

GENERAL DYNAMICS

Ordnance and Tactical Systems

**45th Annual Armament Systems: Gun and Missile
Systems**

Conference & Exhibition

Event #0610

May 17-20, 2010

Dallas, Texas

“Precision and Lethality in Medium and Large Caliber”

Super 40mm Ammunition - Performance/Lethality



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S40mm MK44 Ammunition

- Why S40mm ammunition?
- Lethality of S40mm over 30mm
- Brief S40mm ammunition history
 - US Army Contract Efforts
 - Internal Research and Development (IRAD) Efforts
- S40mm Ammunition Family
 - Armor Piercing Fin Stabilized Discarding Sabot with Tracer (APFSDS-T)
 - Multi Purpose Air Burst with Tracer (MPAB-T)
 - Target Practice with Tracer (TP-T)
- Summary



Why S40mm ammunition?



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S40mm - Introduction

Why S40mm Ammunition?

The up gunned S40mm MK44 weapon and ammunition solution is ready for U.S. Army study and test

- The 30mm MK44 weapon is a battle proven system with a complete family of qualified ammunition ranging from target practice, armor piercing and high explosive cartridges
- The proven MK44 weapon contains growth provisions for S40mm cartridges
 - Increasing lethality over 30mm where...bigger is better
 - Minimal up-gun cost impacts due to a combination of MK44 weapon part commonality and interchangeability

**30mm to S40mm Projectile Growth
Placing more Lethality on Target**



S40mm - Introduction

Why S40mm Ammunition?

It is a solution that meets the Army's future fighting capability growth objective:

- To maintain lethality overmatch against the most common/capable threat
- Leverage existing 30mm cartridge technologies and qualified explosive items
- Existing and established US supplier base currently implementing growth objective needs
- Common 30mm MK44 and S40mm MK44 weapon parts
- Common MK15 cartridge link for 30mm and S40mm
- Nearly common cartridge packaging system for 30mm and S40mm

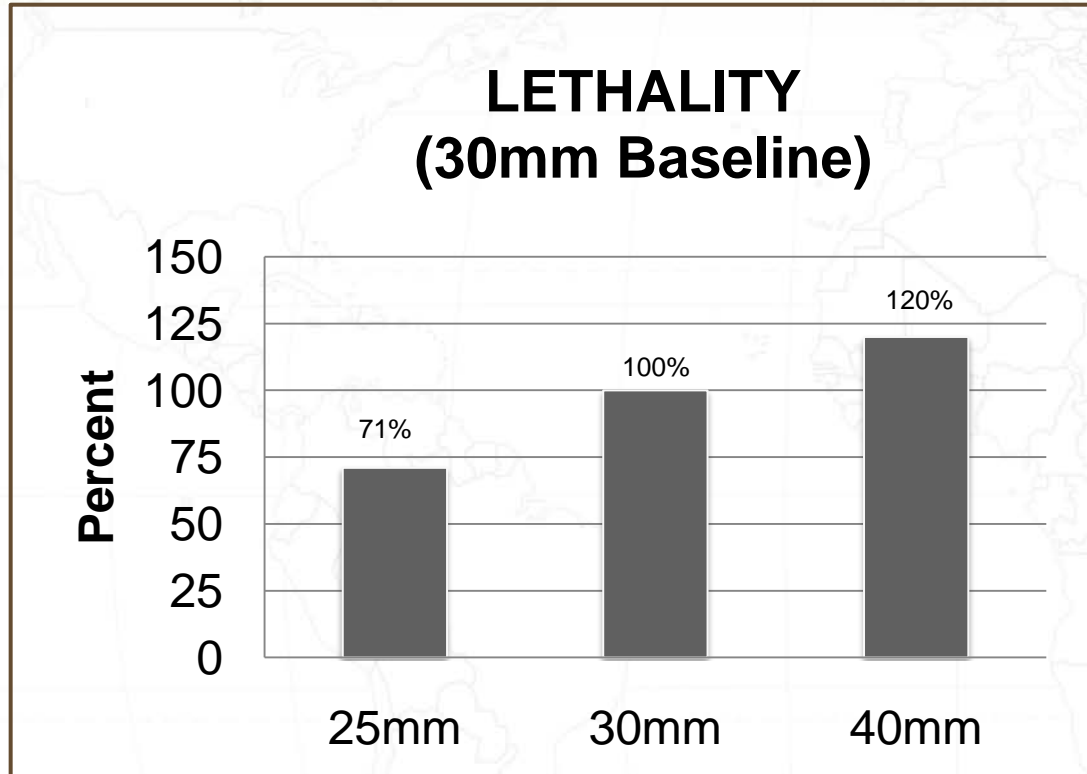
30mm and S40mm commonalities = Lower weapon system costs



