Exclusive! Beware of Brake Dust!

By Bob Cerulli

MOST MECHANICS GO ABOUT the task of cleaning brake and clutch dust know that while doing the job they are inhaling some of this dust. It has been general knowledge that lining and pads are made on the average of 50 to 60 percent asbestos. However, past studies have led us to believe that the asbestos fiber was locked into other materials in the lining and that a change due to the high heat of friction took place during braking or clutch application. This transformed the asbestos fiber into a non-toxic, non-fibrous material called forsterite. The conclusion then was that the dust was harmless.

Studies conducted by the Mt. Sinai School of Medicine in New York City indicate that brake dust may actually contain an average of 3 to 6 percent asbestos with some tests showing concentrations as high as 15 percent. Samples of air were taken under actual working conditions in a taxi-fleet garage and a N.Y. Dept. of Sanitation truck repairshop. These samples were analyzed by electron microscopy and revealed levels of airborne asbestos considerably higher than those permitted by federal law. It should be noted that during the testing in the truck repairshop grinding of brake shoes was carried out.

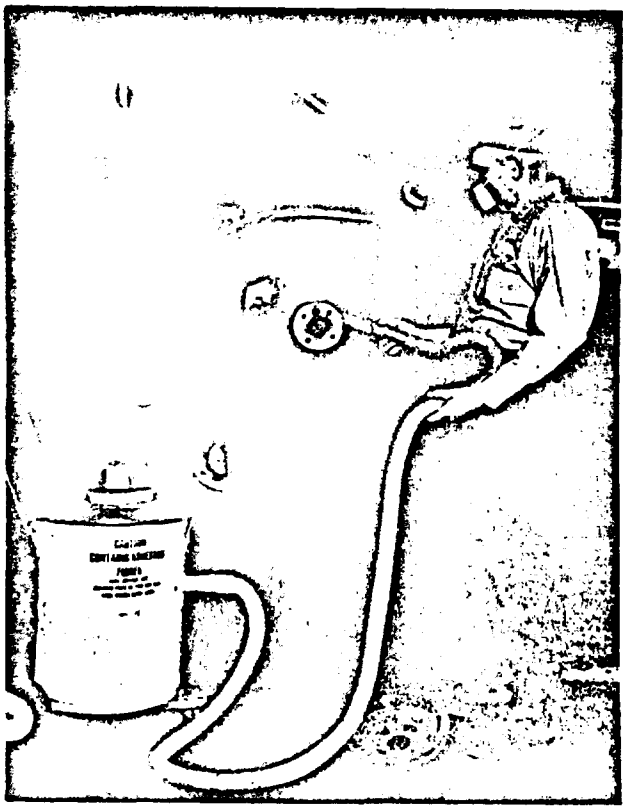

Fig. 1. REMOVE BRAKE DUST with high-efficiency filtered industrial vacuum cleaner. Wear air-purifying respirator.

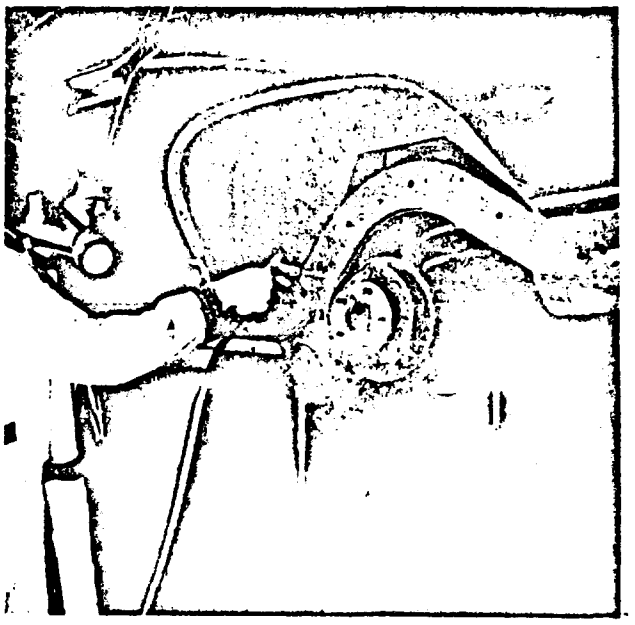

Fig. 2. NEVER BLOW OFF dirt from a brake assembly with an air gun. After vacuuming, use a nearly-dry damp rag.

The work of the researchers at Mt. Sinai was discussed at a meeting of the National Institute for Occupational Safety and Health (NIOSH) where the results of physical examinations given to 90 men who had been working as automobile and truck-brake repairmen for a period of 10 years were examined. Of this small group the doctors stated that X-ray examinations showed that over one-quarter had signs of abnormalities consistent with asbestosis disease; the same tests revealed that one quarter had also restricted pulmonary (lung) functions. This evidence prompted NIOSH to issue an alert to the automotive repair industry indicating that while the full extent of asbestos-related disease in brake-service personnel is not known because this occupational group has not been systematically studied up to now, enough scientific data has been accumulated to point out the need to start immediate control measures so that the health hazard of asbestos can be minimized.

There is no doubt that this health hazard exists and that exposure to asbestos fibers can increase the risk

continued on page 70

FMSI 04791

Y-11 (3)

continued from page 74

of developing four diseases: asbestosis—a non-malignant scarring lung condition; cancer of the lung; cancer of the digestive tract and mesothelioma—a cancer of the lining of the chest or abdominal cavities.

There are some authorities and other studies that place the percentage of asbestos in brake dust at a much lower level than those reported by the Mt. Sinai group and disagree with its findings. All authorities agree that no matter how small the concentration of asbestos in brake and clutch dust, there is an immediate need to initiate work practices in every shop that will eliminate any risk to the health of mechanics.

The danger is associated with drilling, grinding and cutting of brake linings. The dust generated during these operations must be collected in a vacuum-recovery system that has a high-efficiency filter. Many older grinders either have no recovery system or are equipped with vacuums that allow tiny particles of asbestos fiber to be blown into the air. Buying pre-ground shoes will minimize the need for grinding.

Where possible, a separate area should be set aside for brake and clutch work and a sign posted at the entrance that reads:

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.

Dust should never be removed from a brake or clutch assembly with an air blowgun or by brushing. The only way to safely clean dust containing asbestos is with an industrial-type vacuum with a high efficiency filtering system (Fig. 1). Don't use one of your wife's old vacuum cleaners because it probably will do more harm than good. The fine particles of asbestos will pass through most vacuum cleaners and you will end up with a higher concentration of asbestos than you would have if you hadn't used the vacuum at all. The vacuum you buy should have a 99-percent efficiency for 0.3 micrometers diameter aerosols. If there is any remaining dust that was not removed by vacuuming, wash it off using a slightly damp rag. Under no circumstances should you use an air gun or dry brush (Fig. 2).

There is no point in being careful about vacuuming the dust if, when you empty the vacuum cleaner bag, the dust blows all around you and the shop. Brake and clutch dust should be disposed of in a special plastic bag marked as follows:

CAUTION:
CONTAINS ASBESTOS FIBERS.
AVOID BREATHING DUST.
BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM.

Even using a high-efficiency industrial vacuum cleaner will not prevent a small amount of dust from reaching some noses and mouths which will inhale it. To prevent this, you should wear an air-purifying respirator of either the throwaway type like those used in body shops or one with a replaceable particulate filter. Before you buy either type, be sure that it is approved by NIOSH or the Mining Enforcement and Safety Administration. Wear the respirator while you are operating a grinder, drill or when emptying the dust collection bags on your vacuum cleaner.

There is bound to be some brake and clutch dust that falls to the floor while you are working, so be sure to use an industrial vacuum cleaner to pick it up. Don't sweep this part of the shop with a broom. A broom has the tendency to flick the asbestos particles up into the air and that is where they are dangerous. The rest is common sense: If your shop has heavy accumulations of dust on lockers, parts shelves, overhead door channels, beams and on window sills there is a good chance that dust contains some asbestos. Wear your respirator and use your vacuum cleaner to go over all those hidden places carefully and clean up the dust. Change your work clothes regularly and don't bring them home. Have them washed by an industrial laundry. Wash your hands thoroughly before eating and avoid eating in the area where you do brake and clutch work.

