duties deemed necessary to office operation that do not involve handling of sample material, chemicals or equipment operation within the laboratory environment.

V. SAMPLE HANDLING AND CHAIN-OF-CUSTODY

A. SAMPLE ACCEPTANCE

An AmeriSci affiliated laboratory receives customer samples via Federal Express, UPS, U.S. Postal Service, and hand delivery, as well as other major/minor courier services. The shipping container is inspected for an intact custody seal and any shipping damage. The Sample Coordinator or Sample Receiving Technician operating under the supervision of the Sample Coordinator breaks the custody seal following appropriate hygiene methods and inspects the samples (air, dust, bulk, water, etc.) enclosed in the shipping container, recording the sample temperature if appropriate (water). Any damage or unusual sample conditions are observed and documented in writing on the submittal form (see customer contact below). The submittal form/chain of custody (COC) is checked for proper information and the samples evaluated for acceptance. All samples submitted must be accompanied by a COC of some type.

Possible rejection criteria include but are not limited to:

Any sample deemed dangerous to laboratory personnel
Any sample which requires an analysis method not performed by AmeriSci affiliates
Air and bulk samples shipped in a common container (asbestos samples),
Open cassettes or sample containers,
Damaged filters or cassettes,
Duplicated or non-unique sample numbers,
Mixed analysis types on a single submittal form,
Mixed turnaround times (TAT's) on a single submittal form,
Any drinking water sample exhibiting a temperature outside the method required range,
Any drinking water sample exceeding the 48 hour holding time,
Any sample deemed contaminated,
Any sample with insufficient material or information,

B. SAMPLE SUBMITTAL INFORMATION AND CUSTOMER CONTACT

The AmeriSci (or customer) submittal / chain-of-custody form and any other data pertaining to the sample content should be included within the outer shipping container. If any of the samples do not meet the acceptance criteria, the Sample Coordinator will contact the customer to resolve the discrepancy. It is then the customer's decision whether to re-submit new samples or continue with the received samples. In addition, any missing or incomplete data critical to the project will be obtained during this communication. All special instructions, comments or notes on the COC should be recorded in the LIMS on the Job Tracking Sheet or the Batch Traveler - Client Notes or Comment sections as appropriate. All discrepancies and/or incomplete information necessary for the analysis must be resolved through customer contact prior to final release of the job to the laboratory for analysis. All customer contact concerning the job is therefore documented as a permanent part of the LIMS Job File. Any verbal changes in the original submittal information must be verified by submission of a hard copy (fax copy is acceptable), appended to the original COC and documented in the LIMS Any samples entering or leaving the laboratory for return to a customer must be accompanied by a copy of the original COC.

V. SAMPLE HANDLING AND CHAIN-OF-CUSTODY (CONTINUED)

C. LIMS JOB/BATCH CREATION

Once accepted, the sample set is assigned a unique identification number (e.g., AmeriSci affiliated laboratory Job Number X-YY-MM-1002). For an AmeriSci affiliated laboratory's purposes, the X is a numerical corporate location identifier (1&3 = Richmond; 2 = New York, 5 = Boston and 9 = Los Angeles), the second number sequence, YY, represents the year, the third number sequence, MM, represents the month and the fourth number sequence represents the Job order, as received chronologically each month beginning with the 1001 (this sequence has been different in the past). All pertinent information for the project is entered into the LIMS Job File. Hard copy forms may be used temporarily in case of computer malfunction. Following completion of Job/sample data entry into the LIMS Database by the Sample Coordinator, a Job Folder is generated which contains the Job/Batch Traveler, Job Tracking Form, submittal/chain-of-custody form, sample analysis worksheets (if needed), the shipping address form (or copy) and any other hard copy materials provided by the customer with the samples. The Job Folder and samples are passed on to the laboratory for any necessary processing required prior to analysis.

D. SAMPLE SEQUENCING

Before the sample set and Job Folder (with COC included) are passed on to the laboratory, strict procedures are followed which preserve the sample sequencing established by the COC. The samples are each labeled with a unique sequential number consisting of the AmeriSci Job Number followed by the sequential AmeriSci sample number beginning with "1". The laboratory personnel are responsible for properly labeling and preparing the samples in a sequential manner identical to that established by the COC (necessary for analysis of all samples), as described in the appropriate SOP. Insertion of QA samples, laboratory blanks, spiked samples or other quality related special samples into the Job/Batch sequence will not in any way change the relative positions of the original samples in the sequence. When the preparation is completed (if necessary) the Job Folder and labeled samples are transferred to the Ready Area in the appropriate laboratory area (PCM, PLM, TEM, etc.) to await analysis. Any unprocessed sample remaining after sample preparation is retained by the Sample Coordinator for return to the customer or temporary storage prior to disposal.

E. SAMPLE AND CHAIN OF CUSTODY INTEGRITY

The Sample Coordinator (SC) will assure that all samples entering the laboratory are consistent with the submitted COC (or submittal form). While in the laboratory the SC will ensure that they are handled and stored in a manner to insure their integrity, both individually and with respect to the COC, is not compromised in any way (includes temperature of water samples). Any steps necessary will be taken to insure samples are processed in an orderly fashion and in such a manner as to preserve their proper sequencing in relationship to the COC. The SC will ensure that the samples are not unnecessarily damaged during processing or storage at an AmeriSci affiliated laboratory. It must be recognized that some analysis procedures necessarily require alteration of the portion of the sample being analyzed.

V. SAMPLE HANDLING AND CHAIN-OF-CUSTODY (CONTINUED)

F. SAMPLE STORAGE (TEMPORARY)

Drinking water samples remain in shipping containers until filtered, to maintain proper storage conditions (dark and temperature < 5 C but above freezing). Filtered water samples are either returned to the chilled shipping container or stored in a monitored refrigerator until the sample preparation quality has been verified, then moved to room temperature storage. Customer samples are either returned or temporarily stored at AmeriSci affiliates for 60 days before disposal. Samples that are retained for storage are placed in double bags or other appropriate containers and filed by an AmeriSci affiliated laboratory Job Number. The sealed container is placed in storage with other similar samples in a secured storage area. It should be noted that different analysis types (i.e. air filters, bulk samples, water samples) are stored separately, thereby minimizing any potential cross contamination.

G. SAMPLE RETURN

Samples designated for return to the customer are kept in the original shipping container, if appropriate. Upon completion of processing and/or analysis the samples and their container are returned to the Sample Coordinator for retention in the Return Holding Area. After the 60 day retain period, samples held in the Return Holding Area are returned to the customer by a traceable shipping method. All samples leaving the laboratory are accompanied by a COC. In the event of being returned to the original customer they will be accompanied by a copy of the original chain of custody. Portions of the samples may be retained for QA purposes.

H. SAMPLE DISPOSAL

After the 60 day holding period (unless otherwise agreed in writing) samples held in temporary storage are disposed of by a licensed contractor following federal, state and local regulations. The COC copy is retained in the appropriate Job file. Portions of the samples may be retained for QA purposes. Disposal of unused samples and analysis residue will be accomplished following procedures as outlined in the Asbestos SOP's. The local QA Supervisor is responsible for maintaining all Disposal Manifests and other related documents, which become a part of the AmeriSci affiliate permanent files.

I. SUBCONTRACTOR SUBMITTAL

Any subcontract laboratory must maintain an equivalent or superior certification and proficiency status relative to an AmeriSci affiliated laboratory. Asbestos samples may be subcontracted when necessary to another accredited laboratory which has been evaluated and approved by the Compliance Officer or QA Officer. An unbroken COC is maintained in the event of such transfer action. Customer approval must be obtained prior to submittal to the subcontractor. The final report must reflect the identity and certification status of the subcontracting laboratory.

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT

A. ANALYSIS METHODS - Standard Operating Procedures

1. SOP Elements - SOP's should contain the following elements (if appropriate for the specific SOP):

   a. Identification of the test method
   b. Applicable matrix or matrices
   c. Detection limit
   d. Scope and Application
   e. Summary of the test method
   f. Definitions
   g. Interferences
   h. Safety
   i. Equipment and supplies
   j. Reagents and standards
   k. Sample collection, preservation, shipment and storage
   l. Quality control
   m. Calibration and standardization
   n. Procurement
   o. Data analysis and calculations
   p. Method performance
   q. Pollution prevention
   r. Data assessment and acceptance criteria for quality control measurers
   s. Corrective action for out-of-control data
   t. Contingencies for handling out-of-control or unacceptable data
   u. Waste management
   v. References
   w. Any tables, diagrams, flowcharts and validation data.

2. SOP Approval - SOP's are approved by the Chief Technological Officer, Chemical Hygiene Officer and Compliance Officer and validated through a Demonstration of Capability (DOC). Established analytical methods (EPA, OSHA, ASTM, NIOSH, etc.) may be adopted by reference but must be validated by a DOC prior to use. Such methods, modifications of existing methods, or in-house developed special methods may be adopted after development of necessary documentation, verified acceptable method performance, establishment of chemical hygiene policies, laboratory trial as a draft SOP for at least 90 days and validation through an appropriate Demonstration of Capability (DOC) following NELAC Quality Guidelines. Prior to full approval the new method must be approved by the Lab Manager and QA manager.

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT

A. ANALYSIS METHODS - Standard Operating Procedures (continued)

3. SOP Development or Amendment - An SOP or amendment can be suggested by any employee and recommended to the Compliance Officer with approval of the Lab Manager and QA Officer. Proposed SOP's or amendments are evaluated by the Compliance Officer who solicits qualified personnel equipped with adequate resources to provide the method development. The Compliance Officer produces a "draft" copy of the amended procedure to be reviewed by the Chief Technological Officer, Lab Manager, Chemical Hygiene Officer, and QA Officer. Once the amendment is edited by these staff members, approval of the Compliance Officer, Chief Technological Officer and QA Officer is required to address any final discussions on the modified or newly formed "draft" procedure, prior to implementation. A conference call is an approved method by which to hold the final discussion. Once agreed upon, the "draft" copy is published as an SOP or amended SOP. The approved, revised document is placed in the Common Share Folder, replacing the previous image file for an amended SOP. The most recent version of each document will be the only version in use.

4. SOP Attestation - All analysts must read, understand and agree to use the latest version of any SOP for which they are approved as an analyst as signified by their signed training records. Any updated or modified SOP's must be similarly agreed to as indicated by a signed acknowledgment sheet maintained in the analyst's training records.

B. ANALYSIS METHODS - Demonstration of Capability

1. Prior to use as a Standard Operating Procedure any new analysis method must first be validated by a satisfactory Demonstration of Capability (DOC). The DOC tests application and performance of the method in a clean matrix (lacking target analytes or interferences). For analytes which do not lend themselves to spiking, the DOC may be performed using well characterized quality control samples. Quality Control procedures may be used to provide continued satisfactory demonstration of method performance. Methods in use prior to 1999 with no significant changes only require demonstration of continuing method performance.

2. Samples used for Demonstrations of Capability must, when possible, be purchased from an outside source. When not available for purchase the sample generated must be independent of those used for instrument calibration standards. New chemicals must be approved by the QA Officer and Chemical Hygiene Officer before being ordered or accepted for delivery in the laboratory in order to provide for safe handling methods and spill control criteria development. Material control methods outlined in the Chemical Hygiene Manual must be followed for receipt, handling, inventory control, storage and disposal. All such standards must be dated and inventoried upon receipt.

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

C. PHYSICAL FACILITIES NECESSARY

The following facilities are necessary for proper operation of an asbestos laboratory. AmeriSci affiliated laboratory's Virginia and California facilities are located in single story buildings with New York and Boston occupying space within multistory buildings. An AmeriSci affiliated laboratory utilizes the following areas within these facilities:

1. Sample Log-In Area where packages are received, inspected and job files created. After creating a job file in the LIMS database, the Job Folder and samples are set up for inspection, labeling, preparation and analysis. The Log-In Area serves as a staging area for jobs and samples to be properly labeled while awaiting transfer to the laboratory area.

2 Separate clean areas for PCM, PLM and TEM asbestos (TEM bulk, TEM air and TEM water), each equipped with HEPA, filtered workstations

3. TEM rooms containing analytical transmission electron microscopes consisting of tilt stage transmission electron microscopes equipped with energy dispersive x-ray analysis systems.

4. Bulk Prep Laboratory, (completely separate from the TEM air laboratory), equipped with a HEPA hood, microbalance, milling, ashing and filtration equipment.

5. Darkroom facility for negative developing.

6. PLM/PCM analysis areas with individual HEPA filtered workstations.

7. Secured storage area and cabinets for analyzed samples and job files.

8. Storage areas for temporary storage of asbestos samples (asbestos air filter cassettes and bulk samples stored separately) while awaiting disposal.

D. ANALYTICAL EQUIPMENT

All analytical equipment necessary for performance of SOP's and analytical methods in use at an AmeriSci affiliated laboratory must be properly maintained, serviced, and calibrated according to the schedule in Section XIV.K while in service. New or repaired equipment must be calibrated before being put into service initially or returned to service for analysis purposes. See Section VI.M. Traceability of Standards and Calibrations.

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

D. ANALYTICAL EQUIPMENT (continued)

1. The laboratory must have available all necessary equipment and supplies required for the performance of any procedure prior to accepting samples for analysis. The equipment must be appropriate for the intended analysis. Any equipment not owned by the laboratory must meet all requirements for maintenance and calibration.

2. Only authorized personnel shall operate laboratory equipment. Individual training records must be approved and on file with the laboratory QA Supervisor prior to authorization. Authorization is documented in each employee's Job Approval Ledger.

3. Equipment shall be capable of achieving calibration accuracy required by test methods to be performed and shall be supported by a current Demonstration of Capability for the method of interest (DoC validates both instrument and analyst).

4. Any equipment which leaves direct control of the laboratory for any reason shall be checked for specific function and calibration prior to being returned to service for routine analyses. Such periods are documented in the Equipment Log.

5. Equipment found to be defective or out of calibration will be removed from the work area (if possible) until repaired or replaced. If remaining in the laboratory while out of service the equipment will be marked with an orange "Out Of Service" tag stating: "Defective equipment - Do Not Operate - See Equipment Log for Information." The tag will be dated and signed by the Laboratory QA Officer. When any equipment in service is found to be defective, all past analyses performed since the last successful calibration will be verified to be in conformance. Possible impact on previous analyses and reports will be investigated and customers informed of any nonconformance, necessary corrective actions or amended reports. Such occurrences are documented in the Equipment Logs and QA monthly reports.

E. FACILITY SERVICES and ENVIRONMENTAL CONDITIONS

The laboratory equipment, supplies and personnel require controlled environmental conditions to provide optimum reliable operation as follows:

1. Room Temperature - 21°C+/- 5°C

2. Relative Humidity - between 30% and 60%

3. Grounded and fused electrical power (dedicated earth grounds for TEM's)

4. Computer servers and EDS systems require surge protection and UPS power backup.

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

F. LIMS - SOFTWARE MODIFICATION & VALIDATION

LIMS Software development and validation are performed under the direction of a full time, professional programmer. The standard for system use is EPA Document 2185, Good Automated Laboratory Practice.

1. Upgrades to the network, server and workstation hardware are approved by the Chief Technological Officer.

2. Suggested modifications and updates to the LIMS software are approved by the Chief Technological Officer, Software Engineer, Compliance Officer and QA Manager prior to development.

3. The software developer inspects modifications to the software. This will insure the coding standards are followed consistently and, in conjunction with software testing, will expose errors in logic or execution. Release notes and a changed module log are maintained to enable programmers to identify goals of the modifications and where to find the changes to be reviewed.

4. Software updates are initially tested by the developer in a single user, Test Database in order to validate proper system performance and impact on existing system functionality. Example data reduction and report generation is performed and documented with previously produced data sets in order to provide validation of satisfactory performance. Only then is the new release of the update installed for testing on a limited basis under real conditions using non-customer jobs.

5. The laboratory personnel who will use the released changes perform final testing and validation. The validation is performed for each laboratory operation and analysis type. The validation is documented on a "Computer Software Validation Log" which is approved by the relevant Laboratory Manager and QA Officer. Repeatable tests are performed that focus primarily on typical situations which will facilitate detection of critical problems that could greatly disrupt individual analysis reports or operation of the LIMS system.

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

G. EQUIPMENT RECORDS

An Equipment Logbook is maintained for each major item of equipment with the following records included. The logbook and operations manual for each piece of equipment is located in the laboratory area with the equipment involved. For multiple pieces of similar equipment used in the same area a single operation manual may be maintained in the lab area. Scanned copies of the documents should be maintained as an electronic file in the Common Share Folder on the File Server.

1. Equipment name, including manufacturer’s name.

2. Equipment type, model identification and serial number.

3. Source, date received and date placed into service.

4. Location of equipment (building and room).

5. Location of manufacturer's operating manual and relevant SOP's

6. Maintenance and troubleshooting records.

7. Calibration records, reports, control charts and calibration report references.

V. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

H. ASBESTOS EQUIPMENT

The major equipment necessary to the NVLAP Accredited Asbestos Division of an AmeriSci affiliated laboratory operation includes:

1. ELECTRON MICROSCOPY
   HITACHI H-7000 Electron Microscope/ Noran X-Ray EDS (1-CA)
   HITACHI H-7000 Electron Microscope/ Noran X-Ray EDS (1-NY)
   HITACHI H-600 Electron Microscope/ Noran X-Ray EDS (2-NY)
   JEOL JEM-100CX Electron Microscope/EVEX X-Ray EDS (1-VA)
   JEOL JEM-100CXII Electron Microscope/EVEX X-Ray EDS (1-VA)

2. OPTICAL MICROSCOPY
   NIKON Labophot-Pol Polarizing/DS microscope systems (4-CA)
   NIKON Labophot-Pol Polarizing/DS microscope systems (4-MA)
   NIKON Labophot-Pol Polarizing/DS microscope systems (5-NY)
   OLYMPUS BHTP Polarizing/DS microscope system (5-VA)

3. PREPARATION EQUIPMENT

   EMS 150Turbo (1-NY) & LADD (1-NY) Vacuum Evaporators
   DENTON DV502A (2-CA, 2-VA) Vacuum Evaporators
   SPI Plasma Etcher (1-NY, 1-VA, 1-CA)

   Analytical Filtration Manifolds for NOB, Dust, Water and Indirect Air TEM preps

   HEPA filtered workstations - one for preparation of TEM air samples, one for TEM bulk preparation, others for sample handling and one for each PCM and PLM station

   CAPTAIR Ductless Chemical Filtration Hoods for TEM sample preparation.

I. CRITICAL ASBESTOS EQUIPMENT - AHERA REQUIRMENTS

1. PLASMA ETCHER - The plasma etcher is a low temperature system that utilizes oxygen for filter etching. The leak rate is set to minimize disturbance of particles during venting air flow. Gravimetrically tracked etching of collapsed filters is used for calibration purposes. In addition, to minimize any potential contamination, this system is used only for air samples.

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

I. CRITICAL ASBESTOS EQUIPMENT - AHERA REQUIRMENTS (continued)

2. HIGH VACUUM CARBON EVAPORATOR - The carbon evaporator is equipped to attain a high vacuum for proper carbon coating. . An AmeriSci affiliated laboratory uses only spectrochemically pure carbon rods, which are sharpened in a sharpener specifically designed for carbon rods. (Constant sharpened distance for consistent coating).

3. TEM ELECTRON MICROSCOPES - The TEM units used at an AmeriSci affiliated laboratory have the following capabilities:

   a. Voltage of 80-120 kV

   b. Production of SAED patterns for a single fibril of chrysotile.

   c. Display and resolution of hollow tube morphology of chrysotile.

   d. Measurement of fiber length by gradations on fluorescent pad.

   e. Mechanical stage with reproducible movement along perpendicular directions.

   f. Production of a $\leq$250nm spot at crossover for EDXA analysis.

   g. Production of negatives for hard copy documentation of images and calibration of both magnification and SAED patterns.

