NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2003-0367-2973
OmniSource Corporation
Lima, Ohio

July 2005

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

PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, 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 NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Manuel Rodriguez and Jeffrey Nemhauser of HETAB, Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS). Field assistance was provided by Tamara Wise. Analytical support was provided by DataChem Laboratory. Desktop publishing was performed by Robin Smith. Editorial assistance was provided by Ellen Galloway.

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Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Employee Exposures to Metals

On September 8, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation request from the Corporate Director of Safety of the OmniSource Corporation to evaluate cutting of scrap metal at a recycling facility in Lima, Ohio. The request asked NIOSH investigators to determine the need for showers for employees whose lead exposures exceeded the Occupational Safety and Health Administration's Permissible Exposure Limit. Workers identified as having elevated exposures to lead were those who use oxygen/propane torches to cut bulk scrap into smaller pieces using hand-held oxygen/propane torches.

What NIOSH Did

- We took air samples to measure employee exposures to metals during torching operations.
- We took wipe samples of employees' hands, personal protective equipment, and other solid surfaces.
- We reviewed exposure records, OSHA 300 Log of Work-Related Injury and Illnesses, and the OmniSource Lead Program.

What NIOSH Found

- Workers' exposures exceeded the OSHA or NIOSH limits for lead, cadmium, nickel, copper, iron, and arsenic.
- Exposures were higher for workers cutting bulk materials than for those cutting steel plates.
- Lead and other metals were detected on employees' hands and protective equipment.

What OmniSource Corporation Managers Can Do

- Comply with OSHA requirements for reducing employee exposures to hazardous metals.
- Use ventilation systems to reduce workers' exposures.
- Provide shower facilities for employees.
- Include workers cutting steel plates in your lead program.

What the OmniSource Corporation Employees Can Do

- Wear protective equipment.
- Wash your hands before eating or smoking
- Clean your protective equipment daily.
- Shower before going home once showers are installed.

CDC Workplace Safety and Health

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2003-0367-2973

NIOSH

Health Hazard Evaluation Report 2003-0367-2973
OmniSource Corporation, Lima, Ohio
July 2005

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SUMMARY

On September 8, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Corporate Director of Safety of the OmniSource Corporation (OmniSource) to conduct a Health Hazard Evaluation (HHE) at that company's scrap metal (scrap) recycling facility in Lima, Ohio. The request asked NIOSH investigators to assist OmniSource management representatives in determining the need for installing showers for employees whose lead exposures exceeded the Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limit (PEL). Workers identified as having elevated exposures to lead were those who use oxygen/propane torches to cut bulk scrap into smaller pieces using hand-held oxygen/propane torches.

NIOSH investigators conducted site visits to the scrap recycling facility on October 14, 2003, and from April 19–22, 2004. During the initial site visit, a NIOSH industrial hygienist and a medical officer spoke with OmniSource management and labor representatives; they also toured the facility and witnessed the torch cutting and scrap processing. During the second site visit, the NIOSH investigators collected full-shift personal breathing zone (PBZ) air samples and surface samples from workers' hands and solid surfaces. NIOSH investigators sampled during torch cutting operations to detect the presence of lead and other heavy metals.

Ten of the 27 PBZ air samples exceeded the OSHA 8-hour PEL for lead; four samples exceeded the OSHA PEL for cadmium; three samples exceeded the NIOSH 10-hour Recommended Exposure Limit (REL) for nickel; and three samples exceeded the OSHA PEL for copper. NIOSH wipe samples detected lead and other heavy metals on workers' hands, personal protective equipment (PPE), and other surfaces. A NIOSH interim report (September 3, 2004) provided OmniSource representatives with a preliminary summary of sample results and recommendations to control exposures.

OmniSource employees were exposed to lead, cadmium, nickel, copper, and arsenic above the OSHA PEL and/or NIOSH REL while torch cutting scrap metal. Recommendations include adhering to substance-specific OSHA standards for lead, cadmium, and arsenic, including the requirement for employee showers and other hygiene practices. Other recommendations address the use of local exhaust ventilation during torch cutting operations and the need for PBZ air monitoring for welding gases.

Keywords: NAICS: 423930 (Recyclable Material Merchant Wholesalers) scrap metal, torching, cutting, lead, cadmium, nickel, copper, arsenic, iron, welding fumes, welding gases

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INTRODUCTION

On September 8, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a request from the OmniSource Corporation (OmniSource) Corporate Director of Safety to conduct a Health Hazard Evaluation (HHE) at the scrap recycling facility in Lima, Ohio. The Director of Safety stated that some employees at this facility had been identified as having exposures to lead that exceeded the Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limit (PEL) of 50 micrograms per cubic meter of air (50 $\mu g/m^3$).[1] This HHE request asked NIOSH to assist OmniSource in determining the need for showers for employees whose airborne exposures to lead exceeded the PEL.

On October 14, 2003, NIOSH investigators met with OmniSource and employee representatives and conducted a walk through survey of the Lima facility. They also reviewed the company's lead monitoring and respiratory protection programs, blood lead levels, air sampling results, and the OSHA 300 Log of Work-Related Injury and Illnesses.

During April 19-22, 2004 NIOSH investigators conducted a follow-up visit during which they: (1) collected PBZ air samples during scrap torching operations (2) collected surface samples for lead and other metals, (3) interviewed employees conducting torching operations, and (4) assessed the need for engineering controls, personal protective equipment (PPE), and shower facilities.

On September 3, 2004, NIOSH investigators sent OmniSource an interim report with a summary of the PBZ air sampling and surface sampling results. In the letter NIOSH representatives informed the OmniSource Director of Safety that the OSHA General Industry Lead Standard clearly mandates providing showers for employees who work in areas where airborne exposures to lead exceed the PEL, and that OSHA may not grant a variance for that requirement. Because some PBZ sample results for employees were over the OSHA PELs for lead, cadmium, copper, and inorganic arsenic, NIOSH investigators recommended that OmniSource comply with OSHA's substance-specific standards. Other recommendations included using engineering controls and PPE to limit occupational exposures. This final report provides air and surface sample results, toxicological data about metals for which air sampling results exceeded occupational exposure limits, and a more detailed explanation of NIOSH findings and observations.

BACKGROUND

OmniSource Corporation is one of the largest processors and distributors of ferrous and non-ferrous scrap metal in North America. OmniSource, which owns and operates 32 facilities in seven U.S. states and in Canada, employs a workforce of 1450 employees; the OmniSource facility in Lima, Ohio, employs 35 individuals. As one of the largest scrap recycling firms in North America, OmniSource processes over 6,000,000 tons of ferrous and 250,000 tons of non-ferrous material annually.[2]

At OmniSource, scrap is obtained from multiple sources and in many instances workers do not know the exact content of the materials they are processing. Scrap is processed for recycling by one of several methods: shearing, shredding, baling, and/or cutting (also called torching). Sheared and shredded scrap is compressed into 2-ton bales that are then shipped to mills and foundries. Scrap waste reclaimed from boring and drilling operations is compressed into pucks for recycling. Cast iron parts are broken down into smaller parts using an iron ball. Workers use hand-held oxygen/propane gas torches to cut large pieces of scrap into smaller, more easily manipulated pieces.

Bulk steel material (e.g., obsolete machinery, bridge structures, I-beams, and metal equipment) is cut by personnel known as "burners" who work 10- or 12-hour shifts. Due to the mixed nature of the material being processed, burners may be exposed to a variety of toxins. These toxins include lead or other hazardous metals found in paint coatings; volatile organic compounds (VOCs) and other decomposition products derived from the plastics, hydraulic fluid, oil, or other residues adhered to the scrap; and a variety of metals or metal alloys from which the materials are made.

Personnel who cut unpainted steel plates are identified as “plate cutters” in this report. In contrast to burners, plate cutters cut steel plates that are free of any coating or residues. Plate cutters work 8-hour shifts.