Every shop, large or small, is responsible for meeting the requirements of the federal law which calls for industrial hygiene inspections carried out by OSHA representatives. Under this law the level of asbestos shall not exceed 2 fibers longer than 5 micrometers per cubic centimeter of air. (For a list of those firms send a self-addressed stamped postcard in an envelope to Asbestos, MOTOR, 1790 Broadway, New York, N.Y. 10019.)

Research has determined that smoking increases the rate of lung cancer among people exposed to asbestos dust. In short, if you have been working around brakes and clutches for several years, it would be wise to give up smoking.

continued on page 85

FMSI 04792

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It is gratifying to note that a great deal of money and time is being spent by bra[illegible] clutch lining manufacturers to deal with th[illegible] In addition to OSHA's specific requireme[illegible] label, one firm has included useful extra pr[illegible] on the warning label on every box of brak[illegible] clutch facings it sells. This same firm [illegible] mended procedures for reducing asb[illegible] during brake service in their service manua[illegible] training film.

In the final analysis you are the only one who can protect yourself from the potential dangers of exposure to asbestos dust. If you wear a respirator or mask, use an approved brake vacuum cleaner, dispose of the dust in the prescribed manner, vacuum the floors and use good common sense about house cleaning, there is little to fear from the presence of asbestos dust. The few extra precautions involved could prevent you from contracting a very painful if not fatal disease. Start tomorrow to clean up your act . . . you owe it to yourself, your family and your fellow workers. ■

How to Promote Your Service Department

continued from page 78

the clinic will be favorably impressed and may become customers in the future. A clinic of this type invariably uncovers the need for much service work, and the dealer should get a substantial share of this work.

The best promotion won't be effective unless the service department can deliver what it promises. Among the most frequent customer complaints are: work not done when promised, cars not repaired properly and high cost of repairs. Most dealerships will make good on a job if the work is performed improperly or a part is defective. These "warranties" are usually informal in nature, but some dealers have plans that are specific and widely advertised.

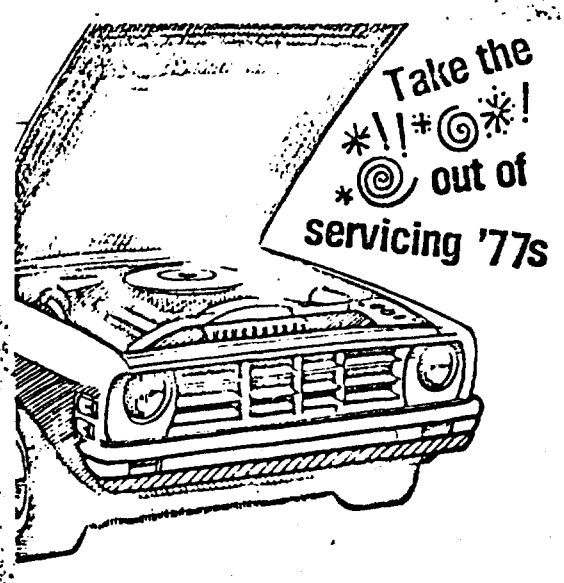
Your shop equipment can also be an important merchandising tool. An optical wheel alignment machine, for example, projects a "pictu[illegible] of the front-end setup of a customer's car. [illegible] wners understand the pattern of an [illegible] most are impressed by the dealer'[illegible] est in such sophisticated equipme[illegible] echnicians in its operation.

Finally, never forget tha[illegible] erchandisers are your shop person[illegible] not be high-pressure salesmen. It [illegible] ss the customer with their courtesy, [illegible] sincerity and back up that impressi[illegible] erformance, your investment in m[illegible] ent and promotional plans will pay off ■

KM

TOOL D...

TOOLS THAT DO THE JOB [illegible] THE FIRST TIME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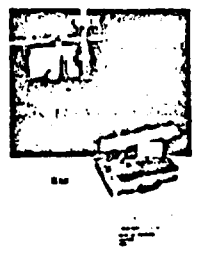
Now, the special service tools you need to quickly, properly and profitably service American Motors and General Motors 1977 models are available directly from Kent-Moore.

Using factory-approved Kent-Moore service tools (the "J" number tool specified in your Service Manual), you can do those tough jobs much faster and easier than with ordinary shop tools. Kent-Moore tools save you time (which is money in your pocket), unnecessary work, and they help you do the job to factory specs. This means greater customer satisfaction, fewer "come-backs."

Kent-Moore special service tools. You owe it to yourself to check them out.



Write for our new catalog of special tools for 1977 models. Write to Kent-Moore Tool Division, 28635 Mound Rd., Warren, Michigan 48092.

FMSI 04793

Bus fleet praised for fighting asbestos hazard

For its "excellent performance in protecting district mechanics from a cancer-causing substance, asbestos in fiber form," California's Health Dept. has commended the Golden Gate Bridge, Highway and Transportation District.

Golden Gate Transit, operating a fleet of 248 buses, was praised for protecting the 42 district mechanics who work with asbestos lining while performing brake and clutch maintenance and repairs on buses.

California is the first state to require employers to report workplace use of asbestos. Asbestos is the most widely used of 18 cancer-causing chemicals and substances regulated in California as part of a comprehensive program to prevent job-related cancer.

Excessive exposure to asbestos fibers can cause lung cancer, a rarer form of cancer known as mesothelioma, and a lung ailment called asbestosis.

State Health Director Jerome A. Lackner, M.D., said, "State industrial hygienists are discovering in inspections that asbestos in bus, truck and auto brake-repair shops is a significant potential health hazard to California workers, but one which safe work practices can control.

"An estimated 74,000 mechanics and other workers in 22,000 auto- and brake-repair shops serving the public are potentially exposed to asbestos through brake-repair work. Several thousand more workers doing brake repairs for transit systems, truck and bus lines and utility-vehicle fleets potentially risk similar exposure. Several citations for unsafe use of asbestos have been issued.

"So it is encouragingly good news when we learn that a large fleet operator such as Golden Gate Transit is effectively protecting its mechanics against exposure to abestos fibers.

"The district's San Rafael brake repair facility is an outstanding example of safe asbestos use. It is well equipped to minimize dust. The district mechanics are using safe work practices."

The district mechanics are members of the International Association of Machinists & Aerospace Workers (IAM), Marin County Lodge No. 238. The Machinists union was represented, along with employer, government, and science representatives, on the State Health Dept. advisory committee, which early this year drafted the asbestos regulation now in effect.

Dr. Fred Ottoboni, Ph.D., head of the department's Occupational Cancer Control Unit, said the transit district followed these key procedures to maximize worker protection against asbestos fibers:

- ☐ New brake linings are "arced" (shaped to fit) with a low-speed lathe rather than a power sanding machine that could produce airborne fibers.
- ☐ Arcing is done in a room separate from other workers so that asbestos waste is isolated from other workers.
- ☐ The small amount of dust generated by this process is collected by an exhaust system.
- ☐ Waste material is put in labelled containers and disposed of in plastic bags.
- ☐ Cleanup of brakes prior to repair is done with a damp rag rather than with compressed air, thus eliminating a serious source of dust.

Anti-lock backflip stirs bus protest

The American Public Transit Assn., Washington, D.C., has protested the now-we're-against-it, now-we're-not moves of the DOT's Truck and Bus Safety Subcommittees on the anti-lock provision of FMVSS 121 (FO—11/77, p. 13).

APTA, whose members carry 90% of U.S. mass transport riders, wrote to William H. Marsh, executive secretary of NHTSA, protecting the subcommittee's reversal of a moratorium recommendation approved by a majority of members at a proper meeting.

APTA's executive director B.R. Stokes said, "It is unconscionable to attempt to reverse this action by the very questionable procedure employed. The safety of the public is too important to allow several individuals to sidestep usual democratic procedures.

"To reverse a carefully considered committee action (within one week) by a telephone/telegram ballot, without even a claim of change in circumstances, presentation of new evidence or the like, is a transparent ploy inconsistent with any procedure acceptable to our courts of law, our congressional representatives or our sense of justice."



