

*UET, LLC.*

Army Expeditionary Technology Search (xTechSearch) Competition  
**CONCEPT PAPER 7-11-2018**

Technology Focus Area:

**Next Generation Combat Vehicles**

Design / Advanced Materials / Vehicle Protection Against Advanced Threats

**Advanced Polymeric Solutions for High-Load, High-Wear,  
Impact, Shock, and Explosive Applications**

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**Advanced high-wear polymers can replace rubber components in many applications that experience high-load, abrasion, impact, shock, high-heat and explosive environments.**

Ultra-polymeric Engineered Technology (UET) (sister company to Bleeding Edge) was founded to develop new advanced polymer solutions for commercial and military field applications that were experiencing rapid part failures with current rubber materials.

UET has created a set of new highly resistant urethanes and polymers specifically for these demanding rugged situations including Polymer Transparent Armor, Polymer Composite IED Explosive Shielding, High-Temperature Body Mounts, High-Wear Track Pads and Free Rotating Bushings, Shock Absorbing Polymers and Foams, and numerous disruptive formulas for extreme environments. The unique variations of this proprietary polymer can significantly decrease maintenance costs while improving the safety and operations of the warfighter.

Through in-house testing and accredited third party and university testing, these polymers have proven their long life and incredible wear resistance.

Below is a summary of primary polymer formulas and their unique characteristics. Some advanced applications and properties are confidential/classified and not listed here.

### **Explosive Blast / Ballistic Armored Panels**

This unique composite of advanced materials successfully stopped a simulated M-19 anti-tank mine.


To provide a baseline, "Aluminum Armor" was used with the simulated M-19 mine explosion 18" from a 1" aluminum armor plate mounted on a Humvee under frame. The under frame was built copying the Humvee 4" box frame construction on 16" centers. The result was a 16"x24" hole blown through the armor and the 4'x4' plate was destroyed as was the Humvee frame.

The advanced UET polymer composite armor adds a 2" thick Blast Deflector, weighing only 18lbs per square foot. The same simulated M-19 anti-tank mine explosive test showed no penetration, no spalling, no other lethal damage. The slight deflection of the assembly would allow complete vehicle operation with no detrimental effects. Further, the addition of ballistic resistance level NATO 7.62 AP was incorporated into the panel and successfully stopped 3 shots in close proximity after the explosion. The blast+ballistic panel weighs 23lbs per square foot and is 2¼" thick.



