PLAINTIFF'S EXHIBIT

CON-37

EVALUATION OF WORKER EXPOSURE TO AIRBORNE FIBERS DURING THE REMOVAL OF RESILIENT SHEET VINYL FLOOR COVERING USING RECOMMENDED WORK PRACTICES

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I. EXECUTIVE SUMMARY

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Many types of resilient sheet vinyl flooring manufactured in the past were backed with a felt containing asbestos fibers bound within a styrene-butadiene rubber matrix. Removal of installed resilient sheet vinyl flooring in an occupational setting (e.g., prior to the installation of a new floor covering) is subject to the standard set by the Occupational Safety and Health Administration (OSHA) for occupational exposure to asbestos in the construction industry (29 CFR 1926.58). This standard requires employers to assure that worker exposures to asbestos do not exceed the permissible exposure limit (PEL) of 0.2 fibers per cubic centimeter (f/cc) of air for an 8-hour time-weighted average (TWA) or the excursion limit of 1.0 f/cc averaged over a 30-minute period.

The OSHA asbestos standard requires initial monitoring of employee exposure at the start of a job to determine whether employee exposure exceeds either the airborne action level (0.1 f/cc for an 8-hour TWA), or the excursion limit (1.0 f/cc over 30 minutes). The standard also provides that, in lieu of initial monitoring, an employer may rely upon objective or historical data, conducted under substantially similar workplace conditions, to demonstrate that the action level and excursion limit are not exceeded.

ENVIRON Corporation was retained by the Resilient Floor Covering Institute (RFCI) and Armstrong World Industries, Inc. (Armstrong) to design and carry out a study of worker exposures to asbestos during removal of resilient sheet vinyl flooring pursuant to work practices recommended by RFCI and Armstrong ("Recommended Work Practices", see Appendix A).

This report presents an analysis of fiber exposures to floor mechanics and observers during resilient sheet vinyl floor removal pursuant to the Recommended Work Practices. Based on a total of 51 exposures measured for floor mechanics and observers (representing typical exposures for supervisory employees) at 17 sites, the average TWA for resilient sheet vinyl floor removal is approximately 0.027 f/cc, which is less than 30% of the action level. The 95% upper confidence limit calculated for all resilient sheet vinyl floor removal operations is approximately 0.067 f/cc, which is less than 70% of the action level. These results are not significantly different if only the exposure of

mechanics is considered. For 34 worker samples, the average TWA is approximately 0.028 f/cc with a 95% upper confidence limit of 0.068 f/cc. Evaluation of worker and observer air sample filters by transmission electron microscopy (TEM) revealed that most asbestos fibers were shorter than 5 μm in length. Many of the longer structures seen, which would qualify as fibers under the OSHA method of analysis, proved not to be asbestos.

Although no samples were taken specifically to examine short-term exposures, the sampling data indicates that the average excursion concentration would be 0.426 f/cc, which is less than 50% of the excursion limit, if the entire exposure is assumed to have occurred within a 30-minute period during each floor removal operation. However, it is highly unlikely that any exposures observed during floor removal operations would occur entirely within a 30-minute period, and the true excursion concentrations should be well below the values calculated. This study demonstrated, with 95% confidence, that the excursion limit would not be exceeded.

Evaluation of samples by transmission electron microscopy (TEM) revealed that most fibers observed were either not asbestos or were much smaller than the qualifying fiber size as defined in the OSHA standard. Therefore, this study conclusively shows that the action level and excursion limit for exposure to asbestos fibers are not exceeded when resilient sheet vinyl flooring is removed in accordance with the Recommended Work Practices. Consequently, an employer should be able to rely upon these exposure results as historical data in lieu of conducting initial monitoring to satisfy the monitoring requirements of the OSHA standard (29 CFR 1926.58(f)(2)(iii)) for a resilient sheet vinyl floor removal job performed in accordance with the Recommended Work Practices.

II. INTRODUCTION

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A. Background

In the past, many types of resilient sheet vinyl flooring manufactured for residential and commercial use were backed with a felt containing asbestos fibers. These fibers were bound in a styrene-butadiene rubber matrix, which served as backing to the resilient wear layer. According to floor covering manufacturers, the asbestos used in resilient sheet vinyl backing was predominantly short-fiber chrysotile asbestos. Therefore, any asbestos fibers seen during removal would most likely be chrysotile, and observation of amphibole asbestos fibers could suggest that another source of asbestos might be present. In fact, the fibers seen were almost exclusively chrysotile.

When new flooring is installed, removal of an existing resilient sheet vinyl floor covering may be necessary. The Recommended Work Practices, however, advise that removal of resilient sheet vinyl flooring should be conducted only if new flooring cannot be installed directly on top of the existing floor. If the backing on the existing resilient sheet vinyl floor contains asbestos, the floor mechanics who remove the floor are potentially exposed to airborne asbestos fibers during the removal process. Consequently, the removal process in an occupational setting is subject to the regulations of the Occupational Safety and Health Administration (OSHA) that limit employee exposures to airborne asbestos. As explained in Chapter III, OSHA has issued two standards regulating occupational exposures to asbestos, one for general industry (29 CFR 1910.1001) and one specifically for the construction industry (29 CFR 1926.58).

Any occupationally-related removal of an asbestos-containing material, such as resilient sheet vinyl floor covering, falls within the scope of construction work according to the OSHA definition. For this reason, the sponsors of this study sought to obtain data (that would satisfy OSHA's requirements for employer reliance upon as historical data) to determine that worker exposures to asbestos fibers during the removal of resilient sheet vinyl floor covering, in accordance with the Recommended Work Practices. An employer who follows the Recommended Work Practices may rely upon these data, in lieu of conducting initial monitoring of workers at future job sites. RFCI and Armstrong have sponsored an independent study to assess the level of worker exposure to asbestos during the removal of resilient sheet vinyl flooring, when the

Recommended Work Practices are followed. In order to obtain representative data that would encompass a variety of conditions that would typify most resilient sheet vinyl floor removals, sites were selected on the basis of the following considerations:

- brand of resilient sheet vinyl flooring and/or manufacturer;
- type of underlayment (e.g., concrete, plywood, or fiberboard);
- type of installation (e.g., perimeter-bound or fully-adhered);
- geographical location; and
- building type (e.g., residential, commercial, or institutional).

A pilot resilient sheet vinyl floor removal study was conducted on December 16, 1988 in Lancaster, PA. The purpose of that pilot study was to refine the sampling and analysis protocol for future floor removal tests and to develop initial monitoring data, for purposes of the study itself. This pilot study showed that worker adherence to the Recommended Work Practices maintained airborne fiber concentrations for workers in the study well below OSHA's action level and excursion limit.

B. Sample Collection and Analysis

Industrial Health Incorporated (IHI) was engaged by ENVIRON to conduct all air monitoring in the principal study. Air sampling was conducted prior to and during each removal operation to monitor the concentration of airborne asbestos fibers. Five types of air samples were collected:

- overnight baseline samples in the work area prior to removal;
- perimeter samples outside of the work area prior to and during removal;
- personal samples on each of two workers during removal;
- personal samples on one individual acting as a supervisor or observer, who spent a significant amount of time in the immediate work area, although he was generally not directly involved in the actual removal; and
- one outdoor sample for determination of local, ambient asbestos levels during removal.

All area samples were collected by setting the sampling apparatus in a stationary location. Filters were held on a stand approximately 4 feet above the floor. Personal air sampling monitors were attached to each worker or observer with the filter located within the individual's breathing zone, as defined by OSHA. In each case, with the

exception of the one outdoor sample, two samples were collected side-by-side for analysis by phase contrast microscopy (PCM) and transmission electron microscopy (TEM).

All air samples intended for PCM analysis were collected in accordance with NIOSH Method 7400 as recommended by OSHA. Samples were collected on Millipore 25 mm diameter, 0.8 μm pore size, cellulose ester membrane filters in cassettes with conductive cowls. Samples intended for TEM analysis were collected in accordance with EPA's Interim Transmission Electron Microscopy Analysis Method. Samples were collected on either Nuclepore or Millipore 25 mm diameter, 0.45 μm pore size, mixed cellulose ester fiber filters with 0.8 μm backup filters in cassettes with conductive cowls. All samples were collected using cassettes in the open-face configuration. Further details concerning the sampling procedures followed by IHI are provided in a companion report[1].

At least three separate bulk samples of the backing material for each resilient sheet vinyl floor removed were taken for Polarized Light Microscopy (PLM) analysis. Analysis of the samples was made using a polarizing light microscope and dispersion staining objective in accordance with guidelines set forth in the EPA Interim Method for the Determination of Asbestos in Bulk Insulation Samples (40 CFR, Part 763, Subpart F, Appendix A - 7-1-87 Edition).

All samples were shipped by Federal Express to RJ Lee Group, Inc. (RJ Lee) for independent laboratory analysis. Blank filters were submitted to the analytical laboratory for analysis with the samples. For PCM analysis, one hundred fields were counted at a magnification of 400X following the rules outlined in NIOSH Method 7400. The method requires that 100 fields be counted, or at least a minimum of 20 fields, depending upon fiber concentration. All fibers or fiberlike particles measuring at least 5 μm in length and having a 3-to-1 length-to-width aspect ratio were counted. For TEM analysis, samples were analyzed using proposed EPA Level II analysis. The analysis for asbestos fibers consisted of fiber morphology, visual selected area electron diffraction

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[1] ENVIRON Corporation. 1990. Supporting Data for Evaluation of Worker Exposure to Airborne Fibers During the Removal of Resilient Sheet Vinyl Floor Covering Using Recommended Work Practices.

(SAED), and elemental chemical analysis by energy dispersive spectroscopy (EDS), supplemented by the measurement and interpretation of micrographs of several SAED patterns. The samples were analyzed at a magnification of 20000X. Particles longer than 5 μm meeting the definition of a fiber length-to-width aspect ratio of greater than 3-to-1 and having substantially parallel sides were classified as chrysotile or amphibole following definitions developed by Yamate[2]. Structures containing such asbestos fibers are classified in conformance with the definitions in the EPA Interim Method.

Based on sampling reports from IHI and analytical data from RJ Lee, ENVIRON Corporation has analyzed the resulting data to assess the mean distribution of asbestos exposure to floor mechanics and observers during resilient sheet vinyl floor removals, pursuant to the Recommended Work Practices. Analysis of the exposure measurements is presented in Chapter VI. An analysis of worker and observer exposure data is presented in Appendix B for both PCM and TEM analysis.

[2] Yamate, G., S.C. Agarwal, and R.D. Gibbons. Methodology for the Measurement of Airborne Asbestos Fibers by Electron Microscopy. EPA Contract No. 68-02-3266.

III. REGULATORY FRAMEWORK

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In 1972, OSHA promulgated a standard dealing with occupational exposures to asbestos for all industries covered by the Act (Occupational Safety and Health Act of 1970). On June 20, 1986 and September 14, 1988, OSHA issued revised standards relating to occupational exposures to asbestos for both general industry (29 CFR 1910.1001) and for the construction industry (29 CFR 1926.58). The 1972 standard established a permissible exposure limit (PEL) of 2 fibers/cc (f/cc) as an 8-hour time-weighted average (TWA). The present standards, among other things, reduced the PEL to 0.2 f/cc as an 8-hour TWA and set an excursion limit of 1.0 f/cc average over a 30-minute sampling period. OSHA has also set an action level of 0.1 f/cc calculated as an 8-hour TWA (29 CFR 1926.58(b)). Although the general industry standard is similar, further references will cite the construction standard only, because removal of resilient sheet vinyl flooring is classified as a construction activity according to OSHA.

The standard for the construction industry requires that each employer who has a workplace or work operation covered by the standard must, with certain exceptions described below, perform initial monitoring to determine the airborne concentrations of asbestos to which employees may be exposed (29 CFR 1926.58(f)(2)(i)). When the action level of 0.1 f/cc or the excursion limit of 1.0 f/cc is exceeded, the employer must continue to perform initial monitoring at the initiation of subsequent new asbestos jobs. Employee training, and under certain circumstances, medical surveillance are also required when exposures exceed the action level. When the PEL of 0.2 f/cc is exceeded, the employer must establish a demarcated, regulated area to which access is limited to authorized persons supplied with respirators (29 CFR 1226.58(e)). Certain additional conditions also apply to a regulated area. When the results of continued periodic monitoring reveal that employee exposures, by statistically reliable measurements, are below the action level and the excursion limit, initial monitoring of continued activities may be discontinued (29 CFR 1926.58(f)(4)).

OSHA provided two exceptions to the requirement for initial monitoring:

- where objective data demonstrate that employee exposures are below the action level and excursion limit (29 CFR 1926.58(f)(2)(ii); or

- where the employer has historical monitoring data to rely upon in lieu of initial monitoring (29 CFR 1926.58(f)(2)(iii).

The regulation states, in pertinent part (29 CFR 1926.58(f)(2)):

> (2) Initial Monitoring:
> (i) Each employer who has a workplace or work operation covered by this standard, except as provided for in paragraphs (f)(2)(ii) and (f)(2)(iii) of this section, shall perform initial monitoring at the initiation of each asbestos, tremolite, anthophyllite, or actinolite job to accurately determine the airborne concentrations of asbestos, tremolite, anthophyllite, or actinolite to which employees may be exposed.
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> (ii) The employer may demonstrate that employee exposures are below that action level and/or excursion limit by means of objective data demonstrating that the product or material containing asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals cannot release airborne fibers in concentrations exceeding the action level and/or excursion limit under those work conditions having the greatest potential for releasing asbestos, tremolite, anthophyllite, or actinolite.
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> (iii) Where the employer has monitored each asbestos, tremolite, anthophyllite, or actinolite job for the TWA, and where he has monitored after March 14, 1988, for the excursion limit, and the data were obtained during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraph (f)(2)(i) of this section.

OSHA did not provide a specific definition for such exceptions in its 1986 amendments. However, OSHA has recently determined[3] that a previous ENVIRON study[4] evaluating exposure to airborne fibers during resilient floor tile removal did provide historical data. Data presented in this study of resilient sheet vinyl floor removal clearly match the quality of data previously found suitable as historical data.

As indicated in the following chapters, the data relied upon in this report more than meet the quality and amount OSHA has previously found acceptable as objective

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[3] Letter from Thomas J. Shepich, OSHA, to William B. King, Armstrong, dated October 27, 1989; letter from Thomas J. Shepich, OSHA, to Walter D. Anderson, RFCI, dated February 6, 1990.

[4] ENVIRON Corporation. 1989. Evaluation of Worker Exposure to Airborne Fibers During Removal of Resilient Floor Tiles Using Recommended Work Practices.

data (53 FR 35621-35622, September 14, 1988), such as data dealing with brake and clutch repair, shrouded tools, and glove bags. For example, the brake and clutch repair exemption appears to rely upon only two samples, whereas the analysis performed in this study utilizes 51 air monitoring samples collected from 17 separate resilient sheet vinyl floor removal operations. The glove bag exemption appears to rely solely upon a theoretical argument, whereas the removal data analyzed in this study are quantitative and supported by a variety of auxiliary data demonstrating that the exposures reported are very likely to be higher that actual exposures to asbestos fibers. Finally, like the A/C pipe study described by OSHA which was based on a specific industry-recommended work practice, the study conducted herein is based on a specific work practice recommended by major floor manufacturers for the removal of resilient sheet vinyl flooring.

IV. RECOMMENDED WORK PRACTICES FOR REMOVAL OF RESILIENT SHEET VINYL FLOOR COVERINGS

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RFCI and Armstrong have developed work practices for resilient sheet vinyl floor removal designed to assure compliance with the OSHA standards governing exposure to asbestos. The Recommended Work Practice for removal of resilient sheet vinyl flooring requires two workers using a technique that features scoring the floor in 4- to 8-inch strips, peeling and rolling the wear layer while wetting the felt backing, and wet scraping of residual backing.

The industry-developed Recommended Work Practices, which have evolved from earlier recommendations for resilient sheet vinyl floors, prohibit sanding the vinyl surface or the residual felt backing. Neither dry scraping of any residual backing material, nor dry sweeping of any removal-related material is recommended. Removal of an existing resilient sheet vinyl floor is recommended as an alternative only if new flooring cannot be installed on top of the existing resilient floor covering.

Additional exposure protection is provided through advice on practices to follow before and after removal. For example, the floor should be thoroughly vacuumed before and after removal with a High Efficiency Particulate Air (HEPA) vacuum cleaner or damp swept/mopped. Both the HEPA vacuum bag and any floor sweepings should be disposed of in a labeled, impermeable trash bag. In addition, removed flooring is also to be rolled up, tied securely, and placed in labeled, impermeable trash bags.

Additional details regarding the Recommended Work Practices for both RFCI and Armstrong are provided in Appendix A.

V. MONITORING INFORMATION

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A comprehensive set of measurements of worker and observer exposures to airborne asbestos during resilient sheet vinyl floor removal, pursuant to the Recommended Work Practices, was carried out by ENVIRON with the assistance of IHI and RJ Lee. ENVIRON designed the sampling and analytical protocols, IHI carried out the air surveys, and RJ Lee performed the laboratory analysis. The analysis of the sampling data is presented in this report. Reports of PCM, TEM, and PLM raw data from RJ Lee and sampling reports prepared by IHI appear in a companion report to this document[5].

ENVIRON, from a list prepared by the sponsors of this study, selected 17 sites for the principal study (plus one site for a pilot study), which entailed monitoring removals of resilient sheet vinyl flooring containing asbestos. These sites encompassed a variety of building types (residential, commercial, and institutional), subflooring (wood, concrete, or fiberboard), geographic areas, types of installation (perimeter-bound or fully-adhered), manufacturer, area of floor, and duration of removal. These pre-removal conditions span the most likely cases for resilient sheet vinyl floor removal.

Workers were locally obtained floor covering professionals, who were instructed prior to the commencement of any removal activities as to the nature of the removal study and the Recommended Work Practices to be employed. Monitoring on the two workers, one observer, and all stationary perimeter samplers began immediately before any floor removal activities commenced. All monitors were run continuously, except for personal monitors during lunch breaks at some sites, until the floor covering was completely removed and the area cleaned in preparation for the subsequent installation of new resilient floor covering. Monitoring was not performed for subsequent activities following removal of the resilient sheet vinyl floor covering, such as the use of leveling compounds, installation of a new underlayment, or installation of a new resilient floor covering. In many instances, these post-removal activities will occupy as much as or

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[5] ENVIRON Corporation. 1990. Supporting Data for Evaluation of Worker Exposure to Airborne Fibers During the Removal of Resilient Sheet Vinyl Floor Covering Using Recommended Work Practices.

more of the working day than the resilient sheet vinyl floor removal and will not entail exposures to asbestos fibers.

