INDUSTRIAL HYGIENE SURVEY REPORT

OF THE

NEW YORK CITY SANITATION, TRAFFIC, AND POLICE
BRAKE SERVICING FACILITIES
QUEENS, NEW YORK

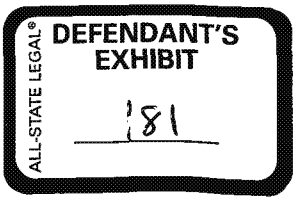
SURVEY CONDUCTED BY:
Dennis R. Roberts
Ralph D. Zumwalde

DATE OF SURVEY:
January 9-11, 1979

REPORT WRITTEN BY:
Dennis R. Roberts

DATE OF REPORT:
May 12, 1980

Industrial Hygiene Section
Industry-wide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio



DISCLAIMER

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

ABSTRACT

Detailed airborne dust sampling surveys were conducted at the New York City Sanitation, Traffic, and Police Brake Servicing Facilities in Queens in January 1979. Personal breathing zone, general area, high-volume general area, and bulk brake dust samples were collected. The results of the airborne samples collected in the breathing zone of workers indicated exposure concentrations which ranged from 0.08 to 0.44 fibers greater than 5 μm in length per cc. The high-volume general area air samples indicated that trace metal concentrations were below current OSHA standards and NIOSH recommended standards.

PURPOSE OF SURVEY:	To characterize dust exposures resulting from vehicle brake maintenance and repair operations while taking into account work practices utilized. This survey is part of the study to evaluate health effects of exposure to asbestos-containing dusts in brakelining maintenance and repair.
EMPLOYER REPRESENTATIVES CONTACTED:	Chief Fishman New York City Department of Sanitation (212) 476-7079 Frank Zimmer New York City Department of Transportation Jim Sherman New York City Police Department
EMPLOYEE REPRESENTATIVE CONTACTED:	John Venios, President SEIU-AFL-CIO New York City Local 246 (212) 233-0616
STANDARD INDUSTRIAL CLASSIFICATION OF PLANT:	7539

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) is required under Section 20(a)7 of the Occupational Safety and Health Act of 1970 to conduct and publish industry-wide studies of the effect of chronic or low level exposure to industrial materials, processes, and stresses on the potential for illness, disease, or loss of functional capacity in aging adults.[1]

An estimated work force of 900,000 brake mechanics and garage workers in the U.S. is potentially exposed to asbestos.[2] Therefore, NIOSH is currently conducting an industry-wide study to evaluate occupational exposures resulting from brake servicing operations. As part of this study a contract has been let to conduct both a feasibility study to locate a cohort of brake lining repair and maintenance workers with sufficient latency to conduct a retrospective mortality study, as well as a cross-sectional medical study to define the current health status of workers occupationally exposed to brake lining dusts. To supplement the cross-sectional medical study, NIOSH is undertaking industrial hygiene assessments at a number of brake lining facilities to document current exposures and work practices and to ascertain the magnitude of past exposures.

DESCRIPTION OF FACILITIES AND WORK FORCE

The three facilities occupied by the Sanitation, Traffic, and Police Departments are operated solely for the periodic maintenance and repair of municipally owned vehicles. The operations are funded and regulated by the City of New York and all employees are part of the New York City Civil Service structure. The workers are represented by the Service Employees International Union (SEIU-AFL-CIO) Local 246 and District Council 37.

DEPARTMENT OF SANITATION CENTRAL REPAIR STATION

The four story building that is presently occupied by the Department of Sanitation Central Repair Station measures approximately 300 feet by 200 feet and has been in use since 1967. From 1914 to 1967 the repair station was located in Manhattan. The present facility has about 400 employees and is comprised of many large shop areas that, overall have the capacity to completely renew any vehicle in the Sanitation Department. Of the employees 35-40 are clerical with the remainder distributed throughout the various shops.

DEPARTMENT OF TRANSPORTATION

The Department of Transportation Central Repair facility is currently located in a one-story building (250 feet by 300 feet) of which approximately 3000 square feet of the shop space is for brake repair. The remaining space is for sign painting, storage, and other minor repairs. This facility has been utilized since 1963; prior to that time it was located on Pearl Street in Manhattan. There are about 175 employees in the entire building; 16 of the employees are in the brake repair shop with five of those directly involved with brake servicing.

POLICE DEPARTMENT CENTRAL REPAIR STATION

The Police Department Central Repair facility is presently located in a one-story building measuring approximately 300 feet by 300 feet. This building has been in use since 1970; prior to that time the facility was located at Avenue C and 16th Street in Manhattan. The present facility is comprised of various maintenance shops in which there are 150 employees; 60 of these are auto mechanics which periodically perform brake maintenance as one of their responsibilities.

