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7. Author(s) Lewis, F. A.			8. Performing Organization Rept. No.	
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ABSTRACT: General air samples were taken at the Smithsonian Institution (Standard Industrial Classification 8411) of Washington, D.C., and at Suitland, Maryland on January 24 and 25, 1979, to determine if employees were exposed to fibers from asbestos (1332214) walls and ceilings at the Museum of Natural History, History and Technology Building, Fine Arts Building, and the Portrait Gallery. The evaluation request came from the institution to evaluate the effectiveness of control efforts that were instituted following a previous evaluation. Sampling equipment was placed at various sites throughout the buildings and phase contrast microscopy was used to analyze the samples. Rainfall provided a disturbed condition. All 20 samples taken were below the analytical limit of detection (0.01 fibers per cubic centimeter), and below the OSHA standard of 2 fibers per cubic centimeter for an 8 hour time weighted average. Although the insulation material contained up to 75 percent asbestos, masonite panel covers were effective in controlling airborne asbestos fibers. The author's general recommendations include regular vacuuming, sampling when environmental conditions change, and using sealants. Special recommendations for the Fine Arts Building include air sampling in the attic during maintenance procedures, the use of respirator protective equipment, and regular clearing of asbestos from the ventilation system. In unoccupied buildings, insulation material should be removed when possible and surveillance should continue when removal is unfeasible. Dropped ceilings or paneled enclosures are acceptable means of control. Development of the Smithsonian health, safety, and hygiene program should be continued.				
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HAZARD EVALUATION AND TECHNICAL ASSISTANCE
REPORT NO. TA 79-11

SMITHSONIAN INSTITUTION
WASHINGTON, D.C.
AND
SUITLAND, MARYLAND

APRIL 1979

I. SUMMARY

On January 24 and 25, 1979, NIOSH Regional (III) Industrial Hygienist, Frank A. Lewis conducted an environmental survey at the Smithsonian Institution in Washington, D.C. and Suitland, Maryland. General area air samples were taken to determine possible employee exposure to asbestos fibers at various locations in the Museum of Natural History, History and Technology Building and the Fine Arts and Portrait Gallery in Washington, D.C. and the Silver Hill Warehouses in Suitland, Maryland. Previous Technical Assistance Surveys (TA 73-5, TA 76-63 and TA 78-4), at the Smithsonian, have determined the asbestos content of the ceiling and wall insulation to be up to 75%, by volume.^{1, 2, 3} This technical assistance project is a follow-up survey to monitor present conditions and to determine the effectiveness of efforts already made to reduce any asbestos exposures.

It is the judgment of this Regional Industrial Hygienist/Project Leader that the employees in these areas would not be exposed to potentially toxic concentrations of asbestos fibers - under present conditions. In fact, all twenty area samples taken were below the analytical limit of detection (< 4500 fibers/filter or < 0.01 fibers/cc of air). This is well below the current OSHA standards of 2 fibers/cc ($> 5\mu$ -8hr. TWA) and 10 fibers/cc ($> 5\mu$ -15 min. ceiling period enforced by OSHA); the proposed OSHA standards of 0.5 fibers/cc ($> 5\mu$ -8hr. TWA) and 5 fibers/cc ($> 5\mu$ -15 min. ceiling); the ACGIH standard of 5.0 fibers/cc ($> 5\mu$ -8hr. TWA) and the NIOSH revised recommended standard of 0.1 fibers/cc ($> 5\mu$ -8hr. TWA) and 0.5 fibers/cc ($> 5\mu$ -15 min. ceiling).^{4, 5, 6, 7}

II. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this Technical Assistance Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent to:

- a) Mr. Richard L. Ault - Director of Support Activities
Smithsonian Institution, Washington, D.C.
- b) Mr. Edward Sniechoski - Chief, Safety Division, Office of Protection
Services
Smithsonian Institution, Washington, D.C.
- c) Ms. Victoria Hershiser - Safety Specialist
Smithsonian Institution, Washington, D.C.
- d) Director, NIOSH
- e) Director, DSHEFS
- f) Mr. William E. Shoemaker - NIOSH Program Consultant, Region III
- g) Mr. Frank A. Lewis - NIOSH Regional Industrial Hygienist, Region III

