RECOMMENDED STANDARD FOR OCCUPATIONAL ASBESTOS EXPOSURE IN CONSTRUCTION AND OTHER NON-FIXED WORK OPERATIONS

I. INTRODUCTION

There is a growing recognition that many components of the health standards customarily adopted by the Occupational Safety and Health Administration (OSHA) for fixed-worksite jobs in manufacturing industries do not appreciably advance OSHA's worker health goals when applied to construction and other non-fixed work operations. OSHA acknowledged over four years ago "that alternative . . . controls may be more appropriate and feasible for the consutruction industry" because of "the uniqueness of the construction industry itself (viz., the multiplicity of non-fixed workplaces, and the utilization of highly transient workforces)." 40 Fed. Reg. 47652, 47653 (October 9, 1975). More recently, in her July 18, 1979 Memorandum asking the Advisory Committee on Construction Safety and Health to study the problem, Assistant Secretary of Labor Dr. Eula Bingham expressed concern that OSHA's "health standards . . . have been focused primarily on general industry," and, as a result "of the mobile and transient nature of their industry, construction employers and employees have had difficulty in complying with these standards."

Accordingly, both government and industry have began to examine alternative regulatory strategies which achieve ample health protection for construction workers without the need for fixed-site requirements such as engineering controls, exposure monitoring, medical surveillance, regulated areas, hygiene facilities, and other provisions which are frequently impracticable in non-fixed operations. In addition to the Construction Advisory Committee study, OSHA recently appointed a Special Assistant for Construction Affairs and, on June 7, 1979, established a Task Force on Construction. All of these steps are designed to provide OSHA with guidance on how to resolve the problems of regulating health hazards in the construction industry.

Industry's efforts have focused on alternative methods for protecting worker health. Attention has been directed increasingly toward the development of safer products and work practices which eliminate the need for the often cumbersome provisions of the customary OSHA health standard. In the asbestos industry, for example, unsafe asbestos-containing construction materials increasingly are being withdrawn from the market and simple work practices which minimize occupational asbestos exposure in construction and other non-fixed operations have been and are being developed and widely disseminated. See Appendix.

The Recommended Standard for Occupational Asbestos Exposure in Construction and Other Non-Fixed Work Operations proposed herein is the logical outgrowth of these efforts. In brief, the Recommended Standard establishes a classification scheme designed to provide a series of economic and regulatory incentives for the development of work practices and product formulations which will provide ample health protection for workers without imposing the often impractical features of the typical fixed-site OSHA standard. More specifically, the Recommended Standard makes the current OSHA asbestos standard, which imposes the usual fixed-site requirements, presumptively applicable to construction and other non-fixed workplaces, but provides for partial and complete exemptions based on a scheme which classifies work operations according to their potential asbestos exposure, as follows:

(i) Paragraph (b)(1) defines a "Category A Operation" as an operation which, based on qualified scientific tests, will not result in the release of airborne asbestos fibers in excess of the permissible exposure limits. Under Paragraph (c), such Category A Operations are exempt from all provisions of the current standard;

(ii) Paragraph (b)(2) defines a "Category B Operation" as an operation which, when validated work practices or other protective measures are used, will not result in the release of airborne asbestos fibers in excess of the.permissible exposure limits. Under Paragraph (d), Category B Operations are partially exempt from the standard, provided validated work practices are followed. This partial exemption would leave in effect labeling, housekeeping, and worker education and training requirements which would help ensure the use and effectiveness of validated work practices; and

(iii) In the case of "Category C Operations" -- i.e., operations which are neither Category A Operations nor Category B Operations -- the existing standard would apply in full. Paragraphs (b)(3) and (e).

The purpose of this classification scheme is to encourage the development of safer products and work practices which eliminate the need for the fixed-site requirements of the current standard, such as monitoring and medical surveillance. The proposed standard creates stronger incentives for primary manufacturers to develop validated work practices so that their construction industry customers will not be required to meet the most burdensome fixed-site requirements of the current standard. An additional incentive (in the form of a complete exemption from regulatory obligations) is provided for innovative product formulations which pose little or no foreseeable threat of significant asbestos exposure in some or all uses (Category A Operations).

Moreover, the Recommended Standard would provide enforceable assurances that validated work practices and product formulations are effective in protecting workers. Thus, validation of product formulations (for Category A Operations) and work practices (for Category B Operations) would be performed only by fully qualified testing laboratories based on objective performance criteria. In addition, OSHA's own enforcement activities would act as an empirical check on the scientific validity of such testing. If monitoring results from an OSHA inspection suggest that a Category A or B Operation is not effective in keeping exposures below permissible levels, the employer would, upon appropriate proof, be put on notice that he can no longer reasonably rely upon assurances from the primary manufacturer, and that additional scientific testing would be required.

In short, the alternative recommended herein will serve OSHA's health protection goals far better than the customary OSHA health standard. In practical effect, the current OSHA approach often leaves construction industry employers no choice except to abandon the use of essential or highly useful construction materials. By contrast, the Recommended Standard encourages the development of cost-effective products and work practices which both protect worker health and meet the practical needs of the construction industry and the economy as a whole.

II. THE NEED FOR A REGULATORY STRATEGY WHICH MORE CLOSELY REFLECTS THE EVERYDAY REALITIES OF CONSTRUCTION AND OTHER NON-FIXED WORKPLACES

The characteristics of employment in the construction industry present unique occupational health and industrial hygiene problems which plainly call for separate regulatory treatment. Employers work in a continuously changing environment, moving from one temporary worksite to another. Each worksite is unique, both because the outdoor nature of much of the work results in exposure patterns that can vary widely with changing weather conditions, and because each temporary worksite involves the use of different materials and processes over differing lengths of time.

As a result, occupational exposure to most toxic substances in construction work is highly variable and completely unpredictable. Nevertheless, high worker mobility among tasks results in exposures which are brief, intermittent and, for many substances, very low on the average. Asbestos dust is an example of such a substance, as the findings of OSHA demonstrate:

> Products containing asbestos are not used consistently [in construction work]. Individual workers may work with a product containing asbestos only very occasionally, although some may do so almost continuously. Thus, the total population exposed over time may be much larger than the population at risk at a moment in time, and average annual and cumulative exposure may be quite low.1/

1/ Research Triangle Institute, Asbestos Dust: Technological

(Footnote 1 continued on next page.)

Apart from the nature of construction work itself, the economic structure of the construction industry strongly suggests that customary occupational health and industrial hygiene measures are not appropriate. The industry is characterized by a predominance of small firms and the absence of stable employer-employee relationships. Over 70 percent of construction industry employers are proprietorships averaging one to four employees.2/ These firms themselves are highly transient. Not only does their number fluctuate widely according to seasonal variations and other short-term shifts in demand, but also firms are frequently formed to undertake specific projects and then disbanded once the projects are completed.

As might be expected, the workforce is also highly transient and temporary, with turnover rates as high as 300 to 600 percent per year depending on the job or craft involved, and with casual (i.e., "walk-on, walk-off") hiring and severence practices common.3/ Thus, individual workers may, over a working life, be employed by a very large number of firms.

(Footnote 1 continued from previous page.)

Feasibility Assessment and Economic Impact, Analysis of the Proposed Federal Occupational Standard p. II-35 (dated September 1978 and released December 1979) (hereinafter referred to as the "RTI Report").

2/ RTI Report p. II-35.

3/ Statement of Fred Graham, National Constructors Association (NCA), OSHA Docket H-90 (Cancer Policy), Ex. 125 at 2; RTI Report p. II-36.

The typical OSHA health standard is simply not designed to accomodate the type of employment involved in the construction industry. Requirements for engineering controls, monitoring, medical surveillance, regulated areas and hygiene facilities can effectively protect worker health only in manufacturing or other "general industry" jobs involving stable employment relationships, and regular assignment to fixed-site operations involving repetitive tasks. Yet, nearly every fixed-site health standard thus far promulgated by OSHA under Section 6(b) of the Occupational Safety and Health Act applies to construction workplaces. 44 Fed. Reg. 8706-8805 (February 9, 1979). The current asbestos standard is a classic example of why a new regulatory strategy for construction and other non-fixed workplaces is badly needed.

For example, the current asbestos standard requires construction industry employers to conduct personal and environmental ("area") monitoring which must be "of such frequency and pattern to represent with reasonable accuracy the levels of exposure of employees." 29 C.F.R. § 1910.1001 (f)(2), (3). The nature of construction work makes this requirement for "representative" exposure monitoring a virtually meaningless (albeit very expensive) exercise. As pointed out above, only a few of the remarkable variety of tasks performed by construction workers involve asbestos-containing products. Each such task may, however, present a markedly different potential for exposure to asbestos fibers.

Exposure levels for any given task will vary considerably depending on the duration of the work, the work procedures followed by the particular employee, the tools used, the fiber-release characteristics of the asbestos-containing product, weather conditions, and other factors.4/ These factors, coupled with high worker mobility among tasks and the absence of any regularity or pattern in worker movement among tasks, preclude any worker's exposure on a given day from being "representative" of his exposure on any other day, much less "representative" of any other worker's exposure.

Consequently, the current OSHA provision for monitoring at "such frequency and pattern as to represent with reasonable accuracy the levels of exposure of employees" imposes an enormous burden, and could be read to require continuous monitoring of all of the millions of workers who may be "exposed" (even though briefly and intermittently) to detectable levels of asbestos fibers.5/ But given the uniqueness of each operation, this endless, repetitive monitoring provides

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4/ See, e.g., Statement of Lt. Col. David Smith on behalf of the Department of Defense, Docket H-004 (Lead), Ex. 130; Statement of C. R. Mattson (NCA), Docket H-004 (Lead), Ex. 98; Statement of Harry Taylor on behalf of the Council of Construction Employers, Docket H-004 (Lead), Ex. 64; Statement of I. J. Meyerson on behalf of Boeing Aerospace Company, Docket H-004 (Lead), Ex. 30.

5/ In 1975, OSHA estimated that three to five million construction workers may be exposed to asbestos dust. 40 Fed. Reg. 47653 (October 9, 1975). The RTI Report (Table II-3 at p. II-27) estimates that about 2.3 million workers are exposed to asbestos dust.

information of little or no value in determining whether an exposure limitation is being satisfied throughout all operations.

Moreover, the monitoring task involved far exceeds the capabilities of existing analytical laboratories. And even if the resources were available, the five-to-six week period needed for laboratory analysis exceeds the life of many construction operations involving asbestos.

The current asbestos standard also requires construction employers to provide preplacement, annual and termination medical examinations involving a battery of tests, including diagnostic x-rays and pulmonary function tests, to every worker exposed to virtually any detectable level of airborne asbestos dust. 29 C.F.R. § 1910.1001(j); OSHA Program Directive 300-16 (October 11, 1978). While imposing a potentialy severe burden on employers, this medical surveillance requirement does little to protect the health of construction industry workers.

So long as the permissible exposure limits are being met, there is no reason for imposing such a heavy medical surveillance burden on the construction industry. As detailed above, asbestos exposures in construction operations are generally brief and intermittent. Perhaps as a result of the nature of the exposures, the available epidemiologic evidence strongly suggests the absence of any asbestos-related health risk among construction workers. Dr. Irving Selikoff's recent study of a roofing workers union from January 1960 to

1977 -- the only long-term epidemiologic study of a cohort of construction workers done to date -- reports the following results:

> [I]f there was enough asbestos exposure in built-up roofing to give a significant hazard due to asbestos, I would have seen at least one mesothelioma. I didn't in 2,500 consecutive deaths and these were all people who were in the union in 1960 and incidentally, had to be in the union also to enter that cohort in 1951. So these people were 25, 30, 35, and 40 years old from onset of their work and I didn't find mesothelioma. So I know that there is not a significant increase although I can't prove that there is none. In the next 2,500 deaths, there may be 1 or 2, but certainly there can't be any great asbestos hazard with built-up roofing.6/

Apart from the absence of any health need, the costly medical surveillance requirements of the current standard cannot be justified because of any need for epidemologic studies of workers exposed to low levels of asbestos fibers. A far more useful data base is available from manufacturing operations covered by the existing standard, which generally involve stable, long-term employment with somewhat more regular exposures than in construction operations.

Moreover, medical surveillance creates health and economic risks to the worker which outweigh the minimal (if any) health benefits achieved. The rapid turnover of both employees and employers creates a significant potential

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6/ Excerpt from transcript of Dr. Selikoff's remarks at the Annual Meeting of the Asbestos Cement Pipe Producers Associations in Mexico City, April 1977.

for unnecessary repeat examinations and over-exposure to diagnostic x-rays.7/ In addition, the results of the examination may discriminate against individual workers by making them unemployable even without any actual disability.8/

Other components of the typical OSHA health standard are equally inappropriate in light of the realities of construction work. For example, the concept of a limited-access "regulated area" is meaningless in construction worksites, where, as the National Constructors Association points out, "work is performed in a continuously changing environment", and "personnel are constantly being called upon to perform work in irregularly occupied areas on a transitory basis."9/

Similarly "hygiene facilities" such as change rooms, shower rooms, or lunch rooms are impractical for many construction employers, because most construction sites have no supply of water or the buildings necessary to house these facilities, and because the cost of procuring mobile, self-contained facilities would often be prohibitive, particularly for small-scale

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7/ See "Health Standards Pose Big Problems for Industry," Engineering News-Record, October 12, 1978. Excessive x-ray exposure creates an increased risk of leukemia and other cancers. [Cites]

8/ Statement of Dr. Clark Cooper before the Subgroup on Health Standards of the Construction Advisory Committee, [date].

9/ Statement of Fred Graham, OSHA Docket H-60 (Cancer Policy), Ex. 125 at 6.

construction projects such as residential dwellings or small office buildings.

Nor is there any reason to believe that the generally small, transitory employers in the construction industry are likely to have the personnel or financial resources to meet these requirements. Indeed, the testimony of the National Constructors Association in OSHA's Cancer Policy proceedings stressed that the routine adoption of fixed-site requirements like those discussed above would "place an intolerable economic and logistical strain on the construction industry -- particularly small contractors." NCA added that "the costs are so extreme as to threaten the continued existence of many small and medium size construction companies throughout the nation, without a clear demonstration of the necessity for such rigid health controls."10/

In sum, many provisions of the typical OSHA health standard -- concededly designed for fixed-site employment in "general industry" -- are misplaced when applied to construction and other non-fixed workplaces. The unique characteristics of these workplaces require a fresh approach which both provides ample health protection for workers and is feasible, cost-effective, enforceable, and likely to encourage the development of safer products and work practices. The next section shows, using asbestos as an example, that such a

10/ Id. at 4, 5.

regulatory strategy can indeed be developed for construction and other non-fixed workplaces.

III. EXPLANATION AND ADVANTAGES OF THE RECOMMENDED STANDARD

Occupational health standards should serve a number of different objectives. First, they should be enforceable regulations which adequately protect workers from occupational health hazards. Second, they should be practical regulations which promote voluntary compliance, avoid unnecessary burdens on employers and the public, and channel available occupational health resources to areas where those resources will achieve the greatest health gains for workers. And third, they should encourage the private sector to develop safer products and work practices which efficiently satisfy the practical and economic needs of the construction industry and the general economy.

The Recommended Standard would achieve these objectives by establishing a classification scheme which would rank construction operations according to their potential for releasing airborne asbestos fibers in excess of the permissible exposure limits. Classifications would be based upon qualified laboratory tests that, over time, will be tested repeatedly by OSHA enforcement officials. Based on this classification scheme, the Standard would impose regulatory requirements commensurate with the exposure risk presented by each operation, applying more stringent requirements for higher-risk tasks, including full compliance with the existing standard for operations presenting the greatest risk of exposure above permissible levels.

A. Explanation of the Recommended Standard

1. Scope and application

Our Model Standard would apply to "construction work and other non-fixed places of employment where asbestos or products containing asbestos are processed or used." Rec. Std. ¶ (a). The definition of the term "construction work" in Paragraph (b)(6) is identical to OSHA's definition of the term under its General Industry Standards. 29 C.F.R. § 1910.12.

The Standard defines the term "non-fixed work operation" to refer to "jobs which do not involve regular assignment to a particular location or set of locations." Rec. Std. ¶ (b)(7). The purpose of this provision is to include highly mobile non-construction operations such as oil well drilling (discussed in the Appendix, Part C), where asbestos exposures may occur under circumstances similar to construction activities.

Lastly, the Recommended Standard contains a provision which clearly separates the coverage of the current OSHA asbestos standard from the proposed new construction standard. The current OSHA standard does not contain any specification of scope and application, but the provisions of the standard make clear that it applies to any workplace where there is occupational exposure to asbestos. Accordingly, the Recommended Standard adds to the current standard a new paragraph which excludes construction and other non-fixed workplaces which would be covered by the proposed new standard.

2. Classification of Operations

The categorization of construction operations involving asbestos-containing products according to their fiber-release potential is the foundation of the recommended approach. The proposal would establish three classifications (called "Category A," "Category B" and "Category C" Operations) which are defined according to an operation's capacity, under reasonably forseeable conditions of processing or use in construction and other non-fixed operations, for releasing airborne asbestos fibers in excess of the permissible exposure limits. As discussed later, different regulatory requirements would apply to each category, both to reflect the degree of risk associated with each type of operation, and to establish incentives for the development and use of safer products and work practices.

A "Category A Operation" is defined in Paragraph (b)(1) as an operation which "does not result in occupational exposure to airborne concentrations of asbestos fibers in excess of" the permissible exposure limits. Category A is the safest classification and will generally involve products in which asbestos fibers are coated, bound or enclosed by other materials in such a way that they will not be released in significant quantities in certain (or perhaps all) construction industry uses. As discussed in the Appendix, these products are likely to include mastics, mechanical packings, oil seals, compressed gaskets, sealants and caulks, and electrical insulating paper.

A "Category B Operation" is defined in Paragraph (b)(2) as "an operation . . . which, when a specified fabrication, installation or removal method is used, does not result in occupational exposure to airborne concentrations of asbestos fibers in excess of" the permissible exposure limits. In effect, Category B Operations are capable of producing airborne asbestos fiber concentrations in excess of the permissible exposure limits, but will not do so if the correct work procedures, tools or other safeguards are employed.

Obviously, some regulatory controls must be applied to Category B Operations to ensure that they are used in a way that prevents the release of excessive concentrations of asbestos fibers. Nevertheless, if properly classified, Category B Operations do not require the full panoply of typical fixed-site requirements such as monitoring, medical surveillance, regulated areas, and hygiene facilities. So long as the use of proper work practices, tools or other safeguards is ensured, additional requirements are unnecessary or redundant. As discussed in the Appendix, AIA/NA and AACPP have developed data showing that work practices for construction operations involving three asbestos-containing products -- asbestos-cement pipe, asbestos-cement sheet and drilling mud additives -- can be validated under Category B of the Recommended Standard. In addition, recommended work practices are being developed and field-tested for two other potential products: -- flooring products and built-up roofing with asbestos felts, -- as well as for removal and repair operations which, as discussed in the Appendix (pp. 3b-5b), represent perhaps the most significant sources of exposure to asbestos dust in construction work.

The last classification -- "Category C Operations" -- covers operations which do not fall into either of the two preceeding categories. Rec. Std. ¶ (b)(3). Because they possess neither the innate physical characteristics nor the validated work practice controls which are needed to ensure that the permissible exposure levels are met, products used in Category C Operations present the greatest potential for significant asbestos exposures, and accordingly require the most stringent regulatory controls.

3. Validation

For any classification scheme to be successful, it is, of course, necessary to provide adequate assurances that operations will properly be classified. The Recommended Standard employs three devices for achieving this goal: (i) validation by qualified testing laboratories, (ii) objective performance criteria, and (iii) empirical field confirmation by OSHA in connection with workplace inspections.

The Recommended Standard makes clear that a construction industry employer can treat a specific operation as falling within Category A or B only if he "reasonably relies on objective data, developed by a Certified Testing Laboratory." Rec. Std. ¶¶ (c) & (d)(1). Paragraph (b)(5) defines a "Certified Testing Laboratory" as a laboratory approved by the American Industrial Hygiene Association (AIHA) and certified by the National Institute of Occupational Safety and Health (NIOSH) as qualified to test for airborne concentrations of asbestos fibers using the method prescribed in the current OSHA asbestos standard. The use of laboratories which are certified by both AIHA and NIOSH provides an important safeguard against invalid or unsupported product classifications.

An additional safeguard is provided by the inclusion of objective performance criteria for classification. The Recommended Standard requires "objective data . . . which show, within confidence limits of 95 percent," that an operation falls into a particular category. Rec. Std. ¶¶ (c) & (d)(1). This requirement would force validating laboratories to design and conduct careful field tests which account for the varying conditions present in construction and other non-fixed workplaces, and to establish, within 95 percent confidence limits, that the applicable exposure limitations will not be exceeded in Category A and B Operations. As discussed in greater detail below (p. 28), the range of uncertainty inherent in analytical methods for measuring airborne asbestos fiber concentrations will, therefore, have been taken into account in determining whether the product or work practice can be expected to maintain exposures below the permissible exposure limit.

