FRICTION MATERIALS STANDARDS INSTITUTE, INC., EAST 210 ROUTE 4, PARAMUS, NJ 07652

November 26, 1986

To: Health and Environmental Affairs Committee

Subject: Recommended Procedures for Reducing Asbestos Dust During Brake Servicing

On September 3, 1986, I wrote the Committee concerning the one page insert that has appeared in Institute Catalogs since 1977 entitled "Recommended Procedures for Reducing Asbestos Dust During Brake Servicing." I advised that the need for revision of this write-up had been discussed with Ms. Grisham, Chairman of the Health and Environmental Affairs Committee.

I have worked with Ms. Grisham in preparing a revised "Recommended Procedures" write-up. A copy is enclosed. We are asking that Committee Members review the proposed write-up, and if there are suggested changes advise the Institute.

I would like to close any comment period by December 20, so that we could take suggested revisions and resubmit them to the Committee for comment by the first week in January. My cut-offs are because of the need to get certain copy out of the way, before I send copy to the Printer for the 1987 Supplement to the 1986 Automotive Data Book.

If you have comments on the proposed revision, please let me know.

E. W. Drislane
Executive Director

FRICTION MATERIALS STANDARDS INSTITUTE, INC., EAST 210 ROUTE 4, PARAMUS, NJ 07652

B U L L E T I N

N O. 8 7 0

October 17, 1986

WORK PRACTICES FOR CONTROL OF OCCUPATIONAL EXPOSURE TO ASBESTOS

The Institute has included a one page insert in its catalogs since 1977 entitled "Recommended Procedures for Reducing Asbestos Dust During Brake Servicing." In addition, the Institute published a booklet entitled "Friction Materials Work Practices Guide" in 1978. This booklet had a 45,000 copy run, with most copies being purchased and circulated in 1979.

When OSHA released its revised standards for occupational exposure to asbestos last June, certain parts of the insert in our catalogs, and the "Friction Materials Work Practices Guide" were rendered obsolete. Our Health and Environmental Affairs Committee was asked to revise the catalog insert in a timely fashion so that our 1987 Supplement would be correct. That has been submitted to the Committee Chairman, and the Committee hopefully will have a new insert by December 1986. We have not as yet taken any action on the booklet, but one Member has now recommended that it be up-dated.

In the meanwhile, Members may use as an interim guide the Appendix F "Work Practices and Engineering Controls for Automotive Brake Repair Operations" that was presented in the FEDERAL REGISTER Notice of June 20, 1986. This was published as pages 22,753-4 of that Notice. A copy of Appendix F is enclosed. Those in search of guidance on practices at the brake repair facility should use these recommendations where appropriate.

While our one page insert revision is now in the hands of the Health and Environmental Affairs Committee, I will forward the Member recommendation on revision of the booklet to the Board of Directors. However, even if the Board were to make a quick recommendation on the booklet, it will take Committee and additional Board action as well as work with a printer to complete the publication of a revised booklet.

The foregoing is for your information.

E. W. Drislane
Executive Director

Distribution:
Delegates and Alternates
H.E.A. Committee

Occupational Safety and Health Administration (OSHA) 1986 Regulations for Occupational Exposure to Asbestos. Appendix F - Non-Mandatory Work Practices and Engineering Controls for Automotive Brake Repair Operations

Appendix F to § 1910.1001—Work Practices and Engineering Controls for Automotive Brake Repair Operations—Non-Mandatory

This appendix is intended as guidance for employers in the automotive brake and clutch repair industry who wish to reduce their employees' asbestos exposures during repair operations to levels below the new standard's action level (0.1 f/cc). OSHA believes that employers in this industry sector are likely to be able to reduce their employees' exposures to asbestos by employing the engineering and work practice controls described in Sections A and B of this appendix. Those employers who choose to use these controls and who achieve exposures below the action level will thus be able to avoid any burden that might be imposed by complying with such requirements as medical surveillance, recordkeeping, training, respiratory protection, and regulated areas, which are triggered when employee exposures exceed the action level or PEL.

Asbestos exposure in the automotive brake and clutch repair industry occurs primarily during the replacement of clutch plates and brake pads, shoes, and linings. Asbestos fibers may become airborne when an automotive mechanic removes the asbestos-containing residue that has been deposited as brakes and clutches wear. Employee exposures to asbestos occur during the cleaning of the brake drum or clutch housing.

Based on evidence in the rulemaking record (Exs. 84–74, 84–263, 90–148), OSHA believes that employers engaged in brake repair operations who implement any of the work practices and engineering controls described in Sections A and B of this appendix may be able to reduce their employees' exposures to levels below the action level (0.1 fiber/cc). These control methods and the relevant record evidence on these and other methods are described in the following sections.

A. Enclosed Cylinder/HEPA Vacuum System Method

The enclosed cylinder-vacuum system used in one of the facilities visited by representatives of the National Institute for Occupational Safety and Health (NIOSH) during a health hazard evaluation of brake repair facilities (Ex. 84–263) consists of three components:

(1) A wheel-shaped cylinder designed to cover and enclose the wheel assembly;

(2) A compressed-air hose and nozzle that fits into a port in the cylinder; and

(3) A HEPA-filtered vacuum used to evacuate airborne dust generated within the cylinder by the compressed air.

To operate the system, the brake assembly is enclosed in a cylinder that has viewing ports to provide visibility and cotton sleeves through which the mechanic can handle the brake assembly parts. The cylinder effectively isolates asbestos dust in the drum from the mechanic's breathing zone. The brake assembly isolation cylinder is available from the Nilfisk Company [1] and comes in two sizes to fit brake drums in the 7-to-12-inch size range common to automobiles and light trucks and the 12-to-19-inch size range common to large commercial vehicles. The cylinder is equipped with built-in compressed-air guns and a connection for a vacuum cleaner equipped with a High Efficiency Particulate Air (HEPA) filter. This type of filter is capable of removing all particles greater than 0.3 microns from the air. When the vacuum cleaner's filter is full, it must be replaced according to the manufacturer's instruction, and appropriate HEPA-filtered dual cartridge respirators should be worn during the process. The filter of the vacuum cleaner is assumed to be contaminated with asbestos fibers and should be handled carefully, wetted with a fine mist of water, placed immediately in a labelled plastic bag, and disposed of properly. When the cylinder is in place around the brake assembly and the HEPA vacuum is connected, compressed air is blown into the cylinder to loosen the residue from the brake assembly parts. The vacuum then evacuates the loosened material from within the cylinder, capturing the airborne material on the HEPA filter.

The HEPA vacuum system can be disconnected from the brake assembly isolation cylinder when the cylinder is not being used. The HEPA vacuum can then be used for clutch facing work, grinding, or other routine cleaning.

B. Compressed Air/Solvent System Method

A compressed-air hose fitted at the end with a bottle of solvent can be used to loosen the asbestos-containing residue and to capture the resulting airborne particles in the solvent mist. The mechanic should begin spraying the asbestos-contaminated parts with the solvent at a sufficient distance to ensure that the asbestos particles are not dislodged by the velocity of the solvent spray. After the asbestos particles are thoroughly wetted, the spray may be brought closer to the parts and the parts may be sprayed as necessary to remove grease and other material. The automotive parts sprayed with the mist are then wiped with a rag, which must then be disposed of appropriately. Rags should be placed in a labelled plastic bag or other container while they are still wet. This ensures that the asbestos fibers will not become airborne after the brake and clutch parts have been cleaned. (If cleanup rags are laundered rather than disposed of, they must be washed using methods appropriate for the laundering of asbestos-contaminated materials.)