4. ENERGY DISPERSIVE X-RAY ANALYZERS - The EDS X-RAY Analyzer units used at An AmeriSci affiliated laboratory have the following capabilities:

   a. Resolution at Mn Ka peak (FWHM) of <175 eV

   b. Detection of significant Na in NIST SRM 1866 crocidolite asbestos.

   c. Ability to obtain significant Mg and Si peaks from single fibrils of NIST 1866 chrysotile.

   d. Background corrected peak intensities for elements Na through Cu

   e. Ability to display x-ray spectrum (0.9-10 keV) on a color monitor.

   f. Ability to produce a hard copy of an asbestos EDS x-ray spectrum.

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

I. CRITICAL ASBESTOS EQUIPMENT - AHERA REQUIRMENTS (continued)

5. *CONTROL CHARTS FOR TEM AND EDS EQUIPMENT*

Control charts indicate appropriate control limits related to the allowable limits of variation (typically with a warning limit of twice the standard deviation and a control limit of three times the standard deviation). Critical equipment such as TEM and EDS units require more specific control chart limits tailored to illustrate "in control" operation of parameters such as:

TEM Magnification - the variation (2 std dev) is <5% of the mean calibration value
TEM SAED Camera Constant - the variation is <5% of the mean calibration value
TEM Minimum Beam Spot Diameter - the variation is <25% of the mean value
EDS MnKa - resolution + variation is <180eV
EDS k-factor - variation is <10% of mean value for Mg, Al, Si, and Fe
EDS k-factor - variation is <20% of mean value for Na

J. SUBCONTRACTING - EQUIPMENT, EMPLOYEES OR ANALYTICAL WORK

In the event that any non-AmeriSci affiliated laboratory equipment or personnel are utilized in any analysis (including as sub-contractors), the Compliance Officer (assisted by the local QA Supervisor) will ensure that the equipment or person(s) is covered by certifications and operating criteria necessary for the actual work processes being performed. If this operation involves complete preparation and analysis at another laboratory, the customer will be notified prior to analysis. In such cases the subsequent report will include all required information as to both the laboratory and analyst identifications and certifications involved.

K. SAMPLING EQUIPMENT, MATERIALS AND PROCEDURES

An AmeriSci affiliated laboratory provides sampling materials or equipment for specific identified procedures where required by the method and/or certification. Procedures for sample collection and use of sampling materials, equipment or containers is covered in relevant AmeriSci affiliates SOP's. An AmeriSci affiliated laboratory does not perform sampling. All deviations from established collection procedures and SOP's must be documented as part of the transmitted records or Chain of Custody. Customers requesting information concerning sampling procedures will be referred to published or established reference materials or procedures if no AmeriSci affiliates SOP is available.

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

L. SUPPLIES, REAGENTS AND STANDARDS

Material supplies, Reagents and Reference Standards are often critical components of methods and procedures. The supplies utilized in method or procedure development are thereafter the only supplies, reagents or standards approved for purchase and use. Alterations in material, reagents or standards by manufacturer or type must be evaluated and approved prior to introduction as an approved change or alternate source. New chemicals must be approved by the QA Officer and Chemical Hygiene Officer before being ordered or accepted for delivery in the laboratory in order to provide for safe handling methods and spill control criteria development. Material control methods outlined in the Chemical Hygiene Manual must be followed for receipt, handling, inventory control, storage and disposal. All materials, chemicals, reagents and standards must be inspected upon arrival before being added to laboratory inventory. Packing slips are reviewed, dated, signed and the material received or backordered is recorded in the Purchase Order - Inventory Control System. Accepted chemical shipments must be affixed with an Inventory Label showing: Accepted By, Date Rec'd, Date Opened and Expiration Date. Materials are not used past the expiration date, are not reevaluated for use and are disposed of if they do not pass initial or subsequent QA/QC procedures.

The following procedures, standards and reference materials are available for use at an AmeriSci affiliated laboratory:

1. CHEMICAL STANDARDS AND REAGENT PROCEDURES

   a. records will be maintained for standards, reagents and media including the manufacturer/vendor, Certificate of Analysis (or purity if supplied), date of receipt, recommended storage conditions, and the expiration date (if relevant, for example some physical standards maintain integrity until physically damaged).

   b. original container labels will be maintained with associated information and expiration dates

   c. records of reagent or standard preparation will be maintained to show traceability to purchased stocks or neat compounds, methods of preparation, date of preparation, expiration date and preparer's initials.

   d. prepared reagents and standards will bear a unique identifier coded to the preparation document

2. OPTICAL STANDARDS

   a. Stage Micrometer

   b. HSE/NPL phase contrast test slide

VI. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

L. SUPPLIES, REAGENTS AND STANDARDS (continued)

3. PLM and TEM ASBESTOS STANDARDS

a. Standard optical grating replica (TEM magnification calibration).

b. NIST Reference Material 8410, 8411.

c. NIST Standard Reference Materials 1866, 1867, and 1876b.

d. Prepared samples of NIST chrysotile, amosite, crocidolite, anthophyllite, tremolite, actinolite and non-asbestos materials.

e. NIST SRM 2063a and traceable Albite for EDS calibration

f. Aluminum and gold film material for SAED and EDS calibration.

g. Ground glass Refractive Index Reference solids

h. Refractive Index Reference liquids

M. TRACEABILITY OF STANDARDS AND CALIBRATIONS

Reference materials and Standards shall, where possible, be traceable to the International System of Units (SI units) of measure, or to certified reference materials such as NIST SRM's (See Section XII.D. Use of Reference Materials and Standards). Internal laboratory calibrations or those performed by an accredited third party must be traceable to NIST or a similar International body, if possible (See Section VI.E. Analytical Equipment). When possible any external calibration laboratory used must be accredited to ISO/IEC 17025 by a recognized accreditation body.

In the event that no accreditation program exists for a specific type of calibration then the program shall adhere to ISO traceability requirements including the calculation of the uncertainty involved.

VII. METHOD SOP'S, FACILITIES AND EQUIPMENT (CONTINUED)

N. CRITICAL SUPPLIES and SUPPLIERS

Critical consumables used in the laboratory, are an important component of the methods and procedures. Subtle changes in composition, texture or treatment history of certain supplies can produce unexpected performance of equipment or an analytical method. Therefore, neither supplies nor suppliers of consumable supplies can be changed without the knowledge of relevant laboratory personnel. Approved supplies and supplier lists were created from historically utilized supplies and suppliers. All supplies must continue to be ordered from the approved supply/supplier list. Supplies and suppliers used during development of new analytical methods validated by a Demonstration of Capability establish the approved list for the method. Continued satisfactory performance of approved supplies and suppliers is monitored through ongoing QA/QC programs. Materials are not used past any stated expiration date, are not reevaluated for use and are disposed of if they do not pass initial or subsequent QA/QC procedures.

New supplies or suppliers must be evaluated for effect on procedures, equipment and Quality Control measures. Evaluation and Approval of new supplies must be documented on a Critical Supply/Supplier Approval Form, approved by the Chemical Hygiene Officer, QA Officer and Laboratory Manager. Approval of the Chemical Hygiene Officer is not necessary for new vendors of previously approved manufacturer's coded product. Each laboratory manager will maintain an active file of approved supply sources, which includes an active summary list showing the latest date of approval.

Asbestos Laboratory supplies must be evaluated for satisfactory performance in procedures and proven to be asbestos free (concentration below the lowest detection limit available to the Laboratory). New vendors and supply manufacturers must be approved by the QA Officer and Lab Manager using a Critical Supplier Approval Form.

VII. AMERISCI ASBESTOS LABORATORY STAFF TRAINING PROGRAM

While several sections of this Quality Manual contain discussions of staff training procedures, this section is designed to summarize training by format and discussion. This outline represents a general list of training subjects, materials and procedures used at all AmeriSci affiliated laboratory locations for incoming or advancing scientific staff. The goal of the training program is to produce analysts who can work independently to provide high quality analytical data which meets the expectations of the analytical method and the professional community.

A. TRAINING PROGRAMS

1. RECOGNIZED EXTERNAL TRAINING

   a. Recognized training courses for PCM, such as NIOSH 582 or other recognized equivalent providers. Advanced Industrial Hygiene, Optical Microscopy courses or seminars.

   b. Recognized training courses for PLM, such as McCrone, MICA, TAKA or other recognized trainers. Advanced PLM courses, Optical Microscopy courses or seminars.

   c. Recognized training courses for TEM provided by recognized trainers or manufacturers. Advanced SAED, TEM, EDS courses, such as McCrone, MVA, or TAKA as appropriate.

   d. Recognized training courses for Industrial Hygiene, or Environmental courses or seminars. Professional development courses (function of individual scientist's background). Conferences such as NIST, EPA, EIA, MSA, MAS, AIHA, ASTM.

2. INTERNAL TRAINING

   a. Training material
   - Quality Assurance Manual
   - Established methods for each analysis area
   - Relevant texts on crystallography, mineralogy, electron microscopy, SAED, EDS, Industrial Hygiene, Air Quality, Inorganic Chemistry, etc.
   - Historical and current journal articles relevant to specific analysis subjects.

   b. Basic training
   - Standard Operating Procedures
   - Demonstration of AmeriSci affiliated laboratory Procedures

VII. AMERISCI AFFILIATED LABORATORY STAFF TRAINING PROGRAM

A. TRAINING PROGRAMS (Continued)

2. INTERNAL TRAINING (Continued)

- Supervised Experience with AmeriSci affiliated laboratory Procedures
- Apprenticeship to Experienced Analyst

c. Standard Operating Procedures (SOP's)
- Sample receiving, handling, custody, storage and/or disposal
- Sample preparation and Clean Room procedures
- Equipment operation and maintenance
- Equipment standardization and calibration
- Analyte specific operations and procedures
- Data handling and calculations
- Quality system requirements and procedures

d. Asbestos Microscopy (PCM, PLM and TEM)
- Basic crystallography and mineralogy
- PLM - Characteristic optical properties, PLM/DS
- PLM - Quantitation, visual estimates, point counting
- TEM - Chrysotile and amphibole SAED patterns, zone axis concepts
- TEM - Use of tilt holders for SAED, calculations, indexing
- Gravimetric reduction for PLM and TEM
- Fiber counting rules, PCM, PLM-P.C., TEM
- Asbestos -vs- non-asbestos minerals
- Differential fiber counting for PCM

e. ATEM - Energy Dispersive X-Ray Spectroscopy Training
- Asbestos and non-asbestos chemistry, typical problems
- Calibration, resolution, sensitivity and K-factors
- Crocidolite identified by detection of Na
- Mg/Si ratios on a single-fibril of chrysotile

f. Analysis Training and Testing
- Asbestos Standards (SRM 1866, 1867, Chatfield, etc.)
- Non-asbestos minerals (hornblende, vermiculite, sepiolite, halloysite, gypsum).
- Asbestos Counting Standards (SRM 1876b, RM 8410, Proficiency samples, PAT Rounds, AmeriSci affiliated laboratory-generated standards).
- Reanalysis of actual samples/blanks
- Hands-on equipment testing
- Asbestos -vs- fiberglass by PCM

VII. AMERISCI AFFILIATED LABORATORY STAFF TRAINING PROGRAM

A. TRAINING PROGRAMS (Continued)

2. INTERNAL TRAINING (Continued)

g. Verified Asbestos Analysis - TEM
- Multiple analysts on marked grid openings
- Record structure type, size and orientation
- >80% True Positives (<20% False Negatives)
- <10% False Positives

h. Quality Control Checks
- Decreasing QC check as analyst gains skills
- Blanks, Blind Reanalysis, Internal audits,
- Intra-analyst, Inter-analyst, Intra-laboratory, Inter-laboratory exchange.

i. Additional Technical Training
- PCM data handling and calculations (conc., TWA, Pair Test)
- PLM data handling and calculations (NOB weights, layers, composites)
- TEM data handling and calculations (conc., MSD, Z-test, geometric mean)
- Report generation and customer contacts
- Quality system review, documentation and corrective procedures

j. Continuing Technical Education and Training
- Laboratory meetings and seminars by Staff
- QA meetings
- New equipment training
- Professional development seminars
- National conferences
- Research projects in related fields, with possible publication

k. Demonstrations of Capability (DOC forms required)
- Initial Demonstration of Capability
- Continuing Demonstration of Capability (performed semi-annually)

l. Ethical and Legal Training
- Employee Policy Manual - corporate ethics statement
- Reports as legal documents
- Analysis and QC records as legal documents
- Examples of improper, unethical or illegal actions
- Potential punishments for improper, unethical or illegal actions
- Review of recent court actions relevant to laboratory employees
- Acknowledgment of employee personal and legal responsibilities

VII. AMERISCI AFFILIATED LABORATORY STAFF TRAINING PROGRAM

B. PERSONNEL TRAINING

1. AREA SPECIFIC - PCM/PLM/TEM LABORATORY TECHNOLOGIST TRAINING

A typical PCM/PLM/TEM Laboratory Technologist training period varies in time, depending on the abilities and experience of each individual. In general, this training period consists of 6-8 weeks in-house. During the training period, progress is documented using training checklists. In-house training for a Laboratory Technologist includes:

a. Initial 7-10 days: an AmeriSci affiliated laboratory Technologist is required to read the relevant manuals including the Employee Policy Manual, Health and Safety Manual and Chemical Hygiene Plan, and the QA Manual in order to properly understand Standard Operating Procedures (SOP's). In addition, to the QA and SOP Manuals, the Technologist is required to read the appropriate sections of NIOSH, AHERA and ASTM documents for PCM, PLM or TEM.

b. Following the introduction to AHERA/NIOSH/AmeriSci affiliated laboratory protocols, a discussion period is held with the QA Supervisor and/or Lab Manager. This discussion should resolve any misunderstandings of these documents and will include discussions of the employee's ethical and legal responsibilities including the potential punishments and penalties for improper, unethical, or illegal actions. A signed acknowledgment of understanding of this training will be required of all AmeriSci affiliate employees.

c. Once the Technologist, QA Supervisor and Laboratory Manager are satisfied of general comprehension of the QA Manual and SOP's, the Technologist performs actual preparation techniques under the direction of a qualified, experienced Technologist. While AHERA, EPA, NIOSH, and ASTM techniques take priority, the laboratory Technologist is also taught in-house preparation techniques for Bulk, Dust, Water and Soil samples as available.

d. Once the trainer has verified a familiarity with all operational procedures and involved equipment, practice samples are used, to allow the trainee to gain supervised experience. To ensure a total understanding, the trainee is required a verbal "walk-through" of each technique as well as instrument operational procedures (*i.e.*, muffle furnace, plasma etcher, carbon coater). This practice period continues until the trainee has shown proficiency in the required protocol. Once achieved, previously analyzed "actual" samples are prepared, simulating customer conditions. These "simulated, actual" samples are evaluated for technique (observed), preparation Quality (viewed by PCM/PLM/TEM as necessary), expeditious sample preparation, representative Subsample selection, and proper split of sample materials, coning, quartering and riffling

VII. AMERISCI AFFILIATED LABORATORY STAFF TRAINING PROGRAM

B. PERSONNEL TRAINING (Continued)

1. AREA SPECIFIC - PCM/PLM/TEM LAB TECH TRAINING (Continued)

-For TEM - Examples of improper grid preparations are illustrated, as follows:
●Overheating during carbon coating causing incomplete dissolution of PC.
●Plucking of fibrous material during preparation
●Blotches, due to incomplete dissolution.
●Contact between complete and incomplete dissolution of a PC filter.

-For PLM and TEM bulk analysis - gravimetric reduction process
●Overheating during muffle furnace treatment.
●Incomplete dissolution during acid treatment
●Proper split of sample materials, coning, quartering and riffling
●Proper drying of filtered material
●Evaluation of coarse/fine particulate distributions
●Modification of respirable material

-For PCM - Sample preparation problems including
●Examples of proper clearing of samples
●Flushing of sample material from the filter
●Thick samples requiring large focal adjustments during counting

e. If all preparation techniques are considered without flaw, the process is repeated twice, under supervision, to allow further experience before preparing customer samples.

f. If any portion of the training process is considered unacceptable by the QA Supervisor or Laboratory Manager, the trainee is required to continue under a "practice mode" until proven acceptable.

2. AREA SPECIFIC - PCM/PLM/TEM ANALYST TRAINING

a. The training program for an Analyst is extensive and may include both on-site (in-house) and outside education. The specific areas covered are listed in detail in the appropriate checklist but specifically include the following:

- Specimen Preparation, Calculations, Reporting, and Documentation
- Evaluation and Proficiency Maintenance
- QA/QC procedures
- Safety Information and Emergency Procedures

VII. AMERISCI AFFILIATED LABORATORY STAFF TRAINING PROGRAM

B. PERSONNEL TRAINING (Continued)

2. AREA SPECIFIC - PCM/PLM/TEM ANALYST TRAINING (Continued)

b. Depending on the Analyst's experience, the order of the training elements are mixed and matched, for the most part, to maximize the learning curve. For example, if a PLM/TEM Analyst has prior mineral experience, the initial in-house exposure should include theory, publications (including AHERA documentation) and general overview. This may be followed up by week long short course in one of the recognized training centers to depict an intense overview. In this manner, the Analyst receives a quick overview to build upon at An AmeriSci affiliated laboratory. The reverse process may be valuable to the more experienced Analyst.

c. During the first few weeks of employment, the PCM/PLM/TEM Analyst is required to read: (1) AmeriSci affiliated laboratory QA and SOP Manuals, (2) AHERA Document 40 CFR 763, (3) information on the mineralogy, crystallography and chemical composition of asbestos mineral and other common fiber types (selected sections are often appropriate for PCM) and (4) applied publications. Following this "THEORY" introduction, there are several discussions between the Analyst, the QA Supervisor and Laboratory Manager to ensure a clear understanding of the subject. Prior to an introduction to An AmeriSci affiliated laboratory's PCM/PLM/TEM microscopes, the PCM/PLM/TEM Analyst is introduced to the appropriate preparation laboratory, to properly understand the preparation process leading to PCM/PLM/TEM grid or slide generation.

d. Once a general knowledge of theory and preparation is achieved, the Analyst is given relevant PCM/PLM/TEM Standard Operating Procedures to master. The time factor and sequence is a function of experience. A knowledgeable operator covers, step-by-step, the procedures to use the relevant microscope. This includes the applied portion of the QA Manual, as well as the Equipment Vender's Instruction Manual. The objective here is for the Analyst to practice enough to gain confidence, understand the steps in the procedure and maintain the instrument in good condition. Instruction is given to the Analyst in Alignment, Calibration, General Operation and Photography (for TEM).

e. Once a level of competence is achieved, the trainee should analyze selected standards. The results are statistically compared with the results obtained by experienced and inexperienced analysts to achieve an independent status. If deficiencies are evident, the trainee works with the Laboratory Supervisor and QA Supervisor to isolate potential problems and expedite the training period. This process continues until the trainee becomes proficient enough on a consistent basis to analyze samples independently.

