HETA 91-376-2154
OCTOBER 1991
U.S. CUSTOMS SERVICE
WORLD TRADE CENTER
NEW YORK, NEW YORK

NIOSH INVESTIGATOR:
Kevin P. McManus, C.I.H.

I. SUMMARY

On May 7, 1991, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation at the U.S. Customs Service firing range at the World Trade Center in New York City, New York. The request was concerned with the potential for lead and noise exposure to range officers and shooters.

On July 31, 1991, an industrial hygiene survey was conducted during the morning handgun qualifying session in the firing range. Each qualifying session consists of 60 rounds fired in 10-12 minutes by each of nine shooters. The qualifying session is preceded by a 50 round practice session. Personal breathing zone air sampling (using NIOSH Method 7082) on four shooters and the range officer measured lead exposures during the practice session and two subsequent qualifying rounds. Total time of exposure was 70 minutes. Shooters in the center booths (4 and 5) had lead exposure below the limit of detection of 7 micrograms per cubic meter (ug/m^3). Shooters in booths 1 and 6 were exposed to lead concentrations of 21 and 23 ug/m^3, respectively. The range officer, located about six feet behind the shooters, was exposed to 13 ug/m^3. These data (for the duration of the sampling period) indicated that all exposures within the firing range were below the Occupational Safety and Health Administration's (OSHA) 8-hour Permissible Exposure Limit (PEL) of 50 ug/m^3.

Noise measurements for intermittent peak noise levels were inconclusive; the noise monitoring equipment did not respond adequately to the impact noise levels. However, all employees wore double hearing protection consisting of ear insert plugs and ear muffs.

Based on the results of this survey, NIOSH has determined that a potential health hazard did not exist as a result of worker's exposure to inorganic lead. Recommendations are found in the body of this report to help insure that present controls remain functional in the future.

KEYWORDS: SIC 9221 (Police Protection), indoor firing ranges, lead, handguns.

II. INTRODUCTION

On May 7, 1991, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation at the U.S. Customs Service firing range at the World Trade Center, New York City, New York. The request was concerned with the potential for lead and noise exposure to range officers and users of the range.

An industrial hygiene survey was conducted by NIOSH on July 31, 1991.

III. BACKGROUND

The U.S. Customs Service firing range is located in the basement of the World Trade Center in New York City. The range consists of 9 shooting booths. The facility conducts two qualifying sessions per day and operates year round. Each qualifying session is preceded by a classroom safety lesson where weapons are inspected and repaired as necessary. There are some 2,000+ Customs inspectors who use this range for qualification. Each qualifying session consists of 60 rounds fired in 10-12 minutes by each of nine shooters. The qualifying session is preceded by a 50 round practice session. The typical firearm used during this survey was a .357 Magnum with .38 ammunition. The ammunition was copper-jacketed and used a lead staphynate primer.

The dimensions of the entire firing range are approximately 90 feet in length, 35 feet in width, and 8 feet in height. Behind the booths is the range officer's desk. Downrange is a bullet trap which consists of an angled steel plate which deflects bullets into a collection trough. Pans within the trough allow for easy removal and recycling of the spent bullets.

Air is exhausted from the firing range at two locations. The first system pulls air through slotted ceiling openings about 20 feet downrange from the shooting booths. The second exhaust system is located in the ceiling above the bullet trap. Exhaust air passes through a filtration system and is exhausted outside the building. Make-up air is drawn through perforated ceiling panels behind the shooters.

IV. EVALUATION DESIGN AND METHODS

The industrial hygiene survey consisted of personal breathing zone air sampling for lead, according to NIOSH Method 7082.[1] Air was sampled at a nominal flowrate of 1.9-2.2 liters per minute (LPM) using calibrated, battery powered sampling pumps. The sampling media was a cellulose ester membrane filter with a 0.8 micrometer (um) pore size. After collecting the samples, the filters were ashed with nitric acid,

diluted to 25 milliliters (ml), and analyzed by means of atomic absorption spectroscopy. The limit of detection (LOD) for this method is 2.0 micrograms (ug) of lead per sample.

Air sampling was performed continuously during the practice session and two subsequent qualifying sessions. Four shooters and the range officer were sampled.

V. EVALUATION CRITERIA

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 of workers may experience adverse health effects because of individual susceptibility, a pre-existing medical condition and/or by 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 considered for this study were: 1) NIOSH criteria documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and 3) the U.S. Department of Labor (OSHA) federal occupational health standards. Often, the NIOSH recommendations and ACGIH TLVs are lower than the corresponding OSHA standards. The OSHA standards 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 by the Occupational Safety and Health Act of 1970 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 8-10 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.

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, gastrointestinal tract, peripheral and central nervous systems, and the blood forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, constipation, anorexia, abdominal discomfort, colic, anemia, high blood pressure, kidney damage, mental deficiency, anxiety, depression, forgetfulness, and/or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.[2,3,4]

Lead has been shown to cause chronic kidney disease (nephropathy) in workers with a lengthy occupational exposure.[5] The process is gradual and dose related. Persons who experience the greatest lifetime risk of manifesting lead-induced kidney disease are those who have experienced the most lead absorption over their working career. The initial signs of lead nephropathy are subtle; affected workers will usually have no symptoms in the early stages. The workers' renal function test values may still be within the broad range of normal, although their test results will tend over time to move toward the high end of the normal range. Because the kidney has an enormous reserve capacity, results of renal function tests, e.g.; blood urea nitrogen (BUN), serum creatinine, and serum uric acid, will not be abnormal until one-third to one-half of kidney function has been compromised.[6] For that reason, more sensitive screening tests of kidney function have been sought. These include serum measurement of 1,2,5-dihydroxy vitamin D, which may decrease in persons with lead induced kidney damage.[7] Other abnormalities which may also be noted in chronic lead nephropathy include aminoaciduria, renal glycosuria, and hypercalcuria. Gout is a particularly noteworthy manifestation of lead nephropathy[8]; the elevated serum uric acid concentrations which may occur in lead nephropathy have been associated with the development of gouty arthritis.