OSHA believes that a variant of this compressed-air/solvent mist process offers advantages over the compressed-air/solvent mist technique discussed above, both in terms of costs and employee protection. The variant involves the use of spray cans filled with any of several solvent cleaners commercially available from auto supply stores. Spray cans of solvent are inexpensive, readily available, and easy to use. These cans will also save time, because no solvent delivery system has to be assembled, i.e., no compressed-air hose/mister ensemble. OSHA believes that a spray can will deliver solvent to the parts to be cleaned with considerably less force than the alternative compressed-air delivery system described above, and will thus generate fewer airborne asbestos fibers than the compressed-air method. The Agency therefore believes that the exposure levels of automotive repair mechanics using the spray can/solvent mist process will be even lower than the exposures reported by NIOSH (Ex. 84–263) for the compressed-air/solvent mist system (0.08 f/cc).

C. Information on the Effectiveness of Various Control Measures

The amount of airborne asbestos generated during brake and clutch repair operations depends on the work practices and engineering controls used during the repair or removal activity. Data in the rulemaking record document the 8-hour time-weighted average (TWA_8) asbestos exposure levels associated with various methods of brake and clutch repair and removal.

NIOSH submitted a report to the record entitled "Health Hazard Evaluation for Automotive Brake Repair" (Ex. 84–263). In addition, Exhibits 84–74 and 90–148 provided exposure data for comparing the airborne concentrations of asbestos generated by the use of various work practices during brake repair operations. These reports present exposure data for brake repair operations involving a variety of controls and work practices, including:

- Use of compressed air to blow out the brake drums;
- Use of a brush, without a wetting agent, to remove the asbestos-containing residue;

[1] Mention of tradenames or commercial products does not constitute endorsement of recommendation for use.

- Use of a brush dipped in water or a solvent to remove the asbestos-containing residue;
- Use of an enclosed vacuum cleaning system to capture the asbestos-containing residue; and
- Use of a solvent mixture applied with compressed air to remove the residue.

Prohibited Methods

The use of compressed air to blow the asbestos-containing residue off the surface of the brake drum removes the residue effectively but simultaneously produces an airborne cloud of asbestos fibers. According to NIOSH (Ex. 84–263), the peak exposures of mechanics using this technique were as high as 15 fibers/cc, and 8-hour TWA exposures ranged from 0.03 to 0.19 f/cc.

Dr. William J. Nicholson of the Mount Sinai School of Medicine (Ex. 84–74) cited data from Knight and Hickish (1970) that indicated that the concentration of asbestos ranged from 0.84 to 5.35 f/cc over a 60-minute sampling period when compressed air was being used to blow out the asbestos-containing residue from the brake drum. In the same study, a peak concentration of 87 f/cc was measured for a few seconds during brake cleaning performed with compressed air. Rohl et al. (1976) (Ex. 90–148) measured area concentrations (of unspecified duration) within 3–5 feet of operations involving the cleaning of brakes with compressed air and obtained readings ranging from 6.6 to 29.6 f/cc. Because of the high exposure levels that result from cleaning brake and clutch parts using compressed air, OSHA has prohibited this practice in the revised standard.

Ineffective Methods

When dry brushing was used to remove the asbestos-containing residue from the brake drums and wheel assemblies, peak exposures measured by NIOSH ranged from 0.81 to 0.81 f/cc, while 8-hour TWA levels were at the new standard's permissible exposure limit (PEL) of 0.2 f/cc (Ex. 84–263). Rohl and his colleagues (Ex. 90–148) collected area samples 1–3 feet from a brake cleaning operation being performed with a dry brush, and measured concentrations ranging from 1.3 to 3.6 f/cc; however, sampling times and TWA concentrations were not presented in the Rohl et al. study.

When a brush wetted with water, gasoline, or Stoddart solvent was used to clean the asbestos-containing residue from the affected parts, exposure levels (8-hour TWAs) measured by NIOSH also exceeded the new 0.2 f/cc PEL, and peak exposures ranged as high as 2.62 f/cc (Ex. 84–263).

Preferred Methods

Use of an engineering control system involving a cylinder that completely encloses the brake shoe assembly and a High Efficiency Particulate Air (HEPA) filter-equipped vacuum produced 8-hour TWA employee exposures of 0.01 f/cc and peak exposures ranging from nondetectable to 0.07 f/cc (Ex. 84–263). (Because this system achieved exposure levels below the standard's action level, it is described in detail below.) Data collected by the Mount Sinai Medical Center (Ex. 90–148) for Nilfisk of America, Inc., the manufacturer of the brake assembly enclosure system, showed that for two of three operations sampled, the exposure of mechanics to airborne asbestos fibers was nondetectable. For the third operator sampled by Mt. Sinai researchers, the exposure was 0.5 f/cc, which the authors attributed to asbestos that had contaminated the operator's clothing in the course of previous brake repair operations performed without the enclosed cylinder/vacuum system.

Some automotive repair facilities use a compressed-air hose to apply a solvent mist to remove the asbestos-containing residue from the brake drums before repair. The NIOSH data (Ex. 84–263) indicated that mechanics employing this method experienced exposures (8-hour TWAs) of 0.8 f/cc, with peaks of 0.25 to 0.68 f/cc. This technique, and a variant of it that OSHA believes is both less costly and more effective in reducing employee exposures, is described in greater detail above in Sections A and B.

D. Summary

In conclusion, OSHA believes that it is likely that employers in the brake and clutch repair industry will be able to avail themselves of the action level trigger built into the revised standard if they conscientiously employ one of the three control methods described above: the enclosed cylinder/HEPA vacuum system, the compressed air/solvent method, or the spray can/solvent mist system.

FRICTION MATERIALS STANDARDS INSTITUTE, INC., EAST 210 ROUTE 4, PARAMUS, NJ 07652

B U L L E T I N

N O. 8 6 7

September 25, 1986

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) EFFECTIVE DATES AND START-UP DATES IN THE FINAL STANDARDS FOR OCCUPATIONAL EXPOSURE TO ASBESTOS

There have been several questions recently concerning the effective dates for various parts of the new Standards for Occupational Exposure to Asbestos. These were the OSHA Standards published in the FEDERAL REGISTER of June 20, 1986. The Institute issued its BULLETIN NO. 858 on June 25, 1986, forwarding copies of the new OSHA Standards to the Membership. Effective dates and start-up dates for various sections of the new Standards were shown on Pages 22,738-22,739 of that Notice.

An excerpt from those pages is enclosed. In chronological order, the dates are:

07-21-86 Effective Date - General
Respiratory Protection where exposure exceeds 2 fibers/cc

10-20-86 Initial Exposure Monitoring
Employee Information and Training

11-17-86 Regulated Areas
Respiratory Protection where exposure exceeds 0.2 fibers/cc but does not exceed 2 fibers/cc
Medical Surveillance

01-16-87 Powered air-purifying respirators (where required)
Plans for Hygiene and Lunchroom Facilities

07-20-87 Hygiene and Lunchroom Facilities constructed (See exception in FR Text)
Written Compliance Program (available for inspection)

07-20-88 Engineering and Work Practice Controls Implemented

For specifics, please refer to the text of the full OSHA Asbestos Exposure Standards. The foregoing is for your information.

