



strength in materials

Technical Product Guide



www.agy.com

Table of Contents

Corporate Overview	2
Glass Fiber Manufacturing	3
Glass Fiber Nomenclature	4
Yarn Nomenclature	5
AGY Glass Yarns	10
AGY Glass Rovings	16
AGY Chopped Glass	18
AGY Forming-Tube Input	20
AGY Packaging and Pallet Specifications	22
Sizing Systems for Yarns, Rovings and Chopped Products	28
Yarn Sizing Grid – Processability and Compatibility	30
Roving Sizing Grid – Processability and Compatibility	32
Chopped Fiber Sizing Grid – Processability and Compatibility	33
Typical Fiber Properties	34
Glossary of Terms	36



Corporate Overview

AGY provides the best quality, highest performance glass fiber yarns to a wide variety of markets and end uses. Founded in late 1998, AGY is a relatively new name in the market with a long history of service to these markets.

Globally, AGY has over 750 employees involved in production, sales, distribution and development of glass fiber yarns. Our world headquarters, technology center and manufacturing is located in Aiken, SC USA.

We have also established commercial and administrative offices in Lyon, France.



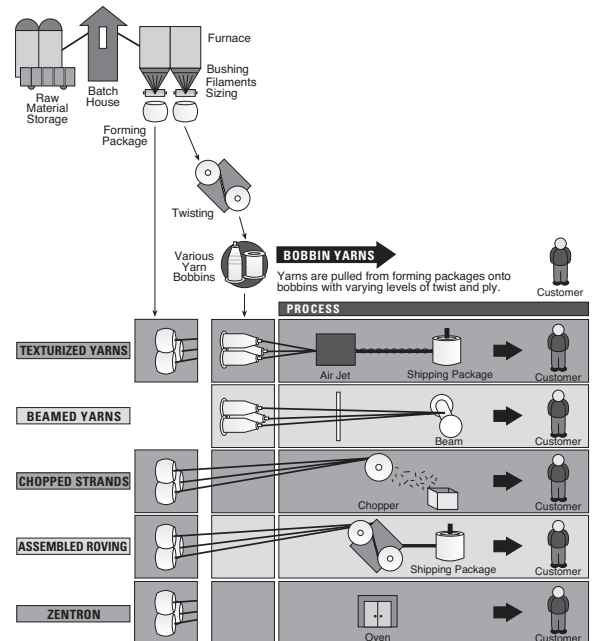
Glass Fiber Manufacturing

AGY glass fiber yarn textile fibers are made from molten glass. The viscous liquid is drawn through tiny holes at the base of the furnace to form hair-like filaments. A protective sizing, applied as the filament cools and hardens, helps prevent abrasion during additional processing and makes the glass compatible with various resin systems.

For yarn products, after sizing is applied, filaments are gathered into strands and wound into intermediate (forming) packages for processing. These strands become the basic components for a variety of textile and roving products.

Textile yarns are produced by twisting and sometimes plying several strands of fiber. Once twisted, the yarns can be further processed by beaming or rewinding onto different packages.

Textile yarns can also be textured for decorative and industrial applications and coated with a variety of resinous or elastomeric materials. For some textile processes, the gathered strands are not wound onto packages but are further processed into chopped strands for wet-formed product end-uses.



Glass Fiber Nomenclature

General

Glass fiber yarns are typically identified by either an inch-pound based system (U.S. customary system) or a TEX/metric system (based on the SI*/metric system). This section gives a brief description of glass fiber yarn nomenclature, including comparisons of the two systems. A more comprehensive description can be found in ASTM D578 – standard specification for glass fiber strands.

AGY's products use standardized nomenclature designations that include both alphabetical and numerical elements. They identify glass composition, filament type, strand count and yarn construction. These designations match either an inch-pound version or a TEX/metric version. Both systems are industry-recognized identifications.

Roving Nomenclature

Glass fiber roving nomenclature is defined by ASTM D578. The nomenclature uses alpha-numeric designations signifying binder, sizing, yield in yards and method of manufacture/construction of a roving. The following is an explanation of the standard alpha-numerical form: XXXX-YY-ZZZZ.

- "XXXX" is a number/character combination signifying a binder (sizing). Typically it is a three-digit number with or without a letter designation afterwards. The final digit would typically reflect a revision to the sizing (e.g., 721B is a successor to 721A but is the same basic chemistry).
- "YY" is a two-character alpha (letter) designation used internally by AGY to identify the method of manufacture or construction of a roving. It may be an assemblage of multiple ends of a G75 yarn input to produce a given yield. The letters would change as the method of production changed. If the method of manufacture changed to a single-end roving, the designator would be changed (e.g., 449-AA-750 multi-end roving compared to ZenTron® 758-AB-675 single-end roving). Note that each company producing glass fiber rovings use their own letter designations so they would not be comparable for similar products from different manufacturers. Because of this, roving nomenclature is often shortened to indicate only the sizing and the yield as in 449-750, dropping the two-letter middle designator.
- "ZZZZ" at the end of the form is the yield in yards/lb for US customary system (or TEX for the SI/metric system), typically rounded to the nearest conventional yield (e.g., AGY's 750 yield rovings are actually 735 yds/lb nominal). Designations such as 250, 750 and 1250 have been in existence for years, and it has become convention to use them instead of actual nominals. Please refer to the appropriate product technical specification for actual yields of a given product.

Yarn Nomenclature

Typical Yarn Nomenclature Identified in U.S. Customary System (based on inch-pound)

E	Glass Composition: E=Electrical C=Chemical S=High Strength
C	Type of Filament: C=Continuous S=Staple T=Texturized
G	Filament Diameter: (see Table 1)
75	Yield Designation: (see Table 2)
1/2	Number of single strands twisted into continuous filament ends/Number of twisted strands plied together
2.8	Number of turns per inch in the twist of the final yarn
S	Direction of twist S=S direction Z=Z direction (See next page)

The example above then identifies the following yarn: ECG75 1/2 2.8S

- E = electrical glass
- C = continuous filament
- G = average filament diameter (see Table 1)
- 75 = 7,500 yards/lb. nominal bare glass in basic strand
- 1/2 = one ply of 2-strand construction (total 2 basic strands)
- 2.8 = the number of turns per inch (TPI) in the twist of the final yarn
- S = the direction of the twist

Typical Yarn Nomenclature Identified in TEX/Metric System (based on SI/metric)

E	Glass Composition: E=Electrical C=Chemical S=High Strength
C	Type of Filament: C=Continuous S=Staple T=Texturized
9	Filament Diameter: (see Table 1)
68	Yield Designation: (see Table 2)
1x2	Number of single strands twisted into continuous filament ends x Number of twisted strands plied together
S	Direction of twist S=S direction Z=Z direction (See next page)
112	Number of turns per meter in the twist of the final yarn

The example above then identifies the following yarn: EC9 68 1x2 S112

- E = electrical glass
- C = continuous filament
- 9 = 9 micrometers
- 68 = 68 grams per 1,000 meters of yarn
- 1x2 = one ply of 2-strand construction (total 2 basic strands)
- S = the direction of the twist
- 112 = the number of turns per meter (TPM) in the twist of the final yarn

*Le System International d'Unites (SI)

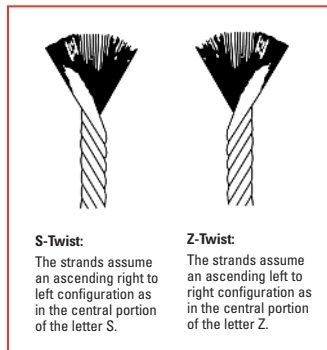
Yarn Nomenclature

(continued)

Twist

The fifth segment in the nomenclature is the number of basic strands* twisted together in a single yarn. Following this number is the number of turns per unit length and either the letter "S" or "Z" which indicates the direction of the twist. The S or Z direction of the yarn is determined by the slope of the yarn when it is held in a vertical position.

A twist is mechanically applied to yarns because, in addition to helping keep all of the filaments together, it provides the yarn higher abrasion resistance, improved processing, and better tensile strength.



U.S. Customary Yield

The approximate length of the fabricated yarn required to make one pound mass can be computed when the yield designation number is multiplied by 100 and divided by the total number of strands. The result of this computation must always be considered approximate. The yards per pound are reduced slightly in the twisting and plying operations, and by the addition of sizes or binders.

* A "basic" strand is one produced from a single bushing.

