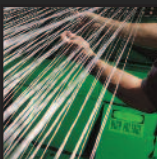
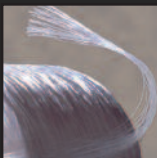




strength in materials

Technical Product Guide



www.agy.com

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strength in materials

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 1200 employees involved in production, sales, distribution and development of glass fiber yarns.

Manufacturing facilities are located in Aiken, South Carolina and Huntingdon, Pennsylvania. Our world headquarters and technology center is located in the manufacturing facility in Aiken.

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

Creeling is 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 unidirectional 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 “pin” 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.

EXPLANATIONS

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

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

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

Chopped strands are chopped to various lengths.

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

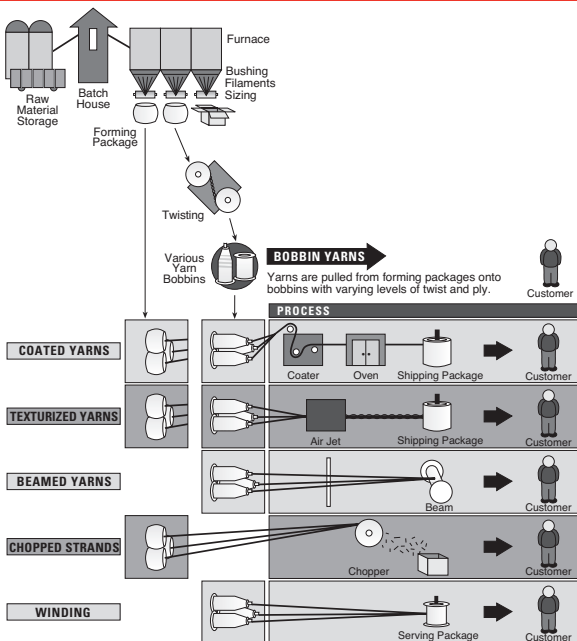
Glass Fiber Manufacturing

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/or makes the glass compatible with various resin systems.

For yarns 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 typically 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 Customer Acceptance Standard (ref. pages 40-41 for list of CAS's) for actual yields of a given product.

*Le System International d'Unites (SI)

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

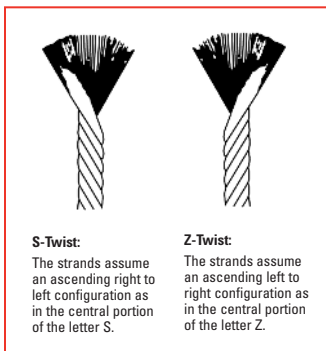
- E = electrical glass
- C = continuous filament
- 9 = 9 micrometers
- 68 = 68 grams per 1,000 meters of yarn
- 1x2 = one ply of 2-strand construction (total 2 basic strands)
- S = the direction of the twist
- 112 = the number of turns per meter (TPM) in the twist of the final yarn

Yarn Nomenclature

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, easier 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

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
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
D	5	225	22,500	22	1,064
E	7	225	22,500	22	408
BC	4	150	15,000	33	204
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
C	4.5	75	7,500	66	1,632
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
	inch	cm	2.5400	0.3937
	foot	m	0.3048	3.2808
	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

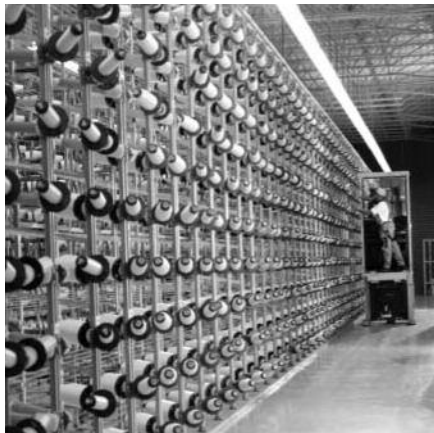
US Units	Metric Units to US Units
Denier = <u>4,464,492</u> (yds/lbs)	yds/lb = <u>4,464,492</u> Denier
TEX = <u>496,055</u> (yds/lbs)	yds/lb = <u>496,055</u> TEX
TEX = <u>590.5</u> Cotton Count	Cotton Count = <u>590.5</u> TEX
Denier = <u>5315</u> Cotton Count	Cotton Count = <u>5315</u> Denier

Denier = TEX x 9.0

Continuous Filament Yarns – E-Glass Products

Continuous Filament Yarn Beams

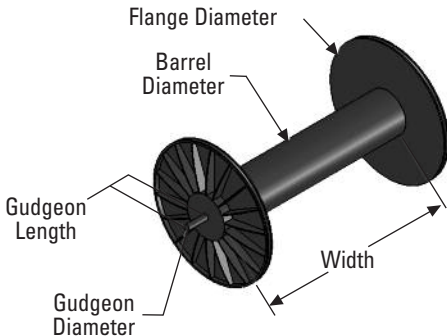
Continuous filament yarns can also be provided as beamed yarns. Beaming is the process of accumulating parallel ends of yarn from a creel under tension and winding them onto large, spool-like packages. For applications requiring many ends of fiber input, this method eliminates the need for creeling many individual bobbins of yarn. There are beam sizes listed in our Packaging CAS. The capacity of each type is a function of the number of parallel ends being wound and the total length of the beam.



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.



E-Glass Continuous Filament Yarns – Products

Filament	Microns	Yield Designation	Construction	Twist	Nominal Yield (TEX) (yds/lb)		Denier
BC	4	150	1/0	1.0Z	33	15,000	297
BC	4	150	1/0	3.0Z	33	15,000	297
BC	4	150	2/0	3.0Z	66	7,450	594
BC	4	150	4/0	3.0Z	134	3,700	1,206
C	4.5	1,200	1/0	1.0Z	4.1	120,000	37
D	5	450	1/0	1.0Z	11	45,000	99
D	5	450	1/0	1.0Z	11	45,000	99
D	5	450	1/0	1.0Z	11	45,000	99
D	5	900	1/0	1.0Z	5.5	90,000	50
D	5	900	1/0	1.0Z	5.5	90,000	50
D	5	1,800	1/0	1.0Z	2.75	180,000	25
D	5	1,800	1/0	1.0Z	2.75	180,000	25
DE	6	37	1/0	0.5Z	134	3,700	1,206
DE	6	37	1/0	1.0Z	134	3,700	1,206
DE	6	50	1/0	0.7Z	99	5,000	891
DE	6	75	1/0	0.5Z	66	7,500	594
DE	6	75	1/0	0.7Z	66	7,500	594
DE	6	75	1/0	0.7Z	66	7,500	594
DE	6	100	1/0	0.7Z	50	10,000	450
DE	6	100	1/0	0.7Z	50	10,000	450
DE	6	150	1/0	0.7Z	33	15,000	297
DE	6	300	1/0	1.0Z	17	30,000	153
E	7	110	1/0	1.0Z	45	11,000	405
E	7	225	1/0	1.0Z	22	22,500	198
E	7	225	1/0	1.3Z	22	22,500	198
E	7	225	1/0	0.7Z	22	22,500	198
E	7	225	2/0	4.0Z	44	11,250	397
F	8	90	1/0	1.6Z	55	90,000	495
G	9	37	1/0	0.3Z	134	3,700	1,206
G	9	37	1/0	3.0Z	134	3,700	1,206
G	9	37	1/0	0.5Z	134	3,700	1,206
G	9	37	1/0	0.7Z	134	3,700	1,206
G	9	37	1/0	4.0Z	134	3,700	1,206
G	9	37	1/0	0.5Z	134	3,700	1,206
G	9	37	1/0	0.7Z	134	3,700	1,207
G	9	37	1/0	0.5Z	134	3,700	1,206
G	9	37	1/2	2.8S	268	1,850	2,413
G	9	37	1/3	3.8S	402	1,233	3,621