Notwithstanding these safeguards, the Recommended Standard does not give Certified Testing Laboratories the final word on product classification. Instead, it requires "reasonable reliance" by employers on the data supplied by the validating laboratory. Rec. Std. ¶¶ (c) & (d)(1). Nor does the Recommended Standard attempt to define "reasonable reliance," but rather leaves that issue to case-by-case determination in enforcement proceedings. Certainly the reputation of the validating laboratory, the employer's previous experience with the laboratory, the facial completeness of the data and the laboratory's specific conclusions would be relevant considerations.

Another key factor in specific cases would be any findings from previous OSHA inspections of an operation. For example, if an OSHA inspection showed that the applicable exposure limits were exceeded during a Category A Operation or during a Category B Operation where the proper work practices were followed, an employer's ability to continue to rely "reasonably" on the data supplied by the validating laboratory would be placed in doubt, depending on the accuracy and extent of data provided by OSHA in each case. This feature of the Recommended Standard gives OSHA a vehicle for monitoring and verifying the correctness of classifications.

4. Regulatory requirements

The Recommended Standard imposes different regulatory controls on each product category, and tailors the applicable controls to the degree of the exposure hazard presented by each type of product or operation.

Category A Operations are exempt from the existing standard by Paragraph (c). Since Category A Operations do not present a risk of significant exposures, no new regulatory requirements are imposed. Moreover, as discussed in greater detail below, the absence of regulatory controls on Category A Operations creates a strong incentive for the development and use of products which will not lead to significant exposure.

There is one situation where the exemption of Category A Operations from the current standard does not apply: As discussed in greater detail in the Appendix (pp. 3b-4b), construction employees working (e.g., making repairs) in a facility which manufactures or fabricates asbestos-containing products will generally be protected by the current standard, which applies to the owner of that facility. However, construction workers could be exposed to excessive concentrations of asbestos dust in an emergency or from dust which has accumulated in normally inaccessible places such as on pipes and ductwork. Accordingly, Paragraph (c)(2) makes the "emergency" and "housekeeping" provisions of the current standard applicable in those special circumstances.

For Category B Operations, the Recommended Standard requires employers to comply with the "fabrication, installation or removal methods" which qualify the operation under Category B. Rec. Std. ¶ (d)(1). The expression "fabrication, installation and removal methods" is defined in Paragraph (b)(4) to include any combination of engineering, work practice or administrative controls. While work practice controls are expected to be the predominant mode of compliance because of the special features of the construction industry discussed above (pp. 6-14), the purpose of the definition is to permit the use of tools with local exhaust ventilation or work scheduling as ancillary protective measures. The use of respirators as part of a Category B classification is not permitted under the Recommended Standard unless no other control method is feasible for a given operation.

Several additional requirements are imposed to ensure the use and effectiveness of the validated work practices and other protective measures. First, the labeling and housekeeping requirements of the current OSHA standard, together with its provisions governing the use of respirators in emergencies, are made applicable to workplaces conducting Category B operations. Rec. Std. ¶ (d)(2).

Second, manufacturers of products used in Category B Operations are required to include on caution labels a reference to the "fabrication, installation or removal methods" which have been validated for the products in question, and a recommendation that such work practices, tools or other measures be used. Rec. Std. ¶ (d)(3).

Third, the employee education and training provisions of Paragraph (f) apply to Category B Operations, and include a requirement that employers provide as part of the training program "specific instructions concerning the proper use of [the] fabrication, installation or removal methods" which were validated as part of the Category B classification. Rec. Std. ¶ (f)(1)(ii).

For Category C Operations, which, by definition, pose the greatest potential for exposure, the current OSHA asbestos standard would apply in full. Rec. Std. ¶ (e). As discussed above (p. 18), products used in Category C Operations have neither the structural product characteristics nor the validated work practice controls needed to protect workers against excessive exposures. While many components of the typical OSHA fixed-site health standard (such as the current asbestos standard) are generally inappropriate for construction and other non-fixed workplaces, those provisions should nevertheless be applied in the case of Category C Operations both to ensure adequate health protection for workers and to provide a strong incentive for developing safer products and work practices. In addition, Paragraph (f) imposes a new employee education and training program (not provided in OSHA's current asbestos standard) on Category C Operations.

It is important to note that the regulatory status of Category A and B Operations is expressed in the form of exemptions from the current standard. As a result, if a construction employer cannot claim one of the exemptions, the entire existing standard could be enforced against him. The threat of citations and penalties for violating the many individual requirements of the existing standard will provide a powerful incentive for employers to make doubly sure that the criteria for Category A or B classifications are met. In addition, in the case of Category B Operations, employers are subject to citation for failing to follow the validated work practices or the warning sign, labeling, housekeeping, and training requirements, even if the classification criteria have been satisfied.

B. Advantages Over OSHA's Typical Fixed-Site Health Standard

The Recommended Standard for Asbestos Exposure in Construction and other Non-fixed Work Operations has a number of distinct advantages over the current OSHA regulation. First, it imposes practical requirements which nevertheless provide ample assurances for worker protection. Second, it creates incentives for the development of safer products and work practices without sacrificing the economic and practical advantages of asbestos-containing products for the construction industry and the economy as a whole. And third, the Recommended Standard can more efficiently be enforced than the current OSHA standard.

1. Worker protection

The Recommended Standard to be sure, departs significantly from the provisions of the traditional OSHA health standard. Nevertheless, as demonstrated above (pp. 6-14), these fixed-site requirements, including monitoring, medical surveillance and other requirements, are impractical in construction and other non-fixed operations and contribute little to worker health. Even if it had unlimited enforcement resources, OSHA could not hope to achieve widespread compliance with these provisions, and construction employers would be left with the "Hobson's choice" of risking noncompliance penalties or abandoning highly useful or, in some instances, essential products.

OSHA itself has, on occasion, limited or modified its traditional regulatory approach in an effort to avoid standards which impose sweeping requirements without any signficant or commensurate health gain. OSHA's current labeling requirement for asbestos-containing products, for example, provides that "no label is required where asbestos fibers have been modified by a bonding agent, coating, binder or other material so that during any reasonably forseeable use, . . . no airborne concentrations of asbestos fibers in excess of the exposure limits . . . will be released." The waste disposal requirement of OSHA's current asbestos standard contains an identical exemption. 29 C.F.R. § 1910.1001(g)(2)(i) and (h)(2). In effect, OSHA has recognized that some asbestos-containing materials do not pose an exposure threat which is significant enough to justify expensive regulatory controls.

Another example of an effort to prevent unduly broad application of monitoring, medical surveillance and other typical OSHA requirements is OSHA's Inorganic Arsenic Standard, which excludes workplaces where inorganic arsenic is present in only small amounts. OSHA justified an exemption in that case as follows:

> [A]rsenic is a naturally occurring material and is present in small amounts in many substances. It is therefore inappropriate to cover situations where very low levels of arsenic may be present in substances or products in the workplace, but where they are handled in such a way that the possibility of airborne exposure is minimal. 43 Fed. Reg. 19612 (May 5, 1978).

Similarly, OSHA's Cotton Dust Standard contains a series of exemptions where application of the standard would achieve little at great cost, including (i) maritime workers, because the "limited duration of exposure makes it unlikely that cotton dust exposure is significant for an appreciable number of the workers handling water borne shipments of cotton"; (ii) workers handling "washed cotton," because of the effectiveness of the washing process in significantly reducing or eliminating the biological effects of cotton dust"; and (iii) harvesting of cotton, because "it is a distinctively farming operation and presents different exposure environments and possibilities for control." 43 Fed. Reg. 27831-32 (June 23, 1978). OSHA took a similar approach in formulating its Benzene Standard. There, it exempted gasoline stations and other operations where the standard would have a sweeping impact, but where exposures are not likley to exceed permissible limits. 29 C.F.R. § 1910.1028(a)(2); 43 Fed. Reg. 27962 (June 27, 1978).

OSHA's Acrylonitrile (AN) Standard, which more closely resembles the alternative standard we propose for asbestos exposure in the construction industry, also reflects an effort to adapt the traditional regulatory approach to unique circumstances. The AN standard imposes the traditional fixed-site requirements on manufacturers of products containing AN, but exempts downstream processors and fabricators of such products where "objective data is reasonably relied upon" to show that a designated action level is not exceeded. 29 C.F.R. § 1910.1045(a)(2)(ii). In adopting this and other exemptions from the overall AN standard, OSHA "recognized that the potential for exposure to AN in the workplace extends to a multitude of workplaces, including many small fabricators, extruders, and other downstream processors of materials containing or made from AN," and that "extending the AN standard that far would be burdensome to both industry and OSHA, and would not be reasonable in light of the degree of exposure involved." 43 Fed. Reg. 45762, 45776 (October 3, 1978).

Significantly, the Recommended Standard goes beyond the AN standard in protecting worker health.

First, it requires that product and work practice testing be performed only by fully qualified testing laboratories.

Second, it provides objective performance criteria which require a high statistical degree of confidence (95 percent) that the permissible exposure limits will not be exceeded. This latter point is especially important in the case of asbestos, where the OSHA technique for measuring airborne asbestos concentrations is subject to a margin of uncertainty so great that "[a]n actual airborne fiber concentration of 0.5 fibers/cc will routinely produce sample counts of 2.0 fibers/cc or more."[11/] Consequently, the 95 percent confidence requirement will, in practice, not be met unless the products and work practices being tested routinely produce measurements far below the permissible exposure limits, adding a significant extra margin of worker safety.

11/ Comments of Johns-Manville, OSHA Docket H-___ (Asbestos), Ex. 3-185 at ex. D, p. 42.

2. Incentives for the development and use of safer products and work practices

Apart from providing superior health protection for workers without the cumbersome fixed-site features of the current standard, the Recommended Standard creates strong incentives for the development of safer products and work practices. Under the current standard, construction employers cannot legally avoid burdensome fixed-site requirements such as monitoring or medical surveillance no matter how safe the asbestos-containing products or work practices which they employ. Thus, they must either ignore the standard to the detriment of employees, or they must stop using extremely valuable construction materials, to the detriment of the economy.

Under the Recommended Standard, the threat that the current standard might be enforced in full provides a powerful incentive for the development and use of products or work practices which qualify for Category A or B classification. As a result, two critical objectives would be advanced. First, worker health would be protected through the use of products and work practices which present no serious risk of dangerous asbestos exposure. Second, the current incentive for across-the-board substitution of inferior non-asbestos-containing products would be eliminated and replaced with a scheme which encourages the use of the best construction materials which do not threaten the health of workers.

3. Enforceability

The third principal advantage of the recommended approach is that it will ease the tremendous enforcement burden OSHA faces in policing the millions of workers potentially exposed to asbestos dust in hundreds of thousands of construction sites throughout the nation. Under the Recommended Standard, in a large majority of cases, OSHA inspectors may have to do nothing more than determine whether the proper products and work practices are being used -- a task much simpler and less time-consuming and expensive than under the current standard, where exposure monitoring may have to be conducted and employer medical, industrial hygiene and other files may have to be searched and reviewed.

Instead of endlessly monitoring individual construction operations to determine whether the permissible exposure limits are being met in each unique case, the Recommended Standard allows OSHA to focus its enforcement activities on identifying improper product classifications. As discussed above, once sampling results from OSHA inspections indicate that an operation may be improperly classified, construction employers and upstream manufacturers of asbestos-containing products throughout the nation will have a powerful incentive to develop substitute products or work practices which ensure that exposure limitations are met.

IV. CONCLUSION

There is a clear need for a new strategy to control health hazards in construction and other non-fixed work operations. The current OSHA approach, which imposes on these operations provisions for endless, repeated monitoring and medical surveillance as well as other requirements designed for fixed-site jobs in manufacturing industries, is simply not feasible. Nor do many of the requirements of the customary OSHA standard contribute appreciably to the health of construction workers. Even if it could be enforced by OSHA, the current asbestos standard would only result in the substitution of inferior materials or, in some cases, the stoppage of construction work altogether.

The better approach is to substitute a regulatory scheme that strongly encourages the use of products and work practices which protect workers against excessive exposures without imposing infeasible fixed-site requirements such as monitoring and medical surveillance. As this paper has illustrated in the particular case of asbestos, such an approach provides fully adequate health protection for workers, establishes continuing incentives for the development and use of safer products and work practices, and considerably eases OSHA's enormous enforcement burden. The proposed standard recommended herein plainly meets these objectives and should therefore be carefully considered by OSHA and the Construction Advisory Committee in connection with their efforts to develop an effective occupational health strategy for construction and other non-fixed work operations.

The Asbestos Information
Association of North America
and
The Association of Asbestos-
Cement Pipe Producers

RECOMMENDED STANDARD FOR OCCUPATIONAL
ASBESTOS EXPOSURE IN CONSTRUCTION
AND OTHER NON-FIXED WORK OPERATIONS

Part 1910 of Title 29 of the Code of Federal Regulations is amended as follows:

1. Section 1910.1001 of Title 29 of the Code of Federal Regulations is amended by adding after Paragraph (j) thereof the following new Paragraph:

"(k) Scope and application. This Section applies to all places of employment where asbestos or products containing asbestos are handled, processed, used, transported, packaged, repackaged, or released, except as provided in Section 1910.1001a."

* * *

2. A new Section 1910.1001a is added as follows:

"1910.1001a Asbestos Exposure in Construction Work and Other Non-Fixed Work Operations

"(a) Scope and application. This Section applies to every place of employment in construction work and other non-fixed work operations where asbestos or products containing asbestos are processed or used.

"(b) Definitions.

"(1) "Category A Operation" refers to an operation within the scope of this Section which does not result in occupational exposure to airborne concentrations of asbestos fibers in excess of (i) an eight-hour time-weighted average concentration of two fibers, longer than five micrometers, per cubic centimeter of air, and (ii) a ceiling concentration of ten fibers, longer than five micrometers, per cubic centimeter of air.

"(2) "Category B Operation" refers to an operation within the scope of this Section which, when a specified fabrication, installation or removal method is used, does not result in occupational exposure to airborne concentrations of asbestos fibers in excess of the exposure levels specified in Subparagraph (1) of this Paragraph.

"(3) "Category C Operation" refers to an operation within the scope of this Section which is neither a Category A Operation nor a Category B Operation.

"(4) "Fabrication, Installation or Removal Method" means any combination of engineering controls, tools, equipment, work practices, task assignment strategies, and respiratory protection, for controlling occupational exposure to airborne concentrations of asbestos fibers; provided, however, that a fabrication, installation or removal method may not include respiratory protection unless no other method for controlling occupational exposure to airborne concentrations of asbestos fibers is feasible.

"(5) "Certified Testing Laboratory" means a laboratory approved by the American Industrial Hygiene Association and certified by the National Institute for Occupational Safety and Health as qualified to test for asbestos fibers using the membrane filter method specified in Paragraph (e) of Section 1910.1001.

"(6) "Construction work" means work for construction, alteration, and/or repair, including painting and decoration.

"(7) "Non-fixed work operation" means non-fixed as to the location where an employee performs his duties and refers to jobs which do not involve regular assignment to a particular location or set of locations.

"(8) All other terms used in this Section shall have the meanings prescribed in Section 1910.1001 and in Section 3(8) of the Act, 29 U.S.C. § 652(8).

"(c) Category A Operations.

"(1) Any employer who reasonably relies on objective data, developed by a Certified Testing Laboratory, which show, within confidence limits of 95 percent, that an operation covered by of this Section is a Category A Operation, is exempt from the provisions of Section 1910.1001 as they apply to such operations, except as provided in Subparagraph (2) of this Paragraph.

"(2) Where a Category A Operation is located in a facility which manufactures or fabricates products containing asbestos, Paragraphs (d)(1)(iii) and (h) of Section 1910.1001, relating to the use of respirators during emergencies and housekeeping, shall apply to such operation.

"(d) Category B Operation.

"(1) Validation. Any employer who reasonably relies on objective data, developed by a Certified Testing Laboratory, which show, within confidence limits of 95 percent, that an operation within the scope of this Section is a Category B Operation, is exempt from the requirements of Section 1910.1001 as they apply to such operation, provided that the employer takes all practicable measures to ensure the use of the fabrication, installation or removal methods which qualify the operation as a Category B Operation.

"(2) Emergencies, Warning Signs, Caution Labels, and Housekeeping. Notwithstanding the provisions of Subparagraph (1) of this Paragraph, employers who use fabrication, installation or removal methods validated under Subparagraph (1) of this Paragraph shall comply with Paragraphs (d)(1)(iii), (g)(2) and (h) of Section 1910.1001, relating to the use of respirators during emergencies, caution labels and housekeeping.

"(3) Notification. "Any manufacturer of a product for which a fabrication, installation or removal method has been validated pursuant to this Paragraph, shall, if he has actual knowledge of such validation, include on the label required by Paragrapy (g)(2) of Section 1910.1001 the following additional statement:

"Follow Recommended Fabrication, Installation or Removal Methods."

"(e) Category C Operation. The requirements of Section 1910.1001, as promulgated on June 7, 1972 (37 F.R. 11318) and amended on March 19, 1976 (41 F.R. 11504), shall apply to any operation within the scope of this Section which is a Category C Operation.

"(f) Employee Education and Training.

(1) All employers covered by this Section shall institute a training program for employees working in operations within the scope of this Section (exceptfor Category A Operations covered by Paragraph (c) of this Section) and shall assure that each such employee is informed of the following:

"(i) the operations where asbestos-containing products are processed or used, and the conditions of processing or use under which exposure to airborne asbestos fibers may take place;

"(ii) if the employer intends to use fabrication, installation or removal methods which have been validated for Category B under Paragraph (d), the training program shall include specific instructions concerning the proper use of such fabrication, installation or removal methods.

"(2) The training program required under this Paragraph shall be provided within 90 days of the effective date of this Section or at the time of initial assignment of an employee to an operation within the scope of this Section (except for Category A Operations covered by Paragraph (c) of this Section), and at least annually thereafter.

"(3) Upon request, the employer shall make available to employees, the Assistant Secretary or the Director, all materials relating to the information and training program instituted under this Paragraph, and any objective data concerning the validation of fabrication, installation or removal methods used by the employer for Category B Operations pursuant to Paragraph (d) of this Section.

APPENDIX

A Preliminary Assessment of How the
Recommended Asbestos Standard Can
Successfully Be Implemented in Construction
and Other Non-Fixed Work Operations

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APPENDIX

A Preliminary Assessment of How the Recommended Asbestos Standard Can Successfully Be Implemented in Construction and Other Non-Fixed Work Operations

As discussed in the body of this paper, the Recommended Standard for Asbestos Exposure in Construction and Other Non-Fixed Work Operations is intended to replace the impractical requirements of the current OSHA asbestos standard with an enforceable, cost-effective regulation which will both ensure that worker health is adequately protected and provide incentives for the development of even safer products and work practices, all without sacrificing the important economic and practical benefits of asbestos-containing construction materials.

The purpose of this Appendix is to present technical data which show that the Recommended Standard is more than just an appealing theoretical construct -- rather, it is a workable regulation which will impose requirements which are both acceptable and cost-effective.

This Appendix begins with an Introduction which presents background information and data on the situations where exposure to airborne asbestos fibers may occur in construction and other non-fixed work operations. The Introduction also assesses preliminarily, based on the asbestos industry's experience with these products and its knowledge of their physical properties, the classifications (Categories A, B or C) of the Recommended Standard under which the materials now in use are likely to fall.

Following this preliminary qualitative assessment, the three succeeding sections of this Appendix contain detailed quantitative documentation showing that work practices for three asbestos-containing products commonly used in construction and other non-fixed jobs -- asbestos-cement pipe, asbestos-cement sheet, and drilling mud additives -- can in fact qualify under Category B of the Recommended Standard. More specifically, simple work practices which have been developed by the manufacturers of these products (and which, in some instances, are already widely used) have been carefully field-tested by qualified laboratories, and the resulting data demonstrate that all three products can be validated under Category B of the Recommended Standard.[1/]

1/ The exposure data presented in Parts A, B and C of this Appendix must be interpreted cautiously. As discussed in the body of this Paper (p. 28 above), the best available technique for measuring airborne concentrations of asbestos fibers is subject to a considerable degree of uncertainty, the magnitude of which (when expressed as a percentage of the actual concentration) increases sharply as concentrations are reduced below 2.0 fibers per cubic centimeter of air.

These statistical monitoring variations would, of course, be taken into account in any formal validation of the products and associated work practices involved. Nevertheless, while the exact range of the uncertainty is not now known (and is currently under study by AIA/NA), the data reported in Parts A, B and C below are so uniformly low that the products and work practices discussed can surely meet the classification criteria for Category B.

Introduction: Potential Asbestos Exposure in Construction and Other Non-Fixed Work Operations

There are three distinct situations in which construction industry employees may be exposed to airborne asbestos fibers: (i) when they perform construction, maintenance, alteration or removal services in environments where asbestos fibers routinely may be present; (ii) when they demolish or remove construction materials which contain asbestos; and (iii) when they install or use construction materials which contain asbestos.

