Asbestos Study
Committee, 1980-81

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FRICTION MATERIALS STANDARDS INSTITUTE, INC., E-210 ROUTE #4, PARAMUS, NEW JERSEY 07652

November 17, 1980

TO: HEALTH AND ENVIRONMENTAL AFFAIRS COMMITTEE

SUBJECT: MEMBERSHIP ON COMMITTEE

This is to advise Committee members on the make-up of the Health and Environmental Affairs Committee. I have attached a roster of those who will be serving on this Committee.

Should there be information of importance to Committee members it will be sent to the names appearing on this roster. When a Committee meeting is called we will advise the members indicated. The foregoing is for your information.

E. W. Drislane
Executive Director

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(2)

2.7 - HEALTH & ENVIRONMENTAL AFFAIRS COMMITTEE

James W. Armstrong, Chairman	Bendix Corporation Bendix Center Southfield, MI 48076 313-827-6350
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B U L L E T I N

N O. 6 8 8

July 29, 1980

NATIONAL WORKSHOP ON SUBSTITUTES FOR ASBESTOS

On July 14-16, 1980 the Consumer Product Safety Commission (CPSC) and the Environmental Protection Agency (EPA) sponsored a national workshop on substitutes for asbestos. I attended the July 14, 1980 session at which a formal presentation was given on friction materials. This presentation was given by Mr. Charles Brunhofer of the Bendix Corporation, and emphasized the use of semi-metallic type linings on automotive disc brakes. This was a formal session with a prepared delivery and a slide program. In the afternoon there were sessions on various subjects which were called "round table discussions." There was a round table discussion concerning friction products in the afternoon which I attended. I did not participate in sessions on gaskets, packings and other such material. But I did sit in on some programs such as the ones on textiles.

I don't believe that there was any major new information developed at this workshop. Some speakers used their time to espouse substitutes that they were promoting. Others took the opportunity to take swipes at the use of asbestos to further their products. Some were state of the art type reports and I would characterize the Bendix presentation as such.

Mr. Brunhofer's talk was well documented and illustrated and indicated the considerable work that Bendix has done on development of semi-metallic materials for disc brakes. He reached back into the history of this development which started prior to the days when asbestos was a target of Mt. Sinai and the environmentalists. The material was developed for use in a brake package to perform at higher levels of severity, which later tied in with reduced sizing of brakes from the vehicle manufacturers' down-sizing programs. This came with a move back towards solid rotors from the ventilated rotors which had been used on most United States passenger cars over the past 10-15 years.

An abstract of Mr. Brunhofer's presentation follows:

> Friction materials for automotive brakes are complex composites containing three general types of ingredient materials: reinforcing fibers; modifiers that adjust or maintain friction level, wear rate, and noise properties; and organic resin binders. Historically, the foundation or major constituent of automotive friction materials has been asbestos fiber, so chosen because of thermal stability, friction level, reinforcing properties, availability, and relatively low cost.
>
> Numerous substitutes for asbestos in conventional organic materials have been evaluated, including both naturally occurring and synthetic materials. Direct substitution of these alternative materials in conventional formulations has resulted in poor friction levels, friction instability, roughness,

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structural failure, increased noise, mating surface deterioration and/or front-to-rear vehicle brake imbalance. Complete reformulation, not simple substitution, is necessary to meet the numerous, complex performance requirements of consumers, manufacturers, and government standards, such as FMVSS 105-75 and FMVSS 121.

In the 1960's, a new class of friction materials called semimetallics was developed to meet severe braking requirements, primarily in heavy-duty disc brake and extreme duty truck block applications. Semimetallics operate satisfactorily against the ventilated cast-iron rotors in the smaller brakes of downsized cars, as well as against the solid rotors found in the lighter brakes of new front wheel drive vehicles. Semimetallics rely on steel fiber and powder metallurgy techniques for reinforcement, and do not require asbestos. The improved performance of semimetallics compensates for their higher costs due to more expensive ingredients, higher specific gravity, and more costly processing requirements. Overall development took more than ten years from introduction to significant customer acceptance.

The characteristics of semimetallics make them extremely difficult and costly to process as a drum lining segment. Consequently, an additional new class of friction materials is under development, specifically for drum lining applications. Additional development effort is necessary, not only to confirm the performance characteristics of these new substitute fiber formulations, but also to develop new processing techniques. These new-type friction materials will be more costly, however, due to the ingredients and new processing techniques.

It will be noted that the talks and discussions at this workshop will be typed and made a part of the proceedings of the workshop. Copies of the proceedings will be available from EPA sometime after the next several weeks. I will attempt to get copies of the proceedings for distribution at that time. During questions following Mr. Brunhofer's presentation as well as at the round table discussion in the afternoon there were several comments. Statements were made to the effect that while semi-metallic type materials have been proven on disc brakes, drum brakes are a completely different problem. Drum brake semi-metallics are difficult process because of weak green strengths and the difficulty in bending the material, as well as the brittleness of the material. Lengthy lead times are involved. Where the changes were "evolutionary" they took from 3-4 years. This would be developing a new semi-metallic in an existing brake package for example. Mr. Brunhofer indicated that where the change was "revolutionary" this would take 5-1/2-8-1/2 years in development. This could be where the vehicles were being down-sized with a completely new brake caliper and solid rotor for example.

In discussions participants indicated that there will be full semi-metallics on disc brakes by 1985. There also is development under way concerning organic drum brake linings using substitute materials for asbestos. The earliest that such non-asbestos drum brake materials may be in production was indicated as 1982-1983. Questions were raised about the replacement market, where a new vehicle takes a semi-metallic type lining. What would be used for replacement? Would the aftermarket install organics where a full semi-metallic was released as original equipment or would they install a like material? It was suggested that in practice the aftermarket may very well use conventional asbestos type materials to replace semi-metallics but that it was recommended that replacement be on a like for like basis. That is, where semi-metallic is used as original equipment it was recommended that the replacement also be a semi-metallic type. A participant from Dupont recommended the use of Tevlar as a substitute for asbestos. He suggested that it not be used as a one for one substitute because it is quite expensive. He suggested that perhaps one might use 5% Tevlar, plus other lower cost inorganic fibers materials to replace the balance of the asbestos. One example of an inorganic material he indicated was wollastonite. It was indicated that materials of this type are used on clutch facings on Mercedes, Audi and Porsche.

During the round table discussion Mr. Lee Burgess of Wheeling Brake Block indicated that where substituting for asbestos may be possible for mass production disc brakes, there is an entirely different field where substitution is not going to be simple. He indicated the use of asbestos type materials on heavy equipment such as Manitowoc and other large off-highway equipment. He particularly mentioned submarines and/or defense equipment. Mr. Burgess indicated that these materials were almost custom made to the requirements of the customer. Where substitute materials are going to be higher in price, the costs to the end consumer will be staggeringly high. Mr. Burgess made several points as regards the fact that straight substitution for asbestos is not as simple as the regulators may assume.

I am not sure whether the items discussed at the round table discussion will be in the proceedings, but if they are they will also be distributed when received. It was not our intention to distribute copies of the sessions other than those for friction materials.

A brief write-up by EPA on asbestos and substitute materials for friction materials is attached.

At the round table discussion, personnel from EPA (which included Mr. Al Colli of the Office of Toxic Substances Control) asked generally the same questions that had been asked the Institute earlier concerning non-asbestos disc brake linings. Those answers had been given to the EPA people. A good deal of the session, and particularly that in the afternoon work session, was repetitive, as EPA was again asking questions asked earlier.

E. W. Drislane
Executive Director

EWD/lmc
Enc.
Distribution:
Active Members - List C
Delegates & Alternates
Regional Members (U.S. Dues)

SECTION 5

FRICTION MATERIALS

Asbestos is well suited for use in friction materials because of its thermal stability, reinforcing abilities, and relatively high ability to withstand friction. Asbestos-containing friction materials are used for brakes for light- and heavy-duty vehicles, aircraft, railcars, various types of heavy equipment and clutch facings.

Several manufacturers of friction materials have active research and testing programs to develop asbestos-free materials. Although industry's research and development activities are highly secretive, we know that among the materials proposed in the past as substitutes are: glass fiber, steel wool, mineral wool, carbon fiber, cermets (sintered metals), semimetallic materials, potassium titanate fibers, aramid fibers, vermiculite, and silicon nitrides. Some firms may have ceased research on one or more of these materials but others may still be under consideration.

Several manufacturers of friction materials have active research and testing programs to develop asbestos-free materials. Some of the materials proposed as substitutes are: glass fiber, steel wool, mineral wool, carbon fiber, cermets (sintered metals), semimetallic materials, potassium titanate fibers, aramid fibers, vermiculite, and silicon nitrides.

As friction applications vary, so do the materials most appropriate for each use. Semimetallic and cermet materials may all be used in direct asbestos substitute applications, semimetallic in disc brakes (it is projected that in 5 years nearly all original equipment disc brakes in passenger cars and light trucks will use semimetallics) and cermets for aircraft brakes (95 percent of all new commercial aircraft use cermets).[23,24] Nonasbestos drum brake linings for passenger cars are currently unavailable commercially.[23]

A cost comparison for various materials proposed as substitutes for asbestos in friction products is given in Table 7.

TABLE 7. COSTS OF MATERIALS PROPOSED AS SUBSTITUTES FOR ASBESTOS IN FRICTION MATERIALS [25]

Material	Price per pound ($)
Asbestos	0.05-0.15
Fibrous glass	0.05-0.75
Mineral wool	0.15
Potassium titanate fibers	1.00-1.25
Graphite and carbon fibers	10.00-12.00
Wollastonite	0.15
Cotton linters	0.15
Aramid fibers	6.00-8.00

Exact costs for semimetallic friction materials are not available, but they are comparable to organic friction materials. Cermets cost three to five times as much as asbestos friction materials.

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HEALTH AND ENVIRONMENTAL AFFAIRS COMMITTEE

. Committee - Reorganization

. This Committee was formed by the Board of Directors in 1971 in response to the Occupational Safety and Health Act of 1970. The Committee was originally formed to keep FMSI advised of OSHA activity on asbestos and thus thru 1979 was called the "Asbestos Study Committee."

In 1979 the Board requested that the Committee expand its scope to monitor asbestos legislation activity in such areas as environmental protection and workers compensation. As a result, the Committee developed a charter and a name change to the Health and Environmental Affairs Committee to more descriptively reflect this expanding role within the Institute.

. The Committee has also been broadened to be more representative of the membership. Representatives now on the Committee are:

- Don Lee - Nuturn - World Bestos Division
- George Bohrer - H.K. Porter Co. - Thermoid Division
- Richard Dean - Thiokol Corporation - Friction Division
- G. Nicholson - Abex Corporation
- D. E. Stone - Bendix Corporation
- H. H. Wagner - Carlisle Corporation
- I. H. Weaver - Raybestos Manhattan

. EPA Action

. On October 17, 1979, the Environmental Protection Agency and Consumer Product Safety Commission published an advance notice of proposed rulemaking. The notice was a request for information regarding the use of asbestos in commercial products, an estimate of a persons risk and an estimate as to how many products could be produced asbestos free.

The Institute replied to EPA's Advance Notice of Proposed Rulemaking on asbestos products. The comments took exception to the Agency's selection of friction materials for control based on allegations of heavy population exposure.

. The EPA has indicated friction materials as being one of the prime products to be regulated. On November 16, 1979, the EPA requested specific "Informational needs for friction products containing asbestos" (Eleven Questions for Friction Materials Manufacturers).

The original list of questions was reviewed and found to be objectionable to the FMSI. On January 3, 1980 a meeting was held with the EPA and major changes were agreed upon which made the questions a little more palatable.

In May 1980, the Institute responded to EPA on their questions concerning non-asbestos disc brake linings for passenger cars and light trucks. This included state-of-the-art information on types, advantages and disadvantages, costs and the lead times involved in conversion.

It is very clear that the EPA is moving toward a ban on asbestos in at least disc brakes and is aggressively pushing that objective.

. The EPA is also pushing for a greater awareness of the hazards of asbestos particularly relating to friction products. It has formulated agreements between OSHA and contractors, Public Media Center, San Francisco, California, for the development of educational and informational materials for vocational and technical students being trained in brake maintenance, their teachers and mechanics.

The Institute worked with the Asbestos Information Association ad hoc Committee for Friction Materials in the preparation and circulating of questionnaries on friction materials industry labelling practices and training programs relating to asbestos.

As part of this Committee's work, we have updated a page in the Institute Catalogs on "Recommended Procedures for Reducing Asbestos Dust During Brake Servicing." Thus, are in a good position to meet any request for training literature.

. On May 19, 1980 the EPA published regulations covering its "Hazardous Waste Management System" for the owners and operators of hazardous waste treatment, storage and disposal facilities. These regulations are included as part of the regulations under Resource Conservation and Recovery Act (RCRA) which was originally inacted in 1976.

The regulations are to be effective on November 19, 1980.

Asbestos is listed as a regulated material but there is an exception. Generators of 1000 kilograms per month or 2200 lbs. do not fall within the system.

Those generators of asbestos material waste in excess of this limit will be required to generate a manifest and assure that the waste disposal site has approval for the receipt of waste containing asbestos.

. Asbestos Compensation

. Legislative activity to develop a federal fund for the payment of asbestos related diseases is still occurring. The Fenwick Bill, which was the first effort, is now considered dead. Senator Hart has introduced legislation but it is still to early to determine if it has support.

. OSHA

. On January 2, 1980, OSHA issued its long awaited Generic Cancer Policy. It was suspected that OSHA would attempt to place asbestos into the list of cancer agents and while still possible is becoming less likely. Latest input would indicate the OSHA direction to be of maintaining a single regulation on asbestos with the eventual lowering of the allowable level from 2.0 to somewhere in the .2 to .5 fiber range. This is not likely to occur until after the elections.

In April 1980, a joint NIOSH-OSHA Work Group recommended to OSHA a reduction in the maximum work place exposure level for asbestos from 2 fibers/cc to 0.1 fibers/cc.

. On May 23, 1980 OSHA issued its final regulations on access to employee exposure and medical records. The regulation which goes into effect August 21, 1980 provides that employee exposure records required under the OSHA asbestos standard be provided to the employees, designated representatives (union included) and the Department of Labor upon request.

This request includes air sampling results, and medical records and requires the employers to retain these records for the duration of employment plus thirty (30) years.

Respectfully submitted,

J. W. Armstrong
Chairman

TELEPHONE (201) 845-0440

FRICTION MATERIALS STANDARDS INSTITUTE, INC.

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

MAR 25 1981

Ms. Joni Repasch
Document Control Officer
Office of Pesticides and Toxic Substances (TS-793)
Environmental Protection Agency
Room E-447
401 M Street, S.W.
Washington, DC 20460

Subject: Document Control Number OPTS 84004
Environmental Protection Agency Proposal on Asbestos;
Reporting and Recordkeeping Requirements

Dear Ms. Repasch:

The Friction Materials Standards Institute is a trade association which includes most of the brake lining and clutch facing manufacturers in the United States. We have other Members worldwide. As friction materials manufacturers, most of our Members use asbestos as a major constitutent in their products. Our comments on these proposals represent the viewpoints of most of our asbestos-using Members.

General Comments

While we will address specific sections of the proposals on reporting and recordkeeping later in this letter, we question the timing and necessity of the proposed requirements. We are familiar with Section 8 of the Toxic Substances Control Act (Public Law 94-469). We understand that this section can require our Members to maintain records and submit reports in great detail, where that information is necessary to regulate substances that may present an unreasonable risk of injury to health or the environment. The friction materials industry agrees that there are health hazards from asbestos in the workplace. These have been addressed by the Occupational Safety and Health Administration (OSHA) and we anticipate further regulation in that area. We do not believe it has been shown there is an unreasonable risk of injury to health or the environment from the sale or use of our products because of the following facts:

1. Asbestos fibers are locked-in to the product in its finished form.

2. There is less than 1% asbestos in the wear debris from used friction materials.

3. Small exposure levels in the general environment have not been established as presenting an unreasonable risk of injury to health and the environment.

We refer you to the enclosed paper "Asbestos & Health in the Friction Material Industry," prepared by the Asbestos International Association in London, England. It summarizes what is known concerning asbestos exposure in the friction material industry, as well as what is known on exposure to friction material wear debris in the general environment. This position paper supports our contention that while asbestos does present a risk to those occupationally exposed, this exposure is now controlled, and that environmental exposure does not present an unreasonable risk--if it presents a risk at all--to the general public.

