DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

NATIONAL INSTITUTE FOR OCCUPATIONAL
SAFETY AND HEALTH
5600 FISHERS LANE
ROCKVILLE, MARYLAND 20852

August 8, 1975

Dear Colleague:

This communication is intended to alert you to recently gathered information indicating a potential health hazard for persons exposed to asbestos during the servicing of motor vehicle brake and clutch assemblies.

On July 21, 1975, the National Institite for Occupational Safety and Health convened a meeting of government and university scientists, industry representatives, and labor union officials to discuss the present state of knowledge with respect to this problem. Data was presented by investigators from the Mount Siani School of Medicine in New York City indicating that workers engaged in the maintenance and repair of automobile and truck brake linings are exposed to potentially hazardous levels of airborne asbestos dust. Specific brake servicing operations studied included blow-out of automobile drum brake assemblies, grinding of used truck brake linings, and bevelling of new truck brake linings. Average peak asbestos air concentrations for these three activities based on personal samples taken within ten feet of the operator were, respectively, 10.5, 3.75, and 37.3 fibers (>5 microns in length) per ml. An analysis of samples of brake drum dust revealed that almost all of the asbestos fibers found were shorter than 0.4 microns in length.

Previous studies of the extent of asbestos emissions from automobile brake lining wear showed that only a very small fraction of the original asbestos content of the brake lining is found in brake drum dust (Ref. 1-3). It was presumed that this is due to thermal degradation of the fibers during braking. The present findings indicate that enough asbestos is preserved to produce significant exposures during certain brake servicing procedures.

The full extent of asbestos-related disease in brake servicing personnel is not known at present because this particular occupational group has not been studied systematically up to now. However, a review of the scientific literature on the association between asbestos exposure and mesothelial tumors of the pleura and peritoneum has revealed at least four cases of these rare tumors in persons who were employed in jobs involving automobile brake servicing (Ref. 4-6).

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For your information and guidance, we are enclosing pertinent references, estimates of the population at risk, a NIOSH interim recommendation for brake and clutch servicing procedures, and a copy of the Department of Labor standard covering exposure to asbestos in the work place.

The environmental studies of brake lining servicing operations outlined above together with observations of mesothelial tumors in persons so employed affirms the necessity for instituting and maintaining recommended control measures in this industry so that the health hazards of asbestos are minimized.

Sincerely yours,

J. William Lloyd

J. William Lloyd, Sc.D.
Director
Office of Occupational Health
Surveillance and Biometrics

Enclosures

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4. Newhouse, M.L. and Thompson, H.: Mesothelioma of Pleura and Peritoneum Following Exposure to Asbestos in the London Area. Brit J Ind Med, 22:261-69, 1965

5. McDonald, A.D. et al.: Epidemiology of Primary Malignant Mesothelial Tumors in Canada. Cancer, 26:914-19, 1970

6. Greenberg, M. and Lloyd Davies, T.A.: Mesothelioma Register 1967-1968. Brit J Ind Med, 31:91-104, 1974

ESTIMATES OF THE WORKFORCE POTENTIALLY EXPOSED TO ASBESTOS IN THE MANUFACTURING AND SERVICING OF BRAKE LININGS AND CLUTCHES

Auto Mechanics	833,535
Garage Workers	67,679
Manufacture (original and rebuilding)	6,657
TOTAL	907,871

SOURCE: Adapted from 1972 Census of Manufacturers, 1972 County Business Patterns, and Census of Population: 1970 Occupation by Industry (all are Department of Commerce, Census Bureau publications)

RECOMMENDED (INTERIM) PROCEDURES FOR
ASBESTOS BRAKE AND CLUTCH SERVICING

The National Institute for Occupational Safety and Health (NIOSH) has research underway concerning dust exposures during brake and clutch servicing. Due to preliminary data demonstrating significant asbestos exposures during presently used brake and clutch servicing techniques, NIOSH has reviewed alternate techniques whereby asbestos exposures are reduced. The following are interim procedures recommended by NIOSH to minimize dust exposures.

1. If possible, an area shall be designated for all brake and clutch repairs. Entrances into this area shall be posted with an asbestos exposure warning sign as follows:

Asbestos
Dust Hazard
Avoid Breathing Dust
Wear Assigned Protective Equipment
Do Not Remain in Area Unless Your Work Requires It
Breathing Asbestos Dust May Cause Asbestosis and Cancer

2. During brake servicing, an air purifying respirator, either single use or with replaceable particulate filter(s), as approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or NIOSH, shall be worn during all procedures starting with the removal of the wheels and including reassembly. During manual clutch servicing, such a respirator shall be worn during removal and cleaning of the clutch, pressure plate and housing assembly and during installation of the new clutch assembly.

3. Dust shall first be cleaned from brake drums, brake backing plates, brake assemblies and clutch assemblies using an industrial type vacuum cleaner equipped with a high efficiency filter system (>99% efficiency for 0.3 μm diameter aerosols). After vacuum cleaning, any remaining dust shall be removed using a rag soaked in water and wrung until nearly dry. Under no circumstances shall compressed air or dry brushing be used for cleaning.

4. During arcing and riveting operations, an approved respirator, as described in (2) above, shall be worn. Grinding (arcing) machines shall be provided with local exhaust ventilation such that worker exposures are maintained at least below the 1976 OSHA asbestos standard (29 CFR 1910.1001).* At a minimum, the dust bag of the arcing machine shall be removed and replaced with the hose of the high efficiency industrial vacuum described in (3) above.

