# HETA 96-0218-2623
# New Hampshire Police Standards and Training Council
# Concord, New Hampshire

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# 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, technical and consultative assistance 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. Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

# ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by David C. Sylvain, M.S., CIH, of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Teresa Ferrara, Industrial Hygienist, Occupational Health and Safety Program, New Hampshire Division of Public Health Services. Desktop publishing by Pat Lovell.

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**Health Hazard Evaluation Report 96-0218-2623**
**New Hampshire Police Standards and Training Council**
**Concord, New Hampshire**
**January 1997**

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# SUMMARY

In July 1996, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from the Building Services Supervisor at the New Hampshire Police Standards and Training facility in Concord, New Hampshire. Although no adverse health effects had been reported, the request was prompted by concern about potential staff and recruit exposures to lead at the James S. Noyes Firearms Training Facility. In response to this request, NIOSH conducted a site visit on September 19 - 20, 1996, which included environmental sampling and a walk-through inspection of the facility.

A total of 15 personal breathing zone (PBZ) samples and two area air samples were collected and analyzed for lead. In addition, seven wipe samples were collected from surfaces in and around the firing range, along with one bulk sample collected from floor sweepings in the range.

The highest airborne lead concentrations were measured in the two samples collected during maintenance activities: 22 micrograms per cubic meter of air (µg/m$^3$) during routine weekly cleaning (sweeping), and 140 µg/m$^3$ during the cleaning of three target-retrieval rails. Lead was detected in all air samples collected during firearms training; six of these samples produced quantifiable results ranging from 0.7 to 9.5 µg/m$^3$. Area samples collected in the control room and the indoor running track revealed concentrations below the minimum detectable concentration (MDC) (control room: < 0.06 µg/m3; track: < 0.1 µg/m$^3$). Wipe sampling revealed lead concentrations on sampled surfaces ranging from 2.5 micrograms per 100 square centimeters of surface area (µg/100 cm$^2$) on a kitchenette countertop, to 1100 µg/100 cm$^2$ in a gun-cleaning tray in a classroom. Analysis of the bulk sample indicated 45,000 µg-lead/g-sample (4½percent lead) in floor sweepings.

Firearms training did not present a health hazard due to exposure to airborne lead. It appeared that some exposure to lead could occur from lead surface contamination in and around the range; however, ingestion of lead can be avoided through good hygiene practices.

Lead exposure during routine range cleaning did not exceed the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL); however, this exposure was unnecessarily high, and should be reduced by cleaning the floor with a HEPA-filter equipped vacuum cleaner, rather than dry sweeping. Air sampling conducted during the cleaning of three target-retrieval rails indicates that lead concentrations are likely to exceed the OSHA PEL during the annual cleaning of all twenty rails. This exposure, although infrequent, could be reduced through the use of a HEPA-filter equipped vacuum cleaner. A respiratory protection program should be established to ensure the reliability of respiratory protection used during maintenance operations.

Keywords: SIC 9221 (police protection), indoor firing ranges, lead.

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# INTRODUCTION

In July 1996, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from the Building Services Supervisor at the New Hampshire Police Standards and Training facility in Concord, New Hampshire. Although no adverse health effects had been reported, the request was prompted by concern about potential staff and recruit exposures to lead at the James S. Noyes Firearms Training Facility.

A site visit was conducted on September 19-20, 1996, which included a walk-through inspection of the facility, and air sampling for lead during range cleaning and firearms training. Wipe samples were collected to evaluate lead contamination on surfaces in and around the firing range. Monitoring for noise and carbon monoxide was conducted during firearms training by an industrial hygienist from the New Hampshire Division of Public Health Services Occupational Health and Safety Program. The results of noise and carbon monoxide monitoring were provided in a State report to the Director of Police Standards and Training.

# BACKGROUND

The James S. Noyes Firearms Training Facility was constructed approximately four years ago on the second floor of the New Hampshire Police Standards and Training Council building. The range consists of 20 firing booths, and occupies an area approximately 85 feet long by 80 feet wide. Targets are controlled from the control room, which is separated from the range by a wall and large observation window. The range has a dedicated ventilation system which was reported to exhaust 58,000 cubic feet of air per minute (cfm). Air is supplied to the range through perforations in the wall behind the firing line, and is exhausted at the bullet trap.