The Institute suggests that before applying the reporting and recordkeeping requirements of Section 8 of the Act, that EPA demonstrate that asbestos-containing friction materials may in fact present an unreasonable risk. We recommend that action of the type proposed by this notice be deferred until reasonable people can demonstrate the need for the costly and detailed records that in may cases go beyond the needs of the Agency. This proposed regulation would place one more burden on our Members, and particularly the United States manufacturers supplying brake linings, clutch facings and other friction articles to its already depressed automotive, construction, and industrial customers as well as to the energy related industry.

The proposed requirements would not only be burdensome to our Members, but in most cases it is difficult to see how the information can be put to use by the EPA. It calls for a complete documentary on asbestos beyond the needs for purposeful regulation, if indeed that regulation is necessary. Our industry stands ready to help with information-gathering even where the need has not been adequately shown, if the EPA can sharply reduce the amount of information, the old information, information which is mostly confidential, and extraneous information apparently being requested for support of parties other than the Office of Toxic Substances. In fact we suggest that much of the information is available from other Government agencies and it may be of value to have Interdepartmental exchanges between the Government agencies concerned with the asbestos issue.

<u>Section 763.65 - Who must report</u>

In Paragraph (f) the proposals exempt "small manufacturers, processors, or importers as defined in Section 763.65(m)." We agree with the exemption of small manufacturers or processors who employ no more than 10 full-time employees. There seems something inconsistent with the maintaining of jobs in the United States by the exempting of importers, who may be importing from factories with 1,000 employees outside of the United States, where a United States factory with more than 10 employees is not exempt.

One "small importer" could be responsible for more friction products, or other products for that matter, in the United States market than a medium-size United States manufacturer, but the importer would be exempt where the United States manufacturer would not. This exemption would be more equitable if based on dollar value, tonnage, pieces or other like index.

Section 763.70(a) - Customer Lists

Several Members indicate that they will invoke claims of confidentiality on distribution of these lists outside their organizations. We question the need for telephone number and technical contact for each customer. In many cases this information is not available. In other cases, this can create an adversary relationship between a customer and a manufacturer. Claims of confidentiality for this type information are valid, as almost all of our Members are interested in lists of his competitor's customers. We would suggest the EPA reconsider the confidentiality of this type information. We further believe the detail requested should not be required if provision of these lists is actually written into the final rules.

Section 763.71 - Schedule for Reporting

The schedule for reporting by our Members, who are all Primary Processors and Bulk Asbestos Importers, and in many cases are Secondary Processors, is unduly harsh. Rather than the 60 days required in sub-sections (a) and (c), and the 30 days required in sub-section (b), we recommend a standard 90 days schedule. Our Members have facilities at more than one location, and records are in many cases at a location other than the Factory. A 90 day requirement is more realistic when one considers the considerable detail asked by this proposal. Further, many of our Members do not have ready access to in-house Professionals to review and approve reports before submission. Our Members are entitled to have their reports reviewed by Outside Safety, Health and EPA Consultants, Legal Counsel, and other Professionals as to its adequacy and to assure that our Members are not harmed by their reporting.

Form B(2) - Quantity of Bulk Asbestos Imported.

The comments on Form B(2) apply to Form B(3) - Quantity of Bulk Asbestos Obtained. Our major concern is with Form B(2), as almost all our Members use Canadian chrysotile.

All Members of the Institute import asbestos, primarily from Canada. The EPA form asks for quantities of asbestos, by type, and chrysotile by grade. The form lists quantities for 10 years, from 1971 through 1980. In most cases, the older the records the more difficult the search. Some Members no longer have data from which to develop quantities before 1976. As the EPA is asking for information on asbestos emissions at the present time, we question the need for 10 years of data, and particularly that of more than two or three years ago. If the EPA were to have information on current consumption that should give sufficient information for estimating current exposures without the extra work involved in going back over ten years. We suggest, if the data is considered actually of value, that the EPA limit the request to that for 1980.

The notice asks for details on types of asbestos and grades of chrysotile. We understand the EPA is searching for information on other types of asbestos, but question the need for grades of chrysotile. This involves considerable searching of records on the part of our Members, if in fact the information exists. We do not believe that anyone to this time has alleged or inferred that the hazards of asbestos are dependent on the grade of chrysotile. We suggest that the form be revised to ask only on quantities of chrysotile, and that reference to grades be removed.

Form C - Primary Processor Production

Our comments on Form C apply in most cases to Form D - Secondary Processor Production. Many of our Members are Secondary Processors in attaching linings to steel shoes or where they perform other assembly operations. We again state that the older the information is, the more difficult it is to develop. We suggest that production figures for the last year only, 1980, be used. These are available. The manufacturer's efforts in compliance with the requirements of this form would be reduced in almost the proportion that the years are removed. Again, we believe the EPA is searching for current exposure information, and that while history is interesting, the requirement to gather it is not necessary to the task.

Still further, in the instructions for this form, under "End Product Shipped," the form calls for information listing the trade name under which the product is marketed, and calls for a listing of all "private brands" under which the product is sold. We fail to see where listing of trade names or "private brands" is pertinent to developing information on emissions or exposures to asbestos. This information is much more difficult to develop for posting to forms such as these. It would multiply the combinations which would have to be listed, when the only relevant information is a product listing such as we suggest below: Drum Brake Lining (light-medium vehicle), etc.

On Page 8225 of the Federal Register notice, "Typical Terms for Products Made From Bulk Asbestos" are listed. Ten different terms are listed under Friction Materials. Most of those are not relevant to exposures in the general environment. We suggest reducing the 10 terms to 7 as follows:

Drum Brake Linings (light-medium vehicle)
Disc Brake Pads (light-medium vehicle)
Brake Blocks (heavy vehicle)
Disc Brake Pads (heavy-vehicle)
Clutch Facings (all applications)
Automatic Transmission Friction
  Components (automotive)'
Friction Materials (industrial and commercial)

There are no woven disc or drum brake linings for light vehicle use.

For other applications, we question whether information on molded verus woven is pertinent to the question of exposure to asbestos in the general environment. We feel there is but limited usage of asbestos-containing friction materials in consumer products. Still further, all units of measure should be "Pieces."

We question particularly whether information on quantities sold under "Private Labels" will be available even in recent years, without painstaking one-by-one analysis of individual invoices. In addition, there may be claims of confidentiality in this area.

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Form H - Summary of Current Worker Exposure

This particular section of the reporting form would cause an undue burden for large facilities which have several hundred workers and a diversity of production operations. Records on worker exposure levels are not maintained in a manner which would permit easy retrieval of the data requested.

To simplify this section, it is recommended that Column 2 - Total Person Hours Per Year at TWA, and Column 3 - Number of Measurements Used, be eliminated as this data serves no useful purpose and is extremely time intensive in its preparation.

Form K - Pollution Control Equipment

We question the need for the Month and Year under the "When Installed" column. Some installations go in over a long period--in some cases as long as 12 months from delivery to final usage. Do you wish the date ordered? The date delivered? The date installed? The date first used? The date put into use on a full-time basis? The year of installation should be sufficient. We believe a definition should be presented so as to clarify what is wanted or needed.

Where there is more than one piece of pollution control equipment, even where there are two, three or more installed, the form calls for a separate listing. We suggest that the form be redesigned to permit listing of any quantity of a particular piece of equipment where that equipment is identical to another piece. The quantities could be listed per piece of equipment, with a total column for all equipment of that same type. The purpose of our recommendation is to reduce the paper work burden.

* * * * *

We question the need for this proposed reporting from manufacturers of friction materials based on the reasons stated under our "General Comments." We suggest a deferral of the proposals on reporting and recordkeeping until reasonable people can demonstrate the need.

We suggest that if the reporting and recordkeeping requirements in this proposal will not be deferred that the proposal be revised to simplify and reduce the paper work burden on our industry. This can be done in three ways:

1. Cancel the study of history--ask for information for 1980 only.

2. Reduce the detail--such as grades of chrysotile, month and year of installation, etc.

3. Eliminate or re-write the proposal on information requests where confidentiality will likely be claimed

Respectfully submitted,

FRICTION MATERIALS STANDARDS INSTITUTE

E. W. Drislane
Executive Director

EWD/erc
Enc: Asbestos & Health in the Friction Material Industry

ASBESTOS INTERNATIONAL ASSOCIATION

(Limited by Guarantee)

68 GLOUCESTER PLACE, LONDON W1H 3HL

MEMORANDUM

TO: Member Associations — AIA/7/3/PROD

FROM: Director General — 12 February 1981

"Asbestos & Health in the Friction Material Industry"

The attached position paper on Asbestos & Health in the Friction Material Industry is forwarded for information. It has been authorised by the Executive Committee who recommend that it should be used as a background reference paper to help members deal with questions in asbestos and health which may arise.

for Director General

FMSI 03568

ASBESTOS AND HEALTH IN THE FRICTION MATERIAL INDUSTRY

The Problem

Exposure to asbestos dust is recognised as a potential occupational hazard. Among work people exposed to high concentrations of respirable asbestos dust, (such as is known to have occurred before present day dust control measures and work procedures were introduced) cases of cancer and asbestosis have been reported throughout the world.[1,2,3] The difficulty of reliably identifying the occupational history of those whose health has been affected many years after has resulted in any contact with asbestos being regarded with caution and all materials containing asbestos being attacked indiscriminately.

Since friction material is widely recognised as one of the products for which asbestos is an important ingredient, it has attracted such attention. Indeed, the asbestos industry, in reminding everyone of the vital role played by asbestos in brake linings, has stimulated such attention. Nevertheless the occupational health record of the asbestos friction material industry is good and only a few cases of asbestos-related disease are on record. However, the widespread use of friction material in all types of vehicles has raised the question of potential pollution of the environment with an assumed consequent danger to the health of the general public.

The friction material industry, therefore, has two basic problems. The first, the occupational health problem, has in many areas been resolved. However, the industry must continue to ensure that those employed in the manufacture of these materials are not exposed to dust levels which are harmful. An extension of this problem is the need to ensure that workers employed in the subsequent use of friction materials, either in the fitting of the products or the maintenance of vehicles, are not exposed to harmful dust levels.

(This page retyped at FMSI because of weakness of original copy)

The other problem for the industry, that of possible environmental pollution, is more difficult to resolve, based as it is on emotional anxieties (which are in no way justified by the evidence). A climate of concern for the effect on the environment of expanding towns and industries has led to the motor vehicle being included as a significant factor in this pollution. This fact together with the publicity given to asbestos and its classification as a carcinogen,[4] have all combined to lead people to question the use of asbestos-based components in motor vehicles.

The automotive industry is also under attack for a number of other reasons, (e.g. pollution, waste of resources and congestion) and would gladly be without the asbestos problem although it must accept that for some years, current models of motor cars will need asbestos-containing material for replacements. The friction material industry itself must therefore dispel anxieties about asbestos-containing products in motor vehicles by ensuring that the existing reassuring evidence is made manifest and is properly understood.

Tackling the Problem

In order to tackle the problem most effectively, it is important that the origins, investigations and remedial measures involved should be well understood. This is especially necessary since the existence of the friction material environmental problem is to a large extent based on confusing two very different phenomena; on the one hand the occupational health experience and dust exposure data related to manufacture (and the subsequent fitting and servicing operations sometimes called "para-occupational") and on the other hand an assumed emission of similar dust into the general environment as a result of the daily wearing down of brake linings and clutch facings. An example of this confusion may be seen in the evidence given to the UK Asbestos Advisory Committee, where claims that the general public are at risk are supported solely by reference to a survey of motor vehicle maintenance workers.[5]

It is therefore important to recapitulate the facts relating to health hazards and the conditions which are believed to give rise to them.

These facts will be reviewed under three headings, the first two covering the Occupational areas of Manufacturing and Servicing, and the third heading covering that of the General Environment.

Manufacture of Friction Materials

There is ample evidence to suggest that, in the manufacture of friction materials, the concentration of asbestos dust compares favourably with that found in most other modern asbestos operations. Within the last ten years efforts to observe a 2 f/ml* standard have led to further improvements in dust control and there are now many operations where levels well below this maximum allowable concentration are achieved[6]. Very few cases of asbestos-related disease arising from friction materials manufacture have been reported.

In evidence presented to the UK Advisory Committee,[5] Ferodo Limited, who have been using asbestos in brake and clutch linings since 1910, reported 8 cases of mesothelioma and 5 cases of asbestosis. The mesothelioma cases had all been exposed in the manufacture of railway brake blocks between 1928 and 1933 or during the war years up to 1943, to crocidolite as well as to the chrysotile asbestos more generally used throughout the plant. The asbestosis cases were all involved in mixing processes where masks should have been worn.

In the same volume of evidence, a report from the two Cape Industries' factories manufacturing both textiles and friction material (one since 1901 and the other since 1923) cites 9 cases of asbestosis and no case of mesothelioma.

Ferodo report that "many millions of man hours have been worked on finishing operations of asbestos-based materials; though the dust concentrations associated with these were at one time very high, there

* f/ml = (asbestos) fibres per millitre

has not been a single diagnosis of asbestosis as a result of this exposure". In more recent years (1968 - 1976) however, average concentrations were well below 2 f/ml following continuous improvements in dust extraction methods.

An investigation in 1975 by Heidermanns, Kuhnen, Schutz and Prochazka[9] into dust hazards which might be associated with the manufacture and use of asbestos-containing friction materials (updated in the Research Report of the German Berufsgenossenschaften[7] quotes concentrations of micro-dust in the range of 0.09 to 0.20 mg/m^3 during grinding, drilling, sawing, turning and milling operations (the current TRK* value is 0.10 mg/m^3 or 2 f/ml:[8] on this basis the current range is 1.8 f/ml to 4 f/ml), on average just below or just above 0.15 mg/m^3 or 3 f/ml.

Such operations, unless subject to dust control, will emit dust containing asbestos. A number of surveys of such operations have been carried out in Germany [7,9], UK [10,11,12], USA [13,14,15,16,17] and elsewhere [3,5,8] and it is clear that, under some conditions of working and where such operations are carried out continuously, dust concentrations above 2 f/ml (or the TRK of 0.10 mg/m^3) can be reached. There is some evidence of effects on health among men engaged for a long period on such work. Medical and epidemiological investigations by Professor Woitowitz, Valentin and others [7] on workers who had been continuously exposed for at least 10 and up to 25 years to asbestos dust suggests a similar risk level for men employed on finishing operations (mainly grinding and drilling) in the automotive industry, to the risk level of workers in the manufacturing industry [7,9]. +

It was noted that the automotive industry group studied had had long exposure from a very early age. [9] A group of men carrying out brake

* TRK = Technical Control Limit

\+ Out of 94 workers (including 43 women) in <u>manufacturing</u>, there were 3 probable cases of asbestosis and 11 "possible". Among 63 men employed in <u>finishing operations on brake linings</u> in the <u>automotive industry</u>, 2 probable asbestosis cases were found and 10 "possible". ("Possible" means showing effects on the lung which might be fibrogenic.)

maintenance services with exposure primarily during the cleaning and brushing out of brake drum dust gave little evidence of inhalation effects in spite of long years of exposure.

Professor Selikoff's investigations [19] quoted indications of abnormalities in 32 out of 87 motor vehicle mechanics (6 out of 29 with five or more years intermittent exposure showed signs on X-ray of changes consistent with asbestosis). Another report of the same investigation quoted 24% of 93 brake service mechanics showing chest abnormalities not necessarily asbestos-related and it is emphasised that there were no confirmed cases of asbestos-related disease. Dust levels quoted in connection with this investigation (in USA) [20,21], refer to mean concentrations for blow-out of brake drums, grinding of used linings and bevelling of new linings of 15.9, 3.8, and 37.3 f/ml respectively - much higher than any found by any other researchers. No information is provided as to the duration of those samples - they are frequently referred to as peak concentrations or the mean of a number of such measurements. It is also clear that in the case of blowing out of brake drums, no asbestos fibres were visible by optical microscopy; some chrysotile was identified by X-ray diffraction. Fibres identified by electron microscopy were all below the minimum size specified in the definition of asbestos fibre (i.e. 5 µm in length)[8]. It should be noted that the methods of sampling and the criteria for measurement of occupational environments did not conform to the methods used by governmental agencies and by other investigators in Germany and UK.

For comparison, concentrations of asbestos dust during brake maintenance reported by Hickish and Knight [10] showed an average daily exposure of 0.68 f/ml (range 0.21 to 1.12) during brake service of 11 cars. During truck brake service, the average was 1.75 f/ml, with peak, during cleaning of the brake drum, of 7.09 f/ml.

