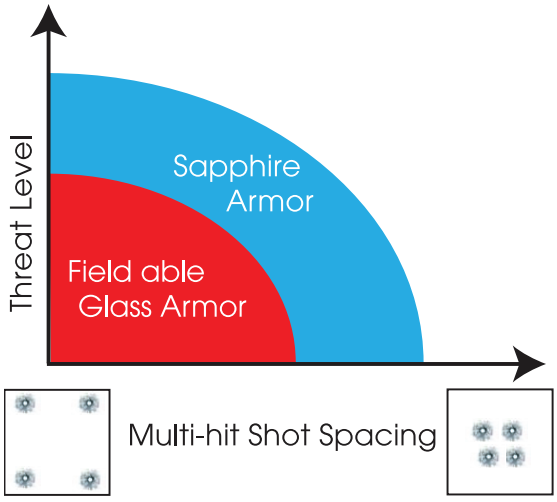
Greater Warfighter Effectiveness and Safety with Sapphire Engineered Transparent Armor

Superior to Glass Armor

- Saint-Gobain's Sapphire Engineered Transparent Armor is lighter, thinner, and offers superior ballistic protection
- Sapphire Engineered Transparent Armor has significantly better abrasion resistance and light transmission in the visible and infrared zones
- Other advantages include increased vehicle payload/range, and greater crew situational effectiveness and safety

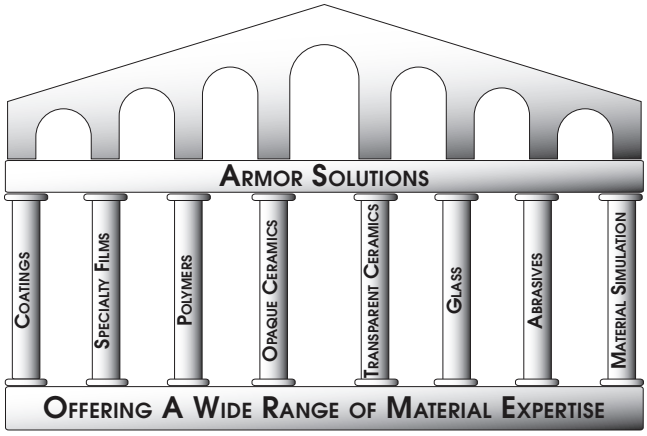
Problem

- Traditional glass transparent armor will add 130-390 lbs to vehicle weight to meet current and future fighting vehicle ballistic threats
- The weight and thickness of glass armor significantly reduces night vision effectiveness, usable crew space and safety, and vehicle maneuverability
- Lifetime cost of glass armor is high because it is vulnerable to field conditions such as rock strikes, sand abrasion and delamination, which in total account for the majority of theater failures



Sapphire Armor solutions are available for high threat levels and/or tight multi-hit shot spacing, where current glass solutions are neither fieldable nor practical

- Saint-Gobain integrates its deep expertise in a wide array of advanced materials to offer innovative transparent armor solutions that protect the warfighter against higher threat levels while demonstrating acceptable lifetime cost of ownership
- Saint-Gobain's large sheet sapphire has been used as an electro-optic window in F-15E, F-16, F-35 and in several battle tanks and submarines, including mission sensitive special operations vehicles
- Saint-Gobain's Sapphire Engineered Transparent Armor was selected for M142 High Mobility Artillery Rocket System (HIMARS®) by U.S. Army and Marine Corps to replace conventional glass-glass armor
- Significantly larger sizes possible with proven 'seamed window' technology
- Widespread acceptance of sapphire engineered transparent armor is expected within the armor community for new and existing vehicle programs because of its unique capabilities to meet field requirements for higher ballistic threats and acceptable lifetime costs



Saint-Gobain has expertise in all critical armor component materials, depicted as the pillars in its mission/ability to develop transparent armor solutions.

