

APPENDIX A

SAMPLE COLLECTION

DYNAMOMETER ROOM PREPARATION

The normal brake cooling air was found to be more variant and higher in dust concentration than was the room air. Consequently, the supply air duct was removed and sealed. To reduce the background asbestos level to a minimum, the dynamometer room was thoroughly cleaned and vacuumed while maximum exhaust airflow was maintained. All potential sources of fiber emissions were removed from the room and asbestos handling was curtailed in adjacent rooms.

A production Pinto disc brake assembly was installed on the single station brake dynamometer, as shown on the schematic of Fig. 1. The major elements of the test setup may be seen in the photograph of Fig. 2. Cooling air was supplied from the room by means of a fan and diffuser screen. Containment of all possible airborne wear dust was assured by fitting a rectangular collector nozzle to the exhaust air duct, about 2 ft downstream of the brake. Metal panels were installed below and beside the brake to contain the cooling airflow further and to help provide a representative airflow over the brake, compared with vehicle service. System parameters were adjusted until the air velocity distribution matched closely with actual usage and the air flowing over the brake assembly was fully captured by the exhaust duct. This was confirmed using a smoke generator.

The exhaust duct throat was partitioned into a 4 × 7 array of roughly 3 in square grids (Fig. 3). The velocity profile within this grid was measured to provide mean values for each grid square.

SAMPLE FILTER PREPARATION

Microporous membrane filters with 0.45 μm pores were selected to assure high retention of asbestos fibrils and most of the wear dust powders. A matched pair of Gelman sampling pumps and 35 mm diameter holders were used. Thin metal

cones of 12 deg included angle were fabricated and sealed to the filter entrance. These cones increased the tip entrance velocity to that of the exhaust air duct so isokinetic sampling could be achieved. The cone tips were carefully matched in size. Flowmeters and differential pressure indicators were installed in the system to monitor the filter airflow during each test and to set the tip entrance velocity before each test.

Tests were performed on the unused filters to determine their weight change with variation of humidity. Filter weights were measured on a microbalance to the nearest 10 μg . Filters were placed in the center of the designated exhaust duct grid and at a fixed position upstream of the brake, but downstream of the diffuser screen. This latter (background) filter was located where the upstream air velocity equalled the average over the test grid. In this way the sampling was isokinetic with essentially equal volume flows through both filters.

TEST PROCEDURE

All brake stops were conducted from the same speed equivalent (40 mph, or 18 m/s) to maintain fixed airflow conditions. Burnish and "normal use" brake applications were at 0.25 "g" (2.45 m/s^2) deceleration and with a 2 min time interval. This provided a peak rotor temperature of 180°C (350°F). The number of brake applications was selected to provide about 1 g of lining wear per test.

Break-in wear was monitored for the first 82 stops. No sampling was performed for about 200 more brake applications, while the linings and rotor developed essentially steady-state conditions.

The "normal use" test was then performed on this burnished brake assembly. Twenty brake applications were made under the same conditions, with the test filter located sequentially at each of the 28 grid locations. The filter cone entrance velocity was adjusted to match the grid velocity at each relocation. Four grids were used to monitor exhaust velocity. Slight

Table A-1 - Test Data

Test	Break-in	Normal Use	High Temperature Use
Brake speed, rpm	535 (40 mph)	535 (40 mph)	535 (40 mph)
Brake decel, "g"	0.25 (2.45 m/s^2)	0.25 (2.45 m/s^2)	0.50 (4.9 m/s^2)
Wheel load, kg	257 (567 lb)	257 (567 lb)	257 (567 lb)
Brake applications	82	560	41
Total energy, kW-h	0.938 (1.25 hp-h)	6.405 (8.54 hp-h)	0.469 (0.625 hp-h)
Maximum apply temperature, °C	115 (240°F)	115 (240°F)	410 (770°F)
Total lining wear, g	1.10	1.60	1.07
Lining wear rate, g/kW-h	1.17 $\left(0.051 \frac{\text{in}^3}{\text{hp-h}}\right)$	0.25 $\left(0.011 \frac{\text{in}^3}{\text{hp-h}}\right)$	2.28 $\left(0.100 \frac{\text{in}^3}{\text{hp-h}}\right)$