Retrofitted bus takes wheelchairs

A 7-year-old Toledo (Ohio) transit bus has been retrofitted with an electric lift platform to accommodate disabled passengers (photo above). Inside the bus are six restraints to keep wheelchairs in place while the bus is moving. The platform, designed by City Machine & Tool Div. of Sheller-Globe, replaces the rear step well and also serves as a standard passenger step entrance. Modification was made with help of a grant from the Urban Mass Transit Authority.

FMSI 04794

top of the news

Find more work-related cancer

A government study estimates that at least 20% and possibly as many as 38% of the cancers that will occur in the U.S. over the next 30-35 years will be work-related. This conclusion represents a significant departure from conventional estimates, which have ranged from 1-5%.

Results of the study, prepared by the National Cancer Institute and the National Institute of Environmental Health Sciences (NIEHS), were disclosed last week by Joseph A. Califano, Jr., Secretary of Health, Education and Welfare. The complete report will be submitted as evidence to the Occupational Safety and Health Administration. The authors want it to be used as part of the data on which OSHA will base its policy for regulating carcinogens.

The HEW report represents a re-evaluation of available studies on occupationally-related cancers, particularly in the light of new evidence concerning the impact of asbestos-related cancer. It predicts that 2.15 million persons will suffer cancer attributable to asbestos over the next 30-35 years—an average of almost 67,000 cases/year. This would represent about 17% of all cancers detected annually in the U.S.

Commenting on the asbestos threat, David P. Rall, director of NIEHS and one of the authors, notes: "It is only in the last year or so that the full magnitude of the asbestos situation has been appreciated."

In addition, four other substances—arsenic; benzene; coal-tar pitch volatiles and coke oven emissions; and vinyl chloride—will result in 1-3% of cancers each year, the study says. Four other compounds—chromium; iron oxide; nickel; and petroleum distillates—will contribute to 3-18% of all cancers. Thus a 20% figure is a "conservative" estimate, Rall says.



NIEHS's RALL: Figures show "we're not in as good shape as we may have thought."

The figures do not include the potential effects of other unknown substances, Rall notes. But the study does carry a *caveat*—it notes that most cancers have multiple causes. Rall says a number of occupational groups, such as chemists and rubber workers, have been found to have an excess incidence of certain cancers but the specific causes are not known.

While Rall conceded that the estimates of the number of workers exposed to carcinogens are probably not accurate, he notes, "They are the best estimates we have," adding that they may in fact understate the situation. "The typical pattern is that the more you study an occupational group, the more relative risk you see," Rall observed. In his view, the message of the study is: "We really have to work much harder to make the workplace safe from chemical carcinogens. There may have been some feeling of complacency, but we're not in as good shape as we may have thought."

OSHA Administrator Eula Bingham underlined Rall's comments, noting that "the study came as no personal surprise" and labeling it as "a clear call to the nation for action." The study indicates that cancer is not necessarily "inevitable," Bingham says, adding that "we should launch an all-out assault to rid workplaces of cancer-causing exposures and turn out energies toward preventive rather than remedial programs."

Industry officials denounced the "premature" use of the HEW

Blair, Dow Chemical's vice president for Health and Environmental Sciences, noted that Califano's decision to release the results is "most unfortunate" and "uncalled for" because the report is in draft stage and so far "unsubstantiated" by data. Blair believes the estimates are another in a series of predictions that are periodically tossed out and not substantiated. "A better procedure would be for these people to have peer review of their study. Many scientific groups or technical people are all qualified to examine this."

Blair's sentiments were echoed by the American Industrial Health Council and the American Council on Science and Health. AIHC Executive Director Ronald A. Lang said the summary released by HEW did not clearly identify the scientific methods used, or the details of the study's results. "The summary Mr. Califano refers to tells us nothing," Lang notes, adding that any new data on cancer from occupational exposure "should be published and critiqued . . . before HEW alarms the public unnecessarily."

ACSH's Executive Director Elizabeth M. Whelan noted that the report "was seriously misleading in that it cited cancer mortality statistics among asbestos workers without even mentioning the contribution of the major lung carcinogen—cigarette smoke. Non-smoking asbestos workers have no more lung cancer than the general non-smoking population." AIHC's Lang added that asbestos exposure conditions that the study linked with 17% of all cancers "were cleaned up long ago."

Cancer link denied

Dow Chemical says that it will "vigorously contest" a $70-million lawsuit brought by a Vietnam veteran who claims that he developed a fatal cancer as a result of exposure to Agent Orange herbicide. Last week, Dow responded to the suit by petitioning to have it moved into U.S. District Court from New York State Supreme Court where it was originally filed late in July.

The suit by 28-year-old Paul Reutershan originally named Dow and five other companies thought to have supplied the defoliant—a blend of 2,4,5-T and 2,4-D herbicides—to the military. On Sept. 6 action was dropped against all but Dow.

In the complaint, Reutershan charges that his cancer was caused by exposure to Agent Orange while serving in Vietnam in 1967 and 1968. He discovered that he had cancer in October 1977. He claims that Dow was aware of the alleged harmful affects but failed to warn those exposed of the potential danger.

According to Dow, the move to federal court will give it greater freedom in examining expert witnesses called by Reutershan to prove his case. Dow maintains that there is no evidence that Agent Orange causes cancer.

Reutershan's attorneys say that this is the first case brought by a veteran over Agent Orange and that others may join the suit. However, a veterans' group called Citizen Soldier says that while a number of veterans seem to have symptoms consistent with dioxin—an inevitable contaminant of 2,4,5-T—proving the connection with cancer is difficult. The group says it is laying groundwork for an epidemiologic study of veterans exposed to Agent Orange.

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July 1978
Volume 42
Number 7

Industrial Health Foundation
5231 Centre Avenue
Pittsburgh, Pennsylvania 15232

INDUSTRIAL HYGIENE DIGEST

NEWS ITEMS

663/78x Actions on the Threshold Limit Values of Chemical Agents.
American Conference of Governmental Industrial Hygienists, May 1978.

Notice of Changes Intended (For 1978)

Additions

Aspirin	5 mg/m^3
Amosite	0.5 fibers/cc
Chrysotile	2 fibers/cc
Crocidolite	0.2 fibers/cc
Cyanogen Chloride	0.25 ppm
Baytex	0.1 mg/m^3
1,3 Dichloropropene	1 ppm
Divinyl benzene	10 ppm
o-sec-Butylphenol	5 ppm-Skin
Chloroacetyl Chloride	50 ppb
Diethanolamine	3 ppm
2-Hydroxypropyl acrylate	0.5 ppm-Skin
Dalapon	1 ppm
m-Isopropylaniline	2 ppm-Skin
Propionic acid	10 ppm
Sodium bisulfite	5 mg/m^3
Tetrasodium pyrophosphate	5 mg/m^3
Trichloroacetic acid	1 mg/m^3

Deletions

140 Flash aliphatic solvent
N-Methyl -2- pyrrolidone.

Y-14

FMSI 04796

TECHNOLOGY

Flash filling for front teeth

The time pressure is off on dental fillings with a composite developed by Imperial Chemical Industries in the United Kingdom. No longer must the dentist rush to fill a difficult cavity or build up a chipped tooth before the filling material hardens. According to a report in the May 8 CHEMICAL AND ENGINEERING NEWS, the new blend, called Fotofil, remains a paste until its catalyst is activated by light from a special source "gun." The paste then cures within a minute to an inert structure, which matches the enamel of neighboring teeth.

The active component of the paste is a resin made of urethane dimethacyclate, a member of the family of materials used to coat chemical tanks. A barium-containing glass filler makes up 80 percent of the paste formulation. The glass is ground to particles of 10 microns and coated with a silicon compound.

The dental material is soon to be marketed in the United States for restoration of front teeth. Molars, however, require a subtance highly resistant to abrasion. The developers are now investigating whether Fotofil or modifications with different glasses and resins are suitable for back teeth. Unlimited time for sculpturing molar work would be especially valuable because accurate shaping of molars prevents wear on the opposing teeth.

