Air Bursting Ammunition Technology

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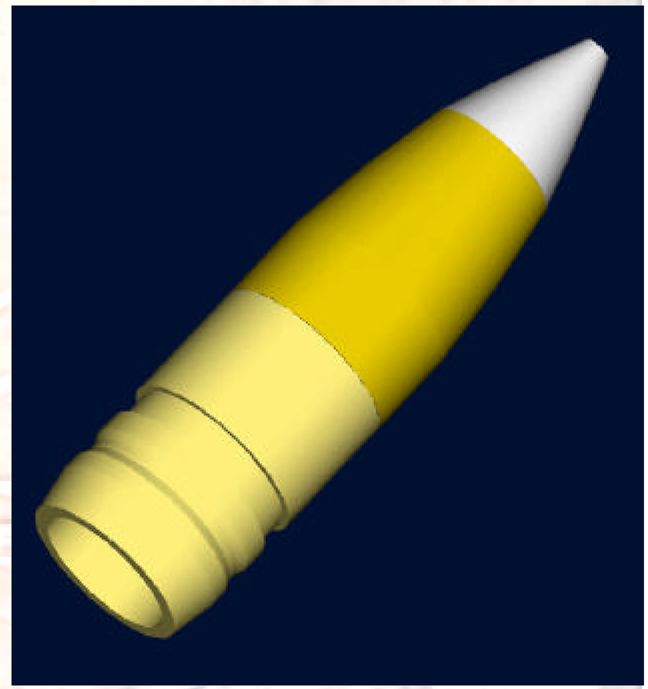
ATK Air Burst Initiatives

20mm HEAB Grenade

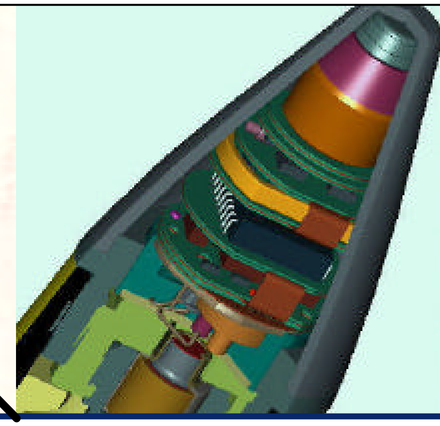
40mm HEAB Projectile



30mm HEAB Cartridge

Air Burst Munitions

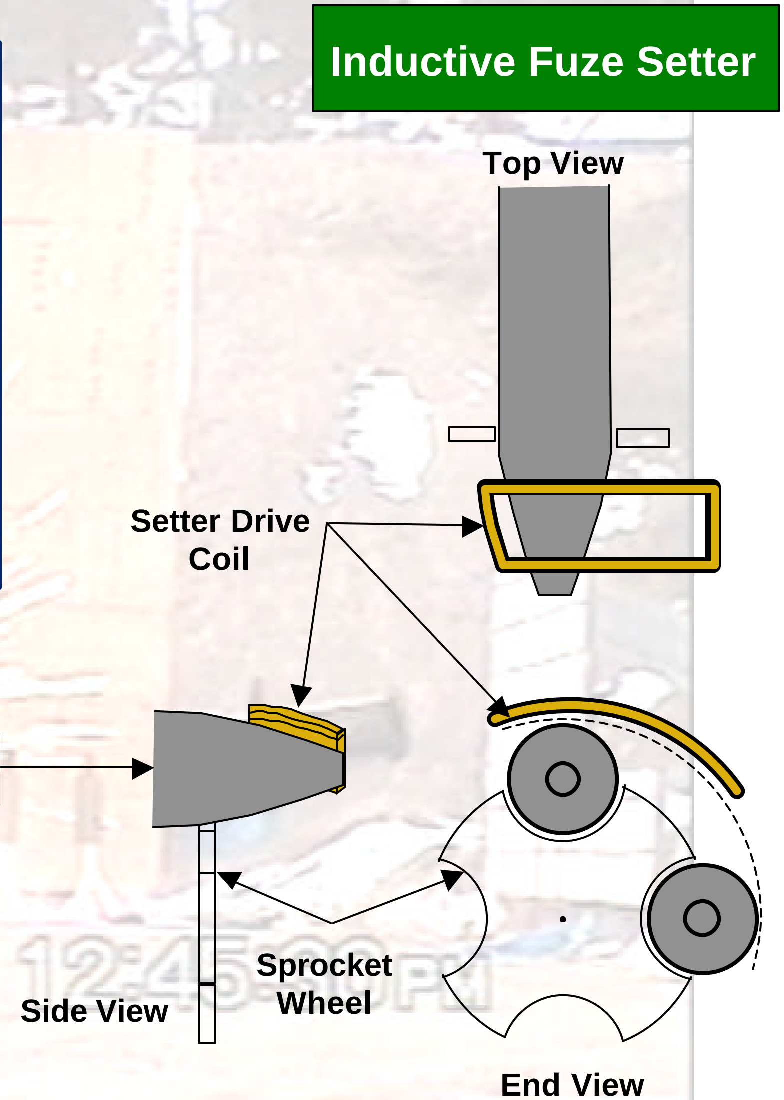
ATK's bursting ammunition is completely self contained requiring no external velocity correction