The German investigation in 1975 [9] (now incorporated in the Berufsgenossenschaften report [7]) recorded high concentrations* in the brake service department and

* 0.03 to 0.79 mg/m^3 and with background workshop atmosphere of 0.03 to 0.05 mg/m^3.

where machining was done without dust extraction. Although high concentrations of dust were observed during blowing out, no chrysotile asbestos could be detected by infra-red spectrometry, and the individual fibres which could be detected optically could not be identified as asbestos.

The General Environment

During the application of drum brakes, disc pads or clutch facings, small quantities of the surface of the friction material are worn away. These materials contain between 30% to 60% of asbestos, and it has been assumed by some that thereby large quantities of dangerous asbestos dust are being regularly discharged into the atmosphere. This, it is argued, creates a dangerous atmosphere akin to that which has produced asbestos-related disease (especially cancer) in some working environments. Since the estimated consumption of asbestos in friction material is annually over 40,000 tons [22] for Europe and over 50,000 tons in the USA the amounts involved are substantial. An estimate carried out by the Bendix Corporation with the support of the US Environmental Protection Agency (EPA) calculated that the amount of friction material worn away in brakes and clutches annually in the USA is around 60,000 tons,[13] (of which 37,000 tons is the asbestos content i.e. 60%. In Europe the content of brake linings is nearer 30%). However it is clear from measurements made at a number of locations with heavy road traffic that insignificant quantities of respirable asbestos dust are so emitted.[23,24]

The most important factor in dispelling anxiety is that the asbestos content of the wear products of friction material is not emitted into the atmosphere in the form of respirable asbestos dust. Indeed, a number of ambient air investigations indicate that it is difficult nowadays to find asbestos fibres in any significant quantity, regardless of size, in the atmosphere - even in the vicinity of asbestos manufacturing plants.[24]

Measurements of the ambient air even in heavy traffic conditions do not show any significant level of asbestos. Again, in underground railway systems, where fierce application of asbestos-containing brakes in the

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confined tunnel environment might be thought to create the worst conditions, no significant build-up of asbestos dust has been detected.[24,25,26]

The explanation is simple and is confirmed by a number of careful scientific investigations. The heat generated in the process of applying the brakes or the clutch (the reason in fact why asbestos is such a vital component) is sufficient to destroy the original structure of the asbestos fibre. From a temperature of 450°C the chrysotile structure begins to convert to a non-crystalline amorphous phase, leading to a loss of stability of the fibre structure. The mechanical strain applied during the braking process has a pulverising and grinding effect, leading to disintegration of the fibre structure. The German report [7] calls it "a kind of micro-milling so that the dust no longer contains any fibres".

From a temperature of 650°C a new crystalline structure develops called Forsterite, which will be fully developed at temperatures of above 700°C. Generally, forsterite cannot be traced in brake lining dusts. This means that temperatures beyond 650°C either do not occur or are only very short-lived. The decrease of the chrysotile content, however, indicates that temperatures beyond 450°C are reached because the amorphous phase of the chrysotile cannot be traced analytically (by either infra red-spectrometric or X-ray diffratcmatic methods).

Examination of the residue of wear products in brake drums confirms that the asbestos content is usually less than 1% of the residue.[27] It has been suggested that the dust escaping into ambient air may contain a higher proportion of the fine respirable asbestos than dust left in the drums but careful studies designed to entrap this escaping portion of the wear product show that this is not so. Various investigations into the amount of asbestos remaining in the residues from friction processes have been carried out which indicate how minute is the fraction of asbestos released in the application of friction. The latest report, [7] from Germany, confirms that technical investigations in recent years have repeatedly shown that the dust generated by friction of the linings in use - as opposed to dust created during the finishing and handling of new linings - as a rule contains only traces of free chrysotile fibre, i.e. of the order of 1%. The working party was unable to provide clearer infra-red spectrographical evidence of chrysotile. Under phase-contrast and electron-microscopic scrutiny, the dust contained just a few isolated fibres which could not even be definitely identified as asbestos. This is consistent with the investigation by UK government and industry investigations in 1969 [10,27] which reported that the free asbestos content of wear products of drum brake linings rarely exceeded 1%. (In disc brakes the content was even lower.)

The Bendix investigations for NIOSH in USA in 1973 gave a range from 1.65% to 0.003% - only three tests were above 1% and the overall average was 0.23%. This study also determined that only 3.2% of the asbestos content of all the wear products over the whole range of US motor vehicles became airborne - estimated at 5060 lbs. annually.[13]

The Ford Motor Company carried out a study [28] based on dynamometer tests which showed that during brake usage less than 0.02% of the lining wear was released in the form of free asbestos. The study estimated that concentrations of asbestos fibre in the urban atmosphere in the US due to brake usage was less than 0.07×10^{-9} g/m^3 (.07 nanograms) (less than one millionth of the 2 f/ml occupational control standard).

Measurements carried out at points of heavy traffic concentrations in the UK by the Asbestosis Research Council, under the observation of the TUC Centenary Institute of Occupational Health, also found no greater concentration. Even in the underground railway system, this survey found the asbestos content to be of the order 10^{-8} g/m^3 to 10^{-7} g/m^3. (10 ngs to 100 ngs/m^3)[24]

Finally, some observations made within the last three years by two eminent occupational health experts, on occupational risks and risks to the general public, are worth quoting.

Dr. John Gilson,[29] reviewing asbestos as an occupational hazard in a general group in which he includes friction materials, says "Despite the thousands of products containing asbestos, evidence of ill effects from their use is very small". He adds the qualification that occupations involving brake shoe maintenance have been shown to be at risk in the past. "Although most of the asbestos in brake shoes is degraded, the dust in the brake drums still contains a small percentage of asbestos". "The magnitude of the risk (of asbestosis and mesothelioma in those working regularly in this employment) is not known but is likely to be small." Professor Zielhuis,[22] in his report on public health risks, concludes "There is evidence of no excess risk of mesothelioma from asbestos pollution which has existed in the neighbourhood of chrysotile and amosite mines. There is no evidence of a risk to the general public at present". Later he repeats this view in his general conclusion "There is no established evidence that true ambient exposure, as prevalent in Western European countries, at this moment carries such a definite risk; however, there exist too many uncertainties to deny such a risk, though if the risk was substantial it is likely it would have been detected by now".

CONCLUSIONS

Manufacture

There can be an occupational health risk in the manufacture of asbestos-based friction materials. However, experience has shown that this is a very limited health risk and that it can be effectively controlled by well tested equipment and work procedures.

Standards based on extensive experience in the industry have been established and equipment is available to maintain these standards so that the occupational health risk can be controlled. In many countries these standards are enforced by legislation, but in any case trade and industry have an obligation, as with any occupational safety problem, to implement the effective risk prevention measures which have been developed by competent and experienced technicians.

Maintenance Work (Servicing)

In certain conditions involving servicing, etc., there may be a para-occupational hazard. The industry can provide information to ensure that users understand under what circumstances such risks can arise and how they can be avoided.[30,31,32,33]

The General Environment

The available data indicate that the general public is not at risk and means should be found to tell them so.

ANNEX - Bibliography

14th January 1981

(Page 10 retyped at FMSI because of weakness of original copy).

ANNEX

ASBESTOS AND HEALTH IN THE FRICTION MATERIAL INDUSTRY

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14 January 1981

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B U L L E T I N

N O. 7 1 3

April 3, 1981

INSTITUTE COMMENTS ON EPA'S PROPOSALS FOR REPORTING AND RECORDKEEPING

In January the Institute sent the Membership a copy of the Federal Register Notice of January 26, 1981, with its proposals for reporting and recordkeeping for asbestos products manufacturers. After this notice was mailed, we had two member inquiries asking if the Institute would be commenting on these proposals.

We then asked the Membership for comments and subsequently prepared a letter of comments through the Institute's Health and Environmental Affairs Committee. The final draft was approved by Mr. Armstrong, the Committee Chairman, and copies were then circulated to the Board of Directors. The proposed comments circulated to the Board were then mailed to the Environmental Protection Agency on March 25, 1981. They requested comments by March 27, 1981.

A copy of the Institute's comments to the EPA are enclosed.

EWD/erc
Enc:
cc-Delegates and Alternates
Active Members - List C

E. W. Drislane
Executive Director

DRAFT

INDUSTRIAL HYGIENE REPORT

ASSESSMENT OF ASBESTOS EXPOSURE TO MECHANICS PERFORMING BRAKE SERVICE OPERATIONS INCLUDING RECOMMENDED PROCEDURE FOR ASBESTOS BRAKE AND CLUTCH SERVICING

REPORT WRITTEN BY:
Dennis R. Roberts
Ralph D. Zumwalde

DATE OF REPORT:
April 27, 1981

REPORT #32.4

Industrial Hygiene Section
Industrywide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio

DRAFT

DISCLAIMER

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

ABSTRACT

NIOSH estimates that 151,000 U.S. mechanics and garage workers are potentially exposed to asbestos brake friction materials. Therefore, NIOSH conducted eleven industrial hygiene surveys to characterize dust exposures and work practices. Personal, general area, and bulk samples were taken and analyzed for TWA and peak fiber concentrations by optical (opt.) and electron microscopy (TEM). Mechanics TWA and peak exposures varied depending on brake assembly cleaning methods and times. Eight of thirteen mechanics TWA's exceeded NIOSH recommended standards but all were within OSHA regulations. Peak exposures, during brake assembly cleaning, were higher (up to 15 fibers/cc) than respective TWA's (0.01 to 0.28 fibers/cc). Fiber levels for all cleaning methods except vacuuming were near the NIOSH ceiling and compressed air cleaning often exceeded the OSHA ceiling. Background TWA's were similar for all facilities. TEM indicated lower fiber concentrations (>5 um) than opt. in most samples and revealed that 80% of the total fiber population was <5 um long. TEM found 30% of the fibers were chrysotile, 20% forsterite, and 50% unknown; also, the geometric mean chrysotile fiber size was 1.7 um length and 1.5 um diameter. The data suggest potential asbestos fiber exposures during brake servicing, principally brake assambly cleaning. Therefore, it is recommended that vacuum cleaning systems and NIOSH approved respiratory portection are used.

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CONTENTS

TABLES

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INTRODUCTION

A major objective of the National Institute for Occupational Safety and Health (NIOSH) is to determine environmental exposures of working populations through occupational health research, field surveys, and industrywide epidemiologic studies. Accordingly, NIOSH conducted comprehensive industrial hygiene surveys to characterize dust exposures resulting from vehicle brake servicing operations and to make a thorough assessment of work practices utilized, as well as document the types of personal protective equipment used. Of particular interest was the potential for exposure to asbestos fibers which could be generated by these types of operations. Limited studies of workers involved in brake servicing have suggested that their work-related exposures may be associated with asbestos-induced diseases.[1]

NIOSH estimates that a workforce of 151,000 brake mechanics and garage workers in the U.S. is potentially exposed to asbestos.[2] Potential exposures are a result of 128 million pounds of asbestos used annually in the U.S. for the production of brake friction materials.[3] Besides asbestos, other materials (e.g. binders, friction modifiers, fillers, etc.) are used in the manufacture of brake linings, which can likewise have a potential for exposure. As noted in one study, thirty materials or compounds that make up the binders, fiber reinforcers, property modifiers, etc., were identified during brake lining manufacturing.[2]

BRAKE MATERIALS, PRODUCTS, AND USAGE

Historical Development of Friction Products[4]

The requirements of early automobile friction materials were relatively minimal. Passenger cars were light and designed for low speed operations. Brakes were of an external contracting type and utilized a variety of materials; this included leather and impregnated cotton products which were commonly used along with wool and felt. In 1903 woven asbestos friction materials were first marketed in the United States by the Keasbey and Mattison Company of Ambler, Pennsylvania.[5] Because of its superior heat resistance and durability they rapidly increased in use and soon dominated the market. The Model T Ford provides an example of the changing use of materials. Initially, cotton bands, reinforced with zinc, copper, or brass wire and impregnated with oils and bituminous material, were used for the brake bands. These were soon replaced by mixed cotton-asbestos materials and finally by woven asbestos products. The woven asbestos brakes continued to be the dominant product used in automobiles until about 1930. They typically contained 70% or more wire-cored asbestos yarn, impregnated with drying oils, such as linseed, and bituminous material.

Molded brake linings were developed in the early 1920's and gained increasing use with the introduction of internal shoe brakes in 1927. By 1940 virtually all automobiles were equipped with molded brake linings, although woven products continue to be used in trucks, heavy equipment and for specialized applications. The molded linings in use were cut to length, usually by the manufacturer, and mounted on brake shoes using rivets. Until the mid 1920's brakes were only mounted on rear wheels. However, with the development of internal shoes, four wheel mountings soon became standard, and by 1930, were generally operated hydraulically.

As automobiles were designed for use at even higher speeds, brake linings improved in both quality and performance. Various new materials were introduced as fillers, binders, and friction modifiers. In 1948 bonded brake linings were developed and soon accounted for approximately 40% of the original equipment brake market. However, they rapidly dominated the replacement market because of the considerable savings in labor during installation. In 1965 the first disc brakes were introduced on American automobiles and rapidly increased in use. In 1975 virtually all original equipment cars had front wheel brakes of this type. However, because of less stringent braking requirements and the difficulty of adapting mechanical parking brakes to the disc configuration, the rear wheel brakes on 95% of currently sold cars are still of the drum variety.

Requirements for Brake Linings

A constant or slightly decreasing coefficient of friction (C.F.) with temperatures up to about 1000°F is required for an efficient brake lining; values of from 0.30 to 0.45 C.F. are normally sought. Lower values produce brakes requiring excess pedal pressure and those with higher values are too sensitive to pressure and develop excess wear. Ideally, the desired frictional qualities should be maintained throughout the life of the lining material. During braking, chemical and physical changes occur in the material at the braking surfaces. These changes may produce an increase (build-up) or a decrease (fade) in friction. Satisfactory linings will fade slightly upon repeated applications, but will return to their initial state upon cooling.[6]

Low wear of the linings is obviously desirable for economical and practical considerations. However, high wear resistance can be associated with the tendency of the lining to glaze, with a concomitant reduction in the coefficient of friction. This can be overcome by allowing a slow alteration of the brake lining material to occur. Pyrolysis of the organic binders and thermal decomposition of the chrysotile fibers under braking provide the necessary continuing renewal of the lining surface.

The lining should be non-abrasive to the drum surface. In addition to causing rapid drum wear, abrasive linings score the drums, which, in turn, leads to a rapid wearing of the lining. Drums made of cast iron and steel are common, with steel being the more susceptible to scoring. Since brake drums have a hardness of from 3.5 to 4.0 on the MOH (mineral hardness range of 1 to 15 in which talc is rated 1 and diamond 15) scale, virtually all lining materials used have lower hardness values.

Other necessary or desirable properties of brake linings include: physical strength, dimensional stability, quiet operation, and safe and non-offensive degradation products. Of the various properties desired in the linings, greatest attention is paid to build-up/fade and recovery characteristics. Wear problems are not as serious and can more readily be overcome with the materials available.

Compounding Ingredients of Brake Linings[7,8,9,10]

To achieve the desired friction properties, a wide variety of ingredients are commonly used in the manufacturer of automobile brake linings. These

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Asbestos

Asbestos is used for fiber reinforcement of the friction product. Chrysotile is used almost exclusively and comprises from 40 to 50 percent of the brake lining. Fiber grades 4 through 7 are used, and occasionally, several sizes are mixed or even calcined to improve performance characteristics. Amosite, crocidolite, or other amphibole asbestos varieties are not used because they are too harsh and tend to score the brake drums.

Organic binders

Organic binders are primarily phenolic type resins selected for high binding strength. Unmodified phenolic resins, when subjected to heat usually become hard and brittle. To prevent this, linseed, cashew nut, or China wood oils or cresols are added. Rubber, which also finds use as a binder, imparts desirable friction qualities and improves the flexibility of the lining material.

Friction modifiers

Friction modifiers are added to achieve a desirable coefficient of friction over all operating conditions. These modifiers also produce a more homogeneous lining surface. Included among these materials are lead, zinc, brass, cashew nut oil, graphite, and oxides of iron and copper.

Fillers

Fillers such as rubber scrap, barites, clays, silica, coke, coal and other minerals are used. These also have utility in achieving desired friction properties, in some cases through action as abrasives to recondition braking surfaces. It is important to note that one major purpose of the reconditioning agents is to retard the formation of forsterite which may accumulate on the surface of the brake lining. Forsterite is a mineral not originally present in the brake material, but is created by dehydroxylation and recrystallization of chrysotile asbestos at high temperatures. The hardness of forsterite (hardness 6.5–7.0 on the MOH Scale) is such that it tends to score and gouge brake drums and discs (hardness 3.5), degrading them prematurely. Therefore, recrystallization of chrysotile to forsterite is an unwanted effect.

