STUDY PROTOCOL:

EVALUATION OF BRAKE DRUM SERVICE CONTROLS

REPORT WRITTEN BY:
Frank W. Godbey
John W. Sheehy
James D. McGlothlin
Thomas C. Cooper
Dennis M. O'Brien

REPORT DATE:
June 1986

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
Division of Physical Sciences and Engineering
Engineering Control Technology Branch
4676 Columbia Parkway
Cincinnati, Ohio 45226

CONTENTS

FMSI 02358

CONTENTS (Continued)

Page

TABLES

I. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) is the primary Federal agency engaged in occupational safety and health research. Located in the Department of Health and Human Services (formerly DHEW), it was established by the Occupational Safety and Health Act of 1970. This legislation mandated NIOSH to conduct a number of research and education programs separate from the standard setting and enforcement functions carried out by the Occupational Safety and Health Administration (OSHA) in the Department of Labor. An important area of NIOSH research deals with methods for controlling occupational exposure to potential chemical and physical hazards. The Engineering Control Technology Branch (ECTB) of the Division of Physical Sciences and Engineering has been given the lead within NIOSH to study the engineering aspects of health hazard prevention and control.

Since 1976, ECTB has conducted a number of assessments of health hazard control technology on the basis of industry, common industrial process, or specific control techniques. Examples of these completed studies include the foundry industry; various chemical manufacturing or processing operations; spray painting; and the recirculation of exhaust air. The objective of each of these studies has been to document and evaluate effective control techniques for potential health hazards in the industry or process of interest, and to create a more general awareness of the need for or availability of an effective system of hazard control measures. Over the years NIOSH has conducted several studies with the support of the Environmental Protection Agency (EPA). NIOSH has solicited the input and support of the EPA Asbestos Action Program in conducting this study.

These studies involve a number of steps or phases. Initially, a series of walk-through surveys is conducted to select plants or processes with effective and potentially transferable control concepts or techniques. Next, in-depth surveys are conducted to determine both the control parameters and the effectiveness of these controls. The reports from these in-depth surveys are then used as a basis for preparing technical reports and journal articles on effective hazard control measures. Ultimately, the information from these research activities builds the data base of publicly available information on hazard control techniques for use by health professionals who are responsible for preventing occupational illness and injury.

THE MAGNITUDE OF THE PROBLEM

Asbestos is found in vehicular brake materials throughout industry. Recognition of asbestos' carcinogenic properties has currently resulted in substitution of less toxic fibers for some brake materials. However, asbestos is still in place in a large number of brakes. This study is concerned with the control of asbestos exposures to workers who are required to repair vehicular brakes.

Dubrow and Wegman published a research and control priority assessment of occupational carcinogens.[1] Their objective was to identify occupations with potentially high cancer risk by combining the results of 12 major occupational disease surveillance studies and to make recommendations concerning priorities for occupational cancer research and control on the basis of the results of this analysis in conjunction with other available epidemiologic, industrial hygiene, toxicologic, and employment data. On the basis of the principles outlined in their paper, some priorities for research and control clearly stood out. Their results pointed to the investigation and control of occupational exposure to asbestos as the number one priority in occupational cancer research and control. "In this situation, where occupational disease surveillance studies point to a likely problem with a known carcinogenic agent, the priority should be placed on industrial hygiene investigations of asbestos exposure in the suspect occupations. If likely exposure is found, control measures should be developed and instituted."

There are frequent asbestos exposures during brake repair in the vehicle maintenance work force. NIOSH in the National Occupational Exposure Survey estimates that a workforce of 151,000 brake mechanics and garage workers in the U.S. are potentially exposed to asbestos.[2] Other estimates run as high as 900,000 potential exposures.[33]

A study of brake service operations is needed because of the following: the known carcinogenic potential of asbestos; a large number of workers are exposed; primarily small businesses perform brake servicing and lack resources to evaluate control devices; and the general lack of information on the effectiveness of control devices currently available. Therefore, the NIOSH Engineering Control Technology Branch proposes to undertake this study.

II. BRAKE SERVICE INDUSTRY

HISTORICAL DEVELOPMENT OF FRICTION PRODUCTS[2]

The requirements of early automobile friction materials were relatively minimal. Passenger cars were light and designed for low speed operations. Brakes were of an external contracting type and utilized a variety of materials; this included leather and impregnated cotton products which were commonly used along with wool and felt. In 1903, woven asbestos friction materials were first marketed in the United States by the Keasbey and Mattison Company of Ambler, Pennsylvania.[3] Because of their superior heat resistance and durability, they rapidly increased in use and soon dominated the market. The woven asbestos brakes continued to be the dominant product used in automobiles until about 1930. They typically contained 70 percent or more wire-cored asbestos yarn impregnated with drying oils, such as linseed and bituminous material.

Molded brake linings were developed in the early 1920's and gained increasing use with the introduction of internal shoe brakes in 1927. By 1940, virtually all automobiles were equipped with molded brake linings, although woven products continue to be used in trucks, heavy equipment, and for specialized applications. The molded linings in use were cut to length, usually by the manufacturer, and mounted on brake shoes using rivets. Until the mid 1920's, brakes were only mounted on rear wheels; however, with the development of internal shoes, four wheel mountings soon became standard.

As automobiles were designed for use at higher speeds, brake linings improved in both quality and performance. Various new materials were introduced as fillers, binders, and friction modifiers. In 1948, bonded brake linings were developed and soon accounted for approximately 40 percent of the original equipment brake market. In addition, they rapidly dominated the replacement market because of the considerable savings in labor during installation. In 1965, the first disc brakes were introduced on American automobiles and rapidly increased in use. In 1975, virtually all original equipment cars had front wheel brakes of this type. However, because of less stringent braking requirements and the difficulty of adapting mechanical parking brakes to the disc configuration, the rear wheel brakes on 95 percent of currently sold cars are still of the drum variety.

REQUIREMENTS FOR BRAKE LININGS[2]

A constant or slightly decreasing coefficient of friction (CF) with temperature up to about 1,000°F is required for an efficient brake lining; CF values of from 0.30 to 0.45 are normally sought. Lower values produce brakes requiring excess pedal pressure, and those with higher values are too sensitive to pressure and develop excess wear. Ideally, the desired frictional qualities should be maintained throughout the life of the lining material. During braking, chemical and physical changes occur in the material at the braking surfaces. These changes may produce an increase (build-up) or a decrease (fade) in friction. Satisfactory linings will fade slightly upon repeated applications, but will return to their initial state upon cooling.[4]

Low wear of the linings is obviously desirable for economical and practical considerations. However, high wear resistance can be associated with the tendency of the lining to glaze, with a concomitant reduction in the CF. This can be overcome by allowing a slow alteration of the brake lining material to occur. Pyrolysis of the organic binders and thermal decomposition of the chrysotile fibers under braking provide the necessary continuing renewal of the lining surface.

The lining should be non-abrasive to the drum surface. In addition to causing rapid drum wear, abrasive linings score the drums which, in turn, leads to a rapid wearing of the lining. Drums made of cast iron and steel are common with steel being more susceptible to scoring. Since brake drums have a hardness of from 3.5 to 4.0 on the MOH (mineral hardness range of 1 to 15 in which talc is rated 1 and diamond 15) scale, virtually all lining materials used have lower hardness values.

Other necessary or desirable properties of brake linings include: physical strength, dimensional stability, quiet operation, and safe and non-offensive degradation products. Of the various properties desired in the linings, greatest attention is paid to build-up/fade and recovery characteristics. Wear problems are not as serious and can more readily be overcome with the materials available.

COMPOUNDING INGREDIENTS OF BRAKE LININGS(5,6,7,8)

To achieve the desired friction properties, a wide variety of ingredients are commonly used in the manufacturer of automobile brake linings. These include asbestos, organic binders, friction modifiers, fillers, and curing agents. Asbestos is used for fiber reinforcement of the friction product. Chrysotile is used almost exclusively and comprises from 40 to 50 percent of the brake lining. Fiber grades 4 through 7 are used, and occasionally, several sizes are mixed or even calcined to improve performance characteristics. Amosite, crocidolite, or other amphibole asbestos varieties are not used because they are too harsh and tend to score the brake drums.

BRAKE LINING REPAIR AND MAINTENANCE PRACTICES HISTORY(2)

To a large extent, the changing character of brake lining materials has led to differing asbestos exposures and changing work practices over the years. From 1920 until about 1930, when braking was done through the use of external brake bands made from woven materials, the predominant exposure to asbestos would have come from the cutting and fitting of the woven lining material. Most likely, the airborne fiber concentrations were considerably less than those developed in later years when machining of molded materials was common.

From 1927, when internal brake shoes were developed using molded linings, until 1948 when bonded brake linings were introduced, all internal brake linings were attached to shoes using rivets. The lining material for use in the replacement market would be precut to appropriate size for various brakes or obtained from rolls of indeterminate length. The precut segments would usually be predrilled at the factory for rapid mounting on shoes. In some circumstances, however, drilling for the rivets and bevelling would be done by the mechanic installing them. The use of rolled linings required cutting the friction material to shape, drilling holes for rivets, and bevelling the edges appropriately. Under the latter circumstances, asbestos exposure to workers could be considerable. Even when shoes with predrilled and bevelled linings were installed, the processes of punching out the rivets on the old shoes and riveting on of the new shoes would give rise to greater exposures than that accompanying the use of bonded linings.

With the introduction of bonded lining, the need for drilling, facing, or grinding operations during installation decreased significantly. However, for a short period of time, in the mid 1950's when automobile shoes were first installed with a fixed anchor, some tapering was necessary on uniform thickness bonded linings to achieve a proper fit. Previously, the end of the shoe opposite to that of the hydraulic cylinder could be mechanically adjusted. Shortly thereafter, tapered bonded linings were available from the factory. Subsequent to 1960, considerably fewer bevelling or grinding operations were performed by an automobile mechanic replacing brake linings.