VII. AMERISCI AFFILIATED LABORATORY STAFF TRAINING PROGRAM

B. PERSONNEL TRAINING (Continued)

2. AREA SPECIFIC - PCM/PLM/TEM ANALYST TRAINING (Continued)

f. At this point, the Analyst is taught how to quantify and record sample analysis results. Once the instructor is comfortable with the trainee's abilities to operate the instrument, and to analyze samples, the trainee is given previously analyzed samples to analyze. After a reasonable period of time, the trainee becomes the original analyst with 100% QC by an experienced analyst. The analyst must continue at 100% QC for a reasonable period of time. After achieving an error rate of <5% for at least two weeks the QC rate may be reduced by 50% (on a relative basis) per two week period. Selected sample types (PLM-floor tile, plaster, caulking, etc) (TEM - samples with look-a-like materials, thin fibers, complex structures, etc.) should remain at 100% QC level for at least 90 days. The PLM and TEM analysts must achieve Verified Counting status in order to work independently. The PCM analyst must establish a personal CV for all three fiber loading ranges.

3. POSITION SPECIFIC - QUALITY ASSURANCE OFFICER TRAINING

a. A Quality Control Supervisor or Officer at an AmeriSci affiliated laboratory, is required to have a B.A. or B.S. degree in one of the major sciences, material science or engineering. In addition, they must have a minimum of two years experience as an analyst prior to being appointed at An AmeriSci affiliated laboratory as a Quality Assurance Officer. The training program for the QA Officer is therefore the same as for an Analyst with the addition of training in Statistical Evaluation of Data and operation of the LIMS QA package.

VII. AMERISCI AFFILIATED LABORATORY STAFF TRAINING PROGRAM

C. TRAINING RECORDS

The local QA officer at each laboratory location is responsible for verifying training records of new employees, documenting previous training and maintaining a local QA file for each laboratory employee. This should include initiation of an area appropriate Training Checklist. Scanned image files of relevant materials are forwarded to the Compliance Officer for central file availability. The QA file should include all materials relevant to training and maintenance of trained status, including but not limited to:

1. Resume and previous training certificates

2. Documentation of in-house training (AmeriSci affiliated laboratory Training Checklist for relevant program)

3. Job assignment/approval ledger

4. Copies of Demonstration of Capability Certification Statement forms (DOC) for each matrix type and or analysis method. These should include both Initial and Continuing DOC's

5. Records of QC activities, proficiency results, continuing education, seminars, group discussions and any other relevant training or update records.

6. Documentation that each employee has read and understands any updates in relevant company Quality Management System Documents including, but not limited to, the QA Manual, SOPs, Chemical Hygiene and Safety Plan and the Code of Ethics.

D. TRAINING CHECKLISTS

Progress in training and analysis experience made by the Preparation Technicians and Analysts is documented on checklist sheets specific to each analysis method. Blank lines and areas marked "Other" are used by the trainee to record specific MSDS sheets and documents studied during the training process.

Examples of the training checklists are included in the following pages of this Manual.

Checklist For Non-Laboratory Training Program (Clerical and Others)

Name:_____ Hire Date:_____

Reference Materials

Date Initials

_____ _____ AmeriSci affiliated laboratory Employee Policy Manual
Issue#_____.

_____ _____ AmeriSci affiliated laboratory Code of Ethics
Issue#_____.

_____ _____ Health & Safety Manual & Chemical Hygiene Plan
Issue#_____ _____.

_____ _____ AmeriSci affiliated laboratory Quality Assurance Manual
Issue#_____
(relevant sections)_____

_____ _____ AmeriSci affiliated laboratory Standard Operating Proc. Man
Issue#_____
(relevant sections)_____.

_____ _____ AmeriSci affiliated laboratory Technical Reference Volumes 1 & 2 **(SLTR 1 & 2)**.
Issue#_____
(relevant sections)_____.

_____ _____ U.S. EPA "Asbestos-Containing Materials in Schools: Final Rule and Notice";
40 CFR Part 763, 41826-41905. **(SLTR1:1)**
(relevant sections)_____.

_____ _____ NYSDOH Environmental Laboratory Certification Manual (Sec 198, 236)
(relevant sections)_____.

_____ _____ Other:_____
_____
_____
_____

Checklist For Non-Laboratory Training Program (Continued)

Name:_____

Sample Receipt And LOG-IN

Date Initials

_____ _____ personal safety & hygiene - lab coat and HEPA hood
_____ _____ date stamp - job number assignment - urgency
_____ _____ Chain of Custody - legal contract criteria - special instruction details
_____ _____ management of time sensitive issues
_____ _____ recording of customer information
_____ _____ package inspection for security seal and damage
_____ _____ check of contamination control procedures
_____ _____ sample acceptance/rejection criteria
_____ _____ verification of Chain of Custody information
_____ _____ validation of samples listed on C of C
_____ _____ hard copy verification of C of C changes
_____ _____ capture of sample shipping documentation
_____ _____ LIMS database and Batch Traveler
_____ _____ transfer of sample information into LIMS database
_____ _____ sample tracking and job/sample labeling
_____ _____ transfer of job/samples to sample preparation area
_____ _____ completion of job boards in preparation area if used

Method Specific Issues

_____ _____ PCM - personal samples - medical implications
_____ _____ PLM - friable vs non-friable methods
_____ _____ PLM - homogenous areas - positive stop criteria
_____ _____ PLM - wet samples criteria
_____ _____ AHERA - clearance sets, inside, outside, blanks
_____ _____ Dust - area of collection
_____ _____ Water - temperature at receipt
_____ _____ Water - State Drinking Water reporting forms

_____ _____ Other:_____
_____
_____
_____

Checklist For Non-Laboratory Training Program (Continued)

Name:_____

Potential or actual specific contributions of trainee to achievement of management system objectives:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Training Approval: **Date**

Supervisor: _____ _____

Login/Receiving Trainee: _____ _____

Checklist For PCM Laboratory Training Program (Prep Tech & Analyst))

Name:_____ Hire Date:_____

Reference Materials

Date Initials

_____ _____ AmeriSci affiliated laboratory Employee Policy Manual Issue _____.

_____ _____ AmeriSci affiliated laboratory Code of Ethics _____.

_____ _____ Health & Safety Manual & Chemical Hygiene Plan _____.

_____ _____ AmeriSci affiliated laboratory Quality Assurance Manual _____.

_____ _____ AmeriSci affiliated laboratory Standard Operating Proc. Man._____.

_____ _____ AmeriSci affiliated laboratory Technical Reference Volumes 1 & 2 **(SLTR 1 & 2)**.

_____ _____ U.S. EPA "Asbestos-Containing Materials in Schools: Final Rule and Notice"; #40 CFR Part 763, 41826-41905. **(SLTR1:1)**

_____ _____ NIOSH 7400 Method Issue 3: 14 June 2019, "Fiber Analysis by PCM", NIOSH Manual of Analytical Methods (NMAM), Fifth Edition, 2019.

_____ _____ US Dept of Labor Reference Method (PCM)

_____ _____ NIOSH 7402 Method Issue 2: 15 August 1994, "Fiber Analysis by TEM", NIOSH Manual of Analytical Methods (NMAM), fourth Edition, 8/15/94.

_____ _____ McCrone, Walter, The Asbestos Particle Atlas, Ann Arbor Science, Michigan, 1980.

_____ _____ NYSDOH Environmental Lab Certification Manual (Sec 198, 236)

_____ _____ Other:_____
_____
_____
_____
_____

Checklist For PCM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Sample Receipt And LOG-IN

Date Initials

_____ _____ recording of customer information
_____ _____ package inspection for security seal and damage
_____ _____ check of contamination control procedures
_____ _____ sample acceptance/rejection criteria
_____ _____ verification of Chain of Custody information
_____ _____ validation of samples listed on C of C
_____ _____ hard copy verification of C of C changes
_____ _____ capture of sample shipping documentation
_____ _____ LIMS database and Batch Traveler
_____ _____ transfer of sample information into LIMS database
_____ _____ sample tracking and job/sample labeling
_____ _____ transfer of job/samples to sample preparation area
_____ _____ completion of job boards in preparation area
_____ _____ Other:_____
_____
_____
_____

Sample Preparation

Date Initials

_____ _____ proper use and cleaning of tools and reagents
_____ _____ operation and maintenance of HEPA hood
_____ _____ operation and maintenance of acetone vaporizer/hot plate
_____ _____ contamination prevention (common problems)
_____ _____ recording of sample preparation data
_____ _____ recognition of sample damage and loading problems
_____ _____ storage of samples after preparation
_____ _____ placement of cover slips
_____ _____ outlining of wedge and wedge edge inspection
_____ _____ slide labeling
_____ _____ Other:_____
_____
_____
_____

Checklist For PCM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Phase Contrast Microscope Use

Date Initials

_____ _____ evaluation of PCM mount quality
_____ _____ routine microscope cleaning and alignment
_____ _____ routine phase ring alignment
_____ _____ use of PTL/HSE slide for resolution determination
_____ _____ calibration of Walton Beckett diameter
_____ _____ use of Reference Slides for Personal CV's
_____ _____ use of NIOSH Pair Test Worksheet
_____ _____ review of NIOSH 7400 fiber counting rules
_____ _____ completion of PCM QC Count sheets, reference slide, blank, and WB calibration
_____ _____ completion of PCM job sheet
_____ _____ use of Personnel Pair Test to determine recount acceptance, recording test factor
_____ _____ use of Duplicate and Replicate Analyses
_____ _____ data entry and review
_____ _____ Reference Slide and other quality control analyses entry
_____ _____ Other:_____
_____
_____
_____

PCM Sample Analysis Data and Reporting

Date Initials

_____ _____ examination of standard samples and related data
_____ _____ evaluation of proficiency data
_____ _____ evaluation of interlaboratory data
_____ _____ evaluation of intra-laboratory data
_____ _____ preparation of calibration standards
_____ _____ recording of data in LIMS database
_____ _____ analysis of blank samples
_____ _____ completion of analysis report
_____ _____ analysis of blind samples
_____ _____ communication of results to customer
_____ _____ resolution of customer complaints

_____ _____ Other:_____
_____

Checklist For PCM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Quality Assurance And Quality Control

Date Initials

_____ _____ quality control sample program
_____ _____ Reference Slide program and reading in control
_____ _____ intra-laboratory quality control, Replicate Analyses
_____ _____ inter-laboratory quality control, Round Robins
_____ _____ transfer of job/samples to sample preparation area
_____ _____ PCM vs TEM quantitation of asbestos
_____ _____ determination and reporting of overloading
_____ _____ location and maintenance of records
_____ _____ reference materials
_____ _____ analysis blanks (laboratory, lot and reagent)
_____ _____ TWA calculations
_____ _____ Other:_____
_____
_____
_____

NIOSH 582 Training (or equivalent)

_____ _____ NIOSH 582 - Provider
_____
_____ _____ NIOSH 582 - equivalent - Provider
_____
_____ _____ certificate scanned for training records

PCM Analysis Experience (In-House & Other)

#Samples Initials

_____ _____ recognition of overloading
_____ _____ evaluation of slide preparation quality
_____ _____ recognition of overloading
_____ _____ sample calculations
_____ _____ Other:_____
_____
_____
_____

Full CV Attained _____ (date)_____

Checklist For PCM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Potential or actual specific contributions of trainee to achievement of management system objectives:

PreviousTraining (courses, etc.):

Relevant Experience:

Checklist For PCM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

COMMENTS:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Supervisor: _____ Date: _____

COMMENTS:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Employee: _____ Date: _____

Training Approval:	**Supervisor**	**Date**
Preparation Technician Trainee:	_____	_____
Preparation Technician:	_____	_____
Analyst Trainee:	_____	_____
Analyst:	_____	_____

Checklist For PLM Laboratory Training Program (Prep Tech & Analyst)

Name:_____ Hire Date:_____

Reference Materials

Date Initials

_____ _____ AmeriSci affiliated laboratory Employee Policy Manual Issue _____.

_____ _____ AmeriSci affiliated laboratory Code of Ethics _____.

_____ _____ Health & Safety Manual & Chemical Hygiene Plan _____.

_____ _____ AmeriSci affiliated laboratory Quality Assurance Manual _____.

_____ _____ AmeriSci affiliated laboratory Standard Operating Proc. Man._____.

_____ _____ AmeriSci affiliated laboratory Technical Reference Volumes 1 & 2 **(SLTR 1 & 2)**.

_____ _____ U.S. EPA "Asbestos-Containing Materials in Schools: Final Rule and Notice"; #40 CFR Part 763, 41826-41905. **(SLTR1:1)**

_____ _____ McCrone, Walter, The Asbestos Particle Atlas, Ann Arbor Science, Michigan, 1980.

_____ _____ U.S. EPA - 600/R-93/116 "Test Method - Method for the Determination of Asbestos in Bulk building Materials"; Perkins, R.L. and Harvey, B.W. **(SLTR2:3a)**

_____ _____ NYSDOH Envir Lab Certification Manual (Sec 198, 236)

_____ _____ NVLAP Asbestos Regional Meeting, Boston 1997, References for Asbestos Identification by Polarized Light Microscopy in Bulk Samples

_____ _____ NIOSH 9002 Method, Issue 2: 15 August 1994, "Asbestos (bulk) By PLM", NIOSH Manual of Analytical Methods (NMAM), Fourth Edition, 8/15/94

_____ _____ Other:_____
_____
_____
_____
_____

Checklist For PLM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Sample Receipt And LOG-IN

Date Initials

_____ _____ recording of customer information
_____ _____ package inspection for security seal and damage
_____ _____ check of contamination control procedures
_____ _____ sample acceptance/rejection criteria
_____ _____ verification of Chain of Custody information
_____ _____ validation of samples listed on C of C
_____ _____ hard copy verification of C of C changes
_____ _____ capture of sample shipping documentation
_____ _____ LIMS database and Batch Traveler
_____ _____ transfer of sample information into LIMS database
_____ _____ sample tracking and job/sample labeling
_____ _____ transfer of job/samples to sample preparation area
_____ _____ Other:_____
_____
_____
_____

Sample Preparation

Date Initials

_____ _____ proper use and cleaning of tools and reagents
_____ _____ operation and maintenance of HEPA hood
_____ _____ operation and maintenance of hot plate
_____ _____ operation and maintenance of chemical hood
_____ _____ operation and maintenance of carbon coater
_____ _____ contamination prevention (common problems)
_____ _____ recording of sample preparation data
_____ _____ operation/main of NOB multi-filtration assembly
_____ _____ operation and maintenance of muffle furnace
_____ _____ operation and maintenance of ultrasonic bath
_____ _____ operation and maintenance of microbalance
_____ _____ TEM bulk NOB sample preparation
_____ _____ TEM bulk Chatfield sample preparation
_____ _____ Other:_____
_____

Checklist For PLM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Polarized Light Microscope Use

Date Initials

_____ _____ stereoscopic examination of asbestos materials
_____ _____ routine polarized microscope alignment
_____ _____ proper Kohler illumination
_____ _____ optical characteristics of asbestos minerals
_____ _____ refractive indices by Becke line
_____ _____ refractive indices by dispersion staining
_____ _____ refractive indices by oblique method
_____ _____ asbestos vs look-a-like minerals
_____ _____ visual estimation of asbestos content
_____ _____ quantitation by point counting
_____ _____ verification of refractive index liquids
_____ _____ data entry and review
_____ _____ quality control analyses
_____ _____ Other:_____
_____
_____
_____

PLM Sample Analysis Data and Reporting

Date Initials

_____ _____ examination of standard samples and related data
_____ _____ evaluation of proficiency data
_____ _____ evaluation of inter-laboratory data
_____ _____ evaluation of intra-laboratory data
_____ _____ preparation of calibration standards
_____ _____ recording of data in LIMS database
_____ _____ recording Stratified Point Count data, benchsheets and 4D LIMS
_____ _____ recording 400 and 1000 Point Count data, benchsheets and 4D LIMS
_____ _____ analysis of blank samples
_____ _____ completion of analysis report
_____ _____ analysis of blind samples
_____ _____ communication of results to customer
_____ _____ resolution of customer complaints
_____ _____ Other:_____
_____
_____
_____

Checklist For PLM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Quality Assurance And Quality Control

Date Initials

_____ _____ quality control samples
_____ _____ unknown standards program
_____ _____ intra-laboratory quality control
_____ _____ Inter-laboratory quality control
_____ _____ gravimetric reduction methods
_____ _____ PLM vs TEM quantitation of asbestos
_____ _____ location and maintenance of records
_____ _____ reference materials
_____ _____ analysis blanks (laboratory, lot and reagent)
_____ _____ MDL analyses
_____ _____ Other:_____
_____
_____
_____

PLM Analysis Experience (In-House & Other)

#Samples

_____ friable materials
_____ non-friable materials
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

Verified Level Attained _____ (date)_____

PLM Qualitative Analysis (non building material samples)

_____ _____ PLM Analysis (non-Bulk -Wipes/Dust/Soil)
_____ _____
_____ _____

Checklist For PLM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Potential or actual specific contributions of trainee to achievement of management system objectives:

Previous Training (Courses, etc):

Relevant Experience:

Checklist For PLM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

COMMENTS:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Supervisor: _____ Date: _____

COMMENTS:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Employee: _____ Date: _____

Training Approval:	**Supervisor**	**Date**
Preparation Technician Trainee:	_____	_____
Preparation Technician:	_____	_____
Analyst Trainee:	_____	_____
Analyst:	_____	_____

Checklist For TEM Laboratory Training Program (Prep Tech & Analyst)

Name:_____ Hire Date:_____

Reference Materials

Date Initials

_____ _____ AmeriSci affiliated laboratory Employee Policy Manual Issue _____.

_____ _____ AmeriSci affiliated laboratory Code of Ethics _____.

_____ _____ Health & Safety Manual & Chemical Hygiene Plan _____.

_____ _____ AmeriSci affiliated laboratory Quality Assurance Manual _____.

_____ _____ AmeriSci affiliated laboratory Standard Operating Procedure. Manual. _____.

_____ _____ AmeriSci affiliated laboratory Technical Reference Volumes 1 & 2 **(SLTR 1 & 2)**.

_____ _____ U.S. EPA "Asbestos-Containing Materials in Schools: Final Rule and Notice"; #40 CFR Part 763, 41826-41905. **(SLTR1:1)**

_____ _____ McCrone, Walter, The Asbestos Particle Atlas, Ann Arbor Science, Michigan, 1980.

_____ _____ U.S. EPA - 600/R-93/116 "Test Method - Method for the Determination of Asbestos in Bulk building Materials"; Perkins, R.L. and Harvey, B.W. **(SLTR2:3a)**

_____ _____ NYSDOH Environmental Lab Certification Manual (Sec 198, 236)

_____ _____ Yamate, G. Agarwal, S.C. and Gibbons, R.D. 1984, "Methodology for the Measurement of Airborne Asbestos". (EPA Level II performed by AmeriSci)

_____ _____ U.S. EPA - 600/4-83-043 "Analytical Method For Determination of Asbestos Fibers in Water"; Chatfield, E.J. and Dillon, M.J.

