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University of Maryland
College Park, Maryland

Gregory A. Burr

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from an employer or authorized representative of the employees, to determine whether any substance normally found in the place of employment has potential toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance to Federal, State, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Gregory A. Burr, of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Medical assistance by Mitchell Singal, M.D., Marian E. Coleman, and Ann M. Krake. Field assistance was provided by Leo M. Blade and Calvin K. Cook. Desktop publishing by Ellen Blythe. Special thanks are extended to Ms. Donna McMahon, an industrial hygienist at the University of Maryland, who was instrumental in scheduling the custodial and janitorial activities which were evaluated in this study.

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SUMMARY

In August 1994, the University of Maryland at College Park (UMCP), Maryland, was selected by the National Institute for Occupational Safety and Health (NIOSH) for the evaluation of potential lead exposure during custodial operations, including painting, carpentry, housekeeping, plumbing, and general maintenance. A survey was performed on October 20-21, 1994, during which personal breathing-zone (PBZ) air samples for lead were collected on 16 UMCP workers. In addition, all participants completed an occupational health questionnaire, and 13 of the 16 workers had a one-time blood lead level (BLL) test.

Airborne lead concentrations ranged up to 36 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), time-weighted average (TWA) over the period sampled (23 of 52 air samples collected [44%] had no detectable [ND] lead). The two highest short-term exposures were during the power belt sanding of a painted wooden door ($36 \mu\text{g}/\text{m}^3$) and heating lead in an open ladle during a plumbing repair ($26 \mu\text{g}/\text{m}^3$). Lead concentrations from four of the five PBZ samples collected on housekeepers performing tasks such as emptying trash receptacles, sweeping floors, and vacuuming carpets were ND (the remaining air concentration was $0.34 \mu\text{g}/\text{m}^3$). All of the PBZ results were below the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for lead of $50 \mu\text{g}/\text{m}^3$, expressed as an 8-hour TWA. The lead content in the bulk samples (primarily paint chips) ranged up to 19% by weight. BLLs ranged from 2.8 to 10 micrograms of lead per deciliter of blood ($\mu\text{g}/\text{dL}$), with a mean of $5.4 \mu\text{g}/\text{dL}$. Both the mean BLL and the BLL range are typical for U.S. adults.

Sixteen UMCP employees completed questionnaires. The average length of employment for the study participants was 8.5 years (range 10 months to 18.5 years) and their average age was 40 years (range 28 to 56 years). The majority of the study participants had received the following: (1) a pre-employment physical and a blood lead test; (2) training about the danger of lead; and (3) a respirator. Most of the participants had not received personal air monitoring to measure their airborne lead exposure. The majority of participants (9 of 16) indicated that they occasionally wore a respirator (typically a high efficiency particulate air [HEPA] type) while performing their job.

Based on the results from this study, janitorial tasks (such as sweeping, vacuuming, and emptying trash receptacles) did not result in a TWA airborne lead exposure in excess of the OSHA PEL. Some custodial activities (such as power sanding on lead-containing paint or the uncontrolled heating of lead with a propane torch during a plumbing repair task) resulted in higher (although still below the OSHA PEL) short-term lead exposures. The risk from these activities, fortunately, can be identified and quantified by evaluating work practices and, as needed, collecting air and bulk samples for lead. The blood lead results indicate that these workers were not overexposed to lead at work.

Keywords: 8221 (Colleges, Universities, and Professional Schools), lead, blood lead level, custodial, janitorial

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INTRODUCTION

In August 1994, the University of Maryland at College Park (UMCP), Maryland, was contacted by investigators from the National Institute for Occupational Safety and Health (NIOSH) to participate in a proposed health hazard evaluation of potential lead exposure during the performance of a variety of custodial operations, including painting, carpentry, housekeeping, plastering, plumbing, and general maintenance. A request for a NIOSH evaluation (dated October 7, 1994) was subsequently received from the Office of the President at UMCP. The selection of UMCP was based upon the following factors: (1) cooperation by administrative staff and employee unions in all phases of planning and scheduling of this study; (2) the availability of a variety of custodial operations at the main campus; and (3) the presence of lead-based paint in many of the older buildings on the campus where the custodial tasks were performed.

NIOSH investigators visited the UMCP campus on August 17, 1994, to discuss the scope of the proposed study and to select appropriate janitorial and custodial operations to evaluate. A follow-up survey was performed on October 20–21, 1994, during which personal breathing-zone (PBZ) air samples for lead were collected on workers performing custodial and janitorial tasks. In addition to the air sampling, all study participants signed a consent form (See Appendix A), completed an occupational health questionnaire (See Appendix B) and had a one-time blood lead level (BLL) measurement. Participants were notified of their BLLs by letter dated November 29, 1994. An interim report containing the results of air sampling and BLL testing (without individual identifiers) was sent to UMCP officials and the American Federation of State, County, and Municipal Employees on December 6, 1994.

BACKGROUND

In the Residential Lead-Based Paint Hazard Reduction Act of 1992 (Public Law 102–550), Congress amended the Toxic Substances Control Act by adding Title IV—the Lead Exposure Reduction Act. In Section 405(c)(2)(A–E) of Title IV, Congress required NIOSH to conduct a comprehensive study of means to reduce hazardous occupational lead abatement exposures. To assess the potential exposures and risks from lead while performing custodial activities, one specific occupational group, janitorial and custodial workers, was targeted for study by Title IV.

METHODS

Custodial and Janitorial Activities

In meetings with UMCP officials and union representatives, several activities were identified in which to assess the potential exposures and risks from lead. These tasks, outlined in Table 1, included housekeeping, maintenance, carpentry, painting, plastering, plumbing, and garage mechanic. All activities were performed on campus.

Task	Activities
Housekeeping	Emptying trash, vacuuming, dry and wet mopping, buffing, cleaning bathrooms
Maintenance	Inspecting/replacing air filters and ventilation systems, repairing water leaks and faulty valves, unclogging drains
Carpentry	Removing and hanging doors, replacing locksets, power sanding, removing baseboards and wall-to-wall carpeting, reglazing windows
Painting	Hand scraping (wet), cleaning work area
Plastering	Chipping and sanding plaster during repair
Plumbing	Removing old lead and oakum from shower drain and replacing with new lead
Automotive	Autobody work on 1979 van with lead paint

All existing UMCP health and safety requirements

pertaining to janitorial and custodial work were followed during this study. For example, in most cases only wet scraping by hand was permitted on surfaces which were being prepared for painting and which had lead-containing paint. To minimize lead contamination to surrounding areas during a repair task, workers were required to protect the work area by covering the floor and surrounding equipment with plastic sheeting. All custodial employees potentially exposed to lead (such as during the removal of lead-containing paint from a surface) were required to wear respiratory protection while performing the required work task. Housekeepers (whose lead exposures were assumed by UMCP to be negligible) were exempted from this requirement. For example, a plumber working with lead to repair a shower drain wore a NIOSH approved half-mask respirator with high efficiency particulate air (HEPA) filters. In another example, a carpenter who was using a power belt sander to prepare a wooden door for painting wore a full-facepiece powered air-purifying respirator (PAPR) with HEPA filters. All of the workers required to wear a respirator had been properly trained and fit-tested by UMCP.