During replacement of internal shoe brakes, common practice was to remove the brake wear dust from the housing by air blowing or brushing. After 1970, increasing awareness of the hazards of asbestos and its presence in brake lining dust led to wet brushing, wet wiping, dry brushing, or vacuuming work practices in some brake servicing facilities. However, even today such improved work practices are not universal.

In the 1930's and 1940's, most automobile shops were relatively small and most mechanics performed all automobile maintenance and repair activities. In recent years, however, there has been an increasing tendency towards specialization, with shops existing for brakes and front end work exclusively. Here, while asbestos exposures during brake work on an individual job may be less than those of previous years, some workers are exposed for considerably longer periods of time.

DESCRIPTION OF BRAKE SERVICING OPERATIONS

The servicing procedures found at each facility are basically as follows. The vehicle is driven into a repair stall or bay for a brake system examination. Pending repairs, the wheels are elevated, removed, and then inspected. Loose dust is cleaned from the drums and brake assemblies by vacuuming, wet or dry wiping/brushing, using compressed air, or a combination of these methods. Parts are then replaced or repaired as needed and the brake system is reassembled and adjusted. Test driving the vehicle for proper fitting and adjustment is the final phase of the servicing operation. During these brake servicing operations the brake repairman and other service personnel in the garage area are potentially exposed to asbestos dust at all times during and following the brake drum removal. If the normal dust buildup inside the drum and brake assembly is removed and disposed of in a controlled manner, these exposures can be prevented.

III. HEALTH EFFECTS

BRAKE DUST CHARACTERISTICS[9]

Asbestos fibers may be released to the air whenever a mechanic works on a brake drum assembly. However, the characteristics of the asbestos in the brake dust differ significantly both from other asbestos exposures and from the asbestos used to make the brake linings. The fibers, which average less than 5 per cent of the asbestos present in the original brake linings, are much shorter than those from other sources, due to the physical degradation involved in the braking process.

The wearing of brake shoes is due to five different types of wear:

- Abrasion;
- Heat;
- Adhesion;
- Fatigue; and
- Macroshear.

Abrasive wear is caused by either two surfaces interfacing (the rotor and the pad) or by foreign particles such as sand, clay, mud, or salt caught between the two surfaces. The amount of wear increases with temperature, braking load, and the concentration, size, and hardness of foreign particles.

Thermal wear includes physical and chemical reactions caused by high temperatures. The reactions include pyrolysis, oxidation, thermoparticulation, melting, evaporation, and sublimation. The amount of wear increases exponentially with temperature.

Adhesive wear involves the adhesion of organic or inorganic materials to the rotor and subsequent tearing or separation of the material from the pad. Adhesive wear increases with temperature, braking load, and the concentration of the adherent component.

Fatigue wear can be caused by repeated heating and cooling, as a result of a single abusive thermal loading, or by repeated mechanical stressing. This wear increases with extreme temperature changes, drums that are out-of-round, discs out-of-parallel, or if the rotor thickness is not uniform.

Macroshear wear causes fracture of the brake pad from heavy loading. The pad weakened by heat, oxidation, or other mechanisms shears away by a single heavy brake application. The fragments of the sheared pad can cause further abrasive damage if caught in the interface between the pad and the rotor.

Most vehicles are subject primarily to abrasive and adhesive wear. Below 450°F, abrasive and adhesive wear are predominant, while above 450°F thermal wear is predominant.(10)

The emission of asbestos from brake shoes is not a simple relationship. Emissions per mile and composition of the dust are dependent on the following:(11)

- Composition of the friction material;
- Composition, metallurgical structure, and hardness of the cast iron rotor (drum or disc);
- Surface roughness of the rotor;
- Previous use of the friction material - primarily thermal history - both recent and overall;
- Third-body contamination of the sliding interface by road dust, wear debris, rain water, salt, and the like;
- Vehicle usage - miles driven (urban, suburban, rural, expressway);
- Vehicle weight including passengers and cargo;
- Vehicle speed at beginning and end of the stop;
- Deceleration (average and instantaneous);
- Frequency of braking due to traffic, terrain, and driver habits;

- Interface temperature, sliding speed, and unit load on the friction material;
- Roadway surface and grade;
- Air temperature, wind velocity, and wind direction relative to vehicle motion;
- Brake design, including brake balance front to rear, and swept area in relation to vehicle weight and horsepower;
- Vehicle design including brake cooling adequacy;
- Operator habits and behavior;
- Brake adjustment and maintenance;
- Type of tires;
- Engine-transmission braking;
- Suspension system; and
- Aerodynamic shape of the vehicle.

Chrysotile asbestos, which comprises 40 to 60 percent of the original brake shoe, is a major component of unused brake shoes.(11) A study by the General Motors Research Laboratory reported tests showing that over 99.9 percent of the mass of original asbestos fibers was broken down into non-fibrous magnesium silicates. The same study estimated that at a stopping rate of 1.2 stops per kilometer, that 2.6 ug of asbestos/km is emitted to the air, 0.76 ug/km settles on the roadway, and 2.2 ug/km is entrained in the wheel.(11) The emitted particles averaged 0.029 percent asbestos.(11)

Both optical microscopy and electron microscopy methods were used in this study.

This breakdown of the asbestos to non-fibrous forms is due to the chemistry of asbestos itself. Asbestos occurs in the fibrous form due to crystallization of the hydrated mineral in the form of long, strong, flexible fibers.(12) Heat during brake use releases the water of hydration, thus breaking the fibrous form. The crystals begin losing water at about 700°F. More water is lost at around 1,170°F, with complete breakdown to olivine powder at 1,520°F.(10) Chrysotile asbestos fibers exist in automobile brake dust in various states of deformation: from relatively undamaged to heavily deformed and recrystallized.(34)

There is some evidence to suggest that the morphology and size of the fiber, regardless of the fiber type, are responsible for its carcinogenicity.(13) These studies tend to suggest that the size dimensions are more important than chemical and surface characteristics in inducing a biological effect.(13)

Studies reviewed by PEI showed brake dust contains from 0.004 to 30 percent asbestos by weight, with the vast majority of the samples under 5 percent asbestos.[8,9,11,14,15,16,] Both optical and electron microscopy methods were used in these studies. In all five studies total fibers were measured rather than just fibers greater than 5 um in length. The majority of the asbestos (75 percent of the fibers in one study) is less than 5 um in length.[15,16] The median length in another study was 0.5 um.[11] It should be noted that both the OSHA standard of 2 f/cc (8-hour TWA), and the NIOSH recommended standard of 0.1 f/cc (8-hour TWA) are only for fibers greater than 5 um in length.[17] As discussed in the next section, there are documented health effects for workers exposed to brake dust.

HEALTH EFFECTS CRITERIA

NIOSH provided an update on the recommended asbestos criteria in the OSHA proposed rule-making hearings for asbestos in June 1984.[18] The NIOSH position is summarized below:

"The carcinogenic potential of asbestos is no longer in doubt; however, there is some uncertainty about the toxicological and morphological properties which determine the carcinogenic potency of various fibers. NIOSH believes that on the basis of available information, there is no scientific basis for differentiating between asbestos fiber types for regulatory purposes. Data available to date provide no evidence for the existence of a threshold level. Virtually all levels of asbestos exposure studied to date demonstrated an excess of asbestos-related disease.

NIOSH continues to believe that both asbestos and smoking are independently capable of increasing the risk of lung cancer mortality. When exposure to both occurs, the combined effect, with respect to lung cancer, appears to be multiplicative rather than additive. From the evidence presented, we may conclude that asbestos is a carcinogen capable of causing lung cancer and mesothelioma, independent of smoking.

NIOSH has recommended that asbestos be controlled to the lowest detectable limit. It is our contention that there is no safe concentration of exposure to asbestos. Any standard, no matter how low the concentration, will not ensure absolute protection for all workers from developing cancer as a result of their occupational exposure. However, lower exposures carry lower risks.

Since the only widely available method, NIOSH Method 7400,[19] is able to achieve (intra-laboratory) accuracy of 12.8 percent RSD at an exposure limit of 0.1 f/cc (100,000 f/m^3) in a 400 liter sample, NIOSH and others have recommended an exposure limit of 0.1 f/cc for asbestos based on 8-hour time-weighted average concentrations.[20] While this is a well understood practice, we can not find compelling arguments to prevent a recommendation based on alternative sampling periods. In fact, such an approach may provide more protection than an 8-hour based sampling period that allows short-term exposures 6 or 10 times greater than the 8-hour exposure limits being considered by OSHA. Furthermore, since there is uncertainty regarding the cumulative dose required to initiate disease, it seems reasonable to make every attempt to control exposures to as narrow a range of concentrations as possible. One way to accomplish this is to restrict the period over which workplace concentrations can be averaged. Personal sampling pumps are available, with flow rates up to 3.5 lpm, which would allow a sampling time of two hours or less.

Finally, we still believe that there are occasions, such as mixed fiber exposures, where fiber specificity is necessary. Therefore, we recommend the use of electron microscopy in the event of process or product modification, in mixed fiber exposures, or when there are other reasons for characterization of fiber type and morphology."

