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RECOMMENDED PRACTICES FOR CONTROL OF ASBESTOS DUST IN SHIPBUILDING, SHIPREPAIR AND SHIPBREAKING

Duncan A. Holaday, Chairman
Ad-Hoc Committee
Environmental Sciences Laboratory
Mount Sinai School of Medicine of
The City University of New York

DRAFT
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I. Introduction

Much of the equipment installed in ships requires thermal insulation. Because of its desirable and, in some cases indispensable, properties, asbestos is widely used as a component of insulating materials. Applying, removing or handling insulation can produce airborne dust which contaminates the workroom air. Inhalation of asbestos fibers may cause serious disease in those exposed. Many studies have found that cases of asbestosis, lung cancer and pleural and peritoneal mesothelioma have occurred following exposure to airborne asbestos fibers. These diseases usually do not become manifest until many years after first exposure.

Cases of asbestos diseases have been reported in men who are not usually considered to be asbestos workers. Pipefitters, steamfitters, boilermakers, welders and shot blasters, for example, may remove insulation in the course of their work. Members of these and other trades who work in the areas where insulation is being applied or removed are potentially exposed to airborne asbestos dust. Although these exposures are intermittent, they may be significant.

Dusts other than asbestos, such as some forms of diatomaceous earth, may also be important in producing pneumoconioses. However, less is known of the hazard which might be created by such exposures as occur in shipyard work. The general goal in all insulation work must be to conduct it in accordance with a control program which minimizes exposures including those caused by brief peak episodes.

Achievement of this goal is particularly necessary because of the uncertainties inherent in the present Threshold Limit Value (TLV) for asbestos which was adopted primarily to prevent development of asbestosis. Studies of the mortality experience of insulators, however, have shown that various forms of cancer are significant occupational diseases in this trade. Therefore, the only prudent course is to reduce dust exposures by all feasible means. Measurements of atmospheric concentrations of asbestos fibers can be used to identify sources of contamination and to point out deficiencies in control methods. Primary reliance for control of exposures, however, must be placed on faithful observance of procedural rules.

Although areas of responsibilities will differ from yard to yard, one responsible person, perhaps the industrial hygienist or the safety professional, should meet with the work superintendent and the foreman to survey the job before any work is started. The object of this survey would be to determine what dust problems might be created and to plan methods to control them. The report should be made available to the cost estimators as well as those concerned for the day-to-day work schedule. Controls may increase costs but clean-up expenses may be reduced, and contractors should be aware of the procedures which they will be required to follow.

Operations which generate large amounts of dust include:

1. Rip-out of old insulation
2. Mixing asbestos mortar and dry cements
3. Cutting insulation material either on site or in fabrication shops by hand or power tools
4. Blocking or hammering on block or pipe covering to seat material
5. Warehousing storage and transportation of material
6. Clean-up and waste handling.

Particular efforts should be made to control dust dispersion during these operations both to reduce peak exposures and to prevent general contamination of the atmosphere of the work area.

The following sections of this manual discuss in detail procedures which have been found useful in reducing atmospheric contamination by insulation dusts. These procedures have been assembled from research of our Laboratory and from several other sources, with major contributions made by the programs developed at the Puget Sound and Long Beach Naval Shipyards. Additional information is given in

NAVSHIP INST 5100.26: Asbestos Exposure Hazards; Control of, of Feb. 9, 1971, which describes the U.S. Navy directives for working with asbestos.

II. Control of Asbestos-Containing Dusts by Use of Substitute Materials

Substitution of materials containing reduced proportions of asbestos or no asbestos at all, is becoming more common in ship construction. Before a material is substituted for asbestos, certain points must be carefully considered. From a health point of view, one must guard against that which has happened in other environmental situations -- where in the desire to minimize use of a substance with some known hazard, an untested substance has been substituted which later turns out to be of the same or greater hazard.

A second consideration must be: will the new material meet engineering specifications and will it perform adequately under conditions of use.

