Multiple Effects Warheads for Defeat of Urban Structures and Armour

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Contents

Images courtesy of Jane's Information Group

01 Background - Defeat of Armour and Structures

Example Targets

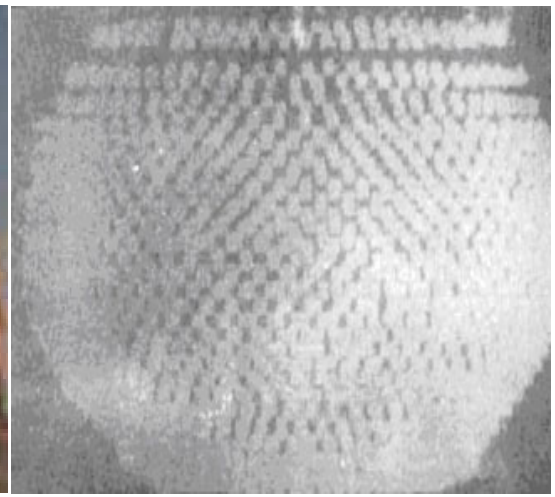
- Heavy armour
  - MBT
- Medium armour
  - MRT, SPG, LAFV
- Light armour
  - Logistics, Improvised carrier (Pick-up)
- Urban structures
  - Double skin brick – sand bag fortified
  - Concrete panel – double steel reinforcement

Images courtesy of Jane's Information Group

01 Background - Lethal Mechanisms

Several lethal mechanisms required to achieve defeat across the target spectrum

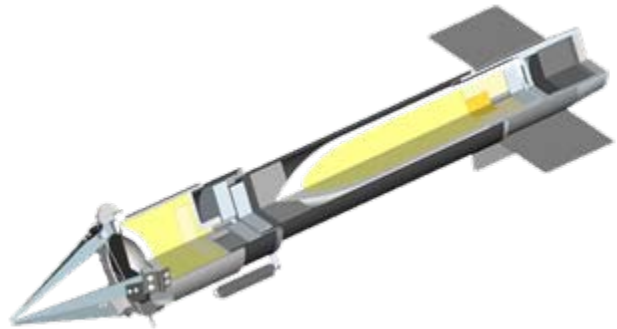
- Blast
- Fragmentation
- Chemical energy – shaped charge, EFP or Slow Stretching Jet (stretching EFP)


01 Background – Supporting Technologies

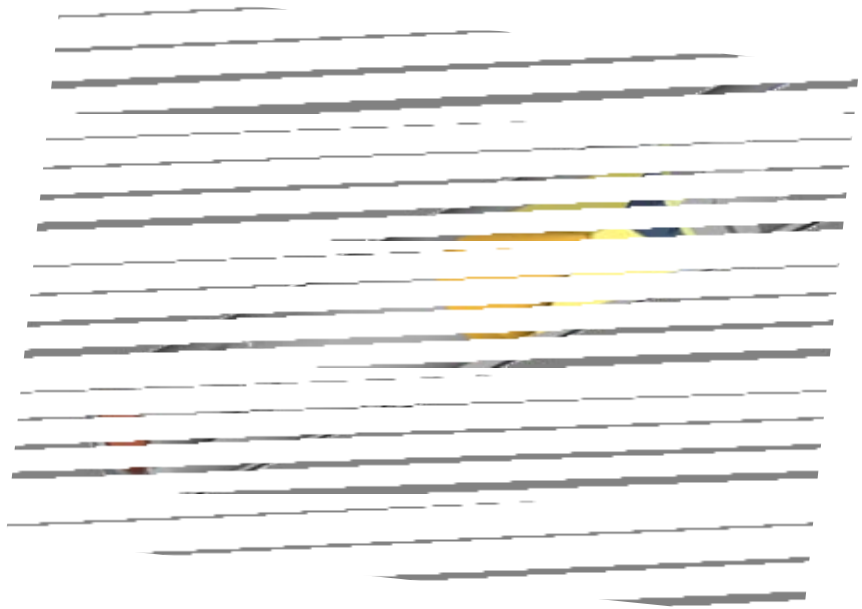
Urban Assault Weapon Programme

- Focussed on structures defeat
  - Utility against light/medium armour
  - Man portable – shoulder launched