Between February and July 2003, the OmniSource industrial hygienist collected 16 PBZ air samples from burners. Several samples exceeded the OSHA PEL for lead, cadmium, copper, inorganic arsenic, iron, and total particulates. Of the 16 samples collected, 7 exceeded the OSHA PEL or action level (AL) for cadmium and lead.

METHODS

Air Samples

From April 19–22, 2004, NIOSH investigators collected PBZ air samples from five burners and six plate cutters during torch cutting operations. A total of 27 full-shift PBZ samples were collected during the 3 days, 15 from plate cutters and 12 from burners. Some employees were sampled all 3 days. Samples were collected using calibrated SKC® AirCheck®-2000 air sampling pumps set to a flow rate of 2 liters per minute (Lpm). Each sampling train consisted of the pump, Tygon® tubing connected to the inlet port of the pump, and a cassette containing a 0.8 micrometer (µm) pore size mixed cellulose ester membrane filter attached to the end of the tubing. Cassettes were attached to workers lapels or protective suits within their breathing zone; a “breathing zone” is defined as an area in front of the shoulders with a radius of 6–9 inches. Samples were analyzed for metals by inductively coupled argon plasma, atomic emission spectroscopy according to NIOSH Manual of Analytical Methods (NMAM) Method 7300 (Elements).[3]

Wipe Samples

NIOSH investigators collected 200 wipe samples to quantitatively assess the level of metal contamination on the hands of plate cutters and burners, their PPE, and on other surfaces in the workplace. Using NIOSH Method 9100, Lead in Surface Wipe samples, investigators asked employees to wipe the palms and the backs of their hands with a moist (lead-free) towelette for 30 seconds. Flat surfaces (for example, tables) were sampled by wiping an area measuring 10 centimeters x 10 centimeters square, from top to bottom and then from left to right. Surface area was not considered when collecting wipe samples from equipment and from non-flat surfaces such as door knobs. All samples were submitted to the DataChem Laboratory for quantitative analysis per NIOSH Method 7300.[3] Sample results were reported by the laboratory as micrograms (µg) of lead and other metals per wipe.

Employee Interviews

The NIOSH industrial hygienist met individually with five burners and five plate cutters and discussed their concerns about health hazards during torching operations. Employees were also asked about what PPE they wore, if they experienced any problems when using the PPE, and if they could smell odors through their air purifying respirators, and other work related health concerns.

Programs Review

NIOSH investigators reviewed OmniSource's Lead Hazard and Respiratory Protection Programs. The NIOSH Industrial Hygienist reviewed PBZ air sampling results for samples collected by the OmniSource Industrial Hygienist from February to July 2003. The NIOSH medical officer reviewed the blood lead results for burners who participated in the company's biological monitoring from April to September 2003.

Other

NIOSH investigators reviewed the types of PPE the burners and plate cutters used. They also looked at the torching process to determine what engineering controls to recommend to reduce workers' exposure to toxic metals. NIOSH investigators reviewed the OSHA 300 Log of Work-Related Illnesses and Injuries for 2003 and 2004.

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 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),[4] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[5] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[6] Employers are encouraged to follow the NIOSH RELs, the ACGIH TLVs, or the OSHA limits, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91–596, sec. 5(a)(1)]. Employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). However, an employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

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 STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Personal air sampling was performed for 27 metals per NIOSH Method 7300. Results for some of the lead, cadmium, nickel, copper, arsenic, and iron samples were found to be over their respectable permissible or recommended exposure limits. These elements are discussed in further detail below.

Lead

Lead can be absorbed into the body through the lungs and also through the digestive tract.[7] Inhalation of lead-containing dusts or fumes is an important route of exposure. In cases where careful attention to hygiene (for example, hand-washing) is not practiced, smoking cigarettes, applying cosmetics, or eating may represent another source of exposure among workers who handle lead. Industrial settings associated with exposure to lead and lead compounds include smelting and refining, scrap metal recovery, automobile radiator repair, construction and demolition (including abrasive blasting), and firing range operations.[7] Occupational exposures also occur among workers who apply and/or remove lead-based paint or among welders who burn or torch-cut metal structures. The DHHS has proposed a national health goal to eliminate occupational exposures resulting in elevated blood lead levels as a goal of increasing life expectancy and the quality of life of people in the USA.[8]

Once absorbed, lead may affect nearly every organ system of the body.[9,10,11] Adverse health effects caused by lead include high blood pressure, anemia (low red blood cell counts), kidney damage, brain and nerve damage, and infertility and impotence. Exposure to lead before or during pregnancy can harm the developing fetus and may cause miscarriage. The developing nervous system of the fetus is particularly vulnerable to lead toxicity.[12]

Exposure to lead can be readily determined by biological monitoring, and two methods are currently used: the zinc protoporphyrin (ZPP) test and the blood lead level (BLL) test.[13] Chronic exposure to lead can be monitored by measuring a ZPP level. The ZPP level generally remains elevated for approximately 3 months following lead exposure. Persistent elevation of the ZPP greater than 3 months indicates more prolonged, ongoing exposure but may also indicate episodic exposures. To better evaluate the time course and level of exposure to lead, the BLL is the preferred test.[13]

In 1997, NIOSH published a review of the medical literature concerning adverse health effects following lead exposure.[14] This review identified evidence showing that at BLLs as low as 10 micrograms per deciliter of blood (µg/dL), lead may first begin to interfere with reproduction, and cause high blood pressure and anemia. Between 10 and 40 µg/dL, health effects may be subclinical (that is, not necessarily evident by a routine physical examination) but nevertheless represent early stages in the development of disease.[14]

In 2000, NIOSH established an REL for inorganic lead of 50 micrograms per cubic meter of air (µg/m^3), consistent with the OSHA Standard for lead (see below).[15] NIOSH recommends that workers with a potential for inorganic lead exposure receive a pre-placement medical evaluation, periodic medical screening and/or biological monitoring, and a medical examination at the time of job transfer or termination.[16]

The ACGIH TLV for airborne lead is 50 µg/m^3 measured as an 8-hour TWA, with worker BLLs not to exceed 30 µg/dL.[5] The OSHA PEL for airborne lead is 50 µg/m^3 measured as an 8-hour TWA.[1] This standard is intended to maintain worker BLLs below 40 µg/dL. Medical removal protection is required when an employee's BLL reaches 50 µg/dL. If a physician believes that an employee is at risk of impairment from exposure to lead, the physician can remove the employee from exposures exceeding the action level (or less). OSHA has also established an AL for airborne lead of 30 µg/m^3, to be measured as an 8-hour TWA. OSHA requires that employees participate in medical surveillance including BLL and ZPP sampling and analysis.

For employees exposed to lead for more than 8 hours in a work day, the OSHA General Industry Lead Standard mandates mathematically-derived exposure limits.[1] Workers shall not be exposed to airborne lead in excess of 400 divided by the number of hours worked. For example, an employee working a 10-hour day should be exposed to airborne lead at levels no greater than 40 µg/m^3 (400 divided by 10) measured as a TWA.

There are no OSHA or NIOSH criteria for acceptable surface contamination of metals. OSHA, in its substance-specific standards, requires maintaining all surfaces as free as practicable of accumulations of lead, cadmium, and inorganic arsenic. It is difficult to predict what an employees exposure to surface contaminants because it depends on many variables such as individual personal hygiene habits, contamination of employee's hands and subsequent ingestion of the contaminant, and the capacity for the contaminant to become airborne and inhaled, and employees personal hygiene habits. Surface contamination results provided in this report should be used as an indication of relative contamination, i.e., a surface with 300 µg/sample is considered more contaminated than a surface with 100 µg/sample.

Cadmium

Workers may inhale cadmium dust when sanding, grinding, or scraping cadmium-metal alloys or cadmium-containing paints.[7] Exposure to cadmium fume may occur when materials containing cadmium are heated to high temperatures such as during welding and torching operations; cadmium-containing solder and welding rods are also sources of cadmium fume.