Materials containing reduced amounts of asbestos have been used in the following applications:

A. Fibrous glass for blanket and pad filling

Amosite blanket covered with asbestos cloth is a standard material for making valve and flange pads. Substitution of the proper grade of fibrous glass as a pad filler not only reduces asbestos dust during fabrication and installation but also tends to lessen the problems during subsequent "rip-out". Asbestos cloth which has been treated with a dust suppressant is available and its use should also be encouraged.

B. Pipe covering and block with reduced asbestos content

Over the years the manufacturers of calcium silicate materials have been steadily reducing the percentage of asbestos fiber in their material. Serious consideration should be given to those products containing lower amounts of asbestos fiber. Several British firms have introduced asbestos-free calcium silicate block and pipe covering. To date, however, this material has not been adequately evaluated in the United States to determine how it will perform in use. Several groups are actively working to develop substitute materials and new products may be expected.

III. Reduction of Dust by Changes in Work Methods

In many operations, changes in work practices will reduce dust dispersion very significantly. All of the procedures discussed in this section have been utilized and found to be effective.

A. Mixing Asbestos Mortar

This operation has usually been done at the job site. While the time spent in mixing is quite short, considerable dust is produced. A tested method of control is to mix the mortar dockside in an exhaust ventilated enclosure and package the mixed mortar in covered containers for transportation to the job site. Mortar is available packaged in several sizes of plastic bags which have a spout through which water is introduced. Sufficient water is added to moisten the mortar; after premixing, the bag is opened and the remaining water added. The carton in which the bag is packaged serves as a mixing box and waste container. Either of these methods minimizes dust dispersion at the job site. One commercially available package is illustrated in Figure 1.

B. Pre-cutting pipe covering and block in the fabrication shop

Hand-cutting of pipe covering and block should be kept to an absolute minimum. Bend sections, pipe cover lengths and blocks should be cut in the fabrication shop on exhaust-ventilated equipment. The procedure used at the Puget Sound Naval Shipyard is shown in Figure 2. Cut sections are dipped in water in a 55-gallon drum and then packed in plastic bags which are labeled to identify the location where they are to be used. This procedure insures that the cut sections are still damp and relatively dust-free when they are applied. Gore breakage is reduced and all parts of the band are kept together. The plastic bags are also available at the job sites for use in collecting wastes. All blocks and pipe sections should also be dipped before application. Puget Sound Naval Shipyard has found that this procedure reduces dust dispersion by 50-60 per cent.

C. <u>Pre-scoring blocks</u>

Insulation blocks should not be scored at the job site. Blocks which have been pre-scored by the manufacturer can be purchased, or standard blocks can be scored in the fabrication shop using an exhaust-ventilated gang saw. Pre-scoring in the shops insures good quality control of scoring depth.

D. <u>Insulating pipe assemblies in the shop</u>

Some pipe assemblies are quite intricate and are troublesome to lag while in place. A satisfactory method of doing these jobs, particularly during ship repair, which is employed by the Puget Sound Naval Shipyard, is to remove the assembly in conveniently sized sections and transport them to the shop. The work is enclosed in an exhaust-ventilated plastic tent, the old insulation removed, any necessary repair of the pipes performed and the assembled section re-lagged. Not only is dust dispersion reduced, but it is much more convenient to re-lag the section in the shop than when it is place shipboard. Any insulation which is damaged during transport and fitting is repaired after the sections are in place. Pipe sections too large to bring into the shop can be covered with temporary exhaust-ventilated plastic enclosures and worked on outside.

E. Hand-cutting at job sites

Some hand-cutting at job sites is unavoidable. However, dispersion of dusts by these operations can be minimized. Figure 3 illustrates a portable down-draft table which is used by the Puget Sound Naval Shipyard. This table has folding legs so it can be carried down companionways and set up conveniently to the work. A small industrial vacuum cleaner is the source of exhaust. Scrap is dropped into a plastic bag and a disposable plastic dropcloth is placed on the deck under the equipment. Six mil polyvinyl chloride sheet is satisfactory. Electrostatic charge on the sheet causes the dust to adhere to it. At the end of the shift, the sheet is folded up to contain the waste and placed in a plastic bag for disposal. A small down-draft table for use in cramped quarters can be constructed from a five-gallon can. A screen is fitted over the open top and a tube soldered to the side near the bottom. A small industrial vacuum cleaner is attached to the tube. These procedures restrict hand-cutting work to relatively small areas, reduce dust dispersion and facilitate clean-up.

