# Indoor Firing Facilities

## Introduction

### 1. Purpose

a. This guide is intended to provide technical information regarding Navy and Marine Corps indoor small arms firing facilities and general guidance in assisting with recognizing, evaluating, and controlling workplace hazards. The content of this guide is based on current general industry information available in Occupational Safety and Health Administration (OSHA) standards, Department of Defense (DoD) instructions, Navy and Marine Corps instructions, consensus standards and other technical documents.

b. This guide is not intended to replace new or existing regulations; therefore, changes in regulatory standards or instructions shall be followed in lieu of this guide. This guide may not effectively provide guidance on unorthodox firing operations performed by Navy Special Warfare, Naval Criminal Investigative Services (NCIS) or other special operations personnel.

### 2. Applicability

a. This guide may be useful to range operators, range safety officers, industrial hygienists, safety professionals and technicians in performing range evaluations, understanding conditions that require additional expertise, and developing operation and maintenance procedures.

b. This guide provides general hazard information; general design and operation aspects; systems and equipment of industrial hygiene concern; general discussion of ventilation design and evaluation; and work practices and recommendations for controlling exposure to hazards and safe operation.

### 3. Changes

a. This document consolidates and presents information to assist industrial hygienists, occupational medicine physicians, and other Navy and Marine Corps department professionals in making informed decisions about the health hazards associated with indoor firing facilities. This guide updates the May 2002 publication of the Indoor Firing Ranges Industrial Hygiene Technical Guide published by the Navy Environmental Health Center (NEHC–TM6290.99-10 Rev. 1).

b. Detailed information on controlling health hazards associated firing facilities are available from numerous sources, including those listed as references in this guide. For questions regarding this guide, users may contact Ask IH.

## Overview of Subject Matter

### 4. Background

a. Navy active and reserve personnel; law enforcement and security; and other military, civilian, and contract personnel whose duties require them to be armed must complete qualification and sustainment training with specified weapons per reference (a). Personnel may complete their training at an indoor small arms firing facility such as an indoor firing range, a mobile firing range, or a close quarter combat (CQC) facility. Properly designed facilities can support small arms weapons firing of handguns, 12-gauge shotguns, 5.56-millimeter (mm) rifles, and 7.62 mm rifles.

b. Weapons firing exercises expose personnel to workplace hazards. A workplace hazard may occur when personnel are exposed to environmental stressors; or physical, chemical, biological, ergonomic, and/or safety hazards within the workplace. A large portion of exposures to stressors at an indoor small arms firing facility is a direct result of firing a weapon within an enclosed environment.

c. The composition of ammunition varies amongst type (i.e., lead or frangible rounds), but components are generally the same. There are 4 main components of ammunition (or cartridges or rounds): the bullet, propellant, casing, and primer. The projectile or bullet is usually made of a dense material such as lead and may be covered or jacketed generally with a copper-zinc alloy. The bullet may be non-jacketed (i.e., totally exposed lead bullet), partially jacketed, or totally jacketed. Even in totally jacketed bullets, the base of the bullet may have exposed lead. Some bullets may be made from metals other than lead (such as copper) that are commonly used in frangible rounds. The composition of frangible rounds consists of mainly copper but may have tin and zinc which turn into powder on impact. The casing contains the propellant and the primer and is usually brass (copper-zinc alloy). Most ranges will recover them for recycling. The propellant (or gun powder) contains explosives which provides the expanding gas that propels the bullet. The propellant is generally a mixture of nitrocellulose and nitroglycerin to form a double base. Sometimes nitroguanidine and other chemicals are added to form a triple base. The propellant is ignited by the primer which is also an explosive. The primer contains an explosive (e.g., lead styphnate) that is oxidized by impacting sensitive metallic salts and metallic nitrate compounds (e.g., barium nitrate, antimony sulfate, and tetrazene). The primer also contains a pyrotechnic system which may consist of lead peroxide or calcium silicates. Lead free primers may contain the explosive diazole, tetrazene, zinc peroxide, and titanium chloride. The primer is struck by the firing pin, causing impact-sensitive metals to explode, igniting the propellant. The burning propellant can generate pressures of 18,000 to 20,000 pounds per square inch (psi) and may reach a temperature of 2000 degrees Fahrenheit. The expanding gas propels the bullet down the barrel. The hollow interior of the barrel is referred to as the bore. The caliber is the inside diameter of the bore and is measured in inches or mm. The bore for handguns and rifles is scored with spiral grooves called rifling but is smooth for shotguns. These grooves cause the bullet to spin as it is traveling down the barrel. A spinning bullet is more stable and resists tumbling as it travels through the air towards the target. The projectile exits the barrel via the muzzle. The muzzle velocity, or initial velocity, is the speed and direction of the projectile at the muzzle. The velocity is dependent upon ammunition type and caliber, the length of the barrel, the propellant quality (determines burn rate), the propellant quantity and the gas produced after initial ignition of the primer. Pistol bullets accelerate to nearly the speed of sound. High-powered pistol and rifle bullets reach speeds above the speed of sound.

