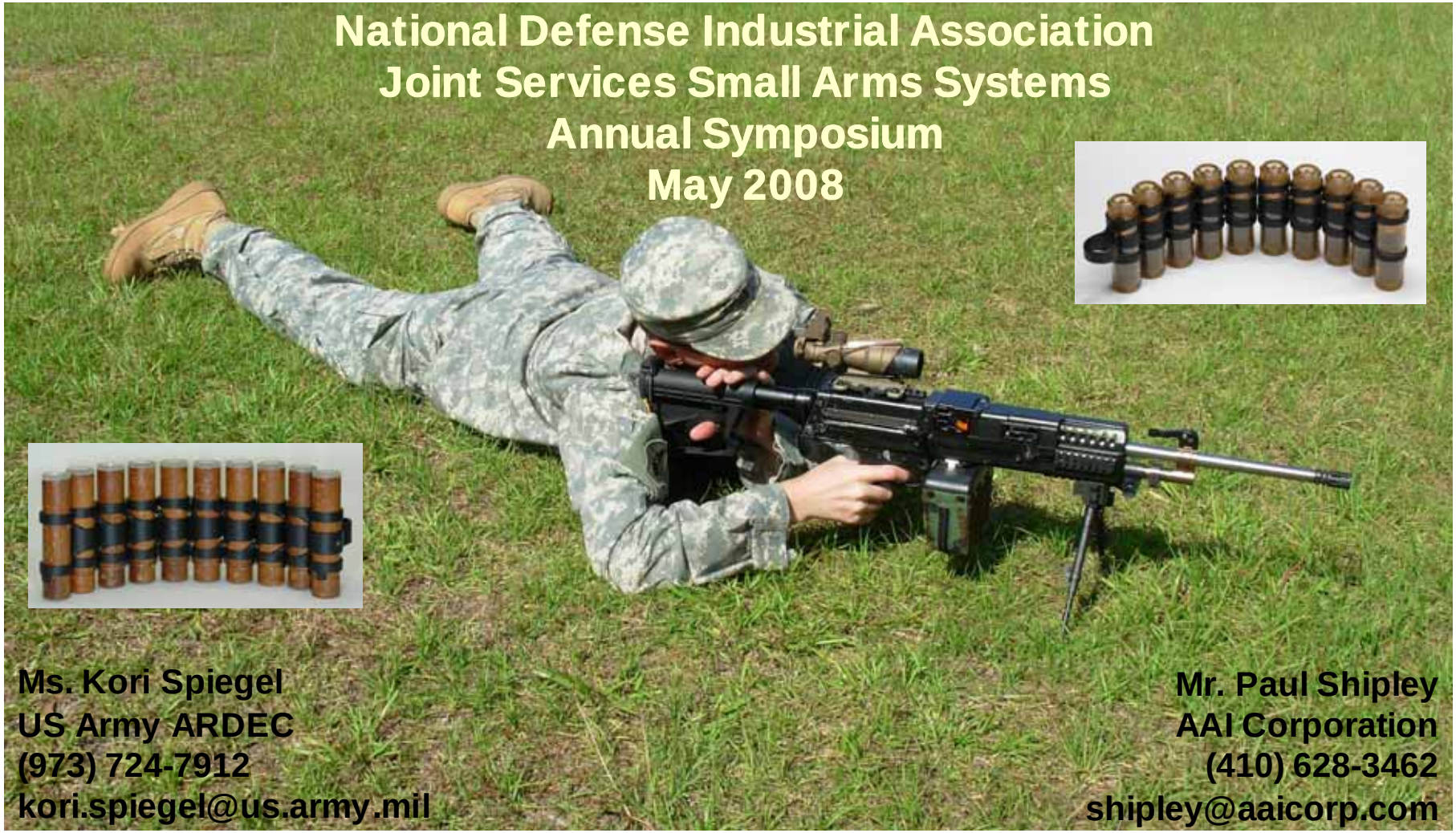
Lightweight Small Arms Technologies



National Defense Industrial Association
Joint Services Small Arms Systems
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Lightweight Small Arms Technologies
Top 5 Soldier Weight Contributors

For Automatic Rifleman:

1. M249 Squad Automatic Weapon w/200 rds Ammo
2. 5.56mm Ammunition (400 rounds)
3. Body Armor & Helmet
4. Communication Equipment
5. Canteen/Water

Lightweight Small Arms Technologies
Goals

Lightweight Small Arms Technologies (LSAT)

Goals:

- 35% weapon weight reduction
- 40% ammunition weight reduction
- Reduced training & maintenance
- Maintain cost of current systems

