

EXPOSURE TO ASBESTOS DURING BRAKE MAINTENANCE*

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EXPOSURE DURING CAR SERVICING

THERE is little maintenance of passenger vehicle brakes involved at the manufacturers' premises, and therefore an investigation was carried out at the Service Bay of a Ford Main Dealer in the Greater London area. This Dealer normally services 10-20 cars per day, but blowing-out of brake shoes and drums is not included in all routine services. It is the blowing-out procedure which is the subject of the study.

Air sampling was carried out using membrane filters, the sampling and subsequent assessment being in accordance with the technique described in the *Hygiene Standard for Chrysotile Asbestos Dust*, published by the British Occupational Hygiene Society (1968).

Static samples were taken by the side of the car (Fig. 1) and composite samples were also taken in the dust-cloud during the blowing-out procedure, continuing by the side of the car for the remainder of the sampling period. Normally the mechanic takes care to blow the dust away from himself, so this sampling procedure should over-estimate exposure. Two sampling periods of 45 minutes were used, and during the first period one Cortina Estate and one Anglia Van received brake blow-outs, and during the second period one Cortina car was dealt with. The results are shown in Table 1.

TABLE 1. ATMOSPHERE SAMPLES DURING CAR BRAKE SERVICE

Location of samples	1st period	Fibres/cm ³	Time-weighted average
		2nd period	
By car	1.12	1.42	1.25
Dust cloud then by car	1.71	3.62	2.55

An estimate of the daily exposure of the mechanic engaged on brake cleaning was obtained by a series of personal samples (Fig. 2), covering an entire workshift, during which brake servicing was carried out on 11 vehicles. The results are shown in Table 2.

*This paper was originally presented at a Conference on Exposure to Asbestos during Brake and Clutch Maintenance, held at Brentwood, Essex, March, 1969.

TABLE 2. PERSONAL SAMPLES DURING CAR BRAKE SERVICE

Sample	Concentration (fibres/cm ³)
1	0.63
2	1.12
3	0.21
4	0.96
5	0.38
6	0.79
Time-weighted average	0.68

EXPOSURE DURING TRUCK SERVICING

Maintenance of truck brakes involves a somewhat different type of operator exposure as the servicing is more complex, and therefore the number of vehicles dealt with is less. The larger size of wheels and drums, on the other hand, makes it difficult for the operator to avoid the dust cloud produced, and personal exposure could be higher than that during car maintenance. Further sampling was therefore carried out in a large fleet workshop with equipment similar to that used for the passenger car tests.

Static samples, each of approximately 3 hr duration, were collected during the morning and afternoon periods at three positions; at the bay adjacent to the one at which brake cleaning was carried out, at the next bay, and in the centre of the garage.

Brakes were blown out during the morning, but not during the afternoon. The results are given in Table 3.

TABLE 3. GENERAL ATMOSPHERE SAMPLES DURING TRUCK BRAKE SERVICE

Location of sample		Concentration (fibres/cm ³)
Adjacent bay	Morning	0.28
	Afternoon	0.07
2 Bays away	Morning	0.17
	Afternoon	0.07
Centre of garage	Morning	0.49
	Afternoon	0.11

Personal samples were obtained from two men—the man engaged on brake cleaning, and the man engaged on clutch repair work at the adjacent bay. The first period of 1.5-2 hr included the period of brake cleaning, and the second period of approximately 5 hr represented the remainder of the shift. The results are shown in Table 4.

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FIG. 1. Static sampler by side of car.

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FIG. 2. Personal sampler.

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TABLE 4. PERSONAL SAMPLES—TRUCK BRAKE SERVICE

Operator	Concentration (fibres/cm ³)
Brake cleaner	
during cleaning	7.09
after cleaning	0.08
Time-weighted average	1.75
Clutch repair—adjacent bay	
during cleaning	2.25
after cleaning	0.11
Time-weighted average	0.79

SIGNIFICANCE OF EXPOSURE LEVELS

The Hygiene Standard suggests that exposure should not exceed an accumulated level of 100 fibre-years/cm³. On this basis, a man exposed for the whole of his working lifetime of 50 years, should not be exposed to concentrations exceeding 2 fibres/cm³. While an exposure to asbestos of this length is somewhat improbable in the case of motor mechanics, nevertheless the results have been interpreted against this value, and the findings are summarized as follows:

Car servicing

While the standard may be exceeded in the dust cloud during actual brake cleaning, the personal exposure of the operator studied was well below the standard.