Yarn Diameter (mm)	Yarn Diameter (inches)	Min Tensile (lbs)	Min Tensile (N)	Sizing	Bobbin	Application	Beam Availability
0.203	0.0080	4.0	17.8	636	7636	Architectural Fabrics	
0.203	0.0080	4.0	17.8	636	7636/9225	Architectural Fabrics	
0.203	0.0080	8.0	35.6	636	9225	Architectural Fabrics	
0.203	0.0080	16.0	71.2	636	9225	Architectural Fabrics	
0.045	0.0017	0.4	1.8	622	7636	Electronics	
0.122	0.0048	1.3	5.8	620-1	8542/7636	Electronics/Industrial	Yes
0.122	0.0048	1.3	5.8	622	8542/7636	Electronics/Industrial	
0.122	0.0048	1.5	6.7	723	7636	Electrical Tape	
0.084	0.0033	0.6	2.7	620-1	7636	Electronics	
0.084	0.0033	0.6	2.7	622	7636	Electronics	
0.068	0.0026	0.3	1.3	620-1	7636	Electronics	
0.068	0.0026	0.3	1.3	622	7636	Electronics	
0.396	0.0156	11.2	49.8	602	8542/8571	Texturizing	
0.396	0.0156	11.2	49.8	636	8542/8571	Weaving	
0.371	0.0146	8.0	35.6	602	8542	Texturizing	
0.269	0.0106	5.7	25.4	602	8542/8571	Texturizing	
0.269	0.0106	5.7	25.4	620	8542/8571	Aerospace/Filtration	Yes
0.269	0.0106	5.7	25.4	636	8542	Weaving	
0.249	0.0098	4.3	19.1	602	8542	Texturizing	
0.249	0.0098	4.3	19.1	636	8542	Weaving	
0.203	0.0080	3.5	15.6	620	8542	Electronics	Yes
0.142	0.0056	2.0	8.9	620-1	8542	Electronics	Yes
0.241	0.0095	4.8	21.4	620-1	8542	Electronics	Yes
0.165s	0.0065	2.4	10.7	620-1	8542	Electronics	Yes
0.165	0.0065	2.4	10.7	751	8542	Vinyl Coating	
0.165	0.0065	2.4	10.7	622	8542	Knitting	
0.201	0.0079	4.8	21.4	620-1	9228	Aerospace	
0.224	0.0090	6.1	27.2	753	8542	Vinyl Coating	
0.396	0.0156	11.2	49.8	602	8571	Texturizing	
0.396	0.0156	10.0	44.5	620	9225	Winding/Braiding	
0.396	0.0156	13.1	58.3	620	8542/8571	Winding/Braiding	Yes
0.396	0.0156	10.0	44.5	620-1	8571	Winding/Braiding	Yes
0.396	0.0156	10.0	44.5	620	9228	Winding/Braiding	
0.396	0.0156	19.4	86.1	517	8542	Pultrusion	
0.396	0.0156	19.4	86.1	603	8542	Pultrusion	
0.396	0.0156	17.0	75.6	723	8542	High Tensile	Yes
0.568	0.0224	20.0	89.0	620	8542	Winding/Braiding	
0.663	0.0261	30.0	133.5	620	8542	Winding/Braiding	

E-Glass Continuous Filament Yarns – Products

(continued)

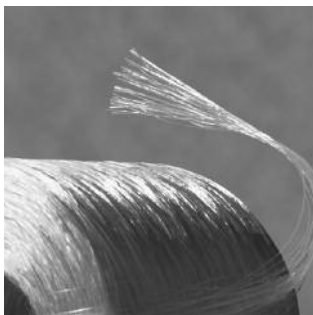
Filament	Microns	Yield Designation	Construction	Twist	Nominal Yield		Denier
					(TEX)	(yds/lb)	
G	9	50	1/0	4.0Z	99	5,000	891
G	9	50	1/0	0.7Z	99	5,000	891
G	9	75	1/0	0.7Z	66	7,500	594
G	9	75	1/0	0.7Z	66	7,500	594
G	9	75	1/0	0.7Z	66	7,500	594
G	9	75	1/0	0.7Z	66	7,500	594
G	9	75	1/0	0.7Z	66	7,500	594
G	9	75	1/0	0.7Z	66	7,500	594
G	9	75	1/0	1.0Z	66	7,500	594
G	9	75	1/0	3.0Z	66	7,500	594
G	9	75	1/2	2.8S	133	3,650	1,197
G	9	150	1/0	4.0Z	33	15,000	297
G	9	150	1/0	1.3Z	33	15,000	297
G	9	150	1/0	0.7Z	33	15,000	297
G	9	150	1/0	0.7Z	33	15,000	297
G	9	150	1/0	0.7Z	33	15,000	297
G	9	150	1/0	0.7Z	33	15,000	297
G	9	150	1/0	1.3Z	33	15,000	297
G	9	150	3/0	3.0Z	99	5,000	893
G	9	150	4/0	4.0Z	137	3,620	1,233
H	11	18	1/0	0.7Z	276	1,800	2,484
H	11	18	1/0	0.7Z	276	1,800	2,484
H	11	25	1/0	0.7Z	198	2,500	1,782
H	11	55	1/0	0.7Z	90	5,500	810
H	11	110	1/0	0.7Z	45	11,000	405
K	13	18	1/0	0.5Z	276	1,800	2,484
K	13	75	1/0	0.7Z	66	7,500	594

