Munition Life Assessments – An AUS/UK Perspective

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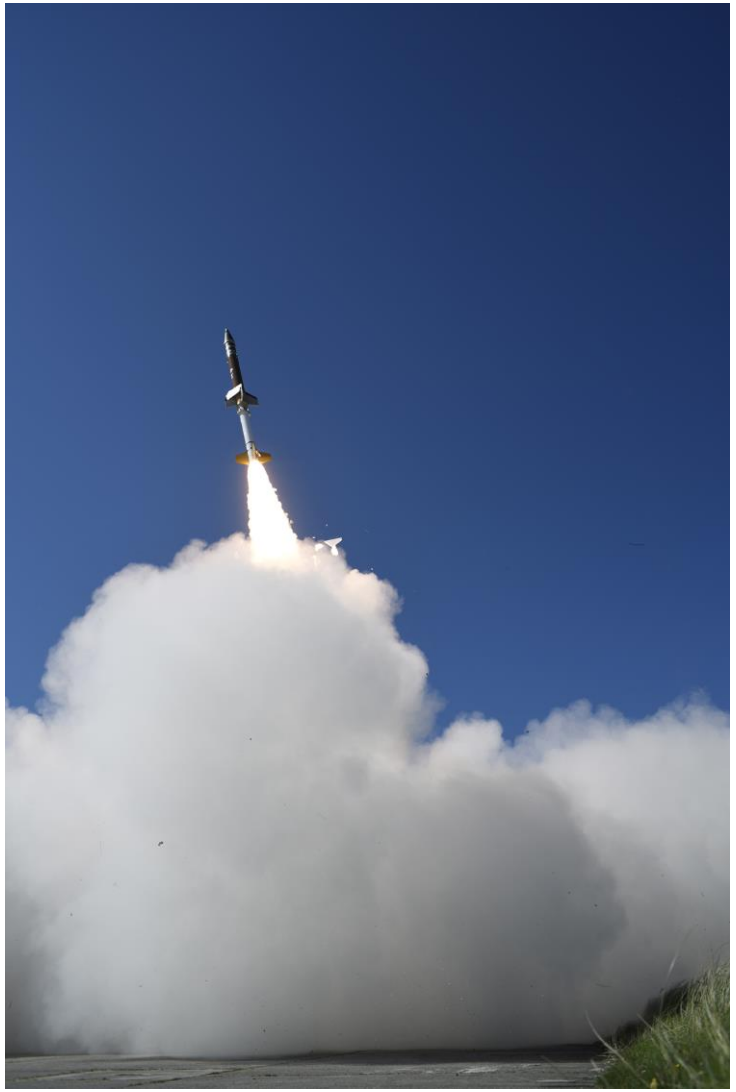
Overview



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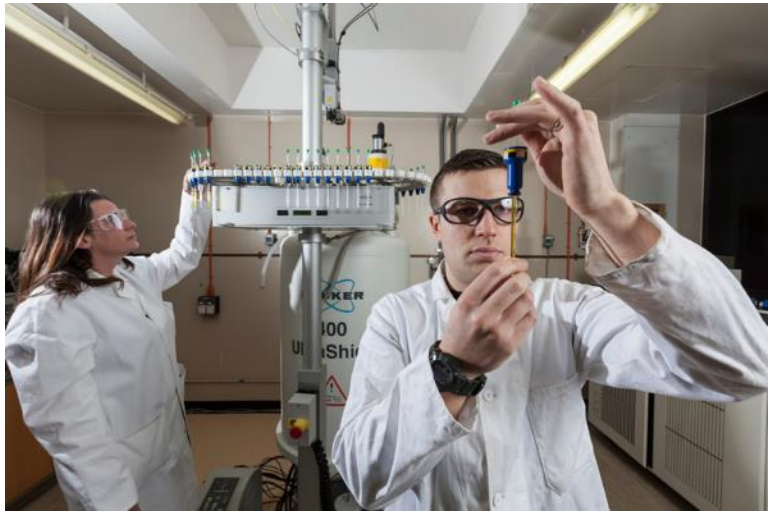
Aim

