CDC

Workplace Safety and Health

Health Hazard Evaluations: Issues Related to Occupational Exposure to Lead

1994 to 1999

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

NIOSH

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Public Health Services
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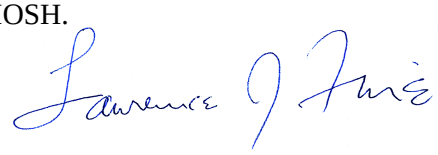
Foreword

The Health Hazard Evaluations and Technical Assistance (HETA) program responds to requests from employers, employees, employee representatives, other Federal agencies, and State and local agencies. Through a staff of industrial hygienists, engineers, occupational physicians, occupational health nurses, epidemiologists, other health professionals, and support personnel, the HETA Branch collaborates with appropriate personnel in other National Institute for Occupational Safety and Health (NIOSH) Divisions, to respond to approximately 400 requests for assistance each year. The typical HETA response to a request for assistance results in an evaluation of the workplace to determine if chemical, physical, biological, or other agents are hazardous to workers. Control procedures, improved work practices, and medical programs may be recommended to reduce any hazardous exposures found and to prevent adverse health effects. The results of individual evaluations may trigger wider studies of similar exposures in other settings, or may stimulate recommendations for implementation or modification of health standards. More than 10,000 evaluations have been completed since the inception of the HETA program in 1972. Requests received by the HETA program tend to reflect widespread occupational problems, such as lead hazards in the work-place.

The HETA program administers health hazard evaluations (HHEs) of occupational exposure to lead and other substances. Site visits are conducted if warranted, and interim and final reports are developed and distributed to the employer, employees, and relevant State and Federal agencies. One-hundred, thirty-nine lead-related HHEs were conducted from 1990 to 1999. The HHE requests came from a variety of workplaces, including secondary lead smelters, battery manufacturers, structural steel painting sites, ship building facilities, and firing ranges.

This document presents titles and summaries of the 31 HHEs related to lead that were completed between 1995 and 1999. In most cases lead exposure was just one of several exposures that NIOSH researchers investigated at a work site. In many cases, corrective measures were made in response to the evaluation and recommendations made by NIOSH.



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Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
AHU	Air handling unit
BEI	Biological Exposure Index (ACGIH)
BLL	Blood lead level
CL	Ceiling limit, an exposure that shall not be exceeded during any part of the workday
°C	Degrees Celsius
CFR	Code of Federal Regulations
cm^2	Square centimeters
EPA	U.S. Environmental Protection Agency
°F	Degrees Fahrenheit
GA	General area (air sample)
GM	Geometric mean
HETA	Hazard Evaluation and Technical Assistance
HETAB	Hazard Evaluation and Technical Assistance Branch
HEPA	High-efficiency particulate air (filter)
HHE	Health hazard evaluation
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, ventilating, and air-conditioning
IAQ	Indoor air quality
IEQ	Indoor environmental quality
IH	Industrial hygiene or industrial hygienist
LBP	Lead-based paint
LEV	Local exhaust ventilation
LOD	Limit of detection (analytical method)
LOQ	Limit of quantitation (analytical method)
Lpm	Liters per minute
MDC	Minimum *detectable* concentration (the smallest amount of a material that can be reliably detected). The MDC is calculated by dividing the analytical LOD by a representative air volume.
mg	Milligrams
mg/g	Milligrams per gram
mg/m^3	Milligrams per cubic meter of air
mL	Milliliter
mm	Millimeter
MQC	Minimum *quantifiable* concentration (the smallest amount of a material that can be reliably measured). The MQC is calculated by dividing the analytical LOQ by a representative air volume.
MSDS	Material safety data sheet
NA	Not applicable, not available
ND	Not detected
NIOSH	National Institute for Occupational Safety and Health
nm	Nanometer
OSHA	Occupational Safety and Health Administration
PBZ	Personal breathing–zone (air sample)
PEL	Permissible exposure limit (OSHA)
ppb	Parts (of a contaminant) per billion parts
PPE	Personal protective equipment
ppm	Parts (of a contaminant) per million parts
REL	Recommended exposure limit (NIOSH exposure criteria)
SIC	Standard Industrial Classification
STEL	Short–term exposure limit
TA	Technical assistance
TLV®	Threshold limit value (ACGIH exposure criteria)
TWA	Time–weighted average
XRF	X-ray fluorescence
ZPP	Zinc Protoporphyrin
μg	Microgram
$\mu g/dl$	Micrograms per deciliter
$\mu g/g$	Micrograms per gram
$\mu g/ft^2$	Micrograms per square foot
$\mu g/m^3$	Micrograms of contaminant per cubic meter of air (a unit of concentration)

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Background

Occupational exposure to lead occurs via inhalation of lead-containing dust and fume and ingestion from contact with lead-contaminated surfaces. Symptoms of lead poisoning include weakness, excessive tiredness, irritability, constipation, anorexia, abdominal discomfort (colic), fine tremors, and "wrist drop."[1,2,3] Overexposure to lead may also result in damage to the kidneys, anemia, high blood pressure, impotence, and infertility and reduced sex drive in both sexes. In most cases, an individual's BLL is a good indication of recent exposure to and current absorption of lead.[4] BLL will also reflect in the body, so it may not be an accurate measure of recent exposure if there has been long-term, high lead exposures. Elevated ZPP levels have also been used as an indicator of chronic lead intoxication. Persons without occupational lead exposure usually have a ZPP level less than 40 μg/dl.[5] However, other factors, such as iron deficiency, can cause an elevated ZPP level, so the BLL is a more specific test for evaluating occupational lead exposure. BLLs for the U.S. population as a whole have declined significantly over the past three decades. In the NHANES III survey, conducted from 1988 through 1991, the geometric mean BLL was 2.8 μg/dl.[6]

In the OSHA lead standards for general industry and construction, the PEL for lead in air is 50 $\mu g/m^3$ (8-hour TWA), which is intended to maintain worker BLLs below 40 μg/dl; medical removal is required when an employee's BLL reaches 50 μg/dl.[7,8] NIOSH has concluded that the 1978 NIOSH REL of 100 $\mu g/m^3$ as an 8-hour TWA does not sufficiently protect workers from the adverse affects of exposure to inorganic lead.[9] NIOSH has conducted a literature review of the health effects data on inorganic lead exposure and finds evidence that some of the adverse effects on the adult reproductive, cardiovascular, and hematologic systems, and on the development of children of exposed workers can occur at BLLs as low as 10 μg/dl.[10] At BLLs below 40 μg/dl, many of the health effects would not necessarily be evident by routine physical examinations but represent early stages in the development of disease. In recognition of this, voluntary standards and public health goals have established lower exposure limits to protect workers and their children. The ACGIH TLV for lead in air is 50 $\mu g/m^3$ as an 8-hour TWA, with worker BLLs to be controlled to $\leq$30 μg/dl. A national health goal is to eliminate all occupational exposures that result in BLLs >25 μg/dl.[11]

