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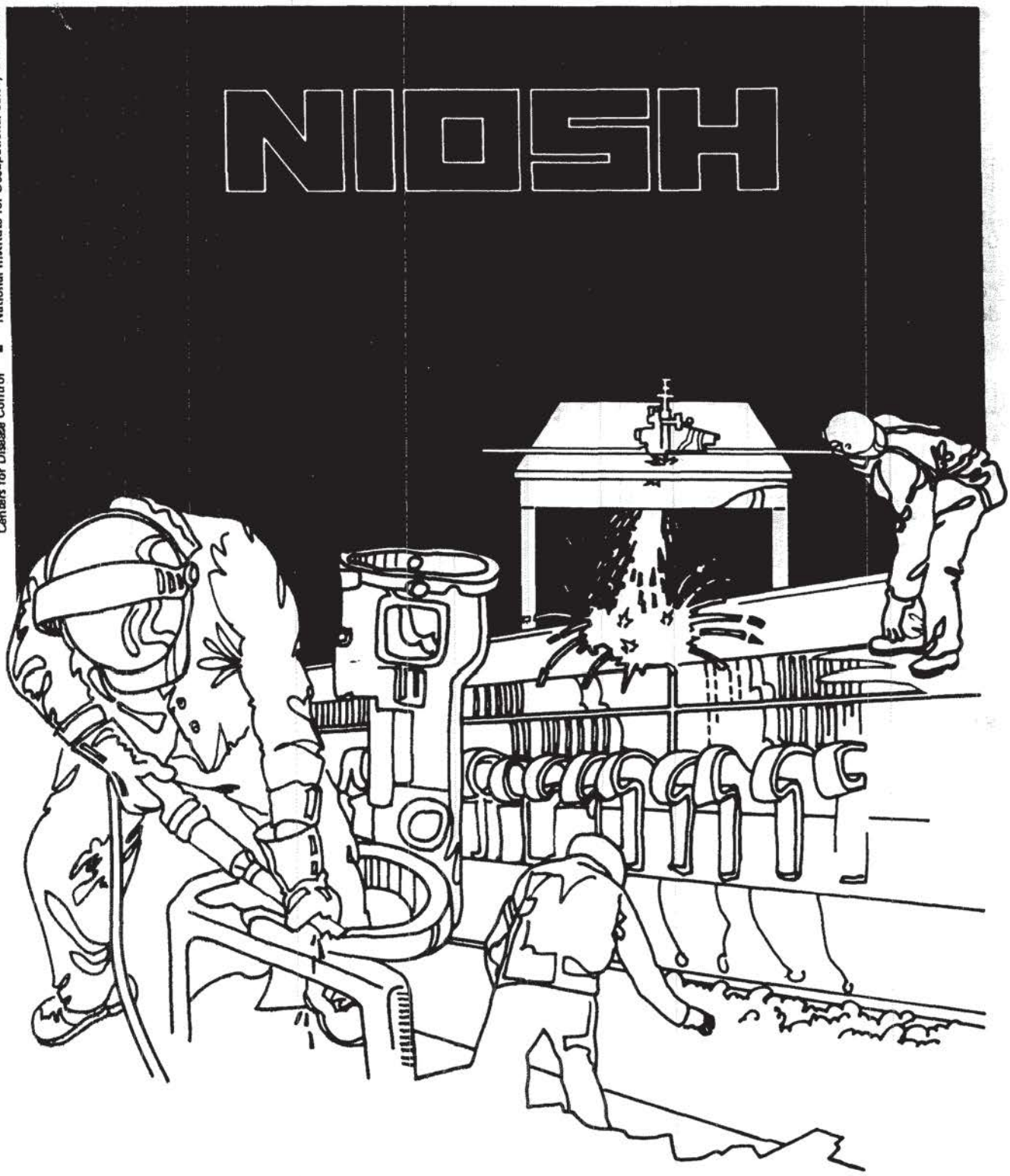

Health Hazard Evaluation Report

HETA 81-303-947
OMAHA BRANCH
FEDERAL RESERVE BANK OF KANSAS CITY
OMAHA, NEBRASKA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer 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.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) 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.

HETA 81-303-947
September 1981
Omaha Branch
Federal Reserve Bank of Kansas City
Omaha, Nebraska

NIOSH INVESTIGATOR:
Ralph J. Bicknell, RPC

I. SUMMARY

On May 4, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Omaha Federal Reserve Bank to evaluate the lead exposure in the indoor firing range located at the bank. This firing range had been evaluated previously in 1974.

On June 30 and July 1, 1981, the NIOSH Investigator collected environmental samples at the range to determine airborne lead concentrations. A total of five personal breathing zone and five general area samples were collected. All of the area samples and four of the five personal samples contained lead above the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) current 8-hour time weighted average of 50 micrograms per cubic meter ug/M^3 and ranged from 60-290 ug/M^3.