- Who am I and what have I done?
  - Energetic Material Chemist
  - Technical Lead for Breakdown Test and Critical Analysis Programme
  - Weapon Science Technology Centre Planning Team
  - Australian Department of Defence Desk Officer for Energetic Materials and Lifing
  - Principal Scientist Safety and Suitability for Service (S3)
    - A slowly going grey beard…
- *“The pep talk…”*
- Demonstrate different approaches taken to OME S3 assessments
  - Compare national AUS to UK approaches
  - How technical assurance is gathered through evidence based assessments
  - Highlight some engineering challenges and T&E examples



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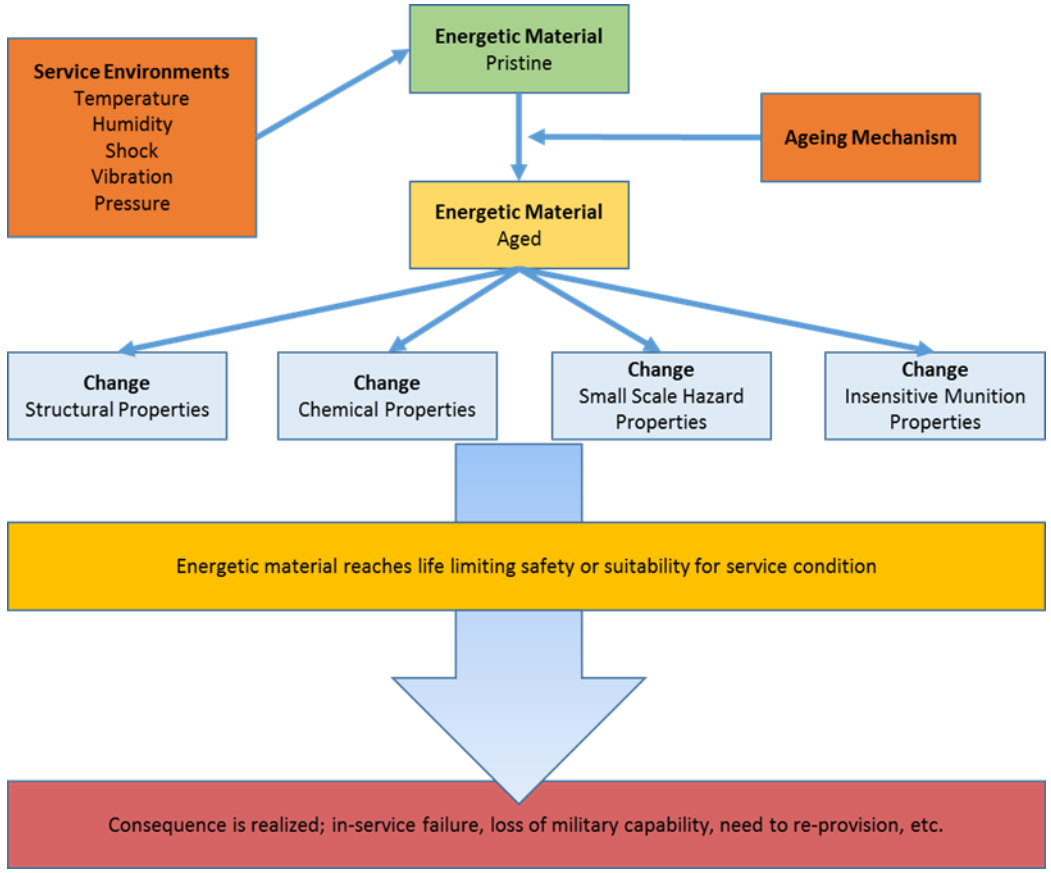
Life Assessment Overview

Robust S3 assessments are conducted through life and are dependant on T&E

- Typical life assessment phases
  - Design configuration
  - Role and environment
    - Manufacture to target or disposal sequence
  - Failure modes
    - Subject matter expert's judgement
  - Risk assessment
    - Likelihood and consequence
      - The Swiss cheese…
  - ***Testing***
    - Informs decision making
    - De-risks hazards
  - Assessment
    - Usage
    - Inventory management



