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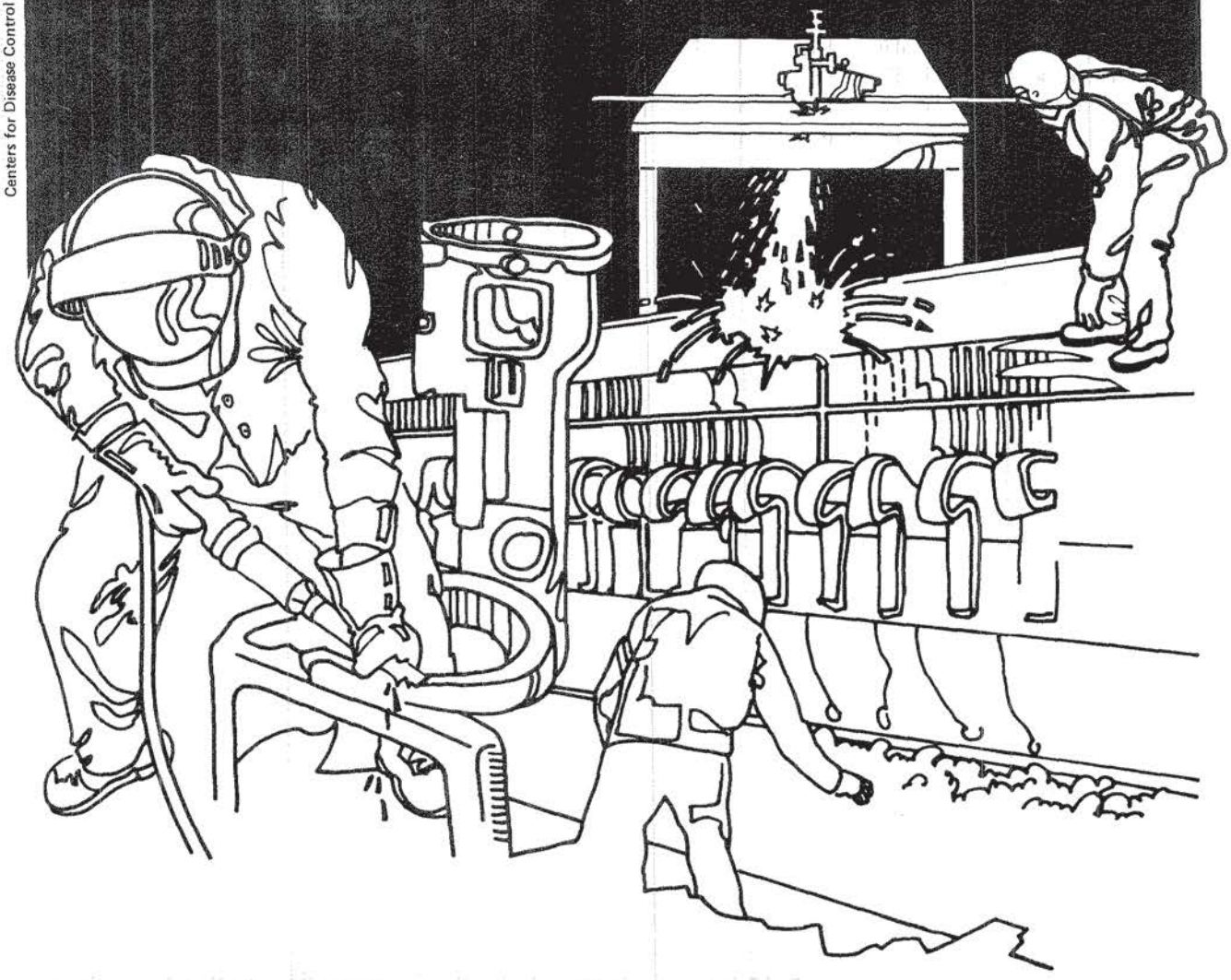

Health Hazard Evaluation Report

HETA 81-010-390
U.S. IMMIGRATION &
NATURALIZATION SERVICE
SWANTON, VERMONT

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 81-010-890
June 1981
U.S. Immigration & Naturalization Service
Swanton, Vermont

NIOSH Investigator:
John R. Love, I.H.