Based on results of environmental samples obtained during this evaluation, NIOSH determined that a hazard of occupational exposure to lead exists at the Omaha Federal Reserve Bank indoor firing range.

Recommendations relating to medical surveillance and general operating procedures at the range are shown on pages 6 and 7.

KEYWORDS: SIC 9221 Police Protection - firing range, lead, ventilation.

II. INTRODUCTION

Law enforcement agencies, some private security agencies, and many banks are requiring that their personnel achieve greater accuracy and proficiency in the use of hand guns. This requirement has resulted in the greater use of existing ranges and the construction of new ranges.

Indoor ranges are advantageous from the standpoint of protection from the weather, control of the environment, and use of the facility around the clock. However, many older facilities and even some newer ranges present a health hazard in the form of lead poisoning due to improper ventilation control.

On May 4, 1981, NIOSH received a request to evaluate potential lead exposures to persons using the firing range at the Omaha Federal Reserve Bank.

III. BACKGROUND

The indoor firing range at the Federal Reserve Bank in Omaha, Nebraska, is a small two-booth facility used only by the security guards at the Bank.

The range is 10'6" wide. It is 15' from the backwall to the firing line and is approximately 63' from the firing line to the bullet trap. There is a large portable fan located on the backwall to blow air directly across the shooters. The air supply duct is located on the ceiling. It is 5' from the wall and 9'6" from the floor. Because the range is so small, there is no control booth for the range officer. He stands 3' to 6' behind the shooter.

There is one permanent range officer. He is on the range a minimum of 6 days a month. The usual sequence is to handle four shooters a day, one at a time, with two shooters firing in the morning and two shooters firing in the afternoon.

The normal qualifying sequence begins with six rounds rapid fire from a standing position. The weapon is reloaded and six more rounds are fired from a kneeling position. The target is then brought back up by the automatic target setter and scored. Six more rounds are fired slow fire from behind the barrier and finally six rounds slow fire are fired from a standing position. The target is checked once more. The weapon is cleaned and the sequence is terminated. The total time for the sequence is never more than 20-25 minutes and may be as short as 15 minutes. On July 1, 1981, the sequence averaged 11 minutes. This was due to the fact that only one revolver was used by all the shooters.

The ammunition was 148 grain lead wadcutter 38 special reloads from the 3D Company.

The survey performed on this range in 1974 by NIOSH resulted in several recommendations which have been acted upon. They are as follows:

a. The installation of an automatic target setter.

b. The installation of a new bullet trap which eliminated cleaning and reclaiming lead in the bullet trap area and eliminated the need for a respirator.

c. Installation of half doors which were designed to reduce the area and increase the cross sectional ventilation thru the booths. These are not always closed as at least one section of the qualifications sequence requires that a minimum of six shots be fired from the kneeling position.

IV. EVALUATION METHOD

Breathing-zone samples and general area air samples were collected by using Mine Safety Applicance, Model G battery operated pumps with Millipore 5 micron polyvinyl chloride filter at a sampling rate of 2.0 liters per minute.

The samples were analyzed for lead in accordance with NIOSH atomic absorption procedure, Physical and Chemical Analysis Branch Method #S-341. The limit of detection was one microgram of lead per sample.

A KurZ Portable Air Velocity Meter, Model 440 Thermal Anemometer and and Alnor Jr. swinging vane anemometer were used to measure air velocities at various locations within the firing range.

V. EVALUATION CRITERIA

A. Environmental Standards or Criteria

The current U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) standard for employee exposure to airborne lead permits a time-weighted-average exposure of 0.05 milligrams of lead per cubic meter of air (mg/M^3) sampled. This is the same as 50 micrograms per cubic meter (ug/M^3).

B. Biological Monitoring Requirements

The OSHA standard requires that the employer institute a medical surveillance program for all employees who are exposed to an airborne concentration of more than 30 micrograms per cubic meter (ug/M^3) of lead for more than 30 days a year.

Biological monitoring shall consist of blood sampling and analysis for lead and zinc protoporphyrins and shall be provided for each exposed

employee at least every 6 months. It shall be provided at least every 2 months for every employee who has a blood level at or above 40 micrograms per 100 grams (ug/100g) of whole blood. This frequency shall continue until two consecutive blood samples indicate a blood level below 40 ug/100g of whole blood.

An employer shall remove an employee from his job when the employee's blood level exceeds 60 ug/100g of whole blood. A second follow-up shall be provided within 2 weeks after the employee receives the first results. The employee shall return to his former job status when two consecutive blood sampling tests are at or below 40 ug/100g of whole blood.