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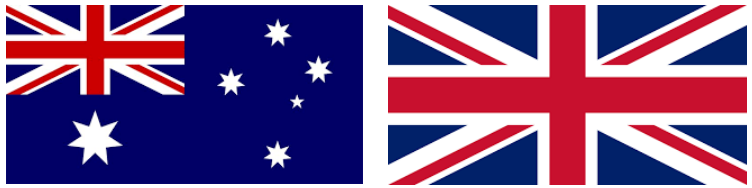
UK/AUS Approaches – Introduction into Service



Difference between *large* and *medium* sized military forces

- Similar usage of international standards (AOP-15, STANAG 4170, AECTP-200, etc.)
  - Greater number of national standards used by larger nations (DEF STAN 00-35)
- Similar method of assessment
  - Consideration of configuration, role and environment (CRE)
  - Failure mode based risk assessment
  - Decision making by operational duty holder / capability manager
- Different approach to ***testing***
  - Based around capability and capacity
  - Larger military forces typically have a bigger industrial base
    - Operate complete qualification test program to home nation manufacture to target or disposal sequence (MTDS)
      - Greatest level of technical assurance and risk reduction
  - Medium military forces are typically more accepting of manufacturer / overseas Authority test data
    - Consider level of evidence and differences between the MTDS of home and nation of manufacture
      - Test the qualification deltas or accept the risk

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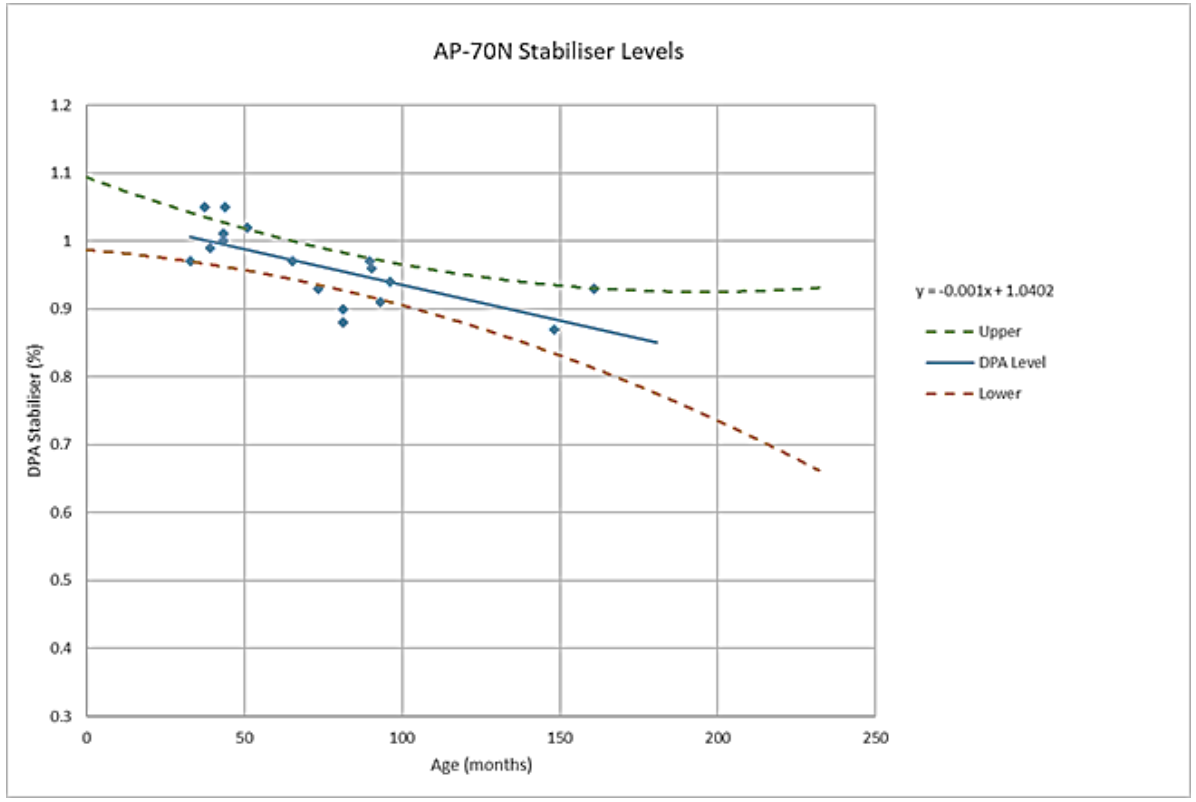
UK/AUS Approaches – In-Service Surveillance