Table 1 – Designations for Glass Strand Filament Diameters

Filament Designation		Range for Filament Diameter Average	
U.S. Units (letter)	SI Units (microns)	Microns	Inches
BC	4	3.60 to 4.40	0.00014 to 0.000170
C	4.5	4.41 to 5.07	0.000171 to 0.000190
D	5	5.08 to 6.32	0.00020 to 0.000249
DE	6	5.72 to 6.96	0.000225 to 0.000274
E	7	6.35 to 7.61	0.00025 to 0.000299
F	8	7.62 to 8.86	0.00030 to 0.000349
G	9	8.89 to 10.15	0.00035 to 0.000399
H	11	10.16 to 11.42	0.00040 to 0.000449
J	12	11.43 to 12.69	0.00045 to 0.000499
K	13	12.70 to 13.96	0.00050 to 0.000549
L	14	13.97 to 15.23	0.00055 to 0.000599
M	16	15.24 to 16.50	0.00060 to 0.000649
N	17	16.51 to 17.77	0.00065 to 0.000699
P	18	17.78 to 19.04	0.00070 to 0.000749
Q	20	19.05 to 20.31	0.00075 to 0.000799
R	21	20.32 to 21.58	0.00080 to 0.000849
S	22	21.59 to 22.85	0.00085 to 0.000899
T	23	22.86 to 24.12	0.00090 to 0.000949
U	24	24.13 to 25.40	0.00095 to 0.000999

The low values stated for each micron range are exact equivalents to inches, rounded to the nearest hundredth micron. The high values stated for each micron range are slightly higher than exact equivalents to inches to provide continuation between ranges. They are consistent for inch-pound and SI filament size descriptions commonly used in the industry. In some publications, the SI designation for H filament size has been shown as 10.



Yarn Nomenclature

(continued)

Table 2 – Description of Continuous Filament Glass Fibers

Filament Designation		Nominal Yarn Number (strand count)			
US Units (letter)	SI Units (microns)	100 yds/lb	Bare Glass (yds/lb)	SI Units TEX (g/1000m)	Approximate Number of Filaments
BC	4	3,000	300,000	1.7	51
BC	4	2,250	225,000	2.2	66
BC	4	1,500	150,000	3.3	102
D	5	1,800	180,000	2.75	51
C	4.5	1,200	120,000	4.1	102
D	5	900	90,000	5.5	102
D	5	450	45,000	11	204
E	7	225	22,500	22	204
BC	4	150	15,000	33	1,064
DE	6	150	15,000	33	408
G	9	150	15,000	33	204
E	7	110	11,000	45	408
H	11	110	11,000	45	204
DE	6	100	10,000	50	612
DE	6	75	7,500	66	816
G	9	75	7,500	66	408
K	13	75	7,500	66	204
H	11	55	5,500	90	408
DE	6	50	5,000	99	1,224
DE	6	37	3,700	134	1,632
G	9	37	3,700	134	816
K	13	37	3,700	134	408
H	11	25	2,500	198	816
G	9	19	1,900	257	1,632
K	13	18	1,800	275	816
H	11	18	1,800	275	1,224

Note that the strand count indicates a basic strand* of yarn.



* A basic strand is one produced from a single bushing.

Table 3 – Yarn Reference and Conversion Formulas

Conversion – Measurements				
	US Units	SI Units	To Convert US Units to SI Multiply By:	To Convert SI Units to US Multiply By:
Length	mile	km	1.6093	0.6214
	inch	mm	25.400	0.0394
	foot	cm	30.48	0.0337
	yard	m	0.9144	1.0936
Area	yard ²	m ²	0.8361	1.1960
	inch ²	cm ²	6.4516	0.1550
	feet ²	m ²	0.0929	10.7639
Textile	oz/yd	g/m	31.0039	0.0323
	oz/yd ²	g/m ²	33.9063	0.0295
	turns/in (tpi)	turns/m (tpm)	39.3700	0.0254
	yd/lb	m/kg	2.0159	0.4961

**Cross Reference – Strand Twist
Turns Per Inch (TPI) vs. Turns Per Meter (TPM) – Industry Standard**

TPI	TPM	TPI	TPM
0.5	20	3.0	120
0.7	28	3.5	140
1.0	40	3.8	152
1.3	52	4.0	160
2.0	80	5.0	200
2.8	112	7.0	280

Conversion – Yardage

US Units	Metric Units to US Units
Denier = $\frac{4,464.492}{\text{(yds/lbs)}}$	yds/lb = $\frac{4,464.492}{\text{Denier}}$
TEX = $\frac{496.055}{\text{(yds/lbs)}}$	yds/lb = $\frac{496.055}{\text{TEX}}$
TEX = $\frac{590.5}{\text{Cotton Count}}$	Cotton Count = $\frac{590.5}{\text{TEX}}$
Denier = $\frac{5315}{\text{Cotton Count}}$	Cotton Count = $\frac{5315}{\text{Denier}}$

Denier = TEX x 9.0

AGY Glass Yarns

E-Glass Yarns

Filament	Microns	Yield Designation	Construction	Twist	Nominal Yield (TEX)	(yds/lb)	Denier	Yarn Diameter (mm)	(inches)	Min Tensile (lbs)	(N)	Sizing	Bobbin	Application
BC	4	150	1/0	1.0Z	33	15,000	297	0.203	0.0080	4.0	17.8	636	7636	Architectural Fabrics
BC	4	150	1/0	3.0Z	33	15,000	297	0.203	0.0080	4.0	17.8	636	7635/9228	Architectural Fabrics
BC	4	150	2/0	3.0Z	66	7,450	594	0.203	0.0080	8.0	35.6	636	9228	Architectural Fabrics
BC	4	150	4/0	3.0Z	134	3,700	1,206	0.203	0.0080	16.0	71.2	636	9228	Architectural Fabrics
BC	4	1,500	1/0	1.0Z	3.3	150,000	30	0.061	0.0024	0.3	1.3	622	7636	Ultrafine Electronics
BC	4	2,250	1/0	0.7Z	2.2	225,000	20	0.046	0.0018	0.2	0.9	622	7636	Ultrafine Electronics
BC	4	3,000	1/0	0.7Z	1.7	300,000	15	0.030	0.0012	0.2	0.7	622	7636	Ultrafine Electronics
C	4.5	1,200	1/0	1.0Z	4.1	120,000	37	0.045	0.0017	0.4	1.8	622	7636	Electronics
D	5	450	1/0	1.0Z	11	45,000	99	0.122	0.0048	1.3	5.8	620-1	7636	Electronics
D	5	450	1/0	1.0Z	11	45,000	99	0.122	0.0048	1.3	5.8	622	8542/7636	Electronics
D	5	450	1/0	1.0Z	11	45,000	99	0.122	0.0048	1.5	6.7	723	7636	Electrical Tape
D	5	900	1/0	1.0Z	5.5	90,000	50	0.084	0.0033	0.6	2.7	620-1	7636	Electronics
D	5	900	1/0	1.0Z	5.5	90,000	50	0.084	0.0033	0.6	2.7	622	7636	Electronics
D	5	1,800	1/0	1.0Z	2.75	180,000	25	0.068	0.0026	0.3	1.3	620-1	7636	Electronics
DE	6	37	1/0	0.5Z	134	3,700	1,206	0.396	0.0156	11.2	49.8	602	8542/8571	Texturizing
DE	6	37	1/0	1.0Z	134	3,700	1,206	0.396	0.0156	11.2	49.8	636	8542/8571	Weaving
DE	6	50	1/0	0.7Z	99	5,000	891	0.371	0.0146	8.0	35.6	602	8542	Texturizing
DE	6	75	1/0	0.5Z	66	7,500	594	0.269	0.0106	5.7	25.4	602	8542/8571	Texturizing
DE	6	75	1/0	0.7Z	66	7,500	594	0.269	0.0106	5.7	25.4	620	8542/8571	Aerospace/Filtration
DE	6	100	1/0	0.7Z	50	10,000	450	0.249	0.0098	4.3	19.1	602	8542	Texturizing
DE	6	100	1/0	0.7Z	50	10,000	450	0.249	0.0098	4.3	19.1	636	8542	Weaving
DE	6	150	1/0	0.7Z	33	15,000	297	0.203	0.0080	3.5	15.6	620	8542	Electronics
E	7	225	1/0	1.0Z	22	22,500	198	0.165	0.0065	2.4	10.7	620-1	8542	Electronics
E	7	225	1/0	0.5Z	22	22,500	198	0.165	0.0065	2.4	10.7	622	8542	Knitting
G	9	37	1/0	3.0Z	134	3,700	1,206	0.396	0.0156	10.0	44.5	620	9225	Winding/Braiding
G	9	37	1/0	0.7Z	134	3,700	1,206	0.396	0.0156	10.0	44.5	620-1	8571	Winding/Braiding
G	9	37	1/0	0.5Z	134	3,700	1,206	0.396	0.0156	19.4	86.1	517	8542	Pultrusion
G	9	37	1/0	0.7Z	134	3,700	1,207	0.396	0.0156	19.4	86.1	603	8542	Pultrusion
G	9	37	1/2	2.8S	268	1,850	2,413	0.568	0.0224	20.0	89.0	620	8542	Winding/Braiding
G	9	37	1/3	3.8S	402	1,233	3,621	0.663	0.0261	30.0	133.5	620	8542	Winding/Braiding
G	9	50	1/0	0.7Z	99	5,000	891	0.356	0.0140	9.0	40.1	620	8571	Winding/Braiding
G	9	75	1/0	0.7Z	68	7,300	612	0.269	0.0106	7.1	31.6	620	8542/8571	Winding/Braiding
G	9	75	1/0	0.7Z	68	7,300	612	0.269	0.0106	9.7	42.7	517	8542	Pultrusion
G	9	75	1/0	0.7Z	68	7,300	612	0.269	0.0106	9.7	42.7	603	8542	Pultrusion
G	9	75	1/2	2.8S	133	3,650	1,197	0.378	0.0149	11.4	50.8	620	8542	Winding/Braiding