C. Toxic/Health Effects

Lead has been found to have profound adverse effects on the health of workers in the lead industry. Inhalation, the most important source of lead intake, and ingestion result in damage to the nervous, urinary and reproductive systems. The adverse health effects associated with exposure to lead range from acute, relatively mild, perhaps reversible stages such as inhibition of enzyme activity, reduction in motor nerve conduction velocity, behavorial changes, and mild central nervous system (CNS) symptoms, to permanent damage to the body and chronic disease.

The signs and symptoms of severe lead intoxication which occur at blood lead levels of 80 micrograms per 100 grams (ug/g) and above are well documented. The symptoms of severe lead intoxication include loss of appetite, metallic taste in the mouth, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pains, fine tremors, numbness, dizziness, hyperactivity, and colic. In lead colic, there may be severe abdominal pain, such that abdominal surgery mistakenly has occasionally been performed.

Evidence accumulated in both adults and children indicates that toxic effects of lead have both central and peripheral nervous system manifestations. The effects of lead on the nervous system range from acute intoxication, coma and cardiorespiratory arrest to mild symptoms, subtle behavorial changes, and electrophysiologic changes associated with lower level exposures.

With respect to the renal system, it is apparent that kidney disease from exposure to lead is more prevelant than previously believed. The hazard here is compounded by the fact that routine screening is ineffective in early diagnosis. Renal disease may be detected through routine screening only after about two-thirds of kidney function is lost or when manifestation of symptoms of renal failure are present.

Over-exposure to lead has profoundly adverse effects on the course of reproduction in both males and females. In the case of male workers, there is evidence of decreased sexual drive, impotence, decreased ability to produce healthy sperm, and sterility.

VI. EVALUATION OF RESULTS AND DISCUSSION

A. Lead Survey

Air sampling results appearing in Table 1 indicate that lead exposures for three of the four shooters firing hand guns and for the range master were excessive. Assuming that exposure for the remainder of the day (period not sampled) is zero, the 8-hour time-weighted-averages (TWA) were 45 ug/M^3 to 190 ug/M^3 with only one shooter at 45 ug/M^3 and all the rest exceeding 50 ug/M^3. Fortunately, the shooters exposure occurs only once a month and usually is no longer than 15-20 minutes.

The rangemaster's exposure is 190 ug/M^3 as an 8-hour TWA, and he does this at a minimum of 6 days a month.

Four areas environmental lead samples were taken at the firing line. A-1 was taken on the left side of the range 6' high and A-2 was in the same location 3' high. These samples were collected almost directly under the exhaust vent which is 11' high and located on the left side of the range at the firing line. The levels here were the highest of the samples taken and were 240 and 290 ug/M^3 respectively. A-3 was taken in the center of the range 5' high and was 190 ug/M^3. A-4 was on the right side of the range 5' high and this concentration was 160 ug/M^3. The purpose of taking these four samples on the line was (a) to evaluate the concentration of lead on the firing line and (b) to see if the concentration of lead increased along the line toward the exhaust duct. The results indicate that the exposure is high and it increases with proximity to the duct. A-5 was taken approximately 6' to the rear of the firing line and was approximately 5' from the floor. This is the general area in which the range officer stands and showed a concentration of 120 ug/M^3. These samples were analyzed for total particulate dust and all contained less than five percent of the environmental criteria of 10 mg/M^3 for total nuisance dust. All area samples were calculated on the basis of an 8-hour TWA.

B. Ventilation Survey

The supply duct is located approximately 10' behind the firing line and is 9'5" from the bottom of the duct to the floor. It supplies 1200 cubic feet per minute (cfm). There is a large fan located against the wall 15' from the firing line and 6' from the floor and is 3' from a door at the rear of the range. This door is always closed so the fan per se is not part of the air supply system but rather is primarily used to blow air across the shooters.

The Air Exhaust System consists of two ducts located on the left sidewall of the range as you look down range. One duct is located at the firing line and is 11' from the floor. The second duct is located 52' down range from the firing line and is also located 11' off the floor. The total exhaust is 1000 cfm.

Air flow measurements were made at both firing positions at 1', 3', 5', and 7' and with the 3' panels closed at 3 1/2', and 7'. However, the perturbations with both instruments were so severe as to make the readings meaningless (i.e., ranging from 20-80 linear feet per minute (lfpm)).

The air flow was measured 5' in front of the firing line at 1', 3', 5', and 7' directly under the automatic target setters for both stations. The air flow was 20 lfpm at 1' and 3' and 30 lfpm at 5' and 7' at both areas.

The air flow measured 50' downrange at exactly the same locations and showed a maximum air flow of 10 lfpm.

Smoke tubes showed large eddy currents with much turbulence and with some air movement back through the firing line.

