

INTERNATIONAL FIREARMS SAFETY SEMINAR 2006
RANGE DESIGN AND CONSTRUCTION

Introduction

Mr Chairman, ladies and gentleman. I am Major Chris (Red) Lawrence of the NZ Army and for the next 30 minutes my presentation will take you on a very quick journey through range design and construction. This presentation will conclude with a workshop, which will be conducted by Wally Cole of Ordnance Developments Limited, at the McLean's Island Range facility tomorrow.

Approach

Laser safety.

It is not possible in the time I have available to cover the subject of range design and construction in any detail. The approach I have taken is to focus on the ballistic safety requirements that are common to most ranges.

This presentation is not intended to criticize any existing range, but will hopefully provide you with some ideas and concepts worth considering. Should you wish to discuss a particular range design and construction in more detail, I would be more than happy to make myself available during the remainder of the seminar.

Presentation Sequence

My presentation will cover:

- Publications.
- Shot distribution and the cone of fire.
- Range types and danger areas:

- Full danger area ranges.
 - Limited danger area ranges.
 - No danger area ranges.
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Publications

Within the international community, there is a large amount of publications on range design and construction that could be used to support this presentation. I have chosen the following four publications:

- The NZ Police Range Manual (a copy of which is in your seminar pack)
- Joint Services Publication Number 403 (JSP 403) - *Handbook of Defence Land Ranges Safety, Volume II – Design, Construction and Maintenance of Small Arms, Infantry Weapon Systems and 30mm Weapon System Ranges* (this publication is produced by the UK MOD and is the primary NZ Army reference).
- Range Design and Construction Guidelines This publication is produced by the Canadian Firearms Centre, Department of Justice Canada.
- NZ Pistol Association Range Manual.

These four publications all have one common thread and that is they are based, at least in part on the scientific trials and technological development that started in the late 1980s and continues to this day.

Explain Romo Beach trial.

Shot Distribution

The first step in the range design process is to determine how far from the intended point of aim shots are likely to fall. As the final result is normally in the shape of a cone, this is known as the cone of fire.

In 1988 an study was conducted to establish the shot distribution on a United Kingdom range. The study used a projectile locating system to accurately record the position of each shot over an 18 month period. The resulting cone of fire for 100m is shown on this slide.

Explain.

Cone of Fire Comparison

Cones of fire for the same firearm type may differ depending on the respective territorial authority's requirements, skill level of the firers, and type of shoot.

Explain table.

Cone of Fire – Factors to Consider

Definition - The cone of fire is intended to contain, in the vertical and horizontal planes, all fired projectiles that are to be allowed for in range design. It includes an allowance for acceptable firearm deviation and an additional margin for firearm deviation that is considered unacceptable. The allowance made for unacceptable firearm deviation is not a scientific prediction but reflects a desire by the user to mitigate as much of the unacceptable deviation as is practicable.

Acceptable Firearm Deviation – is one which has been identified, quantified, and subsequently allowed for procedurally or through the design, construction or layout of a range. Such deviations can be considered tolerable within a risk assessment and result from:

Firearm System Error – Caused by errors associated with the firer and manufacturing tolerances associated with the firearm and ammunition.

Predicted Firing Error – An acceptable margin of deviation from the intended point of impact associated with competently fired shots with predictable yet unintentional aiming errors.

Unacceptable Firearm Deviation – is one that is not allowed for in range design or firing procedures and may result in levels of hazard that are intolerable and which must be reduced to a level as low as is reasonably practicable. They result from.

Misdirected Firing Error – Deviation from the point of aim associated with competently fired yet misdirected shots.

Random Firing Error – Single shots that are unintentionally fired with significant random deviation from the intended point of aim, but which are aligned about the general axis of the range by virtue of good range control and firer discipline.

Wild Firing Error - Results from single shots that may be deliberately aimed or unintentionally fired in gross contravention of good range control and firer discipline, and which may impact anywhere inside the total energy area of the ammunition.

Full Danger Area Ranges

Where a range does not meet the requirements of a Limited or No Danger Area Range it will normally be deemed a Full Danger Area Range. The following method of designing a danger area template is recommended (Example 7.62mm military ammunition):

- **Line AB.** A straight line between the firearm and the target, which has been extended to the maximum length of the template. The maximum length of the template is either:
 - The maximum possible range of the projectile (total energy zone).
 - The maximum possible range of the projectile with a quadrant elevation limitation imposed. This range must not be shorter than the maximum ricochet angle.
- **Line AC** – Cone of fire angle
- **Line AD** – Opening ricochet angle
- **Line CE** – Closing ricochet angle
- **Line ED** – Ricochet boundary
 - **Ground Target** – All surfaces that will deform or break up when impacted at low angle (e.g. earth).
 - **Hard Target** – All material that possesses sufficient strength and surface hardness that suffer little or no deformity when impacted at low angle (e.g. steel).

The template is then applied from all likely firing positions to all likely target positions to determine the overall range danger area.

Post Impact Considerations

- **Air danger height / vertical danger height**
- **Ricochet (1st and subsequent)**
- **Pop-over**
- **Splatter**

- Backsplash
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Limited Danger Area Ranges

Explain gallery range danger area template.

Explain gallery range features.

Explain baffled range features.

Explain hill background dispensation – 56^o

Explain hill background dispensation – 34^o

No Danger Area Ranges

Explain 25m 1908 Barrack Range

Range Features

- Firing positions/mounds
- Range floor (including ricochet pits)

- Baffles (overhead and ground)
 - Mantlet
 - Target area
 - Bullet catcher or bullet trap
 - Stop butt
 - Range danger area
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Summary

- Call attention to range design and construction as an important component of responsible and safe firearms use.
 - Motive quality research into cone of fire dimensions and the post impact behaviour of sporting ammunition.
 - Exchange ideas and concepts for the design and construction of ranges.
 - Encourage your participation in this field by ensuring that your ranges are appropriately designed and constructed for the activities you wish to conduct on them.
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Your questions are invited