SDMS Document ID
2022580

DRAFT

CSF Negative Exposure Assessment Report

Libby, Montana Asbestos Project

Sample Processing

July 8, 2003

Contract No. DTRS57-99-D-00017
Task Order No. 20

Prepared for:

U.S. Department of Transportation
Research and Special Programs Administration
John A. Volpe National Transportation Systems Center
Environmental Engineering Division, DTS-33
55 Broadway, Kendall Square
Cambridge, Massachusetts 02142

Prepared by:

CDM Federal Programs Corporation
One Cambridge Place
50 Hampshire Street
Cambridge, Massachusetts 02139

DRAFT

CSF Negative Exposure Assessment Report

Libby, Montana Asbestos Project

Sample Processing

July 8, 2003

Contract No. DTRS57-99-D-00017
Task Order No. 20

Prepared by: _____ Date: July 8, 2003
Jeff Montefa
CSF Task Manager

Reviewed by: _____ Date: July 8, 2003
Doug Updike
For Site Health and Safety Officer

Reviewed by: _____ Date: 7/8/03
for George DeLullo
QA Manager

DOT Volpe Center
CDM

Contents

Section 1 Introduction

1.1 Soil Sample Processing 1-1
1.2 CDM Close Support Facility Location and Description 1-1
1.3 Close Support Facility Activities 1-1

Section 2 Negative Exposure Assessment

2.1 Air Samples 2-1
2.1.1 Ambient Air Samples 2-1
2.1.2 Personal Air Samples 2-1
2.1.3 Air Sample Analysis 2-1
2.2 Dust Samples 2-1
2.2.1 Microvacuum Dust Samples 2-1
2.2.2 Dust Sample Analysis 2-2

Section 3 Results

Section 4 Findings and Corrective Actions

4.1 Findings 4-1
4.1.1 PCM 4-1
4.1.2 TEM 4-1
4.2 Corrective Actions 4-2
4.2.1 June 18th Aggressive Air Sampling 4-2
4.2.2 June 20th Aggressive Air Sampling 4-5

Section 5 Conclusions

Section 6 References

Appendices

Appendix A Sample result bench sheets
Appendix B U.S. EPA Standard Operating Procedure 2015. Asbestos Sampling.

Figures

1-1 CSF Floor Plan.....1-2
2-1 Negative Exposure Assessment Sampling Locations.....2-3
4-1 Aggressive Air Sampling Locations.....4-6

Tables

3-1 Negative Exposure Assessment Sample Collection Key 3-1
3-2 Summary of the Negative Exposure Assessment PCM Results 3-2
3-3 Summary of the Negative Exposure Assessment TEM Results (Air) 3-3
3-4 Summary of the Negative Exposure Assessment TEM Results (Dust) 3-5
4-1 June 18th Aggressive Air Sampling Sample Collection Key 4-3
4-2 Summary of the June 18th Aggressive Air Sampling TEM Results 4-4
4-3 June 20th Aggressive Air Sampling Sample Collection Key 4-5
4-4 Summary of the June 20th Aggressive Air Sampling TEM Results 4-5

Acronyms

ASTM	American Society for Testing and Materials
CDM	CDM Federal Programs Corporation
cm^2	centimeter squared
CSF	close support facility
EPA	U.S. Environmental Protection Agency
EXC	excursion
f/cc	fibers per cubic centimeter
f/mm^2	fibers per square millimeter
H&S	health and safety
HEPA	high efficiency particulate air
LA	Libby amphibole
L/min	liters per minute
OSHA	Occupational Safety and Health Administration
PCM	phase contrast microscopy
s/cc	structures per cubic centimeter
s/cm^2	structures per square centimeter
SOP	standard operating procedure
TEM	transmission electron microscopy
TWA	time weighted average
Volpe	U.S. Department of Transportation Volpe Center
≥	greater than or equal to
≤	less than or equal to
µm	micron

Section 1
Introduction

A task-based negative exposure assessment was conducted May 27 through May 29, 2003 to determine potential exposures at the CDM Federal Programs Corporation (CDM) close support facility (CSF). The purpose of this report is to present the results of that assessment and the corrective actions taken.

1.1 Soil Sample Processing

CDM has been tasked by the U.S. Department of Transportation Volpe Center (Volpe) to prepare soil samples collected at the Libby site prior to their analysis. The preparation includes drying, sieving, splitting, and grinding. These procedures were developed to produce a sample with well-homogenized material of a standard particle size.

1.2 CDM Close Support Facility Location and Description

CDM prepares soil samples collected in Libby at its CSF located in Denver, Colorado. The CSF consists of approximately 3,000 square feet of space, which includes an office, drying room, wet chemistry room, storage/receiving room, equipment storage room, and the main laboratory. Both the ventilation hood and drying oven are vented to a high efficiency particulate air (HEPA) filter unit designed to remove 99% of particles 0.3 microns (µm) or greater. Figure 1-1 provides floor plan of the CSF.

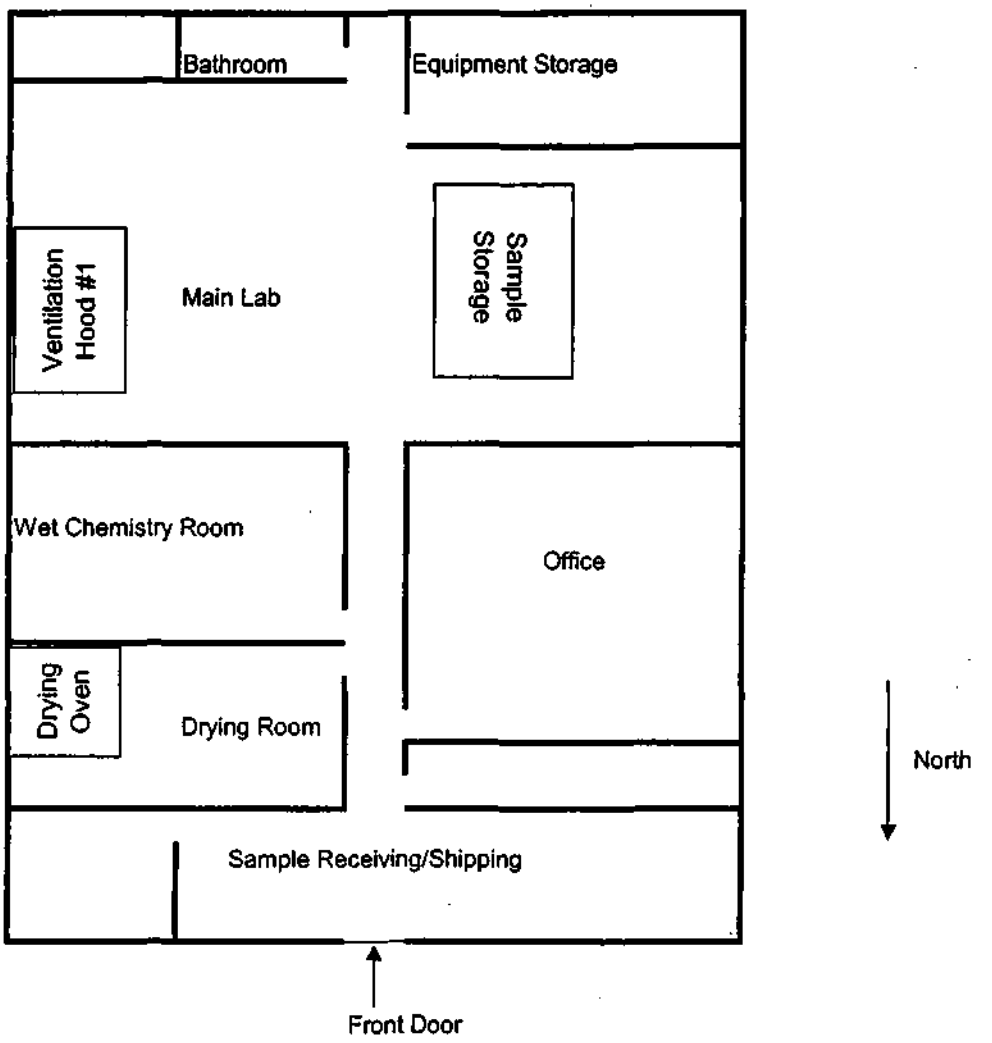
1.3 Close Support Facility Activities

The following is a list of activities that are performed by CDM personnel at the CSF:

- Sample receipt and check-in
- Sample storage
- Sample drying
- Archive sample splitting
- Sample sieving
- Fine sample grinding
- Fine sample splitting and archiving
- Sample packaging and shipping
- CSF measurements
- Documentation
- Equipment decontamination

All sample preparation procedures are described in the Close Support Facility Soil Preparation Plan (CDM 2003).

Figure 1-1 CSF Floor Plan



Section 2
Negative Exposure Assessment

In accordance with the soil preparation plan (CDM 2003), a task-based negative exposure assessment was conducted to assess potential exposures at the CSF. The assessment, conducted May 27 through May 29, 2003, consisted of ambient air samples, personal air samples, and microvacuum dust samples. During the negative exposure assessment, CSF personnel were in modified level-C personal protective equipment. CDM's CSF personnel performed the sampling. Analysis was performed by Reservoirs Environmental Services, Inc.

2.1 Air Samples

2.1.1 Ambient Air Samples

Four ambient air samples were collected on May 27, 2003. Sampling locations included the main lab, office, drying room, and sample receiving room (Figure 2-1). Samples were collected using high-volume pumps at flow rates ranging between 8.35 and 8.58 liters per minute (L/min). All samples were collected in accordance with U.S. Environmental Protection Agency (EPA) standard operating procedure (SOP) 2015 *Asbestos Sampling* (EPA 1994) (Appendix B).

2.1.2 Personal Air Samples

Personal air samples were collected by task. The two tasks sampled were sample receiving/laboratory coordinator and sample preparation. Each task was sampled for 3 consecutive days. During each day, a time-weighted average (TWA) and a 30-minute excursion sample were collected for each task. TWA samples were collected using personal air sampling pumps at flow rates ranging between 1.6 and 1.8 L/min. Thirty minute excursion samples were collected using personal air sampling pumps at flow rates ranging between 1.6 and 1.8 L/min.