New Hampshire Police Standards and Training conducts 12-week police recruit training sessions under the direction of State Police instructors. Firearms instruction includes weekly sessions at the range that last approximately three hours. During this period, each recruit trains and qualifies using weapons and ammunition provided by the department where the recruit is employed. On the sampling date, recruits fired jacketed, lead-primer ammunition using a variety of semiautomatic pistols. The class was divided into groups of approximately 12 recruits who would be firing at any one time. Firing occurred in relays, with thirty-six rounds being fired by each recruit per relay. The number of relays per recruit ranged from three to eight, depending upon whether the recruit qualified at the end of the third relay.

A maintenance person cleans the range and sweeps the floor with a push-broom once a week. The target-retrieval rails are vacuumed and wiped clean approximately once each year. An outside contractor is hired to clean the trap; however, it was reported that maintenance employees occasionally enter the trap area for periods of up to one hour. The high efficiency particulate air (HEPA) filters in the air handler will be changed by building maintenance staff as needed.

# METHODS

On September 19, 1996, personal breathing zone air samples were collected on a maintenance worker while he cleaned three of twenty target-retrieval rails, and then performed routine, weekly range cleaning. On September 20, PBZ air samples were collected on three recruits selected from each of two groups (six recruits, total). The sampling cassettes were changed after each group fired the first relay; cassettes were plugged, and pumps were turned-off between the second and third relays. Upon completion of the third relay, one sampled recruit returned to the range with several other recruits, and fired five consecutive relays without leaving the range. A PBZ sample was collected on one of two instructors who remained in the range throughout the session. Area air samples were collected in the control room, and in the indoor running track that encircles the firing range.

Each sample was collected using a battery-powered sampling pump to draw air through a 37-millimeter (mm) diameter, 0.8 micrometer (µm) pore-size mixed cellulose ester (MCE) membrane filter mounted in a closed-face cassette. The pumps were operated at a nominal flow rate of 2.5 liters per minute (lpm), and were calibrated before and after sampling to ensure that the desired flow rate was maintained throughout the sampling period. Air samples were analyzed for lead using an inductively coupled plasma (ICP) emission spectrometer according to NIOSH Method 7300 (modified). Samples, in which lead was not detected, were re-analyzed using a more sensitive method (NIOSH Method 7105).

Wash'n Dri™ wipes were used to collect seven surface wipe samples from locations in and around the range for lead analysis according NIOSH Method 9100. Each wipe sample was collected from a 100 $cm^2$ area using a 10 cm by 10 cm plastic template. Using a new pair of disposable latex gloves for each sample, a wipe was removed from its protective package, and the area within the template was wiped with firm pressure, using three or four vertical S-strokes. The exposed area of the pad was folded in, and the area was wiped using three or four horizontal strokes. The pad was folded once more, and the area was wiped with three or four vertical strokes. The folded pad was then placed in a disposable scintillation vial. A clean template and new pair of gloves were used for each sample. Care was taken to use the same technique and wiping pressure for each sample to reduce variation in collection efficiency.

# EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the 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 even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a preexisting 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 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 becomes available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs)[1], (2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs™)[2], and (3) the U.S. Department of Labor, OSHA Permissible Exposure Limits (PELs)[3]. In July 1992, the 11th Circuit Court of Appeals vacated the 1989 OSHA PEL Air Contaminants Standard. OSHA is currently enforcing the 1971 standards; however, some states operating their own OSHA approved job safety and health programs continue to enforce the 1989 limits. NIOSH encourages employers to follow the 1989 OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever is the more protective criterion. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard and that the OSHA PELs included in this report reflect the 1971 values.

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 (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

## Lead

Lead is ubiquitous in U.S. urban environments due to the widespread use of lead compounds in industry, gasoline, and paints during the past century. Exposure to lead occurs via inhalation of dust and fume, and ingestion through contact with lead-contaminated hands, food, cigarettes, and clothing. Absorbed lead accumulates in the body in the soft tissues and bones. Lead is stored in bones for decades, and may cause health effects long after exposure as it is slowly released in the body.

Symptoms of lead exposure include weakness, excessive tiredness, irritability, constipation, anorexia, abdominal discomfort (colic), fine tremors, and "wrist drop."[4, 5, 6] Overexposure to lead may also result in damage to the kidneys, anemia, high blood pressure, infertility and reduced sex drive in both sexes, and impotence. An individual's blood lead level (BLL) is a good indication of recent exposure to, and current absorption of lead.[7] The frequency and severity of symptoms associated with lead exposure generally increase with the BLL.

