ADVANCED
GLASSFIBER YARNS LLC

Glassfiber Reference Guide

Yarn Nomenclature

Glassfiber 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 glassfiber yarn nomenclature, including comparisons of the two systems. A more comprehensive description can be found in ASTM D578 – standard specification for glass fiber strands.

Advanced Glassfiber Yarns *(Advanced)* 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.

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

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

The example above then identifies the following yarn:

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

The example above then identifies the following yarn:

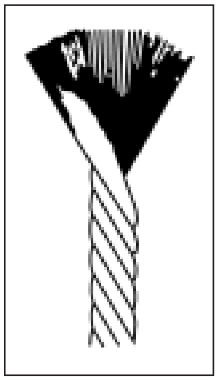
E = electrical glass
C = continuous filament
9 = 9 micrometers
68 = 68 grams per 1,000 meters of yarn
1 x 2 = one ply of 2-strand construction (total 2 basic strands)
S = the direction of the twist
112 = the number of turns per meter (TPM) in the twist of the final yarn

* Le System International d'Unites (SI)

Twist:

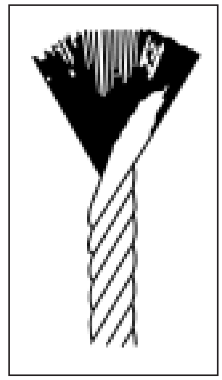
The fifth segment in the nomenclature is the number of basic strands* twisted together in a single yarn. Following this number is the number of turns per unit length and either the letter "S" or "Z" which indicates the direction of the twist. The S or Z direction of the yarn is determined by the slope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



S-Twist:

The strands assume an ascending right to left configuration as in the central portion of the letter S.



Z-Twist:

The strands assume an ascending left to right configuration as in the central portion of the letter Z.

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. Note that the strand count in Table 2 indicates a basic strand* of the yarn.

Table 1. Designations for Glass Strand Filament Diameters

Filament Designation		Range for Filament Diameter Average	
U.S. Units (letter)	SI Units (micrometers†)	Inches	Micrometers
BC	4	0.00014 to 0.00017	3.60 to 4.40
D	5	0.00020 to 0.000249	5.08 to 6.0
DE	6	0.000225 to 0.000274	5.72 to 6.0
E	7	0.00025 to 0.000299	6.35 to 7.61
F	8	0.00030 to 0.000349	7.62 to 8.86
G	9	0.00035 to 0.000399	8.89 to 10.15
H	11	0.00040 to 0.000449	10.16 to 11.42
J	12	0.00045 to 0.000499	11.43 to 12.69
K	13	0.00050 to 0.000549	12.70 to 13.96
L	14	0.00055 to 0.000599	13.97 to 15.23
M	16	0.00060 to 0.000649	15.24 to 16.50
N	17	0.00065 to 0.000699	16.51 to 17.77
P	18	0.00070 to 0.000749	17.78 to 19.04
Q	20	0.00075 to 0.000799	19.05 to 20.31
R	21	0.00080 to 0.000849	20.32 to 21.58
S	22	0.00085 to 0.000899	21.59 to 22.85
T	23	0.00090 to 0.000949	22.86 to 24.12
U	24	0.00095 to 0.000999	24.13 to 25.40

The low values stated for each micrometer range are exact equivalents to inches, rounded to the nearest hundredth micrometer. The high values stated for each micrometer 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.
† 1 micrometer = 1 micron.

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

Yarn Nomenclature

Table 2. Description of Continuous Filament Glass Fibers

Filament Designation		Nominal Yarn Number (strand count)			
U.S. Units (letter)	**SI Units (micrometer)**	**100 Yd. Cuts/Lb.**	**Yds./Lb. (Bare Glass)**	**TEX Grams/1000 meters**	**Approximate Number of Filaments**
D	5	1800	180,000	2.75	51
D	5	900	90,000	5.5	102
D	5	450	45,000	11	204
D	5	225	22,500	22	408
E	7	225	22,500	22	204
BC	4	150	15,000	33	1064
DE	6	150	15,000	33	408
G	9	150	15,000	33	408
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	1632
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	1224
DE	6	37	3,700	134	1632
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	1632
K	13	18	1,800	275	816
H	11	18	1,800	275	1224
H	11	15	1,500	330	1632