2.1.3 Air Sample Analysis

All air samples collected were analyzed by two methods:

1. NIOSH 7400 - Asbestos and Other Fibers by phase contrast microscopy (PCM) (NIOSH 1994)

2. Appendix A to Subpart E of Part 763 - Interim Transmission Electron Microscopy Analytical Methods--Mandatory and Nonmandatory--and Mandatory Section to Determine Completion of Response Actions (also known as the AHERA method)

2.2 Dust Samples

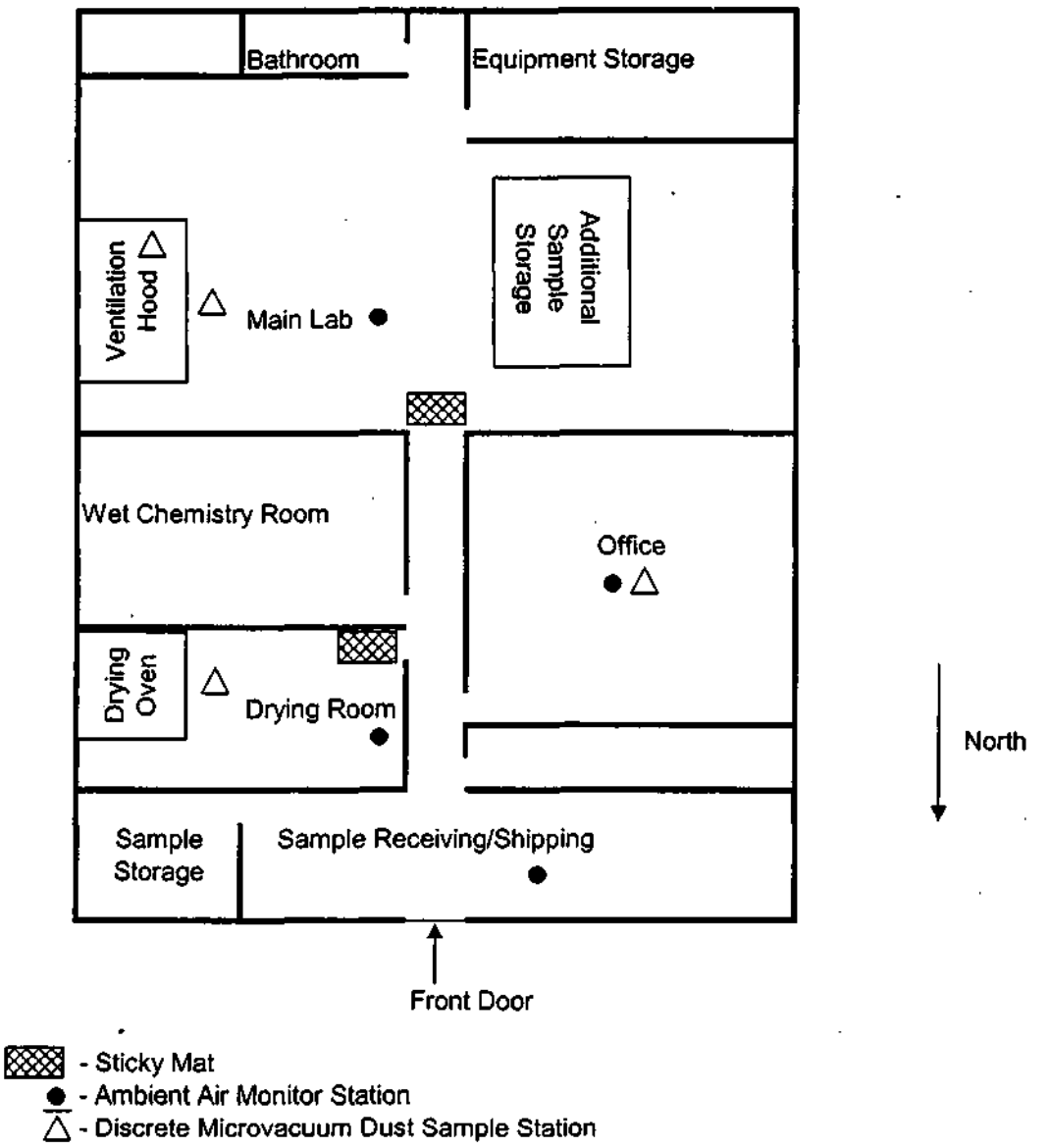
2.2.1 Microvacuum Dust Samples

Four microvacuum dust samples were collected on May 28, 2003. Samples were collected from inside the ventilation hood, the floor beneath the ventilation hood in the main laboratory, the floor beneath the drying oven in the drying room, and the floor in the center of the office (Figure 2-1). Samples were collected using personal air sampling pumps at a volume of 2.15 L/min. Three independent 100 centimeter squared (cm^2) grids were sampled for 2 minutes each for a total of 300 cm^2 and 6 minutes per sampling location. All samples were collected in accordance with American Society for Testing and Materials (ASTM) Standard D 5755-95 "Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations."

2.2.2 Dust Sample Analysis

All dust samples were analyzed using transmission electron microscopy (TEM) (ASTM 1995).

Figure 2-1 Negative Exposure Assessment Sampling Locations



Section 3
Results

A sample collection key is presented in Table 3-1. A summary of all PCM sample results is presented in Table 3-2, and a summary of the TEM sample results is presented in Table 3-3. Detailed bench sheets are included as Appendix A.

Table 3-1. Negative Exposure Assessment Sample Collection Key

	Index Id	Sample Type	Sampling Date	Personnel/Area	Duration (min)	Volume (L)	Area (cm^2)
Personal Air Samples	CS-11339	8-hour TWA	5/27/03	Sample prep.	420	578.7	n/a
	CS-11340	30-min EXC	5/27/03	Sample prep.	30	48.9	n/a
	CS-11341	8-hour TWA	5/27/03	Sample coord.	375	607.5	n/a
	CS-11342	30-min EXC	5/27/03	Sample coord.	32	50.7	n/a
	CS-11343	8-hour TWA	5/28/03	Sample prep.	497	780.3	n/a
	CS-11344	30-min EXC	5/28/03	Sample prep.	30	53.4	n/a
	CS-11345	8-hour TWA	5/28/03	Sample coord.	472	731.9	n/a
	CS-11346	30-min EXC	5/28/03	Sample coord.	30	50.2	n/a
	CS-11347	8-hour TWA	5/29/03	Sample prep.	533	853.8	n/a
	CS-11348	30-min EXC	5/29/03	Sample prep.	32	49.6	n/a
	CS-11349	8-hour TWA	5/29/03	Sample coord.	488	807.8	n/a
	CS-11350	30-min EXC	5/29/03	Sample coord.	30	53.4	n/a
Ambient Air Samples	CS-11351	Ambient air	5/29/03	Main lab	520	4175	n/a
	CS-11352	Ambient air	5/29/03	Office	509	4275.6	n/a
	CS-11358	Ambient air	5/29/03	Soil drying	503	4187.5	n/a
	CS-11359	Ambient air	5/29/03	Receiving	491	4023	n/a
Dust Samples	CS-11360	Microvacuum	5/29/03	Inside hood	6*	n/a	300
	CS-11361	Microvacuum	5/29/03	Floor beneath hood	6*	n/a	300
	CS-11362	Microvacuum	5/29/03	Soil drying	6*	n/a	300
	CS-11363	Microvacuum	5/29/03	Office	6*	n/a	300

* Microvacuum samples were collected in three independent 100 cm^2 (2 min. each) areas for a total of 300 cm^2 (6 min. total).

cm^2 – square centimeter, EXC – excursion, L – liter, min = minute, n/a – not applicable, TWA – time weighted average

Table 3-2 Summary of the Negative Exposure Assessment PCM Results

	ID Number	Sample Type	Date	Personnel/Area	Fiber Concentration (f/cc)	TWA	30 Minute Excursion
Personal Air Samples	CS-11339	8-hour TWA	5/27/03	Sample prep.	0.011	0.018	n/a
	CS-11340	30-min EXC	5/27/03	Sample prep.	<0.055	n/a	<0.0055
	CS-11341	8-hour TWA	5/27/03	Sample coord.	0.011	0.009	n/a
	CS-11342	30-min EXC	5/27/03	Sample coord.	<0.053	n/a	<0.053
	CS-11343	8-hour TWA	5/28/03	Sample prep.	0.007	0.007	n/a
	CS-11344	30-min EXC	5/28/03	Sample prep.	<0.050	n/a	<0.050
	CS-11345	8-hour TWA	5/28/03	Sample coord.	0.009	0.009	n/a
	CS-11346	30-min EXC	5/28/03	Sample coord.	<0.054	n/a	<0.054
	CS-11347	8-hour TWA	5/29/03	Sample prep.	0.005	0.006	n/a
	CS-11348	30-min EXC	5/29/03	Sample prep.	<0.054	n/a	<0.054
	CS-11349	8-hour TWA	5/29/03	Sample coord.	0.005	0.005	n/a
	CS-11350	30-min EXC	5/29/03	Sample coord.	<0.050	n/a	<0.050
Ambient Air Samples	CS-11351	Ambient air	5/29/03	Main lab	0.001	n/a	n/a
	CS-11352	Ambient air	5/29/03	Office	0.001	n/a	n/a
	CS-11358	Ambient air	5/29/03	Soil drying	<0.001	n/a	n/a
	CS-11359	Ambient air	5/29/03	Receiving	0.001	n/a	n/a

TWA = time weighted average EXC = excursion f/cc = fibers per cubic centimeter n/a = not applicable

Table 3-3 Summary of the Negative Exposure Assessment TEM Results (Air)

	ID Number	Sample Type	Date	Personnel/Area	Asbestos Concentration (s/cc)	Asbestos Mineral
Personal Air Samples	CS-11339	8-hour TWA	5/27/03	Sample prep.	<0.006	-
	CS-11340	30-min EXC	5/27/03	Sample prep.	<0.0716	-
	CS-11341	8-hour TWA	5/27/03	Sample coord.	0.013	LA
	CS-11342	30-min EXC	5/27/03	Sample coord.	<0.0690	-
	CS-11343	8-hour TWA	5/28/03	Sample prep.	0.013	LA
	CS-11344	30-min EXC	5/28/03	Sample prep.	<0.0655	-
	CS-11345	8-hour TWA	5/28/03	Sample coord.	<0.0048	-
	CS-11346	30-min EXC	5/28/03	Sample coord.	<0.0697	-
	CS-11347	8-hour TWA	5/29/03	Sample prep.	<0.0046	-
	CS-11348	30-min EXC	5/29/03	Sample prep.	<0.0706	-
	CS-11349	8-hour TWA	5/29/03	Sample coord.	<0.0043	-
	CS-11350	30-min EXC	5/29/03	Sample coord.	<0.0655	-
Ambient Air Samples	CS-11351	Ambient air	5/29/03	Main lab	<0.0021	-
	CS-11352	Ambient air	5/29/03	Office	<0.0020	-
	CS-11358	Ambient air	5/29/03	Soil drying	<0.0008	-
	CS-11359	Ambient air	5/29/03	Receiving	0.0000	C

ND = None Detected
Filter Material = Mixed Cellulose Ester
Average Grid Opening = 0.0110 mm^2
Filter Diameter = 25 mm
s/cc – structures per cubic centimeter
Effective Filter Area = 385 mm^2
C = Chrysotile
LA = Libby Amphibole

Table 3-4 Summary of the Negative Exposure Assessment TEM Results (Dust)

ID Number	Sample Type	Date	Personnel/Area	Sample Area (cm^2)	Asbestos Concentration (s/cm^2)
CS-11360	Microvacuum	5/29/03	Inside hood	300	3700
CS-11361	Microvacuum	5/29/03	Floor beneath hood	300	3000
CS-11362	Microvacuum	5/29/03	Soil drying	300	2900
CS-11363	Microvacuum	5/29/03	Office	300	7900

s/cm^2 – structures per square centimeter

s/mm^2 – structures per square millimeter

Section 4
Findings and Corrective Actions

4.1 Findings

Results from the PCM analysis were received on June 2, 2003. TEM results were received June 12, 2003.

4.1.1 PCM

Ambient air samples and personal air samples were analyzed by PCM. The evaluation criteria, corrective action, and results for each are presented below.

Ambient

Evaluation criteria: The action level for PCM is less than or equal to (≤) 0.01 fibers per cubic centimeter (f/cc).

Corrective action: If this criterion is not met, the laboratory will be wet-wiped and HEPA vacuumed and ambient air samples recollected.

Results: No ambient air PCM results were above the evaluation criteria. Therefore, no corrective action was taken based on these results.