Sifting through the silicon

Finding a needle in a haystack is a difficult type of research problem, whether it involves trace impurities or basic constituents of chemical and biological systems. Researchers at Bell Telephone Laboratories report a new electron microscope technique for identifying and locating minute amounts of certain elements in diverse materials. So far, researchers have used it to identify a few hundred carbon atoms among several hundred billion silicon atoms, unwanted oxygen, nitrogen and carbon in integrated circuits and the storage site of the neurotransmitter serotonin in human blood platelets (reported in the May 5 SCIENCE).

The technique, called electron energy-loss spectroscopy, locates atoms of different elements by their interactions with a beam of electrons generated by the microscope. The beam electrons lose a characteristic amount of energy when they interact with each type of atom. David Joy and Dennis Maher then use a magnetic field to sort the beam atoms by amount of energy lost. In addition to detecting small amounts of elements, the technique allows scientists to measure distances between atoms to within a quarter of the diameter of one atom.

Roy Rogers to the delivery

Cows in labor may soon be calling cowboys, if the Federal Communications Commission approves a new device. A matchbook-size transmitter held in place by an adhesive signals when the cow's cervix dilates just before giving birth. The cowboy's receiver picks up the signal, which directs him to the bearing cow.

The reusable device, which has a range of 15 miles, was developed by Warren R. Jewett, Walter Evans and Lee Ingle of the University of Arizona. Bill Clevenger of Vita Vet, the company that plans to produce the detectors, estimates that 10 to 15 percent of unattended livestock births result in death to the newborn. Cattle and horses don't always take care of their new offspring or protect them from predators. The device will also be useful for zoo animals that often kill their newborns. Jewett's work on a birth signaling device began with an inquiry from the St. Louis Zoo. To save snow leopard cubs, zoo attendants need to be on hand to separate the cubs from their mother within 30 minutes of birth.

ENVIRONMENT

People pollution

Just breathing can make a room without ventilation that is also full of people pretty stuffy. How stuffy? Tsen C. Wang, a chemical engineer with Harbor Branch Foundation in Fort Pierce, Fla., rigged up a monitoring system to find out. Results, in the March CHEMTECH, showed elevated levels of carbon dioxide, carbon monoxide, alcohol, methane and acetone. Wang plotted accumulation and decay rates for CO_2 over time, and the steady-state contamination levels for each chemical based on the number of people in the room. Equations derived from the data permit fairly accurate predictions of necessary ventilation.

Asbestos pollution from auto brakes

Suspicion that automobile brakes release deformed "chrysotile" asbestos has been confirmed by Krishna Seshan, a materials science engineer at Lawrence Berkeley Laboratory in California. Most cars brake by grinding pads against a heat-resistant asbestos brake lining, Seshan says. His work shows that this deforms asbestos fibers, which are released as dust. And studies indicate that when asbestos is deformed, its surface electrical charge is altered, increasing its biological activity — and health risks, Seshan told SCIENCE NEWS. Asbestos has been linked with both lung disease and cancer in humans.

Deformed asbestos had been detected in air samples near highways, but scientists could not be sure where it originated. Seshan reasoned that highly deformed fibers probably came from autos, slightly deformed fibers from building-construction materials and undeformed fibers from natural rock. Since crystals "carry a memory" of their original structure despite later deformation, Seshan figured he might be able to correlate the degree of deformity with the fiber's source.

He examined brake-drum dust using dark field image electron microscopy (a way to observe small particles by looking at diffraction patterns of scattered electrons); the technique is common to microscopists, Seshan says, but relatively ignored by environmental scientists. Not only did he verify the presence of asbestos, but he also ascertained that fibers ranged from slightly to very deformed. He describes his work in the June ENVIRONMENTAL RESEARCH.

There is probably little risk to drivers because of the small amounts they would inhale, LBL says. Not so with mechanics; those who clean brakes using compressed air might inhale up to one million particles per cubic meter of air, LBL says.

Air pollution: More bad news

Results of a study conducted in Allegheny County, Pa., for the Environmental Protection Agency add weight to the theory that air pollution reduces life expectancy. Using statistical data for 1968 to 1972, John J. Gregor of Pennsylvania State University (now of Plymouth State College in New Hampshire) found that reducing total particulates one percent corresponded to a 0.23 to 0.89 percent reduction in pollution-related deaths. He cautions against extrapolating results to other regions, because it is not clear "whether the relatively large influence" of particulates on death rates is due to specific pollutants or to "inherent characteristics of particulate matter." For example, he found the correlation between sulfur dioxide — one of the particulate pollutants — and deaths was statistically insignificant.

The study, Intra-urban Mortality and Air Quality, also concludes that air pollution impacts increase with age, indicating either that the body's ability to counter effects decreases, or that pollutants have a cumulative effect. And although impact on both sexes is near equal after age 65, before 65 men show more adverse effects than women.

Asbestos exposure during brake-lining maintenance and repair

Problem:

Brake-linings may contain as much as 50% chrysotile asbestos, and the disintegration of the lining during braking releases fibers, some of which become constituents of brake drum dust. Other fibers are released into the general environment. An investigation was made to obtain information concerning asbestos exposure of automobile and truck maintenance workmen, particularly those responsible for brake-lining work.

Personal air sampling was carried out at various auto repair shops, taxi fleet repair shops and several municipal truck repair shops. It is estimated that there are about 124,000 men in this work in New York City, alone.

The exposure of workers during brake-lining maintainance and repair is of interest as a background to investigation of their health experience. This, in turn, has considerable significance in determining whether brake-lining dust is pathogenic. If it is not, we would have little concern regarding brake-lining dust as a source of general environmental exposure to asbestos. On the other hand, if workers exposed to this dust are found to have asbestos disease, then the effects of exposure of the general population to the same dust, albeit at much lower levels, would have to be further evaluated.

Materials and methods:

Personal air samples were taken during brake-lining maintenance work. Air samples were also taken at adjacent sites, including customer waiting areas and automobile showrooms. The standard techniques for filter processing and fiber counting which have been adopted by the Occupational Safety and Health Administration of the Department of Labor. Both optical and electron microscopic methods were employed, the latter because the great majority of asbestos fibers were too fine to be detected by optical microscopy. X-ray powder diffraction and microchemical scanning electron microscopic analyses were also utilized to identify chrysotile asbestos in brake drum samples.

FMSI 04798

Results to date:

Table I shows the levels of asbestos found during the most common operation of brake-lining maintenance. When a brake lining is brought into a repair shop for inspection or replacement, the wheel is removed and all loose dust is removed from the drums and back plates by means of a compressed air jet. The cloud that is produced is visible, and remains so for minutes afterward. There is minimal, if any, effort to control dust in most garages and workmen very rarely wear respirators. Table I shows that fiber counts are high in the operator's area, and that there are moderately high concentrations at least 20 feet away. Background sampling during the same operation shows that immediately after jet air blowing and for at least 14 minutes afterward, there are measurable concentrations. These measurements were taken at varying distances from the operator (from 10 to 75 feet) and show that other people within that perimeter are exposed, including mechanics, shop management, salesmen and customers.

Ten samples of brake drum dust were processed for electron micropsopic examination without changing the size distribution, and asbestos fibers present in the dust were measured. The results are shown in Table II. It was found that most fibers are too small to be seen by optical microscopy; almost all of them were shorter than 0.4μ in length. Virtually all were of respirable size.

Prior to this study, it had been generally accepted, on the basis of limited data, that asbestos brake-linings are thermally altered to an inert, presumably harmless dust, during braking action. Our observations show that asbestos fibers do survive. This has been found in every brake drum dust sample analyzed by x-ray diffraction, electron microscopy and microchemical scanning electron microscopy.

Table III and IV present data collected during brake lining maintenance operations at the New York City Department of Sanitation truck repair shop. Two important operations are performed in this large shop for reasons of

economy-grinding and bevelling of linings, otherwise generally performed during manufacture. Accordingly, these studies relate to levels of asbestos exposure experienced by workers engaged in manufacturing. New linings are ground to remove imperfections on the surface and used linings are salvaged by grinding the surface to remove grease and dirt fiber concentrations experienced during grinding ranged from approximately 2.0 to 7.0 large (optically visible) fibers/ml of air ($2x10^6$ - $7x10^6$ /m^3). The background or area samples for this operation ranged from 1.2 to 0.2 fibers/ml (1.2 - 0.2 x 10^6 /m^3) with a general decrease with increasing distance away from the operator. From six to ten other mechanics would thus be exposed to perhaps about one fiber/ml. A concentration of even one fiber/ml is equivalent to inhaling 8 million large fibers per working day, those longer than 5μ. Much larger numbers of shorter fibers would simultaneously be inhaled.