5. Industrial vacuum cleaner bags containing asbestos dust, and cloths used for wiping brake and clutch assemblies shall be sealed in plastic bags and labeled with the following warning label printed in letters of sufficient size and contrast to be readily visible and legible;

Caution
Contains Asbestos Fibers
Avoid Breathing Dust
Breathing Asbestos Dust May Cause Asbestosis and Cancer

All asbestos waste shall be disposed of in accordance with the OSHA asbestos regulation, 29 CFR 1910.1001(h). During removal of vacuum bags, an approved respirator, as described in (2) above, shall be worn.

6. All floor cleaning in areas where brakes and clutches are repaired shall be done with the high efficiency industrial vacuum cleaner as described in (3) above. Grinding (arcing) machines shall also be cleaned with such a vacuum cleaner and any remaining dust wiped with a damp cloth. An approved respirator, as described in (2) above, shall be used during this cleaning.

7. Although adherence to the above procedures should minimize any contamination of work clothing, it is required that the appropriate portions of the OSHA regulations on asbestos (29 CFR 1910.1001(d), (3 and 4)) concerning special clothing, change rooms, etc. be followed.

NOTE: Strict adherence to the above procedures should minimize exposures to mechanics during brake and clutch servicing. These are interim recommendations and are subject to revision pending results of ongoing NIOSH research.

* Section 1910.1001 of the <u>Code of Federal Regulations</u> was formerly Section 1910.93a. This change was noted in the Federal Register, May 28, 1975.

Prepared By
Division of Field Studies and Clinical Investigations
National Institute for Occupational Safety and Health
Cincinnati, Ohio

Recommended Procedures for Sampling and Counting Asbestos Fibers

Procedures for the Evaluation of Occupational Exposures to Airborne Asbestos

Joint AIHA-ACGIH Aerosol Hazards Evaluation Committee

FIBROUS ASBESTOS HAS BEEN IDENTIFIED as the causative agent of asbestosis and has been associated with an increased cancer incidence. The American Conference of Governmental Industrial Hygienists (ACGIH) has established (1974) a Threshold Limit Value (TLV) for asbestos of 5 fibers greater than 5 micrometers in length per milliliter of air. A TLV footnote specifies the determination shall be made by the membrane filter method at 400× to 450× magnification and with phase contrast illumination. These procedures define a standard of sampling and of processing the collected samples in order to evaluate occupational exposure to asbestos fibers.

Sampling

Airborne samples of asbestos must be collected on membrane filters which retain at the surface essentially all of the particles in excess of 0.5 μm in diameter. The filter must be rendered transparent by the mounting medium. The filter should be packed in a sealed holder which is capable of being readily opened for sampling purposes and of being resealed after the sample has been collected. The filter must be fully exposed during sampling. (Recommended filters and filter holders are listed under **Supplies**). The filter must be practically dust-free, with an average background count of less than 25 fibers per square centimeter. At least 2% to 4% of the filters intended for collecting samples should be set aside to determine the background count. (See **Counting** and **Calculations** sections). In addition, the filter resistance should not exceed 3 mm of mercury when filtering air at the rate of 0.3 liters per minute (lpm) per square centimeter of filter.

When collecting the sample, care must be taken to prevent dust from falling or from being projected onto the open filter. This may be accomplished by pointing the filter head downward. A guard or shroud should be attached to the filter holder to further protect the open filter from contamination as well as optimize uniform deposition on the filter. Its diameter should be about the same as the holder so that it can be attached tightly to it and it should project at least 1½ times the filter diameter in front of it. A protective device is particularly important if the filter head is to rest on contaminated clothing. (See Figure 1.) The filter holder may be stored for a limit of six months once it is resealed.

The sample should not be too dense, since samples in which particles overlap must be rejected as uncountable. Similarly, a large enough volume of air should be sampled so that there are sufficient numbers of fibers in each field. Experience indicates that more than 150 particles per field, including non-fibrous background, may interfere with counting the sample. It is desirable that there be no more than 10 fibers per field. Two or three samples should be collected at each sampling location. The results should

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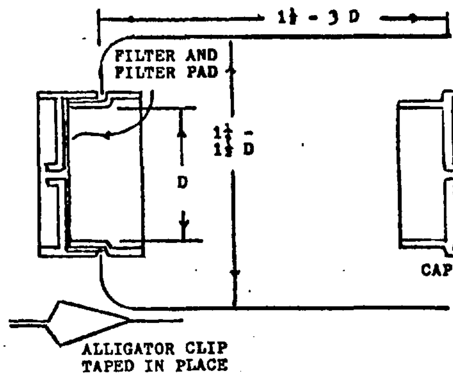

Figure 1. Diagram of shroud for membrane filter holder. The shroud may be constructed from a plastic bottle by cutting off the neck and drilling a hole in the bottom. To use, push the filter holder through the hole and reach in through the top to remove the holder cap. To remove the holder, replace the cap and push the filter holder forward through the hole.

be averaged to obtain the fiber concentration.

Breathing zone samples should reflect the worker's entire normal work day. They must be collected as close to the worker's nose and over as long a time period as possible. Calibrated battery powered personal pumps (see Appendix III, Pump Calibration) are satisfactory air movers. They can be worn by the worker and supported at the belt by means of a clip. The sampling head, which can be pinned to the collar, is connected to the pump by flexible tubing. Such pumps can be operated continuously for about eight hours and recharged overnight.

If a 37-mm filter is used to collect the sample, the pump should be adjusted to sample between 1 and 2 liters per minute. The volume of air sampled should be adjusted so that an optimum density of dust is collected on the filter. Since the dust concentration is not known before sampling, the optimal sampling period must be determined by trial and error. It is suggested that, unless experience indicates otherwise, the first sample should be collected from 20 liters of air, the second from 40 and the third from 80 liters. If a filter other than 37-mm is used, the volume of air sampled should be altered in direct proportion to the open filter area. Samples collected during ~~short~~ periods of exposure should be collected at a high flow rate and if necessary, for the entire exposure period. In all cases the count should be adjusted with regard to time, so that the exposure is expressed as an 8-hour time-weighted average exposure. For compliance evaluations with short term exposures, 37-mm filters samples should be collected for 15 minutes at a minimum of 2 lpm.