Personal Sample Results

Evaluation criteria: The action level for time weighted average PCM results is ≤ 50 percent of the Occupational Safety and Health Administration (OSHA) permissible exposure limit (0.1 f/cc). The action level for excursion PCM results is ≤ 50 percent of the OSHA permissible exposure limit (1.0 f/cc).

Corrective action: If either of these criteria is not met, the laboratory will be wet-wiped and HEPA vacuumed and ambient air samples recollected.

Results: No personal air PCM results were above the evaluation criteria. Therefore, no corrective action was taken based on these results.

4.1.2 TEM

All three types of samples (i.e., ambient air, personal air, and microvacuum dust) were analyzed by TEM. The evaluation criteria, corrective action, and results for each are presented below.

Ambient

Evaluation criteria: The action level for TEM analysis is less than or equal to one Libby amphibole (LA) structure.

Corrective action: If this criterion is not met, the laboratory will be wet-wiped and HEPA vacuumed and ambient air samples recollected.

Results: No ambient air TEM results were above the evaluation criteria. Therefore, no corrective action was taken based on these results

Personal Sample Results

Evaluation criteria: The action level for TEM analysis is 0.10 LA structures per cubic centimeter (s/cc) for structures between 0.5 microns and 5 microns and 0.01 s/cc for structures > 5 microns.

Corrective action: If either of these criteria is not met, the laboratory will be wet-wiped and HEPA vacuumed and ambient air samples recollected.

Results: No personal air TEM results exceeded the action level for structures between 0.5 microns and 5 microns. Two personal air samples (CS-11341 [sample coord.] and CS-11343 [sample prep.]) had results above the action level for structures > 5 microns. The LA concentration for CS-11341 and CS-11343 were 0.013 s/cc and 0.013 s/cc, respectively.

Microvacuum Results

Evaluation criteria: The action level for TEM analysis is ≤ 5,000 structures per square centimeter (S/cm^2).

Corrective action: If dust sample results indicate concentrations greater than 5,000 S/cm^2, the area represented by the sample will be wet-wiped, HEPA vacuumed, and re-sampled.

Results: The four microvacuum dust samples contained LA. However, only one sample (CS-11363 [office]) had a concentration greater than the action level (Figure 2-1). The concentration for CS-11363 was 7,900 S/cm^2.

4.2 Corrective Actions

A meeting was held on June 12, 2003 following the receipt of the TEM results, with CSF staff, health and safety (H&S) staff, field staff, and management to discuss the results of the negative exposure assessment and review the necessary corrective actions. Based on the analytical sample results and corrective action plans the laboratory needed to be wet-wiped, HEPA vacuumed, and samples recollected. However, CDM determined at this stage more rigorous cleaning was warranted. Therefore, it was decided that thorough cleaning of the entire laboratory followed by aggressive air sampling would be performed.

4.2.1 June 18th Aggressive Air Sampling

Soil sample processing operations were placed on hold June 13. The CSF was subsequently cleaned June 16 through June 17. Aggressive air sampling was then conducted June 18 in accordance with EPA standard operating procedure (SOP) #2015 (EPA 1994). Based on the volume of the CSF, five box fans were used to move air for the sampling event (Figure 4-1). Five ambient air samples were collected using

high-volume pumps at flow rates ranging between 8.42 and 8.58 L/min and analyzed for by TEM. The action level was considered zero LA fibers for all samples.

Table 4-1. June 18th Aggressive Air Sampling Sample Collection Key

Index Id	Sample Type	Personnel/Area	Duration (min)	Volume (L)
CS-11421	Ambient air	Receiving	180	1537.2
CS-11422	Ambient air	Main lab	180	1519.2
CS-11423	Ambient air	Receiving	180	1533.6
CS-11424	Ambient air	Soil drying	180	1537.2
CS-11425	Ambient air	Main lab	180	1537.2
CS-11426	Ambient air	Blank	180	n/a
CS-11427	Ambient air	Blank	180	n/a

L – liter min = minute n/a – not applicable

The results of the June 18th clearance sampling are presented in Table 4-2.

Table 4-2 Summary of June 18th Aggressive Air Sampling TEM Results

ID Number	Sample Type	Date	Personnel/Area	Asbestos Concentration (s/cc)	Asbestos Mineral
CS-11421	Ambient air	6/18/03	Receiving	0.0388	Chrysotile
CS-11422	Ambient air	6/18/03	Main lab	<0.0023	ND
CS-11423	Ambient air	6/18/03	Receiving	0.0023	Chrysotile
CS-11424	Ambient air	6/18/03	Soil drying	0.0023	Chrysotile
CS-11425	Ambient air	6/18/03	Main lab	0.0045	Chrysotile/LA
CS-11426	Ambient air	6/18/03	Blank	-	ND
CS-11427	Ambient air	6/18/03	Blank	-	n/a

ND = none detected
Filter Material = Mixed Cellulose Ester
LA = Libby amphibole

BAS = below analytical sensitivity
Filter Diameter = 25 mm
s/cc – structures per cubic centimeter

Average Grid Opening = 0.0110 mm^2
Effective Filter Area = 385 mm^2
NA = not applicable

4.2.2 June 20th Aggressive Air Sampling

The June 18th aggressive air-sampling event found one LA structure on sample number CS-11425 (Main lab) (Figure 4-1). As a result, the CSF was re-cleaned and re-sampled in accordance with EPA SOP #2015 (EPA 1994). Once again, five ambient air monitors along with five box fans were used for the sampling event (Figure 4-1). Samples were collected using high-volume pumps at flow rates ranging between 8.42 and 8.58 L/min and analyzed by TEM.

Table 4-3. June 20th Aggressive Air Sampling Sample Collection Key

Index Id	Sample Type	Personnel/Area	Duration (min)	Volume (L)
CS-11428	Ambient air	Receiving	180	1533.6
CS-11429	Ambient air	Receiving	180	1539
CS-11430	Ambient air	Soil drying	180	1533.6
CS-11405	Ambient air	Main lab	180	1544.4
CS-11406	Ambient air	Main lab	180	1539
CS-11408	Ambient air	Blank	180	n/a
CS-11409	Ambient air	Blank	180	n/a

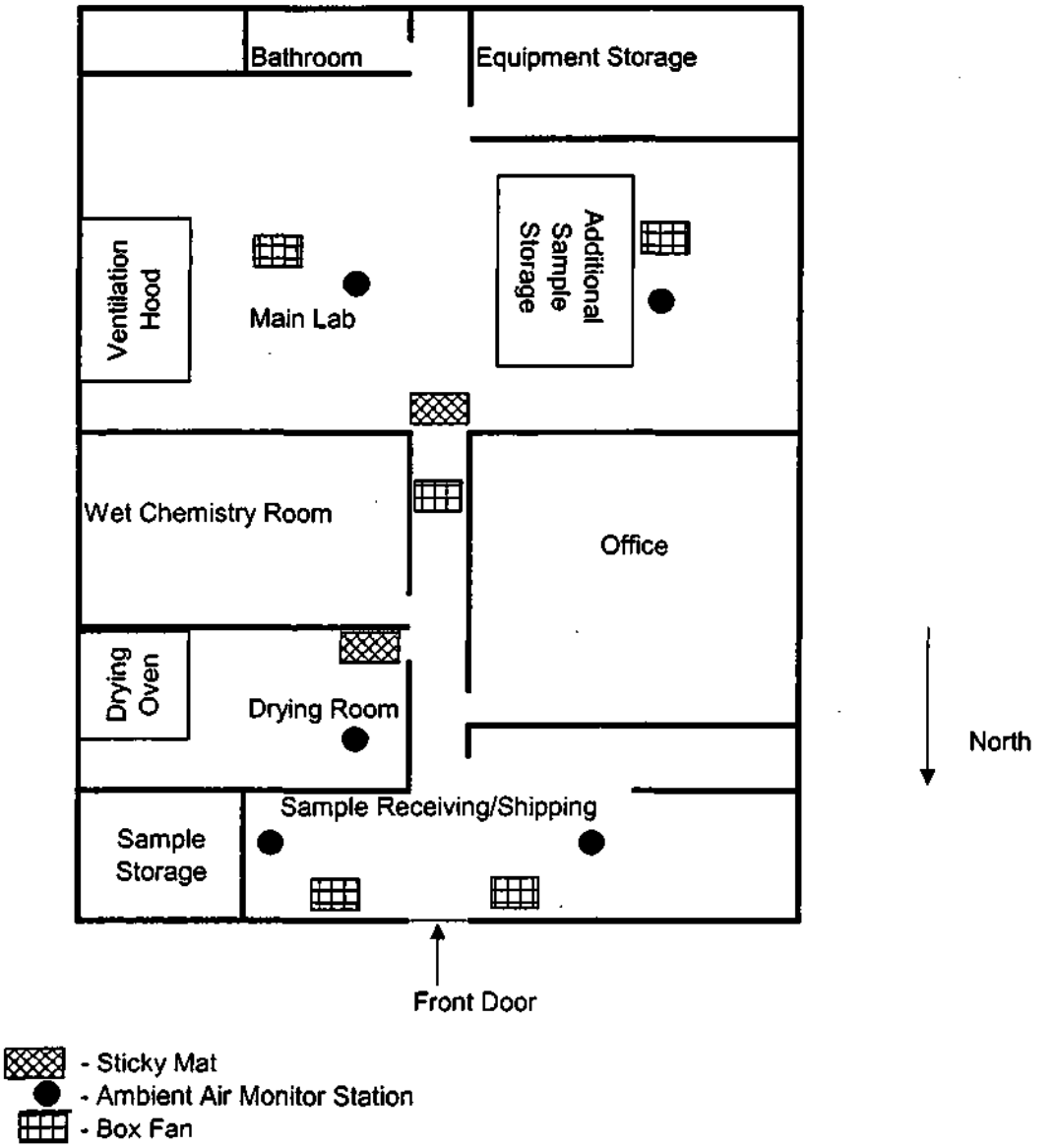
L = liters min = minutes

The results of the June 20th clearance sampling are presented in Table 4-4.

Table 4-4 Summary of June 20th Aggressive Air Sampling TEM Results

Index Id	Sample Type	Date	Personnel/Area	Analytical Sensitivity (s/cc)	Asbestos Concentration (s/cc)
CS-11428	Ambient air	6/20/03	Receiving	0.0046	<0.0046
CS-11429	Ambient air	6/20/03	Receiving	0.0045	<0.0045
CS-11430	Ambient air	6/20/03	Soil drying	0.0046	<0.0046
CS-11405	Ambient air	6/20/03	Main lab	0.0045	<0.0045
CS-11406	Ambient air	6/20/03	Main lab	0.0045	<0.0045
CS-11408	Ambient air	6/20/03	Blank	-	-
CS-11409	Ambient air	6/20/03	Blank	-	-

Figure 4-1 Aggressive Air Sampling Locations



Section 5
Conclusions

Findings from the negative exposure assessment indicated that there was the presence of a few LA structures in the CSF. Once those results were known, soil sample processing operations ceased. Aggressive air sampling was conducted on two occasions, June 18, 2003 and June 20, 2003. One LA fiber was detected during the first round of sampling and zero LA fibers were detected during the second round of sampling. At the time of this document, discussions are being held between EPA, Volpe, and CDM to determine if and what procedural changes need to be made to help ensure that future LA presence is prevented at the CSF.

