GEORGIA INSTITUTE OF TECHNOLOGY — OFFICE OF CONTRACT ADMINISTRATION

PROJECT ADMINISTRATION DATA SHEET

[x] ORIGINAL [ ] REVISION NO. _____

Project No. A-3544 GTRI/~~GIT~~ DATE 5 / 23 / 83

Project Director: ~~Robert Williams~~ BILL EWING GA School/Lab EDL/SHD

Sponsor: Fulton County Board of Education

Type Agreement: Standard Research Agreement No. A-3544

Award Period: From 5/11/83 To ~~9/30/83~~ 10/30/83 (Performance) ~~9/30/83~~ (Reports)

Sponsor Amount:	This Change 10/30/83	Total to Date
Estimated:	$	$ 25,544
Funded:	$	$ 25,544

Cost Sharing Amount: $ _____ Cost Sharing No: _____

Title: Air Sampling, Fulton County Schools

ADMINISTRATIVE DATA OCA Contact Faith G. Costello

1) Sponsor Technical Contact:

Mr. Joby Schilling
Fulton County Board of Education
786 Cleveland Ave., S. W.
Atlanta, GA, GA 30315

2) Sponsor Admin/Contractual Matters:

Ms. Delores G. McGhee
FCBE President
786 Cleveland Ave., S.W.
Atlanta, GA 30315

Defense Priority Rating: NA Military Security Classification: _____

(or) Company/Industrial Proprietary: _____

RESTRICTIONS

See Attached NA Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval – Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with NA

COMMENTS:

COPIES TO:

Project Director
Research Administrative Network
Research Property Management
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Procurement/EES Supply Services
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Reports Coordinator (OCA)
Research Communications (2)
GTRI
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Other I. Newton

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 11/3/83

Project No. A-3544 ~~School~~/Lab EDL/SHD

Includes Subproject No.(s) _____

Project Director(s) Bill Ewing GTRI / ~~GIT~~

Sponsor Fulton County Board of Education

Title Air Sampling, Fulton County Schools

Effective Completion Date: 10/30/83 (Performance) 10/30/83 (Reports)

Grant/Contract Closeout Actions Remaining:

- [ ] None
- [x] Final Invoice ~~or Final Fiscal Report~~
- [ ] Closing Documents
- [ ] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other _____

Continues Project No. _____ Continued by Project No. _____

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Form OCA 60:1028

AIR SAMPLING SURVEY

FULTON COUNTY SCHOOL DISTRICT

Project No. A-3544
Final Report

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Environmental Health and Safety Division
Atlanta, Georgia 30332
October 1983

Asbestos Sampling
Fulton County Schools
Fulton County, Georgia

1.0 Introduction

The Georgia Tech Research Institute was retained by the Fulton County School Board in order to conduct air sampling, analyses, and on-site inspections in conjunction with the removal of asbestos-containing materials from several schools in the Fulton County, Georgia School District. Four high schools in South Fulton County were the work sites for this project: M.D. Collins, Campbell, Lakeshore, and Woodland High Schools . The air sampling was conducted by Messrs. William E. Ewing, Kenneth A. Smith, Kenneth E. Johnson, William H. Spain, and Kevin L. Kamperman of Georgia Tech during the period from June 10, 1983 to August 1, 1983 (no work was performed on either 7/3 or 7/4). Analyses were performed by the Environmental Laboratory of Georgia Tech during the same time period. The following report summarizes the air sampling results. The results of the individual samples can be found in Appendix A, Tables A-1 through A-34. The inspection checklists can be found in Appendix B, and a copy of the sampling and analytical method is included in Appendix C.

2.0 Sampling Protocol

Air sampling was conducted daily at each of the four schools during the removal process. The minimum sampling criteria were as follows:

- Two samples taken inside the work area; minimum 60 liters (air volume)
- Two samples taken out the work area, but inside the building; minimum 240 liters
- One sample taken outside the building; minimum of 480 liters

Pre-removal (prevalent air) samples were also taken in order to obtain some measure of pre-existing fiber concentrations. In addition, a minimum of two samples of at least 2000 liters per sample were taken after the final cleanup in each work area.

A daily written report (commencing on June 30) of the previous day's sampling results and observed work practices was made available to the contractor and to the School Board's representative, Mr. Joby Schilling, through the use of sampling result sheets and an inspector's checklist.

Observations of daily work practices were conducted, and comments noted on the above-mentioned checklist. Any violations in conflict with the contract or EPA/OSHA health and safety regulations were brought to the attention of the on-site supervisor for correction.

All air samples were collected and analyzed in accordance with the National

Institute for Occupational Safety and Health (NIOSH) Method P&CAM 239. There are limitations to NIOSH P&CAM 239 which should be noted. This method is only capable of analyzing for fibers which are longer than 5 micrometers (μm) in length, have an aspect ratio of 3:1, and are wider than approximately 0.3 um. Most importantly, the very small fibers (less than 5 um in length) are usually not visible by this method for counting. Electron microscopy (EM) is the only method of analysis currently available for analyzing these small fibers, but at a cost of 20 times the NIOSH method, EM was not conducted.

The following discussion is divided into two sections: the large scale asbestos removal job at M.D. Collins High School, and the small jobs at Campbell, Lakeshore, Woodland, and Collins High Schools.

3.0 Discussion of Findings (M.D. Collins Main Job)

Prior to starting removal at M.D. Collins, 6 area air samples (prevalent air) were collected inside the building. These samples ranged in fiber concentrations from less than 0.01 to 0.01 fibers per cubic centimeter of air sampled (f/cc). Outside the building, prevalent levels were also less than 0.01 f/cc.

Nine area samples were taken at M.D. Collins during pre-removal prepping. Fiber concentrations ranged from less than 0.01 to 0.05 f/cc. Once the actual removal was started, samples (area and personal) were taken inside the work area, outside the work area (but inside the building) and outside the building itself.

A total of 13 samples were taken outside the building during removal. Outside samples are taken in order to detect any fibers which may have escaped the building. The concentration of fibers ranged from less than 0.01 f/cc to 0.01 f/cc.

Work area monitoring included 10 personal and 54 area air samples. Personal sampling is done to give an estimate of what concentration an individual worker is exposed to at a particular time, and in this case the fiber concentrations ranged from less than 0.01 up to 0.19 f/cc. The general work area samples ranged from less than 0.01 to 0.14 f/cc.

The last type of air sampling conducted during removal at Collins was outside the work area, but inside the building. The purpose of this type of monitoring is to detect any fibers which may escape the work area and enter an occupied or otherwise clean part of the building. In the case of M.D. Collins, most of the building was one large work area, so the sampling was done in the changing room of the decontamination trailer. Three samples were taken, and were all less than 0.01 f/cc.

Upon completion of the removal phase samples were taken in the work area at least 24 hours after the final cleanup. Although this type of sampling is referred to as "clean air" or "clearance" monitoring, it is not intended to convey the idea that the work area is completely clean of all asbestos fibers. The results are merely a measurement of the remaining fibers of all types which are longer than 5 μm and wider than approximately 0.3 μm. The accepted "clean air" level varies from job to job but is in the range of 0.01 to 0.05 f/cc, and usually less than 0.02 f/cc. Seven clearance samples showed fiber concentrations of less than 0.01 f/cc after removal.

3.1 Discussion of Findings (Campbell High School

Asbestos-containing materials were removed from the Band Room, Choir Room, Military Room, and Wood Shop on July 28, 1983. Prevalent air sampling was done on July 20-21, 1983, and clearance testing was conducted on July 30, 1983.

Three prevalent air samples showed concentrations of less than 0.01 f/cc. One outside air sample was less than 0.01 f/cc, as were two of the three work area samples. One work area sample was 0.01 f/cc. Four clean air samples showed post-removal fiber concentrations of less than 0.01 f/cc.

3.2 Discussion of Findings (Lakeshore High School)

Asbestos-containing materials were removed from the Wood Shop of Lakeshore High School on July 30, 1983. Prevalent air sampling was done on July 21-22, 1983, and clean air sampling was conducted on August 1, 1983.

The prevalent air concentration was less than 0.01 f/cc, as were both work area samples. Clean air sampling also showed concentrations of less than 0.01 f/cc.

3.3 Discussion of Findings (Woodland High School)

Asbestos Containing Materials were removed from the Wood Shop of Woodland High School on July 30, 1983. Prevalent area sampling was conducted on July 21-22, 1983, and clean-air sampling was done on August 1, 1983.

The prevalent air concentration was less than 0.01 f/cc, as were the work area samples. Two clearance samples also showed concentrations of less than 0.01 f/cc.

3.4 Discussion of Findings (M.D. Collins High School)

Asbestos-containing materials were removed from the hot water tank of M.D. Collins High School on July 31, 1983, and clearance sampling was conducted on August 2, 1983. Pre-removal prepping was done the same day as the removal. No prevalent air samplings were taken on this job since clearance sampling from the main removal job several weeks earlier showed concentrations of less than 0.01 f/cc.

One outside sample was taken during removal and had a fiber count of less than 0.01 f/cc. The work area sample showed a 6.94 f/cc level. Two outside the work area (inside the building) samples were also taken. These samples were 0.15 f/cc inside the Boiler Room on the opposite side of the barrier, and less than 0.01 f/cc outside the Boiler Room in the hall. One clean air sample showed a fiber concentration of less than 0.01 f/cc.

Details concerning the exact location and concentration of each sample taken on all the jobs described in Section 3 of this report can be found in Appendix A.