Curing agents

Curing agents and/or accelerators are used to assure that appropriate chemical reactions occur to produce the desired brake quality.

Types of Brake Linings and Manufacturing Processes

In making the of different types of brake linings various manufacturing processes are utilized to achieve a wide range of potential applications. These include:

Wired Back

These are made by a calendering process in which putty-like stock is formed into a ribbon about a wire backing. The wire reinforcing serves to maintain strength during the curing process. Further, as linings of this type are invariably riveted, the wire reinforcing provides long term structural strength and prevents shearing of the lining at the rivets during braking. Linings of this type were extensively produced prior to World War II. They are in little use today.

Extruded Linings

These are manufactured by extruding the soft plastic stock through an appropriately sized rectangular orifice. To minimize structural weakness in this lining, curing agents are added to produce a hard inflexible finished product.

Sheet Linings

These are laminated structures formed by winding a 0.001-0.002 inch film of stock about a hot roller. Since the fabrication process is a relatively expensive one, linings of this type are not commonly produced for general use.

Dry Mixed Types

This process involves the dry mixing of various ingredients capable of passing a 200 mesh screen, and then molding the lining under pressures of from 1000 to 3000 pounds per square inch. The resulting lining is among the most heat stable of friction materials in use today and obtains wide use in the manufacture of brake blocks for heavy duty service.

Millboard Type

The manufacture of this type of brake lining material is by a process similar to that utilized in the paper industry. Wet stock is formed and passed over rollers with various drying and baking operations producing sheets of uniform lining material. The equipment for producing such materials is expensive, but the volume of production leads to an economically produced molded lining.

BRAKE LINING REPAIR AND MAINTENANCE PRACTICES

To a large extent the changing character of brake lining materials has led to changing work practices and differing asbestos exposures over the years. From 1920 until about 1930, when braking was done through the use of external brake bands made from woven materials, the predominant exposure to asbestos would have come from the cutting and fitting of the woven lining material. It is thought that airborne fiber concentrations were considerably less than those developed in later years when machining of molded materials was common.

From 1927, when internal brake shoes were developed using molded linings, until 1948 when bonded brake linings were introduced, all internal brake linings were attached to shoes using rivets. The lining material for use in the replacement market would be precut to appropriate size for various brakes or obtained from rolls of indeterminate length. The precut segments would usually be predrilled at the factory for rapid mounting on shoes. In some circumstances, however, drilling for the rivets and bevelling would be done by the mechanic installing them. The use of rolled linings required cutting the friction material to shape, drilling holes for rivets, and bevelling the edges appropriately. In this latter circumstance, asbestos exposure to workers could be considerable. Even when shoes with predrilled and bevelled linings were installed, the processes of punching out the rivets on the old shoes and riveting on of the new shoes would give rise to greater exposures than that accompanying the use of bonded linings.

With the introduction of bonded linings, the need for drilling, facing, or grinding operations during installation decreased significantly. However, for a short period of time, in the mid-1950's when automobile shoes were first installed with a fixed anchor, some tapering was necessary on uniform thickness bonded linings to achieve a proper fit. Previously, the end of the shoe opposite to that of the hydraulic cylinder could be mechanically adjusted. Shortly thereafter, tapered bonded linings were available from the factory. Subsequent to 1960, considerably fewer bevelling or grinding operations were performed by an automobile mechanic replacing brake linings.

During replacement of internal shoe brakes it was common practice to remove the brake wear dust from the housing by air blowing or brushing. After 1970 increasing awareness of the hazards of asbestos and its presence in brake-lining dust led to wet brushing, wet wiping, dry brushing, or vacuuming work practices in some brake servicing facilities. However, even today such improvements in work practices are not universal.

In the 1930's and 1940's most automotive shops were relatively small and most mechanics performed all automobile maintenance and repair activities. In recent years, however, there has been an increasing tendency towards specialization, with shops existing for brakes and front end work exclusively. Here, while asbestos exposures during brake work on an individual job may be less than those of previous years, some workers are exposed for considerably longer periods of time.

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SELECTION OF FACILITIES SURVEYED

The purpose of the industrial hygiene study was to investigate and characterize contemporary dust exposures resulting from vehicle brake maintenance and repair operations taking into account the work practices utilized. Therefore, it was necessary to locate facilities where a variety of brake servicing techniques were used as well as where there were differences in number of vehicles serviced. Six of the eleven sites selected for the investigation were automobile brake service facilities which performed from 2 to 45 brake jobs per week at an average of 65 minutes per vehicle. One of the facilities surveyed only serviced trucks, which often required 6-9 hours per vehicle to service brakes, with an average of three brake jobs per week. The remaining four facilities serviced both autos and trucks and performed from 5 to 45 brake jobs per week which varied in service time depending on the type of vehicle. Detailed airborne dust sampling surveys were conducted at each facility.

Description of Brake Servicing Operations

The servicing procedures found at each facility were basically as follows. The vehicle is driven into a repair stall or bay for a brake system examination. Pending repairs, the wheels are elevated, removed, and then inspected. Loose dust is cleaned from the drums and brake assemblies by vacuuming, wet or dry wiping/brushing, using compressed air, or a combination of these methods. Parts are then replaced or repaired as needed and the brake system is reassembled and adjusted. Test driving the vehicle for proper fitting and adjustment is the final phase of the servicing operation.

A brief description of the individual facilities is outlined as follows. Industrial hygiene survey data collected at each facility are shown in Tables 1-4.

Facility A

Facility A, a private fleet service garage, was responsible for complete automotive maintenance and repair with the exception of internal engine repair and exterior painting. The shop normally operates 8 hours per day, 5 days per week. Of the seven employees working at the facility, only three were responsible for brake servicing. Brake servicing operations were performed (two to five jobs per week) in either of two service stalls.

Facility B

Facility B, a municipal service garage, employed three mechanics that specialized in brake and clutch service and three employees that operated a separate brake repair shop specializing in brake shoe and drum reconditioning. The brake mechanics serviced all vehicles which included, waste collection, dump, and light trucks, autos, and some 2- and 3- wheeled vehicles. The shop operated 8 hours per day, 5 days per week.

Facility C

At Facility C, a municipal garage, there was an average of one complete brake service job per day, taking about 5 hours per job, with most of the vehicles consisting of cars or light trucks. There were five employees responsible for brake servicing and the facility operated 8 hours per day, 5 days per week.

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Facility D

At Facility D, a municipal garage, an average of eight brake jobs per day were performed on cars and trucks. Brake maintenance was performed by any of the 60 auto mechanics. The hours of operation were 8 hours per day, 5 days per week.

Facility E

Facility E, a private fleet service garage, performed complete automotive and light truck maintenance. The shop normally operated two shifts, 5 days per week, and there were usually four full-time mechanics per shift. About one brake job per week, per shift was performed.

Facility F

Although Facility F was an automobile brake service shop, front-end alignment and tire sales were also part of the shop mechanics' duties. The three full-time mechanics worked from two service stalls, 12 hours per day, 5½ days per week. Brake maintenance operations consisted of 10 to 14 brake jobs per week.

Facility G

Major services at Facility G, an automobile brake service shop, consisted of front-end alignment, shock absorber servicing, and brake maintenance. The normal work week was made up of five, 9-hour days and one, 6-hour day. Three service stalls were used by the three full-time employees for brake servicing operations during the 4 to 6 brake jobs per week.

Facility H

Major services provided at Facility H, an auto brake shop, were front-end alignment, shock absorber service, and brake maintenance. The three full-time employees worked from two service stalls, 9-hours per day, 6 days per week. The number of brake jobs per week averaged from 20 to 30.

Facility I

Facility I was the largest of the automobile brake service shops surveyed. Other services provided by this facility were front-end alignment and shock absorber replacement or repair. The five full-time mechanics worked from four service stalls, 9 hours per day, 6 days per week. Brake maintenance operations consisted of 35 to 45 jobs per week.

Facility J

The major services at this facility were front-end alignment, muffler installation, and brake maintenance. Automobile brake repair operations were performed by the shop's three employees and consisted on the average of 4 to 5 brake jobs per week. Normal brake servicing at this facility took about 1 hour and 45 minutes per vehicle.

Facility K

Facility K, a truck brake maintenance facility, involved a somewhat different operation and exposure. Servicing operations were more complex and, therefore, involved more employees with fewer vehicles serviced than auto maintenance facilities. The four service bays at the facility were used by seven mechanics. Other service operations included pad grinding, riveting, and punching (pad removed and/or replaced on shoe), sand blasting of old shoes, and milling of wheels.

SAMPLE COLLECTION AND ANALYSIS

Airborne Samples

Personal and general air samples were collected at each facility on different occasions during a 3-year period. Brake servicing operations and areas not in the immediate vicinity of brake work within each facility, were monitored to provide overall asbestos exposure data. Personal air samples were collected in the breathing zone of the brake mechanics using Millipore Type AA, 37 millimeter (mm) diameter, 0.8 micrometer (μm) pore size, membrane filters at a calibrated sampling flow rate of 2.0 liters per minute (lpm). The filters were changed periodically during the work shift to prevent particulate overloading on the filter. Time-weighted average (TWA) fiber concentrations were determined for the time spent performing brake service at all facilities and peak concentrations determined for time spent cleaning brake dust from drums and assemblies. Samples for peak exposures were collected using Gast pumps calibrated at 11.0 or 10.6 lpm using identical media as above. At facilities B, C, and D, a 2.0 lpm sampling train was used for peak samples. Analysis of the membrane filters for asbestos fibers was conducted in accordance with the procedures outlined by the Occupational Safety and Health Administration[11] and the NIOSH Manual of Analytical Methods P&CAM #239.[12] These procedures require the counting of fibers greater than 5 micrometers (μm) in length and with at least a 3 to 1 length to width aspect ratio utilizing phase contrast optical microscopy at a magnification of 400-450X. Concentrations are expressed as fibers greater than 5 μm in length per cubic centimeter of air (fibers/cc).

Random samples from each facility surveyed, as well as those samples having high fiber concentrations, as determined by the optical counting method, were analyzed on a transmission electron microscope (TEM) utilizing selected area electron diffraction (SAED) and energy dispersive X-ray analysis (EDXRA). Samples were observed at 17,000X magnification with fibers (≥ 3:1 aspect ratio) sized by length and diameter. SAED was attempted on all observed fibers for possible identification. In addition, EDXRA was performed on individual fibers to determine their elemental composition. SAED patterns and EDXRA elemental spectrum ratios were compared with reference minerals (UICC chrysotile, and forsterite obtained from the U.S. Smithsonian Institution). Sample preparation and analysis were performed using the NIOSH method described in the Technical Report "Review and Evaluation of Analytical Methods for Environmental Studies of Fibrous Particulate Exposure".[13]

General area samples for trace metals (lead, zinc, copper, iron, and manganese) were collected at most facilities using Staplex Type TF-1A high-volume samplers at a flow rate of 10 cubic feet per minute, and also with a sampling train and flow rate like that used for asbestos fiber collection. Samples were analyzed for metals by atomic absorption spectrophotometry in accordance with the NIOSH methods P&CAM Number 222, S186, S341, and S366.[14,15]

Bulk Samples

Samples of brake wear dust were collected from the brake drums of several vehicles that were being serviced during the surveys. These samples were analyzed by TEM for characterization and identification of fibrous particulates and to determine fiber size distributions.

WORK PRACTICE CHARACTERIZATION

Considerable emphasis was placed during the surveys on detailing work procedures during brake servicing in order to document the types of cleaning practices (i.e. vacuum, compressed air, brushing, etc.) used in replacing brakes. As previously described in the section "Description of Brake Servicing Operations" the brake servicing work practices utilized were similar for all facilities surveyed; the major difference observed was the methodology utilized for clean-off of brake wear dust from the brake-shoe/backing-plate assemblies. There were six different types of clean-off methods observed during the study. Those six methods are described as follows:

1. Compressed Air Blow-Off. A compressed air stream was used to blow away brake wear dust from the brake assemblies and drums.

2. Compressed Air-Stoddard Solvent Mist Blow-Off. The same as #1 except a spray gun containing stoddard solvent was used to produce a solvent mist for blow-off.

3. Dry Brushing. Brake wear dust was brushed away with a small utility brush (usually 1" diameter).

4. Wet Brushing. Basically the same as dry brushing except the brush was kept saturated with a liquid such as gasoline, water, or stoddard solvent.

5. Squirt-Off. A liquid squirt-bottle containing water was used to wash away brake dust. This was followed by drying off assemblies with a cloth.

6. Vacuum Cleaning. A shop type vacuum cleaner, equipped with a HEPA* filter, was used in combination with compressed air. This system included a brake encapsulation cylinder that completely enclosed the brake-shoe/backing plate assembly. The mechanic operated a compressed air nozzle fixed inside the enclosure to blow off the brake dust, which was immediately drawn into the vacuum system. A separate vacuum hose was used to vacuum the dust from the brake drums.

In Methods 1 to 5, and especially 1 to 3, the brake dust has the potential to enter the ambient air of the facility. Conversely, in Method 6 the dust is contained by the HEPA filter which may be removed from the vacuum cleaning system and disposed of.

*HEPA: High Efficiency Particulate Air - 99.7% efficiency for 0.3 µm diameter aerosols.

SUMMARY OF SURVEY RESULTS

The optical microscopy fiber count analysis for the TWA, peak personal, and background area samples collected during the study are summarized in Table 1. The TWA and peak fiber concentrations for mechanics tended to fluctuate depending on the brake clean-off method used and the time spent performing the task. For example, regardless of the cleaning method utilized, peak exposures are high (up to 15.00 fiber/cc) when compared to their respective TWA exposures (0.01 to 0.28 fibers/cc). The differences between the TWA exposures and the peak exposures are most likely due to the brake assembly cleaning operation generating a higher dust level than the other repair steps. Peak exposures also varied from shop to shop. This is perhaps best explained by variations in work practices utilized, the inconsistencies in performing brake work that existed throughout the various repair shops, and because clean-off is done intermittently and therefore represents a small percent of the work performed during the shift. For example, the amount of time spent servicing brakes and the number of brake jobs that were performed per shift differed among the mechanics; likewise, there were differences in cleaning methods (e.g., compressed air, brush, vacuum, etc.), and procedural techniques (e.g. distance from brake housing to breathing zone). In addition, there were some mechanics who dropped the brake drums on the floor, causing airborne dispersal of brake dust. Environmental conditions at each brake service facility, such as: shop size, ventilation controls, and open windows and doors would also affect individual worker exposure and background concentrations of airborne asbestos fibers.

Regardless of the cleaning method utilized, TWA exposures for mechanics at all facilities were relatively consistent, and did not differ significantly from their respective background (ambient levels in facilities) TWA exposures. The similarities between mechanic TWA and background exposures suggest that all individuals in the immediate work environment are potentially exposed to the same fiber concentrations during a normal work shift. This observation is further supported by the fact that the mechanics spend much of the work shift away from the work site and in other areas of the facility.

TEM Fiber Characterization

Samples were randomly selected for transmission electron microscopy (TEM) with fibers sized by length and diameter. In addition, fiber concentrations (fibers/cc) were determined for total fibers and fibers >5 μm in length. These concentrations were compared to those found by the optical microscopy method and are reported in Table 2. In all but 3 samples, the concentrations of fibers >5 μm in length determined by optical microscopy were somewhat higher than those determined by TEM. This difference could have been caused by particulate loss during sample preparation for TEM, or because of the small number of fibers actually counted on each sample; at low fiber counts, small differences in fibers counted by both microscopy methods would have a significant effect in the calculation of fiber concentrations. Besides determining the concentrations for fibers >5 μm in length, total fibers observed were counted and concentrations calculated. As would be expected, the greatest proportion of fibers observed was shorter than 5 μm in length (80 to 90%).

Fibers observed by TEM were identified utilizing SAED and EDXRA. Approximately 50% of the fibers analyzed by SAED could not be identified due to ambiguous diffraction patterns. The remaining fibers which were identified indicated the presence of chrysotile (∿30%) and forsterite (∿20%). The presence of fibrous forsterite was probably due to the dehydroxylation and recrystallization of chrysotile as a result of high temperatures (>650°C) encountered during braking.[1,2] Some of the fibers which revealed ambiguous diffraction patterns appeared to have crystalline structures similar to both chrysotile and forsterite (probably a transition intermediate[2]) while others were too small for diffraction analysis. EDXRA was performed on the fibers to confirm the SAED analysis that was made for the chrysotile and forsterite fibers. Some of those fibers which gave ambiguous SAED patterns indicated magnesium, silicon, and iron in various elemental ratios.

