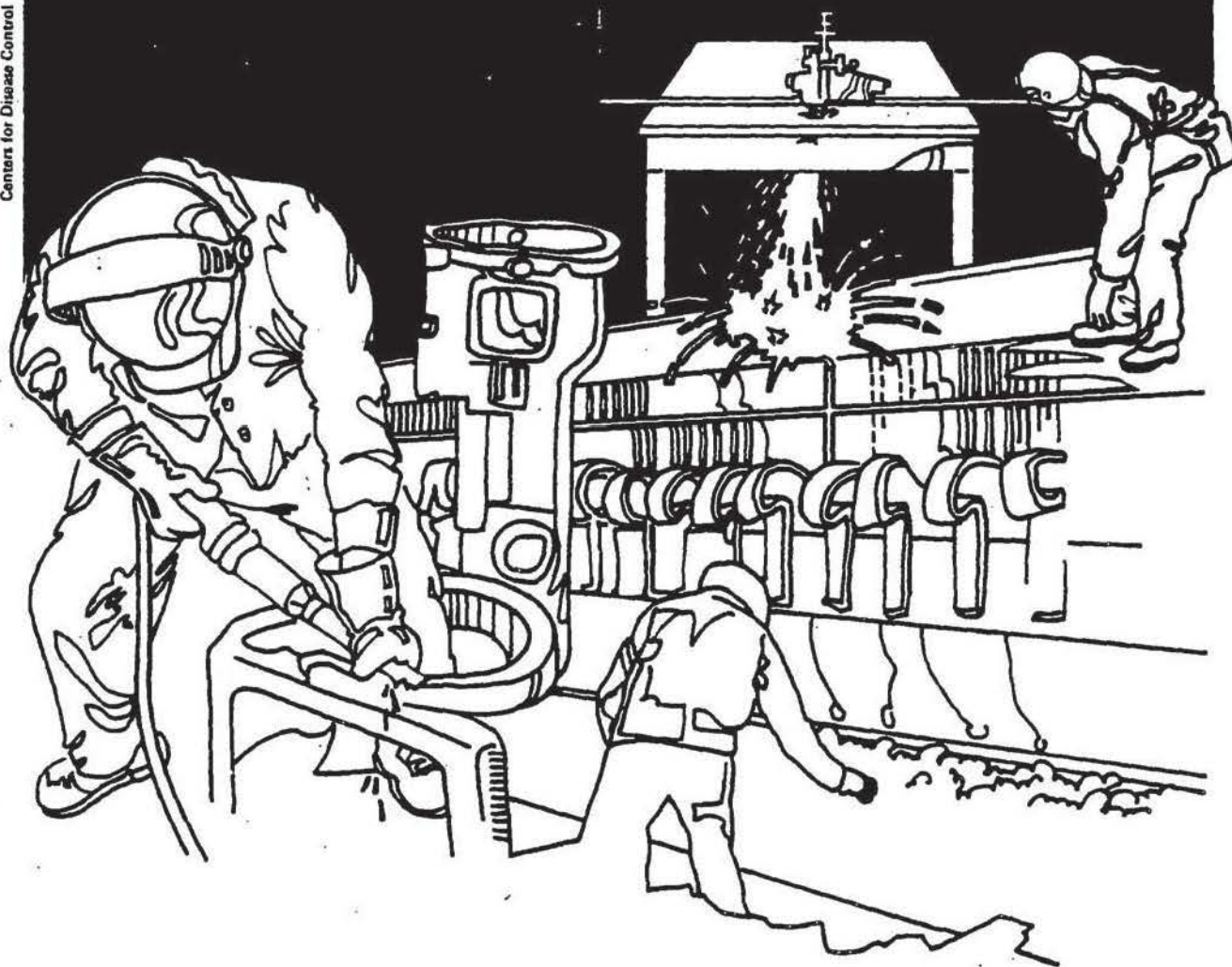


# NIOSH



## Health Hazard Evaluation Report

HETA 83-325-1564  
LADISH COMPANY  
CUDAHY, WISCONSIN

## 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.

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LADISH COMPANY  
CUDAHY, WISCONSIN

NIOSH INVESTIGATORS:  
William J. Daniels, CIH  
Peter Orris, M.D.  
Sara Arnold, M.D.