Lead is commonly found in U.S. urban dust and soil resulting from the past use of lead in gasoline and paints, and also industrial emissions. Lead-contaminated surfaces in the workplace represent a potential source of exposure for workers. Lead exposure may occur either by direct hand-to-mouth contact, or indirectly through contamination of hands, cigarettes, cosmetics, or food. In the workplace, generally little or no correlation occurs between surface lead levels and employee exposures because ingestion exposures are highly dependent on personal hygiene practices and available facilities for maintaining personal hygiene. No Federal standard provides an exposure limit for lead contamination of surfaces in the workplace. HUD currently recommends the following clearance levels for lead on surfaces after residential lead abatement or interim control activities in federally owned or assisted housing: floors, 40 $\mu g/ft^2$; interior window sills, 250 $\mu g/ft^2$, and window wells, 800 $\mu g/ft^2$.[12] Similarly, there are no Federal standards for soil lead contamination in the workplace. The EPA has proposed standards for residential soil-lead levels, expressed as the average total lead by weight in drip-line and mid-yard composite soil samples: 400 ppm as a level of concern that should trigger appropriate risk reduction activities and $\geq$ 2000 ppm as a trigger for permanent abatement of soil lead hazards.[13]

Law Enforcement

HETA 91–0346–2572
April 1996

Toxicity determination: Positive
Requester: Management
Lead concentrations: PBZs from ND to 51.7 $\mu g/m^3$ for non-custodial employees and from ND to 220.0 $\mu g/m^3$ for custodians while cleaning firing range; BLLs averaged <16.2 $\mu g/dl$ from 1989 to 1991
Purpose: To evaluate lead exposures during firearm training and the potential for take-home lead
Keywords: SIC 9221 (police protection), indoor firing ranges, outdoor firing ranges, inorganic lead, ventilation system design, engineering controls, para-occupational exposure, BLL, noise, hearing loss, take-home lead

Abstract: NIOSH investigators conducted an HHE at a firing-range training facility to evaluate lead exposures during firearm training and associated activities among range technicians, gunsmiths, and firing range instructors. Additionally, the potential for "take-home" lead contamination of workers' vehicles and homes and exposure of their families was also evaluated. Sixty-one PBZ and 30 area samples for airborne lead were collected. Personal sampling found firing range instructors' exposures were up to 51.7 $\mu g/m^3$, range technicians' to 2.7 $\mu g/m^3$, and gunsmiths' to 4.5 $\mu g/m^3$. Private medical interviews were conducted with 13 randomly selected workers associated with the firing range. None of the interviews were remarkable for any symptoms or health problems associated with the workplace lead exposures. Records of BLL for all current instructors, range technicians, gunsmiths, and custodians from 1989 to 1991 were reviewed. The mean BLL among instructors decreased from 14.6 $\mu g/dl$ in 1989 to 7.4 $\mu g/dl$ in 1991. In comparison, no appreciable reduction in mean BLL among gunsmiths and range technicians occurred during this time period. Custodians all had BLLs of less than 4 $\mu g/dl$. Carpet dust samples were collected in 14 student dormitory rooms and in 14 nonstudent dormitory rooms. Student dormitory rooms had significantly higher lead concentrations than non-student dormitory rooms. This suggested that students using the firing range might have been contaminating their living quarters with lead. A potential hazard from short-term overexposure to lead via inhalation existed at the outdoor firing ranges at the time of the investigation. In addition, a potential problem of "take-home" lead exposure to families of firearm instructors was found. Recommended modifications for the indoor firing range ventilation system, proper hygiene practices, and safe use of all of the ranges were presented at the end of the full report.

Copies are available from NTIS, individually or on CD-ROM.

HETA 95–0290
February 1996

Toxicity determination: Negative
Requester: Management
Lead concentrations: PBZs of < 0.5 $\mu g/m^3$, BLLs from <5 $\mu g/dl$ to 10.6 $\mu g/dl$
Purpose: To evaluate lead exposures at a State patrol training academy that had recently begun to use cartridges containing copper-jacketed bullets and non-lead primers
Keywords: SIC 9221 (police protection), lead, indoor firing ranges, blood lead, copper

Abstract: NIOSH conducted an HHE to evaluate lead exposures at a State patrol training academy. An independent consultant had previously measured lead exposures of 300 to 5,600 $\mu g/m^3$ and an increase in average BLLs from 6.4 to 51 $\mu g/dl$ after 4 weeks of firearms training. Subsequently, the academy began using cartridges containing copper-jacketed bullets and non-lead primers as a means of reducing lead exposures. NIOSH conducted air and blood sampling to determine the effectiveness of the intervention. All of the air samples were either non-detectable or contained only trace amounts of lead (detected, but below the limit of quantitation, approximately 0.5 $\mu g/m^3$). The BLLs ranged from <5 $\mu g/dl$ to 10.6 $\mu g/dl$, and ZPP levels ranged from 10 to 32 $\mu g/dl$. The data provided evidence that the control measures were effective. NIOSH did recommend that a proper ventilation system be used to control lead exposures so that the firing range

would be safe for a wider variety of firearms and types of ammunition. However, until effective ventilation could be installed, NIOSH recommended the continued use of jacketed bullets and non-lead primers.

Copies are available from HETAB.

HETA 96–0107–2613
December 1996

Toxicity determination: Negative
Requester: Management
Lead concentrations: PBZs below MQC, surface contamination from 6.6 to 31.6 μg/100 cm^2
Purpose: To evaluate the potential lead exposure in an indoor firing range
Keywords: SIC 9221 (police protection), indoor firing ranges, lead

Abstract: NIOSH investigators conducted an HHE at a police department indoor firing range and collected air samples for lead during an in-service firearm training session. The results of air sampling indicated that airborne lead concentrations were below the MQC. The average MQC for personal lead samples collected on officers was 43 μg/m^3, based upon an average sample volume of 27.6 liters (range 30 to 84 μg/m^3). The MQC for the sample collected on the instructor during the training session was 4.4 μg/m^3. The MQC for an area sample was 4.1 μg/m^3. Wipe samples from surfaces inside the trailer revealed lead concentrations ranging from 6.6 to 31.6 μg/100 cm^2. Lead-containing ammunition was the likely source of the surface contamination. Ventilation was provided by two 14–inch axial fans located in the trailer's sidewalls, approximately 60 inches from the floor at either side of the target area. Makeup air entered through a doorway at the back of the room. The airflow was neither well distributed nor adequate to ensure the removal of airborne lead that was generated by the firing of lead-primer ammunition. The firing of copper-jacketed lead-free primer ammunition did not present a health hazard to officers-in-training or the range instructor. However, continued use of lead-primer ammunition by other police departments may expose those officers to lead and result in further surface contamination.

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HETA 96–0218–2623
January 1997

Toxicity determination: Negative
Requester: Management
Lead concentrations: PBZs below MQC to 140 μg/m^3, surface concentrations from 2.5 to 1,100 μg/100 cm^2
Purpose: To investigate potential staff and recruit exposures to lead at this firearm training facility
Keywords: SIC 9221 (police protection), indoor firing ranges, lead

Abstract: NIOSH investigators completed an HHE at a firearm training facility to determine if there was a risk of lead exposure. Investigators collected 15 PBZ samples and two GA air samples. In addition, 7 wipe samples were collected from surfaces in and around the range, and a bulk sample was collected from dust on the floor. The highest airborne lead concentrations were measured during cleaning of the floor and target-retrieval rails (22 and 140 μg/m^3, respectively). Although small amounts of lead were detected in all air samples (0.7 through 9.5 μg/m^3), firearms training did not present a health hazard from exposure to airborne lead. It appeared that some exposure to lead could have occurred from lead surface contamination in and around the range; however, ingestion of lead could have been avoided through good hygiene practices. It was recommended to reduce lead exposure during routine cleaning by use of a HEPA-filter equipped vacuum cleaner.