d. In an indoor or mobile range, the projectile will eventually require its energy to be absorbed. Bullets usually impact onto or into some type of bullet trap. On impact, the bullet may fragment in many directions. This is known as backsplatter. Factors in the generation of backsplatter are the angle at which the projectile impacts the trap, the smoothness of the impacted surface and the impact velocity. The greater the energy of the bullet, the more likely the fragments will continue their original path and not bounce back. Lower energy bullets (e.g., subsonic ammunition) produce the most pronounced backsplatter.

e. Backsplatter fragments that are redirected back towards the shooter are called a ricochet. Ricochets should be rare in a properly designed range. Ricochets may also be caused by the type of target used. Hard targets such as bowling pins and metal targets (poppers) can increase the likelihood of ricochet. Improper ammunition used on the range may dent the bullet stop, increasing the chance of ricochet. Bullet strikes on structural components (target retrieval systems, electrical fixtures, etc.) can cause ricochets. Plate and pit traps in need of cleaning (many bullets in the trap) can increase ricochet. Ricochet is not a major concern at facilities that utilizes unjacketed frangible rounds as the impact turns the rounds into powder thus preventing redirection. Bullets that miss the target and trap can penetrate floors or ceilings of improperly designed or constructed ranges thus posing a severe danger to surrounding areas.

## Hazards

### 5. Physical Hazards

a. The discharge of weapons creates hazardous impulse noise levels. In an indoor small arms firing facility, the impulse noise may act differently when it reflects off of hard surfaces. Repeated exposure to impulse noise greater than 140 decibels peak (dBP) can cause significant hearing loss. The DoD has established requirements for noise hazardous conditions that are presented in reference (b). Further guidance is provided in reference (c).

b. Continuous and intermittent noise (20 to 16,000 hertz (Hz)) where DoD personnel are exposed at or above 85 decibels A-weighted (dBA) as an 8-hour time-weighted average (TWA) is an overexposure. DoD personnel exceeding these criteria for at least one day per year must be enrolled in a Hearing Conservation Program.

c. In a range, reflective surfaces will reverberate noise during firing, extending the decay rate of the noise. Long decay rates (> 1 second) will require the industrial hygienist to treat the noise not only as impulse (peak pressure considerations) but also as continuous noise. Surface design should be considered such as installing absorptive materials to reduce noise within, and outside, firing facilities. Absorptive type acoustical surfacing can reduce the noise within the range. However, noise reduction material with increased porosity of surfaces can become contaminated with fine lead particles, causing difficulty in cleaning such surfaces. Acoustical treatment behind the firing line is acceptable if it can be easily cleaned.

## 6. Chemical Hazards

a. Lead is considered toxic to all organ systems and serves no useful purpose in the body. Lead overexposures can cause adverse effects in the brain, central nervous system, peripheral nervous system, kidneys, reproductive system (conception and developing fetus), and inhibit heme synthesis or erythropoiesis (red blood cell production). Lead is an ototoxicant, which can cause hearing impairment alone or in combination with noise. Lead can be found in lead primers (fulminates) [lead styphnate or lead peroxide], projectiles (bullet), and within the bullet stop (trap).

b. During firing, hot gases from the propellant can vaporize lead in the bullet. Even with "full jacketed" bullets, lead may be vaporized if the base of the bullet is not jacketed. Rifling or misalignment of the barrel, cylinder, clips, or magazines may chip lead from the bullet.

c. As the bullet leaves the barrel, the hot expanding gases from the propellant and the primer will leave the muzzle in all directions (sideways). The expanding gases and the pressure shock can cause disturbances in the air around the breathing zone of the shooter. If effective ventilation is present lead particulates and other contaminants produced are carried down range (toward the trap). Because of their density, lead particulates will settle out of the air quickly, coating the surfaces immediately down range from the shooter with fine lead dust.

