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S-2 Glass®
Reinforcement

# S-2 Glass® Reinforcement Remains Material of Choice As Vehicle Armor Evolves to Meet Higher Threat Levels

***Benefits of High Performance Glass Increase as Ballistic Protection is Enhanced to Stop Armor-Piercing Projectiles***

NP Aerospace Ltd. has been making armored security force vehicles for many years and knows a lot about ballistic protection. When the company recently developed its new CAVCAT vehicle platform that meets threat levels including armor-piercing projectiles, NP made a host of design changes but stayed with their core ballistic protection system – CAMAC® Lightweight Composite Armor incorporating S-2 Glass® reinforcements.

*Armor Vehicle*

According to NP Managing Director Roger Medwell, when the company used more glass-reinforced armor to upgrade the protection level of the new vehicles, the benefits of using high performance glass actually increased.

"When we started using high performance glass-reinforced composites the glass armor was about half the weight of a steel solution," said Medwell. "Now, as we upgrade our designs to meet National Institute of Justice (NIJ) threat levels 5, 6 and 7, the ratio is even better."

NP's CAMAC® Lightweight Composite Armor System features a ceramic surface with an S-2 Glass reinforced core. There is also an inner liner made with polyethylene. The whole system works together to slow, deform and "catch" projectiles. To meet NIJ threat level 7, the system is designed to stop a 9 mm full-metal-jacket, armor-piercing projectile.

Medwell said NP insists on using S-2 Glass because of the "outstanding consistency of the material. We never get any surprises."

NP has been building vehicles and personal protective equipment for more than 80 years. The company now uses composite materials exclusively and is perhaps best known for the CAV-100 Up-Armored Light Wheeled, Land Rover- based Vehicle that first saw action in the early 1990s.

Tests conducted in 2004 on CAV-100 vehicles in service for 10 years verified that the S-2 Glass armor system was essentially equal to the performance expected when the vehicles were brand new.

Medwell said the tested vehicles had been subjected to numerous attacks including petrol bombs and having degreasing agents and acid thrown on them. They had also been driven repeatedly through the tidal flow of salt water in marshy areas.

"The chassis was corroding away but from a ballistics perspective the vehicles were as good as the day

# Case History

## S-2 Glass® Reinforcement

*Armor Vehicle*

they were made," said Medwell. "Composite materials just don't oxidize like metal can and does."

Memory and structural performance are two additional properties of high strength S-2 Glass reinforced composites sought by NP Aerospace.

"Reinforced phenolic resin has excellent memory," explained Medwell. "It always goes back to its original shape. In a blast situation, the body of the vehicle can distort but it will then spring back to the original shape. The vehicle can take a lot of punishment and not show it."

Compared to other lighter-weight materials like aramid fiber, glass has more structural strength, which allows the material to perform a dual function of structural performance and ballistic protection. "We can actually hang loads on the composite structure," said Medwell.

"Composite vehicles are also very repairable," he continued. "Repairing steel structures by welding in new plugs can degrade the ballistics performance of the assembly. With reinforced polymer composites, we have repair practices that have been proven to work. We can just put in a new plug and off she goes."

Development work on the new vehicles started in 2005 and production and sales began in 2006. Each vehicle includes about 900 kilograms of S-2 Glass reinforcements.

The compression molded CAMAC Armor System armor system is now being considered for a light tank application.

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### *S-2 Glass® Reinforced Armor System Benefits*

- Half the weight of a steel solution or less
- Structural performance
- Resists corrosion
- Excellent memory when combined with phenolic resin
- Consistent properties
- Highly repairable


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