Environmental Evaluation Design

Since custodial and janitorial tasks were planned throughout the work day at sites across the UMCP campus, a schedule was developed to notify participants when their particular custodial activity was to be performed. Personal breathing-zone air samples were collected for either the full work-shift (such as for the housekeeping staff) or during the particular work task. For example, if a carpenter was assigned to remove a painted wooden door to plane (trim) the edges, several sequential short-term samples were collected during this activity: (Sample 1) preparation of the work area; (Sample 2) door removal; (Sample 3) planing the door; (Sample 4) reinstalling the door; and (Sample 5) cleaning up the work site. NIOSH investigators realized that some of these individual tasks would be completed in a relatively short period of time (in some instances less than 10 minutes), a situation which results in a

smaller air volume being sampled and, correspondingly, a higher minimum detectable concentration (MDC) for that sample. To partially compensate for this, a separate PBZ air sample was simultaneously collected for the entire activity. This additional sample would have a larger air volume and thus a lower MDC.

Air Samples

Air samples were collected on mixed cellulose-ester filters (37 millimeter diameter, 0.8 micrometer pore size) using a sampling flow rate of either 2 or 3 liters per minute (lpm). All of the air samples were analyzed for lead by means of atomic absorption spectroscopy (graphite furnace) according to NIOSH Sampling and Analytical Method No. 7105.¹ Sample preparation consisted of transferring the filters to a clean microwave vessel, digesting the sample in 5 milliliters (mL) of 1:1 nitric acid and distilled, deionized (DDI) water, and then adding a 20 mL aliquot of DDI water to bring the final sample volume to 25 mL. The limits of detection and quantitation (LOD and LOQ) for lead using this method were 0.02 and 0.08 micrograms (μg) per sample, respectively.

Bulk Surface Samples

Bulk samples^a were collected and analyzed for lead by flame atomic absorption. Sample preparation consisted of weighing out a 0.1 gram sample, followed by microwave digestion in concentrated nitric acid. After digesting, 20 mL of DDI water was added to each sample to bring the final volume to 25 mL. The LOD and LOQ for lead using this method were 0.0002% and 0.0007%, respectively.

Wipe Samples

^a Although most of the bulk samples were paint chips, in some instances, other materials (such as old carpeting and wood shavings) were collected and analyzed for lead content.

Twenty-one surface wipe samples and two hand-wipe samples for lead were collected October 21–22, 1994. The surface samples were collected by wiping a 10 centimeter (cm) by 10 cm area using individually wrapped towelettes (Wash'nDri®, Softsoap Enterprises, Inc., Chaksa, MN) according to NIOSH Method 9100.² For the hand-wipes, an employee was requested to wipe his hands (using the same type of towelette) prior to putting on his work gloves and performing a plumbing repair task. Another hand-wipe sample was collected immediately following the completion of the plumbing repair.

From previous NIOSH studies, these pre-moistened towelettes have been found to be virtually free of lead contamination and result in good analytical recovery for lead.³ Disposable 10 cm x 10 cm sampling templates, cut from 8.5 x 11 inch plastic overhead transparency sheets, were used to define the sampling surface areas and avoid cross-contamination of samples. The disposable templates were held down with masking tape placed on the outside edges, and a fresh template was used for each sample. Once collected, samples were placed in sealable plastic bags for shipment to the laboratory. In the lab, the samples were transferred to 250 milliliter (mL) beakers where 20 mL of concentrated nitric acid and 2 mL of 30% hydrogen peroxide were added. The samples were then heated and reduced on hotplates. Additional nitric acid and/or hydrogen peroxide were added where it was necessary for complete digestion. Samples were brought to final volume and analyzed with by flame atomic absorption. The LOD and LOQ for this sample set were 0.8 and 2.7 µg per wipe, respectively.

Medical Evaluation Design

Questionnaire

As shown in Appendix B, the self-administered two-part questionnaire asked for information regarding work history, work practices, and other sources of lead. Sixteen UMCP custodial employees who worked in buildings known to still contain

lead-based paint volunteered to complete this questionnaire.

Blood Test

The blood test for lead required that one tube (approximately 2 teaspoons) of whole blood be taken from a vein in the arm of the study participant. Blood was drawn by venipuncture directly into an evacuated lead-free glass tube containing ethylenediaminetetraacetic acid (an anticoagulant). The blood sample was then analyzed for lead at the National Center for Environmental Health, Centers for Disease Control and Prevention, by a graphite furnace atomic absorption method.⁴ The lower limit of detection for this method has been calculated to be approximately 0.6 µg per deciliter (µg/dL).

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new

information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),⁵ (2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),⁶ and (3) the U.S. Department of Labor, OSHA Permissible Exposure Limits (PELs).⁷ In July 1992, the 11th Circuit Court of Appeals vacated the 1989 OSHA PEL Air Contaminants Standard. OSHA is currently enforcing the 1971 standards which are listed as transitional values in the current Code of Federal Regulations; however, some states operating their own OSHA approved job safety and health programs continue to enforce the 1989 limits. NIOSH encourages employers to follow the 1989 OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criterion. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard and that the OSHA PELs included in this report reflect the 1971 values.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8-to-10-hour workday. Some substances have recommended short-term exposure limits (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Health Effects of Lead Exposure

Lead is ubiquitous in U.S. urban environments due to

the widespread use of lead compounds in industry, gasoline, and paints during the past century. Exposure to lead occurs via inhalation of dust and fume, and ingestion through contact with lead-contaminated hands, food, cigarettes, and clothing. Absorbed lead accumulates in the body in the soft tissues and bones. Lead is stored in bones for decades, and may cause health effects long after exposure as it is slowly released in the body.

Symptoms of lead exposure include weakness, excessive tiredness, irritability, constipation, anorexia, abdominal discomfort (colic), fine tremors, and "wrist drop."^{8,9,10} Overexposure to lead may also result in damage to the kidneys, anemia, high blood pressure, infertility and reduced sex drive in both sexes, and impotence. An individual's blood lead level (BLL) is a good indication of recent exposure to, and current absorption of lead.¹¹ The frequency and severity of symptoms associated with lead exposure generally increase with the BLL.