High Performance Shaped Charge

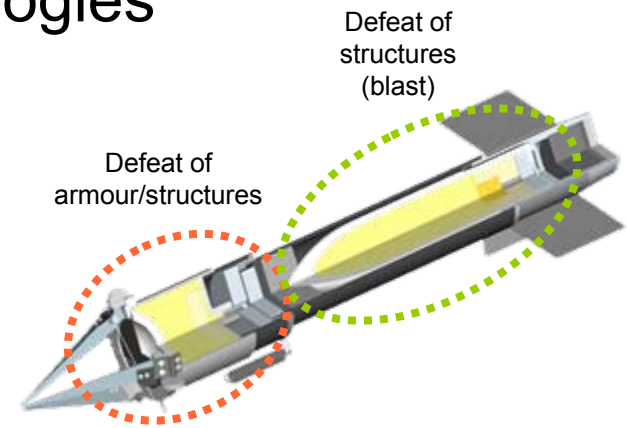
- Focussed on heavy armour defeat
  - Tandem shaped charge
  - Crew portable and Air launched



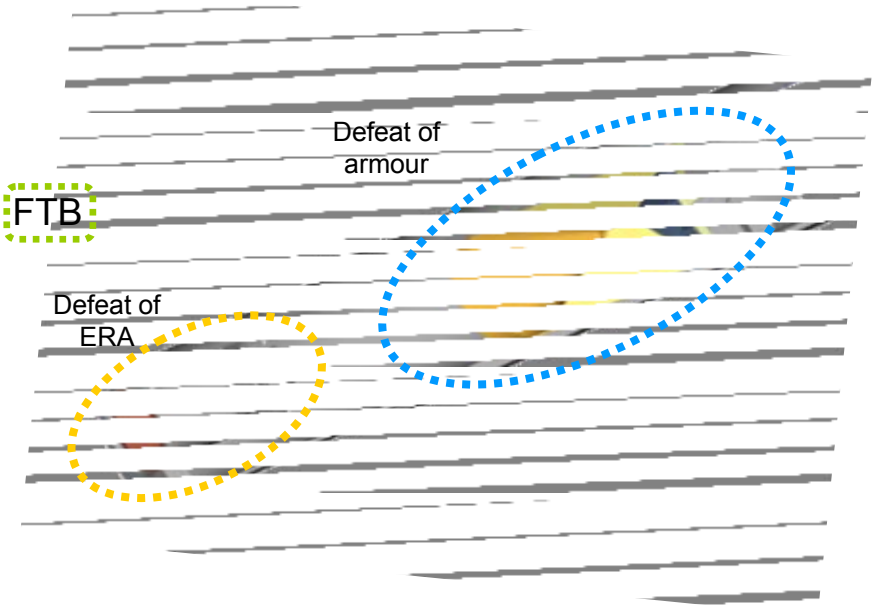
01 Background – Combining Technologies

Enable defeat of armour and structures

- Precursor
  - Combine traditional precursor and BiC warhead functionality



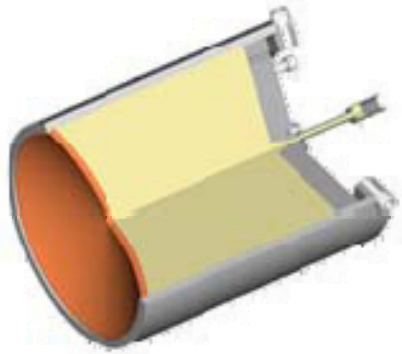
- Main Charge
  - Combine high performance shaped charge with FTB function

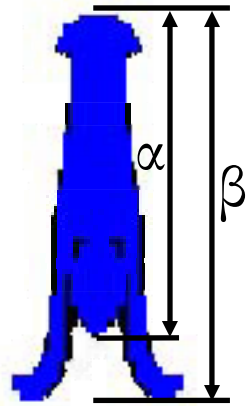


02 Design Study – Break-in-Charge

Baseline BiC - SSJ

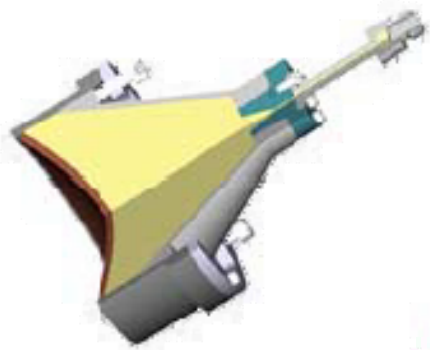
- EDC1s filled warhead design

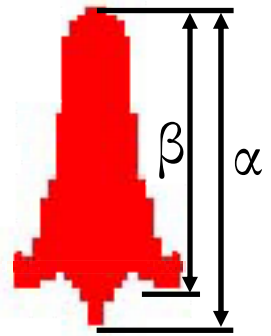




MEW BiC - CSSJ

- PBX filled warhead design
  - PBX replacement – aiding IM compliance
  - Use of PBX reduced CJ pressure by ~7%