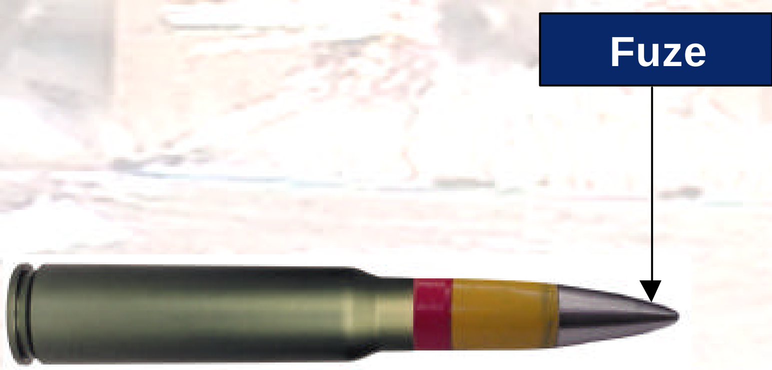


- **Bursting ammunition**
  - **Turns counting fuze**
- **Flexibility**
  - **Programmable**
    - **Mode**
    - **Range**

Air Burst Munitions

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





Marine Airburst Demonstration (05-2002)

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

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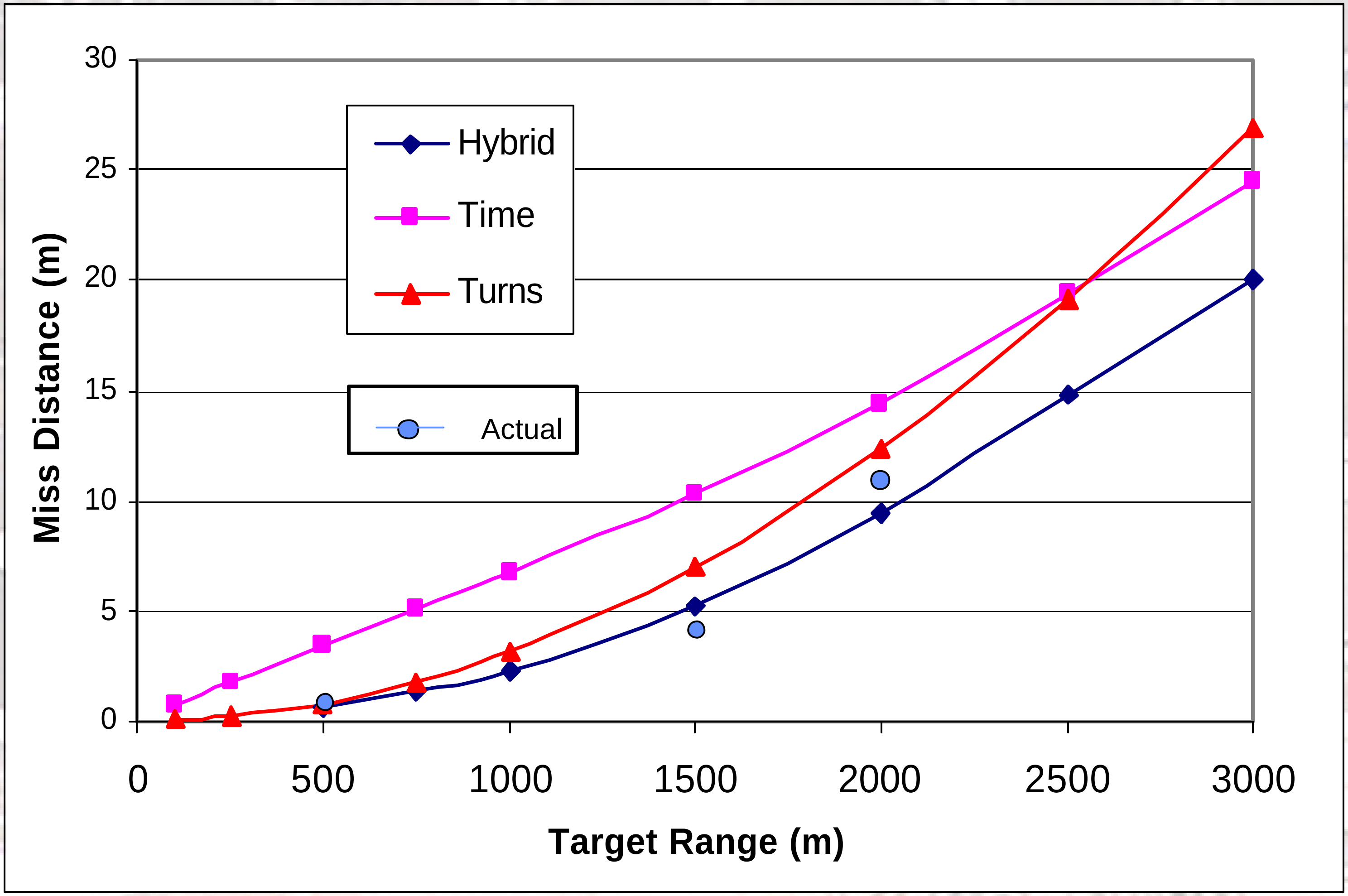
Air Bursting Algorithms