The overall geometric mean BLL for the U.S. adult population (ages 20-74 yrs) declined significantly between 1976 and 1991, from 13.1 to 3.0 micrograms per deciliter of blood (µg/dL)--this decline is most likely due primarily to the reduction of lead in gasoline. More than 90% of adults now have a BLL of <10 µg/dL, and more than 98% have a BLL <15 µg/dL.[8]

Under the OSHA general industry lead standard (29 CFR 1910.1025), the PEL for airborne exposure to lead is 50 µg/m$^3$ (8-hour TWA).[3] The standard requires lowering the PEL for shifts exceeding eight hours, medical monitoring for employees exposed to airborne lead at or above the action level of 30 µg/m$^3$ (8-hour TWA), medical removal of employees whose average BLL is 50 µg/dL or greater, and economic protection for medically removed workers. Medically removed workers cannot return to jobs involving lead exposure until their BLL is below 40 µg/dL. The OSHA interim final rule for lead in the construction industry (29 CFR 1926.62) provides an equivalent level of protection to construction workers. ACGIH has adopted a TLV for lead of 50 µg/m$^3$ (8-hour TWA), with worker BLLs to be controlled to at or below 30 µg/dL, and designation of lead as an animal carcinogen.[2] The U.S. Public Health Service has established a goal, by the year 2000, to eliminate all occupational exposures that result in BLLs greater than 25 µg/dL.[9]

The occupational exposure criteria (above) are not protective for all the known health effects of lead. For example, studies have found neurological symptoms in workers with BLLs of 40 to 60 µg/dL, and decreased fertility in men at BLLs as low as 40 µg/dL. BLLs are associated with increases in blood pressure, with no apparent threshold through less than 10 µg/dL. Fetal exposure to lead is associated with reduced gestational age, birth weight, and early mental development with maternal BLLs as low as 10 to 15 µg/dL.[10] Men and women who are planning on having children should limit their exposure to lead.

The BLL of law enforcement trainees using a poorly ventilated firing range for an average of 7.2 hours during their first month of training rose from a mean of six µg/dL to 51 µg/dL (range 31-73 µg/dL).[11] Assuming a linear relationship between hours of exposure and BLL, employees using or working in this firing range more than 3.6 hours per month were found to be at risk for BLL rising above 40 µg/dL.

When using a poorly ventilated range, range masters or instructors should have their BLL checked at least every six months; law enforcement trainees should be checked approximately three weeks after training begins. Individuals using or working at the range for more than three hours per month, should have their

BLL checked.

### *Lead-childhood exposure*

The adverse effects of lead on children and fetuses include decreases in intelligence and brain development, developmental delays, behavioral disturbances, decreased stature, anemia, decreased gestational weight and age, and miscarriage or stillbirth. Lead exposure is especially devastating to fetuses and young children due to potentially irreversible toxic effects on the developing brain and nervous system.[10]

No threshold has been identified for the harmful effects of lead in children; the Centers for Disease Control and Prevention (CDC) currently recommends a multitier approach to defining and preventing childhood lead poisoning, based on BLL screening.[12] The BLLs and corresponding actions which CDC has recommended are: ≥10 µg/dL, community prevention activities; ≥15 µg/dL, individual case management including nutritional and educational interventions and more frequent screening; ≥20 µg/dL, medical evaluation, environmental investigation and remediation. Additionally, environmental investigation and remediation are recommended for BLLs of 15-19, if such levels persist.

Overall, U.S. population blood lead levels have declined since 1976. A recent national survey found that the geometric mean BLL for children ages 1-11 ranged from 2.5-4.1 µg/dL, with the highest mean BLL among children aged 1-2 years.[13] However, it was estimated from the survey that 8.9% of U.S. children under six years, or about 1.7 million children, have elevated BLLs (≥10 µg/dL).

In homes with a family member occupationally exposed to lead, care must be taken to prevent lead from being carried into the home on clothing, skin, and hair, and in vehicles. High BLLs in resident children, and elevated concentrations of lead in house dust, have been found in homes of workers employed in industries associated with high lead exposure.[14] Particular effort should be made to ensure that children of persons who work in areas of high lead exposure receive a BLL test.