POTENTIAL HEALTH EFFECTS FROM ASBESTOS EXPOSURE(2)

The human toxicological significance for the inhalation of chrysotile asbestos fibers is well documented; and instances of mesothelioma in auto repair workers have been identified.[21,22,23] In a detailed examination of 90 union vehicular maintenance workers in New York City,(24) with 10 or more years of shop work, 29 percent had decreased vital capacity; the percentage increased with age and most markedly after 20 years from the onset of auto work. Many of the workers examined showed signs consistent with asbestosis, with observed changes noted in chest X-rays and indication of restrictive pulmonary function. The prevalence of these changes was significantly higher after 20 years exposure, a result expected after occupational exposure to asbestos.(25)

Unlike chrysotile, the health effects of exposure to forsterite, or transition series fibers (chrysotile/forsterite) with altered crystalline structures are not well documented. In studies by Davis and Coniam,(26) and Koshi(27) in which fibers of chrysotile, chrysotile/forsterite, and forsterite were injected into the pleural and peritoneal cavities of mice, the results suggested varying degrees of toxic effects. Fiber implantation animal studies conducted by Pott, et.al.,(28,29) and Davis, et al.,(30) suggest that the morphology and size of a fiber, regardless of fiber type, are responsible for its carcinogenicity. Likewise, Stanton, et al., (31) suggests that fibers less than 1.5 um in diameter and greater than 8 um in length pose the greatest risk in producing pleural sarcomas. These studies tend to suggest that the physical morphology (size dimensions) and to a lesser degree chemical and surface characteristics of a fiber are the determining factors for inducing a biological effect. The precise fiber dimensional characteristics required for these observed pathologic responses have been difficult to determine experimentally because of the difficulties encountered in producing fibers of specific size dimensions.

IV. CONTROLS

Occupational exposures can be controlled by the application of a number of well-known principles, including engineering measures, work practices, personal protection, and monitoring. These principles may be applied at or near the hazard source, to the general workplace environment, or at the point of exposure to individuals. Controls applied at the source of the hazard, including engineering measures (i.e., material substitution, process/equipment modification, isolation, automation, or local ventilation) and work practices, are generally the preferred and most effective means of control in terms of both occupational and environmental concerns. In the case of brake repair, source control would preferably involve measures that are applied at the point where asbestos is actually removed from the surface.

Control measures may also be applied near individual workers, including the use of work practices and personal protective equipment. With brake repair, work practices, personal protection, and the use of clean, supplied air in the workers' breathing zone are appropriate supplementary controls. A system comprised of a combination of the above types of control measures is often required to provide worker protection in brake repair operations. Since effective source control measures offer the prospect of providing worker protection and preventing building contamination, these measures are the principal focus of this study.

Several techniques have traditionally been used by mechanics to remove brake dust and accumulated dirt and grease. Reduction in asbestos exposure has not always been a primary consideration. This section describes the various controls used by mechanics in brake maintenance.

UNCONTROLLED DUST DISPLACEMENT METHODS

Uncontrolled dust displacement methods are clearly unacceptable and should be discouraged. These include the use of a compressed air gun, a dry brush or rag, a damp brush or rag, or a shop vacuum not equipped with a HEPA filter.

Compressed Air Gun Blowing

One of the simplest methods for removing brake dust is blowing with a compressed air gun. This was once used almost universally, and is still widely used. NIOSH recommends that "Under no circumstances shall compressed air ... be used for cleaning."[13] (See Appendix A) It is important to note that this method does not dispose of the fibers, but merely displaces them into the mechanic's breathing zone or into the work area where they are available for subsequent respiratory exposure and reentrainment.

Brush or Dry Rag

In this technique, the mechanic removes the dust using a dry brush or rag. While not as much dust is entrained as with air blowing, the dust stands more of a chance of falling on the worker's clothing and in the immediate area. NIOSH again recommends that "Under no circumstances shall ... a dry brush be used for cleaning."[13] Although the method could lend itself to collection and disposal of the dust, this is often not the case. If the dust is not collected, it will remain in the workplace available for later reentrainment. The method is highly dependent on the worker's technique. For example, if extreme care is taken and asbestos-containing dust is wiped from the brush or rag into a container for disposal, worker exposure should be considerably lower than for compressed air blowing. If, however, the dust is brushed onto the floor or the worker's clothing, or if the rag is used for other tasks, the exposure could be comparable to exposures caused by compressed air blowing.

Shop Vacuum

Anecdotal evidence indicate limited use of shop vacuums to remove brake dust. Due to the small size of the asbestos fibers in brake dust, it is likely that very little asbestos is caught in the vacuum filter (ordinary filters have larger openings than HEPA filters). Exposures could be high and should relate primarily to the placement of the vacuum exhaust. This technique has no advantages over other methods and may well give the mechanic a false sense of safety.

Damp Brush or Rag

Some mechanics wet the brush or rag prior to cleaning the brake. The quantity of water must be sufficient to wet the dust. When the water dries, asbestos will remain in the workplace available for later reentrainment. Although it seems logical that wetting a brush would reduce the asbestos exposure, the literature suggests that the technique of the individual worker is more important than the presence or absence of a relatively small amount of water.

WET METHODS

Wet methods show considerable improvement from standard practice, but may still result in some worker exposure. These methods include use of a water hose, aerosol brake cleaner, brake cleaner with a compressed air gun, and a brake assembly washer. Indications are that, with good work practices, these methods could be effective in minimizing worker exposure. Testing of these practices is necessary to confirm this.

Water Hose

Soaking the brake assembly with a hose has several advantages over the use of damp brushes or rags. First, sufficient water is supplied to assure adequate wetting of all the asbestos dust. Second, the hose can be used to further wash the dust from the garage floor to a floor drain. Finally, there is little likelihood that the dust will fall on the mechanic's clothing, as the worker would try to not get wet and in the process avoid the asbestos. Disadvantages of this method include possible dust dislodgement and dispersal if pressure is too high and disposal of asbestos down the sewer with the chance that the dust would not be washed down the drain and become available for reentrainment. Unless there are provisions to treat or dispose of the contaminated water in an acceptable manner to avoid sending the asbestos to the drain, this and other wet methods may be unacceptable from the viewpoint of water pollution.

Brake Cleaner as a Wetting Agent

Although brake cleaners are primarily used to remove grease and dirt from the brake housing, several contacts mentioned their use to also control asbestos exposure. Most typical commercial brake cleaners contain a solvent, generally 1,1,1-trichloroethane, in an aerosol container. It is also possible to mix the solvent into a compressed air system and spray it on the brake housing.(13) It is important that the solvent be collected for recycle. If this is not done, and the solvent is allowed to evaporate, the asbestos becomes available for reentrainment. From an asbestos control standpoint, the use of a solvent has no advantage over the use of water. The aerosol blast could cause the brake dust to be entrained in the air. Because brake cleaner solvents evaporate quickly, subsequent exposures could occur later upon drying and reentrainment. Also, there may be exposures to the solvent that is used.

Brake Assembly Washer

The brake assembly washer consists of two pans mounted vertically and connected to a standard mechanic's compressed air gun. The top pan is perforated to allow fluid to flow through, and the bottom pan acts as a sump for the liquid. The manufacturer recommends the use of amended water (i.e., water containing a surfactant) in the system and sells packets of concentrate to mix with the water. Gasoline or flammable solvents should not be used in the system.

Liquid is siphoned from the lower pan into the air line at standard air gun line pressure. This lowers the pressure to 6 to 8 pounds, emitting a light spray. The liquid runs off the part into the upper, perforated pan which catches parts and large debris. The liquid drains into the lower pan for recycle, thus avoiding the problem of disposal.

The cost of the washer system is $252; 20 packets of amending agent concentrate costs $17.50.

VACUUM/ENCLOSURE SYSTEMS

Vacuum/enclosure systems appear to be the best method of controlling asbestos exposure. However, they tend to meet with considerable resistance because of cost and difficulty of use. Three typical systems are described.

Type A brake enclosure equipment consists of a transparent enclosure, available in two sizes, that surrounds the brake drum. The unit has glove inserts for the worker's hands. The asbestos-containing dust is blown using a standard air gun, and the enclosure is vented to a HEPA filter at 246 CFM. The system claims to be superior to other enclosure systems in lowering worker exposure during filter changes on the vacuum. This is because the bag and pre-filter are changed while the vacuum is still running. This creates a negative pressure area around these two filters, drawing clean air into the bag-filters and pre-filter area, reducing the possibility of contaminated dust during filter changes. For other vacuum enclosure systems, the vacuum has to be turned off when closing and twisting shut the polyvinyl bag. During the closing phase, there is the potential for asbestos dust to be expelled from the bag into the worker's environment.

Tests by an independent laboratory show virtual elimination of asbestos exposure when this system is used as directed.(16)

The cost of a complete system for autos and light trucks is $3,000 and the size for commercial vehicles costs $3,100. This is a substantial expenditure for the many small, general-service garages that perform intermittent brake work.

Type B system consists of a clear, flexible vinyl enclosure, available in two sizes, held in place by a wire frame. The asbestos-containing dust is blown using a standard air gun, and the enclosure is vented to a HEPA filter at 95 CFM. There were no independent laboratory tests reported on the effectiveness of this system.

The cost of this system ranges between $1,100 and $1,600 depending upon its size.

Type C system consists of a transparent enclosure cylinder available in three sizes to fit vehicles from passenger cars to large commercial vehicles. The asbestos-containing dust is blown using a standard air gun, and the enclosure is vented to a HEPA filter.

Tests by an independent laboratory show virtual elimination of asbestos exposure when this system is used as directed. (15) One company had used the system for about six years, but has discontinued use of the enclosure portion. The company uses the vacuum portion to remove the dust rather than blowing with an air gun. It claims to have run tests indicating that this approach provided the same worker protection, was less cumbersome for the mechanic, and lessened contamination due to build-ups inside the enclosure. The company also claimed that if the vacuum in the original system were not adjusted properly, air and dust could escape during blowing. They felt that this was because under some conditions, the volume of air from the air gun could exceed the air exhausted through the vacuum, thus causing a positive pressure in the enclosure for a short period.

