

FIFTH INTERNATIONAL CONGRESS ON SOUND AND VIBRATION

DECEMBER 15-18, 1997
ADELAIDE, SOUTH AUSTRALIA

Invited Paper

IMPULSE NOISE FROM FIRE ARMS

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This paper contains basic information on the acoustical environment at several stands where members of the police force perform shooting practices. The object of the study is to gather information to improve the environment in existing and future constructions. Different types of guns were used for this study. Noise levels were recorded and analysed using instrumentation appropriated for this type of studies. The paper also includes details of the weapons used, the instrumentation and the shooting stands. Results are shown and analysed. Finally, recommendations regarding the construction of shooting stands are presented.

1. INTRODUCTION

It is well known that firearms generate impulse noise that can be harmful to the exposed ears. Several measures has been taken or recommended to reduce the sound level and/or the sound exposure while shooting, so that the resulting risk of hearing loss is minimised.

The main activities where non-military people are exposed to noise are hunting and target-shooting. The later is performed in open areas or in enclosed places, especially designed for the purpose.

Noise levels in the enclosed sites are higher, because of the multiple reflections from the surrounding walls, ceiling and floor as well as because at these facilities several persons are shooting at the same time.

The object of the present study was to perform measurements at several locations, to assess the hearing hazard and to make some recommendations on how the noise level could be reduced.

2. THE EXPERIMENT

2.1 MEASUREMENT LOCATIONS

Noise levels were measured at two enclosed target-shooting facilities (denominated Poligono de Tiro), located in

- San Fernando and
- Lomas de Zamora , and
- In the open, far away from any reflecting surfaces

Sketches of locations a) and b) are shown in Figures 1 and 2. It can be seen that at sites locations, there is a waiting area not acoustically insulated from the shooting stands. There also is no proper insulation between stands.

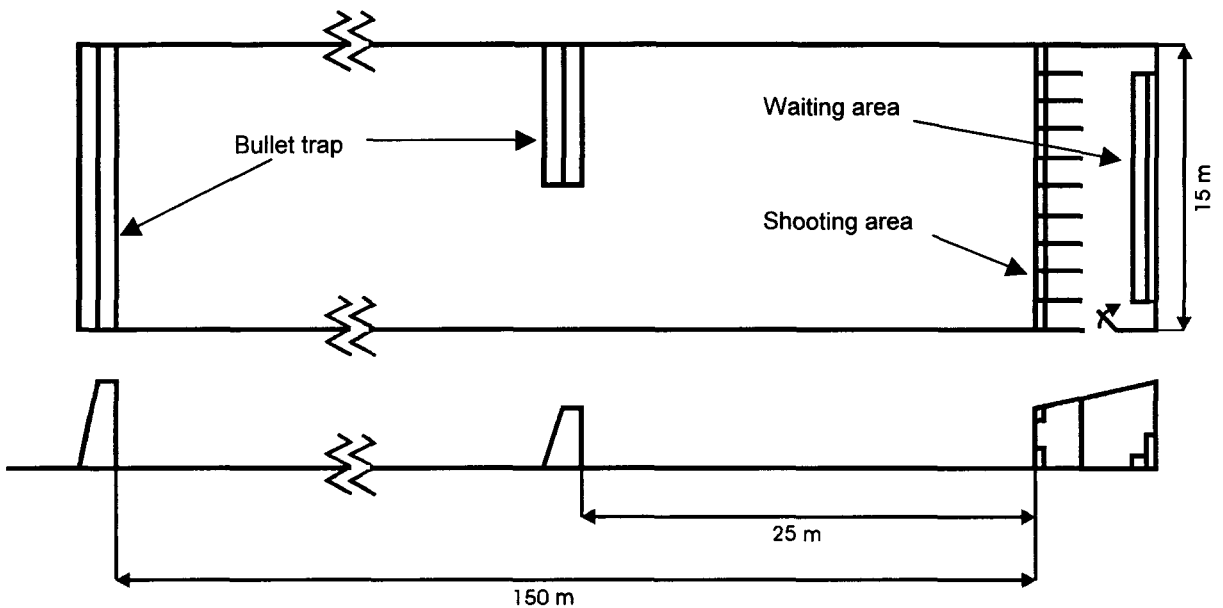


Figure 1: Sketch of San Fernando target-shooting facility.