E. W. Drislane
Executive Director

Distribution:
Delegates and Alternates
H.E.A. Committee

FRICTION MATERIALS STANDARDS INSTITUTE, INC.

FR Notice of June 20, 1986, Effective Date July 21, 1986: Occupational Safety and Health Administration (OSHA) Final Standards for Occupational Exposure to Asbestos - Effective Date and Start-up Dates

(Pages 22,738-9 of FR Notice of 6/20/86)

(o) *Dates*—(1) *Effective date.* This standard shall become effective July 21, 1986. The requirements of the asbestos standard issued in June 1972 (37 FR 11318), as amended, and published in 29 CFR 1910.1001 (1985) remain in effect until compliance is achieved with the parallel provisions of this standard.

(2) *Start-up dates.* All obligations of this standard commence on the effective date except as follows:

(i) *Exposure monitoring.* Initial monitoring required by paragraph (d)(2) of this section shall be completed as soon as possible but no later than October 20, 1986.

(ii) *Regulated areas.* Regulated areas required to be established by paragraph (e) of this section as a result of initial monitoring shall be set up as soon as possible after the results of that monitoring are known and not later than November 17, 1986.

(iii) *Respiratory protection.* Respiratory protection required by paragraph (g) of this section shall be provided as soon as possible but no later than the following schedule:

(A) Employees whose 8-hour TWA exposure exceeds 2 fibers/cc—July 21, 1986.

(B) Employees whose 8-hour TWA exposure exceeds the PEL but is less than 2 fibers/cc—November 17, 1986.

(C) Powered air-purifying respirators provided under paragraph (g)(2)(ii)—January 16, 1987.

(iv) *Hygiene and lunchroom facilities.* Construction plans for changerooms, showers, lavatories, and lunchroom facilities shall be completed no later than January 16, 1987; and these facilities shall be constructed and in use no later than July 20, 1987. However, if as part of the compliance plan it is predicted by an independent engineering firm that engineering controls and work practices will reduce exposures below the permissible exposure limit by July 20, 1988, for affected employees, then such facilities need not be completed until 1 year after the engineering controls are completed, if such controls have not in fact succeeded in reducing exposure to below the permissible exposure limit.

(v) *Employee information and training.* Employee information and training required by paragraph (j)(5) of this section shall be provided as soon as possible but no later than October 20, 1986.

(vi) *Medical surveillance.* Medical examinations required by paragraph (1) of this section shall be provided as soon as possible but no later than November 17, 1986.

(vii) *Compliance program.* Written compliance programs required by paragraph (f)(2) of this section as a result of initial monitoring shall be completed and available for inspection and copying as soon as possible but no later than July 20, 1987.

(viii) *Methods of compliance.* The engineering and work practice controls as required by paragraph (f)(1) shall be implemented as soon as possible but no later than July 20, 1988.

FRICTION MATERIALS STANDARDS INSTITUTE, INC., EAST 210 ROUTE 4, PARAMUS, NJ 07652

September 3, 1986

To: Health and Environmental Affairs Committee

Subject: "Recommended Procedures for Reducing Asbestos Dust During Brake Servicing"

The Institute has included a one page insert in its catalogs since 1977 addressing the question of safely handling brake linings in the brake service areas. This write-up is entitled "Recommended Procedures for Reducing Asbestos Dust During Brake Servicing." It was amended slightly after publication of our "Friction Materials Work Practices Guide" in 1978, to bring both the booklet and the catalog insert into harmony.

With the new OSHA Regulations on Workplace Exposure to Asbestos that were published in the FEDERAL REGISTER on June 20, 1986, the Institute must either bring its "Recommended Procedures" into agreement with the new OSHA Regulations, or discontinue the insert.

I'm enclosing copies of the following:

(1) Institute's "Recommended Procedures for Reducing Asbestos Dust During Brake Servicing"

(2) OSHA's Appendix F as appearing in the June 20, 1986 Notice: Non-Mandatory Work Practices and Engineering Controls for Automotive Brake Repair Operations

(3) EPA Guidance for Preventing Asbestos Disease Among Auto Mechanics

The EPA and OSHA write-ups are not in agreement. The OSHA write-up seems more realistic than the EPA write-up as regards compliance at the small brake repair facility.

The need for revision of the Institute's "Recommended Procedures" has been discussed with Ms. Grisham, Chairman of the Committee. From a timing viewpoint, I would need a final draft by December 1986 in order to have the copy appear in next year's Data Book Supplement. Ms. Grisham has agreed to review this and prepare a first draft for consideration and modification by the Committee. We would hope to do this by mail.

The foregoing is sent for your review and consideration before we circulate a draft revision.

E. W. Drislane
Executive Director

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 should wear a respirator approved by NIOSH for asbestos dust. It should be worn during all procedures starting with the removal of wheels and including reassembly.

3. When removing worn friction materials, remove the accumulated dust in the assemblies with an industrial vacuum cleaner equipped with a high efficiency filter system. If such equipment is not available, dust can be removed with a damp cloth. Do not use compressed air or dry brushing for cleaning unless the assembly is enclosed and properly exhausted.

4. Whenever possible, purchase friction materials preground and ready for installation. If machining is necessary, the precautions which must be taken are of extreme importance. This is the operation in brake service when exposure to asbestos dust may be at its highest. This increases the difficulty in complying with the OSHA standards. In addition to the approved respirator, there must be local exhaust ventilation such that worker exposures are maintained below the 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 Creating Dust
Breathing Asbestos Dust May Cause Serious Bodily Harm

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

6. Good housekeeping is essential in a workplace where asbestos containing materials are handled. Industrial vacuum cleaners equipped with multiple stage high efficiency filters should be used for removing accumulations of asbestos dust and waste. Never use compressed air or dry sweeping for cleaning. Water or other dust suppressants should be applied if brooms are used.

7. Good personal hygiene practices are important in minimizing asbestos dust exposure. Do not smoke. Wash before eating. Shower after work. Change to work clothes upon arrival at work and change from work clothes at conclusion of work. Work clothing should not be taken home. Laundering of asbestos contaminated clothing shall be done so as to prevent release of airborne asbestos fibers in excess of the exposure limits.

CAUTION: DO NOT BREATHE ASBESTOS DUST

Occupational Safety and Health Administration (OSHA) 1986 Regulations for Occupational Exposure to Asbestos. Appendix F - Non-Mandatory Work Practices and Engineering Controls for Automotive Brake Repair Operations

Appendix F to § 1910.1001—Work Practices and Engineering Controls for Automotive Brake Repair Operations—Non-Mandatory

This appendix is intended as guidance for employers in the automotive brake and clutch repair industry who wish to reduce their employees' asbestos exposures during repair operations to levels below the new standard's action level (0.1 f/cc). OSHA believes that employers in this industry sector are likely to be able to reduce their employees' exposures to asbestos by employing the engineering and work practice controls described in Sections A and B of this appendix. Those employers who choose to use these controls and who achieve exposures below the action level will thus be able to avoid any burden that might be imposed by complying with such requirements as medical surveillance, recordkeeping, training, respiratory protection, and regulated areas, which are triggered when employee exposures exceed the action level or PEL.

Asbestos exposure in the automotive brake and clutch repair industry occurs primarily during the replacement of clutch plates and brake pads, shoes, and linings. Asbestos fibers may become airborne when an automotive mechanic removes the asbestos-containing residue that has been deposited as brakes and clutches wear. Employee exposures to asbestos occur during the cleaning of the brake drum or clutch housing.