_____ _____ ASTM Method D 5755-95, "Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations"

_____ _____ NIOSH 7402 Method, Issue 2: 15 August 1994, "Asbestos By TEM", NIOSH

_____ _____ Other:_____

_____

_____

Checklist For TEM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Sample Receipt And LOG-IN

Date Initials

_____ _____ recording of customer information
_____ _____ package inspection for security seal and damage
_____ _____ check of contamination control procedures
_____ _____ sample acceptance/rejection criteria
_____ _____ LIMS database and Batch Traveler
_____ _____ transfer of sample information into LIMS database
_____ _____ sample tracking and job/sample labeling
_____ _____ delivery of job/samples to sample preparation area
_____ _____ Other:_____

Sample Preparation

Date Initials

_____ _____ proper use and cleaning of tools and reagents
_____ _____ operation and maintenance of HEPA hood
_____ _____ operation and maintenance of slide warmer
_____ _____ operation and maintenance of chemical hood
_____ _____ operation and maintenance of plasma etcher
_____ _____ operation and maintenance of carbon coater
_____ _____ contamination prevention and problems
_____ _____ recording of sample preparation data
_____ _____ storage of samples after preparation
_____ _____ operation and maintenance of filtration
_____ _____ operation and maintenance of muffle furnace
_____ _____ operation and maintenance of ultrasonic bath
_____ _____ operation and maintenance of microbalance
_____ _____ TEM AHERA air sample preparation
_____ _____ TEM 7402 air sample preparation
_____ _____ TEM indirect air sample preparation
_____ _____ TEM Dust sample preparation
_____ _____ TEM bulk NOB sample preparation
_____ _____ TEM bulk NOB sample preparation worksheet completion
_____ _____ TEM bulk Chatfield sample preparation
_____ _____ TEM water sample preparation
_____ _____ TEM soil sample preparation
_____ _____ Other:_____
_____

Checklist For TEM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Transmission Electron Microscope

Date Initials

_____ _____ theory
_____ _____ start up and shut down
_____ _____ general operation
_____ _____ routine alignment
_____ _____ EDS operation (protection from electron dosage)
_____ _____ eucentric position determination
_____ _____ Selected Area Electron Diffraction (SAED)
_____ _____ STEM attachment
_____ _____ maintenance (water chiller, filament change, LN2, etc.)
_____ _____ camera operation, loading and unloading film
_____ _____ recording photomicrograph information
_____ _____ developing and reading photomicrographs
_____ _____ Other:_____
_____
_____

TEM Sample Analysis

Date Initials

_____ _____ examination of standard samples and related data
_____ _____ evaluation of grid preparations
_____ _____ measurement of diffraction patterns
_____ _____ examination of EDS spectra
_____ _____ structure counting and sizing
_____ _____ recording of data in LIMS database
_____ _____ grid archiving
_____ _____ calculation of data (TEM formulas)
_____ _____ TEM AHERA air sample analysis
_____ _____ TEM AHERA - recording required SAED negative and EDS spectra per job
_____ _____ analysis of blank samples
_____ _____ TEM AHERA initial screening test
_____ _____ TEM AHERA Z-test evaluation
_____ _____ completion of analysis report
_____ _____ communication of results to customer
_____ _____ Other:_____
_____

AHERA Verified Level Attained _____ (date)_____

Checklist For TEM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

TEM non-AHERA Analysis

Date Initials

_____ _____ TEM 7402 air sample analysis
_____ _____ TEM indirect air sample analysis
_____ _____ TEM Dust sample analysis
_____ _____ TEM bulk NOB (NYSDOH ELAP) sample analysis
_____ _____ TEM bulk Chatfield sample analysis
_____ _____ TEM drinking water analysis
_____ _____ TEM drinking water analysis using 3 specimen grids per sample
_____ _____ TEM soil sample analysis

_____ _____ Other:_____
_____
_____
_____

Quality Assurance And Quality Control

Date Initials

_____ _____ quality control samples
_____ _____ Verified Count Program
_____ _____ Known Standards Program
_____ _____ inter-laboratory testing
_____ _____ magnification calibration
_____ _____ SAED camera constant calibration
_____ _____ electron beam spot size calibration
_____ _____ EDS calibration and sensitivity
_____ _____ beam dose calibration
_____ _____ plasma etcher calibration
_____ _____ location and maintenance of records
_____ _____ gravimetric reduction methods
_____ _____ reference materials
_____ _____ analysis blanks (laboratory, lot and reagent)
_____ _____ grid opening measurement
_____ _____ Other:_____
_____
_____
_____

NIST 1876b Analysis Completed _____ (date)_____

Checklist For TEM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

Potential or actual specific contributions of trainee to achievement of management system objectives:

Previous Training (Courses, etc):

Relevant Experience:

Checklist For TEM Laboratory Training Program (Prep Tech & Analyst)

Name:_____

COMMENTS:

_____
_____
_____
_____
_____
_____
_____
_____
_____

Supervisor: _____ Date: _____

COMMENTS:

_____
_____
_____
_____
_____
_____

Employee: _____ Date: _____

Training Approval:	**Supervisor**	**Date**
Preparation Technician Trainee:	_____	_____
Preparation Technician:	_____	_____
Analyst Trainee:	_____	_____
Analyst:	_____	_____
Verified AHERA Analyst:	_____	_____

VII. AMERISCI AFFILIATED LABORATORY STAFF TRAINING PROGRAM

E. MANAGEMENT SYSTEM TRAINING - CONTINUOUS IMPROVEMENT

At least twice annually, in the Spring and Fall prior to the annual Quality Management System Review, a Management System Training Review will be provided to implement the process of continuous improvement.

1. The results of the most recent internal and external audits and the responses will be presented for review and discussion. In addition other relevant items such as Corrective Action Reports, Customer Feedback and QA results should be discussed if relevant. The presentation method shall use a variety of communication techniques in order to provide optimum interaction of personnel and management.

2. A record of the subjects covered, personnel in attendance and suggested actions will be maintained. Each department or function should evaluate their personal impact on the process in order to suggest solutions and improvements.

F. ANNUAL ETHICS AND DATA INTEGRITY TRAINING

All new employees receive Ethics and Data Integrity Training that is followed by an annual review. The training includes review of the AmeriSci mission, Code of Ethics, data integrity procedures, data monitoring and means of confidential reporting of ethics and data integrity breaches. The review includes examples of ethical controversies, ethical and unethical behavior and resulting developments. Examples of accidental and intentional data integrity breaches such as improper data manipulation, dry labbing, time travel and data falsification among other examples are reviewed and discussed.

1. The reviews include a variety of delivery methods including video and power point presentations, document review and group discussions.

2. A record of the training is maintained in the employees training file.

G. ANNUAL TRAINING UPDATE

Each location shall provide a Training Update related to each employee's job function on at least an annual basis by December 20 of each year or more often in response to an indicated need. The Training will address a review of the job functions supported by formal internal or externally provided instruction. The training outline, materials and completion will be recorded in each employee's permanent training records using AmeriSci Training Form F6.

The items covered shall include relevant items from recent internal and external audits, Training Checklists, Corrective Action Reports, Customer Feedback, QA related issues and publications or on line materials such as webinars.

VIII. LIMS AND DOCUMENT SECURITY AND CONTROL

AmeriSci affiliated laboratory technical and accounting records are maintained in custom computer databases. The standard for system use is EPA Document 2185, Good Automated Laboratory Practice. Scientific data is managed and archived by the Laboratory Information Management System (LIMS) which is backed up daily to a removable data tape using ARCserve software. Fully appended daily backups are provided to a central corporate facility on a weekly basis and a minimum of two weeks of daily backups are maintained at all times in a secure offsite storage location. Each division location operates an independent networked LIMS database or databases. Accounting information is kept in a commercially available accounting software package and is maintained at the corporate headquarters. Control of the LIMS package and database are maintained as follows:

A. LABORATORY INFORMATION MANAGEMENT SYSTEM SECURITY

Both customer information and analysis information are considered confidential and proprietary. Therefore the LIMS packages have limited access by requiring passwords that allow access to different portions of the system.

B. JOB FILE SECURITY

After completion of analysis, data entry, report generation and internal review, the analytical job file is considered complete. The customer is provided the opportunity to review the customer supplied information on the faxed copy of the analysis results prior to assembly and approval of the final report. Each job's status (job logged, analysis completed, report printed, invoice printed, job shipped, etc.) is updated either manually or automatically as it passes through various stages of processing. After the final report and invoice are issued the electronic job file is marked as completed and can no longer be modified through regular functions.

Additional copies of the completed report can be generated but any modification of analytical data must be preceded by approval of the QA Supervisor or Laboratory Manager. Alteration of a completed electronic Job File triggers both a "QC Action report" and an "Amended Report" which is discussed in the next subsequent monthly report for the location. In the event an amended report is issued, both the original and amended reports will be kept on file. The reason for the alteration, name of the person who authorized the alteration, the name of the person implementing the alteration, and the alteration date will be documented and kept on file with the reports.

C. CONTROL MONITORING

The integrity of the LIMS package and database are routinely monitored by company management through the use of Monthly Reports which contain descriptive text, tabular data and control charts for quick review of Quality System Documents, Corrective Actions, Preventive Actions and Quality Control Program operation.

VIII. LIMS AND DOCUMENT SECURITY AND CONTROL (CONTINUED)

C. CONTROL MONITORING (Continued)

1. *MONTHLY AND QUARTERLY REPORTS*

Monthly reports (quarterly reports for some program areas) provide management a review of daily production, quality assurance activities, deficiencies and their resolutions. The report includes professional staffing level, primary analyses completed, QC analyses completed, and analytical accuracy (and precision) for each laboratory, method, and analyst on a monthly and cumulative basis. Laboratory environment factors are also addressed including contamination monitoring, internal error rate, total laboratory external error rate (customer-supplied data, custody errors, etc.). Where possible, data is presented as control charts with warning and control limits to facilitate quick review on a routine basis. Any customer complaint or significant question responded to during the month is also reviewed.

2. *CONTROL CHARTS*

Control charts are utilized to summarize all quality assurance, quality control, calibration and proficiency data. The charts are constructed to show relevant quantities versus time with time on the horizontal axis. Each chart indicates appropriate control limits related to the allowable limits of variation (typically with a warning limit of twice the standard deviation and a control limit of three times the standard deviation). See Section VI.I.5 for special cases of limits.

D. QUALITY MANAGEMENT SYSTEM DOCUMENTS

All current versions of documents that form the Quality System are provided in a controlled manner in the Common Share Folder of the LIMS package at each laboratory location. A Master List of all internal documents and forms indicates the current version and revision status. External Reference documents are maintained in an associated Reference File. The version and revision status of internal documents is evident from the Document Title (and document control header on each page). All documents in the Quality System are reviewed and approved annually, following the stated requirements for the Quality System Documents. Copies of invalid or obsolete versions of documents or PDF files are removed from points of issue upon distribution of updated versions. Any archived copies maintained for historical or other purposes are marked as obsolete with excess copies being destroyed.

Printed copies of Controlled Documents are printed on gray paper.

VIII. LIMS AND DOCUMENT SECURITY AND CONTROL (CONTINUED)

E. QUALITY MANAGEMENT SYSTEM - ANNUAL REVIEW

The annual Quality Management System Review initiated on the first workday of the 4th Quarter includes both an Internal System Audit covering each Analytical Program and a Quality Management System Review. The Management review addresses the Quality System, Analytical Programs and Quality System Documents on an annual basis to ensure their continuing suitability and effectiveness.

The review shall include as a minimum:

policy and procedure suitability,
all internal reports,
internal and external audits,
customer feedback or complaints,
supervisory reports,
work volume and content,
resource changes,
staffing levels,
training needs,

and all Quality Systems resources and activities including:
review of QA Manual and all SOPs
corrective and preventive actions,
intra- and inter-laboratory exchanges and
completed proficiency tests for each certified analyte per matrix per program twice per year.

The annual review may result in recommendations for changes in policies, procedures or management.

IX. ANALYTICAL RECORDS

AmeriSci affiliated laboratory analytical records are maintained as entries in a computer Job File in a custom LIMS Database. In addition, a hard copy Job Folder is maintained for a minimum of five years (ten years for drinking water reports). The Job Folder may be replaced by a scanned electronic document file or files containing the transmitted customer job report and all internal records related to the job. For all samples analyzed, two data forms are of importance to the laboratory as archival records:

> Submittal/Chain-of-Custody Form, for official documentation of customer instructions, analysis authorization and a customer release of the samples to the lab for analysis. All subsequent related laboratory-customer communications must be documented to serve as amendments to the original Chain of Custody.
>
> AmeriSci affiliated laboratory ANALYSIS SHEET (including all data records) for each sample analyzed (hard copy or direct data entry electronic LIMS file).

The AmeriSci affiliates job file record system allows historical reconstruction of all laboratory activities involved in producing and supporting the analytical data and subsequent customer report. The job file records include:

1. Identification of personnel involved in sample receipt, preparation, analysis and review.
2. laboratory facilities, laboratory equipment, analytical test methods, and related activities such as sample receipt, preparation, data generation, and data validation.
3. readily retrievable working files such as work sheets and archived instrument calibrations records.
4. documented record entries or changes signed or initialed by the responsible personnel.
5. automated data records supplemented by personnel observations recorded in permanent ink.
6. written record corrections indicated by a single line marked through an error, signed (or initialed) and dated by the individual making the correction. No record entries will be obliterated by methods such as erasures, overwritten files or markings. These criteria also apply to electronically maintained records which cannot be altered without producing a record of the documented modification.

As described in Section V, the Chain-of-Custody Form follows the job throughout the preparation process to the analyst and final report reviewer. The analyst may enter data directly into the computer worksheet or indirectly by first recording onto a hard copy bench sheet. For PLM all optical parameters necessary for asbestos fiber identification are recorded. For TEM analysis the recorded information includes SAED and/or EDXA data used for identification and the SAED negative number when required for QA purposes. NOB preparation bench documents contain sufficient information to reconstruct laboratory activities and analyst observations of unaltered samples. Documentation of all analyses is maintained in the LIMS electronic database. Bench analysis sheets, if used, are reviewed and signed by the analyst and placed in the individual Job Folder for later archive as electronic scanned files.

IX. ANALYTICAL RECORDS (CONTINUED)

A. *PCM Records* - Digital data available for all PCM air sample analyses includes:

1. Filter/sample identification number
2. Analyst's name and analysis date
3. The total number of fibers counted
4. The total number of fields counted
5. The average fiber count per field and fiber density (fibers per sq mm)
6. For QC samples spaces to record fiber counts for each field of view
7. The blind recount results for the required 10% of samples.
8. The "Pair Test" results for blind recounts
9. The make, model and serial number of the microscope used.

B. *PLM Records* - The following data is available as computer files for each asbestos type identified during PLM bulk sample analyses:

1. The estimated or point counted amounts of each asbestos type
2. The parallel and perpendicular indices of refraction
3. The color and pleochroism
4. The birefringence
5. The extinction characteristics
6. The sign of elongation
7. The asbestos morphology

C. TEM Air Records - The following computer data is available as for all TEM air sample analyses:

1. The ASBESTOS STRUCTURE TYPE (fiber, bundle, cluster, matrix).
2. The number of structures that are ≥0.5 micrometers and <5 micrometers.
3. The number of structures that are ≥5 micrometers.
4. The number of structures as regulated serpentines (chrysotile), amphiboles (amosite, crocidolite, anthophyllite, actinolite or tremolite), or non-asbestos.
5. Verification of both EDS and SAED for a minimum number of structures identified as amphiboles (5-6 structures) for an asbestos concentration of over 70 structures/mm2.
6. Verification of both EDS and SAED for a minimum number of structures identified as chrysotile (5-6 structures) for an asbestos concentration of over 70 structures/mm2.
7. Documentation of positive SAED or EDS for all chrysotile asbestos structures corresponding to a concentration on the filter above 70 structures/mm2 and documentation of positive identification of non-asbestos fibers of over 70 structures/mm2. *NOTE:* For structures whose qualitative chemical composition is distinct from asbestos (e.g., gypsum), only qualitative chemical composition is necessary.
8. Micrograph negative numbers for the required one SAED pattern for every five samples that contain asbestos.
9. Criteria used to classify particles as non-asbestos (morphology, SAED or EDS).
10. TEM used for the analysis.

IX. ANALYTICAL RECORDS (CONTINUED)

D. *TEM Bulk Records* - The following computer data is available as for all TEM bulk sample analyses:

1. The ASBESTOS TYPES observed.
2. Area percentage of the sample identified as each asbestos type .
3. Percent by weight of the organic, acid sensitive, non-asbestos inert and asbestos comprising the sample.
4. TEM used for the analysis

E. *TEM Dust Records* - The following computer data is available as for all TEM dust sample analyses:

1. The ASBESTOS STRUCTURE TYPE (fiber, bundle, cluster, matrix).
2. The number of structures that are ≥0.5 micrometers and <5 micrometers.
3. The number of structures that are ≥5 micrometers.
4. The number of structures as regulated serpentines (chrysotile), amphiboles (amosite, crocidolite, anthophyllite, actinolite or tremolite), or non-asbestos.
5. Verification of both EDS and SAED for a minimum number of structures identified as amphiboles or chrysotile (5-6 structures).
6. Documentation of positive SAED or EDS for all chrysotile asbestos structures corresponding to a concentration on the filter above 70 structures/mm2.
8. Micrograph negative numbers for the required one SAED pattern per asbestos type
9. Criteria used to classify particles as non-asbestos (morphology, SAED or EDS).

F. *TEM Water Records* - The following computer data is available as for all TEM water sample analyses:

1. Temperature of the water sample upon receipt at laboratory.
2. Time and date of sample collection
3. The ASBESTOS STRUCTURE TYPE (fiber, bundle, cluster, matrix).
4. The number of structures that are ≥0.5 micrometers and <10 micrometers.
5. The number of structures that are ≥10 micrometers.
6. The number of structures as regulated serpentines (chrysotile), amphiboles (amosite, crocidolite, anthophyllite, actinolite or tremolite), or non-asbestos.
7. Verification of both EDS and SAED for a minimum number of amphibole structures.
8. Verification of both EDS and SAED for a minimum number of chrysotile structures.
9. Documentation of positive SAED or EDS for all chrysotile asbestos structures
10. Micrograph negative numbers for one SAED pattern for each asbestos type
11. Identification of three different TEM grid preparations per sample analyzed
12. Criteria used to classify particles as non-asbestos (morphology, SAED or EDS).

G. Laboratory Logbook Management - All laboratory calibrations and bench records which are not maintained in customer jobs including logbooks and notebooks will be maintained in sequentially paginated, numbered and bound logbooks which are archived in the laboratory as either hard copies or electronic copies and will be available for review upon request.

X. ANALYTICAL REPORTS

Reporting analytical results in a concise fashion is particularly important to customers in the environmental industry. In order to properly communicate these results, a sequence of verbal, electronic and hard copy reporting, from computer generated chain-of-custody to summary data tables and final reports has been established. All analysis data is considered as confidential information, which may only be communicated to or discussed with the customer. All electronic transmissions must contain the AmeriSci affiliates Confidentiality Notice. Results may be transmitted to third parties only with documented permission of the original customer. The following section addresses these portions of Analysis Reports.

A. SEQUENCE OF REPORTING

The sequence for communicating analytical results from an AmeriSci affiliated laboratory to individual customers is as follows:

1. *Reporting Sequence* - The following Reporting System has been established, to provide quality assurance on report content. The sequence for analysis is:

    a. Submitted materials (samples, chain-of-custody, etc) reviewed and Job File initiated by Log-In Technician using the LIMS package. All submitted paperwork and Batch Traveler placed in Job Folder to provide “paper trail” in the laboratory.

    b. Job (Samples and Job Folder) placed in holding area while awaiting analysis.

    c. Upon completion of the analysis an Analyst’s Report and QC assignment is generated using standardized formats provided by the LIMS package. Any method departures are documented in the final report.

    d. Report reviewed, Calculations Checked and Analysis Sheets signed and placed in Job Folder awaiting any assigned QC analyses and a QA review.

    e. Review of significant figures reported for each method, which should reflect the precision of the analysis (following ASTM E29-13(2019)).

    f. Analytical Data (original and QC) reviewed by QA Analyst and released or referred for revision or corrective action. The "Reviewed By" signature is affixed to the report summary table only when the QC analyses have been performed, reviewed and any discrepancies resolved.

    g. Any necessary changes are made in the Analyst’s Report and released or referred for any needed revision (Amended Report) or corrective action prior to it being transmitted to the client.

