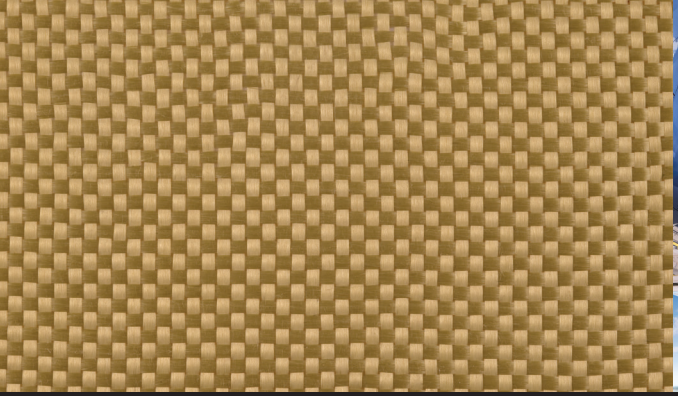





JPS COMPOSITE MATERIALS
A STEEL PARTNERS COMPANY

**JPS Composite Materials**
2200 South Murray Avenue
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ISO 9001 and AS9100 Registered
www.jpscm.com

jpscm.com

JPS COMPOSITE MATERIALS
A STEEL PARTNERS COMPANY

# Technical Reference Handbook

www.jpscm.com




Revision: 2025




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## Company

JPS Composite Materials is the world's leading manufacturer of high strength fiberglass, Astroquartz®, aramid, and specialty reinforcement fabrics. Our materials are used extensively in composite reinforcing, insulating, and safety applications. JPS fabrics are used in consumer and industrial electronics, aerospace interior and exterior structures, advanced commerical and military radomes, in marine and surf applications, sporting goods, and other advanced composites. Our materials are readily adaptable to unlimited applications!

JPS Composite Materials is an ISO 9001:2015 and AS9100:0 certified company.

Direct customer access to customer service:
1-800-431-1110

For further information,
JPS Composite Materials
PO Box 2627, Anderson, SC, 29622
www.jpscm.com

## Locations

**Anderson, South Carolina**
Corporate Headquarters
Aerospace Composite, Astroquartz®, Aramid, and Specialty Fabrics

**Statesville, North Carolina**
Electrical Laminate E-glass Fabrics, Lightweight Advanced and Aerospace Composite Fabrics

# MISSION

Develop, manufacture and support high quality products that solve problems and add value to our customers

Adapt to evolving customer needs and market fluctuations to remain a viable, relevant partner

Create a positive company culture through developing leaders and hiring and retaining talent who embrace our Core Values.

Embrace a continuous improvement mindset and commit to get better every day.

JPS COMPOSITE MATERIALS
A STEEL PARTNERS COMPANY



# VISION

To become the most trusted North American Composite Manufacturer in the Aerospace and Industrial Markets

JPS COMPOSITE MATERIALS
A STEEL PARTNERS COMPANY

# PURPOSE



Deliver our customers a technically superior product on time, and as ordered.



Meet or exceed our commitments to our stakeholders, delivering a fair return on investment.



Create sustainable career opportunities for our people, continuing a rich legacy of impacting our communities.

JPS
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# VALUES

**TEAMWORK** — We drive to the best outcomes together and push each other to become the best individually, so we can be the best collectively.

**RESPECT** — We value and respect all members of the JPS family and work to include all viewpoints and embrace the power that diversity and inclusion gives all of us.

**INTEGRITY** — We do what we say we're going to do. We manage our work responsibilities with a high morale code of conduct, and display honest, productive candor with others.

**COMMITMENT** — We show up. We work hard. We don't quit. We offer solutions instead of complaints. JPS is OUR company and we are committed to see it, and each other, succeed.

**ACCOUNTABILITY** — We set a common expectation for ourselves and our people and live the Vision, Mission, Purpose and Core Values. We learn from mistakes and embrace opportunities each day.

JPS
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## JPS Composite Materials Quality Policy

JPS Composite Materials recognizes that our greatest assets are our people and our customers. Our Quality Policy highlights values that are elemental to our success and includes:

Being driven by integrity, honesty, and a high moral code of conduct, we will maintain our position as the premier supplier for our customers in a global market.

Delivering our customers a technically superior substrate on time and as ordered, accomplished by a teamwork approach that recognizes we achieve more collectively than as individuals.

Establishing partnerships with our suppliers and customers through respect, and development of innovative products designed to meet everchanging market demands.

An unwavering commitment to our people to provide an environment which guarantees Safety and demands accountability.

A commitment to meet or exceed expectations we hold for ourselves and all interested parties.

Our Mission, Vision, Purpose and Core Values will continue to drive JPS forward in the pursuit of excellence for our people, our business, and our partners.

## For Future Generations

JPS is committed to doing our part to ensure that our world continues to provide sustainable resources for generations to come.

While we feel that our footprint should be small, we strive for our impact to be great.

Through the EcoVadis Platform sustainability performance system JPS is demonstrating that we put our values to work not only within the walls of our facilities, but also throughout our local and global communities.

## Through our parent company




JPS Composite Materials offers programs such as **Steel Grow** to further develop our associates.

Steel Sports takes our internal values to the community through the Foundations of Positive Coaching. This program provides coaches with the necessary tools to develop the next generation and is a shining example of our commitment to make the world a better place, one child at a time.

# Parameters for Fabric Selection

In selecting a woven fabric for industrial applications a number of design parameters must be considered. These are broken down into five basic variables: Yarn Weight, Yarn Thickness, Yarn Count, Weave Pattern, and Fabric Finish.

Yarn weight and yarn count determine the majority of the physical properties of the fabric. Yarn count is defined as the number of warp yarn ends (lengthwise) and filling yarn picks (widthwise) used per inch.

The weave pattern determines the stiffness or drapability of the fabric. The pattern will also have an influence on overall thickness. For composite applications there are six basic patterns: Plain, Basket, Leno, Four Harness Satin (Crowfoot), Eight Harness Satin, and Twill.

The fabric finish is the surface chemistry applied to the fabric post weaving. Finishes are generally applied to promote adhesion between the fabric and any resin coatings. They may also serve to add stiffness, prevent moisture uptake, and wear damage caused by handling.

## Glass Yarn

Yarn determines the majority of the end fabric properties, including the fabric weight, thickness, and strength. The yarn properties are determined by the chemical composition, the number of input filaments per yarn strand, the number of yarn strands twisted or plied together, and the overall denier (weight) of the final input yarn.

## Glass Formulations

Glass fibers are made from different formulations: “E” is the most common all-purpose glass. Other types include “S”, “T”, and “L”, among others. Astroquartz ® products are the purest form of silica commercially available.



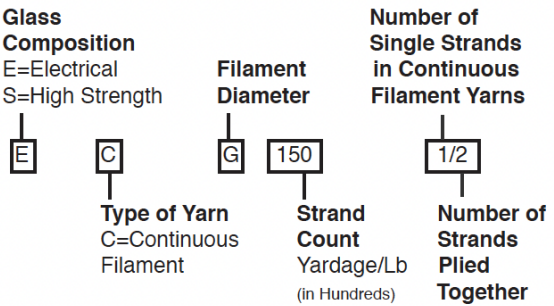
**COMPOSITION OF TYPICAL GLASSES**

(%) by weight

| Ingredient | “E” Glass | “S”, “T” Glass | “Astroquartz ® II & III” |
|---|---|---|---|
| Silicon Dioxide | 52-60 | 64-66 | 99.99 |
| Calcium Oxide | 16-25 | - | - |
| Aluminum Oxide | 12-16 | 24-26 | - |
| Boron Oxide | 8-13 | - | - |
| Sodium and Potassium Oxide | 0-1 | - | - |
| Magnesium Oxide | 0-6 | 9-11 | - |

## Filament/Yarn Nomenclature

An exact system for identifying fiberglass textile yarns is required because of the wide variety of available types. The nomenclature consists of two basic parts. The alphabetical portion describes the composition and construction. The numerical describes the weight and number of yarns twisted and plied together.
As an example:




The above describes the basic strand by composition, type and diameter. The numbers identify strand weight and construction. The above description would be for ECG 150 1/2 yarn, or more simply G-150 1/2, used in style 1581 fabric. The S-glass version for style 6581 fabric

would be SCG 150 1/2, where “S” denotes S-glass. The non-twisted equivalent for 7781 would be ECDE 75 1/0.

