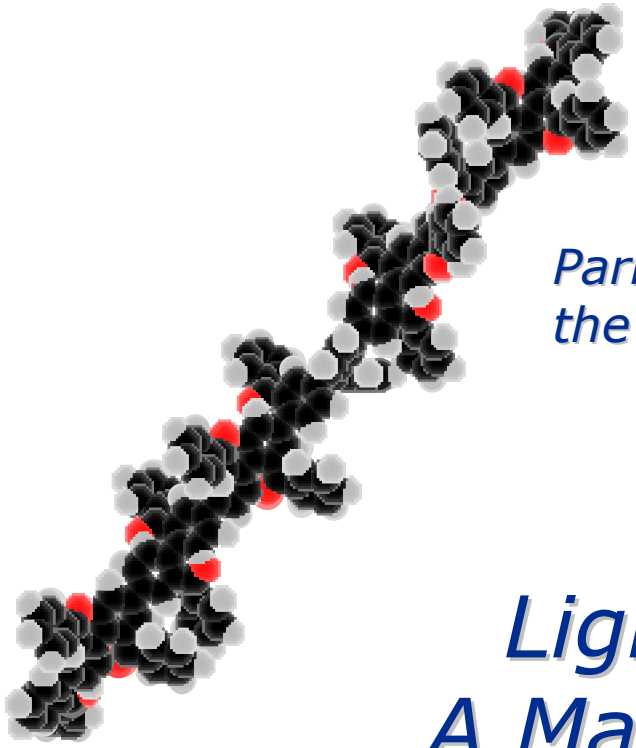


Parmax® Self Reinforced Polymers:
the world's strongest, stiffest, hardest polymers

Lightweight Ammunition: A Material Science Challenge

Presentation to:
NDIA
May 17, 2005

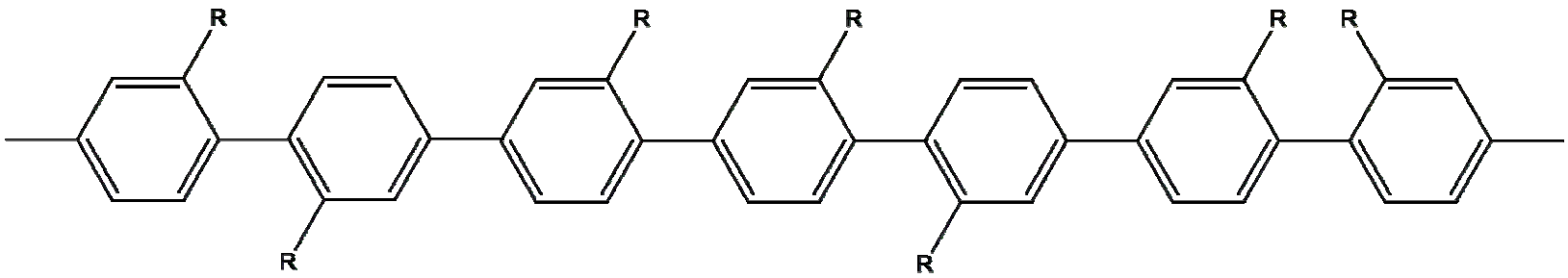
Mississippi Polymer Technologies, Inc.

Nick Malkovich, VP for Technology; e-mail: nmalkovich@MPTpolymers.com
Robert Gagné, Chairman & CEO; e-mail: rgagne@MPTpolymers.com