The OSHA PEL for lead in air is 50 ug/m^3 calculated as an 8-hour TWA for daily exposure.[9] This regulation also requires semi-annual blood lead monitoring of employees exposed to 30 ug/m^3 or greater of lead.[9] Employees whose blood lead level is 40 ug/dl or greater must be retested every two months, and be removed from lead exposure if their

average blood lead level is 50 ug/dl or more over a six-month period. A blood lead level of 60 ug/dl or greater, confirmed by retesting within two weeks, is an indication for immediate medical removal. Workers on medical removal should not be returned to a lead-exposed job until their blood lead level is confirmed to be below 40 ug/dl.[9] Removed workers have protection for wage, benefits, and seniority for up to 18 months until their blood levels decline to below 40 ug/dl and they can return to lead exposure areas.

VI. RESULTS AND DISCUSSION

The results from the personal breathing zone air sampling are shown in Table 1. Total time of exposure was 70 minutes. Shooters in the center booths (4 and 5) had lead exposure below the limit of detection of 7 micrograms per cubic meter (ug/m^3). Shooters in booths 1 and 6 were exposed to lead concentrations of 21 and 23 ug/m^3, respectively, for the qualifying period. The range officer, located about six feet behind the shooters, was exposed to 13 ug/m^3. Assuming that the Customs inspectors have zero lead exposure when not using the firing range, 8-hour TWA exposures for all employees sampled were below 3 ug/m^3. These data indicated that all exposures within the firing range were below the Occupational Safety and Health Administration's (OSHA) permissible exposure limit (PEL) of 50 ug/m^3. These results also indicate that the ventilation system is operating effectively.

VII. CONCLUSIONS

Based on the results of this investigation NIOSH has determined that a health hazard did not exist at the time of this study due to exposure to lead.

VIII. RECOMMENDATIONS

1. It is recommended that the Customs Service develop a formal check system where someone in the Customs Service, preferably the range officer, is responsible for assuring that the fans and filters are maintained. This maintenance should include leak testing whenever new HEPA filters are installed. This person should receive a copy of the ventilation system's maintenance manual, and dated reports from GSA describing what work was performed on the system, and ensure that GSA workers follow a pre-described maintenance schedule.

2. Industrial hygiene sampling, using a protocol similar to that used during this industrial hygiene survey, should be performed on an annual basis. This sampling protocol will provide a yearly test of the ventilation system's ability to protect the shooters and range officers from exposure to lead.

IX. REFERENCES

1. National Institute for Occupational Safety and Health: Manual of Analytical Methods, Third Edition, Volumes 1 & 2. Cincinnati, Ohio: U.S. Department of Health and Human Services, NIOSH, 1984.

2. Hernberg S, Dodson WN, Zenz C: Lead and its Compounds. In Occupational Medicine. 2nd Edition, Chicago: Yearbook Medical Publishers, pp. 547-582, 1988.

3. Landrigan PJ, Froines JR, Mahaffey KR: Body lead burden: summary of epidemiological data on its relation to environmental sources and toxic effects. In Dietary and Environmental Lead: Human Health Effects. Amsterdam: Elsevier Science Publishers, 1985.

4. Proctor NH, Hughes JP, Fischman ML: Lead. In Chemical Hazards of the Workplace. Second Edition, Philaselphia: JB Lippincott Company, pp. 294-298, 1988.

5. Wedeen RP, Maesaica JK, Weiner B, et al: Occupational Lead Nephropathy. Americal Journal of Medicine 59:630. 1975.

6. Page LB, Culver PJ: A syllabus of laboratory examinations in clinical diagnosis. Cambridge: Harvard University Press. 1962.

7. Rosen JF, Chesney R, Hamstra A, DeLuca H, Mahaffey K: Reduction in 1,25-dihydroxyvitamin D in children with increased lead absorption. New England Journal of Medicine 302:1128-31. 1980.

8. Ball GV, Sorensen LB: Pathogenesis of hyperuricemia in saturnine gout. New England Journal of Medicine 280:119. 1969.

9. Occupational Safety and Health Administration: Occupational exposure to LEAD--final standard, 29 CFR Part 1910.1025. Federal Register: 53007. November 14, 1978.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS:

Report written by:

Kevin P. McManus, CIH
Regional Industrial Hygienist
NIOSH - Boston Office

Originating Office:

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report may be freely reproduced and are not copyrighted. Single copies of this report will be available for a period of 90 days from the date of this report from the NIOSH Publications Office, 4676 Columbia Parkway, Cincinnati, Ohio 45226. To expedite your request, include a self-address mailing label along with your written request. After this time, copies may be purchased from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161. Information regarding NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. Safety Officer, U.S. Customs Service
2. Range Officer, U.S. Customs Service
3. OSHA, Region 1
4. NTEU

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.

TA BLE 1
U.S. Customs Service Firing Range
World Trade Center
New York, New York
July 31, 1991

Location	Time(min)	Volume(L)	Lead Concentration (ug/m^3)
Range Officer	70	154	13
Booth 1	70	140	21
Booth 4	70	154	7
Booth 5	70	147	7
Booth 6	70	133	23
Criteria (OSHA)			50