I. SUMMARY

On June 20, 1983, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate asbestos exposure among maintenance workers at a metal forging and machining plant owned by the Ladish Company in Cudahy, Wisconsin, and to assess the adequacy of the company's medical monitoring program for the workers.

Action on the request was initially delayed pending the resolution of a similar investigation being conducted by the Occupational Safety and Health Administration (OSHA). In January 1984, NIOSH investigators conducted an initial visit to the facility. Following this survey, environmental and medical records were obtained from the company, and chest radiographs, which had been obtained by the company, were reviewed by an independent NIOSH certified B-reader.

A review of the environmental monitoring data conducted by the company indicated a total of 28 "maintenance type" activities which involved a potential for asbestos exposure since 1981. Supplied-air respiratory protection was reported to be utilized during all but four of these activities, during which disposable dust respirators had been provided for respiratory protection. Airborne concentration of asbestos measured outside the worker's respirators (thus potential employee exposures) during these operations were generally below 0.1 fibers/cc as an 8-hour TWA; however, in two activities employee exposures were reported to exceed the OSHA PEL for asbestos. In one of these activities, asbestos concentrations exceeded (by less than a factor of 3) the OSHA PEL of 10 fibers/cc as a ceiling concentration, and in a second activity, asbestos concentrations exceeded (by less than a factor of 2) the OSHA PEL of 2 fibers/cc as an 8-hour TWA. It should be noted that supplied-air respirators had been utilized during the first operation, and disposable dust masks during the latter operation. A review of the company's written work procedures indicated that Type C supplied-air respirators are currently used in maintenance operations involving potential asbestos exposure.

A review of the company's medical monitoring program for asbestos exposed employees revealed some shortcomings, particularly in regards to the quality of chest radiographs. Of the 11 chest radiographs reviewed by the NIOSH certified B-reader, five were judged to be unreadable for the assessment of asbestos-related lung disease.

<p>On the basis of the information obtained during this survey, the medical monitoring program for employees exposed to asbestos did not appear adequate for the early detection of asbestos-related lung disease. Recommendations designed to improve the medical monitoring program and reduce employee exposures are included in this report.</p>
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KEY WORDS: SIC 3462 (Iron and Steel Forgings) Asbestos, Asbestosis,  
B-reader

## II. INTRODUCTION

On June 20, 1984, an authorized representative of the employees at Ladish Company, Cudahy, Wisconsin, requested that the National Institute for Occupational Safety and Health (NIOSH) conduct a health hazard evaluation at the facility. The requestor was concerned with asbestos exposure to maintenance employees who had worked in the plant over the past several years.

Further action on the health hazard evaluation request was delayed pending the outcome of a similar investigation being conducted by the Occupational Safety and Health Administration (OSHA). Following a settlement of the OSHA citation, codified by a consent decree concerning medical surveillance of certain asbestos exposed employees, NIOSH investigators conducted an initial survey visit to the facility on January 17, 1984. An opening conference was held with representatives of plant management and the local union during which the nature of the request was discussed, and areas where asbestos removal operations had occurred were inspected. Following this survey, information was obtained from the company related to environmental and medical monitoring, and the current quality assurance procedures for jobs involving potential asbestos exposure. Subsequently, company medical records and x-rays were obtained for review by the NIOSH Medical Officer and a NIOSH certified B-reader.

## III. BACKGROUND

The Ladish Company, founded in 1905, is engaged in the production of pipe fittings and industrial forgings. At the time of this survey, the plant employed approximately 850 administrative, 1200 production, and 300 maintenance employees. Throughout the history of the company, asbestos had been used in a variety of materials and applications within the facility. Over the past four years, operations which were conducted involving potential employee exposure to asbestos included: the use of Transite (an asbestos-Portland cement composite employed as an insulation and construction material), the removal of asbestos coverings on electrical wiring, the removal of asbestos containing insulation from steam supply lines, the drilling and cutting of Transite in the induction Heating Coil Preparation Area, the removal of brick and block furnace insulation containing 1% amosite asbestos, and the removal of expansion joints, gaskets and asbestos-containing refractory materials from furnaces.