I. SUMMARY

In October 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for technical assistance from the U.S. Department of Justice, Immigration and Naturalization Service, Swanton, Vermont. The request asked assistance in evaluating the effectiveness of existing engineering controls, as well as of a nylon-jacketed ammunition and of non-lead alloy ammunition in lowering lead exposures in their pistol range.

On December 16, 1980, NIOSH conducted an environmental survey at the range using three ammunition types: (1) a non-lead alloy bullet; (2) a nylon-jacketed bullet; and (3) regular lead ammunition. Both personal breathing zone and general area air samples were taken.

Results of air sampling calculated as 8-hour time-weighted average (TWA) (assuming zero exposure when not firing weapons) means ($\bar{x}$) and standard deviation (S) for each ammunition sequence are: non-lead, $\bar{x}$ = 0.02 milligrams of lead per cubic meter of air (mg/M^3) and S = 0.01 mg/M^3; nylon-jacketed, $\bar{x}$ = 0.05 mg/M^3 and S = 0.02 mg/M^3; regular lead, $\bar{x}$ = 0.14 mg/M^3 and S = 0.07 mg/M^3 and $\bar{x}$ = 0.14 mg/M^3 and S = 0.05 mg/M^3. The Occupational Safety and Health Administration (OSHA) legally enforceable limit is 0.05 mg/M^3 for an 8-hour TWA.[1]

Analyses of air samples for total particulate emission indicate that the ammunition was producing levels less than 20% of the threshold limit value (TLV) of 10 mg/M^3 as recommended by the American Conference of Governmental Industrial Hygienists (ACGIH).[2] Ventilation measurements indicated that air flow rates varied from 30 to 200 feet per minute (fpm) across the shooting booths.

On the basis of the data obtained in this investigation, NIOSH has determined that a health hazard due to lead exposure from the regular and nylon-jacketed ammunition existed, and that the ventilation system was deemed inadequate to control this hazard. No health hazard to the non-lead ammunition was found at the time of this survey. Recommendations for correcting these hazards are provided in Section VI of this report.

KEYWORDS: SIC 9999 (not otherwise classified), indoor firing range, lead, ventilation, non-lead, nylon-jacketed ammunition, particulates.

II. INTRODUCTION

On September 24, 1980, an official of the Department of Justice, Immigration and Naturalization Service, Regional Office, Burlington, Vermont, requested NIOSH's technical assistance in evaluating their indoor firing range for lead exposure, and for testing a jacketed ammunition for its ability to reduce lead exposure. This evaluation was performed to determine whether airborne lead presented a health hazard to border patrol agents when using the range for pistol qualifications. The survey was conducted on December 16, 1980 by a NIOSH industrial hygienist. Personal breathing-zone air samples were taken on agents firing .357 magnum pistols and also on the rangemaster who was positioned behind the shooters. General environmental air samples were also collected at several locations in the range.

III. BACKGROUND

The 25-yard moveable target firing range in the Swanton Sector Headquarters, Swanton, Vermont had been designed for 6 firing positions. Fresh air was supplied about 10 feet behind and above the firing line with the exhaust duct located just up range from the bullet trap. Hinged panels were used to block air flow below a platform used to hold pistol and ammunition for quick reloads. Also, partial doors could be swung, both right and left, perpendicular to the walls for use in firing from behind barriers.

During a normal qualification sequence each shooter is required to fire 72 rounds using 7 different target and/or shooter positions. The rangemaster sits at a non-enclosed console about 5-7 feet behind the firing line. All guns were cleaned prior to each qualification sequence. All persons, while in the firing range, wore adequate hearing protection at all times.