Personal monitoring of the workers and observer was accomplished in the breathing zone at a nominal pump flow rate of approximately 2.0 liters per minute. For all personal monitors, two companion samples were collected. One sample filter was analyzed by PCM, the other by TEM.

PCM is the required procedure for monitoring employee exposure to airborne asbestos under OSHA regulations. OSHA specifies PCM analysis primarily for practical reasons of cost and reliability, but also because the epidemiologic studies on which its standards are based used PCM or other optical microscopy to describe the exposure levels of the occupational cohorts studied. For any industry in which asbestos fibers are predominant among all particles meeting the counting rules (i.e., greater than 5 μm in length, greater than 0.25 μm in diameter, and having a length-to-width aspect ratio of at least 3-to-1), utilizing PCM is likely to yield appropriate conclusions regarding the level of asbestos exposures. If, on the other hand, the majority of observed particles are non-asbestos, then PCM analysis can exaggerate the potential worker exposure.

TEM was used in this study, in part, to determine the proportion of true asbestos fibers among all fibers meeting the OSHA counting rules. As demonstrated in the following chapter, only a small fraction of the particles observed under TEM analysis that strictly conformed to the PCM counting rules were actually asbestos fibers. Thus, compliance with standards during resilient sheet vinyl floor removal, pursuant to the Recommended Work Practices, is likely to provide a greater margin of protection than a similar level of compliance in an industry where most of the fibers observed can correctly be assumed to be asbestos.

The importance of following the Recommended Work Practices during resilient sheet vinyl floor removal is highlighted by the air quality characteristics typical of most indoor environments. Most residential, commercial, and institutional buildings can contain significant quantities of non-asbestos fibers that could be counted as asbestos under OSHA-required procedures. Fibers from textiles, mineral wool, fiberglass, and paper, in addition to asbestos, may be present in the floor removal environment, even after vacuuming. Many of these fibers could be falsely identified as asbestos fibers

under the requirements to count all geometrically qualifying structures during PCM analysis, independent of their chemical or mineralogical classifications, thereby yielding potentially inaccurate or misleading results.

VI. ANALYSIS OF EXPOSURE MEASUREMENTS

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A. Presentation of Monitoring Data

Fibers of asbestos and many other natural and man-made materials are found in virtually every type of environment, including structures where resilient sheet vinyl floors might be removed. Many of these fibers would qualify for inclusion under the geometric counting rules of the OSHA standard, independent of their composition or origin. These fibers are not attributable to floor removal activities and should not be counted against compliance with the action level. Therefore, acquisition of background concentration data on qualifying fibers is necessary in interpreting the exposure results in floor removal operations.

In this study, the background concentration was obtained from the outdoor sample, taken during the floor removal operation, analyzed via PCM. In general, the outdoor concentration, in contrast to the overnight baseline measurements, rarely exceeded the PCM analytical sensitivity (limit of detection). Since the overnight baseline, with one exception, was always higher than the outdoor sample, employing the outdoor sample as the background concentration allows for a more conservative calculation of net concentration in exposure samples. For those sites where the outdoor concentration was reported to be less than the analytical sensitivity for PCM (see RJ Lee data in the companion report), the concentration for data analysis was chosen to be 0.0 f/cc, rather than the value below the analytical sensitivity reported by RJ Lee. This ensures that the calculated net concentration will be a maximum value.

Some of the filters used in the personal monitors are made of materials that can be contaminated with asbestos fibers as well as other fibrous material. Such contamination should also not be attributable to floor removal activities and should not be counted against the action level. Therefore, blank filters, which were not exposed to the work environment, were analyzed for fiber counts. In all cases, no contamination of the filters was observed.

RJ Lee provided both ENVIRON and IHI with PCM and TEM fiber counting results. In addition, RJ Lee performed Polarized Light Microscopy (PLM) analysis on bulk samples of resilient sheet vinyl floor backing to determine the amount of asbestos material present. For PCM analysis, concentrations reported in fibers per square

millimeter (f/mm^2) detected on the sample filters were converted to airborne fibers per cubic centimeter (f/cc) using the following relationship:

$$C_{air}\ (f/cc) = C_{fltr}\ (f/mm^2) \cdot \text{Filter Area}\ (mm^2) \,/\, \text{Air Volume Sampled}\ (cc) \qquad (1)$$

C_{air} is the concentration of airborne fibers and C_{fltr} is the concentration of fibers analyzed on the sample filter. The total surface area of the sample filters is 491 mm^2; however, 106 mm^2 of this area is shielded by the sampling cassette and cowling. Thus, 385 mm^2 of surface area was available for analysis. Sample volumes were reported by IHI in liters and were converted to cubic centimeters. The net PCM concentration is then obtained by subtracting the background (outdoor) concentration. Similarly for TEM, concentrations reported in structures per square millimeter (s/mm^2) detected on the sample filters were converted to airborne structures per cubic centimeter (s/cc) using Equation (1). All asbestos fibers longer than 5 μm meeting the definition of a fiber length-to-width ratio greater than 3-to-1 and having substantially parallel sides were classified by RJ Lee as either chrysotile or amphibole following definitions developed by Yamate[6]. Structures containing such asbestos fibers are classified in conformance with the definitions in the EPA Interim Method. Filter area and sample volumes for TEM were equivalent to the PCM analysis. For PLM analysis, results were reported as the percentage of asbestos and nonasbestos fibers (RJ Lee data in the companion report).

Following the completion of a floor removal activity, floor mechanics typically proceed to install new flooring or return to their home shop. Therefore, a final time-weighted averaging adjustment is necessary to account for the fact that the floor removal activities and the corresponding monitoring did not always extend over a full 8-hour workday. The TWA was calculated by assuming that all unsampled time, including lunch breaks away from the work area, transit time from the site, and installation of new flooring, would involve no exposure to asbestos. Consequently, the TWA concentrations

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[6] Yamate, G., S.C. Agarwal, and R.D. Gibbons. Methodology for the Measurement of Airborne Asbestos Fibers by Electron Microscopy. EPA Contract No. 68-02-3266.

are lower than the net concentrations by a factor of T/480, where T is the actual sampling time in minutes and 480 is the number of minutes in an 8-hour workday.

A summary of the net concentration data for PCM analysis, TEM analysis, and final adjusted TWA concentrations for floor mechanics and an observer is presented in Table 1. A compilation of worker and observer exposure data is presented in Appendix B. Detailed background, baseline, and perimeter sampling data from IHI and RJ Lee are presented in the companion report to this document. In addition, a summary of the average percentage of asbestos material (based on three separate bulk samples) in the backing of the resilient sheet vinyl floor at each site is shown in Table 2.

It is inherently difficult to compare PCM analytical results with TEM analytical results because the counting methods employed are different. PCM analysis counts all fibers observed with no differentiation between asbestos and non-asbestos. Further, only fibers in excess of 5 μm in length and 0.25 μm in width, and with a 3-to-1 aspect ratio are counted in PCM analysis. The TEM count includes only asbestos fibers, but detects and counts all asbestos fibers that are greater than approximately 0.5 μm in length. TEM can also detect fibers less than 0.25 μm in width, which is the approximate limit of visibility for PCM. Because this study was intended to examine exposures in terms of the OSHA standards, all asbestos fibers greater than 5 μm in length and with an aspect ratio of at least 3-to-1, regardless of width, were considered in the analysis of TEM data.

The results in Table 1 show, with few exceptions, that the total number of asbestos fibers observed via TEM analysis, regardless of width, are lower than the number of total fibers observed under the PCM counting guidelines. Thus, it can be reasonably concluded that the PCM results and, therefore, the TWA values overestimate the actual number of asbestos fibers to which workers were exposed.

B. Statistical Analysis

Without exception, all of the TWA concentrations presented in Table 1 are below the action level of 0.1 f/cc. For the 17 floor removal locations (the exposure results determined for pilot study conducted in Lancaster, PA in December 1988 were not considered in this analysis) in this study, a total of 51 exposure samples of floor mechanics and observers were taken and analyzed by PCM. The average TWA for these samples is approximately 0.027 f/cc, which is less than 30% of the action level.

The sample standard deviation for these samples is approximately 0.021 f/cc. If it is assumed that the exposure samples follow a normal distribution pattern, then confidence intervals on the range of exposure concentrations can be calculated. The 95% upper confidence limit for all resilient sheet vinyl floor removal operations is approximately 0.067 f/cc, which is still less than 70% of the action level (Figure 1).

In order to determine whether the inclusion of observer data influenced the results, the TWA exposure data was reanalyzed for floor mechanics only. The average TWA for worker samples is approximately 0.028 f/cc, which is less than 30% of the action level and roughly 4% higher than the average for both workers and observers. The standard deviation for these samples is approximately 0.020 f/cc. The 95% upper confidence limit is approximately 0.068 f/cc (Figure 2). These differences are inconsequential.

The average TWA values, as described earlier, were calculated from the net concentration by assuming that a floor mechanic would not conduct floor removal activities over a full 8-hour workday, every day. Even if it is conservatively assumed that a floor mechanic does perform floor removal activities for 8-hours every day, then the exposure level would be based upon the net concentration (Appendix B), rather than the TWA. Under this assumption, the average exposure for these samples is approximately 0.048 f/cc, which is still less than 50% of the action level. The sample standard deviation is approximately 0.043 f/cc. It should be reiterated that these reported concentrations do not differentiate between asbestos and non-asbestos fibers. TEM analysis clearly indicates that the number of asbestos fibers is a fraction of the total fibers observed and possibly observed under the OSHA reference standard, such that the actual mean value may be significantly lower than 0.048 f/cc.

Although no samples were taken specifically to examine short-term exposures, the data can be analyzed to provide an extremely conservative excursion concentration by using the following equation:

$$\text{excursion concentration} \leq [\text{net concentration} \cdot \text{sampling time}]/30 \text{ minutes} \qquad (2)$$

Equation (2) assumes that the entire daily exposure received by a worker or observer occurs during a 30-minute period, which greatly overestimates the true excursion concentration. Given that the estimated 30-minute concentrations are maximum values, no elaborate statistical analysis is warranted. The average of the excursion concentrations calculated by Equation (2) for workers and observers is approximately 0.426 f/cc, which is less than 50% of the excursion limit of 1.0 f/cc averaged over a 30-minute period. If only worker samples are considered, the average excursion concentration is 0.454 f/cc. For one set of samples (Kearney, MO), the excursion concentrations calculated using Equation (2) exceeded 1.0 f/cc by a small margin (Appendix B). As these samples were collected over a 6.5 hour monitoring period, it is extremely unlikely that the excursion limit was exceeded during any 30-minute period. Nevertheless, 95% of the values are below the 1.0 f/cc excursion limit. Since it is highly unlikely that the entire daily exposures observed in these studies occurred within any 30 minute period, as Equation (2) assumes, the true excursion concentrations should be well below the values calculated. The range of excursion limit concentrations calculated from Equation (2) for floor mechanics and an observer are presented in Table 1.

The pilot resilient sheet vinyl floor removal study conducted on December 16, 1988 in Lancaster, PA was intended to refine the sampling and analysis protocol for future floor removal tests and to develop initial monitoring data, for purposes of the study itself. This study showed that worker adherence to the Recommended Work Practices maintained airborne fiber concentrations for workers in the study well below OSHA's action level and excursion limit. In this study, however, TEM analysis was not a part of the study protocol. Although the analytical results of the airborne monitoring were not incorporated in the statistical analysis presented, the procedures used and the results obtained in the pilot study were consistent with the procedures and results for the subsequent resilient sheet vinyl floor removal study.

At the onset of the resilient sheet vinyl floor removal study, the Recommended Work Practices called for the complete removal of an existing resilient sheet vinyl floor covering. It should be noted that the removals conducted at 16 of the floor removal sites closely followed these Recommended Work Practices. During the course of the study, an alternative Recommended Work Practice was established to allow the

simultaneous removal of both the resilient sheet vinyl floor and its wood underlayment. According to this Recommended Work Practice, floor mechanics would follow the resilient sheet vinyl floor removal guidelines only to expose the joints in the suspended wood underlayment beneath the resilient sheet vinyl floor. After the removal of strips on either side of each joint, the underlayment is removed with the majority of the resilient sheet vinyl floor still attached. One floor removal, conducted in Lancaster, PA on November 14, 1989, followed this alternative Recommended Work Practice. The exposure results for this underlayment removal site were included in the overall statistical analysis. As can be seen in the data presented in Table 1, the PCM, TEM, and TWA concentrations for this study are consistent with the exposure measurements at the other 16 sites. A close inspection of the TEM data results from RJ Lee for this site (see companion report), however, shows that, in actuality, the only fibers that met the PCM length and aspect ratio requirements were nonasbestos. Incorporation of the data from this site does not alter the results of the statistical analysis presented.

The initial study plan called for TEM analysis of all observer and perimeter samples, however, after an interim review of collected data, which demonstrated that observer and perimeter exposures were unlikely to exceed floor mechanic exposures, further TEM analysis on these samples was suspended. Nevertheless, the number of samples evaluated in this study is sufficient to give adequate statistical precision. In addition, the experimental design is consistent with OSHA-recommended monitoring requirements and is consistent with floor industry Recommended Work Practices for resilient sheet vinyl floor removal.

These results demonstrate that initial monitoring of asbestos concentrations for resilient sheet vinyl floor removal jobs, pursuant to the Recommended Work Practices, is unlikely to show fiber counts in excess of the action level of 0.1 f/cc or the excursion limit of 1.0 f/cc. There is no indication whatsoever that the PEL of 0.2 f/cc would ever be reached when the industry's Recommended Work Practices are followed for removal of resilient sheet vinyl flooring.

C. Reliability of Conclusions

The sampling program and filter analyses were specifically designed to assure that a conservative approach has been evaluated while following the floor industry Recommended Work Practices. For example, PCM, which cannot discriminate between asbestos fibers and other structures of similar morphology, was employed according to OSHA regulations. In general, in industry studies involving the manufacture or processing of asbestos products or in asbestos abatement activities, it can reasonably be assumed that most qualifying structures counted by PCM are asbestos. In resilient sheet vinyl floor removal, however, an a priori consideration of the nature of the activity and materials and a comparison of side-by-side PCM and TEM samples, although they are not directly comparable, confirm that asbestos fibers constitute only a fraction of the fibers counted by PCM in most samples collected during resilient sheet vinyl floor removal operations. If the TEM results in this analysis were adjusted to exclude those asbestos fibers not consistent with PCM counting guidelines, the difference between the number of asbestos fibers counted by TEM and the number of fibers counted by PCM would be significantly greater.

The conclusions are also supported by previous, less comprehensive studies and by the findings of OSHA in its promulgation of the asbestos standards. For example, Walcott and Warrick (1979) conducted monitoring of worker exposures during removal of resilient sheet vinyl flooring by wet scraping following an earlier version of the Recommended Work Practices. Walcott and Warrick estimated that exposure to asbestos fibers was in the range of 0.037 to 0.040 f/cc as a time-weighted average. In its promulgation of the PEL and action level regulations, OSHA (51 FR 22663, 1986) "determined that it is feasible to comply with the 0.2 f/cc PEL during the removal and installation of vinyl/asbestos flooring." In the later establishment of an excursion limit, OSHA (53 FR 35614, 1988) stated that "(a)lthough certain activities involved in removing old flooring may produce exposures which would exceed the TWA and excursion limits, there appears to be no possibility that the excursion limit would be exceeded if the recommendations of the Resilient Floor Covering Institute were followed."

TABLE 1

Adjusted Personal Monitoring Results for Worker and Observer Exposure During Removal of Resilient Sheet Vinyl Flooring Pursuant to Industry Recommended Work Practices

Date	Location	PCM (f/cc)	TEM (s/cc)	TWA (f/cc)	Excursion Limit (f/cc)[a]
12/16/88	Lancaster[b]	0.014-0.053		0.013-0.028	
08/01/89	Lancaster	0.002-0.009	0.000-0.033	0.001-0.007	0.081-0.113
08/02/89	Lancaster	0.010-0.014	0.008-0.053	0.003-0.007	0.056-0.107
09/12/89	Lancaster	0.010-0.029	0.000-0.008	0.007-0.021	0.118-0.330
09/13/89	Lancaster	0.007-0.011	0.000-0.014	0.005-0.010	0.090-0.151
09/27/89	Nashville	0.018-0.029	0.008-0.052	0.015-0.024	0.236-0.380
10/10/89	Plainfield	0.110-0.145	0.037-0.056	0.036-0.047	0.573-0.756
10/11/89	Warrenville	0.030-0.033	0.000-0.011	0.017-0.018	0.268-0.283
10/17/89	Yardley	0.022-0.033	0.038-0.052	0.017-0.026	0.284-0.411
10/19/89	Morrisville	0.055-0.080	0.012-0.070	0.028-0.038	0.449-0.612
10/24/89	Fairless Hills[d]	0.028-0.050	0.053-0.118	0.018-0.033	0.296-0.534
10/26/89	Yardley[d]	0.053-0.073	0.000-0.000	0.041-0.056	0.648-0.894
10/31/89	Kearney[d,e]	0.095-0.111	0.036-0.072	0.076-0.091	1.240-1.448
11/02/89	North Kansas City[d]	0.037-0.059	0.007-0.035	0.031-0.050	0.497-0.803
11/14/89	Lancaster[c]	0.036-0.045	0.000-0.000	0.011-0.014	0.176-0.229
11/15/89	Lancaster[d]	0.005-0.015	0.000-0.016	0.003-0.011	0.056-0.175
11/28/89	Roanoke[d]	0.040-0.044	0.007-0.015	0.031-0.035	0.500-0.558
11/29/89	Salem[d]	0.086-0.222	0.000-0.000	0.020-0.052	0.323-0.836

Notes: Bulk samples taken of sheet vinyl felt backing were assayed at 20-73% chrysotile asbestos (Table 2). PCM, adjusted for background, measures both asbestos and nonasbestos fibers greater than 5 μm in length, 0.25 μm in width, and with a 3-to-1 aspect ratio. TEM results are based on all asbestos fibers greater than 5 μm in length with a 3-to-1 aspect ratio, regardless of width. TWA and excursion limit results, based on PCM analysis, are adjusted for background concentration. Range of results at each site are for exposure to two workers and one observer only, except where noted.

[a] Excursion limit is determined for a 30-minute exposure period. Analysis is based on unlikely assumption that total daily exposure occurred within a 30-minute period.

[b] This pilot study was intended to refine the sampling protocol and provide initial monitoring data. This study showed that worker adherence to the Recommended Work Practices resulted in exposure levels below the action level. Results from this job were not included in calculations shown in Chapter VI.

[c] This job involved resilient sheet vinyl floor removal only to expose joints in fiberboard underlayment. Underlayment was then removed with bulk of the resilient sheet vinyl floor attached.

