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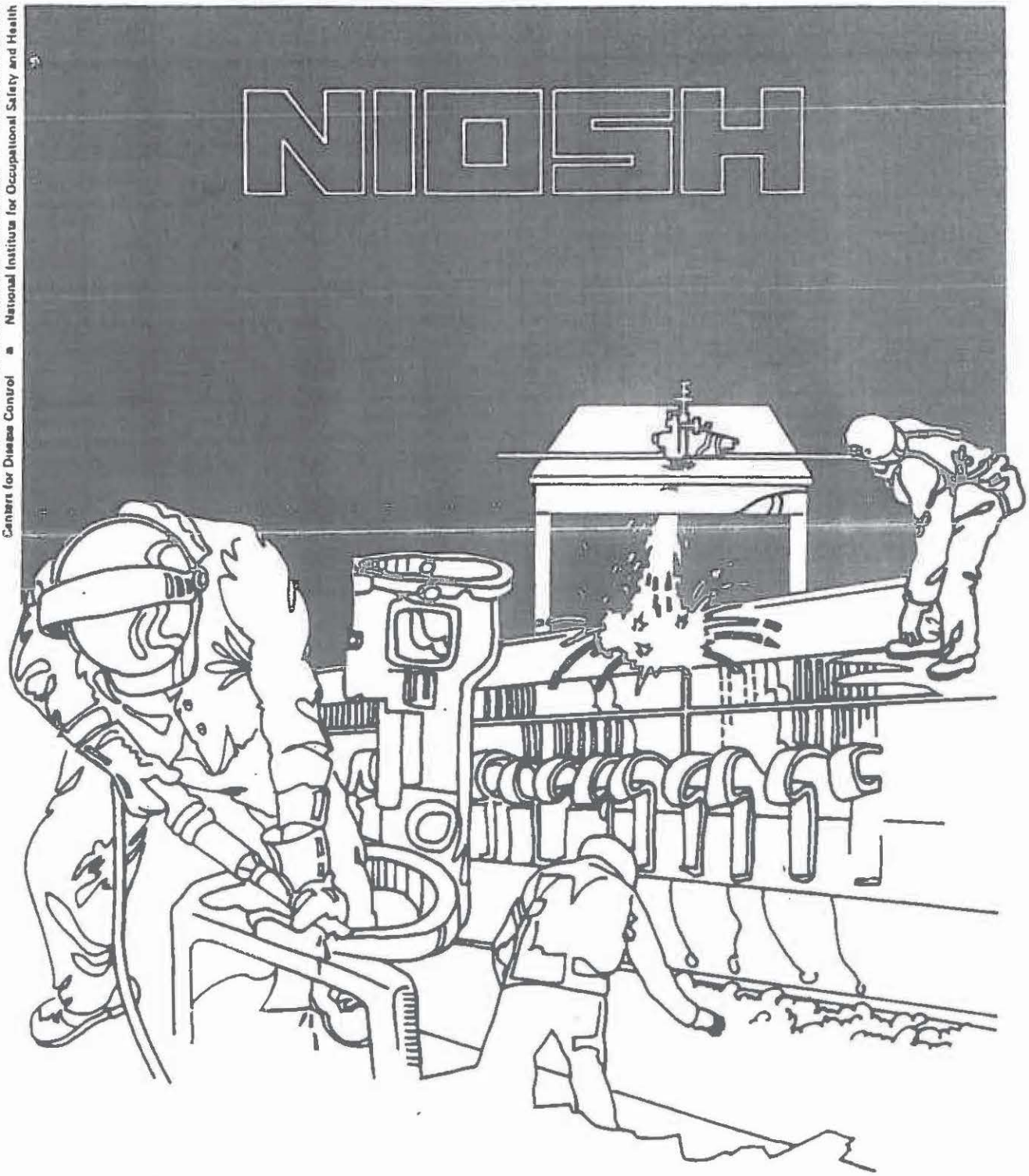

Health Hazard Evaluation Report

HETA 84-321-1590
ASBESTOS SHINGLE TEAR-OFF
ROCKFORD, ILLINOIS

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 84-321-1590
MAY 1985
ASBESTOS SHINGLE TEAR-OFF
ROCKFORD, ILLINOIS

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I. SUMMARY

In May 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate occupational exposure to airborne asbestos fibers during the tear-off of an old asbestos shingle roof from a residential building. On May 12, 1984, a NIOSH investigator conducted an environmental evaluation of the tear-off operation. Seventeen personal breathing-zone samples were collected for approximately two hours to measure potential exposure to airborne levels of asbestos fibers. Ten of these samples were collected from the tear-off crew, 2 from the post tear-off clean-up crew, and 5 from workers applying new asbestos shingles.

For the five tear-off workers, the airborne asbestos fiber concentrations ranged from 0.04 to 0.16 fibers per cubic centimeter of air (f/cc) (arithmetic mean: 0.09 f/cc). For the two clean-up workers, the asbestos fiber concentrations ranged from 0.13 to 0.16 f/cc (mean: 0.14 f/cc). Finally, for the 5 workers applying new shingles, the fiber concentrations ranged from 0.03 to 0.08 f/cc (mean: 0.05 f/cc). NIOSH recommends exposure to asbestos be reduced to the lowest feasible limit.