Section 6
References

AHERA 2002. Asbestos Hazard Emergency Response Act 40 CFR (Protection of Environment) Chapter I (Environmental Protection Agency) Subchapter R (Toxic Substances Control Act) Part 763 (Asbestos) Subpart E (Asbestos Containing Materials in Schools) Appendix A (Interim Transmission Electron Microscopy Analytical Methods - Mandatory and Nonmandatory - and Mandatory Section to Determine Completion of Response Actions). Source is the Federal Register 2 FR 41846, October, 1987 Data current as of the Federal Register Dated May 20, 2002.

ASTM 1995. Standard Test Method for Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations. ASTM D-5755-95

CDM. 2003. Libby Asbestos Site, Operable Unit 4. Libby, Montana. Close Support Facility Soil Preparation Plan. April.

EPA. 1994. Asbestos Sampling. Standard Operating Procedure #2015, Revision #0.0.

NIOSH 1994. NIOSH 7400 - Asbestos and Other Fibers by Phase Contrast Microscopy (PCM). NIOSH Manual of Analytical Methods, Fourth Edition, Revision #3. Issue 2. August 15.

Interim Transmission Electron Microscopy Analytical Methods--Mandatory and Nonmandatory--and Mandatory Section to Determine Completion of Response Actions

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2022580

SITE NAME: LIBBY ASBESTOS

DOCUMENT DATE: 07/08/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX A SAMPLE BENCH SHEETS
Negative Exposure Assessment Air Results
Negative Exposure Assessment Dust Results
June 18th Aggressive Air Sampling Air Results
June 20th Aggressive Air Sampling Air Results

Contact the Superfund Records Center to view available document.
(303) 312-6473

Appendix B
U.S. EPA Standard Operating Procedure
2015. Asbestos Sampling

ASBESTOS SAMPLING

SOP#: 2015
DATE: 11/17/94
REV. #: 0.0

1.0 SCOPE AND APPLICATION

Asbestos has been used in many commercial products including building materials such as flooring tiles and sheet goods, paints and coatings, insulation, and roofing asphalts. These products and others may be found at hazardous waste sites hanging on overhead pipes, contained in drums, abandoned in piles, or as part of a structure. Asbestos tailing piles from mining operations can also be a source of ambient asbestos fibers. Asbestos is a known carcinogen and requires air sampling to assess airborne exposure to human health. This Standard Operating Procedure (SOP) provides procedures for asbestos air sampling by drawing a known volume of air through a mixed cellulose ester (MCE) filter. The filter is then sent to a laboratory for analysis. The U.S. Environmental Protection Agency/Environmental Response Team (U.S. EPA/ERT) uses one of four analytical methods for determining asbestos in air. These include: U.S. EPA's *Environmental Asbestos Assessment Manual*, Superfund Method for the Determination of Asbestos in Ambient Air for Transmission Electron Microscopy (TEM)[1]; *U.S. EPA's Modified Yamate Method for TEM*[2]; National Institute for Occupational Safety and Health (NIOSH) Method 7402 (direct method only) for TEM; and NIOSH Method 7400 for Phase Contrast Microscopy (PCM)[3]. Each method has specific sampling and analytical requirements (i.e., sample volume and flow rate) for determining asbestos in air.

The U.S. EPA/ERT typically follows procedures outlined in the TEM methods for determining mineralogical types of asbestos in air and for distinguishing asbestos from non-asbestos minerals. The Phase Contrast Microscopy (PCM) method is used by U.S. EPA/ERT as a screening tool since it is less costly than TEM. PCM cannot distinguish asbestos from non-asbestos fibers, therefore the TEM method may be necessary to confirm analytical results. For example, if an action level for the presence of fibers has been set and PCM analysis indicates that the action level has been exceeded, then TEM analysis can be used to quantify and identify asbestos structures through examination of their morphology crystal structures (through electron diffraction), and elemental composition (through energy dispersive X-ray analysis). In this instance samples should be collected for both analyses in side by side sampling trains (some laboratories are able to perform PCM and TEM analysis from the same filter). The Superfund method is designed specifically to provide results suitable for supporting risk assessments at Superfund sites, it is applicable to a wide range of ambient air situations at hazardous waste sites. U.S. EPA's Modified Yamate Method for TEM is also used for ambient air sampling due to high volume requirements. The PCM and TEM NIOSH analytical methods require lower sample volumes and are typically used indoors; however, ERT will increase the volume requirement for outdoor application.

Other Regulations pertaining to asbestos have been promulgated by U.S. EPA and OSHA. U.S. EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) regulates asbestos-containing waste materials. NESHAP establishes management practices and standards for the handling of asbestos and emissions from waste disposal operations (40 CFR Part 61, Subparts A and M). U.S. EPA's 40 CFR 763 (July 1, 1987)[4] and its addendum 40 CFR 763 (October 30, 1987)[4] provide comprehensive rules for the asbestos abatement industry. State and local regulations on these issues vary and may be more stringent than federal requirements. The OSHA regulations in 29 CFR 1910.1001 and 29 CFR 1926.58 specify work practices and safety equipment such as respiratory protection and protective clothing when handling asbestos. The OSHA standard for an 8-hour, time-weighted average (TWA) is 0.2 fibers/cubic centimeters of air. This standard pertains to fibers with a length-to-width ratio of 3 to 1 with a fiber length >5 μm[5,6]. An action level of 0.1 fiber/cc (one-half the OSHA standard) is the level U.S. EPA has established in which employers must initiate such activities as air monitoring, employee training, and

medical surveillance [5,6].

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Prior to sampling, the site should be characterized by identifying on-site as well as off-site sources of airborne asbestos. The array of sampling locations and the schedule for sample collection, is critical to the success of an investigation. Generally, sampling strategies to characterize a single point source are fairly straightforward, while multiple point sources and area sources increase the complexity of the sampling strategy. It is not within the scope of this SOP to provide a generic asbestos air sampling plan. Experience, objectives, and site characteristics will dictate the sampling strategy.

During a site investigation, sampling stations should be arranged to distinguish spatial trends in airborne asbestos concentrations. Sampling schedules should be fashioned to establish temporal trends. The sampling strategy typically requires that the concentration of asbestos at the source (worst case) or area of concern (downwind), crosswind, as well as background (upwind) contributions be quantified. See Table 1 (Appendix A) for U.S. EPA/ERT recommended sampling set up for ambient air. Indoor asbestos sampling requires a different type of strategy which is identified in Table 2 (Appendix A). It is important to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data. Field blanks and lot blanks can be utilized to determine other sources.

Much information can be derived from each analytical method previously mentioned. Each analytical method has specific sampling requirements and produce results which may or may not be applicable to a specific sampling effort. The site sampling objectives should be carefully identified so as to select the most appropriate analytical method. Additionally, some preparation (i.e., lot blanks results) prior to site sampling may be required, these requirements are specified in the analytical methods.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Sample Preservation

No preservation is required for asbestos samples.

3.2 Sample Handling, Container and Storage Procedures

1. Place a sample label on the cassette indicating a unique sampling number. Do not put sampling cassettes in shirt or coat pockets as the filter can pick up fibers. The original cassette box is used to hold the samples.

2. Wrap the cassette individually in a plastic sample bag. Each bag should be marked indicating sample identification number, total volume, and date.

3. The wrapped sampling cassettes should be placed upright in a rigid container so that the cassette cap is on top and cassette base is on bottom. Use enough packing material to prevent jostling or damage. Do not use vermiculite as packing material for samples. If possible, hand carry to lab.

4. Provide appropriate documentation with samples (i.e., chain of custody and requested analytical methodology).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Flow rates exceeding 16 liters/minute (L/min) which could result in filter destruction due to (a) failure of its physical support under force from the increased pressure drop; (b) leakage of air around the filter mount so that the filter is bypassed, or (c) damage to the asbestos structures due to increased impact velocities.

4.1 U.S. EPA's Superfund Method

4.1.1 Direct-transfer TEM Specimen Preparation Methods

Direct-Transfer TEM specimen preparation methods have the following significant interferences:

- The achievable detection limit is restricted by the particulate density on the filter, which in turn is controlled by the sampled air volume and the total suspended particulate concentration in the atmosphere being sampled.

- The precision of the result is dependent on the uniformity of the deposit of asbestos structures on the sample collection filter.

- Air samples must be collected so that they have particulate and fiber loadings within narrow ranges. If too high a particulate loading occurs on the filter, it is not possible to prepare satisfactory TEM specimens by a direct-transfer method. If too high a fiber loading occurs on the filter, even if satisfactory TEM specimens can be prepared, accurate fiber counting will not be possible.

4.1.2 Indirect TEM Specimen Preparation Methods

Indirect TEM specimen preparation methods have the following interferences:

- The size distribution of asbestos structures is modified.

- There is increased opportunity for fiber loss or introduction of extraneous contamination.

- When sample collection filters are ashed, any fiber contamination in the filter medium is concentrated on the TEM specimen grid.

It can be argued that direct methods yield an under-estimate of the asbestos structure concentration because many of the asbestos fibers present are concealed by other particulate material with which they are associated. Conversely, indirect methods can be considered to yield an over-estimate because some types of complex asbestos structures disintegrate during the preparation, resulting in an increase in the numbers of structures counted.

4.2 U.S. EPA's Modified Yamate Method for TEM

High concentrations of background dust interfere with fiber identification.

4.3 NIOSH Method for TEM

Other amphibole particles that have aspect ratios greater than 3:1 and elemental compositions similar to the asbestos minerals may interfere in the TEM analysis. Some non-amphibole minerals may give electron diffraction patterns similar to amphiboles. High concentrations of background dust interfere with fiber identification.

4.4 NIOSH Method for PCM

PCM cannot distinguish asbestos from non-asbestos fibers; therefore, all particles meeting the counting criteria are counted as total asbestos fibers. Fiber less than 0.25 um in length will not be detected by this method. High levels of non-fibrous dust particles may obscure fibers in the field of view and increase the detection limit.

5.0 EQUIPMENT/MATERIALS

5.1 Sampling Pump

The constant flow or critical orifice controlled sampling pump should be capable of a flow-rate and pumping time sufficient to achieve the desired volume of air sampled.

The lower flow personal sampling pumps generally provide a flow rate of 20 cubic centimeters/minute (cc/min) to 4 L/min. These pumps are usually battery powered. High flow pumps are utilized when flow rates between 2 L/min to 20 L/min are required. High flow pumps are used for short sampling periods so as to obtain the desired sample volume. High flow pumps usually run on AC power and can be plugged into a nearby outlet. If an outlet is not available then a generator should be obtained. The generator should be positioned downwind from the sampling pump. Additional voltage may be required if more than one pump is plugged into the same generator. Several

electrical extension cord s may be required if sampling locations are remote.

The recommended volume for the Superfund method (Phase I) requires approximately 20 hours to collect. Such pumps typically draw 6 amps at full power s o that 2 lead/acid batteries should provide sufficien t power to collect a full sample. The use of lin e voltage, where available, eliminates the difficultie s associated with transporting stored electrical energy.

A stand should be used to hold th e filter cassette at the desired height for sampling and t he filter cassette shall be isolated from the vibrations of the pump.

5.2 Filter Cassette

The cassettes are purchased wit h the required filters in position, or can be assembled in a laminar flow hood or clean area. When the filters are in position, a shrink cellulose band or adhesive tape should b e applied to cassette joints to prevent air leakage.