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HETA 97–0255–2735
January 1997

Toxicity determination: Positive

Requester: Management

Lead concentrations: PBZs and GAs from ND to 5910 $\mu g/m^3$, surface concentrations below MQC to 102,190 $\mu g/ft^2$

Purpose: To evaluate lead exposures among police officers who used an indoor firing range

Keywords:* SIC 9221 (police protection), indoor firing range, IFR, lead, ventilation, wipe sampling, blood lead levels, BLLs, inhalable sampler, IOM sampler

*At the conclusion of an HHE, the NIOSH investigators provide keywords for inclusion in the HHE Database

Abstract: NIOSH conducted an HHE to evaluate lead exposures among police officers who used the indoor firing range. Air samples and surface wipe samples were collected, and the ventilation system was evaluated. Air sampling results indicated that even while the general ventilation system is operating, range users could be overexposed to lead within a short time (about 1 hour). GA and PBZ samples for lead ranged from ND to 960 $\mu g/m^3$, 8–hour TWA. Wipe samples collected inside the range and in the work areas outside the range showed widespread lead contamination. Surface lead loading levels ranged from 130 $\mu g/ft^2$ in the men's locker room (outside the range) to 102,000 $\mu g/ft^2$ on the curved supply air diffuser inside the range. Both air and wipe samples indicated that lead was escaping from the range into surrounding work areas of the police station. Also, airborne lead was detected downstream of the filter banks in the rooftop AHU in the July 1997 survey, indicating that in the past contaminated air had been recirculated into the range. At the time of the surveys, the general ventilation system performed inadequately to control exposures to range users, range masters, and workers in areas nearby the range. NIOSH recommended that the range be negatively pressurized and that adequate airflow through the range move in a uniform (non–turbulent) manner from the firing line to the bullet trap and main exhaust plenum.

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Manufacturing and Repairing

HETA 91–0272
June 1999

Toxicity determination: Positive
Requester: Union
Lead concentrations: cumulative blood lead index measurements from 138 to 1,446 $\mu g/dl$-yr, TWA-BLLs from 12 to 50 $\mu g/dl$
Purpose: To assess the relationship between long-term occupational lead exposure and several health outcomes related to blood pressure at a battery manufacturing plant
Keywords: SIC 3691 (storage batteries), lead, blood pressure, hypertension

Abstract: NIOSH conducted a study to assess the relationship between long-term occupational lead exposure and several health outcomes related to blood pressure—diastolic pressure, systolic pressure, hypertension, and left ventricular mass. Evidence was found of a dose-response relationship between cumulative occupational lead exposure and diastolic pressure, with a statistically significant difference between the highest and lowest tertiles of exposures. No association was found between lead exposure and hypertension, but that may have been due to the lower participation rate among retirees and the small size of the study. Finally, the study documented a non-statistically significant pattern of slightly increasing left ventricular mass with increasing occupational lead exposure, supporting the idea that the effects of lead on blood pressure may be related to the development of cardiovascular disease. The possibility of further analysis of these relationships by using the blood pressure data in the company's medical records was explored, but the available data was not sufficient for the required analyses.

Copies are available from HETAB.

HETA 91–0292–2467
November 1994

Toxicity determination: Positive
Requester: Management
Lead concentrations: PBZs and GAs from ND to 36 $\mu g/m^3$
Purpose: To evaluate the potential hazards from exposure to paint at this electronics component manufacturing facility

Keywords: SIC 3679 (electronic components, not elsewhere classified), methylene chloride, 2-ethoxyethyl acetate, lead

Abstract: NIOSH investigators conducted an HHE at an electronics component manufacturing facility to evaluate potential hazards in the paint room. Ventilation measurements were made, and PBZ and GA air sampling was conducted for solvents and metals, including lead. In addition, bulk-material samples were analyzed, and observations were made of the operations and work practices. One PBZ air sample exceeded the OSHA action level for lead. Since exposures can vary from day-to-day, higher exposures to lead may occur among paint room employees. The following recommendations were made to reduce worker exposure to lead at this facility: (1) conduct additional air monitoring to more fully characterize worker exposures to lead, (2) provide additional PPE for Paint Room workers, and (3) institute ventilation and administrative changes to further reduce exposures.

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HETA 92–0102–2537
October 1995

Toxicity determination: Undetermined
Requester: Union

Lead concentrations: ND (<1 $\mu g/m^3$)

Purpose: To evaluate the health hazards at an Army depot, including an area that repaired military electro-optic devices with the use of lead solder

Keywords: SIC 7629 (electrical and electronic repair shops), acetone, ethanol, isopropyl alcohol, lead, silica, diisoncyanate, IAQ, IEQ

Abstract: NIOSH conducted an HHE at an Army depot. One of the areas evaluated was a building designed for the repair of military electro-optic devices (night vision systems such as thermal and image enhancers) and laser range finders. Repair activities included the use of various solvents (predominantly ethanol, acetone, and isopropanol) and the use of soldering devices (with lead solder). Along with other industrial hygiene and medical evaluations, air samples were collected and analyzed for lead, but none had detectable amounts (minimum detectable concentration: 1 $\mu g/m^3$ for a 1,000 liter sample). However, solder particulate was observed on workstation surfaces, which could have represented a potential hazard from exposure to lead through ingestion. NIOSH recommended that eating and drinking not be allowed in workstation areas, that hand-washing by employees be emphasized, especially prior to eating or smoking, and that the possibility of bringing lead contaminated objects (i.e., clothing) into the home be stressed to employees.

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HETA 94–0268–2618
December 1996

Toxicity determination: Positive

Requester: Management

Lead concentrations: PBZs from 15 to 495 $\mu g/m^3$

Purpose: To determine if on-going improvements to a battery manufacturing plant's engineering controls would reduce employee lead exposures

Keywords: SIC 3691 (storage batteries), lead, Pb, battery manufacturing, BLLs, wipe sampling, respiratory protection, saliva, anodic stripping voltametry, ASV

Abstract: NIOSH conducted an HHE at a battery manufacturing plant to determine if on–going improvements to the plant's engineering controls would reduce employee lead exposures. Site visits were made during the periods July 13–16, 1994, and March 27–31, 1995. PBZ samples collected in various locations of the plant exceeded the OSHA PEL of 50 $\mu g/m^3$. The highest PBZ exposures were measured in plate pasting operations (range: 68 to 495 $\mu g/m^3$). Exposures in first assembly and pouching ranged from 15 to 418 $\mu g/m^3$ and 31 to 77 $\mu g/m^3$, respectively. Surface wipe samples showed a consistent presence of lead on cafeteria table tops. Significantly increased amounts of lead were present on hand wipe samples obtained from employees finishing lunch compared to hand wipes collected from the same employees before they entered the lunchroom. A unique biological monitoring and sample analysis method (analysis of saliva lead by anodic stripping voltametry) was used to evaluate for the presence of recently absorbed lead in employee saliva samples. Triplicate saliva samples obtained during 4 consecutive workdays documented a consistent daily increase in saliva lead. Video exposure monitoring identified work practices and housekeeping issues, such as dumping dross into unventilated scrap barrels and floor sweeping with corn brooms, that could increase airborne lead concentrations. Modifications to some engineering controls were suggested to optimize capture efficiencies and enhance performance of the ventilation system. The engineering controls evaluation and video exposure assessment monitoring were compiled in two separate appendices to the report. Although the engineering controls were appropriate for battery manufacturing, lead exposures exceeded the OSHA PEL. Operations and maintenance of engineering controls, housekeeping issues, and certain work practices were identified as some of the reasons for overexposures. Recommendations were made to ensure that local exhaust ventilation systems function as designed, improve the company's respiratory protection program, decontaminate and control lead on lunchroom surfaces (cafeteria tables and hand contact surfaces), improve hand decontamination to reduce the potential for ingestion of lead, and modify employee work practices to discourage activities that may result in the suspension of lead dust into the workplace atmosphere.

