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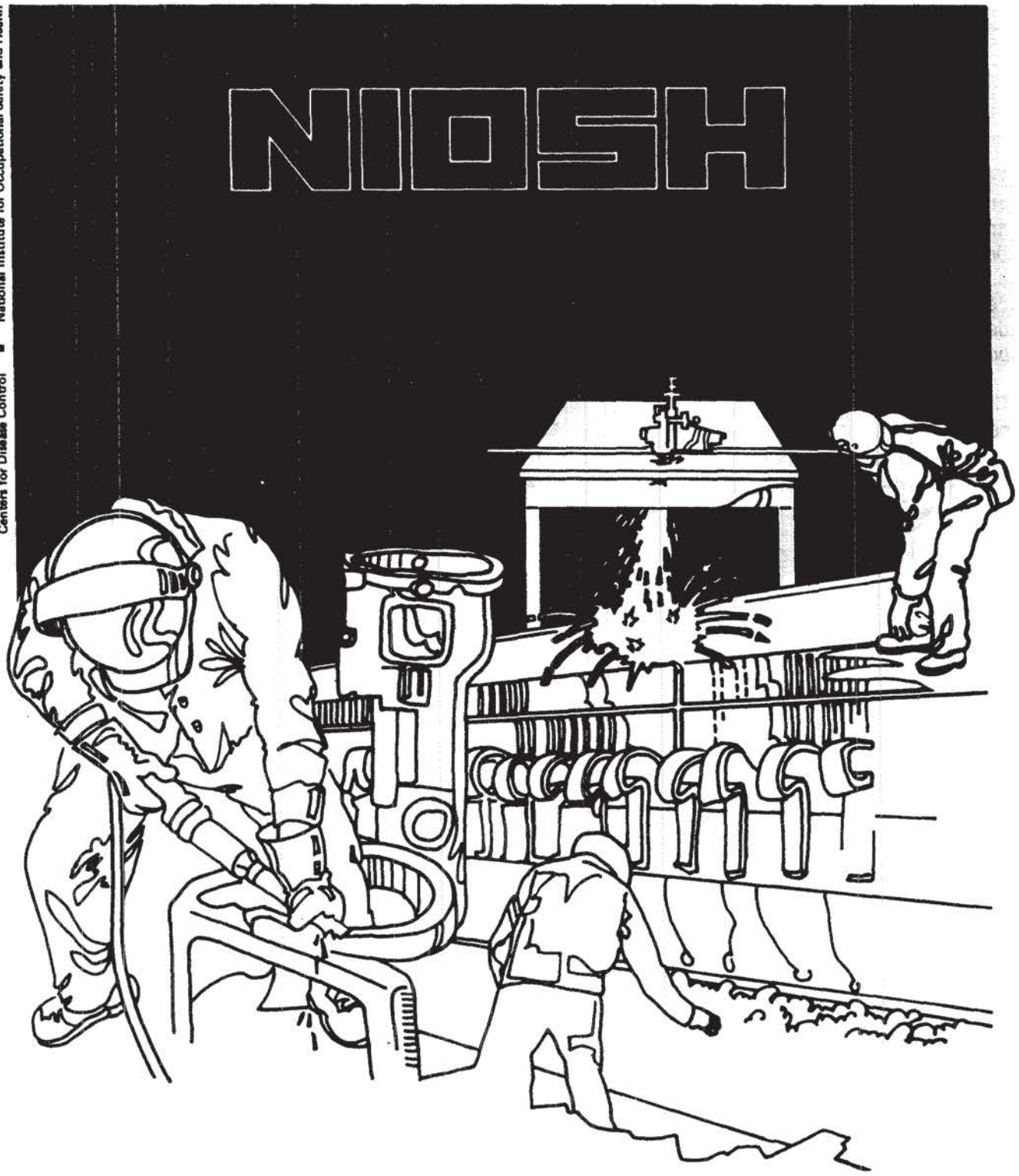

Health Hazard Evaluation Report

HETA 82-380-1219
FIRING RANGE - U.S. COURT HOUSE
KANSAS CITY, MISSOURI

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 82-380-1219
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Firing Range - U. S. Court House
Kansas City, Missouri

NIOSH INVESTIGATOR:
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I. SUMMARY

In August of 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from the General Services Administration to evaluate lead exposure in the indoor firing range located in the U. S. Court House at 811 Grand, Kansas City, Missouri.

On September 10, 1982 the NIOSH Investigator collected environmental samples at the range to determine airborne lead concentrations. A total of 14 samples were collected. These consisted of nine area samples and five personal samples. Six of the nine area samples and one of the personal samples exceeded the U. S. Department of Labor, Occupational Safety and Health Administration (OSHA) current 8-hour time weighted average of 50 micrograms per cubic meter. The area samples ranged from 90 to 488 ug/M^3. The one personal sample above the standard was 79.5 ug/M^3.