Table IV shows fiber concentrations measured during bevelling of new truck brake-linings. The lining edge is bevelled on a grinding wheel, so that the brake will grip properly. Concentrations were very high, ranging from 32 to 72 fibers/ml, and background counts were measurable up to 30 feet away.

Significance:

The data indicate that, during brake-lining maintenance and repair, workmen in garages, service stations and brake repair shops are exposed to asbestos and thus may be subject to serious cancer risk. Others, at some distance from the repair work, are perhaps subject to the same hazard. These environmental measurements will be of value in considering the health experience of brake-lining repair workers, as a background to evaluation of the importance of asbestos from brake-linings as a factor in general community asbestos air pollution.

Publications:

To be published.

Investigators:

A. M. Langer, Ph.D., A. Rohl, Ph.D., Mary S. Wolff, Ph.D.

Support:

Health Research Council: U-1272.
Research Fellowship Award - ES 02565
Career Scientist Award - ES 44812

Period:

1973

AF 2

Table I

PERSONAL SAMPLES - AUTOMOBILE BRAKE SERVICE

Operation	Distance	Concentration (fibers/ml.) *
Blowing dust out of drum brakes	3-5 ft.	13.8
" " " " " "	"	29.4
" " " " " "	"	6.6
" " " " " "	"	13.6
" " " " " "	5-10ft.	3.8
" " " " " "	"	2.0
" " " " " "	"	4.2
" " " " " "	10-20ft.	0.4
" " " " " "	"	4.8

BACKGROUND SAMPLES - AUTOMOBILE BRAKE SERVICE

Operation	Distance from Operation	Time Lapse	Concentration (fibers/ml.)
Blowing dust out of drum brakes	10 ft.	0 min.	0.3
" " " " " "	20 ft.	0 min.	0.8
" " " " " "	12 ft.	5 min.	0.2
" " " " " "	50 ft.	5 min.	0.1
" " " " " "	65 ft.	7 min.	0.1
" " " " " "	75 ft.	14 min.	0.1

* Only fibers longer than 5μ were counted, by phase microscopy at 400x.

Table II

SIZE DISTRIBUTION OF CHRYSOTILE FIBERS IN BRAKE DRUM DUST

Fibers counted and sized at 42,000 X

(all fibers have diameters from 250Å to 500Å)

Sample	750-1500Å	1500-2250Å	2250-3000Å	3000-3750Å	Total
1	40%	34%	11%	11%	96%
2	32	23	32	-	87
3	20	25	25	-	70
4	26	37	26	7	96
5	57	17	4	-	78
6	23	9	12	12	56
7	50	26	21	2	99
8	29	30	21	17	97
9	6	41	18	10	75
10	11	6	31	31	79

Table III

PERSONAL SAMPLES - TRUCK BRAKE SERVICE

Operation	Concentration (fibers/ml.)
Renewing used linings by grinding	2.7
" " " " "	7.0
" " " " "	2.2
" " " " "	4.1
" " " " "	5.0
" " " " "	4.7
" " " " "	5.6
" " " " "	1.7
" " " " "	2.5
" " " " "	2.0

BACKGROUND SAMPLES - TRUCK BRAKE SERVICE

Operation	Distance	Concentration (fibers/ml.)
Background to grinding used linings	10 ft.	1.2
" " " " "	10 ft.	1.7
" " " " "	25 ft.	1.0
" " " " "	25 ft.	0.6
" " " " "	60 ft.	0.2

Table IV

PERSONAL SAMPLES - TRUCK BRAKE SERVICE

Operation	Concentration (fibers/ml.)
Bevelling new linings	31.7
" " "	23.7
" " "	32.7
" " "	72.0
" " "	26.3

BACKGROUND SAMPLES - TRUCK BRAKE SERVICE

Operation	Distance	Concentration (fibers/ml.)
Background to bevelling linings	8 ft.	0.6
" " " "	12 ft.	0.5
" " " "	12 ft.	0.3
" " " "	30 ft.	0.3

PERSONAL SAMPLES - TRUCK BRAKE SERVICE

Operation	Concentration (fibers/ml.)
Punching rivets into brake lining	1.9
" " " " "	2.0
Chipping rust off used brake drums	2.4
Sweeping floor around grinder	3.6
Background taken 15 ft. away during sweeping	3.1

RECOMMENDED (INTERIM) PROCEDURES FOR
ASBESTOS BRAKE AND CLUTCH SERVICING

The National Institute for Occupational Safety and Health (NIOSH) has research underway concerning dust exposures during brake and clutch servicing. Due to preliminary data demonstrating significant asbestos exposures during presently used brake and clutch servicing techniques, NIOSH has reviewed alternate techniques whereby asbestos exposures are reduced. The following are interim procedures recommended by NIOSH to minimize dust exposures.

1. If possible, an area shall be designated for all brake and clutch repairs. Entrances into this area shall be posted with an asbestos exposure warning sign as follows:

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

2. During brake servicing, an air purifying respirator, either single use or with replaceable particulate filter(s), as approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or NIOSH, shall be worn during all procedures starting with the removal of the wheels and including reassembly. During manual clutch servicing, such a respirator shall be worn during removal and cleaning of the clutch, pressure plate and housing assembly and during installation of the new clutch assembly.

3. Dust shall first be cleaned from brake drums, brake backing plates, brake assemblies and clutch assemblies using an industrial type vacuum cleaner equipped with a high efficiency filter system (>99% efficiency for 0.3 μm diameter aerosols). After vacuum cleaning, any remaining dust shall be removed using a rag soaked in water and wrung until nearly dry. Under no circumstances shall compressed air or dry brushing be used for cleaning.

4. During arcing and riveting operations, an approved respirator, as described in (2) above, shall be worn. Grinding (arcing) machines shall be provided with local exhaust ventilation such that worker exposures are maintained at least below the 1976 OSHA asbestos standard (29 CFR 1910.1001).* At a minimum, the dust bag of the arcing machine shall be removed and replaced with the hose of the high efficiency industrial vacuum described in (3) above.

5. Industrial vacuum cleaner bags containing asbestos dust and cloths used for wiping brake and clutch assemblies shall be sealed in plastic bags and labeled with the following warning label printed in letters of sufficient size and contrast to be readily visible and legible;

Caution
Contains Asbestos Fibers
Avoid Breathing Dust
Breathing Asbestos Dust May Cause Asbestosis and Cancer

All asbestos waste shall be disposed of in accordance with the OSHA asbestos regulation, 29 CFR 1910.1001(h). During removal of vacuum bags, an approved respirator, as described in (2) above, shall be worn.

6. All floor cleaning in areas where brakes and clutches are repaired shall be done with the high efficiency industrial vacuum cleaner as described in (3) above. Grinding (arcing) machines shall also be cleaned with such a vacuum cleaner and any remaining dust wiped with a damp cloth. An approved respirator, as described in (2) above, shall be used during this cleaning.

7. Although adherence to the above procedures should minimize any contamination of work clothing, it is required that the appropriate portions of the OSHA regulations on asbestos (29 CFR 1910.1001(d), (3 and 4)) concerning special clothing, change rooms, etc. be followed.

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

* Section 1910.1001 of the Code of Federal Regulations was formerly Section 1910.93a. This change was noted in the Federal Register, May 28, 1975.

Prepared By
Division of Field Studies and Clinical Investigations
National Institute for Occupational Safety and Health
Cincinnati, Ohio

FMSI 04808

MOTOR

1790 Broadway, New York, N. Y. 10019

ROBERT J. CERULLO
CONTRIBUTING TECHNICAL EDITOR

1851-60TH STREET, BROOKLYN, NEW YORK 11204

March 30, 1977

To; E.W.Drislane

Your in good company E.W.since as you will see on the attached sheet the National Institute for Occupational Safety and Health uses the word breathing in their Recommended Procedures for Asbestos Brake and Clutch Servicing.