F. Fabrication of Pads and Blankets

Pads for valves and machinery should be fabricated in the shop whenever this is possible. Amosite has been largely replaced by fibrous glass filling with covers of asbestos cloth which has been treated with dust suppressants. Figure 4 illustrates an effective means for suppressing dust dispersion. The fibrous glass blanket is unrolled, dampened and re-rolled. This procedure insures that all the blanket will be dampened. The blanket and asbestos cloth shapes are cut in the lateral draft booth. Figure 5 illustrates another system for dampening pad material before cutting. As there is no lateral draft booth in this shop, all the operators wear respirators.

G. Housekeeping and Clean-up

Essential parts of a dust control program are housekeeping and clean-up procedures. Meticulous attention must be given to measures for restricting spread of dust and larger wastes. Figure 6 again shows use of a plastic dropcloth under a work area and vividly illustrates how much waste would be distributed over the general area or to lower decks if one were not used. Figure 7 shows use of an industrial vacuum cleaner to collect dust and small scrap. Areas should be cleaned up at the lunch break and the end of each shift. In all possible instances, workmen should clean up their own areas. Where work rules prohibit this, the clean-up crew should be under the direction and supervision of the insulation foreman to insure that proper attention is given to this important subject.

IV. Reduction of Dusts by Use of Local Exhaust Ventilation

A. Ventilation of large power tools

Band Saws

Extensive use of band saws both in dockside fabrication shops and, on larger ships such as aircraft carriers, in the vessel itself, make emissions from band saws a major source of asbestos dust. Figure 8 shows the dust cloud which is produced by use of an un-controlled band saw. Control devices for such saws have been known for years and are relatively simple. Conventional low velocity, high volume systems using a negative pressure bag house for air cleaning are usually more practical in a fixed or portable fabrication shop. A collapsible umbrella type hood attached to a 4" or 5" flexible hood can be positioned close to the work to increase effectiveness of the collection system. Figure 9 shows use of a simple device which is very effective in collecting dust produced during cutting of large diameter pipes.

Because some degree of portability is required in a temporary shipboard fabrication area, a high velocity, low volume dust collection unit is desirable for such use. In Figure 10, a band saw equipped with this system is shown in use. In Figure 11, the table top has been removed to show the pick-up hood and duct. The air mover is an industrial vacuum cleaner which pulls air past the saw blade at a velocity of over 10,000 feet per minute. This system is a very efficient dust collector. Units such as this can also be designed to control dusts produced by table saws.

B. Ventilation of Hand Power Tools

High velocity, low volume collection systems control dust emissions from most small power tools adequately. Saber saws for cutting pipe covering and rotary saws for cutting asbestos cement board are well controlled with these systems. Figure 12 shows a saber saw equipped with this system in use. It is apparent that little dust is escaping. Small industrial vacuum cleaners can be used as the source of exhaust.

V. Reduction of Dust by General Exhaust Ventilation

In addition to use of dust suppression procedures, compartments and other enclosed areas will require general exhaust ventilation to prevent the gradual build-up of asbestos dust in the workroom atmosphere. The exhaust must be discharged to the outside air through an air cleaner.

A. General Exhaust Ventilation of Ship Compartments

Large air movers (10,000 cfm or more) can be placed on the deck and large diameter trunk lines threaded through hatches. Smaller flexible ducts can be led from the trunk lines to the areas requiring ventilation. Provisions must be made for admitting make-up air to the ventilated space in such a manner that air flow sweeps the compartment. The Manual of Recommended Practices for Ventilation of Coating and Surface Preparation Operations which was prepared by the Shipbuilding Departmen supplied with proper protective equipment should always be used for rip-out work and it should be scheduled for rapid completion.

VII. Personal Protective Equipment

In addition to dust suppression and dust control procedures, personal protective equipment is often necessary to reduce exposure and limit the spread of contamination. The equipment described below is used in control programs.

