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Symposium technical overview: Introduction into service of new combat weapon systems onto existing weapon ranges

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Welcome

Introduction

→ **Weapon system elements critical for designing ranges**

Weapon

- Barrel length
- Muzzle pressure
- Rate of fire
- Aiming system

Ammunition

- Propellant
- Calibre
- Weight
- Round composition (heavy metals, plastics, jacketed)
- Cartridge composition (brass, plastics)
- Accuracy in fight

User

- Indoor or outdoor
- Minimum and maximum engagement distance
- Rate of fire
- Grouping

> Topics

Design aspects that will be discussed in this presentation include :

- Range Safety
- Acoustics
- Blast modelling
- Environmental
- Ventilation
- Terminal ballistics
- Summary

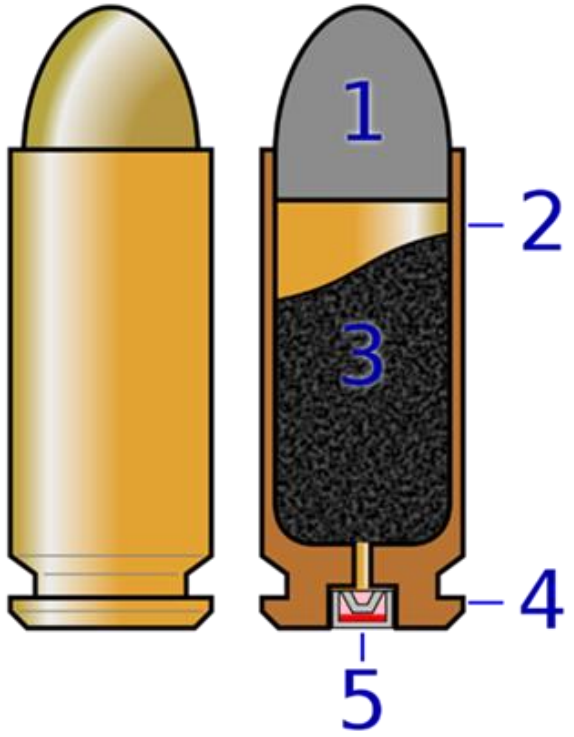
References:

1. Wikipedia, “Cartridge (firearms)”; https://en.wikipedia.org/wiki/Cartridge_(firearms). Accessed 8 Oct 2022.
2. NSW Police Force, Range Users Guide, Version 10 September 2017.
3. Department of Defense, United States of America; Section 742(a)(2) of the National Defense Authorization Act for Fiscal Year 2020 (Public Law 116-92): “Modification of Requirements for Longitudinal Medical Study on Blast Pressure Expore of Member of the Armed Forces”. Annual Status Update Jan 2021
4. Paul Hazel, “Armor, Materials, Theory and Design”; CRC Press, 2015.
5. Department of Defence, “Pollution Prevention Management Manual”, Infrastructure Division Environment and Engineering Branch, Ed 1 2017
6. DSA 03 OME Part 3 Volume 2