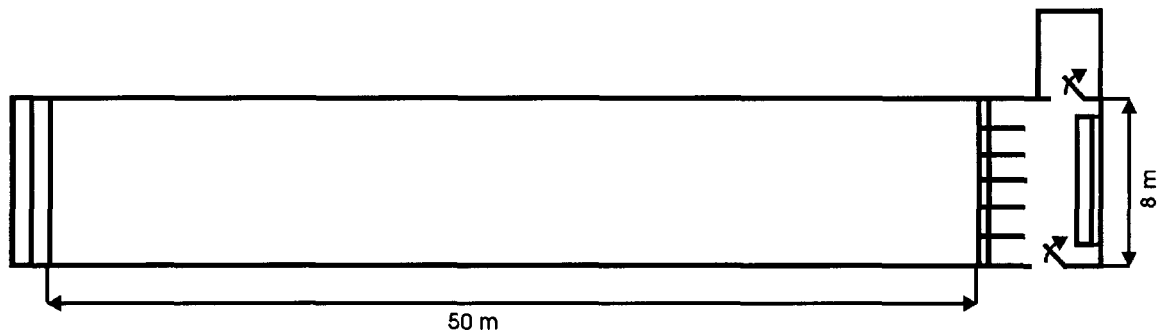


Figure 2: Sketch of Lomas de Zamora target-shooting facility.

2.2 MEASURING INSTRUMENT

Measurements were performed using the following instrumentation:

- SLM B&K type 2209 with a ½" microphone type 4165
- FM Tape Recorder B&K type 7004
- Pistonphone type 4220
- Oscilloscope KIKUSUI type 5020A
- Plotter HP 7004B
- Dosimeter QUEST

Two sets of instruments were used simultaneously. They are shown in the block diagrams on Figures 3 and 4. The first of them was for retrieving the results on the spots, while the second was to allow for the analysis of the results in the Lab.