III. INTRODUCTION

On December 22, 1978, the National Institute of Occupational Safety and Health (NIOSH), Region III received a request from the Smithsonian Institution for technical assistance in evaluating the potential health hazard from asbestos insulation in the Museum of Natural History attics (Washington, D.C.) and in Warehouse Buildings A and B at the Silver Hill Facility (Suitland, Maryland). Insulation in Buildings A and B was recently confined by covering the interior with masonite panels. The Smithsonian is interested in determining the effectiveness of their efforts and to compare this data with that obtained in a previous sampling survey - TA 78-4.³ This survey revealed potential problems with airborne asbestos, particularly during rainfall. An additional request was made and accepted, at the time of the survey, for asbestos sampling to be done in the Fine Arts and Portrait Gallery and the History and Technology Building.

IV. TECHNICAL ASSISTANCE EVALUATION

A. Description - Conditions of Use

During 1964 the interior surfaces (ceilings, walls) of the buildings in question were sprayed with an asbestos-containing insulation to provide both thermal insulation and fireproofing. However, through structural vibration, employee work movement, disturbing air currents, and natural aging/drying out of the insulation, asbestos material has fallen off into the work atmosphere in large "clumps" as well as individual fibers.

Buildings A and B, at the Silver Hill complex, have been used as storage areas and will soon house office facilities. On November 9, 1977, area samples (TA 78-4) of these buildings revealed asbestos levels ranging from none detected to 30,000 fibers/M³ of air (undisturbed conditions) and 120,000 fibers/M³ of air (disturbed conditions - simulated rainfall).³ The highest levels were

obtained during a simulated rainfall and undoubtedly due to vibration of the flexible sheet-metal roof through "rain-drop" impingement. The Smithsonian remedied this situation by covering the ceiling and walls with masonite paneling. No one will occupy these premises permanently until it has been ascertained that there is no air contaminant problem. However, two to three employees may enter to bring in or remove various artifacts for/from storage. It was particularly fortuitous that the present asbestos sampling in these buildings occurred during heavy rainfall and provided a naturally disturbed condition.

The Museum of Natural History (Washington, D.C.) attics contain various artifacts for storage or repair. During the next few months, an account of the inventory is being determined which involves about 2 or 3 employees for each of the three attic areas. Normally, employees do not work in these areas on a regular basis as inventory occurs every few years. However, workers may enter these areas to remove or bring in artifacts or to do repair work. Areas of concern in this museum are the north, east, and west attics and the carpentry shop (basement - 6 workers). Asbestos insulation covers the ceiling in each of these areas and large clumps of fallen insulation were observed on work surfaces and floors. A previous Technical Assistance Survey (TA 76-63) revealed asbestos levels of < 0.01 fibers/cc of air.²

The History and Technology Building contains areas that have asbestos-containing insulation sprayed onto the ceilings. These areas consist of the Film Studio, Registrar Area, Equipment Room, and the Exhibits Production Area. The Film Studio and Equipment Room have equipment that may cause ceiling insulation to fall out through vibrations and movement. Varying numbers of workers occupy these areas throughout the day. Previous Technical Assistance Surveys (TA 73-5 and TA 76-63)^{1, 2} have shown asbestos levels to be < .01 fibers/cc or less than the analytical limit of detection.

