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Acoustical Evaluation of Combat Arms Firing Range, Schriever AFB, Colorado

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TSgt Jerimiah Jackson

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USAF School of Aerospace Medicine
Occupational and Environmental Health Dept/OEC
2510 Fifth St.
Wright-Patterson AFB, OH 45433-7913

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

An acoustical assessment was performed on the Combat Arms Firing Range at Schriever AFB in April 2014. It was determined that the noise in the firing range did not meet the definition of impulse noise in accordance with AFOSH Standard 48-20, due to acoustical reflections. Therefore, it was recommended that acoustical absorption be added to these side walls to reduce the reverberant field.

15. SUBJECT TERMS

Impulse noise, impact noise, decay time, CATM, firing range, hearing, acoustics, noise, firearms

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DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
WRIGHT-PATTERSON AFB OH

19 August 2014

MEMORANDUM FOR 21 AMDS/SGPB
ATTN: MAJ BRUCE MURREN
625 W. ENT AVENUE
Peterson AFB, CO 80914

FROM: USAFSAM/OEC
2510 Fifth Street
Wright-Patterson AFB, OH 45433

SUBJECT: Consultative Letter, AFRL-SA-WP-CL-2014-0011, Acoustical Evaluation of Combat Arms Firing Range, Schriever AFB, Colorado

1. INTRODUCTION:

a. *Purpose*: From 07-11 April 2014, the United States Air Force School of Aerospace Medicine, Consultative Services Division (USAFSAM/OEC), at the request of AFSPC/SGPB and 21 AMDS/SGPB, conducted an acoustical evaluation of the Combat Arms Firing Range at Schriever AFB, Colorado. The process of assessing impulse noise at a firing range is a very complex task using specialized equipment to assess hazardous noise environments. USAFSAM/OEC is the only AF bioenvironmental engineering resource with both the skilled personnel and equipment to accomplish these risk management/mitigation surveys. The purpose of this assessment was to classify the measured noise exposure as continuous or impulse, explain how the classification pertains to Air Force Occupational Safety and Health (AFOSH) Standard 48-20, *Occupational Noise and Hearing Conservation Program*, and provide recommendations for mitigating exposure to hazardous noise.

b. *Survey Personnel*: Two Bioenvironmental Engineering Technicians, Consultative Services Division, USAFSAM/OEC.

c. *Personnel Contacted*:

(1) Bioenvironmental Engineer, 21 AMDS/SGPB
(2) Bioenvironmental Engineering Technician, 21 AMDS/SGPB
(3) NCOIC, Combat Arms, 50 SFS/S4C
(4) Combat Arms Instructor, 50 SFS/S4C

d. *Equipment*:

(1) B&K PULSE Analyzer, Type 3052-A-030, SN: 3052-105153
(2) B&K Microphone, Type 4128C 2530, SN: 2856097, 2856098
(3) Quest Calibrator, Model # QC-20, SN QF8050050

2. BACKGROUND:

a. The Schriever AFB Combat Arms Firing Range is a fully enclosed firing range with six total firing lanes (see Figure 1). The range is used to train personnel on M4, M9, M240, and M249 weapons firing. A noise-reverberant field occurs during firing where the noise energy is reflected off the ceiling, walls, and floor surfaces, thereby increasing noise levels for a longer duration. Downrange of the firing line is a series of steel safety baffles covered with plywood on the ceiling that are designed to deflect stray bullets and prevent bullets from leaving the range. These panels are closely spaced, thereby reflecting acoustical energy and increasing the duration of noise levels.

Figure 1. Schriever AFB Combat Arms Firing Range Lanes

b. During this assessment, data were not collected for the M240 machine gun, as it was inoperative.

c. According to AFOSH Standard 48-20, the maximum level of **continuous noise** that is allowed to reach the ear shall not exceed 115 dBA and the maximum level of **impulse noise** that is allowed to reach the ear shall not exceed 140 dB peak sound pressure level (SPL).