AGY Glass Yarns

(continued)

E-Glass Yarns (continued)

Filament	Microns	Yield Designation	Construction	Twist	Nominal Yield (TEX)	(yds/lb)	Denier	Yarn Diameter		Min Tensile		Sizing	Bobbin	Application
								(mm)	(inches)	(lbs)	(N)			
G	9	150	1/0	4.0Z	33	15,000	297	0.203	0.0080	3.2	14.2	620-1	9228	Leaching
G	9	150	1/0	0.7Z	33	15,000	297	0.203	0.0080	3.5	15.6	620	8542	Winding/Braiding
G	9	150	1/0	0.7Z	33	15,000	297	0.203	0.0080	3.2	14.2	636	9225	Weaving
G	9	150	3/0	3.0Z	99	5,000	893	0.302	0.0119	9.6	42.7	636	9225	Weaving
G	9	150	4/0	4.0Z	137	3,620	1,233	0.348	0.0137	12.8	56.9	620-1	9225	Leaching
H	11	18	1/0	0.7Z	276	1,800	2,484	0.526	0.0206	18.0	80.1	620	8542/8571	Winding/Braiding
H	11	25	1/0	0.7Z	198	2,500	1,782	0.376	0.0148	15.0	66.7	620	8542	Braiding
H	11	55	1/0	0.7Z	90	5,500	810	0.318	0.0125	7.8	34.7	641	8542	Braiding
K	13	18	1/0	0.5Z	275	1,800	2,475	0.526	0.0206	35.4	155.8	517	8542	Pultrusion
K	13	75	1/0	0.7Z	68	7,300	612	0.269	0.0106	9.7	42.7	517	8542	Pultrusion

E-Glass (BC Sewing Thread)

Type	Microns	Package Weight Average (lbs)	Construction	Twist	Nominal Yield (TEX)	(yds/lb)	Denier	Yarn Diameter		Min Tensile		Sizing (N)	Bobbin	Application
								(mm)	(inches)	(lbs)	(N)			
BC-4	4	2.5	2/2	9.6Z	139.7	3,550	1257	0.346	0.014	13.0	57.3	636	8512	Sewing Thread
BC-6	4	6.0	2/3	9.1Z	212.9	2,330	1916	0.438	0.017	20.0	89.0	636	8542	Sewing Thread
BC-8	4	2.5	2/4	8.3Z	236.7	1,730	2581	0.508	0.020	25.0	11.2	636	8512	Sewing Thread

L-Glass® Yarns

Filament	Microns	Yield Designation	Construction	Twist	Nominal Yield (TEX)	(yds/lb)	Denier	Yarn Diameter		Min Tensile		Sizing	Bobbin	Application
								(mm)	(inches)	(lbs)	(N)			
E	7	255	1/0	1.0Z	19.5	25,500	175	0.168	0.0065	1.9	8.5	620-1	7636	Specialty Electronics
DE	6	340	1/0	1.0Z	14.6	34,000	131	0.139	0.0054	1.5	6.7	620-1	7636	Specialty Electronics
D	5	510	1/0	1.0Z	9.7	51,000	88	0.124	0.0048	1.1	4.9	620-1	7636	Specialty Electronics
D	5	1,020	1/0	1.0Z	4.9	102,000	44	0.085	0.0033	0.5	2.2	620-1	7636	Specialty Electronics
C	4.5	1,360	1/0	1.0Z	3.7	136,000	33	0.077	0.0030	0.4	1.8	620-1	7636	Specialty Electronics

S-2 Glass® Yarns

Filament	Microns	Yield Designation	Construction	Twist	Nominal Yield (TEX)	(yds/lb)	Denier	Yarn Diameter		Min Tensile		Sizing	Bobbin	Application
								(mm)	(inches)	(lbs)	(N)			
G	9	75	1/0	1.0Z	66	7,295	612	0.192	0.0076	7.1	31.6	636	7636	Aerospace
G	9	75	1/0	0.7Z	66	7,500	595	0.192	0.0076	10.7	47.5	933	7636	Aerospace
G	9	75	1/0	1.0Z	66	7,500	595	0.192	0.0076	12.9	57.4	493	7636	Aerospace
G	9	150	1/0	1.0Z	34	14,659	297	0.136	0.0054	3.7	16.5	636	7636	Aerospace
G	9	150	1/0	1.0Z	34	14,659	297	0.136	0.0054	5.6	25.0	493	7636	Aerospace
D	5	450	1/0	1.0Z	11	45,000	99	0.076	0.0030	1.75	7.8	636	7636	Aerospace

AGY Glass Yarns

(continued)

S-3 HDI™ Yarns

Filament	Microns	Yield Designation	Construction	Twist	Nominal Yield (TEX) (yds/lb)		Denier	Yarn Diameter (mm) (inches)		Min Tensile (lbs) (N)	Sizing	Bobbin	Application
D	5	450	1/0	1.0Z	11.0	45,000	99	0.124	0.0048	1.3	620-1	7636	Specialty Electronics
C	4.5	1,200	1/0	1.0Z	4.1	120,000	37	0.077	0.0030	0.4	620-1	7636	Specialty Electronics
BC	4	1,500	1/0	1.0Z	3.3	150,000	30	0.062	0.0024	0.3	620-1	7636	Specialty Electronics
BC	4	3,000	1/0	0.7Z	1.7	300,000	15	0.031	0.0012	0.15	620-1	7636	Specialty Electronics
BC	4	3,200	1/0	0.2Z	1.6	320,000	14	0.028	0.0011	0.15	620-1	7636	Specialty Electronics

Multi-Tex (Multi-End Texturized Yarns)