# RESULTS

The results of air sampling for lead are presented in Table 1. Air samples were analyzed for lead according to NIOSH Method 7300 (inductively coupled plasma-atomic emission spectroscopy). Samples with nondetectable or nonquantifiable results were re-analyzed according to NIOSH Method 7105 (graphite furnace-atomic absorption spectroscopy).

The highest airborne lead concentrations were measured in the two samples collected during maintenance activities: 22 µg/m$^3$ during routine weekly cleaning (sweeping), and 140 µg/m$^3$ during the cleaning of three target-retrieval rails. Only two of the 13 samples, collected on six recruits and one instructor during firearms training on the following day, revealed lead concentrations between the minimum detectable concentration (MDC) and minimum quantifiable concentration (MQC) when analyzed according to NIOSH Method 7300. When the analysis was repeated using Method 7105, lead was detected in all air samples collected during firearms training. Six of the samples produced quantifiable results ranging from 0.7 to 9.5 µg/m$^3$. Area samples collected in the control room and the indoor running track revealed concentrations below the MDC (control room: < 0.06 µg/m$^3$; track: < 0.1 µg/m$^3$).

Wipe sampling results are presented in Table 2. Analysis of wipe samples indicated that lead concentrations on sampled surfaces ranged from 2.5 µg/100 cm$^2$ on a kitchenette countertop, to 1100 µg/100 cm$^2$ in a gun-cleaning tray in a classroom. Analysis of a bulk sample of floor sweepings revealed 45,000 µg-lead/g-sample (4½ percent lead).

# DISCUSSION

Air sampling indicates that the 8-hour time-weighted average lead exposures on the sampling date were well below the OSHA PEL during firearms training. Assuming that this training session represents conditions during typical handgun training sessions (e.g., types of weapons and ammunition, number of rounds fired, length of time in the range), overexposure to airborne lead during firearms training appears to be unlikely. However, it should be noted that these sampling results do not represent the exposure of officers when firing shotguns or other weapons which may generate greater (or lesser) lead concentrations than the service pistols that were used during this session.

Air sampling conducted during routine range cleaning indicates that worker exposure to airborne lead was below the OSHA PEL. Nevertheless, exposure to airborne lead could be further reduced by using a HEPA-equipped vacuum cleaner instead of dry-sweeping. Dry sweeping, as is done during weekly range cleaning, creates a dust cloud which contributes to worker exposure. A HEPA-equipped vacuum cleaner would capture lead-containing dust, rather than dispersing it throughout the range, where the dust can contribute to an unnecessarily high worker exposure.

Target rail cleaning generated considerable airborne lead during a 47-minute sample period. Since only three of twenty target rails were cleaned at this time, it is reasonable to expect a much greater exposure when all twenty rails receive an annual cleaning. Assuming 15-minutes per rail and an airborne lead concentration of 140 $\mu g/m^3$ throughout the cleaning process, the 8-hour TWA exposure during rail cleaning is estimated at 90 $\mu g/m^3$; almost twice the OSHA PEL of 50 $\mu g/m^3$. Target rail cleaning was performed using a portable canister vacuum cleaner which was not equipped with HEPA filters. A HEPA-filtered central vacuum system is installed in the range; however, it was reported that shotgun wads and other large debris clog the HEPA filters, thus making this system difficult to use.

Personal protective equipment (PPE) worn during target rail, and routine (weekly) cleaning included a Tyvek® suit, disposable shoe covers, gloves, and a half-face respirator equipped with HEPA filters. The suit and shoe covers help prevent contamination of clothing and skin, as well as minimizing the likelihood that lead will be taken home on shoes and clothing. The respirator was equipped with the correct filters, and should provide adequate protection against inhalable lead dust *assuming* that it fits well, and is maintained properly; however, a respiratory protection program had not been established to ensure the reliability of the respirator. A respiratory protection program, as outlined in the OSHA Respiratory Protection Standard (29 CFR 1910.134) requires that employees be trained in the use of respirators and that they be fit tested. Training of employees is to assure that the worker knows the types of exposure the respirator provides protection against, as well as how to wear, check, and maintain the respirator. The fit testing requirement is to assure that the selected mask does indeed fit the wearer. Even though it appears that routine exposure to lead during range cleaning is unlikely to exceed the PEL, respiratory protection should be worn to reduce exposure to airborne lead dust.