## Advanced Transparent Armors

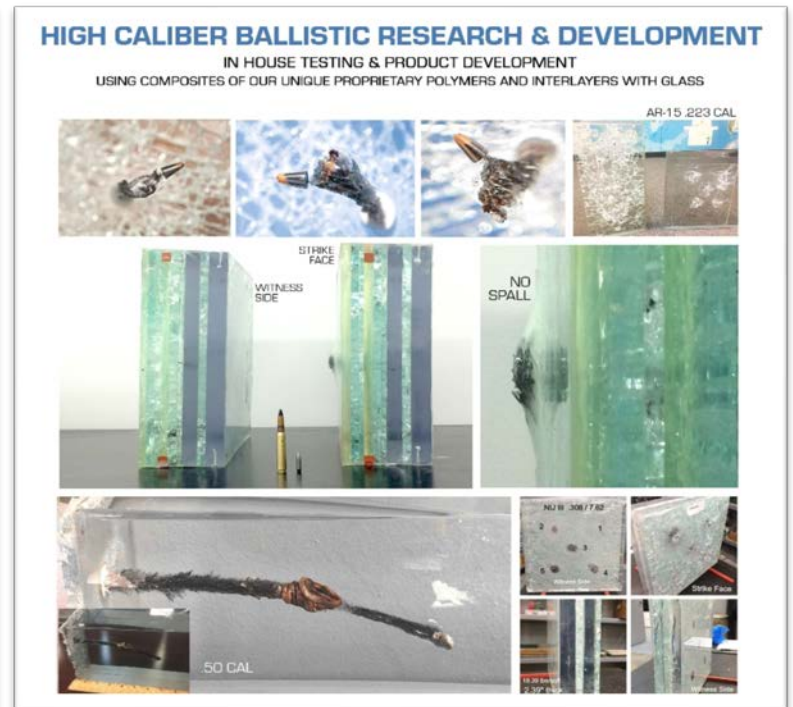
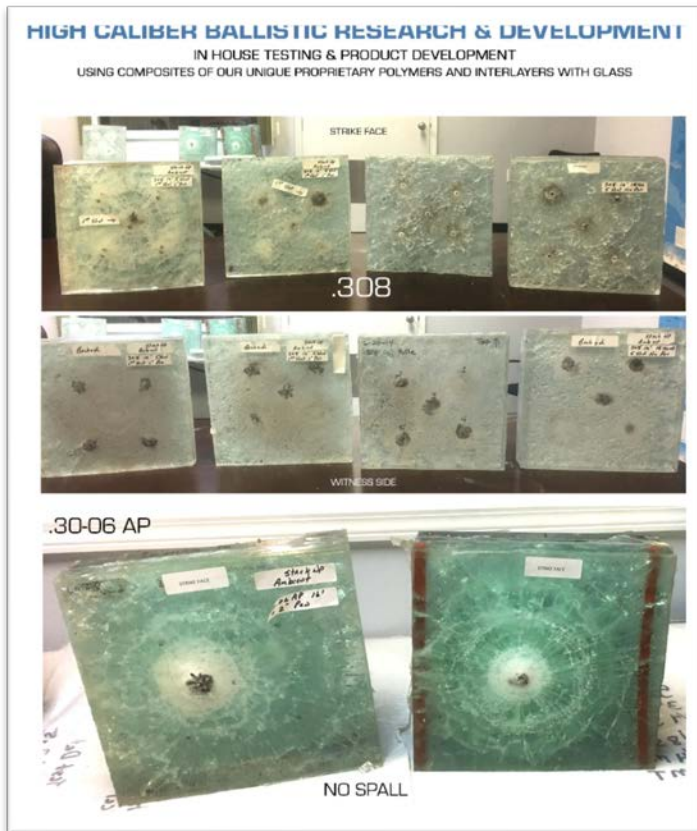
UET has developed a highly transparent, liquid-cast polymer that is rigid and impact resistant. The material can be made any shape and size, maintains its clarity and is not subject to cracking or spalling like glass or acrylic/polycarbonate. The unique polymer chemistry is shock absorbing and can be customized to meet various threats and applications from safety/intruder-resistant windows, to ballistic/high-caliber threats, to tornado/hurricane-resistance as well as construction applications like transparent floors, walls, railings, etc.

FORCED ENTRY-RESISTANT POLY SHEETS	BULLET-RESISTANT POLY SHEETS	BULLET-RESISTANT GLASS-CLAD POLY SHEETS
		
Shot with an AR15 Beat with a crowbar Beat with a splitting maul <b>No Access.</b>	No Glass No Delamination Single Monolithic Sheet <b>Up to UL752 Level 3 / NIJ IIIA</b>	No Spall Multi Shot Custom Shapes & Sizes <b>7.62 / .30-06 AP / .50 Cal</b>