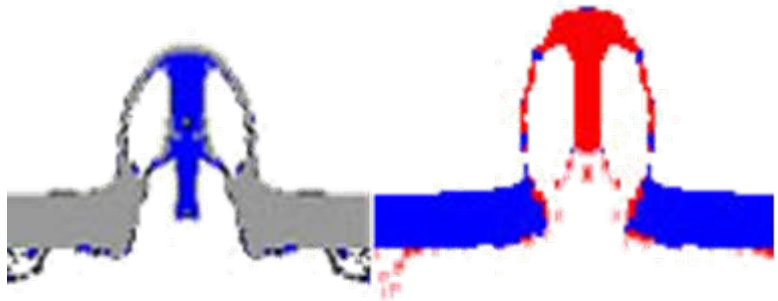
Warhead design

- GRIM 2D hydrocode
  - Mass reduced by 30%
  - Volume reduced by 35%
  - 4% reduction in length of central portion of projectile (α)

02 Design Study - Break-in-Charge

Target defeat modelling

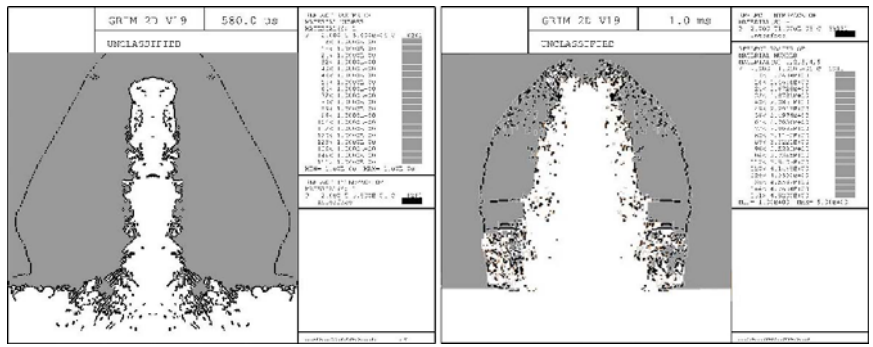
- RHA perforation – hole diameter
  - CSSJ 82% of Baseline hole diameter



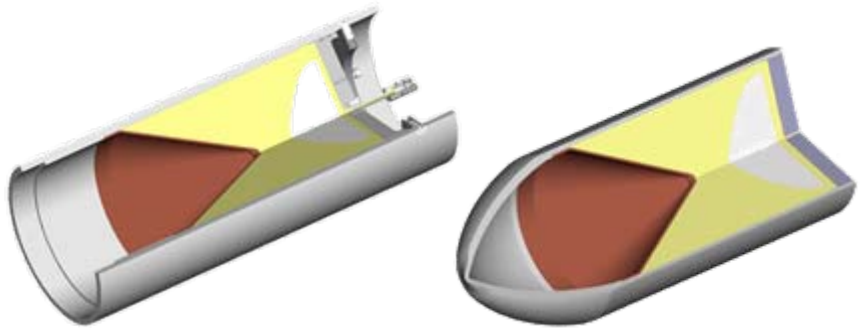
SSJ CSSJ

- Concrete penetration

Whd Type	Stand-off (CD)	Bore Depth	Minimum Bore Diameter (CD)	Throat Diameter (CD)
SSJ	1	100%	100%	100%
CSSJ	1	98%	181%	211%