Challenges in developing lightweight ammunition

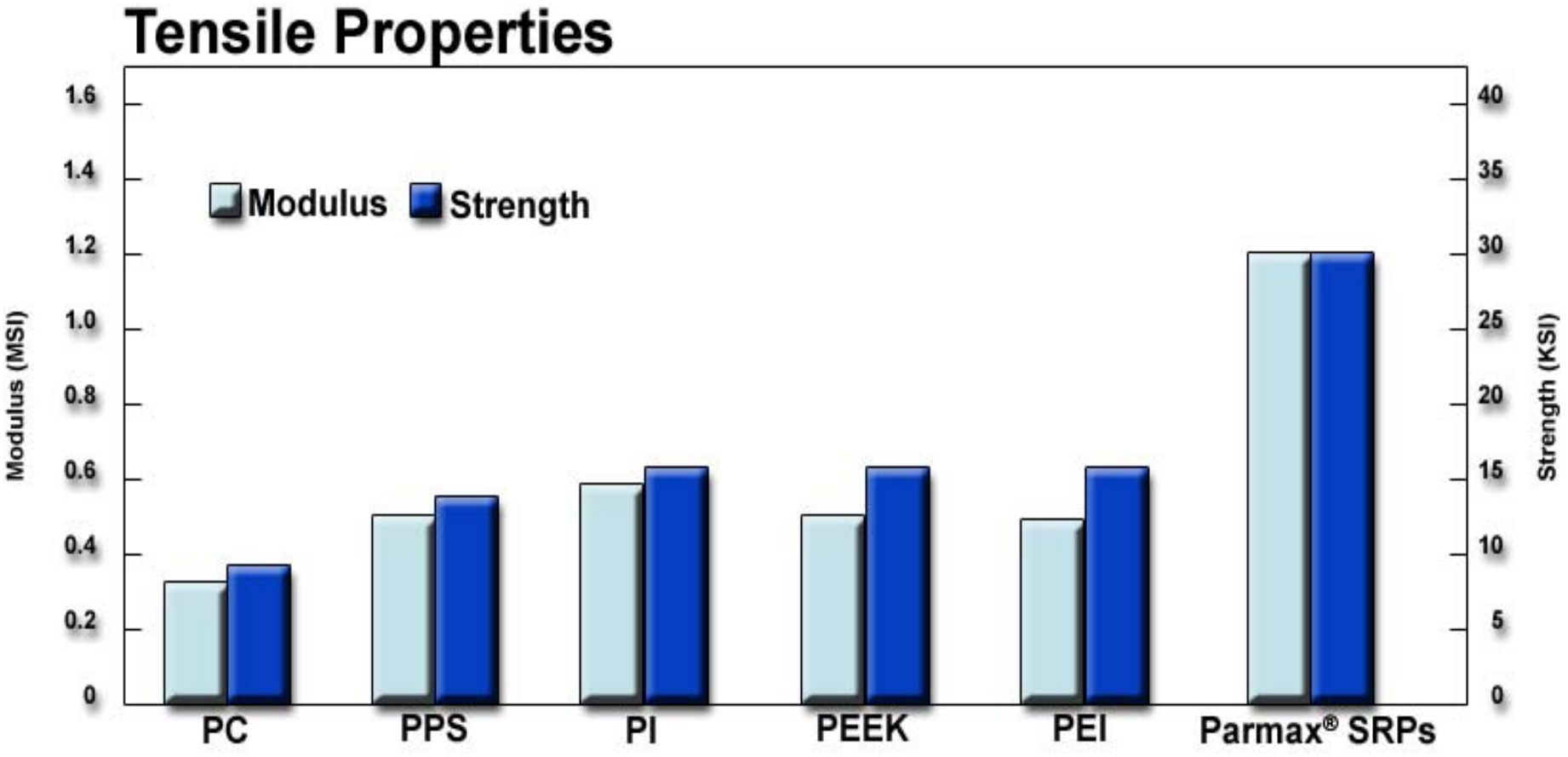
- Functional in current weapon systems
- Must meet current performance specifications
  - **Muzzle velocities**
  - **Chamber Pressures**
  - **Accuracy**
- Must function at all conditions
  - **Cold (-65°F environment)**
  - **Hot (125°F environment; 400 - 600°F chamber)**
- Rugged – storage, transport, in-field use
- Environmentally stable – hot, cold, moisture, UV etc.
- Manufacturable at acceptable cost