DESCRIPTION OF PROCESS

Sanitation Department

At the Sanitation Department Central Repair Station there are three mechanics that specialize in brake and clutch service and three employees that operate a separate Brake Repair Shop specializing in brake shoe and drum reconditioning. The brake mechanics service all the vehicles operated by the Sanitation Department. This consists of waste collection, dump and light trucks, autos, and some 2- and 3- wheeled vehicles. The brake service procedure followed by the mechanics is basically as follows. The vehicle is jacked up, the wheels are removed, and then the brake drums are inspected. The brake wear dust from the brake drums is allowed to fall out on the floor. The brake shoe dust is removed from the brake shoe assembly and backing plate with a water squirt bottle and then dried with a rag. The brake shoe assembly is then removed and placed in a vice where it is disassembled. The brake drum and assembly parts (springs, clips, etc.) are inspected, and if necesary, the drum is sent to the Brake Repair Shop to be turned down. If required, worn out parts are replaced with new ones obtained from the parts department. The replacement shoes and parts are assembled on the work bench and then installed on the backing plate of the brakehousing. The brake drum and wheel are replaced and the brakes are adjusted.

The Brake Repair Shop receives the worn shoes and drums and reconditions them by the following procedures. The brake drum lining is turned down and the worn asbestos brake shoes are stripped from the metal holding plates. This stripping process is accomplished by sandblasting the brake shoe holding plate. There are about ten brake jobs performed per week of which 50% are autos, 30% trucks, and 20% 2- and 3-wheeled vehicles. The job performed during the survey was on a waste collection truck.

Department of Transportation

At the Department of Transportation there is an average of one brake service job per day, taking about five hours per job, with most of the vehicles consisting of cars or light trucks. There are five employees involved in brake servicing. In this process the car is jacked up, wheels removed, and the brake drums disassembled with the dust in the brake drums allowed to fall out on the floor. The shoe lining and holding plates are removed and the backing plate is cleaned with a brush and gasoline to remove dust. The shoe lining and holding plates are replaced with prelined replacements and any other excessively worn parts are subsequently replaced. If necessary the brake drum linings are turned down on a lathe. Some brake shoe grinding is occasionally done on shoes that fit improperly, but this is minimal and was not performed on the day of the survey.

Police Department

At the Police Department facility an average of eight brake jobs per day are performed on cars and one on trucks. Brake maintenance is performed by any one of 60 auto mechanics. The brake servicing process consists of removing the drums and shoes, and then wiping the backing plate off with a dry brush. During servicing the dust is allowed to fall from the drums to the floor. The shoe lining and holding plates are replaced with prelined ones and any other worn parts are also replaced. If needed the brake drum linings are turned down on a lathe.

DESCRIPTION OF PAST EXPOSURES

Department of Sanitation

Until about two years ago, the brake shoe linings were routinely ground and beveled for contour fit by brake repair shop personnel; presized linings are used today and contouring is not done. The backing plate cleaning technique has not changed. There were approximately twelve clutch repair jobs per month fifteen years ago, but the clutch jobs have been phased out to the point that only about two jobs per month are currently performed.

Department of Transportation

Compressed air blow-off of brake shoes and backing plates was used until about one year ago. There were about four clutch facing jobs per month fifteen years ago while today there is about one per month.

Police Department

Compressed air blow-off of shoes and backing plates was utilized until about five years ago. There was also some contour grinding done in the past and about fifteen years ago there were about ten clutch facings done per month whereas there are currently about two per month.

DESCRIPTION OF MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

There are pre-employment physical examinations including chest x-ray required for all New York City Civil Service employees. However, there are no follow-up health examinations given.

Department of Sanitation

A respirator program was started about four years ago at this facility, but NIOSH-approved respirators were not an option to brake repair personnel until about mid-1978. There is no program in effect for the fitting and maintenance of respirators. Safety glasses and gloves are available upon request. There is a first aid technician on duty. There are no eating or smoking restrictions in work areas.

Department of Transportation

NIOSH-approved respirators were made an option to employees a few months before the survey, but there is no program for fitting or maintenance of respirators. Safety glasses and gloves are available upon request. No employee is trained in first aid. There are no eating or smoking restrictions in work areas.

Police Department

NIOSH-approved respirators are available upon request, but there is no fitting or maintenance program in effect. Safety glasses and gloves are available, and there are no eating or smoking restrictions in work areas.