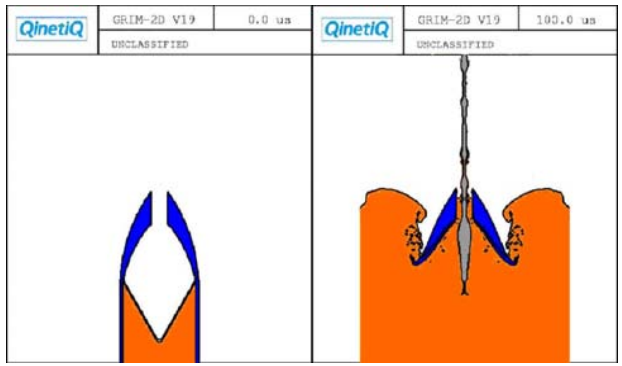


02 Design Study – Main Warhead

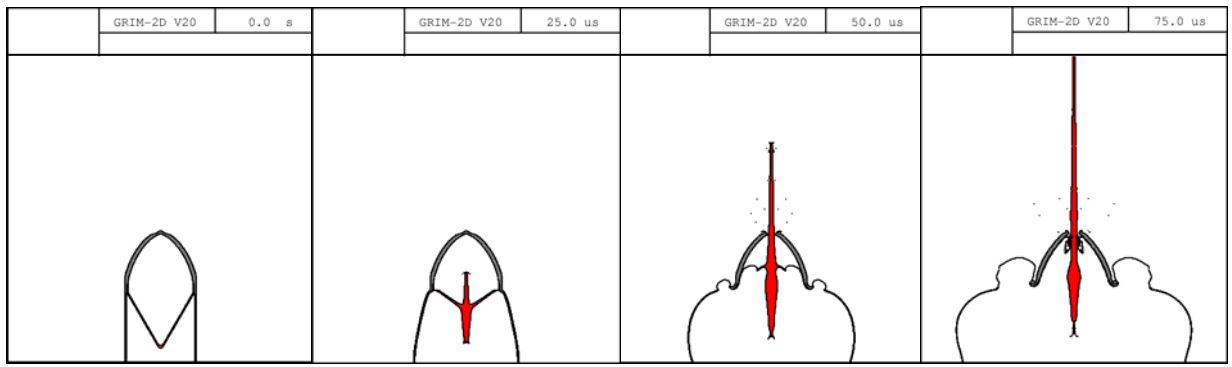


Hydrocode modelling study

- Changes made in several areas
  - Casing material – Aluminium to Steel
  - Casing geometry – inclusion of Ogive
  - Initiation geometry – increase in initiation angle
  - Explosive fill – EDC1s to PBXN-110



