



**LINE OF SIGHT/BEYOND LINE OF SIGHT (LOS/BLOS)  
ADVANCED TECHNOLOGY DEMONSTRATOR (ATD)**

**BRIEFING FOR THE GUNS, AMMUNITION, ROCKETS &  
MISSILES SYMPOSIUM - 25-29 APRIL 2005**

*Providing America Advanced Armaments for Peace and War*



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ANTHONY J. CANNONE  
LOS/BLOS ARMAMENT TEAM**



# LIGHTWEIGHT 120 MM GUN (LW120) LOS/BLOS ATD



ISO 9001 Certified  
FS15149

- **OVERVIEW OF LOS/BLOS ATD GUN**
  - DESIGN CONCEPT
  - REQUIREMENTS
- **OVERVIEW OF TEST STATUS TO DATE**
  - TEST RESULTS PHASE 1
  - TEST RESULTS PHASE 2
  - TEST RESULTS PHASE 3 (PRELIMINARY TEST DATA)
  - IN HOUSE TESTING
- **PATH FORWARD**
- **ACCOMPLISHMENTS**



# LOS/BLOS ATD GUN OVERVIEW



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- **GOAL: DEVELOP A LIGHTWEIGHT 120MM GUN FOR USE ON A 20 TON VEHICLE**
  - **WEIGHT: < 4,400 POUNDS**
  - **RECOIL IMPULSE: < 5,300 POUND-SECONDS**
  - **RECOIL LENGTH 25 INCHES**
  - **SPACE CLAIM LIMITS OF MCS CONCEPT VEHICLE**
- **STATUS & ONGOING ACTIVITIES**
  - **VEHICLE DYNAMIC RESPONSE DEMONSTRATOR (VDRD) GUN DEVELOPED AND COMPLETED TESTING IN FEBRUARY 2004**
  - **LINE OF SIGHT/BEYOND LINE OF SIGHT (LOS/BLOS) ADVANCED TECHNOLOGY DEMONSTRATOR (ATD) PROGRAM BUILT AND TESTED 3 VERSIONS OF THE LIGHTWEIGHT 120MM GUN FROM NOVEMBER - MARCH 2005**
  - **KEY TECHNOLOGIES CONTINUE MATURING IN NEW PROGRAM**