The first type of situation will arise when a construction employee performs his services in an existing asbestos products plant. Such a facility is already subject to the current OSHA asbestos standard, and, as a result, construction workers will be protected by the controls installed by the owner of the facility pursuant to the current standard. Two special circumstances deserve attention, however. First, if an emergency arises requiring the use of respirators by the regular employees of the facility, the contractor must either remove his employees from the site or equip them with appropriate respirators. Second, if the work of the contractor disturbs asbestos-containing dust which has accumulated in inaccessible places (for example, on suspended piping, ducts or wiring or on structural surfaces), special precautions (such as spraying with water or vacuuming) may have to be taken to avoid creating airborne fiber concentrations in excess of mandated levels. As detailed above (pp. 22-23), the housekeeping and emergency provisions of Paragraphs (c)(2) and (d)(2) of the Recommended Standard are intended to deal with these special circumstances.

The second health hazard situation will arise when a contractor performing maintenance, alteration or demolition work must remove construction materials containing asbestos. This is perhaps the most serious asbestos-related health hazard presented in the workplace today. It is serious first, because removal, and particularly demolition, by its nature is destructive and dust generating; second, because the presence of asbestos materials in old structures may be difficult to establish; and third, because friable, dust-producing asbestos products which no longer are marketed may nevertheless be present in older facilities.

As in other construction operations where asbestos health hazards are present, work practices are the only effective means of worker protection in demolition or removal operations. Mandating changes in asbestos construction materials, or even banning their manufacture or sale, will not eliminate the hazard. Nor can permanently installed engineering controls be used to control asbestos dust created by demolition or removal. AIA/NA and AACPP have been studying these operations, and expect to be able to publish in the near future effective work practices which would qualify under Category B of the Recommended Standard.

The third health hazard situation, of course, involves the fabrication and installation of asbestos-containing contruction materials currently offered in the marketplace. Fortunately, the products which are being used today generate little dust. Sprayed asbestos insulations no longer are used. Spackling compounds and joint tapes contain little, if any asbestos. Air cell thermal insulations have been replaced by cheaper, more efficient glass fiber materials. Most molded thermal insulations contain no asbestos, and the few that do are used only in the most critical installations, applied by journeymen wo are thoroughly familiar with the hazards of asbestos and who know well how to protect themselves. The asbestos fibers in asbestos-cement products, asbestos-roofing and pipeline felts, drilling muds, paints, roofing mastics, vinyl asbestos floor tile and sheet vinyl flooring are bonded into or encapsulated by a matrix material, saturant, impregnant or coating. The fibers seldom are released; and the operations which may cause their release are well-defined. Thus, this third asbestos-health hazard situation clearly lends itself to the development and implementation of work practice controls.

As the following table indicates, a variety of asbestos-containing products are presently consumed in the United States, with asbestos-cement products, flloring products, friction materials, and asbestos-paper products comprising two-thirds total consumption:

U.S. Consumption of Asbestos by End Use - 1977

	Short Tons	Percent
Asbestos Cement:		
Pipe	97,000	15.0
Sheets and Shingles	35,000	5.5
Flooring Products:		
Floor Tile	63,000	10.0
Sheet Vinyl	110,000	17.0
Friction Materials	75,000	12.0
Asbestos Paper:		
Roofing Felt	90,000	14.0
Pipeline Felt	10,000	1.5
Other	12,000	2.0
Gaskets and Packings	40,000	6.0
Paints and Coatings	55,000	9.0
Textiles	7,000	1.0
Others	46,000	7.0
TOTAL	640,000	100.0

Source: Johns-Manville Corporation, 1979

Most of the annual production of these materials -- approximately 77% -- is consumed in the construction industry today. 40 Fed. Reg. 47652, 47653 (October 9, 1975). Moreover, based on industry's considerable experience with the use of these products in construction operations, its familiarity with their physical properties, and the results of preliminary testing, there is little doubt that all of these products could be validated under Categories A or B of the Recommended Standard. Because of the efforts of manufacturers of asbestos-containing construction materials to eliminate dangerous products from the marketplace, a large number of products could qualify under Category A for most or, in some cases, all operations in which they are used including the following products:2/

Mastics and Black Line Products Roofing Felt
Roofing Felts
Mechanical Packings
Oil Seals
Compressed Gaskets
Sealants and Caulks
Electrical Insulating Paper
Sheet Flooring
Floor Tile

In the three suceeding sections of this Appendix, detailed exposure monitoring data are presented showing that effective work practices, which in some cases are already widely used, will ensure that the permissible exposure limits

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2/ Source: Johns-Manville Corporation

are met for three other products: asbestos-cement pipe, asbestos-cement sheet, and drilling mud additives.

Recommended Work Practice Procedures
for
Asbestos-Cement Pipe

In order to reduce the generation of airborne concentrations of asbestos during the installation of A/C pipe, ACPPA designed a field manual containing specific work practices for use with its products. ACPPA distributed thousands of copies of this manual to OSHA, construction contractors, municipalities, insurance carriers, states, and others, in an effort to educate and to train their employees in the proper use of the recommended work practice procedures.

Prior to publication, ACPPA contracted with Equitable Environmental Health, Inc. (EEH) to study employee exposure to airborne asbestos during field operations. The purpose of the EEH study was to determine the effectiveness of the work practices being recommended. To that end, EEH performed personal monitoring on employees in the following field operations, utilizing, where appropriate, either non-pressure (sewer) pipe and/or pressure (water) pipe:

1. Unloading
2. Laying pipe in the trench
3. Cutting operations on both pressure and sewer pipe
    a. Cutting with hack saw
    b. Cutting with snap cutting equipment
    c. Cutting with abrasive disc, wet
    d. Cutting with abrasive disc, dry
    e. Cutting with hammer, chisel and rasp

4. Machining operations
   a. Machining with a manual field lathe
   b. Machining with a power-driven lathe
   c. Cutting and machining with Doty machine
5. Hole Cutting
   a. Hole cutting with power-operated equipment
   b. Hole cutting with drill, hammer and rasp
6. Tapping operations
   a. Dry tapping with Mueller J. tool
   b. Tapping operations with Mueller B-100 tool
7. Coupling removal
   a. Removal of coupling with hammer and chisel

The above operations and processes are representative of the types ordinarily encountered at construction sites installing A/C pipe. Certain qualifications, however, should be identified. First, for those operations monitored by EEH, several options may exist for performing a particular operation, e.g. cutting with various tools or under varying conditions. Where appropriate, these operations are also listed. Second, on any given day, any one or all of those operations listed may be conducted. This, of course, depends on the individual job and its requirements.

Pipe installation, cutting, machining, boring holes, and tapping are considered typical fabrication operations. A/C pipe, as with most other A/C products used in the construction industry, requires minimal field fabrication. For example, A/C pipe is supplied pre-assembled, along with a number of half and quarter lengths to minimize field cutting. When necessary, cutting to length is performed intermittently and only when the pipe terminates, as, for example, in a manhole. During the installation of smaller diameter A/C pipe, tapping is sometimes necessary, for example, when providing customer service lines from the main to the home, or when hook-up from other sources is required. The frequency of these operations is, of course, highly variable.

The total time committed to field fabrication is also quite variable. One particular survey, involving the installation of A/C pipe in seven major urban areas around the United States, reported that an average of 1.1 percent of the total job time involved the cutting, tapping, or machining of A/C pipe. Out of an average of 675 man-hours per job, these operations accounted for approximately 7.5 man-hours per job or 5.3 man-minutes per day.

In conducting their study, EEH considered the intermittent, infrequent, and short-term nature of the operations listed and decided to monitor several successive operations during each sampling period. A short-term sampling period of 15 minutes was selected unless, in the industrial hygienist's judgment, a sufficiently large sample could be obtained in a shorter time period. Additional information on the sampling and anlytical method used in the EEH study as well as a full description of the operations sampled is included in pages below.

The following tables summarize the results EEH obtained during its validation tests. In reporting these results, EEH cautions: "It should be emphasized that estimates of fiber concentrations below 5 f/cc are subject to increasing lack of precision, and that those below 0.5 f/cc have a fairly wide margin of error, often being based on the observation of relatively few fibers. Thus, although counts are reported as calculated (in some cases) to two decimal places, differences in counts in these ranges should not be over-interpreted."

Table VI

Average Peak Exposures During Unloading/Laying A/C Pipe

Operation	
1. Unloading Pipe	0.1 fibers/cc
2. Laying Pipe	0.1 fibers/cc
Background	Below detectable limit

Table VII

Average Peak Exposures (Up to 15 Minutes) During Other Operations (fibers/cc)

		A/C Sewer Pipe		A/C Pressure Pipe	
Operation		Operator	Helper	Operator	Helper
3.	Cutting Operations				
3a.	Hack Saw	0.18	<0.10	<0.10	0.11
3b.	Snap Cutting	<0.10	<0.10	<0.10	ND
3c.	Abrasive disc, wet	42.10	10.20	65.00	49.20
3d.	Abrasive disc, dry	35.50	64.00	20.30	59.70
3e.	Chisel, hammer and rasp	0.30	0.25	1.99	0.87
4.	Machining Operations				
4a.	Manual Lathe	0.15	0.13	0.51	0.22
4b.	Power Lathe	<0.10	0.10	0.29	0.18
4c.	Cutting and Machining with Doty Machine Dry	3.83	0.29	1.90	2.23
	Dry, Shroud	0.23	0.10	1.29	0.18
	Wet Shroud	0.20	0.10	0.21	0.27
4d.	Tapering Tool with Airduct Pipe	0.18	<0.10		

Table VII (Continued)

Operation		A/C Sewer Pipe Operator	A/C Sewer Pipe Helper	A/C Pressure Pipe Operator	A/C Pressure Pipe Helper
4e.	Machining with Manual Lathe on Differing Sizes of Pipe				
	4-inch pipe			ND	<0.10
	8-inch pipe			<0.10	0.13
	16-inch pipe			<0.10	<0.10
5.	Hole Cutting				
5a.	Powerhole Cutter	0.44	0.23	1.65	0.38
5b.	Hole Cutting with Drill, Hammer & Rasp	0.23	0.13	0.22	<0.10
6a.	Dry Tap with Mueller J Tool	<0.10	<0.10	<0.10	0.10
6b.	Tapping Operations with Mueller B-100	<0.10	ND	0.11	0.13
7.	Coupling Removal				
7a.	Removal of Coupling with Hammer & Chisel	<0.10	ND	0.30	0.10

It is important to recognize that the above results represent one or more consecutive operations run to a maximum sampling time of 15 minutes. Two operations clearly cannot be recommended and in fact should be prohibited: cutting and machining with Doty tool without a shroud and cutting with abrasive discs. As indicated in the summary data, significant peak exposures can result from their use.

As for the other operations, they are intermittent, short-durational operations. For the purpose of calculating 8-hour TWA's, a conservative calculation was made by assuming employees would work at a given operation 1 hour per day. Further, assuming that during the remaining 7 hours of the day they were not exposed, the following 8-hour TWA's would be expected (excluding the two operations not recommended).

Table VIII

Computed Time-Weighted Average Exposures During Operations Involving A/C Pipe (fibers/cc)

		A/C Sewer Pipe		A/C Pressure Pipe	
Operation		Operator	Helper	Operator	Helper
1.	Unloading Pipe	ND			
2.	Laying the Pipe in Trench	ND			
3.	Cutting Operations	<0.10	<0.10		
3a.	Hack Saw	<0.10	<0.10	ND	<0.10
3b.	Snap Cutting	<0.10	<0.10	ND	ND
3c.	Chisel, Hammer and Rasp	<0.10	<0.10	0.25	0.11
4a.	Manual Lathe	<0.10	<0.10	<0.10	<0.10
4b.	Power Lathe	<0.10	<0.10	<0.10	<0.10
4c.	Cutting and Machining with Doty Tool				
	Dry, Shroud	<0.10	<0.10	0.16	<0.10
	Wet, Shroud	<0.10	ND	<0.10	<0.10

Table VIII Continued

Operation	A/C Sewer Pipe Operator	A/C Sewer Pipe Helper	A/C Pressure Pipe Operator	A/C Pressure Pipe Helper
4d. Tapering Tool with Airduct Pipe	0.10	ND		
4e. Manual Lathe				
4-inch pipe			ND	ND
8-inch pipe			ND	<0.10
16-inch pipe			ND	<0.10
5a. Power Hole Cutter	<0.10	<0.10	0.21	<0.10
6a. Dry Tap with Mueller J Tool	<0.10	ND	<0.10	<0.10
6b. Tapping Operations with Mueller B-100	<0.10	ND	<0.10	<0.10
7a. Removal of Coupling with Hammer and Chisel	<0.10	<0.10	<0.10	<0.10

In addition to the analysis performed above, Table IX below was constructed to illustrate the theoretical TWA range of exposures which might be anticipated when working with A/C pipe during pipeline installation. The theoretical TWA exposure range is calculated by assuming the duration of the operation ranged from 15 minutes to 2 hours, with the remaining time calculated at zero exposure.

Table IX

Ranges of Eight-hour Time-weighted Average Concentrations Derived From Equitable Environmental Health, Inc. Data

	Operation	A/C Sewer Pipe		A/C Pressure Pipe	
		Operator	Helper	Operator	Helper
1.	Unloading Pipe	ND			
2.	Laying the Pipe In Trench	ND			
3.	Cutting Operations				
3a.	Hack Saw	*<0.10	ND-<0.10	ND	ND-<0.10
3b.	Snap Cutting	ND-<0.10	ND-<0.10	ND	ND
3c.	Chisel, Hammer and Rasp	<0.10	<0.10	<0.10-.50	<0.10-.22
4a.	Manual Lathe	<0.10	<0.10	<0.10-.12	<0.10
4b.	Power Lathe	ND-<0.10	ND-<0.10	<0.10	<0.10-.14
4c.	Cutting and Machining with Doty Tool				
	Dry, Shroud	<0.10	ND-<0.10	<0.10-.32	<0.10
	Wet, Shroud	<0.10	ND	<0.10	<0.10
4d.	Tapering Tool with Airduct Pipe	<0.10			
4e.	Manual Lathe				
	4-inch pipe			ND	ND
	8-inch pipe			ND	<0.10
	16-inch pipe			ND	ND-<0.10
5a.	Power Hole Cutter	<0.10-.12	<0.10	0.10	<0.10-.10

*/ No range is reported when both values were <0.10 f/cc.

Table IX Continued

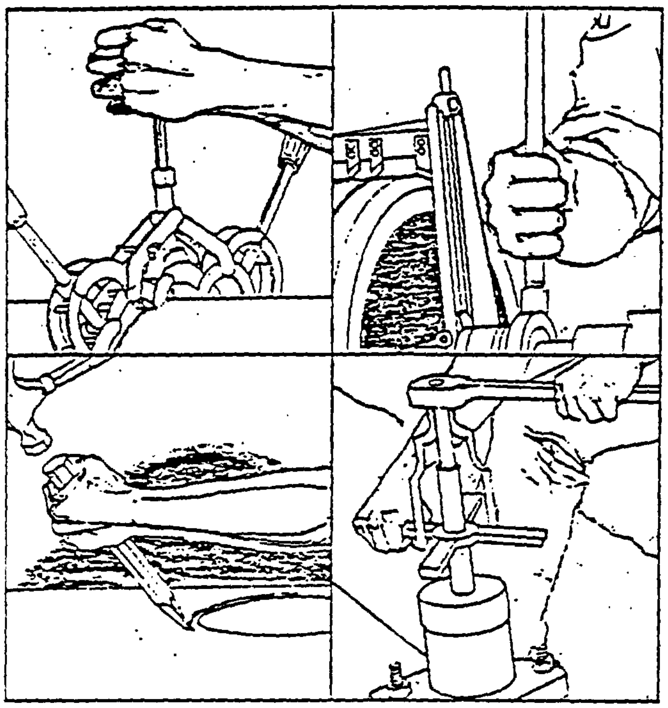
		A/C Sewer Pipe		A/C Pressure Pipe	
Operation		Operator	Helper	Operator	Helper
6a.	Dry Tap with Mueller J Tool	ND-<0.10	ND	ND-0.10	ND-<0.10
6b.	Tapping Operations with Mueller B-100	ND-<0.10	ND	ND-0.10	<0.10
7a.	Removal Coupling with Hammer and Chisel	ND-<0.10	ND-<0.10	0.10	ND-<0.10

As shown in Tables VI, VII, VIII, and IX, the use of certain work practices for A/C pipe will provide effective worker protection that can be feasibly and practically implemented in the construction industry.

Following the completion of the EEH study, ACPPA published and distributed nearly 85,000 copies of its field manual, "Recommended Work Practices for A/C Pipe." The recommendations set forth in the manual are based on the data developed by EEH and experience gained in the field. Based on the wide-spread acceptance of the manual, the American Water Works Association (AWWA) adopted these same work practice recommendations and included them in their manual M-16 1 "Work Practices for Asbestos-Cement Pipe."

ACPPA is convinced that when recommended work practices are followed, no adverse health effects will be realized during normal employment in a construction environment, where A/C pipe is used. It is the position of the asbestos industry that similarly safe and effective work practices can be developed to assure employee protection during the use of all asbestos-containing products in the construction industry.

The following publication sets forth recommended work practices for A/C Pipe.



Recommended Work Practices for A/C Pipe

Products and Operations

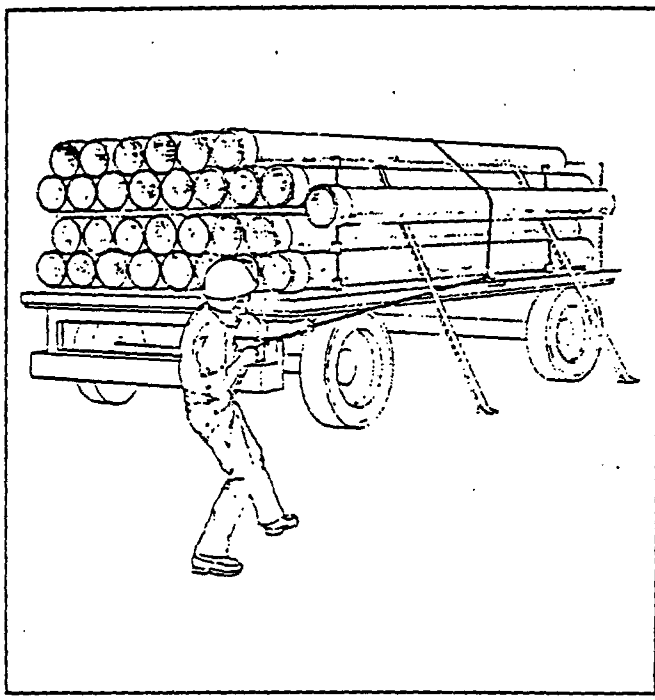
Types of A/C Pipe Products covered by these work practices include:

"Class" Pressure Pipe
"Transmission" Pressure Pipe
Pressure Sewer Pipe
Gravity Sewer Pipe
Building Sewer Pipe
Storm Drain Pipe
Perforated Underdrain Pipe
Electrical Conduit
Telephone Duct
Air Duct

Operations to which these work practices apply include:

Shipping, Receiving and Handling
Cutting
Machining
Hole Cutting
Tapping
Coupling Removal
Housekeeping and Waste Disposal

Shipping, Receiving, Handling and Assembly*



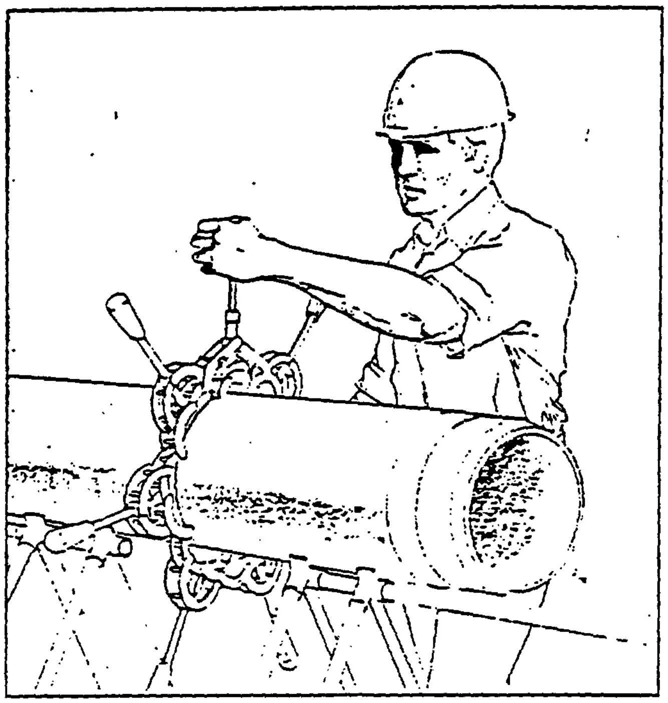
A/C pipe is shipped clean from the factory and carefully loaded using methods acceptable to the carrier. Loading, unloading, stringing out and assembling A/C pipe are essentially dust-free operations. Even in enclosed spaces, airborne asbestos fiber levels from pipe handling operations are far below existing and proposed occupational standards.