Yarn Reference and Conversion Formulas

Conversion - Measurements

	Inch-Pound Units	SI Units	To Convert In.-Lb. Units to SI, Multiply by:	To Convert SI Units to In.-Lb., Multiply by:
Length	inch	mm	25.400	0.03937
	inch	cm	2.5400	0.3937
	foot	m	0.3048	3.2808
	yard	m	0.9144	1.0936
	mile	km	1.6093	0.6214
Area	$inch^2$	cm^2	6.4516	0.1550
	$feet^2$	m^2	0.0929	10.7639
	$yard^2$	m^2	0.8361	1.1960
Textile	oz./yd.	g/m	31.0034	0.0323
	$oz./yd.^2$	g/m^2	33.9057	0.0254
	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)

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

U.S. Customary	Metric Units to U.S. Customary	
$\text{Denier} = \frac{4,464,492}{(\text{yds./lb.})}$	$\text{yds./lb.} = \frac{4,464,492}{\text{Denier}}$	
		Denier = TEX x 9.0
$\text{TEX} = \frac{496,055}{(\text{yds./lb.})}$	$\text{yds./lb.} = \frac{496,055}{\text{TEX}}$	

Glass Manufacturing

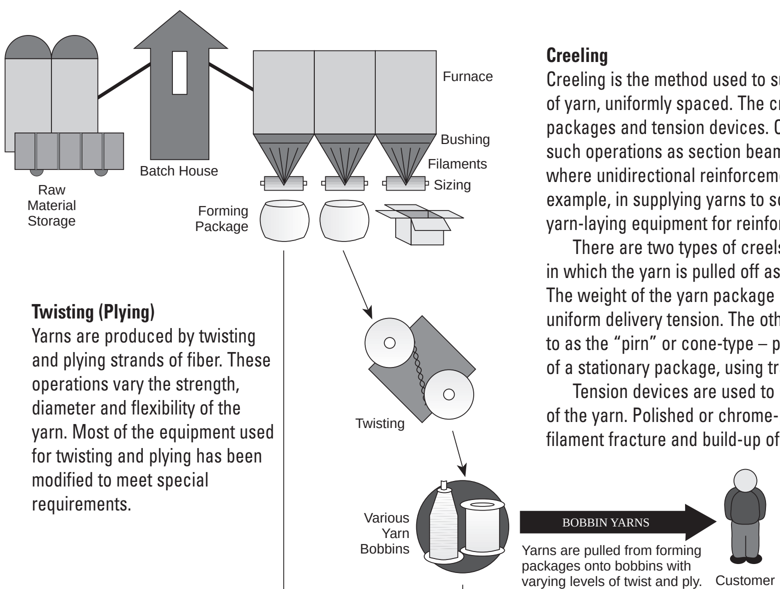
Advanced Glassfiber Yarn textile fibers are made from molten glass. The viscous liquid is drawn through tiny holes at the base of the furnace to form hair-like filaments. A protective sizing, applied as the filament cools and hardens, helps prevent abrasion during additional processing and/or makes the 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.

This section describes the process of making *Advanced* textile fibers as well as some of the end-use applications.