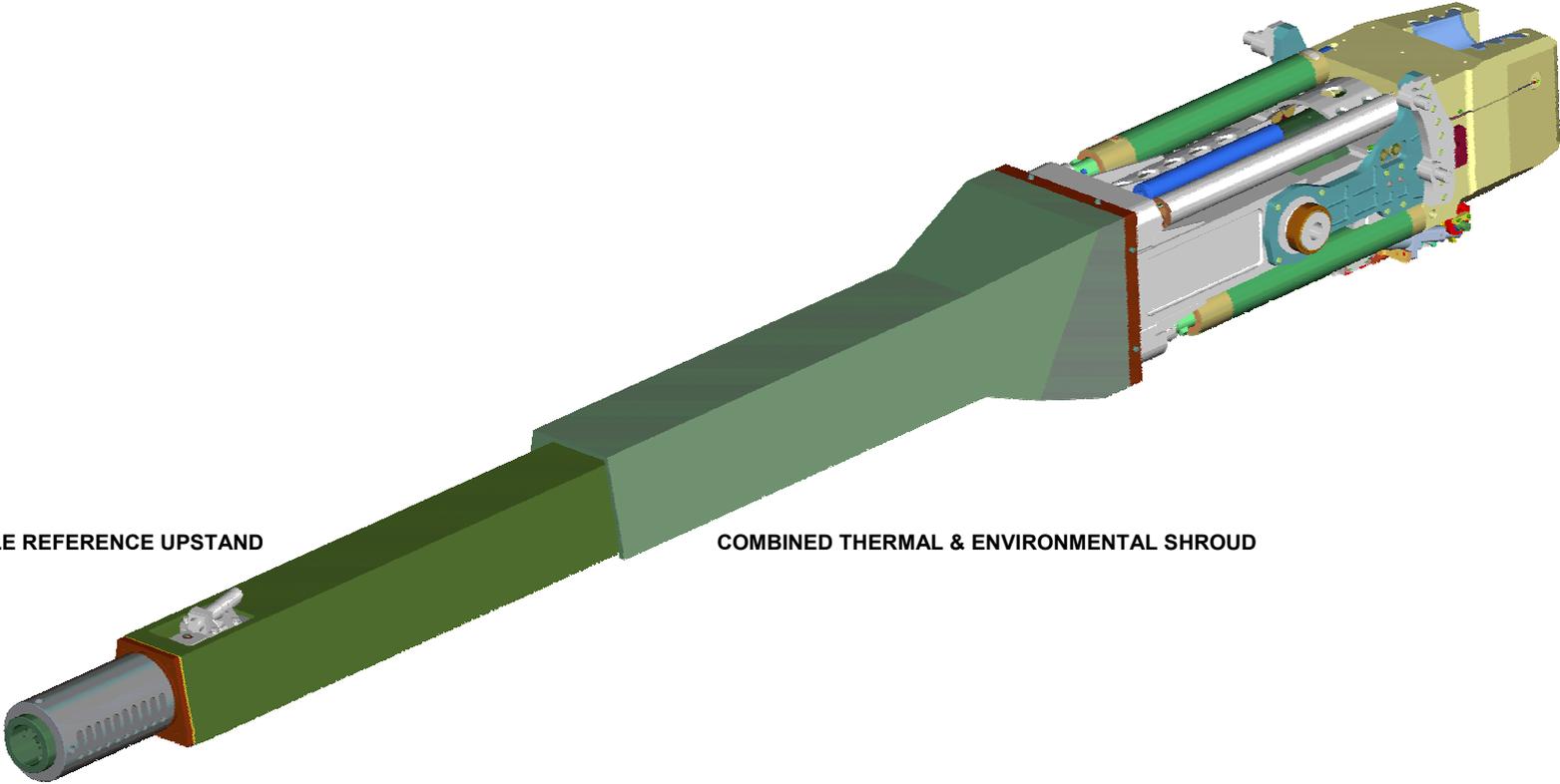


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## GUN ASSEMBLY



MUZZLE REFERENCE UPSTAND

COMBINED THERMAL & ENVIRONMENTAL SHROUD

ATD 1 BLAST DEFLECTOR SHOWN THIS VIEW



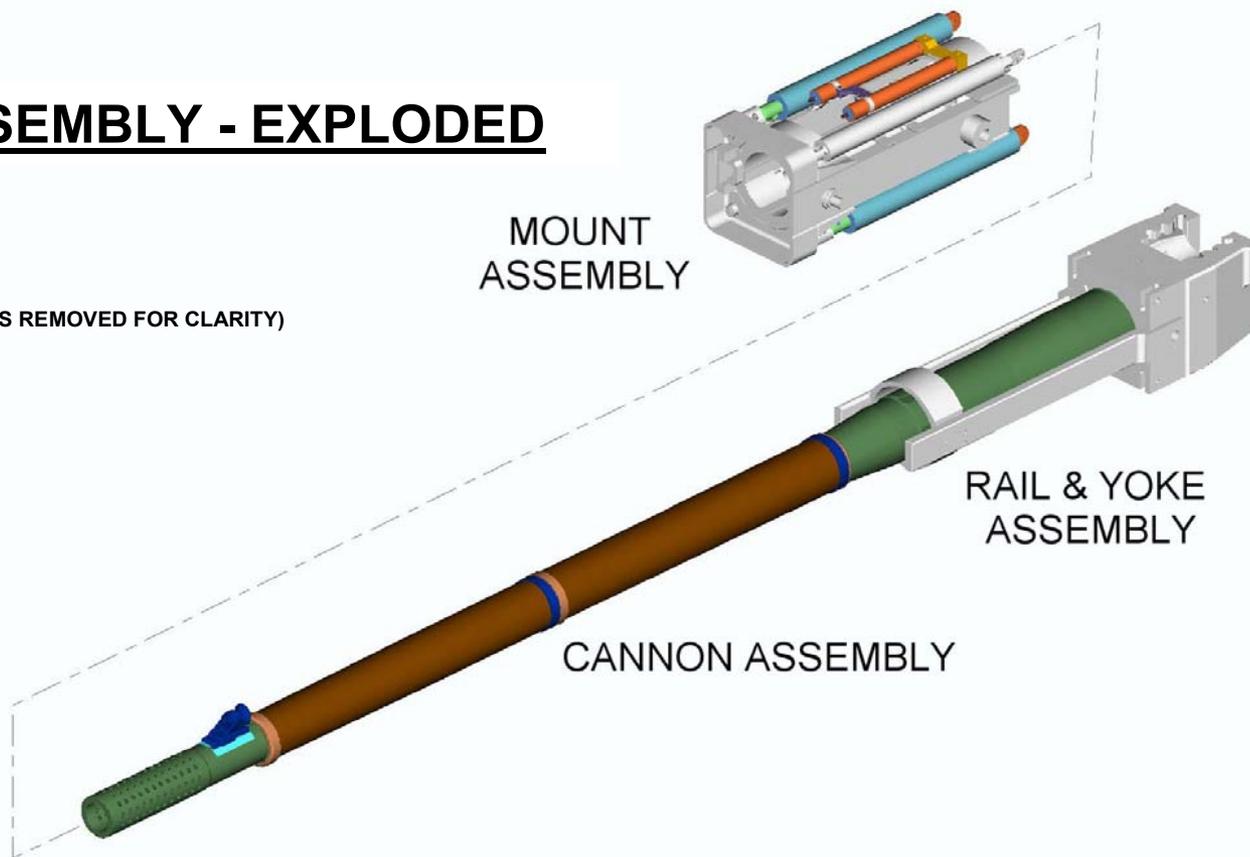
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## GUN ASSEMBLY - EXPLODED

(SHROUDS REMOVED FOR CLARITY)