Yarn Diameter (mm)	Yarn Diameter (inches)	Min Tensile (lbs)	Min Tensile (N)	Sizing	Bobbin	Application	Beam Availability
0.356	0.0140	9.0	40.1	620	9228	Winding/Braiding	
0.356	0.0140	9.0	40.1	620	8571	Winding/Braiding	
0.269	0.0106	7.1	31.6	620	8542/8571	Winding/Braiding	Yes
0.269	0.0106	5.9	26.2	641	8542/8571	Winding/Braiding	Yes
0.269	0.0106	9.7	42.7	517	8542	Pultrusion	
0.269	0.0106	9.0	40.0	723	8571	High Tensile	Yes
0.269	0.0106	7.5	33.4	719	8571	High Tensile Texturizing	
0.269	0.0106	9.7	42.7	603	8542	Pultrusion	
0.269	0.0106	5.7	25.3	620	8571	Vinyl Coating	
0.269	0.0106	5.7	25.4	620	9225	Aerospace/Filtration	
0.378	0.0149	11.4	50.8	620	8542	Winding/Braiding	
0.203	0.0080	3.2	14.2	620-1	9225	Winding/Braiding	
0.203	0.0080	4.3	19.1	751	8542	Vinyl Coating	
0.203	0.0080	3.7	16.5	641	8542	Industrial Scrim	Yes
0.203	0.0080	3.5	15.6	620	8542	Weaving/Braiding	Yes
0.203	0.0080	3.2	14.2	636	8542	Weaving	Yes
0.203	0.0080	3.7	16.5	646	8542	Filament Tape	Yes
0.203	0.0080	4.5	20.0	723	8542	High Tensile	Yes
0.203	0.0080	3.5	15.3	620	8542	Vinyl Coating	
0.302	0.0119	9.6	42.7	636	8542	Industrial	
0.348	0.0137	12.8	56.9	620-1	9225	Leaching	
0.526	0.0206	36.0	160.0	723	8571	High Tensile	Yes
0.526	0.0206	18.0	80.1	620	8542/8571	Winding/Braiding	Yes
0.376	0.0148	15.0	66.7	620	8542	Braiding	Yes
0.318	0.0125	7.8	34.7	641	8542	Braiding	
0.229	0.0090	5.5	24.5	606	8542	Industrial Scrim	
0.526	0.0206	35.4	155.8	517	8542	Pultrusion	
0.269	0.0106	9.7	42.7	517	8542	Pultrusion	

S-2 Glass[®], ZenTron[®] and VeTron[™] High Performance Reinforcements

Nomenclature	Binder	Sliver	Fil. Dia. (microns)	Nominal Yield (yds/lb) (TEX)		End Count	Package
ZenTron[®] Products (single end)							
721B-AC-250	721B	T2.50	24	242	2059	n/a	4044
758-AB-675	758	L6.75	14	675	735	n/a	4044
							4144
VeTron[™] Products (single end)							
VE1-AB-1200	VE1	P4.14	18	414	1200	n/a	4044
VE1-AB-2400	VE1	V2.07	26	207	2400	n/a	4044
Rovings (multi-end)							
463-AA-1250				1222	406	6	
463-AA-750	463	G75	9	735	675	10	4059
463-AA-250				244	2033	30	
449-AA-2500				2444	203	3	
449-AA-1250				1222	406	6	
449-AA-750	449	G75	9	735	675	10	4059
449-AA-250				245	2025	30	
933-AA-1250				1222	406	6	
933-AA-750	933	G75	9	735	675	10	4059
933-AA-310				307	1616	24	
365-AA-1250				1222	406	6	
365-AA-750	365	G75	9	746	665	10	4059
365-AA-250				249	1992	30	

Package Weight (lb)	Package Weight (kg)	Tube Type	Tube ID	Package #	Resin Compatibility	Application
73	33	None		Creel Pak (27)	Epoxy	Thermal Acoustical
16	7	None		Bulk (60)	Epoxy	Filament Winding, Weaving, Pultrusion & Prepeg
16	7	Thick Wall	6 3/8"	Bulk (36)		
16	7	None		Bulk (60)	Vinyl Ester, Polyester	Filament Winding, Weaving, Pultrusion & Prepeg
16	7	None		Bulk (60)	Vinyl Ester, Polyester	
16	7	None		Bulk (60)	Epoxy	Filament Winding, Prepeg
16	7	None		Bulk (60)		
16	7	None		Bulk (60)	Epoxy	Filament Winding, Weaving, Prepeg
16	7	None		Bulk (60)		
16	7	None		Bulk (60)		
16	7	None		Bulk (60)		
16	7	None		Bulk (60)	Polyamides, BMI, PEEK,	Filament Winding, Weaving, Prepeg
16	7	None		Bulk (60)	PEI, PPS, PES, PEK,	
16	7	None		Bulk (60)	PAI, Epoxy & LCP	
16	7	None		Bulk (60)	Polyester, Vinyl Ester Epoxy	Filament Winding, Weaving, Prepeg
16	7	None		Bulk (60)		
16	7	None		Bulk (60)		

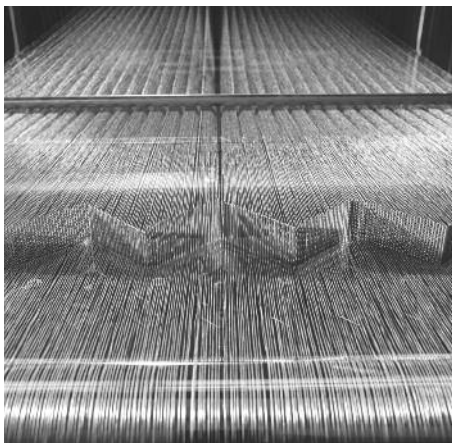


S-2 Glass® Products

Filament	Yield Designation	Construction	Twist	Nominal Yield		Denier
				(TEX)	(yds/lb)	
G	75	1/0	1.0Z	66	7,500	594
G	75	1/0	0.7Z	66	7,500	594
G	75	1/0	1.0Z	66	7500	594
E	75	1/0	N/A	66	7,500	594
G	150	1/0	1.0Z	33	15,000	297
G	150	1/0	1.0Z	33	15,000	297
E	225	1/0	N/A	22	22,500	198
D	450	1/0	1.0Z	11	45,000	99



Yarn Diameter (mm) (inches)		Min Tensile (lbs) (N)		Sizing	Bobbin	Application	Beam Availability
0.192	0.0076	7.1	31.6	636	7636	Aerospace	No
0.192	0.0076	10.7	47.5	933	7636	Aerospace	No
0.192	0.0076	12.9	57.4	493	7636	Aerospace	No
0.192	0.0076	12.0	53.4	762	X-120	Automotive	No
0.136	0.0054	3.7	16.5	636	7636	Aerospace	No
0.136	0.0054	5.6	25.0	493	7636	Aerospace	No
0.165	0.0065	3.8	16.9	762	X-119	Automotive	No
0.076	0.0030	1.6	7.1	636	7636	Aerospace	No



Specialty Products

Chopped Fibers

Type	Length	Package	Notes
H700	2"	50# Bags	Cardable Fiber
799AB	0.25" & 0.5"	40# Bags	Starch/Oil
TP167	misc		Mixed Forming Waste
TP40	misc		Mixed Bobbin/Beam
TP488	2.5" & 3.3"	850# Carton	Twist Waste Chop

BC Sewing Thread – E-Glass

Type	Nomial Yield (yds/lb)	Approx. Dia.	Package	Sizing	Package Weight Average (lb)
BC-4	3,550	.014"	8512	636	2.5
BC-6	2,330	.017"	8542	636	6.0
BC-8	1,730	.020"	8512	636	2.5



Conductive Roving

Product	Resistance		Min Tensile		Package
	(Ohms/m)	(Ohms/ft)	(lbs)	(N)	
B-4	9,800	2,800	150	670	9028
B-5	13,100	4,000	150	670	9028
B-10	6,600	2,000	150	670	9028
BX-10	6,600	2,000	150	670	9028
B-13	11,500	3,500	150	670	9028
CX-19	9,200	2,800	150	670	9028