Approach:

- “Clean Slate” design
- Reduced weight as the priority
- In depth trade studies
- Extensive modeling & simulation

Lightweight Small Arms Technologies
Program Approach

5.56mm Telescoped Ammunition

Cased

Caseless

- Focus is development of technologies- not specific weapon system
- Demo via Light Machine Gun with 5.56mm ammunition
- Spiral development approach

Light Machine Gun Demonstrator

- Achieve 50% overall weight reduction
- Pursue parallel Cased Telescoped and Caseless Ammunition design approaches
- High commonality of design and function, some action component differences

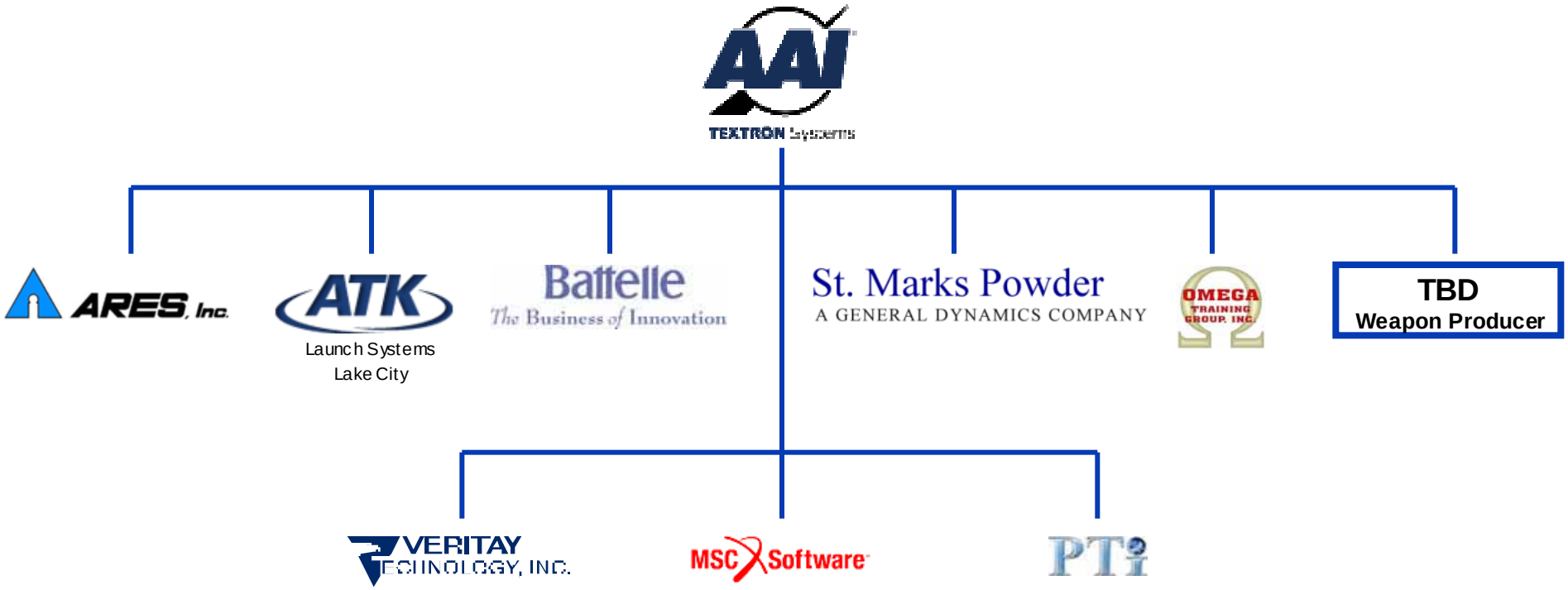
Lightweight Small Arms Technologies
Status vs Goals

Lightweight Small Arms Technologies (LSAT)

Capability	Current (M249)	Current LSAT Program		
		Threshold	Current Status	Objective
Weapon Weight	17.5 lbs	13.1 lbs (25%)	CT 9.8 lbs (44%) CL 9.9 lbs (43%)	11.4 lbs (35%)
Ammo Weight 600 rds Pkgd	20.4 lbs	15.3 lbs (25%)	CT(2) 13.6 lbs (33%) CT(3) 12.2 lbs (40%) CL 9.8 lbs (51%)	12.2lbs (40%)
Affordability	Gun $3600 Ammo $262	Gun $3600 Ammo $262	Equivalent	Gun $3600 Ammo $262
TRL	N/A	5	CT TRL 5 CL TRL 4	5
Effectiveness	Baseline	Maintain Baseline	Potential Improvement	Improve Baseline