3. METHODOLOGY:

a. *Process Description:* The Combat Arms Firing Range is used to train and qualify base personnel on multiple weapons systems. The firing range has two distinct painted floor lines that are used for reference. The first point of reference is the yellow safety line. Students must stand behind this line while not actively firing a weapon. The second point of reference is the red firing line, which is located 8 feet forward of the yellow safety line. The red line is where each student actively fires a weapon at a downrange target. During live-fire weapons training classes, instructors are positioned along the yellow line to ensure the range is safe and to assist students when needed. During this assessment, Combat Arms Instructors were observed wearing dual hearing protection.

b. *Sample Procedures:* The SPL time histories corresponding to individual M4, M9, and M249 weapons firings were measured with 1/8-inch microphones placed 5 feet above ground level along the yellow safety line; see Figure 2 for microphone positions. Combat Arms Instructors' equivalent continuous levels (L_{eq}) data were collected over 30-second periods. These data were collected using the same 1/8-inch microphones as well as a ¼-inch microphone in a Head and Torso Simulator (HATS). The HATS was fitted with the same hearing protection devices that Combat Arms Instructors use. This allowed the collection of data presenting the unprotected vs. protected exposures levels to Combat Arms Instructors.

c. Time histories are measured SPLs over a duration of approximately 10 seconds. This duration provided sufficient time to characterize the decay of the acoustical energy to background levels. These time histories were then used to compute acoustical decay characteristics.

d. The linear SPL decay rates, in decibels per second, were computed by selecting the linear decay phase of each time history and performing a sound level versus time analysis through the decay phase. Decay times are calculated from the linear slope from 150 dB down to 80 dB. The slope of this curve is the decay rate.

e. SPL time history and noise dose data were collected in three phases to represent the spectrum of exposure scenarios typical at this range.

(1) During the first phase, one Combat Arms Instructor fired an M9 from firing lanes 1, 3, and 6. SPL time histories were collected at each microphone position.

(2) For the second phase, one Combat Arms Instructor fired an M4 from firing lanes 1, 3, and 6. SPL time histories were collected at each microphone position.

(3) The third phase of data collection was accomplished while one Combat Arms Instructor shot the M249 from firing lane 3. SPL time histories were collected at each microphone position.

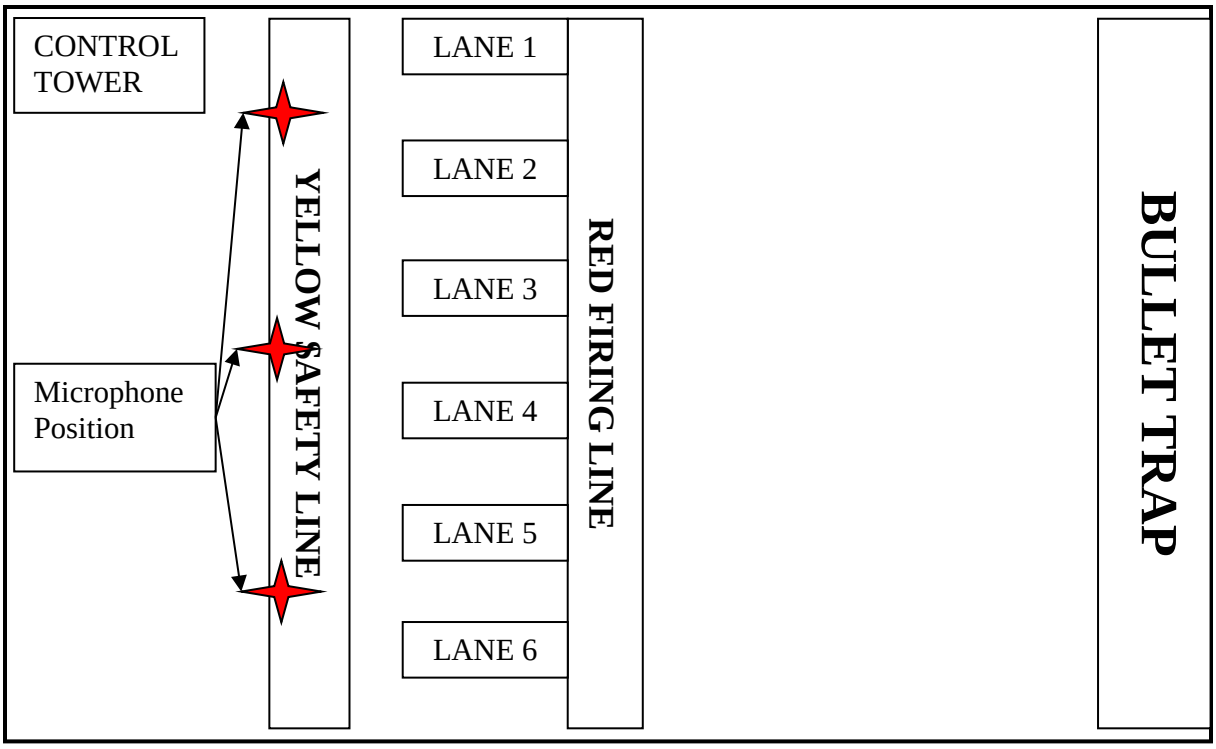

Figure 2. Schriever AFB Combat Arms Firing Range Layout and Microphone Positions

f. L_{eq} data were collected during two phases to represent the typical exposure scenarios at this range.

