Cased Telescoped Small Arms Systems

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Introduction

- **Outline**
  - Background
  - Ammunition Trade Study Summary
  - Cased Telescoped 6.5mm Carbine Development
  - Cased Telescoped 7.62mm Ammunition & Machine Gun

- **Acknowledgements**
  - Textron Systems/AAI Corporation
  - Team Members
    - ARES Inc.
    - MSC Software
    - St. Marks Powder

5.56mm Cased Telescoped System Portfolio

5.56mm Cased Telescoped (CT) System:

- 20 lb weight savings w/1000 CT rds
- 120,000+ rounds of 5.56mm CT ammo
- 10 Light Machine Guns fabricated
- Pilot production facility for ammunition operational
- Technology maturity demonstrated: Ammo & LMG
  - Over 22 standard small arms qualification tests
  - Assessed at TRL 7
- Operational assessments demonstrate strong user support:
  - Military Utility Assessment (SEP 2011)
  - USASOC Assessment (OCT 2012)
  - DNNE LOE (AUG 2013)

CT Light Machine Gun and 5.56mm CT Ammunition

5.56mm Cased Telescoped (CT) Carbine:

- Carbine action - TRL 5 completed

Cased Telescoped Carbine Action

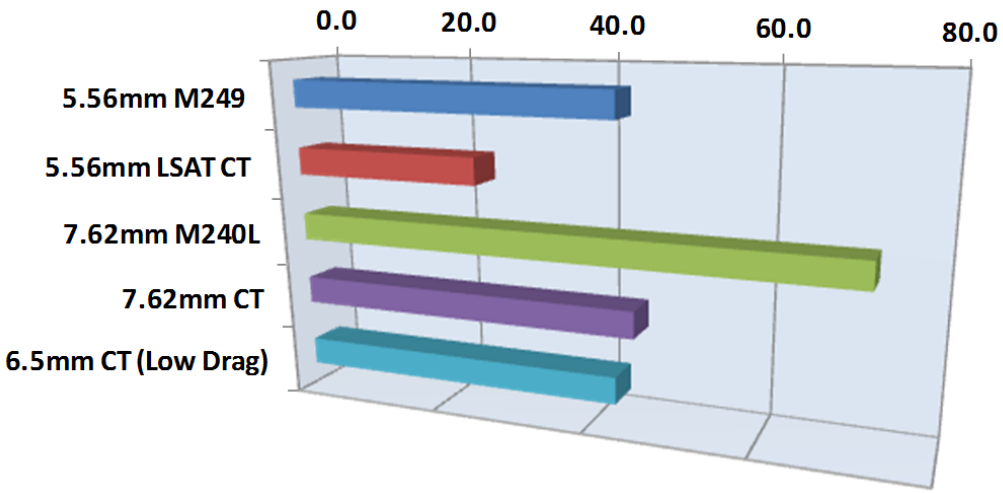
Trade Study Analysis Summary (Completed in 2014)

Requirements and System Level Tradeoff Parameters

- **Lethality Requirements**
  - All projectiles must achieve lethality thresholds
  - Intermediate Range (R1): Based on Projectile Velocity
  - Long Range (R2): Based on Projectile Kinetic Energy
- **Design System from "Target Back"**
  - Apply tailored modeling and simulation tools
  - Derive required muzzle velocity for each projectile caliber and configuration via trajectory analysis
  - Derive projectile delivery system characteristics
    - Cartridge size and weight
    - Machine gun size and weight
    - System characteristics
- **Evaluate System Tradeoffs**