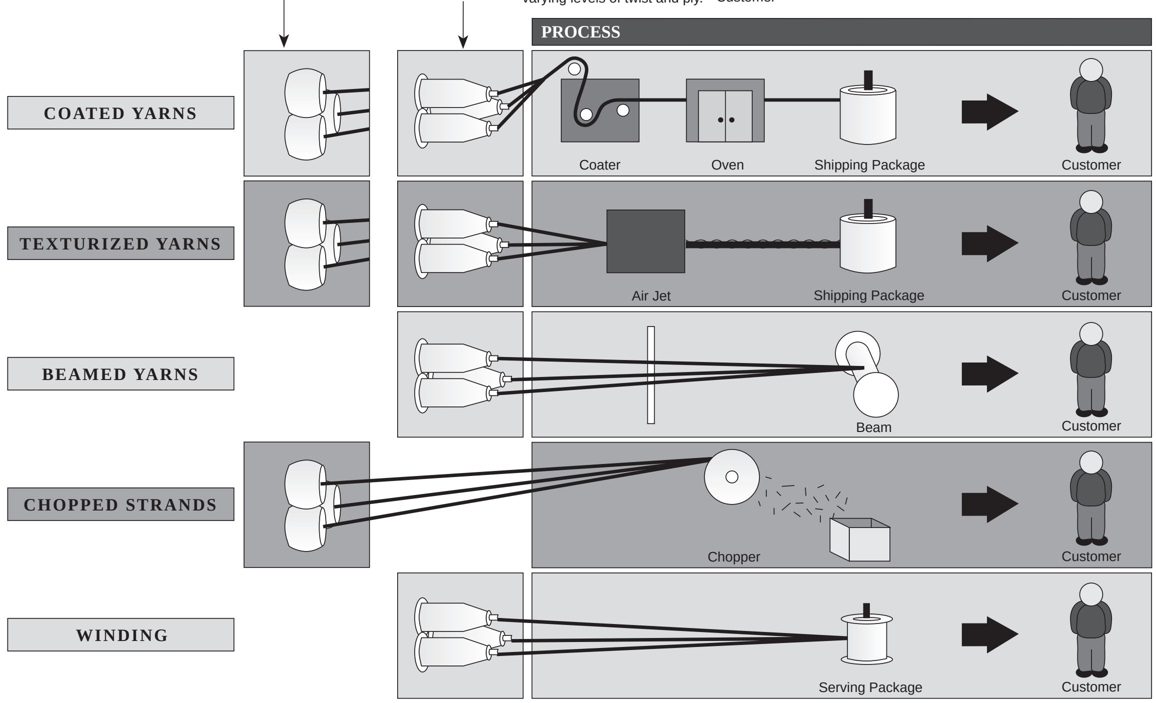


Twisting (Plying)
Yarns are produced by twisting and plying strands of fiber. These operations vary the strength, diameter and flexibility of the yarn. Most of the equipment used for twisting and plying has been modified to meet special requirements.

Creeling
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 "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.



Explanations

Yarns are run through a coating bath then dried in an oven.

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

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

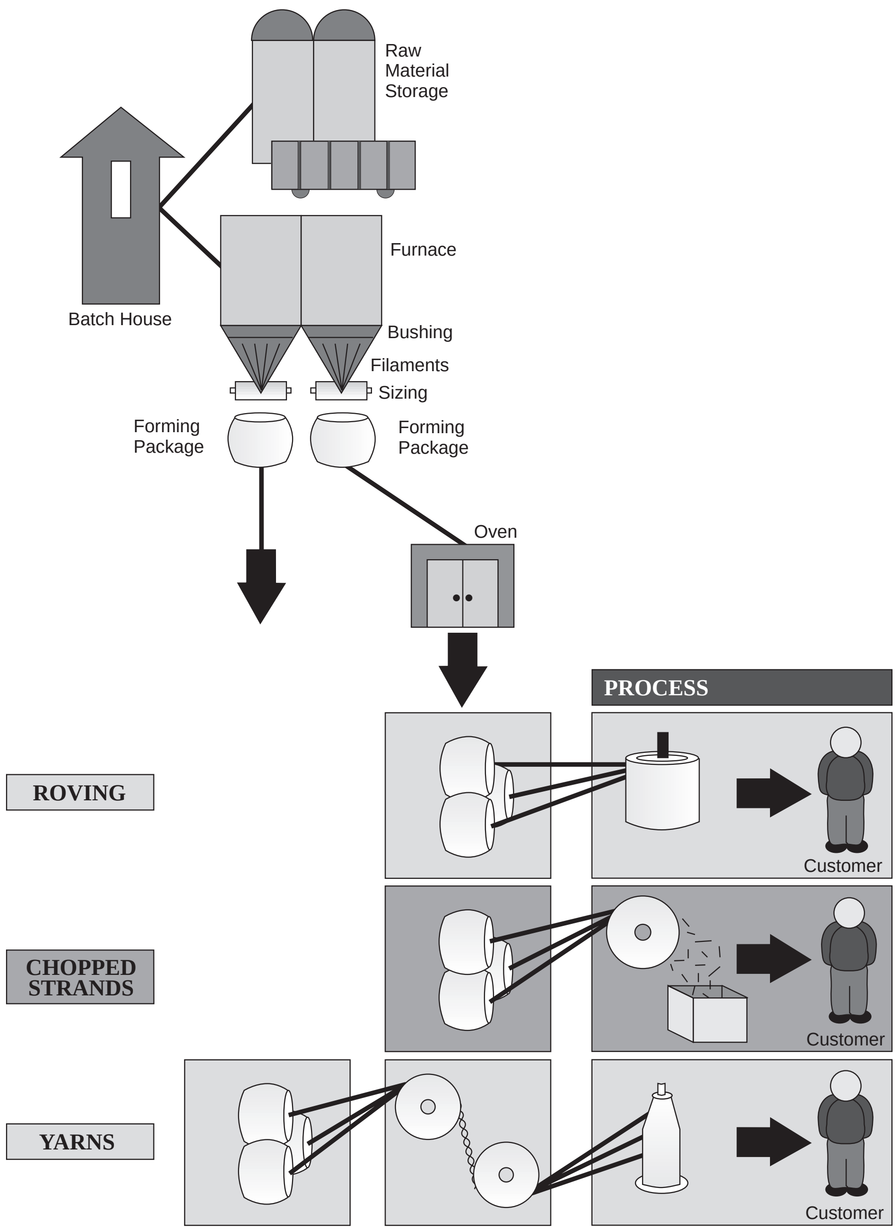
Dry yarns are chopped to various lengths.