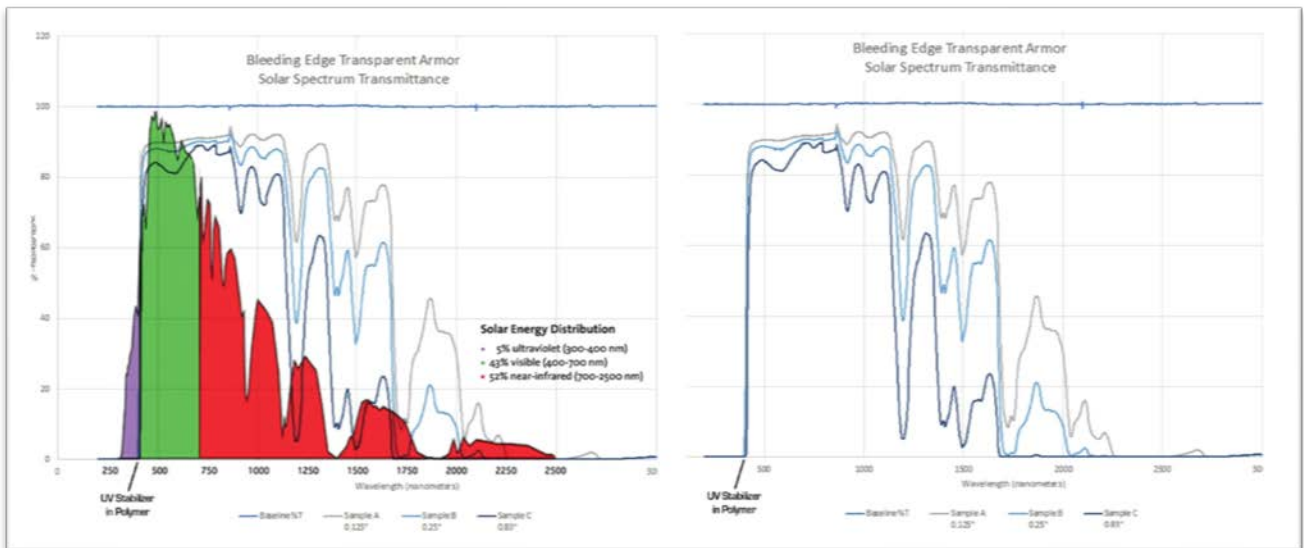
In its “neat” polymer-only state it will pass the EF5 tornado test procedure by the National Wind Institute. The FEMA 320/361, ICC 500 test propels a 15lb wooden 2”x4” at 100mph simulating a 250mph groundspeed EF5 tornado. The window sample was 1¼” thick x 20”x24” with 2” bite of frame. The projectile bounced off the window with no damage.

The neat polymer-only panels are ballistic certified for UL752 Level 2/NIJ2 (.357mag) at 1” thick at 5.23lbs/sqft, UL752 Level 3/NIJ3A (.44mag) at 1½” thick at 8.65lbs/sqft. Tests show no penetration, no cracking, and no spalling, with maintained visibility. The polymer does not fracture around the impact and closes-up behind the bullet. The polymer can be cut or drilled in the field without cracking or chipping.

A series of glass-clad polymer composites were constructed and tested for high caliber ballistics and passed in various thicknesses leading us to continue R&D on perfecting the stack-ups and lowering the thickness. Glass-clad panels have proved to stop the .223/7.62, .308/5.56, .30-06, .30-06 AP, .50 cal with no spalling on either the impact or witness side. The panels can be encased in a proprietary liquid interlayer holding the glass together better and allowing increased multi-shot resistance. The interlayer has proven to bond more securely to glass than traditional PVB interlayers and resist delamination over other types of transparent armor. More R&D work and funding is needed to continue development of high-caliber transparent armor and many new improvements are being discussed.



The transparent polymer accepts films and coatings such as abrasion resistant hard coatings, security/anti-graffiti/tinting films, and has a high resistance to chemicals including acetone. More testing must be done to verify the numerous chemical resistances. The polymer is flame retardant, self-extinguishing and has a UV stabilizer in the formula to resist harmful UV rays and degradation, while allowing most of the color spectrum to pass through showing potential for solar power applications and IR communications.



This unique polymer lends itself to frameless, load-bearing designs, curved windows and optics, and unique custom shapes that would otherwise be difficult to achieve with traditional glass/plastics and maintain the ballistic qualities.

**NO-ACCESS ARMOR  
DESIGN CONCEPTS**

These images are intended to illustrate potential applications only

**Polymer is lighter and easier to work with than glass or other plastics.**

Any shape, any size, custom architectural molding.  
Bullet resistant building blocks. Transparent armored solar windows.



## High Performance Tank Track Pads and Pin Bushings

UET has customized its unique blend of polymers for the high-abrasion and heavy-load/wear applications of military battle tanks. The tank track pads have been tested on an Abrams M1 against rubber pads in a real world simulated environment and proven to last 4-5 times longer than standard rubber track pads. Track pad testing was completed by Michigan Technological University's Keweenaw Research Center (KRC), a TARDEC approved testing facility. These tests showed a five-fold increase in track pad wear resistance with comparable or superior performance to rubber pads. The abrasion-resistance was three times greater and puncture resistance was five times greater. Underwriters Laboratory test procedures show that polymer pads do not burn, which is a significant material and combat advantage over rubber pads.