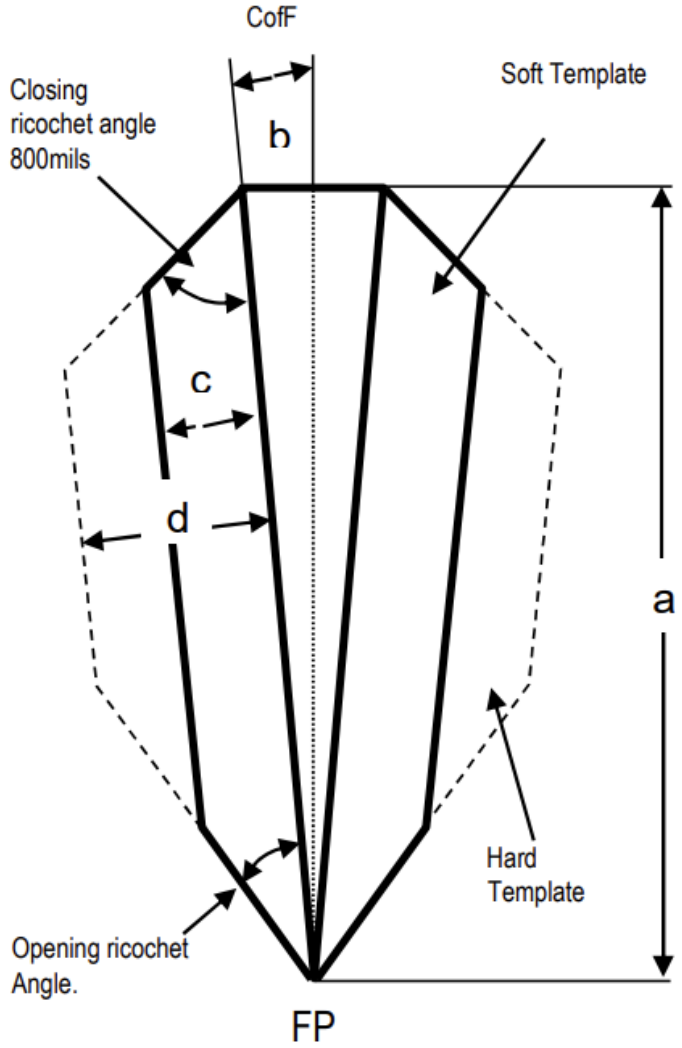
Terminology

A modern round consists of the following:

1. Bullet, as the projectile;
2. Cartridge case, which holds all parts together;
3. Propellant, for example gunpowder or cordite;
4. Rim, which provides the extractor on the firearm a place to grip the casing to remove it from the chamber once fired;
5. Primer, which ignites the propellant. (Reference 1)



Range safety (1/2)