Initial design - heavy Ogive

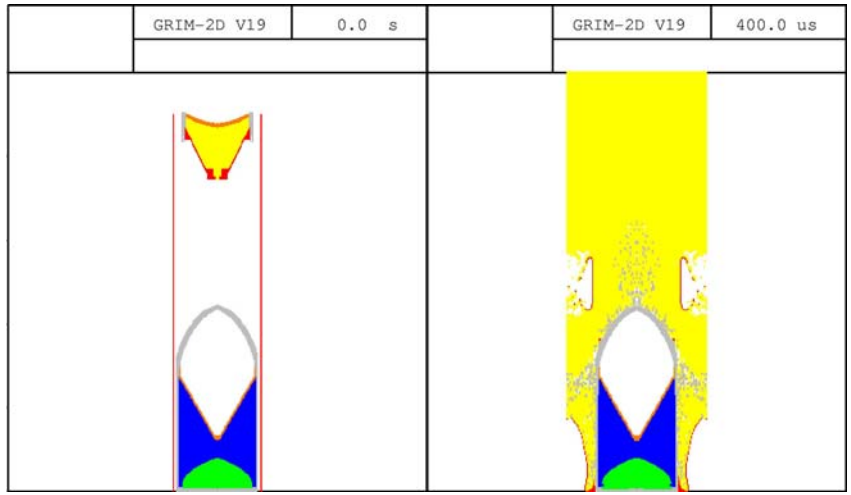


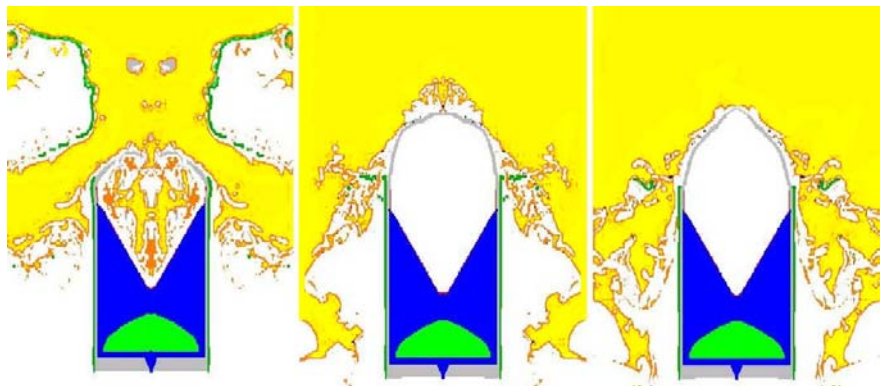
Final design – light Ogive

02 Design Study – Tandem Interaction

Hydrocode modelling study

- Fixed inter-charge spacing
  - Commensurate with in-service ATGWs
  - No inter-charge barrier
- Several iterations
  - Ogive profile
  - Main warhead casing material – Aluminium to Steel
  - Precursor warhead – Polymer composite rear half of casing
- Survival of main charge





03 Firing Programme - Break-in-Charge

BiC warhead Trials

- Anti-structures trial
  - Fortified domestic target
  - Municipal C40 concrete
    - Double steel reinforcement (1/2” bar) to front and rear of target

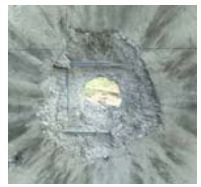
Double skin brick wall

Sandbag reinforcement to rear of brick wall

Steel reinforced concrete wall

- Trial Results
  - Increase in hole diameter noted
  - Performance level maintained
    - Defeat of targets at normal and 45° obliquities

1.5 CD



2 CD

90° attack

4.5 CD

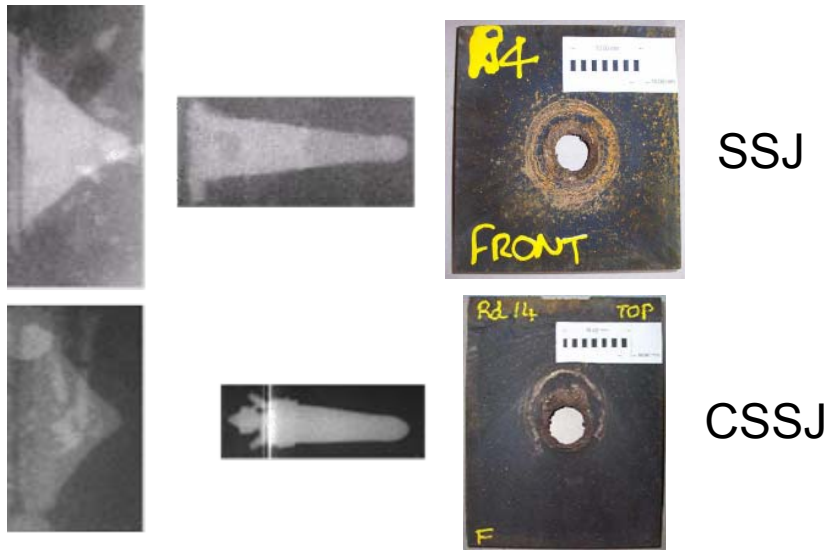
2.5 CD

45° attack

03 Firing Programme - Break-in-Charge

BiC warhead Trials

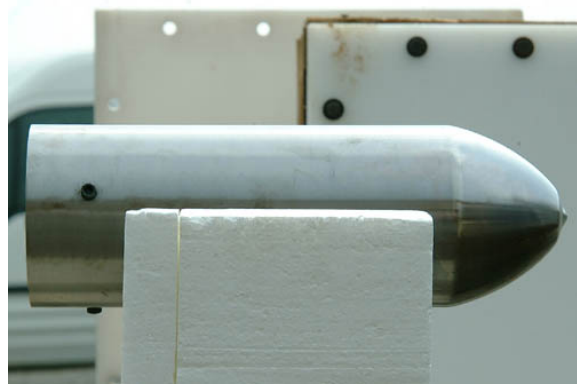
- Anti-armour trial
  - RHA plate
  - MBT heavy ERA
- Performance levels
  - Baseline BiC
    - 0.4 CD through hole
  - MEW BiC
    - 0.4 CD through hole
    - Defeat of heavy ERA targets