Lightweight Small Arms Technologies
AAI Contractor Team Members

Lightweight Small Arms Technologies (LSAT)

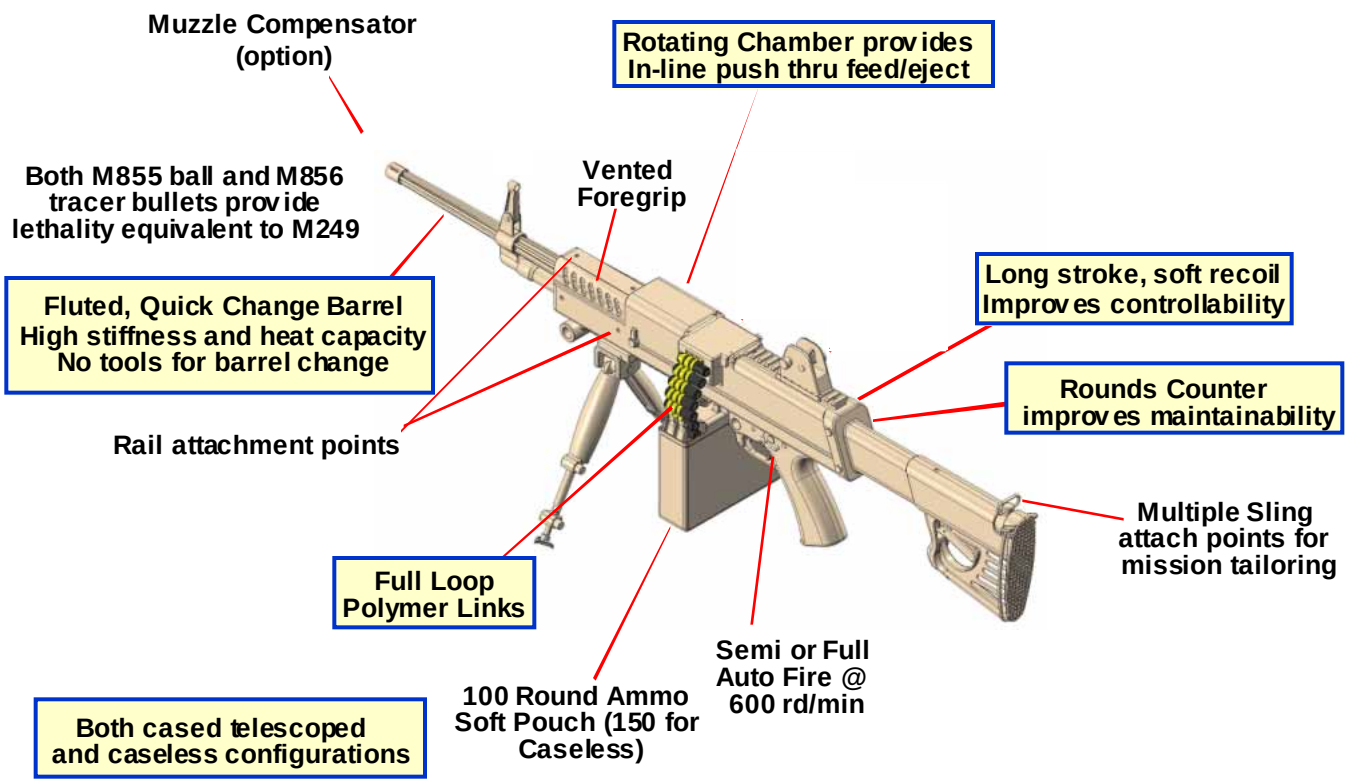


Lightweight Small Arms Technologies
Weapon Design and Performance Features

Lightweight Small Arms Technologies (LSAT)

Key Technologies

- Use of telescoped ammo-cased and caseless
- Lightweight materials & structural configuration
- Thermal management for weight reduction
  - Barrel
  - Caseless chamber components
- Caseless chamber sealing
- Human factors- firing controllability
- Integration of electronics



Lightweight Small Arms Technologies
Ammunition Design Features

Lightweight Small Arms Technologies (LSAT)