INSPECTION OF THE PLANT

Department of Sanitation

The housekeeping was generally very good. There were some general ventilation ducts in the brake service shop that did not operate and others with very low air flow velocities. However, there are current plans to install new ventilation systems in some areas. There is a potential exposure to asbestos fibers during hand sweep-up since dust allowed to fall on the floor from brake drums could become airborne.

A potential exposure to asbestos fibers exists in the cylinder head reconditioning area. In this operation, a worker scrapes the old asbestos gaskets from the heads prior to reconditioning.

Department of Transportation

The housekeeping at this facility was very good. All ventilation systems were operating and large garage doors are usually open year-round. There is a potential exposure to asbestos fibers during hand sweep-up since dust allowed to fall on the floor from brake drums could become airborne.

Police Department

The housekeeping was very good. However, a potential exposure to asbestos fibers exists during the operation of the floor sweeping machine. Since brake dust is allowed to fall to the floor from drums and shoes during clean-off, this material could become airborne during the sweeper operation.

DESCRIPTION OF SURVEY METHODS

Personal and general area samples were collected. Brake repair operations and adjacent areas were monitored to provide time-weighted average and peak asbestos exposure data. Personal air samples were collected in the breathing zones of the brake mechanics and other shop personnel using Millipore type AA, 37 mm diameter, 0.8 micrometer (μm) pore size, membrane filters at a sampling flow rate of 2.0 liters per minute (lpm). The filters were changed periodically during the work shift to prevent overloading of the sampling media. Peak samples were collected using identical media and flow rate as above when workers were cleaning dust from brake assemblies. Analysis of the membrane filters for asbestos fibers was conducted in accordance with the procedures outlined by the Occupational Safety and Health Administration[3] and the NIOSH P&CAM #239.[4] These procedures entail the counting of fibers greater than 5 μm in length and with at least a 3 to 1 length to width ratio (aspect ratio) using phase contrast optical microscopy at a magnification of 400-450X. General area samples were collected for trace metals on Wattman 81 mm diameter membrane filters using Staplex high-volume air samplers at a sampling rate of 10 to 15 cubic feet of air per minute.

Personal samples collected at each facility were analyzed on a transmission electron microscope utilizing selected area electron diffraction (SAED) and energy dispersive X-ray analysis. Sample preparation and analysis were performed using the NIOSH method described in the Technical Report, "Review and Evaluation of Analytical Methods for Environmental Studies of Fibrous Particulate Exposure".[5] Samples were observed at 17,000X magnification with fibers ($\geq$ 3:1 aspect ratio) sized by length and diameter. SAED and energy dispersive x-ray analysis were attempted on all observed fibers for positive identification. High-volume airborne samples collected at each facility were analyzed for trace metals (lead, iron, zinc, chromium, copper, and manganese) by atomic absorption spectrophotometry in accordance with the NIOSH Manual of Analytical Methods, Volumes 1 and 3.[4,6]

RESULTS

Sanitation Department (Facility A)

There was only one brake repair job undertaken on the day of the survey at this facility. This job was on the rear wheels of a waste collection truck and was interrupted before completion in order to correct another mechanical problem that could only be repaired with the braking assembly removed. Therefore, two personal samples were taken on the brake repair mechanic, one during performance of brake work, and another after termination of brake repair. As shown in Table 1 the fibrous dust concentration found on the sample taken during actual brake work was 0.33 fibers greater than 5 µm in length per cubic centimeter of air sampled (fiber/cc) while only 0.12 fibers/cc were found on the sample taken for the remainder of the work shift. A time-weighted average (TWA) exposure of 0.21 fibers/cc was found for the total sampling time of the brake mechanic. A peak sample taken on the brake repair mechanic during the cleaning of brake dust from the brake shoe assembly and backing plate with water showed a concentration of 0.54 fibers/cc. A sample collected on a worker in the relining department of the brake repair shop indicated a concentration of 0.13 fibers/cc. Two general area samples positioned about seven feet from the brake service area were 0.06 and 0.08 fibers/cc.

Transportation Department (Facility B)

As shown in Table 2, the TWA fibrous dust concentrations for personal samples taken on three brake mechanics were 0.23, 0.28, and 0.24 fibers/cc, respectively. Also shown in Table 2 are the concentrations found from peak samples collected during the process of wet brushing brake wear dust from the brake assembly backing plate with gasoline. These concentrations were 2.62, 2.22, 0.87 and 0.67 fibers/cc. General area samples taken at two locations from six to ten feet outside the work bays had concentrations of 0.07 and 0.06 fibers/cc and a sample taken inside the office was 0.06 fibers/cc.