A. Protective Clothing

Protective clothing is required to prevent spread of contamination beyond work areas. One method is to issue disposable coveralls which can be removed when leaving the work area or some time prior to entering the locker room and placed in plastic bags for disposal. A satisfactory type of protective clothing consists of resin impregnated paper coveralls. These are inexpensive, readily disposable, prevent spreading contamination to laundries and eliminate pilferage. They are worn for one shift, then removed and placed in plastic bags for disposal with other asbestos-containing wastes. These coveralls provide sufficient protection for all but extreme conditions.

B. Respiratory protective equipment

Even if dust suppression and dust control procedures are used, some operations generate so much dust that it is impractical to maintain satisfactory atmospheric concentrations of asbestos fibers and respiratory protection must be provided to the workers. A variety of respirators are available which are suitable for various situations involving exposure to asbestos. It is emphasized that unsatisfactory amounts of respirable dust can be present in the air even though conditions are not visibly dusty. The fine particles which can be inhaled settle slowly and will remain in the air for some time after dust-dispersing work has ceased and the air is apparently clear. Clarity of vision is not a good indicator of the absence of respirable particles.

1. Air-supplied Respirators

Extremely dusty jobs, such as rip-out of old insulation where dust concentrations are very high, require use of air-supplied respirators which will deliver clean, dust-free air to a facepiece or hood. Two general types are available: air-line and self-powered.

a. Air-line respirators in which air is supplied to a hood, helmet or facepiece give the greatest degree of protection. Air is fed to the facepiece from a compressed air-line. The quality of the supplied air must meet applicable state or federal regulations. If the source is not specifically designed for breathing purposes, a temperature sensing alarm

Need to mention OSHA specifically or reference at end?

must be installed on the compressor or a carbon monoxide monitoring device must be installed in the air-line. Anti-freeze compounds should not be used in the compressor system; water vapor must be removed by dessicants and oil mists be removed by a filter. [illegible] assure pure[illegible] Figure 13 shows an inexpensive plastic, disposable hood developed by the Puget Sound Naval Shipyard for situations where a very high degree of protection is required. This hood is available commercially. The air-line should be fastened to the hood with a quick-disconnect fitting.

OSHA requirement

b. Air-line respirators connected to a compressed air supply impose limitations on movement, and this limitation can be troublesome. Self-powered respirators do not impose such limitations, but do add to the equipment which the workman must carry and also require careful maintenance. Batteries must be recharged daily, filters replaced and other maintenance done routinely. Workmen usually prefer these devices to air-line respirators.

2. Particulate-filtering respirators

There are several types of particulate-filtering respirators. Those equipped with a half-mask facepiece are considered suitable for use by insulators. Only those approved for protection against pneumoconiosis and fibrosis-producing dusts by the U.S. Bureau of Mines should be used. These devices are recommended for protection in those situations where the atmospheric concentration of asbestos fibers is at relatively low levels. Workmen will not wear respirators all of the time during which they are exposed and this fact must be taken into account when respirators are used to reduce exposures.

OSHA reference prems letter

All the recommendations for respirator-fitting, training of workmen and maintenance, detailed in Z88.2-1971 should be followed. OSHA 1910.134

a. <u>Reusable particulate-filtering respirators</u>

A variety of reusable particulate-filtering respirators are available. To insure proper fitting, several different makes should be available from which the workman can select one. <u>No one model respirator facepiece will fit all faces</u>. Routine maintenance is absolutely necessary to replace clogged filters and leaking inhalation or exhalation valves. <u>Poorly maintained respirators produce a false sense of security</u>.

b. <u>Single-use particulate-filtering respirators</u>

Operation of an adequate respirator maintenance program can be troublesome and, if only a few men are involved, impractical. Single-use respirators are available which are designed to be worn for no longer than one shift and then discarded. Inherently, these devices are not as rugged as a reusable respirator and no attempt should be made to use them longer than one shift. As with any respirator, a training program is required to insure that they are properly fitted and used.