5.2.1 TEM Cassette Requirements

Commercially available field monitors, comprisin g 25 mm diameter three-piece cassettes, wit h conductive extension cowls shall be used for sample collection. The cassette must be new and no t previously used. The cassette shall be loaded with an MCE filter of pore size 0.45 µm, and supplied from a lot number which has been qualified as lo w background for asbestos determination. The cowl s should be constructed of electrically conductin g material to minimize electrostatic effects. The filte r shall be backed by a 5 µm pore size MCE filte r (Figure 1, Appendix B).

5.2.2 PCM Cassette Requirements

NIOSH Method 7400, PCM involves using a 0.8 t o 1.2 µm mixed cellulose ester membrane, 25 m m diameter, 50 mm conductive cowl on cassette (Figure 2, Appendi x B). Some labs are able to perform PCM and TEM analysis on the same filter; however, thi s should be discussed with the laboratory prior t o sampling.

5.3 Other Equipment

- Inert tubing with glass cyclone and hose barb
- Whirlbags (plastic bags) for cassettes
- Tools - small screw drivers
- Container - to keep samples upright
- Generator or electrical outlet (may not b e required)
- Extension cords (may not be required)
- Multiple plug outlet
- Sample labels
- Air data sheets
- Chain of Custody records

6.0 REAGENTS

Reagents are not required for the preservation o f asbestos samples.

7.0 PROCEDURES

7.1 Air Volumes and Flow Rates

Sampling volumes are deter mined on the basis of how many fibers need to be collected for reliabl e measurements. Therefore, one must estimate ho w many airborne fibers m ay be in the sampling location.

Since the concentration of airborne aeroso l contaminants will have some effect on the sample, the following is a suggested criteria to assist in selecting a flow rate based on rea l-time aerosol monitor (RAM) readings in milligrams/cubic meter (mg/m ^{3}).

	Concentration	Flow Rate
• Low RAM readings:	<6.0 mg/m ^{3}	11-15. L/min
• Medium RAM readings:	>6.0 mg/m ^{3}	7.5 L/min
• High RAM readings:	>10. mg/m ^{3}	2.5 L/min

In practice, pumps that are availab le for environmental sampling at remote locations operate under a maximum load of approximately 12 L/min.

7.1.1 U.S. EPA's Superfund Method

The Superfund Method incorporates an indirec t preparation procedure to provide flexibility in th e amount of deposit that be can be tolerated on th e sample filter and to allow for the selectiv e concentration of asbestos prior to analysis. T o minimize contributions to background contamination from asbestos present in the plastic matrices o f membrane filters while allowing for sufficien t quantities of asbestos to be collected, this method also requires the collection of a larger volume of air pe r unit area of fi lter than has traditionally been collected

for asbestos analysis. Due to the need to collect large volumes of air, higher sampling flow rates are recommended in this method than have generally been employed for asbestos sampling in the past. As an alternative, samples may be collected over longer time intervals. However, this restricts the flexibility required to allow samples to be collected while uniform meteorological conditions prevail.

The sampling rate and the period of sampling should be selected to yield as high a sampled volume as possible, which will minimize the influence of filter contamination. Wherever possible, a volume of 15 cubic meters (15,000 L) shall be sampled for those samples intended for analysis only by the indirect TEM preparation method (Phase 1 samples). For those samples to be prepared by both the indirect and the direct specimen preparation methods (Phase 2 samples), the volumes must be adjusted so as to provide a suitably-loaded filter for the direct TEM preparation method. One option is to collect filters at several loadings to bracket the estimated optimum loading for a particular site. Such filters can be screened in the laboratory so that only those filters closest to optimal loading are analyzed. It has been found that the volume cannot normally exceed 5 cubic meters (5000 L) in an urban or agricultural area, and 10 cubic meters (10,000 L) in a rural area for samples collected on a 25 mm filter and prepared by a direct-transfer technique.

An upper limit to the range of acceptable flow rates for this method is 15 L/min. At many locations, wind patterns exhibit strong diurnal variations. Therefore, intermittent sampling (sampling over a fixed time interval repeated over several days) may be necessary to accumulate 20 hours of sampling time over constant wind conditions. Other sampling objectives also may necessitate intermittent sampling. The objective is to design a sampling schedule so that samples are collected under uniform conditions throughout the sampling interval. This method provides for such options. Air volumes collected on Phase I samples are maximized (<16 L/min). Air volumes collected on Phase 2 samples are limited to provide optimum loading for filters to be prepared by a direct-transfer procedure.

7.1.2 U.S. EPA's Modified Yamate Method for TEM

U.S. EPA's TEM method requires a minimum volume of 560 L and a maximum volume of 3,800 L in order to obtain an analytical sensitivity of 0.005 structures/cc. The optimal volume for TEM is 1200 L to 1800 L. These volumes are determined using a 200 mesh EM grid opening with a 25-mm filter cassette. Changes in volume would be necessary if a 37-mm filter cassette is used since the effective area of a 25 mm (385 sq mm) and 37 mm (855 sq m) differ.

7.1.3 NIOSH Method for TEM and PCM

The minimum recommended volume for TEM and PCM is 400 L at 0.1 fiber/cc. Sampling time is adjusted to obtain optimum fiber loading on the filter. A sampling rate of 1 to 4 L/min for eight hours (700 to 2800 L) is appropriate in non-dusty atmospheres containing 0.1 fiber/cc. Dusty atmospheres i.e., areas with high levels of asbestos, 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 (3,000 to 10,000 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. Do not exceed 0.5 mg total dust loading on the filter.

7.2 Calibration Procedures

In order to determine if a sampling pump is measuring the flow rate or volume of air correctly, it is necessary to calibrate the instrument. Sampling pumps should be calibrated immediately before and after each use. Preliminary calibration should be conducted using a primary calibrator such as a soap bubble type calibrator, (e.g., a Buck Calibrator, Gilibrator, or equivalent primary calibrator) with a representative filter cassette installed between the pump and the calibrator. The representative sampling cassette can be reused for calibrating other pumps that will be used for asbestos sampling. The same cassette lot used for sampling should also be used for the calibration. A sticker should be affixed to the outside of the extension cowl marked "Calibration Cassette."

A rotameter can be used provided it has been recently precalibrated with a primary calibrator. Three separate constant flow calibration readings should be obtained both before sampling and after sampling. Should the flow rate change by more than 5% during the sampling period, the average of the pre- and post-calibration rates will be used to calculate the total sample volume. The sampling pump used shall provide a non-fluctuating air-flow through the filter, and shall maintain the initial volume flow-rate to within ± 10% throughout the sampling period. The mean value of these flow-rate measurements shall be used to calculate the total air volume sampled. A constant flow or critical orifice controlled pump meets these requirements. If at any time the measurement indicates that the flow-rate has decreased by more than 30%, the sampling shall be terminated. Flexible tubing is used to connect the filter cassette to the sampling pump.Sampling pumps can be calibrated prior to coming on-site so that time is saved when performing on-site calibration.

7.2.1 Calibrating a Personal Sampling Pump with an Electronic Calibrator

1. See Manufacturer's manual for operational instructions.

2. Set up the calibration train as shown in (Figure 3, Appendix B) using a sampling pump, electronic calibrator, and a representative filter cassette. The same lot sampling cassette used for sampling should also be used for calibrating.

3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 foot) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the electronic calibrator.

4. Turn the electronic calibrator and sampling pump on. Create a bubble at the bottom of the flow chamber by pressing the bubble initiate button. The bubble should rise to the top of the flow chamber. After the bubble runs its course, the flow rate is shown on the LED display.

5. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.

6. Perform the calibration three times until the desired flow rate of ± 5% is attained.

7.2.2 Calibrating a Rotameter with an Electronic Calibrator

1. See manufacturer's manual for operational instructions.

2. Set up the calibration train as shown in (Figure 4, Appendix B) using a sampling pump, rotameter, and electronic calibrator.

3. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6° vertical.

4. Turn the electronic calibrator and sampling pump on.

5. Create a bubble at the bottom of the flow chamber by pressing the bubble initiate button. The bubble should rise to the top of the flow chamber. After the bubble runs its course, the flow rate is shown on the LED display.

6. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.

7. Record the electronic calibrator flow rate reading and the corresponding rotameter reading. Indicate these values on the rotameter (sticker). The rotameter should be able to work within the desired flow range. Readings can also be calibrated for 10 cm^3 increments for Low Flow rotameters, 500 cm^3 increments for medium flow rotameters and 1 liter increments for high flow rotameters.

8. Perform the calibration three times until the desired flow rate of ± 5% is attained. Once on site, a secondary calibrator, i.e., rotameter may be used to calibrate sampling pumps.

7.2.3 Calibrating a Personal Sampling Pump with a Rotameter

1. See manufacturer's manual for Rotameter's Operational Instructions.

2. Set up the calibration train as shown in (Figure 5, Appendix B) using a rotameter, sampling pump, and a representative sampling cassette.

3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 ft) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the rotameter.

4. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6° vertical.

5. Turn the sampling pump on.

6. Turn the flow adjust screw (or knob) on the personal sampling pump until the float ball on the rotameter is lined up with the precalibrated flow rate value. A sticker on the rotameter should indicate this value.

7. A verification of calibration is generally performed on-site in the clean zone *immediately prior to the sampling.*

7.3. Meteorology

It is recommended that a meteorological station be established. If possible, sample after two to three days of dry weather and when the wind conditions are at 10 mph or greater. Record wind speed, wind direction, temperature, and pressure in a field logbook. Wind direction is particularly important when monitoring for asbestos downwind from a fixed source.

7.4 Ambient Sampling Procedures

7.4.1 Pre-site Sampling Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.

2. Obtain necessary sampling equipment and ensure it is in working order and fully charged (if necessary).

3. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety plan.

4. Once on-site the calibration is performed in the clean zone. The calibration procedures are listed in Section 7.2.

5. After calibrating the sampling pump, mobilize to the sampling location.

7.4.2 Site Sampling

1. To set up the sampling train, attach the air intake hose to the cassette base. Remove the cassette cap (Figure 6 and 7, Appendix B). The cassette should be positioned downward, perpendicular to the wind

2. If AC or DC electricity is required then turn it on. If used, the generator should be placed 10 ft. downwind from the sampling pump.

3. Record the following in a field logbook: date, time, location, sample identification number, pump number, flow rate, and cumulative time.

4. Turn the pump on. Should intermittent sampling be required, sampling filters must be covered between active periods of sampling. To cover the sample filter: turn the cassette to face upward, place the cassette cap on the cassette, remove the inlet plug from the cassette cap, attach a rotameter to the inlet opening of the cassette cap to measure the flow rate, turn off the sampling pump, place the inlet plug into the inlet opening on the cassette cap. To resume sampling: remove the inlet plug, turn on the sampling pump, attach a rotameter to measure the flow rate, remove the cassette cap, replace the inlet plug in the cassette cap and invert the cassette, face downward and perpendicular to the wind.

5. Check the pump at sampling midpoint if sampling is longer than 4 hours. The generators may need to be regased depending on tank size. If a filter darkens in appearance or if loose dust is seen in the filter, a second sample should be started.

6. At the end of the sampling period, orient the cassette up, turn the pump off.

7. Check the flow rate as shown in Section 7.2.3. When sampling open-faced, the sampling cap should be replaced before post calibrating. Use the same cassette used for sampling for post calibration (increase dust/fiber loading may have altered the flow rate.

8. Record the post flow rate.

9. Record the cumulative time or run.

10. Remove the tubing from the sampling cassette. Still holding the cassette upright, replace the inlet plug on the cassette cap and the outlet plug on the cassette base.