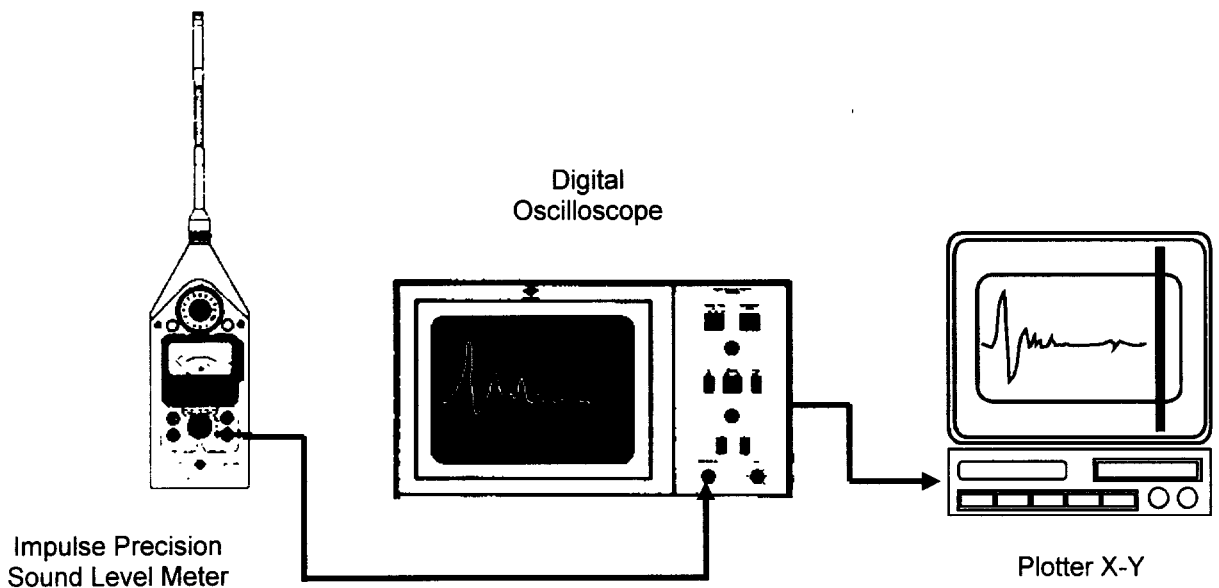


Figure 3

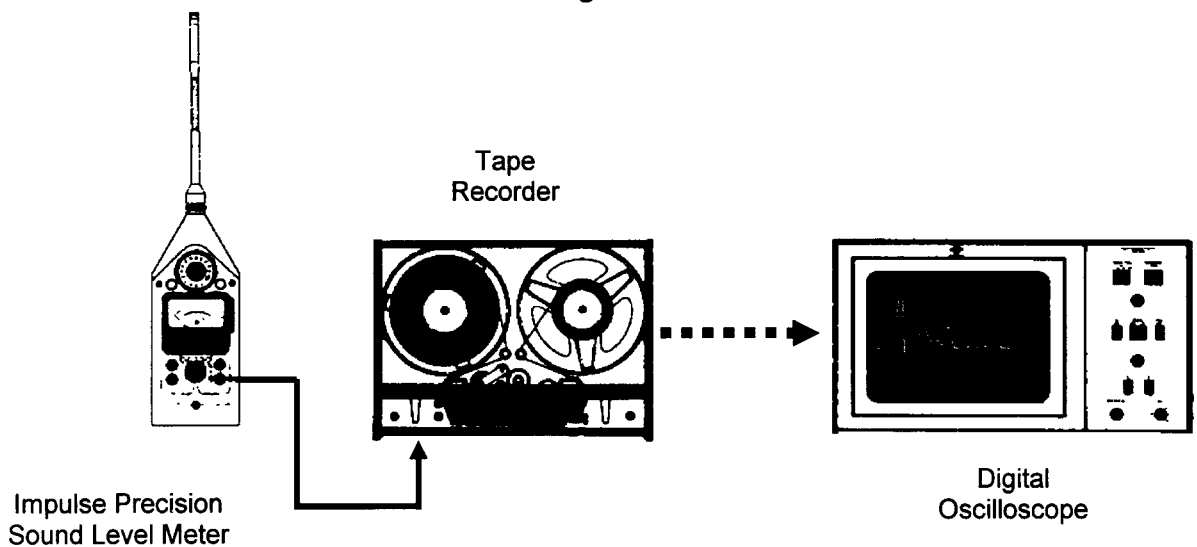


Figure 4

2.3 WEAPONS

Shooting was done using standard weapons.

2.4 PROCEDURES

For the peak level measurements as well as for the reverberation time measurements, the microphone from the measuring instrument was located close to the ear of the shooter.

The noise exposure levels were measured in the waiting areas, where the dosimeter was placed for 15 minutes.

3. MEASUREMENT RESULTS.

The results of the measurements are shown in Table 1, as well as in Figures 5, 6 and 7.

TABLE 1: RESULTS FROM THE MEASUREMENTS

<u>Location</u>	<u>Peak SL (dB)</u>	<u>Duration (ms)</u>	<u>Noise Exposure (dBA)</u>
<u>San Fernando</u>			
Rifle F.A.L. 7.62	153	95	↕ 101
Hand gun Browning 9 mm	146	80	
Shotgun 12/70	150	100	
<u>Lomas</u>			
Rifle F.A.L. 7.62	147	50	↕ 97
Hand gun Browning 9 mm	151	55	
Shotgun 12/70	154	54	
<u>In the open</u>			
Rifle F.A.L. 7.62	146	3	—
Hand gun Browning 9 mm	144	4	—
Shotgun 12/70	146	4	—

Note: Reverberation time in the shooting stands where, in 500 Hz:
San Fernando 1,30s; Lomas 0,85s, calculated using the first 200 ms of the decay.

Peak SL and Duration were measured with only one firing weapon at that certain period of time. Noise Exposure was measured during shooting practices with many weapons firing simultaneously.

Graphs from the decays can be seen in Figure 5, 6 and 7.