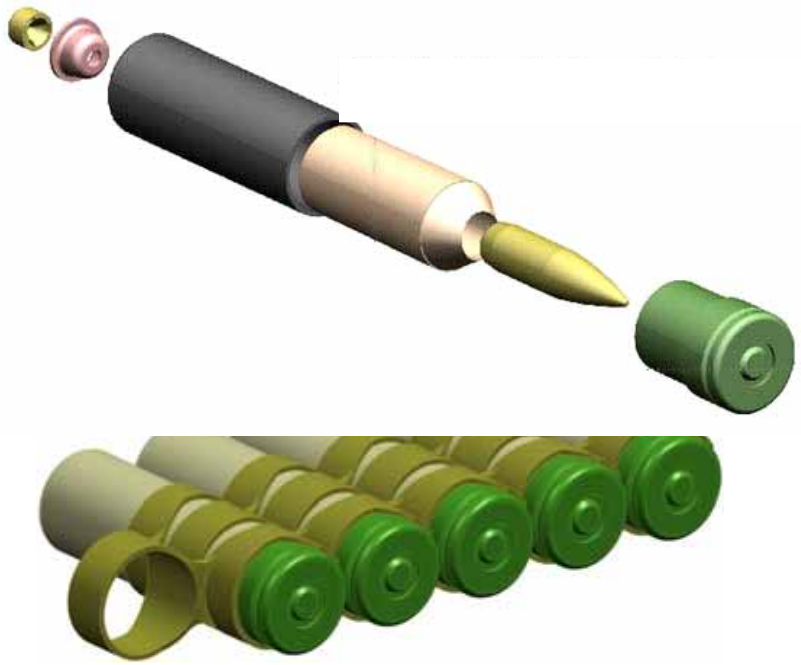
	M855	LSAT CT	LSAT CL
Weight 600 linked pkg'd rnds	20.8 lbs	13.6 lbs (Sp2) *33% reduction* 12.2 lbs (Sp3) *40% reduction*	9.8 lbs 51 *% reduction*
Muzzle velocity (78 ft)	3,020 ft/sec	3,020 ft/sec	3,020 ft/sec
Length	2.25 inches	1.6 inches	1.6 inches
Diameter	0.38 inches	0.45 in (Sp2) 0.38 in (Sp3)	0.35 inches
Primer	Percussion	Percussion	Percussion

Key Technologies

- Telescoped cartridge
- Cased Ammunition
  - Polymer cartridge case and endcap
  - Compacted/consolidated propellant
- Caseless Ammunition
  - High Ignition Temperature Propellant
  - Booster assisted interior ballistics
- Demonstrate in 5.56mm
  - Address producibility
  - Consider scalability

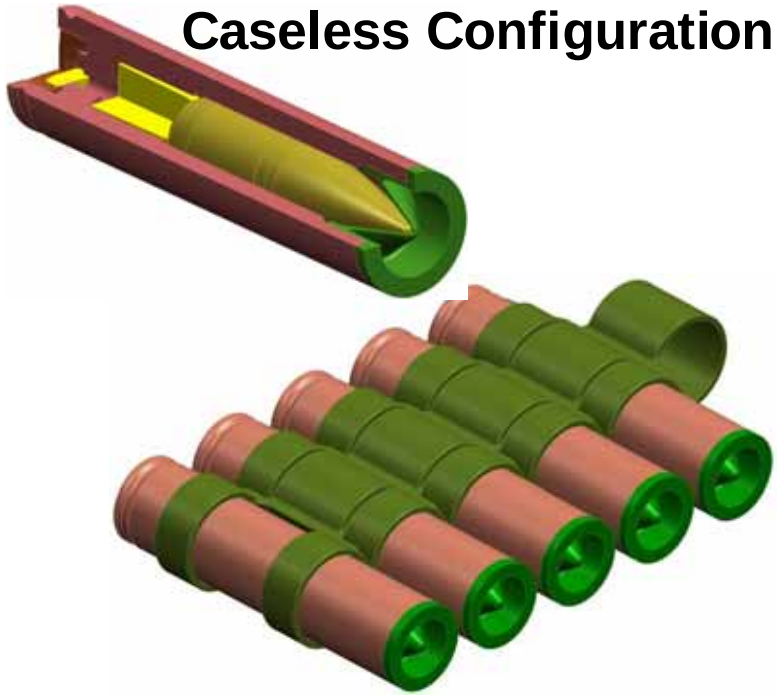
Lightweight Small Arms Technologies
Ammunition Features

Lightweight Small Arms Technologies (LSAT)



- Conventional technology in telescoped configuration
- 30 – 40% weight reduction
- Lower Risk

Caseless Configuration



- High Ignition Temperature Propellant Technology
- 50%+ Weight Reduction
- 40% Volume Reduction
- Higher Risk