As shown in Table 3, when a fiber size distribution was performed for all fibers observed by TEM, a geometric mean length of 1.66 m, and a geometric mean diameter of 0.14 m were determined. Likewise, for those fibers identified as asbestos (chrysotile) a geometric mean length and diameter of 1.70 μm and 0.15 μm were determined, respectively.

Samples of brake wear dust were analyzed by TEM in the same manner as the airborne samples. Identification was attempted on all fibers using SAED and EDXRA. Approximately 45% of the fibers analyzed by SAED could not be identified due to ambiguous or the absence of diffraction patterns. EDXRA was performed on all fibers observed with elemental analysis being successful on about 70% of the fibers. When utilizing SAED and/or EDXRA many of the fibers observed were positively identified as chrysotile (40%) while the remaining were either forsterite (20%) or unknown (40%). Many of the unknowns were thought to be intermediate recrystallized forms between chrysotile and forsterite. In addition, a fiber size distribution was performed which indicated somewhat shorter lengths (0.24–5.88 μm vs. 0.24–10.0 μm) and smaller diameters (0.06–0.29 μm vs. 0.06–1.0 μm) than those observed in the airborne samples (Table 3).

Trace Metal Analyses

Trace metal analyses were performed on airborne samples collected at Facilities B, C, D, I, and K with the results reported in Table 4. Samples were analyzed for the following metals: lead, iron, zinc, copper, and manganese. As noted in Table 4 the metals were often non-detectable (n.d.) or found in trace amounts that were always below the OSHA and NIOSH exposure standards. The range of concentrations for all facilities were: Pb, n.d. – 63.3 $\mu g/m^3$; Fe, n.d. – 1.5 mg/m^3; Zn, n.d. – 352 $\mu g/m^3$; Cu, n.d. – 8.7 $\mu g/m^3$; and Mn, n.d. – 3.5 $\mu g/m^3$.

DISCUSSION

The human toxicological significance for the inhalation of chrysotile asbestos fibers is well documented; and instances of mesothelioma in auto repair workers have been identified.[16,17,18] In a detailed examination of 90 union vehicular maintenance workers in New York City,[1] with 10 or more years of shop work, 29% had decreased vital capacity; the percentage increased with age and most markedly after 20 years from the outset of auto work. Many of the workers examined showed signs consistent with asbestosis, with observed changes noted in chest x-rays and indication of restrictive pulmonary function. The prevalence of these changes was significantly higher after 20 years exposure, a result expected after occupational exposure to asbestos.[19]

Unlike chrysotile, the health effects of exposure to forsterite, or transition series fibers (chrysotile/forsterite) with altered crystalline structures are not well documented. In studies by Davis and Coniam,[20] and Koshi[21] in which fibers of chrysotile, chrysotile/forsterite, and forsterite were injected into the pleural and peritoneal cavities of mice, the results suggested varying degrees of toxic effects. Fiber implantation animal studies conducted by Pott, et. al.[22,23] and Davis, et. al.[24] suggest that the morphology and size of a fiber, regardless of fiber type, are responsible for its carcinogenicity. Likewise, Stanton, et. al.[25] suggests that fibers <1.5 μm in diameter and >8 μm in length pose the greatest risk in producing pleural sarcomas. These studies tend to suggest that the physical morphology (size dimensions), and to a lesser degree chemical and surface characteristics of a fiber are the determining factor for inducing a biological effect. The precise fiber dimensional characteristics required for these observed pathologic responses have been difficult to determine experimentally because of the difficulties encountered in producing fibers of specific size dimensions.

SUMMARY

The TWA airborne asbestos sample results for all facilities were within the current OSHA asbestos standard.[26] This standard states:

> "The 8-hour time-weighted average (TWA) airborne concentration of asbestos fibers to which any employee may be exposed shall not exceed 2 fibers, longer than 5 micrometers in length, per cubic centimeter of air (fibers >5 µm/cc). The ceiling airborne concentration to which no employee may be exposed shall not exceed 10 fibers >5 µm/cc."

However, two of four peak sample results for samples collected at Facility I (Table 1) during the compressed air cleaning of brake assemblies exceeded the OSHA ceiling standard. The compressed air cleaning method also indicated the highest overall peak exposures (up to 15 f/cc) for all cleaning methods examined.

When the overall TWA and peak sample results are compared to the NIOSH recommended standard for asbestos, 8 of 13 of the TWA exposures for mechanics indicated concentrations exceeding the recommendation. This standard recommends an 8-hour TWA exposure of 0.1 fibers >5 µm/cc (fibers/cc) with a ceiling exposure of 0.5 fibers/cc for any 15-minute sampling period.

Many of the samples collected yielded such low fiber counts that their coefficient of variation (CV_t) was above what is considered reliable (i.e. greater than 0.38).[27] Consequently, the fiber concentration data are best utilized for comparing exposure variations among the different cleaning methods/work practices.

CONCLUSION

The results of this and other studies[1,2] indicate varying concentrations of asbestos fiber exposure to brake mechanics. The exposure concentrations are apparently affected by the work practices utilized, and the existing environmental conditions and controls at each facility. The results of this study show that 8 of 13 of the mechanics engaged in brake service had TWA fiber exposures above the NIOSH recommendation, however, all TWA exposures were below the OSHA standard. Furthermore, when samples were analyzed by TEM, only 30% of the fibers observed were identified as asbestos with the remaining fibers being categorized as forsterite (20%) or unknowns (50%). As a result of the TEM analysis the interpretation of the asbestos concentrations, as determined by optical microscopy, is questionable. The analysis indicates that actual asbestos fiber concentrations (>5 μm length) are often less than those reported (see Table 2).

However, this does not preclude the possibility of high airborne asbestos fiber concentrations when all fiber size ranges are considered. As determined by the TEM analysis in this study and from other reported studies[28,29] a significant number (up to 100%) of short fibers (<5 μm in length) are always present (see Table 2) and research [25] has indicated that a potential health risk exists for asbestos fibers <5 m in length. Also, a potential health risk may exist for the unknown fibrous portion (∿50%) of brake dust. The results of animal studies in which various size fibers were implanted in animals [22,23,24,30] concluded that the physical morphology (size dimensions), and to a lesser degree chemical and surface characteristics of a fiber, are the determining factor for inducing a biological effect.

The mechanics surveyed during this study were either full-time brake mechanics, who performed only brake maintenance service and may have serviced up to five cars per day/six days a week, or mechanics who undertook as few as one brake job per week. Regardless of the number of brake jobs performed (per work shift), the TWA fiber exposures were similar for all the mechanics surveyed. The exposures to mechanics who performed full-time brake work were not significantly higher than the exposures for those who did much less brake servicing.

Conversely, the short term (<3 minutes) peak exposures encountered in this study during the dust clean-off of braking assemblies were often higher when compressed air was used. All of the cleaning methods surveyed, except for vacuum cleaning, had peak fiber concentrations that were near or above the NIOSH-recommended ceiling exposure level of 0.5 fibers/cc. However, the compressed air cleaning method was the only type which approached, and in two cases even exceeded, the OSHA ceiling exposure limit of 10 fibers/cc. These findings strongly suggest that brake mechanics are at a higher risk of airborne exposure to asbestos fibers during the cleaning of brake assemblies, except when the vacuum cleaning methods are properly utilized.

The peak fiber exposures found for mechanics during the cleaning of brake assemblies were higher than most of the TWA exposure concentrations. However, there is some question as to the accuracy of the fiber counts from the analysis of the peak samples since the number of fibers counted were small, resulting in a large coefficient of variation.[27]

RECOMMENDATIONS

The data from this study suggests that a potential for airborne fiber exposure exists during brake servicing operations, principally during brake assembly cleaning. While the fiber exposures reported do not represent 100% asbestos fiber, a potential health hazard still exists since at least 30% of the fibers are asbestos. Also, the other fiber types may be pathogenic since animal studies suggest that fiber shape and size may be more important than chemical nature in terms of biological activity. Furthermore, the possibility exists for exposure to much higher asbestos fiber concentrations for fibers $< 5\ \mu m$ length. Since there is no known safe asbestos fiber exposure level[31], and clinical evidence from a study of union vehicular maintenance workers reports that over 25% had evidence of x-ray abnormalities consistent with asbestosis, it would seem prudent to conclude that a potential health hazard exists during the performance of brake maintenance operations. Therefore, it is recommended that appropriate control measures for reducing exposures, especially during brake assembly cleaning, be instituted at brake maintenance facilities. This would best be accomplished by using an appropriate vacuum cleaning system to remove all dust from brake assemblies and drums. Above all, any blow-off of brake dust by compressed air must be eliminated. To further protect the health of the brake mechanics, it would be advisable to initiate a personal respiratory protection program. This would include the wearing of NIOSH approved respirators for asbestos, a program for proper fitting, and a routine maintenance program for the cleaning and replacing of respirator filters. As the exposure data indicates, it would only be necessary for mechanics to wear respirators while performing brake assembly cleaning.

In order to minimize asbestos dust exposures to vehicular mechanics performing brake and clutch maintenance NIOSH has prepared guidelines "Recommended Procedures for Asbestos Brake and Clutch Servicing" (see Attachment 1) to be utilized during these types of work tasks.

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Table 1

Fiber Air Sample Results for Brake Assembly Clean-Off Methods

Cleaning Method	Facility Surveyed	Employee Sampled	Peak Exposures Fibers/cc*	Peak Exposures Sample Time (Sec.)	Peak Exposures Sample Volume (Liters)	TWA Exposures** Fibers/cc*	TWA Exposures** Sample Time (Min.)	TWA Exposures** Sample Volume (Liters)	Background TWA Exposures** Fibers/cc*	Background TWA Exposures** Sample Time (Min.)	Background TWA Exposures** Sample Volume (Liters)
Compressed Air	G	Mechanic #1	1.82	180	6.0						
Compressed Air	G	Mechanic #1	0.14	38	4.7						
Compressed Air	G	Mechanic #1	0.77	34	4.2	0.03	352	604	0.013	380	760
Compressed Air	G	Mechanic #1	0.35	26	3.2						
Compressed Air	G	Mechanic #1	2.69	20	2.5						
Compressed Air	I	Mechanic #1	2.84	60	10.7	0.12	283	566	0.10	133	266
Compressed Air	I	Mechanic #2	0.91	45	8.0	0.10	298	596	0.08	227	454
Compressed Air	I	Mechanic #2	14.54	30	5.3						
Compressed Air	I	Mechanic #3	15.00	30	5.3	0.19	270	540	0.13	94	188
Compressed Air – Solvent Mist	I	Mechanic #1	0.25	60	4.0	0.08	343	686	0.04	231	462
Compressed Air – Solvent Mist	I	Mechanic #1	0.45	45	8.0						
Compressed Air – Solvent Mist	I	Mechanic #2	0.68	30	5.3	0.07	283	566	0.03	222	444
Compressed Air – Solvent Mist	I	Mechanic #2	0.37	180	12						
Dry Brush	D	Mechanic #1	0.81	720	24	0.20	197	394	0.07	414	828
Dry Brush	D	Mechanic #2	0.61	1260	42	0.19	301	602	0.03	382	764
Wet Brush	C	Mechanic #1	2.62	180	6.0	0.23	346	692	0.07	360	720
Wet Brush	C	Mechanic #2	2.22	180	6.0	0.28	369	738	0.07	360	720
Wet Brush	C	Mechanic #2	0.87	540	18	0.24	135	270	0.07	360	720
Wet Brush	C	Mechanic #3	0.67	540	18						
Liquid Squirt Bottle	B	Mechanic #1	0.54	600	20	0.21	326	652	0.06	395	790
Vacuum Cleaning	E	Mechanic #1	0.00	120	16						
Vacuum Cleaning	E	Mechanic #1	0.07	120	16	0.01	240	480	0.01	378	756
Vacuum Cleaning	E	Mechanic #1	0.03	120	16						

* Fibers >5 um in length per cubic centimeter of sampled air

Table 2

Air Sample Results For Fibers
Comparison Between TEM and Optical Microscopy Analyses

Optical Microscopy	Transmission Electron Microscopy		
>5 µm in length fibers/cc	>5 µm in length fibers/cc	Total Fibers fibers/cc	% Fibers >5 µm in length
0.54	0.25	0.50	50
6.0	5.97	11.33	53
0.58	0.17	1.01	17
1.18	0.67	2.35	29
0.13	0.10	0.74	14
6.84	0.07	0.43	17
5.59	0.33	0.39	83
0.82	0.02	0.02	100
0.01	0.0	0.11	0
0.01	0.0	0.0	0
0.02	0.19	2.72	14
0.38	0.16	0.48	33
1.44	0.0	0.08	0
0.01	0.0	1.43	0
0.26	0.09	0.09	100
0.24	0.04	0.16	25
0.06	0.0	0.0	0
0.12	0.01	0.01	100
0.01	0.0	0.03	0
0.03	0.0	0.0	0
0.0 (Blank)	0.0	0.0	0
0.12	0.42	0.86	48
0.17	0.10	0.20	50
0.18	0.14	0.43	33
0.06	0.05	0.15	33
0.12	0.50	0.73	68

* Note: Fibers counted by TEM represent asbestos fibers only.

Table 3

Brake Dust Fiber Size Data

	Fiber Diameter μm				Fiber Length μm			
	Number of Fibers	Range	Geometric Mean	Geometric Std. Dev.	Number of Fibers	Range	Geometric Mean	Geometric Std. Dev.
Airborne Samples (Asbestos Fibers Only)	151	0.06- 1.0	0.15	2.36	151	0.24-10.0	1.70	2.27
Airborne Samples (All Fibers)	523	0.06- 1.0	0.14	2.17	523	0.24-10.0	1.66	2.49
Bulk Brake Dust (Asbestos Fibers Only)	8	0.06-0.18	0.10	1.53	8	0.24-1.76	0.40	2.03
Bulk Brake Dust (All Fibers)	109	0.06-0.29	0.08	1.53	109	0.24-5.88	0.49	1.95

Note: All fiber size data determined by Transmission Electron Microscopy.

Table 4

Trace Metal Analyses

Facility Surveyed	Range of Trace Metal Concentrations $\mu g/m^3$				
	Pb	Fe	Zn	Cu	Mn
B	1.2 - 8.7	1.7 - 2.3	0.2 - 0.3	0.2 - 0.3	0.04 - 0.06
C	19.5 - 24.9	1.2 - 1.4	0.3 - 0.3	0.2 - 0.2	0.04 - 0.05
D	0.4 - 0.8	1.5 - 1.8	0.3 - 0.5	0.1 - 0.2	0.03 - 0.04
I	N.D. - 63.3	N.D. - 349.3	N.D. - 351.9	N.D.	N.D.
K	N.D. - 24.0	N.D. - 1,452.8	N.D. - 26	N.D. - 8.70	N.D. - 3.50
	OSHA Exposure Standard $\mu g/m^3$				
	50	10,000*	5,000**	1,000***	5,000****
	NIOSH Recommended Standard $\mu g/m^3$				
	100	-	5,000	-	-

N.D. - Not Detected by Analysis
* Iron Oxide Fume
** Zinc Oxide Fume
*** Copper Dusts and Mists
**** Ceiling

DRAFT

ATTACHMENT I

DRAFT

RECOMMENDED PROCEDURES FOR

ASBESTOS BRAKE AND CLUTCH SERVICING

The National Institute for Occupational Safety and Health (NIOSH) has conducted research on dust exposures which are generated during brake and clutch servicing. Based on data demonstrating the potential for significant asbestos exposures during brake and clutch servicing, NIOSH has investigated various work practices which are utilized in reducing asbestos exposures. These investigations have indicated vacuum cleaning systems to be the most effective method for minimizing asbestos dust exposures during brake and clutch servicing.[1] Vacuum cleaner testing have demonstrated that these units operate reliably within design specifications.[2] Therefore, NIOSH recommends vacuum cleaning as the primary method to be used for cleaning of asbestos dust during brake and clutch servicing operations.

The following are additional procedures recommended by NIOSH to minimize asbestos dust exposures.

1. Where possible, an area shall be designated for brake and clutch repairs and servicing. Entrances into this area shall be posted with the following asbestos exposure warning sign printed in letters of sufficient size and contrast to be readily visible and legible:

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. 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 particulate air filter system (HEPA-greater than 99% efficiency for 0.3 μm diameter aerosols). After vacuum cleaning, any remaining dust shall be removed using a water dampened cloth or rag. Under no circumstances shall compressed air or a dry brush be used for cleaning. If vacuum cleaning equipment is not available the wet brush cleaning method may be used until a vacuum cleaning system in obtained. Where wet brushing is necessary for cleaning, a NIOSH certified respirator approved for asbestos shall be worn.