Sample Preparation

A solution one-to-one by volume of dimethyl phthalate and diethyl oxylate in which has been dissolved 50 milligrams of membrane filter material per milliliter of solution is the preferred counting medium. The chemicals used to prepare the medium should be examined microscopically to be certain that they are dust free. The fiber material to be dissolved should not be marked and should have a maximum background count of 25 fibers per square centimeter of filter. The counting medium may be stored in a wide-mouthed Wheaton Balsam bottle and should be applied with a glass rod. The counting medium has a refractive index of 1.461 at 25°C. The medium should be made in small quantities since it has a 6 month shelf life.

Asbestos fibers are counted on wedge shaped sections cut from the filter. The wedge should be reasonably sized so that it can be mounted on a 25 x 75 mm (1 x 3 inch) glass microscope slide. The slide should be cleaned of dust before it is used. A drop or two of counting medium is placed on the slide and the filter wedge is placed dust side up on top of the medium. The wedge is covered by a No. 1½ coverslip. Care must be taken while lowering the coverslip to avoid trapping air under it. Air bubbles may be forced out by exerting slight pressure on the cover slip with a pencil eraser. Extreme care must be taken to avoid

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too much pressure, since this causes distortion and stretching in the filter.

The wedge is usually cleared within 15 minutes; however, a residual background granularity may be noted. This will disappear within a day. Counts must be completed within two days since there is a tendency for fiber migration and crystal growth. The prepared medium should be checked periodically for a background count. (See **Counting** and **Calculations** sections.)

An alternate medium may be used when the samples must be counted immediately. It is prepared in the same manner as the preferred viscous medium, except that the added membrane filter is omitted. Since this medium is much less viscous it should be stored in narrow-mouthed bottles. This medium is applied with a glass dropper after the filter wedge has been placed dust side up on the slide. However, a drop should be placed on the slide adjacent to but not on top of each corner of the wedge. This medium acts very rapidly and the No. 1½ coverglass should be lowered within a minute. Slides made up with this "alternate medium" are ready for counting within five minutes and the count must be completed within two hours after preparation.

Filters which have been used to collect samples and which have been resealed in a holder should be removed only in a clean environment. They should not be held with the fingers. They may be held with tweezers and cut with either a scalpel or scissors. Bottles containing media must be tightly closed except during use. All bottles, tools used for handling and cutting filters, and containers used for storing tools must be thoroughly cleaned and dried. Tweezers, scissors, scalpels, etc. should be set aside for this purpose exclusively. Although slides and coverslips are purchased pre-cleaned, they should be wiped lightly with clean lens tisue to remove traces of dust. Do not attempt to reuse slides or coverslips.

Microscope

A microscope equipped with a phase contrast substage condenser, a 4 mm "high dry" phase-contrast objective (40× to 45×) and a 10× eyepiece is used to count the sample. It should have either a pre-focused built-in illuminator supplied with an iris diaphragm or be lighted by a separate bright illuminator-flat mirror combination. If a separate illuminator is used it should be equipped with a condensing lens, iris diaphragm, and means for adjusting both the illuminator level and the distance between the condensing lens and the bulb. Zoom microscopes may be used for counting asbestos fibers, provided that the total magnification is within the 400-450× range.

The illuminator should be equipped with an adjustable constant voltage transformer. Both the microscope condenser and stage require close adjustment and both should be rack and pinion mounted. The stage must move along two perpendicular axes in a horizontal plane, while the condenser must move up and down in a vertical plane. Lighting must be adjusted for optimum balance. The Kohler method of illumination is recommended. (See Appendix I for procedures required to establish Kohler illuminator.)

The counting field is defined by a reticle mounted at the level of the field-limiting diaphragm in the 10× eyepiece. The Porton reticle (Figure 2) is recommended. However, any reticle which contains markings which, in addition to outlining an area of about 0.005 square millimeters, as determined by

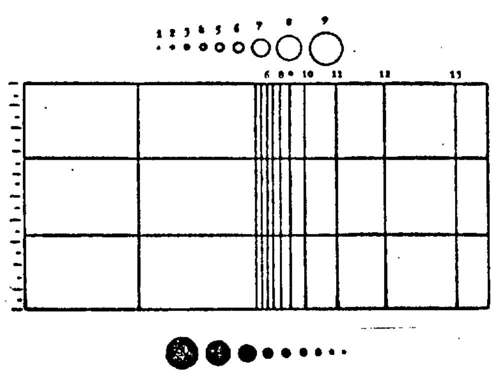

Figure 2. Porton reticle.

the combination of eyepiece and objective, and which defines linear distances that may serve as measuring aids, is satisfactory. The reticle must be calibrated prior to use and recalibrated each time it is removed from the microscope eyepiece or when the microscope tube length or interpupillary distance is changed. Zoom microscopes must be recalibrated each time the zoom position is changed. (See Appendix II for recommended calibration procedures.)

Counting

A fiber is defined as a particle whose length is at least three times greater than its diameter. All fibers longer than 5 μm within the area delineated by the reticle, or which enter it from either of two adjacent sides, are counted. Fibers entering the area from either of the other two sides, *i.e.*, those not arbitrarily chosen as "counting" sides are not counted, nor fibers in excess of 5 μm in diameter. Touching fibers, *i.e.*, one of whose ends touch another fiber regardless of the resulting angle, are considered as one. Fibers that cross each other are counted individually. Fibers that pass through the delineated area are counted provided that they cross at least one of the arbitrarily chosen "counting" sides. (See Figure 3.)