All hand and mechanical unloading operations should be carried out in accordance with the manufacturer's installation manuals.

A/C Pipe Products: All
Size Range: All

*Exposure data not currently available. Recommendation based on exposure data for operations believed to be comparable.

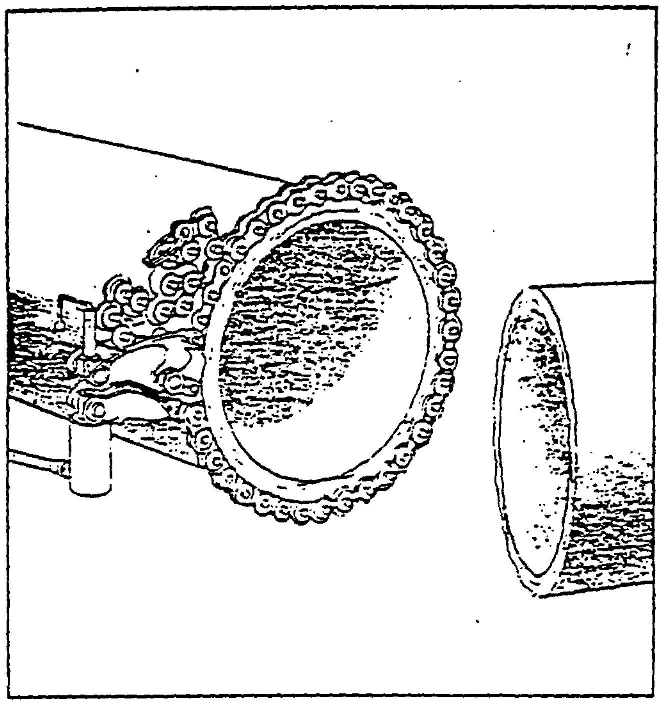
Cutting
Carbide Blade Equipment



Blade cutters consist of a frame adjustable to the circumference of the pipe and a number of outboard, self-tracking rollers that align one or more carbide-tipped cutting blades. Blade cutters are typically hand-operated. Due to the relatively low mechanical input and clean cutting action, significant amounts of airborne asbestos dust are not produced.

A/C Pipe Products: All
Size Range: 3" through 24"

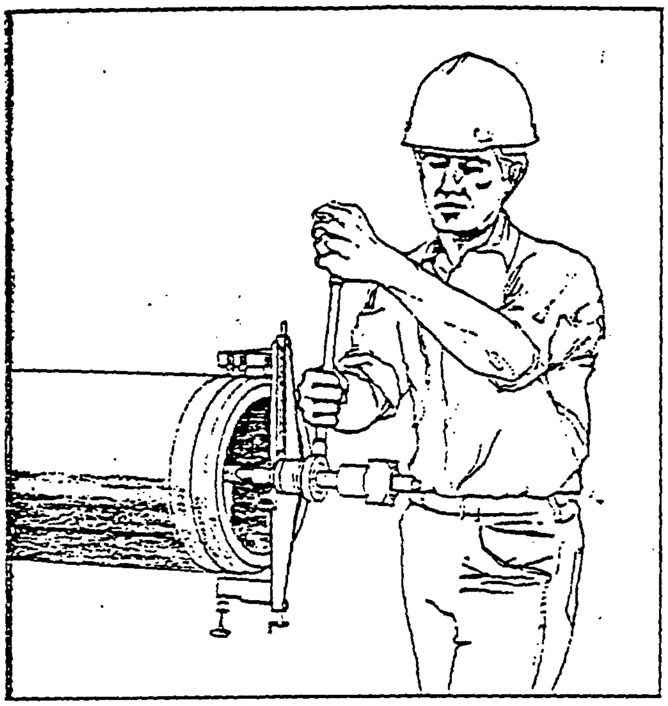
Cutting
Snap Cutting Equipment



Snap cutters or "squeeze and pop" equipment operates by means of cutting wheels mounted in a chain wrapped around the pipe barrel. Hydraulic pressure, applied by means of a remote electric or manually-operated pump, simultaneously squeezes the cutting wheels into the pipe wall until the cut is made.

A/C Pipe Products: All
Size Range: Pressure Pipe—3" through 24"
Pressure, Gravity and Building Sewer; Storm Drain; Air, Electrical and Telephone Duct—3" through 36"

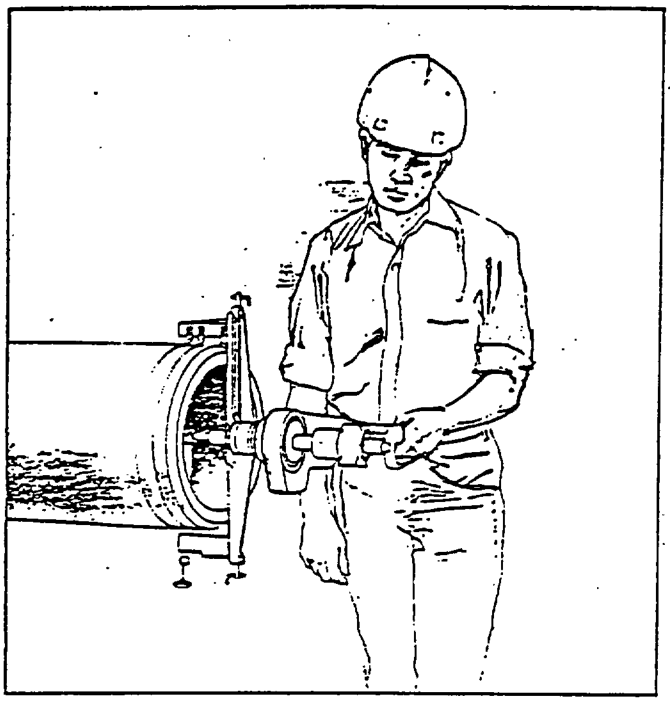
Machining
Field Lathe–Manual



Manual field lathes are designed to end-trim and re-machine rough pipe barrels to factory-machined end profiles. The lathe consists of an adjustable, self-aligning arbor inserted into the pipe bore (which acts as a mandrel upon which the turning handle operates), a screw-fed turning frame, carbide machining blades and manual (hand or ratchet) turning handles.

A/C Pipe Products: All
Size Range: All

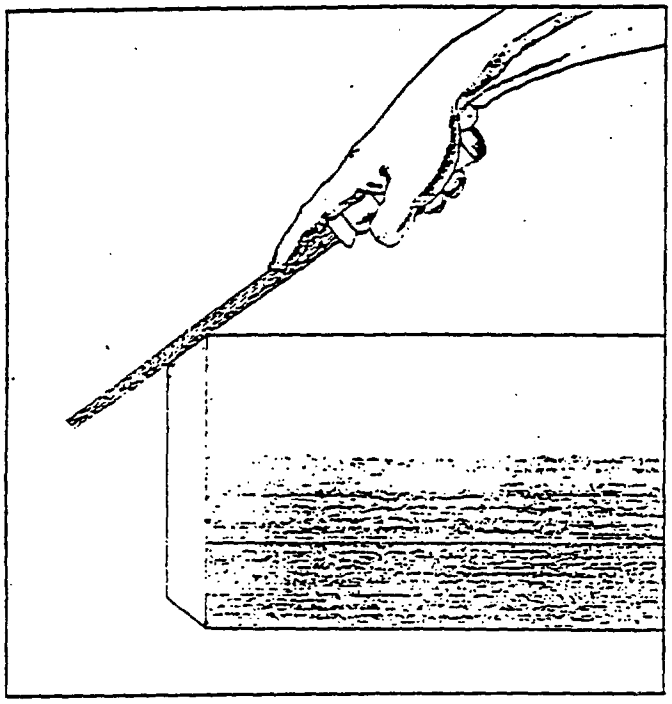
Machining
Field Lathe–Power



Power field lathes, like manual lathes, are designed to end trim and re-machine rough pipe barrels to factory-machined end profiles. The lathe consists of an adjustable, self-aligning arbor inserted into the pipe bore (which acts as a mandrel upon which the turning handle operates), a screw-fed turning frame, carbide machining blades and electric or pneumatic power drive.

A/C Pipe Products: All
Size Range: All

Machining
Rasp–Manual*

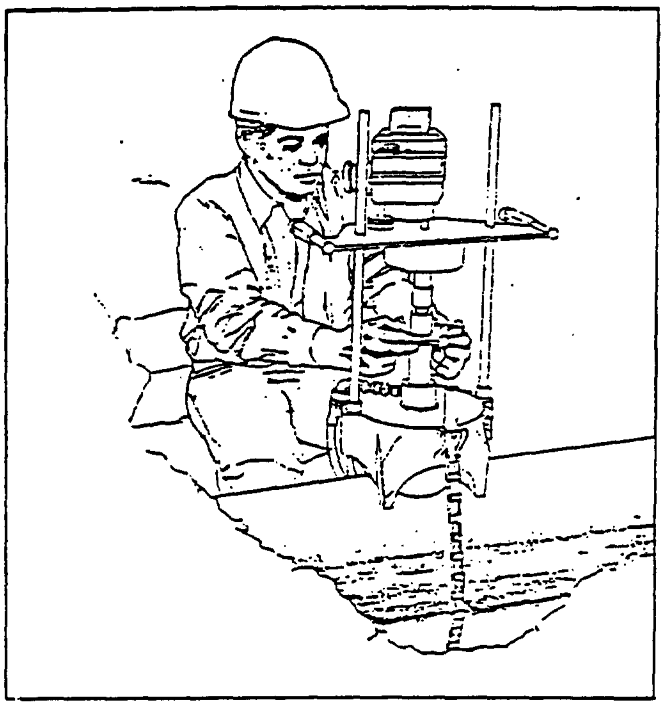


Short lengths of A/C pipe (MEE's & MOA's) can be cut for pipe closures, repairs and to locate fittings exactly. Field cut ends may be rebeveled with a coarse wood rasp to form a taper approximating the same profile as the factory-beveled end.

A/C Pipe Products: All
Size Range: All

*Exposure data not currently available. Recommendation based on exposure data for operations believed to be comparable.

Hole Cutting
Shell Cutters

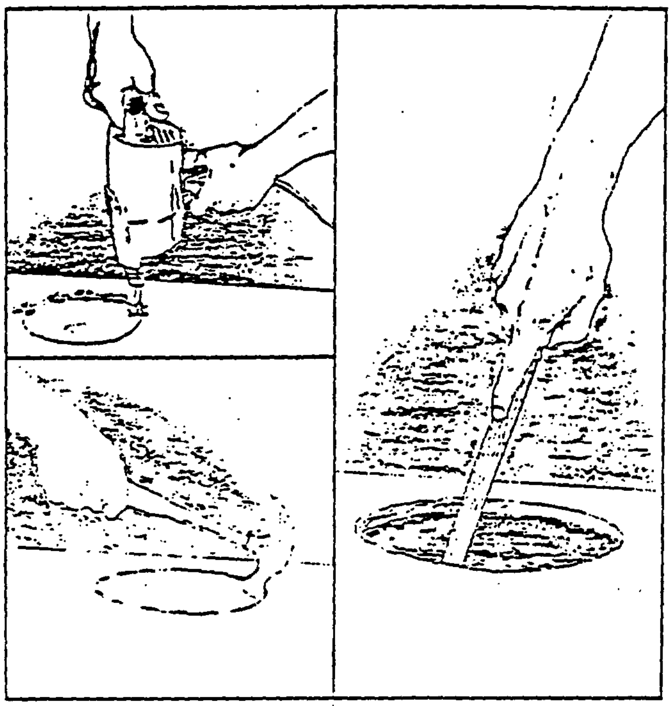


For field connections into A/C pipe, clean, even entry cuts may be accomplished by means of shell cutting equipment. Shell cutters consist of a hole cutter housing mounted on the pipe, a carbide or diamond-tipped hole cutter and a manual ratchet, pneumatic, electric or gasoline drive to power the cutting head.

When cutting holes in A/C pipe products, all dust and cuttings should be removed from the pipe or duct interior after the cutting operation. Removal may be accomplished by flushing with water, wet mopping or vacuuming prior to placing in service. DO NOT BLOW OUT WITH COMPRESSED AIR OR DRY SWEEP.

A/C Pipe Products: Pressure, Gravity and Building Sewer; Air Duct
Size Range: All

Hole Cutting
Drill and Rasp*



Field connections may be made with a heavy duty electric drill and rasp. Using a carbide-tipped drill, a series of closely-spaced holes are first drilled around the hole outline. The disc is knocked free with a hammer and the edges of the hole are dressed with a coarse wood rasp.

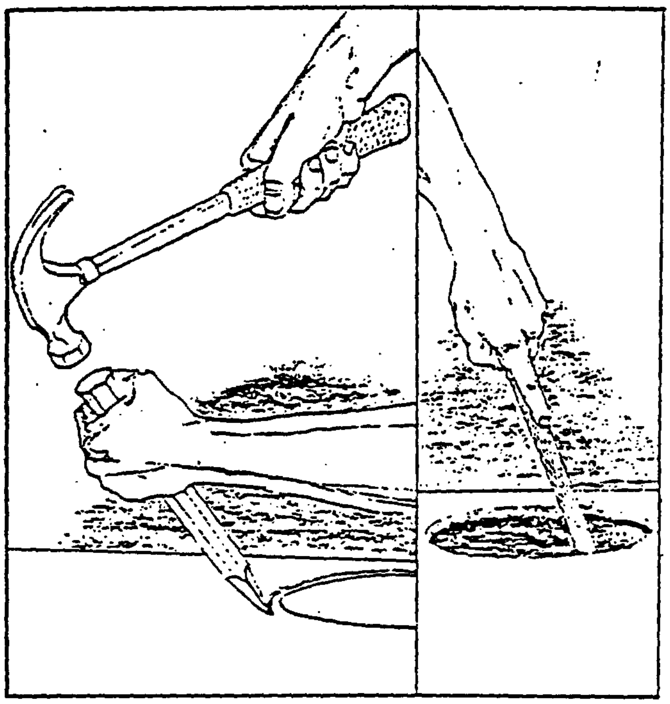
When cutting holes in A/C pipe products, all dust and cuttings should be removed from the pipe or duct interior after the cutting operation. Removal may be accomplished by flushing with water, wet mopping or vacuuming prior to placing in service. DO NOT BLOW OUT WITH COMPRESSED AIR OR DRY SWEEP.

A/C Pipe Products: Pressure, Gravity and Building Sewer;
Air Duct

Size Range: All

*Exposure data not currently available. Recommendation based on exposure data for operations believed to be comparable.

Hole Cutting
Chisel and Rasp



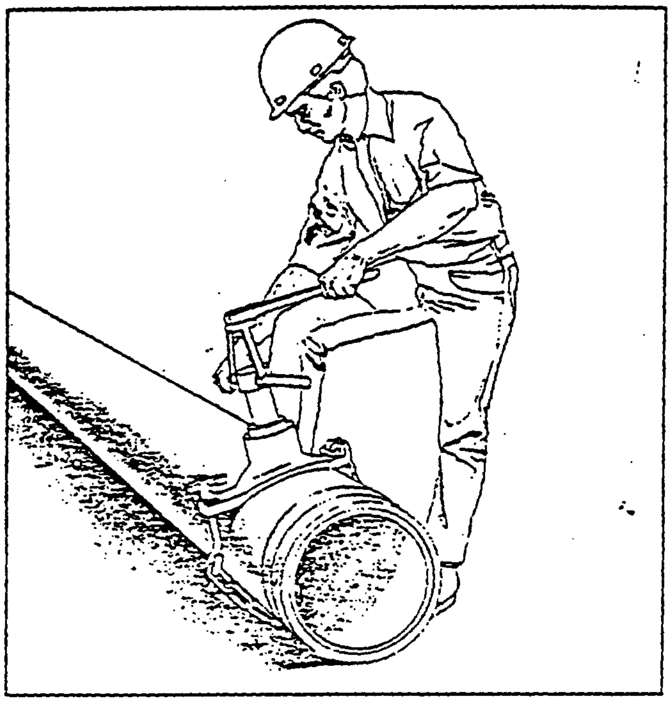
Holes may be cut into A/C pipe with a hammer and chisel. The edge of a plumber's wood chisel is used to cut completely around the hole outline, about a ¼" from the prescribed line. The operation is repeated and the cut deepened until through. The edges of the hole are then dressed with a coarse wood rasp.

When cutting holes in A/C pipe products, all dust and cuttings should be removed from the pipe or duct interior after the cutting operation. Removal may be accomplished by flushing with water, wet mopping or vacuuming prior to placing in service. DO NOT BLOW OUT WITH COMPRESSED AIR OR DRY SWEEP.

A/C Pipe Products: Pressure, Gravity and Building Sewer; Air Duct

Size Range: All

Tapping Non-Pressure*



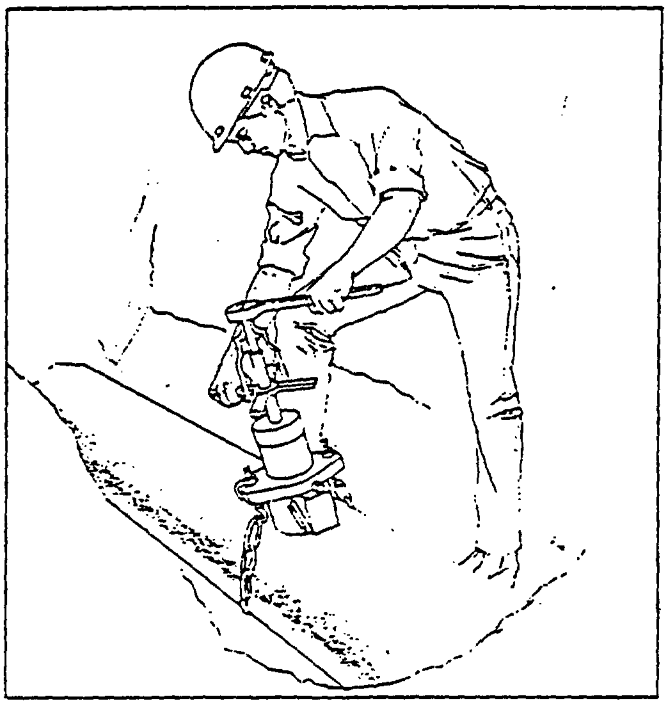
Non-pressure or "dry" tapping for service connections may be performed in or above the trench. The equipment is affixed to the pipe by means of a chain yoke. Separate drills and taps or a combination tool drills and taps the pipe wall. Corporation stops or other connections may then be affixed to the pipe.

To minimize (a) the fouling of valves, regulators, meters, etc. with chips and (b) unnecessary addition of asbestos to drinking water, all dust and cuttings should be removed from the pipe interior by flushing with water, wet mopping or vacuuming prior to placing in service. DO NOT BLOW OUT WITH COMPRESSED AIR OR DRY SWEEP.

A/C Pipe Products: Pressure Pipe
Size Range: All

*Exposure data not currently available. Recommendation based on exposure data for operations believed to be comparable.

Tapping Pressure*



Pressure or "wet" tapping for service connections is performed in the trench while the pipe is under pressure. The equipment (manual or power driven) is affixed to the pipe by means of a chain yoke. A combination boring and inserting bar drills and taps the pipe wall and inserts a corporation stop or pipe plug. The pressure chamber, which protects against water leakage, also catches the asbestos-cement chips, so this is essentially a dust-free operation.

To minimize (a) the fouling of valves, regulators, meters, etc. with chips and (b) unnecessary addition of asbestos to drinking water, provisions should be made for downstream flushing or use of tapping equipment with positive purge or "blow-off" features.

A/C Pipe Products: Pressure Pipe
Size Range: All

*Exposure data not currently available. Recommendation based on exposure data for operations believed to be comparable.

Housekeeping and Waste Disposal

Housekeeping is an important part of any safe construction operation. It is even more essential when airborne dust created by the *lack* of good housekeeping has the potential for harm to employees or others.

EQUIPMENT: All external surfaces of equipment should be maintained free of dust accumulations that might, if dispersed, create asbestos fiber concentrations above permissible exposure limits.

WASTE DISPOSAL: Asbestos-cement chips and cuttings from the field operations described in this booklet should be disposed of in a manner that will not contribute airborne asbestos dust to the atmosphere. Where cutting and machining operations are performed at the construction site, the chips should be placed in the trench and buried with the pipeline.