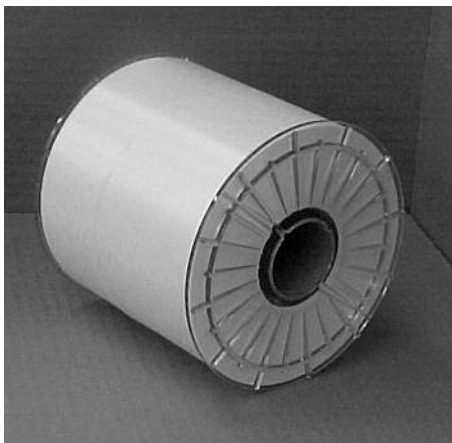
Specialty Products

Wound Products/Magnet Wire Input

Product	Final Twist (TPI)	End Counts	Packages	Linear Density (TEX)	Linear Density (yds/lb)
All Glass					
ECD 450 1/0	1.0Z	2 to 24	5051, 5052	11	45,000
ECD 450 1/2	3.8S	2 to 24	5051, 5052	22	22,140
ECD 900 1/0	1.0Z	2 to 24	5051, 5052	5.5	90,000
ECD 900 1/2	3.8S	2 to 24	5051, 5052	11	44,140

Polyester/Glass

GDD 941 1/2	2.0S	2 to 40	5051, 5052	10	49,323
GDD 471 1/2	2.0S	2 to 40	5051, 5052	19	26,112



Denier	Approximate Diameter		Approximate Build-Up		Min Tensile	
	(mm)	(inches)	(mm)	(inches)	(lb)	(N)
99	0.122	0.0048	—	—	1.30	5.8
198	0.190	0.0074	0.11	0.0042	2.60	11.6
50	0.084	0.0033	—	—	0.60	2.7
100	0.120	0.0049	0.07	0.0027	1.20	5.3
91	0.140	0.0054	0.09	0.0036	0.85	3.8
171	0.200	0.0078	0.11	0.0045	1.63	7.2






Multi-Tex (Multi-End Texturized) Yarns

Nomenclature		Yield Designation	Sizing	Nominal	
US Units	SI Units			(yds/lb)	(TEX)
ETDE 1.75	ET6-2835	1.75	None	173	2867
ETDE 1.75	ET6-2835	1.75	Acrylic	168	2953
ETDE 2.25	ET6-2205	2.25	None	217	2286
ETDE 2.25	ET6-2205	2.25	Acrylic	214	2318
ETDE 3.50	ET6-1417	3.5	None	349	1421
ETDE 3.50	ET6-1417	3.5	Acrylic	346	1434
ETDE 4.50	ET6-1102	4.5	None	440	1127
ETDE 4.50	ET6-1102	4.5	Acrylic	432	1148
ETDE 6.0	ET6-827	6	None	589	842
ETDE 6.0	ET6-827	6	Acrylic	564	880
ETDE 9.0	ET6-551	9	None	878	565
ETDE 10.0	ET6-496	10	Cellosize	1030	482
ETDE 11.60	ET6-428	11.6	None	1205	412
ETDE 11.60	ET6-428	11.6	Cellosize	1193	416
ETDE 25.0	ET6-198	25	Cellosize	2371	209
ETG 1.40	ET9-3543	1.4	None	135	3674
ETG 1.75	ET9-2835	1.75	None	162	3062
ETG 1.75	ET9-2835	1.75	Acrylic	161	3081
ETG 2.25	ET9-2205	2.25	Acrylic	222	2234
ETG 2.75	ET9-1804	2.75	Acrylic	250	1984
ETG 3.50	ET9-1417	3.5	None	362	1370
ETG 3.50	ET9-1417	3.5	Acrylic	257	1930
ETG 4.50	ET9-1102	4.5	None	448	1107
ETG 4.50	ET9-1102	4.5	Acrylic	447	1110
ETG 6.00 12"	ET9-827	6	Acrylic	594	835
ETG 6.00 8"	ET9-827	6	Acrylic	594	835
ETG 9.00	ET9-551	9	None	938	529
ETG 9.00	ET9-551	9	Acrylic	927	535






All Mult-Tex yarns supplied on package number 4002, net weight 3-25 lb (1.4-11 kg) per package

Product Packaging

Bobbin Specifications

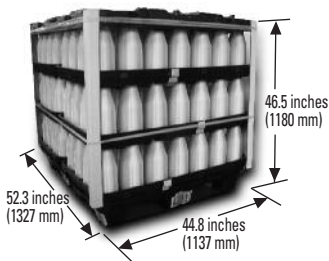
Bobbin		Measurement Units	Type	Inside Diameter (ID)	Length (L)	Traverse (T)	Flange Diameter (FD)
7636		US (in.)	Plastic Tube	2.380	14.00	12.18	3.96
		SI (cm.)	Plastic Tube	6.050	35.56	30.94	10.06
8542		US (in.)	Plastic Tube	2.380	13.25	10.97	6.00
		US (in.)	Plastic Tube	2.380	13.25	10.97	6.00
		SI (cm.)	Plastic Tube	6.050	33.66	27.86	15.24
		SI (cm.)	Plastic Tube	6.050	33.66	27.86	15.24
8571		US (in.)	Plastic Tube	3.304	17.62	15.00	7.70
		US (in.)	Plastic Tube	3.304	17.62	15.00	7.70
		SI (cm.)	Plastic Tube	8.390	44.77	38.10	19.56
		SI (cm.)	Plastic Tube	8.390	44.77	38.10	19.56
9225		US (in.)	Plastic Spool	1.677	11.08	9.13	4.31
		SI (cm.)	Plastic Spool	4.260	28.13	23.18	10.95
9228		US (in.)	Plastic Spool	1.677	11.63	9.14	5.50
		SI (cm.)	Plastic Spool	4.260	29.53	23.16	13.97

Bobbin Packaging

Bobbin		Measurement Units	Carton Number	Carton Type	Packages per Layer	Packages per Carton	Pallet Dimensions
7636		US (in.)	T-306	Tray	18	54	45.5 X 45.5
		SI (cm.)	T-306	Tray	18	54	114.3 X 114.3
8542		US (in.)	T-306	Tray	10	30	45.5 X 45.5
		US (in.)	Returnable Plastic	Tray	28	84	44.75 X 52.25
		SI (cm.)	T-306	Tray	10	30	114.3 X 114.3
		SI (cm.)	Returnable Plastic	Tray	28	84	113.7 X 132.7
8571		US (in.)	T-402	Tray	14	28	45.5 X 45.5
		US (in.)	Returnable Plastic	Tray	15	30	44.75 X 52.25
		SI (cm.)	T-402	Tray	14	28	115.6 X 115.6
		SI (cm.)	Returnable Plastic	Tray	15	30	113.7 X 132.7
9225		US (in.)	T-306	Tray	18	54	45.5 X 45.5
		SI (cm.)	T-306	Tray	18	54	115.6 X 115.6
9228		US (in.)	T-306	Tray	12	36	45.5 X 45.5
		SI (cm.)	T-306	Tray	12	36	115.6 X 115.6