X. ANALYTICAL REPORTS (CONTINUED)

A. SEQUENCE OF REPORTING (Continued)

h. Customer receives Analyst's Report including the summary table and chain of custody. *All Summary Table information should be included in any communication. In such cases it will be incumbent on the customer to verify verbal results with an electronic copy.* Actions are recorded on Job Tracking Log. Any changes made in the transmitted information after this point must result in an Amended Report.

i. Assembled Job file checked, invoice reviewed and the Summary Report finalized by the NVLAP signatory's signature (may be the Laboratory Manager, Supervisor or designee for non-NVLAP reports). The Analyst's Report and any additional supporting information is considered released for final distribution when the Approved Signatory is affixed to the cover letter, completing the Summary Report which is transmitted to the customer (digital or hard copy as a customer option).

j. The Job Folders are maintained in sequential digital files for the required 5 year time period unless specified longer by job or other requirements.

2. *Written Reports* - An Analyst's Report is generated upon completion of the analysis and QC using standardized formats in the LIMS package. The LIMS package archives the original data, the QC data and the Summary Report.

3. *Data Review* - All completed reports must be reviewed after QC completion by a qualified individual who signs "Reviewed By" prior to the report being released. The data review process includes but is not limited to: sample receipt, acceptance criteria, QC comparison and acceptance, computation checks, data transcription checks, correlation of interdependent tested parameters and adherence to SOP's.

4. *Reporting of Results* - Upon completion of the analyses, the LIMS package produces a summary table, data sheets (for some analysis types), QC assignment and later a QC comparison. The QC'd and reviewed Analyst's Report may be communicated digitally by customer request. All such communications must be transmitted utilizing the AmeriSci affiliates Confidentiality Notice and recorded on the Job Tracking Log. Reporting is not considered completed until the Summary Report has been transmitted to the customer.

5. *Amended Report content* – Any changes in report content after the initial transmission to the client must result in an Amended Report Addendum which will include the date of modification, item modified, indicated modification, explanation for the change and identification of the person making the change.

X. ANALYTICAL REPORTS (CONTINUED)

A. SEQUENCE OF REPORTING (Continued)

6. *Archived Reports* - The digital Summary Reports and Worksheets are archived for a minimum of five years (drinking water records maintained for 10 years). The digital files are accessed in the LIMS package using the unique AmeriSci Job number. Either the "looking glass function" at the Job level or "Report Review" button on the Batch Screen will access the digital copy of the signed Summary Reports. See SOP I-C, "SOP for Electronic Archiving of AmeriSci Documents".

B. ANALYSIS REPORT FORMAT

The Analysis Report Format includes:

1. *Cover Letter* - The cover letter provides general information about the samples, including sample numbers/locations, analysis procedure used and description of general report format.

2. *Analytical Result Table (& Sample Analysis or Count Sheets if appropriate)* - Includes all pertinent information on analysis methods (TEM includes fiber size and type, fiber morphology, asbestos concentration in structures/sq mm, fibers/cc of air if appropriate and analytical sensitivity). Any deviations from SOP's or standardized methods will be detailed in the report.

3. *TEM - EDS Spectrograph (if required)* - Documentation of the chemical element ratios characteristic of the materials identified in the sample set.

4. *TEM Photomicrographs (if required)* – Photo documentation of representative TEM areas, showing asbestos fibers or other significant features present.

5. *Chain of Custody* (or submittal form) - including customer change orders or other customer provided documents.

6. *Amended Reports* (if present) – must include Amended Report Addendum.

C. USE OF AGENCY NAMES AND LOGOS

All use of agency names and logos such as the term "NVLAP" and the NVLAP logo shall be in accordance with the terms set forth by the appropriate agency requirements such as Annex A of NIST Handbook 150 (most current edition) for NVLAP. The NVLAP and ELAP logos are not used on AmeriSci affiliated laboratory analytical reports. Uses in advertising or any documents will be in conjunction with relevant requirements for such item.

X. ANALYTICAL REPORTS (CONTINUED)

D. CUSTOMER CONTACT AND COMPLAINTS

Customer Questions or Complaints concerning an analysis result should be resolved to the customer's satisfaction, if possible within regulatory and ethical constraints. Communications with customers relative to AmeriSci Services shall be documented and archived. Acceptable documentation methods include e-mail and other written forms of communication. Any verbal discussions shall be confirmed in writing in an appropriate manner such as e-mail or phone contact logbooks. Archiving of contacts relating to specific jobs or general client instructions are maintained in a Job Tracking Form or in the LIMS Client Notes (Login, General Client Notes, Collection Status, or Analyst Notes) as detailed in SOP I - LIMS System Operation. The following sequence should be followed:

1. Analysis related complaint or question recorded in Customer Service logbook.

2. Call directed to appropriate log in, analysis or management section.

3. If discussion resolves the question, the customer contact information is filed with the appropriate Job Tracking Sheet or Customer Service file as necessary.

4. If discussion does not resolve a question of a technical nature, the call is referred to the local QA Officer for discussion, resolution, referral or possible internal action such as a special QC reanalysis. The customer will be updated within 48 hours on progress until the issue is completely resolved.

5. If the QA Officer (or Manager) decides that reanalysis is necessary, an amended analysis report must be issued if a reported result is changed. If necessary to answer a customer's complaint the sample may be sent to an outside laboratory agreed upon by both AmeriSci and the customer. If a mistake has been made by AmeriSci, a manager may credit the customer account for the original analysis. The actions are documented. A Corrective Action Report will be completed if necessary.

6. Ultimate responsibility for resolution of technical subjects lies with the Laboratory Manager with immediate reporting to the client.

E. NONCONFORMANCE, CORRECTIVE ACTIONS AND REPORTS

The discovery of a Non-Conformance which will alter results of an analysis report must be reported to a Manager and to the client by the Lab Manager. The Manager may halt work and reporting procedures until the issue is resolved. The QA Manager will be notified in order to initiate a Corrective Action Report. If the Non-Conformance impacts a previously released report the Laboratory Manager will be informed. If a change must be made in a released report the client will be informed while an amended report is being prepared.

X. ANALYTICAL REPORTS (CONTINUED)

E. NONCONFORMANCE, CORRECTIVE ACTIONS AND REPORTS (Continued)

A Corrective Action Report is triggered by a nonconformance that results in a change in reported results, analysis procedures or training procedures. Situations arising from Quality Control, Quality Assurance, or Customer Contacts may result in generation of a Corrective Action Report. The Report will identify the analysis type, job number, sample number, background, root cause, action taken, result of the action and the resulting corrective action. Risks and opportunities determined during Corrective Action planning will result in changes in procedures or management if needed.

The intent of the Corrective Action Report is to assure management that the incident has been properly evaluated, root cause corrected and any necessary preventive actions taken to prevent the reoccurrence of any similar problems. The Corrective Action Report is signed by the analyst (if it involves an analyst action) and the QA Supervisor. The Report will be referenced in the Job File, monthly QA files and the next Monthly QA Summary. Resumption of work following any nonconformance or corrective action situation will be authorized by the QA Officer and Laboratory Manager. A CAR follow-up will be performed within 30 days to ensure that an effective, corrective action plan was developed and all CARs are reviewed during annual internal audits as a means of Follow-Up to determine effectiveness.

Corrective Actions shall be appropriate to the effects of the Non-Conformity encountered. The Non-Conformity, its causes, subsequent actions and their effectiveness will be archived and reviewed in order to prevent a reoccurrence.

F. ROOT CAUSE ANALYSIS

A Root Cause Analysis (RCA) is a critical function of every Corrective Action investigation, providing a methodology for finding and correcting the underlying reasons or risks for potential problems. It differs from troubleshooting and problem-solving in that these typically seek solutions to specific symptoms of problems, whereas RCA is directed at underlying issues. It is an investigative thought process and one of the most common methods used is the "Five Why Method". First "why did this occur?" is asked, then "why did that occur?", and so on. The process continues until the fundamental level or something that's completely outside of the lab's control is attained. The rule of thumb is that 5 repeats are reasonable but, in some cases, fewer or more levels of "why" will be needed.

If the "Five Whys" are diagrammed in a Fishbone diagram, questioning each step for alternative considerations, a tree of causal factors and risks leading up to the original problem will result. Some may be less important than others, but a much more complete picture of the risks and causes will result in a better response.

Both training and review materials are provided to facilitate development and proper implementation of CAR, RCA and PAR programs by managers and supervisors.

X. ANALYTICAL REPORTS (CONTINUED)

G. PREVENTIVE ACTION PLAN FOR RISK PREVENTION

A Preventive Action Plan may be developed to prevent the risk of a potential nonconformance. Internal audits, quality control trends, proficiency testing trends, employee feedback or customer feedback point to risks of potential nonconformance issues. PAP monitoring is discussed in monthly/quarterly reports to management.

The Preventive Action Plan reporting assures management that risks have been addressed and preventive actions have been taken to prevent nonconformances.

H. AMENDED REPORTS

Once a customer has received a copy of the Analyst's Report, any change in the Job Report triggers both a "Corrective Action Report" and "Amended Analysis Report", both of which must be approved by the QA Manager and Lab Manager. The altered report is designated by the addition of "Report Amended - date" being added to the "Job Site" data field of the Job File (appears on all pages of the report). All changes or possible compromises of a customer report will be reported within 48 hours to the customer along with the amended report (weekend issues reported within 48 hours beginning Monday at 8:00AM).

The reason for the alteration, the unaltered and altered material, the name of the person implementing the alteration, and the alteration date are documented in the Job File and Amended Report Addendum. The Amended Report must meet the same review criteria as the original report prior to it's release. Both the original Report and Amended Report will be archived. Electronic records of the original report data and all amended records and reports are archived, which allows reconstruction of both the original archived report and subsequent archived, amended reports.

I. UNETHICAL OR PARTIALITY CONDUCT AND FRAUDULENT ACTIONS

Analytical reports require generation of accurate, reliable and impartial data produced in conformance with customer, project and regulatory requirements. Delivery of analytical data in any fashion has potential legal ramifications. An unethical action becomes a fraudulent act when the law is violated. Delivery of false information or data is a violation of the law. The sender can be charged with wire or mail fraud and can be prosecuted. Actions defined as unethical include the following:

1. forging another's name or initials

2. reporting results without actually analyzing the represented sample

3. knowingly reporting results by an incorrect method

X. ANALYTICAL REPORTS (CONTINUED)

I. UNETHICAL OR PARTIALITY CONDUCT AND FRAUDULENT ACTIONS (Continued)

4. signing for review of data without accomplishing the indicated review

5. knowingly altering data without proper justification

6. covering up an occurrence from which loss of data and/or revenue can occur

7. switching of QC samples or data without justification or documentation

8. modifying time data of receipt, to validate holding times, shipping or calibrations.

9. fabrication or falsification of records, samples or data

10. releasing confidential customer information to unauthorized personnel

11. releasing proficiency testing information to unauthorized personnel

12. not reporting known instances of unethical or partiality practices to management

Unethical conduct can result in dismissal. Fraudulent actions can result in both dismissal and prosecution through the legal system. Any employee should report any unethical conduct or partiality to the appropriate manager within 48 hours. No employee will be disciplined for reporting on possible unethical or partiality behavior and such actions will be held in strictest confidence. All employees are encouraged to discuss any data integrity issues, ethical issues, partiality issues or ethical concerns with their supervisor. Alternatively these issues may be discussed privately with the Corporate Compliance Officer in order to provide assurance of complete confidentiality. Reports of inappropriate ethical, partiality or data integrity activities will be investigated, documented and reported to senior level management for corrective action. Such records are maintained for five years.

J. IMPARTIALITY IN GENERATION AND HANDLING OF REPORTS

1. the sequence in which reports are generated or processed shall be handled with absolute impartiality

2. delivery and sharing of reports shall be handled with impartiality and must exclude any commercial, financial, business, or acquaintance relationship, familial or otherwise.

3. any knowledge or suspicion of partiality within the laboratory operation must be reported to management for review.

XI. CONTAMINATION CHECKS & CONTROLS

.

One of the key steps in executing a quality control program in any laboratory is the prevention and detection of sample contamination. An AmeriSci affiliated laboratory utilizes a variety of contamination controls to prevent laboratory and sample contamination. The following checks are performed to determine if there is sample or laboratory contamination

A. CONTAMINATION CONTROLS

Contamination controls should start at the moment the sample is received. At an AmeriSci affiliated laboratory, samples are received in an area separate from the preparation area. The condition of the shipping parcel is noted and a thorough examination of the chain-of-custody is completed.

If there has been a break in the custody seal or substantial damage to the package, the shipper is notified and the shipment is accepted only after communication with the customer.

The shipment is opened in a HEPA filtered hood, where it is documented and marked with the laboratory's unique identification number by the designated Sample Coordinator. Sample cassettes and containers are cleaned of any contamination adhering to the outside surfaces. Air, dust and water samples are prepared in a designated area separate from that in which bulk specimens are prepared.

Personnel who have previously been preparing bulk specimens are required to perform appropriate personal hygiene procedures, *i.e.*, changing lab coats, gloves, washing hands, etc. before they prepare air, dust or water samples.

Laboratory utensils such as forceps, tweezers, scalpels, glassware, etc. are designated for specific sample preparation areas and restricted to those areas only. All glassware and utensils are thoroughly washed with a suitable laboratory detergent and rinsed with fiber-free water.

All consumables are checked for possible contamination and approved by the local QA officer prior to use. New consumable sources must be approved prior to use in analytical procedures.

At no point during the preparation process are bulk samples incorporated with air samples. Collapsing of filters, etching, carbon coating and dissolution of filters in Jaffe washers are always kept separate for each sample type. Upon completion of preparation in separate areas, sample types are stored separately prior to disposal.

XI. CONTAMINATION CHECKS & CONTROLS (CONTINUED)

B. CONTAMINATION CHECKS - ASBESTOS

1. SAMPLE PREPARATION

An AmeriSci affiliated laboratory incorporates several processes that aid in checking potential contamination. The preparation of lab blanks is the most effective to check for immediate contamination. A lab blank is prepared, along with each series of samples. This lab blank also serves as a contamination check of filter lots used in indirect-transfer sample preparation techniques.

The following frequency of blank level check preparations are made:

a. A minimum of one laboratory filter blank per air sample set/job batch - or- 10% of samples (whichever is greater).

b. Prepare all PCM blanks and any sealed blanks with TEM air clearance sets.

The following represents the TEM air blank analysis program:

c. A minimum of one laboratory filter blank per 25 air filter analyses.

d. If air samples are above 70 structures/mm^2, analyze lab blank.

e. When Z-test analysis, analyze both field and sealed blanks.

The following represents the bulk blank analysis program:

f. A minimum of one blank per 20 bulk sample analyses.

The following represents the water blank analysis program:

g. A minimum of one water blank per batch.

XI. CONTAMINATION CHECKS & CONTROLS (CONTINUED)

B. CONTAMINATION CHECKS – ASBESTOS (Continued)

1. SAMPLE PREPARATION (Continued)

NOTE: Definitions of blanks are as follows:

1) Filter lot blanks: sealed filter from filter manufacturer representing a particular manufacturing lot.

2) Field filter blanks: AHERA TEM field blank samples are processed by removing the cassette cap for not more than 30 seconds before sampling. Other field blanks may be processed differently.

3) Sealed filter blank: carried with sample series filters through whole process, but not opened during sampling operations.

4) Laboratory blank: obtained by leaving an unused filter exposed in the clean area while a sample set of filters are prepared.

5) Bulk Blank: obtained by preparing and analyzing a bulk material know to be free of asbestos.

6) Water blank: obtained by filtering 500ml of fiber-free water used during water sample preparation.

7) Blank water filter: obtained by preparing an unused filter from the batch normally used during water sample preparation.

8) Other blanks: as needed to determine and correct source of field or lab contamination (including prep equipment, vaporizer, TEM specimen holders, evaporators, Jaffe wick, etcher, lab air and fallout samples, etc.)

XI. CONTAMINATION CHECKS & CONTROLS (CONTINUED)

B. CONTAMINATION CHECKS – ASBESTOS (Continued)

2. CONTAMINATION - CORRECTIVE ACTION

If any lab blank is found to be contaminated, the sample prep area and equipment used in the preparation process are thoroughly cleaned and another lab blank is prepared and read. If contamination is confirmed in a blank filter, the manufacturer of the filter lot is notified and that particular lot of filters is discarded.

The following represents the maximum contamination level of air filter blanks:

a. Air filter lots
-PCM Single preparation level > 5.5 fibers/100fields
-TEM Cumulative average level of 18 structures/mm^2.
-TEM Single preparation level of 53 structures/mm^2.

b. Laboratory Blanks
-PCM - Single preparation level > 5.5 fibers/100fields
-TEM - Cumulative average level of 18 structures/mm^2.

c. Field blanks
-PCM - Single preparation level > 5.5 fibers/100fields
-TEM - 70 structures/mm^2.

When Clearance samples are prepared, at least the sealed blank is prepared, also. If the area fails, the sealed blank is read and if contamination is found, the lab blank is analyzed. If the lab blank is found to be contaminated, results from any previous unanalyzed lab blanks are reviewed, to determine the approximate time of contamination and the appropriate measures are taken to remedy the situation.

The following represents the maximum contamination level of water filter blanks:

d. Water filter lots (0.1 µm PC) - Cumulative average level of 20 fib/mm^2.

e. Water blanks - 2 fibers per 20 grid squares (or <9.97 fib/mm^2.)

XI. CONTAMINATION CHECKS & CONTROLS (CONTINUED)

B. CONTAMINATION CHECKS - ASBESTOS (Continued)

The following represents the maximum contamination level of bulk blanks:

f. Bulk PLM blank mounts - >One fiber per mount

g. TEM bulk grid mounts - 2 fibers per 10 grid squares

3. LABORATORY AREA CONTAMINATION

The general laboratory area is checked for contamination by collecting microvac samples in areas of concern following ASTM 5755 method and background air samples.

If contamination is suspected in the laboratory for any reason, microvac samples are collected on the surfaces of countertops, hoods and internal chambers of equipment. In some cases, wipes may be collected with 25mm MCE filters.

The air samples, dust samples and/or wipe samples are read and the results of the analyses are reviewed with the Laboratory Manager.

If any area or equipment is found to be contaminated, the area is recleaned and the process repeated until the contamination is eliminated.

A clearance level of <1000 str/sq cm for a microvac sample should be obtained.

Any evidence of contamination is reported to the Laboratory Manager and QA Supervisor for possible action and reporting in monthly summaries.

XII. INTRA-LABORATORY QUALITY CONTROL

In order to properly monitor intra-laboratory quality, a system has been established to monitor calibration of AmeriSci affiliated laboratory analytical equipment, analysts and procedures. This program is administered to evaluate the overall laboratory as well as individual equipment, analysts and the output of the laboratory.

As an example of these procedures, the following sections illustrate the use of these procedures for monitoring equipment calibration, individual analysts and analysis methods. The sections include: (1) a calibration program for equipment, (2) the methods used at an AmeriSci affiliated laboratory for internal monitoring of new and experienced analysts and (3) the standards presently being used for method quality control assessment.

