40 mm Door Breach Munition Concept Study

NDIA Joint Armaments Conference
14 MAY 2014

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Acknowledgements

Work supported by
RDAR-EIJ
Army Research and Development Engineering Center (ARDEC)
Picatinny, New Jersey
under
USG contract DOTC-12-06-INIT025
Briefing Outline

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• Concept Attributes
• Design Constraints
• Approach
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  ▪ Impulse Tests
  ▪ Breaching Tests
• Summary
Background

- US forces need standoff door breaching capability
- Ability to maneuver is key to mission success for MOUT
- New solutions should increase standoff and decrease time to complete mission compared to current methods and techniques
Objectives & Scope

• Objectives
  • Conduct proof-of-concept testing to demonstrate feasibility of 40 DBM as a door breaching technology
  • Establish design feasibility of EFI-based initiation system

• Scope
  • Load laboratory surrogates representing 40 DBM prototypes with enhanced impulse explosive mixtures and standard HE
  • Conduct static proof of concept in the lab
    - Defeat standard solid wood and/or mild steel door with bolt and two hinges (threshold)
  • Conduct preliminary design analysis of EFI-based initiation system
Concept Attributes

• Revolutionary vs. Evolutionary
  ▪ Uses enhanced impulse explosive mixtures to achieve increased near field effects for door breaching while reducing Net Explosive Weight (NEW) in munition
  ▪ Contained in low velocity 40mm munition
  ▪ Explosive foil initiator (EFI) technology for high accuracy and safety
  ▪ Decreases bulk/weight compared to existing breaching methods
  ▪ Electronic fuze may permit multi-mode capability

• Increased range and decreased time to complete mission
  ▪ Extends effective range of current standoff technology
  ▪ Eliminates need to approach doors with hand-emplaced charges
  ▪ Decreases safe separation distance by using enhanced impulse formulations
Design Constraints

• Charge Volume
  ▪ Explosive charge must fit into the payload volume of an existing 40mm grenade (e.g., M662)
  ▪ Allowance for fuzing

• Charge Mass
  ▪ High impulse explosive mixture
  ▪ Total Net Explosive Weight (NEW), impulse, and breaching performance comparable to GREM 120 (120 g of PBXN-109)

• Build and test laboratory surrogates of the 40 DBM
  ▪ Lab surrogate must be no larger than M662
  ▪ Lab surrogate must be able to breach commonly encountered doors (simple wood and steel doors – no barricades)
Approach

• Formulation Research
  ▪ Three different loads (baseline and two enhanced)

• Impulse Tests of Novel Formulations
  ▪ Fabricate, load, test, and down select preferred formulation

• Develop Concept Models
  ▪ Check form / fit / function
  ▪ Preliminary design analysis of fuze EFI-based concept for space claims

• Static Breaching Tests
  ▪ Breaching tests against commercially available external wood and steel doors
Formulation Research

- Determined maximum NEW for test charge will be ~120 g
  - Based on internal volume of 40mm ammo (M662)
  - NEW dependent on amount of impulse enhancing additives
    - Additives displace explosive while maintaining or increasing impulse delivered to target
- Investigated three explosives
  - Baseline: Comp A-3 (91% RDX and 9% polyethylene)
  - Two enhanced impulse formulation types
Impulse Test Background

• Average velocity of steel plate measured with high speed camera and fiducial over the first two feet of travel
• Steel plate, 12 x 12 x 1 in.; dropped into sand pit
• Impulse delivered to plate measured by plate travel distance over time to drop into sand pit

\[
\text{Impulse} = \int F(t)dt = \Delta (mv)
\]

Where
\[d = \text{plate travel distance}\]
\[F(t) = \text{force-time function (blast)}\]
\[g = \text{gravitational acceleration}\]
\[h = \text{height of plate drop}\]
\[m = \text{plate mass}\]
\[t = \text{time}\]
\[v = \text{average plate velocity}\]
Impulse Test Setup
Impulse Test Results

- Impulse can be maintained or increased by additives with lower NEW.
- Too much additive decreases impulse or prevents detonation.
- The ‘best’ formulation increased impulse 42% over bare explosive.

![Graph showing impulse test results](image-url)
Breaching Test Conditions

• Three door types used in standard frames
  ▪ Wooden residential external door (slab/particle filled)
  ▪ Steel residential external door (wood and foam filled)
  ▪ Steel commercial door (16 gauge steel, foam filled)

• Two explosive formulas
  ▪ Plain Comp A-3
  ▪ Enhanced impulse Comp A-3

• Measured impulse delivered to door for each test
Breaching Test Setup
Breaching Test Results – Wood Doors

Wooden Residential External Door – Plain Comp A-3 Charge

Wooden Residential External Door – Enhanced Comp A-3 Charge
Breaching Test Results – Steel Doors

Steel Residential External Door – Bare Comp A-3 Charge

Steel Residential External Door – Enhanced Comp A-3 Charge
Summary

• Either plain high explosive (Comp A-3) or enhanced impulse formulation can defeat residential wooden and commercial steel doors in standard frames in a single shot

• Enhanced impulse formulations deliver similar impulse to plain high explosive but, with lower net explosive weight

• A door breaching charge in a 40 mm grenade is feasible
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