d. Lead particulates (including dusts and fumes) may be inhaled by shooters and range personnel during firing, maintenance, and cleaning of the range. Lead particulates will not penetrate the skin; however, contamination on hands, arms or the face may allow accidental ingestion of lead during eating, drinking, vaping, smoking or applying of cosmetics if the skin is not adequately cleaned.

e. Substance information regarding occupational exposure to lead and a summary of the key provisions of the OSHA regulations are provided in references (d) and (e).

f. Exposure limits are set by OSHA and adopted by the Navy as indicated in reference (f). The permissible exposure limit (PEL) for an 8-hour time- weighted average TWA exposure to airborne lead is 50 micrograms per cubic meter ($\mu g/m^3$) of air. For employee exposure of more than 8 hours in a workday, the PEL shall be determined by the following formula in **Figure 1**.

$$PEL\ (\mu g/m^3) = \frac{400}{\#\ of\ hours\ worked\ per\ day}$$

**Figure 1**

g. The Action Level (AL) for an 8-hour TWA exposure to airborne lead is 30 $\mu g/m^3$ (without regard to respirator use). Exposure to airborne lead at or above the AL, for more than 30 days per year, triggers biological monitoring and medical surveillance requirements per reference (g).

h. There are no directly applicable established limits for occupational surface contamination (mass of lead per surface area). Indoor small arms firing facilities must establish and maintain housekeeping and hygiene practices that keeps all surfaces “as free as practicable” of accumulations of lead particulates per references (d) and (e).

i. Ammunition may contain other metals such as antimony, barium, and tin. Antimony may cause irritation to the skin, eyes and the respiratory system. Barium may cause irritation to skin, eyes and gastrointestinal system. Long-term exposures to these metals may cause pneumoconiosis or dusty lung disease.

j. The ignition of primers and propellants during firing can produce other toxic compounds. Ventilation systems that adequately control lead should also control exposures to any other generated toxic compounds.

k. <u>Other Stressors.</u> Other compounds that may be generated during firing includes oxides of nitrogen that may cause irritation to the skin, eyes and the respiratory system.

l. Carbon Monoxide. Carbon monoxide is a chemical asphyxiant that reduces the ability of blood to carry oxygen. Symptoms of over exposure include headache and nausea.

m. Organic compounds. Other organic compounds may be generated. Of special concern is the unburned propellant that may accumulate down-range over a long period of time. This may create a fire hazard if the range is not cleaned properly and regularly. Unburned propellant may accumulate in porous surfaces or in crevices (concrete joints).

## 7. Ergonomic Hazards

a. Low-light shooting or night-firing exercises. Generally, security personnel are required to perform low visibility fire exercises to familiarize personnel to shooting in that environment. The amount of light is comparable to the amount of natural light 30 minutes past official sunset. Operating in poor or inadequate lighting for extended periods of time may cause headaches, eye strain, dry eyes and/or blurred vision.

b. Awkward shooting positions. Shooting operations may be performed while standing, kneeling, and proning (lying on the chest). Continuous kneeling and proning may subject personnel to awkward postures. For unconditioned shooters this may result in a sprain, strain, or tear injury. Some positions subject shooters to repeated contact between sensitive body tissues and hard surfaces resulting in contact stress.

## 8. Safety Hazards

a. Eye Hazards. Ricochets can be a significant eye hazard at indoor small arms ranges or mobile firing ranges. Poorly maintained traps or misdirected shot can cause fragments to be thrown back toward the firing line/shooter. Extremely hot ejected cartridges may be thrown back toward the shooter causing eye damage. Some shooting operations' course of fire may require the use of lasers. The use of Class IIIb or Class IV lasers on reflective surfaces may cause damage to the eye.

b. Fire Hazards. Class IV laser beams can result in potential fires (radiant power > 2 $W/cm^2$ is an ignition hazard). The use of these lasers in poorly maintained ranges, in addition to combustible materials in the surroundings, can cause a fire. Tracer projectiles have been known to cause fires in the presence of combustibles because they contain a pyrotechnic making the trajectory visible and enabling the shooter to make aiming corrections. These should not be allowed in indoor firing facilities as indicated in reference (h).

## Design

It is critical to properly design an indoor small arms firing facility that meets the purpose of conducting weapons training in a safe manner. This guide specifically addresses the design criteria for ventilation systems for indoor small arms firing facilities. For guidance in the design criteria for other systems, review reference (h).