Blood Lead Levels (Historical)

The overall geometric mean BLL for the U.S. adult population (ages 20–74 yrs) declined significantly between 1976 and 1991, from 13.1 to 3.0 micrograms per deciliter of blood ($\mu\text{g}/\text{dL}$)—this decline is most likely due primarily to the reduction of lead in gasoline. More than 90% of adults now have a BLL of $<10 \mu\text{g}/\text{dL}$, and more than 98% have a BLL $<15 \mu\text{g}/\text{dL}$.¹²

Lead in Air

Under the OSHA general industry lead standard (29 CFR 1910.1025), the PEL for airborne exposure to lead is $50 \mu\text{g}/\text{m}^3$ (8-hour TWA).¹³ The standard requires lowering the PEL for shifts exceeding 8 hours, medical monitoring for employees exposed to airborne lead at or above the action level of $30 \mu\text{g}/\text{m}^3$ (8-hour TWA), medical removal of employees whose average BLL is $50 \mu\text{g}/\text{dL}$ or greater, and economic protection for medically removed workers. Medically removed workers cannot return to jobs involving lead exposure until their BLL is below 40

µg/dL. The OSHA interim final rule for lead in the construction industry (29 CFR 1926.62) provides an equivalent level of protection to construction workers. ACGIH has proposed a TLV for lead of 50 µg/m³ (8-hour TWA), with worker BLLs to be controlled to at or below 20 µg/dL, and designation of lead as an animal carcinogen.¹⁴ The U.S. Public Health Service has established a goal, by the year 2000, to eliminate all occupational exposures that result in BLLs greater than 25 µg/dL.¹⁵

The occupational exposure criteria (above) are not protective for all the known health effects of lead. For example, studies have found neurological symptoms in workers with BLLs of 40 to 60 µg/dL, and decreased fertility in men at BLLs as low as 40 µg/dL. BLLs are associated with increases in blood pressure, with no apparent threshold through less than 10 µg/dL. Fetal exposure to lead is associated with reduced gestational age, birth weight, and early mental development with maternal BLLs as low as 10 to 15 µg/dL.¹⁶ Men and women who are planning on having children should limit their exposure to lead.

Lead in Paint

In the Residential Lead-Based Paint Hazard Reduction Act of 1992 (Public Law 102-550), Congress amended the Toxic Substances Control Act by adding Title IV—the Lead Exposure Reduction Act. In Section 401 of Title IV, lead-based paint is defined as paint or other surface coating that contains lead in excess of 1.0 milligrams per centimeter squared or 0.5 percent by weight. Another criterion is from the Consumer Products Safety Act [CPSA, 15 USC 2057-58, 1978, "Ban of Lead-Containing Paint and Certain Consumer Products Bearing Lead-Containing Paint." According to the CPSA, paint is considered lead-free if it contains less than 0.06% lead by weight. Regardless of which criterion is used, however, it is important to realize that exposures to airborne lead may still occur as a result of removing paint or other surface coatings that contain even small amounts of lead (i.e. paints which would technically be considered "lead-free").

Lead in Surface Dust and Soil

Lead-contaminated surface dust represents a potential source of lead exposure, particularly for young children. This may occur either by direct hand-to-mouth contact, or indirectly from mouth contact with contaminated clothing, cigarettes, or food. Previous studies have found a significant correlation between resident children's BLLs and house dust lead levels.¹⁷ There is currently no federal standard which provides a permissible limit for lead contamination of surfaces in occupational settings. As required by Section 403 of the Toxic Substances Control Act (TSCA), the U.S. Environmental Protection Agency (EPA) is in the process of developing a rule to address hazards from lead-contaminated dust and soil in and around homes.

The U.S. EPA currently recommends that the following clearance levels for surface lead loading be met after *residential* lead abatement or interim control activities: uncarpeted floors, 100 micrograms per square foot (µg/ft²); interior window sills, 500 µg/ft², and window wells, 800 µg/ft².¹⁸ These levels have been established as achievable through lead abatement and interim control activities, and they are not based on projected health effects associated with specific surface dust levels.

RESULTS

Air Samples

Table 2 (pages 11-17) contains the individual results of all PBZ air samples for lead. Twenty-three of the 52 air samples (44%) had no detectable amounts of lead. Airborne lead concentrations ranged from not detected to 36 micrograms per cubic meter (µg/m³), time-weighted averages over the period sampled. The highest lead exposures were measured in short-term air samples collected during the sanding of a painted wooden door using a power belt sander (36 µg/m³), heating lead in an open ladle prior to making a plumbing repair (26 µg/m³), removal of

lead and oakum (a type of caulk) from a plumbing joint ($13 \mu\text{g}/\text{m}^3$), and folding up and removing the plastic sheeting used to protect the floor following carpentry work ($8 \mu\text{g}/\text{m}^3$). No lead was detected in four of the five PBZ air samples collected on housekeepers performing tasks such as emptying trash receptacles, sweeping floors, vacuuming carpets, and other typical housekeeping activities; the remaining air sample had $0.34 \mu\text{g}/\text{m}^3$.

Paint Chip/Bulk Samples

Table 3 (page 18) contains the results from the analysis of paint chip/bulk samples obtained at the various work sites. Five of the 12 paint samples collected from painted surfaces which were being worked on had lead concentrations greater than the Title IV and U.S. Department of Housing and Urban Development (HUD) level of 0.5% lead (by weight), and all samples contained detectable amounts of lead (mean: 2.2%, range: 0.0063% to 19%). The highest PBZ exposures measured during this evaluation (on a carpenter who planed and sanded a painted wood door) correspond to the paint chip samples containing the highest percentage of lead (ranging up to 19% lead by weight). Four other non-paint surfaces tested, including old carpet, also contained lead (mean: 0.23%, range: 0.004% to 0.8%).

Wipe Samples

As shown in Table 4 (page 19), surface contamination levels ranged from the MDC of $0.8 \mu\text{g}$ per 100 cm^2 to $460 \mu\text{g}$ per 100 cm^2 .^b Only one of the wipe sample results exceeded the currently recommended U.S. EPA clearance levels for surface lead loading in *residential* environments. This sample was collected on the fender of a van undergoing body work in the UMCP garage (one of

^b The highest wipe sample result, $460 \mu\text{g}$, was obtained by having an employee wipe his hands following a plumbing repair task. For this reason, it is difficult to compare this result to the other surface wipe samples.

the custodial tasks evaluated during this study).

Blood Lead Levels

Thirteen workers had blood samples analyzed for lead content. Blood lead levels ranged from 2.8 to $10 \mu\text{g}/\text{dL}$. The mean BLL for this sample set was $5.4 \mu\text{g}/\text{dL}$. Both the mean BLL and the BLL range are typical for U.S. adults and do not suggest that this group of workers was over-exposed to lead.