Nomenclature		Yield	Sizing	Nominal	Package	Net
US Units	SI Units	Designation		(yds/lb)	(TEX)	Weight
ETDE 1.75	ET6-2835	1.75	None	173	2,867	4002 3-25 lbs
ETDE 1.75	ET6-2835	1.75	Acrylic	168	2,953	4002 3-25 lbs
ETDE 2.25	ET6-2205	2.25	None	217	2,286	4002 3-25 lbs
ETDE 2.25	ET6-2205	2.25	Acrylic	214	2,318	4002 3-25 lbs
ETDE 3.50	ET6-1417	3.50	None	349	1,421	4002 3-25 lbs
ETDE 3.50	ET6-1417	3.50	Acrylic	346	1,434	4002 3-25 lbs
ETDE 4.50	ET6-1102	4.50	None	440	1,127	4002 3-25 lbs
ETDE 4.50	ET6-1102	4.50	Acrylic	432	1,148	4002 3-25 lbs
ETDE 6.00	ET6-827	6.00	None	589	842	4002 3-25 lbs
ETDE 6.00	ET6-827	6.00	Acrylic	564	880	4002 3-25 lbs
ETDE 9.00	ET6-551	9.00	None	878	565	4002 3-25 lbs
ETDE 10.00	ET6-496	10.00	Cellosize	1,030	482	4002 3-25 lbs
ETDE 11.60	ET6-428	11.60	None	1,205	412	4002 3-25 lbs
ETDE 11.60	ET6-428	11.60	Cellosize	1,193	416	4002 3-25 lbs
ETDE 25.00	ET6-198	25	Cellosize	2,371	209	4002 3-25 lbs
ETG 1.40	ET9-3543	1.40	None	135	3,674	4002 3-25 lbs
ETG 1.75	ET9-2835	1.75	None	162	3,062	4002 3-25 lbs
ETG 1.75	ET9-2835	1.75	Acrylic	161	3,081	4002 3-25 lbs
ETG 2.25	ET9-2205	2.25	Acrylic	222	2,234	4002 3-25 lbs
ETG 2.75	ET9-1804	2.75	Acrylic	250	1,984	4002 3-25 lbs
ETG 3.50	ET9-1417	3.50	None	362	1,370	4002 3-25 lbs
ETG 3.50	ET9-1417	3.50	Acrylic	357	1,390	4002 3-25 lbs
ETG 4.50	ET9-1102	4.50	None	448	1,107	4002 3-25 lbs
ETG 4.50	ET9-1102	4.50	Acrylic	447	1,110	4002 3-25 lbs
ETG 6.00 12"	ET9-827	6.00	Acrylic	594	835	4002 3-25 lbs
ETG 6.00 8"	ET9-827	6.00	Acrylic	594	335	4002 3-25 lbs
ETG 9.00	ET9-551	9.00	None	938	529	4002 3-25 lbs
ETG 9.00	ET9-551	9.00	Acrylic	927	535	4002 3-25 lbs



AGY Glass Rovings



S-2 Glass® (Multi-End Rovings)

Nomenclature	Binder	Sliver	Fil. Dia. (microns)	Nominal Yield (yds/lb) (TEX)		End Count	Package	Package Weight (lb) (kg)		Tube Type	Tube ID	Packages per Pallet	Resin Compatibility	Application
365-AA-1250				1222	406	6		16	7	Rhino Tube	3"	60	Polyester, Vinyl Ester Epoxy	Filament Winding, Weaving, Prepeg
365-AA-750	365	G75	9	746	665	10	4059	16	7	Rhino Tube	3"	60		
365-AA-250				249	1992	30		16	7	Rhino Tube	3"	60		
449-AA-2500				2444	203	3		16	7	Rhino Tube	3"	60	Epoxy	Filament Winding, Weaving, Prepeg
449-AA-1250	449	G75	9	1222	406	6	4059	16	7	Rhino Tube	3"	60		
449-AA-750				735	675	10		16	7	Rhino Tube	3"	60		
449-AA-250				245	2025	30		16	7	Rhino Tube	3"	60		
463-AA-1250				463	G75	9		1222	406	6	4059	16	7	Rhino Tube
463-AA-750	735	675	10				16	7	Rhino Tube	3"		60		
463-AA-250	244	2033	30				16	7	Rhino Tube	3"		60		
933-AA-1250	933	G75	9	1222	406	6	4059	16	7	Rhino Tube	3"	60	Polyamides, BMI, PEEK, PEI, PPS, PES, PEK, PAL, Epoxies & LCP	Filament Winding, Prepeg
933-AA-750				735	675	10		16	7	Rhino Tube	3"	60		
933-AA-310				307	1616	24		16	7	Rhino Tube	3"	60		

S-2 Glass® (Single-End VeTron™ Rovings)

Nomenclature	Binder	Sliver	Fil. Dia. (microns)	Nominal Yield (yds/lb) (TEX)		End Count	Package	Package Weight (lb) (kg)		Tube Type	Tube ID	Package #	Resin Compatibility	Application
VE1-AB-1200	VE1	P4.14	18	414	1200	n/a	4044	16	7	None		60	Vinyl Ester, Polyester	Filament Winding, Weaving, Pultrusion & Prepeg
VE1-AB-2400	VE1	V2.07	26	207	2400	n/a	4044	16	7	None		60	Vinyl Ester, Polyester	Filament Winding, Weaving, Pultrusion & Prepeg

S-2 Glass® (Single-End ZenTron® Rovings)

Nomenclature	Binder	Sliver	Fil. Dia. (microns)	Nominal Yield (yds/lb) (TEX)		End Count	Package	Package Weight (lb) (kg)		Tube Type	Tube ID	Package #	Resin Compatibility	Application
540-AB-675	540	L6.75	14	675	735	n/a	4044	16	7	None		60	Epoxy	Tapes, Pultrusion, LFT
							4144	16	7	Thick Wall	6 3/8"	45		
550-AB-675	550	L6.75	14	675	735	n/a	4044	16	7	None		60	High Temperature Thermoplastic	FTapes, Pultrusion, LFT
							4144	16	7	Thick Wall	6 3/8"	45		
758-AB-675	758	L6.75	14	675	735	n/a	4044	16	7	None		60	Epoxy	Filament Winding, Weaving, Pultrusion & Prepeg
							4144	16	7	Thick Wall	6 3/8"	45		
721B-AC-250	721B	T2.50	24	250	2059	n/a	4044	73	33	None		27	Epoxy	Thermal Acoustical

AGY Chopped Glass

Engineered Chopped Fibers

E-Glass Products

Silver	Binder	Length (in.)	Package Type	Application	Resin Compatibility
9 micron	620	1/4", 1/2"	40lb bags	Various	n/a
6 micron	Various	1/2"	50lb box	Various	n/a
EH18	700	2.0"	50lb box	Carding	n/a

S-2 Glass® Products

Silver	Binder	Length (in.)	Package Type	Application	Resin Compatibility
SG75	401	1/4"	50lb box	Various	Epoxy
SG75	402	1/4"	50lb box	Various	n/a
SE37	544	5/32"	50lb box	TP Chop	Nylon(s)
			2,000lb super-sack	TP Chop	Nylon(s)
SG37	544	5/32"	50lb box	TP Chop	Nylon(s)
			2,000lb super-sack	TP Chop	Nylon(s)
SE37	553	5/32"	50 lb box	TP Chop	High-Temp TP
			2,000 lb super-sack	TP Chop	High-Temp TP
SG37	553	5/32"	50 lb box	TP Chop	High-Temp TP
			2,000 lb super-sack	TP Chop	High-Temp TP

Long Chopped Fibers

Product	Length	Binder	Package(s)
E-Glass Chop D-K	3.3"	Starch	1,000 lb bulk

Miscellaneous Bulk Chopped Fibers

E-Glass Products

Product	Length	Binder	Package(s)
TP-40 Air Run-Back	Various	Starch	1,000 lb bulk
TP-40 Beam Cut Off	Various	Starch	1,000 lb bulk
TP-167 Uncut Forming Hanks	Various	Starch	1,000 lb bulk
TP-167 Cut Forming Hanks	Various	Starch	1,000 lb bulk
TP-167 Thin Tube By Product	Various	Starch	1,000 lb bulk
TP-167 Uncut Thin Tube By Product	Various	Starch	1,000 lb bulk
TP-167 Startup Bands	Various	Starch	1,000 lb bulk

S-2 Glass® Products

Product	Length	Binder	Package(s)
S-2 Fiber By Product	Various	Various	1,000 lb bulk



AGY Forming-Tube Input

E-Glass Product

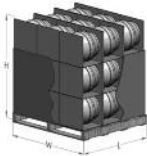
Product	Binder	Sliver	Fil. Dia. (microns)	Nominal Yield (yds/lb)	(TEX)	Package	Package Weight (lb) (kg)		Package ID	Resin Compatibility	Application
ECG50 762 7.7lbs to Full FTI	762	G50	9	5,000	99	Forming Tube	24	10.9	11"	Rubber	Automotive Timing Belts
ECG75 762 7.7lbs to Full FTI	762	G75	9	7,300	68	Forming Tube	22	10.0	11"	Rubber	Automotive Timing Belts
ECH15 762 7.7lbs to Full FTI	762	H15	11	1,500	331	Forming Tube	20	9.1	11"	Rubber	Automotive Timing Belts

S-2 Glass® Product

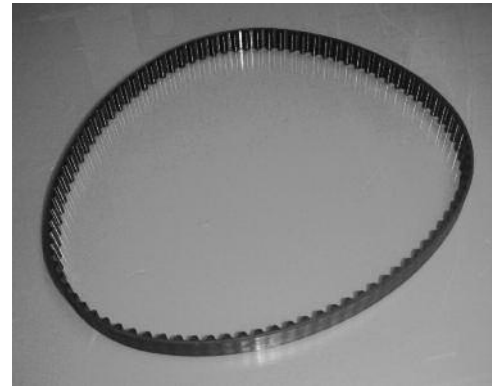
Product	Binder	Sliver	Fil. Dia. (microns)	Nominal Yield (yds/lb)	(TEX)	Package	Package Weight (lb) (kg)		Package ID	Resin Compatibility	Application
SCE225 1/0 762	762	E225	7	22,500	22	Forming Tube	7.2	3.3	6"	Rubber	Automotive Timing Belts