MOUNT  
ASSEMBLY

RAIL & YOKE  
ASSEMBLY

CANNON ASSEMBLY

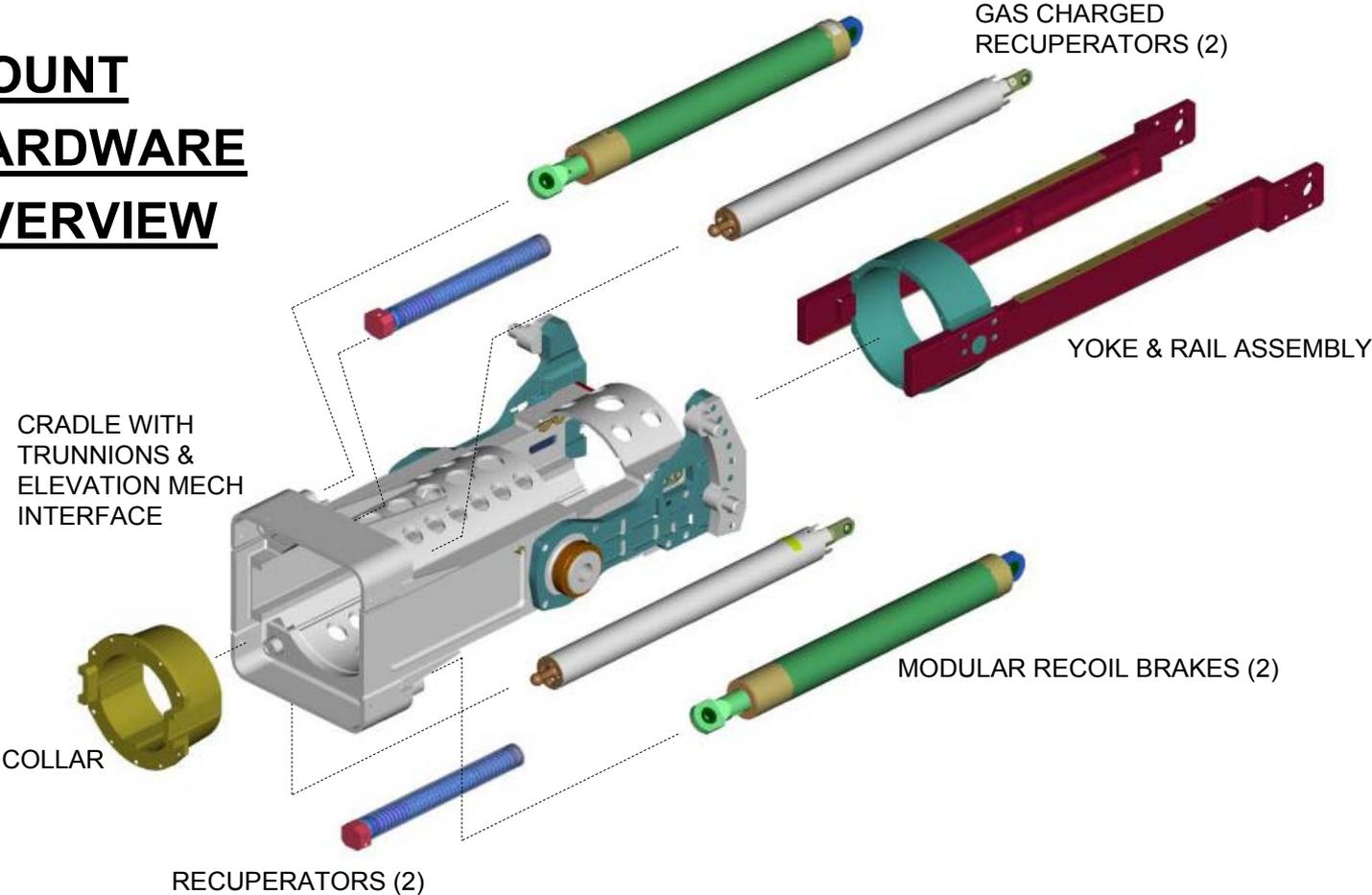


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## MOUNT HARDWARE OVERVIEW



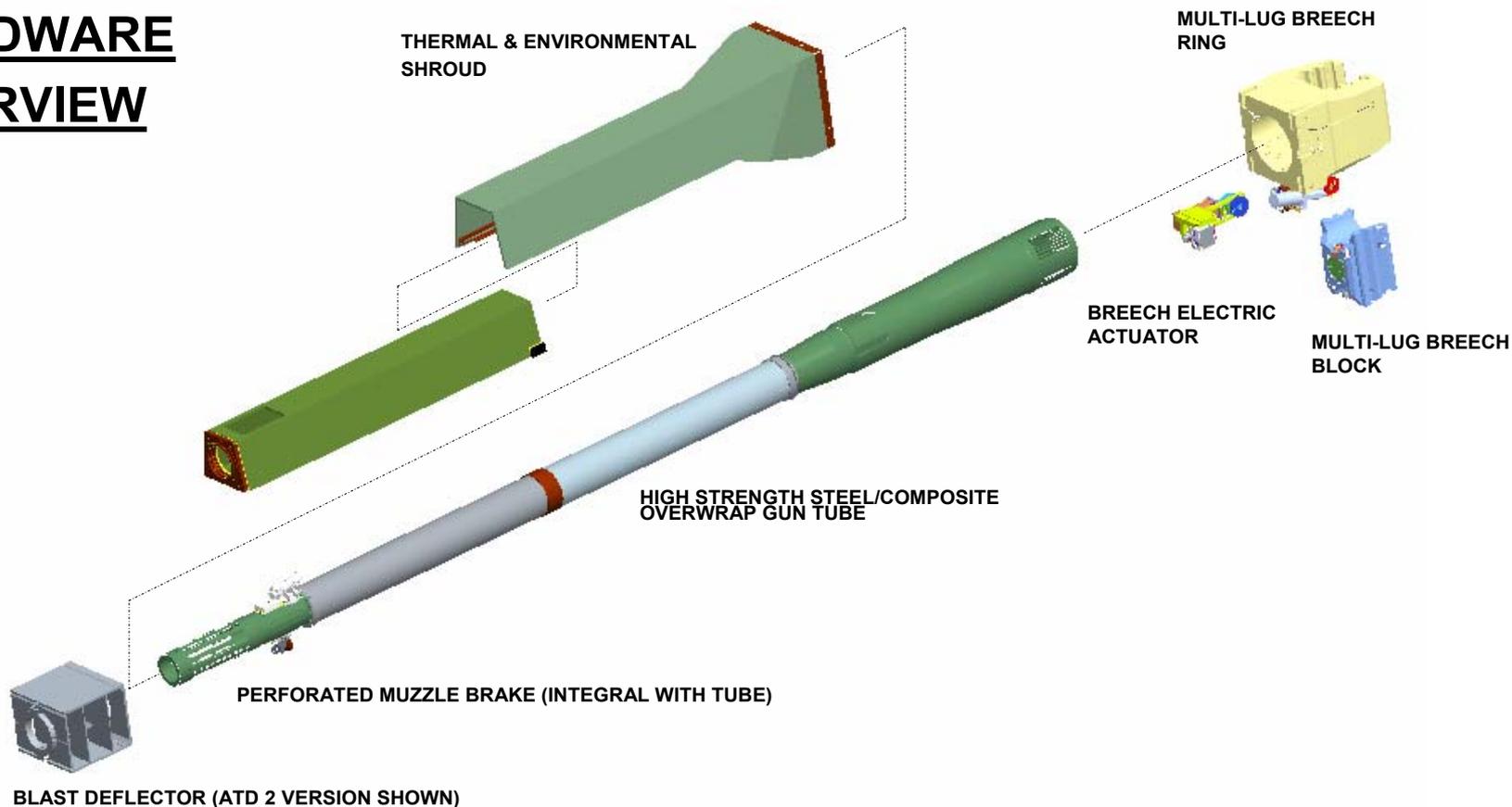


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## CANNON HARDWARE OVERVIEW





# LOS/BLOS ATD GUN DESIGN CONCEPT (ATD # III.WP.2003.01)



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<b>Capability</b>	<b>Current Capability (Baseline)</b>	<b>LOS/BLOS ATD</b>	
		<b>Minimum</b>	<b>Goal</b>
<ul style="list-style-type: none"> <li>• <b>Armament</b> <ul style="list-style-type: none"> <li>• Gun weight (lbs)</li> <li>• Gun elevation</li> <li>• Recoil &amp; Ammo Volume</li> <li>• Stowed Rounds</li> <li>• Weapon Recoil Force</li> <li>• Weapon position error (LOS)</li> </ul> </li> <li>• <b>Ammunition</b> <ul style="list-style-type: none"> <li>• Advanced KE Armor Penetration</li> <li>• MRM – PSSK</li> <li>• Warheads:                             <ul style="list-style-type: none"> <li>Warhead – SC L/D (pen) Capability</li> </ul> </li> </ul> </li> <li>Precision Ignition Demo</li> </ul>	<p>6700 lbs</p> <p>20<sup>0</sup></p> <p>4.5 m<sup>3</sup> (Abrams)</p> <p>42 (Abrams)</p> <p>160,000 Lbf</p> <p>.75 mil (EI and Az) (M1) dynamic</p> <p>M829A2 @ 2km</p> <p>N/A</p> <p>1.7 Armor</p> <p>T2 s of 3 ms (abrams)</p>	<p>4,400 Lbs</p> <p>30<sup>0</sup></p> <p>3.5 m<sup>3</sup></p> <p>38</p> <p>90,000 Lbf</p> <p>.5 mil (EI and Az) dynamic</p> <p>Advanced Armor Threat @2km</p> <p>Pssk (class) 2-12km</p> <p>1.0 (class) Armor</p> <p>T2 s of 0.5 ms</p>	<p>4000 Lbs</p> <p>50<sup>0</sup></p> <p>3.5 m<sup>3</sup></p> <p>43</p> <p>85,000 Lbf</p> <p>.35 mil (EI and Az) dynamic</p> <p>Advanced Armor Threat @4km</p> <p>Pssk (class) 2-16km</p> <p>1.0 (class + 30%) Armor, personnel, Bunker, Urban Helicopter</p> <p>T2 s of 0.1 ms</p>