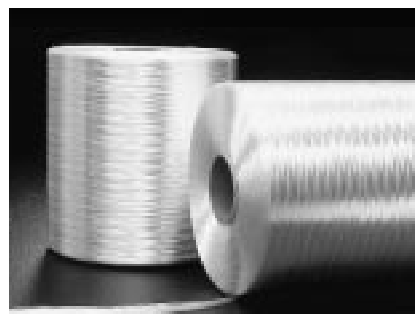
Winding is the process of transferring yarn from one type of package to another yarn package.

Glass Fiber Manufacturing

S-2 Glass® Manufacturing

Advanced provides a unique S-2 Glass® fiber – a new generation of glassfiber that, compared to conventional E-glass fiber, provides enhanced fiber properties and greater finished part performance. The enhanced properties of *S-2 Glass* fiber are: strength, temperature resistance, fatigue resistance, stiffness and radar transparency. These product properties have allowed *S-2 Glass* fiber to be selected and qualified over other fibers for demanding applications that range from firemen's air bottles, helicopter blades, aircraft flooring, shipboard and tank armor, wind surfers and running shoes, to high-temperature filter bags. Although the batch (basic raw ingredients) for *S-2 Glass* products differ from conventional E-glass batch, the manufacturing process of the two is similar. *S-2 Glass* fiber is available in yarn, roving (multi-end and single-end) and chopped forms.





Explanations

Yarns are pulled from forming packages onto bobbins with varying levels of twist and ply.

Dry S-2 Glass® yarns are chopped to various lengths.

Filaments are pulled and gathered at the bushing and sizing is applied. The forming packages are dried in an oven; filaments are then packaged for shipment.

The properties and dimensions of glassfiber textile fibers are precisely measurable and controllable within the limits of the basic raw material itself. These attributes are far more precise than those occurring in natural fibers, and at least as precise as any manmade fiber.

Measured and controlled characteristics provide a basis of comparison. Knowing how glassfiber textile fibers perform in relation to similar fibers allows an informed choice when selecting a material to fit an application.

This section charts the average properties of glassfiber textile fibers.

Typical Properties of E and S-2 Glass® Filaments Compared to Aramid and Carbon Filaments.