Forming-Tube Input Pallet Dimensions

Package Type	Case Type	Packs per Case	Layers per Case	Cases per Pallet	Packs per Pallet	Pallet Type	Pallet Dimensions		Width		Height	
							Length US (in)	SI (cm)	US (in)	SI (cm)	US (in)	SI (cm)
Forming Tube (6")	T-406	36	3	1	36	Wood	45	114.3	31	78.7	38	96.5
Forming Tube (11")	T-406	27	3	1	27	Wood	46.5	118.1	42	x106.7	50.5	130.2
G50 Forming Tube (11")	T-410	27	3	1	27	Wood	49.25	125.1	45	114.3	50.5	128.3



Wood



AGY Packaging and Pallet Specifications

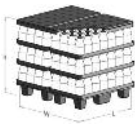
YARN PACKAGING

Yarn Bobbin Dimensions

Bobbin Type	Measurement Units	Type	Inside Diameter (ID)	Length (L)	Traverse (T)	Flange Diameter (FD)	Type Build	Bare Bobbin (Nom. Weight)	Max Full Package Diameter (D)
7636	US (in)	Plastic Tube	2.38	14	12.18	3.96	Double Taper	0.51lbs 229.30g	4.50 1.43
	SI (cm)		6.05	35.56	30.94	10.06			
8512	US (in)	Plastic Tube	1.69	10.63	9.13	4.31	Milk Bottle	0.30lbs 136.1g	4.0 10.16
	SI (cm)		4.29	27.00	23.19	10.95			
8542	US (in)	Plastic Tube	2.38	13.25	10.97	6.00	Milk Bottle	0.55lbs 2.48g	5.88 14.92
	SI (cm)		6.05	33.66	27.86	15.24			
8571	US (in)	Plastic Tube	3.30	17.62	15.00	7.70	Milk Bottle	1.06lbs 480.40g	7.58 19.24
	SI (cm)		8.39	44.77	38.10	19.56			
9225	US (in)	Plastic Spool	1.68	11.08	9.13	4.31	Straight	0.45lbs 200.40g	4.18 10.62
	SI (cm)		4.26	28.13	23.18	10.95			
9228	US (in)	Plastic Spool	1.68	11.63	9.14	5.50	Straight	0.77lbs 347.40g	5.05 12.83
	SI (cm)		4.26	29.53	23.16	13.97			

Yarn Pallet Dimensions

Bobbin Type	Case Type	Bobbins	Layers	Boxes per Pallet	Bobbins per Pallet	Pallet Type	Length		Pallet Dimensions Width		Height	
							US (in)	SI (cm)	US (in)	SI (cm)	US (in)	SI (cm)
7636	T-306	54	3	4	216	Wood	45.5	114.3	45.5	115.6	45	114.3
8512	T-306	75	3	4	300	Wood	45.5	115.6	45.5	115.6	36	91.4
8542	T-306	30	3	4	120	Wood	45.5	115.6	45.5	115.6	43	109.2
	RPPU	84	3	2	168	RPPU	52	132.1	45.5	115.6	46	116.8
8571	T-402	28	2	2	56	Wood	51.5	130.8	45.5	115.6	42	106.7
	RPPU	30	2	2	60	RPPU	51.5	130.8	45.5	115.6	42	106.7
9225	T-306	54	3	4	216	Wood	45.5	115.6	45.5	116.6	38	96.5
9228	T-306	36	3	4	144	Wood	115.6	115.6	115.6	115.6	38	96.5



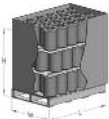
RPPU



Wood

MULTI-END TEXTURIZED YARN PALLET DIMENSIONS

Bobbin Type	Case Type	Bobbins	Layers	Cases	Bobbins	Pallet Type	Length		Pallet Dimensions Width		Height	
							US (in)	SI (cm)	US (in)	SI (cm)	US (in)	SI (cm)
4002 Roving Package	T-405	15	3	1	45	Wood	45	114.3	45	114.3	45	114.3



Wood

AGY Packaging and Pallet Specifications

(continued)

AGY Yarn Beams

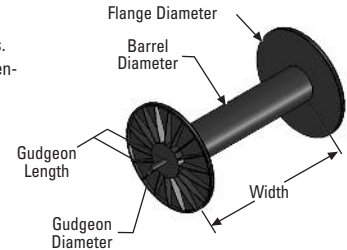
Continuous Filament Yarn Beams

Continuous filament yarns can also be provided as beamed yarns. Beaming is the process of accumulating parallel ends of yarn from a creel under tension and winding them onto large, spool-like packages. For applications requiring many ends of fiber input, this method eliminates the need for creeling many individual bobbins of yarn.

Beam Sizes Available (inches)	9002	9004	9020
Flange Diameter	36	36	40
Width	54.25	64	54.25
Barrel Diameter	11.75	11.75	11.75
Gudgeon Length	5 or 6	5 or 6	6
Gudgeon Diameter	1.625	1.625	1.625

Beaming Capability

Beams are made to specific customer needs. Typical end counts range from 200-800, however, we have capability of over 1000 ends. Please contact your AGY representative for specific details of end counts and lengths for the yarns you are interested in.



ROVING PACKAGING

Roving Package Dimensions

Bobbin Type	Measurement Units	Inside Diameter (ID)	Length (L)	Traverse (T)	Wind Direction	Build	Max Outside Diameter (OD)	Approximate Weight	Direction of Pull
4044	US (in)	6.38	10.50*	10.25	Forward	Square Edge	8.68	15.00lbs 6.80kg	Inside
	SI (cm)	16.9	26.70*	26.04			22.05		
4057	US (in)	3.00	10.90	10.00	Forward	Square Edge	7.00	7" Max diameter	Outside
	SI (cm)	7.62	27.69	25.40			17.78		
4059	US (in)	3.00	10.90	10.00	Forward	Square Edge	7.00	Varies by Metered Length	Outside
	SI (cm)	7.62	27.69	25.40			17.78		
4144	US (in)	6.38	10.90	10.00	Forward	Square Edge	8.83	16.00lbs 7.30kg	Outside
	SI (cm)	16.19	27.69	25.40			22.43		

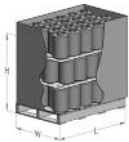
*The 4044 package does not have an inner tube. The glass is packaged into a cylindrical shape without a core.

AGY Packaging and Pallet Specifications

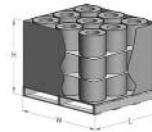
(continued)

Roving Pallet Dimensions

Roving Pack	Case Type	Packages per Layer	Layers per Box	Boxes per Pallet	Packages per Pallet	Pallet Type	Pallet Dimensions					
							Length		Width		Height	
							US (in)	SI (cm)	US (in)	SI (cm)	US (in)	SI (cm)
4044	T-525	20	3	1	60	Wood (60)	46	116.8	32	81.3	39	99.1
4059	T-525	20	3	1	60	Wood (60)	46	116.8	32	81.3	39	99.1
4144	T-525	15	3	1	45	Wood (45)	45.5	115.6	45.5	115.6	37	94
4044	T-525	9	3	1	27	Wood Creel Pak (27)	45.5	115.6	45.5	115.6	36.5	92.7



4059



4044, 4144

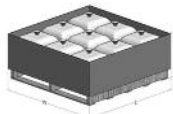
CHOPPED GLASS PACKAGING

Chopped Product Pallet Dimensions

Package Pack	Case Type	Box/Bag per Layer	Layers per Pallet	Box/Bag per Pallet	Nominal Pallet Weight		Pallet Type	Pallet Dimensions					
					(lb)	(kg)		Length		Width		Height	
								US (in)	SI (cm)	US (in)	SI (cm)	US (in)	SI (cm)
50lb Box	T-360	9	3	27	1350	612	Wood	45	110.5	45	110.5	67	170.2
40lb Bag	T-307	22 or 24	1	22 or 24	850-960	400-435	Wood	54	137.2	36	91.4	33+/-3	83.8+/-7
50lb Bag	T-307	1	1	1	1600	725	Wood	54	137.2	36	91.4	33+/-3	83.8+/-7
1,000lb Bulk Box	T-307	20	1	20	1000	435	Wood	54	137.2	36	91.4	33+/-3	83.8+/-7
2,200lb Super-Sack	T-361	n/a	n/a	n/a	2200	1000	Super-Sack	45	114.3	45	114.3	53	134.6