The cost of the smallest size system is $1,536; the medium size system, $1,810; and the larger system, $4,429.

The above vacuum/enclosure systems use polyvinyl bags marked "Contains Asbestos Fibers" to contain the contaminated filters. The filters are placed in the bag, the bag neck is twisted shut, and then the neck is taped. The bags are then ready for disposal in an EPA-prescribed manner.

HEPA FILTERED VACUUM

HEPA filtered vacuums may provide comparable asbestos control to the vacuum/enclosure systems, but there are no data to support this position.

No vendor is marketing a HEPA filtered vacuum as a brake maintenance control system but, as noted above, at least one garage contacted is using an enclosure system in this manner. The user claims that monitoring indicates equivalent exposure levels to that measured when using the complete enclosure and vacuum system. In addition, the use of the vacuum to remove dust has the added advantage of no compressed air blowing, increased mechanic mobility and productivity, and lower cost. In addition, because the vacuum would not have to evacuate air generated by the air gun, the vacuum could be designed smaller and, therefore, sold at a lower cost. The cost of a vacuum with a HEPA filter ranges from $800 to $1,100 depending on the size of the system.

Table 1 summarizes the controls described above.

V. PROPOSED STUDY

OBJECTIVES

The primary objective of this NIOSH control technology assessment is the determination of the level of exposure to brake dust using various control techniques during brake repair, and the transfer of the documented information to the appropriate individuals in industry, labor, academia, and the government (i.e., industrial hygienists, safety engineers, OSHA, EPA, etc.). A secondary objective of this assessment is the determination of additional research needs.

The hypothesis to be tested at the individual study sites can be stated: the specific control measure, as applied, is able to control asbestos exposures within the work area to 0.1 f/cc or less, as measured by PCM. TEM will be used as a secondary descriptor.

EXPERIMENTAL DESIGN

Given the objectives described, it is necessary to formulate an experimental design to account for the variables that exist in brake repair operations. These variables are divided into those relating to the process or work site, and those relating to the controls used.

Process Variables

These variables (e.g., vehicle type, weight, brake size, mileage, use, etc.) may be related to the nature of the work site, particularly in the case of fleet garages. They usually cannot be varied for a particular work site or job. For the most part they are more amenable to observational, qualitative description, and professional judgment than to measurement. As far as practical, these variables will be held constant in the study. These variables will be at least qualitatively addressed in the survey reports.

TABLE 1. Summary of Controls

Control	Advantages	Disadvantages	Capital Cost, $	Comments
1. Uncontrolled				
Compressed Air Gun	None	Higher worker exposure than any other technique tested	None	Probably the worst method
Dry Brush or Rag	May reduce exposure levels from air gun work area; easy to get on worker's clothes	High worker exposure; asbestos remains in area	None	Almost as bad or could be worse than compressed air gun
Damp Brush or Rag	May reduce exposure levels from air gun and dry brush or rag	High worker exposure; asbestos remains in work area; easy to get on worker's clothes; gives workers false sense of safety	None	Highly variable control based on how much water is used
Vacuum/Shop Vacuum	None	Entrains virtually all asbestos into air; gives workers a false sense of safety	45 - 119	Workers should be warned that fibers are not trapped by an ordinary shop vacuum
2. Wet Methods				
Water Hose	Low cost; relatively good control; can remove asbestos from work area; immediately available to all mechanics	Blast from hose can cause fibers to become airborne; Does not eliminate exposure; asbestos left on floor could be reentrained	None	Exposure using hose is less than the exposure for liquid squirt bottle
Brake Cleaner/Aerosol	Low cost; cleans grease off brake housing	Blast from aerosol can cause fibers to become airborne; quick evaporation allows for reentrainment	Less than 50/yr	Although there is no monitoring data exposures are likely to be high

(continued)

TABLE 1 (continued)

Control	Advantages	Disadvantages	Capital Cost, $	Comments
Brake Cleaner/ Compressed Air	Low cost; appears to have some lowering of exposure; cleans grease off brake	Blast from aerosol can cause fibers to become airborne; Does not eliminate exposure; If allowed to dry on floor asbestos can be reentrained	Less than 50/yr	Can be used with brake assembly washer
Brake Assembly Washer	Lowers worker exposure; low cost; allows mechanics free movement	Blast from spray may cause fibers to become airborne; exposure may be higher than with vacuums; liquid disposal	252	Can be used as a degreaser
3. Vacuum/Enclosure	Best worker protection; allows for proper disposal of asbestos	Relatively high cost; restricts worker movement; vacuum must be stronger than air blast	1,100 - 4,500	May virtually eliminate worker exposure
4. HEPA Filtered Vacuum	Lower worker exposure; appeals to mechanics; lower cost than enclosure systems; allows for proper disposal of asbestos	May allow higher exposure than with enclosure	800 - 1,100	Need to quantify worker exposure

Control Variables

These variables include the types of engineering and work practice measures used to reduce or control asbestos emissions and exposures. They may also include key operating parameters (e.g., ventilation rate) of these control measures. These are the principal variables in the study. For the most part, the sites will be selected based on the types of controls being used; an attempt will be made to pick sites that are physically similar. Since the exposure source in brake servicing is in the immediate breathing zone of the mechanic, differences in the physical plant (i.e., general ventilation) should have a minimal effect on the asbestos exposure when compared to the control and process (e.g., brake size) variables. Table 2 summarizes the control variables in the study.

Site Selection

This study will proceed in two phases. The first phase, completed in March 1986, involved ten preliminary site visits (Table 3) to explore the application of asbestos controls in brake repair operations. Phase two of this study will involve six in-depth evaluations of the control technologies identified in the first phase. The specific controls to be evaluated are: no control, wet methods, vacuum/enclosures, and HEPA filtered vacuums (Table 1).

- <u>Site Selection Criteria</u>

  There are a number of factors involved in the selection of specific sites. We will attempt to select sites primarily from fleet garages to control for variables such as vehicle type, use, and maintenance practice, and on physical size of garage. Selection of sites will be made, as judiciously as possible, based on criteria including:

  a) The type of control technique(s) being used at that site.
  b) The type and quantity of vehicles available for brake repair.

  Good work practices and a sound management approach are fundamental to the existence of suitable conditions for study.

  The conduct of in-depth surveys at a particular location is also dependent on the project officer's success in securing cooperation from the facility owner.

  All site visits will be conducted according to the Regulations for Investigations of Places of Employment, Code of Federal Regulations (CFR), Title 42, Part 85a (see Appendix B). The project officer will contact each company in advance of their planned visit date and provide details about the project.

Process Characterization

In order to make the measured control effectiveness as meaningful as possible, it is important to describe the context of the facility or

TABLE 2. Control Variables in the Study

Variable	Expected Effect on Exposures	How Dealt with in this Study
Type of Engineering Control Measure(s) for Asbestos, including types and amounts of wetting agents used, material treatment.	The controls are hypothesized to reduce asbestos below 0.1 f/cc	Sites will be selected to permit the study of various control types as the principal variables
Operating Parameters of the Engineering Control Measures	Capture should improve with increased ventilation rate, wetting agent application, etc.	These parameters will be observed, measured and recorded. For the most part they will not be varied.
Maintenance and Condition of Control Equipment	Can negate or reinforce controls.	Will be observed but not varied intentionally; we would prefer to see how well properly maintained equipment works. Failures will be observed and noted, and historic maintenance or failure records will be sought.
Work Practices	Careful work practices should reduce exposures; careless practices will probably override any other controls.	Will be observed and partially quantified using the HAM and short-term peak exposures.

TABLE 3. Summary of Preliminary Site Surveys

Site Description	Controls Observed	Potential In-depth Survey Site
1. U.S. Government Garage	Vacuum/Enclosure	Yes
2. University Auto Mechanics Area	Vacuum/Enclosure	Yes
3. U.S. Government Garage	Wet Bristle Brushing and Water Rinsing	No
4. Electric Utility Garage	Steam Jenny and Aerosol Spray	No
5. Gas and Electric Utility Garage	Vacuum/Enclosure	Yes
6. Commercial Garage	Brake Assembly Washer	Yes
7. Public School Transportation Garage	Wet Method and Vacuum/Enclosure	Yes
8. State Department of Transportation Garage	Vacuum/Enclosure	Yes
9. State Department of Transportation Garage	Vacuum/Enclosure	Yes
10. Manufacturing Facility Garage	Vacuum/Enclosure	Yes

process-related variables that accentuate or limit the dust controls in use.

The objective of the process characterization is to identify and describe these variables such that a person who is familiar with brake repair operations could at least qualitatively compare the key variable in the case study with those in a different situation.

Evaluation Methods

Air Sampling and Analysis

Personal samples will be collected in duplicate on cellulose ester filters at 3.5 lpm for the duration of a single brake job, or two hours, whichever is longer. A target of twelve brake jobs will be sampled per site. The total volume collected (420 liters) will allow a limit of detection of 0.1 fibers/cc.

Area (source, background, and ambient) air samples will be collected on cellulose ester filters. Two source samples will be collected at 7.0 lpm for the duration of a single brake job, or two hours, whichever is longer. The source samples will be used to determine leakage past enclosure seals, or brake dust dislodged by wetting (spray impingement). A target of twelve brake jobs will be sampled per site. The total volume collected (840 liters) will allow a limit of detection of 0.05 fibers/cc. Two background samples will be collected at 7.0 lpm for a four hour period encompassing pre- and post brake job activities. The background samples will be used to determine effects of general shop cleanliness and overall containment effectiveness of the controls. The total volume collected (1680 liters) will allow a limit of detection of 0.025 fibers/cc. Two ambient samples will be collected at 3.5 lpm for an eight hour period. The ambient samples will be used to determine environmental background levels of asbestos. The total volume collected (1680 liters) will allow a limit of detection of 0.025 fibers/cc.

