Asbestos Study Comm.

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Raybestos-Manhattan

June 1, 1972

Mr. E. W. Drislane, Executive Secretary
Friction Materials Standards Institute, Inc
Bergen Mall Office Center, E.210
Route #4
Paramus, N.J. 07652

Dear Ed:

The attached material concerning automotive emissions of asbestos fibre was received from Illinois Institute of Technology Research Institute yesterday and probably will be of interest to other members of the FMSI Asbestos Study Committee . I suggest that you circulate it to them.

This material was forwarded by Dr. Colin F. Harwood of IITRI as a supplement to information presented at a seminar on asbestos they conducted April 4 through 7. Very little attention was devoted to automotive emission sources during the seminar.

The main issue I would have with Dr. Harwood's conclusion would have to do with whether or not the free fibres or fibrils released from friction material decomposition are truly hazardous in any way, and I also believe he tends to underestimate the problems involved in non-asbestos containing braking systems.

Since it appears unnecessary and probably impossible to schedule an Asbestos Study Committee meeting in June and I will be away the first two weeks in July, I think it might be prudent to tentatively schedule a meeting late in July, preferably during the last week. By that time I expect there will be a number of subjects worthwhile reviewing. If you agree, kindly canvass the other members and pick a date. As far as I know, I will be available anytime during the week of July 24. I am also open the week after that in the event this suits the others better.

Best regards,

IHW

I. H. Weaver

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attachments such that the dust created is arrested at the source and collected in filter bags. Commercial devices are available but normally firms with a sincere interest in pollution control, design and fabricate their own devices. Two examples of such devices are shown in Figures 6 and 7. These control hoods work on the high velocity, low volume principle and can be readily adapted to industrial vacuum cleaner systems.

When arrest-at-the-source systems are not possible, techniques similar to those employed by the asbestos spraying industry may be utilized. Rules which relate more specifically to fabrication of asbestos products may be found in such publications as:

1. "Recommended Practices for Fabricating, Handling and Construction Industries," Health and Safety Council-Asbestos Cement Products Association.

2. "Recommended Health Safety Practices for Handling and Applying Thermal Insulation Products Containing Asbestos," National Insulation Manufacturers Association (NIMA).

3. The Asbestos Research Council - Control and Safety Guides (London, England).

4. "Recommendations for Handling Asbestos," Engineering Equipment Users Association (EEUA), E.E.U.A. Handbook No. 33.

3.3.3 Friction Material Applications

Typical friction materials contain 30 to 50% asbestos and may be up to 70%, and the industry that manufactures these materials is ranked third (1969) in the consumption of asbestos fibers. Crysotile is the preferred variety because it has better frictional properties than amphibol asbestos and does not exert so much wear on the opposing surface.

The major uses of asbestos-containing friction materials include brake linings, brake discs and clutch facings. These products have been applied to a wide variety of industrial and commercial products.

Sources of Emission - Emission of asbestos from friction materials results from normal day-to-day usage. An idea of the scope of this source can be gained from the estimation that the average automobile wears out 3 to 4 sets of brake linings, and 1 to 2 sets of clutch facings during its lifetime and that commercial public transport vehicles wear out many more sets. Data concerning motor vehicle brake linings for the whole of the United States are given in the following:

Vehicle miles during 1968	1,010,000,000,000
Mileage life of brake linings	27,500
Brake lining sets on new vehicles	10,718,000
Pounds of asbestos per set of brake linings	3

Tests performed on brake linings have indicated that under conditions of normal usage, considerable alteration of the asbestos occurs. It is reported that most of the dust collected from brake drums appears non-fibrous and is similar in appearance to thermally degraded asbestos. The suggestion is that high temperatures at the brake lining/drum contact points actually reach degradation levels.

Tests on brake linings, brake discs and clutches have demonstrated that the quantity of fiber emitted is some function of the severity of the braking conditions (see Table 3). However, even at the level of 1%, the total emissions must be considerable when the total tonnage in use is considered. Further, the emissions are likely to occur at places of high density population and restricted ventilation. That is, in busy main streets of towns surrounded by large buildings.

