



“High Performance Reinforcements for Vehicle Up Armoring”

JEC ASIA 2009

Automotive & Mass Transport Forum



INNOVATIONS FOR LIVING™



DELIVERING SOLUTIONS | TRANSFORMING MARKETS | ENHANCING LIVES



Owens Corning Company Highlights

- **Building Materials and Composites**
- **Founded 1938**
- **\$6 Billion sales in 2008**
- **16,500 employees in 30 countries**
- **Industry leader in all markets served**
 - Glass fiber insulation, roofing & asphalt and composite solutions
- **First company to trademark a color – Pink**
- **A Fortune 500 company for 55 consecutive years**
- **2008 Fortune magazine most admired companies**
- **OCV™ Reinforcements, OCV™ Technical Fabrics, OCV™ Non-Woven Technologies**

Armoring of Vehicles

- **Armor is protective covering used to prevent damage from being inflicted to an individual or a vehicle through use of direct contact weapons or projectiles, usually during combat.**
- **Military, Corporate, Cash Vans and VIP vehicles are commonly armored to protect against :**
 - All types of mines
 - Direct and indirect projectiles
- **Important Criteria for Armoring**
 - Excellent mobility
 - High survivability under extreme conditions
 - High payload and internal capacity

Armoring of Vehicles

- **Performance expectations**

- Ability of material to blunt the projectile
- Strain to failure which determines the ability of that material to absorb energy by brittle cracking
- Composite materials rely primarily on brittle micro fracture events to absorb energy.
- Ultimate energy absorption is largely controlled by the strain to failure of the fibers.

- **Traditional Material system used**

- High performance metals
- Steel Armor
- Aluminum Armor

Composite Vs Traditional material systems for Vehicle Armoring

- **Light Weight hence higher payload**
- **Depot / Field Installation Capable**
- **Flat or Curved Plate or Complex Shape Demonstrated**
- **Hybrid or Multiple material systems possible to optimize performance**
- **Inherently corrosion resistant, no corrosion resistant coating required**
- **Enhance Multiple hit performance & Fragmentation can be arrested**
- **Heavy structures**
- **Field Logistical problems due to heavy weight**
- **Limits usage due to fabrication constraints of complex shapes**
- **Coefficient of Thermal expansion can limit the material selection.**
- **Corrosion coating required**
- **Multiple hit performance & Fragmentation is a issue**

Market Driven Innovation in Ballistics



Application Mobility and Ballistic Lethality Drives Performance

NA Defense Vehicle Market

	2009	2014
Total	\$1.7B	\$1.3B
Percent Composites	38%	43%

Ref : Material Requirements and Supply Chain Analysis Of Armor Procurement

For US Military Ground Vehicles

Published March 21, 2008

(This is an updated release of original report published November 1, 2007.)

By Vector Strategy, Inc

Ballistics is a high performance niche market



High Performance Reinforcements Product Line

WindStrand® Reinforcements
FliteStrand® Reinforcements
ShieldStrand® Reinforcements
XStrand® Reinforcements

Available as Single End Roving or Fabric



Fiber glass filament



Roving



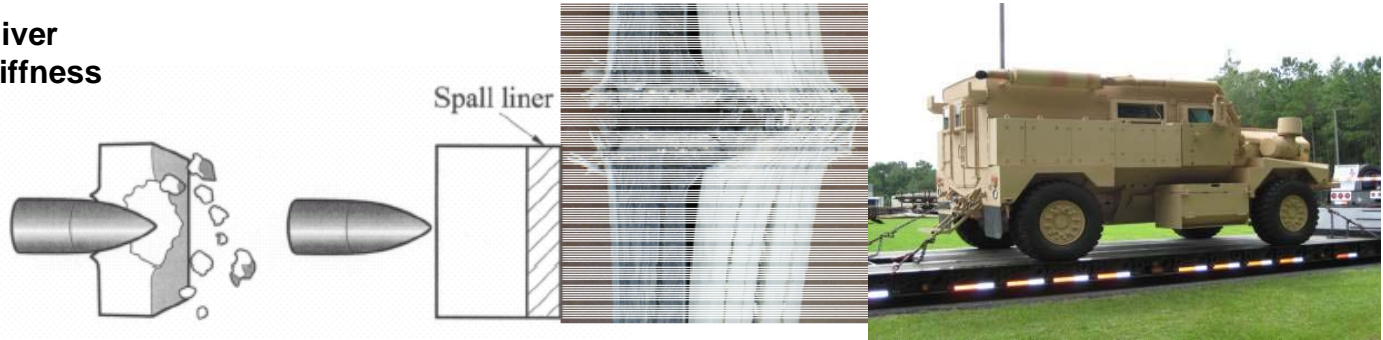
Fabric



Final Applications

OC Innovations are positioned to cause winning for our customers

Shieldstrand® Fibers deliver optimum strength and stiffness



Ultimate energy absorption controlled by **strain to failure** of the fibres.