### 9. Indoor Firing Range Ventilation Systems

a. Ventilation in an indoor firing range controls exposure to lead and other contaminants generated during firing exercises. The exhaust and supply air system design are crucial to proper operation and to achieve good air flow across the firing line. To ensure proper operation, interlocks should be installed that require both the supply and exhaust fans to be running.

b. Exhaust air system. The exhaust system removes contaminated air from the range. The exhausted air flow must be made up by outside air. The exhaust plenum should be located above and downrange of the trap entrance, with a semi-continuous slot at the intake spanning the entire width of the shooting lanes per reference (h). The exhaust flow rate determines the velocity of the air down the range but does not affect the air flow pattern at the firing line. To prevent settling and plugging of the duct, the exhaust system should provide a duct air velocity of 2500 to 3000 feet per minute (fpm) (12.7 - 15.24 meter per second (m/s)) as recommended in Table 5-1 of reference (i). Excessively high duct velocities are unnecessary because it wastes energy and may cause rapid abrasion of ductwork. Exhausting three to ten percent more air than is supplied will maintain negative pressure in the range per reference (j). Ranges should be maintained under negative pressure of -0.05 +/- 0.02 inches water gauge per reference (h). The exhaust discharge must be separated from the supply air intake.

c. Supply air system. The distribution of supply air should provide uniform, diffuse, non-turbulent air flow towards the firing line and a near laminar flow down range. Supply air systems should be designed to distribute air evenly across the width of the firing range. If not evenly distributed, air flow at the firing line will be turbulent, causing lead and other contaminants to be carried back into the shooter's breathing zone. There should be no obstructions to airflow between the supply air inlets and the firing line so that the supply air is distributed uniformly across the width (cross-sectional area) of the firing range. Supply air should be introduced as far up range as possible and should be 100 percent outside air with no recirculation. The perforated rear wall (sometimes known as an "air wall") has been known to provide uniform air distribution per reference (k). Perforated wall hole diameters ranging from 0.25 to 1 inch have been used effectively, with recommended diameters between 0.375 and 1 inch (3/8" - 1") per reference (l). The perforated wall should extend the entire width and height of the range to distribute the supply air evenly. The plenum wall can be constructed of perforated hardboard, metal, or clear plastic sheeting (polycarbonate/acrylic, etc.). The minimum air flow should be 50 fpm over the cross-sectional area at the firing line with a preference of 75 fpm per reference (k). To minimize fall-out of gun emissions downrange of the firing line, downrange airflow should be maintained at a minimum of 30 fpm and should be evenly distributed per reference (k).

d. Filtration. Air exhausted from the firing range should be appropriately filtered or the area near the outside vent should be managed to prevent access and lead mobility in accordance with reference (m). The systems should have a two-stage filtration system with a minimum efficiency reporting value (MERV) 15 Bag filter no less than 26” long (66 cm) followed by a high efficiency particulate air (HEPA) filter with a 99.95 percent efficiency rating per reference (h). Filter end-of-service life is indicated by a high-pressure drop (more resistance to air flow) across the filter bank. Filters should be changed according to the static pressure guidelines provided by the manufacturer. Since pre-filters are the first to encounter contaminated exhaust air from the firing range, they will load fastest. Therefore, pre-filters require more frequent change-outs than HEPA-rated filters per reference (k). A pressure drop (magnehelic/incline manometer) gauge across the filter is recommended to indicate when filter changes are required.

## 10. Close Quarter Combat (CQC) Facilities Ventilation Systems

a. CQC facilities or shoot houses are designed to simulate structures or locations where CQC training is necessary. These environments can be residential, commercial, industrial, or shipboard and allow for 360-degree weapons firing exercises.

**NOTE**: The design criteria for CQC facilities are based on the use of frangible rifle rounds and pistol rounds fired directly into ballistic walls. Frangible rounds produce less hazardous airborne contaminants, have reduced ricochet potential, do significantly less damage to steel plates, and greatly reduce the chance of wall failure.

b. CQC facilities are designed with walls, doors, or rooms that will obstruct airflow creating a turbulent (non-laminar) airflow and an increased possibility of generating eddies. The ventilation criteria for indoor firing ranges does not apply for CQC facilities. The system should be designed to create air movement within all rooms that clears particulates generated between training runs. Systems should be designed to move air and clear smoke from all live fire rooms and meet the following:

(1) Top to Bottom Systems (Downdraft). A minimum exhaust volume to provide a vertical air velocity of 25 fpm (7.2 m/min) in all live fire areas per reference (h).