Fiber length should be determined by measuring against standards such as a circle or a space defined by markings on the calibrated reticle. If the fiber is curved or wavy the total length should be estimated by measuring along the curve. Once sufficient experience has been gained in judging length, only fibers whose length or diameter are in question need be measured.

A routine for choosing counting fields must be selected so that fields are not counted more than once and that a representative fraction of the total filter area is viewed. A convenient procedure which may be used is to select a series of microscope viewing fields along a radial line extending from the apex of the filter to the outer edge of the sample wedge. The viewing fields must be chosen without preference to a particular area and should be approximately equally spaced along the line. The first field should be located a little bit in from the point at which matter is deposited on the filter. If the required number of viewing fields cannot be located on a single radial line, additional lines parallel to the first should be chosen.

Preferably 100 fibers should be counted but all the fibers in 20 fields should be counted even if there are more than 100 fibers. The counting may be terminated after 100 fields have been searched even if 100 fibers have not been counted.

Calculations

The concentration of asbestos fibers in air can be expressed as:

$$\text{Asbestos Conc.} = \frac{\text{Fibers x R}}{\text{Fields x Vol}}\ .$$

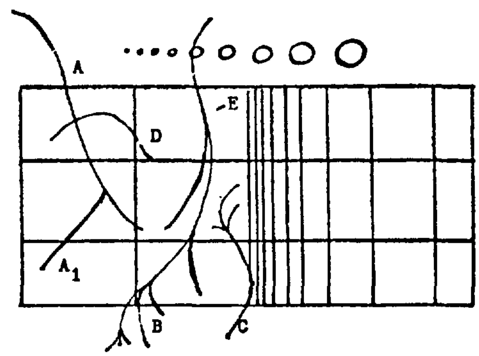

Figure 3. Illustration of fiber counting with a Porton reticle. The top and left side of the large box have been chosen as "counting sides". Circle 6 is 5 μm in diameter. (A) Fiber A crosses the top of the box and is counted, therefore. One end of Fiber A_1 touches Fiber A and thus is considered as part of it and is not counted separately. (B) Fiber B is a bundle containing many spikes. It passes through the box crossing bottom and top. It is counted as one fiber. (C) Fiber C passes through the box but it crosses the right side and bottom. It is not counted. (D) Fiber D is entirely within the box and crosses over Fiber A. It is not part of Fiber A, therefore it is counted as a separate fiber. (E) Fiber E is less than 5 μm in length. It is not counted.

where:

Fibers = total number of fibers counted

Fields = total number of fields counted

$$R = \frac{\text{filtration area}}{\text{area of a counting field}}$$

Vol = sampling rate (lpm) x time (min) x 10^3

= sample volume in ml of air

Since both the filtration area on the membrane filter and the area of the counting field are normally constant, the ratio of areas, R, is constant for the given conditions.

To illustrate: Air is sampled at 1 liter/minute for 50 minutes on a 37-mm membrane filter (filtration area 855 mm²). A total of 60 fibers each longer than 5 μm are counted in 100 fields each 0.003 mm² in area:

$$R = \frac{855 \text{ mm}^2}{3 \times 10^{-3} \text{ mm}^2} = 2.8 \times 10^5$$

and

$$\text{Asbestos Conc.} = \frac{2.8 \times 10^5 \times 60 \text{ Fibers}}{100 \text{ Fields} \times \frac{1 \times 10^3 \text{ ml}}{\text{min}} \times 50 \text{ min}}$$

$$= 3.4 \text{ Fibers/ml}$$

Since the precision of this method is limited, the averaged results of the several samples should be reported to the nearest significant figure.

Appendix I

Recommended Procedure for Establishing Kohler Illumination

The microscope is set on a level surface at a convenient height and in such position that sighting through the eyepieces is possible without undue strain or discomfort.

The illuminator is placed directly in front of and aligned with the microscope. If the illuminator is equipped with a coil filament bulb, its iris should be ten inches from the mirror. If a ribbon filament bulb is used, the front of the filter holder should be at least seven inches from the mirror. Only the plane surface of the mirror should be used. All filters should be removed from the system except that if desired, neutral density filters may be used to reduce the light intensity. If the microscope is equipped with a built-in illuminator, proper illuminator positioning has already been accomplished and need not be of further concern.

Fix a mounted sample on the stage and recheck the alignment. Raise the substage condenser until it nearly touches the bottom of the slide. Turn on the illuminator and use the tilt controls to direct the light to the center of the mirror. Tilt the mirror, directing the beam upward into the stage condenser. Close the microscope substage iris and the illuminator iris. Use the illuminator focus control to focus the image of the filament on the bottom of the substage iris. The reflection of the iris may be viewed in the mirror by leaning over the microscope.

After adjusting the illuminator condenser so that there is a sharp image of the filament on the substage iris, open it about halfway. Recheck proper position of the mirror and then put the objective in place and focus sharply on the sample. It may be necessary to open the substage iris during focusing.

After the sample is in focus, fully close the iris. Readjust the condenser height so that the edge of the iris leaves are in sharp focus and there is a bright spot within the iris. Readjust the mirror to obtain maximum brightness. If the color around the iris is not uniform, recheck the illuminator tilt and focus. If the color is uniform and maximum brightness has been achieved, open the field iris until the blades just pass out of the field of view.

The proper phase stop is inserted or rotated into place in the substage condenser. The phase objective is rotated into place. The eyepiece is replaced with the phase ring centering telescope. The telescope is adjusted for sighting. The location of the phase ring is observed through the telescope. It may be adjusted by using the two rotating shafts provided with the phase condenser. When the ring is centered it appears as a bright annular ring mounted on top of a grey ring. The center is black. There should be no overlap of the bright ring into the center. When the phase stop is centered the telescope is removed and the eyepiece is replaced. The microscope is now ready for use.

