

S-2 Glass®

Assembled Yarns
Epoxy sized

Zentron®

Direct Rovings
Epoxy sized

VeTron™

Direct Rovings
Vinyl Ester sized

High-Strength Solutions to your Toughest Reinforcement Challenges

933 S-2 Glass® yarns and assembled roving by agy

Zentron: Direct pulled epoxy sized S Glass

Vetron: Direct pulled vinyl ester sized S Glass

Resin Compatibility

- Polyamide
- Phenolic
- Polyimide
- PEI, PEEK, PAI, LCP
- BMI
- Cyanate Ester
- Epoxy
- Vinyl Ester

Processes

- Weaving
- Braiding
- Knitting

Product Application

AGY's S 2 Glass yarn is designed to be used in recreation, aerospace and defense applications such as:

- Aircraft Cargo Liners
- Aircraft Flooring
- Aircraft Wings
- Archery Bows
- Ballistic Armor
- Bathroom Fixtures
- Boats / High Performance
- Composite Structures
- Defense
- Fuel Tanks
- Golf Shafts
- Helicopter Blades
- High Temperature Filtration
- High Temperature Insulation
- Pressure Vessels
- Radomes
- Sails
- Skis/Snowboards
- Stove Element Insulation
- Surfboards
- Timing Belts
- Wire Insulation

Product Solutions

High-performance S Glass fibers offer a unique combination of properties: Strength, impact resistance, stiffness, temperature resistance, fatigue resistance and radar transparency. Compared with other reinforcing materials, S Glass fiber laminates weigh less than conventional E-glass fiber laminates and may deliver better cost performance than aramid or carbon. In addition, these yarns meet the requirements of MIL-Y-114OH specifications.

S-2 Glass®



Features:

Extremely high stiffness S-2 Glass® fiber offers significantly more strength than conventional glass fiber: 85% more tensile strength in resin impregnated resins

Better fiber toughness, modulus of resilience and Impact deformation than conventional glass fiber.

Softening point: 1056°C (1932°F)
Annealing point: 816°C (1500°F) Strain point: 766°C (1410°F)

Enhanced stiffness.

Excellent tolerance to damage accumulation

S-2 Glass® fibers deliver 20% reduction in dielectric constant over E-glass fibers.

Long shelf-life, good machinability and excellent durability.

Quick wet-out (penetration of resin into strand).

Performs well in certain modified epoxy resin systems Where high strength and improved hot/wet tensile strength retention are important.

S-2 Glass® fibers facilitate co-mingling and hybridization with other reinforcement or thermoplastic fibers, including carbon fibers.

The 933 sizing is stable at processing temperatures of 670°F and above.

Benefits:

Consistent high performance for reliable and durable finished parts.

Improved impact capabilities to finished parts and higher composite durability and damage tolerance.

Greater fiber tensile strength and stability at elevated temperatures in thermoset and thermoplastic applications.

Delivers 25% more linear-elastic stiffness than conventional Glass fiber.

The ability of composite parts to withstand high levels of tension
And flexural fatigue without catastrophic failure.

Radar transparency

Consistent performance and reliability

Faster, more efficient processing

Improved epoxy performance.

Improvements in impact resistance and damage tolerance, as well as material cost reduction

Facilitates molding with high temperature thermoplastic matrices, yielding exceptional laminate mechanical properties

Advanced Materials
Solutions for Demanding Applications

Typical Fiber Properties

Property (test standard)	S-2 Glass Fiber*		E-Glass		K-49 Aramid		AS4 Carbon	
	gm/cm ³	lb/in ³	gm/cm ³	lb/in ³	gm/cm ³	lb/in ³	gm/cm ³	lb/in ³
Physical								
Density (ASTM-C688)	2.46 - 2.49	0.089 - 0.090	2.55 - 2.58	0.092 - 0.093	1.44	0.052	1.8	0.065
Hardness (Moh's scale)	6.5		6.5		N/A		N/A	
Mechanical - Impregnated Strand	MPa	Ksi	MPa	Ksi	MPa	Ksi	MPa	Ksi
Tensile strength (ASTM D2343) at 22°C (72°F)	3660 - 4280	530 - 620	1860 - 2690	270 - 390	2900 - 3620	420 - 525	3100 - 3790	450 - 550
Creep, % of initial strain (ASTM D2990) at 50% of strength, 10,000 hrs	0 - 3%		0 - 5%		10 - 30%		0 - 2%	
Mechanical - Single Filament	MPa	Ksi	MPa	Ksi	N/A		N/A	
Tensile strength (ASTM D2101) at -180°C (-310°F)	8270	1200	5310	770				
at 22°C (72°F)	4590 - 4830	665 - 700	3450 - 3790	500 - 550				
at 371°C (700°F)	3760	545	2620	380				
at 538°C (1000°F)	2410	350	1720	250				
	GPa	Msi	GPa	Msi	GPa	Msi	GPa	Msi
Tensile Modulus of elasticity (ASTM D2101) at 22°C (72°F)	86 - 90	12.5 - 13	69 - 72	10 - 10.5	134 - 131	18 - 19	221 - 234	32 - 34
at 538°C (1000°F)	89	12.9	81	11.8				
Strain to failure (ASTM D2101)	5.4 - 5.8%		4.5 - 4.9%		2.5 - 2.9%		1.5 - 1.6%	
	MPa	Ksi	MPa	Ksi	MPa	Ksi	MPa	Ksi
Toughness (ASTM D2101)	83 - 90	12 - 13	62 - 69	9 - 10	48 - 55	7 - 8	35 - 41	5 - 6
Moisture Regain (ASTM D1909)	0%		0%		3.5%		0%	
Optical								
Refractive index, 589.3 nm (oil immersion)	1.520 - 1.525		1.547 - 1.562		1.5 - 2.0		N/A	