(2) Over the Top and Open Eave Systems. Systems should be designed to clear smoke from all rooms within three minutes and all hallways within six minutes. To achieve this, the designer must specify a minimum exhaust volume based on the design and

account for short circuiting. As a minimum, use 40 air changes per hour (ACH) per reference (h).

**NOTE**: An exhaust volume selected based on 20 ACH will theoretically clear smoke within 3 minutes. Smoke will usually take much longer to clear due to short circuiting and inefficiencies. The requirement for HEPA filters on the exhaust will be made on a case-by-case basis as determined by the responsible local environmental office.

## Evaluation

From a safety and health perspective, it is necessary to determine and evaluate if an indoor firing facility is operating properly. There are a few important steps that can be taken to properly evaluate an indoor small arms firing facility. The range should be evaluated from two perspectives--the physical/mechanical and the operational. The first includes the facility design, construction and the mechanical systems used in the facility. The second focuses on how the range is operated (i.e., the interaction of the occupants, weapons, and ammunition within the facility).

### 11. Physical and Operational Assessment

Conduct a walk-through assessment of the facility and look for the desired design traits discussed in the Design section of this guide. Note how the facility is maintained and operated. Gather information on the range's construction, layout, maintenance, listed weapon(s) used in the range, training content, expected number of shooters, frequency of use and the average amount expended rounds. This information will be needed to conduct the operational risk assessment of the range.

### 12. Indoor Firing Range Ventilation Assessment

a. Smoke testing. Prior to smoke testing, ensure that the ventilation system is on and operating. Utilize a smoke tube to observe airflow currents and patterns throughout the range. This should identify disturbances, dead spots and directions of airflow. Unnecessary personnel should not be present in the range or near the supply air plenum during the assessment. At the firing line, smoke test each firing station (booth). Test from the floor to about the 6-foot level. Observe the smoke pattern. The smoke should move down range and demonstrate laminar flow. Document unusual smoke patterns or where smoke swirls and returns to the shooter's position. Eddies or swirls near the floor, or other obstructions are a concern and should be noted. If turbulence is observed, air velocities may be high in that area.

   **NOTE**: The air velocity measurements conducted in this area may not truly indicate the direction of the flow as turbulence and eddies may have flow directions other than down range but will be reflected only as a measured value. Conduct additional smoke measurements down range to ensure adequate air velocities and patterns are maintained down range towards the bullet stop. It should be noted that many ranges were designed to have multiple exhaust points down range that will affect the smoke patterns.

b. Measure the ventilation. At the firing line, place a hotwire or a velocity matrix attachment anemometer so that it is perpendicular to the floor at the firing line. Make sure no unnecessary personnel are present or near the supply air plenum during the assessment. Take three measurements at each level in three locations from the floor: approximately 1 foot (prone level firing); approximately 3 feet (kneeling position); and approximately 5 feet (standing position). This will result in 9 readings for each firing station (or three grid meter readings). Average the 9 (or 3) readings and apply to the design criteria (50 – 75 fpm, with preference for 75 fpm). Optional measurements may be conducted down range at the 1-, 3- and 5-foot-high levels to ensure adequate air velocities are maintained at a minimum of 30 fpm per reference (k). This can be conducted at 15-to-20-foot intervals.

c. Static pressure measurements. Since it is desirable to have the range under negative pressure related to other occupied spaces, static pressure measurements can be conducted in one of two ways. A manometer or magnahelic gauge can be used to check the pressure in relation to areas outside the range. A hose can be placed outside the door (careful not to crimp) with at least 6 inches of the hose outside the door. The result can be compared to the desired criterion level (-0.05 +/- 0.02 inches water gauge) per reference (h). Another way to ensure range negative pressure is to use the smoke tube at all entrances or openings into the range. Doors may need to be "cracked" a little to demonstrate. Smoke should enter the range from outside areas. Excessive negative pressure will make doors difficult to open or keep closed. This can be a safety hazard as slamming doors can occur between - 0.05 and - 0.10 inches water gauge. Excessive negative pressure also indicates insufficient supply air for the amount being exhausted.

