HETA 87-262-1852
NOVEMBER 1987
ARTISTIC AWARDS
COLORADO SPRINGS, COLORADO

NIOSH INVESTIGATOR:
Steven A. Lee

I. SUMMARY

In April 1987, the National Institute for Occupational Safety and Health (NIOSH) received a request from Artistic Awards Co., Colorado Springs, Colorado for an evaluation of lead exposures among workers manufacturing lead medallions. The company requested the evaluation after one of the workers suffered from weakness and fatigue and was found to have an elevated blood lead level (43 ug/deciliter). The OSHA lead standard states that a blood lead level averaging 50 ug/dl or more represents excessive lead exposure and the affected employee must be removed from further exposure until the blood lead level is below 40 ug/dl.

The NIOSH investigator collected four personal breathing-zone air samples in May 1987, during the casting, engraving, grinding, and buffing of lead medallions. The performance of local exhaust ventilation (LEV) systems and respiratory protection was also evaluated. Air sampling was repeated by NIOSH in July 1987, following the renovation of metal-working LEV systems.

Air lead exposures during engraving and casting were 7.3 to 8.0 ug/M^3. Exposures during metal-working were 1300 to 1900 ug/M^3, due to the lack of local exhaust ventilation on grinding and buffing wheels. The OSHA permissible exposure limit is 50 ug/M^3. The use of half facepiece respirators with high efficiency particulate filters was required in the metal-working room, but, the respirator worn by the worker with the elevated blood lead level failed the qualitative fit-test during the NIOSH visit. The facepiece appeared to be too small to properly fit his face.

Local exhaust ventilation of the grinding and buffing wheels was found to be very effective during the NIOSH followup visit. Air lead exposures during the buffing and grinding of lead medallions was found to be below the sampling and analytical limit of detection (<6 mg/M^3).

The NIOSH investigator determined that a hazard from overexposure to airborne lead existed at Artistic Awards at the time of the initial visit. After the company developed effective engineering controls, however, the NIOSH investigator determined that the hazard did not exist at the time of the followup visit.

Keywords: SIC: 3499 (Fabricated metal products) inorganic lead, blood lead, respirators.

II. INTRODUCTION

In April 1987, the National Institute for Occupational Safety and Health (NIOSH) received a request from Artistic Awards Company, Colorado Springs, Colorado. The company requested an evaluation of lead exposures among workers manufacturing lead medallions after a private physician diagnosed one of the workers as having adverse health effects due to overexposure to lead.

On May 19, 1987, an evaluation of casting, engraving, grinding, and polishing processes was conducted by the use of personal breathing-zone air sampling and local exhaust ventilation (LEV) measurements. Qualitative respirator fit-testing was also conducted by the NIOSH investigator. At the end of the day, potentially serious problems with the metal-working LEV systems and the respirator fit of one worker were reported to the employer. Recommendations were made to repair the LEV systems and to keep one worker out of the metal-working room until he was properly fitted with a respirator. Copies of the OSHA Lead Standard 1910.1025 and the OSHA Respirator Protection Standard 1910.134 were provided to the employer.

Following their correction of ventilation systems, the company requested a followup evaluation from NIOSH, which was conducted on July 15, 1987.

III. BACKGROUND

This small family-owned business began production in January 1986, and currently employs three workers. The operation is housed in a single-level 1800 sq. ft. area that includes a 10 ft. x 12 ft. office and a 30 ft. x 20 ft. "clean area" for engraving, packing, and shipping. Grinding, buffing, and polishing operations are confined to one 8 ft. x 10 ft. room.

The process begins with the melting of lead or pewter ingots in a pot with automatic controls set to operate between 550° to 600° F. After casting, the sprue marks are ground from the medallions, which are then buffed and polished. The lead medallions are plated in 50-or 90-gallon plating tanks with brass, pewter, nickel, bronze, or copper. The plant is not yet operating at full capacity, so most operations only last a few hours each day.

In mid April 1987, one of the workers went to a private physician with symptoms of weakness and fatigue, and his blood lead concentration was found to be 43 ug/deciliter. Blood samples were then collected from the other two workers and were found to contain 24 and 25 ug lead/deciliter. Since the person with the highest blood lead worked in the "clean area" and did the least amount of buffing and grinding of the three workers, the physician and the company concluded that ingestion of lead caused by smoking, eating, and drinking in the work area was his major route of exposure.

IV. METHODS

On May 19, 1987, four personal breathing-zone (PBZ) air samples and one area air sample were collected by a NIOSH investigator during the engraving, casting, grinding, buffing, and polishing of lead medallions. The air samples were collected on mixed cellulose ester membrane filters using battery-powered sampling pumps operated at 1.8 liters per minute. Lead was analyzed by atomic absorption spectroscopy according to NIOSH method P & CAM 173.[1]

Qualitative respirator fit-testing with irritant smoke was conducted on each of the three workers during the May visit.

On July 15, 1987, two personal breathing-zone air samples were collected during 40 minutes of grinding and buffing lead medallions.

Ventilation measurements were taken on both visits using a Kurz Air Velocity Meter, model 441.

V. EVALUATION CRITERIA

A. Evaluation

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for 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 if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation 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 Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

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

B. Lead

Inhalation (breathing) of lead dust and fume is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion (swallowing) of lead dust deposited on food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. Absorbed lead can damage the kidneys, peripheral and central nervous systems, and the blood forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, mental deficiency, or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.