Based on results of environmental samples obtained during the evaluation, NIOSH determined that a possible hazard of occupational exposure to lead could exist if the range is used repeatedly by the same officers.

Recommendations relating to medical surveillance, ventilation, material substitutions, respiratory protection and general operating procedures at the range are presented in Section 7 of the report.

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.

In August of 1982 NIOSH received a request from the General Services Administration, Kansas City, Missouri, to evaluate potential lead exposure to people using the indoor firing range at the U. S. Court House, 811 Grand.

III. BACKGROUND

The indoor firing range at the U. S. Court House is an old firing range which was modernized in 1979. In February 1980 the NIOSH Regional Office was requested by GSA to evaluate the firing range. The ventilation system was evaluated first and was found to be inadequate both in design and in air supply and exhaust requirements. Several recommendations were made to assist GSA with the correction of the problem. After several modifications to the system, NIOSH was again asked to evaluate the firing range in August of 1982.

There are four firing stations on the range. Each station is 3 feet 7 inches wide and seven feet high. It is approximately 70 feet from the firing line to the bullet trap and 14 feet from the firing line to the control room. There is a door behind booth 4 which leads to a short hall and into a small room. The room has a hand wash area and a small room with a door to the outside hall and one to the control room.

The ventilation system consists of a long supply duct which enters from a rear wall behind position one of the range and runs for eight feet to the rear of position three. The duct is eight feet high and 14 feet behind the firing line and butts up against the control room wall and also supplies air into the control room. There are two exhaust ducts in the ceiling. The first one is four feet six inches in front of the firing line and the second is 58 feet 8 inches down range from the firing line.

There is a permanent range officer assigned to this range and he is responsible for all range use. The range officer supplied to the NIOSH Investigator a chart of the rounds fired, time on range, and type of ammunition. The chart covered from January 1, 1982 through August 31, 1982. The range is used by several Federal agencies for weapons qualification. The qualification schedules vary from agency to agency. For the Federal Protective Agency, it is twice a year. Other agencies may require quarterly qualification, etc. The total time that the range was used for firing in this period was 41.4 hours.

In the conduct of this study, the Federal Protective Agency people were asked to shoot for approximately one hour. They shot for 65 minutes and fired 120 rounds of 158 grain wadcutter and six rounds of Copper Jacketed Hollow Point (JHP).

It is interesting to note that in the eight month period prior to the evaluation, Jacketed Hollow Point 110 grain ammunition was used 56 percent of the time and the 158 grain wadcutter was used the other 44 percent.

IV. EVALUATION METHOD

Breathing-zone samples and general area air samples were collected by using Mine Safety Appliance, Model G battery operated pumps with 37 mm mixed Cellulose Ester Filters in three piece cassettes at a sampling rate ranging from 1.5 to 2.1 liters per minute. Respirable samples were collected using a 10 mm nylon cyclone operating at 1.7 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 four micrograms of lead per sample.

A Kurz Portable Air Velocity Meter, Model 440 Thermal Anemometer and an 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, behavioral 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 behavioral changes, and electrophysiologic changes associated with lower level exposures. In fact, these effects can occur at blood lead levels of less than 80 micrograms.

With respect to the renal system, it is apparent that kidney disease from exposure to lead is more prevalent 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 and the range officer were not excessive. The assumption was made that exposures for the remainder of the day (period not sampled) were zero. The 8-hour time weighted average (TWA) ranged from N.D. (less than 4 ug/filter, the limit of detection) to 36.5 ug/M^3 . One shooter had an exposure of 79.5 ug/M^3, exceeding the current OSHA standard of 50 ug/M^3.

Six area environmental lead samples were taken at the firing line. The firing booths were numbered one through four going from left to right as you stand at the rear and look down range. A sample was taken at each booth and a respirable sample was taken at booths two and three and was placed next to the standard cassette and filter. The height of the filter varied between 60 to 72 inches. Additional area samples were taken at the rear of the firing line in front of the control room, in the control room and behind the control room. The only area samples that were positive were the ones on the firing line. The 8-hour TWA for the firing line varied from 90.3 to 488 ug/M^3. The highest environmental samples were at booth three, just as the highest personal sample was the shooter at booth three. At booth two the respirable sample was 65% of the total sample. At booth three the respirable sample was 70% of the total sample.

B. Ventilation Survey

The air supply consists of one long duct with four vents directed toward the firing line and one vent going into the control room.

The air supply for the firing line was calculated to be 5,076 cfm. The supply required for a 50 fpm across the point is 5110 cfm.