SSJ

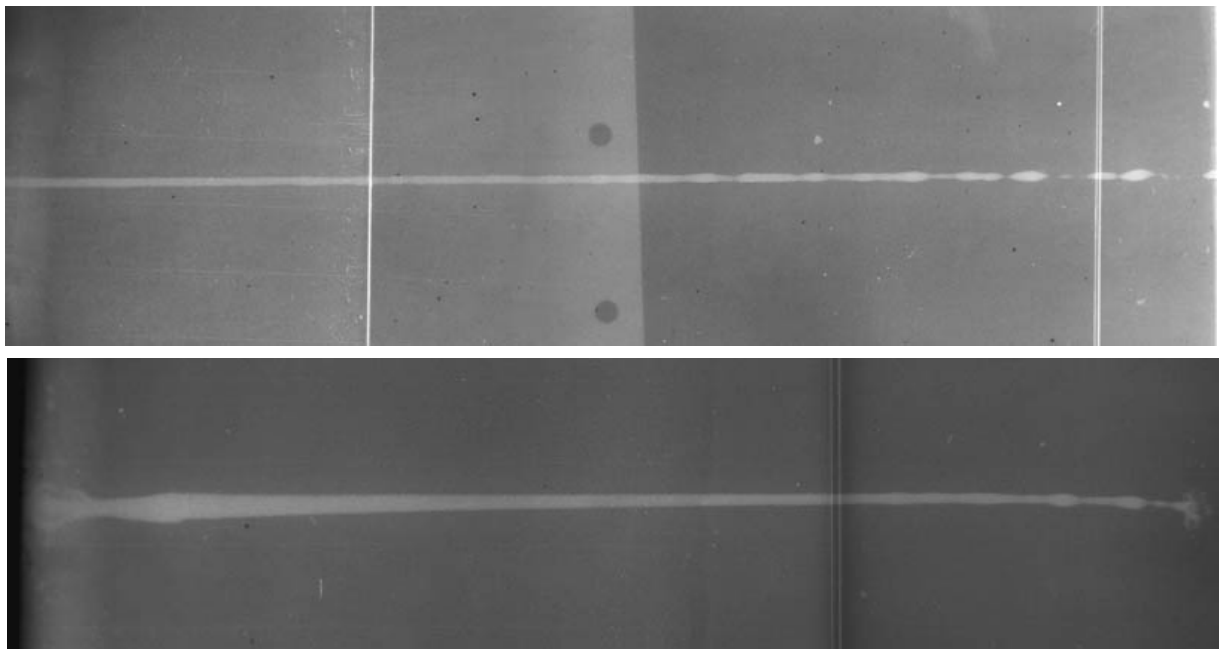
CSSJ

03 Firing Programme – Main Warhead



Static main warhead trial

- Variability in warhead performance observed

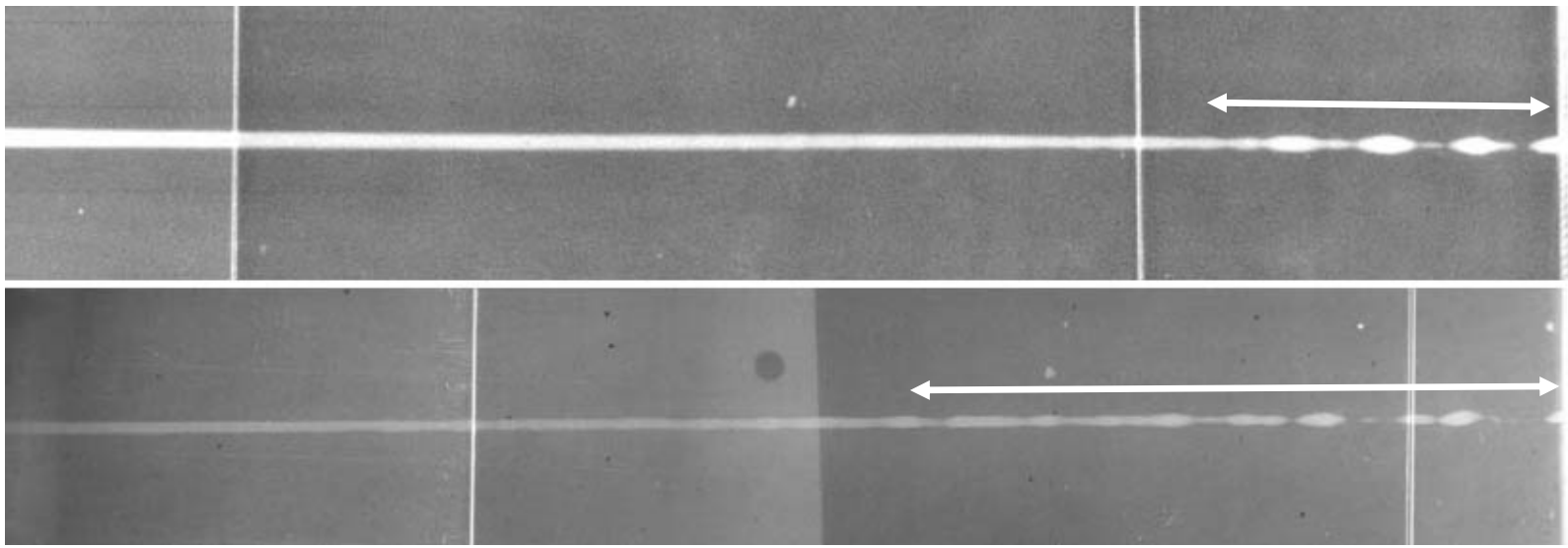


Radiography of two separate FTB/MC firings, (from top) at 100μs, and 170μs

03 Firing Programme – Main Warhead

Comparative break-up characteristics

- On-set of break-up occurs earlier
  - Ogive interaction most probable cause



PBXN-110 filled D2 warhead with no ogive (top) PBXN-110 filled FTB/MC (bottom)

03 Firing Programme – Main Warhead

Eight main warheads fired

- Firings against RHA
  - Def-Stan 95-13 RHA
  - Various stand-offs
- Large reduction in penetration
  - Jet curvature main cause

Warhead #	Stand-off (CD)	*Average Penetration Reduction (%)	Notes
1	8	19	Jet curvature observed, Jet velocity 8.5mm/μs
2	4	N/A	
3	4	N/A	
4	5	N/A	Jet curvature observed on radiography
5	5	N/A	Curvature at front of jet, jet tip unusual geometry
6	10	17	Target key-holed, jet particulation appears advanced
7	8	19	Jet curvature observed on radiography
8	8	19	Jet velocity 8.65mm/μs