This Report Prepared By:

Kevin L. Kamperman
Accident Prevention Officer

This Report Approved By:

James L. Burson, Program Manager
Occupational Safety and Health
Consultation Program

Table A-1

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kenneth E. Johnson and William M. Ewing

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/10/83	AA-172	Outside Bldg - near Decon - Approx 50' from entrance	0952	1717	890	455	<2800	<0.01
6/10/83	AA-177	Lower Level - South Corridor - Locker #348A	0954	1641	814	407	2800	0.01
6/10/83	AA-174	Entrance to Rooms 100 & 101	0956	1643	814	407	2800	0.01
6/10/83	AA-175	Industrial Arts - Wood Shop - on Table Saw - Prepping Started	0959	1646	814	407	2800	0.01
6/10/83	AA-171	Room 126 - On Cabinet **	1007	1650	806	403	< 2800	<0.01
6/10/83	AA-176	Outside Room 218 - on Locker 575A -Moved to Doorway at Stairs	1011	1652	802	401	< 2800	<0.01
6/10/83	AA-180	Blank	----	----	---	---	<2800	----
		Pump Running Strange - Still Running at Pickup						

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kenneth E. Johnson & William M. Ewing

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/19/83	AA-277	Area Sample - Outside Work Area At Entrance to Decon	0936	1347	502	251	<2800	< 0.01
6/19/83	AA-281	Area Sample - outside Work Area In Trailer Clean Room	0943	1346	486	243	9600	0.02
6/19/83	AA-286	Area Sample - Work Area - At Entrance to Dirty Side of Decon	1019	1150	182	91	<2800	< 0.01
6/19/83	AA-282	Area Sample - Work Area - In Main Lobby Near Office	1016	1147	182	91	3600	0.02
6/19/83	AA-287	Area Sample - Work Area - On Top of Microtrap in Front of Gym	1013	1145	184	92	9600	0.05
NOTE:	Actual removal had not yet begun. Removing ceiling tiles and grid. Fibers may or may not represent							
	asbestos since the ceiling tile are composed of mineral wool. All workers wearing powered-air purifying							
	airhats							

Table A-3

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kenneth A. Smith

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/20/83	AA-228	Area Sample - Outside Work Area On Top of Old Shower Stall	0940	1455	630	315	< 2800	< 0.01
6/20/83	AA-234	Area Sample - In Window of Decon Dirty Side	1053	1435	444	222	< 2800	< 0.01
6/20/83	AA-233	Area Sample - Inside Room 204 Lights Being Removed and Cleaned	1057	1440	446	223	5000	0.01
6/20/83	AA-238	Area Sample - Near Left Side Entrance to Gym	1105	1445	440	220	10000	0.02
6/20/83	AA-232	Blank	----	----	----	----	< 2800	----

Table A-4

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District
M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kenneth A. Smith

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/21/83	AA-244	Area Sample - Outside Work Area On Top of Old Shower Stall	0830	1430	720	360	<2800	<0.01
6/21/83	AA-243	Area Sample-Work Area- In Window of Decon Dirty Side	0915	1317	484	242	<2800	<0.01
6/21/83	AA-241	Area Sample - Work Area - Top of Stairs Near Front Entrance	0925	1330	490	245	8000	0.02
6/21/83	AA-220	Area Sample - Work Area - Near Left Side Entrance to Gym	0933	1335	484	242	<2800	<0.01
6/21/83	AA-231	Blank	----	----	---	---	<2800	----

Table A-3

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kenneth A. Smith

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/22/83	AA-239	Personal Sample - On Sam Meyers - Bagging	1048	1103	30	15	4000	0.13
6/22/83	AA-226	Personal Sample - On Sam Meyers - Bagging	1103	1133	60	30	< 2800	< 0.01
6/22/83	AA-229	Personal Sample - On Sam Meyers - Bagging	1410	1433	46	23	< 2800	< 0.01
6/22/83	AA-225	Personal Sample - On Sam Meyers - Bagging	1434	1520	92	46	3000	0.03
6/22/83	AA-222	Personal Sample - On Sam Meyers - Scraping	1351	1410	38	19	3000	0.08
6/22/83	AA-235	Personal Sample - On Henry Biston - Scraping	1354	1414	40	20	< 2800	< 0.01
6/22/83	AA-237	Personal Sample - On Henry Biston - Scraping	1415	1439	48	24	9000	0.19
6/22/83	AA-224	Personal Sample - On Henty Biston - Scraping	1440	1542	124	62	4000	0.03
6/22/83	AA-242	Personal Sample - On Anthony Wentworth - Bagging	1051	1108	34	17	< 2800	< 0.01
6/22/83	AA-240	Personal Sample - On Anthony Wentworth - Bagging	1108	1136	56	28	< 2800	< 0.01
6/22/83	AA-223	Area Sample - Work Area - In Window in Decon Dirty Side	1019	1555	672	336	< 2800	< 0.01
6/22/83	AA-236	Area Sample - Work Area - Just Inside Bldg from Decon	1040	1510	540	270	< 2800	< 0.01
6/22/83	AA-221	Area Sample - Work Area - Near Water Fountain Outside Room 200	1045	1515	540	270	5000	< 0.01
6/22/83	AA-227	Blank	----	----	---	---	< 2800	----

First Day of Scraping

Table A-6

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Michael Lowish

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/23/83	AA-725	Area Sample - Outside Under Loading Ramp	0900	1440	680	340	<2800	<0.01
6/23/83	AA-727	Area Sample -Work Area-In Window Decon Dirty Side	0920	1355	550	275	<2800	<0.01
6/23/83	AA-724	Area Sample - Work Area - In Hall Outside Admin - On Tiles	0935	1352	514	257	<2800	<0.01
6/23/83	AA-719	Area Sample - Work Area - In Hall Leading to Stairwell	0930	1345	510	255	5000	0.01
6/23/83	AA-722	Area Sample - Work Area - Inside Room 102 (near microtrap)	0945	1348	486	243	<2800	<0.01
6/23/83	AA-230	Blank	----	----	---	---	<2800	----

Table A-7

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Paul J. Middendorf

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/24/83	AA-710	Area Sample - Outside Bldg - On Fence	0836	1240	488	244	<2800	<0.01
6/24/83	AA-704	Area Sample - Work Area - In Hall on Second Floor	0931	1201	300	150	15000	0.05
6/24/83	AA-718	Area Sample - Work Area - In Window of Decon Dirty Side	0924	1218	348	174	<2800	<0.01
6/24/83	AA-715	Area Sample - Work Area - In Downstairs Stairwell near Rm118	0939	1211	304	152	<2800	<0.01
6/24/83	AA-726	Area Sample - Work Area - Inside Room 214 - Bagging	0934	1203	298	149	10000	0.03
6/24/83	AA-714	Blank	----	----	---	---	<2800	----

TABLE A-8

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Paul J. Middendorf

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/25/83	AA-717	Area Sample - Outside building - On Fence	0823	1223	480	240	< 2800	< 0.01
6/25/83	AA-720	Area Sample - work area - inside room 127	0859	1135	312	156	17000	0.05
6/25/83	AA-711	Area Sample - work area - outside room 218	0906	1137	302	151	3000	0.01
6/25/83	AA-713	Area Sample - work area - in window of decon dirty side	0834	1142	376	188	3000	0.01
6/25/83	AA-712	Area sample - work area - inside room 132	0902	1133	302	151	*VOID	*VOID
6/25/83	AA-716	Blank	-	-	-	-	< 2800	-
		Filter Grossly Contaminated						

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District
M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kenneth A. Smith, CIH

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/26/83	AA-708	Area Sample - outside building on roof near microtrap vent	0829	1249	520	260	<2800	<0.01
6/26/83	AA-705	Area Sample-outside work area, inside building-trailer clean area	0852	1228	432	216	<2800	<0.01
6/26/83	AA-703	Area Sample-workarea-upstream from microtrap	0907	1225	396	198	<2800	<0.01
6/26/83	AA-723	Area Sample-work area-inside room 125	0900	1220	400	200	3000	<0.01
6/26/83	AA-721	Area Sample-work area-inside room 124	0904	1222	396	198	<2800	<0.01
6/26/83	AA-704	Blank	-	-	-	-	<2800	-

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kenneth A. Smith

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/27/83	AA-696	Area Sample-outside building-downstream from microtrap vent	0945	1440	590	295	<2800	<0.01
6/27/83	AA-729	Area Sample-work area-dirty side of trailer	1005	1410	490	245	<2800	<0.01
6/27/83	AA-702	Area Sample-work area-immediately inside bldg. at stairwell	1015	1422	494	247	<2800	<0.01
6/27/83	AA-733	Area Sample-work area-inside room 112	1026	1430	488	244	<2800	<0.01
6/27/83	AA-692	Area Sample-workarea-in Hallway across from gym	1031	1433	484	242	<2800	<0.01
6/27/83	AA-738	Blank	-	-	-	-	<2800	-

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District
M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/28/83	AA-246	Area Sample-outside work area, inside bldg-trailer clean room	0900	1402	604	302	< 2800	< 0.01
6/28/83	AA-206	Area Sample-workarea-in window trailer dirty room	0907	1408	602	301	< 2800	< 0.01
6/28/83	AA-205	Area Sample-work area-inside room 115	0911	1413	604	302	< 2800	< 0.01
6/28/83	AA-255	Area Sample-work area-inside room 122	0915	1416	602	301	*VOID	*VOID
6/28/83	AA-260	Blank	-	-	-	-	< 2800	-
		Filter Painted-Over						

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District
M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/29/83	AA-253	Area Sample-outside work area, inside bldg-trailer clean room	0950	1451	602	301	< 2800	< 0.01
6/29/83	AA-266	Area Sample-work area-in window of trailer dirty room	0953	1454	602	301	20000	0.03
6/29/83	AA-272	Area Sample-work area-bottom of stairwell near room 121	0957	1458	602	301	3000	< 0.01
6/29/83	AA-263	Area Sample-work area-botton entrance to stairwell near rm 132	1000	1500	600	300	< 2800	< 0.01
6/29/83	AA-265	Blank	-	-	-	-	< 2800	-

TABLE A-13

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District
M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Michael Lowish

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
6/30/83	AA-209	Area Sample-work area-inside room 106	1100	2220	2800	1400	37000	0.01
6/30/83	AA-275	Area Sample-work area-in hallway upstairs on water fountain near	1025 rooftop	2228	2886	1443	110000	0.04
6/30/83	AA-274	Area Sample-Work area-inside room 125	1108	2235	2814	1407	94000	0.03
6/30/83	AA-271	Area Sample-work area-in hallway upstairs on water fountain	1020	2232	2904	1452	68000	0.02
6/30/83	AA-249	Area Sample-work area-industrial arts shop	1115	1445	420	210	< 2800	<0.01
6/30/83	AA-270	Blank	-	-	-	-	< 2800	-

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

Report No. A-3544

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District
M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Phillip L. William, CIH

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/1/83	AA-862	Area Sample-outside building	0942	1542	720	360	4300	< 0.01
7/1/83	AA-867	Area Sample-work area-in window of trailer dirty room	0952	1604	744	372	13000	0.02
7/1/83	AA-868	Area Sample-work area-inside room 100	0956	1605	738	369	*VOID	*VOID
7/1/83	AA-864	Area Sample-work area-in hall-way.	0954	1606	744	372	6400	< 0.01
7/1/83	AA-857	Blank	-	-	-	-	2800	-