IV. EVALUATION DESIGN AND METHODS

Three types of ammunition were used in 4 separate qualification sequences to determine differences in potential exposures. Personal breathing-zone samples were taken on 6 shooters for 4 qualification sequences and on the rangemaster for 3 sequences. A fourth qualification was necessary because of an oversight in not having the exhaust system working in conjunction with a master switch used to activate the air system when occupying the pistol range. Qualification periods varied from about 60 minutes for the first, with the remaining three approximately 35-40 minutes in duration. Each person in the qualification sequence shot 72 rounds; thus a total of 432 rounds per ammunition type were fired. The air samples were collected on mixed cellulose ester filters using a battery powered sampling pump operating at 2.0 liters of air per minute (lpm).

Analysis of filter samples for lead, both personal and general area, was performed according to NIOSH Method P & CAM S-341.[3] Also, total particulate weights on samples were determined gravimetrically. The limit of detection for lead for P & CAM Method S-341 is 3 micrograms per filter (ug/filter), and the instrumental precision of weighing of the filters for particulate weights is 0.01 milligrams (mg).

V. EVALUATION CRITERIA

Inhalation of lead dust and fumes is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion of lead dust contamination from food, cigarettes, or other substances. Once absorbed, lead is excreted from the body very slowly. The 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.

Blood lead levels below 40 ug/100ml whole blood are considered to be normal levels which may result from daily environmental exposure. However, fetal damage in pregnant women may occur at blood lead levels as low as 30 ug/100ml. Lead levels between 40-60 ug/100ml in lead exposed workers indicate excessive absorption of lead and may result in some adverse health effects. Levels of 60-100 ug/100ml represent unacceptable elevations which may cause serious adverse health effects. Levels over 100 ug/100ml are considered dangerous and often require hospitalization and medical treatment.

The new OSHA standard for lead in air is 50 ug/M^3 for an 8-hour time-weighted average for daily exposure. The standard also dictates that in 4 years workers with blood lead levels greater than 50 ug/100ml must be immediately removed from further lead exposure, and in some circumstances workers with lead levels less than 50 ug/100ml must also be removed. At present, medical removal of workers is necessary at blood lead levels of 70 ug/100ml or greater. Removed workers have protection for wage, benefits, and seniority for up to 18 months until their blood levels adequately decline and they can return to lead exposure areas.[4,5]

The evaluation criteria for airborne particulate or "nuisance dust" is based on its ability to reduce workshop visibility; create unpleasant deposits in the eyes, ears, and nasal passages; or cause injury to the skin or mucous membranes by chemical or mechanical action per se, or by the rigorous cleansing procedures necessary for its removal. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended a concentration of 10 milligrams per cubic meter of air (mg/M^3) as a maximum acceptable level for particulate in air.

VI. RESULTS

Results of the air samples obtained, both general area and personal, are shown in Table II. Comparisons of the 3 ammunition types, by use of means and standard deviations (Table I), indicates that the use of the non-lead ammunition produced the lowest lead exposures. This ammunition produced a mean of 0.18 mg/M^3 or 0.02 mg/M^3 as an 8-hour TWA, which is well below the OSHA enforceable standard of 0.05 mg/M^3 as an 8-hour TWA. However, the bullet trap at this pistol range failed to contain this ammunition and some "kick-back" was observed.

The second ammunition tested was a nylon-jacketed regular lead bullet. This nylon-jacketed bullet produced airborne lead levels with a mean of 0.66 mg/M^3 and an 8-hour TWA of 0.05 mg/M^3, the OSHA Permissable Exposure Limit (PEL).

The final ammunition tested was the regular lead ammunition used, commonly called wadcutters. Levels obtained using this ammunition were obtained both with and without the exhaust fans running with means of 2.03 mg/M^3 and 1.88 mg/M^3, respectively, and TWA of 0.14 mg/M^3 for both sequences.

