Air Bursting Ammunition Technology

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ATK Air Burst Initiatives

20mm HEAB Grenade

30mm HEAB Cartridge

40mm HEAB Projectile
Air Burst Munitions

ATK’s bursting ammunition fuze is completely self contained requiring no external velocity correction.

- Bursting ammunition
  - Turns counting fuze
- Flexibility
  - Programmable
    - Mode
    - Range
Air Burst Munitions

- Inductively transmit data to the fuze
  - Power
  - Mode, range
- High rate capable
- Robust relative to position

Inductive Fuze Setter

Top View
Setter Drive Coil

Side View
Sprocket Wheel

End View
**Gun Environment** – 30mm Mann barrel, hardstand

**Ammunition** - 30mm x173mm nose fuzed HEAB round

**Firing mode** – Single shot from 1500 meters

**Results:**

- All 9 rounds within the 10 m deep by 50m wide target area
- Average muzzle velocity – 1094 m/sec
  - 1 sigma = 3.8m/sec
- Average Range error – 0.03m
  - 1 sigma = 3.6m

**Every round engages the target**
PM-MAS Airburst Demonstration (11-2002)

**Gun Environment** – 30mm MK44 mounted on a Bradley FV

**Ammunition** - 30mm x173mm nose fuzed HEAB round

**Firing mode** – Single shot and 3 round bursts from 1500 meters

**Results:**

- 14 rounds fired
  - 12 functioned airburst
  - 2 functioned PD due to premature ground impact
- Average muzzle velocity – 1094.4 m/sec
  - 1 sigma = 3.9m/sec
- Average Range error – 0.1m (.01m - 3 round bursts)
  - 1 sigma = 5.6m (3.8m - 3 round bursts)

**Accuracy is not affected in automatic fire mode**
Air Bursting Algorithms

- Fundamental Challenge of Air Burst: Target no longer “events” Round

- First Order Methods: Timer or Turns Counter estimates when desired range to burst is reached. Assuming accurate Range and MET Data, Random (round-to-round) Errors will define accuracy.

- Second Order: Reduce round-to-round Muzzle Velocity error
  - External Measurement
  - “Hybrid” Utilize on-board timer and turns counter - No need for Gun Muzzle modifications

- Third Order: Direct Range estimate (1-D IMU)
  - Integrate Axial accelerometer twice on the fly
  - Requires higher CPU capabilities, accelerometer must survive Set-back g’s with no zero shift and be accurate to the 0.1 g level
OBR, HE Tests confirms analytical results - simple Turns Counter effective close-in (<1500 m), Hybrid will improve accuracy at greater ranges.
• Average Drag is higher ($\approx 6\%$) out of Bradley mounted system (increased barrel whip, mount effects and higher angle of attack levels in pitch/yaw motion) as compared to Hard-Stand Systems.
Primary Range Error Sources 30mm

- Shot-to-Shot Variation at 1.6% one Sigma Level (Matches levels seen in Hard Stand Testing)

![Graph showing Drag Coefficient vs Mach No. with average, + one Sigma, and - one Sigma lines.](image)
Primary Range Error Sources  30mm

Single-Source Range Error Estimates at 1500 meters nominal burst point

• Drag 1.6% One Sigma
  • Turns: 5.9m
  • Time: 5.7m
  • Hybrid: 5.7m

• Velocity 4.0 m/s One Sigma (Nominal Muzzle Velocity of 1095 m/s)
  • Turns: 0.5m
  • Time: 4.6m (Without Muzzle Velocity Compensation)
  • Hybrid: 0.0m

• Head Wind 3.55 m/s One Sigma
  • Turns: 1.9m
  • Time: 2.0m
  • Hybrid: 1.9m
Next Generation On-Board Accel

• Still require on-board time/turns count for initial muzzle velocity estimate
• Single-Axis Integration
  • Minimizes onboard computation (but will require floating point arithmetic)
  • Muzzle transients, coning motion, yaw-to-repose introduce errors related to projectile and velocity axes alignment
• Inherent accuracy along primary axis after impulsive set back loading of ≈ 100,000 g’s (Dynamic shift)
• Wind Effects
• Cost

Will Improvement in Accuracy and Rounds/Kill be worth the cost for Medium Caliber Systems?
Air Burst Demonstration Video