# LOS/BLOS ATD GUN TEST RESULTS/STATUS

- **ATD GUN FIRING TEST PHASE – COMPLETED TO DATE AT APG**

- **97 ROUNDS FIRED**

40 - M829A3      5 - M829A2      25 - M865      40 - M831A1

10 - M829A2 (PRECISION IGNITION MOD)

3 - MRM-CE SLUG      3 - MRM-KE SLUG      1 MRM-KE FINNED

- **TEST HARDWARE/PHASES COMPLETED**

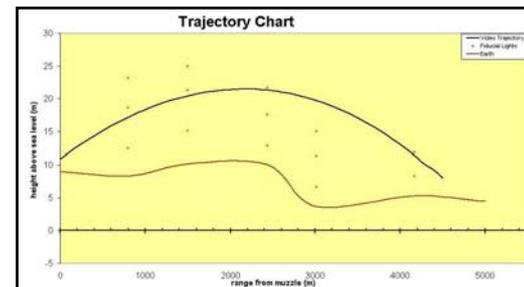
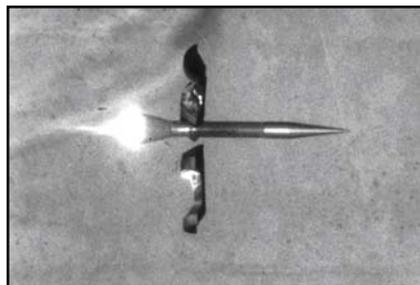
- **GUN TUBE STRUCTURAL INTEGRITY**
- **TRUNNION FORCE**
- **MUZZLE BRAKE EFFICIENCY**
- **MRM ROUNDS**
- **ACCURACY**
- **CMS TANTALUM LINER**



# LOS/BLOS ATD GUN TEST RESULTS/STATUS



- TEST SET UP AT ATC TRENCH WARFARE II FIRING RANGE
- MULTIPLE SOFT TARGET RANGE UP TO 5000M LOS, VIDEO SCORING
- 2 SEPARATE LOF ALLOW DU AND HEAT TO BE FIRED
- FIRE CONTROL DATA COLLECTION
- HIGH SPEED PHOTOGRAPHY, MUZZLE EXIT BALLISTICS
- NEAR REAL-TIME PROCESSING USING TEST SITE INTEGRATION
- RANGE ALLOWED MRM FIRING TO 12 KM





# LOS/BLOS ATD GUN TEST RESULTS/STATUS



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- **ATD GUN FIRING TEST RESULTS TO DATE –**
  - **COMPOSITE JACKETED GUN TUBE FIRED & STRAIN MEASURED**
  - **STRUCTURAL INTEGRITY DEMONSTRATED, PERFORMING WELL.**
  - **TRUNNION FORCE MEASUREMENTS:**
    - **PRELIMINARY RESULTS INDICATE GOOD AGREEMENT WITH PREDICTIONS**
    - **PEAK FORCES FIRING M829A3 WITH MUZZLE BRAKE < 65,000 LBS**
    - **MUZZLE BRAKE EFFICIENCY GOAL OF > 25% FIRING THE M829A3 ROUND DEMONSTRATED.**
  - **MRM-KE ROUND FIRED TO MAX RANGE (30° ELEVATION)**
    - **12 KM RANGE DEMONSTRATED, ACTUAL RANGE 12.8 KM.**
    - **PROPER FIN DEPLOYMENT THROUGH MUZZLE BRAKE DEMONSTRATED.**



# LOS/BLOS ATD GUN TEST RESULTS/STATUS



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- **RESULTS (cont'd)**
  - **INITIAL EROSION TESTING ON CYLINDRICAL MAGNETON SPUTTER (CMS) COATED (TANTULUM) LINER (~2')**
  - **ACCURACY TESTING - TARGET IMPACT DISPERSION (TID)**
    - **M829A3 INITIAL TID COMPLETED**
    - **M865 & M831A1'S GOOD RESULTS – TID WITHIN REQUIREMENTS.**
  - **BREECH BLOCK WITH AMMO DATA LINK (ADL).**
    - **FUNCTIONALITY, STRUCTURAL INTEGRITY OF DUAL DATA PIN ADL DEMONSTRATED.**
    - **SINGLE PIN ADL (GERMAN) SYSTEM DEMONSTRATED.**
    - **PRECISION IGNITION DEMONSTRATION.**
    - **BREECH ACTUATOR HARDWARE DEMONSTRATED**
  - **ULTRA HIGH STRENGTH STEEL TUBE FIRED**



# LOS/BLOS ATD GUN TEST RESULTS/STATUS



**LIGHTWEIGHT 120 MM GUN ASSEMBLY AT ABERDEEN TEST CENTER – 19 OCT 04. NOTE MICROPHONES TO RECORD BLAST OVERPRESSURE, ADDITIONAL RISERS UNDER GUN ‘KNEES’ TO OBTAIN MORE ACCURATE GROUND REFLECTION DATA.**

**PENCIL PROBE AND HULL MOUNT SIMULATOR MICROPHONES WERE CUSTOM DESIGNED AND FABRICATED BY ATC BALLISTICS AT THE REQUEST OF THE BENET LABORATORIES**