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HETA 97–0084–2669
December 1997

Toxicity determination: Negative for lead, positive for other exposures

Requester: Management

Lead concentrations: PBZs of 15.1 and 28.3 $\mu g/m^3$, GAs of 0.06 and 0.07 $\mu g/m^3$

Purpose: To document worker exposures to a wide variety of contaminants, including lead during the cleaning of dross from a wave solder machine

Keywords: SIC 3519 (internal combustion engines), noise, isocyanates, metal working fluids, TDI, MDI, total reactive isocyanate groups, toluene, xylene, formaldehyde, inorganic acids, ammonia, lead

Abstract: NIOSH conducted an HHE to document worker exposures to a wide variety of contaminants in production jobs that included printed circuit boards, electrical product assembly, silk screening, spray painting, shipping, and mechanical production. Samples for lead were collected during the cleaning of dross from the wave solder machine. The two

PBZ samples were 15.1 and 28.3 $\mu g/m^3$ for the 15-minute operation. Although at and near the OSHA action limit for lead, the exposures were short and both workers wore respirators and gloves during the job. The two GA air samples collected above the wave solder machine over the entire work shift were 0.06 and 0.07 $\mu g/m^3$. Recommendations were made to not allow eating or drinking in the work areas where lead solder was conducted; to educate employees involved with soldering to wash their hands prior to eating, drinking, or smoking; and to use sodium phosphate (or something similar) to clean lead from contaminated surfaces.

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HETA 97–0103
July 1997

Toxicity determination: Negative for lead, positive for other exposures

Requester: Management

Lead concentrations: PBZs and GAs from ND to 0.91 $\mu g/m^3$

Purpose: To evaluate exposure to lead while making radiation-shielding molds in this oncology/radiation laboratory

Keywords: SIC 8069 (cancer hospitals), lead, metal molding, oncology, radiation, laboratories

Abstract: NIOSH investigators conducted an HHE at a hospital radiation laboratory to evaluate worker exposures to lead and other metals while making radiation-shielding molds. Investigators conducted air sampling, including PBZ samples from the lab technicians, and full-shift GA air samples within the lab. Results for lead analysis ranged from ND to 0.91 $\mu g/m^3$ of air as a TWA for eight samples collected. All were well below established occupational exposure criteria. The following recommendations were made to reduce worker exposure to lead at this facility: (1) Always pour molds within the fume hood, (2) the metal waste slag from the top of the melting pot also should be ladled into a collection container within the hood, and (3) reestablish the medical surveillance program for oncology lab personnel, especially biological exposure to lead.

Copies are available from HETAB.

HETA 97–0292–2678
March 1998

Toxicity determination: Negative for lead, positive for other exposures

Requester: Union

Lead concentrations: bulk samples from 160 to 9,900 $\mu g/g$, GAs from 1.6 to 51 $\mu g/m^3$, PBZ of 4 $\mu g/m^3$

Purpose: To evaluate mercury (and also lead and cadmium) exposures during fluorescent lamp manufacturing and maintenance activities

Keywords: SIC 3229 (pressed and blown glass and glassware), mercury, urine mercury, central nervous system, renal system, kidneys, cullet, glass recycling, lead, cadmium

Abstract: NIOSH conducted an HHE to evaluate mercury exposures during fluorescent lamp manufacturing and maintenance activities. Bulk samples of dust and cullet (the cut-off tips of the glass tubes) were analyzed for lead and cadmium, as well as mercury. The lead concentrations ranged from 160 to 9,900 $\mu g/g$. The lead GA air samples ranged from 1.6 to 51 $\mu g/m^3$, and the one PBZ was 14 $\mu g/m^3$, below the OSHA PEL. Many recommendations were provided to alleviate the mercury health hazard, which would also help to control the potential for lead exposures.

Copies are available from NTIS, individually or on CD-ROM.

HETA 98–0352
March 1999

Toxicity determination: Negative

Requester: Government

Lead concentrations: ND

Purpose: To provide technical assistance to a public health department by performing an exposure characterization at the home workshop of an electronic components repairman

Keywords: SIC 7629 (electrical and electronic repair shops), lead poisoning prevention program, lead exposure, BLLs, lead ingestion, lead inhalation, lead solder, chewing

Abstract: NIOSH was asked to provide technical assistance to a public health department by performing an exposure characterization at the home workshop of an electronic components repairman. The repairman and his family had elevated BLLs that remained high over a period of 11 months of repeated testing, despite chelation therapy administered twice to the children and improved work practices of the father. NIOSH investigators collected PBZ and GA air samples for lead during the repairman's work process and in the repairman's house while floors were vacuumed with a commercial sweeper (no HEPA filter); none of the samples had detectable lead concentrations. Also, surface contamination was not found in either the work or home areas. However, during discussions with a member of the extended family, it was discovered that the family had a long-standing history of chewing pieces of solder from the supply coil. The family discontinued this practice 6 months prior to the HHE, once they had learned the hazards of lead exposure, but their previous lead ingestion was probably enough to cause the continued high BLLs. Recommendations were made for lead-free solder and improved work and hygiene practices to ensure no further lead exposures.

Copies are available from HETAB.

Lead Abatement and Lead-Based Paint

HETA 93–0818–2646
July 1997

Toxicity determination: Positive

Requester: Joint Employee and Management

Lead concentrations: PBZs from 0.1 to 120 $\mu g/m^3$; BLLs up to 17.5 $\mu g/dl$; average surface lead measured on floors in homes undergoing renovation was 2,045 $\mu g/ft^2$, in vehicles of full-time workers was 310 $\mu g/ft^2$, and in vehicles of volunteers was 140 $\mu g/ft^2$

Purpose: To evaluate worker lead exposures during renovation of homes with LBP

Keywords: SIC 1521 (general contractors), single family houses, remodeling, lead exposure, LBP, home renovation, construction, chemical test kits, take-home toxin