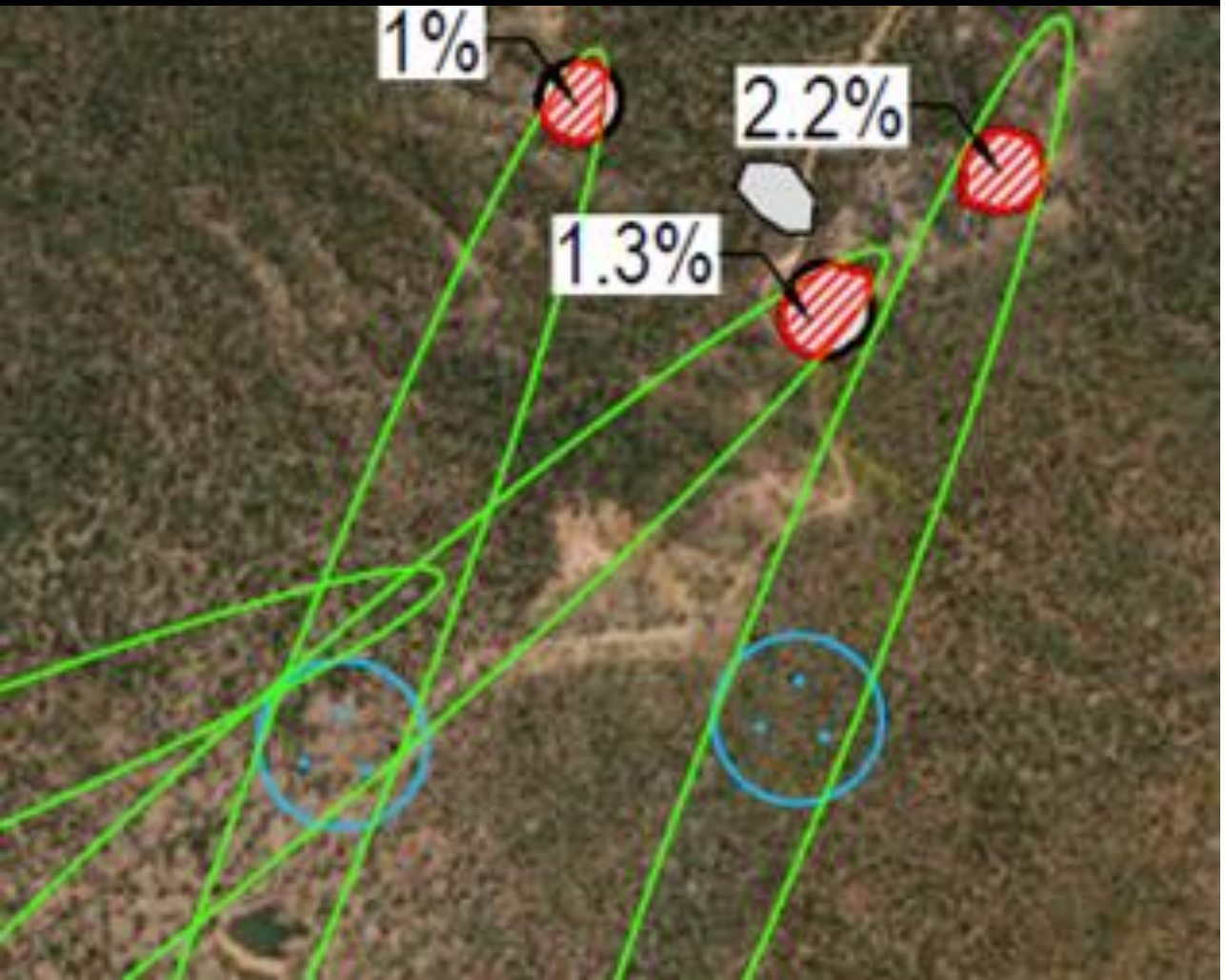


Example Weapon Danger Area template (taken from reference 6 DSA 03.OME Part 3 Volume 2, Figure 15-2)

Weapons systems require:

- Development of Weapon Danger Areas (WDA – UK MoD) including air danger heights or Surface Danger Areas (SDZs - US DoD)
- Range Danger Area Safety Traces (specific to each range)
  - Probabilistic
  - Deterministic
- Limitations to be addressed by Training Area Capability Board
- Changed to infrastructure and /or training ammunition needs identified.

Range Safety (2/2)



Probabilistic WDAs

– Allows detailed assessment of risk of hitting sensitive areas inside the range template

– Allows the option of using other risk controls (not just exclusion zones).

Acoustics

Collection of acoustic data allows noise modelling of ranges so that mitigation measures can be identified. These are:

Community exposure

- Increase distance
- Noise reducing infrastructure
- Limit duration of noise exposure