Type Build	Bare Bobbin (nom. weight)	Max. Full Package Dia. (D)
Double Taper	0.51 lbs	4.50
Double Taper	229.30 g	11.43
Milkbottle	0.55 lbs	5.88
Milkbottle	0.55 lbs	5.88
Milkbottle	2.48 g	14.92
Milkbottle	2.48 g	14.92
Milkbottle	1.06 lbs	7.58
Milkbottle	1.06 lbs	7.58
Milkbottle	480.40 g	19.24
Milkbottle	480.40 g	19.24
Straight	0.45 lbs	4.18
Straight	200.40 g	10.62
Straight	0.77 lbs	5.05
Straight	347.40 g	12.83

Returnable Plastic



Carton/Pallet Height	Cartons per Pallet	Packages per Pallet
45	4	216
114.3	4	216
45	4	120
46.5	2	168
114.3	4	120
118.1	2	168
40.5	2	56
42.8	2	60
102.9	2	56
108.8	2	60
38.5	4	216
97.8	4	216
39	4	144
99.1	4	144

T-306



Product Packaging

Roving Packages

Package	ID		Length		Traverse	
	(in)	(cm)	(in)	(cm)	(in)	(cm)
4002	3.628	9.22	13.000	33.02	12.000	30.48
4044	6.375	16.19	—	—	10.250	26.04
4057	3.000	7.62	10.900	27.69	10.000	25.40
4059	3.000	7.62	10.900	27.69	10.000	25.40
4078	3.000	7.62	10.900	27.69	10.000	25.40
4144	6.375	16.19	10.900	27.69	10.000	25.40
5044	6.375	16.19	—	—	10.250	26.04
9018	6.375	16.19	10.875	27.62	9.375	23.81

Serving Packages

Package	Type	ID (inches)	Length (inches)	Traverse (inches)
5051	Plastic Spool	1.620	3.531	3.000
5052	Plastic Spool	1.620	5.800	5.250

Wind Direction	Build	Max OD		Approx. Wt.	
		(in)	(cm)	(lb)	(kg)
Forward	Square Edge	13.000	33.02	Varies by product	
Forward	Square Edge	8.680	22.05	15.0	6.8
Forward	Square Edge	7.000	17.78	15.0	6.8
Forward	Square Edge	7.000	17.78	Varies by metered length	
Forward	Square Edge	10.000	25.40	32.0	14.5
Forward	Square Edge	8.830	22.43	16.0	7.3
Forward	Square Edge	—	—	74.0	33.6
Parallel	—	16.000	40.64	—	—

Wind Direction	Max. OD (inches)	Min. OD (inches)	Approx. Wt. (lbs)
Parallel	5.9375	4	3.5
Parallel	5.9375	4	5.6

Continuous Filament Mat (CFM)

AGY Continuous Filament Mat (CFM) is a unique glass fiber reinforcement product used as an input in the production of flat sheet laminate, marine parts and accessories, and other products where its strength and durability make it the most cost-effective material to use. CFM increases the mechanical performance, such as stiffness and strength, of products, as well as their resistance to chemicals.

Product Description

CFM is made from continuous glass fiber strands randomly looped and bonded together with a minimal binder that is compatible with a variety of unfilled or filled resin systems including PE/PV, PE/PU, Phenolic, PU, PU/Epoxy.

AGY Product	M8610	M8612	M8615
CAS #	TP-511	TP-641	TP-724
EP/GP	GP	GP	GP
Customer Application	Compression Molding	Proprietary Coating Process	Infusion/RTM
Customer Resin System	PE/PV	Phenolic	PE/PV
Standard Widths	42", 48", 50", 51" and 55"	51.5"	54.3"
Widths Available Non-Standard	12" - 114"	N/A	12" - 114"
Standard Weights (square foot weight in ounces)	1.5 to 3.0	1.25	2.0
Weights Available Non-Standard (square foot weight in ounces)	1.0 to 4.5	N/A	1.0 to 4.5
Packaging Highlights	All rolls produced at 26" diameter then vacuum-packed to 21.5"	All rolls produced at 26" diameter then vacuum-packed to 21.5"	All rolls produced at 26" diameter then vacuum-packed to 21.5"
General Comments/ Markets/Customers	The industry standard molding mat (2.5% LOI) for compression molding	High LOI (8%) version of M8610 for use in flat sheet applications only	Mid level LOI (3.5%) version of M8610 used in RTM and flat sheet molding applications

Note: Non-standard widths and weights are available but are dependent on, volume requirements, packaging needs, manufacturing capacity, etc. Additional charges may apply.

See AGY CFM Product Brochure for metric conversion.

Key Features

- Roll Slitting – mat rolls can be easily slit into various widths.
- Wet-Through/Porosity – offers little resistance to resin flow to allow for easy and complete resin impregnation, resulting in high line speeds.
- Excellent Wet-Out – improves the ability to coat individual glass filaments and strands.
- Mat Strength – resists being pulled apart under tension during impregnation and molding.
- Manageable – can be unrolled, cut and conveyed to the mold or die without losing its integrity.

M8620	M8635	M8635D1	M8635D2	M8636
TP-715	TP-714	TP-718	TP-726	TP-710
GP	EP	EP	EP	EP
Compression Molding	SRIM/RTM/ Infusion	SRIM/RTM/ Infusion	SRIM/RTM/ Infusion	Pultrusion/ High Pressure Laminate
PE/PV	PE/PV	PE/PU	PE/PU	PU/Epoxy
N/A	42", 48", 50", 51", 55", 68" and 72"	49" and 57.5"	N/A	50" and 68"
12" - 114"	12" - 114"	12" - 114"	12" - 114"	12" - 114"
1.0 to 2.0	1.0, 1.5, 2.0, 2.5 and 3.0	2.0	N/A	1.0 and 1.5
3.0	0.75	0.75 to 3.0	0.75 to 3.0	0.75 to 3.0
Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet; 23" dia. rolls also available	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet; 23" dia. rolls also available	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet; 23" dia. rolls also available	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet
Very conformable version of M8635 designed for acute angle molding	Standard infusion product at 2.5% LOI	Higher LOI (3%) version of M8635; can hold a more intricate die-cut shape	Improved flow version of M8635 which reduces resin flow times up to 30%	This product is 100% epoxy compatible

Continuous Filament Mat (CFM)

Applications

CFM is used in many FRP applications such as pultrusion, high pressure laminating, vacuum infusion, and several glass fiber molding processes (SRIM/RTM, etc.). It is particularly suitable for compression molded electrical and non-electrical laminates. Pultruded shapes made with AGY CFM have outstanding transverse- and random-direction strength. Typical applications include electrical flat sheet, grading and railings, window frames, boat hulls and transoms, cooling tower structural shapes and ladder rails.