50lb Box



32-50lb Bags
24-40lb Bags



1000lb Bulk Box



2000lb Super-Sack

Sizing Systems for Yarns, Rovings and Chopped Products

	Sizing	Slivers	Approx. LOI	Sizing Type	Sizing Comments	Application	Product Comments
E-Glass Yarns	517	G37, G75, K18 Yarns	0.55%	Resin	Directly Compatible with Resin Systems	Industrial	Epoxy/Polyester Faster Wetting Than 603
	602	DE50, DE75, DE100, DE37, G37 Yarns	0.45%	Starch/Lube	Made to Texturize	Texturization	Very Efficient Product for Texturizing
	603	G37, G75, H18 Yarns	0.60%	Resin	Directly Compatible with Resin Systems	Industrial	Epoxy/Polyester Compatible
	620	G75, G150, G37, H18, DE75, DE150 Yarns	1.20%	Starch/Lube	Workhorse Sizing Industry Standard	Weaving Industrial	Good Processability General Purpose
	620-1	G37, E225, D450, D900, D1800 Yarns	1.75%	Starch/Lube	Similar to 620	Weaving Industrial	Good Processability Fast Aqueous Wet-Out
	622	E225, D450, D900, C1200	1.50%	Starch/Lube	Air Friendly	Weaving	Good Loom Efficiency
	636	G150, DE100, DE37, BC150 Yarns	1.20%	Starch/Lube	Old Standard	Weaving Industrial	Good Processability Mostly Replaced by 620
	641	G150, G75, H55 Yarns	1.00%	Starch/Lube	Workhorse Sizing for Industrial	Warping Industrial	Good Processability High Strand Integrity
	723	G150, G37, G75, H18	1.20%	Starch/Lube	High Tensile	Industrial	High Tensile Industrial Applications Rubber Compatible
	762	G50, G75, H15,	0.42%	Resin	Directly Compatible	Industrial	Industrial Applications Rubber Compatible
S-2 Glass® Yarns	383	G37 S-2 Glass® Yarns	0.70%	Resin	Directly Compatible with Resin Systems	Industrial	Epoxy/Polyester/Vinyl Ester
	493	G75, G150 S-2 Glass® Yarns	0.45%	Resin	Directly Compatible with Resin Systems	Industrial	Epoxy/Polyester
	550	G75, G150 S-2 Glass® Yarns	0.50%	Resin	Directly Compatible with Resin Systems	Aerospace Industrial	High Temperature Thermoplastics
	636	G75, G150 S-2 Glass® Yarns	1.20%	Starch/Lube	Old Standard	Weaving Industrial	Good Processability Mostly Replaced by 620 Rubber Compatible
	762	E225 S-2 Glass® Yarns	0.42%	Resin	Directly Compatible with Resin Systems	Industrial	Industrial Applications Rubber Compatible
	933	G75, S-2 Glass® Yarns	0.23%	Resin	Directly Compatible with Resin Systems	Aerospace	Toughened Epoxy/Thermoplastics Poor Broken Filament Resistance
Assembled Rovings	365	G75 S-2 Glass® Assembled Rovings	0.50%	Resin	Directly Compatible with Resin Systems	Industrial	Polyester/Vinyl Ester/Epoxy
	449	G75, S-2 Glass® Assembled Rovings	0.65%	Resin	Directly Compatible with Resin Systems	Aerospace Industrial	Epoxy (Amine), Urethane Compatible
	463	G75, G150, S-2 Glass® Assembled Rovings	1.00%	Resin	Directly Compatible with Resin Systems	Aerospace Industrial	Epoxy (Anhydride), Phenolic
	933	G75, S-2 Glass® Assembled Rovings	0.23%	Resin	Directly Compatible with Resin Systems	Aerospace	Toughened Epoxies Thermoplastics Compatible, Poor for Broken Filament Resistance
Direct Rovings	550	G75, G150 S-2 Glass® Yarns	0.50%	Resin	Directly Compatible with Resin Systems	Aerospace Industrial	High Temperature Thermoplastics
	550	G75, G150 S-2 Glass® Yarns	0.50%	Resin	Directly Compatible with Resin Systems	Aerospace Industrial	High Temperature Thermoplastics
	721B	T2.5, S-2 Glass® Rovings	0.40%	Resin	Directly Compatible with Resin Systems	Industrial	Very Efficient Product for Texturizing
	758	L6.75, U2.25 S-2 Glass® Rovings	0.65%	Resin	Directly Compatible with Resin Systems	Aerospace Recreation	Epoxy Compatible Fastest Epoxy Wetout
	VEI	P4.13, V2.07		Resin	Directly Compatible with Resin Systems	Marine Weaving Pultrusion	Vinylester Polyester Compatible
E-Glass Chopped	402	Various Input 1/4" Chop	0.85%	Resin	Directly Compatible with Resin Systems	Industrial	Epoxy/Urethane
	700	H18 2" Chop	0.44%	Special Chopping Size	Made for Carding	Carding	Good Dispersion and Processing in Carding
S-2 Glass® Chopped	401	SG-75 Input 1/4" Chop	0.85%	Resin	Directly Compatible with Resin Systems	Industrial	Epoxy/Urethane
	402	G-75 Input 1/4" Chop	1.20%	Starch/Lube	n/a	Industrial	
	544	SE-37, SG-37 5/32" Chop	0.70%	TP Chop	Made for Extrusion	Industrial	Polyamides (Nylons)
	553	SE-37, SG-37 5/32" Chop	0.75%	TP Chop	Made for Extrusion	Industrial	High Temperature Thermoplastics

Yarn Sizing Grids – Processability and Compatibility

Processability	E-Glass Yarns									
	517	602	603	620	620-1	622	636	641	723	762
Heat Cleanability	Good	Good	Good	Good	Good	Good	Fair	Good	Fair	Fair
Air Texturization	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Air Friendly	Good	Fair	Good	Good	Good	Good	Fair	Good	Fair	Fair
High Strand Integrity	Good	Fair	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
Yarn Tensile Strength	Good	Fair	Good	Fair	Fair	Fair	Good	Good	Good	Good
Tape/Facing Laminate Tensile	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good
Aqueous Wet Out	Fair	Fair	Fair	Fair	Good	Good	Good	Good	Good	Good
Alkali Resistance	Good	Fair	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair
Low Running Tension	Good	Fair	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair
Broken Filament Resistance	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Fair
Polymer/Resin Compatibility	Fair									
PVC (polyvinyl chloride)	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
PVAc (polyvinyl acetate)	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
PVA (polyvinyl alcohol)	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Epoxy	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Polyester	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Vinyl Ester	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Cyanate Ester	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Phenolic	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Acrylic	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Polyurethane	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
SBR	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
BMI (bismaleimide)	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
PTFE (Teflon†)	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
PA (Nylon)	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Polycarbonate	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
PPS	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
PEEK, PEKK	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair

*933 size used on both yarn and roving
 †Teflon® is a registered trademark of E.I. du Pont de Nemours and Company.