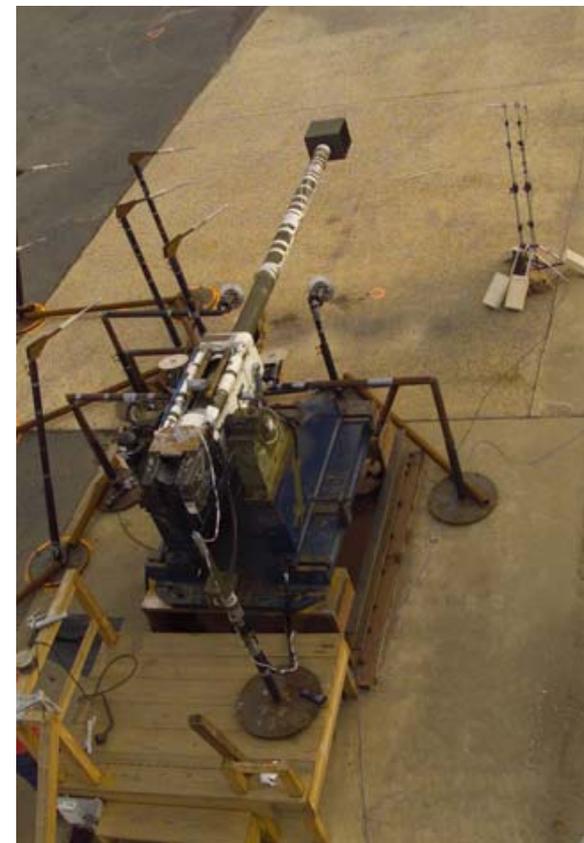




# LOS/BLOS ATD GUN TEST RESULTS/STATUS



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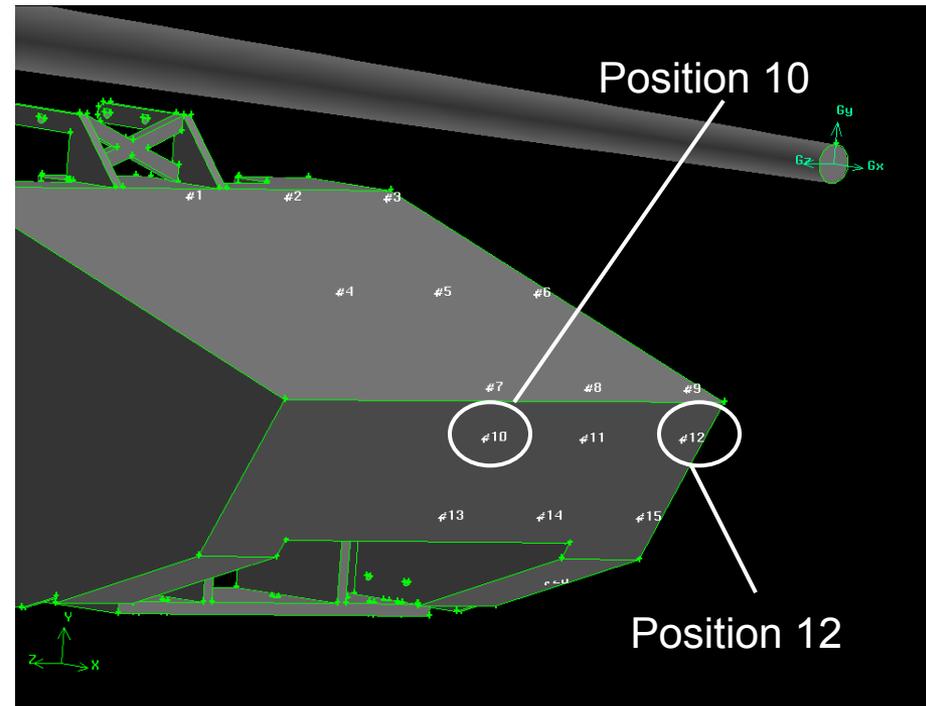
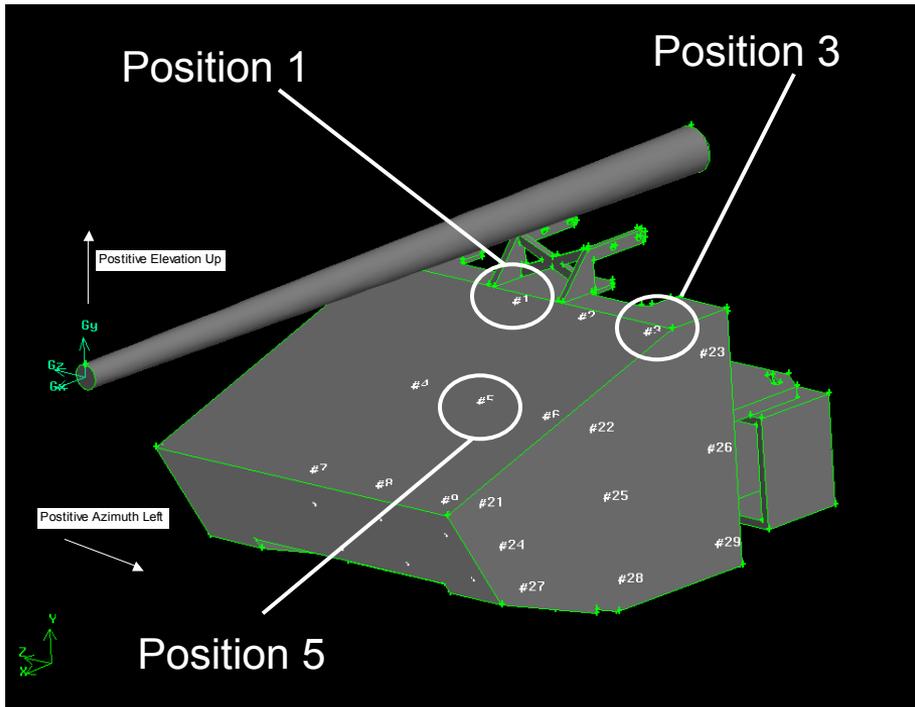