Police Department (Facility C)

The results of sampling for airborne asbestos at this facility are shown in Table 3. The TWA exposure concentration of personal samples collected for the three brake mechanics were 0.20, 0.19, and 0.30 fibers/cc, respectively, and the TWA concentration for the mechanic's helper was 0.30 fibers/cc. Peak samples collected when the mechanic was dry-brushing brake dust from the brake housing backing plate had concentrations of 0.81 and 0.61 fibers/cc. General area samples that were positioned from six to ten feet from the brake servicing bays indicated fiber concentrations of 0.02, 0.07, and 0.03 fibers/cc.

Metal Analyses

Trace metal analyses were performed on the high-volume general area samples collected at each facility. As shown in Table 4 all of the trace metals were found in concentrations well below the current Occupational Safety and Health Administration[3] (OSHA) exposure standards and NIOSH recommended exposure standards.

Airborne Fiber Characterization

All samples except the high-volume general area samples were examined by transmission electron microscopy (TEM). All fibers observed on the samples were sized by length and diameter, and fiber concentrations determined for total fibers and fibers > 5 μm in length. These concentrations were compared to those found by the optical microscopy method and are reported in Table 5. There were only four samples in which fibers were observed by TEM; three of these four samples had fiber concentrations somewhat lower than those observed by phase contrast optical microscopy. This difference and the absence of fibers on many samples examined by TEM could be due to particulate loss during the preparation of samples for TEM. Other factors which may account for the difference found in sample comparisons include the much smaller total filter area that is observed under the high magnification of TEM, as compared to optical microscopy, and because of the small number of fibers actually deposited on each sample. Small differences in the number of fibers counted by both methods would produce significant differences in concentrations.

In addition to determining the concentrations for fibers > 5 μm in length, all fibers observed were counted and concentrations calculated. As would be expected, the greatest number of asbestos fibers observed by TEM were shorter than 5 μm in length (90%) with all fibers being considered potentially respirable since all diameters were less than 3.0 μm.

An attempt was made to identify all observed fibers utilizing selected area electron diffraction (SAED) and energy dispersive X-ray analysis (EDAX). Approximately 40-50% of the total fibers could not be positively identified as chrysotile asbestos. The analysis indicated that a small portion of the fibers had undergone a change in crystal structure with some fibers being converted to a non-asbestos mineral called forsterite.

CHARACTERIZATION OF BULK BRAKE DUST BY TEM

Samples of brake wear dust were collected from the brake drums of several vehicles that were being serviced. These samples were observed by TEM and identification was attempted on all fibers utilizing SAED and EDAX. Approximately 48% of the fibers analyzed by SAED could not be identified due to ambiguous or the absence of diffraction patterns. EDAX was performed on the fibers which could be analyzed by SAED to confirm chrysotile asbestos. This conformation was successful on 52% of observed fibers. Those fibers which revealed ambiguous or no SAED patterns were either too small for diffraction analysis or had undergone metamorphoses probably to forsterite or its intermediate forms; this change probably was a result of intense heat generated during braking. EDAX analysis of the elemental composition of these fibers appeared to confirm the intermediate mineral stages between chrysotile and forsterite.

DISCUSSION

Airborne asbestos sample results for all facilities appear to be within the current OSHA asbestos standard. This standard states:

> "The 8-hour time-weighted average (TWA) airborne concentration of asbestos fibers to which any employee may be exposed shall not exceed 2 fibers, longer than 5 micrometers in length, per cubic centimeter of air (fibers > 5 µm/cc). The ceiling airborne concentration to which no employee may be exposed shall not exceed 10 fibers > 5 µm/cc."

However, when the results are compared to the NIOSH recommended standard, in which the 8-hour TWA exposure to asbestos is 0.1 fibers >5 µm/cc with a ceiling exposure of 0.5 fibers > 5 µm/cc for any 15 minute sampling period, most of the exposures to brake servicing mechanics indicate concentrations which exceed these recommendations. Although most of the reported TWA exposures are based on sampling times less than eight hours (usually 6 to 7 hours), samples were collected for the duration of the performance of all types of brake repair operations, and there appears to be a consistent range of exposure for each given operation.

The range of exposure appears to be dependent upon the work practices utilized in servicing brakes, the actual time spent performing brake repairs, and the length of time spent in the brake repair bays.