The strand count is the first series of numbers following the letters. It indicates approximate yardage per pound, in hundreds. The number of yards in one pound of single yarn strand can be found by multiplying the strand count by 100.

The second series of numbers designates the number of plies in continuous filament yarns. The first digit in the second digit series indicates the number of single strands twisted together. Untwisted single strands are commonly referred to as “singles” yarn and are designated as 1/0. The second digit in the second series, separated from the first digit by a diagonal line, designates the number of strands that are plied together. To find the total number of strands in a yarn, multiply the two numbers (0 multiplied as 1). A typical nomenclature for a continuous yarn:

ECG 150-1/2 Where:
E = E-glass
C = Continuous filament
G = Average filament diameter (see table, page 14)
150 = 15,000 Yd/Lb (Nominal) of basic “singles” strand
1/2 = One continuous filament yarn strand consisting of two strands plied together (1X2)

The approximate yards per pound of fabricated yarn can be found by dividing the strand count, multiplied by 100, by the number of strands.

Therefore, ECG 150 1/2 contains:

$$\frac{150 \times 100}{1 \times 2} = 7500 \text{ yds/lb for fabricated yarn}$$

The results of this computation must always be considered approximate, as yards per pound may be reduced slightly in the twisting and plying operations.



**DESCRIPTION OF CONTINUOUS FILAMENT GLASS FIBERS**

| Filament Name | Filament Diameter mils | Filament Diameter microns | Strand Count (x100=yd/lb) | Tex | Number of Filaments |
|---|---|---|---|---|---|
| C | 0.18 | 4.5 | 150 | 33 | 816 |
| D | 0.20 | 5.0 | 1800 | 2.75 | 51 |
| | | | 900 | 5.5 | 102 |
| | | | 450 | 11 | 204 |
| | | | 225 | 22 | 408 |
| DE | 0.24 | 6.0 | 150 | 33 | 408 |
| | | | 75 | 66 | 816 |
| | | | 50 | 99 | 1224 |
| | | | 37 | 134 | 1632 |
| E | 0.28 | 7.0 | 225 | 22 | 204 |
| G | 0.35 | 9.0 | 150 | 33 | 204 |
| | | | 75 | 66 | 408 |
| | | | 37 | 134 | 816 |
| H | 0.43 | 10 | 25 | 198 | 816 |
| K | 0.51 | 13 | 75 | 66 | 204 |
| | | | 37 | 134 | 408 |
| | | | 25 | 198 | 608 |
| | | | 18 | 275 | 816 |

## DESIGN CONSIDERATIONS FOR GLASS FABRIC SELECTION

There are five basic design variables to consider when choosing fabric for industrial use: thickness, aerial weight, yarn size, construction, finish.

### Thickness

Glass fabrics are available in thicknesses ranging from ~0.001” to ~0.060”.

### Weight
Fabric weights are typically measured in ounces per square yard (osy) or grams per square meter (gsm). Glass fabrics are available from about 0.50 osy up to about 52 osy (17 gsm to 1773 gsm).

### Construction
Construction refers to the fabric pattern, which is both the number of warp yarns per inch (machine direction, ends) and fill yarns per inch (cross-machine direction, picks), and the pattern of interlacing used (plain, twill, satin, etc).
Yarn Size (denier or weight)
Fabric weight and thickness are determined by the input yarn size (denier or weight).

### Finish
The finish is the chemical composition of the surface of final fabric. Organic coatings are applied (or removed) to make the fabric more suitable for future resin coating and end use performance requirements.

## FABRIC CREATION
### Yarn Preparation: Twisting/Plying
This process serves to control the yarn strength, diameter, weight, and flexibility.

Filaments are twisted and or plied based on the end fabric specification requirements.

Most glass fabrics are woven from singles yarns (1/0). Some notable exceptions including styles 108, 120, and 1581.

### Warping
Warping is the laying of the machine direction fibers in parallel order. This creates the warp, or machine direction, of the fabric.



A specified number of yarns per inch are drawn from a creel and wound on a beam. Several “section” beams are then combined to provide the designated number of yarns per inch required in the fabric specifications.

### Slashing/Combining
The section beams from warping are combined during the slashing process to create a warp beam (aka: loom beam).This entire system of parallel threads is wound onto one large beam to become the “warp”, or machine direction, of the fabric.

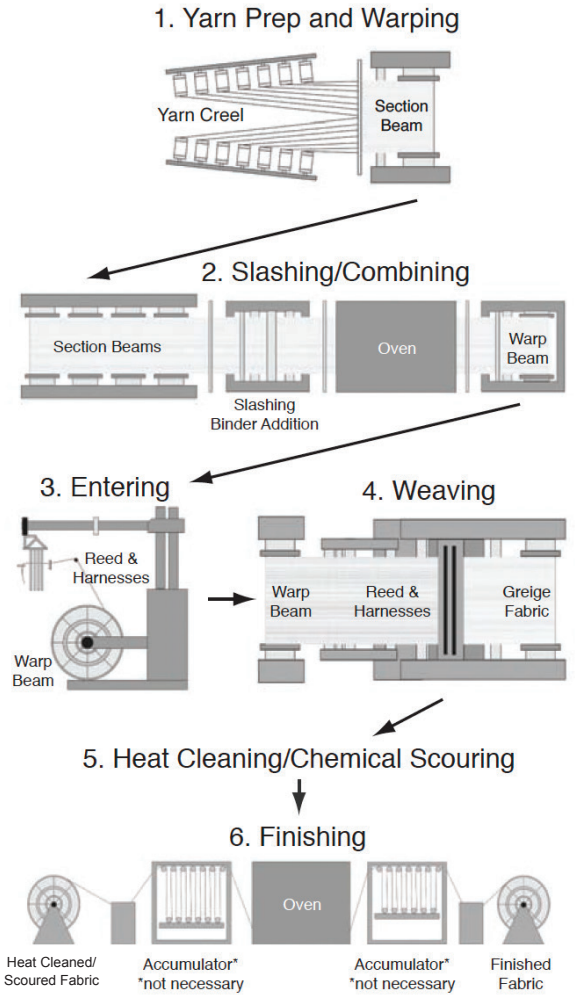
An additional yarn binder may be applied to the warp yarns during the slashing process. The additional binder helpsto improve fabric surface quality by providing extra protection to the warp yarns during the weaving process.

### Entering
The entering operation draws the warp yarns into the loom hardware, setting up the weave pattern, yarn spacing and thread counts. The warp yarns are threaded through the harnesses and reed. The entire warp beam-harness-reed unit is then transferred to the loom to begin weaving.

### Weaving
Weaving is the interlacing of filling (cross machine) yarns through warp (machine direction) yarns in a predetermined pattern, including yarn counts, yarn spacings, over/under sequences and predetermined intersecting angles.

### Cleaning and Finishing
Dependent on the end fabric use, specialty chemical finishes may be applied to the fabric surface. The loom state (greige) fabric surface must first be cleaned. This is accomplished via either heat exposure or chemical washing. Most glass fabrics are ‘heat cleaned’, most polymer based and specialty fabrics are chemically scoured. The specialty finish is applied post cleaning.