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Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kenneth A. Smith, CIH

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/2/83	AA-856	Area Sample-outside bldg-on fence	0828	1305	554	277	< 2800	< 0.01
7/2/83	AA-876	Area Sample-work area-in window of trailer dirty side	0837	1251	508	254	9400	0.02
7/2/83	AA-866	Area Sample-work area-on top of microtrap outside room 100	0839	1250	502	251	18000	0.04
7/2/83	AA-872	Area Sample-work area-inside room 101	0841	1249	496	248	36000	0.07
7/2/83	AA-865	Blank	-	-	-	-	< 2800	-

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M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/5/83	AA-796	Area Sample-outside bldg- on fence	1111	1522	502	251	*VOID	*VOID
7/5/83	AA-797	Area Sample-work area in window of trailer dirty side	1114	1530	512	256	7400	0.01
7/5/83	AA-799	Area Sample-work area-inside room 104	1118	1531	506	253	61000	0.12
7/5/83	AA-830	Area Sample-work area-on top of microtrap	1121	1533	504	252	12000	0.02
7/5/83	AA-842	Blank	-	-	-	-	< 2800	-

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Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/5-6/83	AA-831	Area Sample - Clean Air - Inside Room 125	1113	1120	2894	1447	<2800	<0.01
7/5-6/83	AA-832	Area Sample - Clean Air - Outside Room 203	1136	1114	2836	1418	<2800	<0.01
7/5-6/83	AA-837	Area Sample - Clean Air - Inside Room 213	1139	1115	2832	1416	<2800	<0.01
7/5-6/83	AA-833	Area Sample - Clean Air - Outside Room 115	1146	*VOID	*VOID	*VOID	*VOID	*VOID
7/5-6/83	AA-825	Blank	----	----	----	----	<2800	----
		Pump stopped during night						

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Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/6/83	AA-798	Area Sample - Outside Bldg - On Fence	1145	1604	518	259	<2800	<0.01
7/6/83	AA-839	Area Sample - Work Area - Inside Industrial Arts Room	1133	1549	512	256	<2800	<0.01
7/6/83	AA-826	Area Sample - Work Area - Near Microtrap, Across from Room 102	1129	1547	516	258	<2800	<0.01
7/6/83	AA-828	Area Sample - Work Area - In Window in Trailer Dirty Side	1126	1545	518	259	<2800	<0.01
7/6/83	AA-824	Blank	----	----	----	----	<2800	----

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Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kevin Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/7/83	AA-898	Area Sample-work area-in window in trailer dirty side	1021	1419	476	238	<2800	<0.01
7/7/83	AA-882	Area Sample-outside bldg. on fence	1011	1434	526	263	<2800	<0.01
7/7/83	AA-895	Area sample-work area-in hall outside Asst. Principal's office	1025	1415	460	230	4000	<0.01
7/7/83	AA-899	Area sample-work area-in hall outside administrative offices	1027	1416	458	229	14000	0.03
7/7/83	AA-888	Blank	-	-	-	-	<2800	-

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Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Paul J. Middendorf, CIH

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/8/8	AA-811	Area sample-outside bldg. on fence	0901	1304	486	243	<2800	<0.01
7/8/83	AA-813	Area sample-work area-in hallway near gym	0928	1200	304	152	5000	0.02
7/8/83	AA-814	Area sample-work area-in window of trailer dirty room	0921	1206	330	165	4000	0.01
7/8/83	AA-812	Area sample-work area-on microtrap	0924	1159	312	156	26000	0.08
7/8/83	AA-810	Blank	-	-	-	-	< 2800	-

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Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Phillip L. Williams, CIH

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/9/83	AA-808	Area sample-outside bldg.-on steps to trailer	0835	1236	482	241	6000	0.01
7/9/83	AA-807	Area sample-workarea-on windows of trailer dirty room	0840	1240	480	240	18000	0.04
7/9/83	AA-806	Blank	-	-	-	-	<2800	-

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Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: William H. Spain, CIH

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/10/83	AA-981	Area Sample-work area-near small trophy case by gym	1202	1708	612	306	83000	0.14
7/10/83	AA-971	Area sample-work area-inside room 102	1207	1709	604	302	26000	0.04
7/10/83	AA-966	Area sample-work area-outside counselor and admin. offices	1210	1711	602	301	77000	0.13
7/10/83	AA-982	Area sample-outside bldg. or fence	1218	1715	594	297	< 2800	< 0.01
7/10/83	AA-969	*Area sample CLEAN AIR-in industrail arts	1258	1706	491	246	< 2800	< 0.01
7/10/83	AA-977	Blank	-	-	-	-	< 2800	-
		* CLEAN AIR TEST*						

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Plant Fulton County School District

M.D. Collins High School College Park, Georgia

Materials Fibers Greater than 5 Micrometers in Length

Collected By: Kenneth A. Smith, CIH

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/11/83	AA-956	Area sample-clean air-near small trophy case by gym	1140	1735	710	355	< 2800	< 0.01
7/11/83	AA-978	Area sample-clean air-outside counselor and admin. office	1145	1733	696	348	< 2800	< 0.01
7/11/83	AA-940	Area sample-clean air-in hallway outside of room 102	1150	1730	692	346	< 2800	< 0.01
7/11/83	AA-957	Blank	-	-	-	-	< 2800	-

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INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

Campbell High School Fairburn, Georgia

Materials Fibers greater than 5 micrometers in length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
7/20-21/83	AA-1304	Area sample-prevalent air-in shop window in far wall near fans	1128	1049	2802	1401	< 2800	< 0.01
7/20-21/83	AA-1305	Area sample-prevalent air-in military room chalktray	1134	1050	2792	1396	< 2800	< 0.01
7/20-21/83	AA-1308	Area sample-prevalent air-band-room-below chalktray	1137	1051	2788	1394	< 2800	< 0.01
7/20-21/83	AA-1309	Blank	-	-	-	-	< 2800	-

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INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

Campbell High School Fairburn, Georgia

Materials Fibers greater than 5 micrometers in length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
7/28/83	*C-1	Area sample-work area-in window of trailer dirty side	0820	1442	774	332	< 2800	<0.01
7/28/83	*C-2	Personal sample-on Todd Huffman (scraping)	0845	1442	714	357	4000	<0.01
7/28/83	AA-1369	Area sample-outside bldg-down-wind from microtrap	0946	1442	642	321	< 28000	<0.01
7/28/83	AA-1368	Area sample-work area-choir room on top of shelves against far wall	1019	1442	526	263	6000	0.01
7/28/83	AA-]368	Blank	-	-	-	-	< 2800	-
		* C-1 and C-2 supplied by Cross Construction-pumps at 1.5 l/m						

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Plant Fulton County School District

Campbell High School Fairburn, Georgia

Materials Fibers greater than 5 micrometers in length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc
7/30/83	AA-1372	Area sample-clean air-in shop Chalktray	1601	2339	916	458	< 2800	<0.01
7/30/83	AA-1373	Area sample-clean air-in choir room chalktray	1558	2335	914	457	< 2800	<0.01
7/30/83	AA-1367	Area sample-clean air-in military room chalktray	1600	2337	914	457	< 2800	<0.01
7/30/83	AA-1362	Area Sample-clean air-in band-room chalktray	1556	2333	914	457	< 2800	<0.01
7/30/83	AA-1380	Blank	-	-	-	-	< 2800	-

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INDUSTRIAL HYGIEN SAMPLING SUMMARY

Plant Fulton County School District

Lakeshore High School College Park, Georgia

Materials Fibers Greater than 5 micrometers in length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
7/21-22/83	AA-1254	Area sample-prevalent air- in chalktray	1131	0950	2678	1339	< 2800	<0.01
7/21-22/83	AA-1256	BLANK	-	-	-	-	<2800	-

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INDUSTRIAL HYGIEN SAMPLING SUMMARY

Plant Fulton County School District

Lakeshore High School College Park, Georgia

Materials Fibers Greater than 5 micrometers in length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
7/30/83	AA-1364	Area sample-work area on Lathe	0817	1236	522	261	<2800	< 0.01
7/30/83	AA-1365	Area sample-work area on sander	0815	1236	518	259	4000	< 0.01
7/30/83	AA-1361	Blank	-	-	-	-	<2800	-

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INDUSTRIAL HYGIEN SAMPLING SUMMARY

Plant Fulton County School District

Lakeshore High School, College Park, Georgia

Materials Fibers Greater than 5 micrometers in length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
8/1/83	AA-1231	Area sample-clean air-in right chalktray opposite door	0904	1809	1090	545	< 2800	< 0.01
8/1/83	AA-1225	Area sample clean air-in left chalktray opposite door	0905	1809	1088	544	< 2800	< 0.01
8/1/83	AA-1377	Blank	-	-	-	-	< 2800	-

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INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

Woodland High School East Point, Georgia

Materials Fibers Greater than 5 micormeters in Length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
7/21-22/83	AA-1255	Area sample-prevalent air-inside shop-on floor against rt. wall	1157	0937	2600	1300	<2800	< 0.01
7/21-22/83	AA-1256	Blank	-	-	-	-	<2800	

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INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant Fulton County School District

Woodland High School East Point, Georgia

Materials Fibers Greater than 5 micormeters in Length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
7/30/83	AA-1363	Area sample-work area-on counter aginst right wall	0844	1323	558	279	*VOID	*VOID
7/30/83	AA-1366	Area sample-work area-on window ledge against left wall	0849	1323	548	274	<2800	<0.01
7/30/83	AA-1361	Blank	-	-	-	-	<2800	-
		* Wet Filter-would not clear*						

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Plant Fulton County School District

Woodland High School East Point, Georgia

Materials Fibers Greater than 5 micormeters in Length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
8/1/83	AA-1371	Area sample-clean air-against far wall on saw	0943	1827	1048	524	<2800	<0.01
8/1/83	AA-1378	Area sample-clean air-against left wall on sander	0942	1827	1050	525	<2800	<0.01
8/1/83	AA-1377	Blank	-	-	-	-	<2800	-

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Plant Fulton County School District
M.D. Collins High School College Park, Georgia

Materials Fibers greater than 5 micrometers in length

Completer By: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
7/31/83	AA-1376	Area sample-outside bldg. on fence	0938	1124	212	106	2800	0.01
7/31/83	AA-1375	Area sample-workarea-on shelf near sink	0936	1122	212	106	1470000	6.94
7/31/83	AA-1374	Area sample-inside boiler room	0940	1127	214	107	31000	0.15
7/31/83	AA-1379	Area sample-inside bldg., outside workarea-in hallway	0941	1126	210	105	2800	0.01
7/31/83	AA-1380	Blank	-	-	-	-	-	-

