TELEPHONE (201) 845-0440

FRICTION MATERIALS STANDARDS INSTITUTE, INC.
BERGEN MALL OFFICE CENTER
E. 210 ROUTE 4
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. 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?

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. 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?

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. 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?

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.