	Shieldstrand® R	Metal (Steel & Al)	S2 AGY	Aramid	UHMW Polyethylene
<i>Assumes equal ballistic threat for all materials</i>					
Weight	+	-	+	++	+++
Cost	++	+++	+	-	--
Structural Capability	+	++	+	-	--
Part thickness (thin is +)	+	++	+	-	--
Resistance to acid and chemical attack	++	-	++	+	-
Fire, Smoke and Toxicity	+	++	+	+	-
Temperature Resistance	+	++	+	+	-

Ref : OC Data

A balanced solution 50% weight of Steel and 33% cost of UHMWPE

ShieldStrand® Armor Solutions Weight Saving Benefits

ShieldStrand®
High-Performance Reinforcements

- Up to 30% weight savings versus metals
- Up to 50% cost savings versus Aramid & HMMWV on composite basis
- Up to 40 % cost saving versus AGY S2 on fiber basis



Actual cost and weight savings calculated on these examples

Up Armor Add-on Vehicle Kits



OGH HMMWV Kit

Produced By:
Armor Holdings Inc.
BAE Systems



ARL HMMWV Kit

Produced By:
GSIE/ARL



Troop Carrier Kit

Produced By:
ArmorWorks



**M1114 UAH
Gunners Protection Kit**

Produced By:
Armor Holdings Inc.
BAE Systems



FMTV RACK Kit

Produced By:
ESSI Inc.
(Radian/SEI)



FMTV LSAC Kit

Produced By:
Stewart & Stevenson

OC ShieldStrand® Making Lightweight Protection Affordable

Affordable Lightweight Performance

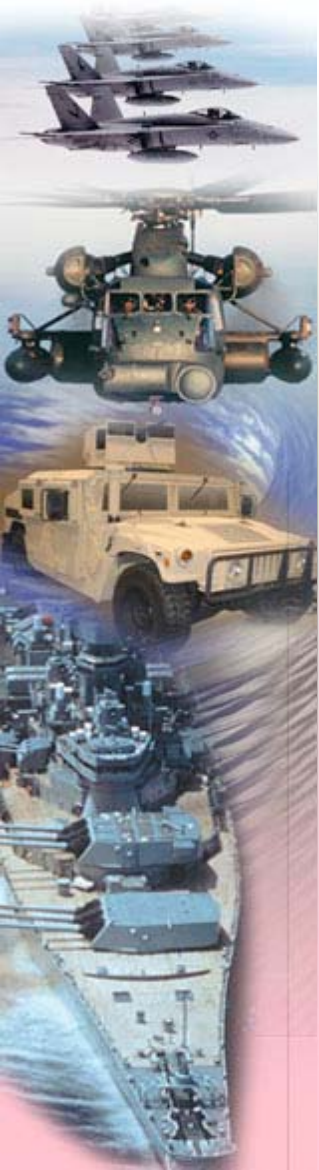
- High strength, high modulus glass fiber available in large quantities
- Comparable ballistic performance to S-Glass in HJ1 phenolic plates at about half the cost.
- Substitution for S-Glass/K29 Aramid in spall liners – lower cost lightweight solution
- Replace or combine with aluminum, steel and E-glass – where weight is critical and over match threat levels exist

• Drivers for Substitution of Aluminum or Steel

- Shortage of metal
- Recent cost increases
- Spall reduction behind armor
- Build more kits faster
- Reduce dependency on foreign source

• ShieldStrand® Armor Validated Supply Chain Performance

- Ballistic performance data qualified in the existing supply chain
- Fibers & fabrics are available to the existing supply chain for processing in low-cost pultrusion, continuous lamination or compression molding of flat plates and compression or infusion molding of complex shapes



Thank you

More information:

www.owenscorning.com/composites/

www.ocvreinforcements.com/hp/