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Plant Fulton County School District

M.D. Collins High School, College Park, Georgia

Materials Fibers greater than 5 micrometers in length

Collected by: Kevin L. Kamperman

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop				
8/2/83	AA-1166	Area sample-clean air-inside b.room on light fixtures against inner wall	0950	*VOID	*VOID	*VOID	*VOID	*VOID
8/2/83	AA-1229	Area sample-clean air-inside b. room on bags & cans against outer wall	0950	1759	978	489	<2800	<0.01
8/2/83	AA-1235	Blank	-	-	-	-	<2800	-
		* Pump belt broke - impossible to determine sampling time*						

Investigator's Survey Checklist

tigator: MICHAEL D. LOWISH Date: _____ Time: _____

tion: COLLEGE PARK - FULTON COUNTY SCHOOLS

ractor name and address: CROSS CONSTRUCTION CO,

Phone: (_____)_____

	YES	NO	Comments
NOVATION/WORK AREA OBSERVATIONS			
Work area isolated?	✓	___	_____
All openings to work area sealed?	✓	___	_____
Air movement system sealed off?	✓	___	_____
Warning signs at all entrances/exits?	✓	___	_____
Entrance to work area securable?	✓	___	_____
EPA and OSHA regulations posted on site?	✓	___	_____
RSONAL PROTECTIVE EQUIPMENT			
NIOSH approved respirators? Type? RHVAL AIR HATS	✓	___	_____
Disposable coveralls?	✓	___	_____
Head covering?	✓	___	_____
Foot/shoe covering?	✓	___	_____
Equipment for inspectors available?	✓	___	_____
Portable toilets on site?	✓	___	_____

	YES	NO	Comments
CONTAIMINATION AREA			
OUTSIDE CHANGE ROOM			
Hangers/lockers/bins for street clothes?	✓		
Lockbox for valubles?	✓		
Airlock to shower?	✓		
Towels available?	✓		
SHOWER FACILITY			
Soap avalable?	✓		
Sanitary conditions maintained?	✓		
Number of shower heads	2		
Container for the disposal of uses respirator filters/cartridges?	✓		
Airlock to inside change room?	✓		
INSIDE CHANGE ROOM			
Disposal bin for contaiminated clothing?	✓		
Sanitary conditions maintained?	✓		
Airlock to work area?	✓		
ORK PRACTICES			
. Are wet methods employed?	✓		
. EPA-recommended wetting agent used?	✓		
. Are HEPA filter vacuums used?	✓		
. Are light fixtures and other equipment cleaned before removal from work area?	✓		
. Furniture and other stationary items in work area covered and sealed?	✓		

	YES	NO	Comments
; waste bagged while wet?	✓		
\re 6 mil bags used?	✓		
\re bags properly labeled?	✓		
\re bags placed in drums and sealed?	✓		
Are workers wearing protective clothing at all times while in work area?	✓		
Are workers disposing of contaiminated clothing at the end of each work period?	✓		
Are respirators worn at all times?	✓		
Smoking or gum/tobacco chewing in work area?	✓		
. Are workers using the shower?	✓		

SPOSAL

Labels on the drums?	✓		
Are drums with ruptured bags disposed of properly?	✓		
Do disposal personnel obtain trip tickets to verify trips to the landfill?	✓		

ISCELLANEOUS

. Does each worker have evidence of having received a medical exam within the last three months?			
. Are there sufficient fire/emergency exits?	✓		

NVESTIGATOR'S COMMENTS (Use reverse side of page if necessary)_____

_____

_____

nvestigator's signature:_____

Investigator's Survey Checklist

Investigator: Phil Will — Date: 7/1/83 Time: 4:00 pm

Location: M.D. Collins H.S. - College Park

Contractor name and address: _____

_____

Phone: (_____) _____

	YES	NO	Comments
RENOVATION/WORK AREA OBSERVATIONS			
1. Work area isolated?	✓		
2. All openings to work area sealed?	✓		
3. Air movement system sealed off?	✓		
4. Warning signs at all entrances/exits?	✓		
5. Entrance to work area securable?	✓		
6. EPA and OSHA regulations posted on site?	not sure		
PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type? _____	✓		
2. Disposable coveralls?	✓		
3. Head covering?	Provided but not worn (use air caps)		
4. Foot/shoe covering?	✓		
5. Equipment for inspectors available?	✓		
6. Portable toilets on site?	✓ (PH)		

	YES	NO	Comments
DECONTAIMINATION AREA			
A. OUTSIDE CHANGE ROOM			
1. Hangers/lockers/bins for street clothes?	✓		
2. Lockbox for valubles?	✓		
3. Airlock to shower?	✓		
4. Towels available?	✓		
B. SHOWER FACILITY			
1. Soap avalable?	✓		
2. Sanitary conditions maintained?	✓		
3. Number of shower heads	1 + hand spray nozzle		
4. Container for the disposal of uses respirator filters/cartridges?	✓		
5. Airlock to inside change room?	✓		
C. INSIDE CHANGE ROOM			
1. Disposal bin for contaiminated clothing?	✓		
2. Sanitary conditions maintained?	✓		
3. Airlock to work area?	✓		
WORK PRACTICES			
1. Are wet methods employed?	✓		
2. EPA-recommended wetting agent used?	✓		
3. Are HEPA filter vacuums used?	✓		
4. Are light fixtures and other equipment cleaned before removal from work area?	✓		
5. Furniture and other stationary items in work area covered and sealed?	✓		

	YES	NO	Comments
6. Is waste bagged while wet?	✓		
7. Are 6 mil bags used?	✓		
8. Are bags properly labeled?	✓		
9. Are bags placed in drums and sealed?	✓		
10. Are workers wearing protective clothing at all times while in work area?	Ø	✓	Remove before entering Showers
11. Are workers disposing of contaiminated clothing at the end of each work period?	✓		
12. Are respirators worn at all times?	✓		Noticed a few employees raise face sheild in work area
13. Smoking or gum/tobacco chewing in work area?		✓	
14. Are workers using the shower?	✓		

DISPOSAL

1. Labels on the drums?	✓		
2. Are drums with ruptured bags disposed of properly?	✓		
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?	Not	Sure	

MISCELLANEOUS

1. Does each worker have evidence of having received a medical exam within the last three months?	✓		
2. Are there sufficient fire/emergency exits?	✓		

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary)

Very clean and orderly worksite

Investigator's signature:

Investigator's Survey Checklist

Investigator: Phil Will Date: 7/2/83 Time: 10:00 AM

Location: M.D. Collins H.S. - College Park

Contractor name and address: _____

_____

Phone: (_____) _____

	YES	NO	Comments
RENOVATION/WORK AREA OBSERVATIONS			
1. Work area isolated?	✓		
2. All openings to work area sealed?	✓		
3. Air movement system sealed off?	✓		
4. Warning signs at all entrances/exits?	✓		
5. Entrance to work area securable?	✓		
6. EPA and OSHA regulations posted on site?	not sure		
PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type? _____	✓		
2. Disposable coveralls?	✓		
3. Head covering?	Provided but not worn		(use air caps)
4. Foot/shoe covering?	✓		
5. Equipment for inspectors available?	✓		
6. Portable toilets on site?	✓ (PH)		

	YES	NO	Comments
DECONTAIMINATION AREA			
A. OUTSIDE CHANGE ROOM			
1. Hangers/lockers/bins for street clothes?	✓		
2. Lockbox for valubles?	✓		
3. Airlock to shower?	✓		
4. Towels available?	✓		
B. SHOWER FACILITY			
1. Soap avalable?	✓		
2. Sanitary conditions maintained?	✓		
3. Number of shower heads	1 + hand spray nozzle		
4. Container for the disposal of uses respirator filters/cartridges?	✓		
5. Airlock to inside change room?	✓		
C. INSIDE CHANGE ROOM			
1. Disposal bin for contaiminated clothing?	✓		
2. Sanitary conditions maintained?	✓		
3. Airlock to work area?	✓		
WORK PRACTICES			
1. Are wet methods employed?	✓		
2. EPA-recommended wetting agent used?	✓		
3. Are HEPA filter vacuums used?	✓		
4. Are light fixtures and other equipment cleaned before removal from work area?	✓		
5. Furniture and other stationary items in work area covered and sealed?	✓		

	YES	NO	Comments
6. Is waste bagged while wet?	✓		
7. Are 6 mil bags used?	✓		
8. Are bags properly labeled?	✓		
9. Are bags placed in drums and sealed?	✓		
10. Are workers wearing protective clothing at all times while in work area?	Ø	✓	Remove before entering Showers
11. Are workers disposing of contaiminated clothing at the end of each work period?	✓		
12. Are respirators worn at all times?	✓		Noticed a few employees raise face sheild in work area
13. Smoking or gum/tobacco chewing in work area?		✓	
14. Are workers using the shower?	✓		

DISPOSAL

1. Labels on the drums?	✓		
2. Are drums with ruptured bags disposed of properly?	✓		
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?	Not	Sure	

MISCELLANEOUS

1. Does each worker have evidence of having received a medical exam within the last three months?	✓		
2. Are there sufficient fire/emergency exits?	✓		

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary)

Very clean and orderly worksite

Investigator's signature: [redacted]

Investigator's Survey Checklist

igator: K Kaufman Date: 7/5/83 Time: 11:45

ion: M. D. Collins H.S. College Park, Ga

actor name and address: Cross Construction

Phone: (_____)_____

	YES	NO	Comments
OVATION/WORK AREA OBSERVATIONS			
ork area isolated?	\		
ll openings to work area sealed?	\		
ir movement system sealed off?	\		
Warning signs at all entrances/exits?	\		
Entrance to work area securable?	\		
EPA and OSHA regulations posted on site?	\		
RSONAL PROTECTIVE EQUIPMENT			
NIOSH approved respirators? Type?_____	\		
Disposable coveralls?	\		
Head covering?	\		
Foot/shoe covering?	\		
Equipment for inspectors available?	\		
Portable toilets on site?	\		