All air samples will be analyzed by Phase Contrast Microscopy (PCM) in accordance with NIOSH Method 7400(19) by UBTL, Inc. In addition to PCM analysis, approximately 50 percent of these samples will be analyzed by light-field Transmission Electron Microscopy (TEM), using NIOSH equipment. Side-by-side dark-field TEM analysis will be done on a limited number of samples. To facilitate analysis by PCM and TEM on the same samples, the direct transfer method of sample preparation described by Burdett and Rood(32) will be used. All fibers with a 3:1 (or greater) ratio will be counted using Method 7400 A counting rules (the Method 7400 B counting rules may also be applied). For TEM analysis, fiber type and size distribution will be reported for fibers in: the less than 2 um range; the 2 to 5 um range; and the greater than 5 um range.

Bulk brake dust samples for each vehicle and bulk rafter samples for each site will be collected and analyzed for asbestos by polarized light microscopy (PLM) and TEM. The percentage of asbestos in the bulk samples will be determined by weight of the total dust and by the number of fibers. The size distribution of the asbestos and other fibers will be measured. Elemental analysis of the non-asbestiform constituents will be performed using energy dispersive x-ray analysis. The extent of deformation or degradation of the asbestos fibers will be qualitatively determined using dark field electron microscopy.[34]

Air sampling and analyses are summarized in Table 4.

Real-Time Monitoring

Because of anticipated low fiber concentrations, it will not be possible to measure the effect of individual job elements (i.e., hub cap removal, drum removal, assembly cleaning) on exposure. To obtain an estimate of the contribution of these activities to the overall exposure, a real-time dust monitor, will be used to obtain measurements of real-time dust aerosol concentrations. Data loggers will be utilized to record sequential real-time dust monitor readings. Personal computers will be used both in the field and in the office for data collection and reduction.

Ventilation

Kurz Model No. 480 and TSI Model No. 1630 air velocity meters will be used to measure air velocities to determine flow rates of air handling equipment. Smoke tubes will be used to assist in observation of general air flow patterns.

Air temperature, humidity, precipitation and wind conditions will be determined using an aspirated psychrometer and a velometer.

Work Practices Documentation

Work practices will be documented with a portable video tape ensemble consisting of a VHS recorder and camera. The camera will record workers as they perform their job. The job will be broken down to a fundamental work cycle and into functional elements to determine what activities during brake maintenance cause potential dust exposure for the worker.

The functional elements will include the posture and positioning of the right and left side of the worker's upper extremities so as to rank order work activities which generate various levels of dust. Machines, tools, personal protective equipment, and environmental conditions, will also be documented as part of the work cycle.

Where possible the video camera will be synchronized with Industrial Hygiene monitoring equipment (i.e., real-time hand held aerosol monitors), and field computers to correlate work activities and changes in dust exposure.

TABLE 4. Sampling Summary

Sample Type	Location	Sample Number	Flowrate (lpm)	Duration (min)	Volume (liters)	Frequency	Total* Number
Personal	Worker	2	3.5	120	420	each brake job	24
Source	Fender	2	7.0	120	840	each brake job	24
Back -ground	10 m from vehicle	2	7.0	240	1680	each brake job	24
Ambient	outdoors	2	3.5	480	1680	each day	24
					Site total:		96

*Total number based on an estimated 12 brake jobs per site

Notes: All samples will be collected on 25 mm cellulose ester filters mounted in cassettes with an extended cowl.
All samples will be analyzed by PCM; all outdoor samples and 50% of all other samples will be analyzed by TEM.
A bulk sample of brake dust will be collected from a brake drum of each vehicle; these samples will be analyzed by TEM to determine the fiber size distribution and the approximate weight percent of asbestos.
A rafter sample will be collected at each site and analyzed by polarized light microscopy (PLM) and TEM.

From the methods and systematic documentation described above, work practices, engineering controls, and personal protective equipment, will be evaluated to determine which of these factors change dust exposure during brake maintenance.

Evaluation Strategy

Samples will be taken at the source to characterize the effectiveness of source controls. Area samples will be taken to check background concentrations. Approximately 96 air samples per work site will be taken over a targeted twelve brake jobs per site. It may be necessary to perform a preliminary site visit to evaluate the suitability of the site and to determine background conditions prior to beginning work.

Personal Air Samples

Two personal samples will be taken for the duration of each vehicle brake job, or two hours, whichever is longer. A target of 12 brake jobs will be sampled per site. The total volume collected (420 liters) will allow a limit of detection of 0.1 fibers/cc.

Area Air Samples

Two samples (source) will be collected in the proximity of the repair activity to provide an indication of the effectiveness of the source controls. These samples will be collected at 7.0 lpm for the duration of a single brake job, or two hours, whichever is longer. The source samples will be used to determine leakage past enclosure seals such as those behind the brake assembly, or brake dust dislodged by wetting (spray impingement). The total volume collected (840 liters) will allow a limit of detection of 0.05 fibers/cc. Another similar series of daily area samples (background) will be collected more distantly, but in the same room as the repair activity to assess the general background fiber concentration and general shop cleanliness. Two background samples will be collected at 7.0 lpm for a four hour period encompassing pre- and post brake job activities. The total volume collected (1680 liters) will allow a limit of detection of 0.025 fibers/cc. Two ambient samples will be collected at 3.5 lpm for an eight hour period. The background samples will be used to determine environmental background levels of asbestos. The total volume collected (1680 liters) will allow a limit of detection of 0.025 fibers/cc.

Bulk Samples

Bulk dust samples from a brake drum for each vehicle and settled dust (rafter) samples for each site will be collected and analyzed for asbestos by polarized light microscopy (PLM) and TEM.

Direct Reading Monitors

Two direct reading real-time dust monitors will be used to provide insight into the correlation of various process and control parameters with the short-term variations in area concentrations. One real-time dust monitor with a data logger will be positioned adjacent to the source samples. A second real-time dust monitor will be employed to observe the changes in dust concentrations in the breathing zone of the repair workers.

Use of Personal Protective Equipment

During the course of this study the type of personal protective equipment and its use will be documented. This will include respiratory protection and protective clothing.

Identification of Safety Hazards

In addition to any evaluations of exposures to asbestos dust, the study will document and qualitatively evaluate potential exposures to and control of safety hazards, such as hazardous surfaces and work practices.

Data Analysis

Data on samples collected and analyzed by two or more sampling/analysis procedures will be statistically analyzed to determine the statistical significance of their differences, by paired t-tests, and a correlation coefficient between pairs of measurements will be calculated. This type of analysis will be performed on duplicate analyses such as Manual PCM and TEM.

T-tests will be applied to personal sample measurements at each site to determine the effectiveness of the control. The null hypothesis for each site is defined as H_0: mean is less than or equal to 0.1 f/cc and the alternate hypothesis H_a: mean is greater than 0.1 f/cc.

Data on samples collected at work sites, where several process variables, work site variables, work practice variables and counting variables are present, will be analyzed by Analysis of Variance Techniques (ANOVA). This technique separates the variations that are present into independent components and determines whether or not the hypotheses stated are valid. Variables, both individually and combined, will be tested in models to determine if any variables contribute significantly to the variation in the data. Separate models will be tested for each control situation (i.e., site). It is recognized that because of the limited sample size, statistical significance cannot be demonstrated for all variables encountered in a field study. The Statistical Analysis System Procedure, General Linear Model SAS PROC GLM, will be used for this analysis. Variables will include (but are not limited to) day of sample, type of sample, work activity, work practices, and type of ventilation.

The area sample data will be collected in sets of six measurements - two background samples, two samples close to the operation, and two ambient along with two personal samples. The analysis of variance will adjust for set-to-set differences, and for location-to-location differences. The residual will provide an estimate of the measurement variance. Transformation, such as the natural log transformation, will be applied to obtain homogeneous variance, normal distribution, and additivity (i.e., no interaction between location means and sets). Residuals will be plotted to test the appropriateness of each transformation.

The F-test will be applied to compare sample means and to compare a sample means with a background sample mean. For making multiple comparisons among sample locations the Duncan or Scheffe statistical techniques will be used (the Scheffe test being the most conservative). Statistical summaries will then be derived using the data transformed back to the original scale.

The above statistical analysis will be performed using SAS procedures.

Field Team Preparation

All members of the field team are currently given a medical examination, including pulmonary function tests to determine their fitness for the conduct of field studies. During the conduct of the study, team members will wear disposable protective clothing.

WORK TO DATE

Preliminary surveys were conducted at 10 sites which were reported to have good controls. These site visits were conducted to subjectively evaluate the control systems in place at these sites. When these preliminary surveys were completed they were reviewed to determine which site conditions presented the best opportunity to achieve good controls (See Table 3). Sites with the desirable characteristics will be selected for in-depth studies to evaluate the source control effectiveness. (See Appendix C for Project Milestones and Cost Allocation.)

VI. STUDY PRODUCTS

Case study reports detailing work done at each study site will be prepared. These individual survey reports will be distributed through NTIS. Based on the outcome of the in-depth studies, recommended controls and work practices will be compiled and documented in a final report and journal articles. There may also be recommendations for further research and development, if deemed appropriate.

The findings of this study will also be shared with EPA, OSHA, and a number of professional groups. This larger audience will be reached through publications in appropriate journals and presentations.

VII. REFERENCES

1. Dubrow, Robert and David Wegman. 1983. "Setting Priorities for Occupational Cancer Research and Control: Synthesis of the Results of Occupational Disease Surveillance Studies," Journal of the National Cancer Institute, 71:6; 1123:1142.