Abstract: NIOSH conducted an HHE for a nonprofit organization that provides home repair and weatherization services to low-income homeowners, primarily in pre-1960 homes, to evaluate worker lead exposures during renovation of homes containing LBP. Lead exposures of full-time professional home renovators and of part-time volunteers who worked a few days per year in an annual Paint-a-Thon event were assessed in 18 homes. Potentially hazardous lead exposures were measured during exterior dry scraping and wet scraping of LBP, with maximum exposures of 120 and 63 $\mu g/m^3$, respectively. These tasks were performed only by volunteers during home painting. Exposures during all the other tasks, including general repair, weatherization, scraping/painting (mostly applying new paint), window replacement, demolition, and plumbing were low (range: 0.1 to 16 $\mu g/m^3$), as were 13 full-shift personal exposures that included break periods, initial set-up, and clean-up (GM = 3.6 $\mu g/m^3$, range: 0.2 to 12 $\mu g/m^3$). BLLs for full-time workers ranged up to 17.5 $\mu g/dl$, with a GM of 5.2 $\mu g/dl$; the

GM for volunteers was 3.2 μg/dl. All 49 painted work surfaces sampled in 15 homes had detectable amounts of lead (GM = 1.05, range: 0.0022 to 58% lead). Sixty-five percent (32) of the work surfaces had an average lead concentration >0.5%, the Federal definition of LBP. Sampling results indicated that chemical spot test kits, when used by industrial hygienists, are highly sensitive (100% positive) in screening for high levels (>9%) of lead in painted work surfaces, and somewhat less so (88% positive) for lower lead levels (>0.5%). Mean paint lead concentrations were correlated with mean worker exposures during renovation, both by house (r = 0.875) and by work surface (r = 0.898). Average surface lead loadings measured on floors in homes undergoing renovation (2,045 μg/ft^2) and in vehicles of full-time workers (310 μg/ft^2) and volunteers (140 μg/ft^2) were relatively high. Further study is needed to assess the prevalence and degree of childhood lead exposure caused by renovation and remodeling work in homes with LBP.

Copies are available from NTIS, individually or on CD-ROM.

HETA 94–0374–2534
October 1995

Toxicity determination: Negative

Requester: Management

Lead concentrations: PBZs from ND to 36 μg/m^3, BLLs from 2.8 to 10 μg/dl

Purpose: To investigate potential lead exposure during custodial operations at a university

Keywords: SIC 8221 (colleges, universities, and professional schools), lead, BLL, custodial, janitorial

Abstract: A large State university was selected by NIOSH for the evaluation of potential lead exposure during custodial operations, including painting, carpentry, housekeeping, plumbing, and general maintenance. PBZ air samples for lead were collected on 16 university custodial workers. In addition, all participants completed an occupational health questionnaire, and 13 of the 16 workers had a one-time BLL test. 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 (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.

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HETA 95–0054
February 1995

Toxicity determination: Positive

Requester: Management

Lead concentrations: paint chip concentrations from 2 to 39 mg/g

Purpose: To evaluate potential hazards to volunteers who were going to be moving objects from and cleaning storage areas prior to renovation activities in a local theater

Keywords: SIC 7832 (motion picture theaters), lead, asbestos, renovation, volunteers

Abstract: NIOSH conducted an HHE at a theater where volunteers were going to be moving objects from and cleaning storage areas prior to renovation activities. Samples of peeling paint were collected and analyzed for lead content, which ranged from 2 to 39 mg/g. Therefore, NIOSH recommended that the volunteers avoid dry sweeping areas as a precaution against potentially excessive short-term lead exposures. If sweeping was necessary, NIOSH recommended half-face respirators with HEPA filters or using vacuums equipped with a HEPA filter. Also, proper hygiene and work practices were recommended.

Copies are available from HETAB.

HETA 96–0140–2606
October 1996

Toxicity determination: Negative

Requester: Union

Lead concentrations: BLLs from 0.6 to 5.6 μg/dl, surface concentrations from ND to 128,000 μg /ft^2

Purpose: To evaluate the presence of LBP in a school building

Keywords: SIC 8221 (colleges, universities, and professional schools), lead, BLL, custodial, janitorial

Abstract: NIOSH investigators conducted an HHE to investigate a possible LBP hazard at a school building. Deteriorating LBP and lead-containing dust were found throughout the building. Because of these findings, the school district initiated a lead abatement project. At the time of the NIOSH evaluation, approximately one-third of the school had been abated, and some employees were working in abated areas. Both environmental sampling and medical monitoring for lead exposure were conducted. The environmental measurements consisted of surface wipe samples from floors, desks, and windowsills. The medical component of the investigation consisted of a questionnaire and a blood lead test offered to all employees in the building. Twenty-three window sills in non-abated areas and 16 window sills in abated areas were sampled. Dust lead loadings (the amount of lead dust per unit surface area) exceeded HUD guidelines (500 μg /ft^2) on 10 of the 39 (26%) window sills sampled. Only one window sill sample from an abated area failed the HUD criterium. Twenty-six floors in non-abated areas and 14 floors in abated areas were sampled. The HUD guideline for lead on floors (100 μg /ft^2) was exceeded in 17 (65%) of the non-abated areas and 3 (21%) of the abated areas. Dust lead loading on desktops (39 sampled) ranged up to 230 μg/ft^2 (no criteria exist for lead on desktops). Wipe samples from employees' hands contained from 2 to 160 μg lead (GM = 9 μg). Correlations between surface and hand contamination were not found. All BLLs were low, ranging from 0.6 to 5.6 μg/dl. The BM was 2.2 μg/dl, similar to that of the general U.S. population. Although in some cases, environmental lead dust loadings on various surfaces exceeded the HUD guidelines, all BLL were low. There were no relationships between BLL and abatement status of assigned work area, BLL and hand lead, or surface lead and hand lead.

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HETA 96–0209–2598
September 1996

Toxicity determination: Negative

Requester: Government

Lead concentrations: NA

Purpose: To investigate potential exposure to LBP at a hospital

Keywords: SIC 8062 (general medical and surgical hospitals), lead, lead-based paint, x-ray fluorescence

Abstract: NIOSH investigators conducted an HHE at a hospital to inspect for LBP. NIOSH assessed the lead content on various interior components designated for removal or remodeling in an upcoming building renovation and asbestos abatement project. Additionally, NIOSH made recommendations concerning safe work practices that contractors should follow when removing lead-containing components and the appropriate waste disposal category for lead-containing waste. During a site visit to the hospital, 87 measurements were conducted with a direct reading XRF detector, and 32 paint chip samples were collected from various interior surfaces. Lead was detected by the XRF detector on 28 of the 87 surfaces sampled, 13 of which exceeded the HUD definition of LBP. None of the components (walls, window sills, doors) with measurable lead had deteriorating paint. Lead was detected in 23 of the 32 paint chip samples. Five of the samples exceeded the HUD criteria for LBP, as determined by the paint chip method. For two samples, the paint chip analysis resulted in reclassifying the component from negative (as determined by XRF) to positive, based on HUD criteria. Interior paint was in good condition; no deteriorating LBP was

identified. Although the presence of lead on painted components in this facility was not considered a hazard to occupants, remodeling and renovation activities at this facility needed to take into account those components identified as containing LBP. The following recommendations were made to further reduce risk of exposure to lead at this facility: (1) LBP precautions should be taken during remodeling activities involving lead-containing materials and (2) trained and certified lead-abatement contractors and workers should be used for those tasks. The contractors and workers should follow OSHA, HUD, and State guidelines.

Copies are available from NTIS, individually or on CD-ROM.