	YES	NO	Comments
CONTAIMINATION AREA			
OUTSIDE CHANGE ROOM			
Hangers/lockers/bins for street clothes?	\		
Lockbox for valubles?	\		
Airlock to shower?	\		
Towels available?	\		
SHOWER FACILITY			
Soap avalable?	\		
Sanitary conditions maintained?	\		
Number of shower heads 1 + hose			
Container for the disposal of uses respirator filters/cartridges?	\		
. Airlock to inside change room?	\		
. INSIDE CHANGE ROOM			
. Disposal bin for contaiminated clothing?	\		
. Sanitary conditions maintained?	\		
. Airlock to work area?	\		
WORK PRACTICES			
1. Are wet methods employed?	\		
2. EPA-recommended wetting agent used?	\		
3. Are HEPA filter vacuums used?	\		
4. Are light fixtures and other equipment cleaned before removal from work area?	\		
5. Furniture and other stationary items in work area covered and sealed?	\		

	YES	NO	Comments
; waste bagged while wet?	\		
,re 6 mil bags used?	\		
,re bags properly labeled?	\		
,re bags placed in drums and sealed?		\	not using drums
Are workers wearing protective clothing at all times while in work area?	\		
Are workers disposing of contaiminated clothing at the end of each work period?	\		
Are respirators worn at all times?	\		
Smoking or gum/tobacco chewing in work area?	\		
Are workers using the shower?	\		
SPOSAL			
_abels on the drums?		\	no drums
Are drums with ruptured bags disposed of properly?		\	"
Do disposal personnel obtain trip tickets to verify trips to the landfill?	\		
SCELLANEOUS			
Does each worker have evidence of having received a medical exam within the last three months?	\		
Are there sufficient fire/emergency exits?	\		

IVESTIGATOR'S COMMENTS (Use reverse side of page if necessary)

vestigator's signature:

Investigator's Survey Checklist

igator: X Vanderman Date: 7/6/83 Time: 1150

ion: M.O. Collins H.S. College Park, Ga

actor name and address: Cross Construction

Phone: (_____)_____

	YES	NO	Comments
OVATION/WORK AREA OBSERVATIONS			
ork area isolated?	✓		
ll openings to work area sealed?	✓		
ir movement system sealed off?	✓		
Warning signs at all entrances/exits?	✓		
Entrance to work area securable?	✓		
EPA and OSHA regulations posted on site?	✓		
RSONAL PROTECTIVE EQUIPMENT			
NIOSH approved respirators? Type?_____	✓		
Disposable coveralls?	✓		
Head covering?	✓		
Foot/shoe covering?	✓		
Equipment for inspectors available?	✓		
Portable toilets on site?	✓		

	YES	NO	Comments
CONTAIMINATION AREA			
OUTSIDE CHANGE ROOM			
Hangers/lockers/bins for street clothes?	✓		
Lockbox for valubles?	✓		
Airlock to shower?	✓		
Towels available?	✓		
SHOWER FACILITY			
Soap avalable?	✓		
Sanitary conditions maintained?	✓		
Number of shower heads 1 + work			
Container for the disposal of uses respirator filters/cartridges?	✓		
Airlock to inside change room?	✓		
INSIDE CHANGE ROOM			
Disposal bin for contaiminated clothing?	✓		
Sanitary conditions maintained?	✓		
Airlock to work area?	✓		
ORK PRACTICES			
Are wet methods employed?	✓		
EPA-recommended wetting agent used?	✓		
Are HEPA filter vacuums used?	✓		
Are light fixtures and other equipment cleaned before removal from work area?	✓		
Furniture and other stationary items in work area covered and sealed?	✓		

	YES	NO	Comments
s waste bagged while wet?	\		
Are 6 mil bags used?	\		
Are bags properly labeled?	\	\	
Are bags placed in drums and sealed?			not using drums
Are workers wearing protective clothing at all times while in work area?	\		
Are workers disposing of contaiminated clothing at the end of each work period?	\		
Are respirators worn at all times?	\		
Smoking or gum/tobacco chewing in work area?	\		
Are workers using the shower?	\		

SPOSAL

Labels on the drums?		\	see above
Are drums with ruptured bags disposed of properly?		\	"
Do disposal personnel obtain trip tickets to verify trips to the landfill?	\		

SCELLANEOUS

Does each worker have evidence of having received a medical exam within the last three months?	\		
Are there sufficient fire/emergency exits?	\		

IVESTIGATOR'S COMMENTS (Use reverse side of page if necessary)_____

_____

_____

vestigator's signature: _____

Investigator's Survey Checklist

gator: K Kamperman Date: 7/7/83 Time: _____

on: M.D. Collins H.S. College Park, Ga

ctor name and address: Bass Construction

_____

Phone: (_____) _____

	YES	NO	Comments
OVATION/WORK AREA OBSERVATIONS			
rk area isolated?	\	___	_____
l openings to work area sealed?	\	___	_____
r movement system sealed off?	\	___	_____
arning signs at all entrances/exits?	\	___	_____
ntrance to work area securable?	\	___	_____
PA and OSHA regulations posted on site?	\	___	_____
RSONAL PROTECTIVE EQUIPMENT			
NIOSH approved respirators? Type? _____	\	___	_____
Disposable coveralls?	\	___	_____
Head covering?	\	___	_____
Foot/shoe covering?	\	___	_____
Equipment for inspectors available?	\	___	_____
Portable toilets on site?	\	___	_____

	YES	NO	Comments
ONTAIMINATION AREA			
UTSIDE CHANGE ROOM			
ngers/lockers/bins for street clothes?	\		
ckbox for valubles?	\		
rlock to shower?	\		
wels available?	\		
HOWER FACILITY			
oap avalable?	\		
anitary conditions maintained?	\		
lumber of shower heads 1 THOSE			
ontainer for the disposal of uses espirator filters/cartridges?	\		
irlock to inside change room?	\		
INSIDE CHANGE ROOM			
Disposal bin for contaiminated clothing?	\		
Sanitary conditions maintained?	\		
Airlock to work area?	\		
ORK PRACTICES			
Are wet methods employed?	\		
EPA-recommended wetting agent used?	\		
Are HEPA filter vacuums used?	\		
Are light fixtures and other equipment cleaned before removal from work area?	\		
Furniture and other stationary items in work area covered and sealed?	\		

	YES	NO	Comments
waste bagged while wet?	\		
re 6 mil bags used?	\		
re bags properly labeled?	\		
re bags placed in drums and sealed?		\	NOT USING DRUMS
Are workers wearing protective clothing at all times while in work area?	\		
Are workers disposing of contaiminated clothing at the end of each work period?	\		
Are respirators worn at all times?		\	SEE BELOW
Smoking or gum/tobacco chewing in work area?		\	
Are workers using the shower?	\		

POSAL

Labels on the drums?		\	NOT USING DRUMS
Are drums with ruptured bags disposed of properly?		\	" " "
Do disposal personnel obtain trip tickets to verify trips to the landfill?	\		

SCELLANEOUS

Does each worker have evidence of having received a medical exam within the last three months?	\		
Are there sufficient fire/emergency exits?	\		

NVESTIGATOR'S COMMENTS (Use reverse side of page if necessary)

SAW ONE WORKER WITH MASK PLATE UP WHILE SCRAPING

nvestigator's signature:

Investigator's Survey Checklist

stigator: P. J. MIDDENDORF Date: 7/5/83 Time: 9:30 am

ation: FULTON Co. Schools; M.D. COLLINS H.S.; College Park

tractor name and address: CROSS CONSTRUCTION Co.

Phone: (_____)

	YES	NO	Comments
NOVATION/WORK AREA OBSERVATIONS			
Work area isolated?	✓		
All openings to work area sealed?	✓		See notes at end
Air movement system sealed off?		✓	Micretrap next to gym pulling air through plastic
Warning signs at all entrances/exits?	✓		
Entrance to work area securable?	✓		Also west outside adj. doors not sealed: tape has pulled off
EPA and OSHA regulations posted on site?	✓		
RSONAL PROTECTIVE EQUIPMENT			
NIOSH approved respirators? Type? Racal Airstream			Current cartr. are not approved
Disposable coveralls?	✓		Hood
Head covering?	✓		between
Foot/shoe covering?	✓		clean & dirty
Equipment for inspectors available?	✓		Soil outside adj.
Portable toilets on site?	✓		

	YES	NO	Comments
ONTAIMINATION AREA			
UTSIDE CHANGE ROOM			
angers/lockers/bins for street clothes?	✓		
ockbox for valubles?			
irlock to shower?	✓		
owels available?	✓		
HOWER FACILITY			
oap avalable?	✓		
anitary conditions maintained?	✓		
umber of shower heads 1			
ontainer for the disposal of uses espirator filters/cartridges?	✓		
irlock to inside change room?	✓		
NSIDE CHANGE ROOM			
isposal bin for contaiminated clothing?	✓		
anitary conditions maintained?	✓		
irlock to work area?	✓		
RK PRACTICES			
re wet methods employed?	✓		
PA-recommended wetting agent used?	✓		
re HEPA filter vacuums used?	✓		
re light fixtures and other equipment leaned before removal from work area?	✓		
urniture and other stationary items in work area covered and sealed?	✓		

	YES	NO	Comments
waste bagged while wet?	✓		
re 6 mil bags used?	✓		
re bags properly labeled?	✓		
re bags placed in drums and sealed?		✓	
Are workers wearing protective clothing at all times while in work area?	✓		
Are workers disposing of contaiminated clothing at the end of each work period?	✓		
Are respirators worn at all times?	✓		
Smoking or gum/tobacco chewing in work area?		✓	
Are workers using the shower?	✓		
POSAL			
abels on the drums?		N/A	
Are drums with ruptured bags disposed of properly?			
Do disposal personnel obtain trip tickets to verify trips to the landfill?	✓		
SCELLANEOUS			
Does each worker have evidence of having received a medical exam within the last three months?	✓		
Are there sufficient fire/emergency exits?	✓		

VESTIGATOR'S COMMENTS (Use reverse side of page if necessary) four areas were observed where the plastic had pulled from the wall ① at the mini trap next to the gym - air appeared to be pulled through the gap to the outside ② at a vent outside the administrative offices ③ a wall in the career center ④ at the hall between the cleanroom and dirty side.

vestigator's signature: _____

Investigator's Survey Checklist

Investigator: Phil Willis Date: 7/9/85 Time: 12:00 noon

Location: M.D. Collins H.S. - College Park

Contractor name and address: Cross Construction

Phone: (_____)