Parmax® SRPs – New Polymeric Materials Ideal for Lightweight Ammunition

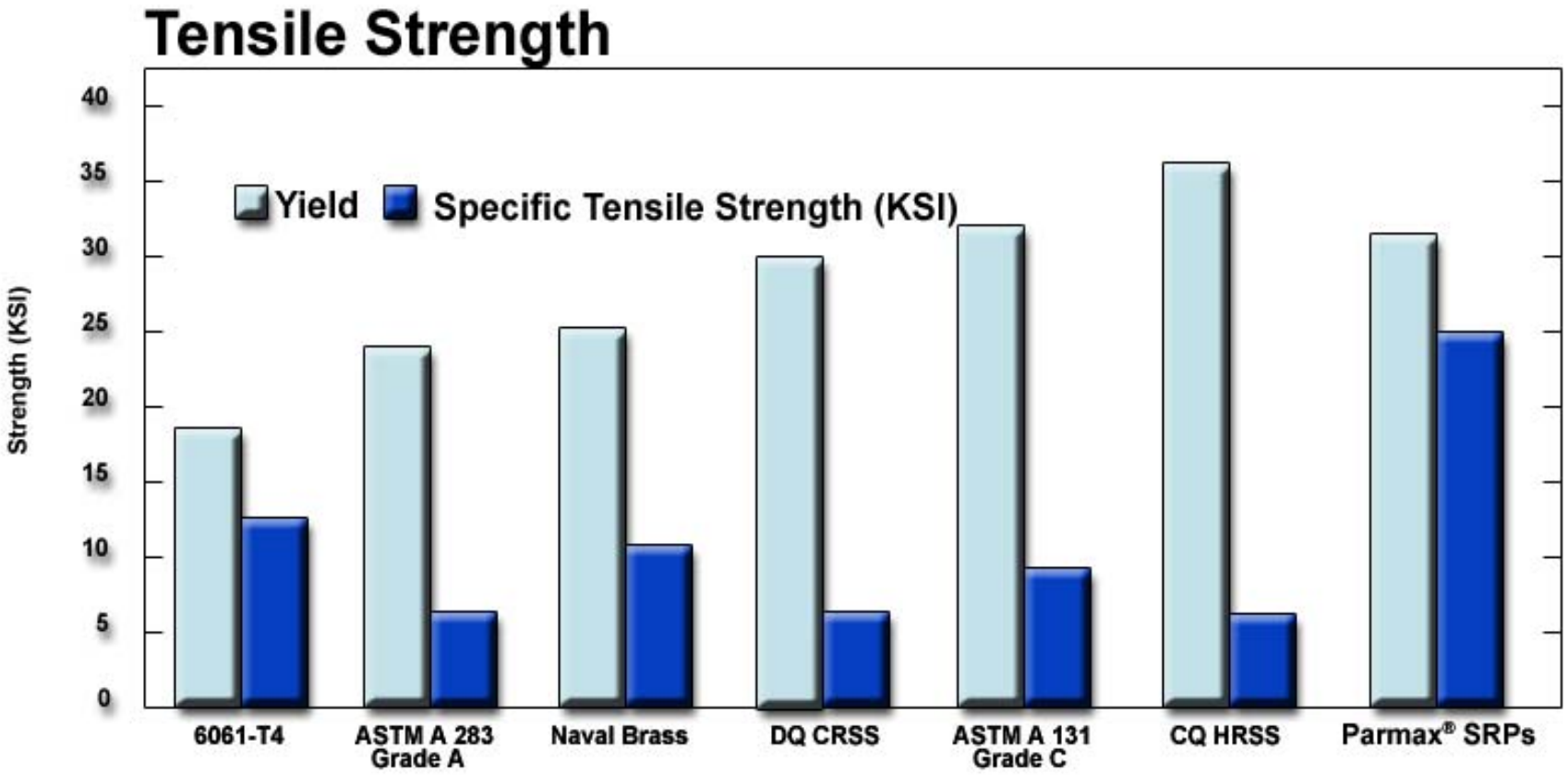


- As strong as mild steel
- Don’t burn
- Maintain properties at low temperatures

Parmax® SRPs Offer Extraordinary Mechanical Properties



Parmax® SRPs Offer Strengths Comparable to Many Metals



Drawing Quality Cold Rolled Sheet Steel and other metal values from ASM Metals Reference Book 2nd Edition

