



**strength** in materials

# Vehicle Armor Composite Systems (VACS)

- ▶ VEHICLE PROTECTION
- ▶ STRUCTURAL INTEGRITY
- ▶ FST PERFORMANCE



# Vehicle Armor Composite System

Vehicle Armor Composite System (VACS) armor systems, based on advanced fibers from AGY, are the no-compromise solution for the full range of commercial and public safety applications.

The VACS family of high performance fibers is comprised of three offerings;

- **Featherlight™ S-2 Glass® roving**, a cutting edge technology that saves 5% additional weight for applications where weight reduction is critical
- **Standard S-2 Glass®/HJ1 fibers**, proven in more than 30 years of demanding military applications
- **Quicksilver™ S-1 Glass roving**, an economical alternative for applications that are not quite as weight sensitive.

The VACS armor systems combine a unique balance of exceptionally high performance across a wide spectrum of critical mechanical properties – including strength, impact and structural characteristics.

High performance glass fiber technology provides the distinct ability to design lighter weight, thinner wall, structural laminates that increase performance and functionality while lowering costs. Utilizing a systems approach to address new program requirements, AGY is able to recommend integrated solutions to complex challenges. They recognize and

understand the relationships among design and process elements, and strive to assist in the optimization of these elements to our customers' advantages.

Additionally, AGY further leverages our capabilities through selective integration with industry

resources for added value in technical and application development. Utilizing this integrated systems approach permits the simplification and acceleration of integrated solutions to complex challenges.



From military rocket motor housings to combat vehicle hulls and from composite inserts for ballistic vests to ballistic armor door protection systems, S-2 Glass armor from AGY has met the threat to personnel and equipment.

Numerous innovative technology development programs have used the unique capabilities of S-2 Glass armor systems to act as both a ballistic and a structural material. Appliqué armor, blast mitigation systems and combat vehicle structures have been constructed of this exceptional material.

With other material systems there is typically a trade-off between ballistic and structural properties in a laminate. S-2 Glass armor systems provide both. Optimized for ballistic protection, S-2 Glass systems also have a significant residual structural load-bearing capability. This structural capability makes S-2 Glass armor well-suited as a weight and space efficient backing for ceramic faced armor systems where multi-hit capability is critical. Moreover, the ability to design applications with thinner walls permits the use of less S-2 Glass fiber to do the same job as other materials. It can also help reduce the weight, as well as the cost of the protection system. With the addition of the new Featherlight and Quicksilver fibers, the VACS armor systems can be tailored to extend your buying power to protect more personnel at higher protection levels.



Today, AGY continues to assist in the development of advanced ballistic resistant systems to shield law enforcement and commercial security personnel. AGY VACS systems stand up to the threat of direct small arms fire and they also meet the protection needs against the shrapnel and fragments created by exploding mines, grenades and other blast-induced threats.

Laminates made from AGY's VACS fibers provide an inherent balance of tensile, compressive, stiffness and fatigue properties, as well as the ability to perform as a ballistic material. And, VACS laminates can be developed from polyester, phenolic, vinyl ester or epoxy resin systems which allow you to tailor the material for specific application

and cost requirements. Each system offers unique benefits to meet your specific needs.

The polyester systems are easier to fabricate and less expensive. Phenolics provide low flammability and low smoke generation. Vinyl ester can improve mechanical properties and weatherability. Epoxy systems are used where exceptionally high structural properties are needed.



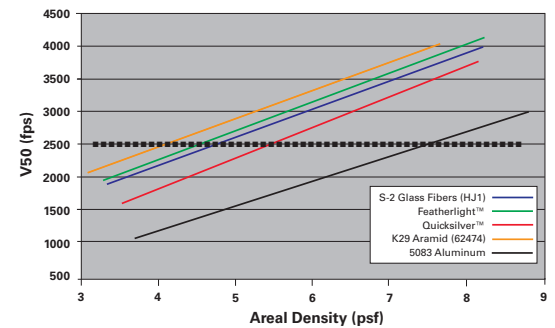
### An Evolution of Products for your Evolving Needs

AGY's high-performance fiber, S-2 Glass, has been joined in the VACS portfolio recently by two new additions for the defense market. The following options are available:

- **Featherlight™ S-2 Glass Roving** – a new version of advanced fiber with the same fiberglass chemistry as S-2 Glass; however, in a new format that results in a 5% lighter armor solution.
- **S-2 Glass® Fibers** – The original fiber used to manufacture HJ1 composite armor panels meeting the MIL-L-64154 and the new MIL-DTL-64154B Class A specification.
- **Quicksilver™ S-1 Glass Roving** – a new fiber glass chemistry that provides very good ballistic protection, but at a reduced manufacturing cost, resulting in a lower priced fiber.

All three VACS fiber systems are available in the same roving format. This allows for a simple transition from one VACS fiber to another. The resulting portfolio allows the armor designer a menu of options for the same solution, each offering a different cost/weight/performance alternative. In order to compare the alternatives, AGY has assembled the data in Graph 1 showing ballistic performance against a standard .30 cal FSP threat.

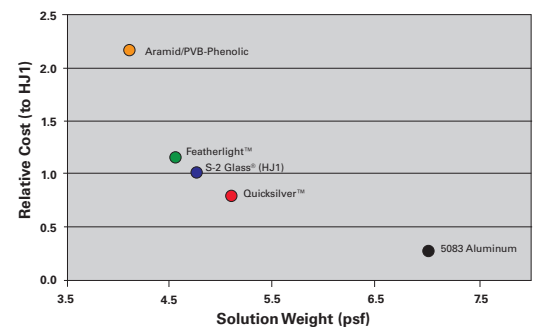
**GRAPH 1: .30 CAL FSP COMPARISON**



The data in graph 2 show typical costs of armor systems made with the fibers from graph 1. The values are normalized to typical S-2 Glass phenolic flat panel costs to account for variation in costs as a result of program size.

**GRAPH 2: COST PERFORMANCE CURVE**

vs. .30 cal fsp @ V50 = 2500 fps



Call AGY today for more information including case studies, technical data sheets, and technical papers describing why AGY armor systems are your best choice for performance and value.



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