VIII. Education and Training

No dust control program can be effective unless workmen and supervisors understand the hazards associated with the jobs, the sources of the hazards and the reasons for following recommended procedures carefully. Understanding is only obtained by education of personnel and training in correct operating procedures and changed work practices. For an education and training program to be successful, both management and labor must be concerned and participate. As with all safety programs, it is essential that first-line supervisors be interested in and cooperate in the work. The program must be evaluated occasionally and refresher training given.

The harmful effects of neglect or improper procedures for controlling asbestos dust are not apparent for many years. Therefore, it is more difficult to convince workmen of the necessity of following rules for working with insulating materials than if physical hazards were involved. However, those shipyards which conduct education and training programs report good success.

Education in hazards associated with use of insulating materials and instruction in correct work practices should be included in apprentice training programs. For the time being, however, training and education must be done at the shipyards. This must be a continuing program and should include not only insulation workmen, but others who may occasionally work with insulation materials.

IX. Medical Program

Medical surveillance of the shipyard workforce is an essential part of the hygiene program. However, because of the long period (years) between onset of exposure and first evidence of disease, such surveillance is an unreliable guide to the efficacy of a control program. Abnormalities which might be found are evidence of the oversights and inadequacies of the past, while the suitability of current practice would only be reflected in the clinical findings of even decades hence. This constraint makes all the more necessary careful, constant, and diligent attention to all engineering phases of the hygiene problem.

On the other hand, a medical program can be of value to the workforce. Should abnormalities be found, appropriate treatment can be rapidly undertaken; in other instances, modification of work stress can be arranged. The special hazard of cigarette smoking can be reviewed with those men who have this habit (lung cancer seems not to be greatly increased among asbestos-exposed workmen except with such smoking history; they have a risk much greater than that of cigarette smokers in general). Also, there is some evidence that lung scarring also is exaggerated with smoking..

While the medical program may vary with circumstances, it should at least include chest X-ray, blood count to eliminate anemia, pulmonary function estimation (a simple vital capacity test, easily and rapidly done, usually suffices), clinical examination of the lungs, and a careful review of pertinent symptoms.

Examination once a year suffices for the younger men (with less than 15 years in the trade); after this point, examination every six months is preferable, especially for men with a history of cigarette smoking.

X. Waste Control

Wastes must be collected and disposed of promptly to prevent dispersion of dusts throughout the work area. Some recommendations for collecting and containing wastes have been given in preceding sections. Additional measures for handling and disposing of wastes are listed below.

1. All used filters from ventilating, dust collecting or cleaning equipment should be treated as asbestos wastes.
2. Wastes should be contained in plastic bags or other impervious containers for handling, stock piling and/or transportation.
3. Wastes should not be permitted to accumulate, but should be taken to the final disposal site as soon as possible. Final disposal should be in accordance with applicable regulations.
4. Exposures of waste handlers should be evaluated and, if indicated, they should wear respirators.

XI. Procedures for evaluation of atmospheric concentrations of asbestos dust

Air sampling procedures and laboratory methods for evaluating samples should conform to those specified in U.S. Dept. of Labor regulations.

Figure 1

High temperature mortar packed in plastic bag. Water is added to bag through spout and mortar moistened before opening. The moistened mortar is removed as required and mixing completed in shipping container. All wastes are placed in container and sent to disposal at end of shift.

Photo courtesy Insulation Industry Hygiene Program.

Figure 2

Procedure used at Puget Sound Naval Shipyard for handling bend sections. Sections are cut in fabrication shop, dipped in water and placed in plastic bag. The bag is then labelled with the job-site description.