[d] Interim review of initial data indicated observer exposure levels should not exceed worker exposure; thus, observer TEM sample was not analyzed for this site.

[e] Sampling time of 6.5 hours. Excursion limit unlikely to be exceeded in any 30-minute period.

TABLE 2

Summary of Reported Chrysotile Asbestos Content in Resilient Sheet Vinyl Floor Backing Bulk Samples Analyzed by PLM

Date	Location	Chrysotile Asbestos (% by Weight by PLM)[a]
08/02/89	Lancaster	73
08/02/89	Lancaster	73
09/12/89	Lancaster[b]	70
09/13/89	Lancaster	20
09/27/89	Nashville	62
10/10/89	Plainfield	47
10/11/89	Warrenville	40
10/17/89	Yardley	55
10/19/89	Morrisville	55
10/24/89	Fairless Hills	50
10/26/89	Yardley	53
10/31/89	Kearney	42
11/02/89	North Kansas City	38
11/14/89	Lancaster	40
11/15/89	Lancaster	60
11/28/89	Roanoke[c]	73
11/29/89	Salem	28

[a] Percentage of chrysotile asbestos in the felt backing represents the average of three separate bulk samples analyzed by PLM.

[b] This represents the average of only two samples; no asbestos was detected in the third sample.

[c] Two of the three samples were assayed to have 95% chrysotile, while the third sample was assayed at only 30%.

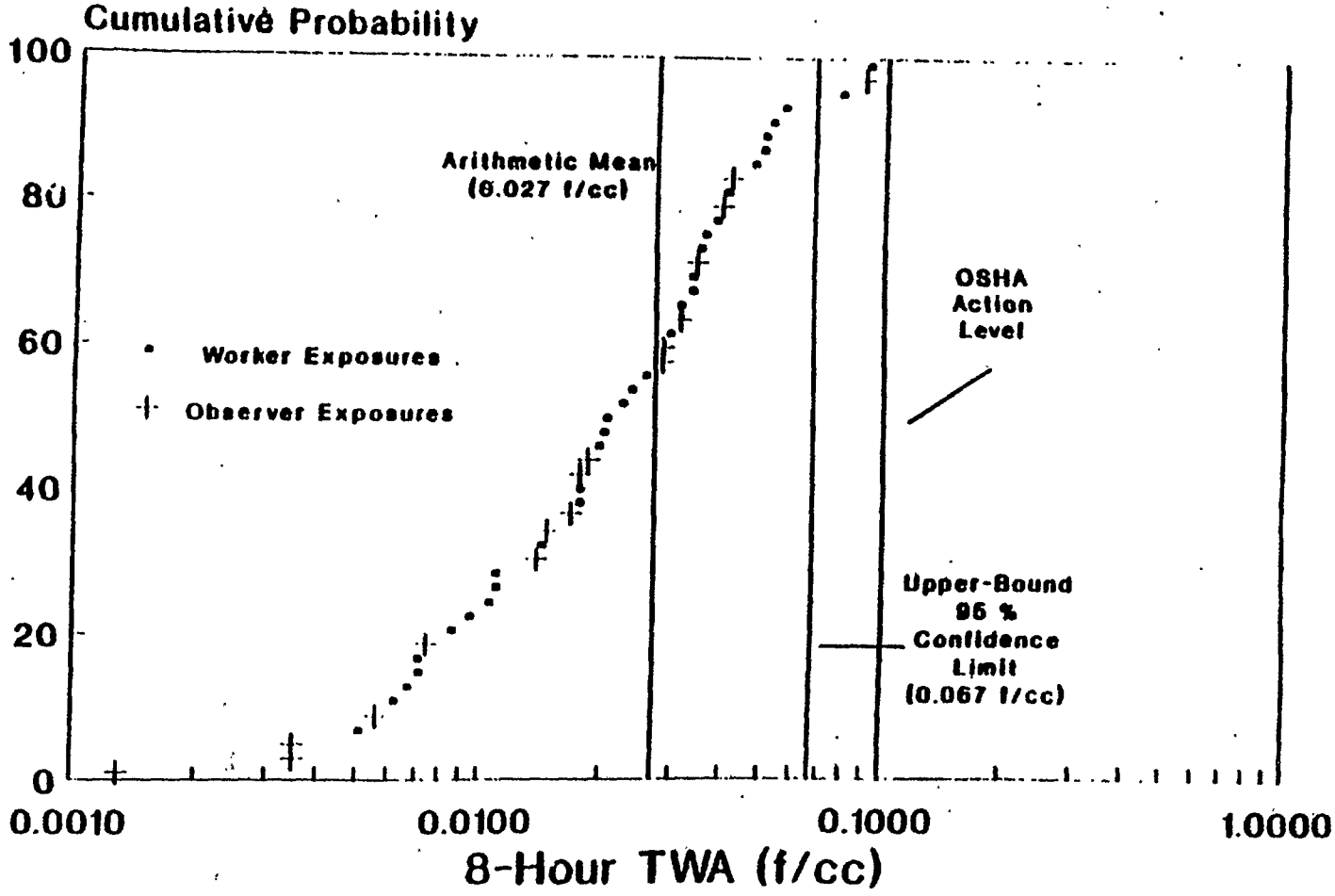

FIGURE 1. Distribution of Floor Mechanic and Observer Exposures to Fibers as Measured by PCM Analysis.

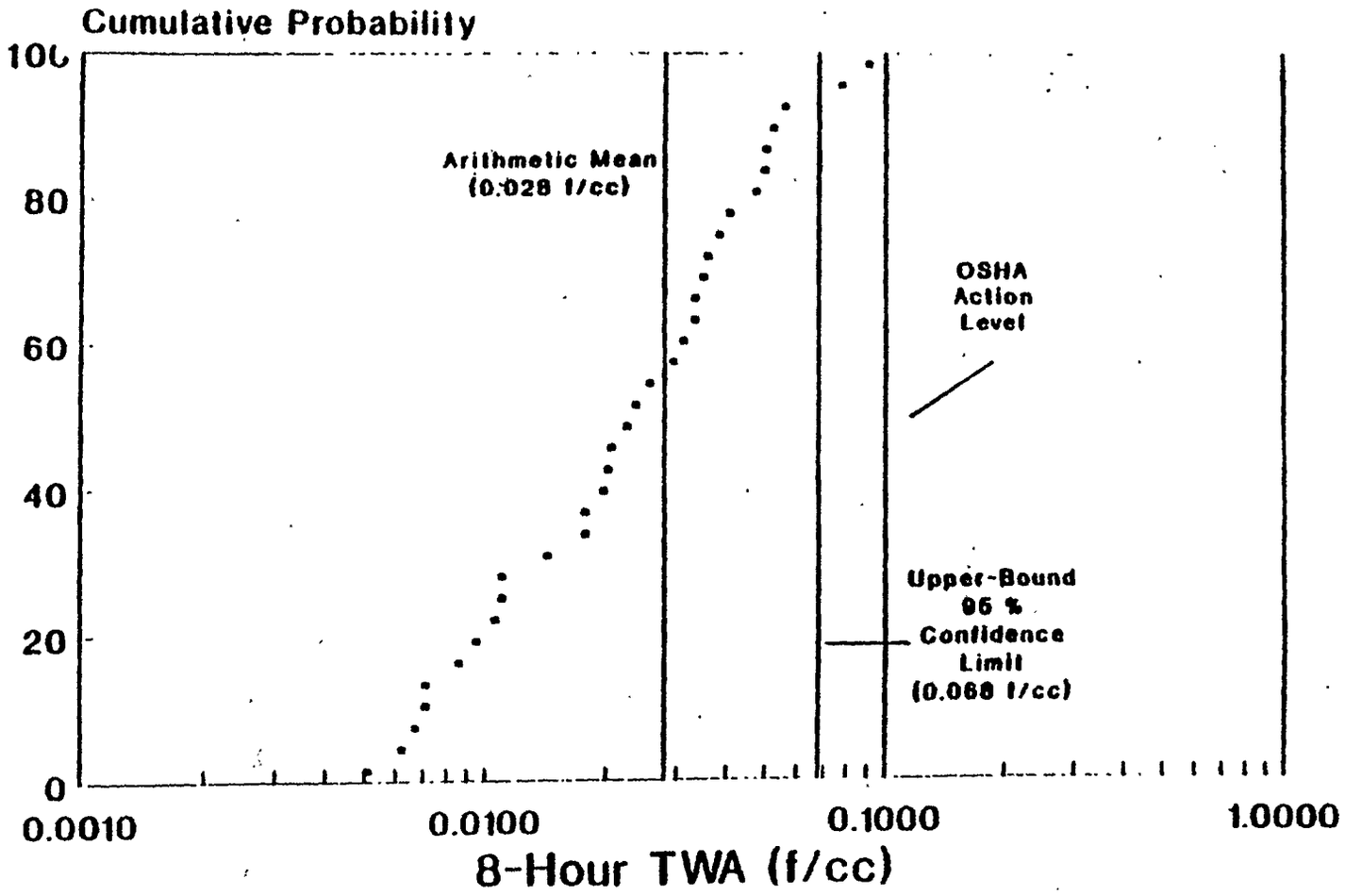

FIGURE 2. Distribution of Floor Mechanic Exposures to Fibers as Measured by PCM Analysis.

VII. CONCLUSIONS

VII. CONCLUSIONS

As demonstrated in this study, the removal of resilient sheet vinyl floors, when carried out in accordance with the floor industry's Recommended Work Practices, results in airborne fiber levels considerably below the OSHA action level of 0.1 f/cc for asbestos fibers based on an 8-hour TWA and the excursion limit of 1.0 f/cc. According to the OSHA asbestos standard for the construction industry, initial monitoring would not be required for resilient sheet vinyl floor removal jobs, pursuant to the Recommended Work Practices, if historical data are available that establish that neither the action level of 0.1 f/cc (8-hour TWA) nor the excursion limit of 1.0 f/cc for a 30-minute average is expected to be exceeded.

Analysis of the airborne fiber concentration monitoring data collected for this study (Chapter VI) clearly meets the OSHA requirements for historical data. The upper bound 95% confidence limit on the individual measurements of exposure to floor mechanics and observers conducted on 17 separate occasions is approximately 0.067 f/cc, which is less than 70% of the action level. In addition, it is highly unlikely that any floor mechanic would be exposed near the calculated upper bound 95% confidence limit every working day; therefore, the mean exposure level of approximately 0.027 f/cc is a better representation of the worker exposure. These results are not significantly affected if only floor mechanic exposure is considered. For 34 worker samples only, the average TWA is approximately 0.028 f/cc with a 95% upper confidence limit of 0.068 f/cc. Even when conservatively assuming an 8-hour daily exposure period for floor mechanics involved in floor removal activities, pursuant to the Recommended Work Practices, the mean exposure level of approximately 0.048 f/cc is still less than 50% of the action level.

Although no samples were taken specifically to examine short-term exposures, the sampling data indicates that the average excursion concentration would be 0.426 f/cc if the entire exposure is conservatively assumed to have occurred within a 30 minute portion of each sampling period. However, it is highly unlikely that any exposures observed occurred totally within a 30-minute period, and the true excursion concentrations should be well below the values calculated. This results from this study demonstrated, with 95% confidence, that the excursion limit would not be exceeded.

Although not directly comparable, side-by-side comparison of PCM and TEM results suggest that only a fraction of the fibers observed via PCM analysis were asbestos. Utilizing a TEM analysis approach that considered all asbestos structures longer than 5 μm with a minimum 3-to-1 aspect ratio, regardless of width, overestimated, in many cases, the number of asbestos fibers that would qualify if PCM counting guidelines were employed. Despite this TEM approach, the exposure concentrations observed in PCM analysis still fell well below the action level, and the true mean exposure level for asbestos fibers only would be expected to be lower than the 0.027 f/cc concentration calculated.

According to the direction provided by RFCI and Armstrong in their Recommended Work Practices, the removal of existing resilient sheet vinyl floor should only be performed when a new floor cannot be installed over the existing floor. Therefore, the results presented represent conservative estimates of exposure to asbestos fibers for a floor mechanic or observer. Nevertheless, exposures associated with resilient sheet vinyl floor removal still were considerably below both the OSHA action level and excursion limit.

The analysis of the results for this study provides historical data to support a determination that floor mechanic and observer exposure to airborne asbestos during removal of resilient sheet vinyl flooring will not exceed the action level or excursion limit if the Recommended Work Practices are followed. Therefore, an employer should be able to rely upon this study in lieu of conducting initial monitoring to comply with the requirements of the OSHA standard when removing resilient sheet vinyl flooring in accordance with the Recommended Work Practices.

VIII. APPENDICES

APPENDIX A

Recommended Work Practices for Resilient Floor Coverings

APPENDIX A.1

Recommended Work Practices for Resilient Floor Coverings
Resilient Floor Covering Institute (February 1990)

(FRONT COVER)

RECOMMENDED WORK PRACTICES FOR THE REMOVAL OF RESILIENT FLOOR COVERINGS

WARNING

Do Not Sand, Dry Scrape, Sandblast or Mechanically Pulverize Existing Resilient Flooring, Backing, Or Lining Felt. These Products May Contain Asbestos Fibers That Are Not Readily Identifiable. Using The Above Non-recommended Procedures On Asbestos-Containing Material Can Create Asbestos Dust. The Inhalation Of Asbestos Dust May Cause Asbestosis Or Other Serious Bodily Harm. Smoking Greatly Increases The Risk Of Serious Bodily Harm.

NOTICE

Various federal, state and local government agencies have regulations covering the removal of asbestos-containing material. If you are considering the removal of resilient floor covering that contains, or is assumed to contain, asbestos, you should determine if these regulations apply. The RFCI recommended work practices are designed to comply with the federal occupational asbestos permissible exposure limits.

This publication replaces prior editions of these work practices. Future editions of these work practices may be issued to replace this publication.

Issued by
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RECOMMENDED WORK PRACTICES FOR RESILIENT FLOOR COVERINGS

CONTENTS

IMPORTANT INFORMATION FOR INSTALLERS OF RESILIENT FLOOR COVERINGS

Introduction

The member companies of the Resilient Floor Covering Institute are manufacturers of the following forms of Resilient Floor Coverings:

1. Sheet Vinyl
2. Vinyl Floor Tile

While today these products do not contain asbestos, it is possible that in the past some of these products including asphalt tile, may have contained firmly-encapsulated asbestos fibers. In the past decade much attention has been focused on the relationship between exposure to asbestos fibers and respiratory ailments. It has been determined that inhalation of free airborne asbestos fibers may be injurious to health However, the asbestos fibers contained in the above types of resilient floor coverings are not free but firmly encapsulated or locked in the product during the manufacturing process Asbestos contained therein will not become airborne during the lifetime of the product when these products are used and maintained as recommended by the manufacturer.

The Resilient Floor Covering Institute is providing this booklet of recommended work practices for installing or removing resilient floors so that you may proceed with this work in a prudent and protected manner.

There are several general rules to follow:

1. Unless absolutely positive beyond any doubt that the floor is a non-asbestos product, assume it contains asbestos and treat it in the manner prescribed in this pamphlet for a floor containing asbestos.
2. It is preferred to install a new floor over a floor which contains asbestos rather than to remove that floor. This can be done by several methods—directly over the existing floor; installing new underlayment; or use of leveling compounds following installation procedures recommended by the floor covering manufacturer.
3. Removal should be considered the last alternative.
4. Never sand any resilient floor or its backing to remove them from the floor (See Warning).
5. Use a vacuum equipped with a HEPA filter, disposable dust bag, and metal floor tool (no brush).
6. All sheet removal must be done using detergent solution.
7. All felt scraping must be done wet.
8. Do not dry sweep.
9. Material removed must be placed in heavy-duty polyethylene bags at least 6 mils thick, properly labeled and disposed of in an authorized landfill.

RECOMMENDED WORK PRACTICES PREPARATION OF FLOORS WITH EXISTING RESILIENT FLOOR COVERINGS TO RECEIVE NEW RESILIENT FLOOR COVERINGS

Follow the installation instructions published by the manufacturer of the new floor covering when a new resilient sheet or tile floor covering is to be installed on a surface presently covered with a resilient floor covering. These instructions will tell you what must be done to the existing surface before the new resilient floor covering can be installed.

Of the four general procedures listed below, Items 1a, b, and c are covered by manufacturers' instructions. Item 2 is covered specifically in this Work Practices Manual.*

1. **Resilient Floor Covering Installed Over . . .**
   (a) **The Existing Surface.** Follow the manufacturer's instructions for removing wax, filling in low spots, etc. **Use wet scrubbing. Never sand an existing resilient floor covering.**
   (b) **New Underlayment.** Install panels on top of the existing surface (wood subfloors only) and apply new floor covering directly over this. Follow the manufacturer's instructions.
   (c) **Leveling Compounds.** Follow the manufacturer's instructions.

* In case of minor variations, the manufacturer's instructions should be followed.

2. **Completely Removed Existing Resilient Floor Covering**
   (a) **Sheet Vinyl**--See instructions below:

   (1) "Complete Removal of Peripherally Adhered Sheet Vinyl Floor Coverings," page 6.
   (2) "Complete Removal of Fully Adhered Sheet Vinyl Floor Covering," page 11.

   (b) **Tile**--See instructions under heading "Complete Removal of an Existing Resilient Tile Floor Covering," page 20.

SHEET VINYL FLOOR COVERING

Preparation of Floors With Existing Sheet Vinyl Floor Covering to Receive a New Resilient Floor Covering

Sheet vinyl floor covering can be installed over existing resilient sheet vinyl floor covering under certain conditions. Be sure to follow the floor covering manufacturer's instructions regarding the conditions and floor preparation required.

If complete removal of the existing sheet vinyl floor covering is required, the following instructions are to be followed:

Supplies and Tools
(refer Sketch 1.)

1. Broad stiff-bladed wall scraper or floor scraper.

2. Utility or hook knife.
3. Tank type wet/dry HEPA (High Efficiency Particulate Air) filter vacuum cleaner with disposable dust bag and metal floor tool (no brush).
4. Large size heavy-duty impermeable trash bags (at least 6 mils thick) or closed impermeable containers, with ties, tapes, or string to tie shut and tags for labeling.
5. Garden sprayer.
6. A liquid dishwashing detergent which is stated to contain anionic, nonionic, and amphoteric surfactants. The detergent should be mixed with water to make a dilute solution (16 oz. of detergent in one gallon of warm water).*
7. Pressure sensitive labels.
8. Ground fault circuit interrupter for connection of HEPA vacuum and any other electrical equipment.

WARNING

Sketch 1. Tools and supplies for sheet removal

*PRECAUTION: Resilient flooring become slippery when wet with a detergent solution. Use caution to contain the solution in the immediate work area. Standing on a new sheet of plywood non-slip surface while working recommended.