Appendix II

Recommended Procedures for Calibrating Reticle

The reticle must be slightly smaller in diameter than the eyepiece in which it is to be used. It fits into the tube and is held in place at the eyepiece focal point by spring pressure. The focal point is marked by an internal collar which prevents the reticle from passing further into the tube. Some manufacturers locate the focal point just below the collar while others prefer a point immediately above it. Thus it may be necessary to insert the reticle between the lens and the collar on one microscope and below the collar on another. In either case the projected image of the reticle on the field must be clear and sharp.

The reticle must project a constant counting area as well as provide markings for sizing. Many types of reticles are satisfactory. The Porton reticle illustrated in Figure 2 is recommended. It outlines a large rectangle that fits easily within the field of vision. The rectangle is divided into two equal squares. The left square is further divided into six rectangles. Each side of each square has a length equal to 100 L, then the large rectangle is 200 L units long and the small ones 50 L units long and 33⅓ L units high. To the left of the left square is a scale which divides the side into 20 equal increments of 5 L units each. The right square is divided horizontally in thirds corresponding to the small rectangles and vertically into a series of increasing spaces. The distance between each vertical line and the center of the large rectangle corresponds to the diameter of a circle. Circles of sizes 1 through 9 are located above and below the large rectangle. The diameter of each circle is related in terms of L units of length in accordance with the formula:

$$D = L\sqrt{2^N}$$

where D is the diameter of the circle or the width of the space and N is the number of the circle, or space.

The unit L is determined by measurement. A stage micrometer is the primary ruler. Any one or more of the definitive linear dimensions may be measured. If the length of the large rectangle is measured then L equals 1/200th of that value.

If the stage micrometer is marked in hundredths of millimeters the value of L is in hundredths of millimeters. If the left square is used as a counting area, its area is equal to

$$(100 \times 0.01\, L)^2 \text{ mm}^2$$

The filtering area of a 37-mm filter is 855 mm² and thus

$$R = \frac{855}{L^2}$$

If other areas are used as counting fields or other sized filters are used, the value of R must be calculated for the individual condition.

It is wise to prepare a chart showing each linear dimension and area for ready reference while counting.

Appendix III

Pump Calibration

Personal sampling pumps should be calibrated for flowrate frequently. They may be calibrated against a primary meter such as a spirometer or against a previously calibrated secondary standard such as a wet gas meter or dry gas meter. The train should be arranged so that the pump is operating against the same resistance it would normally operate against, and that the calibrating meter is at atmospheric pressure. Figure 4 illustrates the recommended arrangement. Air flow through the filter may be limited by both restricting the air flow to the pump as well as by admitting secondary air into

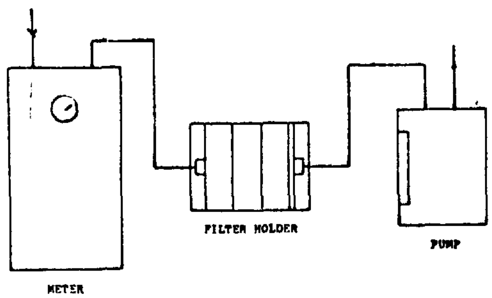

Figure 4. Diagram of set-up for calibration of pump.

the pump. Most personal pumps are constructed with adjustment valves that permit both actions. Calibration should be repeated after each 24 to 36 hours of pump use. If the pump has not been used for a prolonged period of time it should be recalibrated. Temperature and altitude corrections should be made.

Personal sampling pumps should not be used to such an extent that the batteries are allowed to run down below normal operating voltage. Since battery life varies, it is wise to occasionally check the life of the battery by allowing the pump to run down to the first indicated change in voltage under timed simulated conditions.

Supplies

Filters and Filter Holders

Millipore Corp.[a] Field Monitor filter holders preloaded with 37-mm Type AA filters, either white plain (catalog #MAWPO37AO) or gridded (#MAWGO37AO) are recommended. These are sold with a guaranteed average particle background and can be used without additional background checks.

It is less expensive to purchase unloaded field monitors (#MABGO37AO) to be loaded with plain or gridded filters purchased separately in packages of 100 (#AAWPO3700, and AAWGO3700). The field monitor can then be reloaded after each use. However, it is necessary to carefully clean the empty monitor and to check the background count on filters in the reloaded monitor.

Type AA filters can be used in any diameter in any non-leaking open-type filter holder, as long as proper adjustment is made in the calculations for the change in filtering area, and periodic background checks are made.

Membrane filters of other types and manufacturers cannot be recommended at this time, either because they do not become optically clear in the mounting medium or because of excessive particle background.

Personal Battery Powered Sampling Pumps

(1) Casella[b] MK II or MK III Personal Sampler
(2) MSA[c] Monitaire Sampler, Model G.
(3) Bendix[d] VM 22 or Micronair Personal Sampler or C-115.

Microscopes: Phase Equipped

(a) microscope body with a fine focus accuracy of 0.006 mm;
(b) 10× eyepiece;
(c) mechanical stage;
(d) illuminator (preferably built in and having provisions for adjusting light intensity);
(e) 40× to 45× (0.65 N.A. at least) positive (bright field) phase-contrast objective;
(f) annual ring condenser diaphragm (corresponding to the objective); and
(g) phase ring centering telescope.

(*Note:* Most manufacturers sell a basic body unit and built-in illumination system as a unit. Phase-contrast accessories can usually be purchased as a kit consisting of 10×, 40× and 90× phase objectives, a phase condenser containing appropriate annular ring diaphragms, a phase ring centering telescope, and a green filter. It is to the microscopist's advantage to purchase the kit.)

A list of manufacturers of phase-contrast microscopes[e] and reticles[f] is given below to aid in selecting a proper instrument.