The attics (northeast corner of 7th Street wing and over NPG - 4th Floor - center of south wing) in the Fine Arts and Portrait Gallery also have asbestos-containing insulation sprayed on ceilings and walls. The northeast (corner of 7th Street wing) attic occasionally has maintenance workers going in and out to fix or adjust service ducts and the attic over NPG (4th Floor - center of south wing) is presently being renovated. Respirators approved for asbestos dusts are provided and used by these workers to prevent inhalation of asbestos fibers. One to two workers may enter these areas at any one time. Technical Assistance Survey TA 76-63 showed < 0.1 fiber/cc of air in the Fine Arts and Portrait Gallery attics.²

B. Evaluation Design

General area samples were taken rather than personal due to limited employee exposure or no employee exposure at present. These area samples will provide a basis for potential exposure although they would not be indicative of actual employee exposures. Changes in air movement, work practices, structural vibration, and aging of the insulation may influence the concentration of airborne asbestos fibers through disturbance of insulation surfaces. Air sampling equipment was placed in sites that would give an overview of the exposures in that location and in which employees would spend a great deal

of time. Throughout the sampling period, rainfall provided a "disturbed" condition to induce fall-out of asbestos from the ceilings. Thus it was not necessary to simulate rainfall with a firehose as had been done back on October 9, 1977 (TA 78-4).³

C. Evaluation Methods

Asbestos Fibers - Twenty (20) general area samples and two (2) blanks were collected on 0.8 micron (μ) pore size AA millipore filters in three-piece "closed-face" cassettes. Air was drawn through the filters at a flow rate of 1.5 liters/minute with a MSA Model G personal sampling pump for the eight-hour work shift.⁸

All samples and blanks were analyzed according to NIOSH method P&CAM 239 utilizing phase contrast microscopy. The results of these samples and prior TA samples, for these areas, are presented in Tables I and II.

D. Evaluation Criteria

1. Environmental Criteria

The following environmental standards or criteria were considered in this report:

<u>Source</u>	<u>8 Hr.-TWA</u> <u>(*fibers/cc > 5μ)</u>	<u>15 Min. Ceiling</u> <u>(fibers/cc > 5μ)</u>
**NIOSH ⁷	0.1 fibers/cc	0.5 fibers/cc
ACGIH ⁵	5.0	
OSHA (Current) ⁴	2.0	***10.0
OSHA (Proposed) ⁷	0.5	5.0

*Fibers/cc of air greater than 5 microns (μ) - a fiber being defined as "a fundamental form of solid, characterized by relatively high tenacity and an extremely high-ratio of length to diameter."⁹

**The NIOSH criteria are intended to protect the average working population against the non-carcinogenic effects of asbestos and to reduce the risk of asbestos-induced cancer.⁷

***The OSHA Standard (Current) for short-term exposures requires a 15 minute sampling period to be legally enforceable.

2. Toxicological Data

Asbestos is the common name for a group of mineral fiber silicates known as chrysotile (white asbestos), actinolite, amosite (brown asbestos), anthophyllite, crocidolite (blue asbestos) and tremolite. Each contains varying amounts of iron, chromium, calcium, sodium, magnesium, nickel, silicon dioxide, and water.

The majority of asbestos is used in the construction industry as building products, insulation, friction materials, and textiles because of its excellent insulating properties.¹⁰

Asbestos can cause a pneumoconiosis of the lung, ("dust in the lung") called asbestosis and certain forms of cancer. Asbestosis is a chronic lung disease in which is produced fibrous or scar tissue and through which over the years results in respiratory impairment and disability. Lung cancer, mesothelioma (cancer of the pleura or peritoneum), cancer of the esophagus, colon and rectum are thought to be associated with exposure to asbestos.

Cigarette smoking and possibly other "air contaminants" together with asbestos exposure have a synergistic effect upon the lung tissue and exponentially increase the risk of lung cancer.^{6, 10}

NIOSH's latest evaluation of available data of human toxicity to asbestos provides no evidence for a threshold of carcinogenic response or for any so called "safe" level. Therefore, the standard is recommended by NIOSH to be set at the lowest level of detection using the latest analytical equipment and techniques.⁷