Lethality of S40mm over 30mm



APFSDS-T Caliber Comparisons

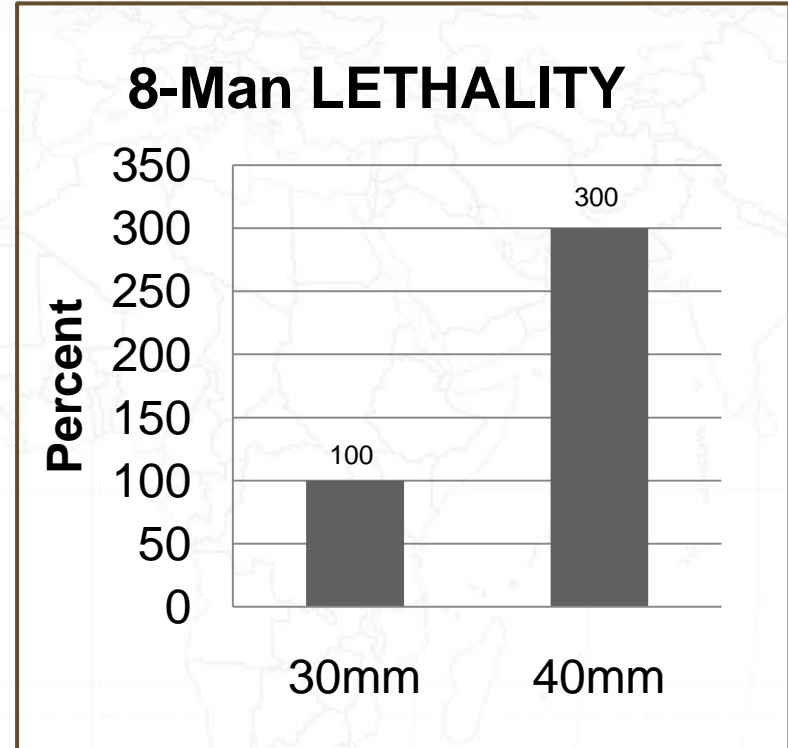
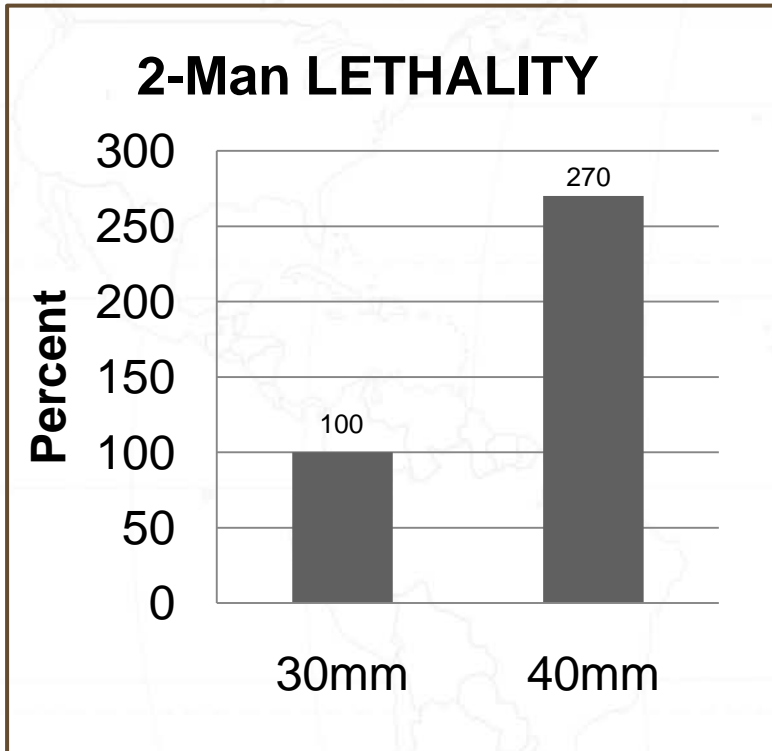