The effect of different braking conditions and different types of friction materials on asbestos emissions is the subject of a study being sponsored by the Environmental Protection Agency. Other studies are being conducted in California and some work on roadsides has been done at Mt. Sinai, New York. The EPA study will establish the extent and nature of the asbestos

Table 3

ASBESTOS EMISSIONS FROM BRAKE LININGS
(Test Results by Electron Micrograph)

	Product	Brand	Test Method	No. of Samples	Conditions of Test-F	Presence of Free Fibers	% Free Fiber*
1.	Automobile drum brakes	A	Friction	6	300-800	Few	<1
2.	"	B	Friction	6	250-800	None	0
3.	"	C	Friction	5	300-700	Few	<1
4.	"	C	Friction	1	700-900	Numerous	~10
5.	"	D French	Friction	5	300-800	Few	<1
6.	"	E	Friction	5	300-700	Few	<1
7.	"	F German	Friction	5	300-800	Few	<1
8.	"	G	Friction	2	100-500	Few	<1
9.	"	G	Friction	1	600-700	Numerous	~15
10.	"	H	Friction	2	100-600	Few	<1
11.	Automobile clutch	J	Dynamometer	1	normal driving	None	0
12.	Automobile disk brake	K	Dynamometer	1	normal driving	Few	<5
13.	Bus drum brake	L	Dynamometer	1	city driving	None	0
14.		M	Friction	2	450-550	None	0
15.	Truck drum brake (light)	F	Friction	10	300-800	Few	<1

*Weight estimated from fiber volume.

emitted from brake drums, disc brakes and clutches of vehicles operating under real conditions. Hopefully the situation will be more clearly understood at the end of those studies.

Emission Control Techniques

Emission at Overhaul - To avoid blowing the accumulated dust into the atmosphere at the time of overhaul devices have been suggested for extraction of the dust from brake and/or clutch housings by suction. Of the devices tried, a simple hand-held vacuum cleaner has proven to be the most flexible unit. Changes to the original design have been limited to the addition of a disposable paper bag inserted in the original cloth bag. The paper bag may be easily sealed before removal to prevent emission.

Substitution - Beyond the adaptation of better cleaning practices during brake and clutch maintenance, as mentioned above, additional controls seem to be limited to improve design of brake and clutch assemblies and/or substitution of other materials for asbestos.

The high temperature properties and exceptional tensile strength of asbestos have resulted in very compact and economical design. These same unique properties which make asbestos applicable to friction materials also make the application of substitute materials very difficult. The tensile strength and modules of rigidity of asbestos as compared to several candidate substitute materials follows:

	Tensile Strength $lb/in.^2$	Modulus of Rigidity $lb/in.^2$
Asbestos	550,000	30,000,000
Fiber yarns	180,000	3,000,000
Steel wool	50,000	100,000
Mineral wool	25,000	60,000

There is no doubt that substitution of other materials for asbestos is possible, but the design changes required to accommodate the stresses and temperatures involved would result in larger, more expensive components.

Brakes - The recent adoption of disc brakes by the automotive industry makes material substitution more plausible. Disc brakes are capable of greater energy dissipation than similar sized drum brakes because the design results in considerably lower heating rates. This is due to the fact that at any one time the friction pad contacts only a section of the disc surface. The lower operating temperatures permit the use of friction materials which do not contain asbestos. Another feature of disc brake design which has reduced the need of asbestos materials is the lower strength requirement of the friction material.

Clutches - The substitution of other material for asbestos in clutch facings of traditional design could only be done by changes in size and design. Two changes in clutch design which have reduced the requirement for asbestos-containing friction materials are the advent of the automatic transmission and the redesign of manual clutch friction surface.

The clutch surface of the automatic transmission is immersed in an oil bath which virtually eliminates airborne pollutants. Further, the cooling affect of the oil bath reduces the requirement for high-temperature capability materials. Automatic transmission clutch facings may be made from either sintered metals or fibrous cellulose materials.

Many manual clutches have redesigned friction surfaces which consist of numerous small circular pads or discs attached to the clutch face as opposed to the standard annular ring friction surface. These small pads act in the same manner as the disc brakes friction pad. Thus, lower stresses and operating temperatures associated with the new design reduce the need for asbestos-containing friction materials.

10. SPECIFIC PROBLEMS

10.1 Emission Levels

In understanding control techniques and their efficiencies, it is important not to be confused with efficiencies quoted on a weight basis and those based on a particle count basis.