## Manufacturing Process Overview




Finishes most commonly act as coupling agents to improve resin wet-out and bonding. Finishes may also be applied to improve water and wear resistance, and high temperature performance.

JPS offers a wide range of existing finishes. We also develop specialty and exclusive finishes based on customer input. For more information please contact us.

### Weave Patterns

The matching of yarn, weave pattern and finish for a particular application is an exacting science. Because glass, aramid and specialty fabrics are highly engineered, the right combination of fabric weight, thickness and construction is essential in selecting the proper fabric. Selecting the right reinforcement fabric for any requirement can be simplified by calling us. Our specialized experience can aid in selecting a reinforcement fabric suited to your requirements.

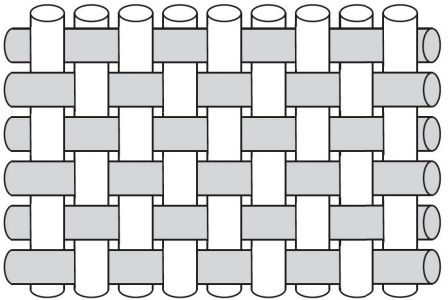
All standard fabric weaves presented here can be produced with fiberglass, aramid, Astroquartz ®, polymer and specialty yarns.

The six most common fabric patterns are presented here. Other fabric patterns are available on request; as well as through development.

Plain Weave fabrics tend to be the most stable pattern, followed by Leno, Basket Weave, 4H Satin, 8H Satin fabrics.

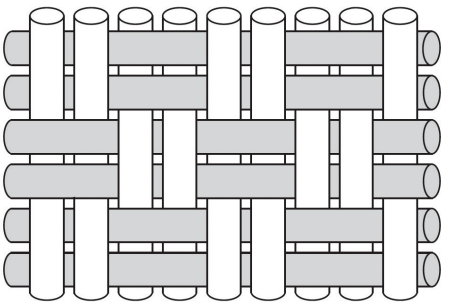
In terms of drape or conformability, 8H Satin is the most conformable, followed by the 4H Satin, Basket Weave, Plain Weave and Leno fabrics.

## Plain Weave



The plain weave consists of yarns interlaced in an alternating pattern, one over and one under every other yarn. The plain weave provides good fabric stability. It is the primary fabric used in the electronics and coating industries.

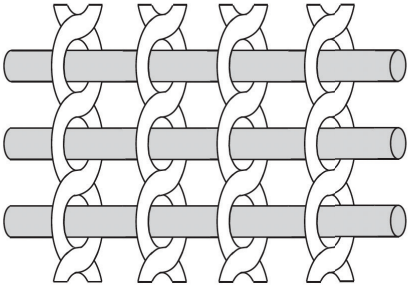
## Basket Weave



The basket weave is similar to the plain weave, except that two or more filling yarns are alternately interlaced over and under one another. The basket weave is more pliable, flatter, and stronger than the plain weave, but is not as stable as a plain weave.

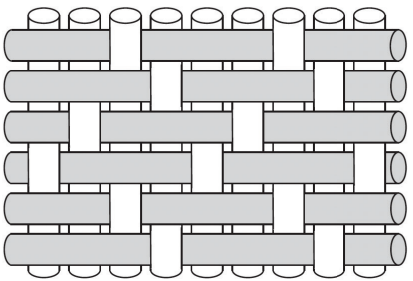


## Leno



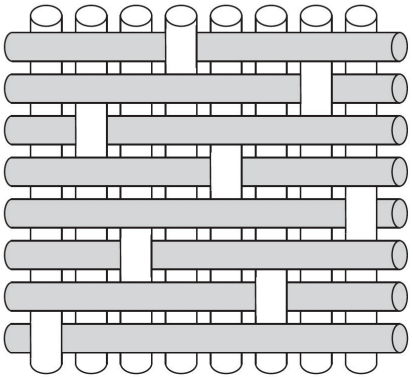
The leno weave is used where relatively low aerial weights are desired but specific thicknesses must be maintained. The leno weave pattern locks the yarns in place by crossing two or more warp threads over each other and interlacing with one or more fill threads. Leno weave patterns are common in EIFS applications and to set bond line thicknesses for adhesives and tapes.

## Four-Harness Satin (Crowfoot)



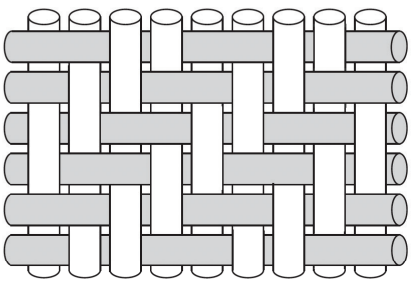
The four-harness satin relies on a three by one interlacing pattern. The fill yarn floats over three warp yarns and under one. The four-harness satin weave is more pliable than the plain weave and is easier to confirm to curved surfaces typical in reinfores plastics.

**Eight-Harness Satin**



The eight-harness satin is similar to the four-harness satin except that one filling yarn floats over seven warp yarns and under one. This is a very pliable weave and is used for forming curved surfaces.

**2x2 Twill**



The twill is used where tightly woven fabric with high density is required. The twill weave is characterized by a diagonal rib or twill line. The warp yarn floats over two consecutive picks, permitting more yarns per unit area.



# Specifications and Standards

JPS fabrics are designed to meet the requirements of a wide range of applications. Listed below is a partial offering of the standards and specifications we manufacture towards. For adherence to a specific standard or specification not listed please contact customer service or technical support.

**AMS-3824 -** Glass Cloth, Finished for Resin Laminates

**AMS-3846 -** Quartz Cloth, Finished for Resin Laminates

**AMS-3902 -** Para-Aramid Cloth for Structural Composites

**AMS-C-9084 -** Glass Cloth, Finished for Resin Laminates

**ASTM-D-579 -** Greige Woven Glass Fabrics

**ASTM-D-1668 -** Standard Specification for Glass Fabrics

**ASTM-D-4029 -** Standard Specification for Finished Glass Fabrics

**BMS 9-3 -** Boeing requirements for E-Glass Fabrics

**IPC-4413 -** Standard Specification for Glass Fabrics for Use in Printed Circuit Boards

**MIL-DTL-62474 -** Aramid-Reinforced-Plastic Composites

**MIL-PRF-64154 -** Glass-Reinforced-Phenolic Composites

**MIL-R-7575 -** Glass-Reinforced-Polyester Composites

**MIL-R-9300 -** Glass-Reinforced-Epoxy Composites

**MIL-Y-1140 -** Greige Woven Glass Fabrics

## Physical Properties of E-glass Fiber

**Approximate Chemistry***

| | |
|---|---|
| $SiO_2$ | 52-56% |
| CaO | 16-25% |
| $Al_2O_3$ | 12-16% |
| $B_2O_3$ | 5-10% |
| MgO | 0-5% |
| Na2O | 0-1% |
| K2O | 0-1% |
| Other Elements | 0-2% |

Physical Properties*

| | |
|---|---|
| Density | 2.54-2.60 g/cc |
| Refractive Index | 1.547 to 1.562 |
| Mohs Hardness | 6.5 |

Mechanical Properties*

| | |
|---|---|
| UTS (room temp) | 3.4-3.5 GPa |
| Breaking Strain | 4.5-5.0% |
| Young's Modulus | 65-75 GPa |
| Shear Modulus | 28-32 GPa |
| Poisson's Ratio | 0.200 |

Thermal Properties*

| | |
|---|---|
| CTE (-30ºC to 250ºC) | 5.4 µm/m-ºC |
| Specific Heat Capacity | 0.80-1.03 kJ/kg-K |
| Thermal Conductivity | 1.0-1.3 W/m-K |
| Softening Point | ≤ 845ºC |

Electrical Properties*

| | |
|---|---|
| Dk @ 1 MHz | 6.6 |
| Dk @ 10 GHz | 6.1 |
| Df @ 1 MHz | 0.003 |
| Df @ 10 GHz | 0.004 |
| Volume Resistivity | $4.02_{10}{}^{15}$ Ω-cm |
| Surface Resistivity | $4.20_{10}{}^{16}$ Ω-cm |
| Dielectric Strength | 103kV/cm |

*All values approximate. Actual values may vary, for further info contact JPS.