The air exhaust system consists of two six foot long one foot wide ducts located side-by-side in the ceiling four feet six inches in front of the firing line. Approximately 4,100 cfm of the air is exhausted through this exhaust. There is a second exhaust duct 58 feet 8 inches down range from the firing range. This duct is 12 feet long four inches wide and exhaust 1,172 cfm per minute. The total exhaust air is 5,272 cfm.

Air flow measurements were made at all four firing stations at 1', 3', 5' and 7'. All readings but one were above the 50 linear feet recommendation. Severe fluctuation in the supply made these readings mostly approximations.

The range officer installed a plexiglass shield over the firing line to protect the automatic target setter mechanism. This diverted much of the supply downward and across the line.

Air flow was checked 20 and 30 feet down range. The air flow was minimal and therefore was not recorded.

VII. RECOMMENDATIONS

A. Ventilation

The ventilation at the range appears close to being adequate. However, there are several recommendations that will be made to improve the supply. The supply does not appear to be consistent; rather, it is a pulsed supply running for a few seconds then stopping and then running again. The air supply does not appear to be equally distributed across the range especially at booth 3. It is recommended that the supply be adjusted to give continuous even flow across the range and the diffuser be adjusted to give a better pattern of flow across booth 3.

B. Substitution

An approach which has been used in other ranges is the elimination or isolation of the major source of emission - the lead bullet. The bullet contains a lead slug plus a primer which contains lead styphnate and lead peroxide. Substituting copper jacketed, nylon jacketed or zinc slugs has been shown to give significant reduction in lead emission when compared with traditional lead target ammunition. There will still be some lead generated from the primer. Of the rounds fired from January through August 1982, 56 percent were Jacketed Hollow Point and 44 percent were 158

grain wadcutter. This survey was done with the shooters shooting only 6 rounds out of 126 using Jacketed Hollow Point. A survey performed when Jacketed Hollow Point ammunition is being used would serve to give a true picture of the actual lead exposure to the personnel. It is interesting to note that at booth 2 the respirable sample is 65 percent of the total lead sampled. In booth 3 the respirable sample was 70 percent of the total lead sampled.

C. Biological Monitoring

It is a current recommendation to most firing ranges that the range officer be started on a program of biological monitoring to ascertain what their current blood lead levels are and to determine whether they exceed the current OSHA standard. In this particular instance the range officer was in the control room and showed exposure below the limit of detectability on his personal sample. However, because the range officer may be on the range at other times, when airborne lead is present, it would be prudent to start this officer on a program of biological monitoring.

VIII. REFERENCES

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY

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Copies of this report have been sent to:

1. General Services Administration, Kansas City, Missouri
2. NIOSH Region VII
3. OSHA Region VII

Table 1

Lead Survey
Firing Range - U. S. Court House
811 Grand, Kansas City, MO

Sample Number	Type of Sample*	Location	Sampling Period	Measured Concentration (ug/M^3)**	8-hr. TWA Concentration (ug/M^3)***
USCH 6	Area	Booth 1	9:55-11:00 AM	714.3	96.7
USCH 15	Area	Booth 2 1/	9:55-11:00 AM	666.7	90.3
USCH 7	Area	Booth 2	9:55-11:00 AM	1021.9	138.4
USCH 16	Area	Booth 3 1/	9:55-11:00 AM	2522.5	341
USCH 14	Area	Booth 3	9:55-11:00 AM	3603.6	488
USCH 13	Area	Booth 4	9:55-11:00 AM	2449	332
USCH 13	Area	Control Rm.	9:55-11:00 AM	N/D	
USCH 2	Area	Rear of Firing Line in Front of Control Rm.	9:55-11:00 AM	N/D	
USCH 9	Area	Behind Control Rm.	9:55-11:00 AM	N/D	
USCH 5	BZ*	Shooter 1	9:55-11:00 AM	255	34.5
USCH 4	BZ*	Shooter 2	9:55-11:00 AM	256	34.6
USCH 12	BZ*	Shooter 3	9:55-11:00 AM	587	79.5
USCH 11	BZ*	Shooter 4	9:55-11:00 AM	270	36.5
USCH 8	BZ*	Range Officer	9:55-11:00 AM	N/D	
U. S. Department of Labor Standard					50

* BZ = Personal Breathing Zone Sample
** ug/M^3 = micrograms of lead per cubic meter of air sampled
*** TWA = Time-weighted average concentration
**** N/D = Less than 4 ug/filter, the limit of detection
1/ = Respirable

NOTE: In calculating the 8-hour TWA concentration(s) for the firing range, consideration was given to actual exposure time of the personnel on the range. For example, an individual receiving a measured exposure of 587 micrograms of lead per cubic meter of air sampled (ug/M^3) during a sixty-five (65) minute period would receive an actual 8-hr. time weighted exposure of 79.5 ug/M^3 (587 ug/M^3 x 65 minutes/480 minutes). 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.

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