# LOS/BLOS ATD GUN TEST DATA



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## HULL POSITIONS MEASURED WITH CHASSIS SIMULATOR GAGES

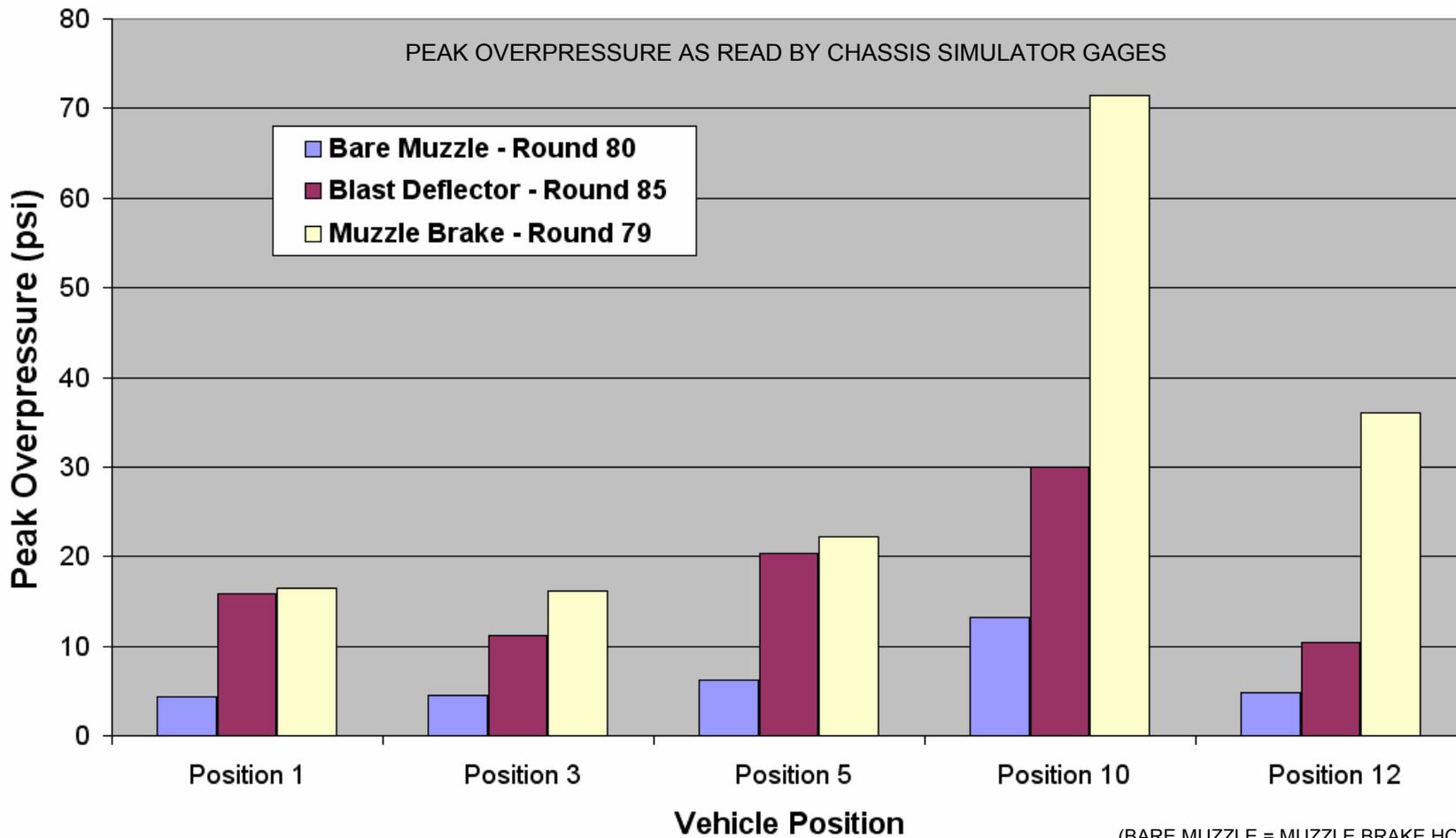




# LOS/BLOS ATD GUN TEST DATA



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(BARE MUZZLE = MUZZLE BRAKE HOLES COVERED)

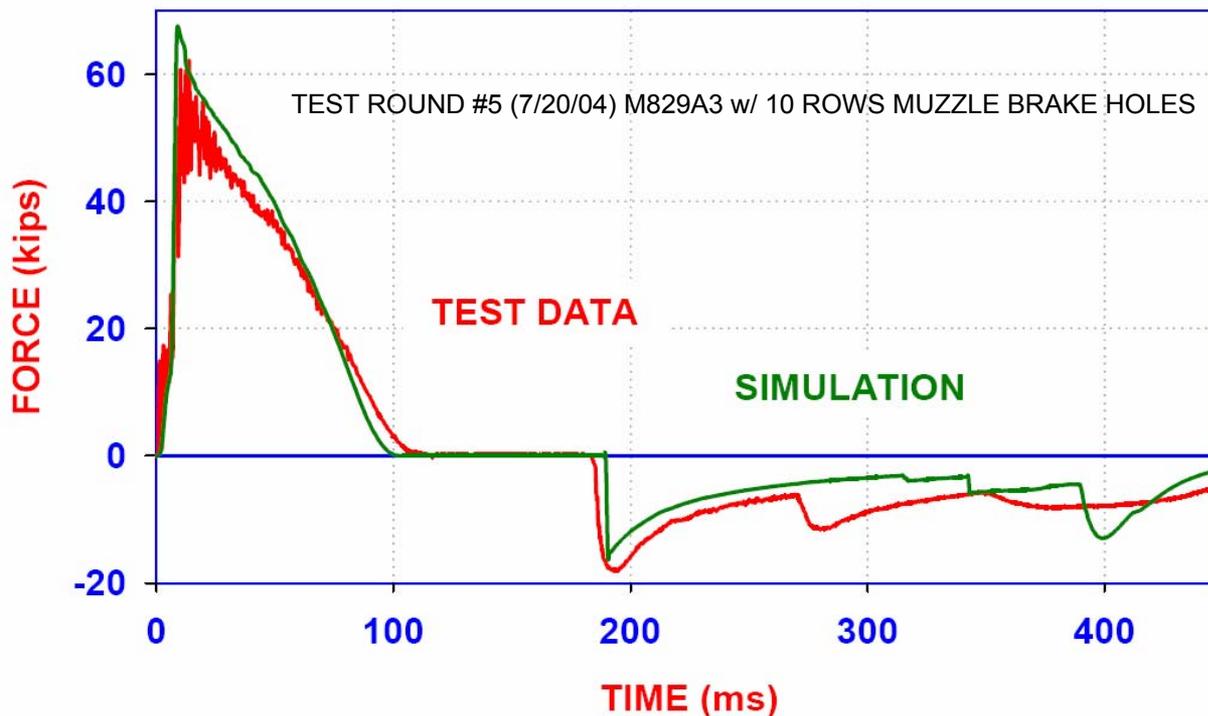


# LOS/BLOS ATD GUN TEST DATA



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## TOTAL BRAKE FORCE vs TIME



ROUND	CARTRIDGE	IMPULSE (LBSEC)	CONFIGURATION
5	M829A3	5,232	Full Muzzle Brake
6	M829A3	5,315	Full Muzzle Brake
7	M829A3	5,360	Full Muzzle Brake