The length of time spent during brake service has a considerable effect on the fibrous dust exposures to brake mechanics. This can be illustrated with the comparison of samples S-1 and S-3 of Facility A. Sample S-1 was taken on the brake mechanic during 136 minutes of actual brake service and showed a fibrous dust exposure concentration of 0.33 f/cc. Sample S-3 was taken on the same mechanic for 190 minutes in the same work area after brake service was

terminated and showed an exposure of only 0.12 f/cc. Another example can be shown with samples P-3 and P-8 of Facility C. Sample P-3 was taken on a brake mechanic for a period of 124 minutes during actual brake service and had a 0.34 f/cc concentration. Sample P-8 was taken on the same mechanic in the afternoon for 177 minutes during which most of the time was spent running errands outside the work bay and showed a fibrous dust concentration of only 0.08 f/cc. Further observation indicated that samples collected mostly outside the work bays (S-3 and P-8) are similar in fibrous concentration to general area samples that were collected to represent shop background exposure levels.

It can also be demonstrated that the amount of time spent in the service area affects exposure concentrations by comparing sample P-8 with samples P-2 and P-6 of Facility C. Samples P-2 and P-6 were collected on a mechanic's helper who did not perform brake service but spent most of the time in the work bay assisting the mechanic during the performance of brake work. Sample P-8 was taken on the mechanic during a period when little or no repair work was performed and whose time was mostly spent outside the service bay area. The exposure for sample P-8 was 0.08 fibers/cc while the TWA exposures for samples P-2 and P-6 were 0.30 fibers/cc. From these sample concentrations it can be concluded that the longer the period of time spent in the brake service area the greater the potential for a higher cumulative asbestos exposure. Further illustration of this can be made by comparing the sample concentrations (Table 1) found on personnel in the work bay who did not perform brake repair with those found on area samples collected at short distances outside the work bays.

This apparent difference in airborne fiber concentrations indicates that dust exposures drop off rapidly outside the work bay area. The rapid drop off is further supported by sample P-8 from Facility C. This sample was taken on the mechanic who was mostly outside the brake service area and showed a concentration of 0.08 fibers/cc which is similar to the levels found on the area samples. This rapid drop in fibrous dust levels was also demonstrated at Facility B where three brake mechanics who spent all of the work shift performing brake service and most of their time in the service bays had TWA exposures of 0.23, 0.28 and 0.24 fibers/cc. These exposures were higher than the area samples TG-4 and TG-6 (collected six and ten feet outside work bays) which had concentrations of 0.07 and 0.06 f/cc, respectively. The TWA exposures to the mechanics at Facilities A and C also support the previous statement that the length of time spent in actual brake service repair contributes to the exposure concentrations to fibrous dust.

The type of maintenance practice that is performed at any given stage of brake repair also affects the magnitude of the exposure concentration to the mechanic. For example, the airborne fiber concentrations found during any type of cleaning of brake wear dust from the brake housing backing plate was higher than the concentrations received

during other types of brake repair. As shown at Facility A the airborne fibrous dust peak concentrations during the backing plate clean-off (sample SP-1) was 0.54 f/cc. For Facility B samples TP-1, TP-2, TP-3 and TP-4 indicated concentrations of 2.62, 0.87, 0.67, and 2.22 f/cc, respectively during this type of cleaning practice. Likewise, Facility C samples PP-1 and PP-2 indicated concentrations of 0.81 and 0.61 f/cc, respectively.

Furthermore, the airborne concentration generated during the cleaning of the brake housing backing plate seems to be related to the technique employed for cleaning. The cleaning techniques utilized at the three facilities were squirt bottle (Facility A), wet brushing (Facility B), and dry brushing (Facility C). The squirt-off method (SP-1) indicated an airborne fiber concentration of 0.54 f/cc for a ten minute sampling period. The wet brush cleaning technique (TP-1, TP-2, TP-3, TP-4) indicated concentrations of 2.62, 0.87, 0.67 and 2.22 for sampling periods of 3, 9, 9, and 3 minutes respectively. Likewise, the dry brush method (PP-1, PP-2) indicated concentrations of 0.81 and 0.61 f/cc for 12 and 21 minute sampling periods. These results appear to indicate that the wet brush cleaning technique yields the highest airborne concentrations to airborne asbestos dust. However, a decrease in exposure concentrations with time was demonstrated on all peak samples and airborne fiber concentrations generated from wet, dry brush, and squirt bottle techniques decreased proportionally with the length of sampling time. If a common time factor is substituted for all peak samples collected during all three techniques than the highest potential exposure would be expected during dry brush cleaning and the lowest found during the water wash with a squirt bottle.