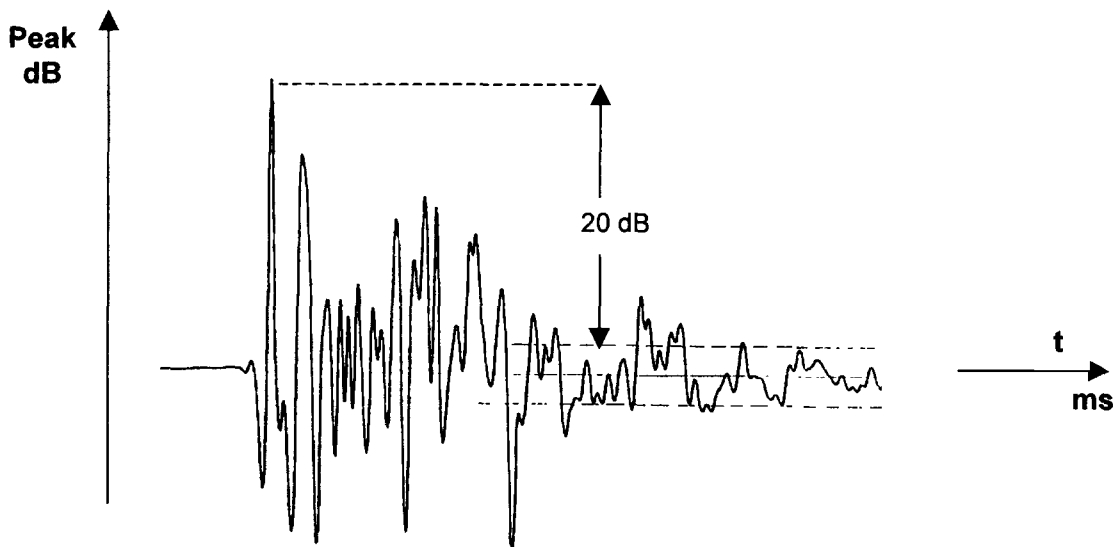


Figure 5: Impulse noise at San Fernando shooting stands.
Weapon: Hand gun Browning 9mm. Peak SL 146 dB; duration 80 ms.

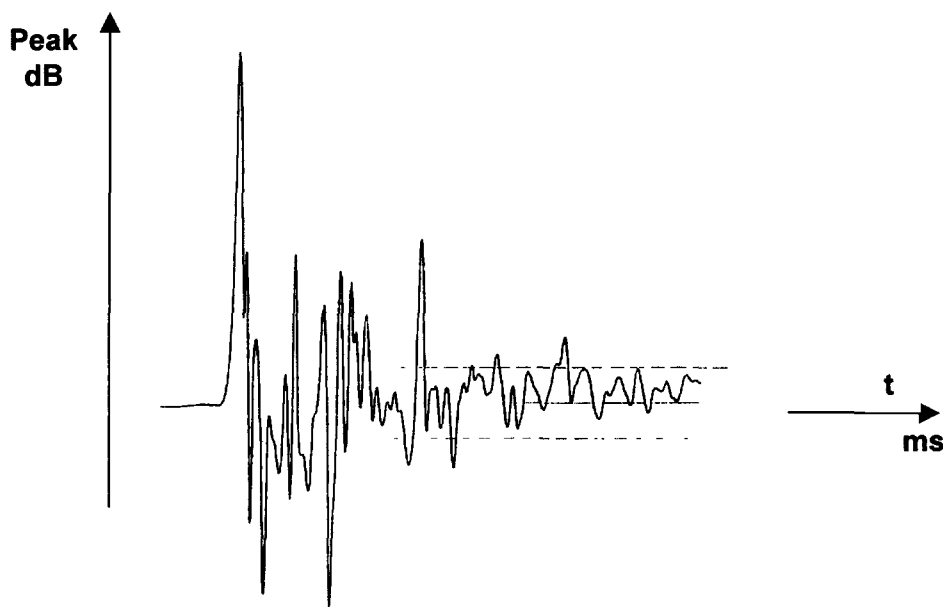


Figure 6: Impulse noise at Lomas de Zamora shooting stands.
Weapon: Hand gun Browning 9mm. Peak SL 151 dB; duration 55 ms.