Good
Fair
Poor
N/A

Processability	S-2 Glass® Yarns						L-Glass	S-3 HDI
	383	493	636	550	762	933	620-1	620-1
Heat Cleanability	Good	Good	Fair	Fair	Fair	Good	Good	Good
Air Texturization	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Air Friendly	Fair	Fair	Fair	Fair	Fair	Good	Good	Good
High Strand Integrity	Good	Good	Good	Good	Good	Fair	Fair	Fair
Yarn Tensile Strength	Good	Good	Good	Good	Good	Good	Good	Good
Tape/Facing Laminate Tensile	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Aqueous Wet Out	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good
Alkali Resistance	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Low Running Tension	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Broken Filament Resistance	Fair	Fair	Good	Fair	Fair	Good	Good	Good
Polymer/Resin Compatibility	Fair						Fair	Fair
PVC (polyvinyl chloride)	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
PVAc (polyvinyl acetate)	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair
PVA (polyvinyl alcohol)	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Epoxy	Good	Good	Good	Good	Good	Good	Good	Good
Polyester	Good	Good	Good	Good	Good	Good	Good	Good
Vinyl Ester	Good	Good	Good	Good	Good	Good	Good	Good
Cyanate Ester	Fair	Fair	Fair	Fair	Fair	Good	Good	Good
Phenolic	Fair	Fair	Fair	Fair	Fair	Good	Good	Good
Acrylic	Fair	Fair	Fair	Fair	Fair	Good	Good	Good
Polyurethane	Fair	Fair	Fair	Fair	Fair	Good	Good	Good
SBR	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
BMI (bismaleimide)	Fair	Fair	Fair	Fair	Fair	Good	Good	Good
PTFE (Teflon†)	Fair	Fair	Good	Fair	Fair	Good	Good	Good
PA (Nylon)	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Polycarbonate	Fair	Fair	Fair	Fair	Fair	Good	Good	Good
PPS	Fair	Fair	Fair	Fair	Fair	Good	Good	Good
PEEK, PEKK	Fair	Fair	Fair	Fair	Fair	Good	Good	Good

Good
Fair
Poor
N/A

Roving Sizing Grid – Processability and Compatibility

Processability	Assembled Rovings				Direct Rovings				
	365	449	463	993	540	550	721B	758	VEI
Air Texturization							Good		
Low Catenary					Good	Good		Good	Good
Low Twist Level					Good	Good		Good	Good
High Strand Integrity	Good	Good	Good						Fair
Composite Tensile Strength	Good	Good	Good					Good	Good
Tape/Laminate Tensile					Good	Good			
Resin Impregnation	Good	Good	Good					Good	Good
Elevated Color Retention				Poor		Good			
Low Running Tension									
Broken Filament Resistance				Poor					
Polymer/Resin Compatibility									
PVC (polyvinyl chloride)									
PVAc (polyvinyl acetate)									
PVA (polyvinyl alcohol)									
Epoxy	Good	Good	Good	Good			Good	Good	Poor
Polyester	Good		Fair					Poor	Good
Vinyl Ester	Good		Fair					Poor	Good
Cyanate Ester				Good					
Phenolic			Fair	Good				Fair	
Acrylic									
Polyurethane	Fair	Good	Fair				Fair	Good	Fair
SBR									
BMI (bismaleimide)				Good					
PTFE (Teflon)					Poor	Poor			
PA (Nylon)					Good	Fair			
Polycarbonate					Fair	Fair			
PPS						Good			
PEEK, PEKK					Poor	Good			

Good
Fair
Poor
N/A

Chopped Fiber Sizing Grid – Processability and Compatibility

Processability	E-Glass Chop		S-2 Glass® Chop			
	402	700	401	402	544	553
Heat Cleanability				Fair		
Hopper Flow	Fair		Fair		Good	Good
Low Fines	Fair		Fair		Good	Good
High Strand Integrity	Fair	Fair	Fair	Poor	Good	Good
Air Conveyance			Fair		Good	Good
Mechanical Conveyance	Fair		Fair		Good	Good
Aqueous Wet Out		Fair		Fair		
Low Static	Fair		Fair		Fair	Good
Plenum Air Dispersion		Fair				
Can Be Carded		Good				
Polymer/Resin Compatibility						
PVC (polyvinyl chloride)						
PVAc (polyvinyl acetate)						
PVA (polyvinyl alcohol)				Fair		
Epoxy	Good		Good			
Polyester	Fair		Fair			
Vinyl Ester	Fair		Fair			
Cyanate Ester						
Phenolic	Fair		Fair			
Acrylic						
Polyurethane						
SBR						
BMI (bismaleimide)						
PTFE (Teflon)			Fair		Poor	Poor
PA (Nylon)					Good	Fair
Polycarbonate					Fair	Fair
PPS					Fair	Good
PEEK, PEKK					Poor	Good

Good
Fair
Poor
N/A

Typical Fiber Properties

Category	Property	Test Method	Units	E-Glass	L-Glass®	S-2 Glass**	S-3 HDI™	S-3 UHM™
Physical	Density	ASTM C693	g/cm ³	2.55 - 2.58	2.27 - 2.29	2.46	2.39 - 2.42	2.83
Physical	Hardness	(Mohs Scale)	–	6.5	6.0	6.5	6.5	6.5
Physical	Moisture Regain	ASTM D1909	%	0	0	0	0	0
Optical	Refractive Index, 589, nm	Oil Immersion	–	1.547-1.562	1.496-1.500	1.520-1.525	1.516-1.520	1.584-1.588
Mechanical	Fiber Tensile Strength	Modified ASTM 2101	MPa	3445	–	4890	4630	4724
Mechanical	Strain to Failure	ASTM 2101	%	4.8	–	5.7	–	–
Mechanical	Impregnated Strand Tensile Strength	ASTM D 2343	MPa	2070-2235	–	3569-3677	3270-3360	3228-3338
Mechanical	Impregnated Strand Tensile Modulus	ASTM D 2343	GPa	69-76	–	87-90	85-86	98-103

UD Fabric Laminate Properties (60% FVF)

Category	Property	Test Method	Units	E-Glass	L-Glass®	S-2 Glass**	S-3 HDI™	S-3 UHM™
Mechanical	Tensile Strength	ASTM D 3039	MPa	775	–	1710	–	1435
Mechanical	Tensile Modulus	ASTM D 3039	GPa	42	–	56	–	62
Mechanical	Flexural Strength	ASTM D 790	MPa	1173	–	1690	–	1777
Mechanical	Flexural Modulus	ASTM D 790	GPa	41	–	55	–	61
Mechanical	Compressive Strength	ASTM D 3410	MPa	600	–	1140	–	1024
Mechanical	Compressive Modulus	ASTM D 3410	GPa	41	–	55	–	61
Thermal	Coefficient of Thermal Expansion	BS 1902-5.3:1990	10 ⁻⁷ /°C	54	39	29	35	54
Thermal	Thermal Conductivity, k	ASTM C177	W/m ² /K	1.15	–	1.25	–	–
Thermal	Softening Point Temp	ASTM C336	°C	846	–	1056	940	964
Thermal	Annealing Point Temp	ASTM C337	°C	657	–	816	715	–
Thermal	Strain Point Temp	ASTM C338	°C	616	–	766	655	–
Thermal	Flame Resistance	ASTM D 2863	Oxygen Index	100%	100%	100%	100%	100%
Electrical	Dielectric Constant, e', 1 MHz	ASTM D150	–	6.60	4.70	5.30	5.50	–
Electrical	Dielectric Constant, e', 10 GHz	Resonant Cavity	–	6.10	4.86	5.20	5.34	–
Electrical	Dielectric Loss, tan d, 1 MHz	ASTM D150	–	0.003	<0.001	0.002	0.005	–
Electrical	Dielectric Loss, tan d, 10 GHz	Resonant Cavity	–	0.004	0.0029	0.007	0.0075	–



Glossary of Terms

In the glass fiber textile industry, as with many other industries, there is widely used and commonly understood terminology. This section defines words or terms used in this publication and within the industry.

ABRASION

Wearing away by friction. Glass is highly resistant to abrasion by other materials, but can be damaged through contact with itself. A lubricant is used during processing and fabrication to prevent abrasion.

BARE GLASS

The glass as it flows from the bushing in fiber form, before binder or sizing is applied.

BATCH OVEN

Large temperature-controlled oven, used to heat-clean rolls of glass fiber fabric.

BEAM

A spool on which is wound a number of parallel ends of singles or plied yarns, for use in weaving or similar processing operations.

BEAMED YARNS

Beamed yarns are pulled in a continuous, parallel manner around a beam.

BEAMING

Operation in which many ends of yarn from a creel are combined on a section beam.

BINDER

A material applied in liquid form to fibers, yarn or fabric, to retain structural integrity during further processing. (Also known as sizing.)

BOBBIN

The spool onto which yarns are wound. (Also known as package.)

BRAID/BRAIDER

A narrow tubular or flat fabric produced by intertwining a single set of yarns in a pattern.

BUSHING

A precious metal plate with holes through which molten glass is extruded into filaments.

CABLED YARN

Yarn that is plied more than once; yarn made by plying two or more previously plied yarns.

CARDING

The process of untangling and partially straightening fibers by passing them between two closely spaced surfaces which are moving at different speeds, and at least one of which is covered with sharp points, thus converting a tangled mass of fibers to a filmy web.

CHEMICAL SIZE

A surface finish applied to the fiber that contains some chemical constituents other than water.

CHOPPED STRANDS

Chopped strands are chopped to various lengths.

COATED YARNS

Coated yarns are run through a coating bath, then dried in an oven.

COLLET

A spool on which the gathered strands from the bushing are wound for further processing.