CONCLUSION

The results of this study suggest that airborne asbestos fiber concentrations vary depending upon the work practices utilized by the brake mechanic, the amount of time spent in actual brake servicing and the length of time spent in the service area. It is evident that peak exposures can be relatively high during the cleaning of brake shoes and/or the brake housing backing plate but that airborne exposures decrease significantly with time after the cleaning process. It was also evident that the higher dust exposures tend to be confined to the service bay areas and especially to the mechanic performing the brake work.

RECOMMENDATIONS

Based on the data from this and other studies demonstrating significant asbestos exposures during brake servicing operations, NIOSH has published interim procedures, "Recommended Procedures for Asbestos Brake and Clutch Servicing" to minimize asbestos dust exposures (Attachment 1). These recommended procedures are periodically updated as research data and engineering controls become available.

As the peak fiber exposure data from these surveys indicates, it would appear prudent that considerable emphasis be placed on reducing exposures during the cleaning of the brake housing and backing plates. This would best be accomplished by using an appropriate vacuum cleaning system to remove all the dust found in the brake housing. However, it has also been demonstrated in other industrial hygiene studies of brake mechanics that a properly implemented wet cleaning technique of the brake housing and backing plates can effectively reduce airborne fiber exposures. To further protect the health of the brake mechanics it would also be wise to initiate a personal respiratory protection program. This would include the wearing of approved NIOSH respirators for asbestos, a program for proper fitting, and a routine maintenance program for the cleaning and replacing of respirator filters. As the exposure data indicates it would only be necessary for mechanics to wear respirators while performing brake service.

REFERENCES

1. Williams-Steiger. Occupational Safety and Health Act of 1970, Public Law 91-596, 91st Congress, S.2193, December 29, 1970.

2. Rohl, A.N., Langer, A.M., Wolfe, M.S., and Weisman, I. "Asbestos Exposure During Brake Lining Maintenance and Repair."

3, U.S. Code of Federal Regulations, Title 29, Part 1910.1001. U.S. Department of Labor, Occupational Safety and Health Administration, Occupational Safety and Health Standards.

4. Taylor, D.G., (1977). NIOSH Manual of Analytical Methods. 2nd Edition, Volume 1, P&CAM No. 239, Publication No. 77-157-A.

5. Zumwalde, R.D., and Dement, J.M., (1977). Review and Evaluation of Analytical Methods for Environmental Studies of Fibrous Particulate Exposures. DHEW (NIOSH) Publication No. 77-204.

6. Taylor, D.G., (1977) NIOSH Manual of Analytical Methods. 2nd Edition, Volume III, Publication No. 77-157.

7. "Recommeded Procedures for Asbestos Brake and Clutch Servicing", Division of Surveillance, Hazard Evaluations, and Field Studies, NIOSH.

TABLE 1
FACILITY A
DEPARTMENT OF SANITATION CENTRAL REPAIR STATION
FIBER AIR SAMPLE RESULTS
OPTICAL MICROSCOPY

Operation and Sample Type	Sample #	Volume (liters)	Time (min.)	Concentration Fibers > 5 µm/cc	
Brake Rebuilding					
Brake and clutch mechanic (personal)	*S-1	272	136	0.33	TWA 0.21
	S-3	380	190	0.12	
Peak sample during brake dust removal using a squirt bottle with water (personal)	*SP-1	20	10	0.54	
Relining Department					
Brake repair shop worker (personal)	S-2	786	393	0.13	
General Area					
8 feet from service bay	SG-1	790	395	0.06	
8 feet from service bay	SG-2	780	390	0.05	

TWA - Time Weighted Average exposure for period of time samples.
* Collected during actual brake repair work.

TABLE 2
FACILITY B
DEPARTMENT OF TRANSPORTATION
FIBER AIR SAMPLE RESULTS
OPTICAL MICROSCOPY

Operation and Sample Type	Sample #	Volume (liters)	Time (min.)	Concentration Fibers > 5 µm/cc
Brake Mechanic I (personal)	T-1	300	150	0.15
				TWA 0.23
Brake Mechanic I (personal)	T-4	392	196	0.30
Brake Mechanic II (personal)	T-2	350	175	0.31
				TWA 0.28
Brake Mechanic II (personal)	T-5	388	194	0.26
Brake Mechanic III (personal)	T-3	270	135	0.24
Peak sample taken during wet brushing of brake dust by Brake Mechanic I (personal)	TP-1	6	3	2.62
Peak sample taken during wet brushing of brake dust by Brake Mechanic I (personal)	TP-4	6	3	2.22
Peak sample taken during wet brushing of brake dust by Brake Mechanic II (personal)	TP-2	18	9	0.87
Peak sample taken during wet brushing of brake dust by Brake Mechanic III (personal)	TP-3	18	9	0.67
General Area Samples				
Near work bay of Mechanic III	TG-4	720	360	0.07
In front of office	TG-5	728	364	0.06
Inside office	TG-6	726	363	0.06

TWA - Time Weighted Average exposure for period of time sampled.