Cost reduction based on longer maintenance intervals is estimated at reduced purchase price by 40% and more than \$2 million per battalion, and reduced labor costs of 75% and more than 3.6 man-years per battalion. Labor savings estimates are based on 48 man-hours per tank, 44 tanks in a battalion and 1740 hours in a man-year.

### Completed Comparative Road Testing at KRC, MI

(report available)

#### RUBBER PADS



0 MILES



500 MILES

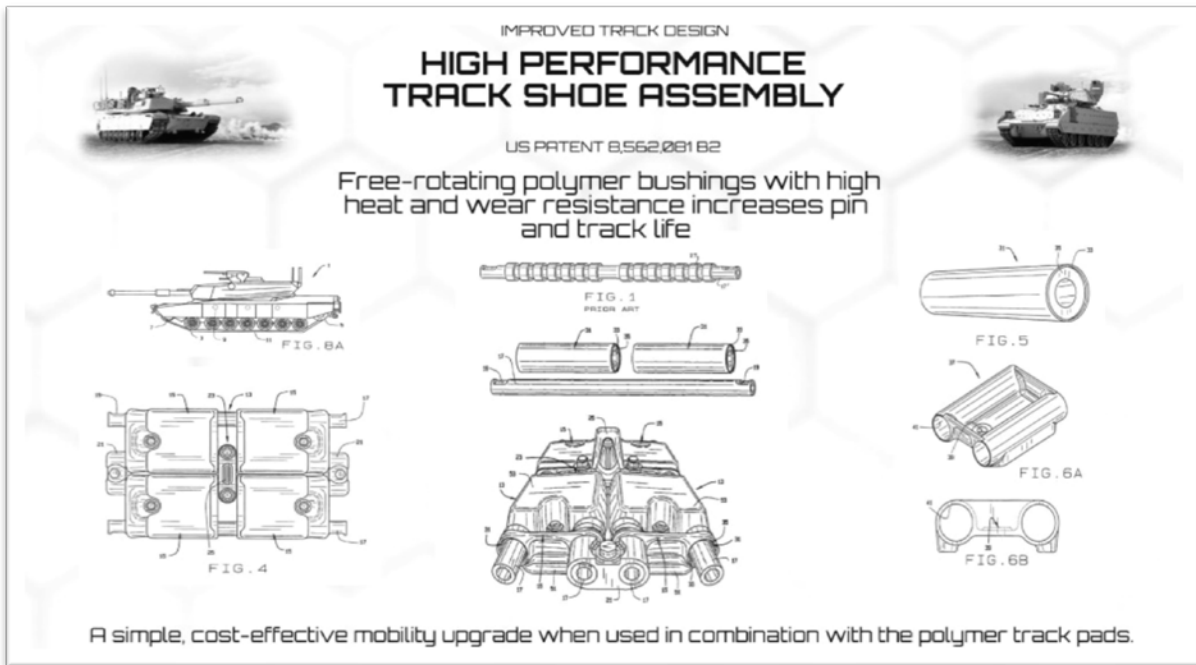
#### POLYMER PADS



0 MILES



500 MILES



### Core Team Members & Primary Experience

- **George Sturmon**, Inventor/Owner/Engineer, founder of ATRO, a leading manufacturer of high-performance polymers for high-wear, high-heat, shock/vibration-mitigation. Work in proprietary chemistry for anti-blast/ballistic polymers and composites. Published works in thermodynamic management/gaseous fuels, worked on Gemini reentry issues, has 50+ global patents.
- **Susan Schmidt**, Vice President/Manufacturing/Purchasing, vast knowledge of purchasing/sourcing manufacturing processes, taking product R&D to market/starting new companies.
- **Mark O'Hare**, Business and Technical Advisor, 18-year CEO experience and retired USN CAPTAIN (PEO) with numerous successful government/commercial production and product deployments in hardware, software, IT and Cyber Security products, has run multi-million/billion-dollar businesses, is technically astute with 300+ global patents granted or applied for.
- **Joshua Medling**, Creative Director/R&D, research/product dev and strategic marketing, won 1<sup>st</sup> Place Award for the AMS submission to NASA/SAE Tech Briefs Create the Future Design Contest 2017.
- **Glenn Harris**, Plant & Quality Manager, uses ISO9000/Mil-Spec procedures for quality-control, extensive manufacturing/machining/automation/inspection knowledge.