NIOSH certified half-face respirators with high-efficiency particulate filters were worn by all members of the tear-off and clean-up crews. Considering the documented air concentration levels for the tear-off operation, half-face respirators should be considered the minimum level of respiratory protection. Half-face respirators should also be worn by personnel working adjacent to and concurrent with the tear-off and clean-up operations.

Based on the results of this evaluation NIOSH investigators concluded that there was a hazard from exposure to airborne asbestos fibers during the tear-off of an asbestos shingle roof. Recommendations directed at reducing worker exposures are contained in Section VII of this report.

KEYWORDS: SIC 1761; (Roofing and Sheet Metal Work); asbestos shingles, roofing tear-off operations.

II. INTRODUCTION

In May 1984, NIOSH received a request to evaluate occupational exposure to airborne asbestos fibers during the manual tear-off of an old asbestos shingle roof from a large residential building. On May 12, 1984, a NIOSH investigator conducted an environmental evaluation of roofing workers for exposure to airborne asbestos fibers.

III. BACKGROUND

The tear-off operation was performed by 7 workers on May 12, 1984. During the 3-hour procedure, old asbestos shingles were removed from the roof using long-handled wedges. The loosened shingles and debris were then shoveled from the roof and moved by wheelbarrow to trucks for discarding. During the tear-off operation, several other workers were applying a new asphalt-shingle roof to adjacent and previously cleared portions of the building.

All workers involved in the tear-off operation wore NIOSH-certified half-face respirators with high-efficiency particulate filters. No other protective clothing was worn.

IV. EVALUATION DESIGN AND METHODS

On May 12, 1984, 17 personal breathing-zone and 4 area air samples were collected from workers on open-face mixed cellulose ester fiber filters for approximately 2 hours at a flow rate of 2.0 liters per minute (lpm). All of these samples were analyzed for fiber count according to NIOSH Method P&CAM 239 utilizing phase contrast microscopy (PCM). Six of these samples were further analyzed for fiber size and for qualitative analysis of the particulate material on the filters using transmission electron microscopy (TEM). The TEM analysis was performed according to the Zumwalde-Dement procedure outlined in NIOSH Publication No. 77-204. The PCM method for fiber counting detects fiber greater than 5 micrometers (um) in length and greater than 0.2 um in diameter and is the fiber count used for comparison with the existing environmental exposure criteria listed in Section V of this report. The TEM method detects fibers of all sizes.

Two area air samples (1 upwind, 1 downwind) were collected on the roof during the 2-hour tear-off operation using pre-weighed polyvinyl chloride (PVC) filters for total particulate weight. Two other area samples were collected from inside the residential building. One of the samples was collected from the interior of the building and the other was collected near an open window.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre existing medical condition, and/or a hypersensitivity (allergy).

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and Recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Increased health risk resulting from occupational exposure to asbestos has been well documented in the scientific literature. Initially, asbestos was associated with a chronic and debilitating lung disease called asbestosis which normally occurred following long-term exposures to high levels of asbestos fibers. More recently, asbestos has also been linked to several types of cancer, including mesothelioma (a rare cancer of the chest and abdominal lining) and cancers of the lung, esophagus, stomach, and colon. These cancers usually appear many years after the initial contact with asbestos, and sometimes result from short-term and/or low level exposures. This indicates that there may not be a "safe" level of exposure to asbestos for the elimination of all cancer risk. Additionally, cigarette smoking in combination with asbestos exposure greatly increases the risk of developing lung cancer.

Listed below are the evaluation criteria for airborne asbestos fibers:

Source	Environmental Exposure Limit
NIOSH	Lowest Feasible Limit
ACGIH	2.0 f/cc (chrysotile asbestos)
OSHA	2.0 f/cc

VI. RESULTS AND DISCUSSION

A bulk sample of the asbestos shingle was analyzed by a NIOSH contract laboratory and was found to contain 30% chrysotile asbestos.

The airborne concentrations of asbestos fibers for the 17 personal breathing-zone samples ranged from 0.03 to 0.16 f/cc (Table I). Ten of the 17 personal samples were collected from the tear-off crew and the concentrations of these samples ranged from 0.04 to 0.16 f/cc (arithmetic mean: 0.09 f/cc). Two of the 17 personal samples were collected from the clean-up crew and the concentration for these samples ranged from 0.13 to 0.16 f/cc (arithmetic mean: 0.14 f/cc). The other 5 personal samples were collected from workers applying new shingles. The range of concentrations for these 5 personal samples was 0.03 to 0.08 f/cc (arithmetic mean: 0.05 f/cc). The airborne asbestos concentrations for the 4 area samples ranged from 0.02 to 0.14 f/cc.