TABLE 3
FACILITY C
POLICE DEPARTMENT
FIBER AIR SAMPLE RESULTS
OPTICAL MICROSCOPY

Operation and Sample Type	Sample #	Volume (liters)	Time (min.)	Concentration Fibers > 5 µm/cc
Brake Mechanic I (personal)	P-1	258	129	0.20
				TWA 0.20
Brake Mechanic I (personal)	P-5	136	68	0.21
Brake Mechanic II (personal)	P-4	248	124	0.34
				TWA 0.19
Brake Mechanic II (personal)	*P-8	354	177	0.08
Brake Mechanic III (personal)	P-3	94	47	0.03
Mechanic Helper (personal)	P-2	324	162	0.15
				TWA 0.30
Mechanic Helper (personal)	P-6	268	184	0.44
Peak sample taken during dry brushing of brake dust by Brake Mechanic I (personal)	PP-1	24	12	0.81
Peak sample taken during dry brushing of brake dust by Brake Mechanic II (personal)	PP-2	42	21	0.61
General Area Samples				
In front of office	PGA-1	826	413	0.02
Work bench in front of work bays	PGA-2	828	414	0.07
Work bench in front of work bays	PGA-3	764	382	0.03

TWA - Time Weighted Average exposure for period of time sampled.
* Mechanic performed very little brake work during the collection time of this sample.

TABLE 4
NEW YORK CITY BRAKE SHOPS
AIR SAMPLE RESULTS
TRACE METAL ANALYSIS

Sample Number	(cubic meters, m^3)	Location of Sample	Trace Metals $\mu g/m^3$				
			Pb	Zn	Cu	Fe	Mn
Sanitation Department							
NHV-1	113.6	Brake Servicing Area	8.7	0.3	0.3	2.3	0.04
NHV-2	143.6	Relining Department	1.2	0.2	0.2	1.7	0.06
Transportation Department							
NHV-3	118.1	Brake Rebuilding Area	19.5	0.3	0.2	1.2	0.05
NHV-4	124.3	Brake Rebuilding Area	24.9	0.3	0.2	1.4	0.04
Police Department							
NHV-5	184.4	Brake Rebuilding Area	0.4	0.3	0.1	1.8	0.03
NHV-6	115.3	Brake Rebuilding Area	0.8	0.5	0.2	1.5	0.04
			OSHA Exposure Standard $\mu g/m^3$				
			50	5000*	1000**	10,000***	5,000****
			NIOSH Recommended Standard $\mu g/m^3$				
			100	5000			

NOTE: Sample analysis for Cr were below limit of detection (5 µg/sample).

* zinc oxide fume
** copper dusts and mists
*** iron oxide fume
**** ceiling

TABLE 5
FIBER AIR SAMPLE RESULTS
COMPARISON BETWEEN TRANSMISSION ELECTRON MICROSCOPY
AND OPTICAL MICROSCOPY ANALYSIS

Sample Number	Optical Microscopy	Transmission Electron Microscopy		% Fibers
	fibers/cc > 5 μm in length	fibers/cc > 5 μm in length	Total fibers/cc	> 5 μm in length (TEM)
S-1	0.33	*	*	*
S-2	0.13	0.04	0.29	13.8
S-3	0.12	*	*	*
SP-1	0.54	*	*	*
T-1	0.15	0.04	0.04	100
T-4	0.30	0.00	0.07	00.0
T-2	0.31	*	*	*
T-5	0.26	*	*	*
T-3	0.24	*	*	*
T-6	0.07	*	*	*
TP-1	2.62	*	*	*
TP-4	2.22	*	*	*
TP-2	0.87	*	*	*
TP-3	0.67	*	*	*
TG-4	0.07	*	*	*
TG-5	0.06	*	*	*
TG-6	0.06	*	*	*
P-1	0.20	*	*	*
P-5	0.21	*	*	*
P-7	0.04	*	*	*
P-2	0.15	*	*	*
P-6	0.44	0.00	0.04	00.0
P-4	0.34	*	*	*
P-8	0.08	*	*	*
P-3	0.30	*	*	*
PP-1	0.81	*	*	*
PP-2	0.61	*	*	*
PGA-1	0.02	*	*	*
PGA-2	0.07	*	*	*
PGA-3	0.03	*	*	*

* No fibers present in sample areas observed by Transmission Electron Microscopy (TEM).