25mm – DU
30mm – Tungsten
40mm – Tungsten

S40mm APFSDS-T offers up to 20% more lethality over the 30mm APFSDS-T while allowing the same number of stowed rounds



MPAB-T Requirements



S40mm Air Burst offers up to 3 times the lethality of the 30mm Air Burst while allowing the same number of stowed rounds



Brief S40mm ammunition history

- US Army Contract Efforts
- Internal Research and Development (IRAD) Efforts



S40mm - US Army Contract Efforts

2001-2005 - US Army Contract for the Advanced Light Armaments Combat Vehicle (ALACV)

- Propellant development for:
 - Armor Piercing Fin Stabilized Discarding Sabot with Trace (APFSDS-T)
 - Multi Purpose Air Burst with Trace (MPAB-T)
 - Target Practice with Trace (TP-T)
- Cartridge development:
 - S40mm x 218 APFSDS-T
 - S40mm x 165 MPAB-T
- Live fire demonstrations at High Rate Bursts (HRB) out of the MK44 mounted in a Bradley Fighting Vehicle
- Successful APFSDS-T ballistic penetration performed
- Successful MPAB-T ballistic function demonstrated



S40mm-Internal Research and Development (IRAD) Efforts

2001-Present -IRAD

- Common S40mm x 180mm case design, development, tooling and manufacture complete for S40mm ammunition family
- S40mm APFSDS-T Cartridge Design:
 - Successful aluminum sabot ballistic testing with common case
 - Composite material sabot solution in process
 - Propellant solutions from GD-OTS St. Marks and GD-OTS Canada within 10% of goal at ambient temperature
- S40mm MPAB-T Cartridge Design
 - Induction or contact set fuze with
 - PD/PD delay
 - Self destruct
 - Selectable short/long fuze arming ranges
- S40mm TP-T Cartridge Design
 - Simple two piece metal projectile design for low cost production



S40mm Ammunition Family



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S40mm Ammunition Family

- APFSDS-T for armor targets. Features include:
 - Cobalt free penetrator
 - Composite sabot assembly
- MPAB-T for urban and troop targets. Features include:
 - PD/PD delay
 - Short or long selectable arming ranges
 - Airburst function
 - Self destruct function
 - Induction or contact communication fuze
- TP-T for training. Features include:
 - Simple two piece projectile construction for low cost production



MPAB-T

TP-T

APFSDS-T



S40mm Armor Piercing Fin Stabilized Discarding Sabot with Tracer (APFSDS-T)