	YES	NO	Comments
RENOVATION/WORK AREA OBSERVATIONS			
1. Work area isolated?	✓		
2. All openings to work area sealed?	✓		
3. Air movement system sealed off?	✓		
4. Warning signs at all entrances/exits?	✓		
5. Entrance to work area securable?	✓		
6. EPA and OSHA regulations posted on site?	✓		
PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type?_____	✓		
2. Disposable coveralls?	✓		
3. Head covering?	✓		
4. Foot/shoe covering?	✓		
5. Equipment for inspectors available?	✓		
6. Portable toilets on site?	✓		

	YES	NO	Comments
DECONTAIMINATION AREA			
A. OUTSIDE CHANGE ROOM			
1. Hangers/lockers/bins for street clothes?	✓		
2. Lockbox for valubles?	✓		
3. Airlock to shower?	✓		
4. Towels available?	✓		
B. SHOWER FACILITY			
1. Soap avalable?	✓		
2. Sanitary conditions maintained?	✓		
3. Number of shower heads	1 + spray		
4. Container for the disposal of uses respirator filters/cartridges?	✓		
5. Airlock to inside change room?	✓		
C. INSIDE CHANGE ROOM			
1. Disposal bin for contaiminated clothing?	✓		
2. Sanitary conditions maintained?	✓		
3. Airlock to work area?	✓		
WORK PRACTICES			
1. Are wet methods employed?	✓		
2. EPA-recommended wetting agent used?	✓		
3. Are HEPA filter vacuums used?	✓		
4. Are light fixtures and other equipment cleaned before removal from work area?	✓		
5. Furniture and other stationary items in work area covered and sealed?	✓		

	YES	NO	Comments
6. Is waste bagged while wet?	✓		
7. Are 6 mil bags used?	✓		
8. Are bags properly labeled?	✓		
9. Are bags placed in drums and sealed?	✓		
10. Are workers wearing protective clothing at all times while in work area?	✓		
11. Are workers disposing of contaiminated clothing at the end of each work period?	✓		
12. Are respirators worn at all times?	✓		
13. Smoking or gum/tobacco chewing in work area?	✓		
14. Are workers using the shower?	✓		

DISPOSAL

1. Labels on the drums?	✓		
2. Are drums with ruptured bags disposed of properly?	✓		
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?	✓		

MISCELLANEOUS

1. Does each worker have evidence of having received a medical exam within the last three months?	✓		
2. Are there sufficient fire/emergency exits?	✓		

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary)_____

_____

_____

Investigator's signature: _____

Investigator's Survey Checklist

stigator: WILLIAM SPAIN Date: 7/10/83 Time: 1720

tion: FULTON COUNTY M.D. COLLINS H.S.

ractor name and address: DWIGHT HOPKINS

Phone: (_____)_____

	YES	NO	Comments
NOVATION/WORK AREA OBSERVATIONS			
Work area isolated?	✓	___	___
All openings to work area sealed?	✓	___	___
Air movement system sealed off?	✓	___	___
Warning signs at all entrances/exits?	✓	___	___
Entrance to work area securable?	✓	___	___
EPA and OSHA regulations posted on site?	___	___	NOT OBSERVED
RSONAL PROTECTIVE EQUIPMENT			
NIOSH approved respirators? Type?_____	✓	___	___
Disposable coveralls?	✓	___	AVAILABLE
Head covering?	✓	___	___
Foot/shoe covering?	✓	___	___
Equipment for inspectors available?	✓	___	___
Portable toilets on site?	✓	___	___

	YES	NO	Comments
ECONTAIMINATION AREA			
OUTSIDE CHANGE ROOM			
Hangers/lockers/bins for street clothes?	✓		
Lockbox for valubles?	✓		
Airlock to shower?	✓		
Towels available?	✓		
SHOWER FACILITY			
Soap avalable?	✓		
Sanitary conditions maintained?	✓		
Number of shower heads	1 + SPRAY		
Container for the disposal of uses respirator filters/cartridges?	✓		
Airlock to inside change room?	✓		
. INSIDE CHANGE ROOM			
Disposal bin for contaiminated clothing?	✓		SOME DISPOSABLE SUITS ON FLOOR
Sanitary conditions maintained?	✓		
Airlock to work area?	✓		
'ORK PRACTICES			
. Are wet methods employed?	✓		WET CLEANING TODAY
. EPA-recommended wetting agent used?	N/A		CLEANING
. Are HEPA filter vacuums used?	✓		
. Are light fixtures and other equipment cleaned before removal from work area?	✓		
. Furniture and other stationary items in work area covered and sealed?	✓		

	YES	NO	Comments
Is waste bagged while wet?	✓		
Are 6 mil bags used?	✓		
Are bags properly labeled?	✓		
Are bags placed in drums and sealed?	NOT OBSERVED		
. Are workers wearing protective clothing at all times while in work area?	AS NEEDED		
. Are workers disposing of contaiminated clothing at the end of each work period?	✓		
. Are respirators worn at all times?	✓		
. Smoking or gum/tobacco chewing in work area?		✓	
. Are workers using the shower?	✓		

ISPOSAL

Labels on the drums?	NOT OBSERVED USING DRUMS		
Are drums with ruptured bags disposed of properly?	"		
Do disposal personnel obtain trip tickets to verify trips to the landfill?	"		

ISCELLANEOUS

. Does each worker have evidence of having received a medical exam within the last three months?	✓		
. Are there sufficient fire/emergency exits?	✓		

NVESTIGATOR'S COMMENTS (Use reverse side of page if necessary)_____

_____

_____

nvestigator's signature: _____

Investigator's Survey Checklist

stigator: Ken Smith Date: 9-11-83 Time: 11:30 A.M.

ation: M.D. Colling H.S.

tractor name and address: Dwight Hopkins - Cross Construction Co.

Phone: (_____)_____

	YES	NO	Comments
NOVATION/WORK AREA OBSERVATIONS			
Work area isolated?	____	____	See note at end.
All openings to work area sealed?	____	____	_____
Air movement system sealed off?	____	____	_____
Warning signs at all entrances/exits?	____	____	_____
Entrance to work area securable?	____	____	_____
EPA and OSHA regulations posted on site?	____	____	_____
ERSONAL PROTECTIVE EQUIPMENT			
NIOSH approved respirators? Type?_____	____	____	_____
. Disposable coveralls?	____	____	_____
. Head covering?	____	____	_____
. Foot/shoe covering?	____	____	_____
. Equipment for inspectors available?	____	____	_____
. Portable toilets on site?	____	____	_____

	YES	NO	Comments
CONTAIMINATION AREA			
OUTSIDE CHANGE ROOM			
Hangers/lockers/bins for street clothes?	____	____	_____
Lockbox for valubles?	____	____	_____
Airlock to shower?	____	____	_____
Towels available?	____	____	_____
SHOWER FACILITY			
Soap avalable?	____	____	_____
Sanitary conditions maintained?	____	____	_____
Number of shower heads _____			
Container for the disposal of uses respirator filters/cartridges?	____	____	_____
Airlock to inside change room?	____	____	_____
INSIDE CHANGE ROOM			
Disposal bin for contaiminated clothing?	____	____	_____
Sanitary conditions maintained?	____	____	_____
Airlock to work area?	____	____	_____
ORK PRACTICES			
Are wet methods employed?	____	____	_____
EPA-recommended wetting agent used?	____	____	_____
Are HEPA filter vacuums used?	____	____	_____
Are light fixtures and other equipment cleaned before removal from work area?	____	____	_____
Furniture and other stationary items in work area covered and sealed?	____	____	_____

	YES	NO	Comments
Is waste bagged while wet?	____	____	_____
Are 6 mil bags used?	____	____	_____
Are bags properly labeled?	____	____	_____
Are bags placed in drums and sealed?	____	____	_____
). Are workers wearing protective clothing at all times while in work area?	____	____	_____
. Are workers disposing of contaiminated clothing at the end of each work period?	____	____	_____
?. Are respirators worn at all times?	____	____	_____
3. Smoking or gum/tobacco chewing in work area?	____	____	_____
). Are workers using the shower?	____	____	_____

ISPOSAL

Labels on the drums?	____	____	_____
Are drums with ruptured bags disposed of properly?	____	____	_____
Do disposal personnel obtain trip tickets to verify trips to the landfill?	____	____	_____

ISCELLANEOUS

. Does each worker have evidence of having received a medical exam within the last three months?	____	____	_____
. Are there sufficient fire/emergency exits?	____	____	_____

NVESTIGATOR'S COMMENTS (Use reverse side of page if necessary) The Cross Construction Crew has left this site except for two workers who remained behind for last minute clean-ups.

nvestigator's signature: _____

ASBESTOS FIBERS IN AIR

National Institute for Occupational Safety and Health

Analytical Method

Analyte:	Asbestos fibers	**Method No.:**	P&CAM 239
Matrix:	Air	**Range:**	0.1-60 fibers/cm³
Procedure:	Filter collection, microscopic count	**Precision (CV_T):**	0.24 to 0.38
Date Issued:	3/30/77	**Classification:**	D (Operational)
Date Revised:			

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 Holland (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)

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

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

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

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:

a. For filters with a low concentration of fine fibers, the coefficient of variation is estimated at 21% and the 95% confidence interval is $\pm$ 43%.

b. For filters with a high concentration of fine fibers, the coefficient of variation is estimated at 25% and the 95% confidence interval is $\pm$ 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 $\pm$ 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 interlaboratory 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 variation) 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:

$$CV_T = [\text{antilog}_{10}(-0.215 - 0.203\,(\log_{10}FB)) + 0.0025]^2$$

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 cm 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 con-

sists 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 eyepicces 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:

$$\text{sampling time} = \frac{(FB/FL)\ (ECA/MFA)}{(FR)\ (AC)\ (1000)} \quad \text{minutes}$$

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 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 $\pm$ 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 (>5μm)/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 (>5μm)/cm^3, [29 CFR 1910.1001(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 ($\pm$ 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 "½ 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 flow rate 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:

$$Q_{actual} = Q_{indicated} \sqrt{\frac{P_{cal}}{P_{actual}} \cdot \frac{T_{actual}}{T_{cal}}}$$

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 dis-

tance 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 $D = L(2^N)^{1/2} = 0.74(2^1)^{1/2} = 0.74 \quad (1.414) = 1.05$ 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:

$$AC = \frac{[(FB/FL) - (BFB/BFL)]\ (ECA)}{(1000)\ (FR)\ (T)\ (MFA)}$$

where:

AC = Airborne fiber concentration in (fibers > 5 μm)/cm^3.
BFB = Total number of fibers counted in the BFL fields 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-I 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:

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

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:

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

where:

FB_1 = lower fiber count on the filter (total fibers)
FB_2 = higher fiber count on the filter (total fibers)
$\overline{FB}$ = average of the two total fiber counts
$CV_{\overline{FB}}$ = CV_T for the value FB. Use the relation in Section 4 or Figure 3.