- 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

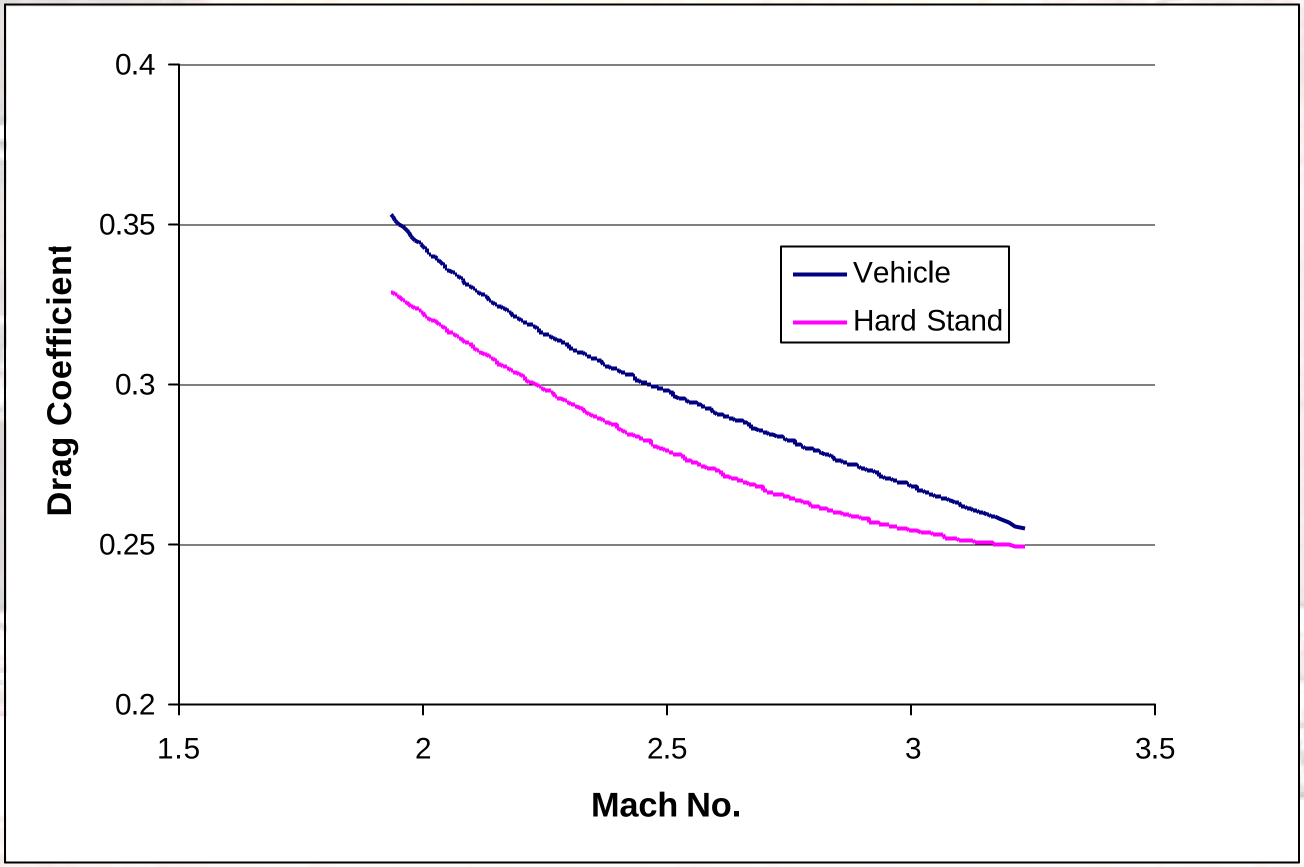
Miss Distances for Typical Error Budget



OBR, HE Tests confirms analytical results - simple Turns Counter effective close-in (<1500 m), Hybrid will improve accuracy at greater ranges