Difference between large and medium sized military forces

- ISS large nations
  - More frequent test
  - Comprehensive characterisation
  - More use of statistical analysis and predictive models
- ISS medium nations
  - Emphasis on NDT
  - Destructive assessments focused on primary failure modes of more accessible materials
  - Reliance on overseas Stockpile Reliability Programmes



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Australian Examples

Thanks to friends and colleagues at Explosive Materiel Branch...

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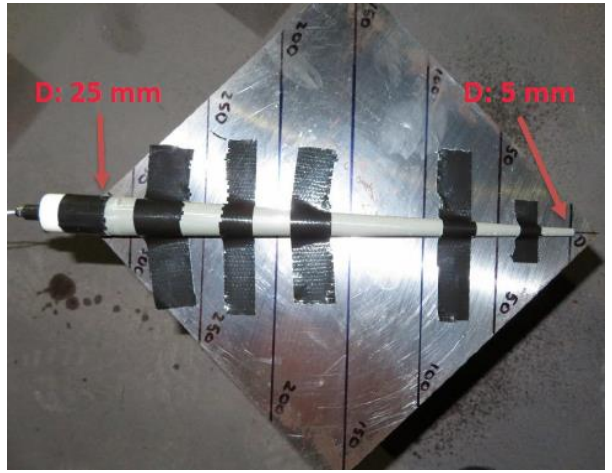
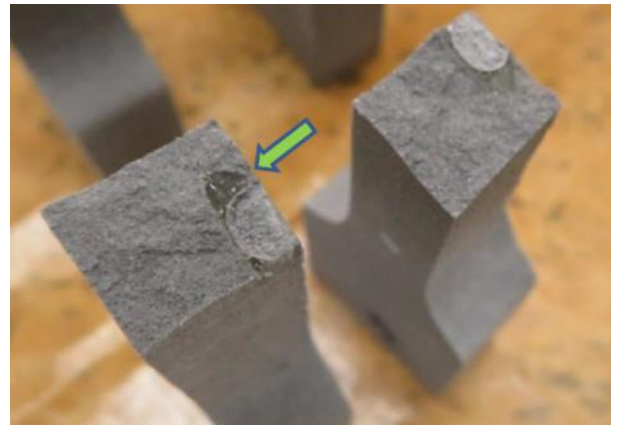
AUS Approaches – Energetic Material Qualification

EMQ assures that energetic materials are S3 for the military application.

- EMQ data is a key requirement in the Technical Certification of OME.
- Essential requirement for new explosives.
  - Steady state production
  - Characterised IAW STANAG 4170 / DEOP-102
- Requalification triggers
  - Change of ingredient vendor
  - Triggers testing to assure no inadvertent impact is caused by the change
    - Thermal stability
      - Compatibility with age
    - Mechanical properties