Property	E-Glass	S-2 Glass®	K-49 Aramid	AS4 Carbon
Physical, Single Filament				
Density, Lbs./Cu. In., ASTM C693	0.092-0.093	0.089-0.090	0.052	0.065
Specific Gravity, g.cu. cm., ASTM C693	2.55-2.58	2.46-2.49	1.44	1.80
Moh Hardness	6.5	6.5		
Moisture Regain, ASTM D1909	None	None	3.5	0
Mechanical, Single Filament				
Poisson's Ratio*	0.22			
Bulk Modulus, psi*	5.0 x 10^{6}			
Tensile Strength, psi (ASTM D2101) @ -310°F	770,000	1,200,000		
@ 72°F	500,000-550,000	665,000-700,000	425,000	550,000
@ 700°F	380,000	545,000		
@ 1000°F	250,000	350,000		
Tensile Modulus of Elasticity ASTM D2101 psi @ 72°F	10-10.5 x 10^{6}	12.5-13.0 x 10^{6}	18-19 x 10^{6}	32-34 x 106
psi @ 1000°F	11.8 x 10^{6}	12.9 x ^{6}		
Hysteresis	None	None		
Creep	None	None		
Elongation at Break, percent, ASTM D 2101	4.5-4.9	5.4-5.8	2.5-2.9	1.5-1.6
Elastic Recovery, percent	100	100		
Mechanical, Impregnated Strand				
Tensile Strength, psi @72°F (ASTM D2343)	270,000-390,000	530,000-620,000	420,000-525,000	450,000-550,000
Toughness, psi (ASTM D2343)	9,000-10,000	12,000-13,000	7,000-8,000	5,000-6,000
Creep, % of Initial Strain at 50% of Strength, 10,000 Hours (ASTM D2990)	0-5	0-3	10-30	0-2
Thermal				
Linear Expansion Coefficient* In./In. • °F, ASTM D696	3.0 x 10^{-6} (@ -20°F to 480°F)	0.9 x 10^{-6} (@ -20°F to 480°F)	-2.4 x 10^{-6}** 23 x 10^{-6} (@ 78°F to 266°F)	-0.6 x 10^{-6}** 9.3 x 10^{-6}
Conductivity Coefficient, @ 72°F* BTU-in./hr. • sq. ft. • °F, ASTM C177	7-9	8-10	0.3-10	50-70
Specific Heat, BTU/lb. • °F* @ 72°F	0.193	0.176	0.33	0.17
@ 392°F	0.247	0.196	0.63	0.29
Softening Point, F,* ASTM C338	1555	1932	(Oxidation	(Oxidation
Strain Point, F,* ASTM C336	1140	1410	Above 300°F)	Above 660°F)
Flame Resistance, % Oxygen Index, ASTM 2863	100	100	29	60
Electrical				
Dielectric Strength, volts/mil @ 190mil thk*	262	330		
Dielectric Constant @ 72°F,* 60 Hz.	6.5-6.8			
1 MHz.	6.3-6.7	5.0-5.4	4.0-4.1	Conductive
10 GHz., ASTM D150	6.13	5.21	3.85	
Dissipation Factor @ 72°F,* 1 MHz.	0.001-0.005	0.002	0.014	Conductive
10 GHz, ASTM D150	0.0039	0.0068	0.0100	
Volume Resistivity @ 72°F and 500 volts dc*, Ohm • m, ASTM D257	0.402 x 10^{15}	0.905 x 10^{13}	0.5 x 10^{12}	0.153 x 10^{-4}
Surface Resistivity @ 72°F and 500 volts dc*, Ohms, ASTM D257	0.420 x 10^{16}	0.886 x 10^{13}	10^{12}-10^{14}	0.1 x 10^{-4}
Acoustical				
Velocity of Sound, ft./sec.*	18,000	19,200	9,000	19,500
Impedance, gm/cm/sec.*	1.4 x 10^{6}			
Velocity of crack propagation, ft./sec.*	5,260			
Optical				
Refractive Index, 589.3nm @ 90°F*	1.547-1.562	1.520-1.525	1.6-2.0	NA
Clarity	Transparent	Transparent		
Ultraviolet Transmission	Opaque			

* Bulk glass properties to be applicable to bare glass filaments
** Range of axial to lateral property due to crystalline orientation