[a] Millipore Corp., Bedford, Mass. 07130.
[b] Willson Products Div., P.O. Box 622, Reading, Penna. 19603. C. F. Casella & Co. Ltd., Regent House, Britannia

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Walk, London, N.1, England.

[c] Mine Safety Appliance Co., 201 Braddock Ave., Pittsburgh, Penna. 15208.

[d] Bendix—NEI, P.O. Box 590, Fall River, Mass. 02722.

[e] Bausch and Lomb, Scientific Instrument Division, 72624 Bausch Street, Rochester, N.Y. 14602.

Olympus Microscopes, Micro Optics Company, 28165 Greenfield, Southfield, Mich. 48075.

American Optical Corporation, Reichert Products, Buffalo, N.Y. 14215.

E. Leitz Inc., Rockleigh, N.J. 07647.

Nikon Inc., Instrument Division, Garden City, N.Y. 11530.

Unitron Instrument Company, Microscope Sales Division, 66 Needham Street, Newton Highland, Mass. 02161.

Carl Zeiss, 444 Fifth Avenue, New York, N.Y. 10018.

[f] Edmund Scientific Co., 701 Edsorp Building, Barrington, N.J. 07007.

BGI, Incorporated, 58 Guinan St., Waltham, Mass. 02154.

Joint AIHA-ACGIH Aerosol Hazards Evaluation Committee

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Donald L. Webster	

Industrial Hygiene Training in Israel

Medical and engineering students at Tel Aviv University will be obligated in the future to undertake training in occupational safety, hygiene and health to inspire them with an awareness of their obligations for the maintenance of the health of the worker and for the prevention of ill effects from work on man.

This has been made possible by the establishment in 1974 by the Faculties of Medicine and Engineering of the University, in collaboration with the Ministry of Labor, of the National Insurance Institute and the Workers Health Insurance (Kupat-Holim) of a Center for Occupational Safety, Hygiene and Health, with four major departments—Physiology of Work and Rehabilitation, Occupational Toxicology, Occupational Hygiene, and Safety Engineering. It comes to fill long-standing gaps in the promotion of safety and health of the working population in Israel and the absence of training facilities for specialists in these fields.

The new Center will immediately provide refresher courses for physicians and nurses, but curricula for the training of Occupational Toxicologists, Hygienists and Physiologists are in preparation. Ultimately the Occupational Health Physician will also be trained at the Center.

Due to lack of suitable personnel in the country the Center is seeking to recruit specialists from abroad.

TELEPHONE (201) 845-0440

FRICTION MATERIALS STANDARDS INSTITUTE, INC.

BERGEN MALL OFFICE CENTER
E. 210 ROUTE 4
PARAMUS. N. J. 07652

February 23, 1977

Subject: Recommended Procedures for Reducing Asbestos Dust During Brake Servicing

Gentlemen:

As I'm sure you are aware, there have been questions raised concerning exposure to asbestos dust during brake servicing. Actually, what applies to brake servicing might equally apply to clutch servicing, except that ordinarily installers do not drill, cut or grind new clutch facings in the field.

As a result of the concern expressed in several quarters, two committees and our Board of Directors reviewed the problem, and have endorsed the enclosed "Recommended Procedures for Reducing Asbestos Dust During Brake Servicing."

It is felt that these are sound and workable procedures, and we suggest that your publication may wish to give them wider distribution, either in a brief article on asbestos, or in a separate commentary on the subject.

You are free to use these recommendations as you see fit. There is no copyright involved, and it is not necessary to give credit to the Institute. If you wish to give credit, you may.

We believe that distribution of such information is in the best interests of all involved in the brake (and clutch) service business. If you have any questions, please let me know.

Sincerely,

FRICTION MATERIALS STANDARDS INSTITUTE

EWD/lmc

E. W. Drislane
Executive Director

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RECOMMENDED PROCEDURES FOR REDUCING ASBESTOS DUST DURING BRAKE SERVICING

Because studies have indicated that exposure to excessive amounts of asbestos dust may be a potential health hazard, OSHA has set maximum limits of levels of airborne asbestos dust to which workers may be exposed. Since most automotive friction materials normally contain a sizable amount of asbestos, it is important that people who handle brake linings and clutch facings understand the nature of the problem and know the precautions to be taken.

1. Areas where brake work is done should be set aside if possible, and entrances should be posted with an asbestos exposure sign as follows:

Asbestos
Dust Hazard
Avoid Breathing Dust
Wear Assigned Protective Equipment
Do Not Remain in Area Unless Your Work Requires It
Breathing Asbestos Dust May Be Hazardous To Your Health

2. The amount of asbestos in the dust from brake lining wear is normally at an extremely low level because of chemical breakdown during use, and if machining of friction material *does not* take place, simple procedures will minimize exposure. During brake servicing, the mechanic snould wear an air purifying respirator, either a throwaway or one with replaceable particulate filter(s), as approved by the mining Enforcement and Safety Administration or NIOSH. It should be worn during all procedures starting with the removal of the wheels and including reassembly.

3. During disassembly, all parts should be carefully placed on the floor to minimize the possibility of creating airborne dust. Dust should first be cleaned from the brake drums, brake backing plates and brake assemblies using an industrial type vacuum cleaner equipped with a high efficiency filter system. After vacuum cleaning, any remaining dust should be removed by using a rag soaked in water and wrung until nearly dry. Under no circumstances should compressed air or dry brushing be used for cleaning.

4. Of extreme importance are the precautions which must be taken during machining of friction material. This is the operation in brake servicing when exposure to asbestos dust is at its highest. In addition to the approved respirator, there must be local exhaust ventilation such that the worker exposures are maintained at least below the 1976 OSHA asbestos standards. If there is any question as to the efficiency of asbestos dust removal by the machine, the manufacturer should be contacted.