Ventilation measurements taken in several booths ranged, while moving from side to side, from 30 to 200 fpm. Several smoke bombs were used to determine actual air patterns, both directly behind and in front of the firing line and also about one-half of the way down range. Observation of the smoke indicated that turbulance in the air was being generated in front of and behind the firing line.

Analyses on the air samples for total particulates indicated that levels being generated ranged from a low of 0.05 mg/M^3 to a high of 1.57 mg/M^3. A mean for these samples was 0.27 mg/M^3 with a standard deviation of 0.38 mg/M^3. The American Conference of Governmental Industrial Hygienists (ACGIH) recommended a standard of 10 mg/M^3, of which these samples represent only about 16%.

VII. RECOMMENDATIONS

Effective control of lead dust and fumes can be achieved through a properly and adequately designed ventilation system. NIOSH has recommended that as an optimum, the flow rate for fresh air across the firing line should be a uniform 75 feet per minute (fpm) and that the minimum acceptable flow rate should be 50 fpm. However, it should be noted that these specific figures were recommended to control lead exposures to below 0.20 mg/M^3, the former OSHA standard. At this time, it is not known how effective these flow rates will be at controlling exposures at the current OSHA standard of 0.05 mg/M^3. Any obstructions that could cause turbulence in the air should be removed.

Performance criteria should be written into any future contracts for the installation or modification of the ventilation system, whereby the system will meet the current OSHA standards. The entire firing range should be maintained at a slightly negative pressure by exhausting about 10% more air than supplied, to insure no contamination of adjacent areas. The supply and exhaust systems must be electrically interlocked, thus eliminating the possibility of turning on one system and not the other.

Cleaning of the range by the use of a hand broom, even with dust suppression compounds, should be discontinued, and a vacuum or wet method should be used in its place.[6]

VIII. REFERENCES

1. OSHA Safety and Health Standards for General Industry, 29 CFR 1910.1000. Table Z-2.

2. "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes." American Conference of Governmental Industrial Hygienists, Cincinnati, OH, 1980.

3. NIOSH Manual of Analytical Methods, 2nd Ed., P & CAM S-341, DHEW (NIOSH) Publication No. 77-157C, Vol. III, April 1977.

4. NIOSH "Criteria for a Recommended Standard...Occupational Exposure to Inorganic Lead" (Revised Criteria). DHEW (NIOSH) Publication No. 78-158, 1978.

5. Federal Register, Vol. 44, No. 206, Rules and Regulations. pp. 60980-95.

6. "Lead Exposures and Design Considerations for Indoor Firing Ranges." DHEW (NIOSH) Publication No. 76-130. pp. 11-13.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available, upon request, from NIOSH, Division of Technical Services, Publications Dissemination, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161.

Copies of this report have been sent to:

1. Department of Justice, Immigration and Naturalization Service, Swanton, Area Sector, Swanton, Virginia.

2. NIOSH, Region I

3. U.S. Department of Labor (OSHA), Region I

TABLE I

Mean and Standard Deviations for Individual Ammunition Types

Dept. of Immigration & Naturalization
Swanton, Vermont
HETA 81-010

Qualification Sequence (72 Rounds)

Non-Lead	Nylon Jacketed	Regular	Regular[4]
n=7[1]	n=7	n=7	n=6
$\bar{x}$=0.18[2]	$\bar{x}$=0.66	$\bar{x}$=2.03	$\bar{x}$=1.88
S=0.09[3]	S=0.28	S=1.05	S=0.76

Time-Weighted Average (TWA)

Non-Lead	Nylon Jacketed	Regular	Regular[4]
n=7	n=7	n=7	n=6
$\bar{x}$=0.02	$\bar{x}$=0.05	$\bar{x}$=0.14	$\bar{x}$=0.14
S=0.01	S=0.02	S=0.07	S=0.05

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1. n = number of personal samples taken using ammunition type.
2. $\bar{x}$ = mean value (in mg/M^3) of n samples.
3. S = standard deviation (in mg/M^3) of mean value.
4. Second qualification sequence with regular ammunition with exhaust fans on. (See Evaluation Design and Methods Section of main body of report.)