Parmax® SRPs Won't Burn or Melt Flow Even When Subjected to an Oxy-Acetylene Torch

- No flame when torch is removed
- No melt flow
- Retain significant mechanical properties above Tg

Parmax® SRP compounded with carbon fiber

Parmax® SRPs Retain Strength at Low Temperatures

	Parmax® SRP		
	295 K	77 K	4 K
Tensile Modulus (MSI)	1.2	1.5	1.4
Tensile Strength (KSI)	24.6	24.6	25
Thermal Contraction (%)	-	0.454	0.557

Parmax® SRPs maintain more of their mechanical performance and exhibit less shrinkage then any other plastic at low temperatures

Plastic Caselets Must Survive Hot Chamber Conditions

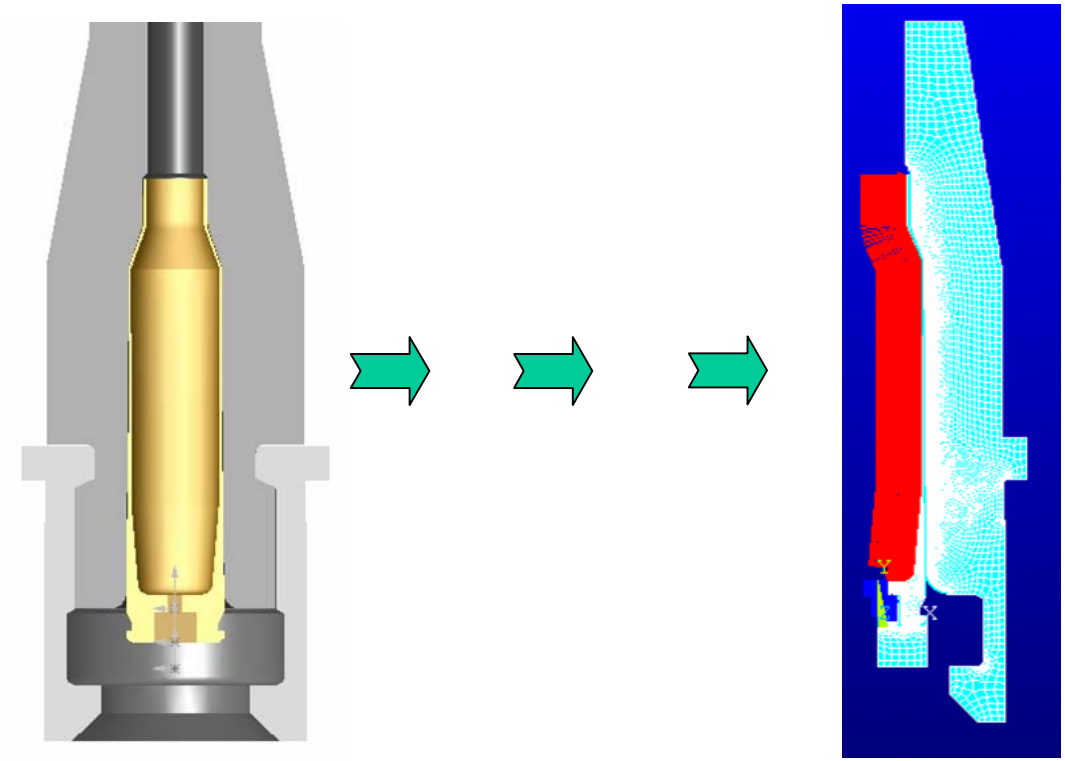
Nylon caselets melt under simulated hot chamber conditions (400 – 600°F)

Parmax® SRP-based caselets do not soften or melt

Solution: Caselets based on Parmax® SRP formulations are expected to perform well at high temperatures