E. Results and Conclusions

1. All twenty of the area samples taken were found to be below the analytical limit of detection. The limit of detection is 4500 fibers/filter or 0.01 fibers/cc of air. (See Tables I and II)
2. It has already been determined that there may be up to 75% asbestos, by volume contained in the insulation material.^{1, 2, 3}
3. The covering of ceilings and walls with masonite panels, in Buildings A and B, has been effective in preventing the release of harmful levels of asbestos fibers into the work environment; this was confirmed by testing under "disturbed" conditions (during rainfall).
4. Under present conditions, it can be concluded that the employees in: Buildings A and B - Silver Hill Facility, Suitland, Maryland, the Museum of Natural History Attics, and Carpentry Shop, History and Technology Building (Film Studio, Registrar Area, Equipment Room and Exhibits Production Area), and the Fine Arts and Portrait Gallery Attics (northeast corner of 7th Street wing, 4th Floor center of south wing) - would not be exposed to potentially toxic concentrations of asbestos fibers.

V. RECOMMENDATIONS

Through discussions with management and the employees, the NIOSH Industrial Hygienist's observations and measurements, and prior Technical Assistance Surveys (TA 73-5, 76-63, and 78-4), the following recommendations are presented to ensure the protection of all employees, under all conditions, from the potentially harmful effects of asbestos fibers. Many of these recommendations have already been presented to the Smithsonian in previous Technical Assistance Surveys (TA 76-63 and 78-4) but will be restated here in this report.^{1, 2, 3}

The recommendations made to the Smithsonian in November, 1976 - report TA 76-63 and February, 1978 - report TA 78-4 are still valid and appear as follows:

TA 76-63

"To help ensure a healthful work environment is maintained, the following recommendations are provided:

All Locations

1. Vacuum clean areas (i.e. floors) where asbestos fibers may accumulate.
2. Sample whenever there are changes in the environmental conditions or work practices which may increase asbestos exposure.
3. Wherever the ceiling material is of asbestos composition, appropriate sealants should be considered for application to help minimize the potential exposure.

Fine Arts Portrait Gallery

1. Conduct personal sampling during maintenance procedures in the attic.
2. Adequate respirator protection should be worn during maintenance procedures unless sampling indicates otherwise.
3. Insure the ventilation system does not become contaminated with asbestos."

It is recommended that wet mopping or wet vacuuming with wetting agents be utilized to prevent fibers from becoming airborne again.

It was not possible to sample the attic areas during maintenance and renovation operations. An appreciable amount of asbestos fibers could become airborne through disturbance from the worker's movements. At the very least, a double-strap single-use respirator for pneumoconiosis - producing dusts should be worn during these operations.

TA 78-4

"In order to protect the health and safety of the employees of these facilities under all conditions the following recommendations are made.

1. In that the buildings are presently unoccupied and their future functions uncertain, it would be most practical, economical, as well as safe, over the long run, to remove the insulation. The insulation could be removed in a variety of ways, one of which would be to use fire hoses to spray it down. This would also serve to control the airborne generation of fibers and the moist material would be easier to control. Any method used to remove and dispose of the material should meet all Department of Labor standards contained in 20 CFR 1910.1001. If water is used all appropriate precautions should be taken, particularly electrical and gas turn offs. It will also have to be warm enough so that the water doesn't freeze inside the building. All local, state and federal regulations should be followed in disposition of the material.

2. If the insulation is not removed, and for areas where it still is present, an environmental and medical surveillance program will have to be developed and must meet the specifics of 20 CFR 1910.1001 and should meet all NIOSH recommended criteria as contained in References 1 and 2.
3. The Smithsonian is encouraged to continue development of its health and safety programs and particularly the industrial hygiene program. To meet these goals, the Institution must rely on and continue to develop its inhouse expertise.
4. Industrial hygiene surveys should be performed in all areas of the Institution to identify problem areas and coordinate medical surveillance."

VI. CURRENT SURVEY RECOMMENDATIONS

A dropped ceiling or paneled enclosure (Buildings A and B - Silver Hill) would also be acceptable as a means of controlling airborne asbestos exposure. Although it was decided to enclose the asbestos insulation (Buildings A and B) with masonite paneling, removal is still an alternative where technically and economically feasible.