3. During brake pad grinding, riveting, and punching operations local exhaust ventilation and dust collection systems shall be designed, installed, and maintained in accordance with the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2 - 1977 to meet the asbestos airborne exposure standard.

4. During clutch servicing, a NIOSH certified respirator approved for asbestos shall be worn during the removal and cleaning of the clutch, pressure plate and housing assembly, and during installation of the new clutch assembly. Whenever possible, cleaning shall be performed with an HEPA vacuum system as described in (2) above.

5. All table and floor cleaning in areas where brakes and clutches are repaired shall be done with the HEPA vacuum cleaner as described in (2) above. Grinding and riveting machines shall also be cleaned with such a

cleaner and the remaining dust wiped with a water dampened cloth. A NIOSH certified respirator approved for asbestos shall be used during this cleaning.

6. If not in effect, a respirator program shall be established in accordance with the Occupational Safety and Health Administration (OSHA) Standards, Title 29, U.S. Code of Federal Regulations (CFR), Part 1910.134.

7. HEPA vacuum cleaner filters containing asbestos dust, cloths or brushes used for wiping brake and clutch assemblies, and all liquid used for wet brushing shall be disposed of in accordance with U.S. Environmental Protection Agency (EPA) regulations. These regulations state that the asbestos waste shall be disposed of in sealed impermeable bags or other containers at a disposal site which meets EPA criteria for asbestos disposal. Also, the waste containers shall display the following warning label or tag printed in letters of sufficient size and contrast to be visible and legible:

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

The EPA regulations for proper asbestos waste disposal are detailed in Title 40, CFR, Part 61, Subparts A and B.

8. A NIOSH certified respirator approved for asbestos shall be worn during removal of vacuum bags which contain asbestos dust.

9. Consumption of food and beverages shall not be permitted in work areas where asbestos exists. An area designated for food consumption shall be separate from the work area so as to provide maximum protection against asbestos dust contamination.

10. If the employee is exposed to airborne concentrations of asbestos fibers which exceed the OSHA ceiling level, the OSHA requirement regarding special clothing, change rooms, locker, etc. as detailed in Title 29, CFR, Part 1910.1001 (D) shall be followed.

The current OSHA asbestos standard is as follows: the 8-hour time-weighted average (TWA) airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed 2 fibers, longer than 5 micrometers in length per cubic centimeter of air (fibers >5 μm/cc).The ceiling airborne concentration to which no employee may be exposed shall not exceed 10 fibers >5 μm/cc.

OSHA in 1975 proposed an 8-hour TWA of 0.5 fibers >5 μm/cc with a permissible ceiling exposure of 5 fibers >5 μm/cc for any period not exceeding 15 minutes. NIOSH currently recommends that the TWA exposure to asbestos be 0.1 fibers >5 μm/cc with a ceiling exposure of 0.5 fibers >5 μm/cc for any 15-minute sampling period.

NOTE: Strict adherence to the above procedures should minimize exposures to employees during brake and clutch servicing. These recommendations are based on the results of research conducted by NIOSH.

Prepared By:

Division of Surveillance, Hazard Evaluations, and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio

DRAFT

FMSI 03627

FRICTION MATERIALS STANDARDS INSTITUTE, INC., E-210 ROUTE 4, PARAMUS, N.J. 07652

B U L L E T I N

N O. 7 0 6

January 29, 1981

ENVIRONMENTAL PROTECTION AGENCY (EPA) PROPOSALS FOR REPORTING AND RECORDKEEPING FOR ASBESTOS MANUFACTURERS, IMPORTERS AND PROCESSORS

The EPA's Office of Toxic Substances has proposed requirements for asbestos products manufacturers, importers and processors on the reporting on asbestos usage. These proposals are authorized in Section 8 (a) of the Toxic Substances and Control Act (TSCA). To indicate how far-reaching these reporting requirements are, one can note the following from the first page of the proposed rules:

> Importers include those persons who import asbestos in bulk form, or as part of any product. Thus, persons who import automobiles that contain asbestos brake linings are "manufacturers" of asbestos for purposes of TSCA.

A brake lining or clutch facing manufacturer in the United States would be a primary processor as he uses raw asbestos in the friction product. He would also be a secondary processor when he assembles brake linings to shoes. A party who imports lined or unlined shoes would be a "manufacturer" as indicated above. A rebuilder who purchased brake linings for assembly would be a secondary processor. For more authoritative definitions, please refer to Page 8213 of the January 26, 1981 Federal Register, copy enclosed.

The Institute is enclosing the notice as it appeared in the Federal Register of January 26, 1981. We have enclosed Pages 8200-8214 only. The forms that are referred to take an additional 35 pages (to Page 8249). If Members wish a copy of these additional pages, please request them of the Institute Office.

It should be noted at this time that this notice is a proposal. As noted, the EPA will accept written comments relative to this proposal which are submitted on or before March 27, 1981.

While this is a far-reaching rule if adopted, a rule of this nature would be expected based on the reading of TSCA and the inititatives that the Office of Toxic Substances has already taken in the asbestos area.

EWD/erc
Enc:

E. W. Drislane
Executive Director

Copies:
Delegates and Alternates
Health and Environmental Affairs Committee
Active Members - List C
Regional Members
Licensees

TELEPHONE (201) 845-0440

FRICTION MATERIALS STANDARDS INSTITUTE, INC.
BERGEN MALL OFFICE CENTER
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PARAMUS, N. J. 07652

May 12, 1980

Mr. Richard Guimond
Environmental Protection Agency
Office of Toxic Substances
401 M Street SW
Washington, D.C. 20460

Dear Rich:

You will recall that we met with a group from EPA in Washington on January 3, 1980 concerning information needs of your office. We stated that we would circulate our Members to get answers to some of the questions that you had asked concerning non-asbestos lining. Our questions were in the area of automotive disc brake lining only.

Respondents asked that their submissions be kept confidential. I am not therefore disclosing the names of those who answered the questionnaire. I feel they are representative of the industry.

I have enclosed a copy of the summary of replies that I received relative to this questionnaire. I had earlier sent you information on usage of non-asbestos disc brake lining on passenger cars and light trucks. This listing included information as to whether there was an asbestos backing with the non-asbestos linings, and where the usage was both inner and outer, or inner only or outer only with asbestos material at the other position. I believe these answers should give some background as to usage, advantages and problems with the non-asbestos disc brake linings.

Sincerely,

FRICTION MATERIALS STANDARDS INSTITUTE

EWD/lmc

E. W. Drislane
Executive Director

COPY

NON-ASBESTOS DISC BRAKE LININGS FOR PASSENGER CARS AND LIGHT TRUCKS

INTRODUCTION

In November 1979, the Environmental Protection Agency's Office of Toxic Substances drafted several questions on what they considered their information needs on friction products containing asbestos. This was general state-of-the art information concerning non-asbestos linings. And, this included all linings--disc and drum.

An Institute Task Force met with EPA on January 3, 1980 to review their needs, and one essential change was that the questions would concentrate on disc brake linings only. The questions were then routed to the Members, asking that replies be only made for (1) disc brake linings used on (2) passenger cars and light trucks. Of the nineteen United States Members, twelve were involved with disc brake linings for passenger cars and light trucks. Of these twelve--and not knowing how many of the twelve have worked on non-asbestos disc brake linings--three replies were received. They represented a decent cross-section with both original equipment and replacement market emphasis. Some were further along on development of non-asbestos disc brake linings than others.

As the request of those replying, names have been omitted. The answers are grouped together under the questions as they were circulated to the Members.

1. What are the basic ingredients used in non-asbestos disc brake linings which were not used in earlier asbestos type formulations? Of particular interest are the materials used to substitute for asbestos--those that reflect a net change.

Without entering into detail on the layered construction with what is usually predominantly resin-asbestos backing, there are essentially two types of non-asbestos compositions. The foremost is what is referred to as semi-metallic, and which is normally compounded using a resin binder similar to that used with asbestos type linings. The other is a synthetic fiber type mixed with resin binders of a conventional type.

1.1 Semi-metallic - This is a resin-bonded metallic type which uses steel fibers (chopped steel wool) predominantly, with or without iron powders (sponge iron). Because of the ferrous nature of the product rust inhibitors may be used. While materials such as graphite, silicas and the like may also be used, these had been used in earlier asbestos type materials.

1.2 Synthetic fibers - This is primarily fiberglass. These are chopped glass fibers sized to adapt to the needs of a friction material compound.

2. As regards the substitute materials, if the substitute is fibrous, what are the physical characteristics of the fiber--structure, fiber size, size distribution?

2.1 Steel fibers

Rectangular cross-section:	75 - 100 microns wide
Circular or elliptical cross-section:	100 - 250 microns diameter
Fiber length:	1 - 5 millimeters

2.2 Fiberglass

Circular cross-section:	13 microns diameter
Fiber length:	3 - 13 millimeters

3. What are the performance characteristics and the problems associated with the use of substitute products for disc brake linings containing asbestos? How do the substitute non-asbestos pads compare with asbestos pads for lining wear, rotor wear, noise, wet recovery, etc.?

3.1 General - Both the semi-metallic and the fiberglass types are inherently more aggressive. That is, they would normally have higher friction levels, more rotor wear, more brake noise. However, in compounding the materials, other ingredients are added to control friction levels, rotor wear, noise and the like. Before new materials can be sold in either the original equipment or replacement markets, the manufacturer must be satisfied that these problems are under control. Where these materials have been sold commercially, it will depend on the manufacturer if his materials--and they will have more than one material--have such properties as wear, noise and friction characteristics better than or equal to earlier asbestos types.

3.2 Advantages - With commercial semi-metallic types, fade resistance and wear resistance has been improved over asbestos materials. This is particularly true where solid rotors have replaced the earlier ventilated rotors on front wheel drive cars with unit brake loading (and temperatures) higher than the passenger cars in the early 1970's. Some manufacturers have shown improved rotor conditions and in some cases less noise with semi-metallics, while others still have problems in these areas.

3.3 Problems - The higher conductivity of metallic type non-asbestos linings results in increased heat transfer to the brake fluid which can result in brake fluid boil. Generally, inferior physical strength is associated with semi-metallic types which can result in attachment problems particularly if the material is riveted to the steel brake shoe. Some, because of the inherently more aggressive nature of the material, have experienced "reverse speed spread." That is, a brake will be more aggressive at higher speeds than at lower speeds. Ferrous materials will show oxidation (rust) and this could be a problem both on-the-shelf and on the vehicle if left standing for long intervals. Some materials--and this depends on the manufacturer--have experienced lower friction when the brakes are cold.

3.4 Backing Layer - Where the manufacturer uses a backing layer (currently backing layers contain asbestos) these can improve the thermal conductivity and physical strength problems. However, these asbestos types are also used because the vehicle owner may permit his linings to wear through to the backing materials, before replacement, and the backing materials must have acceptable friction properties to insure adequate braking.

3.5 Synthetic fiber types - These types are in the development stages and have problems with rotor wear, lining wear and the characteristics normally associated with a more aggressive lining.

4. Where you are the original equipment supplier of non-asbestos type disc brake linings, would you describe the packaging of asbestos and non-asbestos linings within the brake itself? In other words, present model year and application data for:

4.1 Full non-asbestos linings

4.2 Non-asbestos friction material with asbestos backing

4.3 Use of non-asbestos lining at one position (inner or outer) with asbestos type at other position

This question was answered in detail in a letter from Mr. E. W. Drislane of the Friction Materials Standards Institute to Mr. Richard Guimond of the Environmental Protection Agency--letter dated April 21, 1980, a copy of which is attached.

5. Describe the historical development of non-asbestos disc brake linings with data and/or time from (1) initial research, (2) successful laboratory prototype, to (3) availability of commercial product. Also, estimate research and development cost for development of commercial non-asbestos disc brake linings (either in total or for each phase of the development).

There is a wide variation in the answers to this question. The shortest times and lowest costs are those estimated by a manufacturer who has been working on development of non-asbestos linings over the last year or two. The highest costs and longest times are those from a manufacturer who has developed resin-bonded metallic type disc brake linings which are now available commercially.

The estimated time by one manufacturer is a total of four to five years, with two years from initial research to laboratory prototype, with another two to three years from that point to the availability of a commercial product. The low estimate was $250,000. Another manufacturer states that the semi-metallic types have been studied for fifteen years, and its estimate for commercialization would involve a minimum of three years and $500,000. The manufacturer who has a product considered commercial (a semi-metallic type) states that the overall development period took about eight years from initial research, with research and development costs of about $2,000,000 in 1969 dollars.

6. <u>If a vehicle has a non-asbestos pad as original equipment, what problems or advantages do you see in use of asbestos type pads for replacement?</u>

There are essentially two answers to this question. The semi-metallic types have become original equipment on passenger cars in essentially two different environments. One is where the semi-metallic was phased in on a brake originally developed using asbestos linings. These were primarily domestic passenger cars with ventilated rotors. On the other hand, as is best illustrated by the 1980 General Motors X Cars (Citation, Phoenix, Omega and Skylark), recent developments are with solid rotors on front wheel drive cars where the new materials were required due to the increased operating temperatures of the brake. Where non-asbestos disc brake linings--semi-metallic types--were introduced in existing brake envelopes with ventilated rotors, there should be no problem servicing them with standard asbestos type linings.

There may be advantages to use of asbestos type linings to ease problems with thermal conductivity or poor physical strength. One manufacturer believes that there may be some problems magnified in the replacement market where semi-metallics are used, particularly where a rebuilder is assembling lining to the shoe. Also, there is some concern on the oxidation problem due to the time it takes for a product to get through the distribution system. However, where a semi-metallic was designed originally for the solid rotor brake it is felt that the replacement should also be of that type for fade resistance and lining wear properties.

7. <u>Are the composition and manufacture of non-asbestos disc brake linings developed by your company protected by patent? If so, what are the patent numbers?</u>

There are some patents in this area. It is suggested that EPA make its patent search for the information they believe relevant. Caution should be exerted to look at patents probably with dates no earlier than 1970, as the earlier patent literature has considerable information on sintered metal friction materials which are used in aircraft, and in special off-highway high torque high-temperature applications. The sintered materials have not been commercially acceptable in conventional vehicular braking systems.

8. <u>What mechanisms are there for the transfer of this technology to other companies who manufacture disc brake linings? For example, would your company consider licensing of the technology to manufacture non-asbestos brake pads?</u>

While respondents indicated that they have licensed others in friction material technology in the past, all such licensing has been done with organizations in international markets and not in the domestic market with direct competitors. Respondents have either not considered this question, or indicate that any situation involving licensing would be reviewed on its own merits.

9. Can non-abestos disc brake linings be manufactured in existing production facilities or will new facilities be required? Please estimate the capital and operating costs, and the availability and lead times associated with acquisition of the machinery and tooling.

All respondents concur that non-asbestos disc brake linings cannot be manufactured in existing production facilities. There will be additional operating costs as well as capital costs. Estimates on capital costs including tooling run from $2,000,000 to $6,000,000 to convert to manufacture of all non-asbestos disc brake linings. Operating costs are estimated to increase by 5 to 10 percent. Estimates on equipment and tooling acquisition run from twelve months to twenty-four months.

10. What is the projected unit cost differential between these three popular domestic disc brake lining sizes containing asbestos and non-asbestos substitutes? (FMSI 728A, 7013A, 7017A)

Two respondents indicated that the non-asbestos formula would be 200% of the asbestos formula. One respondent indicated (depending on FMSI number) costs of from 275% to 315% of the asbestos formula.

11. Based on your 1979 production, how much asbestos would be eliminated in a total conversion to non-asbestos disc brake pads?

This question could not be answered directly from the respondents as it would be meaningless without knowing the volume produced by each. Based on the answers and an estimate of asbestos disc brake lining production in the United States in 1979, the Institute attempted to develop a response for this question for the entire industry.

Based on estimates of 76,000,000 pieces of disc brake lining sold in the aftermarket, and approximately 40,000,000 pieces sold for original equipment, an estimate for disc brake linings sold in 1979 for passenger cars and light trucks is 116,000,000 pieces. Of the 40,000,000 original equipment, an estimate is made that 30%, or 12,000,000 pieces were non-asbestos types, leaving 104,000,000 pieces of asbestos type disc brake linings sold in the United States in 1979.

With an approximation that for domestic cars each lining weighs .35 pounds, and that half the content is asbestos, a projected total use of asbestos in automotive disc brake linings for 1979 is:

$$104{,}000{,}000 \times .35 \times .50 \times 1/2000 = 9{,}100 \text{ Tons}$$

Allowances were not made for the asbestos in the backing for some non-asbestos linings. However, it is not felt that this would alter the projections significantly. It is estimated, therefore, that 9,100 Tons of asbestos would be eliminated in a total conversion to non-asbestos disc brake pads.