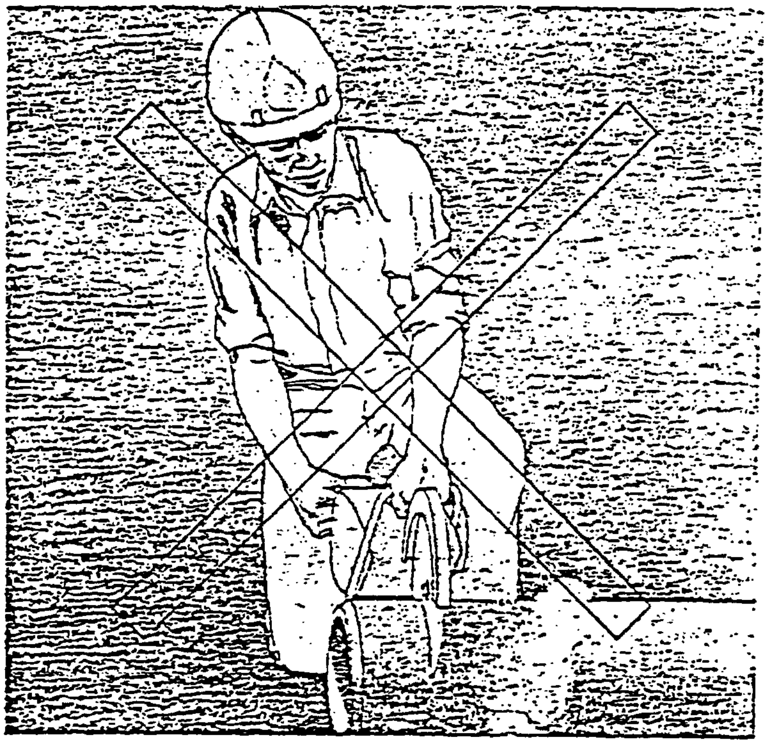
Where operations are performed at a central location such as a contractor's or distributor's yard on a more or less continuing basis, the chips and cuttings may be collected and mixed wet with cement and made into non-friable forms. These forms may be used in the trench as supports for cast iron fittings and valves, as appropriate.

Otherwise, chips and cuttings should be collected in sealed bags or closed containers impermeable to asbestos dust. *Loose material should never be dry swept.* When vacuum equipment is available, it should be used. Water or other dust suppressants should be applied in those circumstances where sweeping is unavoidable. DO NOT BLOW WASTE MATERIAL WITH COMPRESSED AIR.

No visible emissions to the atmosphere may result from the collection, processing, packaging, transporting or deposition of any asbestos-containing material. Wastes should be disposed at a site operated in accordance with the requirements or applicable national, state or local laws.

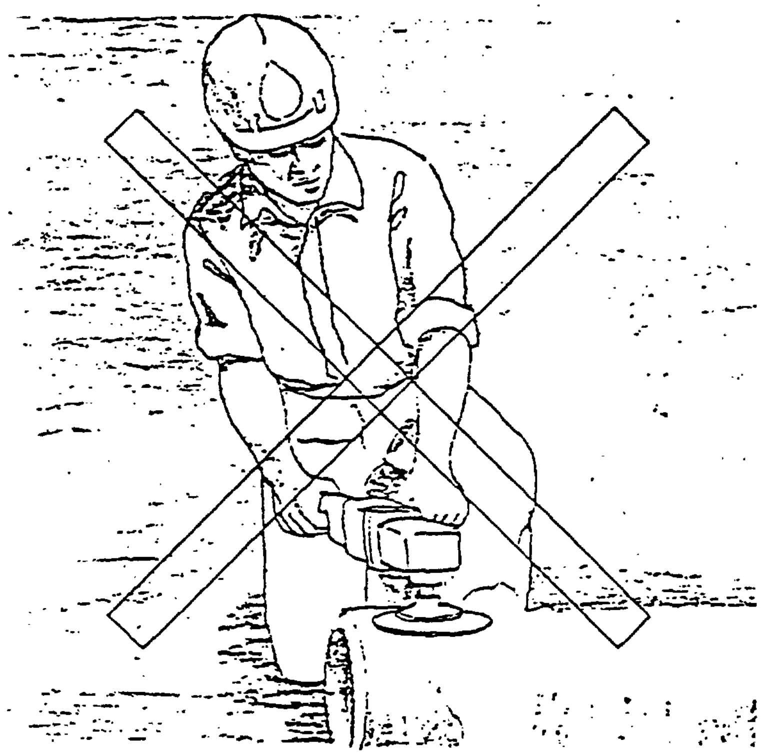
Section 2
Non-Recommended Work Practices

Cutting Any A-C Pipe Using Abrasive Disc-Dry Tools.



Power-driven saws with abrasive discs (masonry blades) should not be used for dry cutting or beveling A-C pipe. Abrasive disc cutters produce concentrations of airborne dust that exceed OSHA permissible levels. *This work practice is therefore specifically not recommended.*

Machining Any A-C Pipe Using Right-Angle Sanders or Other Dry High-Speed Abrasive Tools.



Power-driven abrasive-disc sanders should not be used for shaping or beveling A-C pipe. Abrasive discs produce concentrations of airborne dust that exceed OSHA permissible levels. *This work practice is therefore specifically not recommended.*

Sampling Methodology
and
Operations Sampled
for Asbestos-Cement Pipe

METHODS

Air samples were collected on 37-millimeter diameter, 0.8 micron pore size Millipore cellulose ester membrane filters in accordance with OSHA and NIOSH recommendations. They were all "open-face" (with the cover of the filter cassette removed) samples. Personal sampling pumps were operated at flow rates ranging from 1.6 to 2 liters per minute. The pumps were calibrated by the soap bubble technique before use. Both area and personal (breathing-zone) samples were taken. In the latter, the pump was attached to the worker's belt and the filter clipped to his lapel near his face.

All samples were analyzed by a laboratory accredited by the American Industrial Hygiene Association, following OSHA and NIOSH methods. Briefly, the analytic procedure consisted of rendering the filter transparent with a high viscosity solution of membrane filter material in a mixture of diethyl oxalate and dimethyl phthalate. The asbestos fibers which lie on the surface of the filter are counted with a phase contrast microscope at 400x magnification. The count area was delineated with a Porton graticule. Only fibers exceeding 5 micrometers in length were counted. The laboratory examined 100 microscopic fields or counted 100 fibers, whichever came first. Fiber identification depended upon a particle having an aspect ratio of at least 3:1 and having approximately parallel sides.

It should be emphasized that estimates of fiber concentrations below 2 fibers/cc are becoming increasingly less precise, and those below 0.5 fibers/cc have a fairly wide margin of error, often being based on the observation of relatively few fibers. Thus, although counts are reported as calculated to two decimal places, differences in counts in these ranges should not be overinterpreted.

OPERATIONS SAMPLED

(1) Unloading. This operation was performed with a palletized or "unitized" load, the standard packing/shipping method for A/C pipe using a forklift. The 8 inch pipe was arranged on 4 foot pallets, 8 per bed, plus miscellaneous short lengths and couplings. Using a fork lift, it took approximately 15 minutes to unload a two-bed truck. For this operation, a single 24-minute personal sample was taken on the fork-lift operator while pressure pipe was being unloaded.

(2) Laying the pipe in trench. The operation which was studied involved trenching, laying pipe, and back-filling simultaneously. One worker remained in the trench at the forward end of the pipe. The second worker worked both topside and in the trench. He attached a lowering clamp to the pipe, lubricated the pipe end, then entered the trench to help guide it into place for coupling. Two 1 1/2

hour samples were collected in addition to personal samplers taken from the two workers.

(3a) Cutting with hack saw. A standard hack saw with a hardened steel blade was used for this operation. The blade was changed before each run. Sampling times ranged from 12 to 15 minutes, during which time it was possible to cut about one-half way through the 8" pressure pipe. This tool was not used with sewer pipe.

(3b) Cutting with snap cutting equipment. For this portion of the study, a Wheeler Chain Cutter (Model 2990) was used. It has cutting discs mounted on a chain which is wrapped around the pipe. The action is controlled hydraulically by an operator who can stand as far as 10 to 15 feet from the pipe being cut. The set-up between cuts took about two minutes. Pumping to build up pressure required about 15 seconds. Five to 8 cuts were made during each sampling period; the average ranged from 14 to 16 minutes for sewer pipe and 13 to 16 minutes for pressure pipe.

(3c) Cutting with abrasive disc, wet. A gasoline-powered abrasive disc saw (Stihl) with a 10-inch carbide blade was used. Four 1/4 inch diameter plastic hoses were mounted on the housing of the saw, two on a side. These were connected to a manifold to which was attached a hose delivering water at a rate of 2 to 3 gallons per minute.

A preliminary run was made with a saw that proved to be underpowered, requiring 18 minutes for two cuts. With a more powerful saw (1 1/2 hp motor) a cut would be completed in approximately 1 1/2 minutes. Two to 3 cuts were taken per sample, the sampling periods having been reduced to 3 to 6 minutes after an initial test sampling period of 17 minutes had led to overloading of the filter with dust. This test was run on pressure pipe only.

(3d) Cutting with abrasive disc, dry. A gasoline-powered abrasive disc saw (Stihl) with a 10" diameter carbide blade was used in this test. When cutting with the saw, the operator held the saw while the helper rolled the pipe along the ground toward or away from him. No machining of the ends was performed with this method of cutting. On both sewer and pressure pipe, one cut would be made in 30 to 45 seconds. Each peak sample included four cuts.

(3e) Cutting with hammer, chisel, and rasp. The pipe was cut with a hammer and chisel, and the edges then smoothed with a course file. The helper rotated the pipe as the operator worked. Two cuts of sewer pipe, each taking 4 to 6 minutes, were made during the short-term or peak sampling period. Cutting the pressure pipe lasted 11 minutes, and only one cut was made per sample.

(4a) Machining with a manual field lathe. The equipment (Pilot Ratchet Field Lathe, Model B-12R) was attached to the end of an 8-inch pipe supported 2 to 3 feet from the ground. The lathe had two sets of blades, one for the actual cut and the other to machine and profile the pipe end. The depth of cut could be adjusted manually with screws. A ratchet allowed the operator to turn the lathe by pumping a handle. The helper adjusted the depth of cut as the lathe rotated about the pipe and also assisted in lathe turning. For sewer pipe, one complete cycle took about 8 minutes, i.e., 2 minutes to cut and 6 to 7 minutes for set-up and machining. Each short-term peak sample represented two cycles. Cutting pressure pipe took longer, 4 minutes for cutting and 8 to 9 minutes for set-up and profiling. Each short-term sample covered a single cut.

(4b) Machining with a power-driven lathe. The electric-powered lathe (Pilot Powered Field Lathe, Model B-12P) worked on the same principle as the manual lathe. Due to the ease of operation, a helper was unnecessary. Sewer pipe took 1/2 to 1 minutes to cut and 4 1/2 to 5 1/2 minutes to profile. Two cycles were completed for each short-term ("peak") sample. Again, cutting pressure pipe took longer, 1 1/2 minutes to cut and 5 to 6 minutes to profile; two cycles were used per sample.

(4c) Cutting and machining with Doty machine. The Doty machine is custom-manufactured equipment which has two operating stations, one for cutting, and one for machining. It has three operating modes: dry, dry with shroud, and wet with shroud. The last two modifications were designed to reduce dust generation and dispersion. During tests of the tool in the dry mode with shroud and wet mode with shroud, a plastic bag was placed over the blade to reduce dust.

All cuts were made wet, because a diamond blade was used. A fine spray of water was directed across the blade during operations. A single cut requires one-half minute.

Machining was performed dry with no shroud, dry with shroud, and wet with shroud. Again for the wet mode, a fine spray was used. The operation took about 1 minute with most of the sampling time used for moving pipe. The Doty tool was essentially a one-man operation, a helper was needed only to move large diameter pipe.

Two to four cuts and two to four machining operations were completed per sample cycle. Because visible dust was raised by the dry mode, sampling time was reduced from approximately 51 minutes to approximately 10 minutes. Observers also noted that visible dust was released during bevelling on the dry mode with shroud tests. It was suggested that a gasket or some other seal would be helpful in preventing this.

Sampling times recorded during use of the Doty tool, wet, for pressure pipe were 10 to 11 minutes and for sewer pipe 9 to 15 minutes. In operations involving the Doty tool with shroud the sampling times for pressure pipe were 13 to 17 minutes, and for sewer pipe, 12 to 14 minutes. For usage of the Doty Tool, wet with shroud, 13 to 18 minute sampling times were employed for pressure pipe, 12 to 16 minutes for sewer pipe.

(4d) Use of tapering tool with A/C air duct.

Testing of the tapering tool was limited to 10-inch A/C air duct pipe, which has a wall thickness of approximately 1/4 inch. Its operating principle is similar to that of the manual field lathe. Sampling times ranged from 14 to 22 minutes which included one cut and one tapering operation.

(4e) Machining with manual lathe on differing sizes of pipe. In order to determine whether pipe size had a detectable influence on dust production, a manual lathing operation was carried out on pressure pipe with 4-inch, 8-inch, and 16-inch diameters. For the 4-inch pipe, there was one cut and one machining operation for each sample. The set-up required about 3 minutes, the cut about 3 minutes; the second set-up about 4 minutes, and machining about 8 minutes. The replicate samples ranged 13 to 21 minutes.

For 8-inch pipe, one cut and one machining operation were performed for each sample. The set-up required about 3-1/2 minutes, the cut about 2 minutes; the second set-up took about 2 minutes and machining about 10 minutes. The replicate samples ranged from 19 to 21 minutes.

For the 16-inch pipe there was one partial cut per sample including some machining and some cutting. The set-up required 3 minutes, the cutting about 12 minutes, the second set-up about 2 minutes, and machining about 20 minutes.

(5a) Hole cutting with power-operated equipment. The tool used for this operation (Pilot Hole Cutter, Model HC-38E) is available with either an electric or gasoline engine. In this test, a gasoline powered engine was used to cut a 4 1/2" diameter hole with a small center plug. The cutter was secured to the pipe with a chain. The engine rotated the blade while the operator continuously adjusted the height of the blade. The helper aided in equipment set-up. It took about 1 minute to cut a hole in sewer pipe and 1 1/2 to 2 minutes for pressure pipe. A two minute set-up time was required between hole cutting operations. Four holes were cut for each peak sample.

(5b) Hole cutting with drill, hammer and rasp. For this operation, 5/8 inch holes were drilled on the pipe in a circular pattern about 6 inches in diameter, after which the central portion was knocked out with a hammer and the rough edges smoothed with a rasp. The operator used the exhaust air from the drill to blow off excess dust. The drilling took a long time to complete, so that only about 3/4 of the circumference was finished in one sampling period. Therefore, some samples did not include the hammer and file steps. Sampling times for pressure pipe ranged from 16 to 24 minutes, for sewer pipe, from 17 to 21 minutes.

(6a) Dry tapping with Mueller J tool. The Mueller J tool is used for tapping pipe for customer service connections. In field operations, the operation may be done at the trench tap, or in the trench. A manually operated tool, which cuts a hole and threads it, was used. Two one-inch holes were cut per sampling period. Sampling periods for pressure pipe were 14 to 29 minutes, for sewer pipe 15 to 18 minutes.

(6b) Tapping operations with Mueller B-100 tool. The Mueller B-100 tool is used for tapping pipes already in place and containing water. In the field, a hole is dug to expose the pipe; for the test, an uninstalled pipe was used. It has a pressure chamber to keep the water from flowing out. For the tests, this chamber was filled with water to simulate "wet" tapping conditions. There were two holes cut per sampling period. For pressure pipe, the sampling times were 14 to 19 minutes, for sewer pipe 14 to 19 minutes.

(7a) Removal of coupling with hammer and chisel. A hammer and chisel were used to make a longitudinal trough in the coupling. When this was completed, a crowbar was used to separate the coupling. For pressure pipe, this operation took about 22 minutes with one coupling being removed per sample. For sewer pipe, the same procedure took about 10 minutes per sample. It was soon found that by placing the chisel midline on the coupling, one or two sharp hits would split the coupling, a procedure which took only 10-30 seconds per coupling. For sewer pipe, 3 to 4 couplings were cut per sample, with the major portion of the sampling time used while the pipe was moved and secured to supports.

Recommended Work Practice Procedures
for
Asbestos-Cement Sheet

Shortly after the promulgation of the original asbestos standard in 1972, the Johns-Manville (J-M) Corporation actively began pursuing the development of local exhaust systems for use with portable power tools used in the field fabrication of A/C sheets. Initial attempts to interest tool manufacturers to market a product that was equipped with a hood and suitable for attachment to a vacuum source met with little success. This setback was partially due to the fact that the demand for such specialized equipment had not evolved as rapidly as the development of the exposure standard. Additionally, portable vacuum systems, meeting the efficiency necessary to filter asbestos dust, were also not available.

During the period between 1973 and 1975, two new vacuum systems were introduced. One was a semi-portable, high efficiency system developed by the Hoffman Company; the other, a much smaller but equally efficient unit, was developed by the Niefisk Company of Sweden. With these advances, J-M undertook an in-house tool development program. Several prototypes were examined and tested, ranging from retrofitted enclosures to systems designed specifically for individual tools. A suitable system was eventually developed in 1975. J-M approached tool manufacturers with their new designs and again, was told there was no interest in marketing such a product line.

The tool designs, as well as the vacuum specifications necessary for efficient operation, were first made available by J-M in 1975. AIA/NA subsequently released a pamphlet on A/C sheet illustrating the use of these systems a year later.

Although considered effective, the exhaust system designed for the circular saw was somewhat awkward, i.e., a separate vacuum box collected dust from the bottom of the sheet during cutting operations. In 1977, J-M began development of an improved system. This continued through 1978 and eventually led to the development of a new hood design; one that enclosed the entire saw and eliminated the need for a vacuum box. This design was further refined in early 1979. The Pilot Tool Manufacturing Company (manufacturers of A/C pipe tools) was approached by J-M in early 1979 and agreed to purchase portable tools and equip them with the hoods designed by J-M. Subsequently, the J-M designs were further improved under Pilot's direction.

Through the diligent and persistent effort of J-M, portable power tools equipped with a high velocity/low volume exhaust system are now available for use with A/C sheet.

Air monitoring tests were conducted by J-M on operations involving the use of a circular saw and drill equipped with the newly designed system. The results of these tests are reported in Table XV below.

Table XV

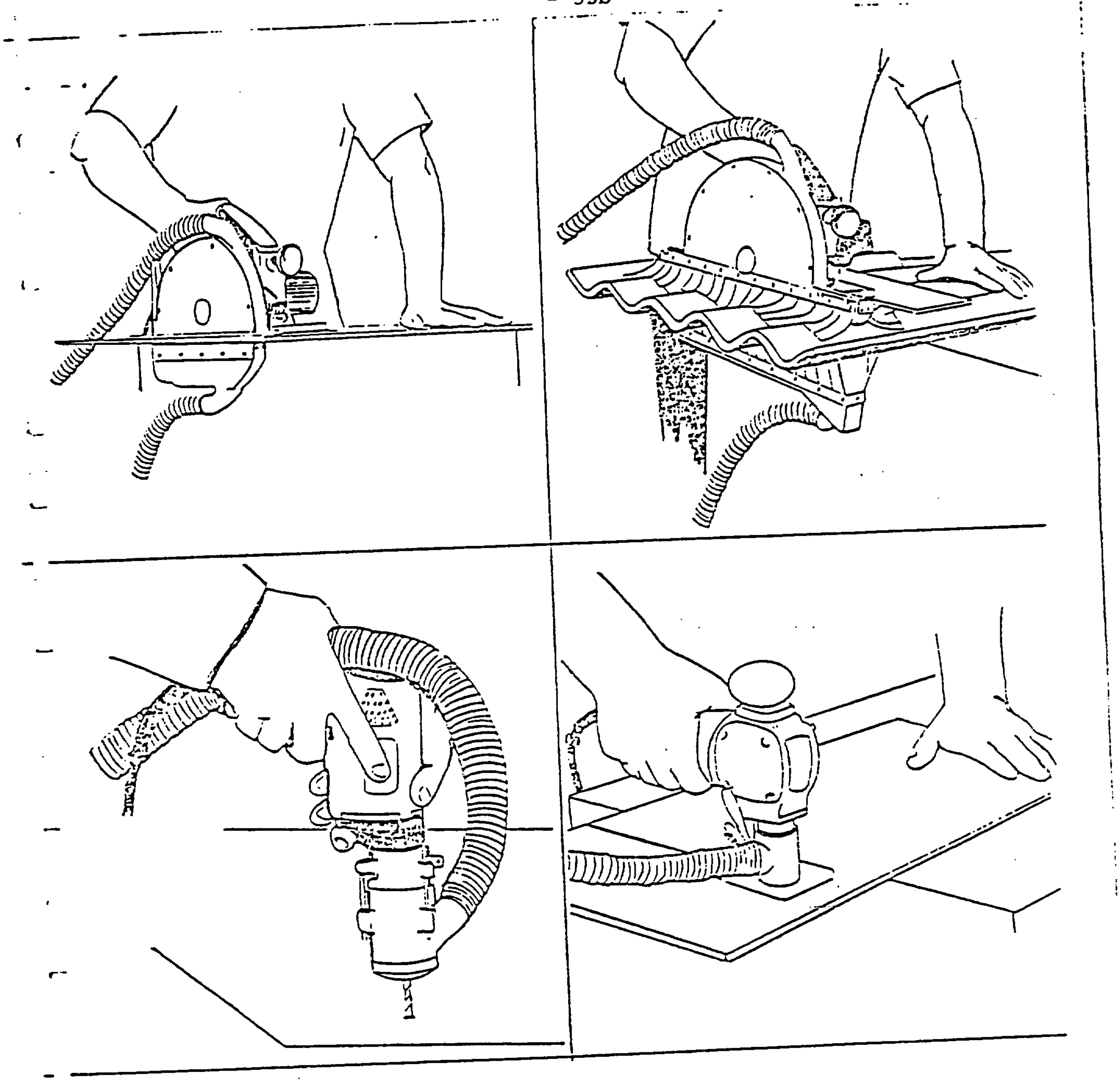
Air Monitoring Test Results Using Circular Saw and Drill

Equipment	Test Conditions*	Test Duration	Material Fabricated			Dust Concentration
			Type	Quantity	Quantity/ Minute	(personal)
Drill with dust pickup shroud	1/4 inch masonary bit, operated at full speed. Drilled downward through horizontal board	40 min	1/4 inch flat A/C sheet	163 holes	4.08 holes	<0.1
Circular saw with dust pick-up shroud	Totally enclosed shroud masonary blade	40 min	1/4 inch flat A/C sheet	720 holes	18 inch	0.0

Based on these results, as well as the results from other testing (e.g., saber saws), a work practice manual was developed. Its primary purpose is to inform the users of A/C sheet products of the proper tool selection and work practices which would permit the field fabrication of asbestos-cement sheets in an acceptably dust-free manner. Excerpts from this manual, entitled "Recommended Work Practices for A/C Sheet," are reproduced below.