Questionnaire Results

Sixteen UMCP employees completed questionnaires. The average length of employment at UMCP for study participants was 8.5 years (range 10 months to 18.5 years), and their average age was 40 years (range 28 to 56 years). The majority of the study participants had received the following: (1) a pre-employment physical and blood lead test; (2) training about the danger of lead; and (3) a respirator. Most of the participants, however, had not received personal air monitoring to measure their airborne lead exposure. Most of the participants (9 of 16) indicated that they occasionally wore a respirator while performing their job. Only four of the 16 workers had either worked with lead-based paints within the past six months or had hobbies or activities (such as working with stained glass, using an indoor firing range, making fishing lures, etc.) which may involve lead exposures.

DISCUSSION

Table 5 summarizes all of the environmental and biological results obtained from this evaluation. All of the lead exposures measured during custodial tasks were very low. None of the exposures exceeded either the OSHA Action Level for lead of $30 \mu\text{g}/\text{m}^3$, 8-hour TWA or the OSHA PEL for lead of $50 \mu\text{g}/\text{m}^3$, 8-hour TWA. The exposure times for the "task-associated" air samples were very short (6 to 11 minutes) and, as a result, the full-shift lead exposures for the respective tasks would probably be lower than

suggested by the short-term sample results. On the other hand, the full-shift exposure of a custodial worker could be higher than those reported here if the worker repeatedly performed certain higher-exposure tasks (such as power sanding on several painted

wooden doors or melting lead to make a series of plumbing repairs) over the course of an entire work day.

Table 5 Summary of Environmental and Biological Results from University of Maryland				
Airborne Lead Exposures (micrograms of lead per cubic meter of air, $\mu\text{g}/\text{m}^3$)				
Janitorial Activity	Mean	Median	Range	Comments
Housekeeping	0.11	ND	ND to 0.34	Full-shift samples
Carpentry	3.9	0.5	ND to 36	Doors, windows, and floors
Painting	0.2	0.2	ND to 0.5	Windows, exterior painted columns, radiator
Plastering	0.18	0.1	ND to 0.6	Removal/ replacement of drywall and plaster
General Maintenance	0.8	ND	ND to 3.7	Replacing and repairing fixtures
Automotive Body Work	1.1	0.9	ND to 2.5	Repair body damage on painted vehicle
Blood Lead Levels (micrograms of lead per deciliter of blood, $\mu\text{g}/\text{dL}$)				
No. of Samples	Mean	Median	Range	Comments
13	5.4	4.6	2.8 to 10	Indicates no occupational exposure
Lead Content of Paint Chip Samples (expressed as the percent lead by weight)				
No. of Samples	Mean	Median	Range	Comments
16	1.8%	0.3%	0.002% to 19%	Compare to Title IV or CPSC criteria

CONCLUSIONS

Based on the results from this study, it would be reasonable to assume that typical janitorial tasks (such as sweeping, vacuuming, emptying trash receptacles, cleaning fixtures, and other related housekeeping activities) would not result in an airborne lead exposure which would be in excess of the OSHA PEL of $50 \mu\text{g}/\text{m}^3$ for an 8-hour TWA. Not unexpectedly, some custodial activities performed in this evaluation (such as power sanding on surfaces covered with lead-containing paint or the uncontrolled heating of lead using a propane torch as part of a plumbing repair task) resulted in short-term airborne lead exposures which were much higher than those received from activities such as

housekeeping, painting, and plastering. However, these short-term exposures were still below the OSHA PEL of $50 \mu\text{g}/\text{m}^3$ for an 8-hour TWA.

Although not part of this evaluation, it is reasonable to assume that custodial work associated with lead abatement or lead hazard reduction projects could have a much greater potential for lead exposure than what was observed in custodians at UMCP. For example, previous studies have found that workers performing cleaning activities are potentially overexposed to lead during lead-based paint abatement and renovation projects.^{19,20,21,22} Such projects could result in exposures much higher than those measured during this evaluation. In these

situations, an initial lead exposure assessment for custodial workers should be conducted.

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Table 2
Airborne Lead Exposure During Custodial Activities at the University of Maryland, College Park, Maryland, on October 20–21, 1994
HETA 94-0374

Custodial Activity	Sample Date	Flow Rate (lpm)	Sample Period	Vol (l)	Lead Concentration $\mu\text{g}/\text{m}^3$	MDC $\mu\text{g}/\text{m}^3$	Comments
Housekeeper	10/20/94	2	8:00 am → 3:23 pm	846	ND	0.07	Housekeeping activities at Somerset Hall, Building #063. Activities included emptying trash cans located on the basement, 1st, 2nd, 3rd, and 4th floors, replacing the plastic liner in all of the cans; emptying the trash in the dumpster; vacuuming carpets and dust mopping all hallways. Cleaned all water fountains. Disinfected all fixtures in bathrooms on basement, 1st, 2nd, 3rd, and 4th floors. Wet mopped 1st floor hallway, including the uncarpeted portion of the lobby. Buffed the floors using a high-speed buffing machine.
Housekeeper	10/20/94	2	8:05 am → 3:34 pm	898	ND	0.07	Housekeeping activities at Queen Anne Hall, Building #061. Activities included emptying trash cans located on the basement, 1st, 2nd, 3rd, and 4th floors, replacing the plastic liner in all of the cans, and emptying this trash in the dumpster. Vacuuming carpet in the lobby. Dust mopped all hallways. Cleaned all water fountains. Disinfected all fixtures in bathrooms on basement, 1st, 2nd, 3rd, and 4th floors. Wet mopped 1st floor hallway, including the uncarpeted portion of the lobby. Buffed the floors using a high-speed buffing machine.
Maintenance	10/20/94	2	8:07 am → 3:25 pm	876	ND	0.07	Maintenance activities in the following buildings: Baltimore, Cecil, Washington, Allegheny, Montgomery, and Calvert. Custodial work performed included replacing air filters, replacing a toilet flush valve, replacing light bulbs, checking and repairing shower valves, unclogging a shower drain (using a "snake"), mechanical repair of an air-conditioning unit, and repairing a shower leak.
Maintenance	10/20/94	2	8:09 am → 3:25 pm	872	ND	0.07	Maintenance activities, including inspecting air filters and air-handling units and replacing light bulbs.
Carpenter	10/20/94	2	8:39 am → 2:58 pm	758	ND	0.08	Working in Room 1107B of Garrett Hall and a stairwell located in Kent Hall; the employee removed wooden windows to measure to make screens and also swept out carpentry shop.