The choice of control method is dependent on the characteristics of the work environment (work movement, building vibration, integrity of insulation, etc.) and also on the economic feasibility.

Where insulation is to remain intact it is important to set up a periodic monitoring program (i.e. quarterly area and personal sampling) in order to keep a watchful eye on potential asbestos exposures.

The Environmental Protection Agency now has the responsibility for heading-up the problem of asbestos hazards in governmental agency buildings. They have published a "Guidance Document of Sprayed Asbestos-Containing Materials in Buildings" and any further information may be obtained by writing or calling: Dr. David P. Rall - FTS: 629-3201; Dr. Raymond Shapiro - FTS: 629-3506 or Mr. John DeKany, EPA - FTS: 426-9000.

VII. REFERENCES

1. Technical Assistance Survey Report TA 73-5, Smithsonian Institution, Washington, D.C., October 19, 1972, Mr. P. A. Froehlich, NIOSH.
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VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Frank A. Lewis
Regional Industrial Hygienist
Project Leader, HETAB, NIOSH

Originating Office:

Jerome P. Flesch
Chief, Hazard Evaluation and
Technical Assistance Branch

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Laboratory Analysis:

Utah Biomedical Test Laboratory
Salt Lake City, Utah

Office of Protection Services:

Edward Sniechoski
Victoria Hershiser
Smithsonian Institution
Washington, D.C.

Report Typed By:

Michelle DiCostanza
Secretary, NIOSH, Region III
Philadelphia, Pennsylvania

TABLE I
Results of Area Air Sampling for Asbestos Fibers
Silver Hill Facility - Buildings A and B
Smithsonian Institution
Suitland, Maryland
January 24, 1979

<u>Sample Number</u>	<u>Sample Time (Minutes)</u>	<u>Location</u>	<u>Asbestos Concentration* (Fibers/Filter)</u>
SI - 14	425	Building A - Left Side/Front	<4500
SI - 17	414	Building A - Left Side/Back	<4500
SI - 11	420	Building A - Middle (Centered)	<4500
SI - 20	415	Building A - Right Side/Back	<4500
SI - 18	414	Building A - Right Side/Front	<4500
SI - 12	408	Building A - Office (Table)	<4500
SI - 7	442	Building B - Left Side/Front	<4500
SI - 9	439	Building B - Office (Table)	<4500
SI - 10	435	Building B - Right Side/Front	<4500
SI - 11	436	Building B - Right Side/Back	<4500

* All samples and blanks were below the analytical limit of detection (4500 fibers/filter or 0.01 fibers/cc).

TABLE II
Results of Area Air Sampling for Asbestos Fibers
Museum of Natural History, History and Technology Building, Fine Arts and Portrait Gallery
Smithsonian Institution
Washington, D.C.
January 25, 1979

<u>Sample Number</u>	<u>Sample Time (Minutes)</u>	<u>Location</u>	<u>Asbestos Concentration* (Fibers/Filter)</u>
SI - 6	428	Museum of Natural History - North Attic (Center)	<4500
SI - 13	438	Museum of Natural History - East Attic (Center)	<4500
SI - 3	425	Museum of Natural History - West Attic (Work Table)	<4500
SI - 10	418	Carpentry Shop - Center (Table)	<4500
SI - 5	430	History and Technology Building - Film Studio	<4500
SI - 2	379	History and Technology Building - Registrar Area	<4500
SI - 1	389	History and Technology Building - Equipment Room	<4500
SI - 35	413	History and Technology Building - Exhibits Production Area	<4500
SI - 42	388	Fine Arts and Portrait Gallery Attic (Northeast corner of 7th Street Wing)	<4500
SI - 4	387	Fine Arts and Portrait Gallery Attic (Over NPG - 4th Floor/Center of South Wing)	<4500

* All samples and blanks were below the analytical limit of detection (4500 fibers/filter or 0.01 fibers/cc).