Although employees in many job categories may have been potentially exposed to asbestos in the past, the employees who were identified as being in jobs with a potential for engaging in asbestos-related work activities (through removal operations etc.) were all employed in the maintenance department. These potentially exposed employees included approximately 3 pipecoverers, 16 maintenance helpers, 5 carpenters, 8 masons, and 40 electricians.



#### IV. MATERIALS AND METHODS

During the initial survey visit of January 17, 1984, information was obtained related to the past and present use of asbestos in the plant, and the job classifications and numbers of employees identified as currently having a potential for asbestos exposure.

Since the requestor was concerned with employee exposures which had occurred in the past, the company's medical monitoring program for those employees exposed to asbestos was reviewed for its adequacy. Additionally, since there were still some isolated activities conducted during which a potential for asbestos exposure existed, the hazard presented by these operations was also assessed. Due to the relative infrequency, the unplanned nature, and the variability of the types of the activities with potential asbestos exposure, environmental monitoring was difficult to arrange and sample results would only be representative of the particular operation monitored. Therefore, in lieu of environmental monitoring of isolated work activities by NIOSH researchers, a review of the company's "Quality Assurance Procedures" (which included work practices, personal protection, and environmental monitoring for asbestos) was conducted in order to determine if proper precautions were being taken to adequately prevent asbestos exposures to maintenance employees.

In order to provide for a more in-depth assessment of these areas, a letter was sent to the company on February 10, 1984, requesting the following information for review:

##### A. Environmental

- 1) the most recent revision of the written quality assurance and safety procedures for asbestos handling and removal operations,
- 2) a copy of the current respiratory protection program for those employees involved in asbestos handling and removal operations,
- 3) environmental monitoring records for asbestos conducted by the company or OSHA since January 1981,

##### B. Medical

- 1) the medical protocols being utilized for surveillance of the health effects of asbestos,
- 2) a listing of those job categories currently screened for the health effects of asbestos,
- 3) medical records related to asbestos surveillance of those maintenance employees enrolled in the asbestos surveillance program, and
- 4) the most recent chest radiographs of the maintenance employees in this surveillance program.

This information was provided to NIOSH in April 1984. However, since "copies" of the original chest radiographs were initially supplied, NIOSH subsequently requested the "original" radiographs, which were later provided. These radiographs were submitted, to an independent NIOSH certified B-reader for review. In January 1985, NIOSH investigators requested and were provided with additional information regarding the scope of the company's asbestos surveillance program.

## V. EVALUATION 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).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

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/Occupational Safety and Health Administration (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 required by the Occupational Safety and Health Act of 1970 (29 USC 651, et seq.) 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.

### A. Asbestos

Asbestos is a generic term applied to a number of hydrated mineral silicates, including chrysotile, amosite, crocidolite, tremolite, and anthophyllite. Asbestos consists of fibers of varying size, color, and

texture. The uses of asbestos are numerous and include thermal and electrical insulation, fire blankets, safety garments, filler for plastics, and roofing materials. The most toxic route of entry is inhalation. The most widely recognized diseases caused by asbestos are asbestosis, cancer of the lungs and digestive tract, and mesothelioma.

Asbestosis is a lung disorder characterized by a diffuse interstitial fibrosis, including pleural changes of fibrosis and calcification. The worker exhibits restrictive pulmonary function, with clinical findings which may include fine rales, finger clubbing, dyspnea, dry cough, and cyanosis. These findings may be delayed 10 - 15 years in onset following cessation of exposure.