TABLE II

Analysis of Filter Samples for Lead and Total Particulate

Dept. of Immigration and Naturalization
Swanton, Vermont
HETA 81-010

Location	Sampling Time (minutes)	Ammunition Type	Sample Type	Results* Lead mg/M³	Lead TWA[1]	Total Particulate mg/M³	Total Particulate TWA
Booth #1	53	Z[2]	Personal (P)	0.34	0.04	1.98	0.22
Booth #2	56	Z	P	0.22	0.03	1.34	0.16
Booth #3	57	Z	P	0.26	0.03	1.05	0.13
Booth #4	74	Z	P	0.13	0.02	0.61	0.09
Booth #5	59	Z	P	0.12	0.01	0.76	0.09
Booth #6	56	Z	P	0.12	0.01	1.25	0.15
Rangemaster	52	Z	P	0.10	0.01	0.48	0.05
Booth #1	37	N[3]	P	1.03	0.08	2.43	0.19
Booth #2	36	N	P	1.03	0.08	2.78	0.21
Booth #3	37	N	P	0.74	0.06	2.03	0.16
Booth #4	39	N	P	0.54	0.04	1.28	0.10
Booth #5	37	N	P	0.47	0.04	1.22	0.09
Booth #6	36	N	P	0.42	0.03	0.83	0.06
Rangemaster	39	N	P	0.40	0.03	0.77	0.06
Booth #1	32	WC[4]	P	3.59	0.24	4.38	0.29
Booth #2	36	WC	P	3.06	0.23	3.06	0.23
Booth #3	34	WC	P	2.50	0.18	2.94	0.21
Booth #4	34	WC	P	1.76	0.12	1.76	0.13
Booth #5	34	WC	P	1.25	0.09	1.18	0.10
Booth #6	35	WC	P	1.21	0.09	0.74	0.05
Rangemaster	35	WC	P	0.81	0.06	1.71	0.13
Booth #1	34	WC	P[5]	2.21	0.16	----	----
Booth #2	34	WC	P[5]	3.09	0.22	----	----
Booth #3	34	WC	P[5]	2.21	0.16	----	----
Booth #4	35	WC	P[5]	1.11	0.08	----	----
Booth #5	34	WC	P[5]	1.21	0.09	----	----
Booth #6	34	WC	P[5]	1.47	0.10	----	----
Halfway down range	171	6	Area (A)	2.79	0.99	4.41	1.57
In front of trap	171	6	A	2.52	0.90	4.28	1.52
On rangemaster's desk	152	6	A	0.76	0.24	1.51	0.48
Halfway down range	41	WC	A	3.17	0.27	3.54	0.30
In front of trap	41	WC	A	1.83	0.16	2.20	0.19
In front of booths	41	WC	A	4.39	0.37	5.37	0.46
On rangemaster's desk	35	WC	A	1.57	0.11	2.00	0.15
Halfway down range	39	WC	A[5]	3.21	0.26	----	----
In front of trap	39	WC	A[5]	6.67	0.54	----	----
On rangemaster's desk	34	WC	A[5]	1.21	0.09	----	----

* Approximate milligrams of substance per cubic meter of air.

1. TWA (Time-Weighted Average) of the personal exposure to airborne lead averaged over an 8-hour day assuming all non-sampled time as zero lead exposure.

2. Z = Non-lead ammunition.

3. N = Nylon jacketed lead ammunition.

4. WC = Regular lead ammunition.

5. Regular ammunition used, but with exhaust fans on (see pg. 1 of report).

6. General area air samples taken during non-lead, nylon jacketed and the first set of regular ammunitions.

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