Wipe sample results indicated the presence of lead on various surfaces in the building. There are currently no Federal standards governing the level of lead in surface dust in occupational settings; however, lead-contaminated surfaces may represent a potential exposure to lead through ingestion. This may occur either by direct hand-to-mouth contact with the dust, or indirectly from hand-to-mouth contact via clothing, cigarettes, or food contaminated by lead dust. The presence of a low (but measurable) concentration of lead on the kitchenette countertop in the John D. Morton Conference Room indicates the presence of lead which may have originated in the firing range. The sample collected from the countertop in the passageway outside the firearms training facility, where coffee and donuts were served, revealed 5.8 $\mu g/100\ cm^2$. Lead contamination on the sole of a shoe cover worn by one of the investigators during the sampling visit demonstrates the potential for carrying lead out of the range on footwear. Individuals working in or using the range should be advised of the exposure potential from carrying lead home on shoes worn in the range (especially if there are small children at home).

Ventilation smoke tubes were used to determine if the range was under negative pressure with respect to the area outside the range near the entry, and presumably, other areas within the building. Smoke tube traces, released near the door entering the range, flowed into the range while the ventilation system was operating and the door was held ajar. This indicated negative pressure within the range: a desirable condition which helps to ensure that airborne lead will not escape into the indoor track and other surrounding areas. Area air samples collected in the control room and indoor track produced results below the minimum detectable lead concentration.

## CONCLUSIONS

Firearms training in the James S. Noyes Firearms Training Facility did not present a health hazard due to exposure to airborne lead. It appeared that some exposure to lead could occur due to lead contamination on surfaces in and around the range; however, ingestion of lead can be avoided through good hygiene practices.

Lead exposure during routine range cleaning did not exceed the OSHA PEL; however, this exposure was unnecessarily high, and should be reduced by cleaning the floor with a HEPA-filter equipped vacuum cleaner, rather than dry sweeping. Air sampling conducted during the cleaning of three target rails indicates that lead concentrations are likely to exceed the OSHA PEL during the annual cleaning of all twenty rails. This exposure, although infrequent, could be reduced through the use of a HEPA-filter equipped vacuum cleaner. A respiratory protection program should be established to ensure the reliability of respiratory protection used during maintenance operations.

## RECOMMENDATIONS

1. Recruits, range instructors, maintenance staff, and others who work in the range, should be instructed in the hazards of lead in firing ranges and ways to minimize or prevent exposure. Recruit training provides an excellent opportunity to instill an awareness of the potential hazard of take-home lead, and lead exposures that officers may encounter in other ranges that they will be using throughout their careers. The New Hampshire Department of Health and Human Services, Occupational Health and Safety Program should be contacted to arrange lead training.

2. The baseline blood lead level should be determined for maintenance staff, instructors, and others who regularly work in the range. Baseline readings provide a basis for monitoring the accumulation of lead in potentially exposed individuals. The New Hampshire Occupational Health and Safety Program may be able to assist in providing baseline blood lead monitoring for instructors and staff.

3. Maintenance staff should be fit-tested, and trained in the selection, use, care, and limitations of respiratory protection. This is most effectively accomplished as part of a respiratory protection program, which should be implemented to ensure the reliability of respirators.

4. Food, beverages, or tobacco products should not be used or stored in or near the range. These items can become contaminated with lead and cause subsequent absorption of lead during eating, drinking, or smoking. Workers and users of the range should be instructed to wash hands and face before eating, drinking, or smoking. Users of the range should be instructed to wash after shooting, handling fired cartridge cases, and after cleaning weapons.

5. Care must be taken to prevent lead from being carried into the home on clothing, skin, hair, and shoes. Shoes worn in the range should not be worn

home. Clothes worn in the range should be washed separately from the family wash. Recruits should be advised that small children and pregnant women are especially susceptible to adverse health effects from exposure to even small amounts of lead.

6. The high lead concentration measured during target rail cleaning indicates that the use of a commercial vacuum cleaner is dispersing lead-contaminated dust throughout the range, resulting in further surface contamination, and high airborne lead concentrations. A HEPA-filtered vacuum cleaner should be used to clean target rails, possibly in conjunction with rail-cleaning using a trisodium phosphate (TSP) solution. In addition, a HEPA-equipped vacuum (portable or central) should be used to remove dust from floors, rather than dry sweeping.