Y-17

FMSI 04809

RECOMMENDED (INTERIM) PROCEDURES FOR
ASBESTOS BRAKE AND CLUTCH SERVICING

The National Institute for Occupational Safety and Health (NIOSH) has research underway concerning dust exposures during brake and clutch

August 6, 1975

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Cincinnati, Ohio

FMSI 04810

Deadly dust fr

FROM PAGE A-1

they do it here. When that happens, I step out of the shop."

However Waller does not follow recommended procedures himself. "I lightly brush off the backing plates, and the dust falls down onto the ground," he said. He said he knows it is safer to clean off brake dust by wetting it first, but adds, "I can't be wasting my time."

"Nobody wears a mask here," he said. "I would wear a mask if it were supplied to me, but I'm not about to go out and buy one."

The masks cost less than $2 each.

Workers in government garages pay more attention to the asbestos danger, but even they do not always follow prescribed safety practices.

William Galdi, who heads the Bergen County Department of Motor Vehicles, said, "We wash the dust with gasoline or a cleaning solution. It comes down into a drain pan rather than get blown into the air."

However William Nicholson, asso director of the Environmental Scie Laboratory at Mount Sinai Me School in New York, said that pr is not recommended:

"Exposure to gasoline fumes is good for you either. They should water. Just a damp rag will take dust but. You don't want to use solv You're not trying to clean up oil, yo trying to clean up dust."

In Passaic County, road depart Supervisor Alex Komar said h workers use vacuums to draw out bestos particles. However, they do wear masks or wet down the dust.

Even when vacuums are supp government workers sometimes fa use them. Adam Caruso, master chanic at the state police repair sho Trenton, said:

"The men are supposed to vac the dust off, but a lot of times if don't watch them, they don't do Sometimes they blow it off with a and get it all over the shop. Some use a brush, catch the dust and thro in the garage.

"The air hose is quicker," he said. "The trouble is it spreads all over the shop. When the workers take off their masks, they breathe the asbestos that is floating in the air."

Many workers ignore precautions because the danger appears so far off — the incubation period for asbestos diseases is between 10 and 35 years. But then the results are debilitating and often fatal.

Dr. Irving Selikoff of Ridgewood who heads the Mount Sinai Medical School's Environmental Sciences Laboratory and is credited with provoking public awareness about asbestos hazards,

Where to call for information

The federal Office of Cancer Communications says workers exposed to asbestos should not smoke and should get regular chest X-rays. A toll-free cancer information service number, (800) 523-3586, has been established to answer questions from the public.

Deadly dust particles from asbestos brakes

By Lucy Komisar

Mechanic Dave Fernicola walks over to a car that slants forward from the jack set under its rear end and bends to touch the exposed metal wheel.

He holds out a finger covered with a charcoal-colored film. "Asbestos dust," he said.

To remove the dust, Fernicola, 26, who works at Circle Brake Service in Hackensack, wipes the brake drums with a dry rag and then tosses the rag into an open barrel.

Like most mechanics, Fernicola ignores recommended procedures, a failing that can lead to cancer or asbestosis, a chronic lung disease caused by inhaling microscopic asbestos fibers. Anyone in the garage is subject to the same hazards.

A recent survey of garages in New Jersey and New York revealed routine disregard of these basic safety precautions. Workers interviewed were all aware of the hazards; they simply ig-

nored them or took no protective precautions.

The National Institute for Occupational Safety and Health, a federal research agency, says asbestos dust should be vacuumed, not blown from brake drums and floors. It rejects dry sweeping and cleaning under any circumstances. Ventilation at the source of the dust is inadequate, workers should wear filter masks, the agency said, to protect themselves from the dust.

Asbestos is used in brake linings because it is resistant to the heat caused when the lining presses against the rotating wheel.

Car repair workers can't avoid working with asbestos, but there are ways they can protect themselves, such as using vacuums.

An industrial vacuum costs $250, but workers can also use shop vacuums that sell for $29 to $129.

Fernicola, who lives in Paterson, said he has been wearing a mask for [illegible] years since he took a biology [illegible] William Paterson College.

Dr. Nicholson of Mount Sinai said he knew of four brake workers who had been hospitalized for asbestos-linked diseases. And he said, he had heard of many others.

Tests on those who work with insulation, many forms of which contain asbestos, have already shown a high rate of asbestosis and cancer. Researchers are now testing brake mechanics.

Sam Meyers, president of United Auto Workers Local 259 in New York City, said medical exams conducted by Selikoff showed that some of the members of his union have been affected by exposure to asbestos.

[illegible] National Safety and Health Administration (OSHA), which enforces this law, requires that the amount of asbestos dust in the air be below a certain limit. If OSHA inspectors find asbestos levels too high, it can require a company to take steps to reduce it.

Firms are first supposed to seek engineering remedies such as supplying vacuums and having exhaust systems installed. If that is not sufficient, masks should be provided.

The dangers of brake asbestos dust are so well known that the refusal to

and we started getting heavy [illegible] gers from cancer."

He said he tried to talk his cowor into wearing the masks which the pany provides, but they ignored hi

"It's uncomfortable," said 34-yea Tim Walsh of Dumont. He said he moves the dust by brushing it off ing it with an air hose, both dangerous procedures.

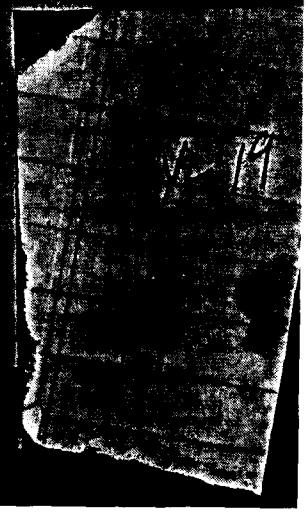
Michael Maresca, 18, of Ridge Park also rejects the mask. "I don lieve in it. If you're going to die going to die," he said.

"Real problem"

Circle Brake Manager [illegible] said he can't make the men wear masks. "It's a real problem. I know what to do myself," he said.

John Weller, a mechanic at the D Service Center in Oradell, sees similar hazards. "A lot of peopl [the dust] with an air gun, [illegible] all over the room and that's

See DUST, Page A-6



FMSI 04811

NIOSH RECOMMENDED PROCEDURES FOR ASBESTOS BRAKE AND CLUTCH SERVICING

1. All procedures performed in a restricted area of facility. Entrances posted with an asbestos exposure warning sign.

2. Respiratory protection during all servicing operations. MESA and NIOSH approved air purifying respirators.

3. Loose wear dust to be removed by well maintained shop vacuum. After vacuum cleaning, remaining material removed with water soaked rag.

4. All new lining grinding machines provided with local exhaust ventilation.

5. All floor and equipment cleaning performed with high efficiency shop vacuum.

6. Vacuum cleaner bag and all other waste sealed in plastic bags and labeled asbestos warning label.

PRELIMINARY

Y-20
(14)

TYPES OF FACILITIES PERFORMING AUTOMOTIVE BRAKE REPAIR

GARAGE TYPE	APPROXIMATE # FACILITIES	PERCENTAGE OF BRAKE WORK PERFORMED
Service Stations	195,000	~ 50
Independent Garages	108,000	~ 30
New Car Shops	39,000	~ 18
Fleet Shops	21,000	1-2

NIOSH Estimates That More Than 900,000 U.S. Workers Are Potentially Exposed To Brake Wear Dust

FMSI 04813

SUMMARY OF BRAKE REPAIR JOBS FOR 1975

PRELIMINARY

VEHICLE AND JOB TYPE	MILLIONS OF WHEELS SERVICED
Automobiles	
New Shoes Installed	12.7
Relined Shoes Installed	38.3
Disc Brake Pad Sets Replaced	16.9
Trucks	
Brakes Relined	7.4
New Brakes Installed	2.5