* All tests conducted in an open room.

Source: Johns-Manville Corporation



RECOMMENDED WORK PRACTICES

FOR

FIELD FABRICATION

OF

ASBESTOS-CEMENT SHEET

Products and Operations

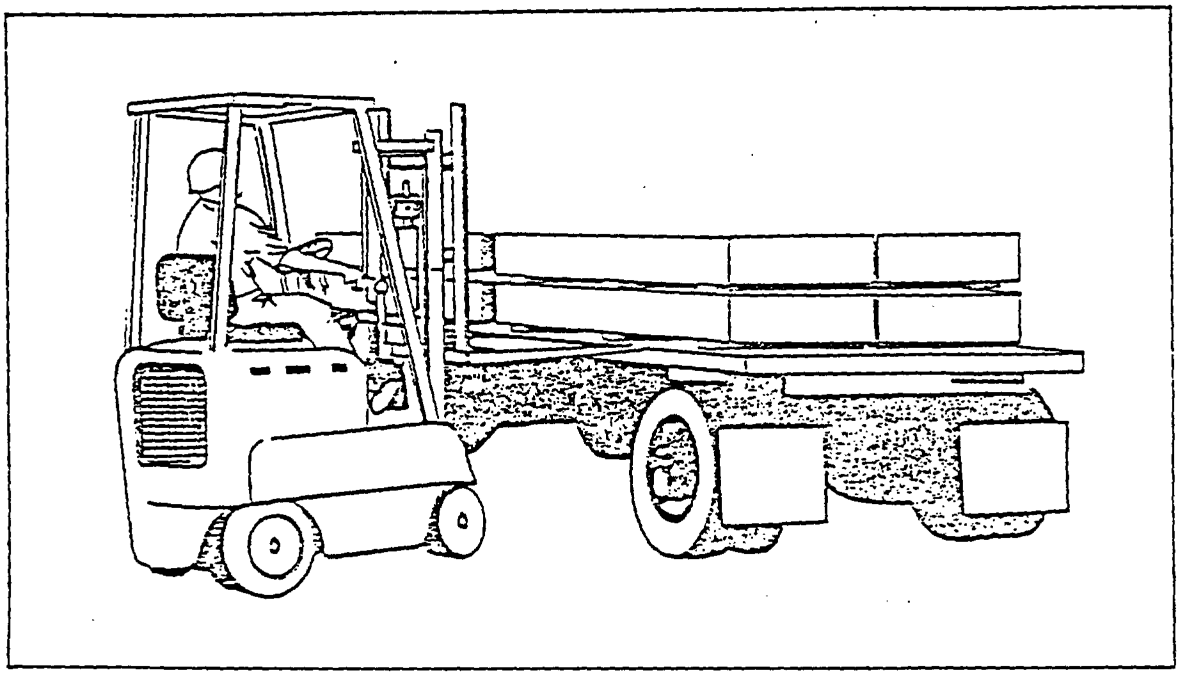
The following work practices are applicable to flat and corrugated A/C sheet products.

Operations to which these work practices apply include:

Shipping, Receiving and Handling
Cutting
Drilling
Hole Cutting and Cutouts
Housekeeping and Waste Disposal

Equipment used with these work practices is available from the sources shown in the equipment list.

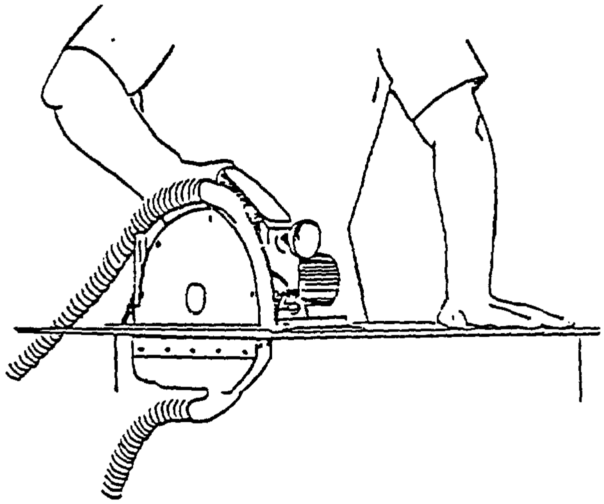
Shipping, Receiving and Handling



A/C sheet is shipped from the factory with clean surfaces, generally in pallet loads, using shipping methods acceptable to the producer and the customer.

All unloading operations should be carefully performed to avoid sheet damage. Pallet loads are normally unloaded by fork truck. Small shipments may require manual unloading.

Cutting - Flat Sheets
Circular Saw



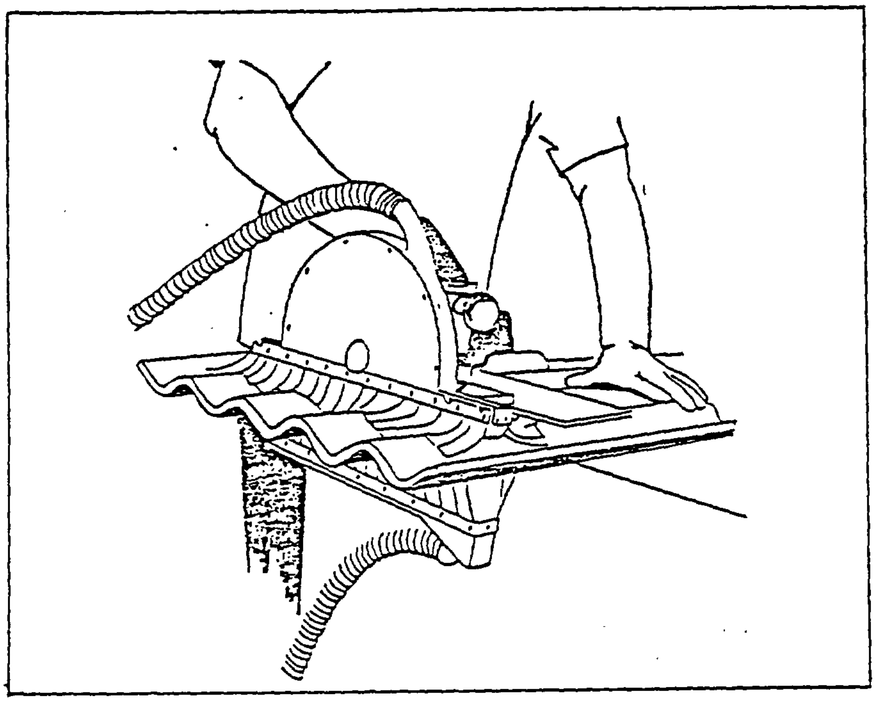
Circular Saw With Dust Collection Hood

Circular saws for cutting flat sheets should be used only when equipped with the specific dust collection hoods pictured above. Exhaust ventilation and dust collection is provided by a vacuum cleaner as described in the specifications (page 15).

A circular saw cuts by a "pulverizing" action which releases asbestos fibers and fine particulate. The combination of hood and vacuum source is highly effective in capturing and collecting these particles and fibers. Saw operating techniques are those normally employed. No special procedures are required except adjustment of the lower hood section to suit thickness of sheet being cut. Saw design requires the use of blades recommended by the tool supplier (abrasive disc or diamond).

For additional information on saw operation, refer to the supplier's instructions in Appendix A.

Cutting - Corrugated Sheets
Circular Saw



Circular Saw With Dust Collection Hood

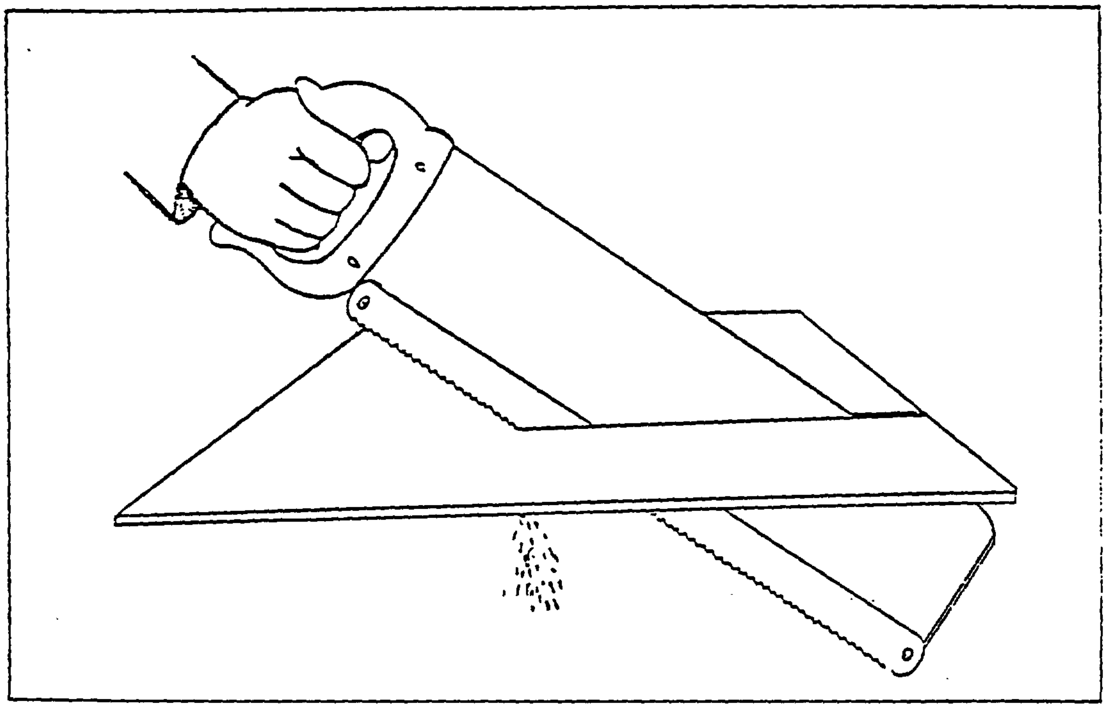
Circular saws for cutting corrugated sheets should be used only when equipped with the specific dust collection hood pictured above. Exhaust ventilation and dust collection is provided by a vacuum cleaner as described in the specifications (page 15).

A circular saw cuts by a "pulverizing" action which releases asbestos fibers and fine particulate. The combination of hood and vacuum source is highly effective in capturing and collecting these particles and fibers. Saw operating techniques are those normally employed. Saw design requires the use of blades recommended by the tool supplier (abrasive disc or diamond).

This tool depends on pliable "fingers" to seal the cutting zone and is designed for use on sheets with 1 1/2" deep corrugations. For cutting sheets with deeper or irregular corrugations, consult the tool supplier.

For additional information on saw operation, refer to the supplier's instructions in Appendix A.

Cutting - Handsaw

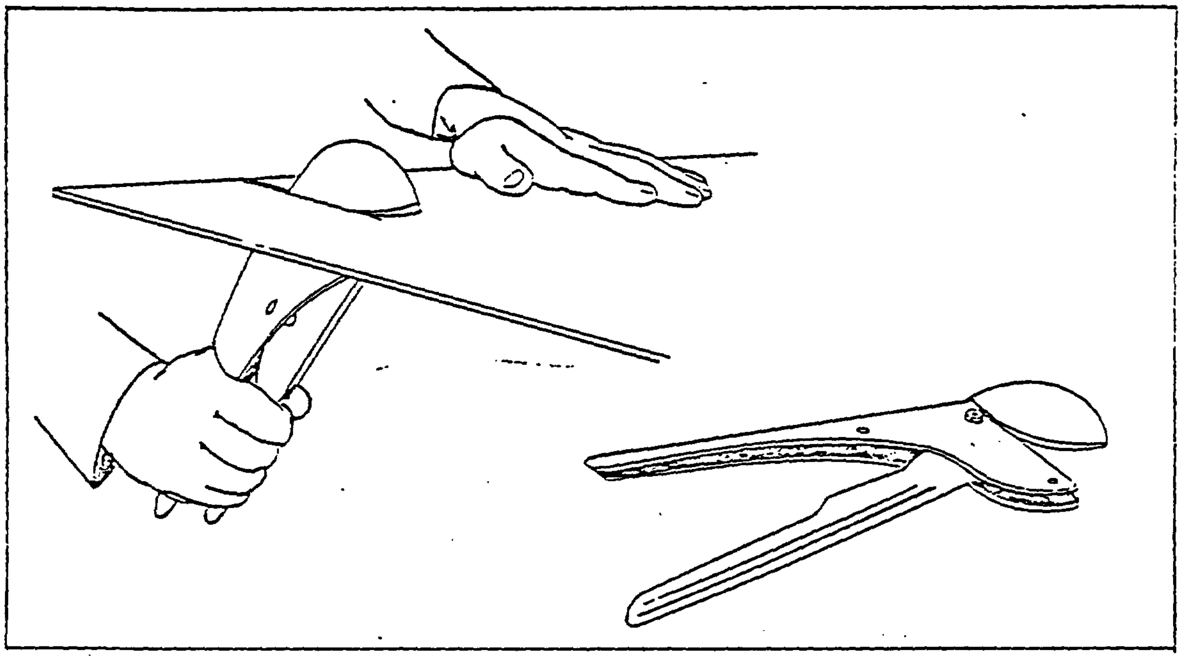


Handtools
Handsaw

This is a handsaw equipped with a carbide blade designed for cutting asbestos-cement sheet. Practical use of this saw is limited by its slow cutting speed. It is most useful in operations where cutting is infrequent and of short duration.

Because of the slow cutting speed, saw operation generates coarse particles of asbestos-cement with few airborne fibers. Its use does not require dust collection equipment for compliance with present exposure limits.

Cutting - Flat Sheets
Hand Clippers

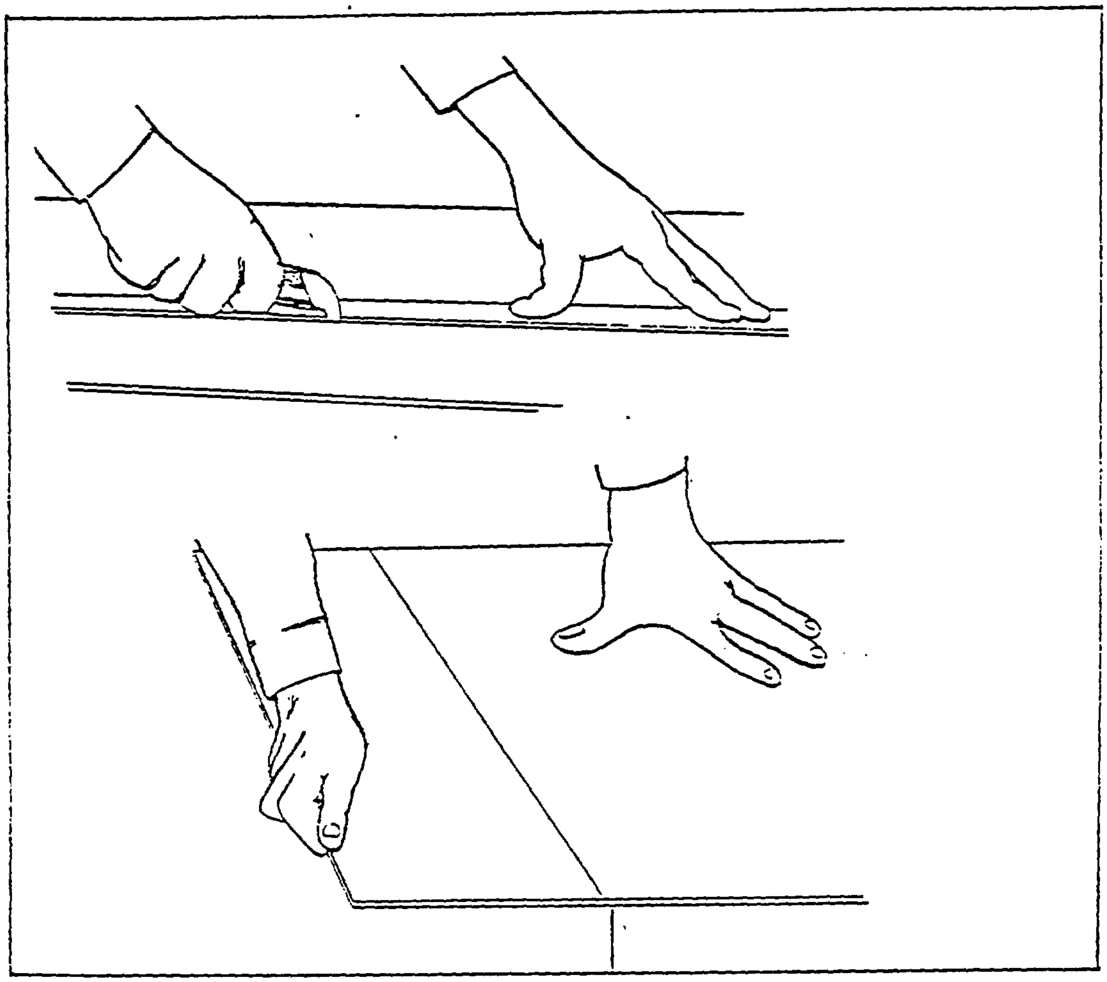


Handtools
Hand Clippers

These hand clippers are designed for cutting sheet material up to 1/4" in thickness. Practical use is limited by slow cutting speed. It is most useful in operations where cutting is infrequent and of short duration.

The clipper cutting action generates coarse particles of asbestos-cement with few airborne fibers. Its use does not require dust collection equipment for compliance with present exposure limits.

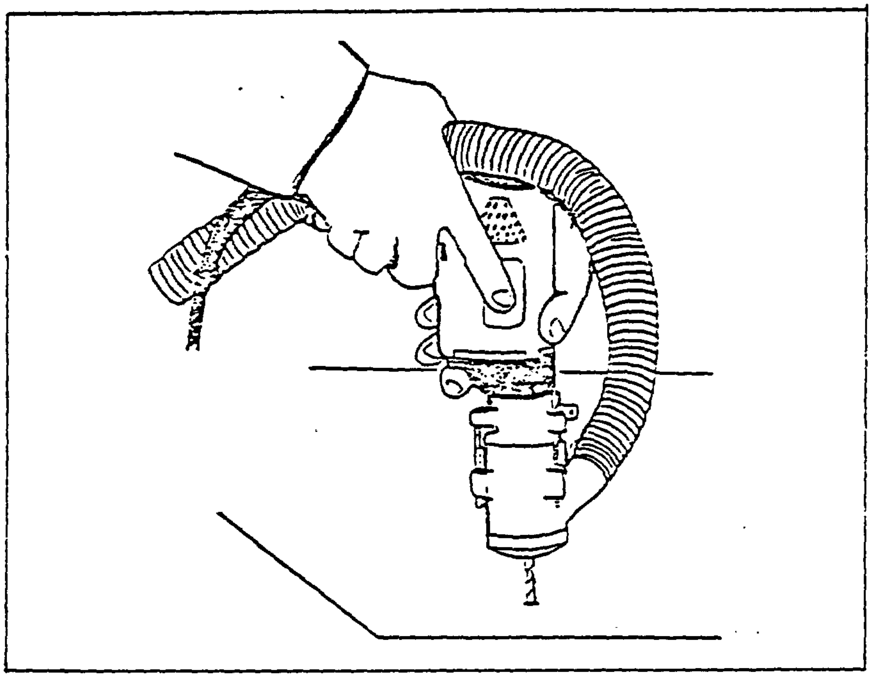
Cutting - Flat Sheets
Score & Snap Knife



Handtools
Scoring Knife

The scoring knife can be used with sheets up to 1/4" in thickness. However, it performs best with sheets 1/8" and 3/16" thick. The sheet is placed on a worktable or saw horses. A suitable guide bar is placed or clamped along the cut line and the sheet scored repeatedly. After scoring, the sheet is hand snapped along the score line. This cutting procedure generates little dust and few airborne fibers. Its use does not require dust collection equipment for compliance with present exposure limits.

