THALES

A successful path to interchangeability

Establishing a US-qualified digital X-ray capability for Guided Weapons and Explosive Ordnance (GWEO) types.

Roger Broughton
Production Engineer / Industrial Radiographer
NAS410 Level III RT
Australian Munitions

AUSTRALIAN MUNITIONS

Pictures from Defence Imagery and Thales production files

Agenda

- Why conduct Radiography?
- How does Radiography fit into interchangeability
- Journey to achieve NAS410
- Film to digital transition
- Benalla facility
- Technique and Process Controls
- Conclusion

Why conduct radiography on *artillery rounds*

Risk mitigation.
Function as designed, when required.
Specs call for it.
Standards require it.
Normal process.

Source https://www.quora.com/How-does-an-artillery-projectile-not-explode-and-destroy-the-artillery-that-fired-it

Why conduct radiography on GWEO

Avoidance of Rapid Unscheduled Disassembly

Static firing surveillance test at DST Missile Test Area – Rocket motor explosion.

Source Space Autonomy Group, DSTG

How does Radiography fit into interchangeability

US Qualifications of locally produced Ordnance.

- More sophisticated US designed materiel being produced in Australia to meet sovereign capabilities and global demand.
- Required compliant processes and qualifications to produce.
- This includes NAS410 (US based Standard Practice) Certification and Qualification of NDT personnel.
- This allowed the Benalla site to transition towards digital with new products bypassing film and using digital immediately.

Source; https://www.australian-munitions.com.au/australian-made-blu-111-bombs-enter-service/

NAS410 Certification

Journey to achieve NAS410

- Understanding of Standard Practice and Guides.
- Develop written practice & procedures.
- Procure and develop equipment to suit.
- On the Job Training (Film and Non-Film).
- Exams (General, Specific, and Practical).

Thales Benalla

- 155mm, initial start using film but quickly moved to digital.
  - Develop Techniques from Specs.
  - Incorporate into procedures
    - Process Controls
    - Shooting
    - Viewing and Sentencing
    - Reporting
  - Gain confidence in process
  - Participate in FAT, Exams, Audits, etc

Source https://www.military.com/equipment/m198-howitzer

References for X-ray Radiography

NAS410
ASTM-E2698
ASTM-E2736
ASTM-E1030
ASTM-E1742
ASNT-CP-189
ASNT SNT-TC-1A
ASTM-E543
ISO 17636-2
NCRP 144
ASTM-E1316
ISO 5579
ASTM-E94
AWS A2.4
ASTM-E747
ASTM-E801
ISO 10012
ASTM-E1359
ASTM-E999
ASTM-E1815
NCRP 116
ASTM-E1079
ASTM-E746
ANSI/NCSL Z540-3
ASTM-E1032
ASTM-E1025
ASTM-E1416
ASTM-E1165
ISO 9712
ASTM-E1212
ASTM-E1254
ASTM-E2737
ASTM-E1411
ASTM-E1390

Film to Digital transition.

