40 mm Door Breach Munition Concept Study

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Briefing Outline

- Background
- Objectives & Scope
- Concept Attributes
- Design Constraints
- Approach
  - Formulation Research
  - Impulse Tests
  - Breaching Tests
- Summary

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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

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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

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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

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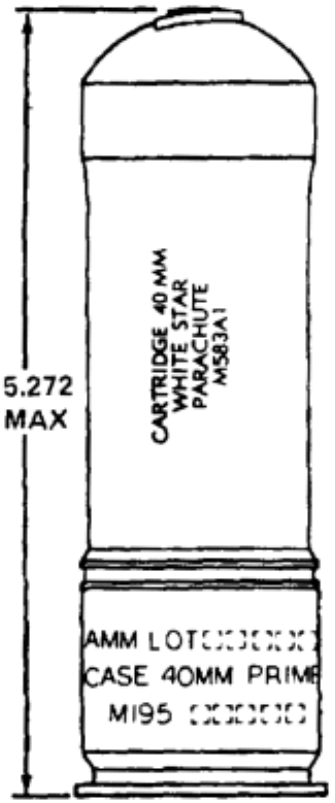
Design Constraints

- 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)



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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

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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

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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

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

$$t = \sqrt{\frac{2h}{g}}$$

$$v = \frac{d}{t}$$

Where
d = plate travel distance
F(t) = force-time function (blast)
g = gravitational acceleration
h = height of plate drop
m = plate mass
t = time
v = average plate velocity

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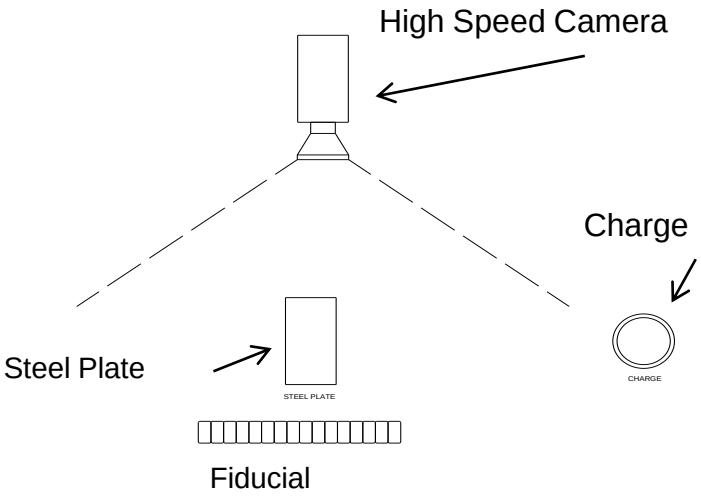
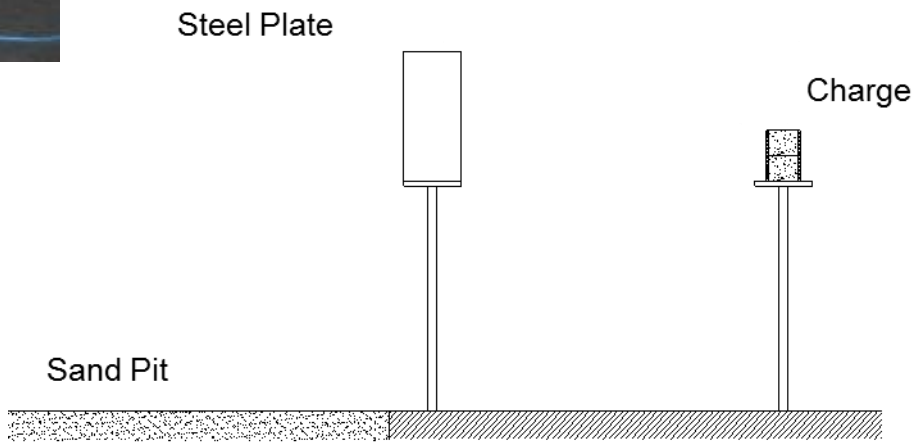
Impulse Test Setup





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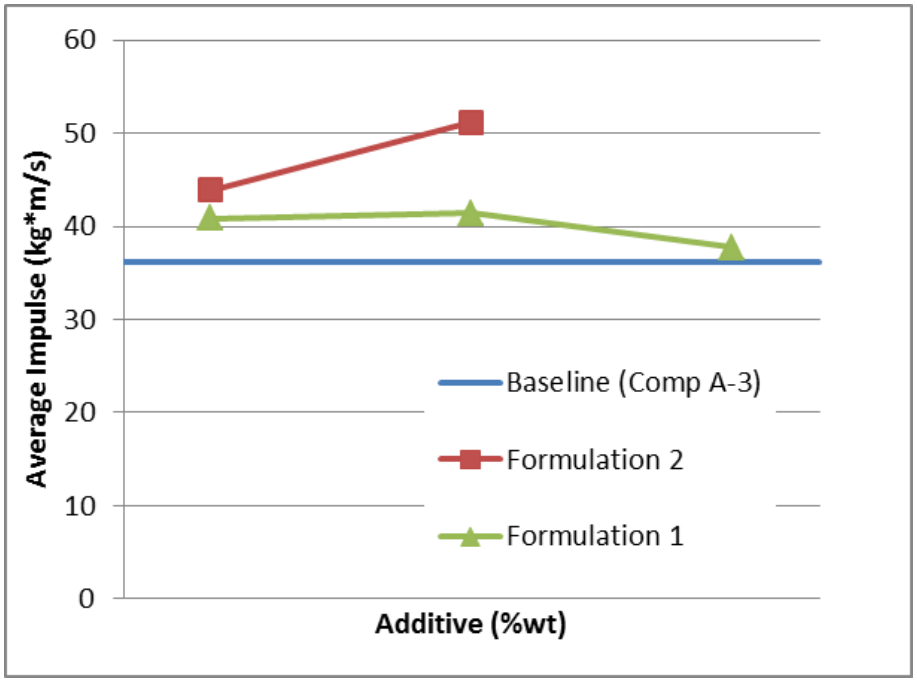
Impulse Test Results

- 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



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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

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Breaching Test Setup

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Breaching Test Results – Wood Doors

Wooden Residential External Door – Plain Comp A-3 Charge

Wooden Residential External Door – Enhanced Comp A-3 Charge

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Breaching Test Results – Steel Doors


Steel Residential External Door – Bare Comp A-3 Charge


Steel Residential External Door – Enhanced Comp A-3 Charge

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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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