## Physical Properties of S-Glass

**Approximate Chemistry***

| | |
|---|---|
| $SiO_2$ | 64-66% |
| $Al_2O_3$ | 24-26% |
| MgO | 9-11% |
| Other Elements | 0-1.2% |

**Physical Properties***

| | |
|---|---|
| Density | 2.46-2.49 g/cc |
| Refractive Index | 1.520 to 1.525 |
| Mohs Hardness | 6.5 |

**Mechanical Properties***

| | |
|---|---|
| UTS (room temp) | 4.6-4.8 GPa |
| Breaking Strain | 5.4-5.8% |
| Young's Modulus | 85-90 GPa |
| Shear Modulus | 33-37 GPa |
| Poisson's Ratio | 0.230 |

**Thermal Properties***

| | |
|---|---|
| CTE (-30ºC to 250ºC) | 1.6 µm/m-ºC |
| Specific Heat Capacity | 0.74-0.82 kJ/kg-K |
| Thermal Conductivity | 1.1-1.4 W/m-K |
| Softening Point | ≤ 1055ºC |

**Electrical Properties***

| | |
|---|---|
| Dk @ 1 MHz | 5.3 |
| Dk @ 10 GHz | 5.2 |
| Df @ 1 MHz | 0.002 |
| Df @ 10 GHz | 0.007 |
| Volume Resistivity | $0.905_{10}{}^{13}$ Ω-cm |
| Surface Resistivity | $0.886_{10}{}^{13}$ Ω-cm |
| Dielectric Strength | 130kV/cm |

*All values approximate. Actual values may vary, for further info contact JPS.

# Fiberglass Fabric Applications

Fiberglass fabrics are used in a wide range of industrial applications, some of which are outlined below.

### Aerospace Applications
Fiberglass is used for interior cabin structures including seats, luggage bins, bulkheads, lavatories, wall panels, and in honeycomb structures. Other applications include gasketing, as galvanic barriers between carbon and metal, for structural parts, and in support of radomes. JPS is BMS, AMS, SAE and MIL spec approved for your needs.

### Electrical Applications
Fiberglass fabrics can be found in printed circuit boards, antennas, high voltage generators, transformers, switches, cables and many other electrical applications.

### Structural Applications
Fiberglass fabrics are used as reinforcements in highly engineered composite materials in many of the world's leading aircraft, automobiles, buildings, and roadways too.

### Recreational Applications
JPS fiberglass is found in many recreational composites, including in high performance racecars and motorcycles, bicycles, bats, racquets, hockey sticks, and in high end surf and snow boards.

### Thermal Insulation
The U.S. Navy, commercial shipyards, the automotive, and aerospace industries all use fiberglass almost exclusively for pipe lagging, thermal pad cover, thermal protection, and insulation applications.

### General Industrial Applications
Fiberglass fabrics can be found in window shades, vapor barriers, movie screens, packaging tapes, awnings, protective clothing, gaskets, conveyor belts, food cooking applications, and countless other products that improve our lives daily.



# Fiberglass Fabric Finishes

Fiberglass fabrics are available with a variety of finishes and treatments. The most common finishes are listed here. For specific applications, or to develop a custom finish for your application please contact customer service or your technical support representative.

| Finish Name | Functionality: Primary | Secondary | Notes |
|---|---|---|---|
| Greige | Uncoated | Phenolic | Loom state fabric with yarn binders |
| Caramelized (210) | Uncoated | PTFE | Loom state fabric, partially volatized |
| F3 | Polyester | Epoxy | Volan, green tint |
| F12 | Silicone | | Neutral pH |
| F16 | Polyester | Epoxy | Volan, green tint |
| 112 | Uncoated | Phenolic | Fully heat cleaned **BMS 9-3 Listed** |
| CS-309 | Polyimide | Epoxy, BT | Silane Finish |
| CS-310 | Epoxy | | Silane Finish **BMS 9-3 Listed** |
| CS-550 | PE, Epoxy | Phenolic | Volan, green tint |
| CS-616 | Melamine | | Silane finish, tan |
| CS-718 | Epoxy | | Silane Finish |
| CS-724 | Epoxy | | Silane Finish **BMS 9-3 Listed** |
| CS-745 | Epoxy | BT, Cyanate Ester, PI | Silane Finish |
| CS-767 | Epoxy, Cyanate Ester | BMI, Phenolic, SBR | Silane Finish **BMS 9-3 Listed** |

# Fiberglass Fabric Finishes (cont.)

| Finish Name | Functionality: Primary | Secondary | Notes |
|---|---|---|---|
| S-910 | Polyester | | High clarity for surf |
| S-912 | Polyester | Epoxy | High clarity for surf |
| A-1100 | Phenolic | Epoxy | Silane finish **BMS 9-3 Listed** |
| A-1100S | Phenolic | Epoxy | Recommend for hand layup, **BMS 9-3 Listed** |
| Z-6040 | Epoxy | Phenolic | Common base silane |
| 9464 | Uncoated | Epoxy | Antimony-free Hull Board |
| 9465 | Uncoated | Epoxy | Higher flame retardant Hull Board |
| 9466 | Uncoated | Epoxy | Standard Hull Board |
| 9827 | Epoxy | Polyimide | Silane finish |
| 9837 | Vinyl Ester | Polyester | Vinyl silane finish |
| Great White | Polyester | | Highest clarity for surf |
| Volan | Polyester | Epoxy | Volan finish, green tint, **BMS 9-3 Listed** |