## 13. CQC Facility Ventilation Assessment

a. Smoke testing. Prior to smoke testing, ensure that the ventilation system is on and operating. Utilize a smoke tube or non-irritant fog machine to observe the effectiveness of the ventilation system. This may also identify disturbances, dead spots, and directions of airflow. Document unusual smoke patterns or where smoke swirls and returns to the shooter's position. Eddies or swirls near the floor or other obstructions are a concern and should be noted. Observe the smoke patterns, which will differ when compared to each system. The smoke should move in the direction specified in the system design. While ensuring no obstructions are above, smoke testing of a top-to-bottom ventilation system should demonstrate smoke being forced downwards and exhausted through floor vents. Smoke testing of an over-the-top and open eave ventilation system should demonstrate that smoke clears all rooms within three minutes and all hallways within six minutes per reference (h).

b. Top-to-bottom ventilation system measurements. Place a hotwire or a velocity matrix attachment anemometer so that it is parallel to the floor in live fire areas. Take measurements based on the height of the course of fire. Take three measurements at that height level. The system should provide a vertical air velocity of 25 fpm (7.2 m/min) in all live fire areas per reference (h).

c. Over-the-top and open eave ventilation system measurements. Measure the ventilation in all exhaust registers/ducts in the live area utilizing a hotwire anemometer, a manometer, or a pitot tube. Based on the design and to account for short circuiting, the systems should produce a minimum cfm (m/min) to provide 40 ACH per reference (h).

## 14. Air Sampling

Air sampling the personal breathing zones of shooters and range instructors is imperative in assessing exposures. Follow the procedures presented in references (n) and (o). In order to properly assess health risks, the following information should be recorded in addition to the required data presented in the reference (n): the type of training being conducted; frequency of training; number of shooters; shooter placement (lane number); weapon type(s); caliber and manufacturer of the ammunition; jacketed or non-jacketed bullets; frangible or non-frangible rounds; number of rounds expended; and other activity that would contribute to exposure. Compare the air sampling results to permissible exposure limits.

## 15. Wipe Sampling

To determine contamination levels of lead dust or to determine the effectiveness of cleanup, surface wipe sampling is performed. Follow the procedures outlined in reference (n) or consult reference (o) for specific instructions. Once deposited, leaded dust is difficult to clean effectively. Cleaning is the process of removing visible debris and dust particles too small to be seen by the naked eye. Wipe samples for settled lead dust can be collected from floors, interior contact areas, and other reasonably smooth surfaces. There is a very strong possibility that wipe samples will give a false negative; that is, that some or all the existing surface contamination will not be removed by a wipe sample.

## Controls

### 16. Lead Controls

To control lead exposures, the most desirable means is substitution with less hazardous materials. For example, utilizing reduced lead or "lead-free" ammunition. If allowed by the cognizant training activity, these "lead-free" alternatives should be considered for use. Lead exposures can be reduced by using jacketed rounds. Rounds that contain non-lead primers such as diazodinitrophenol (DDNP) can be used as a substitute for primers containing lead styphnate. Non-lead bullets or copper containing frangible rounds reduce lead exposure and ricochet and provide similar ballistic properties. For ventilation controls see Section 18

### 17. Noise Controls

Engineering solutions to reduce the noise levels from tube ranges are limited and may consist of sandbags along the bottom of the tube. Cement-based acoustical treatment may also be used. Additional sound attenuating materials can also be added to the interior surfaces of square tubes. Appropriate operational mitigation must be established to reduce the high impact noise exposure per reference (h). The use of hearing protection devices such as earplugs or circumaural muffs is mandatory when personnel are occupationally exposed to noise levels greater than 85 dBA or greater than 140 dBP. Areas or equipment where the sound pressure levels are 104 dBA or greater or 165 dBP or greater shall be labeled and require the use of double hearing protection (earplugs and circumaural muffs).

### 18. Ventilation Controls

Ventilation systems used within indoor firing facilities can be effective in controlling lead exposures and other contaminants. Existing systems may be inadequate. Some systems may be retrofitted to improve their performance; however, ventilation system modifications require engineering analysis by professionals experienced in indoor firing facilities ventilation design. Because any modification of a system affects the operation of other parts of the system, a thorough evaluation of the whole system is necessary. "Self-help" modifications rarely improve the control of exposures.

### 19. System Design and Maintenance

System design could control or eliminate health and safety hazards if designed around a facility’s intended use. For example, designing a facility for laser use can prevent associated hazards by eliminating all reflective surfaces inside the range. No system, regardless of design, can remain effective over time without proper maintenance. The evaluation of the ventilation system and recommended modifications should take into consideration the availability of qualified personnel committed to proper maintenance.

