PLAINTIFF'S EXHIBIT

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B U L L E T I N

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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.
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> 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

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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.