WARNING
Sketch 2. Never dry scrape adhered areas of floor covering

WARNING
Sketch 3. Never sand an existing floor covering and never sand or dry scrape residual felt

WARNING
Sketch 4. Wash hands before eating and at the end of the work day

COMPLETE REMOVAL OF PERIPHERALLY ADHERED SHEET VINYL FLOOR COVERING

A. Preparation
   1. Move all appliances and furniture from the work area.
   2. Remove all binding strips or other restrictive molding from doorways, walls, etc.
   3. Mix a detergent solution (16 ounces of the specified liquid detergent [See page 5, #6] to 1 gallon of warm water) and pour into a garden sprayer.
   4. Clean the entire floor using a wet/dry vacuum cleaner equipped with a HEPA Filtration System and metal floor attachment (no brush). Do Not Sweep.

WARNING
ELECTRICAL SHOCK HAZARD EXISTS. USE A GROUND FAULT CIRCUIT INTERRUPTER FOR ANY ELECTRICAL CONNECTIONS IN A WET ENVIRONMENT.

B. Make a cut in the adhered floor covering 4 to 8 inches wide, parallel with the walls, around the perimeter of the room.

C. Starting on either side of the entrance door, pry up the corner of the first strip, separating the backing layer. As the strip is being removed, a constant mist of the detergent solution must be sprayed into the delamination nip point to minimize any airborne dust particles.* When done properly, any felt remaining on the floor and on the back of the strip will be thoroughly wet. The strip is peeled by pulling upward at an angle that permits the best separation or by rolling around a core.

D. Roll the strip tightly as it is removed. Tie or tape securely and place in a heavy-duty impermeable trash bag or closed impermeable container for disposal.

E. It may be necessary to remove a second strip following steps (B, C & D) if the unadhered subfloor area has not been exposed.

***PRECAUTION:** Resilient flooring becomes slippery when wet with a detergent solution. Use caution to contain the solution in the immediate work area. Standing on a new sheet of plywood or non-slip surface while working is recommended.

F. Remove all of the exposed residual felt by wet scraping before proceeding.

RESIDUAL FELT MUST BE REMOVED BY WET SCRAPING; DO NOT SAND OR DRY SCRAPE IN ANY WAY; DO NOT DRY SWEEP; AVOID CREATING DUST. SEE WARNING STATEMENT.

Wet Scraping Residual Felt

1. Thoroughly wet the residual felt with the detergent solution and allow a few minutes to soak.

2. Stand on the remaining floor covering (not the felt) and use the stiff-bladed scraper or a floor scraper with a replaceable blade to remove the wet felt.

WARNING

Never sand or dry scrape residual felt. See Warning Statement.

3. Re-wet the felt if the solution has not completely penetrated, if drying occurs or if dry felt is exposed during scraping. Scrape all felt from this floor area before proceeding further. Pick up the scrapings as they are removed from the floor and place in a heavy-duty impermeable trash bag or closed impermeable container.

PRECAUTION: Wet residual felt as above but do not excessively soak or flood wood floors with detergent solution. Excessive water can damage wood floors to the extent that new underlayment could be required. A floor that has been wet scraped must be allowed to dry thoroughly before new resilient flooring is installed.

G. Continue around the room completely removing the adhered flooring along the perimeter, one strip at a time following steps B through F. Do not remove the flooring in the entrance doorway until all other flooring has been completely removed.

H. Place all flooring strips and felt scrapings immediately while wet in the recommended trash bags. Close full bags tightly and seal securely for disposal. Identify with a label stating, "Caution--Contains Asbestos. Avoid opening or breaking bag or container. Breathing asbestos may cause serious bodily harm. Dispose of in an approved landfill only."*

I. Vacuum up any residue of wet felt scrapings immediately with a wet/dry vacuum equipped with a HEPA filter

*NOTICE

Various federal, state, or local governmental agencies have regulations covering the disposal of asbestos containing material. If you are considering the removal and disposal of resilient floor covering that contains or is assumed to contain asbestos, you should determine if these regulations apply. The RFCI recommended work practices are designed to comply with the federal occupational asbestos permissible exposure limits.

and metal floor attachment (no brush).

J. Remove the unadhered flooring as detailed in the following steps.

COMPLETE REMOVAL OF SHEET VINYL FLOORING IN UNADHERED AREAS AND FLOORING INSTALLED LOOSE LAID (WITHOUT ADHESIVE)

A. Preparation
- o Move all appliances and furniture from the work area.
- o Remove all binding strips or other restrictive molding from doorways, walls, etc.
- o Prepare a detergent solution (16 ounces of the specified liquid detergent [See page 5] to 1 gallon of warm water) and pour into a garden sprayer.
- o Clean the entire floor with a wet/dry vacuum equipped with a HEPA Filtration System and metal floor attachment (no brush). Do Not Sweep.

B. Start at the end of the room farthest from the entrance doorway and cut a strip 4 to 5 inches wide in the unadhered flooring.

C. Remove the cut strips while spraying the detergent solution directly into the separation nip point.* Do not

*PRECAUTION: Resilient flooring becomes slippery when wet with a detergent solution. Use caution to contain the solution in the immediate work area. Standing on a new sheet of plywood or non-slip surface while working is recommended.

stand or kneel on the exposed subfloor during the removal process

D. Roll the wet strip tightly and tie or tape to secure. Continue working toward the doorway, cutting each strip and removing it while spraying the separation nip point with detergent solution. Place cut strips immediately into a heavy-duty impermeable trash bag or closed impermeable container. Close full bags tightly and seal securely for disposal. Identify with a label stating, "Caution--Contains Asbestos. Avoid opening or breaking bag or container. Breathing asbestos may cause serious bodily harm. Dispose of in approved landfill only. (See NOTICE page 9.)

E. After removing three strips of flooring, vacuum the exposed floor using a wet/dry vacuum equipped with a HEPA filter and metal floor attachment (no brush).

F. Seams and other adhered areas should be removed as they are encountered by stripping the wear surface while spraying the detergent solution into the delamination nip point and with scraping the residual felt as previously described in complete removal of peripherally adhered flooring.

G. Continue removing flooring doing only one three-strip area at a time until the entire floor has been completely removed.

H. When the whole floor has been completely removed, let it dry and

vacuum up any dust using a vacuum with a HEPA Filtration System and a metal floor tool (no brush). Stand only in vacuumed areas as you proceed across the floor. Position the vacuum cleaner so that discharge air does not blow on the floor being cleaned.

WARNING
Do not dry sweep; avoid creating dust. SEE WARNING STATEMENT.

I. Take the vacuum cleaner outside and carefully remove the dust bag and place it in a heavy-duty impermeable trash bag or closed impermeable container, which is labeled as above, for disposal. (See page 11 paragraph D.)

J. When the floor is dry, install the new resilient floor covering following manufacturers' installation recommendations.

COMPLETE REMOVAL OF AN EXISTING ADHERED SHEET VINYL FLOOR COVERING

If complete removal is required, follow these instructions:

WARNING
Never Sand an Existing Floor Covering

A. Preparation
1. Move all appliances and furniture from the work area.
2. Remove all binding strips or other restrictive molding from doorways, walls, etc.
3. Prepare a detergent solution (16 ounces of the specified detergent

[See page 5] to 1 gallon of warm water) and pour into a garden sprayer.
4. Clean the entire floor with a wet/dry vacuum equipped with a HEPA Filtration System and metal floor attachment (no brush). Do Not Sweep.

B. Make a series of parallel cuts 4 to 8 inches apart, parallel to a wall.

C. Start at the end of the room farthest from the entrance door; pry up the corner of the first strip, separating the backing layer. As the strip is being removed, a constant mist of the detergent solution must be sprayed into the delamination nip point to minimize any airborne dust particles. When done properly, the felt remaining on the floor and on the back of the strip will be thoroughly wet. The strip is peeled by pulling upward at an angle that permits the best separation or by rolling around a core.

WARNING
ELECTRICAL SHOCK HAZARD EXISTS. USE A GROUND FAULT CIRCUIT INTERRUPTER FOR ANY ELECTRICAL CONNECTIONS IN WET ENVIRONMENT.

D. Roll the strip tightly as it is removed. Tie or tape securely and place in a heavy duty impermeable trash bag or closed impermeable container for disposal.

E. Occasionally, parts of the foam inner-layer will remain stuck to the backing. This condition can

sometimes be eliminated by pulling the strips loose from the opposite end. Peel the foam inner-layer from the floor while spraying the detergent solution into the delamination nip point.

Some resilient flooring is not readily strippable by hand. When these conditions are encountered, it may be necessary to employ a sharp, stiff blade scraper to assist cleavage of the wearlayer from felt (distance between cuts in wearlayer should be narrower, 3" to 5" wide).

NOTE: Regardless of which one of the previously mentioned methods is used for stripping the wear surface, the detergent solution must be sprayed into the delamination nip point to minimize any airborne dust particles.

F. Repeat the wetting and removal process on the next two strips, placing them immediately into the recommended trash bags or containers for disposal.

NOTE: During the stripping process, do not stand or walk on the exposed felt.

G. After removing three strips of the wear surface, the remaining residual felt must be removed by wet scraping before proceeding.

WARNING

RESIDUAL FELT MUST BE REMOVED BY WET SCRAPING; DO NOT SAND OR DRY SCRAPE IN ANY WAY; DO NOT DRY SWEEP; AVOID CREATING DUST. SEE WARNING STATEMENT.

H. **Wet Scraping Residual Felt**

1. Thoroughly wet the residual felt with the detergent solution. Avoid excessive wetting or standing water. Wait a few minutes to allow the solution to soak into the felt.

2. Stand on the remaining floor covering (not the felt) and use the stiff-bladed scraper or floor scraper with a replaceable blade to remove the wet felt.

WARNING

Never sand or dry scrape residual felt. See Warning Statement.

3. Re-wet the felt if the solution has not completely penetrated if drying occurs or if dry felt is exposed during scraping. Scrape **all** felt from this floor area before proceeding further. Pick up the scrapings as they are removed from the floor and place in a heavy-duty impermeable trash bag or closed impermeable container.

PRECAUTION: Wet residual felt as above but do not excessively soak or flood wood floors with detergent solution. Excessive water can damage wood floors to the extent that new underlayment could be required. A floor that has been wet scraped must be allowed to dry thoroughly before new resilient flooring is installed.

4. After removing the three strips of flooring vacuum the exposed

floor using a wet/dry vacuum equipped with a HEPA filter and metal floor attachment (no brush).

I. Repeat the operation (wetting the delamination nip point while removing the next three strips, then wet scrape the residual felt then vacuum the exposed floor). Do only one three-strip area at a time until the entire floor has been completely removed.

WARNING
ELECTRICAL SHOCK HAZARD EXISTS. USE A GROUND FAULT CIRCUIT INTERRUPTER FOR ANY ELECTRICAL CONNECTIONS IN A WET ENVIRONMENT.

J. Place all flooring strips and felt scrapings immediately while wet into the recommended trash bags. Close full bags tightly and seal securely for disposal.

Identify with a label stating, "Caution—Contains Asbestos. Avoid opening or breaking bag or container. Breathing asbestos may cause serious bodily harm. Dispose in an approved landfill only." (See NOTICE page 9.)

WARNING
Do Not Dry Sweep; Avoid Creating Dust. See Warning Statement.

K. When the whole floor has been completely removed, let it dry and vacuum up any dirt using a vacuum with a HEPA Filtration System and a metal floor attachment (no brush). Stand only in vacuumed area as you proceed across the floor. Position the vacuum cleaner so the discharge

air does not blow on the floor being cleaned.

L. Take the vacuum cleaner outside and carefully remove the dust bag and place it in a heavy-duty impermeable trash bag or closed impermeable container for disposal, which is labeled as above.

M. When the floor is dry, it is ready to have a new resilient floor covering installed. Follow the floor covering manufacturer's instructions.

COMPLETE REMOVAL OF THIN WOOD UNDERLAYMENT COVERED WITH EXISTING SHEET VINYL RESILIENT FLOORING

The removal of resilient flooring over wood subfloors using the wet stripping/wet scraping method may not be practical in cases where multiple layers of floor covering are present, where non-recommended underlayments were used or where the flooring was made with heavy foam backing. As an alternative the wood underlayment can be removed with the flooring adhered to it. Following are the details.

A. Preparation
- o Move all appliances and furniture from the work area.
- o Remove all binding strips or other restrictive molding from doorways, walls, etc.
- o Prepare a detergent solution (1 ounces of the specified liquid detergent [See page 5] to gallon of warm water) and pour into a garden sprayer.
- o Clean the entire floor with a

wet/dry vacuum equipped with a HEPA Filtration System and metal floor tool (no brush).

B. Locate the joints of the underlayment panel farthest from the entrance door.

C. Cut a strip of the flooring 4 to 6 inches wide centered over the underlayment joint in the panel being removed.

D. Pry up the corner of the strip separating the backing layer. As the strip is being removed, a constant mist of the detergent solution must be sprayed into the delamination nip point to minimize any airborne dust particles. When done properly, any felt remaining on the floor and on the back of the strip will be thoroughly wet. The strip is peeled by pulling upward at an angle that permits the best separation or by rolling around a core.

PRECAUTION: Resilient flooring becomes slippery when wet with a detergent solution. Use caution to contain the solution in the immediate work area. Standing on a new sheet of plywood or non-slip surface while working is recommended.

E. Roll the strip tightly as it is removed. Tie or tape securely and place in a heavy-duty impermeable trash bag or closed impermeable container for disposal, which is labeled "Caution—Contains Asbestos. Avoid opening or breaking bag or container. Breathing asbestos may cause serious bodily harm. Dispose

of in an approved landfill only."

WARNING
RESIDUAL FELT MUST BE REMOVED BY WE SCRAPING; DO NOT SAND OR DRY SCRAPE I ANY WAY; DO NOT DRY SWEEP; AVOI CREATING DUST. SEE WARNING STATEMENT.

F. Remove all of the exposed residua felt by wet scraping before proceeding.

Wet Scraping Residual Felt

1. Thoroughly wet the residual fel with the detergent solution a allow a few minutes to soak.

2. Stand on the remaining floo covering (not the felt) and use the stiff-bladed scraper or a floor scraper with a replaceabl blade to remove the wet felt.

WARNING
Never sand or dry scrape residual felt See Warning Statement

3. Re-wet the felt if the solutio has not completely penetrated if drying occurs or if dry fe is exposed during scrapin Scrape all felt from this flo area before proceeding furthe Pick up the scrapings as th are removed from the floor a place in a heavy-dut impermeable trash bag or clos impermeable container.

4. Continue around the underlayme panel completely removing t adhered flooring over t joints.

5. Place all flooring strips and felt scrapings immediately while wet into the recommended trash bags. Close full bags tightly and seal securely for disposal. Identify with a label stating, "Caution--Contains Asbestos. Avoid opening or breaking bag or container. Breathing asbestos may cause serious bodily harm. Dispose in an approved landfill only." (See NOTICE page 9.)

6. Vacuum the exposed floor area using a wet/dry vacuum equipped with a HEPA filter and metal floor attachment (no brush).

G. Drive a cold chisel using a hammer or mallet into the joint at a corner of the panel. Now use the chisel to pry the panel up far enough to insert a pry bar. Continue working around the panel, lifting all edges slowly. Use one or two pry bars to pry up the underlayment panel a little at a time until the panel is completely loose and can be removed. Every attempt should be made to remove the panel in one piece.

H. If the underlayment panel breaks, cut the resilient flooring at the break and spray the detergent solution onto the exposed felt. Allow the solution to penetrate for a few minutes, then continue lifting the broken underlayment.

WARNING

ELECTRICAL SHOCK HAZARD EXISTS. USE A GROUND FAULT CIRCUIT INTERRUPTER FOR ANY ELECTRICAL CONNECTIONS IN A WET ENVIRONMENT.

I. Remove each underlayment panel or piece from the work area as it is lifted to avoid injury. Wear heavy gloves when handling removed panels. Be very careful of wood splinters and protruding fasteners. Flatten the fasteners with a hammer and stack the panels back to back on pallets or place in dumpster. Identify panels with a label stating, "Caution--Contains asbestos. Avoid breaking panels. Breathing asbestos may cause serious bodily harm. Dispose of in an approved landfill only." Place any small wood or flooring scraps in a heavy-duty impermeable trash bag or closed impermeable container for disposal. Identify all of the containers and bags with a label stating, "Caution—Contains Asbestos Avoid opening or breaking bag or container. Breathing asbestos may cause serious bodily harm. Dispose of in an approved landfill only."

J. If the underlayment extends under cabinets or wall partitions, it will be necessary to cut through the flooring with a knife as close to the vertical surface as possible, deeply scoring the panel. This should allow removal.

K. After each panel has been lifted and removed from the work area, pull up any remaining nails or fasteners in the subfloor.

L. Continue removing each underlayment panel following steps G through K.

M. When the underlayment/resilient flooring removal is completed prepare the subfloor following

manufacturer's installation recommendations.

RESILIENT TILE FLOOR COVERING

Preparation of Floors With Existing Resilient Tiles to Receive New Resilient Floor Covering

Some resilient floor coverings can be installed over existing resilient tile installations. Follow the installation instructions published by the manufacturer of the new floor covering when a new resilient floor covering is to be installed on a surface presently covered with a resilient floor covering.

These instructions will tell you what must be done to the existing surface before the new resilient floor covering can be installed.

WARNING
Never Sand an Existing Tile Installation
(see Sketch 4)

Complete Removal of Existing Resilient Tile Floor Covering

Supplies and Tools
(refer Sketch 14)

1. Sharp stiff blade floor scraper.
2. Weighted scraper with long handle.
3. Safety glasses.
4. Hammer
5. Hot air gun.
6. Wet/dry vacuum with a HEPA Filtration System and metal floor attachment (no brush).
7. Heavy-duty, impermeable, plastic

trash bags with minimum 6 mil wall thickness.
8. Garden sprayer.
9. A liquid dishwashing detergent which is stated to contain anionic nonionic, and amphoteric surfactants. The detergent should be mixed with water to make dilute solution (1 oz. of detergent to one gallon of water).
10. Pressure-sensitive labels 3" x 5" or larger.
11. Ground fault circuit interrupter for connection of HEPA vacuum and any other electrical equipment.

Whenever possible, existing tile floor should be left in place and the new floor adhered directly to the tile following manufacturer's directions.

Occasionally, there is no alternative except to remove the tile; curling, poor bond and breakage are common reasons. If removal is unavoidable, consideration must also be given to subfloors coated with asphalt tile adhesive. The following procedures address the recommended work practice for removal of floor tile and preparation of adhesive-coated floors.