The blood lead test is the best available measure of recent lead absorption. Adults not exposed to lead at work usually have a blood lead concentration less than 30 ug/dl; the average is less than 15 ug/dl. Fetal damage in pregnant women may occur at blood lead levels as low as 25 ug/deciliter. Lead levels between 40-60 ug/deciliter in lead-exposed workers indicate excessive absorption of lead and may result in some adverse health effects. Levels of 60-100 ug/deciliter represent unacceptable elevations which may cause serious adverse health effects. Levels over 100 ug/deciliter are considered dangerous and often require hospitalization and medical treatment.

The occupational Safety and Health Administration (OSHA) standard for lead in air is 50 ug/M^3 calculated as an 8-hour time-weighted average for daily exposure[2]. The standard also dictates that workers with blood lead levels greater than 50 ug/deciliter must be immediately removed from further lead exposure and , in some circumstances, workers with lead levels of less than 50 ug/deciliter must also be removed. Removed workers have protection for wage, benefits, and seniority for up to 18 months until their blood levels decline to below 40 ug/deciliter and they can return to lead exposure areas.

VI. RESULTS AND DISCUSSION

Three full-shift PBZ air samples ranged from 7.3 to 1900 ug/M^3 (Table 1). The high exposure most likely was caused by short periods of buffing lead medallions, since a full-shift area sample taken in the clean room where this person spends most of his time showed that the air lead concentration was only 4.3 ug/M^3. A PBZ air sample collected on another worker for 25 minutes of grinding lead medallions found 1300 ug lead/M^3. The OSHA permissible exposure limit for lead is 50 ug/M^3 for an 8-hour shift.

The metal-working room had 4 stations of various grinding and buffing wheels, each fitted with well-enclosed LEV hoods of proper design.[3] However, the ductwork of one system was almost completely clogged with buffing-wheel material, and the ducts for the other three systems were disconnected inside the cabinets behind the wheels. Therefore, there was no ventilation for the high speed metal-working of lead medallions during the first NIOSH visit. The buffing wheel operates at a much higher speed than the other wheels, which probably results in the highest emissions of the smallest lead particles.

The use of Willson A R 700 half-facepiece respirators with high efficiency particulate filters was required before entering the metal-working room. The worker who had previously been found to have the elevated blood lead level was the only person whose respirator failed the qualitative fit test during the NIOSH visit. The facepiece appeared to

be too small to properly fit his face.

In early July 1987, the LEV hoods were hooked up to one central fan with each of the ducts ending in a large settling chamber for the collection of buffing and grinding materials. Standard procedures were developed for using only one wheel at a time while keeping the other LEV systems blocked in order to maximize the capture velocity of the LEV being used.
During the NIOSH followup visit in July, capture velocities for each of the LEV hoods were found to be at least 1000 fpm and smoke tube observations indicated their capture potential to be very good. Two PBZ air samples collected on one worker during 40 minutes of grinding and buffing lead medallions showed his air lead exposure to be below the sampling and analytical limit of detection (<6 ug/M^3).

VII. CONCLUSIONS

The adverse health effects from overexposure to lead in one worker was most likely caused by intermittent, short-term exposures to very high airborne lead concentrations while wearing a poorly fitted respirator. Ingestion of lead deposited on cigarettes, food, or drinks may have been a secondary source of exposure.

VIII. RECOMMENDATIONS

The installation of effective local exhaust ventilation in July 1987 reduced airborne lead exposures to the point that respiratory protection was no longer necessary under the conditions that existed at the time of the NIOSH followup visit. However, whenever there is a production, process, control, or personnel change that may result in new or additional exposure to lead, or whenever the employer has any other reason to suspect a change that may result in new or additional exposures to lead, additional monitoring should be conducted in accordance with OSHA 1910.1025. Until such monitoring can be conducted, properly fitted respirators should be used in accordance with OSHA 1910.134 to ensure that workers are not overexposed to lead.

No eating, drinking, or smoking should be allowed in work areas. Hands should be thoroughly washed before eating, drinking, or smoking.

IX. REFERENCES

1. National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Methods. 3rd ed. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1984. (DHHS (NIOSH) publication no. 84-100).

2. Occupational Safety and Health Administration. Occupational exposure to lead – final standard. Federal Register 1978 Nov. 14:53007.

3. American Conference of Governmental Industrial Hygienists, (ACGIH) industrial ventilation: a manual of recommended practice. ACGIH Committee on Industrial Ventilation: Lansing, Michigan, 1986.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:	Steven A. Lee, C.I.H. Industrial Hygienist NIOSH - Denver Region Denver, Colorado
Originating Office:	Hazard Evaluations and Technical Assistance Branch Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS)
Report Typed By:	Marile F. DiGiacomo Secretary NIOSH - Denver Region Denver, Colorado

XI. DISTRIBUTION AND AVAILABILITY

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1. Artistic Awards
2. U.S. Dept. of Labor/OSHA - Region VIII
3. NIOSH - Denver Region
4. Colorado State Health Dept.

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1

Air Lead Concentrations (ug/M^3)
Artistic Awards
Colorado Springs, Colorado
May 19, 1987

Job/Location	Sampling Time	Concentration
Manager, BZ*	900 - 1330	8.0
Casting, BZ	905 - 1450	7.3
Master Engraver, also buffed lead medallions for 30 minutes, BZ	903 - 1450	1900
Manger, grinding lead medallions, BZ	1416 - 1441	1300
Middle of "Clean Area", Area Sample	913 - 1450	4.3
OSHA Permissible Exposure Limit		50

*BZ = Personal breathing - zone sample