AGY Product	M8636X1	M8643	M8643X3
CAS #	TP-727	TP-607	TP-607 S-5 LD
EP/GP	EP	EP	EP
Customer Application	Infusion/ Compression Molding	Pultrusion/ Compression Molding	Proprietary Coating Process
Customer Resin System	PU/Epoxy	PE/PV	N/A
Standard Widths	N/A	50", 68" and 72"	N/A
Widths Available Non-Standard	12" - 114"	12" - 114"	12" - 114"
Standard Weights (square foot weight in ounces)	1.0 & 1.5	1.0, 1.5, 2.0, and 3.0	1.0
Weights Available Non-Standard (square foot weight in ounces)	N/A	0.75, 1.25, 1.75	N/A
Packaging Highlights	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet
General Comments/ Markets/Customers	The infusion version of M8636 designed for epoxy resin systems	Standard pultrusion product	N/A

Note: Non-standard widths and weights are available but are dependent on, volume requirements, packaging needs, manufacturing capacity, etc. Additional charges may apply. See AGY-CFM Product Brochure for metric conversion.

Packaging

AGY CFM products are wound on a 4" ID cardboard core. The resulting rolls are individually wrapped in polyethylene. The pallet is covered with a cap and stretch-wrapped.

M8643X4	M8643X5	M8645	M8686
TP-607 S-12	Pending Qualification	TP-725	TP-711
EP	EP	EP	EP
Pultrusion	Pultrusion	PU Foam	Pultrusion/ Compression Molding/High Pressure Laminate
PE/PV	PE/PV	PU	Phenolic
68"	72"	N/A	50" and 68"
12" - 114"	12" - 76"	12" - 114"	12" - 114"
1.0 and 1.5	0.625	1.5	1.0 and 1.5
0.75 to 3.0	N/A	N/A	0.75 to 3.0
Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet	Rolls under 42" are stacked 2 or 3 rolls high on pallet resulting in 12 to 18 rolls per pallet
Whiter version of M8643 used in consumer applications	Improved pultruded surface appearance using this mat	Mat designed to flow with foam as it expands during processing	Phenolic compatible product designed for pultrusion and high pressure lamination

Sizing Systems for Yarns and Rovings

	Sizing	Slivers	Approx. LOI	Sizing Type
YARNS	493	G75, G150, S-2 Glass® Yarns	0.45%	Resin
	517	G37, G75, K18 Yarns	0.55%	Resin
	602	DE50, DE75, DE100, DE37, G37 Yarns	0.45%	Starch/Lube
	603	G37, G75, H18 Yarns	0.60%	Resin
	606	H110 Yarns	1.00%	Starch/Lube
	620	G75, G150, G37, H18, DE75, DE150 Yarns	1.20%	Starch/Lube
	620-1	G37, E225, D450, D900, D1800 Yarns	1.75%	Starch/Lube
	622	E225, D450, D900, C1200	1.50%	Starch/Lube
	636	G150, DE100, DE37, BC150 Yarns, S-2 Glass® Yarns	1.20%	Starch/Lube
	641	G150, G75, H55 Yarns	1.00%	Starch/Lube
	646	G150 Yarns	1.20%	Starch/Lube
	700	H18, H15 Yarns	0.44%	Special Chopping Size
	719	G75	0.60%	Starch/Lube Texturizing Binder
	723	G150, G37, G75, H18	1.20%	Starch/Lube
	751	G150, F90, E225, DE300	0.80%	Resin
	753	F90, Yarns	1.50%	
	762	E225, S-2 Glass® Yarns	0.42%	Resin
YARNS AND ROVINGS	933	G75, S-2 Glass® Yarns & Rovings	0.23%	Resin
ROVINGS	365	G75 S-2 Glass® Rovings	0.50%	Resin
	449	G75, G150, S-2 Glass® Rovings	0.65%	Resin
	463	G75, G150, S-2 Glass® Rovings	1.00%	Resin
	721B	T2.5, S-2 Glass® Rovings	0.40%	Resin
	758	L6.75, U2.25 S-2 Glass® Rovings	0.65%	Resin
	VEI	P4.13, V2.07		Resin

Sizing Comments	Application	Product Comments
Directly Compatible with Resin Systems	Industrial	Epoxy/Polyester Compatible
Directly Compatible with Resin Systems	Industrial	Epoxy/Polyester Compatible Faster Wetting Than 603
Made to Texturize	Texturization	Very Efficient Product for Texturizing
Directly Compatible with Resin Systems	Industrial	Epoxy/Polyester Compatible
Industrial Standard	Industrial Facings	Good Processability High Tensile
Workhorse Sizing Industry Standard	Weaving Industrial	Good Processability General Purpose
Similar to 620	Weaving Industrial	Good Processability Fast Aqueous Wet-Out
Air Friendly	Weaving	Good Loom Efficiency
Old Standard	Weaving Industrial	Good Processability Mostly Replaced by 620
Workhorse Sizing for Industrial	Warping Industrial	Good Processability High Strand Integrity
Similar to 636	Industrial Beams	Good Processability High Tensile
Made For Carding	Carding	Good Dispersion and Processing in Carding
High Tensile Industrial	Industrial Applications	High Tensile
High Tensile		High Tensile Industrial Applications
Directly Compatible with Resin Systems	VCY	Good Processability in Coating Lines
Made for Single-End Coating	VCY	in Coating Lines (VCY)
Directly Compatible with Resin Systems	Industrial	Rubber Compatible
Directly Compatible with Resin Systems	Aerospace	Toughened Epoxies Thermoplastics Compatible, Poor for Broken Filament Resistance
Directly Compatible with Resin Systems	Industrial	Polyester/Vinyl Ester/Epoxy Compatible
Directly Compatible with Resin Systems	Aerospace Industrial	Epoxy (Amine), Urethane Compatible
Directly Compatible with Resin Systems	Aerospace Industrial	Epoxy (Anhydride), Phenolic Compatible
Directly Compatible with Resin Systems	Industrial	Very Efficient Product for Texturizing
Directly Compatible with Resin Systems	Aerospace Recreation	Epoxy Compatible Fastest Epoxy Wetout
Directly Compatible with Resin Systems	Marine Weaving Pultrusion	Vinylester Polyester Compatible