Table 2
Airborne Lead Exposure During Custodial Activities at the University of Maryland, College Park, Maryland, on October 20-21, 1994
HETA 94-0374

Custodial Activity	Sample Date	Flow Rate (lpm)	Sample Period	Vol (l)	Lead Concentration $\mu\text{g}/\text{m}^3$	MDC $\mu\text{g}/\text{m}^3$	Comments
Carpenter	10/20/94	2	9:13 → 10:28 am	150	13	0.4	Sample collected over duration of carpenter activities performed in Shriver Building
		3	9:20 → 9:26 am	18	TRACE	3.3	Plane the edge of door to Room 1111B and re-install the hinges. Re-hang the door. No respirator worn for this task.
Carpenter (Continued)	10/20/94	3	9:13 → 9:20 am	21	ND	2.9	Removed hinges of door to Room 1111B. No respirator worn for this task.
		"	9:43 → 9:53 am	30	ND	0.7	Removed outside entrance door (ID # E-E1195A) to Shriver Hall, remove the metal kickplate, remove the plastic sign, and remove the metal ID tag (#E-E1195A) from upper corner. Used a Makita Cordless Drill/Screwdriver to remove the screws.
		"	9:53 → 10:08 am	45	36	0.4	Power sanded door E-E1195A using a Porter-Cable Model 360 Belt Sander with dust pick-up. Using a 3X24" sanding belt (50 grit/aluminum oxide belt). 10.5V, 1500 rpm sander. Employee wore a powered air-purifying respirator (PAPR) during the sanding activity.
		"	10:08 → 10:20 am	36	12	0.6	Re-attached the metal ID door tag, the metal kickplate, and re-hung the door. Note: When the freshly sanded door was lifted to its vertical position, visible dust was observed falling off of the door and on to the plastic sheeting. No respirator worn during this task.
		"	10:20 → 10:28 am	24	7.5	0.8	Folded up the 4-mil plastic sheeting used to protect the floor during the carpentry work and dry-swept the tiled floor using a straw broom. No respirator worn during this clean-up task. The swept dust was deposited into a trash can.

Table 2
Airborne Lead Exposure During Custodial Activities at the University of Maryland, College Park, Maryland, on October 20-21, 1994
HETA 94-0374

Custodial Activity	Sample Date	Flow Rate (lpm)	Sample Period	Vol (l)	Lead Concentration $\mu\text{g}/\text{m}^3$	MDC $\mu\text{g}/\text{m}^3$	Comments
Carpenter	10/20/94	2	8:44 → 10:42 am	236	2.1	0.3	Removed wood door; plane bottom edge of door; sand edges of door, remove lockset, replace hinges and lockset. Tools used included a power sander, power drill, hammer, and chisel. Worker did not wear a respirator, safety glasses, or disposable protective clothing while performing this carpentry work.
		3	8:45 → 9:32 am	141	4.2	0.4	Remove door and plane bottom edge of door. Sand edges of door.
		3	9:32 → 10:42 am	210	1.5	0.3	Remove hinges and lockset. Replace hinges and lockset.
Carpenter	10/20/94	2	11:39 am → 12:54 pm	150	ND	0.4	Sanding floor with "stand-behind" power disc sander (using a fiberglass disc screen); sweeping; scraping floor near corner; clean-up of the debris and placing debris in container
		3	12:29 pm → 12:54 pm	75	ND	0.8	Sweeping; scraping floor near corner; clean-up of the debris and placing debris in container.
		3	11:39 am → 12:29 pm	150	TRACE	0.4	Sanding floor with "stand-behind" power disc sander (using a fiberglass disc screen).
Painter	10/20/94	2	1:50 → 3:06 pm	152	TRACE	0.1	Hand scraping and sanding east column of Shriver Hall. Both of these activities were performed "wet" (meaning that the surfaces being scraped or sanded were moistened using a hand-held spray bottle filled with water.
		3	1:50 → 2:07 pm	51	ND	0.4	Spreading 4-mil plastic sheeting around base of the east column at Shriver Hall. Worker not yet wearing a respirator

Table 2
Airborne Lead Exposure During Custodial Activities at the University of Maryland, College Park, Maryland, on October 20-21, 1994
HETA 94-0374

Custodial Activity	Sample Date	Flow Rate (lpm)	Sample Period	Vol (l)	Lead Concentration $\mu\text{g}/\text{m}^3$	MDC $\mu\text{g}/\text{m}^3$	Comments
		"	2:07 → 2:24 pm	51	ND	0.4	Hand scraping (using a 2" metal blade scraper). The surface being scraped was moistened using a handhold spray bottle filled with water. Wearing an AOSafety half-mask respirator with high-efficiency particulate air (HEPA) filter cartridges.
		"	2:24 → 2:54 pm	90	ND	0.2	Hand sanding using 3M Brand 220 grit wet/dry paper. Wetting the surface prior to sanding using a plastic spray bottle filled with water. Wearing the AOSafety half mask respirator.
		"	2:54 → 3:06 pm	36	TRACE	0.6	Removing the plastic sheeting and dry sweeping the immediate area using a straw broom. Painter was still wearing a respirator.
Carpenter	10/20/94	2	8:48 → 9:42 am	108	TRACE	0.6	Remove wooden baseboards; cut and pull up wall-to-wall carpeting; scrape walls near baseboard; scrape carpet adhesive residue from floor; sweep floor
		3	8:47 → 9:14 am	81	ND	0.7	Remove wooden baseboard; cut and pull up wall-to-wall carpeting
		3	9:14 → 9:42 am	84	TRACE	0.7	Scrape walls near baseboard; scrape carpet adhesive residue from floor; sweep floor
Carpenter	10/20/94	2	1:49 → 2:12 pm	46	ND	1.3	Removing window casing and wooden molding; removing the window sash; heating the glazing; scraping and removing the softened glazing
		3	1:49 → 2:00 pm	33	ND	1.8	Removing window casing and molding; removing the window sash.
		3	2:00 → 2:19 pm	57	ND	1.1	Heating the glazing; scraping and removing the softened glazing; reglazing the glass. This activity was performed outdoors .

Table 2
Airborne Lead Exposure During Custodial Activities at the University of Maryland, College Park, Maryland, on October 20-21, 1994
HETA 94-0374

Custodial Activity	Sample Date	Flow Rate (lpm)	Sample Period	Vol (l)	Lead Concentration $\mu\text{g}/\text{m}^3$	MDC $\mu\text{g}/\text{m}^3$	Comments
		3	2:36 → 2:51 pm	45	4.9	1.3	Re-install the sash, rehang the window, and install the wooden molding.
		3	2:19 → 2:36 pm	51	ND	1.2	Heating the glazing; scraping and removing the softened glazing; reglazing the glass. This activity was performed indoors .
Plaster	10/20/94	2	10:24 → 11:27 am	84	TRACE	0.2	Removing old plaster in Room 1197 (approximately 2 X 3 feet). Re-plastered this wall and manually sanded the baseboard in Room 1197 (stair well) in the Fire House. Note: Since the worker left the immediate work area between 10:49 and 11:10 a.m., the sampling pump was turned off during this period. A respirator (half-mask air-purifying equipped with HEPA cartridges) and disposable protective suit was worn. Worker neither wore safety glasses nor a head cover (to prevent contamination of head and hair).
Plaster (Continued)	10/20/94	3	10:24 → 10:49 am	75	ND	0.8	Removed the plaster wall in Room 1197 (stair well) located in the Fire House. He had to break the plaster wall to square up the hole and prepare it for repair. Squared up the hole to approximately 2 X 3 feet. Obvious visible dust generated while breaking the wall with hammer and chisel.
		"	11:10 → 11:27 am	51	ND	0.4	Applied plaster (i.e., mud) to the squared up hole in the wall. Also manually sanded the baseboard.
Garage Mechanic	10/20/94	2	4:30 → 6:01 pm	182	0.9	0.1	Auto body work on 1979 Chevy van. Removing existing paint to bare metal and repairing damage with two-part body filler.
		3	4:30 → 4:53 pm	69	ND	0.3	Using an 8-inch and 3-inch circular body sander (rotary sander) to remove paint to the bare metal. Using 36 and 40 grit paper. Also using compressed air to clean the dust from the metal surface and also the mechanic's clothing.

