

January 31, 1973

PLAINTIFF'S EXHIBIT

FD-739

AO4 VEHICLE SAFETYFriction Materials (R-120 R)1. 1975 Disc Brake Lining Development

The test data for our experimental organic linings which were given the FMVSS 105 test on a disc/drum Lincoln vehicle have now been reviewed. Our linings were inadequate in that high fluid displacement resulted in the brake pedal reaching the floorboard on some high speed, high energy stops. Despite this deficiency, our lining was stated to be the best balanced with regard to effectiveness for disc/drum brake systems of all linings tested to date. Most of the Federal braking requirements were met in this first car test. The fluid displacement problem was due to lining compressibility rather than lining wear. Processing changes have been effected since the vehicle test which reduce fluid displacement by over 20%. Optimal processing conditions should reduce fluid displacement another 10% to assure adequate brake pedal reserve.

In addition to the promising lining results, the vehicle tests established that a single station brake dynamometer can be used to predict vehicle braking performance for high torque stops. Prior to the vehicle test, our dynamometer tests had indicated that our lining would provide a good match with the Lincoln rear drum brake, but it appeared marginal in fluid displacement properties.

Personnel: Anderson, Johnson

Weintraub (Chemical Engineering Department)

2. Brake Lining QC Procedure

We were requested by Car Engineering to evaluate an IBM System 7 computer that Bendix Corp. has installed for automatic data reduction of brake lining PGC pyrograms and to determine if the system is adaptable to the current brake lining specifications. The computer program, developed jointly by Bendix and IBM, essentially duplicates the specified manual-disc integrator procedure. Specific

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program details were not made available, however, it appears that the program is equivalent to the one developed by our staff (AR 69-4). Comparison of the data obtained from the System 7 and from the disc integrator shows they are in good agreement. Suggestions were made to Bendix to resolve some minor PGC peak definition difficulties with the System 7 program. Recommendations as to incorporating this system into the brake lining Q.C. specifications will be furnished to Car Engineering.

Personnel: Weintraub (Chemical Engineering Department)

3. Wet Clutches

A theoretical analysis of the effects of surface roughness on the squeeze film behavior between two parallel annular discs has been performed. The analysis is based upon a stochastic theory of hydrodynamic lubrication. Preliminary results show that, if the density function of the stochastic film thickness variable is non-symmetric, the presence of the surface roughness reduces load capacity, and squeeze time to some finite value, in agreement with experimental results by D. F. Moore. The analysis has also been extended to consider that one of the discs has a porous facing. Since the parameters related to surface roughness and permeability always appear together in the derived pressure, load and squeeze time-film thickness relations, it was concluded that the effects of surface roughness and permeability on annular disc squeeze film behavior are similar. Numerical results are being obtained. Unsteady motion of the disc and deformation of the porous facing material will be considered in future clutch analyses.

Personnel: Ting

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