Based on evidence in the rulemaking record (Exs. 84–74, 84–263, 90–148), OSHA believes that employers engaged in brake repair operations who implement any of the work practices and engineering controls described in Sections A and B of this appendix may be able to reduce their employees' exposures to levels below the action level (0.1 fiber/cc). These control methods and the relevant record evidence on these and other methods are described in the following sections.

A. Enclosed Cylinder/HEPA Vacuum System Method

The enclosed cylinder-vacuum system used in one of the facilities visited by representatives of the National Institute for Occupational Safety and Health (NIOSH) during a health hazard evaluation of brake repair facilities (Ex. 84–263) consists of three components:

(1) A wheel-shaped cylinder designed to cover and enclose the wheel assembly;

(2) A compressed-air hose and nozzle that fits into a port in the cylinder; and

(3) A HEPA-filtered vacuum used to evacuate airborne dust generated within the cylinder by the compressed air.

To operate the system, the brake assembly is enclosed in a cylinder that has viewing ports to provide visibility and cotton sleeves through which the mechanic can handle the brake assembly parts. The cylinder effectively isolates asbestos dust in the drum from the mechanic's breathing zone. The brake assembly isolation cylinder is available from the Nilfisk Company [1] and comes in two sizes to fit brake drums in the 7-to-12-inch size range common to automobiles and light trucks and the 12-to-19-inch size range common to large commercial vehicles. The cylinder is equipped with built-in compressed-air guns and a connection for a vacuum cleaner equipped with a High Efficiency Particulate Air (HEPA) filter. This type of filter is capable of removing all particles greater than 0.3 microns from the air. When the vacuum cleaner's filter is full, it must be replaced according to the manufacturer's instruction, and appropriate HEPA-filtered dual cartridge respirators should be worn during the process. The filter of the vacuum cleaner is assumed to be contaminated with asbestos fibers and should be handled carefully, wetted with a fine mist of water, placed immediately in a labelled plastic bag, and disposed of properly. When the cylinder is in place around the brake assembly and the HEPA vacuum is connected, compressed air is blown into the cylinder to loosen the residue from the brake assembly parts. The vacuum then evacuates the loosened material from within the cylinder, capturing the airborne material on the HEPA filter.

The HEPA vacuum system can be disconnected from the brake assembly isolation cylinder when the cylinder is not being used. The HEPA vacuum can then be used for clutch facing work, grinding, or other routine cleaning.

B. Compressed Air/Solvent System Method

A compressed-air hose fitted at the end with a bottle of solvent can be used to loosen the asbestos-containing residue and to capture the resulting airborne particles in the solvent mist. The mechanic should begin spraying the asbestos-contaminated parts with the solvent at a sufficient distance to ensure that the asbestos particles are not dislodged by the velocity of the solvent spray. After the asbestos particles are thoroughly wetted, the spray may be brought closer to the parts and the parts may be sprayed as necessary to remove grease and other material. The automotive parts sprayed with the mist are then wiped with a rag, which must then be disposed of appropriately. Rags should be placed in a labelled plastic bag or other container while they are still wet. This ensures that the asbestos fibers will not become airborne after the brake and clutch parts have been cleaned. (If cleanup rags are laundered rather than disposed of, they must be washed using methods appropriate for the laundering of asbestos-contaminated materials.)

OSHA believes that a variant of this compressed-air/solvent mist process offers advantages over the compressed-air/solvent mist technique discussed above, both in terms of costs and employee protection. The variant involves the use of spray cans filled with any of several solvent cleaners commercially available from auto supply stores. Spray cans of solvent are inexpensive, readily available, and easy to use. These cans will also save time, because no solvent delivery system has to be asembled; i.e., no compressed-air hose/mister ensemble. OSHA believes that a spray can will deliver solvent to the parts to be cleaned with considerably less force than the alternative compressed-air delivery system described above, and will thus generate fewer airborne asbestos fibers than the compressed-air method. The Agency therefore believes that the exposure levels of automotive repair mechanics using the spray can/solvent mist process will be even lower than the exposures reported by NIOSH (Ex. 84–263) for the compressed-air/solvent mist system (0.08 f/cc).

C. Information on the Effectiveness of Various Control Measures

The amount of airborne asbestos generated during brake and clutch repair operations depends on the work practices and engineering controls used during the repair or removal activity. Data in the rulemaking record document the 8-hour time-weighted average (TWA_8) asbestos exposure levels associated with various methods of brake and clutch repair and removal.

NIOSH submitted a report to the record entitled "Health Hazard Evaluation for Automotive Brake Repair" (Ex. 84–263). In addition, Exhibits 84–74 and 90–148 provided exposure data for comparing the airborne concentrations of asbestos generated by the use of various work practices during brake repair operations. These reports present exposure data for brake repair operations involving a variety of controls and work practices, including:

- Use of compressed air to blow out the brake drums;
- Use of a brush, without a wetting agent, to remove the asbestos-containing residue;

[1] Mention of tradenames or commercial products does not constitute endorsement of recommendation for use.

- Use of a brush dipped in water or a solvent to remove the asbestos-containing residue;
- Use of an enclosed vacuum cleaning system to capture the asbestos-containing residue; and
- Use of a solvent mixture applied with compressed air to remove the residue.

Prohibited Methods

The use of compressed air to blow the asbestos-containing residue off the surface of the brake drum removes the residue effectively but simultaneously produces an airborne cloud of asbestos fibers. According to NIOSH (Ex. 84–263), the peak exposures of mechanics using this technique were as high as 15 fibers/cc, and 8-hour TWA exposures ranged from 0.03 to 0.19 f/cc.

Dr. William J. Nicholson of the Mount Sinai School of Medicine (Ex. 84–74) cited data from Knight and Hickish (1970) that indicated that the concentration of asbestos ranged from 0.84 to 5.35 f/cc over a 60-minute sampling period when compressed air was being used to blow out the asbestos-containing residue from the brake drum. In the same study, a peak concentration of 87 f/cc was measured for a few seconds during brake cleaning performed with compressed air. Rohl et al. (1976) (Ex. 90–148) measured area concentrations (of unspecified duration) within 3–5 feet of operations involving the cleaning of brakes with compressed air and obtained readings ranging from 8.6 to 29.8 f/cc. Because of the high exposure levels that result from cleaning brake and clutch parts using compressed air, OSHA has prohibited this practice in the revised standard.

Ineffective Methods

When dry brushing was used to remove the asbestos-containing residue from the brake drums and wheel assemblies, peak exposures measured by NIOSH ranged from 0.61 to 0.61 f/cc, while 8-hour TWA levels were at the new standard's permissible exposure limit (PEL) of 0.2 f/cc (Ex. 84–263). Rohl and his colleagues (Ex. 90–148) collected area samples 1–3 feet from a brake cleaning operation being performed with a dry brush, and measured concentrations ranging from 1.3 to 3.6 f/cc; however, sampling times and TWA concentrations were not presented in the Rohl et al. study.

When a brush wetted with water, gasoline, or Stoddart solvent was used to clean the asbestos-containing residue from the affected parts, exposure levels (8-hour TWAs) measured by NIOSH also exceeded the new 0.2 f/cc PEL, and peak exposures ranged as high as 2.62 f/cc (Ex. 84–263).