Cased Telescoped System

Design and Development Status

- Ammunition -

- Weapon -

CT Ammunition Chronology

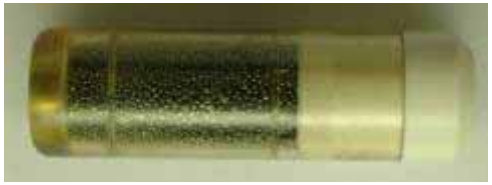
Lightweight Small Arms Technologies (LSAT)

2005

Spiral 1 Cartridge

- 24% wt red, 0.50” OD
- Off the shelf propellant
- Demonstrated concept and performance
- Used for initial weapon development testing and cartridge geometry studies

2006



Spiral 2 Cartridge

- Reduced size, weight
- Custom LSAT powder w/reduced flash
- Material optimization across temperatures
- Supported integrated weapon development

2007 (May)

Spiral 2 Cartridge

- 33% wt red, 0.46” OD
- Continued refinements
- Baseline established for materials, design, tooling
- Supported weapon development, demos

Spiral 3 Cartridge

- Initiated development

CT Ammunition 2007/08 Update

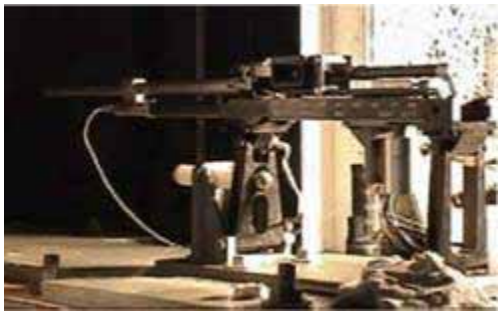
Lightweight Small Arms Technologies (LSAT)

- *Spiral 2- Fabricated ammunition to support weapon testing*
- *Spiral 3- Conducted initial performance testing*
  - Compacted propellant
  - Consolidated propellant
  - 0.38” diameter
  - 40% Weight Reduction
- *Over 9,000 rounds fired*
  - Mann Barrels and Machineguns
  - Temperatures ranging from -65F to +160F
- *Preparing 2,000 rd contract delivery*

CT Weapon Chronology

Lightweight Small Arms Technologies (LSAT)

2005



SN 1

- Action function assessed using dynamic test fixture
- Spiral 1 ammo
- Validated kinematic model

Lubricious coating assessment

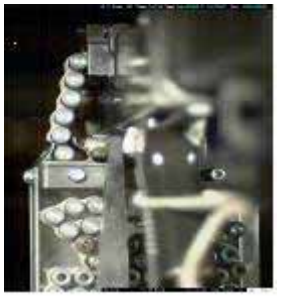
2006

SN 1

- Integrated weapon/action
- Conducted functional assessments, incorporated design refinements
- Fixture and shoulder firings
- TRL 5 demo with Spiral 1 ammo

SN 2

- Initiated design updates
- Fabricated hardware



CT Weapon Chronology

Lightweight Small Arms Technologies (LSAT)

2007 (May)

SN 1

SN 2

SN 1

- Fired approx 3,000 rds
- Converted weapon to Spiral 2 ammo
- Army DTC limited safety release for manned fire
- Conducted shootability assessment
- Confirmed TRL 5 with Spiral 2 ammo

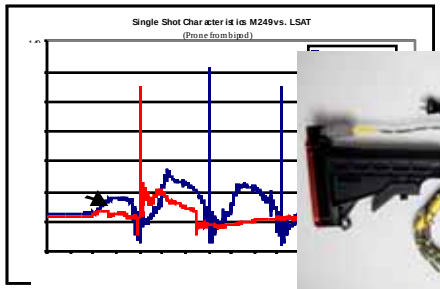
SN 2

- Weapon Action in test, approx 750 rds fired
- Integrated weapon components ready

CT Weapon 2007/08 Update

Lightweight Small Arms Technologies (LSAT)

- *SN1*
  - Fired approx 6,500 total rds
  - Conducted 4 major live fire demos
  - Measured system characteristics
    - Aim disturbance/compensation
    - Recoil
    - Barrel thermal/ablator heat reduction
  - Incorporated design refinements
- *SN2*
  - Fired approx 2,000 rds
  - Integration complete
  - TRL 5 verification underway