## Fiberglass Fabrics

| Style | Weave | Count Warp | Count Fill | Yarn Warp | Yarn Fill | Weight (osy) | Weight (gsm) | Thickness (mils) | Thickness (mm) | Strength (lb/in) Warp | Strength (lb/in) Fill |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | Plain | 75 | 75 | ECD 1800 1/0 | ECD 1800 1/0 | 0.47 | 15.9 | 0.7 | 0.02 | 35 | 30 |
| 104 | Plain | 60 | 52 | ECD 900 1/0 | ECD 1800 1/0 | 0.55 | 18.6 | 1.4 | 0.04 | 40 | 15 |
| 106 | Plain | 56 | 56 | ECD 900 1/0 | ECD 900 1/0 | 0.73 | 25.0 | 1.5 | 0.04 | 45 | 40 |
| 108 | Plain | 60 | 47 | ECD 900 1/2 | ECD 900 1/2 | 1.40 | 47.5 | 2.1 | 0.05 | 70 | 40 |
| 112 | Plain | 40 | 39 | ECD 450 1/2 | ECD 450 1/2 | 2.08 | 70.5 | 3.4 | 0.08 | 100 | 70 |
| 116 | Plain | 60 | 58 | ECD 450 1/2 | ECD 450 1/2 | 3.09 | 105.0 | 3.5 | 0.09 | 150 | 130 |
| 117 | Plain | 54 | 39 | ECD 450 1/2 | ECD 450 1/2 | 2.40 | 81.4 | 3.7 | 0.09 | 125 | 100 |
| 120 | 4H Satin | 60 | 58 | ECD 450 1/2 | ECD 450 1/2 | 3.12 | 106.0 | 3.6 | 0.09 | 150 | 140 |
| 128 | Plain | 43 | 32 | ECE 225 1/3 | ECE 225 1/3 | 5.87 | 199.0 | 6.0 | 0.15 | 250 | 200 |
| 138 | 4H Satin | 65 | 60 | ECE 225 1/2 | ECE 225 1/2 | 6.53 | 221.4 | 6.6 | 0.17 | 270 | 260 |
| 162 | Plain | 28 | 16 | ECE 225 2/5 | ECE 225 2/5 | 11.96 | 405.5 | 13.0 | 0.33 | 650 | 400 |
| 220 | 4H Satin | 60 | 58 | ECE 225 1/0 | ECE 225 1/0 | 3.08 | 104.4 | 3.4 | 0.09 | 150 | 150 |
| 332 | 4H Satin | 48 | 32 | ECG 37 1/0 | ECG 37 1/0 | 12.36 | 419.1 | 12.7 | 0.32 | 526 | 370 |
| 880 | 8H Satin | 73 | 72 | ECDE 150 1/0 | ECDE 150 1/0 | 5.70 | 193.0 | 5.5 | 0.14 | 300 | 230 |
| 1014 | Knit | 18 | 20 | ECDE 150 1/0 | ECDE 150 1/0 | 6.60 | 223.0 | 10.5 | 0.26 | 20 | 10 |
| 1025 | Knit | 18 | 20 | ECDE 225 1/0 | ECDE 225 1/0 | 4.90 | 167.0 | 8.4 | 0.21 | 20 | 10 |
| 1035 | Plain | 65 | 68 | ECD 900 1/0 | ECD 900 1/0 | 0.87 | 29.0 | 1.2 | 0.03 | 45 | 45 |
| 1037 | Plain | 70 | 73 | ECC 1200 1/0 | ECC 1200 1/0 | 0.70 | 24.0 | 1.0 | 0.03 | 40 | 40 |
| 1039 | 2X2 Twill | 30 | 29 | ECG 75 1/0 | ECG 75 1/0 | 4.85 | 164.0 | 6.6 | 0.17 | 400 | 300 |

## Fiberglass Fabrics

| | | Count | | Yarn | | Weight | | Thickness | | Strength (lb/in) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Style | Weave | Warp | Fill | Warp | Fill | (osy) | (gsm) | (mils) | (mm) | Warp | Fill |
| 1067 | Plain | 70 | 70 | ECD 900 1/0 | ECD 900 1/0 | 0.91 | 31.0 | 1.0 | 0.03 | 19 | 18 |
| 1071 | Plain | 60 | 30 | ECD 900 1/0 | ECD 900 1/0 | 0.58 | 19.7 | 1.2 | 0.03 | 55 | 16 |
| 1076 | Plain | 60 | 25 | ECD 450 1/0 | ECD 900 1/0 | 0.98 | 33.2 | 1.4 | 0.03 | 100 | 20 |
| 1078 | Plain | 54 | 54 | ECD 450 1/0 | ECD 450 1/0 | 1.40 | 47.0 | 2.0 | 0.05 | 70 | 80 |
| 1080 | Plain | 60 | 47 | ECD 450 1/0 | ECD 450 1/0 | 1.40 | 47.5 | 1.9 | 0.05 | 98 | 65 |
| 1125 | Plain | 40 | 39 | ECD 450 1/2 | ECG 150 1/0 | 2.60 | 88.2 | 3.4 | 0.09 | 100 | 150 |
| 1131 | Plain | 120 | 52 | ECD 450 1/0 | ECG 150 1/0 | 3.66 | 124.1 | 4.6 | 0.12 | 130 | 150 |
| 1142 | Plain | 31 | 21 | ECG 37 1/0 | ECG 37 1/0 | 8.33 | 282.4 | 9.8 | 0.25 | 400 | 250 |
| 1161 | Plain | 100 | 42 | ECD 450 1/0 | ECDE 100 1/0 | 3.83 | 130.0 | 4.4 | 0.11 | 110 | 250 |
| 1162 | Plain | 100 | 36 | ECD 450 1/0 | ECG 75 1/0 | 4.30 | 145.8 | 5.3 | 0.13 | 100 | 180 |
| 1165 | Plain | 60 | 52 | ECD 450 1/2 | ECG 150 1/0 | 3.53 | 119.7 | 3.8 | 0.10 | 125 | 190 |
| 1167 | Plain | 60 | 55 | ECD 450 1/2 | ECG 150 1/0 | 3.76 | 127.5 | 4.0 | 0.10 | 110 | 200 |
| 1188 | 4H Satin | 46 | 30 | ECH 25 1/0 | ECG 150 1/0 | 12.36 | 419.1 | 12.0 | 0.30 | 500 | 35 |
| 1280 | Plain | 60 | 60 | ECD 450 1/0 | ECD 450 1/0 | 1.58 | 53.6 | 1.9 | 0.05 | 88 | 79 |
| 1297 | Plain | 50 | 20 | ECD 450 1/0 | ECD 900 1/0 | 0.77 | 26.1 | 1.7 | 0.04 | 83 | 12 |
| 1299 | Plain | 50 | 20 | ECD 450 1/0 | ECD 450 1/0 | 0.90 | 30.5 | 2.0 | 0.05 | 80 | 30 |
| 1521 | Plain | 30 | 16 | ECG 150 1/2 | ECG 75 1/0 | 3.49 | 118.0 | 4.4 | 0.11 | 200 | 148 |
| 1522 | Plain | 24 | 22 | ECG 150 1/2 | ECG 150 1/2 | 3.57 | 121.0 | 5.0 | 0.13 | 147 | 143 |

## Fiberglass Fabrics

| | | Count | | Yarn | | Weight | | Thickness | | Strength (lb/in) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Style | Weave | Warp | Fill | Warp | Fill | (osy) | (gsm) | (mils) | (mm) | Warp | Fill |
| 1523 | Plain | 28 | 20 | ECG 150 3/2 | ECG 150 3/2 | 11.26 | 381.8 | 12.0 | 0.30 | 510 | 370 |
| 1526 | Plain | 35 | 32 | ECG 150 1/2 | ECG 150 1/2 | 5.30 | 180.0 | 6.2 | 0.16 | 300 | 250 |
| 1526 | Plain | 35 | 32 | ECG 150 1/2 | ECG 150 1/2 | 5.30 | 180.0 | 6.2 | 0.16 | 300 | 250 |
| 1527 | Plain | 17 | 17 | ECG 150 3/3 | ECG 150 3/3 | 11.80 | 400.0 | 14.0 | 0.35 | 400 | 425 |
| 1528 | Plain | 43 | 32 | ECG 150 1/2 | ECG 150 1/2 | 6.03 | 204.0 | 6.7 | 0.17 | 280 | 200 |
| 1530 | Plain | 20 | 18 | ECG 150 3/3 | ECG 150 3/3 | 13.20 | 448.0 | 14.4 | 0.37 | 500 | 470 |
| 1538 | Plain | 44 | 32 | ECDE 150 1/2 | ECDE 150 1/2 | 6.00 | 203.4 | 7.0 | 0.18 | 300 | 200 |
| 1543 | 4H Satin | 49 | 30 | ECG 75 1/2 | ECE 225 1/0 | 8.52 | 289.0 | 7.9 | 0.20 | 700 | 80 |
| 1557 | 4H Satin | 58 | 30 | ECG 150 1/2 | ECE 225 1/0 | 5.13 | 174.0 | 4.6 | 0.12 | 300 | 85 |
| 1562 | Leno | 30 | 16 | ECG 150 1/0 | ECG 150 1/0 | 1.86 | 63.1 | 4.7 | 0.12 | 75 | 37 |
| 1564 | Plain | 20 | 18 | ECG 37 1/2 | ECG 37 1/2 | 12.07 | 409.2 | 13.0 | 0.33 | 520 | 500 |
| 1568 | Leno | 16 | 8 | ECH 25 1/0 | ECG 37 1/3 | 7.97 | 270.0 | 16.5 | 0.42 | 237 | 374 |
| 1581 | 8H Satin | 57 | 54 | ECG 150 1/2 | ECG 150 1/2 | 8.66 | 294.0 | 7.8 | 0.20 | 400 | 342 |
| 1582 | 8H Satin | 60 | 56 | ECG 150 1/3 | ECG 150 1/3 | 13.26 | 449.6 | 12.0 | 0.30 | 600 | 530 |
| 1583 | 8H Satin | 54 | 48 | ECG 75 1/2 | ECG 75 1/2 | 16.10 | 546.0 | 17.0 | 0.43 | 700 | 600 |
| 1584 | 8H Satin | 44 | 35 | ECG 150 4/2 | ECG 150 4/2 | 25.13 | 852.0 | 24.0 | 0. 61 | 950 | 800 |
| 1597 | Triple Plain | 30 | 30 | ECG 37 1/4 | ECG 37 1/4 | 36.69 | 1244.0 | 36.9 | 0.94 | 900 | 900 |
| 1609 | Plain | 32 | 10 | ECG 150 1/0 | ECG 450 1/0 | 1.39 | 47.1 | 2.5 | 0.06 | 130 | 10 |