Preferred Methods

Use of an engineering control system involving a cylinder that completely encloses the brake shoe assembly and a High Efficiency Particulate Air (HEPA) filter-equipped vacuum produced 8-hour TWA employee exposures of 0.01 f/cc and peak exposures ranging from nondetectable to 0.07 f/cc (Ex. 84–263). (Because this system achieved exposure levels below the standard's action level, it is described in detail below.) Data collected by the Mount Sinai Medical Center (Ex. 90–148) for Nilfisk of America, Inc., the manufacturer of the brake assembly enclosure system, showed that for two of three operations sampled, the exposure of mechanics to airborne asbestos fibers was nondetectable. For the third operator sampled by Mt. Sinai researchers, the exposure was 0.5 f/cc, which the authors attributed to asbestos that had contaminated the operator's clothing in the course of previous brake repair operations performed without the enclosed cylinder/vacuum system.

Some automotive repair facilities use a compressed-air hose to apply a solvent mist to remove the asbestos-containing residue from the brake drums before repair. The NIOSH data (Ex. 84–263) indicated that mechanics employing this method experienced exposures (8-hour TWAs) of 0.8 f/cc, with peaks of 0.25 to 0.68 f/cc. This technique, and a variant of it that OSHA believes is both less costly and more effective in reducing employee exposures, is described in greater detail above in Sections A and B.

D. Summary

In conclusion, OSHA believes that it is likely that employers in the brake and clutch repair industry will be able to avail themselves of the action level trigger built into the revised standard if they conscientiously employ one of the three control methods described above: the enclosed cylinder/HEPA vacuum system, the compressed air/solvent method, or the spray can/solvent mist system.

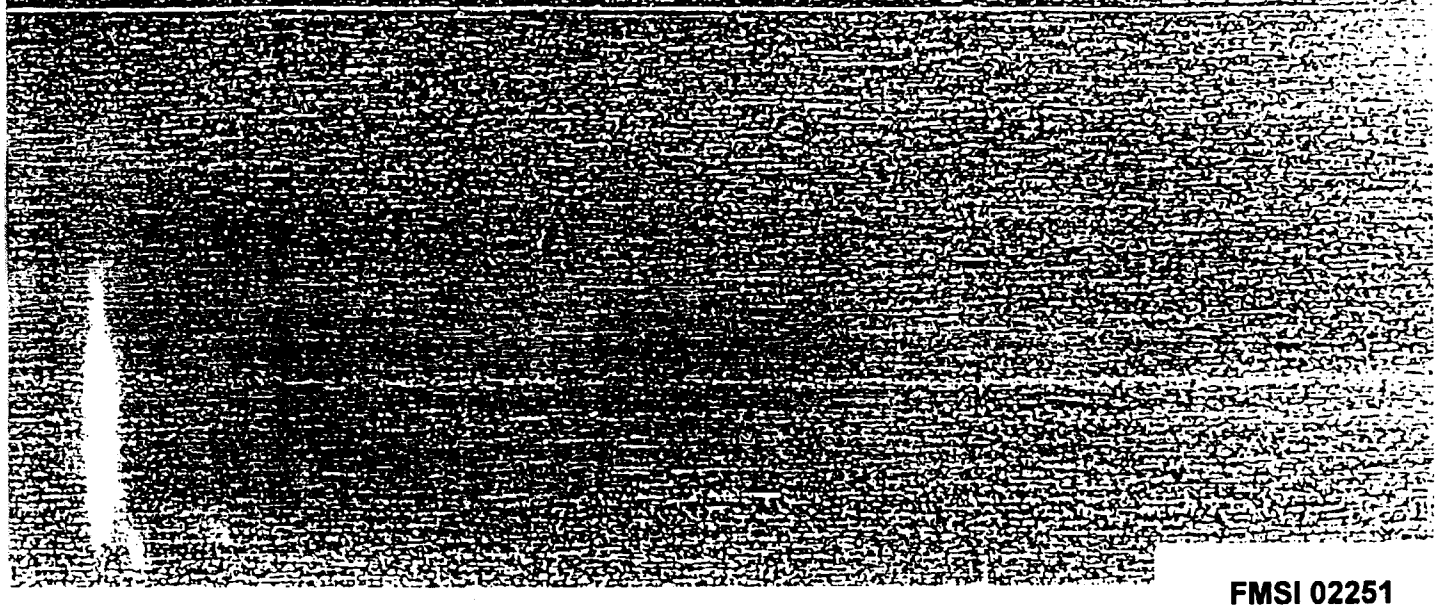
United States
Environmental Protection
Agency

Office of Pesticides and
Toxic Substances
Asbestos Action Program

June 1986

EPA

Guidance for Preventing Asbestos Disease Among Auto Mechanics



PREVENTING ASBESTOS DISEASE AMONG AUTO MECHANICS

I MECHANICS' EXPOSURE TO ASBESTOS

Friction materials, such as brake linings and clutch facings, often contain asbestos. Millions of asbestos fibers can be released during brake and clutch servicing (1-8). Grinding and beveling friction products can cause even higher exposures (1,8). Like germs, asbestos fibers are small enough to be invisible and they can remain and accumulate in the lungs. When you see a dust cloud during brake work, you are seeing clumps containing thousands of fibers. Most of the smaller fibers will not show up with the methods commonly used for measuring asbestos levels in the air, such as the method used to determine compliance with the OSHA asbestos standard, since most asbestos fibers in brake dust are too small to be measured by these methods (1-3,5-8).

Asbestos released into the air lingers around a garage long after a brake job is done and can be breathed in by everyone inside a garage, including customers. While lowering exposure lowers risk, there is no known level of exposure to asbestos below which health effects do not occur (9-12). The EPA has proposed phasing out the use of asbestos products. In situations where asbestos exposures cannot be eliminated entirely, they should be reduced to the lowest possible level (9,13).

Asbestos can be carried on work clothing, contaminating the family car and home. This can cause asbestos disease among family members. An ordinary house vacuum cleaner cannot collect these asbestos fibers, since its filter is not fine enough to trap them. In fact, an ordinary house vacuum cleaner is likely to stir these fibers up and and scatter them into the air.

Asbestos can also get on a mechanic's hands and be swallowed when eating or smoking a cigarette. This is a particularly difficult problem for mechanics, since they often get grease on their hands and asbestos fibers can stick to the grease.

II HEALTH EFFECTS OF ASBESTOS EXPOSURE

Until the use of asbestos products is phased out, the best best way of limiting health damage to workers exposed to asbestos is to use proper controls. It is not possible to predict whether an individual person exposed to asbestos will later develop asbestos-related disease. But studies of disease patterns among large groups of workers exposed to asbestos make general observations possible. The following can be the consequences of inadequate prevention:

Asbestosis

Asbestos exposure can cause scar tissue to form in the lungs. This is a very gradual process that usually takes many years before its effects are noticed. This scarring is called asbestosis. It causes gradually increasing shortness of breath. A person with this disease must breathe harder and deeper to get his or her breath because the scar tissue makes it harder for oxygen to get into the blood stream. This scarring is caused by repeated exposures to asbestos and is permanent. Nearly one half of mechanics who work for many years without proper control measures can develop this scarring (7,14).

Cancer

1. Mesothelioma

Mesothelioma is a type of fatal cancer of the lining of the chest or abdominal cavity. It can be caused by very low exposures to asbestos. This cancer has occurred among brake mechanics (15-20), their wives (20), and their children (21).