Caseless System

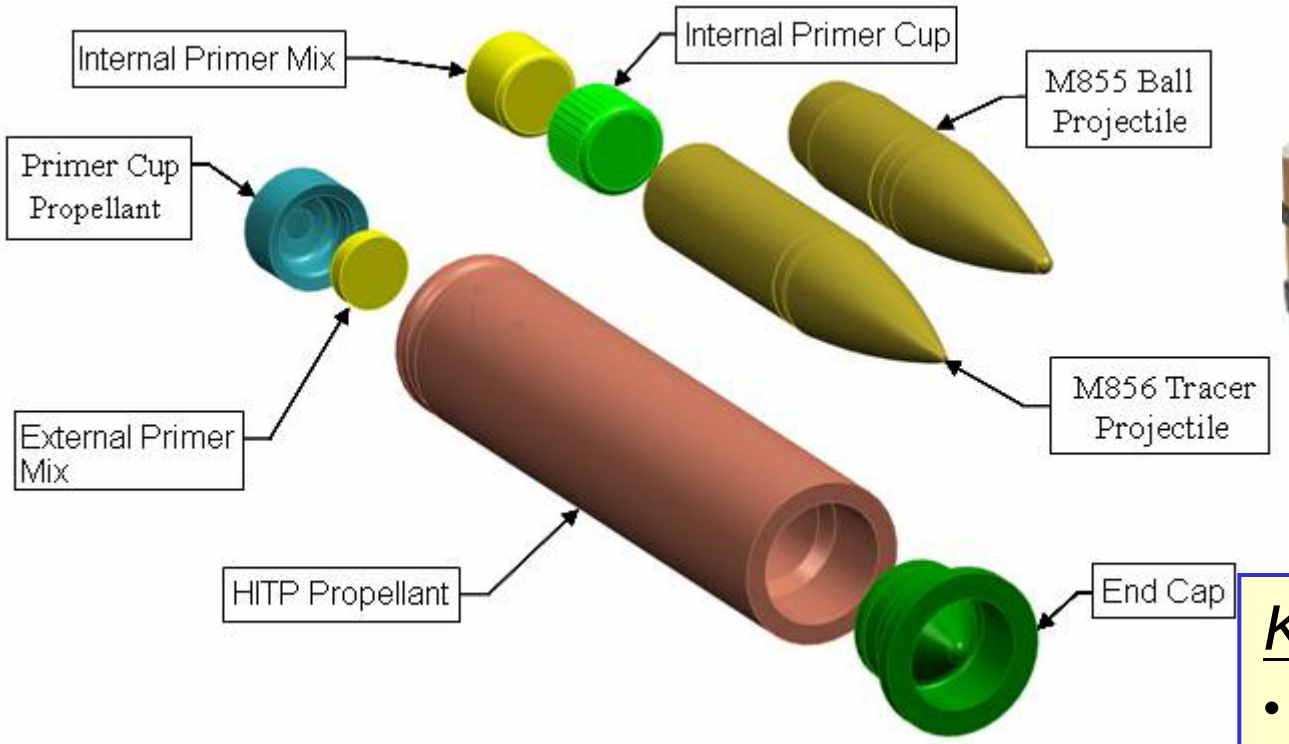
Design and Development Status

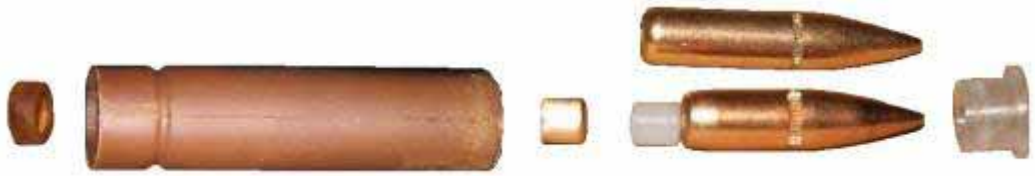
- Ammunition -

- Weapon -

CL Cartridge Components & Technologies

Lightweight Small Arms Technologies (LSAT)





Key Technologies

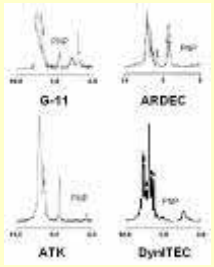
- Telescoped configuration
- High Ignition Temperature Propellant (HITP)
- Internal Primer assisted interior ballistics

CL Ammunition Chronology

Lightweight Small Arms Technologies (LSAT)

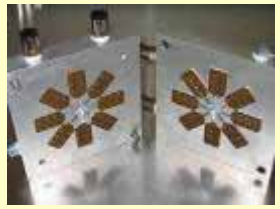
2005

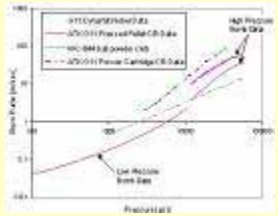
Characterize HITP



2006

Replicate 4.92mm ACR





2007 (May)