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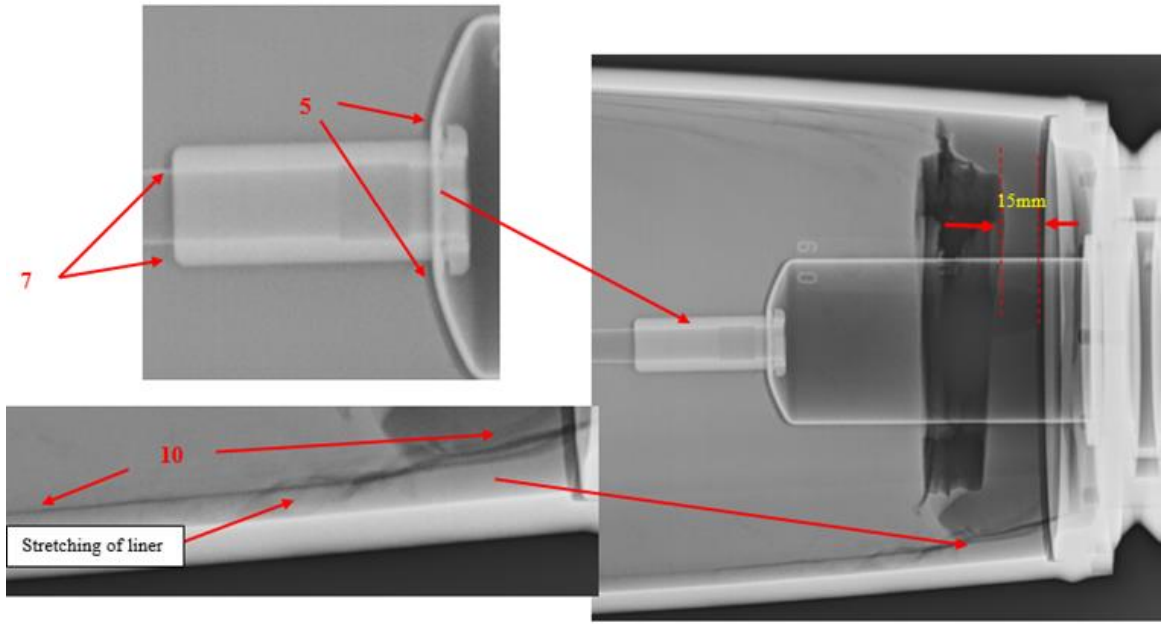
AUS Approaches – Introduction Into Service

A limited Sequential Environmental Trials program delivered in support of domestic Air Force Bombs.

- Assessed the environmental impact of the MTDS
- An efficient program developed to test a sub-set of impactors to build upon overseas data
- Radiography pre and post environmental trials
  - High and low temperature storage
  - Solar radiation and diurnal cycling
  - 28 day temperature and humidity
- Transport vibration:
  - C-17
  - C130J
  - Road
- Defect identification
  - Liner flow and separation
  - Informs risk assessment



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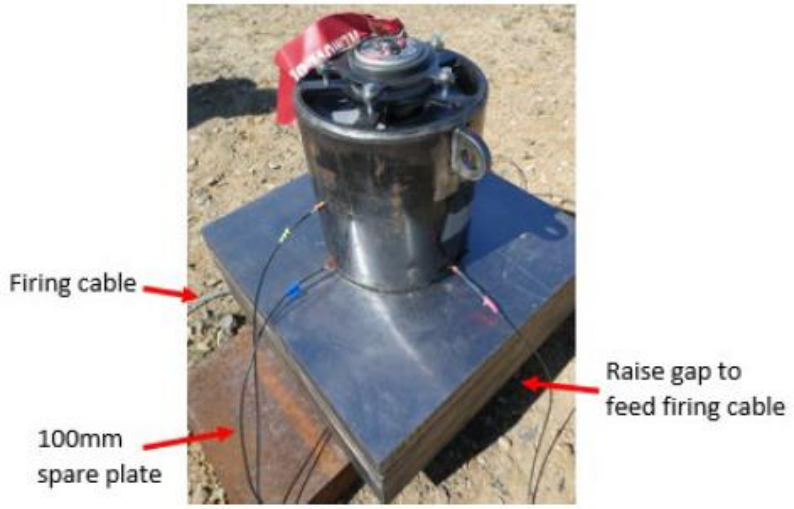
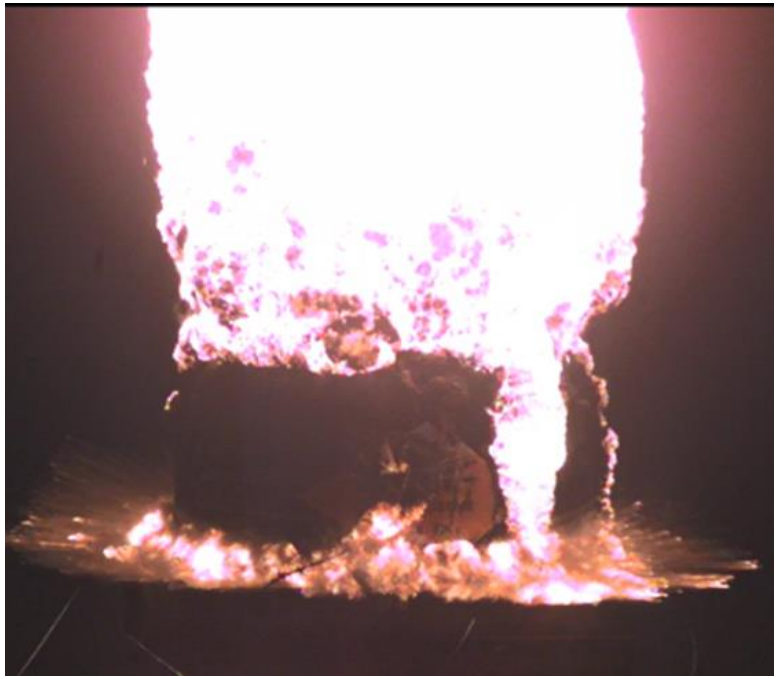
AUS Approaches – Specification Tolerances