2. Lung Cancer

Lung cancer is currently responsible for the largest number of deaths from exposure to asbestos (22). Even short-term occupational exposures have been shown to increase the risk of lung cancer (22-24). Each added exposure increases the risk of cancer. Like asbestos, smoking can independently cause lung cancer, increasing the risk by about 10 times. When smokers are exposed to asbestos, the risks do more than add together; they actually multiply. For example, asbestos insulators who smoke have a lung cancer risk over fifty times higher than nonsmokers without asbestos exposure. However, stopping smoking greatly reduces this risk, even if a person has smoked for many years. Smokers who have been exposed to asbestos should be especially encouraged to stop smoking. The extent of risk of lung cancer among mechanics is not now known; but, given the known lung cancer risk among other groups exposed to asbestos, caution is necessary.

3. Other Cancers

Other cancers which appear to be caused by asbestos include cancer of the voice box (25,26) and of the stomach and large intestine (27, especially page 315).

Latency Period

It usually takes 15 to 30 years or more for cancer or asbestos lung scarring to show up after exposure. (Scientists call this the latency period.) Until then, the victim often feels fine. This gives a false sense of security. For

example, if one touches a hot stove, one gets burned right away. With asbestos, the damage isn't obvious until many years later. This false sense of security can easily lead a worker and/or supervisor to follow work practices which can cause harmful exposures, since they are not aware that disease may develop later.

III MEDICAL TESTS

Medical tests only discover asbestos-related disease after it has developed. In some cases, where the condition may be curable, especially with asbestos-related cancers of the large intestine and voice box, early detection can be very important.

Asbestosis

Asbestosis, or lung scarring from asbestos, is permanent and cannot be treated. It is diagnosed by chest x-rays, breathing tests (called lung or pulmonary function tests), and/or listening to the lungs, together with a history of exposure to asbestos. Very early asbestosis may be missed by these techniques. Early asbestosis is difficult to see on a chest x-ray and is best evaluated by a doctor who has experience and/or specialized training with asbestosis. (This type of specialist is called a "B reader" of x-rays.)

Lung Cancer

Very often lung cancer from asbestos has already spread by the time it can be seen on a chest x-ray or by tests of the phlegm. This is why more frequent tests for lung cancer do not help the average person who develops this cancer to live longer. Lung cancer is thus a condition needing prevention more than early detection and cure.

Intestinal Cancer

Cancer of the large intestine can often be detected early by yearly exams of the rectum and sigmoid area, with a hemoccult test for blood in the stool. Early detection and treatment of this condition can result in cure.

Voice Box Cancer

Voice box cancer can often be discovered at a curable stage by a medical exam. It may show up as hoarseness that does not go away in a few weeks.

IV EXTENT OF EXPOSURE DURING BRAKE AND CLUTCH MAINTENANCE

Using a compressed air hose to clean drum brakes can release up to 16 million asbestos fibers in the cubic meter of air around a mechanic's face (1).* Even hitting a brake drum with a hammer can release over a million asbestos fibers (4). Much less dust from asbestos-lined disc brake pads will settle on disc brakes, but some dust can get on a mechanic's hands and into the garage air during maintenance. The asbestos fibers released from brake and clutch work can be scattered throughout a garage, where they can present a hazard for months or years.

Because of this, many garages are now turning to newer methods for brake cleaning. However, some of these newer methods may actually contribute to the problem. For example, millions of asbestos fibers can be released from drum brakes with these methods:

- Wiping with a dry rag or brush (1-3).
- Wiping with a wet rag or brush (2,3). The water doesn't prevent scattering of much of the asbestos, and when the rag dries or is shaken, asbestos is spread around the garage.
- Liquid squirt bottles or solvent sprays (3). The water or solvent under pressure scatters much of the asbestos, and when it dries the asbestos is still all over the surrounding work surfaces. Brake cleaning equipment using these methods with a brush or squirt gun is likely to have the same problems. In fact, measurements from one manufacturer using a liquid spray system showed that over a million fibers can be released near a mechanic's face (28). Using a specially designed low-pressure spray and properly collecting and disposing of contaminated liquid may prevent some asbestos from spreading around the garage. Some recirculating wet method equipment uses a solvent to collect brake dust into a tray. If the solvent evaporates from the tray, normal air currents easily lift the asbestos fibers back into the air.
- Using a garden hose may prevent some brake dust from becoming airborne, but this can easily contaminate the garage floor or other work areas by scattering the asbestos.
- Using a standard shop vacuum cleaner. A shop vacuum cleaner can spread asbestos about a garage as much as does a compressed air hose (6: using a shop vacuum cleaner raised asbestos concentrations in adjacent bays to levels greater than those found using a compressed air hose). A shop vacuum cleaner filter is not fine enough to collect asbestos fibers.

All of these brake cleaning methods can release enough asbestos into a garage (6,29) so that an average of over one million of the larger fibers could be breathed each day by workers in that garage. These brake cleaning methods can

*These are the larger fibers measured by common methods for counting asbestos fibers. The very small ones are far more numerous, but can be only be seen with the electron microscope.

also cause customers to be exposed, since asbestos from brake work can be spread 75 feet away from the mechanic (1).

When grinding is done to renew used brake block linings, concentrations of up to seven million asbestos fibers per cubic meter can be released. Bevelling new linings can release concentrations of up to 72 million fibers and light grinding of new linings of up to 4.8 million fibers (7).

V CONTROLLING EXPOSURES

NIOSH, OSHA, and EPA recommend that where asbestos exposures cannot be eliminated, they must be controlled to the lowest level possible (9,13). Effective containment prevents problems associated with housekeeping and with stirring up settled dust (13). The best approach is to contain brake dust and prevent its release into a garage.

Brake Cleaning

Enclosure equipment for brake cleaning is available, which slips easily over the brake assembly and forms a tight seal against the backing plate. A compressed air system can then be used inside this type of enclosure system for good brake cleaning without exposing the brake mechanic or others. Clear plastic walls or windows allow easy visibility of the work being done. Brake dust is sucked into a vacuum cleaner equipped with a special filter called a HEPA or "high-efficiency particulate air" filter. Only this type of filter can capture the small, invisible asbestos fibers. Non-permeable glove attachments on some equipment allow a mechanic to do work inside the enclosure without getting asbestos on the hands. If glove attachments are available only as an option, this option should be selected.

How to Use Enclosure Equipment for Cleaning Drum Brakes

Steps for using this type of equipment on drum brakes are simple:

1. Check that the hose is securely fastened to the HEPA vacuum container and to the brake enclosure. Also check that the vacuum container seals and clips are in proper functioning order according to the manufacturer's instructions.
2. Remove the wheel.
3. Turn on the asbestos vacuum cleaner.
4. Place the enclosure over the drum, making sure it forms a tight seal behind the backing plate.

5. Place hands into the attached rubber gloves.
6. Remove the brake drum. Some equipment allows use of a hammer or other tools inside the enclosure for drums that are hard to remove.
7. Blow dust off the drum and brake assembly using the air gun attachment inside the enclosure.
8. Blow dust off all inside surfaces of the enclosure towards the vacuum exit using the air gun attachment inside the enclosure.
9. Remove the enclosure and turn off the vacuum cleaner.

If grease accumulates on the inside surfaces of the enclosure, clean according to the manufacturer's instructions with a soft cloth and with the vacuum running. Dispose of the cloth according to OSHA regulations (30). This cloth should not be handled with bare hands.

Disc Brakes

For disc brakes, vacuum the pads, rotor, and caliper directly with a crevice attachment and avoid handling them before vacuuming.