Drilling - Power Drill



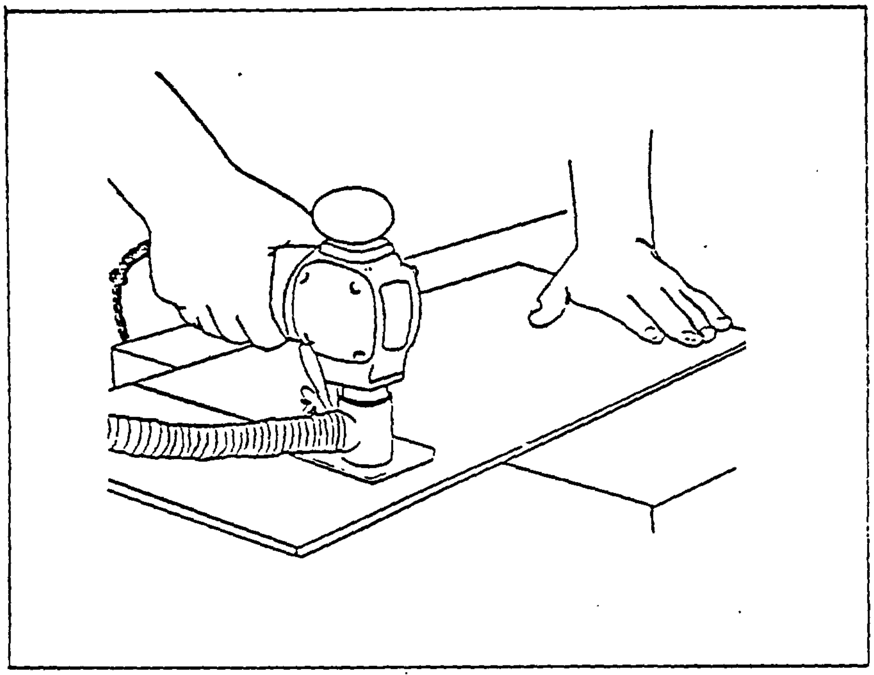
Drill With Dust Collection Hood

Drilling of small holes (1/4" or less) on vertical surfaces, or downward usually can be done without dust collection equipment and in compliance with present exposure limits.

Drilling of larger holes, and drilling overhead, requires dust collection equipment on the drill in order to achieve compliance. Equipment includes a hood (Cape Universal Building Products, Ltd.) and vacuum cleaner to provide exhaust ventilation and dust collection. Vacuum cleaner should be as described in specifications (page 15).

Drilling techniques are those normally employed. No special procedures are required.

Hole Cutting and Cutouts - Flat Sheets
Sabre Saw



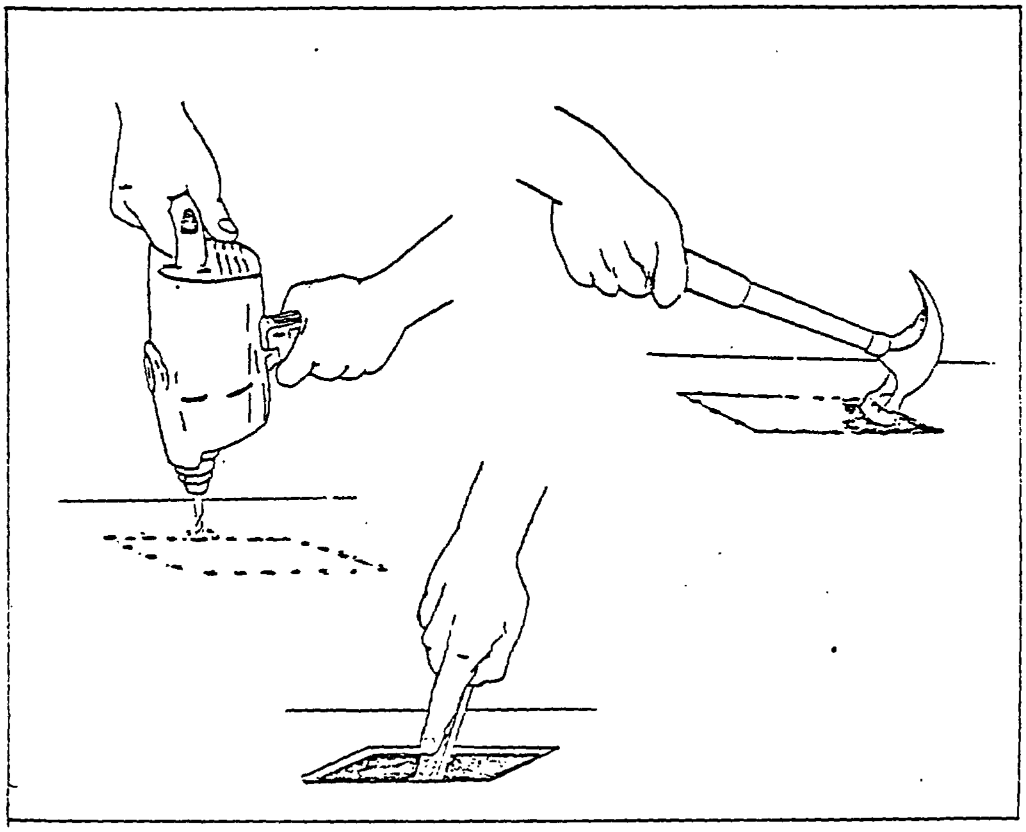
Sabre Saw With Dust Collection Hood

Sabre saws should be used only when equipped with the specific dust collection hood pictured above. Exhaust ventilation and dust collection is provided by a vacuum cleaner as described in the specifications (page 13).

Saw operating techniques are those normally employed. No special procedures are required.

For additional information on saw operation, refer to supplier's instructions in Appendix A.

Hole Cutting and Cutouts - Drill and Rasp



A simple method of making cutouts is to drill small holes around the edge of the opening to be cut and knocking out the material to be removed with a hammer. A rasp is used to dress or bevel edges of the cut.

This procedure does not require dust collection equipment for compliance with present exposure limits.

Vacuum Cleaner Specifications

(Values shown below are minimum recommended)

Circular Saw - Flat and Corrugated Sheet Cutting

Vacuum (lift):	59" W.G. (water gage)
Airflow:	175 SCFM (standard cubic feet per minute)
Filtration System:	Multi-stage, designed for use with asbestos-containing dusts.
Dust Collection:	Unit must be provided with, or capable of using, a disposable plastic or paper bag for collecting and removing dust.

Sabre Saw and Drill

Vacuum (lift):	59" W.G.
Airflow:	65 SCFM
Filtration System:	See Above
Dust Collection:	See Above

Housekeeping and Waste Disposal

Housekeeping is an essential part of any safe construction operation. It is even more essential when airborne dust created by the *lack* of good housekeeping has the potential for harm to employees and others.

EQUIPMENT: All external surfaces of equipment should be maintained free of dust accumulations that might, if dispersed, create asbestos fiber concentrations above permissible exposure limits.

WASTE DISPOSAL: Asbestos-cement dust chips and cuttings from the field operations described in this booklet must be collected in a manner that will not contribute airborne asbestos dust to the atmosphere. *Loose material should never be dry swept.* When vacuum equipment is available, it should be used. Water or other dust suppressants should be applied in those circumstances where sweeping is unavoidable. DO NOT BLOW WASTE MATERIAL WITH COMPRESSED AIR.

No visible emissions to the atmosphere are permitted from the collection, processing, packaging, transporting or deposition of any asbestos-containing material. Wastes must be collected and disposed in accordance with the requirements of the U.S. Environmental Protection Agency. For full text of EPA waste disposal requirements (40 CFR, Chapter 1, Part 61) refer to Appendix C.

Equipment Suppliers

Tools shown in this pamphlet are available from:

Wheeler-Pilot International
P. O. Box 3128
20433 Earl Street
Torrance, CA 90510
(213) 371-1238

Nilfisk of America, Inc.
201 King Manor Drive
King of Prussia, PA 19406
(215) 277-3900

Suppliers claiming to have vacuum cleaning units suitable for use with asbestos-containing dusts are:

American Cleaning Equipment Corp., 111 South Route 53, Addison, IL 60101

Beamco, Inc., 707 Stierlin Road, Mountain View, CA 94040

Breuer Electric Manufacturing Co., 5100 No. Ravenswood Ave., Chicago, IL 60640

Hild Floor Machine Co., Inc., 5339 West Lake St., Chicago, IL 60644

Kari-Vac Inc., 4360 W. 127th St., Alsip, IL 60653

Nilfisk of America, 201 King Manor Drive, King of Prussia, PA 19466

Pullman/Holt Products, 10702 46th Street, Tampa, FL 33617

Vac-U-Max, 227 Main St., Belleville, NJ 07109

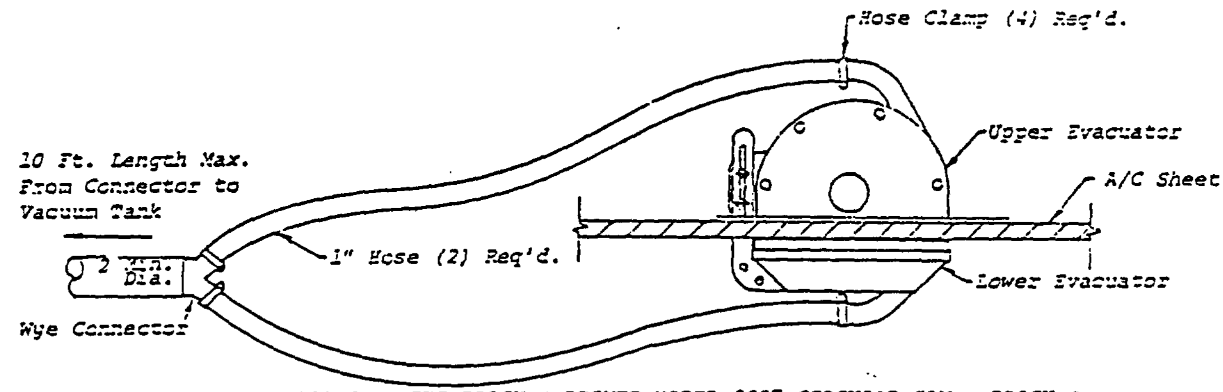
Wheeler-Pilot International, 20433 Earl Street, Torrance, CA 90510

Note:

It is recognized that equipment suppliers other than those listed above may be available. Mention of any company is not to be considered an endorsement by AIA/NA.

7-11-79

OPERATING INSTRUCTIONS
WHEELER-PILOT FLAT SHEET CIRCULAR SAW
MODEL 888



1. THE WPI MODEL 888 USES THE BLACK & DECKER MODEL 3037 CIRCULAR SAW. BLACK & DECKER OPERATING INSTRUCTIONS FOR MODEL 3037 MUST BE READ AND UNDERSTOOD PRIOR TO OPERATION.

2. ONLY VACUUM CLEANERS CERTIFIED BY THE MANUFACTURER FOR USE WITH ASBESTOS DUST AND HAVING A CAPABILITY OF 175 CFM ~~MIN.~~ MINIMUM ARE TO BE USED WITH THIS TOOL. A VACUUM HOSE OF NOT LESS THAN 2 INCH DIAMETER AND NOT MORE THAN 10 FEET LONG IS TO BE USED BETWEEN THE WYE CONNECTOR AND VACUUM TANK. THE VACUUM MANUFACTURER'S OPERATING INSTRUCTIONS MUST BE READ AND UNDERSTOOD BEFORE OPERATION.

3. INSPECT ALL SYSTEM ELEMENTS FOR CRACKS, PUNTURES OR OPENINGS, i.e. HOOD, VACUUM HOSE AND CONNECTORS. REPAIR OR REPLACE ANY FAULTY ITEM OR PART.

4. CONNECT THE VACUUM HOSES AS SHOWN, INSURING ALL CONNECTIONS AND CLAMPS ARE TIGHT.

5. TURN ON VACUUM AND CHECK FOR ANY STOPAGES OR AIR LEAKS IN THE VACUUM LINE OR HOOD AND INSURE ADEQUATE AIR FLOW IN THE OPEN AREA OF THE SAW.

6. IF ANY LEAKS OR STOPAGES ARE LOCATED, CHANGE OR REPAIR FAULTY ITEM.

7. ADJUST LOWER EVACUATOR SO THAT THE ~~NEOPRENE~~ RUBBER SKIRT CONTACTS THE UNDERSIDE OF THE SHEET TO BE CUT.

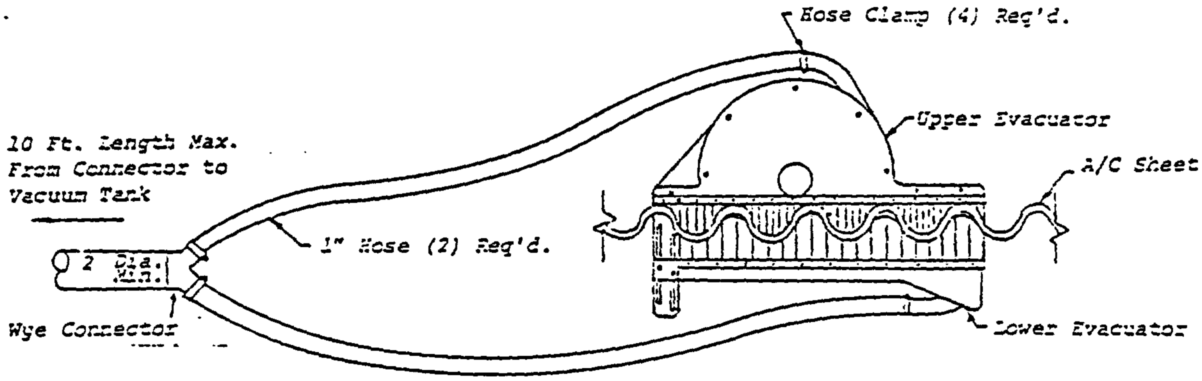
8. CONNECT CIRCULAR SAW TO ELECTRICAL OUTLET AND FEED INTO WORK. THERE SHOULD BE VIRTUALLY NO VISIBLE DUST OR DEBRIS. IF EXCESS DUST IS VISIBLE, (a) CHECK VACUUM CLEANER BAG FOR OVERLOAD-PER MANUFACTURER'S INSTRUCTIONS, (b) CHECK LINES FOR AIR LEAKS AND (c) CHECK PROPER ADJUSTMENT OF LOWER EVACUATOR.

9. AVOID USING EXCESSIVE FORCE FEEDING SAW INTO WORK. IF GREAT FORCE IS REQUIRED, STOP AND CHECK TOOL FOR PROPER OPERATION.

BLADE REPLACEMENT
(IN ADDITION TO BLACK & DECKER OPERATING INSTRUCTIONS)

1. DISCONNECT UNIT FROM ELECTRICAL OUTLET.
2. LOWER OR REMOVE LOWER EVACUATING HOOD.
3. REMOVE (4) SCREWS AND COVER TO EXPOSE BLADE.
4. GRASP THE EXPOSED LOWER PORTION OF THE BLADE AND REMOVE HUB SCREW WITH WRENCH.
5. BLADE CAN BE REMOVED OR REPLACED (CAUTION: SILICON CARBIDE BLADES MUST BE MOUNTED WITH APPROPRIATE SIDE OUT, THE BLADES ARE MARKED ACCORDINGLY).

OPERATING INSTRUCTIONS
WHEELER-PILOT CORRUGATED SHEET CIRCULAR SAW
MODEL 898



1. THE WPI MODEL 898 USES THE BLACK & DECKER MODEL 3037 CIRCULAR SAW. BLACK & DECKER OPERATING INSTRUCTIONS FOR MODEL 3037 MUST BE READ AND UNDERSTOOD PRIOR TO OPERATION.

   MINIMUM

2. ONLY VACUUM CLEANERS CERTIFIED BY THE MANUFACTURER FOR USE WITH ASBESTOS DUST AND HAVING A CAPABILITY OF 175 CFM ~~MIN.~~ ARE TO BE USED WITH THIS TOOL. A VACUUM HOSE OF NOT LESS THAN 2 INCH DIAMETER AND NOT MORE THAN 10 FEET LONG IS TO BE USED BETWEEN THE WYE CONNECTOR AND VACUUM TANK. THE VACUUM MANUFACTURER'S OPERATING INSTRUCTIONS MUST BE READ AND UNDERSTOOD BEFORE OPERATION.

3. INSPECT ALL SYSTEM ELEMENTS FOR CRACKS, PUNTURES OR OPENINGS, i.e., HOOD, VACUUM HOSE AND CONNECTORS. REPAIR OR REPLACE ANY FAULTY ITEM OR PART.

4. CONNECT THE VACUUM HOSES AS SHOWN, INSURING ALL CONNECTIONS AND CLAMPS ARE TIGHT.

5. TURN ON VACUUM AND CHECK FOR ANY STOPAGES OR AIR LEAKS IN THE VACUUM LINE OR HOOD AND INSURE ADEQUATE AIR FLOW IN THE OPEN AREA OF THE SAW.

6. IF ANY LEAKS OR STOPAGES ARE LOCATED, CHANGE OR REPAIR FAULTY ITEM.

7. ADJUST LOWER EVACUATOR SO THAT THE RUNNERS ON THE INSIDE OF THE SKIRT FINGERS ARE APPROXIMATELY 1/4 INCH FROM THE BOTTOM OF THE SHEET.

8. CONNECT CIRCULAR SAW TO ELECTRICAL OUTLET AND FEED INTO WORK. THERE SHOULD BE VIRTUALLY NO VISIBLE DUST OR DEBRIS. IF EXCESS DUST IS VISIBLE, (a) CHECK VACUUM CLEANER BAG FOR OVERLOAD-PER MANUFACTURER'S INSTRUCTIONS, (b) CHECK LINES FOR AIR LEAKS AND (c) CHECK PROPER ADJUSTMENT OF LOWER EVACUATOR.

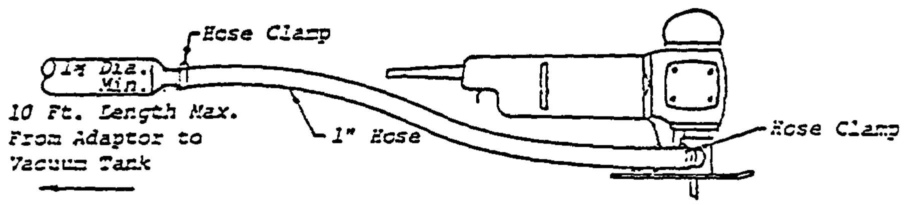
9. AVOID USING EXCESSIVE FORCE FEEDING SAW INTO WORK. IF GREAT FORCE IS REQUIRED, STOP AND CHECK TOOL FOR PROPER OPERATION.

<u>BLADE REPLACEMENT</u>
(IN ADDITION TO BLACK & DECKER OPERATING INSTRUCTIONS)

1. DISCONNECT UNIT FROM ELECTRICAL OUTLET.
2. LOWER OR REMOVE LOWER EVACUATING HOOD.
3. REMOVE (8) SCREWS AND COVER TO EXPOSE BLADE.
4. GRASP THE EXPOSED LOWER PORTION OF THE BLADE AND REMOVE HUB SCREW WITH WRENCH.
5. BLADE CAN BE REMOVED OR REPLACED (CAUTION: SILICON CARBIDE BLADES MUST BE MOUNTED WITH APPROPRIATE SIDE OUT, THE BLADES ARE MARKED ACCORDINGLY)

7-11-79

OPERATING INSTRUCTIONS
WHEELER-PILOT SABER SAW
MODEL 878



1. THE WPI MODEL 878 USES THE BLACK & DECKER MODEL 3155 SABER (JIG) SAW. BLACK & DECKER OPERATING INSTRUCTIONS FOR MODEL 3155 MUST BE READ AND UNDERSTOOD PRIOR TO OPERATING THIS UNIT.

2. ONLY VACUUM CLEANERS CERTIFITED BY THE MANUFACTURER FOR USE WITH ASBESTOS DUST AND HAVING A CAPABILITY OF 65 CFM MIN. ARE TO BE USED WITH THIS TOOL. A VACUUM HOSE OF NOT LESS THAN 1¼ INCH DIAMETER AND NOT MORE THAN 10 FEET LONG IS TO BE USED. THE VACUUM MANUFACTURER'S OPERATING INSTRUCTIONS MUST BE READ AND UNDERSTOOD BEFORE OPERATION.