Specification tolerances need to be understood in terms of S3 impact and adjusted accordingly.

- Test plans developed to determine tolerable gaps between Warhead Fuze and explosive.
- Gaps 4 to 20 mm at ambient
  - In triplicate
- 12 and 16 mm at temperature extremes
  - Time of arrival
  - Witness plate assessment
  - High speed video

Make informed decisions to revise manufacturing tolerances and save on rejection rates.





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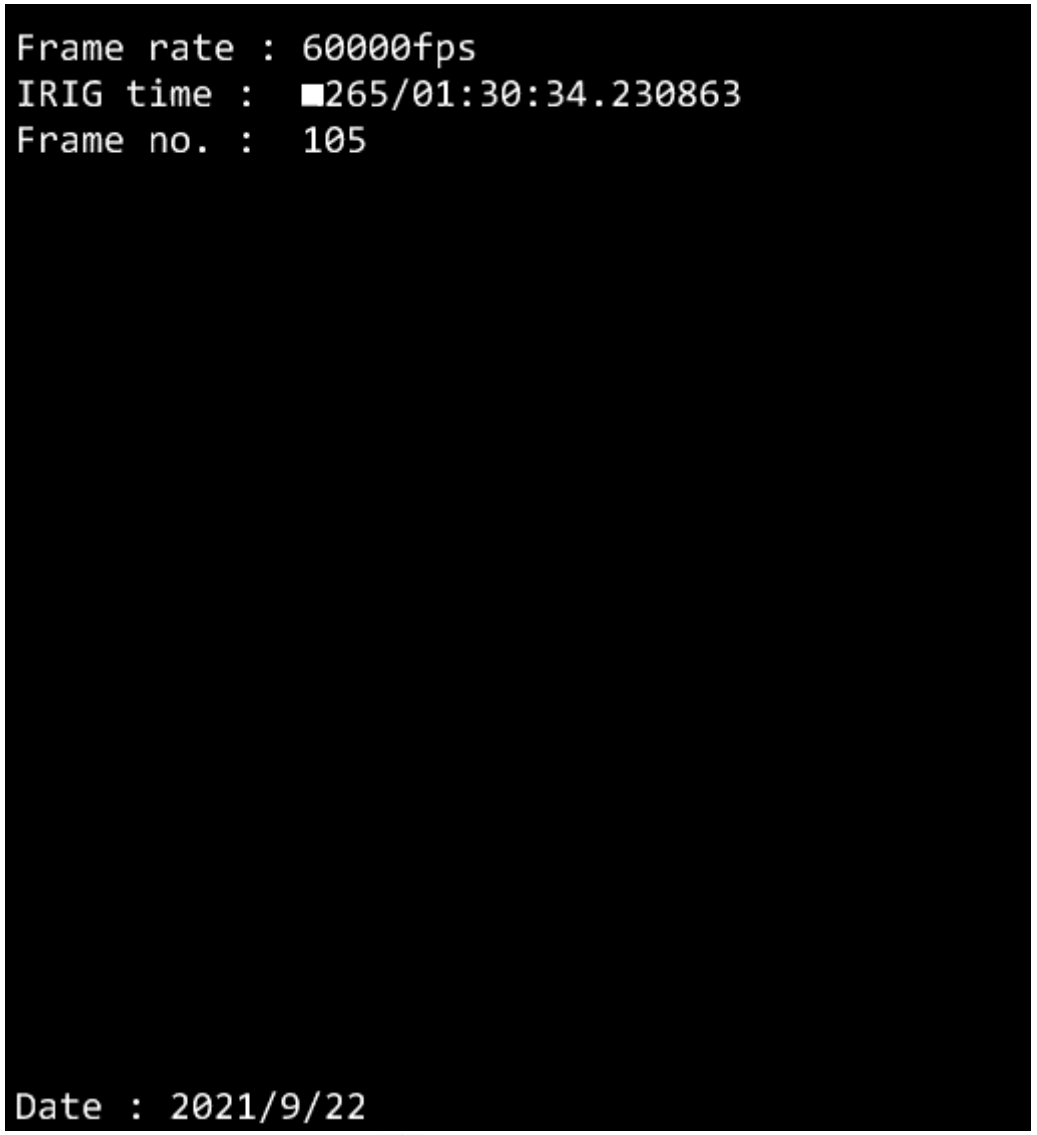
AUS Approaches – Specification Tolerances