2. NIOSH. (1982) Asbestos Exposure Assessment for Brake Mechanics. Industrial Hygiene Summary Report No. 32.4. 1982.

3. Keasbey and Mattison products catalog, 1926. Ambler, PA.

4. Friction Materials on Automobile brakes. Flett Owner, (August 1963).

5. Carroll, W.G. The Manufacture of Brake Linings. British Plastics 414-417 (August 1962).

6. Anderson, A.E., and R. Gealer. Ford Motor Co., Detroit, MI. Unpublished notes.

7. White, Andrew J. Brake Dynamics: An Introduction to Brakes at the Inspection Station Level. Motor Veh. Resh. of N.H., Lee, N.H., Chapter 11, 463-472. (1968).

8. Rohl, Arthur N. et al. (1975) Asbestos Exposure During Brake Lining Maintenance and Repair, Environmental Sciences Laboratory, Mount Sinai School of Medicine, New York, NY. Environmental Research 12. 1976. 110-128.

9. PEI Associates, Inc. (1985) Asbestos Dust Control in Brake Maintenance. EPA Contract No. 68-02-3976. 1985.

10. Bendix Research Laboratories. (1973) Brake Emissions: Emission Measurements from Brake and Clutch Linings from Selected Mobile Sources. Prepared for the U.S. Environmental Protection Agency, Office of Air and Water Programs. PB-222 372.

11. Williams, Ronald L. and Jean L. Muhlbaier. (1982) Asbestos Brake Emissions. Environmental Science Department, General Motors Research Laboratories, Warren, MI. Environmental Research 29. 1982. 70-82.

12. OSHA and the National Bureau of Standards. (1978) Proceedings of Workshop on Asbestos: Definitions and Measurement Methods. Workshop held at Gaithersburg, MD. July 18-20, 1977. NBS Special Publication 506.

13. NIOSH. (1981) Industrial Hygiene Report. Assessment of Asbestos Exposure to Mechanics Performing Brake Service Operations.

14. Inoko, Masanori and Kyoko Arisso. (1982) Determination of Chrysotile Fibers in Residual Dust on Road Vehicle Brake Drums. Institute of Environmental Science and Technology, Yokohama National University, Yokohama, Japan. Environmental Pollution (Series B) 4. 1982. 249-255.

15. Rohl, Arthur N. (1979) Letter dated April 11, 1979 from Dr. Rohl to Robert Magdelain, President, Nilfisk of America describing the results of tests run on the Nilfisk system.

16. Rohl, Arthur N. (1984) Letter dated October 12, 1984 from Dr. Rohl to Jim Clayton, President, Clayton Associates, Inc., describing the results of tests run on the Clayton system.

17. NIOSH. (1976) Revised Recommended Asbestos Standard. DHEW (NIOSH) Publication No. 77-169.

18. NIOSH. (1984). Statement of the National Institute for Occupational Safety and Health, The Public Hearing on Occupational Exposure to Asbestos June 21, 1984, Testimony on Proposed Rule Making at OSHA Hearings.

19. NIOSH Method 7400. (1984) NIOSH Manual of Analytical Methods, Third Edition Vol. 2, DHHS (NIOSH) Publication NO. 84-100.

20. Revised Recommended Asbestos Standard. U.S. Department of Health, Education, and Welfare, DHEW (NIOSH) Publication No. 77-169, p. 93, December 1976.

21. Newhouse, M.L. and H. Thompson. Mesothelioma of Pleura and Peritoneum Following Exposure to Asbestos in the London Area. Brit. J. Ind. Med. 22:261-269, 1965.

22. McDonald, A.D. et al. Epidemiology of Primary Malignant Mesothelial Tumors in Canada. Cancer 26:914-19, 1970.

23. Greenberg, M. and T.A. Lloyd Davies. Mesothelioma Register 1967-1968 Brit. J. Ind. Med. 31:91-104, 1974.

24. Lorimer, W.V., A.N. Rohl, A. Miller, W.J., Nicholson, and I.J. Selikoff. "Asbestos Exposure in Brake Repair Workers in the United States." Mt. Sinai J. of Med. 43:207-218, (May-June 1976).

25. Bader, M.E., R.A., Bader, A.S., Teirstein, A. Miller, and I.J. Selikoff. Pulmonary Function and Radiographic Changes in 598 Workers with Varying Duration of Exposure to Asbestos. Mt. Sinai J. of Med. 38:492-500, 1970.

26. Davis, J.M.S., and S.W. Coniam. Experimental Studies on the Effects of Heated Chrysotile Asbestos and Automobile brake Lining Dust Injected into the Body Cavities of Mice, Experimental and Molecular Pathology, Vol. 19, pp. 339-353 (1973).

27. Koshi, K., H. Hayashi, and H. Sakabe. Biological and Mineralogical Studies on Serpentine Minerals in Heat Treated State, Ind. Health, Vol. 7, pp. 66-85 (1969).

28. Pott, F., F. Huth, and K.H. Friedricks. Tumorigenic Effects of Fibrous Dusts in Experimental Animals. Environmental Health Perspectives, Vol. 9, pp. 313-315 (1974).

29. Pott, F., F. Huth, and K.H. Friedricks. Tumorigenic Effects of Fibrous Experiments Concerning the Carcinogenic Effects of Fibrous Dusts. Interpretation of Results Considering the Carcinogenesis in Humans. Annales d'Anatomie Pathologique, Paris (1976), Vol. 21, pp. 237-246.

30. Davis, J.M.G. The Fibrogenic Effects of Mineral Dusts Injected into the Pleural Cavity of Mice, British Journal Exp. Pathology, Vol. 53, pp. 190-201, 1972.

31. Stanton, M.F., M. Layard, A. Tegeris, E. Miller, M. May, and E. Kent. The Carcinogenicity of Fibrous Glass: Pleural Response in the Rat in Relation to Fiber Dimension. J. Natl. Cancer Institute. 58:587-603, March 1977.

32. Burdett, Garry J., and Anthony P. Rood. (1983). Membrane-Filter, Direct-Transfer technique for the Analysis of Asbestos Fibers or Other Inorganic Particles by Transmission Electron Microscopy, American Chemical Society, Environmental Science and technology, 17-11:643-649.

33. Current Intelligence Bulletin 5. Asbestos Exposure During the Servicing of Motor Vehicle Brake and Clutch Assemblies. National Institute for Occupational Safety and Health. August 8, 1975.

34. Seshan, Krishna: On the Utility of Dar k-Field Electron Microscopy in the Determination of the Degree of Deformation In Chrysotile Asbestos: An Environmental Research Application. Environmental Research 16:383-392 (1978).

APPENDIX A[13]

RECOMMENDED PROCEDURES FOR ASBESTOS BRAKE AND CLUTCH SERVICING

The National Institute for Occupational Safety and Health (NIOSH) has conducted research on dust exposures which are generated during brake and clutch servicing. Based on data demonstrating the potential for significant asbestos exposures during brake and clutch servicing, NIOSH has investigated various work practices which are utilized in reducing asbestos exposures. These investigations have indicated vacuum cleaning systems to be the most effective method for minimizing asbestos dust exposures during brake and clutch servicing. Vacuum cleaner testing have demonstrated that these units operate reliably within design specifications. Therefore, NIOSH recommends vacuum cleaning as the primary method to be used for cleaning of asbestos dust during brake and clutch servicing operations.

The following are additional procedures recommended by NIOSH to minimize asbestos dust exposure:

1. Where possible, an area shall be designated 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 Be Hazardous to Your Health

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 particulate air filter system (HEPA - greater than 99 percent efficiency for 0.3 um 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 a dry brush be used for cleaning. If vacuum cleaning equipment is not available, the wet brush cleaning method may be used until a vacuum cleaning system is obtained. Where wet brushing is necessary for cleaning, a NIOSH-certified respirator approved for asbestos shall be worn.

3. During brake pad grinding, riveting, and punching operations, local exhaust ventilation and dust collection systems shall be designed, 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 clutch servicing, a NIOSH-certified respirator approved for asbestos shall be worn during the removal and cleaning of the clutch,

pressure plate, and housing assembly, and during installation of the new clutch assembly. Whenever possible, cleaning shall be performed with an HEPA vacuum system as described in 2 above.

5. All table and floor cleaning in areas where brakes and clutches are repaired shall be done with the HEPA vacuum cleaner as described in 2 above. Grinding and riveting machines shall also be cleaned with such a cleaner and the remaining dust wiped with a water-dampened cloth. A NIOSH-certified respirator approved for asbestos shall be used during this cleaning.

6. If not in effect, a respirator program shall be established in accordance with the Occupational Safety and Health Administration (OSHA) Standard, Title 29, U.S. Code of Federal Regulations (CFR), Part 1910.134.

7. HEPA vacuum cleaner filters containing asbestos dust, cloths, or brushes used for wiping brake and clutch assemblies, and all liquid used for wet brushing shall be disposed of in accordance with U.S. Environmental Protection Agency (EPA) regulations. These regulations state that the asbestos waste shall be disposed of in sealed impermeable bags or other containers at a disposal site which meets EPA criteria for asbestos disposal. Also, the waste containers shall display the following warning label or tag printed in letters of sufficient size and contrast to be visible and legible:

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

   The EPA regulations for proper asbestos waste disposal are detailed in Title 40, CFR, Part 61, Subparts A and B.

8. A NIOSH-certified respirator approved for asbestos shall be worn during removal of vacuum bags which contain asbestos dust.

9. Consumption of food and beverages shall not be permitted in work areas where asbestos exists. An area designated for food consumption shall be separate from the work area so as to provide maximum protection against asbestos dust contamination.

10. If the employee is exposed to airborne concentrations of asbestos fibers which exceed the OSHA ceiling level, the OSHA requirement regarding special clothing, change rooms, locker, etc., as described in Title 29, CFR, Part 1910.1001 (D), shall be followed.