Sizing Grid – Processability and Compatibility

Processability	YARNS								
	493	517	602	603	606	620	620-1	622	636
Heat Cleanability	Red	Red	Black	Red	White	Black	Black	Black	Grey
Air Texturization	White	White	Black	White	White	Grey	White	Grey	White
Air Friendly	Grey	Red	Grey	Red	White	Black	Air	Black	Grey
High Strand Integrity	Black	Black	White	Black	Black	Grey	Grey	Grey	Black
Yarn Tensile Strength	Black	Black	Grey	Black	Black	Grey	Grey	Grey	Grey
Tape/Facing Laminate Tensile	White	White	White	White	Black	Grey	White	White	Grey
Aqueous Wet Out	White	White	White	White	Grey	Grey	Black	Black	Grey
Alkali Resistance	White	Black	White	Black	White	Grey	White	White	White
Low Running Tension	White	Red	Grey	Red	Black	Grey	Grey	Grey	Grey
Broken Filament Resistance	White	Black	White	Black	Black	Black	Black	Grey	Black
Can be Carded	White	White	White	White	White	White	White	White	White
Polymer/Resin Compatibility									
PVC (polyvinyl chloride)	White	Grey	White	Grey	White	Grey	White	White	White
PVAc (polyvinyl acetate)	White	Black	White	Black	White	White	White	White	White
PVA (polyvinyl alcohol)	White	White	White	White	White	Grey	Grey	Grey	Grey
Epoxy	Black	Black	White	Black	White	White	White	White	White
Polyester	Black	Black	White	Black	White	White	White	White	White
Vinyl Ester	Grey	White	White	White	White	White	White	White	White
Cyanate Ester	White	White	White	White	White	White	White	White	White
Phenolic	White	White	White	White	White	White	White	White	White
Acrylic	White	Black	White	Black	White	White	White	White	White
Polyurethane	White	Black	White	Black	White	White	White	White	White
SBR	White	Grey	White	Grey	Black	White	White	White	White
BMI (bismaleimide)	White	White	White	White	White	White	White	White	White
PTFE (Teflon†)	White	White	White	White	White	White	White	White	Grey

*933 size used on both yarn and roving

†Teflon® is a registered trademark of E.I. du Pont de Nemours and Company.



									ROVINGS						
641	646	700	719	723	751	753	762	933*	365	449	463	721B	758	VEI	
Good	Good	N/A	Fair	Fair	N/A	N/A	N/A	Poor	N/A	N/A	N/A	N/A	N/A	N/A	
Fair	Fair	N/A	Good	Fair	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Good	N/A	N/A	
Poor	Fair	N/A	Fair	Fair	N/A	Poor	N/A	Good	N/A	N/A	N/A	N/A	N/A	N/A	
Good	Fair	N/A	Fair	Fair	N/A	Poor	N/A	Good	N/A	N/A	N/A	N/A	N/A	N/A	
Fair	Good	N/A	Good	Good	Good	Fair	Good	Good	N/A	N/A	N/A	N/A	N/A	N/A	
Fair	Good	N/A	Good	Good	Good	N/A	Good	Good	N/A	N/A	N/A	N/A	N/A	N/A	
Good	Good	N/A	Good	Good	Fair	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Good	Fair	N/A	Fair	Fair	Fair	Poor	N/A	Poor	N/A	N/A	N/A	N/A	N/A	N/A	
Good	Good	N/A	N/A	N/A	Good	Fair	N/A	Poor	N/A	N/A	N/A	N/A	N/A	N/A	
N/A	N/A	Good	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	Good	Fair	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Good	Fair	N/A	Fair	N/A	N/A	Good	Good	Good	Good	Good	Good	Good	Good	Poor	
N/A	N/A	N/A	N/A	N/A	N/A	Good	Good	Good	Good	Good	Fair	Good	Poor	Good	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Good	Good	Good	Good	Fair	Good	Poor	Good	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Good	Good	N/A	N/A	Fair	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	Good	N/A	Good	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Good	N/A	N/A	N/A	N/A	N/A	Good	Good	Good	N/A	N/A	N/A	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	Good	Good	N/A	N/A	N/A	N/A	N/A	N/A	

Good	Good
Fair	Fair
Poor	Poor
N/A	N/A

Typical Fiber Properties

Property (test standard)	S-2 Glass*		E-Glass	
THERMAL	per deg. C	per deg. F	per deg. C	per deg. F
Coefficient of Thermal Expansion (ASTM D696)	2.9×10^{-6} <i>(at -30°C to 250°C)</i>	0.9×10^{-6} <i>(at -20°F to 480°F)</i>	5.4×10^{-6} <i>(at -30°C to 250°C)</i>	3×10^{-6} <i>(at -20°F to 480°F)</i>
	Watts/m•K	Btu-in/hr•ft²°F	Watts/m•K	Btu-in/hr•ft²°F
Conductivity, k (ASTM C177)	1.1-1.4	8-10	1-1.3	7-9
	kJ/kg•K	Btu/lb°F	kJ/kg•K	Btu/lb°F
Specific Heat at 22°C (72°F)	0.737	0.176	0.807	0.193
at 200°C (392°F)	0.820	0.196	1.03	0.247
Softening Point	1056°C	1932°F	846°C	1555°F
Annealing Point (ASTM C336)	816°C	1500°F	657°C	1215°F
Strain Point (ASTM C336)	766°C	1410°F	616°C	1140°F
Flame Resistance Oxygen Index (ASTM D2863)	100%		100%	
ELECTRICAL				
Dielectric Constant (ASTM D150) at 22°C (72°F)				
1 MHz	5.3		6.6	
10 GHz	5.2		6.1	
Dissipation Factor (ASTM D150) at 22°C (72°F)				
1 MHz	0.002		0.003	
10 GHz	0.007		0.004	
Volume Resistivity (ASTM D257) at 22°C (72°F)				
500VDC, Ohm•cm	0.905×10^{13}		0.402×10^{15}	
Surface Resistivity (ASTM D257) at 22°C (72°F)				
500VDC, Ohm	0.886×10^{13}		0.42×10^{16}	
	kV/cm	Volts/mil	kV/cm	Volts/mil
Dielectric Strength volts/mil at 190 mil thick	130	330	103	262

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

K-49 Aramid		AS4 Carbon	
per deg. C*	per deg. F*	per deg. C*	per deg. F*
-4.3 x 10 ⁻⁶	-2.4 x 10 ⁻⁶	-1.1 x 10 ⁻⁶	-0.6 x 10 ⁻⁶
41 x 10 ⁻⁶	23 x 10 ⁻⁶	17 x 10 ⁻⁶	9.3 x 10 ⁻⁶
(at 26°C to 130°C)	(at 78°F to 266°F)		
Watts/m•K	Btu-in/hr•ft ² °F	Watts/m•K	Btu-in/hr•ft ² °F
0.04-1.4	0.3-10	71-100	50-70
kJ/kg•K	Btu/lb°F	kJ/kg•K	Btu/lb°F
1.380	0.330	0.711	0.170
2.630	0.630	1.210	0.290
(Oxidation above 150°C, 300°F)		(Oxidation above 350°C, 660°F)	(ASTM C338)
	29%		60%
	4.0		Conductive
	3.9		
	0.014		Conductive
	0.010		
	0.5 x 10 ¹²		0.153 x 10 ⁻⁴
	1012 x 10 ¹⁴		0.1 x 10 ⁻⁴
	N/A		N/A