## Fiberglass Fabrics

| | | Count | | Yarn | | Weight | | Thickness | | Strength (lb/in) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Style | Weave | Warp | Fill | Warp | Fill | (osy) | (gsm) | (mils) | (mm) | Warp | Fill |
| 1610 | Plain | 32 | 28 | ECG 150 1/0 | ECG 150 1/0 | 2.30 | 78.0 | 3.6 | 0.09 | 90 | 70 |
| 1614 | Leno | 30 | 14 | ECG 150 1/0 | ECG 75 1/0 | 2.33 | 79.0 | 5.5 | 0.14 | 75 | 85 |
| 1617 | Leno | 30 | 14 | ECG 150 1/0 | ECDE 75 1/0 | 2.31 | 78.0 | 5.5 | 0.14 | 50 | 25 |
| 1620 | Plain | 20 | 20 | ECG 150 1/0 | ECG 150 1/0 | 1.57 | 53.2 | 2.7 | 0.07 | 70 | 60 |
| 1628 | Plain | 40 | 28 | ECDE 150 1/0 | ECDE 150 1/0 | 2.60 | 88.2 | 3.5 | 0.09 | 170 | 100 |
| 1632 | Plain | 30 | 32 | ECG 150 1/0 | ECG 75 1/0 | 3.73 | 126.5 | 4.5 | 0.11 | 140 | 200 |
| 1633 | Plain | 40 | 20 | ECG 150 1/0 | ECG 75 1/0 | 3.07 | 104.1 | 4.2 | 0.11 | 150 | 120 |
| 1634 | Plain | 40 | 24 | ECDE 150 1/0 | ECDE 150 1/2 | 3.49 | 118.3 | 5 | 0.13 | 150 | 150 |
| 1636 | Plain | 40 | 24 | ECDE 150 1/0 | ECDE 150 1/0 | 2.55 | 86.5 | 4.4 | 0.11 | 175 | 70 |
| 1652 | Plain | 52 | 52 | ECG 150 1/0 | ECG 150 1/0 | 4.14 | 140.4 | 4.2 | 0.11 | 180 | 120 |
| 1658 | Plain | 20 | 10 | ECG 150 1/0 | ECG 75 1/0 | 1.57 | 53.2 | 3.5 | 0.09 | 60 | 70 |
| 1659 | Leno | 20 | 10 | ECG 150 1/0 | ECG 75 1/0 | 1.57 | 53.2 | 4.3 | 0.11 | 40 | 60 |
| 1669 | Plain | 60 | 12 | ECG 150 1/0 | ECD 450 1/0 | 2.50 | 85.0 | 2.8 | 0.07 | 300 | 15 |
| 1674 | Plain | 40 | 32 | ECG 150 1/0 | ECG 150 1/0 | 2.85 | 97.0 | 3.7 | 0.09 | 140 | 100 |
| 1675 | Plain | 40 | 32 | ECDE 150 1/0 | ECDE 150 1/0 | 2.84 | 96.3 | 3.8 | 0.10 | 180 | 140 |
| 1676 | Plain | 55 | 48 | ECDE 150 1/0 | ECDE 150 1/0 | 4.00 | 136.0 | 4.5 | 0.11 | 200 | 160 |
| 1677 | Plain | 40 | 40 | ECDE 150 1/0 | ECDE 150 1/0 | 3.12 | 105.8 | 4.0 | 0.10 | 190 | 160 |
| 1680 | 8H Satin | 72 | 70 | ECDE 150 1/0 | ECDE 150 1/0 | 5.57 | 189.0 | 5.3 | 0.13 | 355 | 314 |

## Fiberglass Fabrics

| | | Count | | Yarn | | Weight | | Thickness | | Strength (lb/in) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Style | Weave | Warp | Fill | Warp | Fill | (osy) | (gsm) | (mils) | (mm) | Warp | Fill |
| 1681 | Plain | 56 | 36 | ECDE 150 1/0 | ECDE 150 1/0 | 3.57 | 121.0 | 4.2 | 0.11 | 220 | 180 |
| 1688 | Plain | 31 | 20 | ECG 150 1/0 | ECG 75 1/0 | 2.88 | 97.6 | 4.7 | 0.12 | 100 | 120 |
| 1692 | Plain | 40 | 22 | ECG 150 1/0 | ECG 75 1/0 | 3.19 | 108.2 | 5.2 | 0.13 | 140 | 160 |
| 1694 | Plain | 40 | 24 | ECG 150 1/0 | ECG 75 1/0 | 3.51 | 119.0 | 4.9 | 0.12 | 170 | 200 |
| 1695 | Plain | 40 | 24 | ECDE 150 1/0 | ECDE 75 1/0 | 3.44 | 117.0 | 4.9 | 0.12 | 150 | 200 |
| 1800 | Plain | 16 | 14 | ECH 18 1/0 | ECH 18 1/0 | 9.39 | 318.4 | 11.2 | 0.28 | 460 | 410 |
| 2025 | Plain | 20 | 14 | ETDE 11.6 TEX | ETDE 11.6 TEX | 18.0 | 610.3 | 3.0 | 0.08 | 420 | 320 |
| 2112 | Plain | 40 | 39 | ECE 225 1/0 | ECE 225 1/0 | 2.07 | 70.2 | 2.9 | 0.07 | 109 | 112 |
| 2113 | Plain | 60 | 56 | ECE 225 1/0 | ECD 450 1/0 | 2.32 | 78.7 | 2.5 | 0.06 | 168 | 65 |
| 2114 | Plain | 56 | 48 | ECE 225 1/0 | ECE 225 1/0 | 2.74 | 93.0 | 3.4 | 0.08 | 175 | 135 |
| 2116 | Plain | 60 | 58 | ECE 225 1/0 | ECE 225 1/0 | 3.07 | 104.1 | 3.4 | 0.09 | 130 | 130 |
| 2117 | Plain | 66 | 55 | ECE 225 1/0 | ECE 225 1/0 | 3.18 | 108.0 | 3.7 | 0.09 | 200 | 150 |
| 2157 | Plain | 60 | 35 | ECE 225 1/0 | ECG 75 1/0 | 4.27 | 144.8 | 5.8 | 0.15 | 165 | 275 |
| 2165 | Plain | 60 | 52 | ECE 225 1/0 | ECG 150 1/0 | 3.65 | 123.8 | 4.0 | 0.10 | 170 | 190 |
| 2313 | Plain | 60 | 64 | ECE 225 1/0 | ECD 450 1/0 | 2.46 | 83.4 | 2.8 | 0.07 | 140 | 60 |
| 2523 | Plain | 28 | 20 | ECH 25 1/0 | ECH 25 1/0 | 11.01 | 373.3 | 12.2 | 0.31 | 493 | 394 |
| 2532 | Plain | 16 | 14 | ECG 25 1/0 | ECG 25 1/0 | 6.79 | 230.2 | 8.6 | 0.22 | 417 | 316 |
| 3070 | Plain | 70 | 70 | ECDE 300 1/0 | ECDE 300 1/0 | 2.79 | 94.6 | 2.9 | 0.07 | 133 | 110 |