Removal Procedure

A. Preparation
   1. Move all appliances and furniture from the work area.
   2. Remove all binding strips or other restrictive molding from doorways, walls, etc.
   3. It is also suggested that the entire floor be cleaned with a wet/dry vacuum equipped with a HEPA Filtration System and metal floor attachment (no

brush). Do Not Sweep.

B. Those areas normally exposed to heavy foot traffic patterns usually have tiles adhered the tightest. As a matter of good practice in starting the tile removal, those sections which receive the least traffic should be the locations selected for starting the removal of the tile. Since tiles are normally in a 9" x 9" or 12" x 12" dimension, it should be the goal to remove individual tiles as a complete unit although breakage of some tiles is unavoidable.

C. Start the removal by carefully wedging the wall scraper in the seam of two adjoining tiles and gradually forcing the edge of one of the tiles up and away from the floor. Continue to force the balance of the tile up by working the scraper beneath the tile and exerting both a forward pressure and a twisting action on the blade to promote release of the tile from the adhesive and the floor.

D. When the first tile is removed, place it, without breaking it further into smaller pieces, in a heavy-duty impermeable trash bag or closed impermeable container which will be used for disposal.

E. With the removal of the first tile accessibility of the other tile is improved. Force the wall scraper under the exposed edge of another tile and continue to exert a prying twisting force to the scraper as it is moved under the tile until the tile releases from the floor. Again, dispose of the tile, and succeeding

tiles, by placing in the heavy-duty bag or closed container without additional breaking.

F. Some tiles will release quite easily while others require varying degrees of force. Where the adhesive is spread heavily or is quite hard, it may prove easier to force the scraper through the tightly adhered areas by striking the scraper handle with a hammer using blows of moderate force while maintaining the scraper at a 25° to 30° angle to the floor.
Caution: Use safety goggles.

G. If some areas are encountered where even the technique detailed in the previous paragraph proves to be inadequate, the removal procedure can be simplified by thoroughly heating the tile(s) with a hot air blower until the heat penetrates through the tile and softens the adhesive.

NOTE: Handle the hot air blower, tiles and adhesive carefully to avoid personal burns.

NOTE: Do not handle the heated tiles and adhesive without suitable glove protection for the hands.

H. As small areas of subfloor are cleared of tile, the adhesive remaining on the floor must be treated. The degree of treatment for residual "cut-back" adhesive is dependant upon the type of the resilient floor covering materials

to be installed and the type of subfloor. See page 32 Preparation of Adhesive Coated Subfloor for special recommendations.

If new resilient floor tile is to be installed over a concrete subfloor using an asphaltic adhesive, the residual asphaltic "cut-back" adhesive must be left so that no ridges or puddles are evident and what remains is a thin, smooth film.

Wet Scraping Residual Adhesive

(1) Start in the corner of the room farthest from the entrance door and moisten an area approximately 3' x 10' with water mixed with the specified liquid dishwashing detergent (1 oz. specified liquid dishwashing detergent to one gallon of water) to aid in wetting the adhesive. Wet scrape with a stiff-bladed wall or floor scraper removing ridges and any loose adhesive.

(2) Place loosened adhesive residues into a heavy-duty impermeable trash bag or other impermeable container and seal with ties, tape or string and label "Caution--Contains Asbestos. Avoid opening or breaking container. Breathing asbestos is hazardous to your health. Dispose in an approved landfill only."

(3) Wet vacuum standing water with HEPA wet/dry vacuum.

(4) Continue steps (1) through (3) until what remains of the residual asphaltic "cut-back" adhesive is a thin, smooth film.

I. As indicated in previous paragraphs, tiles should be placed immediately in a heavy-duty impermeable trash bag or closed impermeable container. Do not attempt to break tiles further after they are in the bag.

J. When all tiles and adhesive residue have been removed from the floor and placed in heavy-duty polyethylene bags at least 6 mil thick or closed containers, seal the bags securely for disposal and label: "Caution--Contains Asbestos. Avoid opening or breaking bag or container. Breathing asbestos may cause serious bodily harm. Dispose in an approved landfill only."

K. Vacuum up any dirt in the area using a vacuum equipped with a HEPA filter and metal floor attachment (no brush).

L. After vacuuming, used HEPA filter and cleaner bags should be removed according to manufacturer instructions and placed in a heavy-duty impermeable trash bag with label stating "Caution—Contains Asbestos. Avoid opening or breaking container. Breathing asbestos is hazardous to your health. Dispose in an approved landfill only." Close and seal trash bags securely for disposal.

Complete Removal of Thin Wood Underlayment Covered with Existing Tile

Supplies and Tools

1. Chisel.
2. Hammer or mallet.
3. Short- and long-handled pry bars.
4. Heavy gloves.
5. Sharp stiff-blade floor scraper.
6. Weighted scraper with long handle.
7. Safety glasses.
8. Hammer.
9. Hot air gun.
10. Wet/dry vacuum with a HEPA Filtration System and metal floor attachment (no brush).
11. Heavy-duty, impermeable, plastic trash bags with minimum 6 mil wall thickness.
12. Pressure-sensitive labels 3" x 5" or larger.
13. Ground fault circuit interrupter for connection of HEPA vacuum and any other electrical equipment.

Removal Procedure

A. Preparation
   1. Move all appliances and furniture from the work area.
   2. Remove any binding strips or other restrictive molding from doorways, walls, etc.
   3. It is also suggested that the entire floor be cleaned with a wet/dry vacuum equipped with a HEPA Filtration System and a metal floor attachment (no brush). Do Not Sweep.

B. Starting at the doorway or a floor ventilation vent, locate a joint in an underlayment board.

C. Start the removal by carefully wedging the wall scraper in the seam of two adjoining tiles and gradually forcing the edge of one of the tiles up and away from the floor. Continue to force the balance of the tile up by working the scraper beneath the tile and exerting both a forward pressure and a twisting action on the blade to promote release of the tile from the adhesive and the floor. Continue to remove tile in this manner, at all joints, until all board joints are exposed.

D. When the first tile is removed place it, without breaking it further into smaller pieces, in a heavy-duty impermeable trash bag or closed impermeable container which will be used for disposal.

E. With the removal of the first til accessibility of the other tile i improved. Force the wall scrape under the exposed edge of another tile and continue to exert a pryin twisting force to the scraper a it is moved under the tile unti the tile releases from the floor Again, dispose of the tile, ar succeeding tiles, by placing in th heavy-duty bag or closed containe without additional breaking.

F. Some tiles will release quit easily while others require varyin degrees of force. Where th adhesive is spread heavily or i quite hard, it may prove easier t force the scraper through th tightly adhered areas by strikin the scraper handle with a hammer

using blows of moderate force while maintaining the scraper at a 25° to 30° angle to the floor.
Caution: Use safety goggles.

G. If some areas are encountered where even the technique detailed in the previous paragraph proves to be inadequate, the removal procedure can be simplified by thoroughly heating the tile(s) with a hot air blower until the heat penetrates through the tile and softens the adhesive.
NOTE: Handle the hot air blower, tiles and adhesive carefully to avoid personal burns.
NOTE: Do not handle the heated tiles and adhesive without suitable glove protection for the hands.

H. After all the tiles have been removed from the underlayment joints, drive a chisel, using a hammer or a mallet, between the underlayment board and the subfloor. Use the chisel to pry up the underlayment enough to insert a pry bar and remove the chisel. Slowly and carefully use pry bars to pry up the underlayment board a little at a time until the board is completely loose and can be removed.

I. Caution must be used to avoid breaking the underlayment board. The underlayment board should be removed in one piece. If the underlayment board breaks, heat and cut the tile at the break, then continue to remove broken underlayment.

J. Wear heavy gloves and be very careful of wood splinters and fasteners sticking out of the back of the underlayment. Each underlayment

board (or piece of board) should
removed from the work area as so
as it has been pried up to avo
injuries (such as stepping on a
nail). Fasteners protruding from
removed board should be flatten
with a hammer. Place remov
underlayment boards on skids wi
the nails pointing downward. Wr
skid with 6 mil polyethyle
plastic sheeting and secure wi
duct tape. Identify with a lab
stating "Caution--Contai
Asbestos. Avoid opening
breaking container. Breathi
asbestos may cause serious bodi
harm. Dispose in an approved
landfill only."

K. After each board has been remove
pull out any nails or faster
still in the subfloor. Dispose
these and any other nails
fasteners which have been remo
but are still lying in the w
area.

L. A chisel is not needed to start
removal of boards after the fi
board has been removed. Sim
work the pry bar under the expo
edge of the next board.

M. When removal of the underlaymer
existing tile floor is comple
thoroughly check the expos
subfloor. Renail loose areas
reset any "popped" nails
fasteners.

N. Vacuum up any dirt in the a
using the vacuum cleaner equip
with the HEPA filter and me
floor attachment (no brush).

O. After the underlayment is completely removed, install the new underlayment and/or floor covering according to the manufacturer's installation instructions.

PREPARATION OF ADHESIVE COATED SUBFLOORS

The degree to which residual asphalt adhesive has to be removed depends on the new flooring material which is being installed. Generally installation of Vinyl Composition Tile requires only the wet removal of adhesive ridges, excess adhesive, and loose adhesive residues. (See page 25, paragraph H.)

Installation of sheet flooring and specialty tiles requiring latex, resin, or epoxy adhesives will require that the residual asphaltic adhesive be essentially completely removed.

Warning Regarding Complete Adhesive Removal: Some Solvent Based "Cut-Back" Asphaltic Adhesives May Contain Asbestos Fibers That Are Not Readily Identifiable. Do Not Use Power Devices Which Create Asbestos Dust in Removing These Adhesives. The Inhalation Of Asbestos Dust May Cause Asbestosis Or Other Serious Bodily Harm. Smoking Greatly Increases The Risk Of Serious Bodily Harm.

I. **Recommended Method for Preparing Concrete Subfloors Coated with Cut-Back or Emulsion Tile Adhesive**

Unless absolutely positive beyond any doubt that the adhesive is a non-asbestos product, assume it contains

asbestos and treat it in the manne prescribed in this pamphlet for cut-back or emulsion tile adhesiv containing asbestos.

A. Trowelable Underlayment
Cover the adhesive residue wit trowelable underlaymen following the manufacturer' recommended applicatio procedures. (Recommended fc residential use only.)

B. Self-Leveling Cementitiou Underlayment
Follow manufacturer's recommendations for use c these types of underlayments a covering for adhesive coate concrete.
NOTE: All warranties and recommendations as to t suitability and performance o these products are t responsibility of t manufacturer of t underlayment.

C. Adhesive Removers
The Resilient Floor Coveri Institute does not recommend approve the use of the products. There are a numb of commercial adhesive remove on the market that wi properly remove cut-back emulsion adhesive residue fr a subfloor; however, there a concerns that these produc may adversely effect the n adhesive and new flo covering.

D. Wet Removal

Supplies and Tools

1. Broad stiff-bladed wall or floor scrapers, a 4-inch wide blade with handle is recommended.
2. No. 1 sandblasting sand (clean, sharp, course cutting sand).
3. Terrazzo or low-speed floor machine fitted with a floor plate attachment (Clark Assy. 500212-6).
4. Hand-held rubbing stones.
5. Wet/dry tank-type vacuum cleaner equipped with a High Efficiency Particulate Air (HEPA) filter and metal floor attachment (no brush).
6. Heavy-duty polyethylene bags at least 6 mils thick, tape or ties, and labels.
7. Slip-resistant shoes or rubber heels.
8. Ground fault circuit interrupter for electrical connection of the HEPA vacuum and any other electrical connections required.
9. Garden sprayer.
10. A liquid dishwashing detergent which is stated to contain anionic, nonionic, and amphoteric surfactants. The detergent should be mixed with water to make a dilute solution (1 oz. of liquid in one gallon of water).

Procedure

1. Start in the corner of the room farthest from the entrance door and moisten an area of the adhesive approximately 3' x 10' with water mixed with liquid dishwashing detergent (to aid in wetting the adhesive). Wet scrape with a stiff-bladed wall or floor scraper removing ridges and any loose adhesives, until only thin smooth film remains.
2. Place loosened adhesive residues into a heavy-duty impermeable trash bag or other impermeable container and seal with ties, tape or string and label "Caution-Contains Asbestos. Avoid opening or breaking bag or container. Breathing asbestos may cause bodily harm. Dispose in an approved landfill only."
3. Wet vacuum standing water with HEPA wet/dry vacuum.
4. Continue steps 1 through 3 until entire area is wet scraped.
5. Place cutting sand into container (enough to cover an approximate 6' x 6' area), add water mixed with liquid detergent (1 oz. of the specified detergent [See page 33] to one gallon of water) to the sand to dampen (20 lbs. of sand to 1/2 gallon of solution).
6. Place sand over a 6' x area and wet remove the

existing adhesive residue using a terrazzo floor machine. Keep sand under rubbing stones when operating the machine. The sand and the subfloor must be continuously kept wet.

7. Occasionally push away cutting sand from the subfloor with a wall or floor scraper to check for complete removal.
8. Adhesive around the edge of the room and areas that were missed can be removed with dampened, clean, sharp cutting sand and a hand-held rubbing stone.
9. Wet scrape sand into a pile using a stiff-bladed floor or wall scraper and place sand and adhesive residue in a heavy-duty impermeable container, seal with ties or tape and label "Caution-Contains Asbestos. Avoid opening or breaking bag or container. Breathing asbestos may cause bodily harm. Dispose in an approved landfill only."
10. Rinse area with clear, clean water using the hand sprayer.
11. Wet vacuum standing water with a wet/dry vacuum equipped with a HEPA filter and metal floor attachment (no brush).
12. Continue steps 1 through 8 until the entire room is complete.
13. Allow subfloor to dry and vacuum up any remaining

dirt or sand using a vacuu equipped with a HEPA filter an metal floor tool (no brush).

WARNING

Electrical Shock Hazard Exists Use A Ground Fault Circui Interrupter For Any Electrica Connections In A Wet Environment.

II. **Recommended Methods for Preparir Wood Subfloors Coated with Cut-Ba or Emulsion Tile Adhesive**

A. Trowelable Underlayment
Cover the adhesive residue wi trowelable underlayment following manufacturer recommended applicati procedures. (Recommended f residential use only).

B. Wood Panel Underlayment*
Normally it will not necessary to remove the c tile when installing n underlayment over a sing layer of tile. However, if t tile must be removed, t tackiness of the adhesive m be "dried-up" before installi new underlayment. This can done by spreading a layer powder from latex patchi compound (either type) a vacuuming up the exces Another method is to place layer of asphalt saturat pattern scribing felt or two layers of newspaper over the tacky adhesive residue

* See manufacturers' recommendations for approved underlayment types.

before the underlayment is installed. If the old adhesive is not "dried-up" before the underlayment is installed, there is the possibility that a "cracking" sound will be heard when the new floor is walked on, creating an unsatisfactory condition. This occurs because the underlayment is pressed into the tacky adhesive by foot traffic. When the pressure is released, the underlayment sticks momentarily and then springs from the tacky adhesive, creating a "cracking" noise.

C. Removal of Adhesive Coated Underlayment Panels

If removal of the existing underlayment panels is necessary follow the procedure outlined under "Complete Removal of Thin Wood Underlayment Covered with Existing Resilient Flooring" steps G - M (pages 19 - 21).

WARNING

**Do Not Sand, Dry Scrape, Beadblast (
Mechanically Pulverize Existir
Resilient Flooring, Backing Or Lini
Felt. These Products May Contai
Asbestos Fibers That Are Not Readi
Identifiable. Using the Above No
recommended Procedures On Asbesto
Containing Material Can Create Asbest
Dust. The Inhalation Of Asbestos Du
May Cause Asbestosis Or Other Serio
Bodily Harm. Smoking Greatly Increas
The Risk of Serious Bodily Harm.**

(BACK COVER)

Issued By

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February 1990

This publication replaces prior editions of these work practices. Future editions of these work practices may be issued to replace this publication.

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Revised 1987
Revised 1990

APPENDIX 2

Recommended Work Practices for Resilient Floor Coverings

Armstrong World Industries, Inc. (March 1990)

Armstrong

F 2622 390J

Printed in United States of America

Armstrong

Recommended Work Practices for Removal of **Resilient Floor Coverings**

Effective MARCH 1990
Through DECEMBER 1990

⚠WARNING ASBESTOS-CONTAINING RESILIENT FLOOR COVERING MATERIALS

DO NOT SAND EXISTING RESILIENT FLOOR TILE AND SHEET FLOORING, BACKING, OR LINING FELT. THESE PRODUCTS MAY CONTAIN ASBESTOS FIBERS THAT ARE NOT READILY IDENTIFIABLE. AVOID CREATING DUST. INHALATION OF ASBESTOS DUST MAY CAUSE ASBESTOSIS OR OTHER SERIOUS BODILY HARM. SMOKING GREATLY INCREASES THE RISK OF SERIOUS BODILY HARM.

⚠WARNING ASBESTOS-CONTAINING ASPHALTIC "CUTBACK" ADHESIVE

SOME IN-PLACE ASPHALTIC ADHESIVES MAY CONTAIN ASBESTOS FIBERS THAT ARE NOT READILY IDENTIFIABLE. IN THE REMOVAL OF ASPHALTIC "CUTBACK" ADHESIVES, DO NOT USE POWER DEVICES WHICH CAN CREATE DUST. THE INHALATION OF ASBESTOS DUST MAY CAUSE ASBESTOSIS OR OTHER SERIOUS BODILY HARM. SMOKING GREATLY INCREASES THE RISK OF SERIOUS BODILY HARM. ASSUME THAT ALL IN-PLACE ASPHALTIC "CUTBACK" ADHESIVES CONTAIN ASBESTOS.

NOTICE: Regulations Affecting the Removal of Existing Resilient Floor Covering Structures

Various government agencies have regulations governing the removal of in-place asbestos-containing material. If you contemplate the removal of a resilient floor covering structure that contains (or is assumed to contain) asbestos, you should determine whether such regulations apply.

THIS EDITION OF THE RECOMMENDED WORK PRACTICES, F-2622-390J SUPERCEDES ALL OTHERS. ALL PREVIOUS EDITIONS ARE NOW OBSOLETE.

Important information for installers of resilient floor coverings

What You Should Know About Existing Resilient Floor Covering Structures

Vinyl-asbestos tile and asphalt tile contain asbestos fibers, as did some asphaltic "cutback" adhesives and the backings of many sheet vinyl floorings and lining felts. The presence of the asbestos in these products is not readily identifiable.

Unless absolutely positive beyond any doubt that the product is a nonasbestos-containing material, always assume it does contain asbestos.