For the 6 samples (4 personal, 2 area) which were further analyzed by TEM (Table 1), the airborne concentrations of asbestos fibers ranged from 0.32 to 1.12 f/cc (4 personal: 0.32 to 1.12 f/cc, 2 area: 0.51 to 0.74 f/cc). All 6 samples showed higher fiber concentrations when analyzed by TEM than by PCM because TEM detects fibers of all sizes. In addition, the TEM analysis of these 6 samples showed the primary particulate constituents of the filters to be aluminum-silicate and iron compounds, as well as organic material. All of the asbestos fibers measured by TEM were chrysotile asbestos.

Because of temperature and humidity conditions (75°F, 20% RH) during sampling, the measured airborne concentrations of asbestos fibers are probably lower than actual concentrations because of the build-up of electrostatic charge on the sampling cassettes. This charge build-up resulted in a visibly substantial accumulation of fibers on the inside of the cassettes.

The highest level (mean: 0.14 f/cc) of airborne asbestos fibers was found during the post tear-off clean-up operation. The mean fiber concentration for personal samples taken during the tear-off operation (0.09 f/cc) was approximately double the mean concentration (0.05 f/cc) for the new shingle application workers. Both upwind and downwind area asbestos concentrations were low (<0.02 f/cc). However, the area sample taken within the building near the open window was comparatively high (0.14 f/cc) indicating contamination from the tear-off and clean-up operation.

VII. DISCUSSION AND RECOMMENDATIONS

The following recommendations should help reduce worker exposure to airborne asbestos fibers.

1. All workers involved in the tear-off and clean-up operations should wear NIOSH-certified half-face respirators with high-efficiency particulate filters.

   Considering the documented air concentrations, this should be considered the minimum level of respiratory protection for the tear-off, clean-up, and new shingle application personnel. All respirators should be properly fitted, cleaned, inspected for maintenance problems and placed in a zip-lock bag after each use. Also, the high-efficiency filter media should be changed periodically, particularly when breathing through the respirator becomes labored.

2. To help minimize airborne levels of asbestos fibers, the roof should be wetted with water or some other wetting agent before the tear-off operation.

3. Where feasible, building occupants should be evacuated during asbestos shingle tear-off and clean-up operations.

4. To minimize contamination of the inside of the building, doors and windows should be closed off and the heating/air conditioning system should be turned off during tear-off and clean-up operations.

5. To help minimize the exposure of the roofing workers and their family members, NIOSH recommends that contaminated work clothes be removed and placed in a bag for commercial laundering before leaving the work site. These clothes should be washed after each use.

VIII. REFERENCES

1. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to asbestos. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW publication no. (NIOSH) 77-169).

2. National Institute for Occupational Safety and Health. NIOSH/OSHA occupational health guidelines for chemical hazards. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1981. (DHHS (NIOSH) publication no. 81-123).

3. American Conference of Governmental Industrial Hygienists. Threshold limit values for chemical substances and physical agents in the workroom environment and biological exposure indices with intended changes for 1984-85. Cincinnati, Ohio: ACGIH, 1984.

4. National Institute for Occupational Safety and Health. Occupational diseases: a guide to their recognition. Revised ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW (NIOSH) publication no. 77-181).

5. National Institute for Occupational Safety and Health. The industrial environment: it's evaluation and control. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1973. (DHEW (NIOSH) publication no. 74-117).

6. Proctor NH, Hughes JP. Chemical hazards of the workplace. Philadelphia: J.B. Lippencott Company, 1978.

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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:

1. United Union of Roofers, Waterproofers and Allied Workers
2. NIOSH, Region V
3. OSHA, Region V

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table I

Asbestos Fiber Concentration for Personal and Area Samples

Asbestos Roof Shingle Tear-Off
Rockford, Illinois
HETA 84-321

May 12, 1984

Job Classification	Sample Duration	Asbestos Concentration (f/cc) PCM[1]	TEM[2]
Personal:			
Tear-off #1	8:20-9:31	<0.04	
	9:31-10:35	0.16	
Tear-off #2	8:21-9:34	0.14	0.75
	9:34-11:15	0.11	1.12
Tear-off #3	8:26-9:34	<0.04	
	9:34-10:35	<0.08	
Tear-off #4	8:22-9:32	0.06	
	9:33-10:35	0.09	
Tear-off #5	8:23-9:33	0.08	
	9:33-10:51	0.11	
New Shingle #1	8:19-10:05	0.03	
New Shingle #2	8:16-10:05	0.03	
New Shingle #3	8:11-10:05	0.07	0.32
New Shingle #4	8:10-10:05	0.04	
New Shingle #5	8:36-10:05	0.08	.37
Asbestos Clean-up #1	10:44-11:15	0.13	
Asbestos Clean-up #2	10:40-11:09	0.16	
Area:			
Area #1 (inside building - shelf)	8:45-11:18	0.05	0.51
Area #2 (inside building - window)	8:45-11:05	0 14	0.74
Area #3 (roof - upwind)	8:52-10:55	<0.02	
Area #4 (roof - downwind)	9:01-10:55	<0.02	

1 Measured by Phase Contrast Microscopy (PCM)
2 Measured by Transmission Electron Microscopy (TEM)

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