Textile Filament Comparison Table

(Obtained from the fiber manufacturers. For complete definitions, see ASTM Standards on Textile Materials.)	Glass		Aramid	Carbon	Fluorocarbon	
	Glassfiber (Advanced)		Kevlar*	AS4	Teflon*	
Fiber Type	E-Glass single filament	*S-2 Glass* single filament	K49 single filament	AS4 single filament	TFE multifilament	FEP monofilament
Breaking Tenacity (gf/d) Std.	15.3	19.9	23	24.1	0.9-2.0	0.5
Breaking Tenacity (gf/d) Wet	15.3	19.9	21.7	24.1	0.9-2.0	0.5
Breaking Elongation % Std.	4.8+	5.3 to 5.7+	2.5-2.9	1.5-1.6	19-140	52
Breaking Elongation % Wet	4.8+	5.3 to 5.7+	2.5-2.9	1.5-1.6	19-140	52
Tensile Strength, psi @ 72°F	500,000-550,000	665,000-700,000	425,000	550,000	40,000-50,000	14,000
Elastic Recovery % @ % Strain	100 @ 100	100 @ 100	100 @ 1, 2, 3	100 @ 100		
Average Stiffness (gf/d)	320	380	900	1500	1.2-8.8	1.0
Specific Gravity, g/cc, ASTM C 643	2.55-2.58	2.46.-2.49	1.44	1.80	2.1	2.1
Water Regain, %	(Surface)	(Surface)				
21°C, 65% R.H.	None	None	4.3		0	0
21°C, 95% R.H.	Up to 0.3	Up to 0.3	6.0			
Effect of Heat	Will not burn. Tensile Retention at 342°C: E-glass retains 75% *S-2 Glass* retains 80% Tensile Retention at 538°C; E-glass retains 50% *S-2 Glass* retains 60%		Difficult to ignite. Does not propagate flame. Does not melt. Decomposes at about 482°C.	Does not melt. Oxidizes very rapidly in air at temperatures above 316°C.	(TFE) Extremely resistant. Safely used at -213 to +288°C. Melts at 327°C (FEP). Highly resistant. Melts at 288°C. Sublimation = 0.0002%/hr. at 290°C. Vapors toxic.	
Effect of Acids and Alkalis	Good resistance by *S-2 Glass* to most acids Fair resistance by E-glass to most acids. (at low concentrations)		Good resistance to dilute acids and bases. Degrading by strong mineral acids and, to an extent, by strong mineral bases.	Excellence resistance to acids and alkalis, even at high concentrations and temperatures. Strong oxidizers will degrade fiber.	Essentially inert to acids and alkalis.	
Effect of Bleaches and Solvents	Unaffected.		Should not be bleached. Excellent solvent resistance.	Inert to all known solvents. Poor resistance to hypochlorite.	Most chemical-resistant fiber shown. The only known solvents are alkalis meals and certain perfluorinated organic liquids at above 299°C.	
Dyes Used	Resin-bonded pigment systems, vat, acid, or chrome dyes will tint.		Naturally yellow. Use pigmented sizings for other colors.	Cannot be dyed.	Cannot be dyed.	
Resistance to Mildew, Aging, Sunlight	Excellent resistance to sunlight and aging. Not attacked by mildew (binder may be affected by mildew).		Excellent resistance to mildew and aging. Prolonged exposure to sunlight causes deterioration, but fibers are self-screening.	Excellent resistance to mildew, aging and sunlight. Poor abrasion resistance.	Not weakened by mildew. Excellent resistance to aging and sunlight. Good abrasion resistance.	

* denotes trademarks
(single filament virgin glass strength test)

Olefin		Polyester		Nylon	
Polypropylene	**Spectra 1000***	**Dacron***		**Nylon 6,6**	
Isotactic multifilament	Spectra 1000	Regular Tenacity filament	High Tenacity filament	Regular Tenacity filament	High Tenacity filament
3.0-8.0 3.0-8.0	35 35	2.8-5.6 2.8-5.6	6.8-9.5 6.8-9.5	2.3-6.0 2.0-5.5	5.9-9.8 5.1-8.0
20-80 20-80	2.7 2.7	24-42 24-42	12-25 12-25	25-65 30-70	15-28 18-32
35,000-90,000	425,000	50,000-99,000	106,000-168,000	40,000-106,000	86-134
94-98 85-95 @ 5 @ 10		76 @ 3	88 @ 3	88 @ 3	89 @ 3
17-40	2,000	10-30	30	5-24	21-58
0.90-0.91	0.97	1.38	1.39	1.13-1.14	1.13-1.14
0.01-0.1 0.01-0.01	Negligible	0.4	0.4	4.0-4.5 6.1-8.0	4.0-4.5 6.1-8.0
Softens at 140-165°C. Melts at 160-177°C. Decomposes at 288°C. 0-5% shrinkage at 118°C, 5-12% at 129°C.	Melts at about 149°C.	Sticks at 227-229°C. Melts at 250°C.		Sticks at 229°C. Melts at 249-260°C. Yellows slightly at 149°C when held for five hours.	
Excellent resistance to most acids and alkalis with the exception of elevated temperature to chlorosulfonic acid, concentrated nitric acid and certain oxidizing agents.	Excellent resistance to most acids and alkalis with the exception of elevated temperature exposer to some acids.	Good resistance to most mineral acids. Dissolves with partial decomposition in concentrated solutions of sulfuric acids. Good resistance to weak alkalis. Moderate resistance to strong alkalis at room temperature. Disintegrates in strong alkalis at boil.		Unaffected by most mineral acids except hot mineral acids. Dissolves with partial decomposition in concentrated solutions of hydrochloric, sulfuric and nitric acids. Soluble in formic acid. Substantially inert in alkalis.	
Resistant to bleaches and most solvents. Some hydrocarbons cause swelling, especially at elevated temperatures.		Excellent resistance to bleaches and other oxidizing agents. Generally insoluble except in some phenolic compounds.		Can be bleached in most bleaching solutions. Generally insoluble in most organic solvents. Soluble in some phenolic compounds.	
Acid, dispersed and chelating. Certain vats, sulfurs and azoics.	None.	Dispersed, developed and cationic (for some types), with carrier or at high temperature.		Dispersed, acid and premetalized are usually preferred, but most organic classes are also used.	
Not attacked by mildew. Good resistance to aging and indirect sunlight. Can be stabilized to give good resistance to indirect sunlight.	Excellent resistance to mildew, aging and abrasion. Some loss of strength with long exposure to sunlight.	Not weakened by mildew. Excellent resistance to aging and abrasion. Prolonged exposure to sunlight causes some strength loss.		Excellent resistance to mildew, aging and abrasion. Prolonged exposure to sunlight causes some deterioration.	