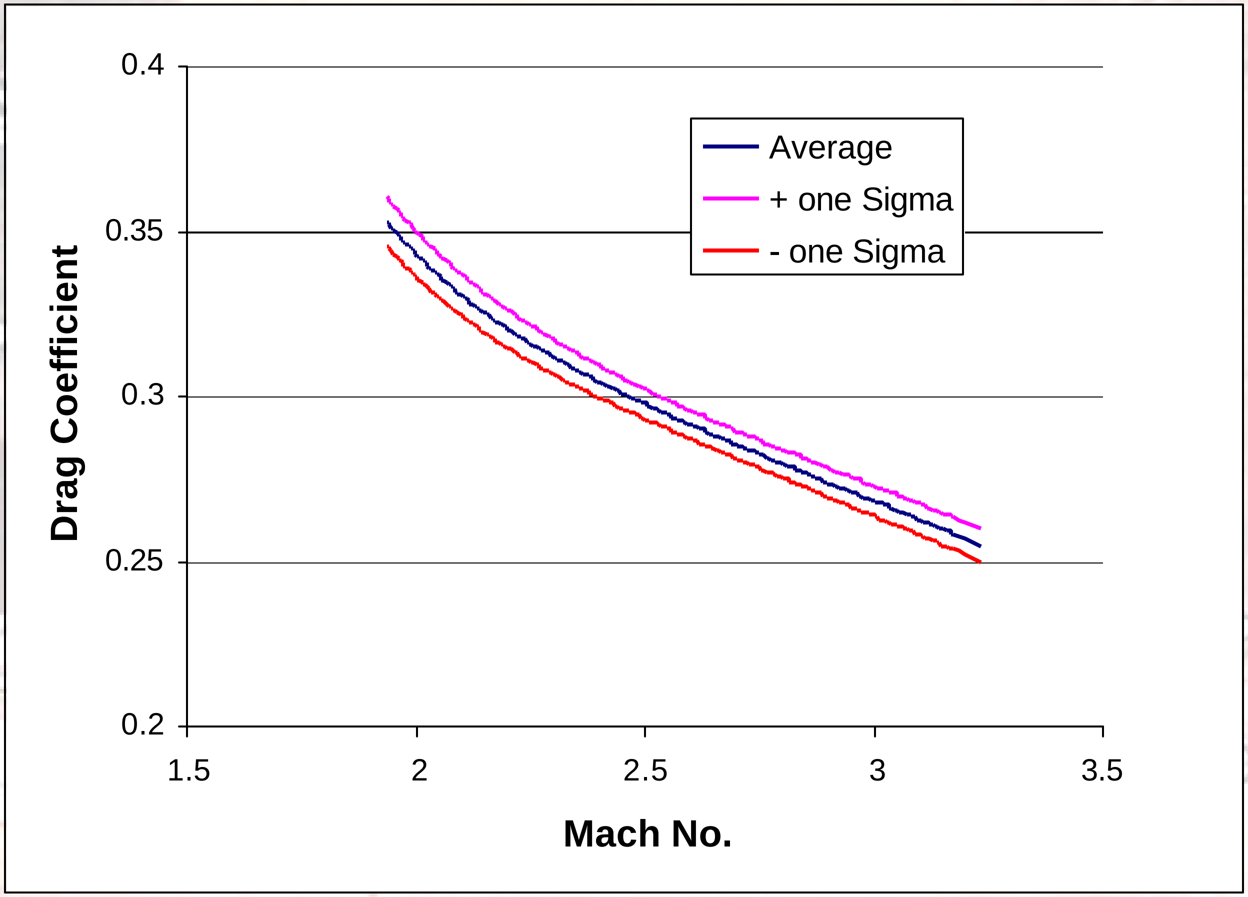
Primary Range Error Sources 30mm

•Average Drag is higher (» 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)



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**
  - **Times: 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