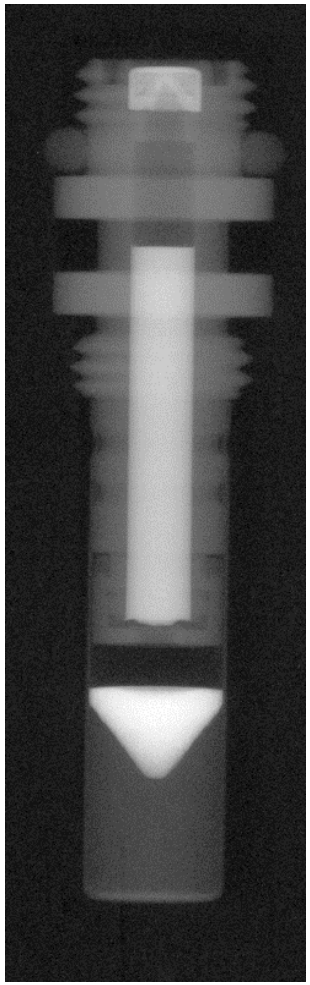
Differences

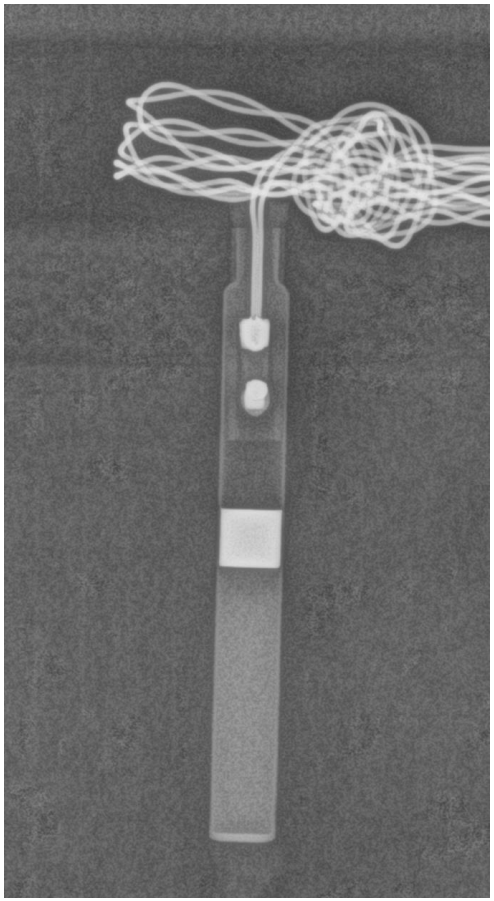
- Higher capital costs with Digital Detector Array (DDA).
- Lower portability of DDA panels.
  - Bulky and “delicate”
- Increased process controls for DDA.
  - Proving stability with more complex tests.
- Faster throughput.
  - Automation.
  - No developing time/instant access to images.
- No messy and environmentally damaging chemicals and waste.
- Improved analysis capability to view images and detect indications.
- Storage on LAN forever, if required.