HETA 98–0283
April 1999

Toxicity determination: Positive

Requester: Government

Lead concentrations: PBZ from <1 to 27,000 $\mu g/m^3$

Purpose: To evaluate worker lead exposures during a pilot project at a historic home

Keywords: SIC 1521 (general contractors—single family houses), lead, lead abatement, renovation, home painting

Abstract: NIOSH conducted an HHE to evaluate worker lead exposures during a pilot project at a historic home. NIOSH investigators collected task-based PBZs while several methods for residential surface preparation were demonstrated on painted surfaces. The lead exposures ranged from <1 to 27,000 $\mu g/m^3$ for the various tasks. The lead exposures for the Paint Shaver® and Paint Blitzer® tools (1,400 and 1,600 $\mu g/m^3$, respectively) were significantly lower than those for the conventional orbital sander (27,000 $\mu g/m^3$). When the conventional power sander was used after the paint had been removed with Paint Shaver®, the exposure was extremely low, <2 $\mu g/m^3$. NIOSH concluded that all of the demonstrated methods for removal of LBP were potentially hazardous. Further evaluation of the innovative power tool methods were recommended, especially when it would be possible to compare them to conventional methods.

Copies are available from HETAB.

HETA 98–0331
December 1998

Toxicity determination: Positive

Requester: Employee

Lead concentrations: paint chip concentrations from 56 to 480,000 $\mu g/g$

Purpose: To evaluate the potential for asbestos and lead exposure in a school during renovation

Keywords: SIC 8211 (elementary and secondary schools), LBP, asbestos, renovation, school

Abstract: NIOSH conducted an HHE to evaluate the potential for asbestos and lead exposure in a school where renovation was occurring. Nine paint chip samples were collected from areas where renovation work had not yet been completed and were analyzed for lead content. The results ranged from 56 to 480,000 $\mu g/g$. Every sample except the 56 $\mu g/g$ sample from the auditorium would be considered LBP, based on the definition from Title X of the Housing and Community Development Act of 1992 (Public Law 102–550). For that reason, NIOSH recommended that the school follow the HUD guidelines for removal of LBP.

Copies are available from HETAB.

Abrasive Blasting

HETA 93–0502–2503
April 1995

Toxicity determination: Positive

Requester: Union

Lead concentrations: PBZs from 0.09 to 1,800 $\mu g/m^3$, BLLs from 2.2 to 16.5 $\mu g/dl$, face and hand surface concentrations from 1 to 5,600 μg/wipe, clothing surface concentrations from 1 to 7,700 μg/gauze pad

Purpose: To evaluate the workers' potential to carry home lead-containing dust produced during removal of LBP

Keywords: SIC 1622 (bridge, tunnel, and elevated highway construction), lead, take-home exposures, construction, bridge workers, lead-paint abatement, surface lead contamination

Abstract: NIOSH investigators conducted an HHE to evaluate occupational health hazards during bridge renovation, particularly the workers' potential to carry home lead-containing dust produced during removal of LBP. Workers performed abrasive blasting and painting inside a total enclosure containment structure and also abatement-related activities outside the containment structure. The State Department of Transportation included performance specifications in the contract requiring medical monitoring, personal air sampling, PPE, hygiene facilities, and worker training. The HHE, conducted several months after work began, included monitoring of BLLs, and measurement of PBZ airborne lead exposures, as well as assessment of surface lead levels on skin and clothing and in automobiles. At the time of the study, employees' BLLs ranged from 2.2 to 16.5 $\mu g/dl$. The mean BLL was 7.2 $\mu g/dl$. Thirty-six percent of the workers had BLLs over 10 $\mu g/dl$. The 13 employees who worked in or near the containment structure had significantly higher BLLs than the 9 other workers in less exposed jobs (8.9 versus 4.7 $\mu g/dl$, respectively; $p = 0.04$). NIOSH researchers were not able to collect blood from workers in one potentially highly exposed job category, the recycling machine operators. The arithmetic means of PBZ air lead concentrations for workers in the blaster/painter, apprentice, and recycling equipment operator job categories were higher than the OSHA 10-hour TWA PEL of 40 $\mu g/m^3$ (250 $\mu g/m^3$, 6.25 times PEL; 110 $\mu g/m^3$, 2.8 times PEL; and 140 $\mu g/m^3$, 3.5 times PEL, respectively). PBZ exposures for blaster/painters and apprentices were highly variable; for example, among the 24 samples taken from blaster/painters, 16 had air lead concentrations below the PEL, but 3 exceeded 1,000 $\mu g/m^3$. Categories of workers having high levels of lead on their hands included the apprentices, blasters, and recycling equipment operators (430, 1,000, and 1,700 μg/sampling wipe, respectively, at the end-of-shift and before washing). Workers in these same categories had high levels of lead on their clothing (460, 360, and 3,100 μg/sampling pad, respectively). Inspectors, security personnel, and industrial hygienists/safety personnel had lower levels of lead on both their hands (64, 10, and 34 μg/wipe, respectively) and their clothing (10, 1.6, and 14 μg/pad, respectively). While skin absorption of lead in paint is not thought to be significant, the presence of' lead on skin and clothing may result in accidental ingestion of the lead by the worker and may be an important pathway for carrying the lead dust into the home. Lead was present in each of the 27 automobiles sampled. The highest lead loadings were found on the driver's floor (GM = 1,900 $\mu g/m^2$), which suggests that lead is being carried into cars on work shoes. Lead-contaminated skin or clothing is also a source of car contamination, as evidenced by the presence of lead on armrests (GM = 1,100 $\mu g/m^2$) and steering wheels (GM = 240 $\mu g/m^2$) . The mean dust loading on the floor and seat area was highest in cars of the workers in low exposure categories, such as industrial hygiene/safety and security personnel (1,000 $\mu g/m^2$). Abrasive blasters, who typically had the highest exposures to airborne lead, had the lowest mean dust loading in their cars (370 $\mu g/m^2$) . These findings may be explained by the observation that blasters regularly changed out of work clothing and showered before entering their cars, whereas other personnel, thought to be only minimally exposed to lead, did not regularly follow these practices. To prevent lead from being carried into cars and homes, personal hygiene practices such as leaving work clothes and shoes at the job site, showering, and changing into clean clothes before leaving the work site were recommended for ALL personnel involved in or working near lead abatement activities.

Copies are available from NTIS, individually or on CD-ROM.