Armstrong's Recommended Work Practices are a defined set of instructions addressed to the task of removing all resilient floor covering structures whether or not they contain asbestos. When Armstrong's Recommended Work Practices are followed, resilient floor covering structures that contain (or are assumed to contain) asbestos can be removed in a manner that will comply with the current OSHA Occupational Exposure to Asbestos Standard's Permissible Exposure Limits (PEL).

Numerous products, devices and techniques have been recently introduced and/or recommended for the removal of resilient floor covering structures. Armstrong is only able to endorse its own Recommended Work Practices. Before you use any other practice for the removal of an in-place resilient floor covering product that contains (or is assumed to contain) asbestos, you should determine if the practice meets all applicable regulations or standards including those of the Occupational Safety and Health Administration (OSHA) for Occupational Exposure to Asbestos and that the material will be compatible with the new floor covering to be installed.

Recommended Work Practices for Removal of Resilient Floor Coverings

TABLE OF CONTENTS

1. ALTERNATIVES TO REMOVAL OF EXISTING RESILIENT FLOOR COVERINGS

Removal of the existing resilient floor is the final alternative (see note below). Armstrong recommends that whenever possible you leave the existing resilient floor covering in place and go over the top with your new floor.

Note: Alternatives to the removal of an existing resilient floor over approved subfloors are:

(1) Installing directly over a single layer of approved existing resilient flooring.

(2) Filling the embossing of the existing resilient flooring with S-188 Embossing Leveler before installation (residential products only).

(3) Covering existing resilient flooring on an approved suspended wood subfloor with a recommended wood underlayment.

Contact your local Armstrong dealer for our recommendations or consult Armstrong's brochure F-5061, "Armstrong Engineered Installation System."

• Installing resilient floor covering over existing resilient floor covering

When you plan to install a new resilient sheet or tile floor covering over an existing resilient floor covering, follow the installation instructions published by the manufacturer. Those instructions will tell you what must be done to the existing surface before the new resilient floor covering can be installed. Remove wax by wet stripping only.

⚠WARNING

NEVER SAND AN EXISTING RESILIENT FLOOR COVERING. SEE WARNINGS ON PAGE ONE.

• Use of embossing leveler

When you use Armstrong's S-188 Embossing Leveler to fill the embossing of the existing resilient flooring, follow the Armstrong recommendations found in brochure F-5061, "Armstrong Engineered Installation System."

• Installing resilient floor covering over new underlayment

When you install a new floor covering over new underlayment, follow the Armstrong recommendations found in brochure F-5061, "Armstrong Engineered Installation System."

2. REMOVAL OF RESILIENT SHEET FLOORING

⚠WARNING

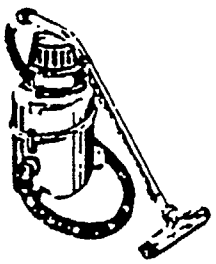
DO NOT SAND EXISTING RESILIENT TILE AND SHEET FLOORING, BACKING, OR LINING FELT. SEE WARNINGS ON PAGE ONE.

• Supplies and tools

1. Stiff-bladed wall or floor scraper.

2. Utility or hook knife.

3. Tank-type High Efficiency Particulate Air (HEPA) wet/dry vacuum cleaner *with disposable dust bag* and metal floor tool (no brush).



4. Hand sprayer or sprinkling can.

5. Large-size heavy-duty impermeable trash bags (or closed impermeable containers) with ties, tape, or string to tie the bags shut, and tags for labeling.

6. A liquid dishwashing detergent which is stated to contain anionic, nonionic, and amphoteric surfactant. Mix this specified liquid dishwashing detergent with water to make a dilute solution (16 oz. specified liquid dishwashing detergent in one gallon of water).

7. Ground fault circuit interrupter for electrical connection of the HEPA vacuum and any other electrical connections required.

• Removal procedure, fully adhered resilient sheet flooring

⚠WARNING

NEVER SAND AN EXISTING FLOOR COVERING OR FELT BACKING. SEE WARNINGS ON PAGE ONE.

a. Remove any binding strips or other restrictive moldings from doorways, walls, etc.

b. Prepare the specified liquid dishwashing detergent solution (16 oz. of specified liquid dishwashing detergent to one gallon of water) and pour into a hand sprayer or sprinkling can.

c. Clean the entire floor with the HEPA vacuum cleaner using the metal floor tool.

d. Make a series of parallel cuts 4" to 8" apart through the top layer of the flooring and about halfway through the backing, parallel to the wall, for the entire floor.

⚠ CAUTION

RESILIENT FLOORING BECOMES SLIPPERY WHEN WET WITH THE SPECIFIED LIQUID DISHWASHING DETERGENT SOLUTION. USE CAUTION TO CONTAIN THE SOLUTION IN THE IMMEDIATE WORK AREA. STANDING ON A NEW SHEET OF PLYWOOD OR NONSLIP SURFACE WHILE WORKING IS RECOMMENDED.

e. Wear layer removal:
One worker starts at the end of the room farthest from the entrance door and pries up the corner of the strip, separating the backing from the wear layer. As the strip is being removed, another worker sprays a constant mist of the specified liquid dishwashing detergent solution into the delamination nip point to minimize any airborne dust particles. When done properly, the felt remaining on the floor and on the back of the strip will be thoroughly wet. Do only one three-strip area at a time. Stand on the remaining floor covering or clean floor (do not stand on the felt). The cut strips should be peeled from the backing by pulling or rolling around a core which will control the stripping angle to create a uniform tension (some resilient flooring wear layers may not be readily strippable and may require wet-scraping). Tie or tape the removed material securely and place in the heavy-duty impermeable trash bag or closed impermeable container for disposal.

f. Remove and dispose of each succeeding strip in the above manner. Avoid walking on the exposed felt as much as possible. Close full bags tightly, and seal securely for disposal. Identify with a label stating — "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only."

g. Occasionally, parts of the top layer will stuck to the backing. This can often be eliminated by peeling in the opposite direction. The stiff-bladed scraper may aid in the removal or peeling of the wear layer.

⚠ WARNING

NEVER SAND OR DRY-SCRAPE RESIDUAL FELT BACKING. SEE WARNINGS ON PAGE ONE.

h. Wet-scraping residual felt:

(1) Thoroughly wet the residual felt with the specified liquid dishwashing detergent solution. Wait a few minutes to allow the specified liquid dishwashing detergent solution to soak into the felt.

(2) Stand on the remaining floor covering (not the felt) and use the stiff-bladed scraper to scrape up the wet felt.

(3) Rewet the felt if the specified liquid dishwashing detergent solution has not completely penetrated, if drying occurs, or if dry felt is exposed during scraping. Pick up the scrapings as they are removed from the floor and place in a heavy-duty impermeable trash bag or closed impermeable container. Wet-scrape all felt from this floor area before proceeding further.

PRECAUTIONS: EXCESSIVE MOISTURE CAN CAUSE PERMANENT DAMAGE TO WOOD UNDERLAYMENTS. IT IS THE INSTALLER'S RESPONSIBILITY TO USE THE CORRECT AMOUNT OF SPECIFIED LIQUID DISHWASHING DETERGENT SOLUTION TO PRE-

VENT UNDERLAYMENT DAMAGE. A FLOOR THAT HAS BEEN WET-SCRAPED MUST BE ALLOWED TO DRY BEFORE INSTALLING ANY NEW RESILIENT FLOORING.

(4) When this floor area has been cleaned free of felt, vacuum up any dirt using the HEPA vacuum cleaner with the metal floor tool. Position the vacuum cleaner so that the discharge air does not blow on the area being cleaned.

(5) Repeat the above on the next series of strips.

(6) Repeat this operation until the felt has been removed from the whole floor. Close full bags tightly and seal securely for disposal. Identify with a label stating — "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only."

(7) When the whole floor has been cleaned free of felt, vacuum up any dirt using the HEPA vacuum cleaner with the metal floor tool and let it dry. Position the vacuum cleaner so that the discharge air does not blow on the area being cleaned.

⚠ WARNING

DO NOT DRY-SWEEP. AVOID CREATING DUST. SEE WARNINGS ON PAGE ONE.

(8) After vacuuming, used HEPA filters and cleaner bags should be removed according to the manufacturer's instructions and placed in a heavy-duty impermeable trash bag with a label stating "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only." Close and seal the trash bag securely for disposal.

(9) When the floor is dry, it is ready to have a new resilient floor covering installed. Follow the manufacturer's installation instructions.

• Removal procedure, unadhered (loose-lay) or peripherally adhered resilient sheet flooring

a. Remove any binding strips or other restrictive moldings from doorways, walls, etc.

b. Prepare the specified liquid dishwashing detergent solution (16 oz. of the specified liquid dishwashing detergent to one gallon of water) and pour into a hand sprayer or sprinkling can.

c. Clean the entire floor with the HEPA vacuum cleaner using the metal floor tool.

d. If flooring is unadhered, start at the end of the room farthest from the entrance doorway and cut flooring into strips about 18" wide for the entire room. One worker removes the cut strips while another worker sprays the specified liquid dishwashing detergent solution directly into the separation nip point. Do not stand on the exposed subfloor during the removal process.

⚠ CAUTION

RESILIENT FLOORING BECOMES SLIPPERY WHEN WET WITH SPECIFIED LIQUID DISHWASHING DETERGENT SOLUTION. USE CAUTION TO CONTAIN THE SOLUTION IN THE IMMEDIATE WORK AREA. STANDING ON A NEW SHEET OF PLYWOOD OR NONSLIP SURFACE WHILE WORKING IS RECOMMENDED.

e. Roll the wet strip tightly and tie or tape securely so it will not unroll. Place it in a heavy-duty impermeable trash bag or closed impermeable container big enough to accommodate several rolls for disposal.

Use this method for nonbonded areas of peripherally adhered floors. To remove bonded areas, follow instructions under "Removal procedure, fully adhered resilient sheet flooring."

f. Clean the exposed floor with a HEPA vacuum cleaner with the metal floor tool positioned so that the discharge air does not blow on the area being cleaned.

⚠WARNING

DO NOT DRY-SWEEP. AVOID CREATING DUST. SEE WARNINGS ON PAGE ONE.

g. Repeat the above, cutting, rolling and disposing of one strip at a time and cleaning the newly exposed area immediately until the entire floor covering has been removed and the entire floor is vacuumed clean.

h. If any residual felt remains stuck to the floor, it should be removed by the wet-scraping method described in Section (h) of the "Removal procedure, fully adhered resilient sheet flooring."

⚠WARNING

DO NOT DRY-SCRAPE OR SAND. SEE WARNINGS ON PAGE ONE. PLACE THE REMOVED FLOOR COVERING IN THE HEAVY-DUTY IMPERMEABLE TRASH BAG OR CLOSED IMPERMEABLE CONTAINER.

i. After vacuuming, used HEPA filters and cleaner bags should be removed according to manufacturer's instructions and placed in a heavy-duty impermeable trash bag with a label stating — "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only." Close and seal the trash bags securely for disposal.

j. After the underlayment is dry, install the new resilient floor covering according to the manufacturer's installation instructions.

3. REMOVAL OF RESILIENT TILE

⚠WARNING

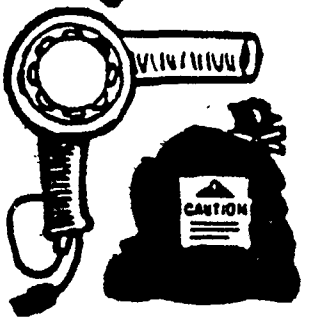
NEVER SAND AN EXISTING RESILIENT FLOOR TILE INSTALLATION. SEE WARNINGS ON PAGE ONE.

• Supplies and tools

1. Heavy-duty scraper with approximately 4" blade and 6" to 8" handle.

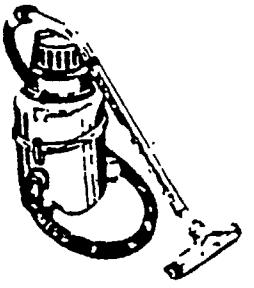
2. Hammer.

3. Commercial-type hand-held hot-air blower or a radiant heat source.



4. Large size heavy-duty impermeable trash bags (or closed impermeable containers), with ties, tape or string to tie the bag shut, and tags for labeling.

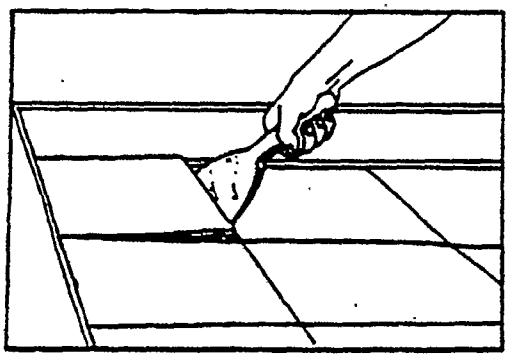
5. Tank-type High Efficiency Particulate Air (HEPA) wet/dry vacuum cleaner with disposable dust bag and metal floor tool (no brush).



• Removal procedure

a. Those areas normally exposed to heavy foot-traffic patterns usually have tiles adhered the tightest. As a matter of good practice in starting the tile removal, select those sections which receive the least traffic. Since tiles are normally in a 9"x9" or 12"x12" dimension, try to remove individual tiles as a complete unit.

b. Start the removal by carefully wedging the scraper in the seam of two adjoining tiles and gradually forcing the edge of one of the tiles up and away from the floor. Do not break off pieces of the tile, but continue to force the balance of the tile up by working the scraper beneath the tile and exerting both a forward pressure and a twisting action on the blade to promote release of the tile from the adhesive and the floor.



c. When the first tile is removed, place it, without breaking it into smaller pieces, in the heavy-duty impermeable trash bag or closed impermeable container which will be used for disposal. Removed tiles can be placed in empty tile cartons first and then placed in the heavy-duty impermeable trash bags. To prevent tearing of the heavy-duty impermeable trash bag, place only one full carton of removed tile in a bag.

d. With the removal of the first tile, accessibility of other tiles is improved. Force the scraper under the exposed edge of another tile, and continue to exert a prying, twisting force to the scraper as it is moved under the tile until the tile releases from the floor.

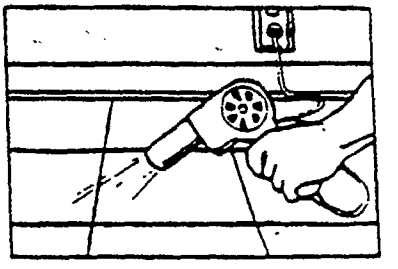
Remove and dispose of each tile in the manner above. Avoid walking on the exposed adhesive as much as possible. Close full bags tightly and seal securely for disposal. Identify with a label stating "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only."

e. Some tiles will release quite easily while others require varying degrees of force. Where the adhesive is spread heavily or the tile is bonded tightly, it may prove easier to force the scraper through the tightly adhered areas by striking the scraper handle with a hammer, using blows of moderate force while maintaining the scraper at a 25° to 30° angle to the floor.

⚠CAUTION

WEAR SAFETY GLASSES WHEN USING THIS PROCEDURE.

f. If you encounter areas where even the above methods will not remove the tiles, the removal procedure can be simplified by thoroughly heating the tiles with a hot-air blower or a radiant heat source until the heat penetrates through the tile and softens the adhesive.



NOTE: Handle the hot-air blower carefully to avoid injury. Do not use a blowtorch or open flame. Use caution not to burn or char tile. Use adequate ventilation.

NOTE: The treatment of residual asphaltic "cutback" adhesive is dependent upon the type of new resilient floor covering material to be installed and the type of subfloor. See Section 4, Removal of Residual Adhesive for Armstrong's recommendations for the treatment of residual asphaltic "cutback" adhesive.

g. If new resilient floor tile is to be installed over a concrete subfloor using an asphaltic adhesive, the residual asphaltic "cutback" adhesive must be left so that no ridges or puddles are evident and what remains is a thin, smooth film. This can be accomplished by wet-scraping the residual adhesive. NOTE: See Section 4, Removal of Residual Adhesive, for Warning and Supplies and Tools.

Wet-scraping residual adhesive:

(1) Start in the corner of the room farthest from the entrance door and moisten an area approximately 3' x 10' with water mixed with the specified liquid dishwashing detergent (1 oz. specified liquid dishwashing detergent to one gallon of water) to aid in wetting the adhesive. Wet-scrape with a stiff-bladed wall or floor scraper removing ridges and any loose adhesive.

(2) Place loosened adhesive residues into a heavy-duty impermeable trash bag or other impermeable container and seal with ties, tape or string and label "Caution—contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only."

(3) Wet vacuum standing water with the HEPA vacuum cleaner.

(4) Continue steps (1) through (3) until what remains of the residual asphaltic "cutback" adhesive is a thin, smooth film.

h. Clean the entire floor with the HEPA vacuum cleaner using the metal floor tool to remove debris before applying new asphaltic adhesive or installing new resilient floor tile.

i. After vacuuming, used HEPA filters and cleaner bags should be removed according to manufacturer's instructions and placed in a heavy-duty impermeable trash bag with a label stating—"Caution—contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only." Close and seal the trash bags securely for disposal.

4. REMOVAL OF RESIDUAL ADHESIVE

⚠ WARNING

ASBESTOS CONTAINING ASPHALTIC "CUTBACK" ADHESIVE.

SOME IN-PLACE ASPHALTIC ADHESIVES MAY CONTAIN ASBESTOS FIBERS THAT ARE NOT READILY IDENTIFIABLE. IN THE REMOVAL OF ASPHALTIC "CUTBACK" ADHESIVES, DO NOT USE POWER DEVICES WHICH CAN CREATE DUST. THE INHALATION OF ASBESTOS DUST MAY CAUSE ASBESTOSIS OR OTHER SERIOUS BODILY HARM. SMOKING GREATLY INCREASES THE RISK OF SERIOUS BODILY HARM. ASSUME THAT ALL IN-PLACE ASPHALTIC "CUTBACK" ADHESIVES CONTAIN ASBESTOS.

• Recommendations for the treatment of residual asphaltic "cutback" adhesive

The treatment of residual asphaltic "cutback" adhesive is dependent upon the type of new resilient floor covering material to be installed and the type of subfloor. Armstrong's recommendations for the treatment of residual asphaltic "cutback" adhesive are shown in the following chart.