Bronchogenic and gastrointestinal carcinomas, as well as mesotheliomas of the pleura and peritoneum are also caused by asbestos exposure. These cancers may occur following a limited exposure years earlier.<sup>1</sup>

Due to its carcinogenic nature, NIOSH recommends that employee exposures to asbestos be reduced to the lowest feasible limit. The NIOSH recommended standard set in September 1976 is 0.1 fibers greater than 5 microns in length per cubic centimeter (fibers/cc), which was at that time the lowest level detectable by phase contrast microscopy.<sup>2</sup> Phase contrast microscopy is considered the only practical analytical technique currently available to industry and official agencies which is valid and reproducible. It should be noted that recent improvements in the reproducibility and sensitivity of the sampling and analytical method now allow for detection of fiber concentrations as low as 0.01 fibers/cc in some environments depending on background contamination.<sup>3</sup> The current OSHA standard for asbestos is an 8-hour TWA exposure is 2 fibers/cc, and 10 fibers/cc as a 15-minute ceiling concentration.<sup>4</sup> The ACGIH has recommended the following TLV's for asbestos fibers greater than 5 microns in length; 0.2 fibers/cc for crocidolite, 0.5 fibers/cc amosite, 2.0 fibers/cc chrysotile, and 2.0 fibers/cc for other forms.<sup>5</sup>

#### B. Medical Surveillance

Appropriate medical surveillance is crucial to detect and minimize the progression of some asbestos-related disease. Considerable emphasis should be placed on baseline medical examinations for all workers potentially exposed or who are exposed to asbestos at or above the OSHA action level of 0.1 fibers/cc.

##### 1. Medical Examinations shall include, as a minimum:<sup>4,6</sup>

- A history to elicit symptomatology of respiratory disease, smoking experience, and prior asbestos exposure;

- A physical examination emphasizing cardiovascular and pulmonary pathology;

- A chest roentgenogram (posterior-anterior 14 x 17 inches);

- Pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV<sub>1.0</sub>);

In addition, sputum cytology should be considered for exposed smoking employees.

These examinations should be provided by the employer to each of his employees prior to the time of first exposure, at the termination of employment, and annually if the employee is regularly exposed and a smoker, and biannually if the patient is regularly exposed and not a smoker. If the employee is no longer exposed, did not have long-term substantial exposure, and has no asbestos-related changes on chest x-ray on by pulmonary function studies, no specific asbestos medical surveillance is necessary. A medical removal protection program should be in place for employees showing signs of asbestos-related disease.

All medical examinations should be promptly reviewed and the results reported to the employee, who should have access to independent medical review of these results. Medical records should be retained by employers for at least 40 years or for 20 years after termination of employment, whichever is longer. Furthermore, there should be periodic reporting of aggregate medical information concerning the entire exposed workforce. Results should be displayed in an aggregate format, deleting information that would identify individuals, in a location accessible to the employees and their representatives.

## VI. RESULTS AND DISCUSSION

### A. Environmental

A review of the information contained in the company's latest revision of the "Quality Assurance Procedures" indicated that written procedures designed for the protection of employees engaged in work with asbestos were in place, and contained in two major documents addressing the scope of these activities. The first, entitled "Respirators; Purchase, Use, Maintenance, Storage & Employee Training" (revised 1/30/84) covered the basic elements of a respiratory protection program as specified by OSHA standards 29 CFR 1910.134. This included sections covering program administration, medical requirements, respirator selection, employee training and fit testing, and respirator maintenance, care, and storage.

A second document, entitled "Asbestos, Handling and Safety Procedures" (revised 5/19/83) covered the procedures to be used in identifying, handling, or removing asbestos-bearing materials. In summary, this document specified that overall program administration was to be carried out by the Safety and Chemistry Departments, with Maintenance Supervision responsible for implementing all specified control measures. Prior to any job activity where insulating material was to be removed, the supervisor was to perform an inspection of the job site, and collect samples of any material suspected of containing asbestos. The Chemistry department would then analyze the sample by "a commercially available test kit" or other appropriate means. If the test is negative, then work would proceed without the use of respirators. If the test is positive, the job would be delayed until confirmational tests were carried out. If the job could not be delayed, all aspects of the procedures for working with asbestos would be put in



place. It should be noted that during the course of the evaluation, the company acquired in-plant polarized microscopic capabilities. This should help to eliminate potential problems associated with the analytical screening procedures previously employed.