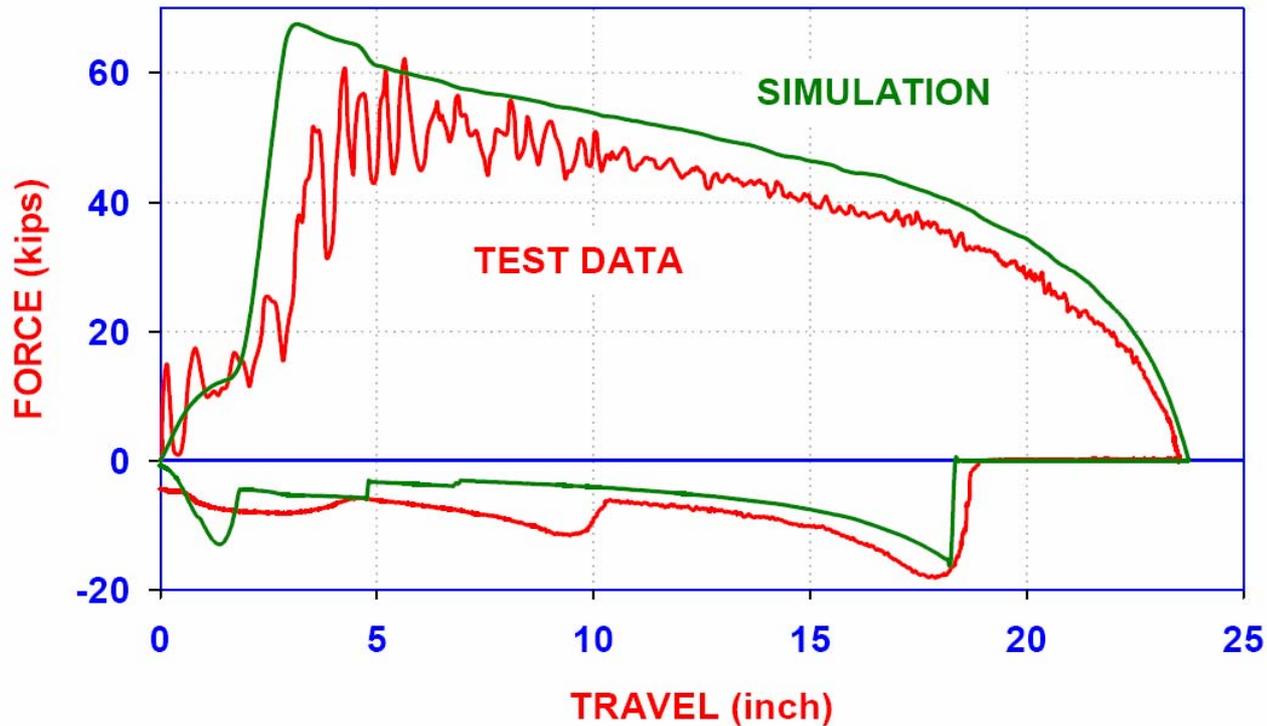


# LOS/BLOS ATD GUN TEST DATA



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## TOTAL BRAKE FORCE vs TRAVEL



ATD #1 RECOIL SYSTEM TEST RESPONSETEST ROUND #3 (7/20/04) M829A2 w/ 10 ROWS MUZZLE BRAKE HOLES



# LOS/BLOS ATD GUN PRELIMINARY TEST RESULTS



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## ROUND M829A2 @ 70DegF

ATD - TEST	BALLISTIC IMPULSE	IMPULSE at TRUNNION	PERCENT REDUCTION
1 (3)	6428	4818	25.0
2 (10)	6327	4803	24.1

## ROUND M831A1

ATD - TEST	BALLISTIC IMPULSE	IMPULSE at TRUNNION	PERCENT REDUCTION
1 (3)	5645	4322	23.4
2 (10)	5560	4442	20.1

## ROUND M865

ATD - TEST	BALLISTIC IMPULSE	IMPULSE at TRUNNION	PERCENT REDUCTION
1 (3)	4833	3628	24.9
2 (10)	4825	3549	26.4



# LOS/BLOS ATD GUN TEST RESULTS/STATUS



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# LOS/BLOS ATD GUN TEST RESULTS/STATUS



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**ATD MOCK GLACIS ASSEMBLED AT ABERDEEN TEST CENTER**





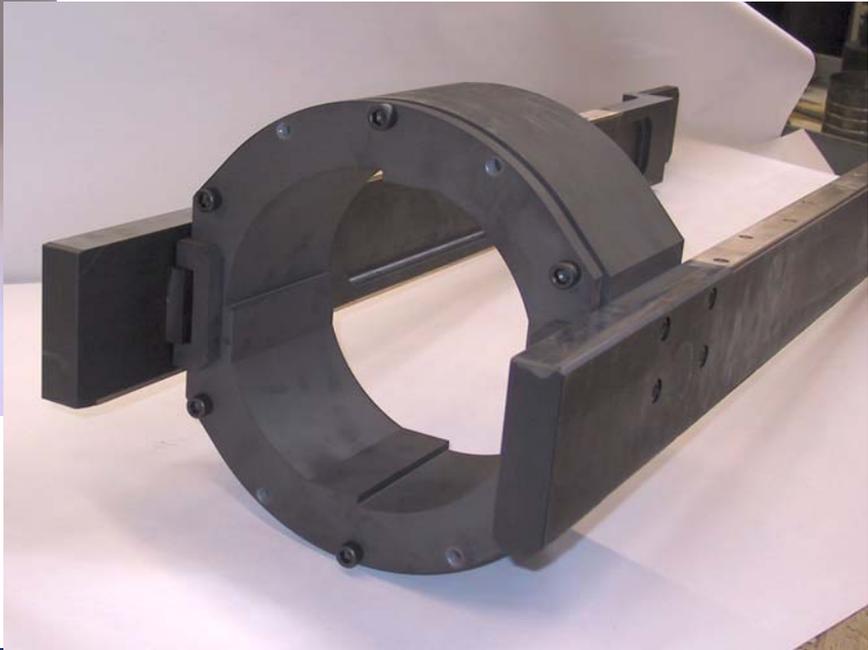
# LOS/BLOS ATD GUN TEST RESULTS



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**ATD 3 TITANIUM  
RAILS, YOKE & ADAPTOR**





# LOS/BLOS ATD GUN TEST RESULTS/STATUS



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**ENVIRONMENTAL/SIGNATURE  
SHROUD COMPOSITE SECTIONS  
(POST CURE) MADE AT BENET**