Table 2
Airborne Lead Exposure During Custodial Activities at the University of Maryland, College Park, Maryland, on October 20-21, 1994
HETA 94-0374

Custodial Activity	Sample Date	Flow Rate (lpm)	Sample Period	Vol (l)	Lead Concentration $\mu\text{g}/\text{m}^3$	MDC $\mu\text{g}/\text{m}^3$	Comments
		"	4:53 → 6:01 pm	204	2.5	0.3	Using a 2-part body filler; using a dual action (DA) sander to smooth the repaired site; using an "air file" (which was equipped with a dust collection bag) to prepare a final finish surface suitable for painting; 30 grit paper used with the DA sander; also used compressed air to blow the metal surface (and the mechanic's clothing) clean
Maintenance	10/20/94	2	2:18 → 2:57 pm	78	TRACE	0.3	Wet scraping of window and door on the exterior of the Cambridge Dining Hall, Building # 097.
		3	2:39 → 2:57 pm	54	ND	0.4	Wet scraping window.
		3	2:18 → 2:39 pm	63	3.7	0.3	Wet scraping door.
Plumber	10/21/94	2	9:41 → 10:16 am	70	12.6	0.3	Manually remove the old lead and oakum from around a shower drain; heat lead in an open ladle using a propane torch; pour the molten lead from ladle into the cavity surrounding the drain; rapidly cooling the unused hot lead using cool water from a sink faucet. Employee was wearing a half-mask air-purifying respirator equipped with high-efficiency air-purifying (HEPA) cartridges and used leather gloves during this repair activity.
		3	9:41 → 10:05 am	72	TRACE	0.3	Manually remove the old lead and oakum surrounding a shower drain
		3	10:05 → 10:16 am	33	26.4	0.6	Heat lead in an open ladle using a propane torch; pour the molten lead from ladle into the cavity surrounding the drain; rapidly cooling the unused hot lead using cool water from a sink faucet.

Table 2
Airborne Lead Exposure During Custodial Activities at the University of Maryland, College Park, Maryland, on October 20-21, 1994
HETA 94-0374

Custodial Activity	Sample Date	Flow Rate (lpm)	Sample Period	Vol (l)	Lead Concentration $\mu\text{g}/\text{m}^3$	MDC $\mu\text{g}/\text{m}^3$	Comments
Plaster	10/21/94	2	1:17 → 1:50 pm	66	TRACE	0.3	Chipping and sanding
		3	1:17 → 1:39 pm	66	ND	0.3	Chipping
		3	1:39 → 1:50 pm	33	TRACE	0.6	Sanding
Housekeeping	10/21/94	2	5:13 → 9:37 am	582	ND	0.03	Housekeeping activities in the TAP temporary buildings associated with Energy Research. Work included cleaning water fountains, dustmopping (wicking) the halls, cleaning and wet mopping the bathrooms, emptying trash cans, sweeping dust into dust pans. No vacuuming was performed.
Housekeeping	10/21/94	2	5:14 → 9:37 am	526	0.34	0.04	Housekeeping tasks performed in the Computer Science and Geology Buildings. Activities included cleaning water fountains, dusting and cleaning chalkboards, mop and clean the bathrooms, emptying trashcans. No vacuuming was performed. This worker's shift ended early (10:00 a.m.) due to a class.
Painter	10/21/94	2	8:01 → 8:54 am	106	TRACE	0.2	Scraping old paint from hot-water radiator in Room 2101A of Symons Hall. Activities included spreading plastic around the radiator to collect the paint chips, wet scraping of the radiator using a 2 inch metal blade, and clean-up of the immediate area after scraping was completed. A hand-held spray bottle filled with water was used to wet the radiator during scraping and to wet the floor during the clean-up.
		3	8:01 → 8:10 am	27	TRACE	0.2	Preparing the area for scraping by spreading plastic around the radiator

Table 2
Airborne Lead Exposure During Custodial Activities at the University of Maryland, College Park, Maryland, on October 20-21, 1994
HETA 94-0374

Custodial Activity	Sample Date	Flow Rate (lpm)	Sample Period	Vol (l)	Lead Concentration $\mu\text{g}/\text{m}^3$	MDC $\mu\text{g}/\text{m}^3$	Comments
		3	8:10 → 8:41 am	93	TRACE	0.2	Wet scraping the radiator using a hand-held spray bottle and a 2 inch metal blade. The painter wore a powered air-purifying respirator (PAPR) when scraping.
		3	8:41 → 8:54 am	39	TRACE	0.5	Clean-up of the area immediately surrounding the radiator, including folding up the plastic on the floor, followed by broom sweeping the floor. The worker used the water spray bottle to wet the floor during the clean-up.

Comments:

1. Since the air sample volumes covered wide range in this sample set (18 to 898 liters), the minimum detectable concentration (MDC) for each sample was calculated and is shown in the table.

Abbreviations:

1. l =liters
2. $\mu\text{g}/\text{m}^3$ =micrograms of lead per cubic meter of air
3. MDC=Minimum detectable concentration. The MDC represents the lowest lead concentration which could be reliably detected using this analytical method, based on the amount of air sampled. The larger the amount of air sampled, the lower the MDC.
4. lpm=liters of air per minute
5. TRACE=Lead was detected at a concentration above the minimum detectable concentration (MDC) but below the level where it could be reliably quantified.