FMSI 04814

SUMMARY OF FIBER EXPOSURES IN GARAGES AS DETERMINED BY OPTICAL MICROSCOPY

PRELIMINARY

	FIBER CONCENTRATION (FIBERS > 5μm/cc)				
EXPOSURE SUMMARY	GARAGE SURVEYED				
	A	B	C	D	E
Mechanic's Exposure					
Mean Daily TWA*	0.11	0.13	0.12	0.10	0.12
Range of Daily TWA Values	0.08 to 0.12	0.11 to 0.15	0.05 to 0.19	0.04 to 0.18	----
Garage General Air Concentrations					
Mean Daily TWA	0.07	0.09	0.05	0.07	0.04
Range of Daily TWA Values	----	----	----	----	----
Highest Peak Concentration Observed	0.58	2.33	0.72	15.33	0.16

*TWA = Time-weighted-average. NIOSH Recommended TWA = 0.10 fibers >5μm/cc

FMSI 04815

PRELIMINARY

SUMMARY OF FIBER EXPOSURES ...
RENEWING USED BRAKE AND CLUTCH ASSEMBLIES

FIBER CONCENTRATION (FIBERS > 5 um/cc)				
FACILITY	RECEIVING & CLEANING	BONDING & RIVETING	CUTTING & GRINDING	INSPECTION & PACKAGING
A				
MEAN CONCENTRATION	1.1	0.6	1.1	0.7
RANGE	0.4-4.8	0.2-1.4	0.8-1.6	6.8-1.1
# SAMPLES ( )	(15)	(20)	(6)	(4)
B				
MEAN CONCENTRATION	4.0	2.7	5.0	
RANGE	1.0-7.6	1.1-5.8	1.5-9.3	------
# SAMPLES ( )	(5)	(6)	(6)	
C				
MEAN CONCENTRATION	1.3		0.8	
RANGE	1.2-1.3	------	0.6-1.3	------
# SAMPLES ( )	(2)		(2)	

NIOSH Recommended Standard = 0.10 fibers >5µm/cc

FMSI 04816

PRELIMINARY

SUMMARY OF ASBESTOS FIBER EXPOSURES IN FRICTION PRODUCT PRODUCTION FACILITIES AS DETERMINED BY OPTICAL MICROSCOPY

	FIBER CONCENTRATION (FIBERS > 5μm/cc)				
PLANT	MIXING & FORMING	HOT PRESSING & CURING	GRINDING, CUTTING & DRILLING	BONDING & RIVETING	INSPECTION & PACKAGING
A MEAN CONC RANGE # SAMPLES ( )	0.7 0.0- 2.5 (29)	0.6 0.0-3.8 (19)	0.8 0.0- 3.6 (39)	0.4 0.0-1.3 (9)	2.3 0.0-10.3 (32)
B MEAN CONC RANGE # SAMPLES ( )	1.7 0.0- 8.4 (59)	1.2 0.2-7.0 (44)	2.2 0.0-17.5 (72)	1.5 0.3-5.7 (13)	1.2 0.1- 4.6 (32)
C MEAN CONC RANGE # SAMPLES ( )	9.9 1.5-18.4 (19)	5.2 2.7-7.4 (10)	6.6 1.1-22.1 (40)	------	5.1 0.7-11.1 (4)
D MEAN CONC RANGE # SAMPLES ( )	0.8 0.1- 2.0 (5)	1.1 1.0-1.3 (2)	2.3 0.4-20.5 (15)	0.2 ------ (1)	0.9 0.1- 3.4 (6)

FMSI 04817

PRELIMINARY

SUMMARY OF ASBESTOS FIBER EXPOSURES IN FRICTION PRODUCT PRODUCTION FACILITIES AS DETERMINED BY OPTICAL MICROSCOPY

	FIBER CONCENTRATION (FIBER > 5μm/cc)				
PLANT	MIXING & FORMING	HOT PRESSING & CURING	GRINDING, CUTTING & DRILLING	BONDING & RIVETING	INSPECTION & PACKAGING
E MEAN CONC RANGE # SAMPLES ( )	4.5 0.6-16.2 (10)	1.8 0.3-3.7 (14)	5.8 0.6-14.4 (11)	------	2.9 0.5- 5.4 (7)
F MEAN CONC RANGE # SAMPLES ( )	7.1 0.3-77.5 (23)	11.9 0.1-3.6 (20)	9.2 0.2-61.8 (14)	0.21 ------ (1)	19.0 0.5-105.0 (14)

NIOSH Recommended TWA = 0.1 Fibers >5μm/cc

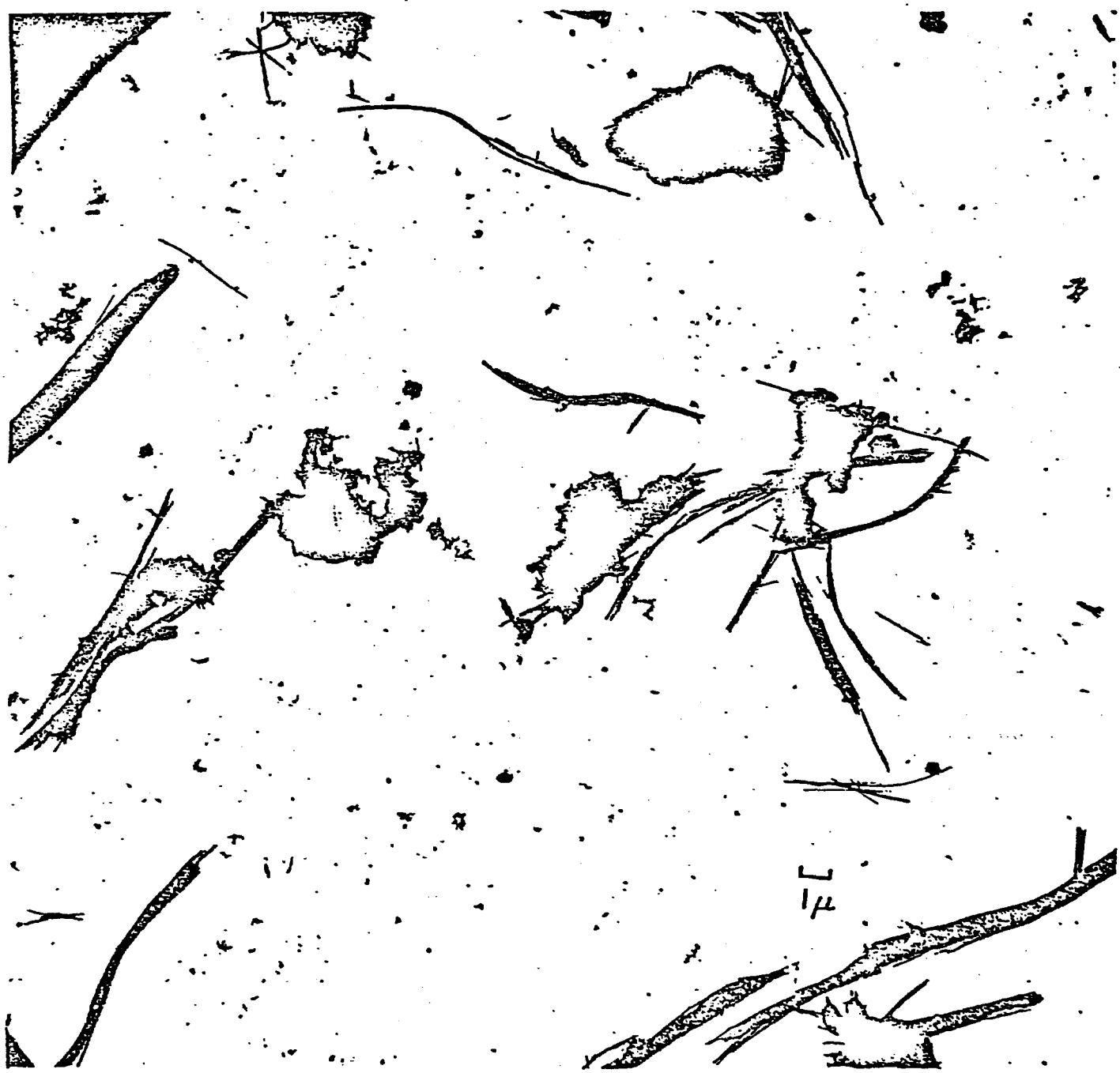
FMSI 04818

COMPARISON OF AIRBORNE FIBER LENGTHS IN FRICTION PRODUCT OPERATIONS

PRELIMINARY

INDUSTRY AND OPERATION	GEOMETRIC MEAN μM	% OF FIBERS >5μM
PRODUCT MFG.		
RAW MATERIAL MIXING	1.3	9.8
PRODUCT FORMING	1.4	9.2
FINISHING	1.8	17.2
GARAGE REPAIR OPERATIONS		
BRAKE MECHANIC	<1.0	<1