VII. RECOMMENDATIONS

A. In the NIOSH report of 1974, the recommendation was made to retain the existing system of dividing the range officer's duties between three individuals. Since that time, this sytem has been eliminated and there is only one range office. It is recommended that the old system of dividing the duties between three individuals be reinstituted.

B. Air Supply

1. The present air supply is 1200 cfm.

2. The recommended air flow is a minimum of 50 linear feet per minute and a desired air flow of 75 linear feet per minute across the shooter.

Air Supply at 50 lfpm
with half doors open = 3750 cfm
" " " closed = 2100 cfm

Air Supply at 75 lfpm
with half doors open = 5625 cfm
" " " closed = 3150 cfm

It is recommended that the air supply be increased. A portion of the qualification requirements is that six rounds be fired from a kneeling position. Therefore, it is recommended that the figures given with the half door open be used in engineering redesign. These are an air supply of 3750 cfm at a flow of 50 lfpm and a supply of 5625 cfm with 75 lfpm. The linear air flow should be equal at all heights, that is it should be 75 lfpm at 1', 3', 5', and 7' at both stations.

C. Air Exhaust

1. The present air exhaust is 1000 cfm.

2. The present air exhaust vent is right at the firing line and on the left hand wall. This is one of the main reasons for turbulence at the firing line. The exhaust should be closed and the air exhaust system redesigned. It is preferable to exhaust a portion of the air at ceiling height 10' to 20' downrange from the shooting booths. The exhaust grills should extend across the width of the range for best results. The remaining portions should be exhausted at the target end of the range, preferably behind the bullet trap. The configuration which seems to give the best results is one which exhausts 20-40 percent of the air at the grills in front of the shooters and 60-80 percent at the bullet trap.

3. It is recommended that the total amount of air exhausted from the firing range exceed the amount of air supplied to the range by 10 percent. This will ensure that the range is at a lower pressure than surrounding areas of the bulding, so that fumes generated in the range will not escape to other parts of the building.

D. It is recommended that the range officer be started on a program of biological monitoring to ascertain what are his current blood lead levels and to determine whether they exceed the current OSHA standard.

VIII. REFERENCES

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by and Evaluation Conducted by:

Ralph J. Bicknell
Regional Program Consultant
NIOSH,Region VII
Kansas City, Missouri

Originating Office:

Hazard Evaluations and Techncial Assistance Branch
Division of Surveillance, Hazards Evaluations, and Field Studies
NIOSH, Cincinnati, Ohio

Laboratory Analysis: Utah Biomedical Test Laboratory
Salt Lake City, Utah

Report Typed By: Donna Small
Staff Assistant
NIOSH, Region VII
Kansas City, Missouri

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Copies of this report have been sent to:

1. Federal Reserve Bank of Kansas City, Omaha, Nebraska
2. NIOSH Region VII
3. Department of Health - Nebraska
4. OSHA - Region VII

Table 1

Lead Survey
Omaha Branch
Federal Reserve Bank of Kansas City
Omaha, Nebraska

Sample Number	Type of Sample*	Location	Sampling Period	Measured Concentration (mg/M^3)**	8-hr. TWA Concentration (mg/M^3)***
A-1	A	P-1 Left Side Firing Line 6' High	0818-0932	1.55	0.24
A-2	A	P-1 Left Side Firing Line 3' High	0818-0932	1.89	0.29
A-3	A	Center Range Firing Line 5' High	0818-0932	1.22	0.19
A-4	A	P-2 rt. Side Firing Line 5' High	0818-0932	1.01	0.16
A-5	A	6' Behind Firing Line 5' High	0818-0935	.81	0.12
P-1	P	Range Officer	0818-0935	1.17	0.19
P-2	P	Shooter #1	0818-0828	5.00	0.11
P-3	P	Shooter #2	0840-0851	2.00	0.045
P-4	P	Shooter #3	0859-0910	3.00	0.07
P-5	P	Shooter #4	0920-0931	2.73	0.06
U.S. Department of Labor Standard					0.05

* A=Area, P=Personal
** mg/M^3=milligrams of lead per cubic meter of air sampled
***TWA=time-weighted-average concentration

Note: In calculating the 8-hour TWA concentration(s) for the firing range, consideration was given to the actual exposure time of the personnel on the range. For example, an individual receiving a measured exposure of 2 milligrams of lead per cubic meter of air sampled (mg/M^3) during an 11 minute period would receive an actual 8-hour time weighted average exposure of 2 milligrams per cubic meter x (0.18 hr/8hr) or .045 mg/M^3. In order for this approach to be valid, it is assumed that the applicable person leaves the area following completion of the firing period and does not return to the range area during the remainder of the 8-hour "workday." Should the range officer's duties require that he be on the range for the majority of the day (i.e., morning and afternoon firings), the "measured" concentration level would, in essence. represent his/her 8-hour TWA exposure.

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