Report 41/68

Exposure to Asbestos during the Servicing of Brakes of Passenger Cars

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Dr D E Hickish - 1/163
Industrial Hygiene
Specialist

I INTRODUCTION

This investigation was undertaken in view of the increased national concern regarding exposure to asbestos, and of the impending revision of the Asbestos Regulations of the Ministry of Labour.

One of the operations within the motor industry which could involve exposure to asbestos dust is the cleaning of brake drums and clutch assemblies, normally carried out during routine servicing by "blowing-out" with compressed air jets.

The brake linings in current use may contain 40 to 60% asbestos when manufactured - the asbestos being normally in the chrysotile form, and occasionally in the amosite form. Crocidolite asbestos is said not to be used.

II FIELD INVESTIGATION

It was considered that any hazard to health from exposure to brake-drum or clutch dust would be more widespread within the Dealer Repair Organisation than within Ford of Britain, so the initial investigation was carried out at a large Main Dealer service bay. At this garage, the number of cars per day given a routine service varies between 10 and 20, but not all servicing involves brake cleaning.

Air sampling was carried out initially on two occasions, A and B, using thermal precipitators (T.Ps) as the sampling instruments. On the second occasion, samples were also collected on membrane filters. This latter technique has been developed in recent years, and is likely to become the preferred method of sampling for asbestos in Great Britain and the U.S.A.

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In each case, measurements were made:

(a) By the side of cars being given a service which included brake cleaning, and

(b) In the dust-cloud during brake cleaning, and then near to the car for the remainder of the service period.

As the mechanic normally blows the dust away from himself, the sampler at (b) would be exposed during "blow-off" to dust concentrations greater than those actually pertaining at the breathing zone. It was considered, however, that to sample in this way would provide an additional factor of safety. Details of the sampling are given in Table 1.

A further period of air sampling, C, was carried out, when membrane filter samples were collected from the breathing zone of the brake-clean operative, by means of a personal sampler, with suitably modified flow rate (approx. 250 cc/min.). The sampling covered an entire work shift, during which brake blow-out was carried out on the following vehicles:

5 Corsairs
1 Zodiac
4 Cortinas
1 Prefect

The thermal precipitator slides were subsequently incinerated and examined by micro-projection using a 4 mm objective and X.17 eyepiece. The membrane filter samples were rendered translucent by the addition of triacetin, and examined in a similar manner. Phase contrast microscopy was not used.

The results of the T.P. counts for occasions A and B are given in Table 2, and for the membrane counts on the

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occasions B and C in Table 3. The counts are expressed in terms of particles with diameter greater than 1μ, and of fibres (i.e. particles with aspect ratio greater than 3:1 and length greater than 5μ).

III LABORATORY INVESTIGATION

In view of the relatively few fibres present in the air samples, a laboratory investigation was undertaken, comprising microscopic examination of samples from brake lining material (which was filed to produce dust) and brake drum dust (collected by spatula from brake drums immediately prior to blowing-out). The samples were sieved through 200-mesh screens and then examined before and after incineration.

The results are shown as fibre proportions in Table 4.

Samples of material collected from the brake drums of (a) an Anglia van, (b) a Mark II Cortina, and (c) an Anglia car were analysed by Dr S Holmes of Messrs. Turner Brothers Asbestos Co.Ltd., and his findings are shown in Table 5.

IV DISCUSSION OF RESULTS

(a) Standards of dustiness

In June 1968, the British Occupational Hygiene Society published a Hygiene Standard for Chrysotile Asbestos Dust, which suggested that in order to reduce the risk of contracting asbestosis to 1% of those with a lifetime's exposure to the dust, the accumulated exposure should not exceed 100 fibre-years/cc, i.e. 2 fibres/cc for 50 years, or 4 fibres/cc for 25 years. In this standard, fibres are

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defined as those exceeding 5μ in length, as determined by the membrane filter method.

Categories of dustiness are designated as follows:

Dust Category	Concentration averaged over 3 months (Fibres/cm^3)
Negligible	0 - 0.4
Low	0.5 - 1.9
Medium	2.0 - 10.0
High	Over 10.0

As an alternative index, a thermal precipitator count of 25 particles/cc greater than 1μ after incineration is regarded as equivalent to 2 fibres/cc by membrane filter count.

While it is considered unlikely that a mechanic will be engaged on brake cleaning for a working lifetime of up to 50 years, an additional factor of safety should be provided if a Threshold Limit Value (TLV) of 2 fibres/cc, i.e. corresponding to this length of exposure, is adopted in considering the results of the present air sampling.

(b) Field investigation

The thermal precipitator particle counts are in excess of the alternative TLV of 25 particles/cc. but these counts would include many non-asbestos particles - road dust etc., whereas the TLV was determined from counts within asbestos factories. The fibre counts by thermal precipitator are lower than those obtained by membrane filter.