System Tradeoff Evaluation
Current Systems versus CT Systems

MG System Weight- 800 rds + Weapon



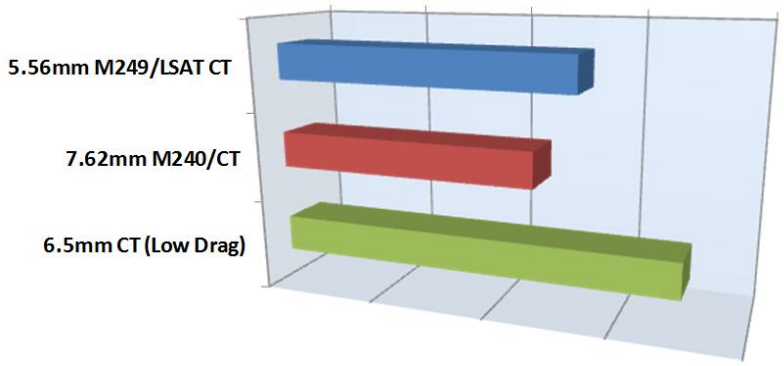
Projectile Calibers/Configurations

5.56mm M855
62 grains, Low Downrange Energy

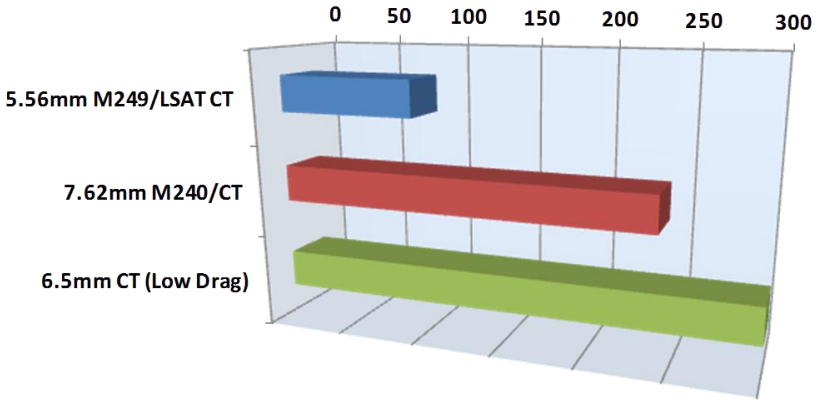
7.62mm M80A1
130 grains, High Drag Shape
Highest Recoil

6.5mm Low Drag Profile
125 grains, Best Downrange
Velocity & Energy, Lower Recoil

Range to Achieve Impact Velocity Requirement



Impact Energy at 1200m



CT Caliber/Configuration Tradeoff Study Summary

- Findings
  - Cased Telescoped Design
    - Provided 35%+ weight reduction benefit for all concepts
    - All projectile configurations/calibers were compatible with CT cartridge
    - Long-stroke/soft recoil weapon characteristics maintained for all cartridge designs
  - Low drag projectile configuration delivers significant performance and packaging benefits in smaller caliber

6.5mm selected as "representative" optimized caliber CT cartridge based on Trade Study. Results scalable to other calibers

Conclusion: CT implementation of optimized caliber low drag projectile provides multiple benefits:

> **Up to 45% weight reduction versus 7.62mm system**
> **More lethality and range than 7.62mm system**
> **Reduced recoil and improved controllability versus 7.62mm system**

6.5mm Cased Telescoped Ammunition and Carbine Development

6.5mm Cased Telescoped Ammunition and Carbine

- Background
  - 5.56mm CT Carbine mechanism previously designed and demonstrated
  - Successfully tested rising chamber and 4-row magazine

- Current Effort
  - Ammunition Activities
    - Incorporate low drag 6.5mm projectile configuration
    - Develop custom ball powder blend to optimize ballistic performance
    - Demonstrate interior ballistics, dispersion, structure across temperature range
  - Carbine Activities
    - Revisit design tradeoffs for 6.5mm CT system due to larger cartridge size and higher impulse versus 5.56mm CT system
    - Develop detailed Carbine design
    - Fabricate, demonstrate weapon action and integrated weapon

6.5mm CT Ammo Characteristics

7.62mm NATO | 7.62mm CT | 6.5mm CT | 5.56 mm CT

		Brass	Cased Telescoped		
	Metric	7.62mm	7.62mm	6.5mm	5.56mm
Size	Length [in]	2.8	2.032	2.032	1.556
Size	Diameter [in]	0.487	0.504	0.504	0.419
Weight	Projectile Weight [grains]	131	131	125	62
Weight	Ctg Weight [grains]	362	240	237	127
Weight	Ctg % Weight Savings	-	34%	35% (2)	33% (1)
Weight	Belted Weight, 200 rds [lbs]	12.2	7.5	-	3.8
Weight	Belted % Weight Savings, 200 rds	-	38%	-	39% (1)
Volume	Volume	.486 in^3	.398 in^3	.398 in^3	.215 in^3
Volume	% Volume Reduction	-	18%	18% (2)	12% (1)