7.4.3. Post Site Sampling

1. Follow handling procedures in Section 3.2, steps 1-4.

2. Obtain an electronic or hard copy of meteorological data which occurred during the sampling event. Record weather: wind speed, ambient temperature, wind direction, and precipitation. Obtaining weather data several days prior to the sampling event can also be useful.

7.5 Indoor Sampling Procedures

PCM analysis is used for indoor air samples. When analysis shows total fiber count above the OSHA action level 0.1 f/cc then TEM (U.S. EPA's Modified Yamate Method) is used to identify asbestos from non-asbestos fibers.

Sampling pumps should be placed four to five feet above ground level away from obstructions that may influence air flow. The pump can be placed on a table or counter. Refer to Table 2 (Appendix A) for a summary of indoor sampling locations and rationale for selection.

Indoor sampling utilizes high flow rates to increased sample volumes (2000 L for PCM and 2800 to 4200 L for TEM) in order to obtain lower detection limits below the standard, (i.e., 0.01 f/cc or lower [PCM] and 0.005 structures/cc or lower [TEM]).

7.5.1 Aggressive Sampling Procedures

Sampling equipment at fixed locations may fail to detect the presence of asbestos fibers. Due to limited air movement, many fibers may settle out of the air onto the floor and other surfaces and may not be captured on the filter. In the past, an 8-hour sampling period was recommended to cover various air circulation conditions. A quicker and more effective way to capture asbestos fibers is to circulate the air artificially so that the fibers remain airborne during sampling. The results from this sampling option typifies worst case condition. This is referred to as aggressive air sampling for asbestos. Refer to Table 2 for sample station locations.

1. Before starting the sampling pumps, direct forced air (such as a 1-horsepower leaf blower or large fan) against walls, ceilings, floors, ledges, and other surfaces in the room to initially dislodge fibers from surfaces. This should take at least 5 minutes per 1000 sq. ft. of floor.

2. Place a 20-inch fan in the center of the room. (Use one fan per 10,000 cubic feet of room space.) Place the fan on slow speed and point it toward the ceiling.

3. Follow procedures in Section 7.4.1 and 7.4.2 (Turn off the pump and then the fan(s) when sampling is complete.).

4. Follow handling procedures in Section 3.2, steps 1-4.

8.0 CALCULATIONS

The sample volume is calculated from the average flow rate of the pump multiplied by the number of minutes the pump was running (volume = flow rate X time in minutes). The sample volume should be submitted to the laboratory and identified on the chain of custody for each sample (zero for lot, field and trip blanks).

The concentration result is calculated using the sample volume and the numbers of asbestos structures reported after the application of the cluster and matrix counting criteria.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

Follow all QA/QC requirements from the laboratories as well as the analytical methods.

9.1 TEM Requirements

1. Examine lot blanks to determine the background asbestos structure concentration.

2. Examine field blanks to determine whether there is contamination by extraneous asbestos structures during specimen preparation.

3. Examine of laboratory blanks to determine if contamination is being introduced during critical phases of the laboratory program.

4. To determine if the laboratory can satisfactorily analyze samples of known asbestos structure concentrations, reference filters shall be examined. Reference filters should be maintained as part of the laboratory's Quality Assurance program.

5. To minimize subjective effects, some specimens should be recounted by a different microscopist.

6. Asbestos laboratories shall be accredited by the National Voluntary Laboratory Accreditation Program.

7. At this time, performance evaluation samples for asbestos in air are not available for Removal Program Activities.

9.2 PCM Requirements

1. Examine reference slides of known concentration to determine the analyst's ability to satisfactorily count fibers. Reference slides should be maintained as part of the laboratory's quality assurance program.

2. Examine field blanks to determine if there is contamination by extraneous structures during sample handling.

3. Some samples should be relabeled then submitted for counting by the same analyst to determine possible bias by the analyst.

4. Participation in a proficiency testing program such as the AIHA-NIOSH proficiency analytical testing (PAT) program.

10.0 DATA VALIDATION

Results of quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures. More specifically, when entering an unknown situation involving asbestos, a powered air purifying respirator (PAPR) (full face-piece) is necessary in conjunction with HEPA filter cartridges. See applicable regulations for action level, PEL, TLV, etc. If previous sampling indicates asbestos concentrations are below personal health and safety levels, then Level D personal protection is adequate.

12.0 REFERENCES

(1) Environmental Asbestos Assessment Manual, Superfund Method for the Determination of Asbestos in Ambient Air, Part 1: Method, EPA/540/2-90/005a, May 1990, and Part 2: Technical Background Document, EPA/540/2-90/005b, May 1990.

(2) Methodology for the Measurement of Airborne Asbestos by Electron Microscopy, EPA's Report No. 68-02-3266, 1984, G. Yamate, S.C. Agarwal, and R. D. Gibbons.

(3) National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Method. Third Edition. 1987.

(4) U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 763. July 1, 1987. Code of Federal Regulations 40 CFR 763 Addendum. October 30, 1987.

(5) U.S. Environmental Protection Agency. Asbestos-Containing Materials in Schools; Final Rule and Notice. 52 FR 41826.

(6) Occupational Safety and Health Administration. Code of Federal Regulations 29 CFR 1910.1001. Washington, D.C. 1987.

APPENDIX A

Tables

TABLE 1. *SAMPLE STATIONS FOR OUTDOOR SAMPLING*		
Sample Station Location	Sample Numbers	Rationale
Upwind/Background [1]	Collect a minimum of two simultaneous upwind/background samples 30 ° apart from the prevailing windlines.	Establishes background fiber levels.
Downwind	Deploy a minimum of 3 sampling stations in a 180 degree arc downwind from the source.	Indicates if asbestos is leaving the site.
Site Representative and/or Worst Case	Obtain one site representative sample which shows average condition on-site or obtain worst case sample (optional).	Verify and continually confirm and document selection of proper levels of worker protection.

[1] More than one background station may be required if the asbestos originates from different sources.

APPENDIX A (Cont'd)

Tables

TABLE 2

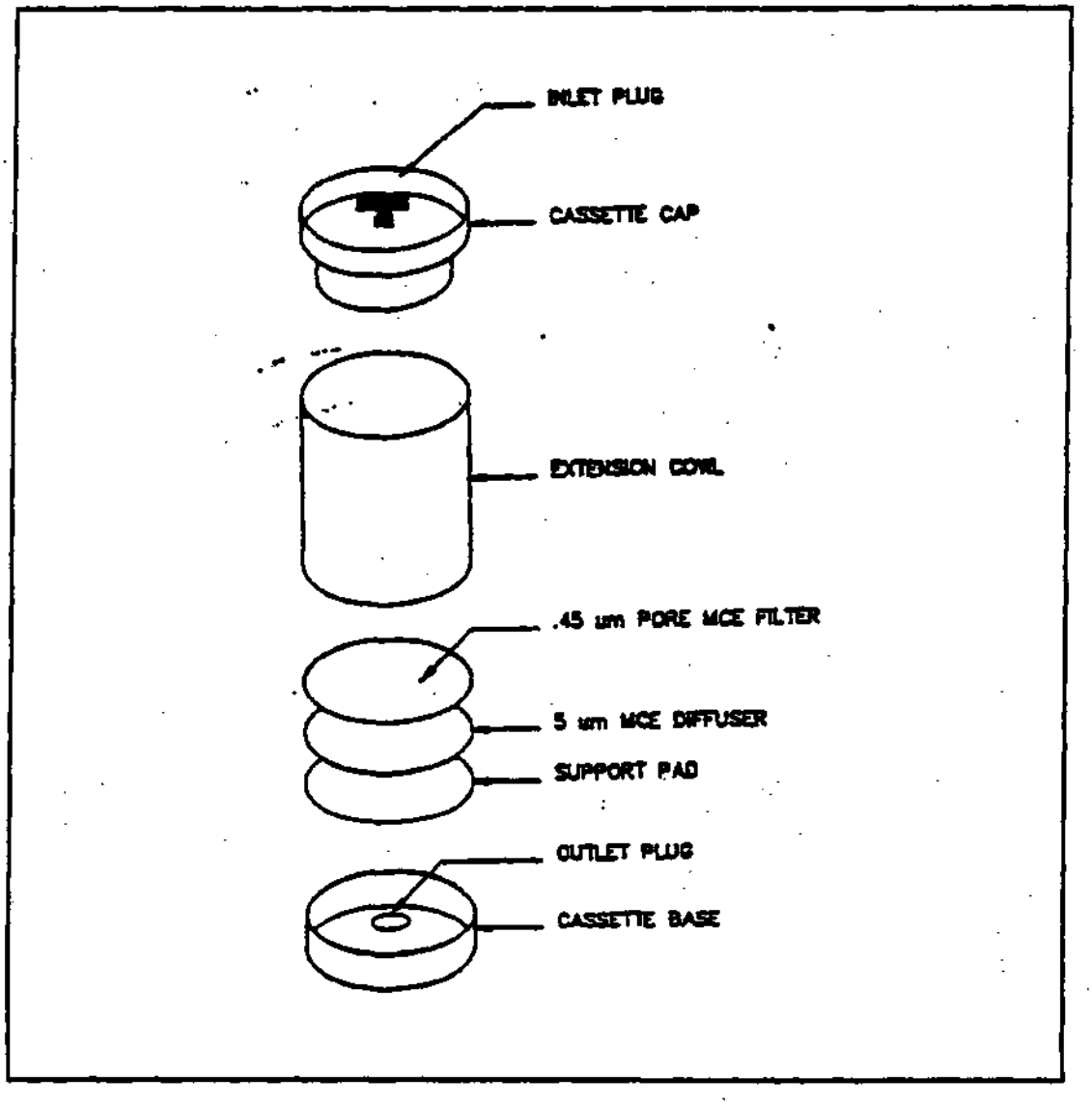
SAMPLE STATIONS FOR INDOOR SAMPLING

Sample Station Location	Sample Numbers	Rationale
Indoor Sampling	If a work site is a single room, disperse 5 samplers throughout the room. If the work site contains up to 5 rooms, place at least one sampler in each room. If the work site contains more than 5 rooms, select a representative sample of the rooms.	Establishes representative samples from a homogeneous area.
Upwind/Background	If outside sources are suspected, deploy a minimum of two simultaneous upwind/background samples 30 ° apart from the prevailing windlines.	Establish whether indoor asbestos concentrations are coming from an outside source.
Worst Case	Obtain one worst case sample, i.e., aggressive sampling (optional).	Verify and continually confirm and document selection of proper levels of worker protection.