* Annealed Bulk Glass Properties by Sonic Resonance at 20°C (86°F) for S-2 Glass fiber.

Young's Modulus 13.6 Msi Poisson's Ratio 0.23
Shear Modulus 5.53 Msi Bulk Density 2.486 gm/cm³

From: AGY LIT-2004-341



Advanced Materials
Solutions for Demanding Applications

Typical Fiber Properties

Property (test standard)	S-2 Glass Fiber**		E-Class**		K-49 Aramid		AS4 Carbon	
	cm/cm°C	In/In°F	cm/cm°C	In/In°F	cm/cm°C*	In/In°F*	cm/cm°C*	In/In°F*
Thermal								
Linear expansion coefficient (ASTM D696)	1.6 x 10 ⁻⁴ (at -30°C to 260°C)	0.9 x 10 ⁻⁴ (at -30°F to 480°F)	5.4 x 10 ⁻⁴ (at -30°C to 350°C)	3 x 10 ⁻⁴ (at -30°F to 480°F)	4.9 x 10 ⁻⁴ 41 x 10 ⁻⁴ (at 26°C to 150°C)	2.4 x 10 ⁻⁴ 29 x 10 ⁻⁴ (at 78°F to 286°F)	-1.1 x 10 ⁻⁴ 17 x 10 ⁻⁴	-0.6 x 10 ⁻⁴ 9.3 x 10 ⁻⁴
Conductivity k (ASTM C177)	Watts/m-K 1.1 - 1.4	Btu-In/h-ft ² -F 8 - 10	Watts/m-K 1 - 1.2	Btu-In/h-ft ² -F 7 - 9	Watts/m-K 0.04 - 1.4	Btu-In/h-ft ² -F 0.3 - 10	Watts/m-K 71 - 100	Btu-In/h-ft ² -F 60 - 70
Specific heat	kJ/kg-K	Btu/lb °F	kJ/kg-K	Btu/lb °F	kJ/kg-K	Btu/lb °F	kJ/kg-K	Btu/lb °F
at 22°C (72°F)	0.787	0.176	0.807	0.190	1.88	0.88	0.711	0.17
at 200°C (382°F)	0.820	0.196	1.08	0.247	2.68	0.83	1.21	0.29
Softening point (ASTM C385)	1060°C	1932°F	540°C	1000°F	(Oxidation above 167°C, 300°F)		(Oxidation above 385°C, 690°F)	
Annealing point (ASTM C385)	516°C	950°F	667°C	1216°F				
Strain point (ASTM C386)	789°C	1410°F	618°C	1140°F				
Flame resistance								
Oxygen Index (ASTM D2885)	100%		100%		29%		60%	
Electrical								
Dielectric constant (ASTM D189) at 22°C (72°F)								
1 MHz	5.8		6.6		4		Conductive	
10 GHz	5.2		6.1		3.9			
Dissipation factor (ASTM D189) at 22°C (72°F)								
1 MHz	0.002		0.008		0.014		Conductive	
10 GHz	0.007		0.004		0.01			
Volume resistivity (ASTM D287) at 22°C (72°F)	9.06 x 10 ¹²		0.402 x 10 ¹²		0.5 x 10 ¹²		0.183 x 10 ¹²	
800VDC, Ohm-cm								
Surface resistivity (ASTM D287) at 22°C (72°F)	0.886 x 10 ¹²		0.42 x 10 ¹²		10 ¹² - 10 ¹⁴		0.1 x 10 ¹²	
800VDC, Ohm								
Dielectric strength	kV/cm	Volts/mil	kV/cm	Volts/mil				
Volts/mil at 190 mil thick	180	880	108	262	N/A		N/A	
Acoustical	m/sec	ft/sec	m/sec	ft/sec	m/sec	ft/sec	m/sec	ft/sec
Velocity of sound	6880	19200	6480	18900	2740	9000	6940	19600

*Axial and lateral property respectively due to crystalline orientation.
**Bulk glass properties considered to be applicable to fiber.

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