<u>The OSHA asbestos standard as of July 1976 states</u>: 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 in length per cubic centimeter of air (fibers greater than 5 um/cc). The ceiling

airborne concentration to which no employee may be exposed shall not exceed 10 fibers greater than 5 um/cc.

OSHA in 1975 proposed an 8-hour TWA of 0.5 fibers greater than 5 um/cc with a permissible ceiling exposure of five fibers greater than 5 um/cc for any period not exceeding 15 minutes. NIOSH currently recommends that the TWA exposure to asbestos be 0.1 fibers greater than 5 um/cc.

NOTE: Strict adherence to the above procedures should minimize exposures to employees during brake and clutch servicing. These recommendations are based on the results of research conducted by NIOSH.

APPENDIX B

DEPARTMENT OF HEALTH AND HUMAN SERVICES REGULATIONS FOR INVESTIGATIONS OF PLACES OF EMPLOYMENT

(Code of Federal Regulations, Title 42, Part 85a, 41 FR 45003, October 14, 1976; amended at 45 FR 2651, January 14, 1980; amended at 49 FR 4739, February 8, 1984)

Title 42-Public Health

CHAPTER I-PUBLIC HEALTH SERVICE, DEPARTMENT OF HEALTH AND HUMAN SERVICES
SUBCHAPTER G-OCCUPATIONAL SAFETY AND HEALTH RESEARCH AND RELATED ACTIVITIES

Part 85a-OCCUPATIONAL SAFETY AND HEALTH INVESTIGATIONS OF PLACES OF EMPLOYMENT

Sec.
85a.1 Applicability.
85a.2 Definitions.
85a.3 Authority for investigations of places of employment.
85a.4 Procedures for initiating investigations of places of employment.
85a.5 Conduct of investigations of places of employment.
85a.6 Provision of suitable space for employee interviews and examinations.
85a.7 Imminent dangers.
85a.8 Reporting of results of investigations of places of employment.

AUTHORITY: Sec. 8(g), 84 Stat. 1600; 29 U.S.C. 657(g) and Sec. 508.83 Stat. 803.30 U.S.C. 957. [Authority citation amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

85a.1 Applicability

(a) Except as otherwise provided in paragraph (b) of this section, the provisions of this part apply to investigations of places of employment which are conducted by NIOSH under sections 20 and 8 of the Occupational Safety and Health Act of 1970 and sections 501 and 103 of the Federal Mine Safety and Health Act of 1977.
[Section 85a.1(a) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(b) The provisions of this part do not apply to those activities covered by Part 85 of this chapter.

85a.2 Definitions

Any term defined in the Occupational Safety and Health Act of 1970 or the Federal Mine Safety and Health Act of 1977 and not defined below shall have the meaning given it in the Acts. As used in this part:

(a) "OSH Act" means the Occupational Safety and Health Act of 1970 (29 U.S.C. 651 et seq.) and "FMSH Act" means the Federal Mine Safety and Health Act of 1977 (30 U.S.C. 801 et seq.).
[Sections 85a.2 and 85a.2(a) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(b) "Assistant Regional Director" means any one of the ten Occupational Safety and Health Administration Assistant Regional Directors for Occupational Safety and Health.

(c) "Informed consent" means the knowing consent of an individual or his legally authorized representative, so situated as to be able to exercise free power of choice without undue inducement or any element of force, fraud, deceit, duress, or other form of constraint or coercion. The basic elements of information necessary

FMSI 02391

to such consent include:

(1) A fair explanation of the procedures to be followed, and their purposes, including identification of any procedures which are experimental;

(2) A description of any attendant discomforts and risks reasonably to be expected;

(3) A description of any benefits reasonably to be expected;

(4) A disclosure of any appropriate alternative procedures that might be advantageous for the subject;

(5) An offer to answer any inquiries concerning the procedures; and

(6) An instruction that the person is free to withdraw his consent and to discontinue participation in the investigation at any time without prejudice to the subject.

(d) "Investigation" means research projects, experiments, demonstrations, studies, and similar activities of NIOSH which are conducted under section 20 of the OSH Act and section 501 of the FMSH Act.
[Section 85a.2(d) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(e) "Legally authorized representative" means an individual or judicial or other body authorized under applicable law to consent on behalf of a prospective subject to such subject's participation in the particular activity or procedure.

(f) "NIOSH" means the National Institute for Occupational Safety and Health of the Centers for Disease Control, Public Health Service, Department of Health and Human Services.

(g) "NIOSH authorized representative" means a person authorized by NIOSH to conduct investigations of places of employment, including any person that is fulfilling a contract agreement with NIOSH or is serving as an expert or consultant to NIOSH pursuant to the Act.

(h) "NIOSH Regional Office" means any one of the ten Department of Health and Human Services Regional Offices, the addresses of which are specified in 5.31 of Title 45, Code of Federal Regulations.

(i) "Places of employment" means any coal or other mine, factory, plant, establishment, construction site, or other area, workplace or environment where work is performed by any employee of an employer.
[Section 85a.2(i) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(j) "MSHA District Office" means any one of the Mine Safety and Health Administration's District Offices.
[Section 85a.2(j) added at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(k) "BOM" means of the Bureau of Mines, Department of the Interior.
[Section 85a.2(k) added at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(l) "Employee" has the same meaning as stated in the OSH Act and for the purpose of this part includes "miner" as defined in the FMSH Act.
[Section 85a.2(l) added at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(m) "Employer" has the same meaning as stated in the OSH Act and for the purposes of this part includes "operator" as defined in the FMSH Act.
[Section 85a.2(m) added at 45 FR 2651, January 14, 1980, effective February 13, 1980]

85a.3 Authority for investigations of places of employment

(a) NIOSH authorized representatives who have been issued official NIOSH credentials are authorized by the Director, NIOSH, under sections 20 and 8 of the OSH Act, sections 501 and 103 of the FMSH Act, and this part: To enter without delay any place of employment for the purpose of conducting investigations of all pertinent processes, conditions, structures, machines, apparatus, devices, equipment, and materials within the place of employment; and to conduct medical examinations, anthropometric measurements and functional tests of employees within the place of employment as may be directly related to the specific investigation being conducted. Such investigations will be conducted in a reasonable manner, during regular working hours or at other reasonable times and within reasonable limits. In connection with any investigations, such NIOSH authorized representatives may question privately any employer, owner, operator, agent, or employee from the place of employment; and review, abstract, or duplicate employment records, medical records, records required by the Act and regulations, and other related records. In those instances where systems of records subject to review, abstraction or duplication are of a confidential nature, such as medical records, and are abstracted or duplicated, NIOSH will maintain such systems in accordance with the Privacy Act of 1974 (5 U.S.C. 552a) and the implementing regulation of the Department of Health and Human Services (45 CFR Part 5b).
[Section 85a.3(a) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(b) Areas under investigation which contain information classified by an agency of the United States Government in the interest of national security will be investigated only by NIOSH authorized representatives who have obtained the appropriate security clearance and authorization.

85a.4 Procedures for initiating investigations of places of employment

(a) Except as otherwise provided in paragraph (b) of this section, NIOSH authorized representatives will contact an official representative of the place of employment prior to any site visits and will provide the details of why an investigation of the place of employment is being conducted. Prior to the initiation of a site visit of a place of employment, representatives of the following organizations will be advised of the site visit and the reason for its conduct:

(1) The appropriate State agency designated under section 18(b) of the OSH Act or if no State agency has been designated under the OSH Act and in the case of the FMSH Act, the State agency which, in the judgment of NIOSH, would benefit the most from the investigation's findings.
[Section 85a.4(a)(1) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(2) If there is a local union at the place of employment, the local president, business manager or other appropriate individual.
[Section 85a.4(a)(2) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(3) The appropriate Assistant Regional Director, when investigations are conducted under the OSH Act.
[Section 85a.4(a)(3) amended at 45 FR 2651, January 14, 1980,

effective February 13, 1980]

(4) The appropriate MSHA District Office: the Director, BOM, and the Assistant Director for Mining, BOM, when investigations are conducted under the FMSH Act.

[Section 85a.4(a)(4) added at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(b) Advance notice of site visits will not be given to the place of employment or local union at the place of employment when, in the judgment of the NIOSH authorized representatives, giving such notice would adversely affect the validity and effectiveness of an investigation. Those individuals and organizations specified in 85a.4(a)(1), (a)(3), and (a)(4) will be notified prior to the initiation of such a site visit. After the site visit has been initiated, and, as soon as possible thereafter, the NIOSH authorized representatives will contact those individuals specified in 85a.4(a)(2) concerning the nature and details of the site visit.

[Section 85a.4(b) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(c) In those instances where site visits are not necessary to the conduct of an investigation, the NIOSH authorized representatives will contact an official representative of the place of employment either verbally or through a written communication and provide the details of why an investigation of the place of employment is being conducted. If appropriate, the NIOSH authorized representatives will contact those individuals stipulated in paragraphs (a)(1), (a)(2), (a)(3), and (a)(4) of this section about the nature of details of the investigation.

[Section 85a.4(c) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

85a.5 Conduct of investigations of places of employment

(a)(1) Prior to beginning a site visit, NIOSH authorized representatives will present their credentials to the employer, owner, operator or agent in charge at the place of employment, explain the nature, purpose and scope of the investigation and the records specified in 85a.3 which they wish to review, abstract or duplicate.

(2) In those instances where site visits are not necessary to the conduct of an investigation and the initial contact is made verbally, NIOSH authorized representatives will, at the request of the employer, owner, operator or agent in charge at the place of employment, provide a written explanation of the nature, purpose and scope of the investigation and the records specified in 85a.3 which they wish to review, abstract or duplicate.