Firstly, considering efficiency based on a weight basis, it is relatively easy to get a very high efficiency with particles whose size is in excess of 5μ with a variety of control devices (see Figure 10). However, the efficiency does drop off considerably with decrease of particle size, for example, see Figure 11 for 1μ particles. (It should be noted that these graphs refer to spherical particles - information on fibrous particles is not presently available.)

Now consider what these apparent high efficiencies mean in terms of numbers of fibers. It can be assumed that 10^3 average fibers of asbestos weigh approximately 1 ng.

If 1 g of asbestos material approaches a filter rated at even as high as 99.999% efficiency, then the quantity passing through will be 0.00001 g, or 10^4 ng. And since 1 ng $\simeq 10^3$ fibers, then <u>a total of 10^7 fibers</u> will pass through the filter for every 1 g of material impinging upon it.

This is a situation not frequently brought out, but is very significant when exposure levels are monitored in terms of fibers per cubic centimeter.

Thus the quoting of efficiency in terms of mass efficiency is a "red-herring" statement that flatters to deceive. It bears no obvious relation to the number of <u>fibers</u> being emitted.

However, based on tests which actually measure the number of fibers being emitted, it would seem that both fabric filters and high efficiency wet scrubbers are capable of reducing the fiber counts to acceptable levels. British experience is that 0.2 f/cc is routine and Johns Manville finds that 1 f/cc is an acceptable value when the results are averaged over a time period.

The medical evidence as to the size of fiber responsible for adverse health effects is not positive nor is the question of whether fibrils of fibers are most hazardous. Until the medical questions are fully resolved, it would seem premature to impose inflexible or overly rigid regulations.

This has been the view held by the Federal occupational health authorities in assessing their standards. It would seem that thei approach in limiting exposure to that which is possible using good modern technology is sensible. The same may be said for their monitoring techniques.

10.2 Water Pollution

Recycling of waste water is possible and is practiced in certain segments of the industry. The question of the damage done to streams, rivers, and lakes by indiscriminant dumping of asbestos containing waste waters needs careful study. One must remember it is a natural material which will appear in water in any case. On the other hand, there is evidence that asbestos particles ingested into the stomach may cause stomach cancer.

Again, until medical evidence is clear, it would seem sensible to recycle water whenever this can be accomplished.

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

June 6, 1972

Asbestos SC

TO: Members of Asbestos Study Committee
SUBJECT: Asbestos Fibers Emissions - Friction Materials

A seminar was held at the Illinois Institute of Technology Research Institute back in April of this year. Dr. Colin Harwood of IITRI was one of the advisors to the Illinois Pollution Control Board who was in favor of the proposed 1971 regulations as written—that is to include a ban on the" use of asbestos in the brake lining of vehicles manufactured after January 1, 1975 and sold for use in Illinois."

The pages from the IITRI paper are: pages 22, 25, 26, 27, 28, 46, 49, 65, 66, 67, 68, 69, 70, 71, 72, 73.

Your Chairman, Mr. I. H. Weaver, sent this data to me for distribution to the Committee. He commented on the paper: "The main issue I would have with Dr. Harwood's conclusion would have to do with whether or not the free fibers or fibrils released from friction material decomposition are truly hazardous in any way, and I also believe he tends to underestimate the problems in non-asbestos containing braking systems."

Your Chairman believes that a meeting of the Committee should be called. I'm asking for a reply on the attached form, for which weeks not to call a meeting. From this I will try to arrive at a meeting date (perhaps late July or late August).

EWD/lmc

E. W. Drislane
Executive Secretary

PLAINTIFF'S EXHIBIT
NO. BK-215

MEETING SCHEDULE - ASBESTOS STUDY COMMITTEE

TO: Friction Materials Standards Institute, Inc.
E-210 Route #4
Paramus, N. J. 07652

Gentlemen:

Concerning a proposed meeting of the Asbestos Study Committee, PLEASE DO NOT SCHEDULE IT FOR THE FOLLOWING WEEKS:

July 24-28 ________

August 7-11 ________

August 14-18 ________

August 21-25 ________

August 28-31 ________

Additional Comments: ____

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By ______________________

Company ______________________

Date ______________________