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APR 21 1980

Mr. Richard Guimond
Environmental Protection Agency
Office of Toxic Substances
Waterside Mall-East Tower
401 M Street Southwest
Washington, D.C. 20460

Dear Rich:

In our meeting in January we drafted several questions for the Membership concerning friction products containing asbestos. At our January 3, 1980 meeting we agreed on revision of some of the wording. Our question #4 was worded as follows: "Where you are the original equipment supplier of non-asbestos type disc brake linings would you describe the packaging of asbestos and non-asbestos linings within the brake itself? In other words, present model year and application data for:

4.1 Full non-asbestos linings
4.2 Non-asbestos friction material with asbestos backing
4.3 Use of non-asbestos lining at one position (inner or outer) with asbestos type lining at other position

The Friction Materials Standards Institute gathered some of this information from original equipment sources and we have the enclosed presentation to make as regards that information. I wish to caution, however, that some of the information is not clear-cut. In other words, in certain model years some semi-metallics which have been used on disc brakes were phased in and may not have been production for the full year.

We are still attempting to gather the information on the other questions that were asked. I must admit that replies have been slow. I will continue to attempt to gather sufficient information to provide you with reasonable answers to the other questions that were sent the Membership.

Sincerely,

FRICTION MATERIALS STANDARDS INSTITUTE, INC.

EWD/lmc

E. W. Drislane
Executive Director

FMSI 03635

POLICE AND TAXI USAGE OF NON-ASBESTOS DISC BRAKE LINING ON FRONTS

Police and Taxi usage of non-asbestos disc brake linings was as a Police/Taxi option--actual usage depended on customer ordering that option. Ford-Mercury in 1976-78 also had non-asbestos disc rears for the Police/Taxi option.

		Non-Asbestos Lining (With Asbestos Backing)
AMERICAN MOTORS		
1978,	Concord Police, Taxi	Outer only
1978-75,	Matador Police	Both I & O
BUICK		
1980-71,	Buick Police, Taxi	Both I & O
1980-79,	Century Police	Both I & O
CHEVROLET		
1980-71,	Chevrolet Police, Taxi	Both I & O
1979-77,	Nova Police	Both I & O
1980-79,	Malibu Police	Both I & O
CHRYSLER		
1980-76,	Chrysler Police, Taxi	Both I & O
1980-78,	Cordoba Police	Both I & O
1980-77,	LeBaron Police, Taxi	Both I & O
DODGE		
1980-77,	Aspen Police, Taxi	Both I & O
1980-79,	St. Regis Police, Taxi	Both I & O
1980-77,	Diplomat Police, Taxi	Both I & O
1978-77,	Monaco Police, Taxi	Both I & O
1977,	Royal Monaco Police, Taxi	Both I & O
FORD		
1980-78,	Fairmont Police, Taxi	Both I & O
1980-76,	Ford Police, Taxi	Both I & O
1980-76,	Granada Police, Taxi	Both I & O
1979-78,	LTD II Police, Taxi	Both I & O
MERCURY		
1980-78,	Zephyr Police, Taxi	Both I & O
1980-76,	Mercury Police, Taxi	Both I & O
1980-76,	Monarch Police, Taxi	Both I & O
OLDSMOBILE		
1980-71,	Oldsmobile Police	Both I & O
1980-79,	Cutlass Police	Both I & O
PLYMOUTH		
1980-77,	Volare Police, Taxi	Both I & O
1980-77,	Gran Fury Police, Taxi	Both I & O
1978,	Fury Police, Taxi	Both I & O
PONTIAC		
1980-71,	Pontiac Police, Taxi	Both I & O
1980-79,	Phoenix Police	Both I & O

PASSENGER CAR AND LIGHT TRUCK USAGE OF NON-ASBESTOS DISC BRAKE LININGS

(See separate listing for Police/Taxi option usage)

		Non-Asbestos Lining (With Asbestos Back)		Non-Asbestos Lining Only
AMERICAN MOTORS				
1980,	Spirit, Concord 4's	Outer only		
1980,	Spirit, Concord, Eagle 6's	Outer only		
1979,	AMX	Outer only		
BUICK				
1980,	Buick Electra			I & O
1980-79,	Riviera	I & O		
1980,	Regal, Century	I & O	or	I & O
1980,	Skylark (Power brakes)			I & O
1980,	Skylark (Manual brakes)			Inner only
1980-76,	Skyhawk	I & O		
1979-78,	Regal, Century (Power brakes)			I & O
1979-78,	Regal, Century (Manual brakes)			Outer only
1979-76,	Skylark			Outer only
1977-76,	Century (Manual brakes)	Outer only		
1975-73,	Apollo (Manual brakes)			Outer only
CADILLAC				
1980-79,	Eldorado (Diesel)	I & O		
1980-79,	Seville (Diesel)	I & O		
1980-68,	Commercial	I & O		
CHEVROLET				
1980,	Monte Carlo, Malibu	I & O	or	I & O
1980,	Citation (Power brakes)			I & O
1980,	Citation (Manual brakes)			Inner only
1980-76,	Monza	I & O		
1980,	Chevette			Outer only
1980-76,	Camaro			Outer only
1979-78,	Monte Carlo, Malibu (Power brakes)			I & O
1979-78,	Monte Carlo, Malibu (Manual brakes)			Outer only
1979-76,	Nova			Outer only
1977-76,	Malibu (Manual brakes)	Outer only		
1977-76,	Vega	I & O		
1975-73,	Nova (Manual brakes)			Outer only

I = Inner Lining   O = Outer Lining

FMSI 03637

	Non-Asbestos Lining (With Asbestos Back)		Non-Asbestos Lining only
CHEVROLET TRUCK			
1980-78, El Camino			I & O
1980-79, C-,K-,P-20	I & O	or	I & O
1980-79, C-,P-30	I & O	or	I & O
1980-79, K-30	I & O		
1980-79, P-30 (JF-9) (Front & Rear)	I & O		
1980-79, G-30			I & O
1978-76, C-,K-,P-20	I & O	or	I & O
1978-76, C-,G-,P-30	I & O	or	I & O
DODGE			
1980-78, Omni	I & O		
DODGE TRUCK			
1978-76, Mini Bus	I & O		
1976, W-300	I & O		
FORD			
1980-79, Fairmont V8	I & O		
1980, Thunderbird	I & O		
1980-79, Mustang V8, Turbo 4	I & O		
1980-79, Fiesta	Outer only		
1980, Mustang V6	I & O		
FORD TRUCK			
1980-76, F-100 (4x4)	I & O		
1980-77, F-150 (4x4)	I & O		
1980-76, Bronco	I & O		
1978-76, F-250 (Lt)	I & O		
1980-76, E-250, F-250 (HD), E-350, F-350	Inner only		
1980, E-350 School Bus	I & O		
GMC TRUCK			
1980-78, Caballero			I & O
1980-79, C-,K-,P-2500	I & O	or	I & O
1980-79, C-,P-3500	I & O	or	I & O
1980-79, K-3500	I & O		
1980-79, P-3500 (JF-9) (Front & Rear)	I & O		
1980-79, G-3500			I & O
1978-76, C-,K-,P-2500	I & O	or	I & O
1978-76, C-,G-,P-3500	I & O	or	I & O
MERCURY			
1980-79, Zephyr V8	I & O		
1980, Cougar	I & O		
1980-79, Capri V8, Turbo 4	I & O		
1980, Capri V6	I & O		

		Non-Asbestos Lining (With Asbestos Back)		Non-Asbestos Lining Only
OLDSMOBILE				
1980,	Oldsmobile 98			I & O
1980-79,	Toronado	I & O		
1980,	Cutlass	I & O	or	I & O
1980,	Omega (Power brakes)			I & O
1980,	Omega (Manual brakes)			Inner only
1980-76,	Starfire	I & O		
1979-78,	Cutlass (Power brakes)			I & O
1979-78,	Cutlass (Manual brakes)			Outer only
1979-76,	Omega			Outer only
1978-76,	Toronado	Outer only		
1977-76,	Cutlass (Manual brakes)	Outer only		
1975-69,	Oldsmobile Commercial	I & O		
1975-74,	Toronado	I & O		
1975-73,	Omega (Manual brakes)			Outer only
PLYMOUTH				
1980-78,	Horizon	I & O		
PONTIAC				
1980,	LeMans, Grand Prix	I & O	or	I & O
1980,	Phoenix (Power brakes)			I & O
1980,	Phoenix (Manual brakes)			Inner only
1980-76,	Sunbird	I & O		
1980-76,	Firebird (drum rears)			Outer only
1980-79,	Firebird (organic disc rears)	I & O		
1979-78,	LeMans, Grand Prix (Power brakes)			I & O
1979-78,	LeMans, Grand Prix (Manual brakes)			Outer only
1979-78,	Phoenix			Outer only
1977-76,	Ventura			Outer only
1977-76,	LeMans (Manual brakes)	Outer only		
1977-76,	Astre	I & O		
1975-73,	Ventura (Manual brakes)			Outer only
Toyota				
1980,	Corolla Coupe	I & O		

TELEPHONE (201) 845-0440

FRICTION MATERIALS STANDARDS INSTITUTE, INC.

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

March 6, 1980

Mrs. Joni T. Repasch, Record Clerk
Office of Toxic Substances (TS-793)
Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Subject: Docket Number OTS-61005, Environmental Protection Agency ANPRM on Asbestos--Friction Materials

Gentlemen:

The Friction Materials Standards Institute is an association of manufacturers of brake linings and clutch facings. The Institute would like to comment on the Environmental Protection Agency's Advanced Notice of Proposed Rulemaking in the FEDERAL REGISTER of October 17, 1979, concerning the use of products containing asbestos. In particular, we would like to comment on questions posed on Page 60067 as they relate to Friction Materials.

Friction Materials is a broad classification which covers such products as automobile brakes, both disc and drum, truck brakes, fan and transmission clutches, and other devices used in the Automotive, Truck, Bus, Heavy Vehicle, Aircraft and other industries to stop, slow or control moving mechanical parts. We believe the largest usages to be in the Automotive, Truck, Bus, Heavy Vehicles and Aircraft industry.

Friction Materials may contain anywhere from zero (0) to 60% asbestos by composition depending upon the nature of the heat build up generated and required for control of the mechanical device involved.

Brake and clutch emissions and information related to the disposition of asbestos is contained in a report prepared for the Environmental Protection Agency, Office of Air and Water Programs, Ann Arbor, Michigan 48105, entitled Brake Emissions: Emission Measurements from Brake and Clutch Linings from Selected Mobile Sources, EPA Contract #68-04-0020, conducted by M. G. Jacko and R. T. DuCharme, Final Report for Period May 1971-March 1973. The EPA technical officer was Dr. Joseph H. Somers.

We call this report to your attention in that it provides the information and data to answer many of the questions posed in the EPA advance notice of Proposed Rulemaking.

The answers to the questions of (a) number of people exposed (b) routes duration and frequency of exposure (c) the intensity of exposure and (d) fiber size distributions require several source documents. We suggest you refer to a January 3, 1979 draft by Dr. W. J. Nicholson of Mount Sinai Hospital entitled "Investigation of Health Hazards in Brake Lining Repair and Maintenance Workers Occupationally Exposed to Asbestos". As that paper was a draft for comments, we believe you should contact Dr. Nicholson for that information on exposure levels and fiber sizes.

We are familiar with an IIT Research Institute report prepared for the Office of Toxic Substances, in which they attempted to develop a people exposure index based on several factors such as releasability of the fiber, frequency of exposure, duration of exposure, etc. While we will comment analyzing the inputs used for the IIT Research Institute exposure index, we do not wish to indicate that the mathematical exposure index is a meaningful index. It is constructed with several assumptions and arbitrary numerical levels which make it anything but an absolute index. We would like to provide an explanation of the brake repair business within the framework which IIT Research Institute arbitrarily constructed. By doing this, a better understanding of the actual number of persons exposed and duration of exposure will be presented.

Essentially, there are two areas where a brake repair worker may be exposed to airborne asbestos dust. They are: (1) In a shop which performs machining operations--such as grinding, drilling, bevelling, etc., and (2) In a shop where the brake repair worker blows brake wear debris from the drum and brake parts of a car being serviced. To take three factors from the IIT Research Institute report from their Table 2 for Brake Linings (Releasability 2, User 1, Population Exposure 2), these factors cannot be put in the same equation for perhaps 99% of brake work. Where the User and Population Exposure is high,i.e., the national chain, the corner garage--the shops involved most often do not have access to machining equipment and thus the releasability code would be 3 rather than 2--"fibers locked in and not likely to be released in normal use." Contrariwise, in the shops that have machining operations,i.e., fleets, municipal garages, where the releasability factor may be 2--"fibers locked in but releasable" during machining--the overall work force exposed is small.

The IIT Research report gives all brake repair a duration factor of 1 (12 hours per day). The average brake repair worker in a busy shop could do three or four brake jobs a day. The only exposure he will have--since most brake repair shops do not machine the friction materials--would be from the dust blown from the brake being serviced. While we agree for common sense reasons that blowing dust of any type should be discouraged, the brake wear debris has only a small fraction of asbestos--less than 1% in most studies.

Even with the blowing out of debris from brake drums, the duration cannot be 12 hours. The duration is more likely less than one minute per brake. With the advent of disc brakes on the fronts of most cars, this means less than 2 minutes per vehicle if the rear drum brakes are relined. When the time, the low asbestos content in the wear debris, and the fact that four brake jobs per day would be a busy shop, the 12 hour duration assigned to all brake repair is not justified.

We would like to comment on the do-it-yourselfer. He has the best of all worlds. (1) He doesn't have machining equipment so his repair job cannot have a releasability factor of 2; (2) He doesn't have access to an air hose so his duration must be near zero; (3) The do-it-yourselfer probably does no more than one brake job a year so he cannot have the frequency assignment of 365 (daily) given to the brake repair worker.

While additional examples could be given where the same factors or codes could not be assigned to all groups of brake repair workers, the point is that all brake workers cannot be categorized under one set of exposure codes. In other words, the IIT Research Institute report took the "Population Exposed" and "User" characteristics which are based on perhaps 900,000 workers in the brake repair area, and assigned them all the second most objectionable code for releasability and the worst codes for frequency and duration.

The exposure criteria should be analyzed by the segments of the work force and not by the total work force if one is to assign correct codes for releasability, duration and frequency. While estimates are necessary, we have prepared a table to indicate what we estimate the exposure factors (or codes) to be in brake repair facilities.

ESTIMATED EXPOSURE FACTORS IN BRAKE REPAIR FACILITIES BY TYPE

Type Brake Repair Operation	Releasability	Frequency	Duration	Estimated Number of Brake Repair Workers
Fleet Garages, Municipal Garages, with machining operations (2-20 jobs per month) (2-10 brake repair workers)	2	1-2	1-2	10-30,000
Fleet and Taxi Garages without machining equipment (2-20 jobs per month) (2-10 brake repair workers)	3	1-2	2	10-30,000
National and Regional Chain, Tire Company, Car Dealer (10-50 jobs per month) (2-10 brake repair workers)	3	1	3	50-100,000
Gas Station, Corner Garage (2-10 jobs per month) (1-2 brake repair workers)	3	1-2	3	400-800,000
Do-It-Yourselfer (1 job per year)	3	4	4	1-5,000,000

A simple conclusion is (1) Where the releasability, frequency, and duration is highest, the smallest population is exposed, and (2) Where the population "exposed" is high, releasability, frequency and duration are low. In the fleet and municipal garages, where exposures are highest, these shops should be taking steps to comply with OSHA regulations. Shops of this type should be in compliance with OSHA regulations and thus will have the necessary exhaust ventilation equipment and procedures to maintain exposure levels below those suggested in the IIT Research Institute report and in the table shown above.

In summary, the shops which may potentially have the greatest population exposed do not have the asbestos exposure factors of the fleet and municipal garages with grinding equipment. It is suggested that a voluntary action program, with labeling and education be aimed at these smaller facilities. Compliance with OSHA regulations should be emphasized at the larger facilities, and particularly those with machining operations and thus new regulation from the EPA is not necessary.

Sincerely,

FRICTION MATERIALS STANDARDS INSTITUTE, INC.

EWD/erc

E. W. Drislane
Executive Director

February 19, 1980

Mr. Albert Colli
Environmental Protection Agency
Office of Toxic Substances
Waterside Mall - East Tower
401 M Street SW
Washington, D.C. 20460

Dear Al:

Thank you for the copies of your minutes of the meeting that we had with EPA on January 3, 1980.