Begin Scale-up to 5.56mm

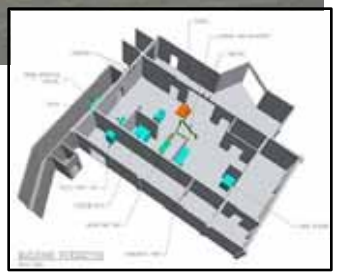
- Fabricate initial Spiral 1 5.56mm ammo using lab-scale process

- Design and equip process scale-up facility

CL Ammunition 2007/08 Update

Lightweight Small Arms Technologies (LSAT)

- *Spiral 2 Process scale-up facility complete and in use*
  - Located at ATK Launch Systems (Utah)
  - Equipment includes
    - 50 ton transfer mold
    - Dry material feed and handling
    - Solvent processing
    - Horizontal mixer
  - Several Design-of-Experiments process studies
- *Dedicated primer fabrication facility nearing completion at ATK Lake City AAP*



Spiral 2

CL Ammunition 2007/08 Update

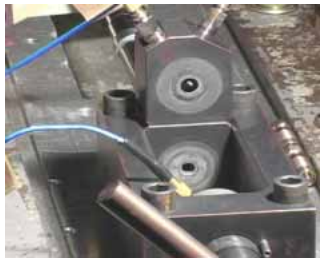
Lightweight Small Arms Technologies (LSAT)

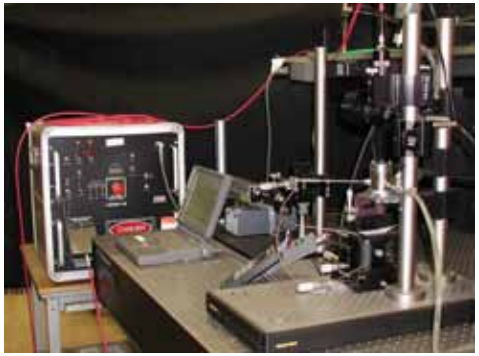
- *Refined Spiral 2 Ammunition*
  - Several Design-of-Experiments HITP process studies
  - FNGUN interior ballistics model updated
  - Primer (internal and external) material studies
  - Preparing contract deliverable ammunition
- *Initiated Spiral 3 Development*
  - Replace energetic binder
    - Improve cost/environmental considerations
    - Reduce production facility impact
  - Reduce thermal load on weapon
    - Burn rate modifiers- reduce flame temperature, improve barrel life
    - Exterior coatings- reduce heat transfer rate

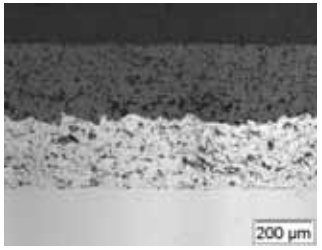
CL Weapon Chronology

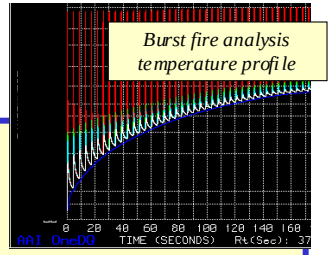
Lightweight Small Arms Technologies (LSAT)

2005 → 2006 →









Component Studies

- Chamber sealing
- Firing pin interface
- Characterize thermal loads
- Utilized residual 4.92mm ACR ammo
- Maximize CT commonality

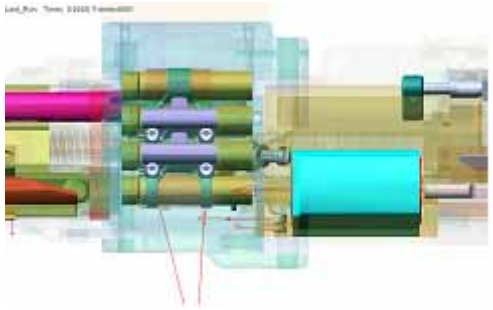
Thermal Focus

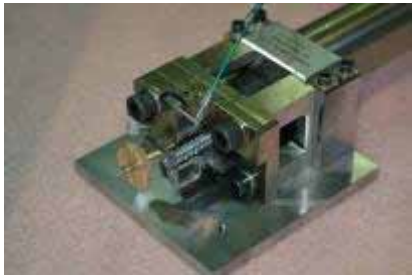
- Initial material studies
  - High temperature
  - High heat capacity
  - Insulating materials
- Thermal configuration studies
- Ablator heat reduction assessment