## Fiberglass Fabrics

| | | Count | | Yarn | | Weight | | Thickness | | Strength (lb/in) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Style | Weave | Warp | Fill | Warp | Fill | (osy) | (gsm) | (mils) | (mm) | Warp | Fill |
| 3118 | Plain | 60 | 59 | ECD 450 1/2 | ECE 225 1/0 | 3.11 | 105.4 | 3.7 | 0.09 | 150 | 100 |
| 3313 | Plain | 61 | 62 | ECDE 300 1/0 | ECDE 300 1/0 | 2.43 | 82.4 | 2.8 | 0.07 | 124 | 101 |
| 3582 | 8H Satin | 59 | 55 | ECG 50 1/0 | ECG 50 1/0 | 13.60 | 462.0 | 12.5 | 0.32 | 712 | 674 |
| 3733 | Plain | 17 | 17 | ECG 37 1/0 | ECG 37 1/0 | 5.48 | 186.0 | 6.4 | 0.16 | 354 | 291 |
| 3743 | 4H Satin | 48 | 30 | ECG 37 1/0 | ECE 225 1/0 | 7.89 | 268.0 | 7.3 | 0.19 | 600 | 60 |
| 3783 | 8H Satin | 53 | 48 | ECG 37 1/0 | ECG 37 1/0 | 15.76 | 534.4 | 16.0 | 0.41 | 900 | 873 |
| 3784 | 8H Satin | 45 | 36 | ECG 37 1/2 | ECG 37 1/2 | 25.53 | 866.0 | 23.1 | 0.59 | 1000 | 875 |
| 3788 | 12H Satin | 42 | 36 | ECG 37 1/4 | ECG 37 1/4 | 49.74 | 1686.5 | 45.2 | 1.15 | 1523 | 1265 |
| 3884 | 8H Satin | 46 | 36 | ECDE 37 1/2 | ECDE 37 1/2 | 26.43 | 896.1 | 25.7 | 0.65 | 1000 | 800 |
| 4180 | 4H Crowfoot | 80 | 100 | SCD 450 1/0 | SCD 450 1/0 | 2.19 | 74.3 | 2.4 | 0.06 | 129 | 133 |
| 4527 | Plain | 24 | 22 | SCG 75 1/0 | SCG 75 1/0 | 3.58 | 121.4 | 5.2 | 0.13 | 300 | 250 |
| 6060 | Plain | 60 | 60 | ECDE 600 1/0 | ECDE 600 1/0 | 1.11 | 38.0 | 1.5 | 0.04 | 60 | 40 |
| 6080 | Plain | 60 | 47 | SCD 450 1/0 | SCD 450 1/0 | 1.27 | 43.1 | 1.9 | 0.05 | 100 | 70 |
| 6580 | 8H Satin | 72 | 69 | SCG 150 1/0 | SCG 150 1/0 | 5.67 | 192.2 | 6.1 | 0.15 | 300 | 250 |
| 6781 | 8H Satin | 57 | 54 | SCG 75 1/0 | SCG 75 1/0 | 8.64 | 293.0 | 8.8 | 0.22 | 420 | 400 |
| 7500 | Plain | 16 | 14 | ECG 37 1/2 | ECG 37 1/2 | 9.14 | 310.0 | 11.0 | 0.28 | 420 | 320 |
| 7510 | Plain | 18 | 21 | ECG 75 1/2 | ECG 150 1/2 | 4.50 | 153.0 | 5.8 | 0.15 | 200 | 100 |
| 7523 | Plain | 28 | 20 | ECG 75 1/3 | ECG 75 1/3 | 10.85 | 368.0 | 13.0 | 0.33 | 680 | 500 |
| 7531 | Plain | 23 | 14 | ECG 75 1/2 | ECG 75 1/2 | 5.50 | 186.5 | 7.3 | 0.19 | 250 | 150 |

## Fiberglass Fabrics

| | | Count | | Yarn | | Weight | | Thickness | | Strength (lb/in) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Style | Weave | Warp | Fill | Warp | Fill | (osy) | (gsm) | (mils) | (mm) | Warp | Fill |
| 7532 | Plain | 16 | 13 | ECG 75 1/3 | ECG 75 1/3 | 6.89 | 234.0 | 8.9 | 0.23 | 350 | 300 |
| 7533 | Plain | 17 | 17 | ECG 75 1/2 | ECG 75 1/2 | 5.46 | 185.1 | 6.8 | 0.17 | 170 | 160 |
| 7544 | 2 End Plain | 28 | 14 | ECG 37 1/2 | ECG 37 1/4 | 17.63 | 598.0 | 18.6 | 0.47 | 700 | 700 |
| 7581 | 8H Satin | 57 | 54 | ECG 75 1/0 | ECG 75 1/0 | 8.95 | 303.5 | 8.3 | 0.21 | 500 | 400 |
| 7587 | Mock Leno | 40 | 20 | ECG 37 1/2 | ECG 37 1/2 | 19.81 | 672.0 | 24.0 | 0.61 | 900 | 560 |
| 7618 | Plain | 43 | 18 | ECG 75 1/0 | ECG 75 1/0 | 4.94 | 167.5 | 6.2 | 0.16 | 300 | 120 |
| 7624 | Plain | 44 | 24 | ECG 75 1/0 | ECG 75 1/0 | 5.49 | 186.1 | 7.0 | 0.18 | 395 | 174 |
| 7626 | Plain | 34 | 32 | ECG 75 1/0 | ECG 75 1/0 | 5.17 | 175.3 | 5.8 | 0.15 | 225 | 200 |
| 7628 | Plain | 44 | 31 | ECG 75 1/0 | ECG 75 1/0 | 6.00 | 203.0 | 7.0 | 0.18 | 300 | 200 |
| 7629 | Plain | 44 | 33 | ECG 75 1/0 | ECG 75 1/0 | 6.20 | 210.2 | 6.8 | 0.17 | 250 | 215 |
| 7635 | Plain | 44 | 29 | ECG 75 1/0 | ECG 50 1/0 | 6.90 | 234.0 | 8.5 | 0.22 | 300 | 400 |
| 7637 | Plain | 43 | 22 | ECG 75 1/0 | ECG 37 1/0 | 7.02 | 238.0 | 9.5 | 0.24 | 282 | 203 |
| 7642 | Plain | 44 | 20 | ECG 75 1/0 | ECG 37 1/0 TEX | 6.69 | 227.0 | 9.7 | 0.25 | 350 | 250 |
| 7645 | 8H Satin | 47 | 42 | ECG 75 1/2 | ECG 75 1/2 | 14.54 | 493.0 | 12.8 | 0.33 | 650 | 550 |
| 7715 | Modified Plain | 80 | 18 | ECG 75 1/0 | ECG 150 1/0 | 7.13 | 242.0 | 7.7 | 0.19 | 650 | 40 |
| 7725 | 2X2 Twill | 54 | 18 | ECG 75 1/0 | ECH 25 1/0 | 8.55 | 290.0 | 9.0 | 0.23 | 575 | 475 |
| 7781 | 8H Satin | 57 | 54 | ECDE 75 1/0 | ECDE 75 1/0 | 8.5 | 288.0 | 8.6 | 0.22 | 500 | 400 |
| 7791 | Conform | 58 | 58 | ECDE 75 1/0 | ECDE 75 1/0 | 9.0 | 305.2 | 10.0 | 0.25 | 500 | 440 |

