FINAL REPORT

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on

ANALYSIS OF THE FEASIBILITY OF REPLACING ASBESTOS IN AUTOMOBILE AND TRUCK BRAKES

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This is a report of an expert panel assembled by ASME to address the technical issues associated with the removal of asbestos from vehicle friction products. This panel convened on December 3 and 4, 1986, to discuss issues of vehicle safety, friction material availability and performance, and future trends in the development of asbestos-free friction products.

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EXECUTIVE SUMMARY AND CONCLUSIONS

Due to reported health problems associated with the use of asbestos, the Office of Toxic Substances has proposed a regulation to ban the use of asbestos over a 10-year phase-down period. Since asbestos is currently a critical constituent in some vehicle friction products, the Environmental Protection Agency is interested in determining whether the proposed ban could have adverse effects on vehicle braking safety.

In order to assess the potential effects of the proposed ban on vehicle brake system operation and vehicle safety, a panel of individuals knowledgeable in the various aspects of vehicle brakes and friction materials was assembled by the American Society of Mechanical Engineers (ASME). The panel addressed technological issues associated with the removal of asbestos from friction materials, specifically:

(1) Identification of substitute brakes and systems,

(2) Influence of the ban on motor vehicle safety standards,

(3) Problems associated with replacing asbestos friction materials in aftermarket vehicles, and

(4) Pace of research and commercialization and effects on phase-out.

This report addresses the technical issues related to the proposed ban considered by the panel to be the most important.

Conclusions

The panel has made the following observations and conclusions:

(1) Vehicle controllability during braking is strongly affected by friction material performance.

Vehicle controllability during braking is affected by both driver and brake system performance. Generally, vehicle front-to-rear braking ratios are adjusted on a per vehicle basis to provide optimal braking. Too much braking on an axle results in premature wheel lock-up and this can lead to loss of steering control (front lock-up) or spin-out (rear lock-up). While the effectiveness of disc brakes is directly proportional to pad-disc friction levels, the effectiveness of drum brakes can be greatly affected by changes in lining-drum friction. Therefore, unqualified substitution of friction materials in either vehicle disc pads or drum linings may have an adverse effect on vehicle brake balance and controllability. Friction materials that exhibit reduced effectiveness also can result in brakes having insufficient torque needed to stop the vehicle. Different drum brake designs exhibit dramatic differences in effectiveness, and brake effectiveness can be affected by the friction properties of the friction material. For these reasons, automobile and truck manufacturers have strongly opposed the immediate ban of asbestos in aftermarket friction materials for older vehicles.

Information supporting this conclusion is presented in Chapter 2 of this report.

(2) Vehicle manufacturers submit braking systems and friction products to numerous levels of qualification tests.

The qualification of original equipment braking systems is regulated under Federal Motor Vehicle Safety Standards (FMVSS) 105 and 121. For many original equipment manufacturers, these requirements represent minimal standards of performance, and supplemental qualifications are usually satisfied due to customer demand. Satisfactory compliance with FMVSS 105 and 121 requires vehicle and inertial dynamometer test facilities to evaluate brake system performance on a per vehicle basis. Results obtained using scaled-down laboratory apparatus, such as friction material testing machines (FMTM) or friction assessment screening test (FAST) machines, have been shown to correlate poorly with vehicle test results. No simple bench-top tests are available to evaluate the performance characteristics of friction materials. The performance of aftermarket friction materials is not regulated by law.

(3) Qualified, non-asbestos friction materials are not yet available for all current applications.

Non-asbestos friction material technology is advancing rapidly. Several new asbestos-free car, light truck, and heavy vehicle brake systems have been released for OEM applications in the past 3 years. More new vehicle brake systems will be released with non-asbestos friction materials for the 1988 model year.

Original equipment vehicle manufacturers in the United States and Europe are rapidly moving toward asbestos-free brake systems for all new cars, light trucks, and heavy trucks. Adequate non-asbestos friction material formulations presently are not available for all vehicle systems, but with present progress continuing, most new passenger cars should be equipped with totally non-asbestos frictional systems by 1991, and most light trucks and heavy trucks with S-cam brakes, by 1992. However, a few low-volume new vehicle applications may not have acceptable non-asbestos friction materials at that time. Heavy truck wedge brake blocks, medium truck drum brake linings and many off-road vehicle brake linings may not be developed in time for incorporation by 1992.

New classes of non-asbestos friction materials have unique compilations which may have new and unexpected failure mechanisms. In many cases, unique failure modes are revealed only through extensive vehicle testing.

(4) The substitution of unqualified non-asbestos friction materials in the aftermarket poses the largest potential safety issue.