(1) Compared to 5.56mm NATO
(2) Compared to 7.62mm NATO

6.5mm CT cartridge has significantly better performance than 7.62mm CT cartridge

6.5mm Carbine Weapon Overview

M4A1
- Length (collapsed): 29.8”
- Barrel length (rifled): 12.7”
- Barrel length (overall): 14.5”
- Width (w/out handguard): 2.4”
- Height: 7.2”

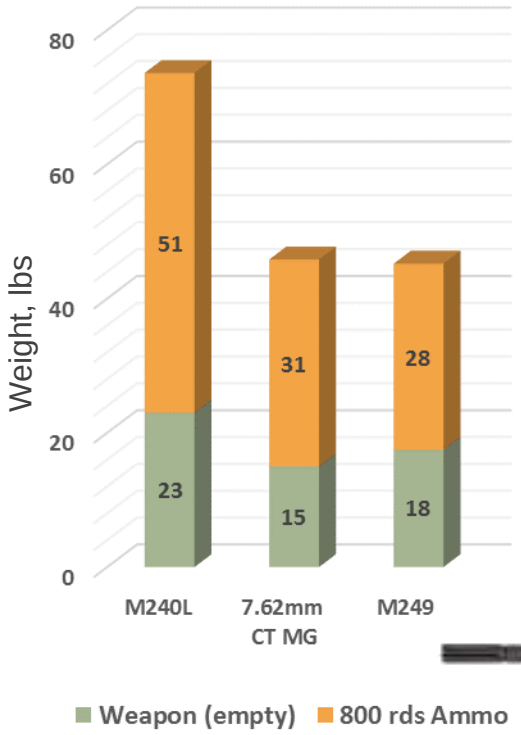
- Preliminary weapon weight 9.7 lbs (not optimized)
- 2” longer barrel than M4
- Closed bolt, forward feed
- Gas operated tappet & piston
- Rate of fire: 600 rounds per minute
- 20 round magazine
- Notional lower receiver based upon AR15 dimensions

6.5mm Carbine System Status

- Initial ammunition design complete
  - Baseline cartridge meets performance requirements
  - Propellant optimization in work to further improve performance
- Weapon action and magazine design complete
  - Kinematic analysis complete
  - Dynamic test fixture (DTF) design complete
- Fabrication of weapon operating system and DTF underway
- Carbine action testing scheduled to begin in May, with TRL 5 in late 2016
- Integrated weapon testing to begin in mid 2017

7.62mm Cased Telescoped Ammunition and Machine Gun Development

7.62mm CT Ammunition and Machine Gun



Ammunition

- Incorporate M80A1 projectile in lightweight CT cartridge, maintain current muzzle velocity and lethality
- Demonstrate scalability of CT technology and growth potential for future enhanced lethality projectiles/ calibers

Machine Gun

- Reduced weight: 27 pounds less than current M240L and brass cased M80A1 ammunition
- Increased performance: 7.62mm capability at **same weight** than current M249 5.56mm SAW
- Incorporate weapon recoil mitigation/controllability features demonstrated in 5.56mm CT system