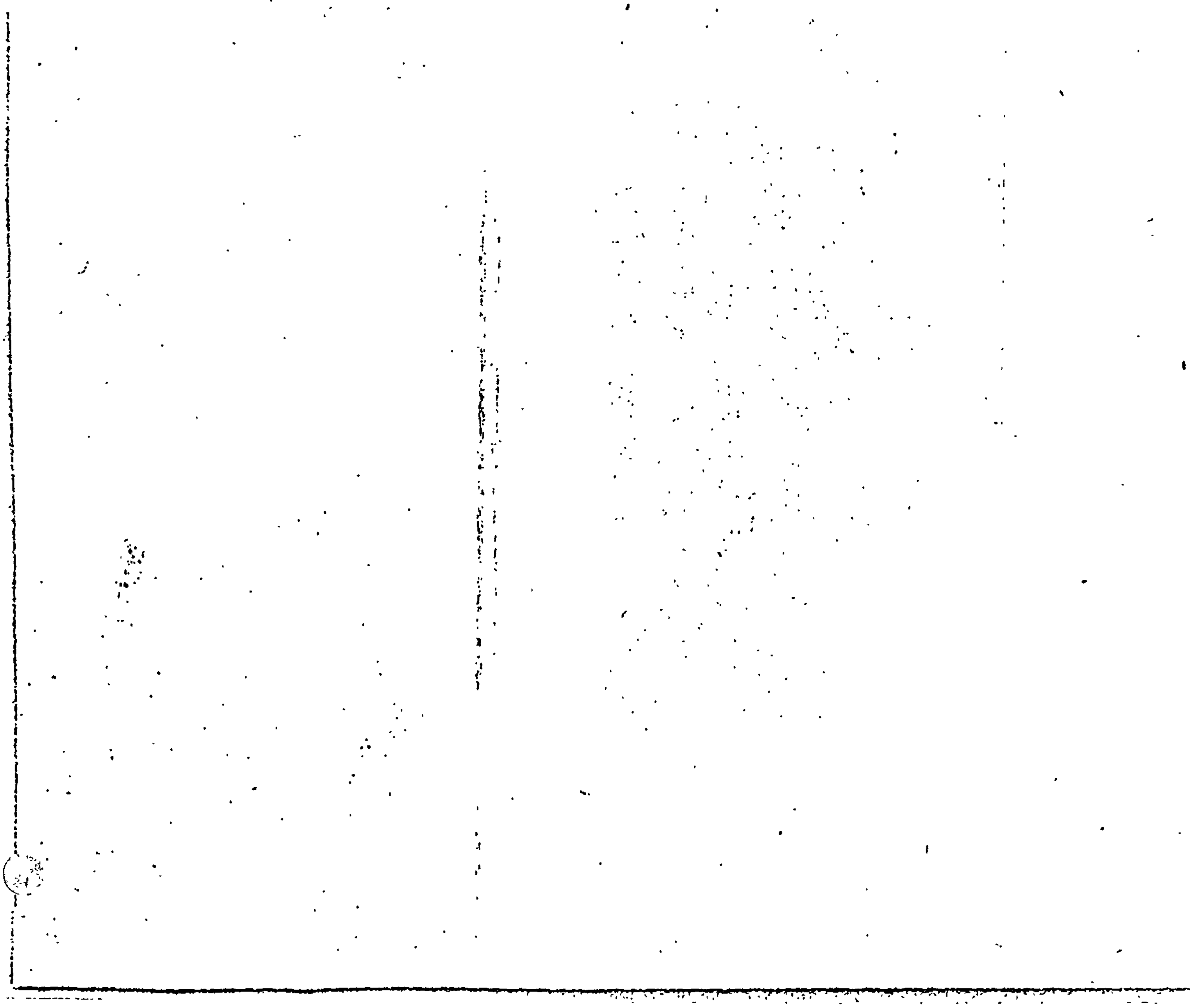

Figure 3

Portable down-draft table developed by Puget Sound Naval Shipyard for use shipboard. Light weight industrial vacuum cleaner used as air mover. Note plastic bag for scrap and dropcloth on deck.

Figure 4

Dampening fibrous glass blanket filler before cutting. Note lateral draft hood in which fabrication is done. This procedure is used at Puget Sound Naval Shipyard.

Figure 5

Fabrication of pads at Long Beach Naval Shipyard. Fibrous glass filler is dampened before cutting. As no lateral draft hood is available, all operators wear respirators.

Figure 7

Use of small industrial vacuum cleaner for clean-up.

Photo courtesy of Puget Sound Naval Shipyard.

Figure 8

Dust produced by use of an unventilated band saw. Without the back lighting used here, much of the dust would not be visible.