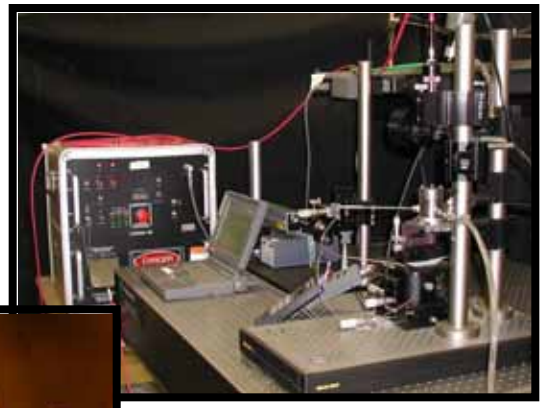
CL Weapon Chronology

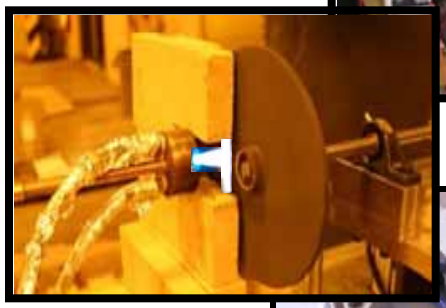
Lightweight Small Arms Technologies (LSAT)

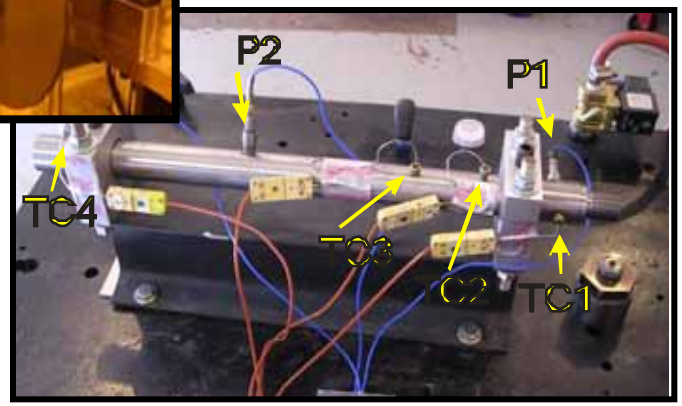
2007 (May)











Design Finalization

- 3D models, kinematics
- Subsystem test fixtures

Mat'l Thermal Investigations

- Insulating materials
- Laser pulse heating apparatus
- Ballistic fixture
- Automatic fire barrel heating/model

CL Weapon 2007/08 Update

Lightweight Small Arms Technologies (LSAT)

- *Conducted Weapon Subsystems Tests*
  - Ballistic interfaces
    - Firing pin
    - Chamber volume
    - Seals
  - Weapon/Cartridge interfaces (via CT wpn)
    - Rammer loads
    - Cross feed loads
    - Free belt dynamics
    - Validated kinematic model
- *Weapon action tests underway*
- *Continued thermal tests*
  - Insulating materials

Rifle Design Activity

Lightweight Small Arms Technologies (LSAT)

- *Initiated in 2008*
- *Requirements analysis*
- *Concept development and tradeoffs*
  - Both CT and CL designs (ctg same as LMG)
  - 17 rifle concepts- various mechanisms and overall configurations
  - Two magazine approaches- weapon powered, spring powered. Focused on high capacity.
  - Evaluated, downselected to two each CT and CL
- *Detailed design*
  - Nearing completion
  - Full detail 3D models
  - Structural analysis, kinematic analysis

Ongoing Supportability Activities

Lightweight Small Arms Technologies (LSAT)

- *Supportability Focus*
  - Evaluate technology implementation considerations
  - Fully integrated with development effort
- *Key Activities Nearing Completion*
  - Logistics Support Analysis- Level of Repair analysis (COMPASS), Life Cycle Cost analysis (ACEIT), O&M task identification (new Army maintenance concept)
  - Reliability, Availability, Maintainability- Failure modes, effects, and criticality analysis, reliability tracking, mean time to repair
  - Training analysis and materials- Training concept, training task analysis
  - Human System Integration- Human factors design support, system safety evaluations, fightability assessments (2 complete), shootability assessment (1 complete)

Lightweight Small Arms Technologies
Summary

- System design meets all program requirements:
  - Weight reduction exceeds goals
  - Improves lethality
  - Improves logistics
  - Improves ergonomics
- Maintaining parallel, synergistic Cased Telescoped and Caseless development plan
  - Emphasizes commonality
  - Reduces program risk
  - Initiated Rifle design activity- requirements, concepts, detailed designs
- Scalable design provides significant modularity and commonality
- Cohesive Government/industry team ensures success in development, user acceptance, and production

Comments/Questions?