APPENDIX B

Figures

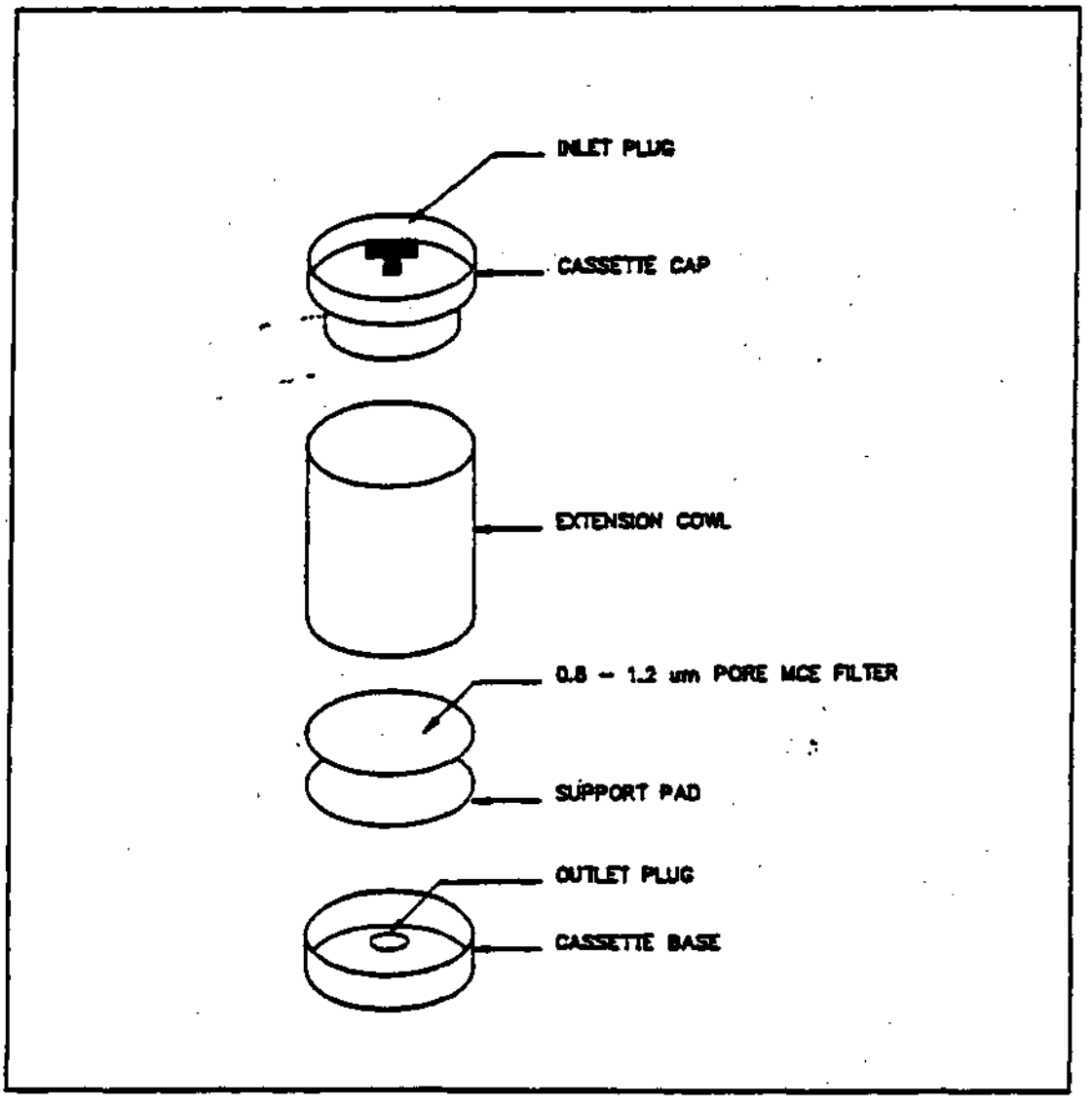
FIGURE 1. Transmission Electron Microscopy Filter Cassette



APPENDIX B (Cont'd)

Figures

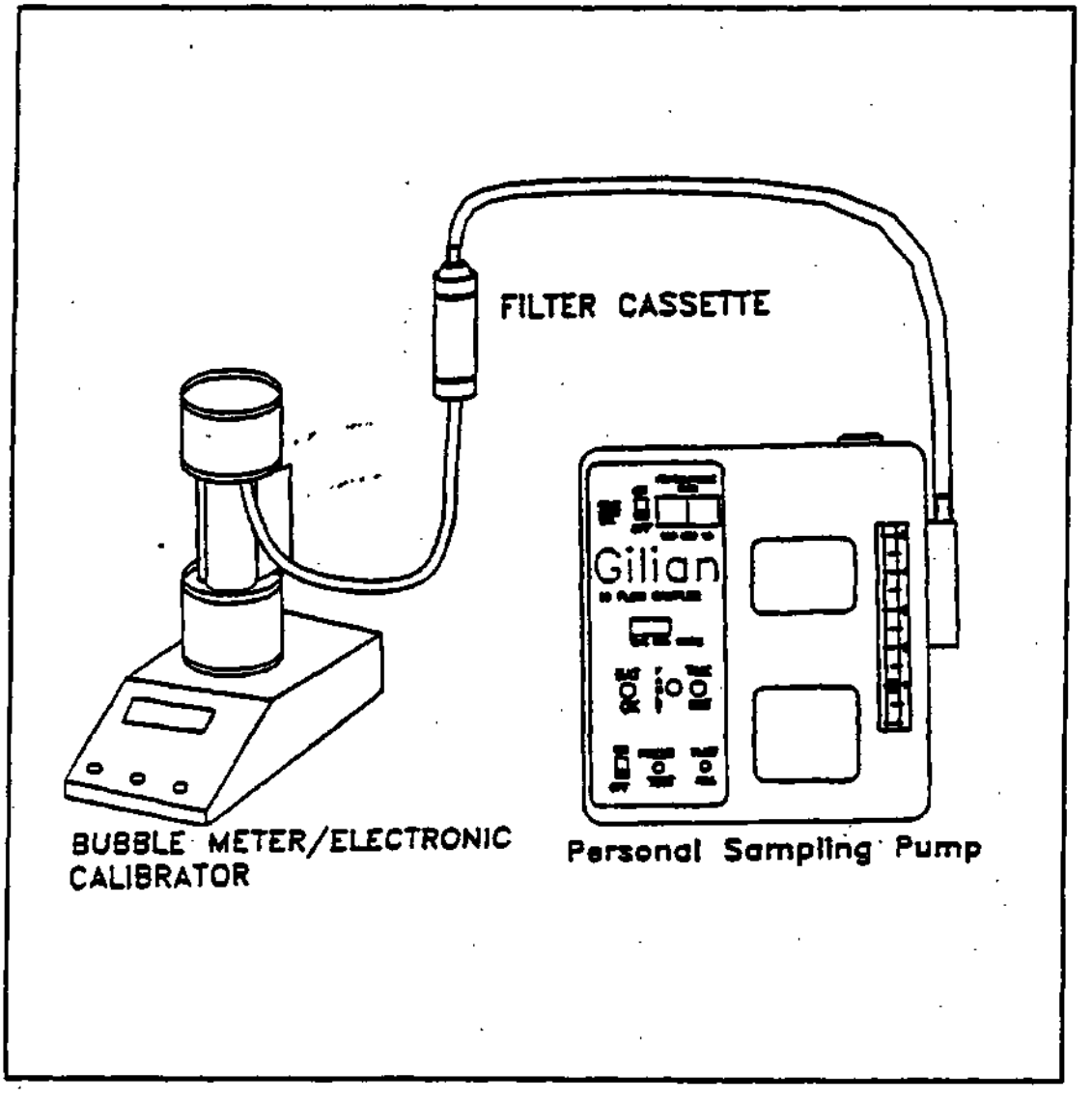
FIGURE 2. Phase Contrast Microscopy Filter Cassette



APPENDIX B (Cont'd)

Figures

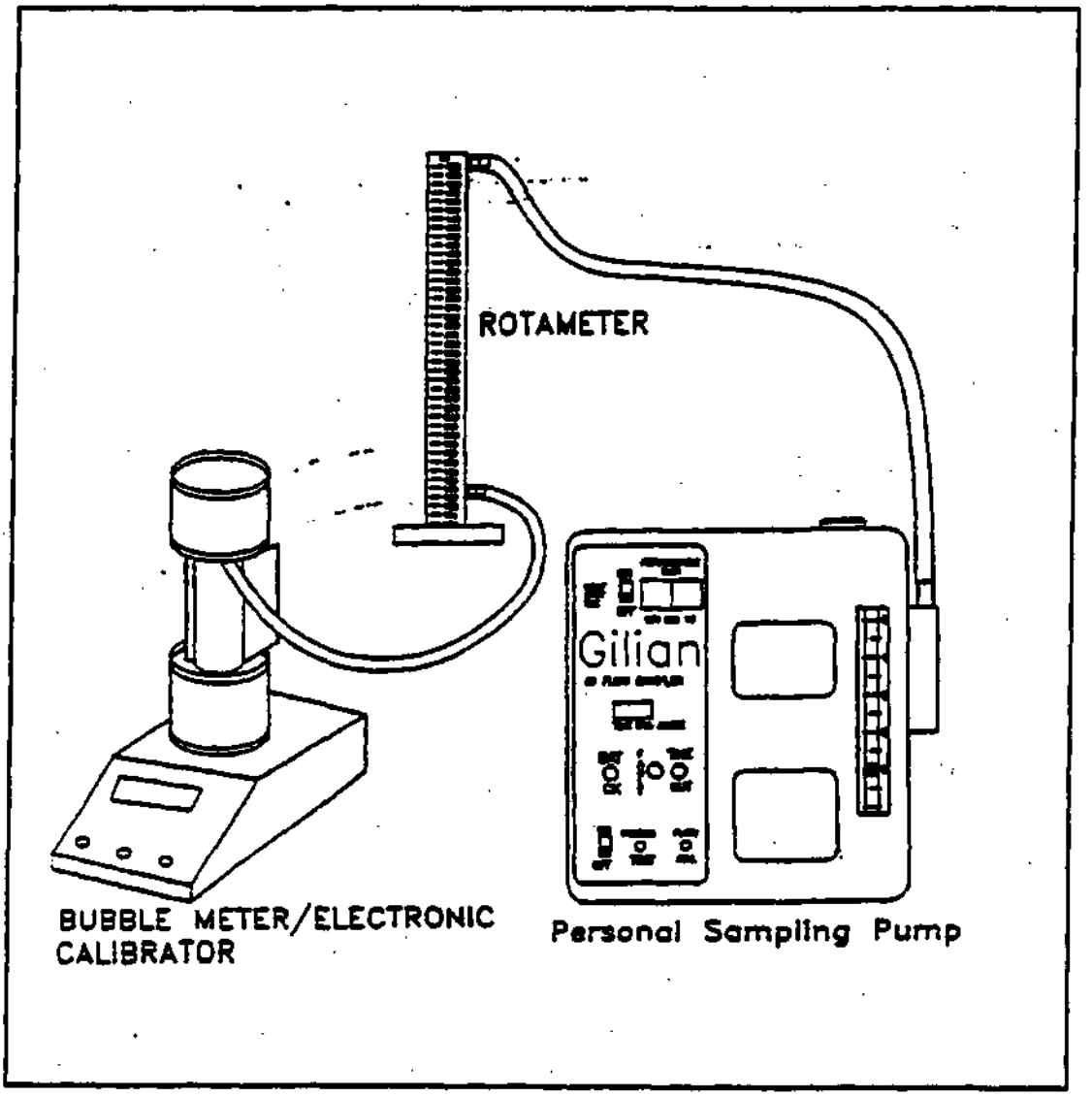
FIGURE 3. Calibrating a Personal Sampling Pump with a Bubble Meter



APPENDIX B (Cont'd)