HETA 94–0122–2578
May 1996

Toxicity determination: Undetermined

Requester: Management

Lead concentrations: PBZs from ND to 7.1 mg/m^3 (Note: potential overestimation — see abstract)

Purpose: To evaluate the accuracy of personal air monitoring conducted during abrasive blasting in confined spaces at a shipyard

Keywords: SIC 3731 (ship building and repairing), abrasive blasting, air sampling, elemental metals, lead

Abstract: NIOSH performed an HHE to evaluate the accuracy of personal air monitoring conducted during abrasive blasting in confined spaces at a shipyard. The shipyard industrial hygiene staff provided information indicating that abrasive grit particles enter environmental air sampling cassettes, resulting in an overestimation of worker exposure to inhalable airborne metals. Therefore, NIOSH collected 15 PBZ air samples during manual abrasive blasting in confined spaces, and a second sample, concurrently with each PBZ, from behind each blaster's head to determine if sample placement had an effect on reducing the amount of grit entering the cassette. In addition to analysis for lead and selected metals, a visual assessment of the grit in the cassettes was made. Then, on a second site visit, ten sets of side-by-side PBZ air samples were collected during abrasive blasting inside a steel tank. Each set consisted of a sample using a standard closed-face cassette; a closed-face cassette fitted with a metal guard to shield the inlet from high-velocity grit ("grit guard"); and a sample using a 10 mm nylon cyclone at a flow rate of 300 cc/minute. Prior to sample analysis, the steel grit was separated from the filters and dust in the closed-face cassettes; the fractions were analyzed separately. Although only low levels of lead and other contaminants were present in the base-metal, surface coating, and steel grit, the relatively large mass of grit that entered the air sampling cassettes resulted in an overestimation of the airborne lead concentration. Evaluation of air samples collected during this HHE indicated that conventional air sampling methods overestimated concentrations of lead and other inhalable airborne contaminants present in abrasive blasting environments. Use of the metal guard and locating sampling cassettes behind the head (or body) were not reliable methods for preventing grit from entering cassettes. Grit did not penetrate most of the cyclones in the test tank; however, cyclones would not be useful under actual blasting conditions because they would be inverted as the blasters climbed through confined spaces. Neither grit guards nor placement of several samples appeared to effectively control entrance of abrasive blasting grit.

Copies are available from NTIS, individually or on CD-ROM.

HETA 95–0225–2596
September 1996

Toxicity determination: Negative for lead

Requester: Government

Lead concentrations: NA

Purpose: To provide technical assistance to a State health department by conducting medical screening of workers involved in or around abrasive blasting activities

Keywords: SIC 1721 (painting and paper hanging), SIC 1791 (structural steel erection), silica, crystalline silica, pneumoconiosis, silicosis, respirable quartz, sandblasting, construction, lead, abrasive blasting, respirator, steel-plate fabrication, painting contractor

Abstract: NIOSH provided technical assistance to a State health department by conducting medical screening of workers involved in or around abrasive blasting activities. This request was a follow-up to an investigation of a worksite where an employee who worked as an abrasive blaster had died with accelerated silicosis. Given the fact that abrasive blasting may also result in exposure to lead, the health department requested that NIOSH expand the scope of the technical assistance to include blood-lead screening. NIOSH investigators conducted medical

screening, which consisted of a work history and medical questionnaire, chest x-ray, and blood lead test. A total of 170 participants from two different sites were screened, including workers whose primary occupations were abrasive blasters, painters, tapers (drywall finishers), general laborers, and foremen. Ninety-six of the participants (56%) participated in the blood-lead screening, and none of them had BLLs that exceeded the limits or action levels specified by OSHA. The median BLL was 5 (μg/dl) with a range of 2 to 30 μg/dl.

Copies are available from NTIS, individually or on CD-ROM.

HETA 97–0260–2716
November 1998

Toxicity determination: Undetermined

Requester: Union

Lead concentrations: Abrasive blasting PBZs outside the hood from 1 to 10 $\mu g/m^3$ for the small particle component and from 8 to 260 $\mu g/m^3$ for the large particle component, abrasive blasting PBZs inside the hood of <0.8 $\mu g/m^3$, welding PBZs from 3 to 10 $\mu g/m^3$

Purpose: To evaluate exposures at a shipyard that might be related to the reported symptoms of breathing problems and nose bleeds

Keywords: SIC 3731 (ship building and repairing), abrasive blasting, air sampling, lead, arsenic, welding fume, ventilation

Abstract: NIOSH conducted an HHE at a shipyard to evaluate exposures that might be related to the reported symptoms of breathing problems and nose bleeds. Among other samples, lead was sampled in the shot house during abrasive blasting. Eleven abrasive blasters wore three samplers each—one inside the abrasive blasting hood, one outside the hood, and one "passive" sampler to determine the extent of rebound, or inertia-driven, shot that entered the sampling cassette. The lead concentrations outside the hood ranged from 1 to 10 $\mu g/m^3$ for the small particle component and 8 to 260 $\mu g/m^3$ for the large particle component. The concentrations inside the hood were all <0.8 $\mu g/m^3$. During welding operations, lead concentrations ranged from 3 to 10 $\mu g/m^3$. The "passive" samples contained highly variable but significant amounts of inertia-driven grit, ranging from 1.58 to 366.5 mg. Data indicated that the PPE used during abrasive blasting was sufficiently protecting the workers but that a higher degree of respiratory protection was necessary to reduce all welding fume exposures. The source of lead detected in the shot house appeared to be the small amounts present in the steel grit. It was hypothesized that during blasting, the finer lead dust particles were continuously generated from the fracturing of grit and then recirculated through the system. Recommendations were made to reduce welding exposures and improve the safety and health program.

Copies are available from NTIS, individually or on CD-ROM.

Electric Services

HETA 94–0093
June 1996

Toxicity determination: Negative

Requester: Union

Lead concentrations: BLLs from 1.9 to 12.6 μg/dl

Purpose: To determine the prevalence of chewing plastic electrical wire insulation and of overt or subclinical lead poisoning among electricians

Keywords: SIC 1731 (electrical contractors), lead, blood lead, electrician

Abstract: NIOSH conducted an HHE to determine the prevalence of chewing plastic electrical wire insultation and of overt or subclinical lead poisoning among electricians. A total of 75 electricians completed a consent form and questionnaire and provided a blood sample. None of them had elevated BLL or ZPP levels, but a union newsletter 3 months prior to the HHE had warned about the hazards of chewing the wire insulation. The mean BLL was 4.8+2.6 μg/dl, with a range of 1.9 to 12.6 μg/dl. Some of the reported symptoms were consistent with lead

exposure but could also be caused by other exposures or conditions. The reported symptoms of joint pain, muscle ache, muscle weakness, and nervousness were all related to the reported history of chewing wire clippings or connecting nuts with statistical significance, but a cause-effect relationship was not possible to determine. NIOSH recommended that the union join them in petitioning electrical wire manufacturers to print a warning on their products.

Copies are available from HETAB.

HETA 94–0273–2556
January 1996

Toxicity Determination: Positive

Requester: Union

Lead concentrations: PBZs from ND to 182 $\mu g/m^3$

Purpose: To evaluate potential exposures to arsenic and other heavy metals encountered during the rebuilding of coal-fired boilers

Keywords: SIC 4911 (electric services), electricity generation, coal-fired power plant, coal-fired power station, fly ash, arsenic, heavy metals, crystalline silica, lead, beryllium

Abstract: NIOSH conducted an HHE to evaluate potential exposures to arsenic and other heavy metals encountered by workers during the rebuilding of coal-fired boilers. The HHE focused on 33 plumbers and steamfitters. Forty-five PBZ samples for metals, 12 PBZ samples for respirable dust and silica, 8 bulk fly ash samples, and 11 hand wipe samples were collected during the survey. Employees removed retractable soot blowers and boiler drains located on the exterior of the boiler during the air monitoring. Employees worked six 10-hour workdays, which equated to a 60-hour workweek, so the evaluation criteria was adjusted. Lead was detected on 12 of the 43 samples; concentrations ranged from 1.7 to 182 $\mu g/m^3$, with one sample above the adjusted OSHA PEL of 28 $\mu g/m^3$. Hand wipe samples collected to evaluate the potential for contaminant hand-to-mouth contact showed that employees could be exposed to arsenic and other metals through ingestion. Recommendations were made to improve housekeeping procedures to reduce the amount of fly ash on working surfaces and to improve work practices.