Residual Asphaltic "Cutback" Adhesive

New Material To Be Installed	Concrete Subfloor: Removal of Residual Adhesive	Concrete Subfloor: Alternative to Removal	Wood Underlayment Subfloor: Removal of Residual Adhesive	Wood Underlayment Subfloor: Alternative to Removal
Resilient floor tile to be installed using S-89 or S-90 cutback adhesive.	Residual adhesive must be wet-scraped so that no ridges or puddles are evident and what remains is a thin, smooth film. See wet-scraping of residual adhesive.	Application of a cementitious underlayment that is approved by the underlayment manufacturer for use over residual asphaltic "cutback" adhesive.*	Armstrong does not recommend the use of a cutback adhesive over wood underlayment subfloor.	Armstrong does not recommend the use of a cutback adhesive over wood underlayment subfloor.
Armstrong Step Master Tile or Armstrong Rubber Tile to be installed using S-215 Adhesive or Armstrong SDT to be installed using S-202 Adhesive.	Enough of the residual adhesive must be removed so that 80% of the original substrate of the overall area is exposed. Subfloor must be porous when using S-202 Adhesive. See removal of residual adhesive.	Application of a cementitious underlayment that is approved by the underlayment manufacturer for use over residual asphaltic "cutback" adhesive.*	Complete removal of Wood Underlayment. See Complete Removal of Wood Underlayment Under Existing Tile.	Covering residual asphaltic "cutback" adhesive on an approved wood subfloor with a recommended wood underlayment.* When installing this new wood underlayment, felt or polyethylene sheeting may be placed over the residual adhesive to prevent a cracking or tacky sound when walking on the floor.
Resilient floor tile to be installed using an adhesive other than S-89 or S-90 cutback adhesive, S-202 Adhesive or S-215 Adhesive.	Residual adhesive must be wet-scraped so that no ridges or puddles are evident and what remains is a thin, smooth film. See wet-scraping of residual adhesive.	Application of a cementitious underlayment that is approved by the manufacturer for use over residual asphaltic "cutback" adhesive.*	Complete removal of Wood Underlayment. See Complete Removal of Wood Underlayment Under Existing Tile.	Covering residual asphaltic "cutback" adhesive on an approved wood subfloor with a recommended wood underlayment.* When installing this new wood underlayment, felt or polyethylene sheeting may be placed over the residual adhesive to prevent a cracking or tacky sound when walking on the floor.
Interlex or other vinyl-backed sheet flooring.	100% of the residual adhesive must be removed from the area to be covered. See removal of residual adhesive.	Application of a cementitious underlayment that is approved by the underlayment manufacturer for use over residual asphaltic "cutback" adhesive.*	Complete removal of Wood Underlayment. See Complete Removal of Wood Underlayment Under Existing Tile.	Covering residual asphaltic "cutback" adhesive on an approved wood subfloor with a recommended wood underlayment.* When installing this new wood underlayment, felt or polyethylene sheeting may be placed over the residual adhesive to prevent a cracking or tacky sound when walking on the floor.
Felt-backed sheet flooring.	Enough of the residual adhesive must be removed so that 80% of the original substrate of the overall area is exposed. See removal of residual adhesive.	Application of a cementitious underlayment that is approved by the underlayment manufacturer for use over residual asphaltic "cutback" adhesive.*	Complete Removal of Wood Underlayment. See Complete Removal of Wood Underlayment Under Existing Tile.	Covering residual asphaltic "cutback" adhesive on an approved wood subfloor with a recommended wood underlayment.* When installing this new wood underlayment, felt or polyethylene sheeting may be placed over the residual adhesive to prevent a cracking or tacky sound when walking on the floor.

* All warranties and/or performance guarantees concerning underlayment's failure rest with the underlayment manufacturer and not with the resilient floor covering's manufacturer.

NOTE: For further installation recommendations consult Armstrong's brochure F-5081 "Armstrong Engineered Installation System."

cools usually employ solvents which leave a residue within the subfloor that can adversely affect the new adhesive or floor covering. The warranties provided by the manufacturers of the new floor covering materials will not cover instances where existing subfloor conditions damage their products or affect its installation.

The use of asbestos encapsulants or bridging materials over asphaltic adhesive is not recommended as those products may affect the bonding properties of the new adhesive. The application of asphaltic adhesives, as an installation medium, has been demonstrated to be an effective cover for the existing residual adhesive. The encapsulant use of the new adhesive must, however, be consistent with other installation recommendations.

• Supplies and tools

1. Stiff-bladed wall or floor scraper.

2. No. 1 sandblasting sand (clean, sharp, coarse cutting sand)

3. Terrazzo or a low speed floor machine fitted with a floor plate. (Clark Assembly No. 500212-6)

4. Hand held rubbing stones.

5. Tank-type High Efficiency Particulate Air (HEPA) wet/dry vacuum cleaner with disposable dust bag and metal floor tool (no brush).

6. Large-size heavy-duty impermeable trash bags (or closed impermeable containers) with ties, tape, or string to tie the bags shut, and tags for labeling.

7. Slip-resistant shoes or rubber boots.

8. Ground fault circuit interrupter for electrical connection of the HEPA vacuum and any other electrical connections required.

9. Hand sprayer or sprinkling can.

10. A liquid dishwashing detergent which is stated to contain anionic, nonionic, and amphoteric surfactant. Mix this specified liquid dishwashing detergent with water to make a dilute solution (1 oz. of the specified liquid dishwashing detergent to one gallon of water).

• Wet-scraping residual adhesive

a. Start in the corner of the room farthest from the entrance door and moisten an area of the adhesive approximately 3' x 10' with water mixed with the specified liquid dishwashing detergent (to aid in wetting the adhesive). Wet-scrape with a stiff-bladed wall or floor scraper removing ridges and any loose adhesive.

b. Place loosened adhesive residues into a heavy-duty impermeable trash bag or other impermeable container and seal with ties, tape or string and label "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only."

c. Wet vacuum standing water with the HEPA vacuum cleaner.

d. Continue steps a through c until entire area is wet-scraped.

• Removal of residual adhesive

a. Place cutting sand into a container, add water mixed with the specified liquid dishwashing detergent (1 oz. specified liquid dishwashing detergent to one gallon of water) to the sand to dampen. Approximately 20 lbs. of sand to 1/2 gallon of water should provide a workable slurry for a 6' x 6' area.

b. Start in corner of the room farthest from the entrance door. Place sand slurry on the residual adhesive over a 6' x 6' area and remove the existing adhesive using a terrazzo floor machine. Keep sand under rubbing stones when operating the machine. The sand and the subfloor must be continuously kept wet.

⚠ WARNING

ELECTRICAL SHOCK HAZARD EXISTS. USE A GROUND FAULT CIRCUIT INTERRUPTER FOR ANY ELECTRICAL CONNECTIONS IN A WET ENVIRONMENT.

c. Occasionally push away cutting sand from the subfloor with a wall or floor scraper to check for complete removal.

d. Adhesive around the edge of the room and area that were missed can be removed with dampened, clean, sharp, cutting sand and ground off with a rubbing stone.

e. Wet-scrape sand into a pile using a stiff-bladed floor or wall scraper and place sand and adhesive residue in a heavy-duty impermeable container and seal with ties or tape, and label "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only."

f. Rinse area with clean water using a hand sprayer or sprinkling can.

g. Wet vacuum standing water with the HEPA vacuum cleaner.

h. Continue steps a through g until the entire room is complete.

i. Allow subfloor to dry and vacuum with a HEPA vacuum cleaner.

j. After vacuuming, used HEPA filters and cleaner bags should be removed according to manufacturer's instructions and placed in a heavy-duty impermeable trash bag with a label stating — "Caution—contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only." Close and seal the trash bags securely for disposal.

5. COMPLETE REMOVAL OF WOOD UNDERLAYMENT

Complete Removal of Wood Underlayment Under Existing Sheet Flooring

• Definitions

a. Wood Subfloor - A subfloor is selected for structural purposes and is the substrate for the underlayment.

b. Wood Underlayment - This is the smooth surface that is selected to receive the resilient floor covering.

c. Wood Subfloor Underlayment Combination - This is the type of construction that must meet the structural requirements as well as have a suitable surface to receive the resilient floor covering.

• Supplies & tools

1. Chisel
2. Hammer or mallet

3. Short and long handled pry bars
4. Heavy gloves

5. Utility or hook knife
6. Stiff-bladed wall or floor scraper

7. Large-size heavy-duty impermeable trash bags (or closed impermeable container) with ties, tape, or string to tie the bag shut and tags for labeling
8. Tank-type High Efficiency Particulate Air (HEPA) wet/dry vacuum cleaner with disposable dust bags and metal floor tool (no brush)

9. Hand sprayer or sprinkling can
10. A liquid dishwashing detergent which is stated to contain anionic, nonionic, and amphoteric surfactant. Mix this specified liquid dishwashing detergent with water to make a dilute solution (16 oz. specified liquid dishwashing detergent to one gallon of water

... 6 mil polyethylene sheeting

12. Duct tape 

13. Ground fault circuit interrupter for electrical connection of the HEPA vacuum and any other electrical connections required.

• Removal of sheet flooring at underlayment joints

a. Remove any binding strips or other restrictive moldings from doorways, walls, etc.

b. Prepare the specified liquid dishwashing detergent solution (16 oz. of specified liquid dishwashing detergent to one gallon of water) and pour into a hand sprayer or sprinkling can.

c. Clean the entire floor with the HEPA vacuum cleaner using the metal floor tool.

d. Starting at the doorway or a floor ventilation vent, locate a joint in an underlayment board.

e. Make a series of parallel cuts 4" to 8" wide centered over the underlayment joint, through the top layer of the flooring and about halfway through the backing. Continue this procedure for all underlayment joints over the entire floor.

⚠ CAUTION

RESILIENT FLOORING BECOMES SLIPPERY WHEN WET WITH SPECIFIED LIQUID DISHWASHING DETERGENT SOLUTION. USE CAUTION TO CONTAIN THE SOLUTION, IN THE IMMEDIATE WORK AREA. STANDING ON A NEW SHEET OF PLYWOOD OR NONSLIP SURFACE WHILE WORKING IS RECOMMENDED.

f. One worker starts at the end of the room farthest from the entrance and pries up the corner of a strip, separating the backing from the wear layer. As the strip is being removed, another worker sprays a constant mist of the specified liquid dishwashing detergent solution into the delamination nip point to minimize any airborne dust particles. When done properly, the felt remaining on the floor and on the back of the strip will be thoroughly wet. Stand on the remaining floor covering or clean floor (do not stand on the felt). The cut strips should be peeled from the backing by pulling or rolling around a core which will control the stripping angle to create a uniform tension (some resilient flooring wear layers may not be readily strippable and may require wet-scraping). Tie or tape the removed material securely and place in the heavy-duty impermeable trash bag or closed impermeable container for disposal.

g. Remove and dispose of each succeeding strip in the above manner. Avoid walking on the exposed felt as much as possible. Close full bags tightly, and seal securely for disposal. Identify with a label stating: "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only."

h. Occasionally, parts of the top layer will stick to the backing. This can often be eliminated by peeling in the opposite direction. The stiff-bladed scraper may aid in the removal or peeling of the wear layer.

i. Wet-scraping residual felt:

(1) Throughly wet the residual felt with the specified liquid dishwashing detergent solution. Wait a few minutes to allow the specified liquid dishwashing detergent solution to soak into the felt.

(2) Stand on the remaining floor covering (not the felt) and use the stiff-bladed scraper to scrape up the wet felt.

(3) Rewet the felt if the specified liquid dishwashing detergent solution has not completely penetrated, if drying occurs, or if dry felt is exposed during scraping. Pick up the scrapings as they are removed from the floor and place in a heavy-duty impermeable trash bag or closed impermeable container. Wet-scrape all the felt from this 4" to 8" strip before proceeding to remove the next strip.

(4) When this 4" to 8" strip has been cleaned free of felt, vacuum up any dirt using the HEPA vacuum cleaner with the metal

...sition the vacuum cleaner so that the discharge air does not blow on the area being cleaned.

(5) Repeat steps (1) – (4) on the next strip.

(6) Repeat this operation until the felt has been removed from the 4" to 8" strips over all the underlayment joints. Close full bags tightly and seal securely for disposal. Identify with a label stating: "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is hazardous to Your Health. Dispose in an approved landfill only."

• Removal of wood underlayment boards

a. After all felt has been wet-scraped from the underlayment joints, drive a chisel, using a hammer or mallet, between the underlayment board and the subfloor. Use the chisel to pry up the underlayment enough to insert a pry bar and remove the chisel. Slowly and carefully use pry bars to pry up the underlayment board a little at a time until the board is completely loose and can be removed.

b. Caution must be used to avoid breaking the underlayment board. The underlayment board should be removed in one piece. If the underlayment board breaks, cut through the resilient flooring at the break and spray any exposed felt with the specified liquid dishwashing detergent solution. Allow the specified liquid dishwashing detergent solution to penetrate for a few minutes, then continue lifting the broken underlayment.

c. Wear heavy gloves and be careful of wood splinters and fasteners sticking out of the back of the underlayment. Each underlayment board (or piece of board) should be removed from the work area as soon as it has been pried up to avoid injuries (such as stepping on a nail). Fasteners protruding from removed board should be flattened with a hammer. Place removed underlayment boards on skids with the nails pointing downward. Wrap skid with 6-mil polyethylene plastic sheeting and secure with duct tape. Identify with a label stating: "Caution — contains asbestos. Avoid Opening or Breaking C tainer. Breathing Asbestos is Hazardou Your Health. Dispose in an approved la only."

d. After each panel has been removed, out any nails or fasteners still in the sul Dispose of these and any other nails or fasteners which have been removed but still laying in the work area.

e. A chisel is not needed to start the re of boards after the first board has been removed. Simply work the pry bar under exposed edge of the next board.

f. When removal of the underlayment un the existing floor is complete, thoroughly check the exposed subfloor. Renail loose areas and reset any "popped" nails or fasteners.

g. Vacuum up any dirt using the HEPA vacuum cleaner with the metal floor tool.

h. After vacuuming, used HEPA filters an cleaner bags should be removed accordin to the manufacturer's instructions and plac in a heavy-duty impermeable trash bag w a label stating "Caution—contains asbesto Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill onl Close and seal the trash bag securely for disposal.

i. After the wood subfloor is completely dry install the new underlayment and/or floor covering according to the manufacturer's installation instructions.

Complete Removal of Wood Underlayment Under Existing Tile

• Definitions

a. Wood Subfloor - A subfloor is selected fc structural purposes and is the substrate for the underlayment.

b. Wood Underlayment - This is the smooth surface that is selected to receive the resilie floor covering.

c. Wood Subfloor Underlayment Combinatior This is the type of construction that must

[illegible] requirements as well as have a suitable surface to receive the resilient floor covering.

• Supplies & tools

1. Chisel
2. Hammer or mallet
3. Short and long handled pry bars
4. Heavy gloves
5. Utility or hook knife
6. Large-size heavy-duty impermeable trash bags (or closed impermeable container) with ties, tape, or string to tie the bag shut and tags for labeling
7. Tank-type High Efficiency Particulate Air (HEPA) wet/dry vacuum cleaner with disposable dust bags and metal floor tool (no brush)
8. 6-mil polyethylene sheeting
9. Commercial-type hand-held hot air blower or a radiant heat source
10. Duct tape

• Removal of tile at underlayment joints

a. Remove any binding strips or other restrictive moldings from doorways, walls, etc.

b. Starting at the doorway or a floor ventilation vent, locate a joint in an underlayment board.

c. Start the removal of the tile at the underlayment joint by carefully wedging the scraper in the seam of two adjoining tiles and gradually forcing the edge of one of the tiles up and away from the floor. Do not break off pieces of the tile, but continue to force the balance of the tile up by working the scraper beneath the tile and exerting both a forward pressure and a twisting action of the blade to promote release of the tile from the adhesive and the floor. Continue to remove tile in this manner at all underlayment joints until all board joints are exposed.

d. When the first tile is removed, place it, without breaking it into smaller pieces, in the heavy-duty impermeable trash bag or closed impermeable container which will be used for disposal. Removed tiles can be placed in empty tile cartons first and then placed in the heavy-duty impermeable trash bags. To prevent tearing of the heavy-duty impermeable trash bag, place only one full carton of removed tile in a bag.

e. With the removal of the first tile, accessibility of the other tiles is improved. Force the scraper under the exposed edge of another tile, and continue to exert a prying, twisting force to the scraper as it is moved under the tile until the tile releases from the underlayment. Remove and dispose of each tile in the manner above. Avoid walking on the exposed adhesive as much as possible. Close full bags tightly and seal securely for disposal. Identify with a label stating: "Caution — contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only."

f. Some tiles will release quite easily while others require varying degrees of force. Where the adhesive is spread heavily or the tile is bonded tightly, it may prove easier to force the scraper through the tightly adhered areas by striking the scraper handle with a hammer, using blows of moderate force while maintaining the scraper at a 25° to 30° angle to the floor.

g. If you encounter areas where even the above methods will not remove the tiles, the removal procedure can be simplified by thoroughly heating the tiles with a hot-air blower or a radiant heat source until the heat penetrates through the tile and softens the adhesive.

NOTE: Handle the hot-air blower carefully to avoid injury. Do not use a blowtorch or open flame. Use caution not to burn or char the tile. Use adequate ventilation.

• Removal of wood underlayment boards

a. After all the tiles have been removed from the underlayment joints, drive a chisel, using a hammer or a mallet, between the underlayment board and the subfloor. Use the chisel to pry up the underlayment enough to insert a pry bar and remove the chisel. Slowly and carefully use pry bars to pry up the underlayment board a little at a time until the board is completely loose and can be removed.

b. Caution must be used to avoid breaking the underlayment board. The underlayment board should be removed in one piece. If the underlayment board breaks, heat and cut the tile at the break, then continue to remove broken underlayment.

c. Wear heavy gloves and be careful of wood splinters and fasteners sticking out of the back of the underlayment. Each underlayment board (or piece of board) should be removed from the work area as soon as it has been pried up to avoid injuries (such as stepping on a nail). Fasteners protruding from removed board should be flattened with a hammer. Place removed underlayment boards on skids with the nails pointing downward. Wrap skid with 6-mil polyethylene plastic sheeting and secure with duct tape. Identify with a label stating: "Caution — contains asbestos. Avoid Opening or Breaking Container Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only."

d. After each board has been removed, pull out any nails or fasteners still in the subfloor. Dispose of these and any other nails or fasteners which have been removed but are still laying in the work area.

e. A chisel is not needed to start the removal of boards after the first board has been removed. Simply work the pry bar under the exposed edge of the next board.

f. When removal of the underlayment under the existing floor is complete, thoroughly check the exposed subfloor. Renail loose areas and reset any "popped" nails or fasteners.

g. Vacuum up any dirt in the area using the HEPA vacuum cleaner with the metal floor tool.

h. After vacuuming, used HEPA filters and cleaner bags should be removed according to manufacturer's instructions and placed in a heavy-duty impermeable trash bag with a label stating — "Caution"—contains asbestos. Avoid Opening or Breaking Container. Breathing Asbestos is Hazardous to Your Health. Dispose in an approved landfill only." Close and seal the trash bags securely for disposal.

i. After the floor is completely dry, install the new underlayment and/or floor covering according to the manufacturer's installation instructions.