Cadmium may be absorbed either through inhalation or ingestion; non-occupational sources of cadmium exposure include cigarette smoke and dietary intake.[7] Inhaled cadmium can irritate of the nose and throat, and the lungs may be affected by repeated or prolonged exposure to dust particles. At higher exposure concentrations, cough, chest pain, sweating, chills, shortness of breath, and weakness may develop.[17]

The most severe effect of inhalation of cadmium fume is a condition known as "cadmium fume fever." This condition results from inhalation overexposure of freshly generated fume of heated cadmium.[7] Effects of exposure may be delayed for several hours but include serious injury to the lungs and respiratory tract including tracheobronchitis, pneumonitis, and pulmonary edema. The mortality rate for cadmium fume fever is high, about 20%.[7]

Long-term exposure to cadmium fume may cause a loss of the sense of smell, nasal septum ulceration, shortness of breath, kidney damage, and anemia. The risk of prostate cancer reportedly increases in males exposed to cadmium. The estimated biological half-life of cadmium is 10 to 30 years.[7]

NIOSH considers cadmium to be a potential occupational carcinogen and recommends limiting exposure to cadmium fume to the lowest feasible concentration. Workers exposed to hazardous levels of cadmium should receive initial and periodic medical examinations according to NIOSH recommendations.

ACGIH has recommended an 8-hour TLV of 10 µg/m^3 for the inhalable portion of cadmium (measured as total particulates) and 2 µg/m^3 for the respirable fraction.[5] The TLV for total particulates (10 µg/m^3) is intended to minimize the risk of kidney damage while the TLV for the respirable fraction (2 µg/m^3) is intended to prevent lung cancer due to cadmium deposition in the lungs. ACGIH has assigned cadmium an A2 Suspected Human Carcinogen notation.

ACGIH also has recommended Biological Exposure Indices (BEIs®) for cadmium. For chronic exposure to cadmium, monitoring of cadmium in urine is recommended. As an indication of recent exposures, ACGIH recommends monitoring for cadmium in the blood. The BEI of 5 micrograms per liter (µg/L) of cadmium in the blood is intended to protect workers against renal dysfunction.

OSHA has established an 8-hour PEL for cadmium of 5 µg/m^3 and an AL of 2.5 µg/m^3.[17] The OSHA Cadmium Standard includes specific requirements for medical examinations and exposure monitoring.

Nickel

Nickel may exist in several chemical forms: as a gas, as an elemental metal, and as either a soluble or insoluble compound. Industrially it is used in the manufacture of stainless steel and other corrosion-resistant alloys. Welding or torch-cutting nickel alloys generates fume whereas sanding, grinding, and abrasive blasting can create nickel-containing dusts. Absorption of fumes or dusts into the body following occupational exposures may occur either through inhalation or through ingestion.[18] Metallic nickel is absorbed into the body by dust inhalation – it is poorly absorbed through the intestinal tract.[19] By contrast, soluble and insoluble nickel compounds may be absorbed into the body both by inhalation and by ingestion with soluble compounds being better absorbed than insoluble ones.[18] Absorption of nickel through the gastrointestinal tract occurs when inhaled particles of nickel are coughed up from the lungs and respiratory tract and are then swallowed.[18] Nickel and inorganic nickel compounds are not well absorbed into the body through intact skin.[7,18]

Metallic nickel and inorganic nickel compounds have all been identified as capable of causing adverse health effects in exposed individuals. The organs primarily affected by nickel exposure include the lungs and the skin; contact dermatitis (sometimes severe) commonly occurs after direct exposure of the skin to nickel and nickel compounds.[7] [18] Chronic irritation of the nose (rhinitis) and nasal sinuses (sinusitis) resulting in loss of the ability to smell (anosmia), nasal septal perforations, and irritation of the lungs resulting in asthma have all been described in workers with concentrated exposures to nickel fume and dust.[7,18]

In addition to the health effects described above, exposures to soluble and insoluble nickel compounds and nickel subsulfide are associated with an increased risk for the development of cancer in the respiratory tract; this includes the lungs, nasal sinuses, and upper airway.[7]

According to the International Agency for Research on Cancer, nickel compounds are classified as carcinogenic to humans.[20] Although at one time it was believed that metallic nickel also led to an increased risk for lung and nasal cancer, current evidence concerning its carcinogenicity is less conclusive.[7,20]

The NIOSH REL does not distinguish between metallic nickel, and soluble and insoluble nickel compounds. The 10-hour REL of 15 µg/m^3 applies equally to metallic nickel and inorganic nickel compounds. Furthermore, because NIOSH has classified nickel and nickel compounds as potential occupational carcinogens, current recommendations are to limit occupational exposures to the lowest feasible concentration.

Additional NIOSH recommendations for workers exposed to nickel and inorganic nickel compounds include: (1) a comprehensive pre-employment medical evaluation and work history emphasizing skin conditions, allergies, upper and lower respiratory tract illnesses, and smoking; (2) a complete physical examination with particular attention to the upper respiratory tract and skin; and (3) specific clinical tests such as chest x-ray. Thereafter, workers exposed to nickel or inorganic nickel compounds are advised to undergo periodic medical exams at least annually, including the same physical examination and clinical tests performed during the pre-employment physical. All medical records should be maintained for at least 40 years following a worker's last occupational exposure to nickel.[21]

ACGIH TLVs have been proposed with the intent of minimizing the risk of lung and sinus cancer, or the development of inflammatory pulmonary disease.[7] ACGIH has recommended the following 8-hour TLVs (all based on the inhalable fraction of nickel particulate mass): for elemental nickel, 1500 µg/m^3; for soluble inorganic nickel compounds, 100 µg/m^3; for insoluble inorganic nickel compounds, 200 µg/m^3; and for nickel subsulfide, 100 µg/m^3. ACGIH has assigned both insoluble inorganic nickel compounds and nickel subsulfide an A1 notation, Confirmed Human Carcinogens.[5]

Like NIOSH, OSHA does not distinguish between metallic nickel and nickel compounds for the purposes of establishing an exposure limit. The OSHA 8-hour PEL for metallic nickel, and soluble and insoluble nickel compounds is 1000 µg/m^3.

Copper

Exposure to copper fume occurs in foundries and smelters and among workers who weld or torch-cut copper-containing metal alloys. Short-term exposure to copper can cause irritation to the eyes, nose, and throat; a metallic or sweet taste in the mouth; nausea; and a condition known as metal fume fever. Symptoms of metal fume fever include fever, muscle aches, nausea, chills, dry throat, cough, and weakness. Long-term exposure to copper fume may cause the skin and hair to change color.[16] NIOSH has a 10-hour REL of 100 µg/m^3 for copper fume, and 1000 µg/m^3 for copper dust. ACGIH has an 8-hour TLV of 200 µg/m^3 for copper fume, and 1000 µg/m^3 for copper dust.[5] OSHA's PEL for copper fume is 100 µg/m^3, and for copper dust is 1000 µg/m^3, both measured as an 8-hour TWA.[6]

Arsenic

The toxicity of arsenic varies with its chemical state. Elemental and organic arsenic (found in seafood) are virtually non-toxic, while trivalent arsenic and arsine gas are potent poisons. Depending on the dose, symptoms of arsenic poisoning may develop within minutes to hours following exposure. Short-term exposure to inorganic arsenic can result in weakness, nausea, vomiting, diarrhea, loss of appetite, cough, chest pain, giddiness, headache, and breathing difficulty.[16] Long-term health effects may include nausea, vomiting, diarrhea, skin and eye irritation, skin hyperpigmentation, thickening of the skin on the palms and soles, contact dermatitis, skin sensitization, perforation of the nasal septum, numbness and weakness in the legs and feet, and cardiac and peripheral vascular disease.[16]

NIOSH considers inorganic arsenic a potential occupational carcinogen and recommends limiting exposure to inorganic arsenic to the lowest feasible concentration. NIOSH has a REL-Ceiling (REL-C) for inorganic arsenic of 2 µg/m^3.[4] PBZ air monitoring for arsenic should occur during the work shift to determine if the REL-C has been exceeded. At least three short-term (15-minute) samples should be collected during periods of maximum expected airborne exposure to inorganic arsenic; the sample with the highest result is then used to estimate a worker's level of exposure. NIOSH recommends that workers with a potential for exposure to inorganic arsenic receive pre-placement, periodic, and termination or job transfer medical examinations. NIOSH also recommends biological monitoring to identify effects of arsenic exposure to the skin, blood, lymphatic system, peripheral nervous system, liver, and respiratory tract, as compared to the baseline examination.