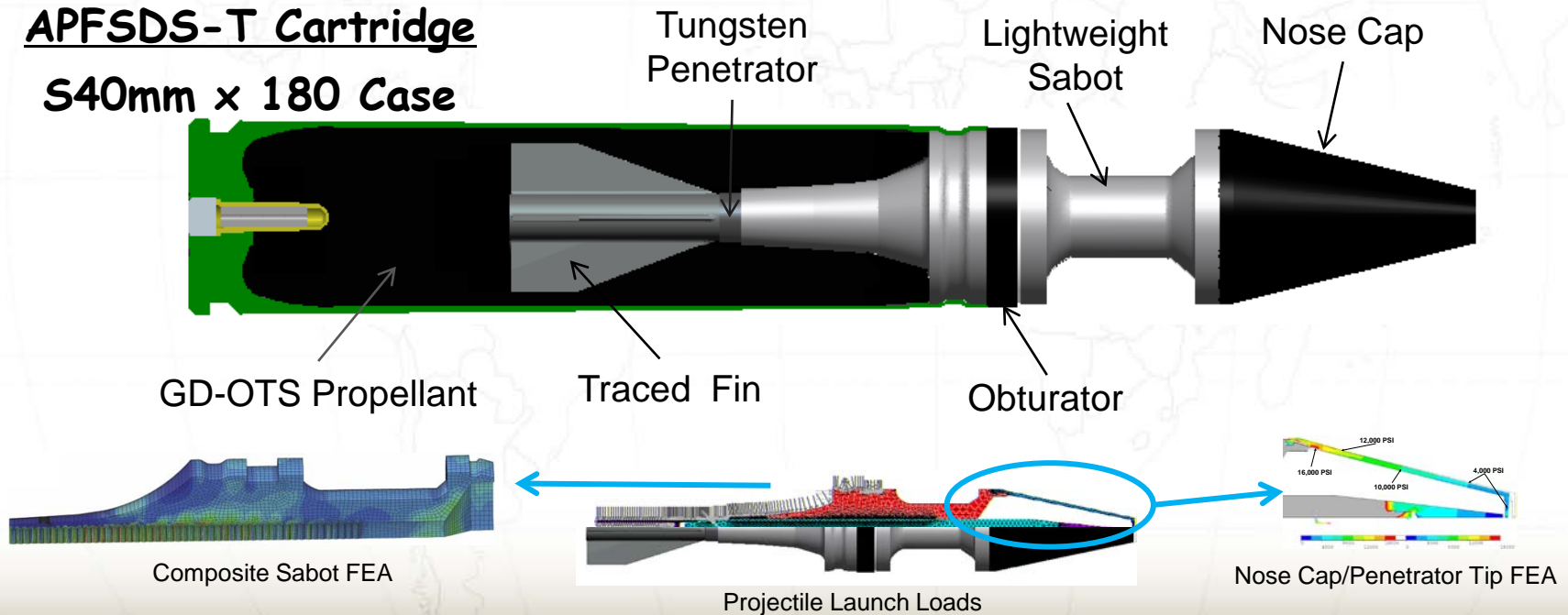
S40mm APFSDS-T - Design Characteristics

Projectile Features:

- S40mm provides ~50% higher flight weight (penetrator, fin, and windscreen) than the 30mm APFSDS-T
- Muzzle velocity consistent with the 30mm APFSDS-T at 1430mps
- This yields an ~ 20-25% increase in penetration capability over the 30mm and >145% more kinetic energy on target at 2,000m

APFSDS-T Cartridge

S40mm x 180 Case



S40mm APFSDS-T - Penetrator



25mm

30mm

S40mm

S40mm penetrator comparison placing more lethality on target over current 25mm and 30mm solutions



S40mm Challenges and Solutions

Challenge: Muzzle velocity goal of 1430m/s

Solution:

- GD-OTS propellant solutions:
 - SHP831 Hybrid Propellant produced by St. Marks Powder
 - Mixed propellant from:
 - St. Marks Powder, SHP831 Hybrid
 - GD-OTS Canada, Extruded SPDN
- Transition from aluminum to composite sabot decreasing projectile mass



Propellant Example



Composite Sabot Assembly Example

Status:

- Current velocity breakthrough with General Dynamics St. Marks SHP831 Hybrid propellant at ambient temperature
 - Within ~10% of the ambient velocity goal with aluminum sabot
 - Loose fill propellant pour
- Additional testing planned with composite sabot later in 2010 to reach velocity goal



S40mm APFSDS-T - Demonstrated Performance

Spin, yaw, dispersion, penetration, trajectory, and autogun testing have been successfully performed



Back Side of 2"
Armor Plate
(3km equivalent)