Modeling Indicates Greatest Stress on the Base

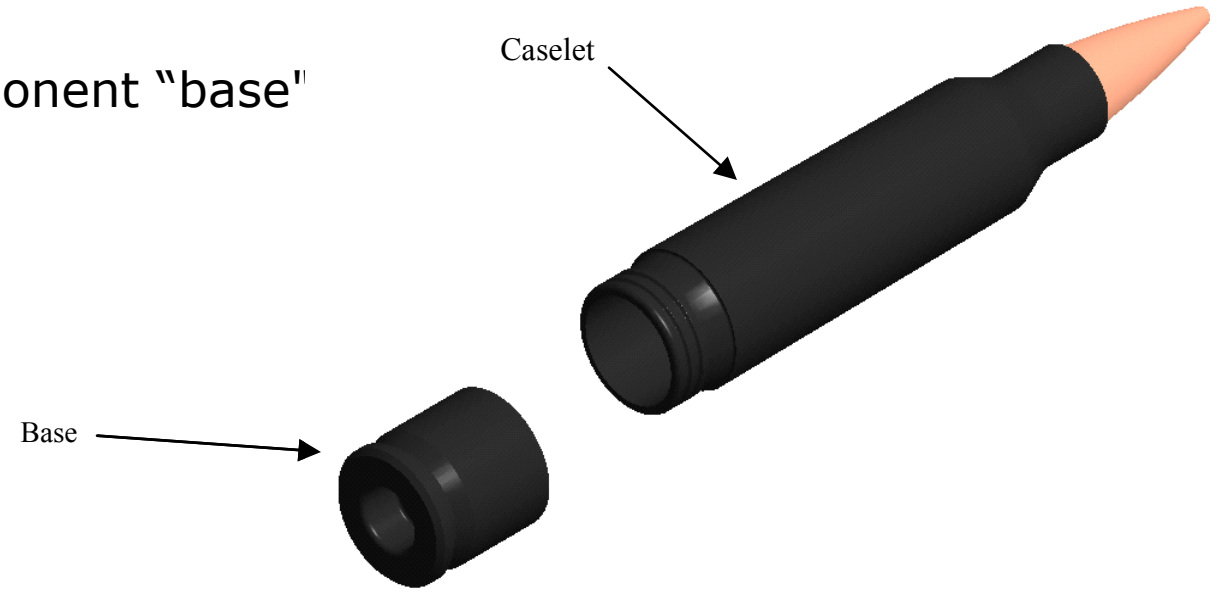
Finite Element Analysis (FEA) modeling (MPT/ARL)



Two Component Design

Design solution:

- Two component design
- Top component “caselet”
- Bottom component “base"



Design Options and Weight Savings (.50 cal)

Caselet		Polymer	Polymer	Polymer
Cap	Brass	Steel	Aluminum	Polymer
Projectiles	42.0	42.0	42.0	42.0
Primer	1.3	1.3	1.3	1.3
Powder	15.2	15.2	15.2	15.2
Caselet		8.1	8.1	8.1
Cap		21	7.6	3.5
Cartridge	53.1	29.1	15.7	11.6
Total	111.5	86.3	72.9	68.8
Weight Savings	0%	**23%**	**35%**	**38%**
Demonstrated	YES	YES	YES	NO
Technical Risk	Low →			High

Weight savings for 5.56 mm are comparable to .50 cal

Both Aluminum and Brass Caps Work Well

Interior Ballistic Specifications Have Been Met

Needs:

- Muzzle velocities
- Chamber Pressures
- Accuracy

Problems with polymer ammunition:

- Walls will be thicker
- Internal volume is decreased
- Propellant charge is decreased

	C-63989C – A4	MPT Ammunition
Median Muzzle Velocity	3,010 fps ± 40 fps	3,027 fps
Max. Median Pressure	58,700 psi ± 3 σ	57,954 psi
Max. Individual Pressure	64700 psi	59,727 psi

The first polymer-cased ammunition that delivers full milspec interior ballistic performance

Parmax® SRP Caselets Work At High Temperatures

Need: Cartridges must survive chamber temperatures of 400 - 600°F

Parmax® SRP Caselets Work At Low Temperatures

Need: Cartridges must be useful in coldest Arctic regions (-65 ºF)

Polymer-Cased Ammunition Has Arrived

- Up to 35% lighter
- Full interior ballistics
- Survives hot chamber
- Useful at extremely low temperatures
- Cost effective