7. The company that designed and installed the range could be contacted to investigate ways to minimize the filter clogging that has discouraged the use of the central HEPA-filtered vacuum system.

8. Countertops and other surfaces should be cleaned with a TSP solution. In addition, spray bottles of TSP could be used by recruits to remove lead from gun-cleaning trays after cleaning weapons. (Hands should be washed after cleaning gun-cleaning trays or other surfaces.)

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**Table 1. Air Sampling. NH Police Standards & Training (HETA 96-0218), September 19 - 20, 1996**

| ID | Location/operation | Sample # | Date, Time | Period (minutes) | Volume (Liters) | Pb[1] (µg/m³) | Pb (µg/m³) 8-hr TWA |
|---|---|---|---|---|---|---|---|
| **Maintenance** | cleaning rails | 1 | 9/19, 1415-1502 | 47 | 118 | 140 | 13 |
| | weekly cleaning | 2 | 9/19, 1503-1543 | 40 | 101 | 22 | 1.8 |
| ***Group 1*** | | | | | | | |
| **Recruit A** | booth # 8 | 6 | 9/20, 0837-0853 | 16 | 40 | (2.0) | (0.066) |
| | | 14 | 9/20, 0912-0925<br>0944-1000 | 29 | 73 | 1.6 | 0.099 |
| **Recruit B** | booth # 14 | 7 | 9/20, 0837-0853 | 16 | 40 | (1.2) | (0.039) |
| | | 15 | 9/20, 0912-0927<br>0944-1000 | 31 | 78 | 1.2 | 0.077 |
| **Recruit C** | booth # 7 | 8 | 9/20, 0837-0853 | 16 | 40 | (1.9) | (0.063) |
| | | 16 | 9/20, 0912-0925<br>0944-0959 | 28 | 71 | (0.94) | (0.055) |
| ***Group 2*** | | | | | | | |
| **Recruit D** | -- | 11 | 9/20, 0854-0912 | 18 | 46 | (1.5) | (0.058) |
| | | 17 | 9/20, 0927-0943<br>1003-1020<br>1025-1140 | 108 | 273 | 0.70 | 0.16 |
| **Recruit E** | booth # 5 | 12 | 9/20, 0854-0912 | 18 | 45 | 2.5 | 0.092 |
| | | 18 | 9/20, 0927-0943<br>1003-1020 | 33 | 82 | 3.0 | 0.21 |
| **Recruit F** | booth # 14 | 13 | 9/20, 0854-0911 | 17 | 42 | (1.8) | (0.062) |
| | | 19 | 9/20, 0927-0943<br>1003-1021 | 34 | 84 | 9.5 | 0.67 |
| **Instructor** | firing range | 10 | 9/20, 0837-1140 | 183 | 459 | 0.28 | 0.11 |
| **Area** | control room | 9 | 9/20, 0838-1145 | 187 | 469 | < 0.06 | < 0.02 |
| **Area** | indoor track | 20 | 9/20, 1008-1150 | 102 | 257 | < 0.1 | < 0.02 |

1. Average lead concentration during sample period.
µg/m³ = Micrograms of lead per cubic meter of air.
< = Less than. Analytical results preceded by "<" are reported in terms of the minimum detectable concentration (MDC) presented in the table. The MDC is the minimum concentration that can be detected, based upon sample volume and analytical sensitivity.
( ) = Value is between the MDC and minimum quantifiable concentration (MQC).

**Table 2. Wipe Samples, NH Police Standards & Training, September 19-20, 1996**

| Sample | Location | Lead† ($\mu$g/100 cm$^2$) |
|---|---|---|
| W-1 | door, exit from range | 13. |
| W-2 | center of lateral target system controls | 15. |
| W-3 | countertop, outside firearms facility | 5.8 |
| W-4 | barricade, firing booth # 8 | 240. |
| W-5 | gun cleaning tray in classroom | 1100. |
| W-6 | kitchenette countertop in conference room | 2.5 |
| W-9 | sole of Tygon shoe cover | 260. |

† micrograms of lead per 100 square centimeters of surface area (approximately 4 inches by 4 inches).

**Table 3. Bulk Sample, NH Police Standards & Training, September 19, 1996**

| Sample | Location | Lead† ($\mu$g/g) |
|---|---|---|
| K-1 | firing range (floor sweepings) | 45000. |

† micrograms of lead per gram of sample (parts per million).

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