In addition to the areas identified as containing asbestos by the previously mentioned method, the asbestos work procedures would also be required for those areas included on a list of possible asbestos-containing furnaces, which is published annually.

The specific work practices and personal protection to be employed were also specified in this document. This included directives for the securing and posting of areas of asbestos work, the wetting of materials prior to work, cautions against fracturing or abrading materials to minimize dust generation, and the proper sealing of waste materials and work clothing in containers bearing appropriate labelling for disposal in an appropriate landfill. Personal protection provided to the employee was to include a Type "C" supplied air respirator, either continuous-flow or pressure-demand. Additionally, disposable coveralls, head coverings, gloves, and foot coverings were to be provided where asbestos concentrations could be expected to exceed the OSHA ceiling level of 10 fibers/cc. During asbestos removal operations, air monitoring was to be performed and maintained as prescribed in section 1910.1001 of the OSHA Act.<sup>3</sup>

A review of the information supplied by the company regarding environmental monitoring for asbestos exposure indicated a total of 28 "maintenance type" activities which had been conducted since 1981 and involved a potential for asbestos exposure. Broadly categorized, these activities included, 16 operations involving the removal of pipe insulation, seven involving the removal of furnace components (gaskets, joints, or refractory materials), two involving the removal of ceiling insulation, and single occurrences of miscellaneous activities; including the removal of asbestos from electrical wiring, clean-up of asbestos-containing material, and removal of a motor from an area where asbestos was present. Air-supplied respiratory protection was reported to be utilized during all but four of these activities, during which NIOSH/MSHA approved disposable dust respirators had been provided for respiratory protection (these were primarily utilized in activities occurring in 1981 and 1982). While NIOSH continues to approve single-use and replaceable dust/mist respirators for use against asbestos because of legal requirements, NIOSH does not recommend the use of such respirators where exposure to asbestos may occur on the basis that such is not a prudent occupational health risk.

The frequency of employee exposure during these activities was as follows; one employee was involved in thirteen separate pipe insulation removal operations, a second employee was involved in two separate pipe insulation removal operations, a third employee was involved in two miscellaneous activities, with the remaining employees reported as being involved only in single operations where asbestos was determined to be present. Asbestos concentrations outside the worker's respirator (thus potential employee exposures) measured during these operations were generally below 0.1 fibers/cc as an 8-hour TWA; however, in two activities potential employee exposures were reported to exceed the OSHA PEL for asbestos. In one of these activities, asbestos concentrations exceeded (by less than a factor of 3) the OSHA PEL of 10 fibers/cc as a

ceiling concentration, and in a second activity, asbestos concentrations exceeded (by less than a factor of 2) the OSHA PEL of 2 fibers/cc as an 8-hour TWA. It should be noted that air-supplied respirators had been utilized during the first operation, and disposable dust masks during the latter operation.

#### B. Medical

A review of the company's medical policy indicated that it provides follow-up medical examinations on an annual basis for the following employees:

- 1) Electricians from the maintenance department whose jobs involve them in work with electrical insulation,
- 2) An employee whose job involves removing insulation from pipes,
- 3) Selected employees from the Metallurgy Department whose jobs include performing analytical tests on samples of material which contains asbestos, and
- 4) Nine maintenance department employees who were included in the medical surveillance program as part of the two settlement agreements with OSHA in 1982.

Each examination includes a physical and spirometry. A chest x-ray is included in the examination when, in the opinion of the company's Medical Director, it is medically needed and safe for the employee. The employees are eligible for the medical examinations as long as they remain employed by the company or have rehiring rights. The decision to have an examination is voluntary on the part of each employee. A summary of the results of the medical examination are forwarded to each employee 30 days after the examination.

Summary medical reports prepared by the company Medical Director were reviewed by the NIOSH Medical Officer. One report was from 1980, six from 1982, and four from 1983. The reports each contained a brief history, physical examination, chest radiograph, and pulmonary function study. Ten of the records contained a summary impression which included the phrase "no signs of asbestos lung disease". However, the one record reviewed that did not contain a summary impression by the Medical Director, was judged by the company radiologist to have changes possibly consistent with asbestos exposure.