CONTINUOUS FILAMENT

A yarn made of filaments that extend substantially throughout the length of the yarn.

CORONIZING

Continuous heat cleaning and weave setting.

CREEL

That part of a twisting, winding or warping machine that holds packages of strands for further fabrication.

CREELING

the method used to supply many parallel ends of yarn, uniformly spaced. The creel is a support for yarn packages and tension devices. Creeling is performed for such operations as section beaming and warping, and where uni-directional reinforcement is required; for example, in supplying yarns to scrim masters and other yarn-laying equipment for reinforcing paper tapes.

There are two types of creels. One is a simple pin creel, in which the yarn is pulled off as the package is rotated. The weight of the yarn package is usually sufficient for uniform delivery tension. The other type of creel – referred to as the “pirn” or cone-type – pulls the yarn over the end of a stationary package, using transfer tails.

Tension devices are used to maintain uniform delivery of the yarn. Polished or chrome-plated surfaces minimize filament fracture and build-up of fuzz and dirt.

Glossary of Terms

(continued)

DENIER

A direct numbering system for expressing linear density, equal to the mass in grams per 9000m of yarn, filament, fiber or other textile strand.

DENSITY, FIBER

Mass per unit volume of the solid matter of which a fiber is composed, measured under specified conditions.

DIRECT-SIZED YARN

Specially formulated sizings on textile yarns that allow them to be resin compatible.

DISPERSION

The process of suspending individual fibers (filaments) in an aqueous medium.

E-GLASS

A family of calcia-alumina-silicate glasses which has a certified chemical composition and which is used for general purposes and most electrical applications. (ASTM D578-90)

END

A single fiber, strand, roving or yarn being incorporated into a product.

FIBER/FILAMENT

An individual rod of glass, of sufficiently small diameter to be flexible, and of limited length.

FILAMENT YARN

A yarn composed of continuous filaments assembled with or without twist.

FILL

The system of yarns running crosswise in a woven fabric (short for filling). (Also known as weft.)

FINISH

Coupling agent applied to fabric to improve compatibility with resins or to improve high-temperature lubricity.

FLY

Fibers which fly out into the atmosphere during carding, drawing, spinning or other textile processes.

FUZZ

Untangled or broken fiber ends that protrude from the surface of a yarn or fabric.

GLASS BLENDS

When several different fiber types, i.e., different lengths and diameters, are blended in the fiber slurry.

HEAT CLEANING

Batch and continuous processes in which organic yarn binder is removed from glass fabrics.

KNITTED FABRIC

A structure produced by interlooping one or more ends of yarn or comparable material.

LOOM

A mechanical device that interlaces fibers at right angles with varying degrees of weave construction (weight, thickness and design). More modern looms are air jet, but more traditional shuttle and rapier equipment is still in use.

LOOM BEAM

A large, flanged cylinder onto which all warp yarns are wound and from which yarns enter the looms.

NON-WOVEN FABRIC

A textile structure produced by bonding or interlocking of fibers, or both, accomplished by mechanical, chemical, thermal or solvent means and combinations thereof.

OVERSPRAY

A specially formulated binder applied to texturized yarn that helps retain the bulk of the yarn after texturizing.

PACKAGE

A bobbin or spool onto which yarns or rovings are wound.

PLIED YARN

A yarn formed by twisting together two or more single yarns in one operation. (Also known as folded yarn or formed yarn.)

PLY

1. The number of single yarns twisted together to form a plied yarn. 2. The number of plied yarns twisted together to form a cord or cable. 3. The individual yarn in a plied yarn, cord, or cable. 4. One of several layers of fabric.

POLYESTER COMBINATION YARN

A polyester/fiber glass hybrid yarn.

ROVING

A multiplicity of filaments or yarns gathered together into an approximately parallel arrangement without twist.

RPPU

Reusable plastic packaging unit.

Glossary of Terms

(continued)

S-GLASS

A family of magnesium-alumina-silicate glasses with a certified chemical composition which conforms to an applicable material specification and which produces high mechanical strength. (ASTM D578-90)

S-2 GLASS® FIBER

The AGY trademarked brand of high tensile strength “S” glass fibers.

SCRIM

A light, woven or non-woven fabric with relatively large openings between the yarns, used as reinforcement for paper and other products.

SECTION BEAM

A flanged cylinder onto which yarn is drawn and accumulated from yarn bobbins or packages.

SERVING

Wrapping of yarn around a product in one or more layers, to form a protective covering.

SEWING THREAD

A flexible, small diameter yarn or strand, usually treated with a surface coating, lubricant, or both, intended to be used to stitch one or more pieces of material or an object to a material.

SINGLE YARN

The simplest strand of textile material suitable for operations such as weaving, knitting, etc.

SIZE/SIZING

A generic term for compounds which, when applied to yarn or fabric, form a more or less continuous solid film around the yarn and individual fibers. (Also known as binder.)

SLASHING

The method of applying sizing to a width of warp yarns on a continuous basis.

SLIVER

Overlapping and parallel staple fibers that have been gathered into a loose, continuous bundle.

SPLICE

The joining of two ends of yarn by intertwining, knotting, overlapping or adhering them together.

STRAND

1. A single fiber, filament or monofilament. 2. An ordered assemblage of textile fibers having a high ratio of length to diameter and normally used as a unit including slivers, rovings, single yarns, plied yarns, cords, braids, ropes, etc.

TENSION DEVICE

A mechanical or magnetic device that controls tension.

TEX

A unit for expressing linear density, equal to the mass in grams of 1,000 m of yarn, filament, fiber or other textile strand.

TEXTURIZED YARNS

Texturized yarns are run through an air jet to achieve various degrees of fiber bulk and loft.

TEXTURIZED GLASS YARN

A yarn processed from continuous filament yarn in such a manner to induce bulk to the yarn by disorientation of the filaments.

TURN

One 360° revolution of the components around the axis of the strand.

TWIST AND PLY FRAMES

Machines used to twist and ply glass yarns.

VETRON™ ROVING

AGY's single end high strength glass roving designed specifically for compatibility with vinylester and polyester resin systems.

VINYL-COATED GLASS YARN

Continuous glass filament yarn, coated with plasticized vinyl chloride resin.

WARP

1. The yarn running lengthwise in a woven fabric. 2. A group of yarns in long lengths and approximately parallel, put on beams or warp reels for further textile processing including weaving, knitting, twisting, dyeing, etc.

WARP SIZE

Chemicals applied to the warp yarn to improve strand integrity, strength and smoothness to withstand rigors of weaving.

WEFT

The system of yarns running crosswise in a fabric. (Also known as fill.)

WINDING

Winding is the process of transferring yarn from one type of package to another yarn package.



strength in materials

www.agy.com

AGY – World Headquarters/Americas

2556 Wagener Road
Aiken, South Carolina 29801 USA
Phone: +(1) 888.434.0945 (toll free)
 +(1) 803.643.1501
Fax: +(1) 803.643.1180
Email: asktheexperts@agy.com

AGY – Europe

Le Gemellyon Nord
57 Boulevard Marius Vivier Merle
69003 Lyon, France
Phone: +(33) 4727 81775
Fax: +(33) 4727 81780

AGY – Asia

Suite 1306-8, Bldg 1,
No.1628 Jinshajiang Rd.
Shanghai 200333 China
Phone: +(86) 21 3251 3871
Fax: +(86) 21 3251 2839

DISCLAIMER OF LIABILITY

This data is offered solely as a guide in the selection of a reinforcement. The information contained in this publication is based on actual laboratory data and field test experience. We believe this information to be reliable, but do not guarantee its applicability to the user's process or assume any liability arising out of its use or performance. The user, by accepting the products described herein, agrees to be responsible for thoroughly testing any application to determine its suitability before committing to production. It is important for the user to determine the properties of its own commercial compounds when using this or any other reinforcement.

BECAUSE OF NUMEROUS FACTORS AFFECTING RESULTS, WE MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS, FOR A PARTICULAR PURPOSE. STATEMENTS IN THIS DOCUMENT SHALL NOT BE CONSTRUED AS REPRESENTATIONS OR WARRANTIES OR AS INDUCEMENTS TO INFRINGE ANY PATENT OR VIOLATE ANY LAW, SAFETY CODE, OR INSURANCE REGULATION.

S-2 Glass® and ZenTron® are registered trademarks of AGY. VeTron™ is a trademark of AGY.

Pub No. LIT-2014-351 R1(1/14) Printed in USA © 2014 AGY