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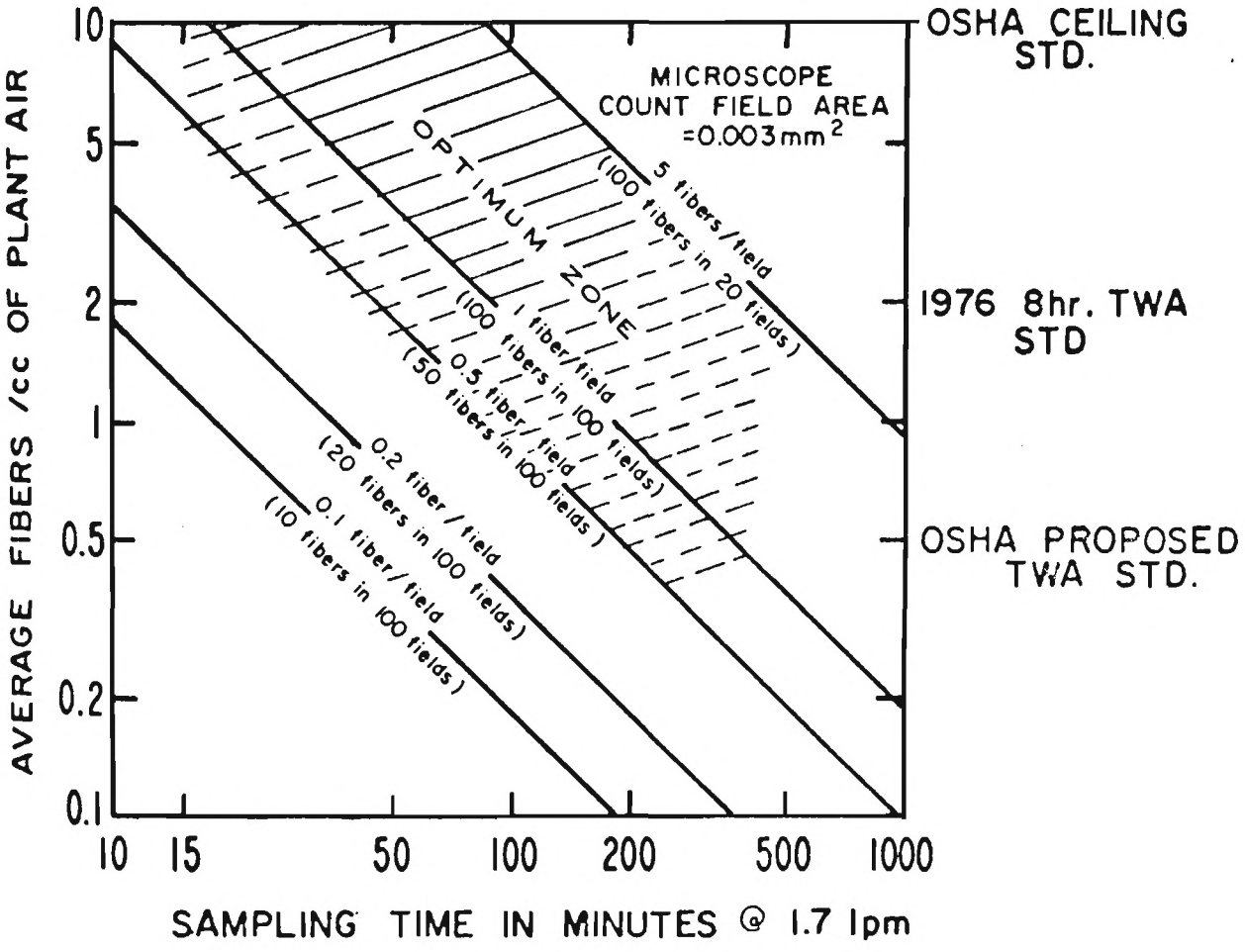

FIGURE 1. Optimum Sampling Times for airborne asbestos where microscopic field area = 0.003 mm²

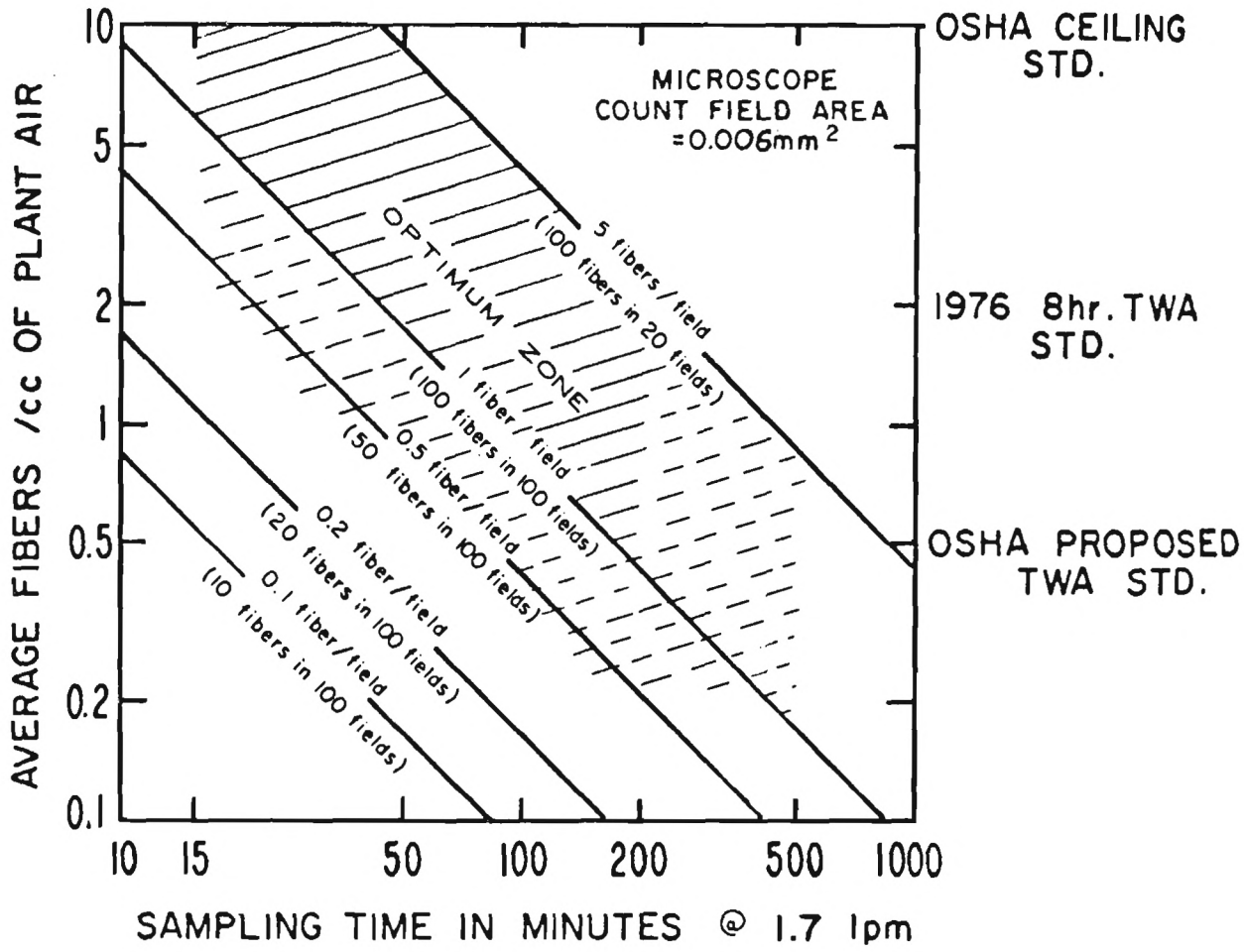

FIGURE 2. Optimum sampling times for airborne asbestos where microscopic field area = 0.006 mm²

