



**High-Performance
Reinforcements**

ShieldStrand[®]S
High-Performance Reinforcements



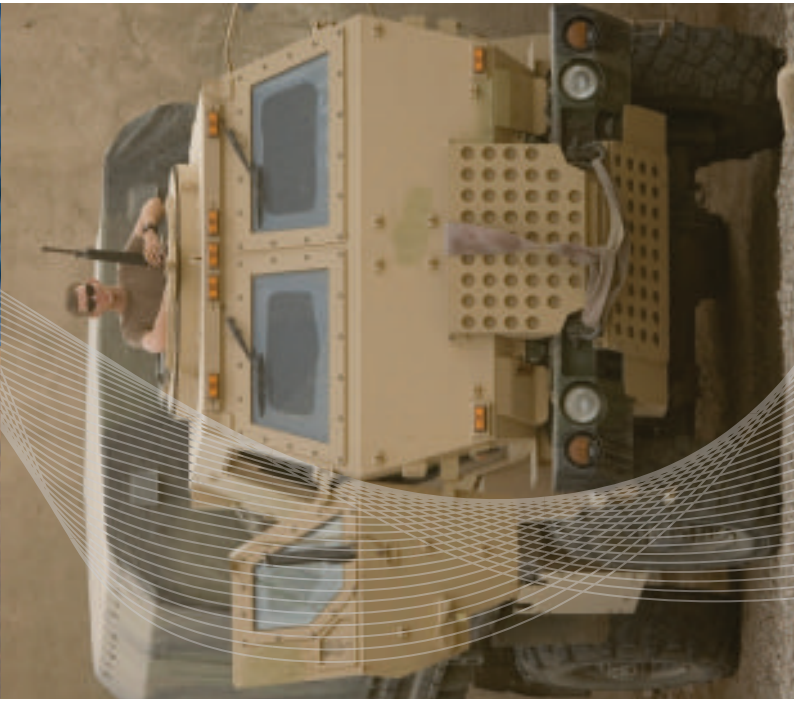
ShieldStrand[®]S
High-Performance Reinforcements

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OCV™ Reinforcements

High-Performance Reinforcements

INTRODUCING SHIELDSTRAND® S

OCV™ has developed a new high performance fiber that enables durable lightweight protection.

Delivering Performance

- The ballistic performance has been tested and validated in the supply chain and exceeds the MIL-DTL-64154B (Class A) V50 requirement. Approval is pending.
- ShieldStrand® S provides up to a 50% weight savings versus steel for equivalent FSP protection, increasing vehicle payload and mobility.
- ShieldStrand® S has been tested in combination with a steel or ceramic strike face to provide protection when armor piercing and multi hit capability is required or an overmatched threat exists.
- ShieldStrand® S meets fire, smoke and toxicity requirements.
- ShieldStrand® S solutions provide better durability in high temperature, corrosive and high humidity environments.

Enabling Possibilities

- The strength of ShieldStrand® S provides structure as well as protection, allowing armor to be integrated into the vehicle structure, reducing overall vehicle weight.
- ShieldStrand® S can be molded into large complex-shaped structural parts using proven large scale composite manufacturing technologies.
- ShieldStrand® S composite armor is affordable, at 1/3 the cost of UHMWPE solution, enabling more vehicles to be protected, increasing warfighter survivability.

Readily Available

- ShieldStrand® S reinforcements are produced on a large scale using OCV innovative breakthrough glass fiber technology. Production can support surges common in defense applications.
- ShieldStrand® S composite panels provide an alternative supply chain where pricing is less volatile than aluminum alloys.