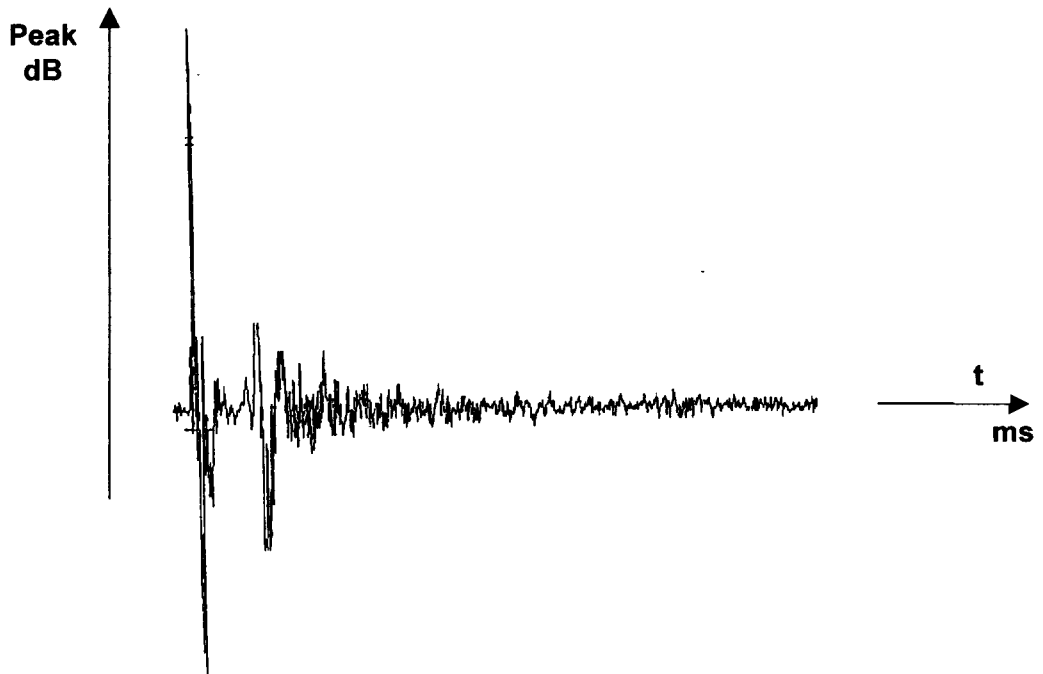


Figure 7: Impulse noise in the open.
 Weapon: Hand gun Browning 9mm. Peak SL 144 dB; duration 4 ms.

4. ANALYSIS OF THE RESULTS

Table 1 shows clearly, that the peak noise levels always exceed the limit established in the Argentinean Law of Hygiene and Safety, set at 130 dB peak for 100 shots of duration 50 milliseconds.

The same applies for the noise exposure level, where the measured value will limit the exposure of the waiting people to no more than 15 minutes, without hearing protection, resulting not only from the high noise levels, but also from the long reverberation time, also shown in Table 1.

One person shooting alone could stand only one shot, without hearing protection. In normal conditions, many shooters practising simultaneously are exposed too 100 or more shots. In that case, the improper use of protection may produce a serious hearing loss risk.

Nowadays, people in the waiting area are always exposed to the same risk.

5. RECOMMENDATIONS

From the above study, the following recommendations apply:

- a) Shooters should wear mandatory hearing protectors with an NRR of at least 25. They should be properly trained in their use, fit and care.
- b) The waiting area should be acoustically insulated from the shooting stands, so that noise levels there be at or below noise levels that could be dangerous to the hearing of people that are there. Recommended levels are: $L_{eq, 8hs} \leq 80$ dBA and peaks of less than 110 dB.
- c) There should be a proper acoustical separation between stands, so that the noise from one shooter should not be dangerous to others, and, finally.
- d) The reverberation time should be reduced in the waiting area as well as at the different stands. This will further reduce the noise exposure.

6. ADITIONAL CONSIDERATIONS

The location of these target-shooting facilities sometimes generates claims from the neighbourhood. That is why a study has been started in order to evaluate the situation and find possible solutions to the problem.

7. ACKNOLEDGMENTS

The authors wish to thank Prof. Alberto Behar for valuable discussion about the details of the measurements.