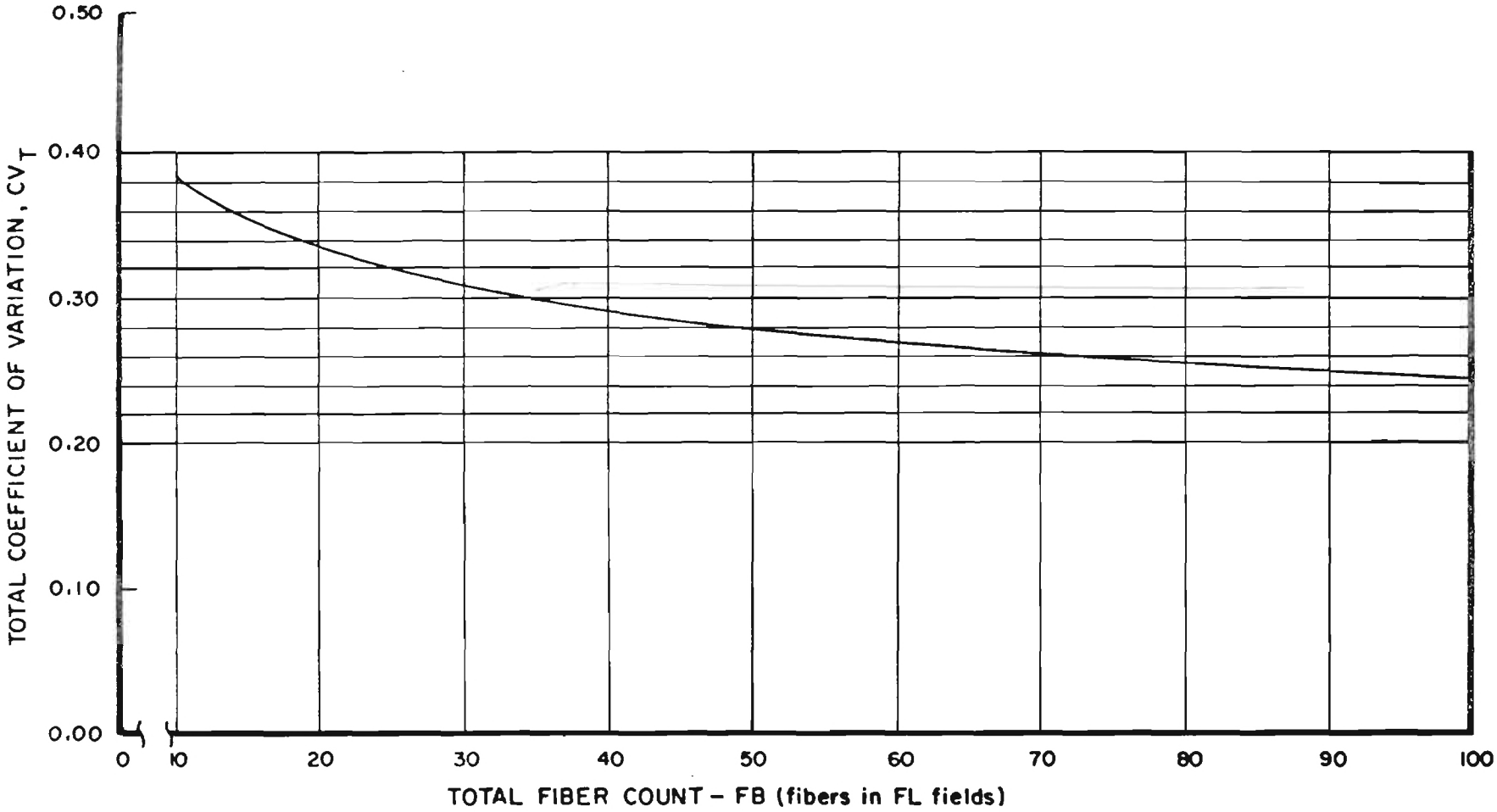

FIGURE 3. Total coefficient of variation as a function of total fiber count

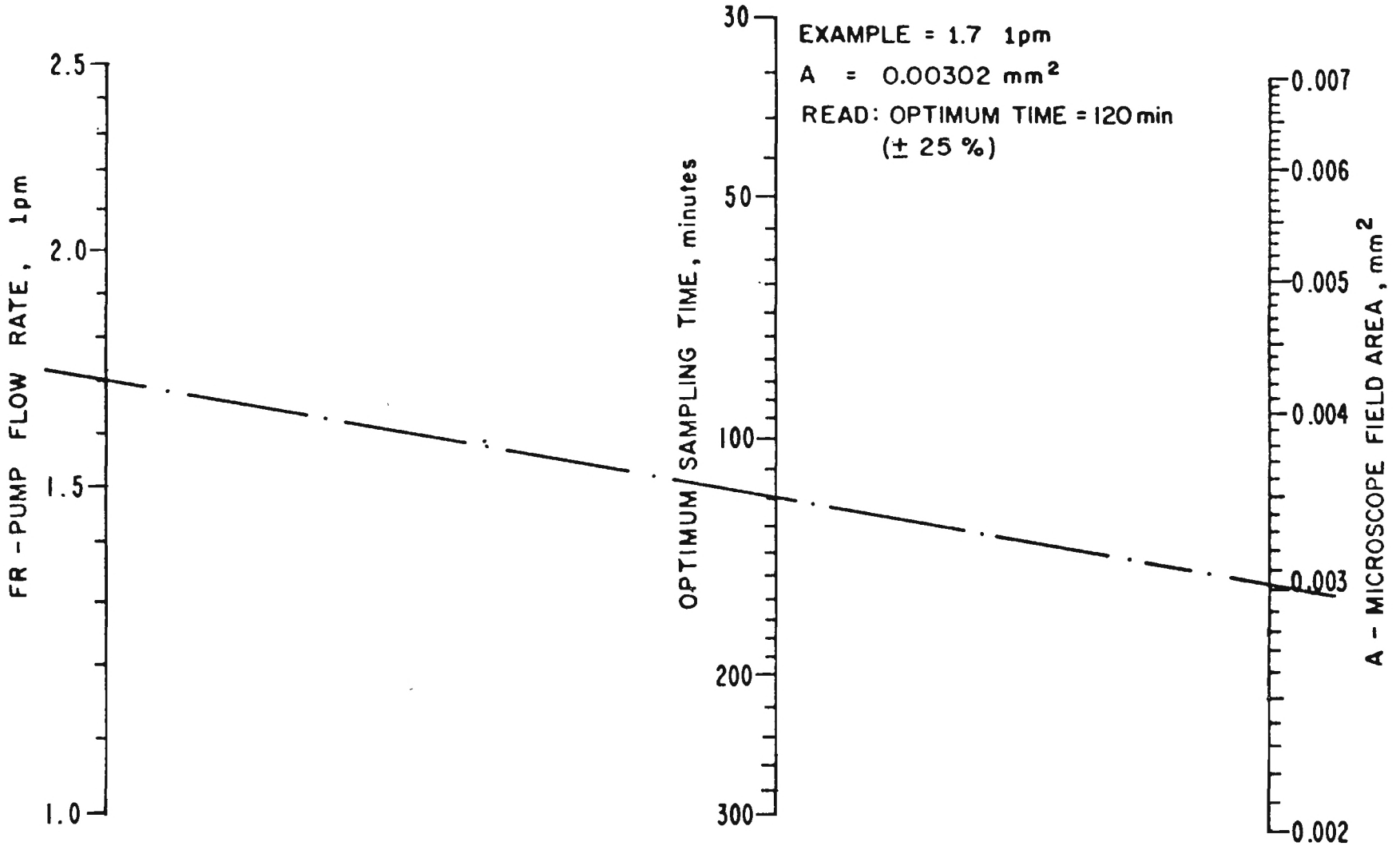

FIGURE 4. Nomogram of optimum sampling times for airborne asbestos fibers in concentrations of 1 to 10 fibers/cm³

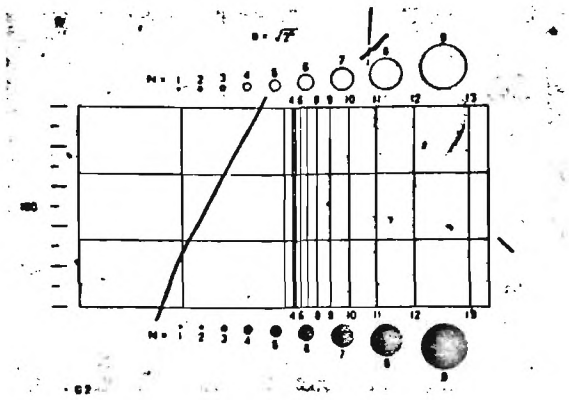

FIGURE 5

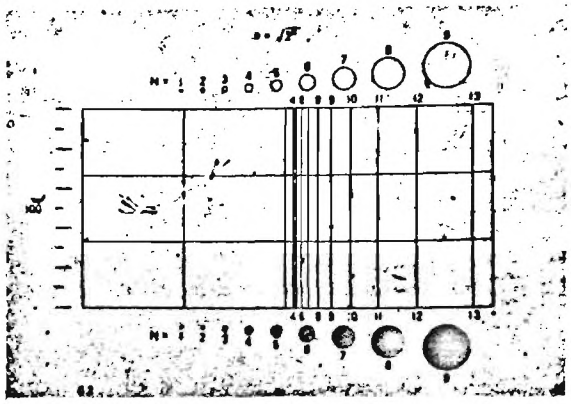

FIGURE 6

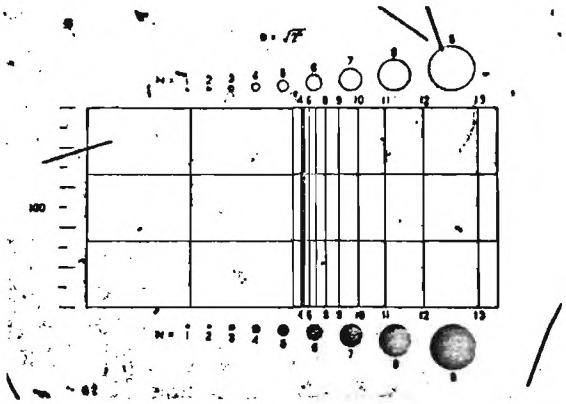

FIGURE 7

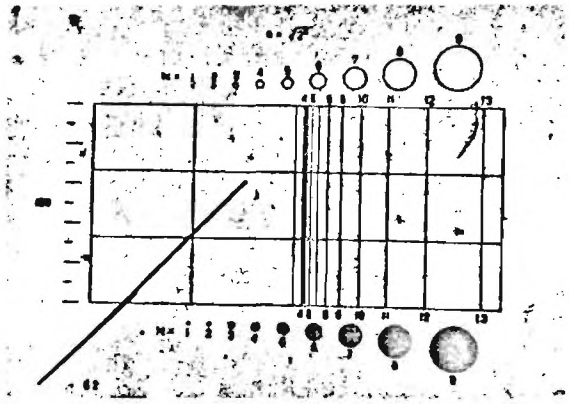

FIGURE 8

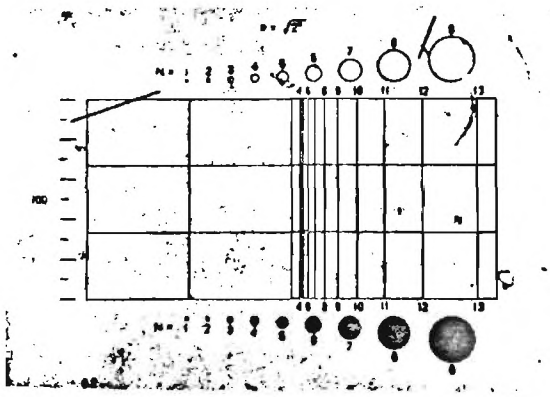

FIGURE 9

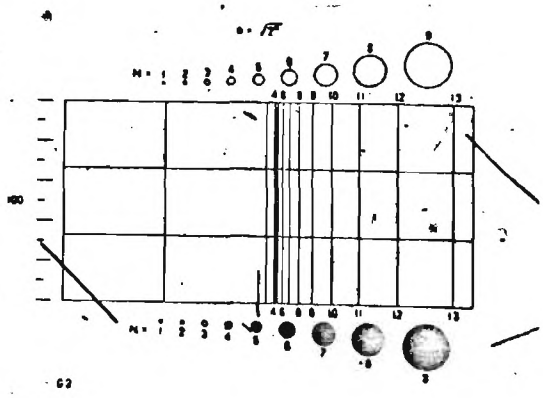

FIGURE 10

LIST OF FIGURES

(5 through 10)