(1) During the first phase, data were collected while six Security Forces personnel each fired M9 pistols.

(2) During the second phase, data were collected while six Security Forces personnel each fired M4 rifles.

4. RESULTS:

a. Under the monitored conditions of this assessment, the average noise decay time for each of the weapons fired was greater than 1 second, with peak SPLs greater than 115 dB; therefore, the noise is classified as continuous. According to AFOSH Standard 48-20, Table 3, there is no allowed exposure time above 115 dBA.

b. The average decay time and noise characterization of the three different types of weapons are summarized in Table 1.

Table 1: Noise Characterization by Decay Time

Weapons System/Class Type	Average Decay Time (s)	Noise Characterization	Maximum Unprotected Continuous Noise Level (dB)	Exceeds Continuous Noise Std. (Yes/No)
M9 single shooter	1.7			
M4 single shooter	1.9	**Continuous**	**115**	**Yes**
M870 single shooter	2.1			

c. The average unprotected and protected L_{eq} for the Combat Arms Instructors for each weapon system are summarized in Table 2.

Table 2: Unprotected and Protected Noise Level Averages

Weapons System/Class Type	Average Unprotected Noise Level (dB)	Average Protected Noise Level (dB)
M9 Class	113	63
M4 Class	118	69

5. CONCLUSION:

a. Based on the average decay times, the noise in the range is classified as continuous noise. According to AFOSH Standard 48-20, there is no allowed exposure time above 115 dBA.

b. Based on the L_{eq} data, Combat Arms Instructors receive adequate protection from hazardous noise with dual hearing protection.

c. Speech intelligibility is poor due to the strong reverberant sound field of the range. This condition increases safety risks.

6. RECOMMENDATIONS:

a. Install sound-absorbing material to reduce the reverberant field. The reverberant field in the range should be minimized to reduce the noise level to protect instructors and students from hazardous noise exposure and to improve speech intelligibility.

(1) Treat the firing area's first overhead baffle, the ceiling, and side walls from the red line back to the rear wall, as well as the the rear wall, with acoustical absorption material. Quilted fiberglass, or other fiberglass panels wrapped in a manner allowing easy cleaning, is one option. There are also more fixed installation materials available, such as products offered by Pyrok or Troy Acoustics. The ideal goal of engineering controls is to reduce decay time to less than 1 second and peak SPLs to below 140 dB in accordance with AFOSH Standard 48-20, para

2.11.3.1. Controls to reduce the peak levels have been deemed operationally unacceptable. The goal of the sound-absorbing material is to change the noise classification from continuous to impulse noise by reducing the noise decay time to less than 1 second.

b. Both Combat Arms Instructors and students should continue to wear dual hearing protection during all live firing at the range.

c. Until effective engineering controls can be implemented, consider close scrutiny audiograms as defined in AFOSH Standard 48-20, 2.12.3 for all Combat Arms Instructors.

d. Combat Arms Instructors should provide just-in-time training to students on proper use of hearing protection devices as part of classroom instruction. The National Institute for Occupational Safety and Health has a short video, as well as a printable brochure, on proper insertion of foam ear plugs available for download at http://www.cdc.gov/niosh/mining/works/coversheet1840.html.

e. Request a USAFSAM follow-up noise assessment after acoustical treatment of the range is complete.

7. If you have any further questions regarding this report, please contact TSgt Jerimiah Jackson at DSN 798-3312 or jerimiah.jackson@us.af.mil. Please direct any questions or comments regarding Industrial Hygiene Consultative support to Maj Marc Sylvander at DSN 798-3855 or marc.sylvander@us.af.mil. To improve our services, please complete the critique located at https://www.surveymonkey.com/s/OECUSTOMERSURVEY.

JERIMIAH M. JACKSON, TSgt, USAF
Industrial Hygiene Consultant