## 20. Administrative Controls

Administrative controls or operational policies, although least desirable, can be used to reduce exposures. This can take the form of limiting exposure time (limiting range use). This should be part of the facilities' standard operating procedures per reference (f). Other lead exposures resulting from hobbies, off-duty shooting and other work duties such as soldering can contribute to the individual's total lead exposure.

## 21. Ergonomic Controls

Reduce time in low-light settings where possible especially for range operators to reduce injuries such as eye strains or fatigue. If feasible, rotate personnel. Personnel should adjust poor posture as needed such as taking breaks or alternating legs while kneeling where feasible.

## 22. Facility Cleaning

Floors and horizontal surfaces should be cleaned on a regular basis. Cleaning frequency depends on how heavily the range is used. Floors and horizontal surfaces such as booth shelves or target retrieval systems may need daily cleaning if heavily used. Otherwise, cleaning should be performed once or twice a week. Cleaning can be conducted either with a vacuum equipped with a HEPA filter or wet methods. Consideration for an explosion-proof HEPA vacuum is necessary due to the possibility of buildup of unburned powder. The vacuum should be dedicated for lead dust cleanup. Individuals performing cleaning operations should be properly trained and not try to hurry the process. Dry sweeping or the use of compressed air to "blow down" the range or within CQC facilities is prohibited. The cleanup of spent shell casings ("brass") should not use brooms (a wooden "casino rake" can be useful). The ventilation system should be on during cleanup operations.

## 23. Hygiene Practices

a. Specific practices should be in place to prevent the accidental ingestion of lead or other contaminants. Personnel and shooters should know in what areas of the range they are allowed and in what spaces clothing or skin may become contaminated. Shooters should not be allowed past the firing line. Provide disposable shoe coverings for individuals who may have to walk down the range. Provide sticky walk-on mats at the exit door to remove dust from shoes of individuals exiting the firing facility.

b. The use or consumption of food and beverages, tobacco (smoking, dipping) use, vaping, or applying cosmetics is prohibited in firing facilities. Lead dust on hands can easily contaminate such items leading to accidental ingestion.

c. Shooters must wash hands and face thoroughly before consuming food, beverages, etc. Consider using lead decontamination wipes in addition to soap and water to remove lead from hands after cleaning firearms and picking up spent casings and before eating, drinking, or smoking. For operations where contamination is likely, personnel must vacuum off their clothing with a HEPA vacuum before exiting the range. Vacuuming reduces the spread of lead dust contamination to other areas of the building and to personal vehicles or quarters. A change room must be provided with a shower if personnel are exposed above the permissible exposure limit per references (d) and (e). If a break (lunch) room is available, it should have smooth, easily cleanable surfaces. It must be cleaned often enough to ensure surfaces are maintained as free as practicable of accumulation of particulates generated from firing exercises per references (d) and (e). To limit contamination of objects, bags and clothing, only the weapon to be fired and the necessary ammunition should be carried into the range. Coat racks or lockers external to the range are recommended.

d. Proper protective clothing must be maintained and available for personnel who perform range maintenance or cleaning where contamination is likely. Range support and cleaning equipment should be easily accessible but in a separate storage closet. An active range should not be used as a storage or office area.

## References

a. OPNAVINST 3591.1 Series, Small Arms Training and Qualification

b. DoD Instruction 6055.12, Hearing Conservation Program (HCP), latest revision

c. Navy and Marine Corps Public Health Center (NMCPHC) Technical Manual, NMCPHC TM-6260.51.99-3, Navy Medicine Hearing Conservation Program Technical Manual, latest revision

d. 29 CFR 1910.1025, "Lead" (General Industry)

e. 29 CFR 1926.26, “Lead” (Construction Industry)

f. OPNAVINST M-5100.23 Series, Navy Occupational Safety and Health Program Manual

g. Navy and Marine Corps Public Health Center (NMCPHC), Technical Manual, NMCPHC-TM OM 6260, Medical Surveillance Procedures Manual and Medical Matrix, latest revision

h. United Facilities Criteria (UFC), 4-179-02, Small Arms Ranges

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o. Navy and Marine Corps Public Health Center (NMCPHC) Industrial Hygiene Sampling Guide for Comprehensive Industrial Hygiene Laboratories (CIHLs), latest revision