A large number of older vehicles in the United States have brake systems designed with asbestos friction products. The use of different materials in place of proven asbestos materials could result in a loss of vehicle controllability during braking.

Currently, there are no required performance evaluation tests for aftermarket brake friction materials. In addition, most of the aftermarket non-asbestos material suppliers lack the facilities to evaluate their materials under dynamometer and vehicle braking test conditions.

Non-asbestos friction materials that have been developed to date have provided some new and unexpected failure modes and mechanisms due to their unique combinations of new raw materials and manufacturing processes. Mandating aftermarket non-asbestos friction materials for vehicles that were originally equipped with asbestos-based linings would lead to a potentially serious customer safety risk, unless stringent friction material qualification specification tests are included.

(5) The majority of the automobiles sold in the United States now are fitted with front disc brakes and rear drum brakes, and this trend will most likely continue for some time.

Non-asbestos drum brake materials for automobile drum brakes have been difficult to qualify in the past. For this reason , several European automakers use 4-wheel disc brakes in conjunction with semi-metallic pad materials as a means of eliminating asbestos. Because of differences between qualification standards and driver preference in the United States and Europe, American and Japanese automakers are utilizing rear drum brakes. Suitable non-asbestos materials are not available for all of these applications, and industry-wide substitution of non-asbestos materials in all existing brake designs would require considerable development. It is unrealistic to assume that all automakers will redesign all passenger car and truck braking systems around disc brakes in order to utilize semimetallic materials.

(6) Industry gave mixed response to the proposed EPA action.

Numerous automobile, truck, and friction material manufacturers responded with written comments to the Federal Register announcement of the proposed EPA action. While most of the automobile and truck manufacturers were optimistic about the future availability of asbestos-free materials, they were unanimous in their opposition to a proposed phase-down schedule in which the amount of allowable asbestos would be phased out over a 10-year period. Instead, they favored a 5-year lead time prior to any ban. In addition, they were unanimously opposed to banning asbestos materials for older aftermarket vehicles. Although suitable substitutes have been found for automobile front disc brakes, material qualification for rear automobile drum brakes and medium truck drum brakes is still in progress.

Friction product manufacturers gave mixed response to the issues. One manufacturer indicated that for many applications, suitable substitutes are available, although for many vehicle applications no qualified materials exist. Another manufacturer indicated that suitable substitutes were produced by their company, although no FMVSS 105 or FMVSS 121 qualification capabilities existed at their facility.

Recommended Future Work

vehicles

Industry trends for the next 5 years appear to be directed toward the elimination of asbestos in all new passenger cars. For these applications, the use qualified non-asbestos friction materials may not present a vehicle safety problem over the life of the friction product. However, the use of unqualified non-asbestos materials for the aftermarket still remains a safety issue. If the eventual elimination of all asbestos in friction products is to be accomplished, additional future studies are required. Several possible research tasks are briefly outlined in the following sections.

Task 1: Determine Populations of Aftermarket Vehicle Classes and Brake System Designs in the United States

The purpose of this task would be to determine and project, over the next 10 years, the general classes of brake designs found on older vehicles (passenger cars and light trucks, medium trucks, and heavy trucks) that will require aftermarket friction materials. For example, it would be useful to determine how many passenger cars in the 3000-3500 lb weight range are fitted with duo-servo drum brake and how many utilize leading-trailing drum brakes. In addition, the population of vehicles having 4-wheel drum-brakes as opposed to rear wheel drum-front wheel disc brakes could be determined. Thus, vehicle populations would be assessed with respect to weight range, brake design, and front-to-rear braking balance.

This information would help the EPA to determine where the qualification of non-asbestos friction materials for the aftermarket would have the greatest impact on asbestos elimination. For example, if the results indicate that 80 percent of the passenger vehicles using asbestos materials are fitted with duo-servo rear drum brakes and front disc brakes, and are within the 3300-3800 lbs weight range, then the requalification of non-asbestos materials for these vehicles would have the greatest impact on asbestos elimination.

Task 2. Conduct Dynamometer and Vehicle Qualification Tests on Non-Asbestos Materials Using Representative Vehicles

The purpose of this task would be to determine whether current non-asbestos materials could be safely used in aftermarket vehicles designed for use with asbestos friction products. This task would draw upon the results of Task 1 by limiting the vehicle studies to these vehicles known to represent the majority of vehicles now in service. In this way, the study could be conducted in a more cost-effective manner.

This experimental study would use dynamometer and vehicle tests to determine friction product effectiveness under vehicle service conditions. The ability of brake systems and friction materials to satisfy Federal motor vehicle safety standards would also be assessed.

This second task would determine (1) whether safe effective substitute materials are available for some aftermarket applications and (2) what range of effectiveness currently exists among suppliers of aftermarket non-asbestos materials.