

APPENDIX C

DATA REDUCTION

Table C-1 contains the pertinent test data and calculated results from the brake dynamometer tests.

ESTIMATION OF BRAKE LINING ASBESTOS DILUTION IN URBAN ATMOSPHERE

The concentration of asbestos fiber from the brake lining wear debris is assumed to be the same as was found in the "normal usage" dynamometer test and to be dispersed and have the same residence times as the lead emitted from the engine. Assume an average mileage of 15 mpg from cars which emit 75% of the lead to the atmosphere.

When gasoline averaged 2.52 g Pb/gal, the typical Pb concentrations in urban atmospheres were about 2 $\mu\text{g}/\text{m}^3$ (JAPCA, September 1969, Vol. 19, p. 684). Typical United States cars wear 202 g of lining/year and drive 10,000 miles/year. The "normal use" dynamometer tests provided asbestos fiber amounting to 0.0023% (2.3×10^{-5}) of the brake lining worn.

Allowing a factor of ten to provide an upper bound in this

determination, the asbestos concentration in urban atmospheres from brake wear should be less than

$$10 (2.3 \times 10^{-5}) \left(\frac{202 \text{ g}}{10,000 \text{ miles}} \right) \left[\frac{2 \mu\text{g Pb}/\text{m}^3 (15 \text{ mpg})}{2.52 \frac{\text{g Pb}}{\text{gal}} (0.75)} \right]$$

or 0.07 ng/m^3

Urban atmospheres vary in asbestos fiber concentration from city to city, within a city, and from one time to another. This variation does not correlate with expected automobile brake usage. The concentration has been reported to reach 100 ng/m^3 (2). Thus, it appears that the wear of brake lining produces, at most, a small fraction of the asbestos fiber in urban air. This is not surprising when one considers that brake lining wear involves only 1.5% of United States asbestos usage and that brake usage converts over 99.95% of this to nonfibrous dust.

Table C-1 - Test Data and Calculated Results from Brake Dynamometer Tests

Test Sample	Break-in		Normal Use		High Temp Use		Calculation Basis
	Test	Bkgrd	Test	Bkgrd	Test	Bkgrd	
1. Filter airflow, m^3	2.22	2.22	23.00	21.80	0.564	0.564	Measured
2. Filter pickup, mg	0.36	0.10	1.56	0.90	0.27	0.00	Measured
3. Filter asbestos concentration, ng/cm^2	15.32	1.06	7.98	4.64	5.37	0.12*	Measured
4. "Blank" asbestos concentration, ng/cm^2	0.33	0.33	0.33	0.33	0.33	0.33	Measured
5. Filter area, cm^2	9.62	9.62	9.62	9.62	9.62	9.62	Measured
6. Filter asbestos, ng	144.2	7.02	73.59	41.46	48.48	1.07*	[(3) - (4)] X (5)
7. Asbestos concentration in air, ng/m^3	64.95	3.16	3.19	1.90	85.96	1.90*	(6) $\div$ (1)
8. Lining asbestos in exhaust air, ng/m^3	61.8		1.29		84.1		$\Delta(7)$
9. Lining asbestos on filter, ng	137.2		29.7		47.4		(8) X (1)
10. Duct flow/filter flow	1235		1235		1235		From measure
11. Lining asbestos released, mg	0.169		0.0367		0.0586		(9) X (10)
12. Lining worn, mg	1100		1600		1070		Measured
13. Asbestos released as % of wear	0.015		0.0023		0.0055		(11) $\div$ (12) X 100
14. Lining dust on filter, mg	0.26**		0.61†		0.27**		$\Delta(2)$
15. Lining dust in air, mg	321		754		333		(10) X (14)
16. % asbestos in wear dust	0.053		0.0049		0.018		(11) $\div$ (15) X 100
17. Lining dust as % of wear	29**		47		31**		(15) $\div$ (12) X 100

*Value calculated based on "normal use" background, due to insufficient sample.

**Filter in one (central) location, and thus possibly nonrepresentative.

†Corrected for flow volume difference through test and background filters.