Photo courtesy Insulation Industry Hygiene Research Program.

Figure 9

Dust collection system for cutting large diameter pipe sections. Air is exhausted from the end of the pipe farthest from the cut.

Photo courtesy Insulation Industry Hygiene Research Program.

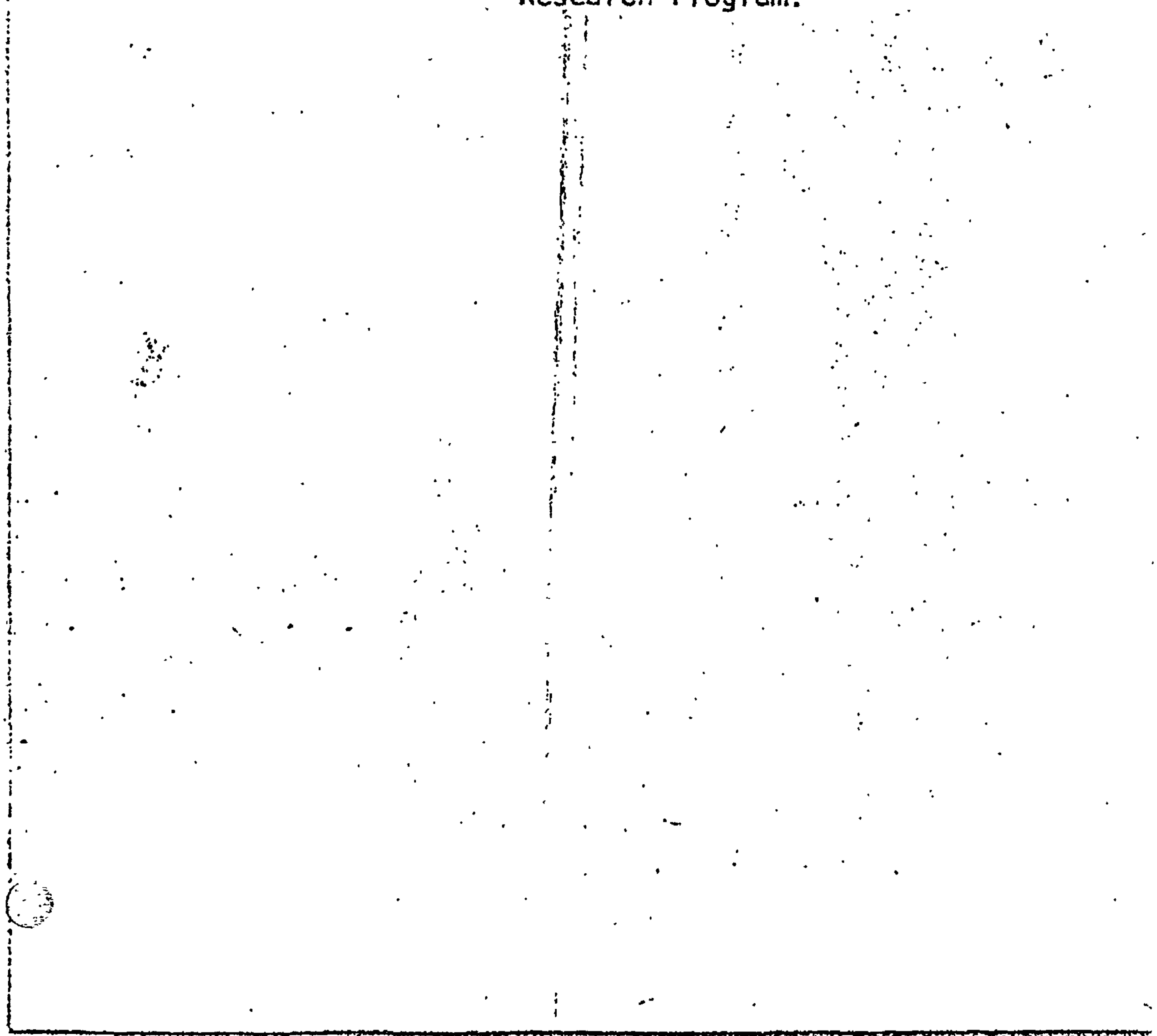

Figure 10

Cutting pipe with band saw equipped with high-velocity, low-volume exhaust system. Compare dust produced with that shown in Figure 8.