Benalla facility capability

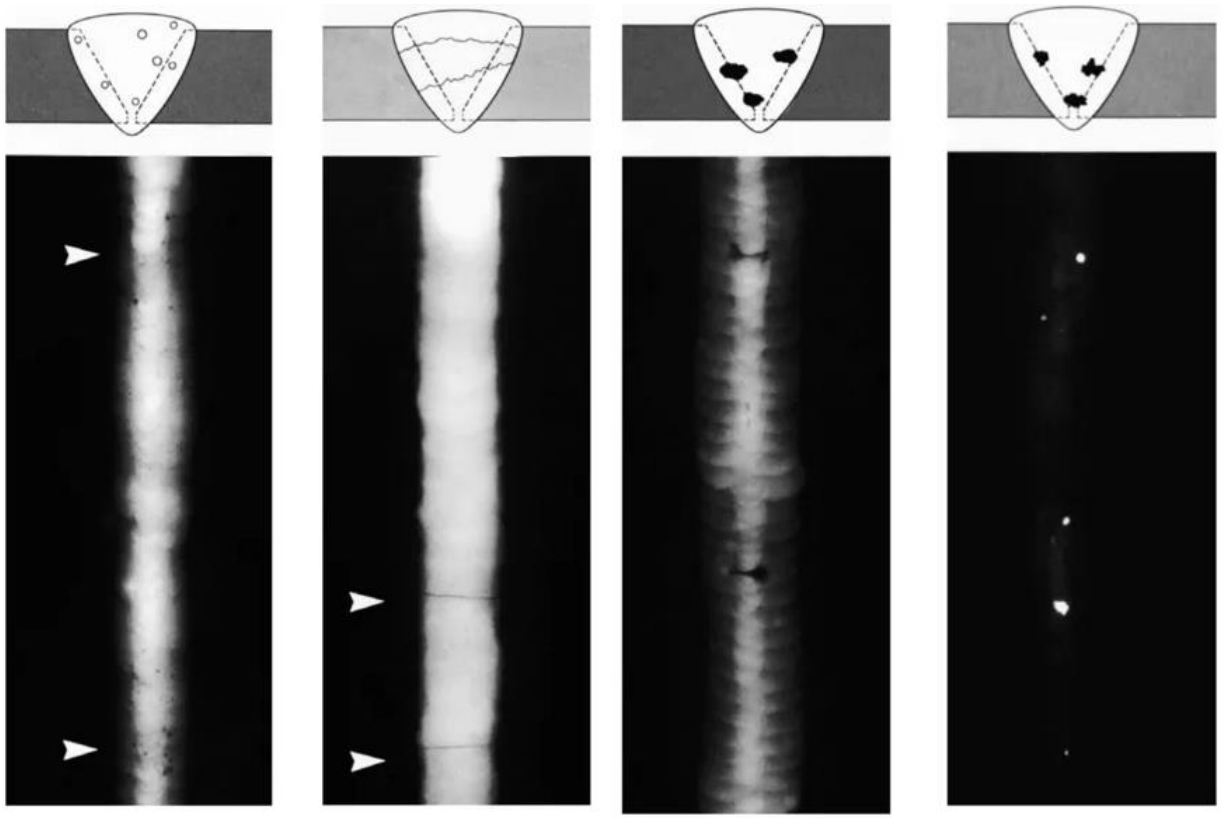
What can we shoot

- Wide range of X-ray capability.
  - Portable low energy unit, for remote imaging, is available.
- Items as small as Detonators and Grenade Fuzes, small arms Projectiles
- Large Projectiles
- Bombs
- Rocket Motors
- Other Defence products
- Other commercial products