DoD Qualified Solution

- Saint-Gobain's Sapphire Engineered Transparent Armor enables program managers and fighting vehicle design engineers to significantly improve vehicle ballistic performance, crew effectiveness and situational awareness while lowering lifetime and operational cost

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Key Benefits over Traditional Glass Armor

Ballistic Performance

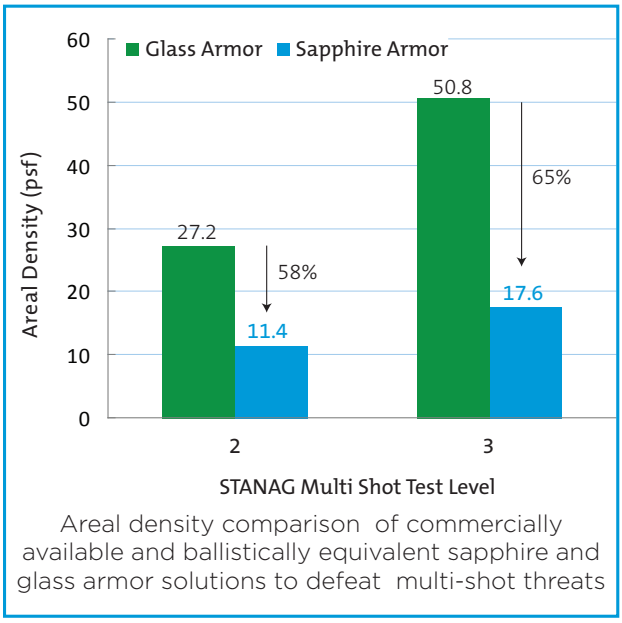
- Comparable ballistic protection at >50% weight savings
- Better multi shot resistance due to higher strike-face integrity
- Enhanced protection due to fracture on impact of hard and armor piercing projectile

Lifetime Durability

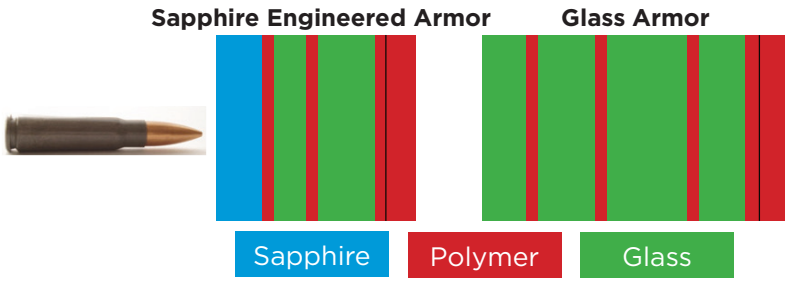
- Approximately 3X higher rock strike resistance due to high fracture toughness
- Superior strike-face avoids most of the delamination risk
- High hardness and chemical stability of the strike-face protects against sand abrasion and munitions related corrosion

Warfighter Effectiveness

- Improved situational awareness due to higher luminous and NVG transmittance
- Better visual clarity due to lower haze, optical distortion and glare due to few layers in the laminate
- Significantly reduced rollover risk due to lower center of gravity from window weight reduction
- Lower vehicle weight provides greater range & payload, and facilitates rapid deployment
- Reduced thickness increases space inside cab
- Faster de-icing & de-fogging due to 30X thermal conductivity improvement over glass

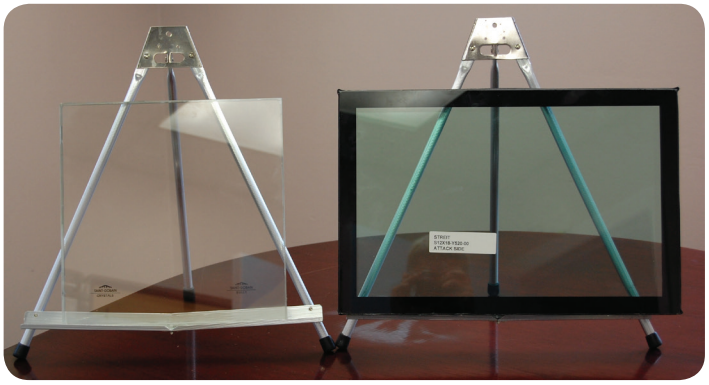


Areal density comparison of commercially available and ballistically equivalent sapphire and glass armor solutions to defeat multi-shot threats



Schematic of Sapphire engineered and traditional glass armor

Side by side comparison of sapphire and glass armor designed to defeat the same threat.



Saint-Gobain Crystals, Photonic Products
33 Powers Street
Milford, NH 03055
Tel: (603) 673-5831
Photonics-Info@saint-gobain.com
www.photonic.saint-gobain.com

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Transparent armor solutions from Saint-Gobain Crystals are protected under US Patents 7793580, 7584689 and 8025004

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