Figures

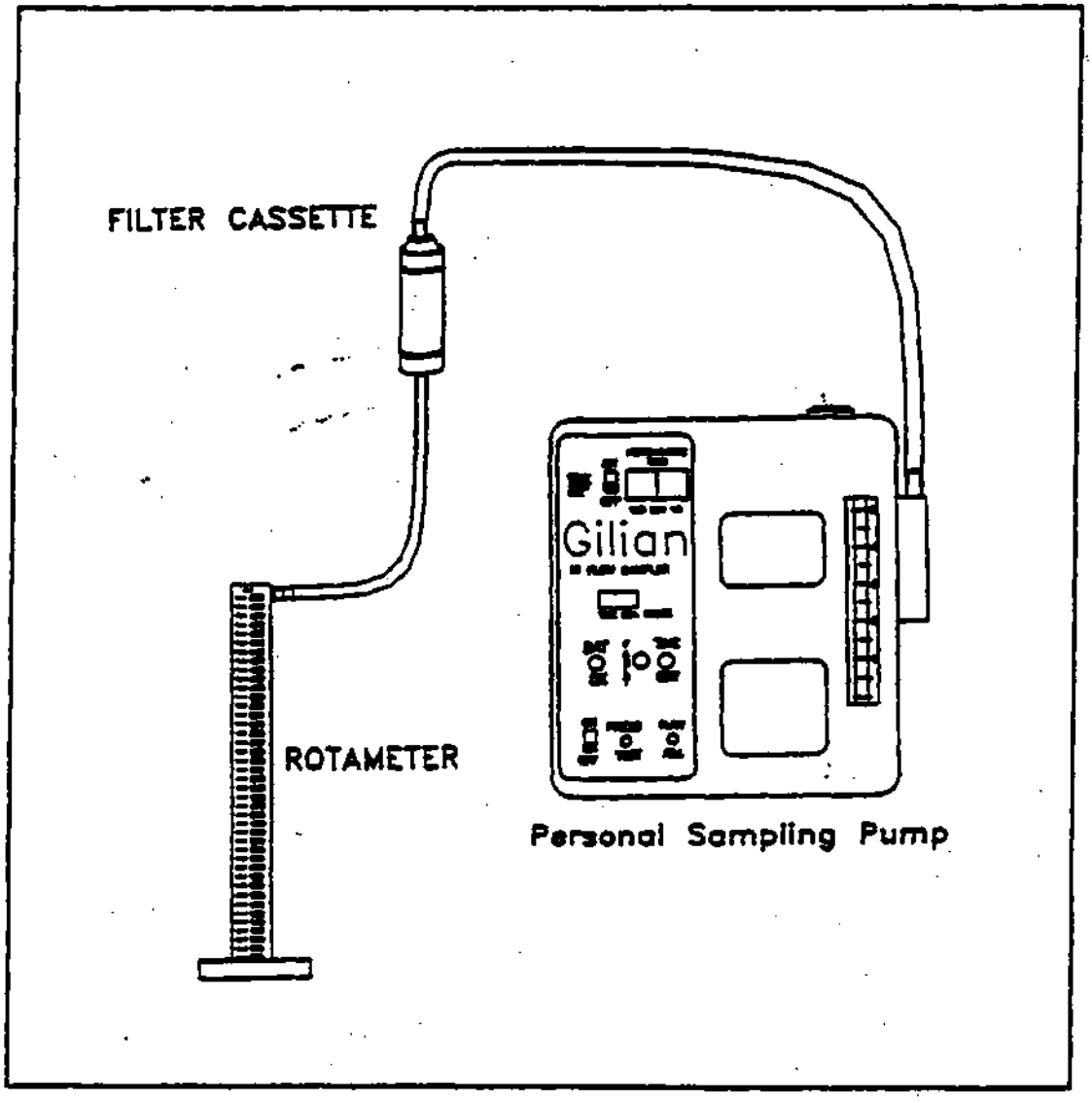
FIGURE 4. Calibrating a Rotameter with a Bubble Meter



APPENDIX B (Cont'd)

Figures

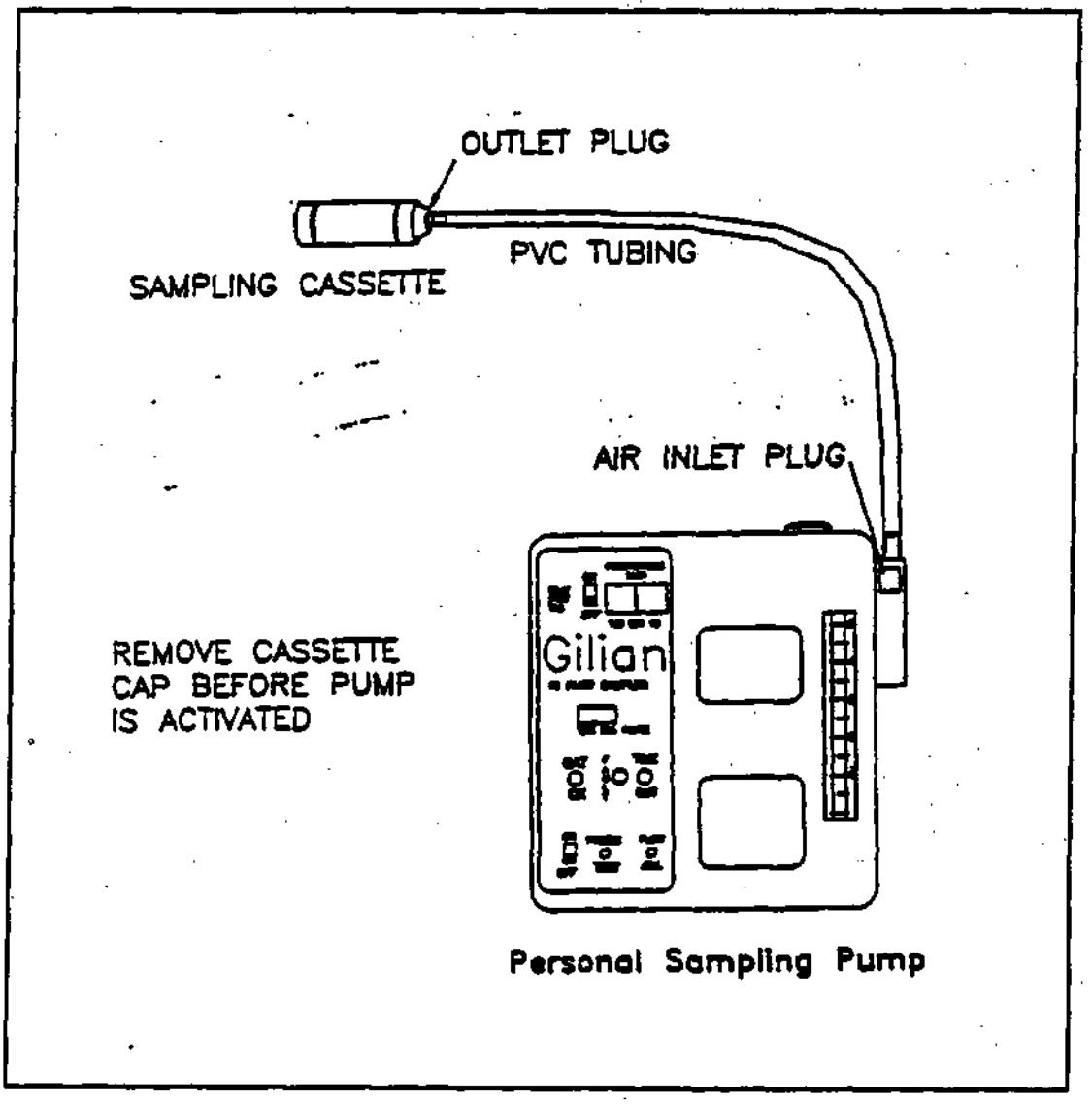
FIGURE 5. Calibrating a Sampling Pump with a Rotameter



APPENDIX B (Cont'd)

Figures

FIGURE 6. Personal Sampling Train for Asbestos



APPENDIX B (Cont'd)

Figures

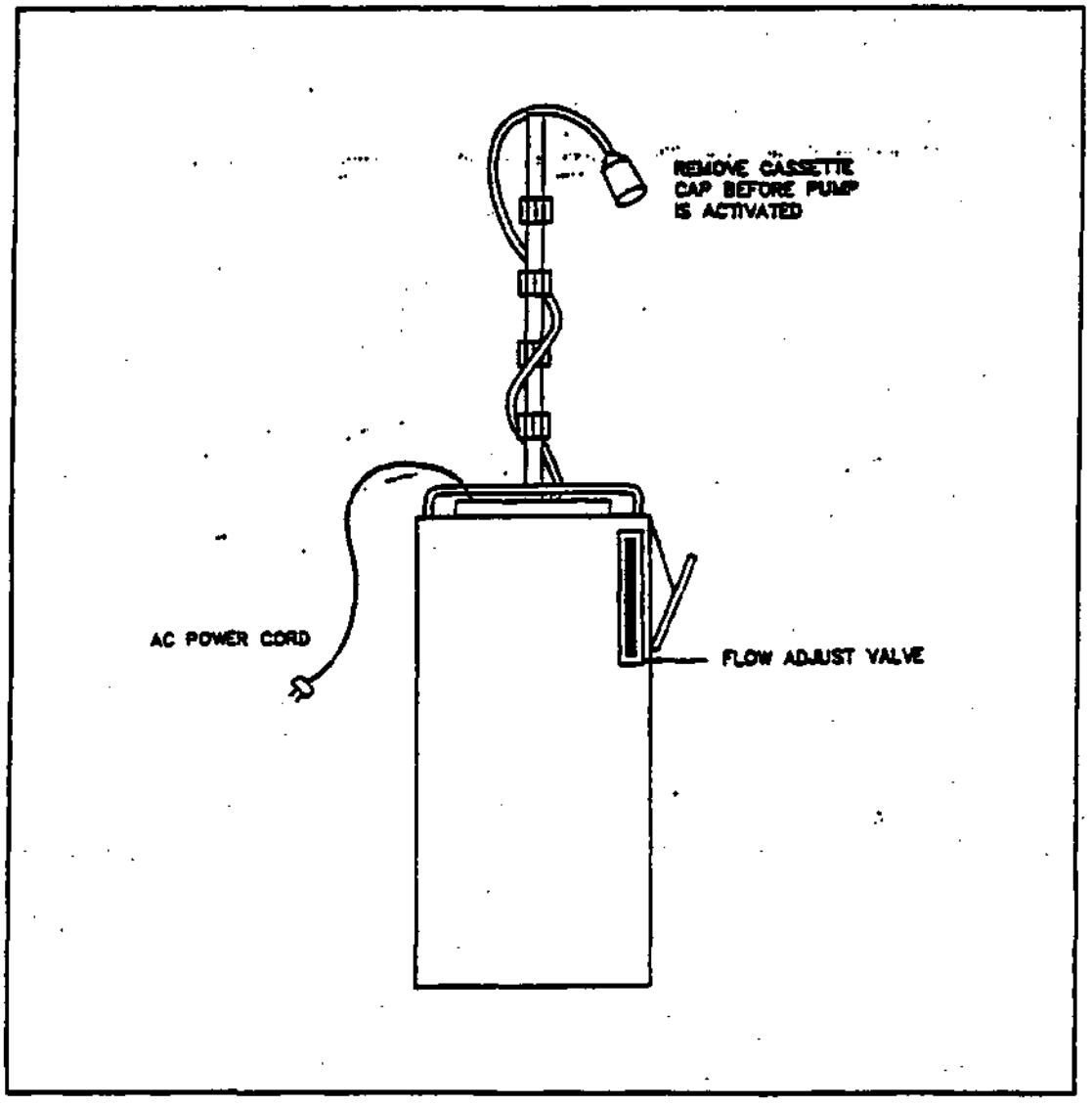



FIGURE 7. High Flow Sampling Train for Asbestos