5. Industrial vacuum cleaner bags containing asbestos dust and cloths used for wiping brake assemblies should be sealed in plastic bags and labeled with the following warning label printed in letters of sufficient size and contrast to be readily visible and legible:

Caution
Contains Asbestos Fibers
Avoid Breathing Dust
Breathing Asbestos Dust May Cause Serious Bodily Harm

All asbestos waste should be disposed of in accordance with the OSHA asbestos regulation. During removal of vacuum bags, an approved respirator, as described in (2) above should be worn.

6. All floor cleaning in areas where brakes are repaired should be done with the high efficiency industrial vacuum cleaner as described in (3) above. Under no circumstances should dry sweeping take place. Grinding (arcing) machines should also be cleaned with such a vacuum cleaner and any remaining dust wiped with a damp cloth. An approved respirator, as described previously should be used during this cleaning.

7. Although adherence to the above procedures should minimize any contamination of work clothing, it is necessary that the appropriate sections of the OSHA regulations on asbestos be followed when ceiling levels on asbestos dust exceed current standards. This could involve special clothing, change rooms, etc. At the very least the work clothes should not be taken home but should remain at work for industrial laundering.

8. Proper hygiene practices will help minimize exposure to asbestos dust. Wash thoroughly before eating and do not eat in the work area. Remember, smoking is harmful to the health, and smoking coupled with breathing asbestos dust is extremely dangerous.

CAUTION: DO NOT BREATHE ASBESTOS DUST

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FMSI 06274

The Hazards of Asbestos for Brake Mechanics

BARRY CASTLEMAN, LUCILLE A. CAMAROTA, ALBERT J. FRITSCH, SUSAN MAZZOCCHI, and ROBERT G. CRAWLEY

ASBESTOS is the generic name of a group of hydrated magnesium silicate mineral fibers. There are two groups of these minerals—serpentine (chrysotile) and amphibole (amosite, crocidolite, anthophyllite, tremolite, and actinolite). Ninety-five percent of the world's asbestos production is chrysotile.

Reports of epidemiologic and pathological studies *(1–4)* reveal that occupational exposure to commercial asbestos minerals enhances the likelihood of a number of diseases—asbestosis and cancers of the lung, pleura, peritoneum, larynx, and gastrointestinal tract. The time from onset of exposure to the time of clinically apparent disease is usually more than 20 years. Cancer from asbestos is not limited to workers who handle the material. There are also reports of pleural and peritoneal mesothelioma (tumors rarely seen in the general population) in persons with family, or neighborhood, or indirect occupational exposure to asbestos *(4–7)*.

Mesothelioma was the cause of death of a man who had regularly sanded vinyl asbestos floor tile *(8)*. Under simulated conditions of this man's work, a maximum asbestos dust concentration of 1.3 fibers per ml (fibers longer than 5 microns) was found in air samples passed through membrane filters worn by a person sanding vinyl asbestos *(8)*. The type of asbestos now used in domestic floor tile is chrysotile—the same as that used in brake friction materials, according to the Asbestos Information Association. A case of mesothelioma in a brake mechanic has been reported *(9)*.

Commercial friction materials used in the United States for braking passenger cars and trucks contain an average composition of 50 percent chrysotile by weight *(10)*. Asbestos has been used for brake drum linings, disk pads, and clutch facings for the past 50 years. Jacko and DuCharme *(11)* estimated that the United States annually uses 103 million pounds of asbestos for brake friction materials and 4.5 million pounds in automotive clutch friction materials.

In 1968 Lynch reported that because of the heat of friction caused by braking, almost all of the asbestos in brake linings is transformed to a nonfibrous mineral, and a small fraction of asbestos escapes as free fiber *(12)*. Jacko and co-workers determined that vehicles in this country emit 158,000 pounds of asbestos per year, of which 11.2 percent is retained in the brake and disposed of during service *(13)*.

Brake mechanics have low and intermittent exposure to asbestos. This exposure has been reported to be 0.79 fiber per ml time-weighted average (fibers longer than 5 microns), with peaks up to 7 fibers per ml when brake parts are being cleaned *(14)*. The standard method for removing dust from brake parts is to blow it out with a

☐Mr. Castleman, an environmental engineer, was with the Center for Science in the Public Interest when this paper was prepared; he is now with the Maryland Public Interest Research Group. Dr. Fritsch is director of the Center for Science in the Public Interest. Ms. Camarota is an occupational health nurse, District of Columbia Department of Human Resources. Ms. Mazzocchi was a research associate, Environmental Cancer Research Project, Environmental Sciences Laboratory, Mount Sinai School of Medicine, New York City. Mr. Crawley is a sanitarian, Baltimore County Department of Health.

Tearsheet requests to Barry Castleman, Maryland Public Interest Research Group, 3110 New Main Dining Hall, University of Maryland, College Park, Md. 20742.

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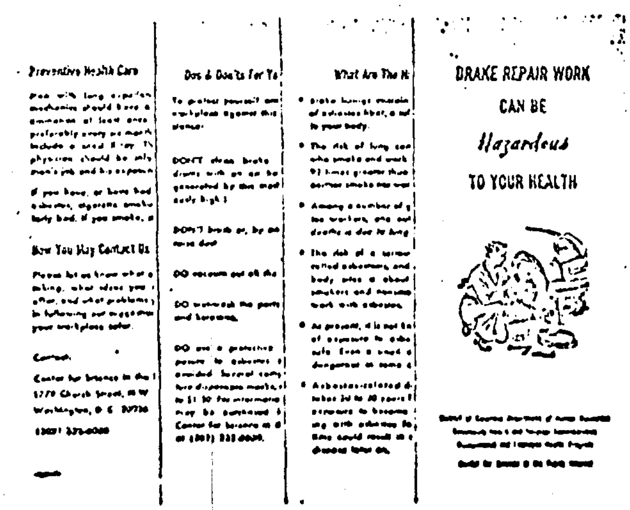
compressed air hose. In 1970 several reports (*14–18*) described the levels of exposure of brake mechanics to asbestos, alternative friction materials, and specific changes in brake repair practices which would reduce the levels of exposure.