ACGIH classifies inorganic arsenic as an A1 Confirmed Human Carcinogen and recommends an 8-hour TLV of 10 µg/m^3.[5] Exposures at or below this TLV are expected to minimize the potential for adverse effects on the skin, liver, peripheral blood vessels, upper respiratory tract and lungs, including cancer. ACGIH also recommends a biological exposure index (BEI) for inorganic arsenic of 35 µg/L of arsenic in urine.

OSHA has established an 8-hour PEL for inorganic arsenic of 10 µg/m^3 and an AL of 5 µg/m^3 averaged over an 8-hour period.[22] OSHA has specific guidelines for personal air monitoring and medical examinations that depend upon employee exposure levels.

Iron oxide

Chest x-rays of workers exposed to iron oxide dust or fume (in the absence of asbestos or crystalline silica) may display characteristic, unusual lung markings. These findings, however, are not predictive of adverse health effects. In fact, iron deposition in the lung (called siderosis) is considered benign and workers do not experience changes in lung function.[7] Exposures may occur during the heating or melting of cast iron or iron alloys, in the production of steel ingots, while processing iron ore, when hot rolling sheet and strip steel, or during the forging or welding of iron or steel. NIOSH recommends a 10-hour REL for iron oxide dust and fume of 5000 µg/m^3. The ACGIH TLV for iron oxide dust and fume is 5000 µg/m^3 measured as an 8-hour TWA.[5] The 8-hour OSHA PEL for iron oxide is 10,000 µg/m^3.[6]

RESULTS

Air Samples

Of the 15 PBZ air samples collected from plate cutters, there were four overexposures to lead. One sample exceeded the OSHA PEL, three samples exceeded the OSHA AL, two additional samples approached, but did not exceed the AL. Within this worker group, NIOSH investigators did not measure any other exposures to hazardous metals that exceeded published Occupational Exposure Limits (OELs).

Among burners, however, NIOSH investigators identified elevated exposures to several toxic metals. The highest numbers of overexposures were for lead. Nine of twelve PBZ samples collected from burners exceeded the OSHA PEL; and one sample exceeded the AL. Two other samples approached but did not exceed the AL for lead. Four samples exceeded the OSHA PEL and one sample approached (but did not exceed) the AL for cadmium. Three samples exceeded the NIOSH REL for nickel, and three samples exceeded the OSHA PEL for copper. One sample exceeded the OSHA PEL and two other samples exceeded the OSHA AL for arsenic. Finally, one sample exceeded the NIOSH REL for iron. PBZ air sampling results are provided in Table 1.

Wipe Samples

NIOSH investigators collected a total of 200 wipe samples from the hands of OmniSource plate cutters and burners, their helmets, face shields, and respirators, and from other sources within the workplace environment. These other workplace source included the break room (tables, coffee pot, microwave oven, refrigerator, vending machine, etc.), the changing (locker) room, and from doors and door knobs. Lead, nickel, and other metals were detected on employees' hands, PPE, and other surfaces. Levels of lead and other metals on hands and PPE were generally higher for burners than for plate cutters. The highest levels of surface contamination were identified on the helmets and respirators of burners. Lead levels were generally higher inside the helmets than outside in the mornings and higher outside at the end of the shift. The wipe sample results for lead, cadmium, nickel, copper, and arsenic are provided in Table 2. A summary of the results is provided in Table 3.

Employee Interviews

In April 2004, a NIOSH industrial hygienist interviewed nine of the employees who participated in PBZ air monitoring for hazardous metals. Four of the employees had been with the company for less than 1 year. Six of the employees reported concerns about sustaining burns on their hands, feet, or their necks. Workers reported that slag gets caught between their two pairs of gloves. By the time they can remove the outer leather glove the slag has burned through the inner glove. Burners expressed concern about overheating due to the policy of wearing coveralls over their uniform, even in the hottest weather. Workers also complained about smelling burned materials through the respirators. One worker was concerned about torch cutting during lightning storms. Another worker was concerned about fires and flame-ups when cutting certain machines that contained or used hydraulic fluid or oil. Other concerns included being downwind from burners without a respirator, and getting sprayed by sparks from other workers cutting metal with torches.

Programs Review

Lead Hazard Program

During the opening conference (October 2003) OmniSource representatives reported that neither an OSHA inspection in July 2001, nor internal sampling conducted by the company's industrial hygienists (during that same time period) had identified elevated exposures to lead. Further air sampling in 2003 identified elevated airborne lead exposures to workers cutting bulk material. In response, OmniSource established the Lead Hazard Program for all employees with a potential for lead exposure at the Lima facility, however the written program does not include plate cutters.

As of October 2003, according to OmniSource representatives, 9 or 10 of the 18 torch cutting facilities had a Lead Hazard Program. Plans were being made to initiate a Lead Hazard Program at all OmniSource facilities whether or not airborne lead levels in excess of the PEL were identified. The OmniSource Lead Hazard Program was specifically developed to decrease levels of lead exposure among burners.

As part of the Lead Hazard Program, burners undergo additional training about the health hazards of lead. Included in this training are hygiene guidelines. These guidelines prohibit the consumption or storage of food, beverages, or tobacco in lead contaminated areas. Although workers are instructed to keep their hands away from their mouths, the guidelines do not specifically address the issue of washing hands before smoking cigarettes or eating. Also according to hygiene guidelines, clean and contaminated locker rooms are located in separate areas; workers are instructed not to take home dirty clothing (uniforms and coveralls) or to wear dirty clothing into the clean locker area. Work clothes are to be doffed in the dirty locker room; these are then collected and laundered by a contract uniform company. At the time of the NIOSH site visit, hygiene guidelines did not address provisions for mandatory showers at the end of a worker's shift.

In addition to training and hygiene guidelines, the OmniSource Lead Hazard Program provides for routine personal exposure and biological monitoring for burners. Personal exposure monitoring as specified by the program includes quarterly PBZ air monitoring for lead. Biological monitoring includes measuring BLL and ZPP. Serum samples are collected at varying intervals depending upon an employee's work area, frequency of exposure, and past blood lead levels.

According to the Lead Hazard Program, all OmniSource employees enrolled in the program will have their blood drawn at least quarterly. Employees with BLLs less than 30 µg/dL will be tested again the following quarter. Any employee found to have a BLL greater than or equal to (≥) 30 µg/dL will be tested monthly until 2 consecutive test results are established below 30 µg/dL. In addition, a health care provider may recommend additional or continued testing at any time.

Based on the results of BLL testing, employees will, for medical reasons, be temporarily removed from their job. This can occur: 1) when any single BLL ≥ 50 µg/dL is identified; 2) if the average of an employee's last three BLLs is ≥ 40 µg/dL; or 3) if a medical doctor feels that lead exposure can cause further complications.

Blood Lead Level Results

Review of biological monitoring revealed that two workers have had measured BLLs ≥ 30 µg/dL since the initiation of the Lead Hazard Program. One individual had a BLL of 39 µg/dL during the first round of blood draws in April 2003. Monthly BLLs tracked a lowering of this worker's BLL to 21 µg/dL; the most recent BLL for this worker was approximately 13 µg/dL. Another employee had a BLL of 30 µg/dL; this level also decreased over time and the most recent BLL for this worker was approximately 13 µg/dL. Based on the most recent data, BLLs among burners are ≤ 13 µg/dL.