4" Back-up
Plate



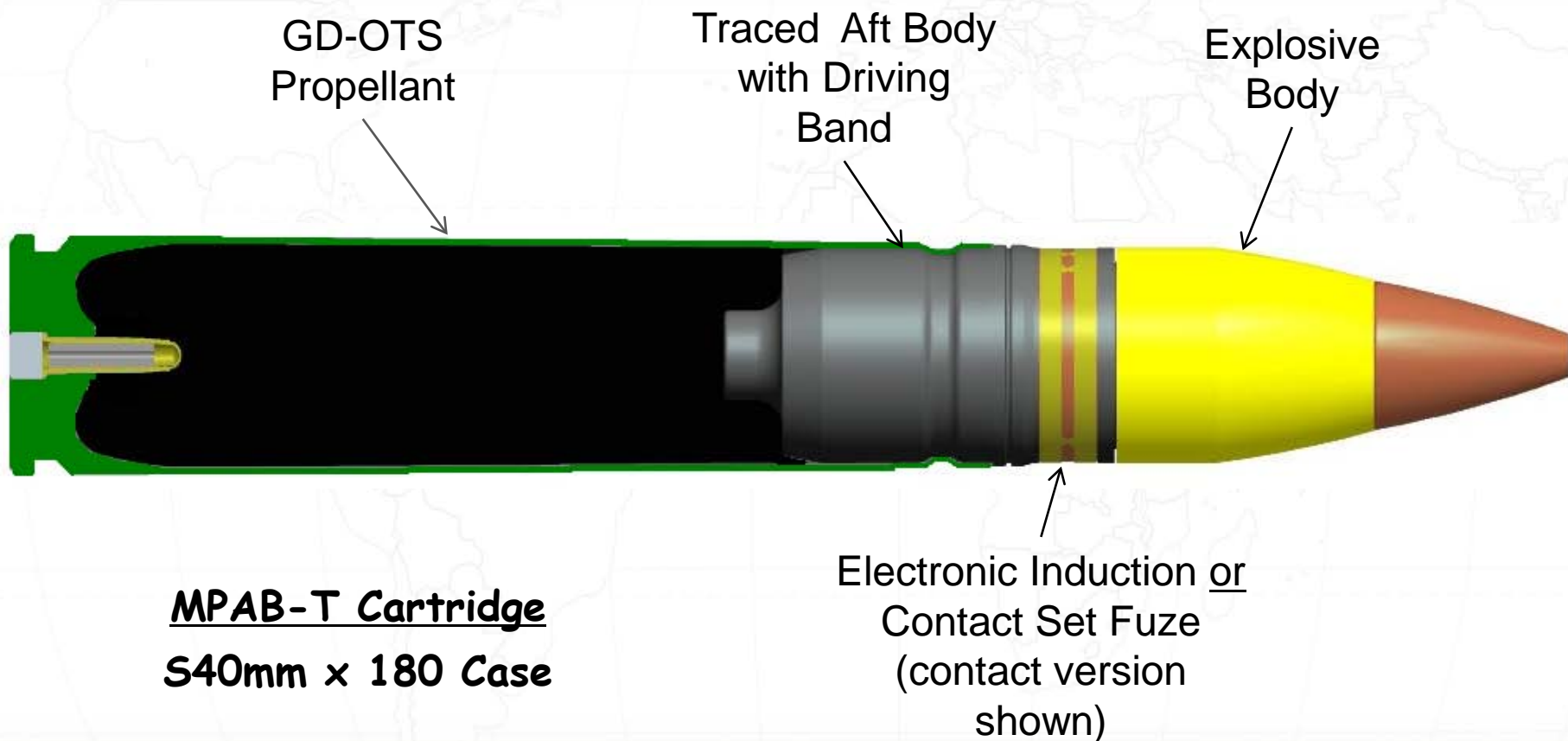
S40mm Multi Purpose Air Burst with Tracer (MPAB-T)