Baltimore and Washington Studies

In December 1972, the Baltimore County Department of Health mailed a 1-page mimeographed circular to about 130 establishments which provide brake repair service. These businesses included new car and truck dealerships, certified motor vehicle inspection stations, and other concerns advertising brake repair as a specialty. Some of the establishments initially contacted had either gone out of business or replied that they do not do brake repairs. The circular warned that inhalation of the dust from brake cleaning could cause serious diseases, including cancer, and advised vacuuming brakes of accumulated dust. Additional measures suggested were improved ventilation and the use of face masks (*19*). Two student volunteers went to 100 of the places on the mailing list 4 months later to ask shop managers what methods they were using in brake repair.

A similar study was started in Washington, D.C., in August 1973. This work was conducted by the Center for Science in the Public Interest and the District of Columbia Department of Human Resources. Of 186 brake service establishments initially contacted, 120 were followed up. Several new methods were tried in order to improve the effectiveness of the warning. The warning leaflet was more eye-catching and readable than the paragraph-form sheet used in Baltimore; the leaflets were handed out by an occupational health nurse to the mechanics themselves—none were mailed; and followup to ascertain the degree of effectiveness was conducted by the same nurse who interviewed the repair shop managers. The Washington study was also featured in a local television program at the time the leaflets were first handed out.



To assure that students trained in brake repair by public vocational schools would learn proper methods, health officials met with appropriate school officials in both locations. At the time they were contacted, school officials in Baltimore and Washington reported that the schools were teaching the "blow out" method of brake dust removal to the trainees.

The standard method of cleaning brakes is "blowing out" with a compressed air hose. In Baltimore, 65 percent (65 per 100) of the brake repair establishments contacted were using this method at the time they received the warning circulars. In Washington, the figure was 91 percent (110 of 120). Most of the managers and workers interviewed had never heard about the hazardous potential of brake dust. Predictably, the responses ranged from annoyance to appreciation.

Of the 65 places in Baltimore initially blowing out brakes, 11 were using either vacuum or wet brushing methods at the time of followup. Four others were still blowing out brakes, but had improved ventilation or provided dust masks, or both, to reduce workers' exposures.

In Washington, only two establishments had changed to wet brushing, but none were vacuuming brakes. Four others provided face masks. Interestingly, two others decided to change brake shoes in all brake repairs, thereby simplifying the problem of dust removal and reducing the mechanics' exposures.

The degree of improvement, indexed by the percentage of establishments converting from blowing out brakes to safer techniques after a single warning, was 23 percent in Baltimore County and 7 percent in Washington. This disparity probably arises more from differences in the methods of the studies than from differences in the study groups.

It may be critically important to approach management at the outset in order to enlist the cooperation needed to implement any changes in practice. A mechanic who is approached directly with a warning may simply disregard it. The mechanic might reason that if the dust were really dangerous, there would be a law requiring the use of preferred methods in brake repair. And the employer, if not asked to participate from the beginning, may well conclude that he need not be concerned with the matter. The failure to involve management may be the main reason why the Washington study produced less gratifying results than the Baltimore study.

Brake warning programs consisting merely of mailed warning notices require little manpower, compared to other health programs. Also, the effort to implement safe techniques in public vocational schools is time well spent.

Conclusion

Over a 7-year period ending in 1976 (*20,21*), the U.S. standard for time-averaged exposure to asbestos will have been reduced from 5 million particles per cubic foot of air to 2 fibers per ml (fibers longer than 5 microns). For asbestos textile plants, this reduction is about 15-fold (*22*). Present and scheduled standards claim only to protect workers against asbestosis, the disease for which the dose-response relationship is most quantitatively known. The British standards for chrysotile and amosite asbestos, which are comparable to the asbestos standard scheduled to take effect in the United States in 1976, do not purport to provide protection against increased risk of cancer (*23,24*).

Previously studied cohorts of asbestos workers were exposed to time-averaged concentrations greater than 2 fibers per ml (fibers longer than 5 microns). Current studies of cohorts with time-averaged exposure on the order of 1 fiber per ml (greater than 5 microns in length) may provide evidence of hazard at that level. In view of alarming preliminary findings of pulmonary fibrosis in such a cohort, the National Institute of Occupational Safety and Health has suggested to the Department of Labor that consideration be given to further lowering of the asbestos standard (*25*).

The average brake mechanic is not aware of the potential hazard of airborne brake dust. Nor is he quick to change time-hardened habits when warned of dangers if he cannot feel their effects. Nonetheless, substantial reduction in asbestos exposures during brake repair can be achieved by simple changes in technique, with the use of equipment already available in most brake service establishments.

In view of the tendency of the accumulating literature to reveal cancer induction from asbestos at progressively lower levels of exposure, mechanics should be advised not to blow out brake parts and to use instead methods which create less airborne dust. The manufacturers of automotive friction materials could easily attach a clear hazard warning to every item sold.

The limited success of both the Baltimore and Washington studies shows the limited efficacy of voluntary compliance with health warnings—the shop managers and the mechanics simply do not have the same regard for a warning that they have for a regulation. The margin of safety, if any, provided by the current asbestos standards has been sharply criticized as insufficient (*26*). While it is advisable that brake mechanics at least be warned of the potential hazard of their work, it is also apparent that blowing out brakes will be a common practice so long as health regulations permit it.

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