Respiratory Protection Program

According to the company's Lead Hazard Program engineering controls "are not feasible while torching bulk material." Thus, employees working in areas where lead levels exceed the OSHA AL are enrolled in the OmniSource Respiratory Protection Program. This program has all the elements required by OSHA Code of Federal Regulations Standard 29 CFR 1910.134. These employees receive additional training and are fit-tested with a half-face negative pressure respirator to be used when torch cutting bulk material. Only burners are included in the Respiratory Protection Program.

Burners are provided 3M half-face air purifying respirators (model 7502) with high efficiency particulate air (HEPA) pancake filters (2091-P100). The filters are changed every 7-10 days.

Personnel whose jobs do not require a respirator may use one voluntarily in accordance with OSHA guidelines for voluntary respirator use. During the NIOSH site visit some burners stated they were detecting odors, possibly welding gases, through the respirators. OmniSource's industrial hygienist provided the employees 3M 2097-P100 HEPA filters with a charcoal layer for nuisance organic vapors.

Other

Personal Protective Equipment

Burners wear coveralls over the uniform to prevent contamination of their street clothes or skin with metal fumes. They also wear leather sleeves and spats to protect their skin from burns, helmets with a face shield, and half-face air purifying respirators with HEPA filters. Plate cutters are not provided uniforms, coveralls, or respirators. They wear leather sleeves and spats, and helmets with a face shield. The face shields are tinted a number five shade.[23] Some employees wear a clear lens face shield and number five shade safety glasses underneath. OSHA general standards, 29 CFR 1910, sub part Q, welding, cutting, and brazing, 1910.252 General Requirements, provides a table with shade numbers for specified welding operations. The higher the number the darker the lens and the more radiant energy it will filter. Workers wear two pairs of gloves one pair for protection from cuts while handling scrap metal and a second pair for protection from spattered slag. Noise dosimetry conducted by OmniSource indicated that employees were exposed to noise levels ranging from 85 to 92 dBA. OmniSource provides hearing protection for employees exposed to noise levels exceeding 85 dBA.

Engineering Controls

The OmniSource Lima facility does not use engineering controls to reduce employees' exposures to lead and other hazardous metals. OmniSource has determined that engineering controls are not feasible while torching bulk material because torching is performed outdoors and on material of multiple shapes and sizes. Placing bulk material in a ventilated room is not considered feasible due to the size of the material and the delay in transporting the material to and from the room. The delay would result in employees remaining idle during material transfer. Portable local exhaust ventilation units are difficult to maneuver through the scrap waste and are subject to environmental conditions such as rain and snow.

OSHA 300 Log

NIOSH investigators reviewed the company’s OSHA Form 300 OSHA Log of Work-Related Injury and Illnesses for 2003 and 2004. Because environmental sampling had not identified elevated lead in air levels prior to 2003, we restricted our review of OSHA 300 Logs to these two years. In 2003, there were nine recordable injuries; two injuries occurred among plate cutters and one occurred to a burner. All three injuries were burns, two of which necessitated extended time (> 50 days) away from work. At the time of the second NIOSH site visit (April 2004) there were six recordable injuries for the calendar year. Three had occurred among torchmen and none among burners. One injury was a burn, another a strained muscle, and the third, a foreign body in the eye.

DISCUSSION

The American Welding Society defines welding fumes as, “solid particles which originate from welding consumables, the base metal, and any coatings present on the base metal.”[24] Fumes, like dust, are particulates that settle on surfaces such as skin, clothing, and equipment, hence the OSHA hygiene requirements, including showers. Wipe sampling conducted by NIOSH investigators identified the presence of hazardous metals on employees’ skin, clothing, and PPE. These hazardous metals came from the fume generated by the torch cutting of bulk scrap. Burners are exposed to a wider variety of metals and decomposition products from coatings and other materials that may adhere to scrap metal than are plate cutters who cut only unpainted steel plates. Due to the dynamic nature of the work environment it is difficult to predict a given employee's exposure to hazardous metals and other contaminants. The type of scrap cut and environmental conditions vary daily since employees are cutting scrap metal outdoors. Sample results indicated that burners and plate cutters may both be exposed to concentrations of hazardous metals over occupational exposure limits.

Since April 2003, BLLs for burners have been lowered and remain so, which may be a result of the Lead Hazard and Respiratory Protection Programs implemented by OmniSource. Presumably, these programs have also decreased the level of exposure to other hazardous metals; however OmniSource is not conducting biological monitoring for other hazardous metals such as cadmium or arsenic.

Personnel torching scrap metal may be exposed to welding gases and other decomposition products generated while cutting through paint coatings, rubber, plastic, and other materials attached to the scrap metal. Welding gases include nitrogen oxide, carbon monoxide, and ozone. Other contaminants such as volatile organic compounds and polycyclic aromatic hydrocarbons may be released.

PPE should be the last control method used to reduce employee exposures to environmental hazards. PPE can be costly, usually requires training, and places an added physical burden on workers. From an industrial hygiene perspective, local exhaust ventilation is a more desirable alternative to reduce employee exposures to hazardous metals. Properly designed and implemented, local exhaust ventilation can reduce employee exposures to hazardous metals, welding gases, and other combustion by products. OmniSource has elected to provide employees respiratory protection in lieu of engineering controls because they consider engineering controls infeasible while torching bulk material.

CONCLUSIONS

Based on personal and surface sampling results NIOSH investigators conclude that:

1. Burners cutting scrap at the time of the NIOSH survey were overexposed to lead, cadmium, nickel, copper, and inorganic arsenic.

2. Some plate cutters were overexposed to lead.

3. In general, levels of exposures to hazardous metals were higher for burners than for plate cutters.

4. Burners were not exposed to metals at levels that exceeded the protection factor of their air purifying respirators (APR).

5. Lead and other hazardous metals were detected on employees' hands and on their PPE. Surface levels of hazardous metals were higher for burners than for plate cutters.

RECOMMENDATIONS

The following recommendations are provided to assist in minimizing worker exposures to lead and other hazardous metals during torching operations.

1. Comply with the substance-specific OSHA Standards 29 CFR 1910.1018 [Arsenic], 29 CFR 1910.1025 [Lead], and 29 CFR 1910.1027 [Cadmium]. OSHA Standard 29 CFR 1910.1000 [Air Contaminants] provides general compliance requirements for other metals such as copper and nickel.

2. Use engineering controls to reduce worker exposures. A properly designed cross-draft or side-draft booth (similar to a paint booth) may reduce employee exposures to metal fumes. The ACGIH Industrial Ventilation manual has examples of designs for a large drive-through spray paint booth, an automated/high production water wash downdraft paint booth, a production line welding booth, and a torch cutting ventilation system that may be modified for your torch cutting operations.[25]

The booth may also help protect employees from adverse weather conditions (for example, it could be heated in the winter and air conditioned in the summer to provide a more comfortable work environment). Another option would be to use fans to blow the fumes away from the workers' breathing zones. The fan should be angled upwards. A company called Spitfire™ manufactures gas or electric powered positive pressure ventilators that may serve this purpose. Model PPV-20GH, a gas powered blower provides 15,277 cubic feet per minute of air. The fan can be set at various angles. You can obtain more information on this product from Air Systems International, Inc. at 1-800-866-8100, or contact other companies that provide similar products.

3. Provide showers for employees exposed to hazardous metals as required by the substance-specific OSHA standards until engineering controls to reduce occupational exposures are implemented. If engineering controls cannot reduce exposures below applicable occupational exposure limits, then showers must continue to be provided as required by the referenced OSHA standards.

4. Require employees to clean the interior and exterior surfaces of their personal protective equipment daily. A station such as a sink with cleaning supplies should be provided for employees to clean respirators and other PPE (refer to OSHA Standard 29 CFR 1910.134 [Appendix B-2] for mandatory respirator cleaning procedures)

5. Require employees to wash hands before eating or smoking to avoid ingesting hazardous metals and contaminating the break room area. This topic should be added to the list of Hygiene Rules in the OmniSource written Lead Hazard Program.