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S40mm MPAB-T Cartridge

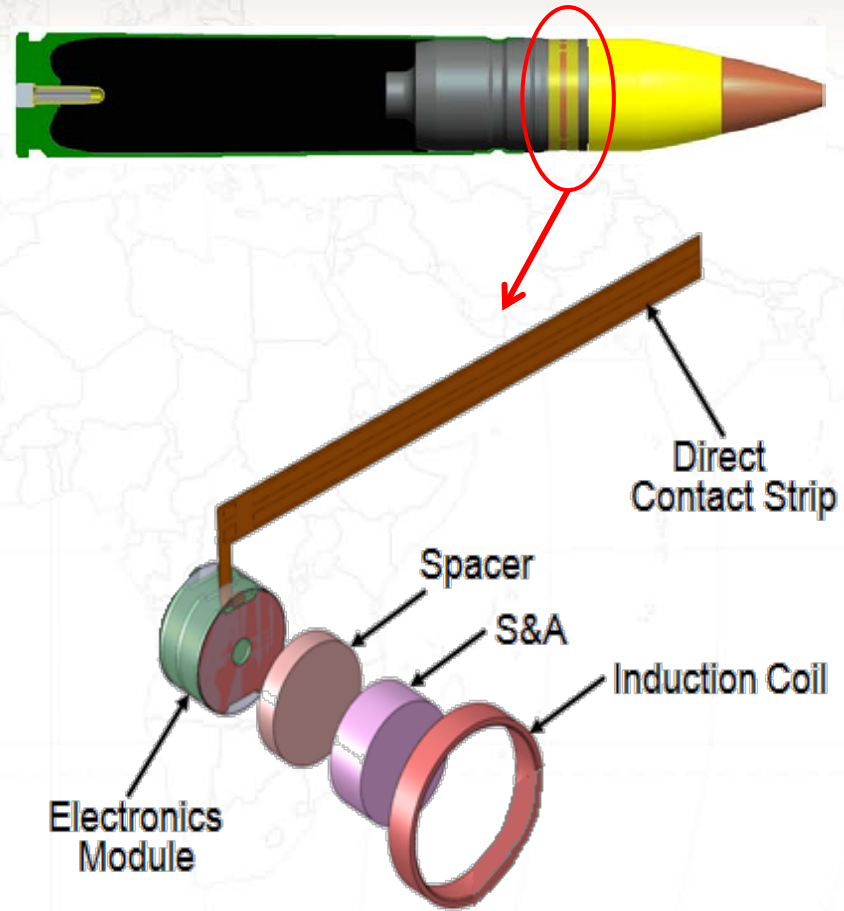


MPAB-T Cartridge
S40mm x 180 Case



S40mm Air Burst - Fuze Characteristics

- Inductive or contact set, time-based, programmable electronic fuze
- Airburst function
- PD/PD Delay feature to:
 - Increase capability of the ammunition and eliminate the need for HEI PD ammunition
 - Defeat light materiel targets
 - Provide PD function in the unlikely event that an air burst communication signal fails
- Selectable arming: allows user to select an arming range of short or long
- Self destruct function



**Induction/Contact
Airburst Fuze**



S40mm Air Burst - Demonstrated Performance



One 3-rd burst hit 12 of 12 mannequins and perfed vests/helmets 7 times (2 mannequins) @ 600m



S40mm Target Practice with Tracer (TP-T)



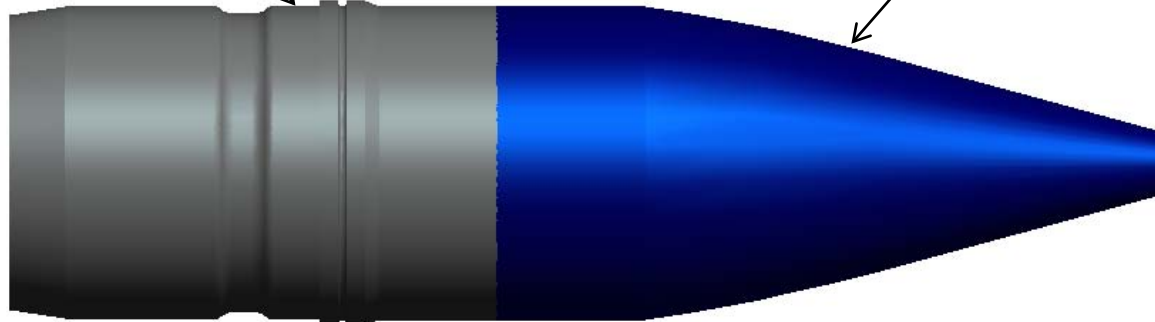
S40mm TP-T

Projectile Features:

- Simple two piece metal projectile design for low cost production
- Ballistic match to the MPAB-T
- Qualified tracer configuration: PGU-30 trace igniter and M793 trace sustainer

Traced Aft Body
with Driving Band

Forward Body



Summary

- The S40mm cartridges offer greater lethality than 30mm without reducing the number of stowed rounds:
 - Developed link and linkless MK44 feed systems have provisions for S40mm ammunitions
 - APFSDS-T design provides ~20-25% more penetration than 30mm
 - MPAB-T design is up to 3 times more lethal than 30mm
- APFSDS-T sabot and GD-OTS propellant development will yield goal muzzle velocity by end of 2010
- The S40mm APFSDS-T and MPAB-T munitions have been successfully demonstrated out of the MK44 cannon

Storage Volume
30mm = 40mm



MK44 Weapon

S40mm Family



MPAB TP KE