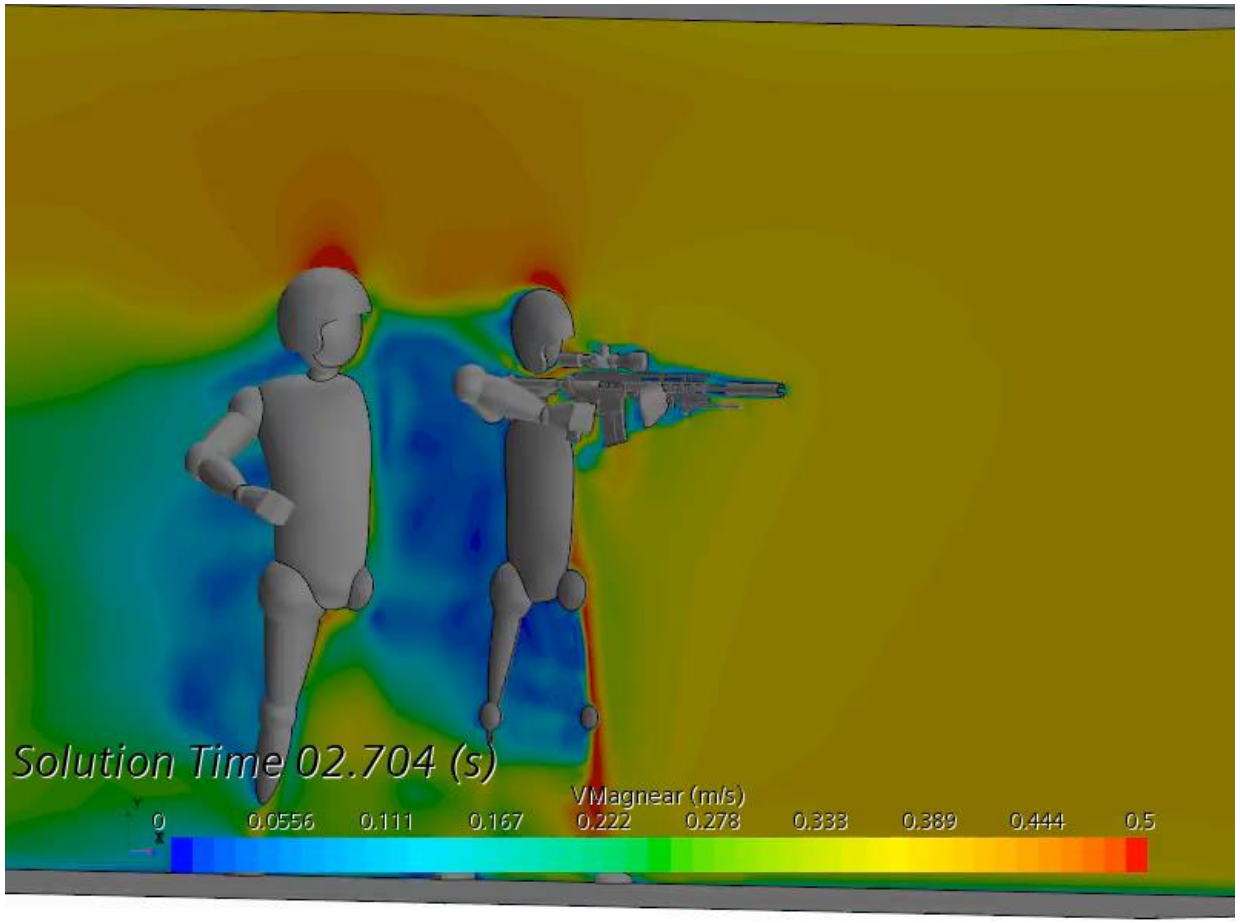
Personnel exposure

- Noise (direct hearing damage)
  - Reduce by PPE
  - Reduce by exposure
- Concussive overpressure
  - Use of PPE (hearing protection)
  - Repetitive brain injury (reduce exposure)
- Simultaneous exposure to noise and toxic agents

Environmental

- DPPM (reference 5) already provides policy for heavy metal management.
- Assessment of environmental risk requires long term pre and post assessments to determine risk.
- The current introduction into service process for ammunition, involves the development of a PERM – but this is range agnostic.
- Any new ammunition type used on a range should be tested in presence of a suitably qualified environmental scientist as early as possible to confirm any additional constraints

Ventilation



Purpose of ventilation is to ensure time weighted averaged exposure to air contamination is within AS.

Compliance is checked through:

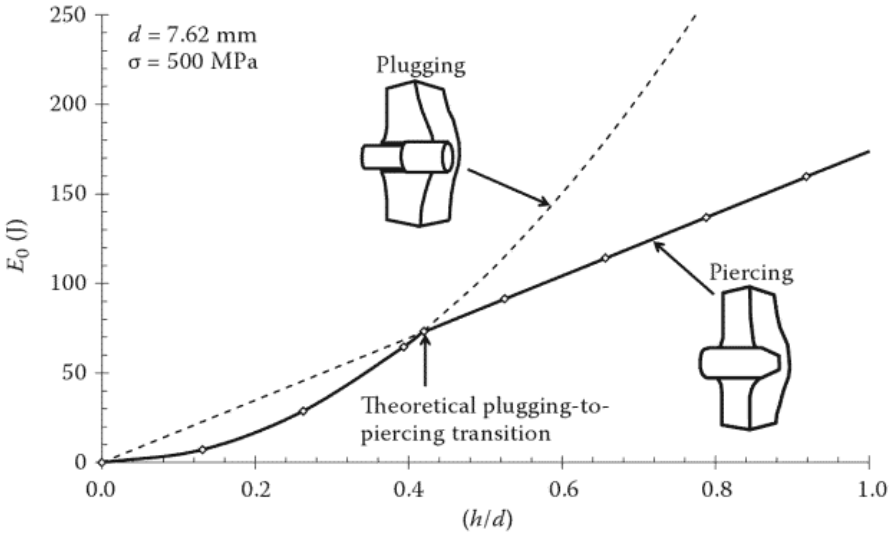
– Live fire testing with personal samplers OR

– Use of CFD modelling (to be developed).

[Modelling requires access to data on the weapon and ammunition to be used]

Ranges are designed for specific ammunition and weapons. Options for fast tracking new ammunition would be to:

- Establish baseline tests for the design rounds and compare to known ammunition.
- Baseline tests could include:
  - fracture energy assessment of new rounds,
  - penetration testing of known materials (such as BHN 500 steel)
  - post firing fragmentation assessment (i.e. measurement of the fragments generated when impacted on a hard and semi-hard surface), and
  - fragmentation velocity measurement.



Taken from reference 4; Figure 4.1

FIGURE 4.1
Transitioning from plugging to piercing during penetration (E_0 = energy required to perforate the plate, σ = 500 MPa and d = 7.62 mm).

Conclusion

Intent of this presentation is to discuss testing requirements of weapons systems with regards to:

- Range safety,
- Acoustic,
- Blast overpressure,
- Ventilation,
- Terminal Ballistic design, and
- Environmental review

Aim is to start a conversation – how best to introduce new weapons systems into ranges through:

- Early testing during procurement
- Early identification of infrastructure needs

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Thank You

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