Photo courtesy Insulation Industry Hygiene Research Program.

Figure 11

Dust collection port and duct installed on Forrest band saw whose use is shown in Figure 10. Duct connects to Hoffman industrial vacuum cleaner.

Photo courtesy Insulation Industry Hygiene Research Program.

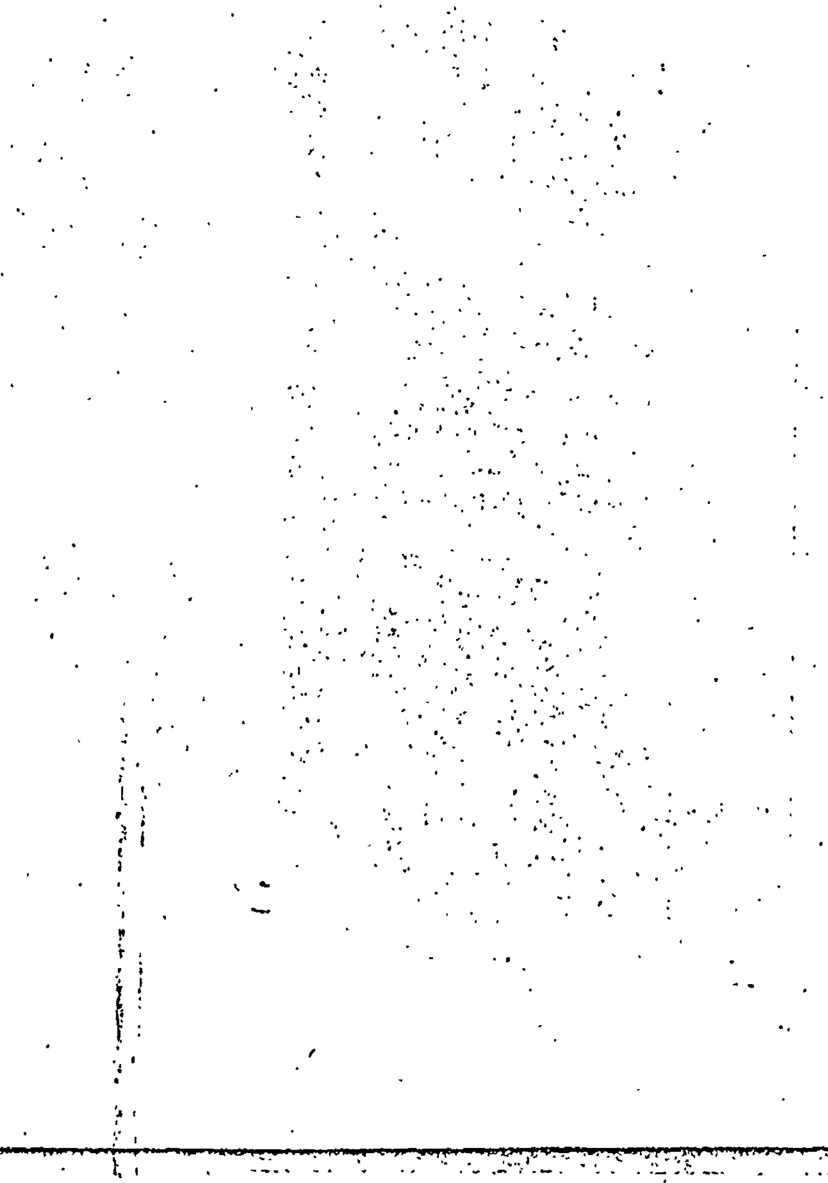

Figure 12

Saber saw equipped with high-velocity, low-volume exhaust system.

Photo courtesy Insulation Industry Hygiene Research Program.

Figure 13

Air-supplied plastic hood developed
Puget Sound Naval Shipyard. Coverall
are pulled over inner bib which holds
the hood in place tightly. This, or
similar equipment, is required for such
operations as rip-out of old insulation.