Video:

- 20 mm gap at ambient



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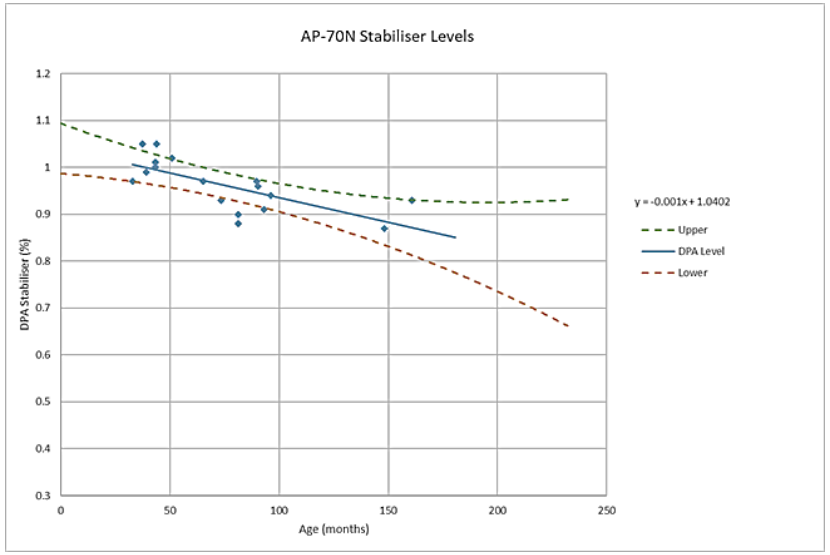
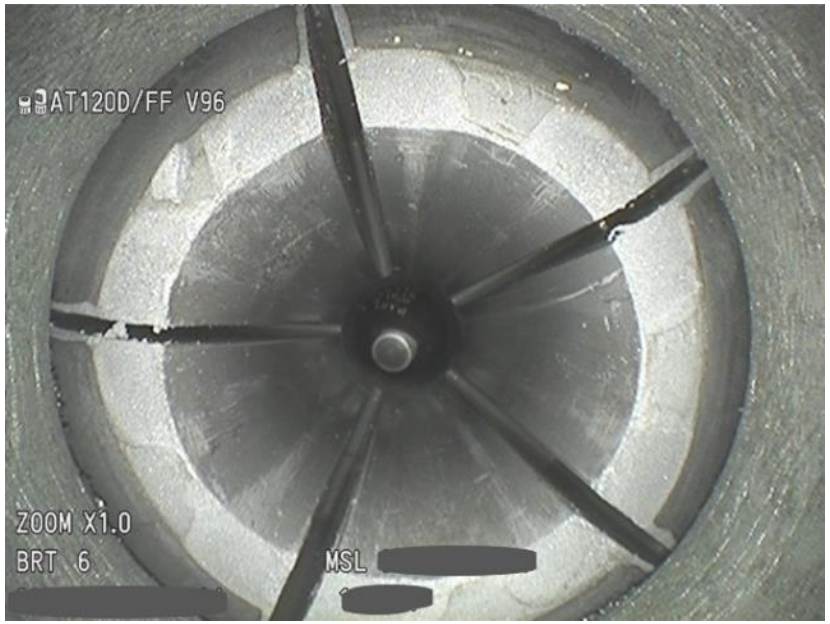
AUS Approaches – In-Service Surveillance (ISS)