ATTACHMENT 1

RECOMMENDED (INTERIM) PROCEDURES FOR ASBESTOS BRAKE AND CLUTCH SERVICING AS OF NOVEMBER 1978

The National Institute for Occupational Safety and Health (NIOSH) has research underway concerning dust exposures during brake and clutch servicing. Due to preliminary data demonstrating significant asbestos exposures during presently used brake and clutch servicing techniques, NIOSH has reviewed alternate techniques whereby asbestos exposures are reduced. It should be mentioned that vacuum cleaner testing and efficiency data at this time are not available. However, when this research is completed this data will be included in the recommendations as applicable. The following are interim procedures by NIOSH to minimize asbestos dust exposures.

1. Where possible, an area should be designated and constructed for brake and clutch repairs and servicing. Entrances into this area shall be posted with the following asbestos exposure warning sign printed in letters of sufficient size and contrast to be readily visible and legible:

Asbestos
Dust Hazard
Avoid Breathing Dust
Wear Assigned Protective Equipment
Do Not Remain in Area Unless Your Work Requires It
Breathing Asbestos Dust May Cause Asbestosis and Cancer

2. Dust shall first be cleaned from brake drums, brake backing plates, brake assemblies, and clutch assemblies using an industrial type vacuum cleaner equipped with a high efficiency filter system (> 99% efficiency of 0.3 μm diameter aerosols). After vacuum cleaning, any remaining dust shall be removed using a water dampened cloth or rag. Under no circumstances shall compressed air or dry brushing be used for cleaning. Where wet brushing is necessary for cleaning an approved respiator shall be worn.

3. During brake pad grinding, riveting, and punching operations local exhaust ventilation and dust collection systems shall be designed, constructed, installed, and maintained in accordance with the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2 - 1977 to meet the asbestos airborne exposure standard.

4. During brake replacement and maintenance when engineering controls are not feasible or work practices are not effective in limiting exposures an air purifying respirator, either single use or with replaceable particulate filter(s), as approved by NIOSH, shall be worn during all procedures starting with the removal of the wheel and including reassembly. During manual clutch servicing, such a respirator shall be worn during the removal and cleaning of the clutch, pressure plate and housing assembly and during installation of the new clutch assembly. If needed a respirator program shall be established in accordance with the requirements of the American National Standards Practices for Respiratory Protection, ANSI Z88.2 - 1969.

5. All table and floor cleaning in areas where brakes and clutches are repaired shall be done with the high efficiency industrial vacuum cleaner as described in (2) above. Grinding and riveting machines shall also be cleaned with such a vacuum cleaner and the remaining dust wiped with a water dampened cloth. An approved respirator shall be used during this cleaning.

6. Industrial vacuum cleaner bags containing asbestos dust and cloths used for wiping brake and clutch assemblies shall be disposed of in sealed impermeable bags or other containers and labeled with the following warning label printed in letters of sufficient size and contrast to be readily visible and legible:

CAUTION
Contains Asbestos Fibers
Avoid Breathing Dust
Breathing Asbestos Dust May Cause Serious Bodily Harm

An approved respirator shall be worn during removal of vacuum bags.

7. Consumption of food and beverages shall not be permitted in work areas. The area designed or designated for food consumption shall be separate from work area so as to provide minimal protection against asbestos dust contamination.

8. If the employee is exposed to airborne concentrations of asbestos fibers which exceed the ceiling level the OSHA requirement regarding special clothing, change rooms, lockers, etc. (29 CFR 1910,1001(d)) shall be followed.

The current OSHA asbestos standard is as follows: The 8 hour time-weighted average (TWA) airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed 2 fibers, longer than 5 micrometers per cubic centimeter of air (fibers > 5 μm/cc).

The ceiling airborne concentration to which no employee may be exposed in excess of is 10 fibers > 5 µm/cc.

OSHA in a recent proposed revision of the asbestos standard has proposed a TWA of 0.5 fibers > 5 µm/cc with a 5 fibers > 5 µm/cc ceiling over a 15 minute sampling period.

NIOSH currently recommends that the TWA exposure to asbestos be 0.1 fibers > 5 µm/cc with a ceiling value of 0.5 fibers > 5 µm/cc over a 15 minute sampling period.

Note: Strict adherence to the above procedures should minimize exposures to mechanics during brake and clutch servicing. These are interim recommendations and are subject to revision pending results of ongoing NIOSH research.

Prepared by:
Division of Surveillance, Hazard Evaluations and Field Studies,
National Institute for Occupational Safety and Health
Cincinnati, Ohio