7.62mm CT Ammo Characteristics

7.62mm NATO | 7.62mm CT | 6.5mm CT | 5.56 mm CT

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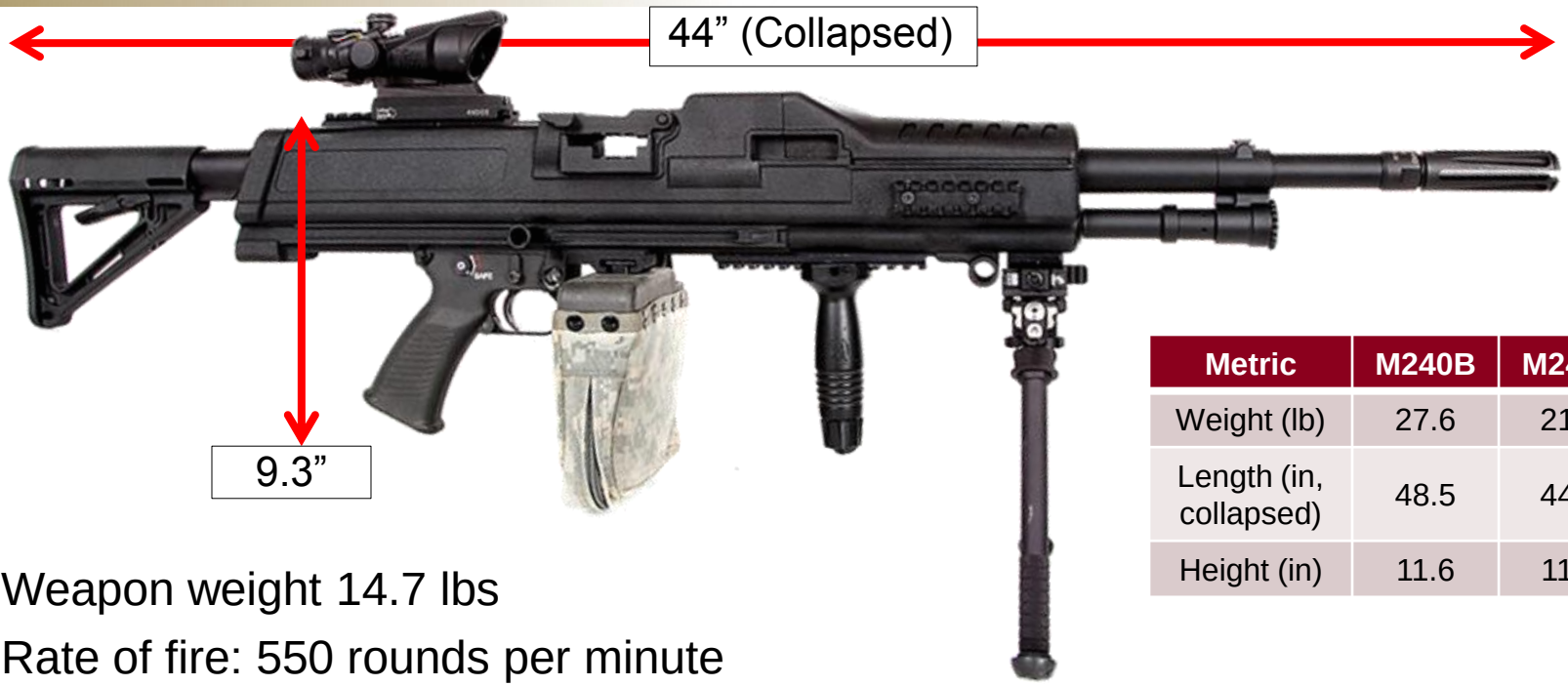
(1) Compared to 5.56mm NATO
(2) Compared to 7.62mm NATO

7.62mm CT cartridge allows for direct comparison to M240 system

7.62mm CT Machine Gun Overview



Metric	M240B	M240L
Weight (lb)	27.6	21.8
Length (in, collapsed)	48.5	44.5
Height (in)	11.6	11.6

- Weapon weight 14.7 lbs
- Rate of fire: 550 rounds per minute
- Open bolt, forward feed, side ejection, gas operated piston system
- Maintains long-stroke, soft-recoil kinematics demonstrated in 5.56mm CT LMG
- Short and long barrel options available to match M240B/L
- Can be readily converted for use with 6.5mm CT ammunition

7.62mm Cased Telescoped Ammunition and Machine Gun Status

- Ammunition Activities
  - Cartridge meets all ballistic performance requirements and functions across the full temperature range
  - Propellant optimization in work to further improve performance
- Machine Gun Activities
  - Completed structural and kinematic analyses
  - Fabrication of weapon action complete
  - Weapon action testing underway. Initial firing tests show favorable performance
    - Belt pull up to 200 rds
    - Burst fire up to 20 rds
    - Dispersion
- Mid 2017 integrated weapon capability demonstration planned