A. INSTRUMENT CALIBRATION PROGRAM (see schedules in XII.K.)

1. Inhouse Instrument Calibration Verification: Numerous pieces of equipment and supplies such as Thermometers and Index of Refraction liquids are verified within the laboratory on a routine basis against reference materials or items traceable to ISO 17025. Individual records logs are maintained for each individual item and reviewed in Monthly Quality Assurance Reports. Each log lists equipment ID, manufacturer, model, date acquired, date put into service, location, maintenance and details of past calibrations and next due date,

2. External Calibration Facilities: Numerous pieces of equipment such as InfraRed thermometers, pyrometers, micrometer slides and phase test slides are sent to external facilities for calibration to ISO 17025 reference standards. Individual records logs are maintained for each individual item and reviewed in Monthly Quality Assurance Reports. Each log lists equipment ID, manufacturer, model, date acquired, date put into service, location, maintenance and details of past calibrations and next due date,

3. Third Party Calibration Services: Numerous pieces of equipment such as Fume Hoods, Microbalances and Asbestos Workstations are serviced and calibrated onsite to ISO 17025 reference standards. Individual records logs are maintained for each individual item and reviewed in Monthly Quality Assurance Reports. Each log lists equipment ID, manufacturer, model, date acquired, date put into service, location, maintenance and details of past calibrations and next due date,

B. MONITORING OF PCM ANALYSTS

1. NEW PCM ANALYSTS
   Before an optical microscopist can become a certified AmeriSci affiliated laboratory PCM analyst, he/she must go through a period of apprenticeship. The training period consists of reviewing basic preparation procedures, counting rules and quality control methods for analyst control methods.

XII. INTRA-LABORATORY QUALITY CONTROL (CONTINUED)

B. MONITORING OF PCM ANALYSTS (Continued)

2. EXPERIENCED PCM ANALYST
The Experienced Analyst is a person that does independent PCM fiber counting and evaluation work on a daily basis at an AmeriSci affiliated laboratory. This person has achieved the full CV verified status designation. To maintain this status, the analyst must maintain a clean history of counting "in control" through the use of Reference Slide analyses, Pair Test evaluations and Proficiency PAT round control charts. These results will be recorded and plotted for each analyst.

3. FIBER COUNTING CONSENSUS REFERENCE SLIDES
AIHA-LAP PAT Rounds
The PT rounds from various agencies are supplemented with selected slides from the workflow to use as consensus fiber counting reference slides. These samples are used to (1) achieve statistically significant information on new analysts (2) develop individual analyst CV's and (3) develop laboratory CV's. The individual analyst CV's and laboratory CV used in the LIMS package for QC comparison calculations are updated on a semi-annual basis.

C. MONITORING OF PLM ANALYSTS

1. NEW PLM ANALYSTS
Before an optical microscopist can become a certified AmeriSci affiliated laboratory PLM analyst, he/she must go through a period of apprenticeship. The training period consists of reviewing basic mineralogy, crystallography and geochemistry, for the different types of asbestos and asbestos-look-a-likes that will be encountered during bulk analysis.

The final step of the apprenticeship process, prior to being allowed to participate in the daily analysis of PLM bulk analysis, will be to successfully achieve the appropriate results for RTI quantitation reference slides. Apprentices showing proper progress may be allowed to participate in daily PLM analysis under close supervision of an Experienced Analyst. Daily analysis results are monitored thorough use of the QA comparison reports.

2. EXPERIENCED PLM ANALYSTS
The Experienced PLM Analyst is a person that does bulk analysis work on a daily basis at An AmeriSci affiliated laboratory. This person has achieved the verified status designation. To maintain this status, the analyst must maintain a VERIFIED status with a demonstrated low error rate on all sample types.

XII. INTRA-LABORATORY QUALITY CONTROL (CONTINUED)

C. MONITORING OF PLM ANALYSTS (Continued)

3. PLM ASBESTIFORM STANDARDS AND REFERENCE MATERIALS

a. NIST SRM 1866 & 1867 (bulk material) - Used to prepare unknowns of asbestiform materials with known optical properties. These samples are used to achieve statistically significant information on new and experienced analysts.
- Chrysotile
- Amosite
- Crocidolite
- Fiberglass
- Anthophyllite
- Actinolite
- Tremolite

g. RTI permanent reference slides with known low levels of asbestos (bulk material) - These samples are used to develop statistically significant information for new and experienced analysts by both visual estimation and point counting quantification methods.

D. MONITORING OF TEM ANALYSTS

1. NEW TEM ANALYSTS

Before an electron microscopist can become a certified AmeriSci affiliated laboratory TEM analyst, he/she must go through a period of apprenticeship. The training period consists of reviewing basic mineralogy, crystallography and geochemistry, for the different types of asbestos and asbestos-look-a-likes that will be encountered during AHERA work. This includes the use of TEM photomicrographs, SAED patterns, and EDS X-ray spectra for each asbestos mineral and common non-asbestos types. Following this introductory period of inorganic geochemistry and mineralogy, a review of the instrument is made, to implement principles and hands-on use of the Transmission Electron Microscope. The New Analyst practices by analyzing an AmeriSci affiliated laboratory's Standard Reference Asbestos materials. The analyst also practices analyzing non-asbestos materials that could possibly be mistaken for asbestos as discussed in a previous section. At this stage, AmeriSci affiliated laboratory test material is introduced and data collected. This data is collected by the verified counting method. The New Analyst will be compared to a Verified Analyst (an analyst that has a proven average accuracy of greater than or equal to 85% true positives and less than or equal to 5% false positives) and must achieve greater than or equal to 80% true positives, less than or equal to 10% false positives, and less than or equal to 20% false negatives (this equals VERIFIED status).

XII. INTRA-LABORATORY QUALITY CONTROL (CONTINUED)

D. MONITORING OF TEM ANALYSTS (Continued)

The final step of the apprenticeship process, prior to being allowed to participate in the daily analysis of AHERA work, will be to successfully achieve the appropriate results for SRM 1876B. Apprentices showing proper progress may be allowed to participate in daily TEM analysis under close supervision of an EXPERIENCED ANALYST

2. EXPERIENCED TEM ANALYST

The Experienced Analyst is a person that does AHERA work on a daily basis at An AmeriSci affiliated laboratory. This person has achieved the verified status designation. To maintain this status, the analyst must maintain a VERIFIED status. In addition, results will be tabulated for the SRM 1876B testing material in a similar fashion. These results will be recorded and plotted for all analyst. An AmeriSci affiliated laboratory's quality assurance analyses represents at least 10% of all AHERA work done by the Experienced Analysts (as per the AHERA document). The 10% consists of three parts. The first part tests the precision of each operator. This is done by the reanalysis of the same grid openings of the specimen grids by the same operator. The samples will be randomly selected from 3.75% of all AHERA work for each operator. The results will be recorded and plotted on a control chart on a monthly basis.

XII. INTRA-LABORATORY QUALITY CONTROL (CONTINUED)

D. MONITORING OF TEM ANALYSTS (Continued)

2. EXPERIENCED TEM ANALYST (Continued)

The second part will test the precision of the laboratory. This will be done by the reanalysis of the same grid openings of the specimen grids by another operator who is a staff member of this laboratory. The samples will be randomly selected from 3.75% of all TEM air work for each operator. That work will then be divided evenly between the other analysts. The results will be recorded and plotted on a monthly control chart. The third part will test the intra-laboratory method precision. This will be done by reanalysis of the same specimen grids by the same operator, without restricting analysis to the same grid openings and by reanalysis of the same specimen grids by another operator who is a staff member of the same laboratory, without restricting analysis to the same grid openings. The samples will be randomly selected from 2.5% of all TEM air work and divided between the analysts. The results will be recorded and plotted monthly on a control chart. Also analysis of internal proficiency testing material will be recorded for each analyst. Verified counting procedures will be utilized for the first two parts with the data tabulation of greater than or equal to 80% true positives, less than or equal to 10% false positives, and less than or equal to 20% false negatives for each analyst.

By definition, the Verified Counting Procedure consists of multiple operators independently analyzing the same grid square and comparing results. The Verified Counting Procedure generally includes at least one qualified analyst with a proven average accuracy of greater than or equal to 85% true positives and less than or equal to 5% false positives. Grid squares are counted in the same manner (same grid orientation, same starting point, same initial traverse direction and pattern) and the size, number of structures, and identification data (and major axis orientation for grid openings with more than 5 structures) of the structures are recorded. These data are compared for the multiple independent analyses and any questionable structures are reanalyzed and confirmed.

To verify any inter-TEM variability, one AHERA air sample will be compared on both microscopes once a month if both microscopes are operational. If there is a significant difference in results, a determination will be made whether the variability is analyst or instrument-related and the appropriate measures for correction will be taken.

XII. INTRA-LABORATORY QUALITY CONTROL (CONTINUED)

E. USE OF REFERENCE MATERIALS AND STANDARDS

1. ASBESTOS STANDARD MATERIALS

a. SRM 1866 & 1867 (bulk material) - Used to prepare samples that have 1,000-5,000 structures/mm2. These samples are used to achieve statistically significant information on new analysts.
- Chrysotile
- Amosite
- Crocidolite
- Fiberglass
- Anthophyllite
- Actinolite
- Tremolite

b. SRM 8410 (carbon-coated PC filter portion) is used to test sample preparation for PC-type air filters. The fiber density is roughly 1,000 fibers/mm2.

c. SRM 8411 (carbon-coated MCE filter portion) is used to test sample preparation for MCE-type air filters. The fiber density is roughly 18,000 fibers/mm2.

d. SRM 1876B is an MCE preparation used for industry wide structure counting.

e. Albite and SRM 2063a for calibration of EDS x-ray system k-factors.

f. AmeriSci affiliated laboratory MATERIALS - asbestos and non-asbestos materials -
- Hornblende
- Vermiculite
- Sepiolite
- Halloysite
- Zeolites (erionite and mordenite)

g. STANDARD OPTICAL GRATING REPLICA - for magnification calibration.

h. GOLD FILM MATERIAL - for camera constant calibration of TEMs.

i. ALUMINUM FILM MATERIAL - for EDS calibration.

XII. INTRA-LABORATORY QUALITY CONTROL (CONTINUED)

E. USE OF REFERENCE MATERIALS AND STANDARDS (Continued)

2. STANDARD REFERENCE MATERIALS

Standard Reference Materials (SRM's) from the National Institute of Standards and Technology are used when available to assess the precision and accuracy of new and experienced TEM analysts in the identification of asbestos and non-asbestos structures. The following is a description of the types of standards available for use at an AmeriSci affiliated laboratory:

a. SRM 1866 is a set of three common bulk, mine-grade asbestos materials and one synthetic glass fiber sample. The three asbestos types are chrysotile, grunerite (amosite which is a commercial name and acronym for grunerite asbestos, originating from Asbestos Mines of South Africa), and riebeckite (crocidolite). This standard set is used primarily for polarized light microscopy. This material is mixed together to produce quality control sample sets with varying percentages of each component. Following analysis, the data is compiled and statistically analyzed for each analyst to confirm greater than or equal to 80% true positives, less than or equal to 10% false positives, and less than or equal to 20% false negatives. SRM 1867 (anthophyllite, tremolite and actinolite) is used similarly.

b. SRM 8410 is an unprepared polycarbonate filter containing about 1,000 stru/mm2 of chrysotile asbestos. This material is used in developing and refining sample preparation and analysis procedures for asbestos analysis in air samples.

c. SRM 8411 is an unprepared mixed cellulose ester filter containing approximately 13,800 structures/mm2 of chrysotile asbestos and 4,300 structures/mm2 of grunerite (amosite) asbestos. This filter has been collapsed with dimethylformamide/oxygen plasma etching and carbon coated to prevent particle loss during storage and handling. This material is used in refining sample preparation and training analysts to distinguish between grunerite asbestos and chrysotile asbestos using x-ray spectrometry, selective area electron diffraction, and morphology for asbestos identification.

d. SRM 1876B is a fiber distribution standard used for proficiency testing of each laboratory. The laboratory must obtain a mean analytical result that falls within 80% of the 95% confidence limits as published on the certificate.

XII. INTRA-LABORATORY QUALITY CONTROL (CONTINUED)

E. USE OF REFERENCE MATERIALS AND STANDARDS (Continued)

2. STANDARD REFERENCE MATERIALS (Continued)

e. AmeriSci affiliated laboratory STANDARDS include bulk as well as prepared grids of asbestos and non-asbestos samples. The non-asbestos bulk materials are hornblende, sepiolite, halloysite and vermiculite. They are used with SRM 1866 and 1867 to produce materials for the all analyst to examine. The prepared grids consist of sepiolite (non-asbestos), anthophyllite, tremolite, and actinolite (asbestos).

f. SRM 2063a is used to characterize the EDS systems. It is a thin film of the following elements: Mg, Si, Ca, Fe. X-ray energy -vs- channel number counts is recorded for each element. The elemental sensitivity factors (k-factors) relative to silica are determined for each of the above elements. EDS units are characterized with SRM 2063a and traceable albite.

g. NIST traceable albite is used to characterize the EDS systems. Albite is a mineral which contains the following elements: Na, Al, Si, K, and Ca. X-ray energy -vs- channel number counts is recorded for each element. The elemental sensitivity factors (k-factors) relative to silica are determined for Na and Al.

h. TEM MAGNIFICATION STANDARDS

Carbon replicas of diffraction gratings are used to accurately determine the magnification on both the fluorescent viewing screen and photographs. To calibrate for the high magnifications, a diffraction grating of 21,600 lines/cm is used. Other separations are available. The formula for this calculation is the following:

$$\text{MAGNIFICATION} = \frac{\text{(DISTANCE (cm) BETWEEN LIMITING LINES) x (DIFF GRATING (21,600 L/cm))}}{\text{NUMBER OF SPACES BETWEEN LIMITING LINES}}$$

The photograph negative magnification should be approximately 100% of the nominal magnification setting, with a screen magnification of about 80%. The calibration standards may also be used to check the TEM grid opening sizes.

XII. INTRA-LABORATORY QUALITY CONTROL (CONTINUED)

E. USE OF REFERENCE MATERIALS AND STANDARDS (Continued)

2. STANDARD REFERENCE MATERIALS (Continued)

i. CAMERA CONSTANT CALIBRATION

One of the tasks that a TEM can accomplish is to study the internal structure of crystals. This is done by examination of the Selected Area Electron Diffraction (SAED) pattern. The camera constant relates the measurements in a selected area electron diffraction pattern to the structural spacings in a crystal. The camera constant requires calibration at camera lengths of interest, usually done with a gold film. The following equations are used:

$$\frac{\text{CAMERA CONSTANT (lambda * L, mm}\Delta)}{\text{MEASURED DISTANCE - RADIUS (D1, mm)}} = \text{d-spacing } \Delta$$

The radius of the first gold ring is measured and used with the known d-spacing for this ring into the above equation to calculate the camera constant. This allows the calculation for the d-spacing for an unknown material. The only measured value needed is the radius or the distance (a vector = D1) from the central spot (000), to the reciprocal lattice point. Therefore, the camera constant divided by D1 is equal to the d-spacing for this specific Miller indices of the diffracting face. If we know the Miller indices of the diffracting face we can use the d-spacing to look up our unknown material in a table. The camera constant is checked on a weekly basis for any TEM in use, by comparison of SAED patterns. If changes are noticed then a complete Camera Constant Calibration with a gold film is prepared. (Refer to Sect VII-D-4-b).

F. DETERMINATION OF ANALYST AND LAB UNCERTAINTY

The uncertainty in the measurement of a value is the parameter which characterizes the dispersion of the values that could be reasonably attributed to the measurement. Its components for any analytical method depend on many factors. For methods which have a stated uncertainty, the stated value will be assumed to be correct until sufficient statistical data is available to provide an alternative statement of uncertainty. A minimum of 30 QC data points for measurements of a traceable reference standard (See Section VI.M. Traceability of Standards and Calibrations) is required to estimate the bias and precision for an analyst. Based on ISO guidelines the measurement uncertainties expected for asbestos analysis may be determined statistically (Type A contributors) by measuring the dispersion of values for traceable reference standards or duplicate samples. Bias and precision data for all analysts are utilized to provide an estimate of the overall laboratory uncertainty. For published methods the recommended procedures shall be followed (ie 95% confidence limits for NIOSH 7400).

XIII. INTER-LABORATORY QUALITY CONTROL

In addition to other QA measures an AmeriSci affiliated laboratory enters into sample exchanges with other laboratories on a routine basis. Every attempt is made to provide routine samples representative of the general sample stream normally observed on a day-to-day basis. Each sample exchange should include a minimum of 4 samples, with at least two samples with significant asbestos (fiber) content in order to test the analytical capabilities of the laboratories involved. The samples should be accompanied by a Chain of Custody numbered with a Batch-sample identification in order to provide unambiguous sample identification (as follows): Batch (XX0211RL-3) where "XX" indicates source affiliated lab, "0211" indicates year and month of Batch creation, "RL" indicates the analysis type for the Round Robin Batch, "-3" indicates the 3rd sample within the batch. The sample batch should be logged into the AmeriSci affiliated lab QC job appropriate for the arrival date at the lab.

A. PCM SLIDE EXCHANGE

An AmeriSci affiliated laboratory has a sample exchange program with at least three PCM asbestos laboratories (minimum of semi-annual). An AmeriSci affiliated laboratory alternates (every other time) on sample preparation placed on slides. Before sending the sample set, the originating lab determines the fiber concentration. After the receiving lab has analyzed the sample set, they relay the fiber concentration identified per slide back to the originating lab. The results are compared both statistically (average, standard deviation and percent coefficient of variation) and graphically (histogram). A copy of the tabulated results is sent to each exchange lab.

B. PLM BULK SAMPLE EXCHANGE

An AmeriSci affiliated laboratory has a bulk sample exchange program with at least three PLM asbestos laboratories (minimum of semi-annual). An AmeriSci affiliated laboratory alternates (every other time) on sample selection. Before sending the sample set, the originating lab determines the total asbestos type and content. After the receiving lab has analyzed the sample set, they relay the results back to the originating lab. An AmeriSci affiliated laboratory compares the results and a copy of the tabulated results is sent to each exchange lab.

C. TEM AHERA AIR SAMPLE EXCHANGE

An AmeriSci affiliated laboratory has a sample exchange program with at least three TEM asbestos laboratories (minimum of semi-annual). At least one filter is sent to compare the effects of sample preparation on the total structure count. The samples should contain at least 1-3 structures/grid opening or calculated (for five samples) for a mean concentration of 70-150 structures/mm2. Before sending the sample set, the originating lab determines the total asbestos structures identified per grid. After the receiving lab has analyzed the sample set, they relay the total asbestos structures identified per grid back to the originating lab. The results are compared both statistically (average, standard deviation and percent coefficient of variation) and graphically (histogram). A copy of the tabulated results is sent to the exchange lab.

XIV. QUALITY AUDITS

Regardless of the procedures and principles set forth within other sections of this QA MANUAL, an AmeriSci affiliated laboratory uses a set of QA AUDITS to CHECK the entire LABORATORY SYSTEM. While it is the job of every employee to implement QA guidelines on a daily basis, it is the QA SUPERVISOR (or their designee) for each division that monitors the procedures to ensure proper quality. Therefore, audit checklists are used by each laboratory division highlighting the QA/QC program components for each laboratory division (given at the end of this section). Listed below are abbreviated discussions of selected aspects. It should be noted that a more detailed description of each item is given in the respective sections of the SOP MANUAL

A. OPTICAL MICROSCOPES (PCM & PLM Asbestos)

1. PHASE CONTRAST LIGHT MICROSCOPES are aligned by each operator daily. . Replacement of light sources is recorded. An HSE/NPL slide is used to check the detection limit and phase-ring alignment daily. The Walton-Beckett graticule field diameter is checked monthly. The actions are recorded in the PCM logbook.

2. POLARIZED LIGHT MICROSCOPES are aligned by each operator daily. Replacement of light sources is recorded. An Olympus style alignment slide is used for alignment of the crosshairs, polarizer and analyzer. The dispersion staining colors of reference amosite are checked monthly. This procedure is performed by each analyst and recorded in the PLM workstation logbook.