Table 3
Lead Concentrations in Bulk Samples Collected at the University of Maryland
College Park, Maryland
HETA 94-0374
[Samples Collected on October 20-21, 1994]

Painted Surfaces	Lead (% by weight)
Radiator (located in Symons Hall)	0.21
Wood door (located in Cambridge Dining Hall)	3.7
Wood window frame (located in Cambridge Dining Hall)	0.11
Plaster wall (located in old fire house)	1.2
Door and frame (located in Wicomico Hall, Rm. 214)	0.79
Wood door (located in Shriver Hall)	19
Outside wall (exterior of Shriver Hall)	0.55
Window sash (located in Wicomico Hall, Rm. 214)	0.39
Glazing (located in Wicomico Hall, Rm. 214)	1.4
Exterior column (exterior of Shriver Hall, east end)	0.036
Wall (located in North Gym)	0.02
Gym floor (located in North Gym)	0.0063
MEAN	2.2
RANGE	0.0063 – 19
Other Surfaces	Lead (% by weight)
Scrapings from floor where carpeting was removed (located in Wicomico Hall, Lobby Area)	0.12
Old carpet which was removed (located in Wicomico Hall, Lobby Area)	0.0018
Paint and wood shavings from door frame (located in Shriver Hall)	0.8
Sanding dust, containing abrasive and paint from floor (located in North Gym)	0.004
MEAN	0.23
RANGE	0.004 – 0.8

Table 4
Lead Concentrations in Wipe Samples Collected at the University of Maryland
College Park, Maryland
HETA 94-0374

[Samples Collected on October 20-21, 1994]

Sample Location	Lead ($\mu\text{g per } 100 \text{ cm}^2$)
Wicomico Hall (surface of old carpet prior to removal)	Trace
Shriver Hall (swept tiled floor, Room 1111B, after the removal of door hinges by carpenter)	14
Shriver Hall (unswept tiled floor, Room 1111B, after the removal of door hinges by carpenter)	6.2
Automotive garage (from surface of van receiving body work)	240
Symons Hall (Room 2101A, 2nd floor restroom, middle of floor, after wet scraping of radiator)	Trace
Symons Hall (Room 2101A, 2nd floor restroom, near radiator, after wet scraping of radiator)	11
Hand-wipe sample from plumber (before putting on work gloves)	17
Hand-wipe sample from plumber (after completing repair and work gloves removed)	460
Computer and Space Sciences 224, Room 2354 (North Wall, right side)	Trace
Computer and Space Sciences 224, Room 2354 (North Wall, center)	Trace
Computer and Space Sciences 224, Room 2463 (South Wall)	Trace
Geology Building 237 (2nd floor central corridor, east wall)	2.8
Geology Building 237 (2nd floor central corridor, west wall)	Trace
Geology Building 237 (3rd floor central corridor, west wall)	Trace
Energy Research 223 (Reference library, north part of room)	Trace
Energy Research 223 (Reference library, east part of room)	Trace
Energy Research 223 (Corridor outside Room 112, north wall)	Trace
Queen Anne Hall (1st floor, near room 1118)	Trace
Queen Anne Hall (1st floor, near room 1121)	Trace
Queen Anne Hall (3rd floor, near room 3722)	Not Detected
Somerset Hall (1st floor, lobby area)	Not Detected
Somerset Hall (1st floor, lobby area)	Trace
Somerset Hall (2nd floor, room 2108)	Not Detected
$\mu\text{g per } 100 \text{ cm}^2$ = micrograms of lead per 100 square centimeters of surface area Trace: Concentration between the Minimum Detectable and Minimum Quantifiable Concentrations Minimum Detectable Concentration = $0.8 \mu\text{g per } 100 \text{ cm}^2$ Minimum Quantifiable Concentration = $2.7 \mu\text{g per } 100 \text{ cm}^2$	

Appendix A
CONSENT TO PARTICIPATE IN A HEALTH HAZARD EVALUATION (RESEARCH STUDY)
University of Maryland, College Park, Maryland
HETA 94-0374

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
CENTERS FOR DISEASE CONTROL AND PREVENTION
U.S. PUBLIC HEALTH SERVICE
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

- I. You are being asked to participate in a NIOSH health hazard evaluation (research study) of possible lead exposure at the University of Maryland. This health hazard evaluation was requested by University management at the suggestion of NIOSH investigators evaluating occupational lead exposure among janitorial and custodial workers, which the Housing and Community Development Act of 1992 requires NIOSH to do. The purpose of this evaluation is to determine whether janitorial staff at the University of Maryland are exposed to lead at work.
- II. The study will include the following procedures:
 1. A questionnaire about your work history, work practices, and other possible sources of lead exposure. You will be asked to complete the questionnaire yourself, but a NIOSH representative will be present to assist you and check it for completeness. It should take from 10 to 15 minutes.
 2. A blood test for lead. One tube (about 2 teaspoons) of blood will be taken from a vein in your arm. The needle stick may produce momentary discomfort and possibly some residual soreness and discoloration of the skin due to blood leaking from the vein; this discoloration may last a few days but is harmless. Infrequently, the procedure causes someone to faint. This procedure should take only a few minutes. The blood will be used only for the tests specified above.
- III. The benefits to you from participating in the study include the free medical test described above. Your participation may also benefit your co-workers, and possibly other people, as a result of what is learned from this study. NIOSH will provide you and your doctor (if you wish) with the results of your blood lead test. We will do this when the study is finished, or sooner, if appropriate. The overall study results (without names or other personal identifying information) will be provided to the employer and union; the employer is required to post a copy of the final report in a place accessible to employees for a period of 30 days. In addition, if you so request, NIOSH will send you a copy of the final report. The only disadvantage, besides the slight discomfort and inconvenience described above, is that the test result may be outside the range of "normal" even though nothing is wrong. This could result in a recommendation for further medical evaluation that, ultimately, may not have been necessary.
- IV. The blood test described above is a standard medical test; alternative procedures are less reliable, riskier, more difficult to interpret, or more time-consuming.
- V. Injury from this project is unlikely. But if it results, medical care is not provided, other than emergency treatment. If you are injured through negligence of a NIOSH employee or an agent of NIOSH, you may be able to obtain compensation under Federal Law. If you want to file a claim against the Federal government your contact point is: Public Health Service Claims Office: 301-443-1904. If an injury

should occur to you as the result of your participation, you should contact Mitchell Singal, M.D., Senior Medical Officer, (513) 841-4252, or Michael J. Colligan, Ph.D., (513) 533-8225, the chair of the NIOSH Human Subjects Review Board.

- VI. The National Institute for Occupational Safety and Health (NIOSH) of the Centers for Disease Control and Prevention (CDC), an agency of the Department of Health and Human Services, is authorized to collect this information, including your social security number (if applicable), under provisions of the Public Health Service Act, Section 301 (42 U.S.C. 241); Occupational Safety and Health Act, Section 20 (29 U.S.C. 669); and Federal Mine Safety and Health Act of 1977, Section 501 (30 U.S.C. 95). The information you supply is voluntary and there is no penalty for not providing it. The data will be used to evaluate occupational lead exposure. Data will become part of CDC Privacy Act system 09-20-0147, "Occupational Health Epidemiological Studies" and may be disclosed: to appropriate state or local HEALTH departments to report certain communicable diseases; to the State Cancer Registry to report cases of cancer where the state has a legal reporting program providing for the information's confidentiality; to private contractors assisting NIOSH; to collaborating researchers under certain limited circumstances to conduct further investigations; to one or more potential sources of vital statistics to make a determination of death; to the Department of Justice in the event of litigation; and to a congressional office assisting individuals in obtaining their records. An accounting of the disclosures that have been made by NIOSH will be made available to you upon request. Except for these and other permissible disclosures expressly authorized by the Privacy Act, no other disclosure may be made without your written consent.