(b)(1) At the commencement of an investigation, the employer, owner, operator or agent in charge at the place of employment shall precisely identify that information which is trade secret and might be seen or obtained by the NIOSH authorized representatives during the investigation. If the NIOSH authorized representatives have no clear reason to question such identification, such information will not be disclosed by NIOSH in accordance with the provisions of section (15) of the OSH Act. Generally, NIOSH will not question trade secret designations; however, if NIOSH at any time does question such identification, not less than 15 days' notice to the employer, owner, operator or agent will be given of the intention to remove the trade secret designation from

such information. The employer, owner, operator or agent may within that period submit a request to the Director, NIOSH, to reconsider this intention and may provide additional information in support of the trade secret designation. The Director, NIOSH, will notify the employer, owner, operator or agent in writing of the decision which will become effective no sooner than 15 days after the date of such notice.
[Section 85a.5(b)(1) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(2) In those instances where the NIOSH authorized representative is a person fulfilling a contract agreement with NIOSH or is serving as an expert or consultant to NIOSH pursuant to the Act, the employer, owner, operator or agent in charge at the place of employment may, after advising the NIOSH contractor or consultant in writing, elect to withhold information deemed to be a trade secret from such a NIOSH authorized representative or prohibit entry into the area of the place of employment where such entry will reveal trade secrets. In those instances, where the subject information is needed or access to the area of the place of employment is necessary, in the judgment of NIOSH, to fulfill the goals of the investigation, NIOSH regular employees will then obtain the information or enter the subject area of the place of employment.

(c)(1) NIOSH authorized representatives will be in charge of site visits conducted pursuant to this part.

(2) Where there is a request by the representative of the State agency and/or employees, who were notified pursuant to 85a.4(a)(1) or 85a.4(a)(2) to accompany the NIOSH authorized representatives during the site visit of the place of employment, the NIOSH authorized representatives will allow this request if they determine that this will aid the investigation; or where in the judgment of the NIOSH authorized representatives, good cause has been shown why accompaniment by a third party who is not an employee of the employer is reasonably necessary to the conduct of an effective and thorough site visit, they may permit such third party to accompany them during the site visit; provided, however, that access by such person(s) to areas described in 85a.5(c)(4) shall be in accordance with the requirements of such provision and access to areas containing trade secrets shall be with the consent of the employer, owner, operator or agent in charge at the place of employment.

(3) NIOSH authorized representatives are authorized to deny the right of accompaniment under this paragraph to any person whose conduct in their judgment interferes with a fair and orderly site visit. In all instances, a representative of the employer shall be permitted to accompany the NIOSH authorized representatives during the site visit of the place of employment.

(4) With regard to information classified by an agency of the United States Government in the interest of national security, only persons authorized to have access to such information may accompany NIOSH authorized representatives in areas containing such information.

(d)(1) NIOSH authorized representatives are authorized: To collect environmental samples and samples of substances; to measure environmental conditions and employee exposures (including measurement of employee exposure by the attachment of personal sampling devices to employees with their consent); to take or obtain photographs, motion pictures or videotapes related to the purpose of the investigation; to employ other reasonable investigative techniques, including medical examinations, anthropometric measurements and standardized and experimental functional tests of employees with the informed consent of such employees; to review, abstract, and duplicate such personnel records as are pertinent to mortality, morbidity, injury, safety, and other similar studies; and to question and interview privately any employer, owner, operator, agency, or employee from the place of employment. The employer, owner, operator, or agency shall have the opportunity to review photographs, motion pictures, and videotapes taken or obtained for the purpose of identifying those which contain or might reveal a trade secret. [Section 85a.5(d)(1) amended at 49 FR 4739, February 8, 1984, effective March 9, 1984]

(2) Prior to the conduct of medical examinations, anthropometric measurements or functional tests of any employees, the NIOSH authorized representatives will obtain approval of the procedures to be utilized from the NIOSH Human Subjects Review Board and no employee examination, measurement or test will be undertaken without the informed consent of such employee.

(e) NIOSH authorized representatives will comply with all safety and health rules and practices at the place of employment and all NIOSH, Occupational Safety and Health Administration, and Mine Safety and Health Administration regulations and policies during a site visit and will provide and use appropriate protective clothing and equipment. In situations requiring specialized or unique types of protective equipment, such equipment shall be furnished by the employer, owner, operator or agent in charge at the place of employment.
[Section 85a.5(e) amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

(f) The conduct of site visits will be such as to preclude unreasonable disruption of the operations of the place of employment.

85a.6 Provisions of suitable space for employee interviews and examinations

An employer, owner, operator or agent in charge at the place of employment shall, on request of the NIOSH authorized representatives, provide suitable space at the place of employment, if such space is reasonably available, to NIOSH to conduct private interviews with, and medical examinations, anthropometric measurements and functional tests of employees. NIOSH authorized representatives will consult with the employer, owner, operator or agent as to the time and place of the private interviews, medical examination, anthropometric measurements and functional tests and will schedule same so as to avoid undue disruption of work at the place of employment. NIOSH will conduct the medical interviews, measurements, examinations, and tests specified under this part at its own expense.

85a.7 Imminent dangers

Whenever, during the course of, or as a result of, an investigation

under this part, the NIOSH authorized representatives believe there is a reasonable basis for an allegation of an imminent danger, NIOSH will immediately advise the employer, owner, operator or agent in charge at the place of employment and those employees who appear to be in immediate danger of such allegation and will inform the agencies identified in 85a.4(a)(1), (a)(3), and (a)(4).
[Section 85a.7 amended at 45 FR 2651, January 14, 1980, effective February 13, 1980]

85a.8 Reporting of results of investigations of places of employment

(a)(1) Specific reports of investigations of each place of employment under this part, with identification of the place of employment, will be made available by NIOSH to the employer, owner, operator or agent in charge at the place of employment, with copies to the appropriate officials and Agencies notified pursuant to 85a.4(a). Prior to release of such reports, a preliminary report will be sent by NIOSH to the employer, owner, operator or agent for review for trade secret information and technical inaccuracies that may inadvertently be presented in the report. If requested in writing, the data used to compile the reports will be made available by NIOSH to the employer, owner, operator or agent in charge at the place of employment, except that data will not be released in a form that is individually identifiable.

(2) All specific reports of investigations of each place of employment under this part will be available to the public from the NIOSH Regional Consultant for Occupational Safety and Health in the appropriate NIOSH Regional Office.

(3) In certain instances, specific reports of investigations of each place of employment will not be prepared. In such instances, a closing conference at the place of employment will be conducted by the NIOSH authorized representatives and those individuals participating in the site visit to discuss the findings of the site visit and appropriate recommendations.

(b)(1) Any specific findings of individual employee medical examinations, anthropometric measurements and functional tests will be released by NIOSH authorized representatives to the company physician, private physician, or other person only pursuant to the written authorization of the employee; otherwise, the specific findings and other personal records concerning individuals will be maintained in accordance with 45 CFR, Part 5b and section 3 of the Privacy Act of 1974 (5 U.S.C. 552a). Notice of all NIOSH systems of records as defined in 45 CFR 5b.1(n) as a result of the investigations of places of employment pursuant to this part will be published in the FEDERAL REGISTER under Notices of Systems of Records for the Department of Health and Human Services.

(2) In cases where an employee shows positive significant medical findings, the employee and the physician(s) designated by the employee under 85a.8(b)(1) will be immediately notified by NIOSH.

(3) A summary of the findings of the examinations for each employee will be sent by NIOSH to the individual.

(c) The findings of a total investigation generally will be disseminated as part of NIOSH criteria documents, NIOSH technical reports, NIOSH information packets, scientific journals, presentations at technical meetings, or in other similar manners. These findings of a total investigation will be presented in a manner which does not identify any specific place of employment; however, it should be noted that the specific reports of investigations of each place of employment under this part are subject to mandatory disclosure, upon request, under the provisions of the Freedom of Information Act (5 U.S.C. 552).

[Title 42, Part 85a added 41 FR 45003, October 14, 1976]

APPENDIX C

Project Milestones and Cost Allocation

Milestone	FY 1986 Q1	FY 1986 Q2	FY 1986 Q3	FY 1986 Q4	FY 1987 Q1	FY 1987 Q2	FY 1987 Q3	FY 1987 Q4	Cost Allocation	FY 1986	FY 1987	Totals
									EPA Support			
1. Complete preliminary site surveys.	(5)	(10)							Travel	$ 5,000	$ 8,000	
2. Complete preliminary site survey reports.	(5)	(10)							Equipment	20,000	$10,000	
3. Conduct peer review.			X						Supplies	5,000	2,000	
4. Complete protocol and identification of controls for in-depth surveys.				X					Subtotal	$30,000	$20,000	
									20% overhead	6,000	4,000	
										$36,000	$24,000	
									Analytical-TEM Support(ORD)[a]	14,000	30,000	
									Total EPA Support	$50,000	$54,000	
5. Complete in-depth site surveys.			(1)	(2)	(4)	(6)						
6. Complete in-depth site survey reports.							X					
									NIOSH Support			
7. Present findings at professional meeting.							X		Travel	$ 2,000	$ 2,000	
									Analytical-PCM Support	8,000	16,000	
8. Submit final report and journal article to Director DPSE.								X	Personnel (4 M-Y per year at $40,000/M-Y)	160,000	160,000	
									Total NIOSH Support	$170,000	$178,000	

(a) Estimated analytical cost of $250 per sample for TEM, based on present cooperative work being done by EPA/ORD and PEI. The money will go directly to ORD to support the PEI analysts, who will work on NIOSH/EPA equipment under the technical supervision of NIOSH/EPA staff.

FMSI 02399