Copies are available from NTIS, individually or on CD-ROM.

HETA 95–0393–2633
April 1997

Toxicity Determination: Negative for lead, positive for other exposures

Requester: Union

Lead concentrations: PBZs from <0.07 to 3.3 $\mu g/m^3$

Purpose: To evaluate exposures to arsenic, other heavy metals, and silica during rebuilding of coal-fired boilers

Keywords: SIC 4911 (electric services), electricity generation, coal-fired power plant, coal-fired power station, fly ash, arsenic, heavy metals, crystalline silica, lead, beryllium, nickel, boilermakers, welding, air arc gouging

Abstract: NIOSH conducted an HHE at a power plant because of concerns about worker exposures to arsenic, other heavy metals, and silica during rebuilding of coal-fired boilers. Full-shift PBZ air samples were collected from 29 workers (25 boilermakers and 4 laborers)—48 PBZ air samples for heavy metals, 9 PBZ air samples for respirable dust and silica, 8 hand wipe samples, and 12 bulk fly ash samples. During the sampling period, boilermakers removed secondary inlet and secondary outlet boiler elements and removed and replaced portions of the steel boiler casing, exposing them to fly ash and fumes from air arc gouging, welding, and torch cutting. Laborers maintained walkways and prepared work areas by dry sweeping and vacuuming, primarily exposing them to fly ash. Employees worked six, 10-hour workdays (equal to a 60-hour workweek). Because of this increase in hours worked per week, the PBZ air sample results are compared to adjusted occupational exposure limits calculated by the Brief

and Scala model. Lead concentrations ranged from less than 0.07 to 3.3 $\mu g/m^3$. The highest concentration was found while workers torch cut on the boiler casing. Samples were below the adjusted OSHA PEL and ACGIH TLV of 28 $\mu g/m^3$. Recommendations were made to reduce worker exposures to contaminants through the use of engineering controls and improvements in housekeeping procedures.

Copies are available from NTIS, individually or on CD-ROM.

HETA 98–0124–2743
July 1999

Toxicity determination: Positive

Requester: Government

Lead concentrations: PBZ of 2300 $\mu g/m^3$, GA of ND

Purpose: To evaluate exposures from fly ash contaminants from burning used motor oil in two different boilers at a school

Keywords: SIC 8211 (boarding schools), boilers, maintenance, lead, arsenic, used motor oil, confined space

Abstract: NIOSH conducted an HHE to evaluate exposures from fly ash contaminants from burning used motor oil in two different boilers at a school. Wipe sampling revealed no evidence of lead contamination in the plumbing or machine shop areas. Air sampling results indicated overexposures to lead and arsenic when cleaning the inside of the boilers but that engineering controls effectively limited exposures when cleaning the boiler tubes. The boilers fit the criteria of a Class B confined space, which warranted that certain precautions be taken. These requirements were described along with other recommendations for reducing exposures.

Copies are available from NTIS, individually or on CD-ROM.

Others

HETA 94–0109–2494
March 1995

Toxicity determination: Positive

Requester: Government

Lead concentrations: PBZs from 7.4 to 280 $\mu g/m^3$ BLLs from 13 to 54 $\mu g/dl$

Purpose: To assess occupational exposures to heavy metals and sulfur dioxide at a large tin smelter located near Oruro, Bolivia

Keywords: SIC 3339 (primary smelting and refining of nonferrous metals, except copper and aluminum), arsenic, lead, tin, antimony, cadmium, smelting, sulfur dioxide, international health, take-home toxins

Abstract: At the request of the Pan American Health Organization, and in collaboration with the National Center for Environmental Health, NIOSH conducted an assessment of occupational exposures to heavy metals and sulfur dioxide at a large tin smelter located near Oruro, Bolivia. Workers were pre-selected for inclusion in the study based on several criteria, including presumed high exposure to lead, arsenic, and other metals. During the survey, 15 workers, representing 12 job titles, were sampled to assess their occupational exposures to antimony, arsenic, bismuth, cadmium, lead, iron, tin, zinc, and sulfur dioxide. Additionally, BLL and urine arsenic were measured in 15 workers—not necessarily the same workers who participated in air sampling. All of the workers had been provided half-mask air-purifying respirators, but they were not used consistently. The GM for lead exposures was 42 $\mu g/m^3$ (range: 7.4 to 280 $\mu g/m^3$). Dust sampling results indicated that surfaces throughout the facility, including worker locker rooms, were highly contaminated with heavy metals. Fifteen workers, with a median of 17 years of employment, participated in biological monitoring. The median BLL was 19 $\mu g/dl$ (range: 13 to 54 $\mu g/dl$). Five of the 15 workers had BLLs greater than the ACGIH

BEI of 20 μg/dl; 4 exceeded the U.S. Public Health Service goal of 25 μg/dl; 2 exceeded a World Health Organization study group recommended limit of 40 μg/dl; and 1 exceeded the OSHA medical removal level of 50 μg/dl. The results of this study indicated that a significant health hazard existed for some employees. Recommendations for better control of the health hazards, including further study of exposures, implementation of engineering controls, improved hygiene facilities, implementation of a medical surveillance program, and improvements for the respiratory protection program, were provided.

Copies are available from NTIS, individually or on CD-ROM.

HETA 95–0355
October 1995

Toxicity determination: Positive

Requester: Employee

Lead concentrations: NA

Purpose: To evaluate exposures to flaking lead paint in a weatherization supply warehouse

Keywords: SIC 4225 (warehousing—general), indoor air quality, IAQ, IEQ, lead

Abstract: NIOSH conducted an HHE at a weatherization supply warehouse where there was concern about flaking lead paint, rat and pigeon waste, and safety hazards. NIOSH investigators inspected the warehouse and reviewed an independent consultant's report, which documented airborne lead exposures below the relevant evaluation criteria and BLLs within normal ranges. Since the warehouse was to be permanently vacated, NIOSH provided recommendations for safe work practices during the moving and cleaning so as to avoid potentially excessive short-term lead exposures.

Copies are available from HETAB.

HETA 97–0291–2681
April 1998

Toxicity determination: Negative for lead, positive for other exposures

Requester: Government

Lead concentrations: PBZs and GAs below MQC, soil concentrations from 15 to 640 μg/g

Purpose: To evaluate exposures to vehicle exhaust and noise at a Port of Entry

Keywords: SIC 9721 (international affairs), border crossing station, San Ysidro, immigration and naturalization service, carbon monoxide, lead, noise, VOCs

Abstract: NIOSH conducted an HHE at a Port of Entry between Mexico and the United States to evaluate exposures to vehicle exhaust and noise. PBZ samples were collected on four inspectors and analyzed for lead, but only trace amounts were detected (less than the MQC of 0.06 $\mu g/m^3$). Three composite soil samples were also collected, and the results ranged from 15 to 640 μg/g, well below the EPA concern level of 2,000 μg/g for soil where there is not high potential for use by children. Recommendations were provided to address the other exposure problems.

Copies are available from NTIS, individually or on CD-ROM.

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