6. Conduct PBZ air monitoring to evaluate potential exposures to welding gases. The same engineering controls implemented to reduce exposures to metal fumes should also effectively reduce exposures to welding gases.

7. Include plate cutters in the OmniSource Lead Hazard and Respiratory Protection Programs.

8. Encourage employees to wear gauntlet leather gloves designed for torch cutting to minimize the risk of burn injury and review torch cutting practices to determine the cause of burns and take corrective action to minimize these injuries.

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Table 1
Metals Full-Shift Personal Air Samples
OmniSource Corporation, Lima, Ohio HETA 2003-0367-2973

Sample Number	Job Description	Sample Date	Sample Volume	Sample Time (min)	Concentration (micrograms per cubic meter)					
					Lead	Cadmium	Nickel	Copper	Iron	Arsenic
P001	Burner	4/20/04	1134	567	**229 #**	**5.47 #**	**18.5 +**	63.4	1940	**5.82 ***
P002	Burner	4/20/04	342	171	**155 #**	**13.7 #**	8.18	120	2800	ND
P003	Burner	4/20/04	1057	531	**189 #**	**16.1 #**	7.19	114	1610.	ND
P004	Burner	4/20/04	1065	535	**291 #**	1.13	12.2	41.2	1130	Trace
P005	Cutter	4/20/04	1054	527	**56.9 #**	0.33	5.88	25.5	1520	ND
P006	Cutter	4/20/04	1052	525	10.5	0.58	2.00	9.34	522	ND
P007	Cutter	4/20/04	1049	524	**33.4 ***	0.32	2.19	11.4	790	ND
P008	Cutter	4/20/04	774	386	29.7	1.12	4.52	20.6	1110	ND
P009	Burner	4/21/04	1187	595	**80.0 #**	1.18	11.8	27.7	1430	**5.64 ***
P010	Cutter	4/21/04	1016	509	**31.5 ***	0.67	9.25	43.2	1480	ND
P011	Burner	4/21/04	894	445	**112 #**	**6.49 #**	5.82	89.4	2120	ND
P012	Cutter	4/21/04	1048	516	8.02	0.12	6.30	31.4	791	ND
P013	Cutter	4/21/04	1037	517	4.34	0.12	3.09	15.4	356	ND
P014	Burner	4/21/04	939	468	29.8	0.54	2.66	18.0	797	ND
P015	Burner	4/21/04	967	490	26.9	0.28	**20.7 +**	13.4	733	ND
P016	Cutter	4/21/04	1031	513	19.4	0.20	3.40	14.5	765	ND
P017	Cutter	4/21/04	1037	517	27.0	0.39	2.12	12.5	519	ND
P018	Burner	4/22/04	1192	603	**98.4 #**	1.87	**33.5 +**	**177 #**	**6590 +**	**20.7 #**
P019	Burner	4/22/04	1042	517	**192 #**	2.40	7.58	72.9	1340	Trace
P020	Burner	4/22/04	1217	604	**39.4 ***	0.99	4.60	18.8	1640	Trace
P021	Cutter	4/22/04	501	246	**39.9 ***	0.30	6.79	27.8	2990	ND
P022	Cutter	4/22/04	991	529	6.56	0.19	6.05	25.2	665	ND
P023	Cutter	4/22/04	1070	525	3.55	0.17	1.31	4.69	363	ND
P024	Cutter	4/22/04	1008	501	23.8	0.23	3.47	22.7	921	ND
P025	Cutter	4/22/04	329	163	7.90	0.30	0.33	27.4	59.8	ND
P026	Cutter	4/22/04	979	489	9.30	1.43	5.41	22.4	806	ND
P027	Burner	4/22/04	844	423	**190 #**	0.59	1.54	24.8	686	ND
NIOSH Recommended Exposure Limit (μg/m^3)					**50**	LFC	15	100	5000	2 (Ceiling)
OSHA Permissible Exposure Limit (μg/m^3)					**50**	5	1000	100	10000	10

= indicates that the sample exceeded the OSHA PEL
+ = indicates that the sample exceeded the NIOSH REL
* = indicates that the sample exceeded the OSHA Action Level
LFC = Lowest feasible concentration
Note: the minimum detectable concentration (MDC) for arsenic was 0.83. The MDC was calculated by dividing the LOD by 1.2 m^3.
Note: the minimum quantifiable concentration (MQC) for arsenic was 3.33. The MQC was calculated by dividing the LOQ by 1.2 m^3
ND = below the MDC
Trace = Result between MDC and MQC

Table 2
Metals Quantitative Wipe Sample Results
OmniSource Corporation, Lima, Ohio HETA 2003-0367-2973
April 20–21, 2004

Sample No.	Sample Type	Time	Job Title	Concentration, micrograms per wipe sample				
				Pb	Cd	Ni	Cu	As
L-1	Hands	3:15 PM	Burner	49	0.8	17	50	2
L-2	Hands	3:15 PM	Burner	23	1.5	22	69	ND
L-3	Hands	3:15 PM	Mgmt	31	2.1	26	57	2
L-4	Hands	3:15 PM	Burner	6.4	0.3	3.5	20	ND
L-5	Hands	3:15 PM	Mgmt	5.9	0.4	6.1	16	ND
L-6	Blank	3:20 PM		ND	ND	0.7	0.6	ND
L-7	Torch	6:15 AM	Burner	6.2	0.4	7.8	39	ND
L-8	Respirator	6:15 AM	Burner	22	ND	4.3	11	ND
L-9	Hands	6:15 AM	Burner	14	0.3	1.8	6.5	ND
L-10	Helmet in/out	6:15 AM	Burner	240	0.66	24	40	3
L-11	Respirator	6:18 AM	Burner	92	3.1	18	110	1
L-12	Hands	7:30 AM	Burner	26	1.1	4.6	30	ND
L-13	Face shield inside	7:30 AM	Burner	250	3	63	320	5.1
L-14	Face shield outside	7:30 AM	Burner	52	1.5	14	42	ND
L-15	Hands	7:35 AM	Cutter	7.3	0.4	4.7	22	ND
L-16	Face shield outside	7:35 AM	Cutter	1	ND	0.8	2.6	ND
L-17	Face shield inside	7:35 AM	Cutter	3.5	ND	5.1	7.3	ND
L-18	Hands	7:38 AM	Burner	6.3	ND	2.5	11	ND
L-19	Face shield outside	7:38 AM	Burner	36	1.2	10	52	3
L-20	Face shield inside	7:38 AM	Burner	46	1.5	20	66	3
L-21	Respirator	7:38 AM	Burner	5.6	0.4	2.8	10	ND
L-22	Hands	7:40 AM	Cutter	3.3	0.63	4	14	ND
L-23	Hands	7:42 AM	Cutter	3.8	0.4	3.9	15	ND
L-24	helmet	8:42 AM	Cutter	24	0.5	8.7	27	1
L-25	Helmet	9:42 AM	Cutter	54	0.5	25	40	2
L-26	Hands	7:45 AM	Burner	4.9	0.4	4.3	25	ND
L-27	Helmet outside	7:45 AM	Burner	60	1.4	30	110	2
L-28	Helmet inside	7:45 AM	Burner	110	2.3	58	240	3.4
L-29	Helmet front	7:50 AM	Burner	11	0.2	4.7	25	ND
L-30	Hands	7:50 AM	Cutter	4.2	0.4	3.2	11	ND
L-31	Helmet inside	7:50 AM	Cutter	13	0.2	1.8	0.7	ND
L-32	Helmet outside/cutter	7:52 AM	Cutter	25	ND	7.5	15	ND
L-33	Respirator	7:52 AM	Burner	6.6	0.3	3.7	15	ND
L-34	Helmet outside	7:52 AM	Cutter	ND	ND	1.8	3.2	ND
L-35	Helmet inside	9.00 AM	Cutter	2	0.2	3.5	6.2	ND
L-36	Blank	9.00 AM		ND	0.9	0.7	0.75	ND
L-37	Blank	9.00 AM		ND	0.6	ND	0.5	ND
L-38	Blank	9:04 AM		ND	0.98	0.9	0.82	0.9
L-39	Door knob	9:04 AM		2	0.2	8.9	3	1
L-40	Door knob	9:04 AM		1	ND	1	1.7	ND
L-41	Hands	9:04 AM	Burner	9.6	1.1	4.7	11	ND
L-42	Hands	7:40 AM	Burner	3.2	13	1.7	9.1	0.9
L-43	Hands	9:10 AM	Burner	2	0.77	5.4	15	ND

