PLAINTIFF'S EXHIBIT
FD-734

AOV VEHICLE SAFETY

Friction Materials (R-190 F)

1. Disc Brake Lining Development

No progress was made in this program during June due to other commitments.

2. Support to Divisions

A. Rear Brake Drum Lining Wear/Effectiveness

Several 10" and 11" rear brake vehicles at the Michigan Proving Ground (MPG) have exhibited an excessively high rear effectiveness and/or premature lining wearout during general durability testing. We were asked to determine the probable cause of failure. Dye impregnants showed the failed drums to have thermal rupture cracks in the central rubbing path. These cracks are generated during cooling after high energy stops. Rapid surface heating of the drum can cause compressive yielding of the surface material in the circumferential direction. Upon temperature stabilization the surface then is in tension and may develop axial cracks. The input power density to cause these cracks was calculated and found to exceed any scheduled brake input on the Romeo test circuit. However, some drivers were believed to apply the brakes at 90 MPH in a portion of the test circuit where a closed throttle coast to 60 MPH is specified. This would produce drum stresses which theoretically should crack the drum surface. Dynamometer tests were performed which confirmed that the problem would not result during the scheduled MPG sequence. Five stops from 90 MPH at 15 fps^2 did crack the drums. Once cracked, the drum brake effectiveness increases which in turn produces excessive temperatures, greater work input, and excessive lining wear.

Personnel: Anderson, Johnson

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B. Vendor Visitations

Two brake lining sources, Thiokol and Bendix (Troy, N.Y.), were visited to confirm compliance with our production and Q. C. requirements.

The most recent shipment of asbestos at Thiokol appears to be high in magnetite and other impurities. A sample was taken for our examination. Since asbestos is the major "natural product" used in brake linings and since all our asbestos comes from the same area of Canada, a change of raw material quality could have serious consequences for all of our friction materials.

Initial approval was given Bendix to use the IBM System 7 automatic data reduction method of PGC data reduction.

Personnel: Johnson

Weintraub (Chemical Engineering Department)

C. Overseas Brake Lining Q. C.

At the request of Overseas Engineering, we are assisting Ford of Argentina in updating their quality control capabilities and have performed tests of their materials to provide a reference. Diagnostics were performed to determine the cause of a rotor wear problem. Their FAST machine valve body was received for inspection, found to be defective, and repaired.

Personnel: Anderson

Weintraub (Chemical Engineering Department)

D. Automatic Transmission Diagnostics

Failed friction materials and used ATF from a Labeco dynamometer test (used for emissions certification testing) were submitted for testing to establish the cause of failure. The use of the automated dynamometer tests for 50,000 mile certification testing appears to have precipitated more frequent transmission failures in which the friction materials lose capacity. The Labeco test runs

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continuously and has less cooling than is obtained in vehicle use. Thus the transmission temperatures are both higher and more constant. Diagnostics are in progress.

Personnel: Anderson

Weintraub (Chemical Engineering Department)

3. Automatic Transmission Clunk Investigation

Work continues on the transmission "clunk" problem. Tests of an instrumented C-6 transmission are in progress to establish the causative factors and to determine the sound producing elements.

Personnel: Anderson, Johnson

A03 RELIABILITY AND DURABILITY

Wear (R-111 R)

1. Cast Iron Wear Program

Two wear tests were conducted on the Hohman wear machine with hardenable iron. In the first test, the load and speed were equivalent to normal valve spring load and engine idling speed, respectively, as seen by the camshaft and tappet. The test ran for only eight revolutions before the machine stalled due to high frictional forces. Both wear test surfaces were severely galled. For the second test, the load and speed were reduced by one order of magnitude and the specimens completed two hours of testing. Both wear test surfaces were coated with red iron oxide. The friction coefficient stabilized at about 1.0. These unlubricated results will be compared to the results of future tests on lubricated specimens simulating camshafts and tappets. A Honeywell visicorder, to be used with the Hohman machine, is being installed. This has caused a temporary delay in the wear test program. The installation is nearly completed and testing should resume by the end of June.

Personnel: Hall, Janotik

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