COMPARISON OF OCV™ HIGH PERFORMANCE GLASSES

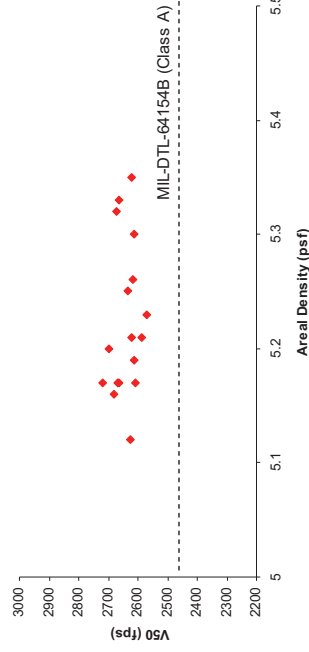
	Text Method	E-glass	ShieldStrand®	ShieldStrand® S
Prime Fiber Tensile Strength GPa (KSI)	ASTM D2101	3.45-3.79 Gpa (500-550 KSI)	4.58 Gpa (664 KSI)	5-11-5.30 Gpa (741-769 KSI)
Integrated fiber Tensile Strength GPa (KSI)	ASTM D2343	1.99-2.48 Gpa (290-360 KSI)	3.17-3.48 Gpa (460-505 KSI)	3.41-3.85 Gpa (495-555 KSI)
Young's Modulus GPa (ksi)	Sonic Resonance @ 20C	(10-10.5 MSI)	86.9-95.8 Gpa (12.6-13.9 KSI)	88 Gpa (12.7 MSI)
Density g/cc (lb/in ³)	ASTM C693	2.55-2.58 g/cc (0.092-0.093 lb/in ³)	2.55 g/cc (0.0921 lb/in ³)	2.45 g/cc (0.0885 lb/in ³)
Specific Prime Tensile Strength (m)	Calculated	1.36-1.5 x10 ⁶ m	1.83 x10 ⁶ m	2.01-2.12 x10 ⁶ m
Specific Tensile Modulus (m)	Calculated	2.75-2.85 x10 ⁶ m	3.49x10 ⁶ m	3.67x10 ⁶ m

COMPARISON OF OCV™ SHIELDSTRAND® S TO COMMON ARMOR MATERIALS

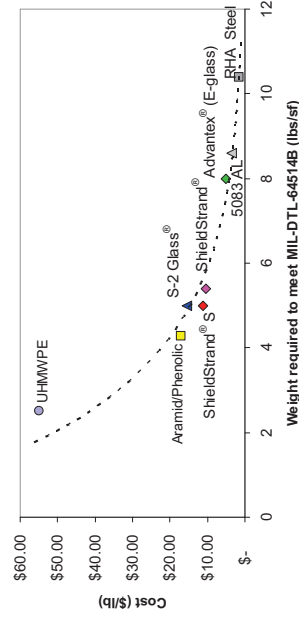
Performance	ShieldStrand® S	S-2 Glass®	Steel	Aluminum	Aramid	UHMW Polyethylene
Weight	+	+	---	-	++	+++
Cost	++	+	+++	+++	-	---
Structural Capability	+	+	+++	++	-	---
Part thickness (thin is +)	+	+	+++	++	-	---
Corrosion resistance	++	++	---	-	+	-
Fire, Smoke and Toxicity	+	+	++	++	-	---
Temperature Resistance	++	++	+++	++	+	-

ShieldStrand® S provides a balanced solution.

SHIELDSTRAND® S MEETS CLASS A BALLISTIC PERFORMANCE



SHIELDSTRAND® ENABLES LIGHTWEIGHT ARMOR



SHIELDSTRAND® S PROVIDES STRUCTURE AS WELL AS PROTECTION

	ASTM Test Method	ShieldStrand® S Phenolic Plate (typical mean property range)
Fiber Volume	D2734	61 - 66%
Resin Weight	D2584	16 - 24%
Water Absorption	D570, D792	< 1.5%
Longitudinal Flexural, Wet Ret.	D790	> 70%
Thickness (in.)		0.470 - 0.530
Ply Thickness (in.)	25 ply	0.019 - 0.020
Areal Density (lb/sf)	25 ply	4.6 - 5.4
Density (lb/ci)	D792	0.072 - 0.074
Hardness (M scale)	D785	> 80
Thermal Transition	D4065	210 - 240
Flammability	UL 94	V0
Time to Ignition @ 50k W/sm	EI354	500 - 600
Total Heat Release (MJ/sm)	EI354	25 - 60
MAHRE (kW/sm)	EI354	20 - 35
FIGRA	EI354	0.10 - 0.20

VARIOUS PRODUCT FORMS ARE AVAILABLE



- ShieldStrand® S roving is 360 tex (1377 yds/lbs). The filament diameter is 9 micron.
- Standard 24oz woven roving and custom fabrics are available
- ShieldStrand® S can be processed in low-cost pultrusion, continuous lamination, compression molding of flat plates or infusion of complex shapes