Table 2
Metals Quantitative Wipe Sample Results
OmniSource Corporation, Lima, Ohio HETA 2003-0367-2973
April 20–21, 2004

Sample No.	Sample Type	Time	Job Title	Concentration, micrograms per wipe sample				
				Pb	Cd	Ni	Cu	As
L-44	Microwave #1	9:10 AM		ND	ND	ND	1.2	ND
L-45	Coffee pot	9:10 AM		ND	ND	0.5	1.6	ND
L-46	Microwave #2	9:10 AM		ND	ND	0.4	1.4	ND
L-47	Refrigerator	9:10 AM		2	ND	1.2	5.2	ND
L-48	Hands	9:20 AM	Mgmt	1	0.3	1.3	5.4	0.9
L-49	Break room door knob (inside)	9:25 AM		ND	ND	1.9	2.8	ND
L-50	Break room door knob (outside)	9:25 AM		ND	ND	5.4	5.7	ND
L-51	Towel dispenser	9:30 AM		ND	ND	2.1	10	ND
L-52	Hands	9:32 AM	Mgmt	14	0.95	15	110	ND
L-53	Hands	9:32 AM	Cutter	ND	ND	3.1	18	0.8
L-54	Hands	9:37 AM	Cutter	3.5	0.3	4.5	12	ND
L-55	Hands (2 wipes in 1)	9:37 AM	Cutter	7.7	0.5	6	25	ND
L-56	Hands (dropped on table)	9:37 AM	Cutter	57	ND	5.6	98	ND
L-57	Hands (dropped on floor)	9:37 AM	Cutter	44	2.7	8.2	64	ND
L-58	Hands	9:54 AM	Mgmt	ND	ND	1	2.6	ND
L-59	Hands	10:05 AM	Other	4.7	0.5	1.9	23	ND
L-60	Hands	10:05 AM	Fabrication	4	0.6	3.6	15	ND
L-61	Hands	10:05 AM	Fabrication	1	0.5	4.3	16	ND
L-62	Hands	10:05 AM	Fabrication	1	0.6	2.7	12	1
L-63	Vending machine #1	10:22 AM		9.4	0.5	5.5	30	ND
L-64	Vending machine #2	10:22 AM		16	0.5	5.4	38	1
L-65	Hands	11:30 AM	Cutter	5.8	0.66	5	20	ND
L-66	Hands	11:30 AM	Other	ND	0.69	4.5	76	ND
L-67	Hands	11:30 AM	Cutter	ND	0.2	7	14	ND
L-68	Hands	11:30 AM	Cutter	11	0.6	6.1	22	1
L-69	Hands	11:30 AM	IH	ND	ND	1.4	3.9	ND
L-70	Hands	11:30 AM	IH	ND	1.1	ND	1.7	ND
L-71	Table 1A	1:30 PM		ND	ND	1.3	4.9	ND
L-72	Blank	1:30 PM		ND	ND	0.6	0.62	ND
L-73	Table 1C	1:30 PM		4.9	ND	1.3	8.9	ND
L-74	Table 2A	1:30 PM		5.3	ND	3.4	8.5	1
L-75	Blank	1:30 PM		ND	ND	0.5	0.67	ND
L-76	Blank	1:30 PM		ND	ND	0.5	0.4	ND
L-77	Table 2D	1:30 PM		4.9	ND	1.9	10	2
L-78	Table 2E	1:30 PM		3.3	ND	1.5	6.6	1
L-79	Blank	1:30 PM		ND	ND	ND	0.5	1
L-80	Table 3A	1:30 PM		5	ND	0.7	6.8	1
L-81	Blank	1:30 PM		ND	ND	ND	0.4	1
L-82	Table 3C	1:30 PM		4.2	ND	1.4	10	1
L-83	Table 3D	1:30 PM		3.3	ND	1.6	6.8	0.9
L-84	Table 3E	1:30 PM		2	ND	1.2	5.2	ND
L-85	Hands	2:00 PM	Burner	4.9	0.3	1.7	7.6	1

Table 2 Metals Quantitative Wipe Sample Results OmniSource Corporation, Lima, Ohio HETA 2003-0367-2973 April 20–21, 2004								
Sample No.	**Sample Type**	**Time**	**Job Title**	**Concentration, micrograms per wipe sample**				
				Pb	**Cd**	**Ni**	**Cu**	**As**
L-86	Hands	2:00 PM	Burner	4.1	ND	1.5	4.1	ND
L-87	Hands	2:00 PM	Burner	30	1.2	14	64	1
L-88	Hands	2:00 PM	Cutter	9.2	0.6	7	24	1
L-89	Hands	2:00 PM	Cutter	16	0.92	16	63	2
L-90	Hands	2:00 PM	Cutter	6.2	0.4	8.1	16	1
L-91	Hands	2:30 PM	Burner	6.8	0.2	1.1	10	2
L-92	Door handle outside	3:31 PM		7.5	ND	6.5	10	1
L-93	Steering wheel	3:31 PM		3	ND	0.6	7.9	0.9
L-94	Seat and back rest	3:31 PM		12	0.4	3.1	14	1
L-95	Hands	4:20 PM	Burner	27	1.1	8.6	39	1
L-96	Hands	4:20 PM	Burner	27	160	10	44	0.8
L-97	Sample pump #2005 (tube)	4:20 PM		140	100	21	150	6.2
L-98	Hands	4:20 PM	Burner	51	5.5	8.3	79	ND
L-99	Hands	4:20 PM	Cutter	11	0.63	8.2	15	2
L-100	Helmet inside	4:20 PM	Burner	170	6.5	25	350	3.7
L-101	Helmet outside	4:20 PM	Burner	760	14	88	1700	20
L-102	Helmet inside	4:20 PM	Cutter	31	ND	10	9.5	2
L-103	Helmet outside	4:20 PM	Cutter	45	ND	18	18	2
L-104	Hands	4:20 PM	Cutter	18	0.75	13	47	2
L-105	Helmet inside got new shield since AM	4:20 PM	Cutter	14	ND	8.7	13	2
L-106	Helmet outside	4:20 PM	Cutter	18	ND	8.4	16	2
L-107	Hands	4:20 PM	Cutter	9.8	1.1	7.4	25	2
L-108	Helmet inside	4:20 PM	Cutter	7	ND	6.8	7.9	1
L-109	Helmet outside	4:20 PM	Cutter	9.8	0.3	6.2	9.7	1
L-110	Hands	4:20 PM	Cutter	7.6	1.9	3.6	14	0.8
L-112	Helmet inside	4:20 PM	Cutter	12	ND	7	7	2
L-113	Hands	4:20 PM	Burner	92	3	23	110	3.9
L-114	Respirator	4:35 PM	Burner	21	ND	11	24	ND
L-115	Helmet inside	4:35 PM	Burner	140	1.4	71	170	6.1
L-116	Helmet outside	4:35 PM	Burner	71	0.74	15	41	3
L-117	Hands	4:35 PM	Burner	40	3.4	10	32	1
L-118	Respirator	4:40 PM	Burner	30	2	17	26	1
L-119	Helmet outside	4:40 PM	Burner	320	3.3	13	49	4.5
L-120	Helmet inside	4:40 PM	Burner	290	1.6	110	180	5.4
L-121	Hands	4:40 PM	Mgmt	33	1.3	14	63	1
L-122	Hands	5:00 PM	Burner	9.6	0.3	3.6	11	ND
L-123	Helmet inside	6:05 AM	Burner	280	1.3	53	71	6.4
L-124	Helmet outside	6:05 AM	Burner	130	0.6	3.7	12	1
L-125	Respirator	6:05 AM	Burner	11	0.2	3.7	6.6	ND
L-126	Hands	6:05 AM	Burner	2	ND	1.7	4.6	ND
L-127	Respirator	6:15 AM	Burner	180	6.3	29	270	4.6
L-128	Helmet inside	6:15 AM	Burner	58	2.4	6.4	63	1