The original radiographs of the 11 maintenance employees participating in the company's asbestos surveillance program were submitted to an independent radiologist who is a NIOSH certified B-reader for evaluation. This independent review was in agreement with the original company secured radiographic interpretation for all 11 employees for all non pneumoconiotic pathologies. As for the evaluation of asbestos-related pneumoconiosis, five of the films were judged to be unreadable under the UICC/ILO standards for the assessment of asbestos-related lung disease. The remaining six films were found to have been correctly taken and interpreted by the original radiologist.

## VII. CONCLUSIONS AND RECOMMENDATIONS

### A. Environmental

The company should continue in its efforts to eliminate the use of asbestos, substituting materials with low chronic toxicities wherever possible. The acquisition of in-plant polarized light microscope capabilities, which occurred during the period of the survey, should greatly help to eliminate the potential problems associated with less reliable screening methods and the uncertainty of the material composition during the time required for outside analysis.

The revision of the Quality Assurance Procedures, which was provided to NIOSH for review, addressed the key elements of employee personal protection and work practices as required by OSHA regulations. However, some additional recommendations are provided below to enhance the effectiveness of the current procedures.

1. A systematic program of identifying asbestos-containing materials within the facility should be implemented (information supplied by the company indicates that such a listing is currently published annually for asbestos-containing and non-asbestos-containing furnaces). Such information would help to alleviate inadvertent employee exposures to asbestos and enable early identification of areas which may pose potential exposure problems due to physical damage or deterioration.
2. Since the potential for the contamination of skin, hair, or clothing may exist despite the use of disposable coveralls, the current work procedures should include provisions addressing changing of work clothing, showering, and personal hygiene.
3. The use of wetting agents designed to enhance water penetration and reduce the possibility of fiber dispersion should be examined for inclusion in those applications where they might prove beneficial.
4. Since a potential for contamination of nearby work areas may exist during asbestos removal operations where significant fiber concentrations are generated, the possibility of exposure in these areas should be routinely assessed, with enclosure of the work area or other measures taken as appropriate.

### B. Medical

The company and union should be commended for developing a medical surveillance program for asbestos exposed employees. The scope of this program included the provisions of the OSHA standards and many of the NIOSH recommendations. However, the following additional recommendations are made in order to further enhance this surveillance program.

1. Since almost 50% of the X-ray films reviewed were determined to be technically inadequate for the evaluation of asbestos-related changes, the company should include the use of a NIOSH certified B-reader for chest radiographs in their surveillance program.

2. The environmental data supplied by the company indicated that the majority of the maintenance employees were not regularly exposed to asbestos during the maintenance activities monitored since 1981. However, any employees who may have had significant asbestos exposure prior to this, should also be included in the surveillance program.
3. The single medical evaluation with x-ray evidence of possible asbestos lung disease contained no summary statement by the company physician. There is, therefore, no evidence that the company physician evaluated the data and communicated this evaluation to the employee. All medical evaluations should contain a summary impression by the company physician, and this impression as well as the information on which it is based, should be communicated to the employee.
4. Because cigarette smoking enhances the carcinogenic effect of asbestos on the lung, particular emphasis should be placed on the development of an educational program toward smoking cessation for those potentially exposed employees who currently are smokers.

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

William J. Daniels, CIH  
Industrial Hygienist  
NIOSH - Region V  
Chicago, Illinois

Peter Orris, M.D.  
Medical Officer  
NIOSH - Region V  
Chicago, Illinois

Sara Arnold, M.D.  
Medical Officer  
NIOSH - HETAB  
Cincinnati, Ohio

Originating Office:

Division of Surveillance, Hazard  
Evaluations & Field Studies  
Hazard Evaluation and  
Technical Assistance Branch  
Cincinnati, Ohio

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- A. Requestor
- B. Ladish Company
- C. U. S. Department of Labor, OSHA - Region V
- D. NIOSH Regional Offices/Divisions

For the purposes of informing the affected employees, copies of the report should be posted in a prominent place accessible to the employees, for a period of 30 calendar days.