Glossary of Terms

In the glassfiber 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 glassfiber 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 or shipping package on to which textile yarns are wound.

BRAID/BRAIDER
A narrow tubular or flat fabric produced by intertwining a single set of yarns according to a definite pattern.

BUSHING
A platinum plate full of 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.)

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. (See warp.)

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 rapier and more traditional shuttle 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.

PLIED YARN
A yarn formed by twisting together two or more single yarns in one operation. (Synonyms: folded yarn, formed yarn.)

PLY
The number of single yarns twisted together to form a plied yarn; also the number of plied yarns twisted together to form a cord. The individual yarn in a plied yarn or in a cord. 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.

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 Advanced 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
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 size 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
A single fiber, filament or monofilament. 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.

STRAND COUNT
U.S. Yardage System: the length, in hundreds of yards, of a single strand having a mass of one pound. European TEX System: the mass, in grams, of a strand 1000 meters in length.

TAPE
A narrow fabric with a mass per unit area of less than 0.5kg/m^2(0.1lb/ft^2) for each 25.4mm(1 in.) of width and which is used primarily for utilitarian purposes.

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 km 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.

UNTREATED
A descriptive term for glassfiber yarns having no applied chemicals or coatings, other than the minimal lubricant or binder used to control intra-fiber abrasion.

VINYL-COATED GLASS YARN
Continuous glass filament yarn, coated with a pigment and plasticized vinyl chloride resin.

WARP
The yarn running lengthwise in a woven fabric. 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.

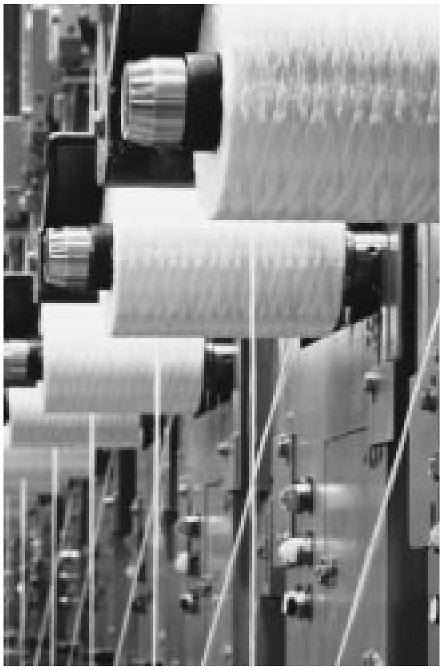
WARP SIZE
Chemicals applied to the warp yarn to improve strand integrity, strength and smoothness in order to withstand rigors of weaving.

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

WET-PROCESS
A process for forming a non-woven web from a water slurry on "papermaking" equipment. Also known as "wet-laid" or "wet-formed."

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.

ZENTRON® ROVING
Advanced's single-end rovings made from S-2 Glass® fibers.



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