Table 2 Metals Quantitative Wipe Sample Results OmniSource Corporation, Lima, Ohio HETA 2003-0367-2973 April 20–21, 2004								
Sample No.	**Sample Type**	**Time**	**Job Title**	**Concentration, micrograms per wipe sample**				
				Pb	**Cd**	**Ni**	**Cu**	**As**
L-129	Helmet outside	6:15 AM	Burner	120	9.3	7.3	70	3
L-130	Hands	7:30 AM	Cutter	2	0.3	2.3	7.7	1
L-131	Hands	7:30 AM	Cutter	4.3	0.4	3.7	16	ND
L-132	Hands	7:30 AM	Cutter	3	0.4	1.7	7.9	ND
L-133	Hands	7:30 AM	Burner	6.1	0.5	2.8	9.3	ND
L-134	Hands	7:30 AM	Burner	5.8	0.64	2.3	9.1	0.9
L-135	Hands	7:30 AM	Cutter	5.7	1.1	7.3	14	ND
L-136	Hands	7:30 AM	Cutter	5.5	0.3	7	25	ND
L-137	Hands	7:30 AM	Burner	3.9	0.3	3.3	13	ND
L-138	Hands	9:05 AM	Cutter	18	2.2	13	66	2
L-139	Hands	9:05 AM	Cutter	4.1	0.3	5.9	18	ND
L-140	Hands	9:10 AM	Cutter	4.6	0.5	2.5	9.6	ND
L-141	Hands	9:10 AM	Cutter	8.3	0.85	8.3	24	2
L-142	Hands	9:10 AM	Cutter	9.8	1.3	9	73	1
L-143	Hands	9:15 AM	Cutter	2	0.2	3.4	12	1
L-144	Hands	9:20 AM	Burner	3.5	ND	1.9	4.2	ND
L-145	Hands	9:20 AM	Burner	3.5	0.3	1.6	8.9	ND
L-146	Hands	9:20 AM	Burner	12	0.6	12	42	ND
L-147	Hands	9:20 AM	Burner	6.9	0.3	1.5	9.6	ND
L-148	Door inside	11:25 AM		1	ND	3.3	4.7	ND
L-149	Door outside	11:25 AM		ND	ND	5.1	3.2	ND
L-150	Locker front	11:25 AM		4.2	ND	3.4	8.3	ND
L-151	Door front	11:25 AM		3.9	0.3	1.5	6.4	ND
L-152	Hands	11:35 AM	Cutter	6.9	0.3	8	30	ND
L-153	Hands	11:35 AM	Cutter	7.8	0.6	7.9	53	ND
L-154	Hands	11:35 AM	Cutter	10	0.66	8.6	31	ND
L-155	Hands	11:35 AM	Cutter	7.2	0.91	3.8	15	ND
L-156	Hands	11:35 AM	IH	2	1.8	0.9	4.6	ND
L-157	Blank	2:00 PM		ND	ND	0.5	0.6	ND
L-158	Blank	2:00 PM		ND	ND	ND	0.6	ND
L-159	Hands	2:05 PM	Burner	13	8.9	8.9	29	ND
L-160	Hands	2:05 PM	Burner	35	2.5	14	64	ND
L-161	Hands	2:07 PM	Burner	19	0.4	2.4	24	ND
L-162	Hands	2:07 PM	Burner	3	ND	3.3	7.3	ND
L-163	Hands	2:07 PM	Cutter	4.4	ND	6.3	15	ND
L-164	Hands	2:10 PM	Cutter	16	2.1	19	77	1
L-165	Hands	2:15 PM	Burner	3.5	0.3	6.8	26	ND
L-166	Table 1B	2:35 PM		31	ND	9.2	32	0.9
L-167	Table 2B	2:35 PM		9.6	0.3	3.9	13	ND
L-168	Table 2C	2:35 PM		13	0.5	4.7	15	1
L-169	Table 3F	2:39 PM		8.1	0.2	2.5	11	ND
L-170	Table 4B	2:39 PM		7.3	ND	2.5	9.4	0.8
L-171	Hands	3:50 PM	Burner	48	2.5	18	83	ND

Table 2 Metals Quantitative Wipe Sample Results OmniSource Corporation, Lima, Ohio HETA 2003-0367-2973 April 20–21, 2004								
Sample No.	**Sample Type**	**Time**	**Job Title**	**Concentration, micrograms per wipe sample**				
				Pb	**Cd**	**Ni**	**Cu**	**As**
L-172	Helmet inside	3:50 PM		47	ND	96	46	3
L-173	Helmet outside	3:50 PM		23	ND	15	15	1
L-174	Blank/sample dropped	3:50 PM		ND	ND	0.4	0.4	ND
L-175	Blank	3:50 PM		ND	ND	0.3	0.4	ND
L-176	Respirator	3:50 PM	Burner	12	ND	7.1	32	ND
L-177	Hands	4:05 PM	Burner	18	0.5	6.4	29	ND
L-178	Respirator	4:05 PM	Burner	19	0.4	9.8	21	0.9
L-179	Helmet	4:05 PM	Burner	170	ND	95	130	9.8
L-180	Helmet	4:05 PM	Burner	110	0.82	8.7	36	7.1
L-181	Hands	4:05 PM	Burner	29	1.8	3.9	33	ND
L-182	Hands	4:05 PM	Burner	29	14	37	54	2
L-183	Hands	4:05 PM	Cutter	7.6	0.87	8.7	26	ND
L-184	Hands	4:05 PM	Burner	37	13	25	71	1
L-185	Helmet inside	4:05 PM	Cutter	9.4	0.93	12	16	0.9
L-186	Hands	4:05 PM	Cutter	7.1	0.64	7.9	36	1
L-187	Helmet outside	4:05 PM	Cutter	2	0.3	3.7	5.9	ND
L-188	Helmet inside	4:05 PM	Cutter	26	1.9	41	48	3.4
L-189	Helmet outside	4:05 PM	Cutter	5.6	0.3	4.9	12	ND
L-190	Helmet inside	4:15 PM	Burner	440	6	47	410	5.7
L-191	Helmet outside	4:15 PM	Burner	170	3	16	120	2
L-192	Hands	4:15 PM	Cutter	8.8	0.66	7	26	ND
L-193	Helmet inside	4:15 PM	Cutter	96	2.7	56	110	8.6
L-194	Helmet outside	4:15 PM	Cutter	16	0.4	6.7	16	ND
L-195	Hands	4:15 PM	Cutter	11	1.2	4	17	ND
L-196	Helmet inside	4:15 PM	Cutter	34	1.1	17	26	1
L-197	Helmet outside	4:15 PM	Cutter	40	0.4	2.8	8.2	ND
L-198	Hands	4:15 PM	Cutter	15	1.6	19	50	1
L-199	Helmet inside	4:15 PM	Cutter	13	0.7	14	19	1
L-200	Helmet outside	4:15 PM	Cutter	17	0.69	13	22	0.9
Pb = lead Cd = cadmium Ni = nickel Cu = copper As = arsenic								

Table 3
Summary of Quantitative Wipe Samples Results for Elements
OmniSource Corporation, Lima, Ohio HETA 2003-0367-2973
April 20-21, 2004

Micrograms per sample					
	Lead	**Cadmium**	**Nickel**	**Copper**	**Arsenic**
Minimum	1	0.2	0.4	0.4	0.8
Maximum	760	160	110	1700	20
Average	35	2.5	11	46	1.1

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