A blood lead level of 25 µg/dL or more is a reportable condition in Maryland. If our study finds that you have this condition, we will report this, with your name and other relevant information, to the Maryland Department of the Environment.

- VII. If you have any reaction to the tests or procedures, you should contact Mitchell Singal, M.D., Senior Medical Officer, (513) 841-4252. You should also contact Dr. Singal (or Mr. Gregory Burr at the study site) if you have any questions concerning this study or your participation.
- VIII. Your participation is voluntary and you may withdraw your consent and your participation in this study at any time without penalty or loss of benefits to which you are otherwise entitled.

IX. SIGNATURES

I have read this consent form and I agree to participate in this study.

PARTICIPANT _____ Age ____ Date _____
(signature)

I, the NIOSH representative, have accurately described this study to the participant.

REPRESENTATIVE _____ Date _____
(signature)

APPENDIX B

WORKER PARTICIPANT OCCUPATIONAL HEALTH QUESTIONNAIRE

**University of Maryland
College Park, Maryland
HETA 94-0374**

7. **Which of the following have been provided to you by the University.**
- a. Pre-employment physical or blood lead test No...__ Yes...__ {54}
- b. Training about the danger of lead No...__ Yes...__ {55}
- c. Respirators No...__ Yes...__ {56}
- d. Personal air monitoring for lead No...__ Yes...__ {57}
8. **Your most recent blood lead test was on:** 19 |__|__| |__|__| |__|__| {58-63}
 (YEAR) (MONTH) (DAY)
 (___ Check here if you never had a blood lead test by the University)
9. **Are you provided the results of blood lead testing by the University?** No, never.....__ {64}
 Yes, always.....__
 Yes, sometimes...__
 Not applicable...__
10. **What type(s) of respirators are you provided by the University?** NONE.....__ {65}
 Disposable dust mask.....__
 Non-disposable, Air-purifying...__
11. **Do you wear a respirator at your job?** No, never.....__ {66}
 Yes, always.....__
 Yes, sometimes...__
12. **Were you trained in the proper use of respirators?** No...__ Yes...__ {67}
13. **Do you wear gloves at the job site?** No, never.....__ {68}
 Yes, always.....__
 Yes, sometimes...__
14. **Do you have a beard?** No...__ Yes...__ {69}
15. **Do you currently smoke tobacco products?** No...__ (IF NO, GO TO QUESTION 16C)
 Yes..__ (IF YES, GO TO QUESTION 16A) {70}
- a. **Do you smoke at work?** No.....__ {71}
 Yes, anywhere at the work site.....__
 Yes, only in designated smoking areas. __
- b. **Before smoking a cigarette, do you wash your hands?** No, never.....__ {72}
 Yes, always.....__

- c. **Did you ever smoke?** No...__ Yes...__ {73}
16. **Do you currently chew tobacco or gum at work?** No...__ (If no, go to Question 19) {74}
Yes...__
17. **Do you wash your hands before starting a new plug/piece?** No, never.....__ {75}
Yes, always.....__
Yes, sometimes...__
18. **Where do you generally eat your lunch?** In the work area.....__ {76}
In a non-work area designated only for eating and drinking.....__
In my personal vehicle at the University__
In a company vehicle at the University..__
Off the work site.....__
19. **Before eating lunch, do you wash your hands?** No, never.....__ {77}
Yes, always.....__
Yes, sometimes...__
20. **How do you usually travel to and from work? (Check only one)** Company vehicle...__ {78}
Personal vehicle...__
Carpool employee's vehicle...__
Public transportation...__
Other...__
21. **Before going home at the end of the day, do you change your clothing?** No, never.....__ {79}
Yes, always.....__
Yes, sometimes...__
- If "yes":*
- a. **Where do you change?** In a designated change area...__ {80}
Other
22. **Do you wear company-supplied work clothes?** No, not provided.....__ {81}
No, but company provides...__
Yes, always.....__
Yes, sometimes.....__
- If "yes":*
- a. **Are the clothes:** Disposable.....__ {82}
Non-disposable...__
23. **Do you take your work clothing home for laundering?** No, never.....__ {83}
Yes, always.....__
Yes, sometimes...__

24. **Do you take your work shoes home?** No, never.....__ {84}
 Yes, always.....__
 Yes, sometimes...__
25. **Before going home at the end of the day, do you shower?** No, never.....__ {85}
 Yes, always.....__
 Yes, sometimes...__
26. **Before going home at the end of the day, do you wash your hand and face?** No, never.....__ {86}
 Yes, always.....__
 Yes, sometimes...__

Part II. Personal Information

27. **What is your age?** |__|__| (in years) {87-88}
28. **What is your race?** White.....__ {89}
 Black.....__
 American Indian/Alaskan native...__
 Asian/Pacific Islander.....__
29. **Are you of Hispanic origin?** No...__ Yes...__ {90}
30. **What is the last year of school that you completed? (CHECK ONE)** {91}
 ___ Grade school (1-8)
 ___ Some high school (9-12)
 ___ High school graduate
 ___ Some college or college graduate
31. **How many other persons share a household with you?** ____ {92-93}
- How many children under 10 live in your household?** ____ {94-95}
32. **While not at work, have you used or removed lead-based paint during the past six months?** No...__ Yes...__ {96}
33. **Do you work with stained glass?** No...__ Yes...__ {97}
34. **Do you use indoor firing ranges?** No...__ Yes...__ {98}
35. **Do you make your own fishing lures?** No...__ Yes...__ {99}
36. **Do you make your own bullets?** No...__ Yes...__ {100}

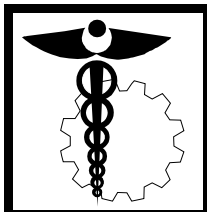
37. Do you have any other hobbies/activities in which you are exposed to lead? No...__ Yes...__ {101}
If yes, please list them: {102-103}

38. Are you currently, or have you been, pregnant within the past 12 months? No...__ Yes...__ Not Applicable...__ {104}

39. Have you ever received training about the hazards of exposure to lead? No...__ Yes...__ {105}

Name: _____
Street: _____
City: _____ State _____ Zip _____

Thank you for your cooperation!



NIOSH

Delivering on the Nation's promise:
Safety and health at work for all people
Through research and prevention