AIRBORNE PARTICULATES IN FRICTION PRODUCT PRODUCTION FACILITY



PRELIMINARY

FMSI 04820

PRELIMINARY

PRELIMINARY RESULTS OF GARAGE LEAD EXPOSURE STUDIES

	LEAD CONCENTRATION µg/m3
Peak Exposure Using Compressed Air For Cleaning Wear Dust	2,660*
Brake Reassembly	20
Garage General Air	10

*- These values do not represent time-weighted-average exposures

OSHA Proposed Lead TWA = 100 $\mu g/m^3$

FMSI 04821

SUMMARY OF LEAD EXPOSURES IN FRICTION PRODUCT PRODUCTION FACILITIES

PRELIMINARY

	LEAD CONCENTRATION ($\mu g/m^3$)				
PLANT	MIXING & FORMING	HOT PRESSING & CURING	GRINDING, CUTTING & DRILLING	BONDING & RIVETING	INSPECTION & PACKAGING
A					
MEAN CONC	28	2	8	4	5
RANGE	<1-89	<1-3	4-15	2-6	<1-8
# SAMPLES ( )	(4)	(4)	(6)	(2)	(4)
B					
MEAN CONC	7	19	4	4	3
RANGE	2-11	2-55	3-7	2-6	<1-5
# SAMPLES ( )	(6)	(4)	(6)	(2)	(4)
C					
MEAN CONC	729	8	6	------	6
RANGE	2-7000	3-16	1-11		2-10
# SAMPLES ( )	(22)	(4)	(7)		(2)

Proposed OSHA Lead TWA = 100 $\mu g/m^3$

FMSI 04822

PRELIMINARY

SUMMARY OF LEAD EXPOSURES IN FACILITIES RENEWING USED BRAKE AND CLUTCH ASSEMBLIES

FACILITY	LEAD CONCENTRATION ($\mu g/m^3$) RECEIVING & CLEANING	BONDING & RIVETING	CUTTING & GRINDING	INSPECTION & PACKAGING
A				
MEAN CONCENTRATION	187	79	77	77
RANGE	60-700	40-170	50-100	40-70
# SAMPLES ( )	(15)	(20)	(6)	(4)
B				
MEAN CONCENTRATION	34	9	16	
RANGE	6-80	2-41	2-57	------
# SAMPLES ( )	(5)	(6)	(5)	
C				
MEAN CONCENTRATION	3		3	
RANGE	2-4	------	2-4	------
# SAMPLES ( )	(2)		(2)	

OSHA Proposed TWA = 100 $\mu g/m^3$

FMSI 04823

SUMMARY OF LEAD EXPOSURES IN FRICTION PRODUCT PRODUCTION FACILITIES

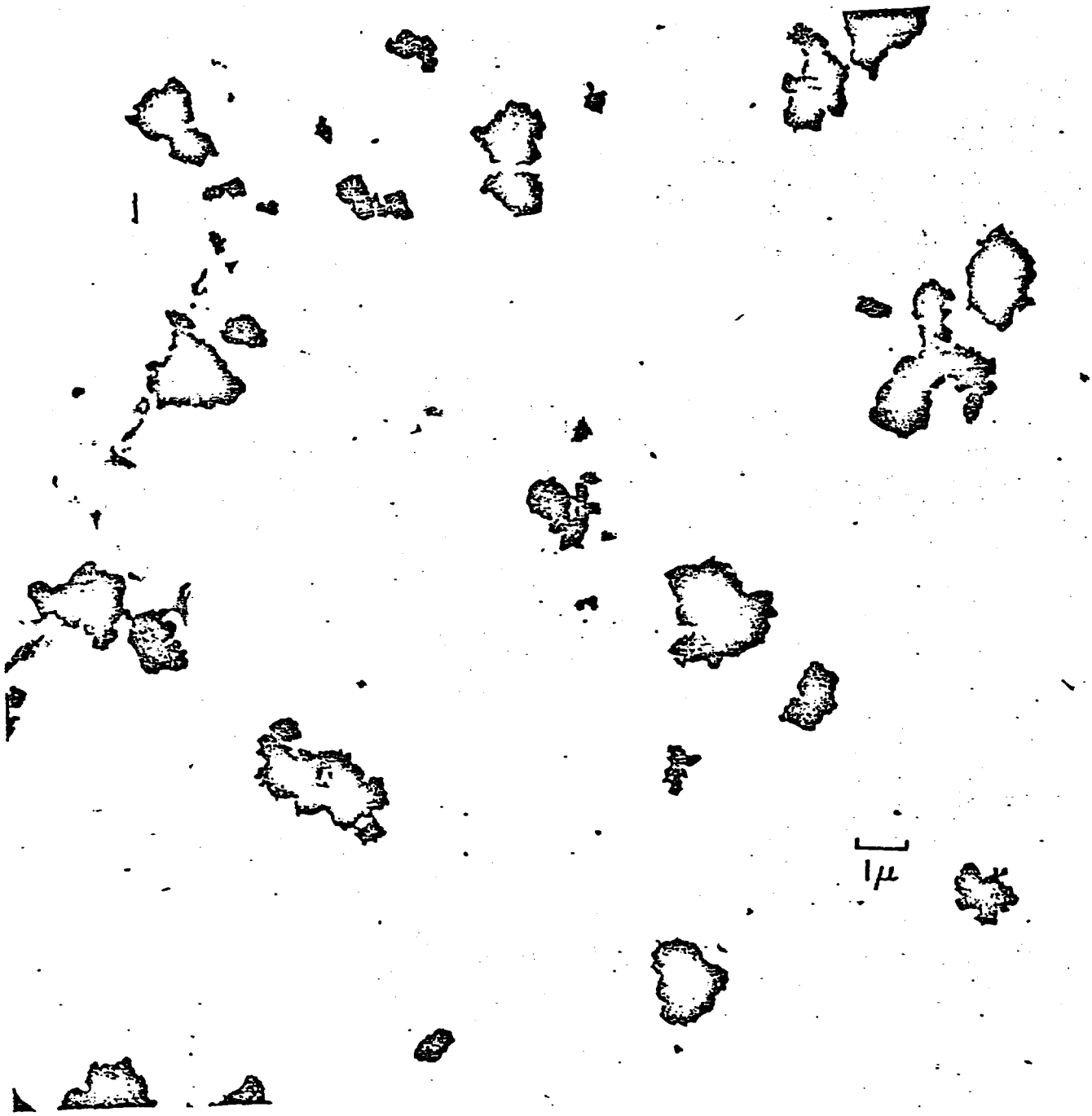
PRELIMINARY

	LEAD CONCENTRATION ($\mu g/m^3$)				
PLANT	MIXING & FORMING	HOT PRESSING & CURING	GRINDING, CUTTING & DRILLING	BONDING & RIVETING	INSPECTION & PACKAGING
D					
MEAN CONC	4	3	14	<2	
RANGE	1-12	2-4	1-77	1-3	------
# SAMPLES ( )	(4)	(3)	(6)	(4)	
E					
MEAN CONC	17	2	5	------	3
RANGE	3-45	2-2	<1-17		1-5
# SAMPLES ( )	(4)	(3)	(4)		(4)
F					
MEAN CONC	3	<1	1	------	3
RANGE	1-4	<1-1	1-2		<1-8
# SAMPLES ( )	(2)	(4)	(5)		(4)

Proposed OSHA Lead TWA = 100 $\mu g/m^3$

FMSI 04824

AIRBORNE PARTICULATE IN GARAGE PERFORMING BRAKE REPAIR



PRELIMINARY

FMSI 04825