ANALYSIS OF IHI DATA ON EXPOSURE OF FLOOR MECHANICS AND OBSERVER TO ASBESTOS CONCENTRATIONS DURING SHEET FLOORING REMOVAL

Phase-Contrast Microscopy

Date	Survey Location	Job Site	Sample Type	Sample ID	Duration (min)	Volume (liters)	Filter Density (f/sq mm)	Asbestos Concentr (f/cc)	Background (f/cc)	Net Conc. (f/cc)	8-hr TWA (f/cc)	Excursion Limit
08/01/89	Lancaster, PA	ARMSTRONG	WORKER	ARM2-W01	363	700	21.656	0.0119	0.0052	0.0067	0.0051	0.0811
08/01/89		INSTALLATION	WORKER	ARM2-W03	362	706	26.752	0.0146	0.0052	0.0094	0.0071	0.1132
08/01/89		TRAINING	OBSERVER	ARM2-W05	313	610	11.465	0.0072	0.0052	0.0020	0.0013	0.0212
08/02/89		CENTER	WORKER	ARM2-W07	373	727	26.115	0.0138	0.0052	0.0086	0.0067	0.1072
08/02/89		ROOM 101	WORKER	ARM2-W09	366	714	24.841	0.0134	0.0052	0.0082	0.0062	0.0999
08/02/89			OBSERVER	ARM2-W11	354	690	17.834	0.0100	0.0052	0.0047	0.0035	0.0560
08/02/89			OUTDOOR	ARM2-T01	411	801	10.828	0.0052	0.0052	0.0000	0.0000	
09/12/89	Lancaster, PA	ARMSTRONG	OUTDOOR	ARM4-T01	363	740	0.000 *	0.0000	0.0000	0.0000	0.0000	
09/12/89		HOUSE NORTH	WORKER	ARM4-W01	343	697	52.229	0.0288	0.0000	0.0288	0.0206	0.3298
09/12/89		ROOM 108	WORKER	ARM4-W03	330	666	26.752	0.0155	0.0000	0.0155	0.0106	0.1701
09/12/89			OBSERVER	ARM4-W05	342	688	18.471	0.0103	0.0000	0.0103	0.0074	0.1178
09/13/89	Lancaster, PA	RINEER	OUTDOOR	ARM6-T01	381	762	0.000 *	0.0000	0.0000	0.0000	0.0000	
09/13/89		RESIDENCE	WORKER	ARM6-W01	405	826	21.656	0.0112	0.0000	0.0112	0.0095	0.1512
09/13/89			WORKER	ARM6-W03	402	824	19.745	0.0102	0.0000	0.0102	0.0086	0.1373
09/13/89			OBSERVER	ARM6-W05	393	794	12.739	0.0069	0.0000	0.0069	0.0056	0.0901
09/27/89	Nashville, TN	JONES	OUTDOOR	OUT-26	413	859	0.000 *	0.0000	0.0000	0.0000	0.0000	
09/27/89		RESIDENCE	WORKER	W-19	390	791	55.414	0.0292	0.0000	0.0292	0.0237	0.3798
09/27/89			WORKER	W-21	390	799	46.497	0.0243	0.0000	0.0243	0.0197	0.3155
09/27/89			OBSERVER	O-23	390	791	34.395	0.0181	0.0000	0.0181	0.0147	0.2358
10/10/89	Plainfield, IL	BIERNAT	WORKER	PF-05	157	318	90.446	0.1095	0.0000	0.1095	0.0358	0.5731
10/10/89		RESIDENCE	WORKER	PF-07	156	317	119.745	0.1454	0.0000	0.1454	0.0473	0.7562
10/10/89			OBSERVER	PF-10	173	351	100.000	0.1097	0.0000	0.1097	0.0395	0.6325
10/10/89			OUTDOOR	PF-14	154	316	0.000 *	0.0000	0.0000	0.0000	0.0000	
10/11/89	Warrenville, IL	MORGAN	WORKER	W-05	260	525	50.300	0.0369	0.0042	0.0326	0.0177	0.2830
10/11/89		RESIDENCE	WORKER	W-07	257	519	50.300	0.0373	0.0042	0.0331	0.0177	0.2834
10/11/89			OBSERVER	W-09	266	540	48.400	0.0345	0.0042	0.0303	0.0168	0.2684

ANALYSIS OF IHI DATA ON EXPOSURE OF FLOOR MECHANICS AND OBSERVER TO ASBESTOS CONCENTRATIONS DURING SHEET FLOORING REMOVAL

Phase-Contrast Microscopy

Date	Survey Location	Job Site	Sample Type	Sample ID	Duration (min)	Volume (liters)	Filter Density (f/sq mm)	Asbestos Concentr (f/cc)	Background (f/cc)	Net Conc. (f/cc)	8-hr TWA (f/cc)	Excursion Limit
10/11/89			OUTDOOR	W-13	357	746	8.210	0.0042	0.0042	0.0000	0.0000	
10/17/89	Yardley, PA	KASACAVAGE	OBSERVER	YD-07	383	762	43.949	0.0222	0.0000	0.0222	0.0177	0.2835
10/17/89		RESIDENCE	WORKER	YD-09	374	752	64.331	0.0329	0.0000	0.0329	0.0257	0.4106
10/17/89			WORKER	YD-11	372	752	56.688	0.0290	0.0000	0.0290	0.0225	0.3599
10/17/89			OUTDOOR	YD-13	436	881	0.000 *	0.0000	0.0000	0.0000	0.0000	
10/19/89	Morrisville, PA	SENIOR	WORKER	SR-05	247	496	83.439	0.0648	0.0000	0.0648	0.0333	0.5332
10/19/89		RESIDENCE	WORKER	SR-07	230	458	94.904	0.0798	0.0000	0.0798	0.0382	0.6116
10/19/89			OBSERVER	SR-09	245	495	70.701	0.0550	0.0000	0.0550	0.0281	0.4491
10/19/89			OUTDOOR	SR-13	316	648	0.000 *	0.0000	0.0000	0.0000	0.0000	
10/24/89	Fairless	SIMON	WORKER	FL-05	321	644	83.439	0.0499	0.0000	0.0499	0.0334	0.5337
10/24/89	Hills, PA	RESIDENCE	WORKER	FL-07	317	640	73.885	0.0444	0.0000	0.0444	0.0294	0.4697
10/24/89			OBSERVER	FL-09	314	634	46.497	0.0282	0.0000	0.0282	0.0185	0.2955
10/24/89			OUTDOOR	FL-13	404	816	0.000 *	0.0000	0.0000	0.0000	0.0000	
10/26/89	Yardley, PA	SMITH	WORKER	Y-05	367	732	100.637	0.0529	0.0000	0.0529	0.0405	0.6475
10/26/89		RESIDENCE	WORKER	Y-07	367	741	140.687	0.0731	0.0000	0.0731	0.0559	0.8942
10/26/89			OBSERVER	Y-09	374	750	103.822	0.0533	0.0000	0.0533	0.0415	0.6644
10/26/89			OUTDOOR	Y-13	362	726	0.000 *	0.0000	0.0000	0.0000	0.0000	
10/31/89	Kearney, MO	HAYES	WORKER	K-05	393	811	232.774	0.1105	0.0000	0.1105	0.0905	1.4476
10/31/89		RESIDENCE	WORKER	K-07	392	803	197.942	0.0949	0.0000	0.0949	0.0775	1.2401
10/31/89			OBSERVER	K-09	392	811	227.480	0.1080	0.0000	0.1080	0.0882	1.4111
10/31/89			OUTDOOR	K-13	430	893	0.000 *	0.0000	0.0000	0.0000	0.0000	
11/02/89	North Kansas	EBLING	WORKER	NK-05	407	829	127.389	0.0592	0.0000	0.0592	0.0502	0.8026
11/02/89	City, MO	DISTRIBUTORS	WORKER	NK-07	406	831	126.752	0.0587	0.0000	0.0587	0.0497	0.7947
11/02/89			OBSERVER	NK-09	399	814	78.981	0.0374	0.0000	0.0374	0.0311	0.4968
11/02/89			OUTDOOR	NK-13	448	911	0.000 *	0.0000	0.0000	0.0000	0.0000	

ANALYSIS OF IHI DATA ON EXPOSURE OF FLOOR MECHANICS AND OBSERVER TO ASBESTOS CONCENTRATIONS DURING SHEET FLOORING REMOVAL

Phase-Contrast Microscopy

Date	Survey Location	Job Site	Sample Type	Sample ID	Duration (min)	Volume (liters)	Filter Density (f/sq mm) %	Asbestos Concentr (f/cc)	Background @ (f/cc)	Net Conc. (f/cc)	8-hr TWA (f/cc)	Excursion Limit $
11/14/89	Lancaster, PA	BODINE	WORKER	LAN-05	154	313	36.306	0.0447	0.0000	0.0447	0.0143	0.2292
11/14/89		RESIDENCE	WORKER	LAN-07	148	295	27.389	0.0357	0.0000	0.0357	0.0110	0.1763
11/14/89		(FLOORBOARD	OBSERVER	LAN-09	155	313	35.032	0.0431	0.0000	0.0431	0.0139	0.2226
11/14/89		REMOVAL)	OUTDOOR	LAN-13	194	392	0.000 *	0.0000	0.0000	0.0000	0.0000	
11/15/89	Lancaster, PA	ARMSTRONG	WORKER	AIC-05	361	724	27.389	0.0146	0.0000	0.0146	0.0110	0.1753
11/15/89		INNOVATION	WORKER	AIC-07	366	733	17.834	0.0094	0.0000	0.0094	0.0071	0.1143
11/15/89		CENTER	OBSERVER	AIC-09	362	734	8.917	0.0047	0.0000	0.0047	0.0035	0.0564
11/15/89			OUTDOOR	AIC-13	387	782	0.000 *	0.0000	0.0000	0.0000	0.0000	
11/28/89	Roanoke, VA	MARTIN	WORKER	R-05	382	789	89.809	0.0438	0.0000	0.0438	0.0349	0.5580
11/28/89		RESIDENCE	WORKER	R-07	376	781	80.892	0.0399	0.0000	0.0399	0.0312	0.4998
11/28/89			OBSERVER	R-09	374	774	87.898	0.0437	0.0000	0.0437	0.0341	0.5451
11/28/89			OUTDOOR	R-13	499	1028	0.000 *	0.0000	0.0000	0.0000	0.0000	
11/29/89	Salem, VA	ESPERTI	WORKER	RV-05	113	235	135.520	0.2220	0.0000	0.2220	0.0523	0.8363
11/29/89		RESIDENCE	WORKER	RV-07	113	232	51.592	0.0856	0.0000	0.0856	0.0202	0.3225
11/29/89			OBSERVER	RV-09	109	222	71.975	0.1248	0.0000	0.1248	0.0283	0.4535
11/29/89			OUTDOOR	RV-13	105	220	0.000 *	0.0000	0.0000	0.0000	0.0000	

* Less than analytical sensitivity. For outdoor samples, the concentration was assumed equal to zero to provide the most conservative estimate.

Estimate only, pump stopped running during the night.

@ Background values for each job are based on the concentration of outdoor sample.

% Filter density is calculated by RJ Lee as the number of fibers detected (quantity not reported) times the filter area analyzed

ANALYSIS OF IMI DATA ON EXPOSURE OF FLOOR MECHANICS AND OBSERVER TO ASBESTOS CONCENTRATIONS DURING SHEET FLOORING REMOVAL

Transmission Electron Microscopy &

Date	Survey Location	Job Site	Sample Type	Sample ID	Duration (min)	Volume (liters)	Asbestos Filter Density (str/sq mm)	Asbestos Concentr (str/cc)	# Qual. Asbest Struc	Qualifyng Asbestos (str/cc)
08/01/89	Lancaster, PA	ARMSTRONG	WORKER	ARM2-W02	362	496	395.800	0.3071	3	0.0328
08/01/89		INSTALLATION	WORKER	ARM2-W04	362	706	212.000	0.1156	4	0.0308
08/01/89		TRAINING	OBSERVER	ARM2-W06	314	612	56.500	0.0355	0	0.0000
08/02/89		CENTER	WORKER	ARM2-W08	376	612	423.900	0.2667	6	0.0532
08/02/89		ROOM 101	WORKER	ARM2-W10	366	501	183.700	0.1412	1	0.0108
08/02/89			OBSERVER	ARM2-W12	354	690	141.300	0.0788	1	0.0079
09/12/89	Lancaster, PA	ARMSTRONG	WORKER	ARM4-W02	341	698	91.600	0.0505	1	0.0084
09/12/89		HOUSE NORTH	WORKER	ARM4-W04	327	668	15.300 *	0.0088	0	0.0000
09/12/89		ROOM 108	OBSERVER	ARM4-W06	339	682	15.300	0.0086	0	0.0000
09/13/89	Lancaster, PA	RINEER	WORKER	ARM6-W02	403	822	244.300	0.1270	2	0.0143
09/13/89		RESIDENCE	WORKER	ARM6-W04	401	826	45.800	0.0237	0	0.0000
09/13/89			OBSERVER	ARM6-W06	392	784	213.700	0.1169	1	0.0075
09/27/89	Nashville, TN	JONES	WORKER	W-18	390	799	381.700	0.1839	2	0.0147
09/27/89		RESIDENCE	WORKER	W-20	390	791	717.600	0.3493	7	0.0521
09/27/89			OBSERVER	O-22	390	791	442.700	0.2155	1	0.0074
10/10/89	Plainfield, IL	BIERNAT	WORKER	PF-06	156	315	137.400	0.1679	3	0.0561
10/10/89		RESIDENCE	WORKER	PF-08	154	313	106.900	0.1315	2	0.0376
10/10/89			OBSERVER	PF-11	171	347	91.600	0.1016	3	0.0509
10/11/89	Warrenville, IL	MORGAN	WORKER	W-06	257	519	122.100	0.0906	0	0.0000
10/11/89		RESIDENCE	WORKER	W-08	256	517	274.800	0.2046	1	0.0114
10/11/89			OBSERVER	W-10	265	533	45.800	0.0331	0	0.0000
10/17/89	Yardley, PA	KASACAVAGE	OBSERVER	YD-08	381	766	685.500	0.3445	7	0.0524
10/17/89		RESIDENCE	WORKER	YD-10	376	752	1028.300	0.5265	5	0.0381
10/17/89			WORKER	YD-12	370	729	1028.300	0.5431	5	0.0393

ANALYSIS OF INI DATA ON EXPOSURE OF FLOOR MECHANICS AND OBSERVER TO ASBESTOS CONCENTRATIONS DURING SHEET FLOORING REMOVAL

Transmission Electron Microscopy

Date	Survey Location	Job Site	Sample Type	Sample ID	Duration (min)	Volume (liters)	Asbestos Filter Density (str/sq mm)	Asbestos Concentr (str/cc)	# Qual. Asbest Struc	Qualifyng Asbestos (str/cc)
10/19/89	Morrisville, PA	SENIOR	WORKER	SR-06	246	490	968.700	0.7611	6	0.0702
10/19/89		RESIDENCE	WORKER	SR-08	250	458	506.700	0.4259	3	0.0376
10/19/89			OBSERVER	SR-10	244	488	402.400	0.3175	1	0.0118
10/24/89	Fairless	SIMON	WORKER	FL-06	319	640	715.400	0.4304	6	0.0538
10/24/89	Hills, PA	RESIDENCE	WORKER	FL-08	316	634	1132.600	0.6878	13	0.1176
10/24/89			OBSERVER		NOT ANALYZED					
10/26/89	Yardley, PA	SMITH	WORKER	Y-06	367	741	119.200	0.0619	0	0.0000
10/26/89		RESIDENCE	WORKER	Y-08	366	719	163.900	0.0878	0	0.0000
10/26/89			OBSERVER	Y-10	NOT ANALYZED					
10/31/89	Kearney, MO	HAYES	WORKER	K-06	392	798	736.100	0.3551	5	0.0362
10/31/89		RESIDENCE	WORKER	K-08	393	800	886.300	0.4265	10	0.0722
10/31/89			OBSERVER		NOT ANALYZED					
11/02/89	North Kansas	EBLING	WORKER	NK-06	409	824	105.200	0.0492	1	0.0070
11/02/89	City, MO	DISTRIBUTORS	WORKER	NK-08	406	821	856.200	0.4015	5	0.0352
11/02/89			OBSERVER		NOT ANALYZED					
11/14/89	Lancaster, PA	BODINE	WORKER	LAN-06	153	316	14.900 *	0.0182	0	0.0000
11/14/89		RESIDENCE	WORKER	LAN-08	148	293	14.900	0.0196	0	0.0000
11/14/89		FLOOR REMOVL	OBSERVER	LAN-10	156	309	14.900	0.0186	0	0.0000
11/15/89	Lancaster, PA	ARMSTRONG	WORKER	AIC-06	368	736	45.100	0.0236	2	0.0157
11/15/89		INNOVATION	WORKER	AIC-08	366	730	15.000 *	0.0079	0	0.0000
11/15/89		CENTER	OBSERVER		NOT ANALYZED					
11/28/89	Roanoke, VA	MARTIN	WORKER	R-06	383	786	270.600	0.1324	1	0.0073

ANALYSIS OF IHI DATA ON EXPOSURE OF FLOOR MECHANICS AND OBSERVER TO ASBESTOS CONCENTRATIONS DURING SHEET FLOORING REMOVAL

Transmission Electron Microscopy

Date	Survey Location	Job Site	Sample Type	Sample ID	Duration (min)	Volume (liters)	Asbestos Filter Density (str/sq mm) &	Asbestos Concentr (str/cc)	Qual. Asbest Struc #	Qualifying Asbestos (str/cc)
11/28/89		RESIDENCE	WORKER	R-08	375	763	285.400	0.1440	2	0.0151
11/28/89			OBSERVER		NOT ANALYZED					
11/29/89	Salem, VA	ESPERTI	WORKER	RV-06	112	230	90.100	0.1508	0	0.0000
11/29/89		RESIDENCE	WORKER	RV-08	114	234	15.000	0.0247	0	0.0000
11/29/89			OBSERVER		NOT ANALYZED					

& Asbestos Filter Density - This value is calculated from RJ Lee data by multiplying the observed number of chyrsotile or amphibole structures by the analytical sensitivity (limit of detection). Analytical sensitivity is equal to the inverse of the analyzed area in sq mm.

QUALIFYING ASBESTOS STRUCTURES - All fibers deemed to be asbestos that are 5 um or more in length, but are of any width. This will count more thin fibers, which would increase the total count, however, it does not consider nonasbestos fibers that meet these criteria.

* Less than analytical sensitivity. Since background values were not used in calculating concentration in structures/cc, these values indicate the detection limit level.