**ENVIRONMENTAL/SIGNATURE  
SHROUD ASSEMBLIES BEING  
TEST FIT TO TUBE AT BENET**





# LOS/BLOS ATD GUN IN HOUSE TESTING



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**COMPOSITE TUBE (ATD 3)  
STRAIN TESTING AT  
BENET**

**HIGH TENSION  
COMPOSITE SPECIMEN**

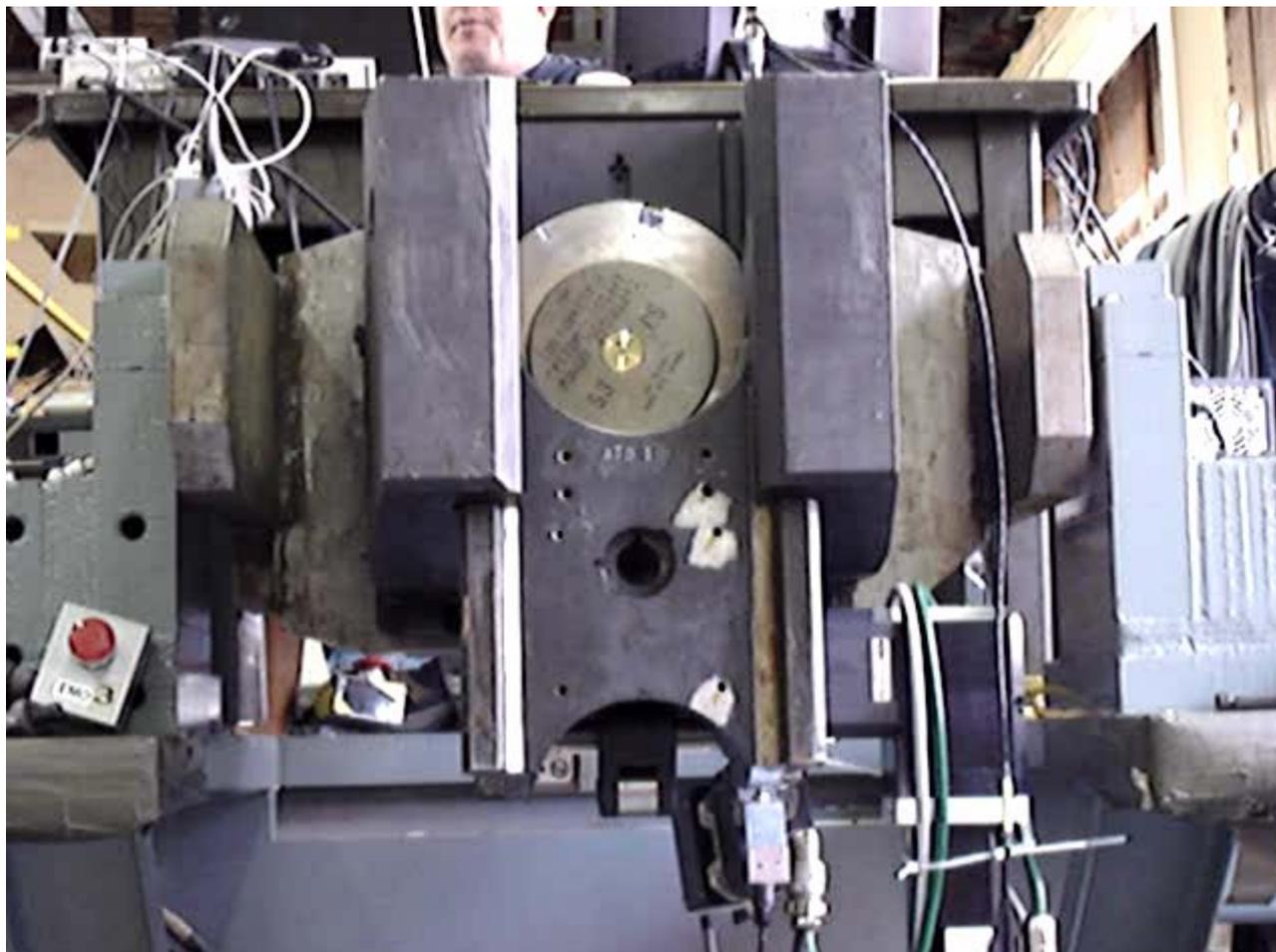




# LOS/BLOS ATD GUN IN HOUSE TESTING



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# LOS/BLOS ATD GUN PATH FORWARD



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- **COMPLETE ANALYSIS OF ALL TEST DATA OF LOS/BLOS ATD TEST PHASES (ONGOING THROUGH MAY 05) AND INCORPORATE INTO GUN TECHNICAL DATA PACKAGE**
- **START NEW STO PROGRAM “LIGHTWEIGHT ARMAMENT ENHANCEMENTS”**
  - **EXPLORE/MATURE HIGHER RISK ARMAMENT WEIGHT REDUCTIONS AND ACCURACY ENHANCEMENTS**
  - **DEMONSTRATE TECHNOLOGIES FOR TRANSITION INTO SDD**
- **SDD PROGRAM START**
  - **TAILOR GUN INTERFACES FOR THE MCS**
  - **REFINE TECHNICAL DATA PACKAGE TO OPTIMIZE COST & PERFORMANCE**
  - **INCORPORATE INTERFACES FOR NEW MUNITIONS**



# FCS/MCS LW120 GUN DESIGN CONCEPT – GUN ASSY WEIGHT



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	M256 (M1A2)	SDD Estimate	LAEP Estimate
<b>Breech Ring &amp; Block Assemblies</b>	<b>1525</b>	<b>1,072</b>	<b>842</b>
<b>Breech Mech. Housing Assembly</b>	<b>(included)</b>	<b>42</b>	<b>42</b>
<b>Breech Actuator Assembly</b>	<b>N/A</b>	<b>43</b>	<b>43</b>
<b>Gun Tube</b>	<b>2350</b>	<b>1960</b>	<b>1590</b>
<b>Thermal Shrouds</b>	<b>180</b>	<b>77</b>	<b>77</b>
<b>MRS</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Blast Deflector</b>	<b>N/A</b>	<b>90</b>	<b>65</b>
<b>Cradle Assembly</b>	<b>2560</b>	<b>532</b>	<b>532</b>
<b>Replenisher Assembly</b>	<b>(included)</b>	<b>18</b>	<b>18</b>
<b>Elevation interface plates</b>	<b>(included)</b>	<b>78</b>	<b>78</b>
<b>Recoil Brakes (2)</b>	<b>(included)</b>	<b>164</b>	<b>100</b>
<b>Recuperators (2)</b>	<b>(included)</b>	<b>84</b>	<b>75</b>
<b>Rails, Yoke, Adapter</b>	<b>(included)</b>	<b>283</b>	<b>168</b>
<b>Bore Evacuator</b>	<b>50</b>	<b>N/A</b>	<b>N/A</b>
<b>Total Weight (lbs)</b>	<b>6,665.00</b>	<b>4,443.00</b>	<b>3,630.00</b>

-180 LBS - FULL  
THREAD  
-50 LBS - TI BLOCK

-200 LBS - COMPOSITE  
-100 LBS - SUHSS  
-70 LBS - DUAL  
AUTOFRETTAGE

-25 LBS - BLAST  
DEFLECTOR

-64 LBS - BRAKES  
-9 LBS - RECUPS

-115 LBS - ATD DESIGN  
DEMO IN LAEP

813 LBS  
savings

M256 GUN WEIGHT DOES NOT INCLUDE ROTOR SHIELD

LAEP WEIGHT SAVINGS OF 813 LBS

SDD ESTIMATE INCLUDES OTHER WEIGHT REDUCTION INITIATIVES NOT SHOWN IN PREVIOUS SLIDES



# LOS/BLOS ATD GUN ACCOMPLISHMENTS



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ATD GUN MOD 1 FIRING DEVELOPMENTAL MRM CARTRIDGE 19 JUL 04 – SHOT 28





# LOS/BLOS ATD GUN ACCOMPLISHMENTS - SUMMARY



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- **ACCOMPLISHMENTS**
  - **ACHIEVED A SYSTEM WEIGHT OF 4,240 POUNDS (ALL STEEL TUBE)**
  - **IMPULSE WITHIN SPECIFIED LIMIT**
  - **INITIATED TESTING DECEMBER 2003**
  - **DEMONSTRATED A MUZZLE BRAKE EFFICIENCY OF 25%**
  - **TEST FIRED TWO ITERATIONS OF BLAST DEFLECTOR TO REDUCE BLAST OVERPRESSURE**
  - **TEST FIRED TWO ITERATIONS OF A COMPOSITE OVERWRAPPED GUN TUBE (JUL 04)**
  - **SUCCESSFULLY PROOF TESTED AN ULTRA HIGH STRENGTH GUN STEEL TUBE (OCT 04)**
  - **ACHIEVED TRL 6 IN OCTOBER 2004 (CANNON) WITH ALL STEEL TUBE**