Membrane filter counts show a concentration in the general atmosphere below the TLV, except when the sampler is placed in the dust cloud during blow-out. The personal

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exposure is shown to be at a level of 1/3 of the TLV, and corresponds to a "low" dust category.

(c) Laboratory investigation

It is, at first sight, surprising that the exposure to asbestos is as low as found, in view of the quantity of asbestos present in the original material of the brake linings.

Comparison of the fibre proportions in brake lining material and brake drum or air-borne dust (Table 4) shows that in the latter, the percentage of fibres is greatly reduced. The analyses of the brake drum dust samples confirm a very low asbestos content. These findings suggest that during usage, the material undergoes changes in physical and/or chemical form.

Enquiries from research workers in UK and USA indicate that this is a finding which has been observed elsewhere, and current thought is that during braking, high point contact temperatures are reached. As a result, thermal decomposition of chrysotile asbestos takes place, producing an amorphous, non-fibrous magnesium silicate. Under very extreme operating conditions, the binder may decompose and release part of the asbestos as free fibre, but such circumstances would be most unusual.

(d) Conclusions

On the environmental and analytical evidence obtained, it does not appear that a significant hazard to health should occur during brake drum blow-out in a typical Dealer Passenger Car Repair Shop. It would be helpful, however, for

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clinical examinations to be made of some repair mechanics with long experience of brake cleaning to confirm this view.

It would also be desirable to include in Service manuals, a general instruction that inhalation of dust during brake cleaning should be minimised, and if practical alternative methods, which would produce less dust, can be devised, their use should be recommended.

The present investigation has been confined to servicing of passenger cars, and a further study of heavy vehicle servicing is under consideration.

Table 1. Details of air sampling

Sample No.	Type	Location	Duration mins. (approx)	Activity during sample period
Day A				
A1	T.P.*	(a) Static by car	30	1 Cortina
A2	"	(b) Dust cloud, then static	30	1 Cortina
A3	"	(b) " " " "	45	1 Corsair
A4	"	(a) Static, by car	45	1 Corsair
A5	"	(b) Dust cloud, then static	35	1 Corsair
A6	"	(a) Static, by car	30	1 Corsair
Day B				
B1	T.P.	(a) Static, by car	45	1 Cortina Estate
B2	M.≠		45	1 Anglia Van
B3	T.P.	(b) Dust cloud, then static	45	1 Cortina Estate
B4	M.		45	1 Anglia Van
B5	T.P.	(a) Static, by car	35	1 New Cortina
B6	M.		35	
B7	T.P.	(b) Dust cloud, then static	35	1 New Cortina
B8	M.		35	
Day C				
C1	M.	Personal sample	60	1 Corsair
C2	"	" "	56	1 Corsair, 1 Zodiac
C3	"	" "	59	None
C4	"	" "	56	1 Cortina, 2 Corsairs
C5	"	" "	60	1 Cortina, 1 Prefect (part)
C6	"	" "	64	1 Prefect (contd.)
C7	"	" "	70	2 Cortinas, 1 Corsair

* T.P. Thermal Precipitator ≠ Membrane

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Table 2. Results of Thermal Precipitator Samples

Sample No.	Sample details	Sample time mins.	Dust concentration Particles/cc (>1μ)	Dust concentration Fibres/cc (>5μ)
	(a) Static - by car			
A1		30	99	2
A4		45	134	1
A6		30	62	2
	Time-weighted average		103	1.57
B1		45	124	0.5
B5		35	102	0
	Time-weighted average		115	0.28
	(b) In dust cloud, then static			
A2		30	71	3
A3		45	141	2
A5		35	92	0
	Time-weighted average		106	1.64
B3		45	103	0.5
B7		35	181	0.2
	Time-weighted average		137	0.37

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Table 3. Results of Membrane Filter Counts

Sample	Details	Sample time mins.	Fibres/cc.
I. General atmosphere samples			
	(a) Static by car		
B2		45	1.12
B6		35	1.42
	Time-weighted average		1.25
	(b) In dust cloud, then static		
B4		45	1.71
B8		35	3.62
	Time-weighted average		2.55
II. Personal samples			
C1		60	0.63
C2		56	1.12
C3		59	0.21
C4		56	0.96
C5	Sample lost		
C6		64	0.38
C7		70	0.79
	Time-weighted average		0.68

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Table 4. Fibres - as percentage of total particles observed

Sample	Fibre proportion - %	
	Un-Incinerated	Incinerated
Brake lining material	28	12.3
Brake drum dust	0.6	1.6
Air-borne dust	-	1.3

Table 5. Analysis of Brake drum dust

Sample	Electron diffraction microscopy	X-ray diffraction (normal specimen)	X-ray diffraction (extracted specimen)
1.Anglia Van	Chrysotile present	Iron & quartz present. No chrysotile detected.	Less than 5% chrysotile, possibly 0.1% to 1%.
2.Cortina Mk.II	"	"	Less than specimen 1.
3.Anglia car	"	"	As specimen 1.

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