B. ATEM ANALYSIS EQUIPMENT (TEM & EDS Asbestos)

1. CALIBRATION - The TEM is aligned by each operator daily. This procedure is done by each analyst and recorded in the TEM logbook. The exchange of an old filament with a new one is recorded also. The apertures (condenser, objective, and SAED) are cleaned when needed. The camera constant is checked once a week. Any significant variation will be evaluated by calibration with a gold standard at selected camera lengths. The calibration of magnification for the Fluorescent Viewing Screen, STEM Screen (optional based on use), and the Photographic Negative is done monthly. The numbers are used statistically to calculate a percent coefficient of variation. If this is > 5 percent, action must be taken to resolve the problem with the individual TEM. The Electron Probe Spot Size is calibrated quarterly to assure that the X-rays are produced from the appropriate location of the sample. The acceptable percent coefficient of variation is less than or equal to 25 percent.

XIV. QUALITY AUDITS (CONTINUED)

B. ATEM ANALYSIS EQUIPMENT (TEM & EDS Asbestos) (Continued)

.

2. INTERSCOPE TEM QA - This will require the need to determine if there are any inter-microscope biases for the analysis of the same sample. This will be done quarterly when multiple scopes are operating. The results will be plotted for each microscope, with the percent coefficient of variation less than 5 percent.

C. TEM SAMPLE PREPARATION EQUIPMENT (Asbestos)

1- PLASMA ETCHER is calibrated on a monthly basis with the proper settings recorded in the EQUIPMENT CALIBRATION AND MAINTENANCE NOTEBOOK. This notebook will be the calibration and maintenance document for all equipment used at each AmeriSci affiliated laboratory location. The proper settings should ash approximately 10 percent of the collapsed MCE filter. The R.P. oil is changed once a year or as needed.

.2- VACUUM EVAPORATOR is calibrated on a monthly basis using the chrysotile SAED pattern method. In summary, a minimum amount of carbon is deposited per sample set to assure a good SAED pattern from single chrysotile asbestos fibrils. The R.P. and D.P. oil is changed annually or as needed.

.

3- TEM GRID OPENINGS - An AmeriSci affiliated laboratory buys TEM grids in batches of 1,000 (same batch) minimum. The average cross sectional area per grid opening per batch is determined according to the optical microscopy procedure discussed in the SOP. This number should not vary more than 5 percent using the percent coefficient of variation. This is a critical determination for structure concentration of TEM air samples. This number is recorded in the LIMS package "constants".

D. CONTAMINATION - SUPPLIES AND WORK AREAS

1 Analytical supplies and reagents are controlled and checked on a daily basis. All analytical materials and reagents used in analytical procedures must be pre-approved by the local QA officer prior to use in analytical procedures. Reagents are dated and initialed upon receipt and upon being opened. A method or reagent blank is processed with each batch per method as appropriate. The individual method SOP's detail the specific requirements for method, lot or reagent blanks.

2 LABORATORY CONTAMINATION is checked on a <u>continuous basis</u> through the analysis of laboratory blanks. If any contamination is discovered on blanks, samples are collected in appropriate locations of the respective lab in order to identify the source of the contamination. Air samples, tape lifts, wipes or micro-vacuum filter samples as appropriate for the contaminant are collected and analyzed until the problem is resolved under the direction of the appropriate QA Supervisor.

XIV. QUALITY AUDITS (CONTINUED)

E. ANALYSIS OF REFERENCE MATERIALS

Each analyst is responsible for the analysis of at least one of an AmeriSci affiliated laboratory's Reference Standards at least once per month in order to determine analyst accuracy and bias. The materials include asbestos or fibrous non-asbestos materials. This data will be reviewed for each analyst on a monthly basis.

F. QUALITY CONTROL ANALYSES - PRECISION

1. Asbestos TEM (AHERA) - An AmeriSci affiliated laboratory's quality assurance analyses represent at least 10% of all AHERA work done by the Experienced Analyst (as per the AHERA document). The 10% consists of three parts. The first part will test the precision of each operator. This will be done by the reanalysis of the same grid openings of a specimen grid by the same operator. The samples will be randomly selected from 4% of all AHERA work for each operator. The results will be recorded graphically on a monthly basis and plotted with the mean result, along the abscissa (x) and the coefficient of variation along the ordinate (y). The second part will test the precision of the laboratory. This will be done by the reanalysis of the same grid openings of a specimen grid by another operator from the same laboratory (intra-laboratory). The samples will be randomly selected from 4% of all AHERA work for each operator. The results will be recorded monthly and plotted as described above. The third part will test the intra-laboratory method precision. This will be done by repreparation and reanalysis of the same specimen both by the same operator and by another operator. The samples will be randomly selected from all AHERA work with above background counts and divided between the analysts. In addition to this, analysis of internal proficiency testing material is recorded for each analyst once a month using verified counting procedures. The data is used to verify greater than or equal to 80% true positives, less than or equal to 10% false positives, and less than or equal to 20% false negatives for each analyst.

2. Asbestos PLM (AHERA) - An AmeriSci affiliated laboratory's quality assurance analyses represent at least 10% of all AHERA work performed by the Experienced Analyst (as per the AHERA document). The 10% consists of two parts. The first part will test the precision of each analyst. This will be done by the blind reanalysis of the same sample by the same analyst (intra-analyst). The second part will test the precision of the laboratory. This will be done by the reanalysis of the samples by another analyst from the same laboratory (inter-analyst). The QC results will be recorded graphically on a control chart (see section VIII. C. 2.) and reviewed on a monthly basis. In addition to this, analysis of internal proficiency testing material is recorded for each analyst at least once a month. These data are used to determine precision, accuracy and bias for each analyst.

XIV. QUALITY AUDITS (CONTINUED)

G. REPORT REVIEW

The QC of an AmeriSci affiliated laboratory's customer reports occurs daily. All jobs are reviewed by four individuals, beginning with the analyst. The analyst prepares the report using standard formats in the LIMS package. The ultimate integrity of AmeriSci's service is in the analyst's ability to communicate the results to the customer in the most precise way.

Upon completion of the analysis the Analyst prints it for review, generating QC selection. The QC function of the LIMS compares the original and QC analysis results for acceptance. If accepted, the Analyst's Report and CoC are transmitted to the customer for review of the transcribed information. If the QC is not accepted, the QA Officer resolves any QC problems, critiques the calculations and signs "Reviewed By". The Lab Manager (or designee) reviews the job file, approves the Invoice and releases the completed report package. The NVLAP (and/or ELAP) approved signatory is affixed by the appropriate Technical Officer, officially releasing the report for final distribution.

H. INTERLABORATORY QC EXCHANGE

The interlaboratory QC program is performed by exchanging previously analyzed materials with an outside laboratory at least semi-annually. An AmeriSci affiliated laboratory alternates with each lab selecting samples for analysis. The QA Officer is responsible for selection and submission of the samples and the recording of the data in the Interlaboratory QA/QC records. The results are compared both qualitatively and quantitatively if possible. The results are compared statistically and graphically as indicated in the SOP for each analysis type. The comparisons are reviewed in the Monthly QA Summaries.

I. INTERNAL AUDIT PROGRAM

Each AmeriSci location will undergo at least one Internal Audit annually in order to verify that the operations comply with the Quality System requirements and relevant standards such as ISO 17025, NVLAP or NYDOH ELAP. The audit will include a follow up review of all CARs issued since the previous audit. Internal audits will be conducted by trained and qualified individuals who are independent of the operation. A report will be issued to the laboratory manager covering the areas audited and the audit findings. The manager will assign any necessary corrective actions and the time frame for completion, typically 30 days. If the audit findings cast doubt on the correctness or validity of any test results the results will be validated within 14 business days and customers will be notified within 48 hours in writing if any reported results were affected. Corrective Action Reports and Amended Reports will be issued within 48 hours.

A follow-up review of any resulting CARs from the audit will be performed within 30 days to verify and record the implementation and effectiveness of any CARs undertaken.

XIV. QUALITY AUDITS (CONTINUED)

J. QUALITY MANAGEMENT SYSTEM REVIEW

A Quality Management Review will be conducted annually by executive management. It will commence on the first workday of the 4th Quarter, unless rescheduling is necessary. The Management review addresses the Quality System, Analytical Programs and Quality Documents on an annual basis to ensure their continuing suitability and effectiveness. The review shall include as a minimum: policy and procedure suitability, all internal reports, internal and external audits, customer feedback or complaints, supervisory reports, work volume and content, resource changes, staffing levels, training needs, and QA/QC activities including, corrective and preventive actions, intra- and inter-laboratory exchanges and proficiency tests.

Findings from the review will be detailed in a report that will be maintained along with its actions and their follow-up findings for a minimum of five years. Any evidence of inappropriate actions or potential risks related to data integrity and impartiality of the laboratory will be investigated. Such issues will be handled in a confidential manner until appropriate actions have been completed. The report will include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of customers.

The completed report will be shared with laboratory personnel for the purpose of soliciting feedback from employees. Records of the meeting will be maintained including signatures of those attending along with the items discussed.

K. Maintenance and Calibration Plans and Schedules

Plans and schedules for maintenance and calibration of PCM, PLM, TEM and Support Equipment have been developed as examples of items appearing on certifying agency checklists routinely used during external audits. Note that some items of equipment or calibrations may appear in more than one list if they are involved in more than one method or application.

PCM
Maintenance - Calibration Plan

Preparation Equipment

1. One Blank per Group Processed (*each work day)*_____
2. HEPA-hood Flow Rate Check *(quarterly, Third Party Certified semi-annually)*____

Phase Contrast Light Microscope

1. Alignment *(daily or next use)*_____
2. Phase-ring Alignment Checked *(daily or next use)*_____
3. Phase Shift Detection Limit Check (HSE/NPL) *(weekly)*_____
4. Field Diameter of Walton-Beckett Graticule *(monthly)*_____
5. PCM Clicker, 100 count tally verification *(monthly)*_____
6. Klarmann Ruling, stage micrometer (*5 years)*_____

Intra-laboratory

1. 10% of All Analyses Reanalyzed (*daily or next use)*_____
2. Reference Slide (alternate 3 loadings) Read by All Analysts (*daily or next use)*_____
3. Review of Completed Analysis Reports *(daily or next use)*_____
4. Update CV for each inexperienced analyst (less that 1 year) *(monthly)*_____
5. Update CV for each experienced analyst (more than 1 year) *(semi-annually)*_____
6. Compliance Officer On-site Quality Assurance review *(semi-annually)*_____

Inter-laboratory

1. Exchange with Outside Laboratory *(semi-annually)*_____
2. Update laboratory CV *(semi-annually)*_____
3. Proficiency Materials Read by All Analysts (*when received)*_____

Analysts

1. Completion of QC and Reference Analyses Requested *(daily or next use)*_____
2. Analysis of Low-fiber Count Slide *(twice monthly)*_____
3. Analysis of Medium-fiber Count Slide *(twice monthly)*_____
4. Analysis of High-fiber Count Slide *(twice monthly)*_____

Contamination Check

1. One Blank per Group Analyzed (*each work day)*_____

_____ Date _____

_____ Date _____

PLM
Maintenance - Calibration Plan

Preparation Equipment

1. One Blank per 20 Bulk NOB Samples Processed (*each work day)*_____
2. Refractive Index Oil Calibration *(when opened, then quarterly)*_____
3. Analytical Balance Calibration *(daily, serviced-annually)*_____
4. Muffle Furnace Temperature Calibration *(monthly)*_____
5. HEPA-hood Flow Rate *(quarterly, Third Party Certified semi-annually)*_____

Polarized Light Microscope

1. Alignment *(daily)*_____
2. Refractive Index Colors of Amosite Slide *(monthly)*_____

Intra-laboratory (s-a = single-analyst shifts, m-a = multi-analyst shifts)

1. Reanalysis of 10% of All Samples Analyzed (*each work day)*_____
2. Reanalysis of Samples by Different Analyst *(minimum of 1 per 15,* **m-a shift***)*___
3. Reanalysis of Samples by Same Analyst *(minimum 1 per 50,* **m-a shift***)*_____
4. Reanalysis of Samples by Same Analyst *(minimum 1 per 10,* **s-a shift***)*_____
5. Standard or Reference Material Read by All Analysts (*1 per 100)*_____
6. Review of Completed Analysis Reports *(each work day)*_____
7. Compliance Officer On-site Quality Assurance review *(semi-annually)*_____

Inter-laboratory

1. Exchange with Outside Laboratory *(quarterly)*_____
2. Exchange of QC'd Samples *(1 per 500)*_____
3. Proficiency Materials Read by All Analysts (*when received)*_____

Analysts

1. Completion of Available Training Updates *(quarterly)*_____
2. Completion of QC and Reference Analyses Requested *(each work day)*_____

Contamination Check

1. One Blank per 50 Bulk Samples Analyzed (*each work day)*_____

_____ Date _____

_____ Date _____

TEM
Maintenance - Calibration Plan

Preparation Equipment

1. Plasma Etcher Etching Rate Calibration *(quarterly)* _____
2. Vacuum Evaporator Carbon Film Calibration *(monthly)*_____
3. Analytical Balance Calibration *(daily, serviced-annually)*_____
4. Muffle Furnace Temperature Calibration *(monthly)*_____
5. HEPA-hood Flow Rate Check *(quarterly, Third Party Certified semi-annually)*____
6. Drinking Water storage refrigerator temperature monitor (*monthly*)_____

Transmission Electron Microscopes/ Energy Dispersive Spectrometers

1. Alignment *(daily)*
2. Filament Change and Hours Used *(when needed)*_____
3. Condenser, Objective and SAED Aperture Cleaning *(when needed)*_____
4. TEM Beam Dose / Chrysotile Damage *(quarterly)*_____
5. SAED Camera Constant *(weekly)*_____
6. Spot Size of Electron Probe (*quarterly, photo-annually)*_____
7. STEM Screen Magnification Calibration *(monthly if used)*_____
8. Phosphor Screen Calibration at 0.5, 5.0 & 10.0 microns (*monthly)*_____
9. Photographic Negative Magnification Calibration *(monthly)*_____
10. EDS Calibration Al/Cu *(each work day)*_____
11. EDS Detector Resolution (Mn <175ev) *(semi-annually)*_____
12. EDS k-factors for Na, Al, Mg, Ca, and Fe vs Si *(semi-annually)*_____
13. EDS Sensitivity for Na (crocidolite) and Mg and Si (chrysotile fibril) *(quarterly)*____

Intra-laboratory

1. Standard or Reference Samples Read by All Analysts (*monthly)*_____
2. Reanalyze 10% of Analyzed Samples (*each work day)*_____
3. Reanalyzed by Same Analyst (blind to original analysis) (*1 of 25)*_____
4. Reanalyzed by Different Analyst (blind to original analysis) (*1 of 25)*_____
5. Inter-microscope Analysis (*monthly)*_____
6. Grid Opening Size Calibration (*when new batches are received)*_____
7. Repeat Preparation and Analysis by Different Analyst (*semi-annually)*_____
8. Repeat Preparation and Analysis by Same Analyst (*semi-annually)*_____
9. Review of Completed Analysis Reports *(each work day)*_____
10. Compliance Officer On-site Review *(annually)*_____

Inter-laboratory

1. Exchange of Grids and Filter Material *(semi-annually)*_____
2. Proficiency Materials Read by All Analysts (*after receipt)*_____

TEM
Maintenance - Calibration Plan
(continued)

Analysts

1. Completion of Available Training Updates *(quarterly)* _____
2. Analysis of proper number of grid preparations per sample *(air-2, water - 3)*_____
3. Recording of SAED negative and EDS spectrum per asbestos type *(min -1 per job)*____
2. Maintenance of Verified Analyst Status *(1 per 200 grid squares, min.)*_____

Contamination Check

1. Air Sample Blanks (prep 1 per set) (1 per 25 analyzed) (*each work day)*_____
2. One Blank per Batch of Water Samples Prepared (*each work day)*_____
3. One Blank per 20 TEM Bulk Samples Prepared (*each work day)*_____

_____ Date _____

_____ Date _____

Support Equipment and Instruments Maintenance - Calibration Plan and Schedule

Inhouse Calibrations (performed by AmeriSci Employees)

1. Thermometers, digital workstation (*annually)*_____
2. Thermometers, digital refrigerator (*annually)*_____
3. Thermometers, Infrared (IR) gun (*quarterly – single point)*_____
4. Index of Refraction Liquids, (*quarterly)*_____
5. Microbalance (*daily verification in use range)*_____
6. Pipettes, volumetric dispensing devices *(quarterly)*_____
7. HEPA filter workstations *(quarterly)*_____
8. Fume filter workstations *(quarterly)*_____
9. Exhaust Hood *(quarterly)*_____

Inhouse Calibrations (performed by Certified Third Party Services)

1. Fire Extinguishers (semi-*annually)*_____
2. HEPA filter workstations *(semi-annually)*_____
3. Fume filter workstations *(semi-annually)*_____
4. Exhaust Hood *(semi-annually)*_____
5. Microbalance (*annually)*_____

External Calibration Services (shipped to Certified Third Party Locations for Service)

1. Thermometers, Memory Wide-Range (*annually)*_____
2. Thermometers, Stainless-Steel Type-K Probe (*annually)*_____
3. Thermometers, Infrared (IR) gun (*annually)*_____
4. Troemner, analytical weight set (*annually)*_____
5. Klarmann Ruling, stage micrometer (*5 years)*_____
6. Phase Shift Detection Limit Slide (HSE/NPL) *(5 years)*_____

_____ Date _____

_____ Date _____

XV. PROFICIENCY TESTING

This section summarizes the protocol followed at an AmeriSci affiliated laboratory for Proficiency Testing. Prior to this discussion, it should be stated that an AmeriSci affiliated laboratory will analyze all Proficiency Testing Materials "in-house" using standard SOP's, and will not contract out Proficiency Testing to another laboratory. All Proficiency testing data is considered confidential information and is not discussed with any other laboratory or individual until after the latest possible agency submission date has passed (typically the agency results release date).

Method specific details are available in the SOP for each method. The following represents a general outline depicting handling, analysis and use of Proficiency Testing Materials:

A. Proficiency Testing Materials are managed, analyzed and reported in the same manner as customer samples (i.e. using the same staff, methods, calibration and QC procedures, replicates, equipment, facilities, and frequency of analysis).

B. The PT Samples will be assigned the typical longest TAT (turn around time) for the sample type (typically 5 days).

C. The "as received" documents are archived as an electronic document. Once the initial analysis is completed and reported to the originating agency a QA Job File is created (for example an October 2023 PCM proficiency would be entered as Job 2QA2310PC).

D. If appropriate for the sample type all analysts will analyze, record and report test results in the QA Job as well as the agency PT form.

E. Once the PT results are returned by the PT Agency, the test results are used for inter-analyst comparisons, laboratory characterization and DOC generation.

F. Any problems indicated by the PT are discussed with the appropriate personnel for instructional purposes and documented in the individuals QA file.

G. If any potential problems persist, plans are developed and implemented for resolution.

H. Any proficiency testing material remaining with an AmeriSci affiliated laboratory will be used for internal proficiency testing and training programs.

XVI. REFERENCES

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

American National **Standard** for Laboratory Ventilation ANSI/AIHA Z9.5, 3.3.1

Anderson, C.M. and J.M. Long, "Interim Method for Determining Asbestos in Water", EPA 600/4-80-005

ASTM D3670-91 (Reapproved 2022), "Determination of Precision and Bias of Methods of Committee D22."

ASTM D5755-09R14E01, "Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations".

ASTM D6281-15 (2016), "Airborne Asbestos Concentration in Ambient and Indoor Atmospheres as Determined by Transmission Electron Microscopy Direct Transfer".

ASTM D6480-19, "Wipe Sampling of Surfaces, Indirect Preparation, and Analysis for Asbestos Structure Number Surface Loading by Transmission Electron Microscopy".