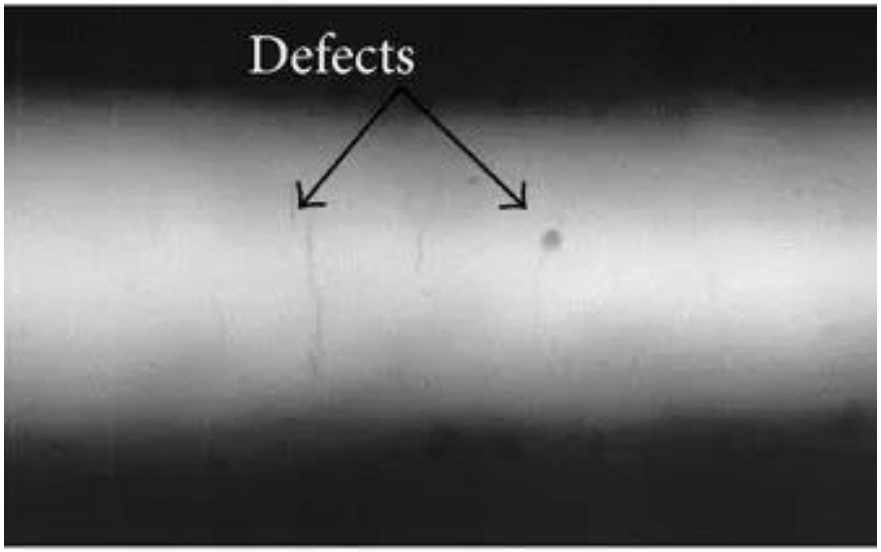


Benalla facility capability



Porosity **Cracks** **Slag Inclusion** **Tungsten Inclusion**

Source https://www.orangecoasttesting.com/radiographic

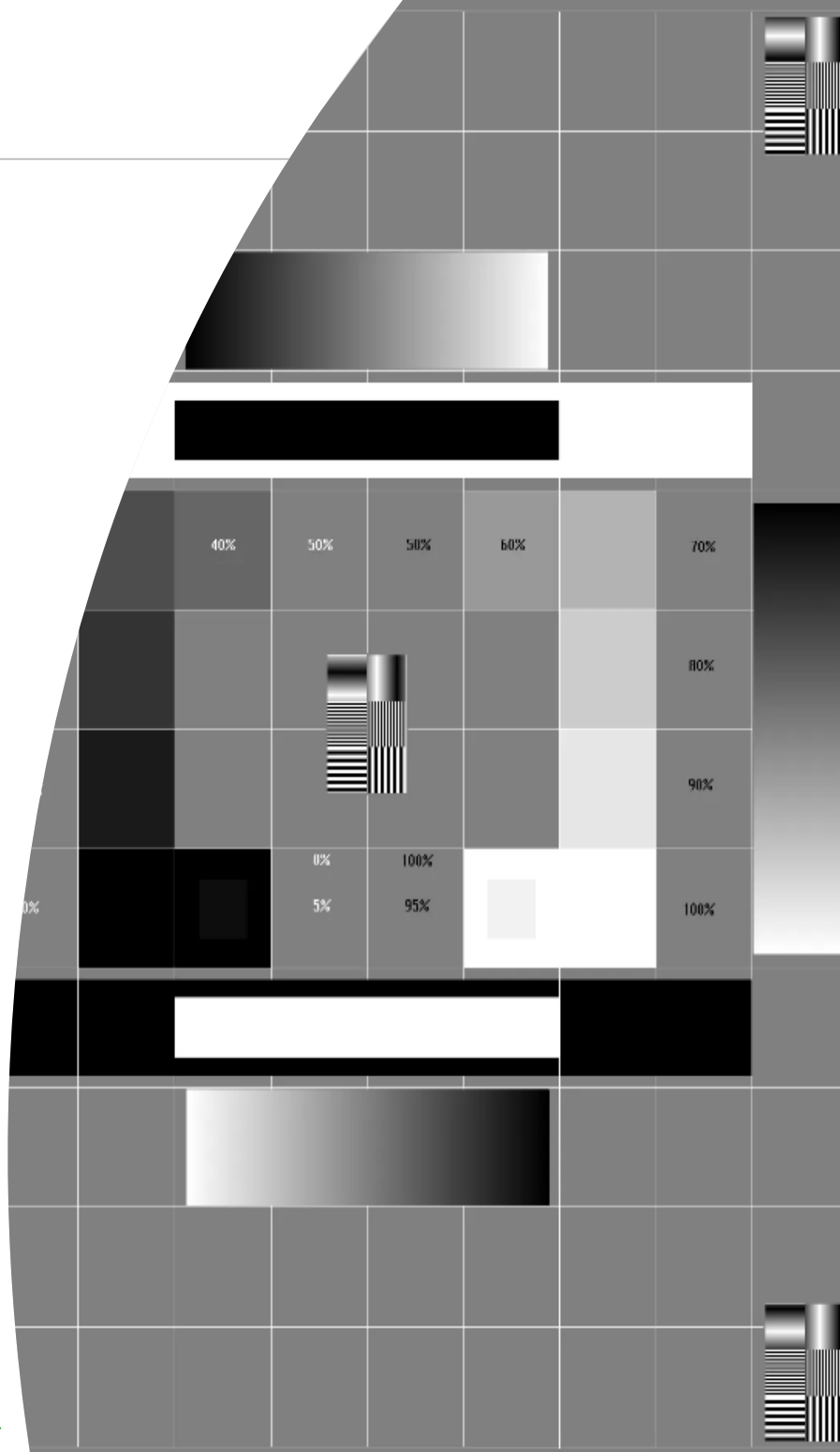


Indicative of defects found.

https://www.researchgate.net/figure/Example-of-weld-radiography-image-with-defects-porosities-circular-and-a-longitudinal_fig2_288480629