Filter Change and Waste Disposal

Asbestos vacuum cleaners have several filters. Changing filters and disposing of asbestos waste can release dangerous concentrations of asbestos unless done properly. Some equipment allows for filter or collection bag change while the vacuum motor is running. This draws loose brake dust into the vacuum collector and away from the mechanic, reducing the risk of exposure. Some equipment has a renewable main filter that can be cleaned repeatedly without opening the vacuum cleaner. Ideally, all vacuum equipment should be designed to prevent opening the vacuum chamber when the vacuum motor is turned off, since opening the chamber can cause release of collected asbestos into the air.

Always follow the manufacturer's instructions for filter or collection bag change. Request a demonstration and practice session from the manufacturer to go through all steps for equipment use and filter or collection bag change, until each person who is to use this equipment is completely familiar with these procedures. Place the filter or collection bag directly into a 6 mil (heavy) plastic bag and double tie. Place the bag directly into a 55-gallon drum or similar leakproof, air-tight container designated for asbestos waste according to OSHA regulations (30) and mark it as follows:

CAUTION
Contains Asbestos Fibers
Avoid Breathing Dust
Breathing Asbestos Dust Can Cause Lung Disease and Cancer

Keep this drum for asbestos waste locked between filter or collection bag changes. Transport and disposal of asbestos waste should be done only by individuals familiar with procedures for handling asbestos waste in accordance with EPA's asbestos disposal guidance (31).

Clutch Repair

Significant exposure can also occur during clutch repair. Since a mechanic's head is typically under the clutch assembly during clutch repair, asbestos often falls on a mechanic's face and clothing. Enclosure equipment with a HEPA vacuum cleaner to prevent this exposure is under development.

Non-Asbestos Brake Linings

The use of non-asbestos friction materials is increasing. Available information suggests that none of these substitute materials is as dangerous as asbestos. Unless a mechanic is certain before brake work starts that a particular vehicle's brakes are not lined with asbestos, it should be assumed for the sake of caution that there is asbestos in the brake dust. In addition, friction materials often contain adhesives, toxic metals, and other hazardous chemicals which can harm the body (2). Thus, even for non-asbestos friction products, an enclosure system can control exposures to materials which may be harmful.

What to Look for in Enclosure Equipment for Brake Cleaning

Recommended features to look for in selecting enclosure equipment include:

1. Features which prevent hand contact with asbestos, including rubber (or other non-permeable) gloves to cover both hands. Look for attached gloves with no spaces for leakage. If attached gloves are not standard with the equipment, they should be selected as an option.

2. Enclosures large enough to fit around the biggest size brake drums likely to be encountered to prevent exposure during drum removal.

3. Reports of air sampling with analysis by transmission electron microscopy that show no release of asbestos fibers when using this equipment during brake maintenance. This helps ensure against design defects.

4. A sturdy seal behind the backing plate to prevent leakage during blow out.

5. A pressure gauge or manometer indicating when vacuum filter change or cleaning of renewable filter is needed. This helps ensure effective suction during use.

6. Safety of filter change or renewable filter cleaning. Ideally, future models of these devices will have a feature that prevents opening the filter housing while the vacuum motor is switched off.

Enclosure system manufacturer information is discussed in references 32-35.

Machining and Bevelling

Whenever possible, pre-ground, installation-ready brake linings and clutch facings should be used. If friction materials must be arced, this should be done by lathe-turning at low speed, rather than by grinding. Linings should not be ground to fit brake systems for which they were not designed. Where friction materials must be machined, bevelled, or lathe-turned, adequate local exhaust ventilation equipment connected to a HEPA vacuum collector should be used to prevent mechanic exposure and shop contamination. Such equipment should be designed and set up by a professional ventilation engineer, using specifications such as those found in the American Conference of Governmental Industrial Hygienists' ventilation manual (36) as a minimum design standard. There must be a comprehensive asbestos control and monitoring program where machining, bevelling, or lathe-turning is done (30).

Special Areas for Brake Work

Eating, drinking, and smoking should not be done in an area where brake work is done. Mechanics should wash their hands and face before eating and wash all exposed skin and change clothes before going home. If possible, work clothes should be laundered at special facilities equipped to wash clothing contaminated with asbestos. Smokers should be urged to quit and, if necessary, be provided assistance in entering a smoking cessation program.

VI RESPIRATORS

The National Institute for Occupational Safety and Health (NIOSH) recommends the use of engineering controls and good work practices as the primary means of reducing exposures (9,13). Proper use of a respirator specially recommended for asbestos (37) when using the brake cleaning methods described in Part IV of this guidance can only protect a mechanic while the respirator is being worn. Since any of the brake cleaning methods described in Part IV could contaminate a garage with brake dust, mechanics and other employees would have to wear such a respirator all day to be protected. In addition, effective respirator use requires a complete respiratory protection program, including worker training, medical evaluations, proper respirator selection and maintenance, fit testing, and periodic inspections. Furthermore, NIOSH and EPA recommend only certain air-supplied respirators for asbestos exposure (37). These respirators could be very cumbersome in a garage setting.

Air-purifying respirators with HEPA cartridges may be appropriate for secondary protection during floor cleaning, filter or collection bag changing, and waste disposal. Air-purifying respirators with HEPA cartridges should be used only as a precaution against the accidental disturbance of asbestos, and not as a substitute for effective engineering controls. It should be noted that, while NIOSH and EPA do not recommend the use of air-purifying respirators with HEPA cartridges in asbestos environments, various existing regulations currently allow their use.

Additional Information

This guidance was prepared to support technical materials being developed as part of the Brake Mechanic Education Program under EPA's Asbestos Action Program. The following are additional sources of information on asbestos:

EPA Regional Asbestos Coordinators

(CT, MA, ME, NH, RI, VT)
EPA Region I
JFK Federal Building
Boston, Mass. 02203
(617) 223-0585

(NJ, NY, PR, VI)
EPA Region II
Woodbridge Avenue
Edison, N.J. 08837
(201) 321-6668

(DE, MD, PA, VA, WV)
EPA Region III
Curtis Building
6th and Walnut Streets
Phila., Penna 19106
(215) 597-9859

(AL, FL, GA, KY, MS, NC, SC, TN,)
EPA Region IV
345 Cortland St., N.E.
Atlanta, Georgia 30365
(404) 881-3864

(IL, IN, MI, MN, OH, WI)
EPA Region V
230 S. Dearborn St.
Chicago, Ill. 60604
(312) 886-6003

(AR, LA, NM, OK, TX)
EPA Region VI
Internfirst II Bldg.
1201 Elm Street
Dallas, Texas 75270
(214) 767-2734

(IA, KA, MO, NE)
EPA Region VII
726 Minnesota Ave.
Kansas City,
Kansas 66101
(913) 236-2835

(CO, MT, ND, SD, UT, WY)
EPA Region VIII
One Denver Place
999 18th St., Suite 1300
Denver, Colorado 80202
(303) 293-1730

(AZ, CA, HI, NV, CM, American Samoa, Guam)
EPA Region IX
215 Fremont Street
San Francisco, CA 94105
(415) 974-8588

(AK, ID, OR, WA)
EPA Region X
1200 6th Avenue
Seattle, Wash. 98101
(206) 442-2870

Toll-Free Numbers

EPA 800-424-9065	Where general public can get technical assistance	Consumer Product Safety Commission 800-638-2772	For information on asbestos in consumer products or homes

NIOSH

National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, Ohio 45226
(513) 533-8323

U.S. Occupational Safety and Health Administration

OSHA Office of Information and Consumer Affairs, Room N-3637
200 Constitution Avenue, N.W.
Washington, D.C. 20210
(202) 523-8151

References

1. Rohl, A.N., Langer, A.M., Wolff, M.S., and Weisman, I. Asbestos Exposure during Brake Lining Maintenance and Repair. Environmental Research 12:110-128. 1976.