ASTM E29-02, "Using Significant Digits in Test Data to Determine Conformance with Specifications".

ASTM E542–22 (Revised 2022) "Calibration of Laboratory Volumetric Apparatus".

ASTM E2623–14 (Reapproved 2021) "Reporting Thermometer Calibrations".

Buetow, D.H. 1998, "The Identification of Refractory Ceramic Fibers in Bulk Building Materials by Optical and Physical Methods", EIA Technical Monographs, Vol 4, 8 pages.

CARB: Method 435, "Determination of Asbestos Content of Serpentine Aggregate" California Air Resources Board, California Environmental Protection Agency, 18 p, June 6, 1991.

Chatfield, E. J.. 1988, "Determination of asbestos in resilient floor tile", SOP-1988-02 Rev. 1: Analysis of resilient floor tile, Chatfield Technical Consulting Limited, Mississauga, Canada, 6 pages.

Denton Evaporator Instruction Manual, Denton Vacuum LLC, Moorestown, NJ.

EVEX Global LLC. NanoAnalysis Hardware & Software Operations Manual, Princeton, New Jersey

XVI. REFERENCES (CONTINUED)

EMS 150T S/E/ES Sample Preparation System Instruction Manual, Electron Microscopy Sciences, Hatfield, PA

EMS 950X Sample Preparation System Instruction Manual, Electron Microscopy Sciences, Hatfield, PA

EPA 560/5-89-001 Guidelines for Conducting the AHERA TEM Clearance Test to Determine Completion of an Asbestos Abatement Project, May 1989

HITACHI LTD. Instruction Manual for Model H-600 Electron Microscope, Part No. 542-E201-4, Tokyo, Japan

HITACHI LTD. Schematic Diagrams for Model H-6010A Scanning Electron Image Accessory, Part No. 542-E411-1, Tokyo, Japan

HITACHI LTD. Instruction Manual for Model H-7000 Electron Microscope, Part No. 747-9800, Tokyo, Japan

HITACHI LTD. Instruction Manual for Model H-7110 Scanning Electron Image Accessory, Part No. 747-9801, Tokyo, Japan

HITACHI LTD. Schematic Diagrams for Model H-7000 Electron Microscope, Part No. 747-9807-1, Tokyo, Japan

ISO/IEC 17025:2005 Analytical Measurement Uncertainty

JEOL LTD. JEM-100CX Electron Microscope Operations Manual, Tokyo, Japan

JEOL LTD. JEM-100CX II Electron Microscope Operations Manual, Tokyo, Japan

Joy, David C., Alton D Romig Jr., and Joseph I. Goldstein, 1989 Principles of Analytical Electron Microscopy, Plenum Press, New York, 448 pages.

Ladd Evaporator Instruction Manual, Cat. No. 30000, Ladd Research Industries, Inc., Burlington, VT

Method 100.1 - Chatfield, E. J. and M.J. Dillion, "Analytical Method for the Determination of Asbestos in Water", EPA 600/4-83-043.

Method 100.2 - Brackett, K.A., P.J. Clark, and J.R. Millette, "Determination of Asbestos Structures Over 10 um in Length in Drinking Water", EPA 600/R-94/134

XVI. REFERENCES (CONTINUED)

New York Environmental Laboratory Approval Program "Environmental Analysis/NYSDOH Methods - PLM Methods for Identifying and Quantifying Asbestos in Bulk Samples, latest revision.

New York Environmental Laboratory Approval Programs (Item 198.8.2 – Polarized-Light Microscope Method for Identifying and Quantitating Asbestos in Surfacing Material Containing Vermiculite Bulk Samples, latest revision.

New York State Department of Health, Asbestos / Fibers – Frequently Asked Questions, latest revision of April 8, 2011 list

New York State Department of Health , Vermiculite Interim Guidance v5 – Rev July 9, 2013.

New York State Department of Health , Testing Requirements for Sprayed-on Fireproofing Containing Vermiculite (SOF-V) July 22, 2014.

New York Environmental Laboratory Approval Program "Environmental Analysis/NYS DOH Methods - PLM Methods for Identifying and Quantitating Asbestos in Bulk Samples"

NIOSH Manual of Analytical Method, 4th Edition, Method 9002, issued 8/15/94

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.

NIOSH: Method 9002, "Asbestos (bulk) by PLM", Issue 2, 8/15/94, NIOSH Manual of Analytical Methods, 4th Edition, issued 8/15/94.

NIST Laboratory of Metrology, SOP 29 - 2019, Standard Operating Procedure for the Assignment of Uncertainty, 11 pages

Noran System 7 Information Manual 950A, Rev D., ThermoFisher Scientific, Madison, Wis, USA.

OSHA Reference Method – Mandatory – 1920.1001 Appendix A

OSHA Reference Method – Non-Mandatory – 1910.1001 Appendix B

XVI. REFERENCES (CONTINUED)

OSHA 29 CFR 1910.1001 Asbestos Standard for the General Industry.

Plasma Prep II Maintenance & Instruction manual, SPI Supplies Division of STRUCTURE PROBE, Inc. West Chester, PA

Proceedings NVLAP Asbestos Regional Meeting, Boston, MA, Using Dispersion Staining Method", References for Bulk Asbestos Identification by PLM, 1997

Su, Shu-Chun 1992, "Calibration of Refractive Index Liquids By Using Optical Glass Standards With Dispersion Staining". Microscope, v.40, pp.95-108.

Su, Shu-Chun 1994, (November 2002 Revision): "Refractive Index Liquid Calibration Using Calibrated Refraction Index Solids, A Standard Operation Procedure For Bulk Asbestos Analysis By Polarized Light Microscopy". 10 pages.

Su, Shu-Chun 1996, "Rapidly and Accurately Determining Refractive Indices of Asbestos by Polarized Light Microscopy".

USEPA: "Asbestos-Containing Materials in Schools: Final Rule and Notice. Federal Register, 40 CFR part 763, Appendix A to Subpart E., October 30, 1987.

USEPA: "Interim Method for the Determination of Asbestos in Bulk Insulation Samples", EPA/600/M4-82-020, Dec 1982

USEPA: "Method for the Determination of Asbestos in Bulk Building Materials", Perkins, R.L. and Harvey, B.W., EPA/600R-93-116, July 1993

USEPA: "Analytical Method for the Determination of Asbestos Fibers in Water", Chatfield, E.J. and Dillon, M.J., EPA/600/4-83-043,

40 CFR Ch I (2011 ed) Pt 763, Subpt. E, App. A, pages 865-901. (AHERA TEM Air)

40 CFR part 763, Appendix A to Subpart F, October 1987.

Williams, David B and C. Barry Carter, 1996 Transmission Electron Microscopy – A Textbook for Materials Science, Plenum Press, New York, 729 pages. ------ also available as a 4 volume soft cover set from Springer Science+Business Media, LLC 1996, 2009

Yamate, G., Satish C. Agarwal, and Robert D. Gibbons, Methodology for the Measurement of Airborne Asbestos by Electron Microscopy, EPA Contract 68-02-3266, July 1984, 112 page

XVII. APPENDICES

A. AMENDMENT & REVIEW RECORD

This section is an annualized record documenting the Annual Review and periodic amendments of the various parts of the QA System. Annual Reviews do not necessarily result in Amended issues of the QA System Manual as the annual review process does not always result in amendments to this document. In consideration of this situation each annual review is listed in this section. All Amendments must be approved by the QA Supervisor, Laboratory Manager (Asbestos Coordinator), and Chief Technological Officers of the AmeriSci affiliated laboratories and AmeriSci Group respectively. Upon approval of any new revisions, all old copies are replaced by revised versions. Copies of manuals removed from circulation are on file with the QA Officer if needed.

1st Edition	October 1989 Publication of 1st Edition
October 1992	General Review and update to include computer LIMS package
October 1993	General Review and inclusion of PLM sections
May 1994	General Review and modification for sub-facility operation
August 1994	Completion of NVLAP modifications for PLM and TEM at sub-facility
2nd Edition	Revision of Manual after company reorganization, separation of SOP and QA sections as separate manuals, published as 2nd Edition 3/25/95.
November 1996	Completion of 1996 annual review and incorporation of new NVLAP General Operations Checklist (ISO Guide 25), publication delayed pending completion of delayed site visit.
February 1997	Completion of November 1996 review and modifications in response to the delayed 1996 NVLAP site visit.
December 1998	Completion of modifications in response to staffing changes.
December 1999	Update in response to changes of equipment and job numbering.
3rd Edition	January 2001 - published as a document with controlled pagination including changes for NELAC, AIHA-LAP and staffing changes.
May 2001	Completion of modifications in response to staffing changes.
June 2001	Completion of modifications in response to staffing and administrative changes and updates for recent NVLAP site visits

XVII. APPENDICES (CONTINUED)

A. AMENDMENT & REVIEW RECORD (Continued)

October 2001	Completion of modifications for new NELAC requirements
November 2001	Completion of modifications for new NVLAP requirements
4th Edition	May 2002 - completion of Microbiology additions
November 2002	Additional Microbiology changes for AIHA-LAP & Staffing Changes
November 2003	Additional Microbiology changes for AIHA-LAP & Staffing Changes
5th Edition	January 2004 - Separation of Scientific Laboratories into separate corporations as AmeriSci Group and AmeriSci affiliated laboratories;
March 2006	Modifications for ISO/IEC 17025:2005 requirements
March 2007	5th Edition, Revision 1 issued - Separation of asbestos and microbiology,
December 2008	Staffing Changes and ISO/IEC 17025:2005 items (NY- AIHA-LAP on site)
April 2009	5th Edition, Revision 2 issued
December 2009	Completion of annual review, issue draft changes for review
December 2010	Completion of annual review, modification for NVLAP, NY-ELAP and AIHA-LAP in process, issue draft changes for review
December 2011	Completion of annual review, issue draft changes for review
December 2012	Completion of annual review, modification for NVLAP and AIHA-LAP, issue draft changes for review.
August 2013	Modification for NY-ELAP and AIHA-LAP , issue draft changes for review
February 2014	Completion of annual review
March 2015	Completion of annual review & NYSDOH ELAP related changes
February 2016	Completion of annual review
February 2017	Completion of annual review and audit related changes

XVI. APPENDICES (CONTINUED)

A. AMENDMENT & REVIEW RECORD (Continued)

February 2018	Completion of annual review
May 2019	Completion of annual review, ISO 17025-2017 & AIHA-LAP changes
April 2020	Completion of NYSDOH ELAP & AIHA-LAP related changes
Dec 2020	Completion of annual review QA system including SOPs
Dec 2021	Completion of annual review QA system including SOPs
Aug 2022	Change of Managers and requirements plus updates
Dec 2022	Completion of Annual Review plus NVLAP and NYSDOH ELAP related changes of QA system and selected SOPs

XVI. APPENDICES (CONTINUED)

B. GLOSSARY OF TERMS

DATA QUALITY:

The totality of features and characteristics of data that bear on its ability to satisfy a given purpose. The characteristics of major importance are: accuracy, precision, completeness, representativeness and comparability. These characteristics are defined as follows:

Accuracy - The degree of agreement of a measurement (or an average of measurements of the same thing). X, with an accepted reference or true value; T, usually expressed as the difference between the two values; X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T, and sometimes expressed as a ratio, X/T. Accuracy is a measure of the bias in a system.

Precision - A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the "prescribed similar conditions."

Completeness - A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.

Representativeness - Expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Comparability - Expresses the confidence with which one data set can be compared to another.

Uncertainty of Measurement - Result of the evaluation aimed at characterizing the range within which the true value of a test result is estimated to lie, generally within a given likelihood.

DATA VALIDATION:

A systematic process for reviewing a body of data against a set of criteria to provide assurance that the data are adequate for their intended use. Data validation consists of data editing, screening, checking, auditing, verification, certification and review.

QUALITY ASSURANCE:

The total integrated program for assuring the reliability of monitoring and measurement of data. A system for integrating the quality planning, quality assessment and quality improvement efforts to meet user requirements.

XVI. APPENDICES (CONTINUED)

B. GLOSSARY OF TERMS (Continued)

QUALITY ASSURANCE PROGRAM PLAN:

An orderly assemblage of management policies, objectives, principles and general procedures by which an agency or laboratory outlines how it intends to produce data of known and accepted quality.

QUALITY ASSURANCE PROJECT PLAN:

An orderly assembly of detailed and specific procedures which delineates how data of known and accepted quality is produced for a specific project. (A given laboratory would have only one quality assurance program plan, but would have a quality assurance project plan for each of its projects).

QUALITY CONTROL:

The routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process.

STANDARD OPERATING PROCEDURE (SOP):

A written document which details an operation, analysis or action whose mechanisms are thoroughly presented and which is commonly accepted as the method for performing certain routine or repetitive tasks. A manual which is separate from the Quality Assurance Manual.

TRACEABILITY:

The process of documenting the value of a reference material or standard as related to NIST standards or equivalent through an unbroken chain of comparisons with stated uncertainties.

NONCONFORMANCE.

Noncompliance with any quality assurance policy, procedure, or specification.
Nonconforming work results from an analysis event in which the QC results are not within acceptance limits and/or method specifications are not met.

XVI. APPENDICES (CONTINUED)

B. GLOSSARY OF TERMS (Continued)

DEFINITION OF BLANKS AS FOLLOWS:

1) Filter lot blanks: sealed filter from filter manufacturer representing a particular manufacturing lot.

2) Field filter blanks: field blank samples are cassettes which have had the cap removed in the field during the sampling exercise.

3) Sealed filter blank: carried with sample series filters through whole process, but not opened during sampling operations which may be used to check for contamination of the sampling media.

4) Laboratory blank: obtained by leaving an unused filter exposed in the lab preparation area while a sample set of filters are prepared.

5) Bulk Blank: obtained by preparing and analyzing a bulk material know to be free of asbestos.

6) Water blank: obtained by filtering 500ml of fiber-free water used during water sample preparation.

7) Blank water filter: obtained by preparing an unused filter from the batch normally used during water sample preparation.

XVI. APPENDICES (CONTINUED)

C. ABBREVIATIONS

In addition to normal abbreviations for SI units of measurement, the following abbreviations are used in the text portion of this Quality Assurance Manual:

ACM	Asbestos Containing Materials
AHERA	Asbestos Hazard Emergency Response Act
AIHA	American Industrial Hygiene Association
ATEM	Analytical Transmission Electron Microscope
BA Degree	Bachelor of Arts Degree
BS Degree	Bachelor of Science Degree
cc	cubic centimeter
COC	Chain of Custody
CFR	Code of Federal Regulations
CHP	Chemical Hygiene Plan
CHO	Chemical Hygiene Officer
CV	Coefficient of variation, or relative standard deviation
D.P.	Diffusion Pump (electrically heated, oil vapor high vacuum pump)
DMF	Dimethylformamide
DOC	Demonstration of Capability (for an analyst)
ED	Electron Diffraction
EDS	Energy Dispersive Spectroscopy (X-Ray Microanalysis)
EPA	Environmental Protection Agency
EPA Level II	TEM asbestos air analysis following Yamate, et. al. (only Level II performed)
EDXA	Same as EDS (X-Ray Microanalysis)
ELAP	Environmental Laboratory Accreditation Program (state program - CA, NY)
EM	Electron Microscopy (normally TEM or ATEM for asbestos analysis)
FR	Federal Register
GO	Grid Opening (TEM sample mount) (typically 0.01 sq mm for locator grids used for quantitative air, dust and water analysis at AmeriSci affiliates)
HEPA	High Efficiency Particulate Air - filter for use with asbestos & microbiology
H.V.	High Voltage
HVAC	Heating, ventilating and air conditioning
IAQ	Indoor Air Quality
iDOC	Initial Demonstration of Capability (for a new analyst)
IHLAP	Industrial Hygiene Laboratory Accreditation Program
IRM	Internal Reference Material
ISO	International Organization for Standardization
LCL	Lower confidence limit (typically 95%, mean - 3 standard deviations)
LIMS	Laboratory Information Management System
LLD	Lower limit of detection
LOD	Limit of Detection
LN	liquified nitrogen used for cryogenic cooling of EDS detector

XVI. APPENDICES (CONTINUED)

C. ABBREVIATIONS (Continued)

MA Degree	Master of Arts Degree
MS Degree	Master of Science Degree
MCE	Mixed Cellulose Ester Filter
ml	milliliter
mm	millimeter
SDS	Safety Data Sheet (replaced Material Safety Data Sheet)
NACHO	National Association of Chemical Hygiene Officers
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NOB	Non-friable Organically Bound (type of bulk asbestos sample)
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Agency
PAPR	Powered Air Purifying Respirator
PAT	Proficiency Analytical Testing Program (AIHA-LAP for PCM)
PC	Polycarbonate Filter (possible low levels of asbestos contamination)
PC	Personal Computer
PCM	Phase Contrast Microscopy (NIOSH 7400 method)
pH	negative log of hydrogen ion concentration (acid - base measurement)
Ph.D.	Doctor of Philosophy Degree
PLM	Polarized Light Microscopy
PLM/DS	Polarized Light Microscopy / Dispersion Staining
QAM	Quality Assurance Manual
QA/QC	Quality Assurance / Quality Control
QMP	Quality Management Program
R.I.	Refractive Index (reference fluid used for PLM analysis)
R.P.	Roughing Pump (mechanical vacuum pump, typically rotary)
SAED	Selected Area Electron Diffraction
SD	Standard deviation
SEM	Scanning Electron Microscopy
SOP	Standard Operating Procedure (for laboratory use)
SRM	Standard Reference Material (provided by NIST)
STEM	Scanning Transmission Electron Microscope
TAT	Turn Around Time (time from sample receipt to reporting)
TEM	Transmission Electron Microscope
TNI	The NELAC Institute
TWA	Time weighted average (composite exposure for a work shift/period)
UCL	Upper confidence limit (typically 95%, mean + 3 standard deviations)

XVI. APPENDICES (CONTINUED)

D. AMERISCI ASBESTOS ANALYSIS METHODS

Airborne asbestos and other fibers by PCM and TEM

NIOSH 7400, Issue 3, 6/14/19 (PCM)

NIOSH 7402 Method, Revision 8/15/94 (TEM)

40 CFR Ch I (2011 ed) Pt 763, Subpt. E, App. A, pages 865-901 (TEM)

Yamate, et.al. EPA Level II, Contract 68-02-3266, July 1984 (TEM)

ISO 10312:1995(E) (Ambient Air - Direct TEM)

Bulk Materials by PLM and TEM

EPA 600-M4-82-020, December 1982 (PLM)

40 CFR Ch I (2011 ed) Pt 763, Subpt. E, App. E, pages 918-932 (Interim Method - PLM)

EPA 600-R-93-116, July 1993 (PLM & TEM)

NYS DOH ELAP 198.1 (Friable PLM)

NYS DOH ELAP 198.6 (Non-Friable PLM)

NYS DOH ELAP 198.4 (Non-Friable TEM)

NYS DOH ELAP 198.8 (Vermiculite)

CARB 435 – California EPA Air Resources Board, June 6, 1991 (PLM)

ASTM D5755 Microvacuum Sampling - Dust Structure Number - TEM

ASTM D6480 Wipe Sampling – Asbestos Structure Number - TEM

Drinking Water by TEM

EPA 600-R-93-134 reassigned as method EPA 100.2

XVI. APPENDICES (CONTINUED)

E. HEALTH & SAFETY MANUAL and CHEMICAL HYGIENE PLAN

This section is reserved for the CHP, which contains a section specific to each affiliate laboratory location and includes a number of forms commonly used in the laboratory for safety and training purposes.