3. INSPECT ALL SYSTEM ELEMENTS FOR CRACKS, PUNTURES OR OPENINGS, i.e. HOOD, VACUUM HOSE AND CONNECTORS. REPAIR OR REPLACE ANY FAULTY ITEM.

4. ASSEMBLE VACUUM HOSE AS SHOWN ABOVE, INSURING ALL CONNECTIONS AND CLAMPS ARE TIGHT.

5. TURN ON VACUUM AND CHECK FOR ANY STOPAGES OR AIR LEAKS IN THE VACUUM LINE OR HOOD AND INSURE ADEQUATE AIR FLOW IN THE OPEN AREA OF THE SAW.

6. IF ANY LEAKS OR STOPAGES ARE LOCATED, CHANGE OR REPAIR FAULTY ITEM.

7. CONNECT SABER SAW TO ELECTRICAL OUTLET AND FEED INTO WORK. THERE SHOULD BE NO VISIBLE DUST OR DEBRIS. IF EXCESS DUST IS VISIBLE, (a) CHECK VACUUM CLEANER BAG FOR OVERLOAD-PER MANUFACTURER'S INSTRUCTIONS, (b) CHECK LINES FOR AIR LEAKS.

TO INSTALL OR REMOVE BLADE
(IN ADDITION TO BLACK & DECKER OPERATING INSTRUCTIONS)

1. DISCONNECT UNIT FROM ELECTRICAL OUTLET.

2. REMOVE THE TWO SCREWS WHICH RETAIN THE SHIELD.

3. PULL SHIELD STRAIGHT DOWN (SHIELD FITS FIRMLY IN POSITION. A SOFT TAP MAY BE NECESSARY)

4. REMOVE BLADE (SEE BLACK & DECKER OPERATING INSTRUCTIONS)

5. REASSEMBLE.

Recommended Work Practice Procedures
for
Drilling Mud Additives

During the early 1970's, concern was raised within the drilling industry regarding the health and safety of employees handling asbestos in drilling muds. In order to reduce the concentration of airborne asbestos fibers at the rig site, Drilling Specialties Company, the producer of these drilling mud additives, reformulated their drilling mud grade asbestos into a water-soluble flake. Subsequent field tests were conducted to confirm the reduction in the airborne concentrations of asbestos. The results of these tests are present in Tables X-XIV below.

TABLE X

CONCENTRATIONS OF ASBESTIFORM FIBERS IN THE WORK ENVIRONMENT

DRILLING MUD ADDITIVES

Phillips Petroleum Company - Peter "2", No. 2 Well

Panola County, Texas

H & S Drilling Company

Sample No.	Location and Description	Sampling Time Date	Hour	Duration (min)	Concentration (Fibers/cc)
1	Breathing Zone, (BZ) Floor Man No. 1	1/3/79	1500	435	<0.1
2	BZ, Motorman, as conducts normal duties during shifts	1/3/79	1500	435	<0.1
3	BZ, Derrick Man, as conducts normal duties during shift. 22 bags Flosal added during shift	1/3/79	1500	435	<0.1
4	BZ, Floor Man No. 2, as conducts normal duties during shift	1/3/79	1500	435	<0.1
5	BZ, Driller, as conducts normal duties during shift	1/3/79	1500	435	<0.1
6	Area Sample collected during shift	1/3/79	1511	424	<0.1
7	Area Sample collected during shift	1/3/79	1515	420	<0.1

TABLE XI

CONCENTRATIONS OF ASBESTIFORM FIBERS IN THE WORK ENVIRONMENT DURING

THE ADDITION OF DRILLING MUD ADDITIVES

Phillips Petroleum Company - Black "A" No. 1 Well

Canadian County, Oklahoma

Sample No.	Location and Description	Sampling Time			Concentration (Fibers/cc)
		Date	Hour	Duration (min)	
1	BZ, Driller, as performs normal duties	1/15/79	0805	480	*
2	BZ, Derrickman, as performs normal duties	1/15/79	0806	479	*
3.	BZ, Floorman, as performs normal duties	1/15/79	0808	480	*
4	BZ, Derrickman, during addition of 3, 50-pound bags Flosal® and 12, 50-pound bags Milgel	1/15/79	0945	[illegible]	1.3

* Filter loaded with unknown substance which precluded the required analysis.

TABLE XII

CONCENTRATION OF ASBESTIFORM FIBERS IN THE WORK ENVIRONMENT

Norwegian North Sea - Edda Platform

Phillips Petroleum Company - Eldfisk 2/7, No. A-21 Well

Loffland Bros. North Sea., Inc.

Sample No.	Location and Description	Sampling Time Date	Hour	Duration (min)	Concentration (Fibers/cc)
1	Breathing Zone (BZ) Derrick Man as added 12, 50-pound sacks Flosal© to mixing hopper	2/11/79	1505	10	0.2
2	NW side of rig floor about BZ height	2/11/79	1315	433	<0.1
3	BZ, Service Engineer, as performs normal duties throughout shift	2/11/79	1305	450	<0.1
4	BZ, Derrick Man as performs normal duties during shift including addition of Flosal as indicated in No. 1 above	2/11/79	1255	465	<0.1
5	BZ, Driller as performs normal duties	2/11/79	1255	570	*
6	Area Sample, near mixing hopper	2/11/79	1515	435	*

* Filter loaded with unknown substance which precluded the required analysis.

TABLE XIII

CONCENTRATION OF ASBESTIFORM FIBERS IN THE WORK ENVIRONMENT DURING

OFFSHORE DRILL SHIP OPERATION

Phillips Petroleum Company - Mississippi Canyon Block No. 282
Well No. 1 - OCS-3819
Louisiana Gulf Coast

Sample No.	Location and Description	Sampling Time			Concentration (Fibers/cc)
		Date	Hour	Duration (min)	
	MUD ENGINEER				
1	BZ, as performs normal duties primarily in mud pit room	4/21/79	0445	138	<0.1
2	Same as No. 1 above	4/21/79	0703	167	<0.1
3	Same as No. 1 above	4/21/79	0950	137	<0.1
	TIME-WEIGHTED AVERAGE			442	<0.1
	DERRICK MAN				
4	BZ, as performs normal duties	4/21/79	0500	125	<0.1
5.	Same as No. 4 above	4/21/79	0705	135	*
6	Same as No. 4 above	4/21/79	0920	105	<0.1
7	BZ, as performs normal duties, also began addition of Flosal® (4, 50-pound sacks added 1015 to 1200 hours)	4/21/79	1105	81	<0.1
	TIME-WEIGHTED AVERAGE			311	<0.1
	MUD ROOM				
8	Area sample, near mud additive hopper	4/21/79	0505	122	<0.1
9	Same as No. 8 above	4/21/79	0707	135	<0.1
10	Same as No. 8 above	4/21/79	0922	106	<0.1
11	Same as No. 8 above	4/21/79	1103	76	<0.1
	TIME-WEIGHTED AVERAGE			439	<0.1

* Filter loaded with unknown substance which precluded the required analysis.

TABLE XIII

(Continued)

Sample No.	Location and Description	Sampling Time Date	Hour	Duration (min)	Concentration (Fibers/cc)
	DRILLER				
12	BZ, as performs normal duties	4/21/79	0515	125	<0.1
13	Same as No. 12 above	4/21/79	0720	130	<0.1
14	Same as No. 12 above	4/21/79	0930	175	<0.1
		TIME-WEIGHTED AVERAGE		430	<0.1
	ASSISTANT DRILLER				
15	BZ, as performs normal duties	4/21/79	0519	123	<0.1
16	Same as No. 15 above	4/21/79	0722	127	<0.1
17	Same as No. 15 above	4/21/79	0929	178	<0.1
		TIME-WEIGHTED AVERAGE		428	<0.1

TABLE XIV

CONCENTRATIONS OF ASBESTIFORM FIBERS IN THE WORK ENVIRONMENT

DRILLING MUD ADDITIVES

Phillips Petroleum Company

Burnhoff C No. 1

Canadian County, Oklahoma

Sample No.	Location and Description	Sampling Time Date	Sampling Time Hour	Sampling Time Duration	Concentration (Fibers/cc)
	DOGHOUSE				
1	Area Sample, located across doghouse from door near driller's console.	5/29/79	0727	118	<0.1
2	Same as No. 1 above	5/29/79	0925	133	<0.1
3	Same as No. 1 above	5/29/79	1138	116	<0.1
4	Same as No. 1 above	5/29/79	1334	70	<0.1
		TIME-WEIGHTED AVERAGE		437	<0.1
	MUD HOUSE				
5	Area Sample, located about 1 foot above cone-jet hopper apron, even with outside edge.	5/29/79	0729	119	<0.1
6	Same as No. 5 above	5/29/79	0928	133	<0.1
7	Same as No. 5 above	5/29/79	1141	93	<0.1
8	Same as No. 5 above	5/29/79	1340	70	<0.1
		TIME-WEIGHTED AVERAGE		415	<0.1
	DERRICK MAN				
9	BZ, as performs normal duties. Began addition of bentonite.	5/29/79	0747	120	<0.1
10	BZ, continued bentonite addition and 3 sx Flosal	5/29/79	0947	116	<0.1
11	BZ, 1 sk Flosal added	5/29/79	1143	119	<0.1
12	BZ, as performs normal duties	5/29/79	1342	69	<0.1
		TIME-WEIGHTED AVERAGE		424	<0.1

TABLE XIV

(Continued)

Sample No.	Location and Description	Sampling Time Date	Hour	Duration (min)	Concentration (Fibers/cc)
FLOORMAN					
13	BZ, as performs normal duties	5/29/79	0752	122	<0.1
14	Same as No. 13 above	5/29/79	0954	111	<0.1
15	Same as No. 13 above	5/29/79	1145	119	<0.1
16	Same as No. 13 above	5/29/79	1344	64	<0.1
	TIME-WEIGHTED AVERAGE			416	<0.1
DRILLER					
17	BZ, as performs normal duties	5/29/79	0754	116	<0.1
18	Same as No. 17 above	5/29/79	0910	PUMP MALFUNCTION - NO SAMPLE	
19	Same as No. 17 above	5/29/79	1148	108	<0.1
20	Same as No. 17 above	5/29/79	1336	72	<0.1
	TIME-WEIGHTED AVERAGE			296	<0.1

The values presented in these tables demonstrate that all sampling results are well below the permissible exposure limit specified in the current asbestos regulations. Based on these results, the following recommended work practices for a drilling mud additive (DMA) containing asbestos. When used in accordance with these recommendations, the drilling mud additives can be safely handled by personnel at the rig site.

PRODUCTS AND OPERATIONS

DMA is furnished in flake form.

Operations to which these work practices apply include:

Shipping, receiving, handling, warehousing, and storage.

Additions of DMA to the mud.

Handling of empty sacks.

Disposing of empty sacks.

Disposing of mud.

SHIPPING, RECEIVING, HANDLING, WAREHOUSING, AND STORAGE

DMA is furnished in loose or palletized sacks. (With palletized DMA, the pallets are sometimes shrink-wrapped.) The sealed, unopened sacks should be handled by normal warehouse practices.

Precautions must be taken if a sack is broken, torn or punctured. The sack should be sealed with heavy duty tape or placed in a slip-over sack (over-sized, open-mouthed bag) to prevent spillage. The slip-over sack should be securely sealed, preferably by a twist wire. Any spillage should be cleaned up with a vacuum sweeper equipped with a disposable bag. Unless additional protection is required under applicable federal or other regulations, a certified, reusable single-use air-purifying respirator should be worn by the person cleaning up. DO NOT BLOW MATERIAL WITH COMPRESSED AIR, NOR DRY-SWEEP. The material in broken or damaged sacks should be used first. In storing DMA, it is recommended that it be stacked no more than 10 sacks high.

ADDITIONS OF DMA TO THE MUD

DMA should be added to the mud in the same manner as other dry mud additives. The DMA should be added directly to the mud system, preferably by emptying the sack at a uniform rate into the hopper of a cone-type jet mixer (eductor system, Figure 1).

Other systems in use are also suitable for the addition of DMA, such as an eductor with suction hose attached to withdraw the DMA directly from the sack, or from a drum into which several sacks have been emptied (Figure 2). Care should be used in pouring the DMA into another container to reduce the amount of "fines" generated when air is displaced from the receiving hopper or drum.

In adding DMA to the mud, it is a recommended practice to position oneself so that any air currents present are moving from the individual's back toward the receiving container, rather than blowing into the face. A light weight streamer or "air sock" above the hopper may be used to determine wind direction (Figure 3).

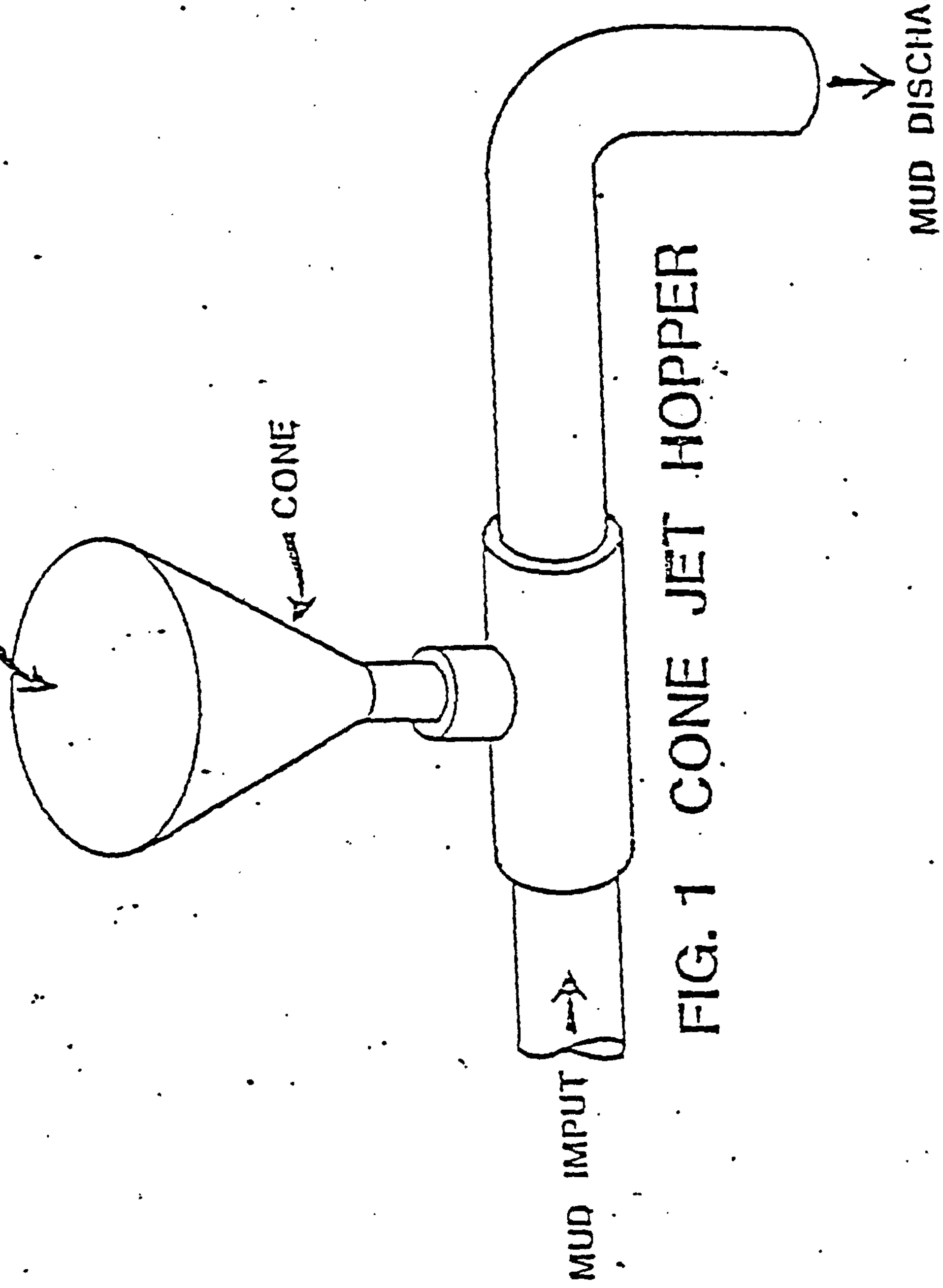


FIG. 1 CONE JET HOPPER

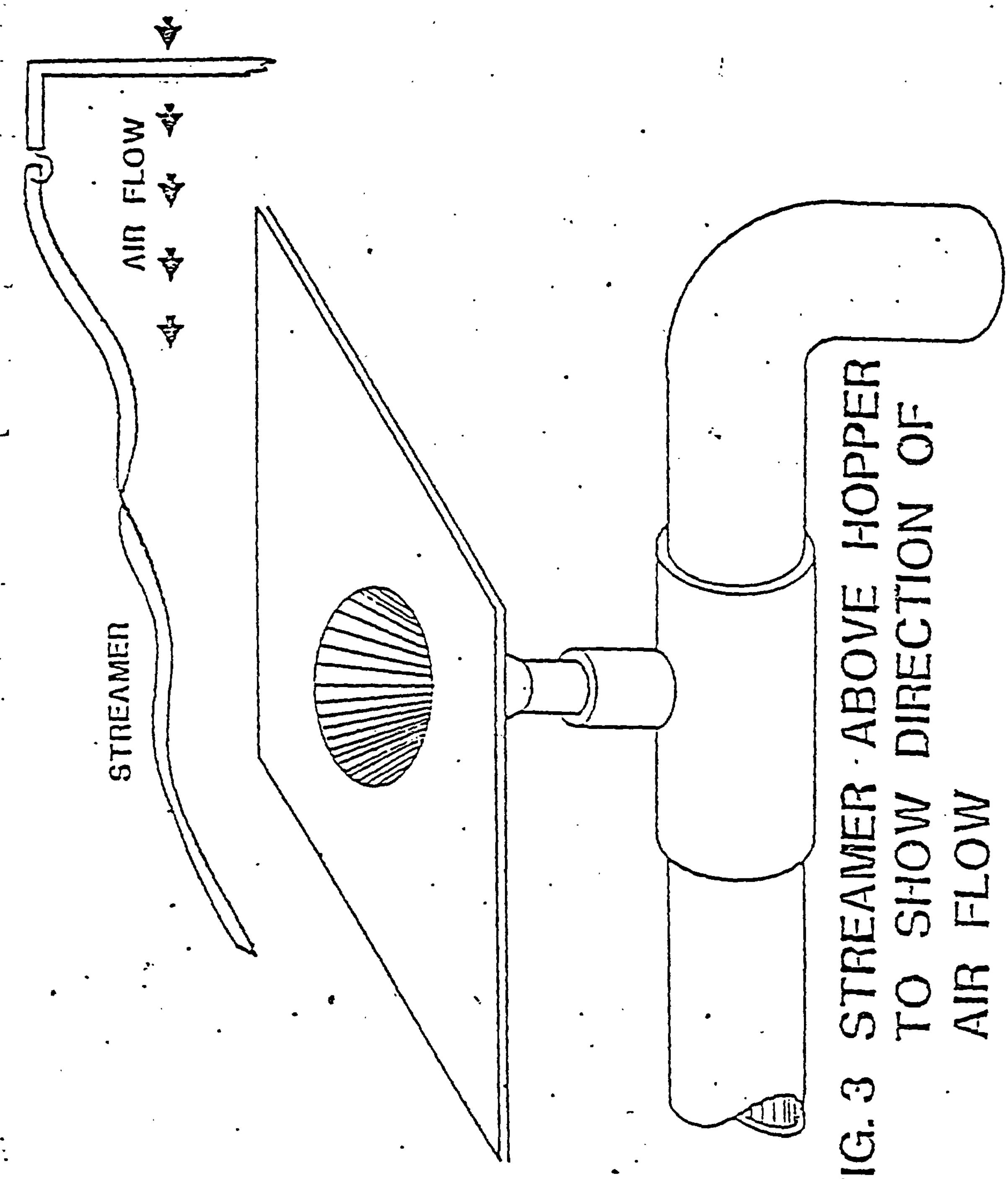


FIG. 3 STREAMER ABOVE HOPPER TO SHOW DIRECTION OF AIR FLOW

HANDLING OF EMPTY SACKS

After a sack is emptied, it should be discarded in accordance with current Federal Regulations. Normally, sacks of all types should be carried away for disposal as soon as time permits.

DISPOSING OF EMPTY SACKS

When an adequate precipitator is attached to the incinerator, onshore burial or incineration is the preferred method of disposing of empty DMA sacks from offshore sites. DO NOT BURN DMA SACKS WITHOUT A PRECIPITATOR. The empty sacks should be accumulated in sealed impermeable bags until a sufficient number is on hand to require burning or burial.

It is preferable to bury empty DMA sacks onshore. DMA sacks are biodegradable. An incinerator with an adequate precipitator can be used. DO NOT BURN DMA SACKS WITHOUT A PRECIPITATOR.

DISPOSING OF MUD

When a well is finished, there is usually little or no DMA left in the mud. Any accepted method of storing the mud for reuse, or disposing of it, can be used.