*Average values are those of PBXN-110 filled precision shaped charge

04 Conclusions

BiC Warhead

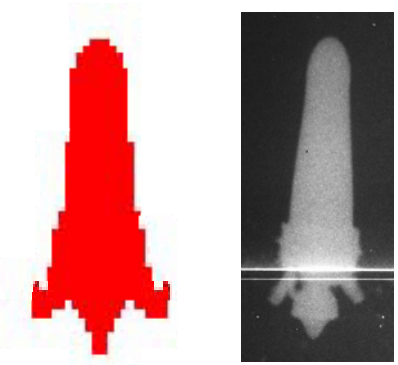
- Performance level maintained
  - More IM compliant explosive
  - Reduced overall mass and volume

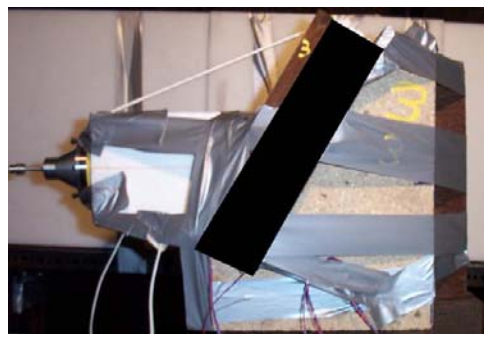
Main Warhead

- Reasonable level of RHA penetration
  - Jet curvature through initiation inaccuracies – major loss in performance
  - Ogive – jet interaction

Tandem Interaction

- Hydrocode modelling
  - Main charge appears unaffected by BiC 400µs after detonation





04 Conclusions

Overall concept

- Tandem interaction must be observed
  - Current research work is investigating this issue
- Design for production
  - Minor changes required to accommodate through life issues
    - Expansion/contraction of explosive fill under service environment
    - FCO/SCO design features
- Compliancy with system mass/centre of gravity constraints
  - Use in crew portable system
    - Requires re-engineering of warhead solution
  - Use in air launched system
    - No major changes envisaged

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