Truck servicing

The standard is not exceeded during brake cleaning in the general atmosphere away from the immediate vicinity of the operation, but personal exposures in the vicinity do exceed the standard. On a daily basis, the personal exposure levels are below the standard, although that of the brake cleaner approaches it.

It should be noted, however, that in a fleet workshop, brake cleaning operations do not necessarily take place daily.

THE NATURE OF AIR-BORNE DUST

Brake lining materials contain 40–60 per cent of asbestos, and it was somewhat surprising to find that particles of a fibrous nature were scarce in the air samples collected. In a laboratory investigation, specimens of dust were obtained by filing brake lining material, and after sieving through a 200-mesh sieve, these were examined microscopically before and after incineration. Samples of dust were collected from brake drums during car servicing and examined in similar manner.

The results of the examination were expressed as the percentage of particles which were fibrous in nature, and are compared in Table 5, together with a result from an incinerated thermal precipitator sample obtained during brake cleaning.

TABLE 5. ASSESSMENT OF FIBROUS FRACTIONS OF DUST SAMPLES

Sample	Percentage of particles seen to be fibrous	
	Sample not incinerated	Sample incinerated
Brake lining material	28	12.3
Brake drum dust	0.6	1.6
Air-borne dust	—	1.3

It is clearly shown that the percentage of fibres in the drum dust and airborne dust is much lower than that in the dust formed from the original lining material.

Samples of drum dust were examined by Dr S. Holmes, and his tests showed that chrysotile was present only in trace quantities, or at most at 1 per cent, compared with the original lining content of 40-60 per cent. These findings suggest that there is a change in the physical and/or chemical form of the asbestos during its use as a brake material.

Enquiries were made of research workers in the UK and USA as to whether they had observed a similar effect. LYNCH (1968) reported that tests on brake testing dynamometers had shown the presence of few or no fibres in the dust produced from bus and automobile brakes, except under severe braking conditions. In the latter instance, the brake temperature reached 320-370°C, compared with the design maximum temperature of 290-320°C, and it appeared that, under these conditions, the binder decomposed and released part of the asbestos as free fibre. At lower bulk lining temperatures within the normal operating range, the binder behind the surface remains intact. However, the spot temperature at the point of contact between the lining and the drum may be higher than the decomposition temperature of asbestos. The decomposition product, therefore, includes not free asbestos fibres but a different mineral, resulting from thermal metamorphosis.

HOLMES (1967) in reporting the analyses described earlier in this paper, commented that the normal thermal decomposition product of chrysotile is forsterite, a non-fibrous crystalline magnesium silicate. However, our samples of brake drum dust contained very little forsterite, but rather were mainly comprised of an amorphous magnesium silicate, which is non-fibrous. Little was known at that time about the structure and composition of this substance. Whilst there was no evidence to suggest that the material was a health hazard, this possibility could not be dismissed, and animal experimentation has been commenced in the U.S.A.

CONCLUSIONS

Our investigations show that exposure to asbestos during brake maintenance is not as severe as was anticipated, and in the situations we examined, the personal exposure of the operators was below the limit corresponding to 50-year exposure.

It is however recommended that care should be exercised during brake cleaning to avoid inhalation of the dust produced, and the development of cleaning procedures which would reduce air contamination is desirable. The present trend towards the

introduction of "flow-line" servicing at Dealers works, in which one individual may be engaged almost entirely on brake servicing, emphasises this point.

Our environmental studies have not included maintenance procedures which involve the filing or grinding of brake lining material, and we would envisage that these would give rise to considerably increased air contamination by chrysotile asbestos, with the attendant need for strict precautions to prevent the inhalation of fibres.

REFERENCES

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