Typical Fiber Properties

Property (test standard)	S-2 Glass*		E-Glass	
ACOUSTICAL	m/sec	ft/sec	m/sec	ft/sec
Velocity of Sound	5,850	19,200	5,480	18,000
PHYSICAL	g/cm³	lb/in³	g/cm³	lb/in³
Density (ASTM C693)	2.46-2.49	0.089-0.090	2.55-2.58	0.092-0.093
Hardness (Moh's scale)	6.5		6.5	
MECHANICAL				
Impregnated Strand	MPa	ksi	MPa	ksi
Tensile Strength (ASTM D2343) at 22°C (72°F)	3660-4280	530-620	1860-2690	270-390
Creep, % of initial strain (ASTM D2990) at 50% of strength, 10,000 hrs.	0-3%		0-5%	
MECHANICAL				
Single Filament	MPa	ksi	MPa	ksi
Tensile Strength (ASTM D2101) at -190°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
Tensile Modulus of elasticity (ASTM D2101) at 22°C (72°F)	86-90	12.5-13	69-72	10-10.5
at 538°C (1000°F)	89	12.9	81	11.8
Strain to Failure (ASTM D2101)	5.4-5.8%		4.5-4.9%	
	MPa	ksi	MPa	ksi
Toughness (ASTM D2101)	83-90	12-13	62-69	9-10
Moisture Regain (ASTM D1909)	0%		0%	
OPTICAL				
Refractive Index, 589.3 nm (oil immersion)	1.520-1.525		1.547-1.562	

*Annealed bulk glass properties by sonic resonance at 20°C (68°F) for S-2 Glass® Fiber.

Young's modulus – 13.6 Msi; Poisson's ratio – 0.23; Shear modulus – 5.53 msi; Bulk density – 2,488 gm/cm³

K-49 Aramid		AS4 Carbon	
m/sec	ft/sec	m/sec	ft/sec
2,740	9,000	5,940	19,500
g/cm³	lb/in³	g/cm³	lb/in³
1.44	0.052	1.8	0.065
N/A		N/A	
MPa	ksi	MPa	ksi
2900-3620	420-525	3100-3790	450-550
10-30%		0-2%	
N/A	N/A	N/A	N/A
—	—	—	—
—	—	—	—
—	—	—	—
GPa	msi	GPa	msi
124-131	18-19	221-234	32-34
—	—	—	—
2.5-2.9%		1.5-1.6%	
MPa	ksi	MPa	ksi
48-55	7-8	35-41	5-6
3.5%		0%	
1.6-2.0		N/A	

Customer Acceptance Standards (CAS)

Product (s)	CAS	Latest Issue Date
Continuous Yarns and Slivers		
Yarn Wound on Serving Packages	TP-33	13-May-04
High Tensile Applications	TP-200	28-Aug-07
Polyester Combination Yarn	TP-210	29-Apr-04
Yarn For Weaving Industry	TP-227-LD	01-Jun-07
Texturizing Yarn for Weaving Industry	TP-227-S4-LD	14-Jun-04
Texturizing Yarn for Weaving Industry	TP-227-S5-LD	23-Jun-03
Yarn for Paper, Film and Foil Industry	TP-234-LD	29-Nov-07
Yarn for FR Mattress Applications	TP-234-S3-LD	08-Aug-07
Yarn for Electrical Industry	TP-330	15-May-07
Yarn For High Silica Fabrics-Weavers	TP-360	14-Jun-04
S-2 Glass® Yarn	TP-378	25-May-07
S-2 Glass® Direct Sized Yarn	TP-379	25-May-07
BC Sewing Thread	TP-386	14-Jun-04
Yarns for Polyvinyl Chloride Plastisol Coating Process	TP-575	03-Mar-08
Yarns for Structural Reinforcement	TP-668	28-Feb-08
Yarn for Rubber Reinforcement	TP-100	01-Mar-06
Coated, Texturized Yarns and Chopped Strands		
S-2 Glass® Chopped Strand for Molding Compound	TP-679	14-Aug-06
Low Yield Texturized Yarn	TP-823	02-Feb-06
Cardable Fiber for Intimate Blend Yarns and Fabrics	TP-860	02-Feb-06
Beamed Yarn		
Beamed Yarn for Filament Tape Reinforcement	TP-194	01-Mar-06
Beamed Yarn	TP-194-S12	22-Nov-04
Beamed Yarn for Weavers	TP-227-S1-LD	22-Nov-04
Conductive Roving and S-2 Glass® Roving		
Conductive Roving	TP-390	30-May-06
463-AA S-2 Glass® Roving	RF-47	01-Mar-07
449-AA S-2 Glass® Roving	RF-49	20-Apr-07
517-BA E-Glass (C1474) Roving	RF-51	01-Mar-07
933-AA S-2 Glass® Roving	RF-60	01-Mar-07
365-AA S-2 Glass® Roving	RF-65	01-Mar-07
Zentron® K Fiber	RF-66	01-Mar-07

Product (s)	CAS	Latest Issue Date
Zentron® Muffler Fill	RF-67	01-Mar-07
Zentron®, L Fiber	RF-68	01-Mar-07
762 S-2 Glass® Products	RF-69	25-May-07
VE1 VeTron™ Roving	RF-70	01-Mar-07
933 S-2 Glass® Roving	RF-71	12-Dec-07
Offware		
Synthetic Fiber Waste- Cut Yarn & Bulk Continuous Yarn	TP-40	02-Feb-06
Synthetic Fiber Waste- Mixed Strands from Forming Tubes	TP-167	22-Nov-04
799-AB Chopped Strand	TP-277	02-Feb-06
Chopped Twisted Strand	TP-488	22-Nov-04
Textile By-Product	TP-503	22-Nov-04
Dry Chopped Strand for Industrial Applications	TP-805	17-Jan-06
Miscellaneous		
Yarn Packaging and Workmanship	AGY PD1	22-Nov-04
Beaming Packaging and Workmanship	BM PKG1	08-Sep-06
Best Practice Guidelines for S-2 Glass Processing	BP-100	11-Mar-05
Continuous Filament Mat Products		
M8610 Matched Metal Die Molding	TP-511	15-Oct-07
M8643 Pultrusion Mat	TP-607	15-Oct-07
M8643X3 Proprietary Mat	TP-607-S5-LD	15-Oct-07
M8643 Pultrusion Mat	TP-607-S11-LD	15-Oct-07
M8643X4 Pultrusion Mat	TP-607-S12-LD	15-Oct-07
FM8636 Continuous Mat	TP-710	15-Oct-07
M8686 Phenolic Pultrusion Mat	TP-711	15-Oct-07
M8635 Infusion Molding Mat	TP-714	15-Oct-07
M8620 Matched Metal Die Molding RIM Scrim Mat	TP-715	15-Oct-07
M8635D1 Infusion Mold Mat	TP-718	04-Feb-07
M8515 Matched Metal Molding or Scrim Mat	TP-724	15-Oct-07
M8645 Urethane Resin and Foam Mat (Draft Only)	TP-725	15-Oct-07
M8636X1 Epoxy Resin Infusion Mat	TP-727	05-Feb-08

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.

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.

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.

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)

Glossary of Terms

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.

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.

Glossary of Terms

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 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.)

YARN

A generic term for a continuous strand of textile fibers, filaments or material in a form suitable for knitting, weaving or otherwise intertwining to form a textile fabric.

YIELD

A measure of mass per unit of length.

ZENTRON® ROVING

AGY's single-end rovings made from S-2 Glass® fibers.



strength in materials

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