ISS routinely carried out via the Explosive Ordnance Safety and Reliability program.

- ISS provides continued S3 assurance through life
- Well established for Small Arms Ammunition
  - Stabiliser
  - Heat flow
- Less established for Guided Weapons
  - The extension of this program to Guided Weapons leads to further realisation of the benefits in terms of reduced whole life cycle costs.





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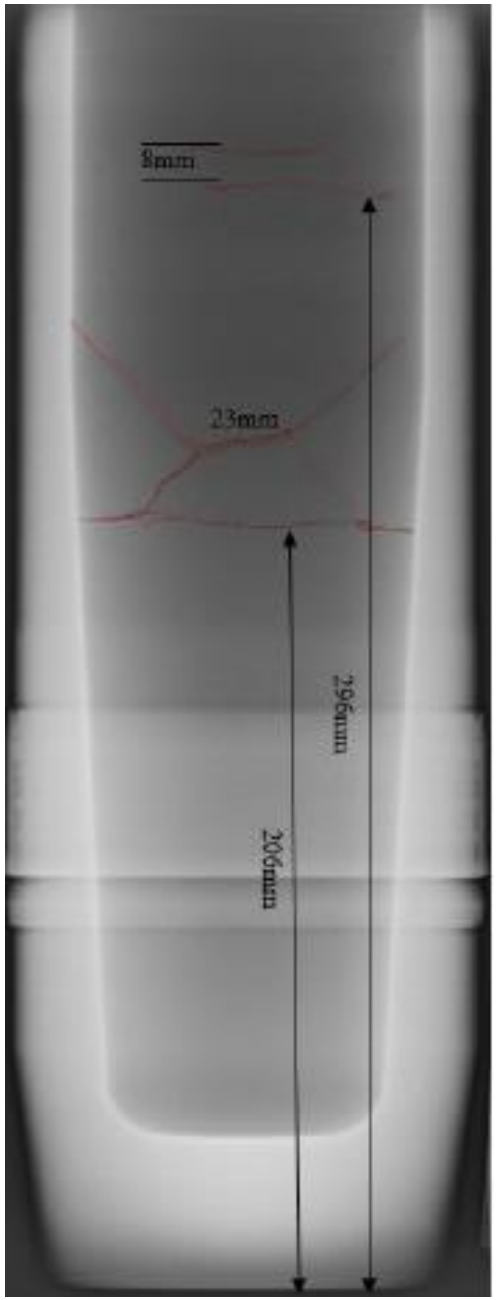
AUS Approaches – Life Extension

Australian road transport vibration requirements.

- Increase life cycle exposure
  - 10 000 km, 20 000 km and 30 000 km
- Assess the S3 impact of defects
  - Positive LAT results
  - Through life deviation from manufacturing specification
  - Premature failure of the projectile
- Positive outcome of testing
  - NDT
  - Performance
  - Supported by overseas work
- Worst case assessment of configuration and environment
  - Confidence with service life extension
  - Reality tracked with ISS



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Summary

Some Takeaway thoughts…

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Final Summary – Conclusions/Thoughts

- Demonstrated the different approaches taken to OME safety assessments
  - Introduction into service
  - In-service surveillance
- Highlighted some engineering challenges and how T&E can inform decision making
- Successful outcomes taken from Australian approach:
  - Principles of EMQ and requalification assures S3 nature of energetics
  - Introduction of AF Bombs with limited SET program
  - Manufacturing tolerance adjusted with OQE
  - Through life assurance with ISS
  - Increase in road transport limits with test

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