I do not believe that we have basic differences, but the questions drafted to correspond to your Enclosure III are as shown on the attached two pages. As I indicated, I don't believe there are any significant differences, but Question 2 for Enclosure III did not include a question regarding the evaluations on health effects of non-asbestos disc brake linings or materials used therein. As indicated at the meeting, no one has that information and the question was re-worded to determine the physical characteristics of the fibers should they be the cause of health problems. Also, where you have Questions 4 and 5, we were more specific in our Question 4. The questions had to directly address the problem and be more specific than was indicated in your Questions 4 and 5. I believe the rest of the questions go along with the wording in your Enclosure III.

After my return from Washington I went over these questions and the wording to be used with both Mr. Moalli and Mr. Armstrong. It was agreed that this wording that we show was as we understood it from the meeting. If you feel that the differences in the wording are of substance and could present a problem please let me know, as we have already sent our questionnaire to the members using the wording indicated in our write-up.

If there are problems with the foregoing please let me know.

Sincerely,

FRICTION MATERIALS STANDARDS INSTITUTE

EWD/lmc

E. W. Drislane
Executive Director

February 19, 1980

Mr. Jim Armstrong
Bendix Corporation
Bendix Center
Southfield, Michigan 48076

Dear Jim:

I am enclosing a copy of EPA's version of the "minutes" of the meeting held with EPA personnel in Washington on January 3, 1980. Without going into the wording of the covering letter and the minutes, any differences are in the wording of the questions as we agreed at the January 3 meeting.

The questions indicated in Enclosure III do not appear to differ in substance from the questions the way we drafted them. There may be some question as regards Question 2 concerning the effects of non-asbestos disc brake linings and the materials used therein. My notes specifically indicated that we were not asking this question but instead were asking concerning the fibrous characteristics of the materials. Also, for example, our question number 4 and question number 10 are more specific then the questions indicated with their Enclosure III.

I have replied to Mr. Colli with the comments indicated with the copy enclosed. The foregoing is sent to you as a matter of information.

Sincerely,

FRICTION MATERIALS STANDARDS INSTITUTE, INC.

EWD/lmc

E. W. Drislane
Executive Director

FMSI 03645

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 24 1980

OFFICE OF TOXIC SUBSTANCES

Mr. E. W. Drislane, Executive Director
Friction Materials Standards Institute Incorporation
Bergan Mall Office Center
E. 210 Route 4
Paramus, New Jersey 07652

Dear Mr. Drislane:

I have attached a copy of the minutes of the meeting between Environmental Protection Agency (EPA) personnel and representatives of FMSI that was held on January 3, 1980. Please let me know if you have any corrections, deletions or additions to the minutes.

Sincerely,

Albert Colli

Albert Colli

Enclosure

OFFICE OF TOXIC SUBSTANCES

Meeting with the Friction Materials Standards Institute
January 3, 1980

At the request of the Friction Materials Standards Institute (FMSI), EPA staff met with FMSI representatives at EPA, Washington, D.C. A list of attendants is attached as enclosure (1).

The purpose of the meeting was to discuss a list of questions on friction products provided to the FMSI by EPA on November 16, 1979. FMSI was to determine whether their members would answer the questions and what mechanisms should be used to solicit the responses. The list of questions are attached to these notes as enclosure (2).

Ralph P. Moalli, representing FMSI, stated that the chances of obtaining responses from the members of FMSI would be increased if the questions could focus on disc brakes and exclude drum brakes at this time. He suggested that a second questionaire could be submitted, specifically addressing drum brakes, after the responses to the questions on disc brakes had been secured. Changes to the original questions were made by mutual agreement during the meeting which resulted in a revised list which has been included as enclosure (3).

At the conclusion of the meeting, E.W. Drislane, representing FMSI, stated that the questions as phrased would probably be submitted to 15 of their 19 members. He indicated that responses to the questions would be obtained in about 3 months.

ENCLOSURE I

Name	Company/Code	Telephone Number
Al Colli	OPTS/CAD	755-8023
Hope Pillsbury	OPTS/CAD	755-8023
Jim Armstrong	Bendix	313-352-6350
E.W. Drislane	FMSI	201-845-0440
Eugene L. Rogers	Bendix	518-273-6550
Ronald P. Moalli	FMSI/Raybestos	202-371-0101
Alan Carpien	EPA/OGC	755-0794
Richard J. Guimond	OPTS-CAD	755-8023
Jim Silverman	OPTS/CAD	755-6660
David Mayer	OPTS/PID	755-5854
Jim Hughes	OPTS/ORA	755-6660
Bob Liss	OPTS/CAD	755-8023
Jane Nowak	OPTS/CAD	755-8023

DRAFT

NOV 15 1979

ENCLOSURE II

Informational Needs for Friction Products Containing Asbestos

1. What are the basic ingredients used in nonasbestos linings for disc brakes? Specific formulations are not necessary.

2. What are the basic ingredients under consideration for use in nonasbestos linings for drum brakes? Specific formulations are not necessary.

3. What data or evaluations are available regarding the health effects of nonasbestos brake linings or materials used in them?

4. What are the performance characteristics and the problems associated with the use of substitute products for brake linings containing asbestos?

5. Are nonasbestos brake pads used in conjunction with asbestos pads? For example, is the outer part of the pad nonasbestos and does the inner pad contain asbestos?

6. Are nonasbestos brake pads interchangeable with asbestos brake pads? If the vehicle has a nonasbestos pad as original equipment, must the replacement pad be nonasbestos?

7. Are the composition and manufacture of nonasbestos brake linings developed by your company protected by patent or are they trade secret?

8. Are there mechanisms for the transfer of this technology to other companies who manufacture brakes for vehicles? For example, would your company consider licensing of the technology to manufacture nonasbestos brake pads?

9. Can nonasbestos brake products be manufactured in existing production facilities or will new facilities be required? What will be the capital and operating costs associated with change over?

10. What is the projected price differential between brake linings containing asbestos and nonasbestos substitutes?

11. Do brake systems which utilize nonasbestos friction products require a different design from brake systems with linings containing asbestos? If component parts for use with nonasbestos linings are different, what is the product price differential?

DRAFT

ENCLOSURE III

Informational Needs for Friction Products Containing Asbestos

1. What are the basic ingredients used in nonasbestos linings for disc brakes? (Specific formulations are not necessary). The materials used to substitute for asbestos are of particular interest.

2. What data or evaluations are available regarding the health effects of nonasbestos disc brake linings or materials used in them? If the substitute is a fiber what are its physical characteristics and size distribution?

3. What are the performance characteristics and the problems associated with the use of substitute products for disc brake linings containing asbestos? How do the substitute pads compare with asbestos pads? (For example: expected wear, noise levels from use, etc.)

4. For orignal equipment applications describe the asbestos-nonasbestos braking system. Include part number, vehicle application, and model years for each system decribed.

5. Describe the asbestos-nonasbestos braking system used for original equipment applications. Specify the vehicle applications and the model years for each system described.

6. Describe the historical development of nonasbestos disc brakes in your company. For example, provide date of initial research, dates of initial testing, dates of commercial available product. Estimates research and development costs for developing commercial product. Provide either total cost or cost for each phase.

7. Are nonasbestos pads interchangeable with asbestos brake pads? If the vehicle has a nonasbestos pad as original equipment, what problems or advantages do you foresee with replacement pads that contain asbestos?

8. Are the composition and manufacture of nonasbestos disc brakes linings developed by your company protected by patent? What are the patent numbers?

9. What mechanisms are there for the transfer of this technology to other companies who manufacture disc brakes for vehicles? For example, would your company consider licensing of the technology to manufacture nonasbestos brake pads?

10. Can nonasbestos disc brake products be manufactured in existing production facilities or will new facilities be required? What will be the capital and operating costs associated with change over? (For example: machinery, tooling, and time considerations.)

11. What is the projected unit cost differential between disc brake linings containing asbestos and nonasbestos substitutes for the part numbers specified above.

12. How much of the asbestos used by your firm in 1979 would have been eliminated had all disc brakes been nonasbestos in that year?

FRICTION MATERIALS STANDARDS INSTITUTE, INC., E-210 ROUTE 4, PARAMUS, N.J. 07652

February 8, 1980

TO: Delegates and Alternates

SUBJECT: EPA Office of Toxic Substances Questions Concerning
Asbestos and Non-Asbestos Disc Brake Linings

Based on Board of Directors recommendations, an Institute Task Force met with EPA in Washington to clarify and modify the Eleven Questions that EPA had drafted to ask manufacturers of friction materials. As you may be aware, the EPA is permitted under the Toxic Substances Control Act to subpoena information relative to initiatives in this area. The Institute feels it to be prudent to work with EPA on a voluntary basis in providing information and background so that any actions they take will be based on facts rather than assumptions.

We are asking, therefore, that member companies who manufacture asbestos or non-asbestos disc brake linings for passenger cars and/or light trucks (under 10,000# GVW) respond to this questionnaire. At some later date, the EPA will probably ask similar questions concerning drum brake linings, brake blocks, etc.

Control of Individual Company Response

It is suggested that individual member companies have one individual control and coordinate the response. In this fashion, he will insure that contradictory responses are not sent to the regulators by individual contacts or questions from others in Washington. Along this line, it has been suggested that responses to EPA and others be only sent where the request for information is in writing. This is to avoid conflicting responses to telephone inquiries and the like.

Institute-Coordinated Response Versus Individual Direct Response

The Institute is attempting to coordinate the response to EPA. Replies will not be attributed to companies, but it must be remembered that EPA does have subpoena power and could determine the source of the answers. If individual companies wish to comment on other aspects of this subject--beyond those suggested in the questions--they should add comments. We will code the answers for our response to EPA.

Legal Counsel Review of Responses to Questionnaire

Institute's Legal Counsel had asked to review the questionnaire. He has failed to respond to several requests to review and approve this questionnaire for circulation. It has been decided to release this questionnaire as written, but the Members are urged to have their own Legal Counsel review the individual replies.

Replying Directly to EPA

If a member company feels it would be in its best interest to reply directly, the response should be sent to:

Mrs. Joni T. Repasch (Record Clerk)
Office of Toxic Substances (TS-793)
U. S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
(Mark Prominently: Docket Number OTS-61005)

If you do reply directly, your response is part of the public record. If you provide any confidential or proprietary information, you should provide it only if the EPA can assure you that the confidentiality of the information can be safeguarded.

* * * * *

There is no question but that the EPA is considering a ban on asbestos in friction materials. Their first step is with automotive disc brake linings. We believe that accurate objective information can influence decisions to be made in this area, and recommend that all member companies help with this response. As indicated earlier, if they do not get this information on a voluntary basis, they can compel it.

We are trying to gather this information so that we can forward it to EPA no later than March 31, 1980.

EWD/erc
cc-Health & Environmental Affairs Committee

E. W. Drislane
Executive Director

1. What are the basic ingredients used in non-asbestos disc brake linings, which were not used in earlier asbestos type formulations? Of particular interest are the materials used to substitute for asbestos--those that reflect a net change.

2. As regards the substitute materials, if the substitute is fibrous, what are the physical characteristics of the fiber--structure, fiber size, size distribution?

3. What are the performance characteristics and the problems associated with the use of substitute products for disc brake linings containing asbestos? How do the substitute non-asbestos pads compare with asbestos pads for lining wear, rotor wear, noise, wet recovery, etc.?

4. Where you are the original equipment supplier of non-asbestos type disc brake linings would you describe the packaging of asbestos and non-asbestos linings within the brake itself? In other words, present model year and application data for:
   4.1 Full non-asbestos linings
   4.2 Non-asbestos friction material with asbestos backing
   4.3 Use of non-asbestos lining at one position (inner or outer) with asbestos type lining at other posititon

5. Describe the historical development of non-asbestos disc brake linings with date and/or time from (1) initial research, (2) successful laboratory prototype, to (3) availability of commercial product. Also, estimate research and development cost for development of commercial non-asbestos disc brake linings (either in total or for each phase of the development).

6. If a vehicle has a non-asbestos pad as original equipment, what problems or advantages do you see in use of asbestos type pads for replacement?

7. Are the composition and manufacture of non-asbestos disc brake linings developed by your company protected by patent? If so, what are the patent numbers?

8. What mechanisms are there for the transfer of this technology to other companies who manufacture disc brake linings? For example, would your company consider licensing of the technology to manufacture non-asbestos brake pads?

9. Can non-asbestos disc brake linings be manufactured in existing production facilities or will new facilities be required? Please estimate the capital and operating costs, and the availability and lead times associated with acquisition of the machinery and tooling?

10. What is the projected unit cost differential between these three popular domestic disc brake lining sizes containing asbestos and non-asbestos substitutes? (FMSI 728A, 7013A, 7017A)

11. Based on your 1979 production, how much asbestos would be eliminated in a total conversion to non-asbestos disc brake pads?

The foregoing questions relate to passenger car and light truck (under 10,000 lbs. GVW) disc brake linings. The Office of Toxic Substances has indicated that they will be asking questions along a similar line, at some later date, for drum brake linings used on passenger cars and light trucks. And at still a later date, they will ask about brake blocks and probably clutch facings.

FRICTION MATERIALS STANDARDS INSTITUTE, INC., E-210 ROUTE #4, PARAMUS, NEW JERSEY 07652

January 8, 1980

TO: BOARD OF DIRECTORS
ENVIRONMENTAL AFFAIRS COMMITTEE

SUBJECT: MEETING WITH EPA OFFICE OF TOXIC SUBSTANCES PERSONNEL CONCERNING THEIR REQUEST FOR INFORMATION ON FRICTION MATERIALS

At the December 4, 1979 meeting of the Board of Directors, among the many items discussed were the eleven questions asked by the EPA's Office of Toxic Substances Control concerning asbestos and non-asbestos friction materials. At the Board meeting it was decided that a Task Force would be formed to meet with the Office of Toxic Substances to clarify and re-define these questions. This Task Force consisted of: Mr. R. R. Moalli, President of the Institute; Mr. J. W. Armstrong, Chairman of the Health and Environmental Affairs Committee and Mr. E. W. Drislane, Secretary. Mr. Armstrong invited Mr. E. L. Rogers of the Bendix Friction Materials Division to help with the questions. Messrs. Moalli, Armstrong, Rogers and Drislane met with the personnel from the Office of Toxic Substances on January 3, 1980 at 10:00 A.M. at the EPA Offices, Waterside Mall, Washington, D.C. Those in attendance from the EPA are listed below:

Name	EPA Office	Telephone (Area Code 202)
Al Colli	CAD/OPTS	755-8023
Hope Pillsbury	CAD/OPTS	755-8023
Alan Carpien	EPA/OGC	755-0794
Richard J. Guimond	EPA/OCC	755-8023
Jim Silverman	CAD/OPTS	755-6660
David Mayer	PID/OPTS	755-5851
Jim Hughes	ORA/OPTS	755-6660
Bob Liss	CAD/OPTS	755-8023
Jan Nowak	CAD/OPTS	755-8023

The elven questions that had been submitted earlier were covered in detail at this meeting. Without going into the detail, every question was discussed and the proposed new draft of the eleven questions is attached. Essentially, the questions are limited at this point to automotive disc brake linings. Questions or inferences as regards drum brake linings or others have been removed. However, the EPA indicated that at some later date they will be seeking similar information on drum brake linings. The questionnaire at this time will refer to asbestos and non-asbestos disc brake linings only.

Further, these are for passenger cars and light trucks which will be defined as vehicles under 10,000# GVW. For example, question #2 on drum brake linings was eliminated. Other questions were almost completely restructured. Question #11 of the original eleven questions was also eliminated because it involved a knowledge of the brake system itself rather than brake linings. Further, a new question #11 was added concerning how much asbestos would actually be eliminated by conversion to non-asbestos brake pads.

In response to a question from EPA, the Secretary indicated that he felt that it would be three months before this information would be available. He suggested that this material must go to both our Legal Counsel and our Board of Directors before we can even solicit replies.

Among other matters it was stated that where a respondent prefers to go direct to the EPA rather than through the Institute that replies should be addressed to the docket established with the Federal Register notice of October 17, 1979. That would be Docket OTS-61005. It was pointed out that replies would be concentrated on domestic passenger car linings which would mean that the imports are not being addressed directly. Also, the questions would be directed to United States Active Members and not to Regional Members. This would mean, of course, that some information relating to imported cars and replacement linings therefor will not be included. Before this questionnaire is sent to the Membership, it must be approved by Legal Counsel and the Board of Directors.

The foregoing is sent along as a matter of information.

EWD/lmc

E. W. Drislane
Executive Director