2. NIOSH. Report 32.4 Industrial Hygiene Summary Report of Asbestos Exposure Assessment for Brake Mechanics. November 22, 1982.

3. PEI Associates. Asbestos Dust Control in Brake Maintenance. EPA Office of Pesticides and Toxic Substances Contract No. 68-02-3976. September 30, 1985.

4. GCA Corporation. Asbestos Product Test Results. EPA Office of Pesticides and Toxic Substances Contract No. 68-02-3168. February 1980.

5. Hatch, D. Possible Alternatives to Asbestos as a Friction Material. Annals of Occupational Hygiene 13:25-29. 1970.

6. Knight, K.L. and Hickish, D.E. Investigations and Alternative Forms of Control for Dust Generated during Cleaning of Brake Assemblies and Drums. Annals of Occupational Hygiene 13:37-39. 1970.

7. Lorimer, W.V., Rohl, A.N., Miller, A., Nicholson, W.J., and Selikoff, I.J. Asbestos Exposure of Brake Repair Workers in the United States. Mount Sinai Journal of Medicine 43:207-218. 1976

8. Rohl, A.N., Langer, A.M., Klimentidis, R., Wolff, M.S., and Selikoff, I.J. Asbestos Content of Dust Encountered in Brake Maintenance and Repair. Proceedings of the Royal Society of Medicine 70:32-37. 1977.

9. NIOSH-OSHA Asbestos Work Group. Workplace Exposure to Asbestos: Review and Recommendations. DHHS (NIOSH) Publication No. 81-103. November 1980.

10. OSHA. Occupational Exposure to Asbestos: Emergency Temporary Standard. Federal Register Vol. 48, No. 215. November 4, 1983.

11. National Research Council. Asbestiform Fibers: Nonoccupational Health Risks. National Academy Press. 1984.

12. Chronic Hazard Advisory Panel on Asbestos. Report to the U.S. Consumer Product Safety Commission. July 1983.

13. NIOSH. Statement of the National Institute for Occupational Safety and Health. Public Hearing on Occupational Exposure to Asbestos. June 21, 1984.

14. Nicholson, W.J. Investigation of Health Hazards in Brake Lining Repair and Maintenance Workers Occupationally Exposed to Asbestos. NIOSH Contract No. 210-77-0119. February 1983.

15. McDonald, A.D., Harper, A., El Attar, O.A., and McDonald, J.C. Epidemiology of Primary Malignant Mesothelial Tumors in Canada. Cancer 26:914-919. 1970.

16. Greenburg, M. and Lloyd Davies, T.A. Mesothelioma Register 1967-68. British Journal Of Industrial Medicine 31:91-104. 1974.

17. Newhouse, M.L. and Thompson, H. Mesothelioma of the Pleura following Exposure to Asbestos. British Journal of Industrial Medicine 22:261-269. 1965. (Table on p. 269, case #58.)

18. NIOSH. Asbestos: Asbestos Exposure during Servicing of Motor Vehicle Brake and Clutch Assemblies. Current Intelligence Bulletin 5. August 8, 1975.

19. Langer, A.M. and McCaughey, W.T.E. Mesothelioma in a Brake Repair Worker. Lancet 8307:1101-1103 November 13, 1982.

20. Ziem. G. Three case reports of mesothelioma in brake mechanics. In: Castleman, B. Asbestos: Medical and Legal Aspects. Harcourt Brace Jovanovich. 1984. (Four additional cases in mechanics and a case in a mechanic's wife in publication.)

21. Yorkshire Television. "Alice: A Fight for Life." July 14, 1982. (Mesothelioma in a ten-year old son of brake mechanic described and filmed.)

22. EPA. Asbestos; Proposed Mining and Import Restrictions and Proposed Manufacturing Importation and Processing Prohibitions. Federal Register Vol. 51, No. 19. January 29, 1986.

23. Seidman, H., Selikoff, I.J., and Hammond, E.C. Short-term Exposure to Asbestos and Long Term Observation. Annals of the New York Academy of Sciences 330:61-90. 1979.

24. EPA. Support Document for Final Rule on Friable Asbestos-Containing Materials in School Buildings: Health Effects and Magnitude of Exposure. January 1982.

25. Stell, P.M. and McGill, T. Asbestos and Laryngeal Cancer. Lancet 7826:416-417. August 25, 1973.

26. Shettigara, P.T. and Morgan, R.W. Asbestos, Smoking and Laryngeal Carcinoma. Archives of Environmental Health 30:517-519. 1975.

27. Selikoff, I.J. and Lee, D.K. Asbestos and Disease. Academic Press. 1978.

28. National Loss Control Service Corportation. Report of Industrial Hygiene Study for Ammco Tools, Inc. 1978.

29. Data from reference 3 show TWA levels with these methods at about 200,000 fibers per cubic meter. The average worker doing light to moderate work, such as a mechanic, breathes ten cubic meters of air during an eight-hour work day, thus inhaling about two million asbestos fibers daily. Rohl's data (reference 1) shows that levels twelve feet away using a dry brush were the same as using a compressed air hose. His data also show shop contamination of 100,000 fibers per cubic meter at distances of up to 75 feet from the site of compressed air use, and other measurements indicating significant scatter.

30. OSHA. 29 CFR 1910.1001(h)(2).

31. EPA. Asbestos Waste Management Guidance - Generation, Transport, Disposal. EPA/530-SW-85-007. May 1985.

32. Nilfisk. Nilfisk Asbesto-Clene Systems; Rohl, A. Letter to Robert Magdelain, April 11, 1979, on air sampling during equipment use with transmission electron microscopic analysis reporting virtual elimination of asbestos levels; Nilfisk instructions for use; Nilfisk Simplifies the Safe Collection and Disposal of Toxic, Hazardous, and Nuisance Waste Materials. Nilfisk of America, Inc., 300 Technology Drive, Malvern, Pennsylvania 19355 (215) 647-6420.

33. Clayton Associates. Asbestos in Automotive Shops; Rohl, A. Letter to Jim Clayton, October 12, 1984, on air sampling during equipment use and filter change using transmission electron microscopic analysis reporting virtual elimination of asbestos levels; Asbestos and You. Clayton Associates, Inc., P.O. Box 589, 30 Southard Avenue, Farmingdale, New Jersey 07727 (201) 938-6700.

34. Control Resource Systems. CRSI 2000 and CRSI Labmaster Vacuums, Brakemaster enclosure system description. Control Resource Systems, Inc., 670 Mariner Drive, Michigan City, Indiana 46360. (219) 872-5591.

35. Hako Minuteman. Hako Minuteman Asbestos Brake Drum Vacuum System. Hako Minuteman, Inc., 111 South Route 53, Addison, Illinois 60101 (312) 627-6900.

36. American Conference of Government Industrial Hygienists. Industrial Ventilation: A Manual of Recommended Practice. 18th Edition. ACGIH. Page 5-128. 1984.

37. NIOSH. Guide to Respiratory Protection for the Asbestos Abatement Industry. EPA/560-OPTS-86-001. April 1986. This contains NIOSH's most extensive recommendations for a program of respiratory protection against asbestos.