Technique set up considerations

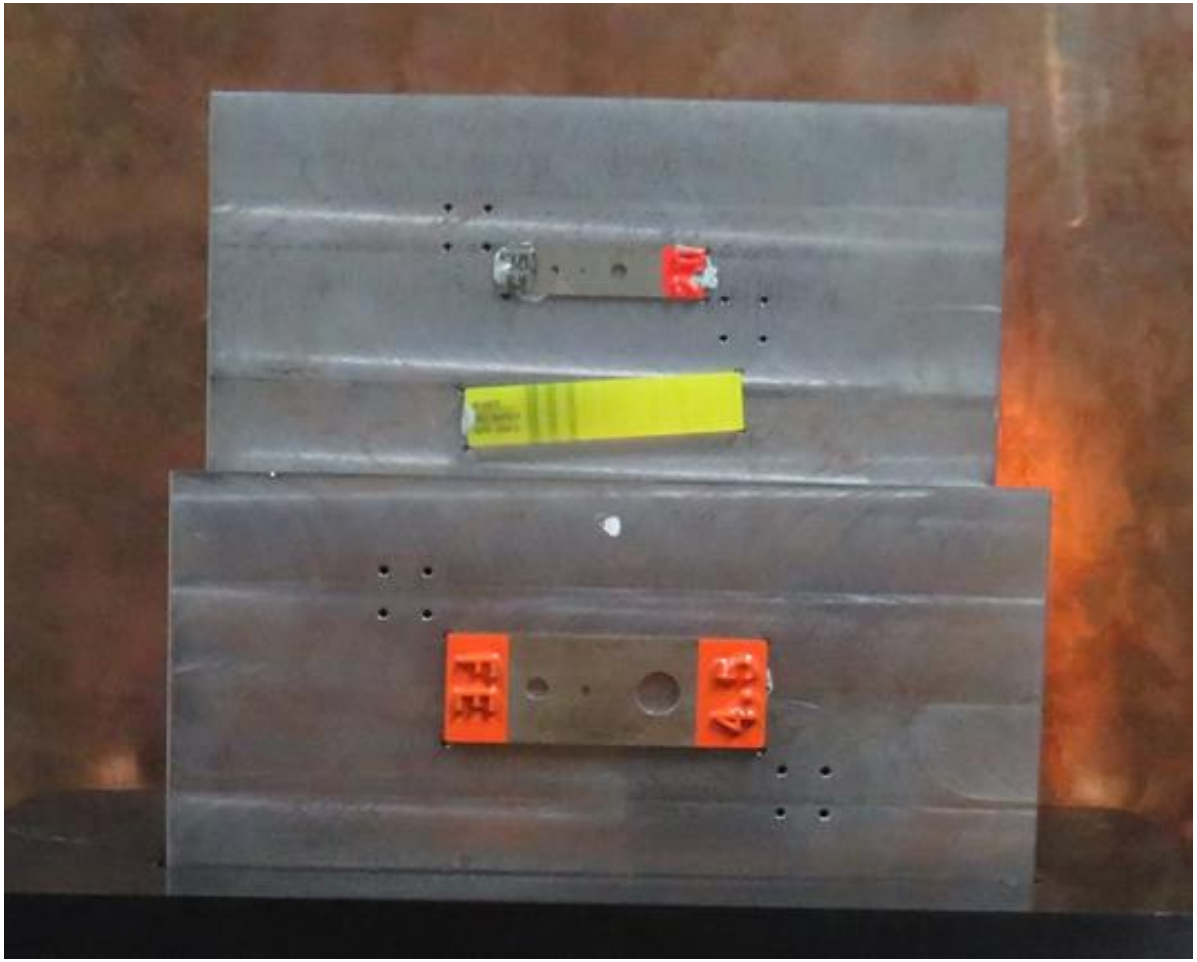
- Each product has its individual set up with considerations for safety, security, timing, quality, dimensions, etc.
- Dimensional factors such as Ug, Uim, Geo Mag, SDD, SOD, ESS, need to be considered
- Equipment stability
- Image Quality/Process Controls



https://dptoys.tw/smpte+test+pattern+download

Process Controls and Image Quality

Phantom used for process stability.



Conclusion

- A Radiographers top priority is safety of all that associate with the store.
- More components are being manufactured in Australia to overseas specifications.
- New products developed in Australia, such as GWEO.
- Compliance to original specification is mandatory.
- Radiography assists in interchangeability.

Testing of a Thales manufactured 80kg NEQ 10-inch class, composite case, composite propellant solid rocket motor as part of the Advanced Rocket Motor Technology Demonstrator (ARMTD) Program at Woomera.

Thank you