## Fiberglass Fabrics

| | | Count | | Yarn | | Weight | | Thickness | | Strength (lb/in) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Style | Weave | Warp | Fill | Warp | Fill | (osy) | (gsm) | (mils) | (mm) | Warp | Fill |
| 16550 | Plain | 24 | 22 | S2CG 150 1/2 | S2CG 150 1/2 | 3.63 | 123.0 | 5.1 | 0.13 | 125 | 120 |
| 16781 | 8H Satin | 57 | 55 | SCG 75 1/0 | SCG 75 1/0 | 9.08 | 308.0 | 9.1 | 0.23 | 481 | 410 |
| 17645 | 8H Satin | 47 | 42 | SCG 75 1/2 | SCG 75 1/2 | 14.54 | 493.0 | 13.4 | 0.34 | 650 | 550 |
| 17781 | 8H Satin | 57 | 55 | ECDE 75 1/0 | ECDE 75 1/0 | 8.74 | 296.3 | 8.5 | 0.22 | 500 | 380 |
| 20095 | Plain | 33 | 33 | ECD 900 1/0 | ECD 900 1/0 | 0.43 | 15.0 | 1.1 | 0.03 | 25 | 20 |
| 21522 | Plain | 24 | 22 | ECG 150 1/2 | ECG 150 1/2 | 3.65 | 124.0 | 4.6 | 0.12 | 147 | 158 |
| 24527 | Plain | 25 | 22 | SCG 75 1/0 | SCG 75 1/0 | 3.47 | 118.0 | 4.9 | 0.12 | 338 | 292 |
| 24629 | Plain | 24 | 22 | SCG 75 1/0 | ECG 75 1/0 | 3.6 | 122.1 | 4.5 | 0.11 | 240 | 220 |
| 26781 | 8H Satin | 57 | 55 | SCG 75 1/0 | SCG 75 1/0 | 8.71 | 295.3 | 9.0 | 0.23 | 450 | 400 |
| 27533 | Plain | 17 | 17 | ECG 75 1/2 | ECG 75 1/2 | 5.60 | 190.0 | 8.0 | 0.20 | 400 | 400 |
| 76281 | 4H Satin | 44 | 31 | ECG 75 1/0 | ECG 75 1/0 | 6.03 | 204.4 | 6.4 | 0.16 | 400 | 300 |
| 85392 | Plain | 44 | 31 | SCG 75 1/0 | STG 150 1/2 Tex | 5.93 | 201.0 | 7.3 | 0.19 | 350 | 200 |

## Fiberglass Fabrics Weight Index

| | Weight | | | Weight | | | Weight | | | Weight | | | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Style | (osy) | (gsm) | Style | (osy) | (gsm) | Style | (osy) | (gsm) | Style | (osy) | (gsm) | Style | (osy) | (gsm) |
| 20095 | 0.43 | 15.0 | 1609 | 1.39 | 47.1 | 2113 | 2.32 | 78.7 | 1633 | 3.07 | 104.1 | 1165 | 3.53 | 119.7 |
| 101 | 0.47 | 15.9 | 108 | 1.40 | 47.5 | 1614 | 2.33 | 79.0 | 2116 | 3.07 | 104.1 | 1522 | 3.57 | 121.0 |
| 104 | 0.55 | 18.6 | 1078 | 1.40 | 47.0 | 117 | 2.40 | 81.4 | 220 | 3.08 | 104.4 | 1681 | 3.57 | 121.0 |
| 1071 | 0.58 | 19.7 | 1080 | 1.40 | 47.5 | 3313 | 2.43 | 82.4 | 116 | 3.09 | 105.0 | 4527 | 3.58 | 121.4 |
| 1037 | 0.70 | 24.0 | 1620 | 1.57 | 53.2 | 2313 | 2.46 | 83.4 | 3118 | 3.11 | 105.4 | 24629 | 3.6 | 122.1 |
| 106 | 0.73 | 25.0 | 1658 | 1.57 | 53.2 | 1669 | 2.50 | 85.0 | 120 | 3.12 | 106.0 | 16550 | 3.63 | 123.0 |
| 1297 | 0.77 | 26.1 | 1659 | 1.57 | 53.2 | 1636 | 2.55 | 86.5 | 1677 | 3.12 | 105.8 | 2165 | 3.65 | 123.8 |
| 1035 | 0.87 | 29.0 | 1280 | 1.58 | 53.6 | 1125 | 2.60 | 88.2 | 2117 | 3.18 | 108.0 | 21522 | 3.65 | 124.0 |
| 1299 | 0.90 | 30.5 | 1562 | 1.86 | 63.1 | 1628 | 2.60 | 88.2 | 1692 | 3.19 | 108.2 | 1131 | 3.66 | 124.1 |
| 1067 | 0.91 | 37.0 | 2112 | 2.07 | 70.2 | 2114 | 2.74 | 93.0 | 1695 | 3.44 | 117.0 | 1632 | 3.73 | 126.5 |
| 1076 | 0.98 | 33.2 | 112 | 2.08 | 70.5 | 3070 | 2.79 | 94.6 | 24527 | 3.47 | 118.0 | 1167 | 3.76 | 127.5 |
| 1070 | 1.03 | 35.0 | 4180 | 2.19 | 74.3 | 1675 | 2.84 | 96.3 | 1521 | 3.49 | 118.0 | 1161 | 3.83 | 130.0 |
| 6060 | 1.11 | 38.0 | 1610 | 2.30 | 78.0 | 1674 | 2.85 | 97.0 | 1634 | 3.49 | 118.3 | 1676 | 4.00 | 136.0 |
| 6080 | 1.27 | 43.1 | 1617 | 2.31 | 78.0 | 1688 | 2.88 | 97.6 | 1694 | 3.51 | 119.0 | 1652 | 4.14 | 140.4 |

## Fiberglass Fabrics Weight Index

| Style | Weight (osy) | Weight (gsm) | Style | Weight (osy) | Weight (gsm) | Style | Weight (osy) | Weight (gsm) | Style | Weight (osy) | Weight (gsm) | Style | Weight (osy) | Weight (gsm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2157 | 4.27 | 144.8 | 27533 | 5.60 | 190.0 | 7532 | 6.89 | 234.0 | 7581 | 8.95 | 303.5 | 1582 | 13.26 | 449.6 |
| 1162 | 4.30 | 145.8 | 6580 | 5.67 | 192.2 | 7635 | 6.90 | 234.0 | 7791 | 9.0 | 305.2 | 3582 | 13.60 | 462.0 |
| 7510 | 4.50 | 153.0 | 880 | 5.70 | 193.0 | 7637 | 7.02 | 238.0 | 16781 | 9.08 | 308.0 | 7645 | 14.54 | 493.0 |
| 1039 | 4.85 | 164.0 | 128 | 5.87 | 199.0 | 7715 | 7.13 | 242.0 | 7500 | 9.14 | 310.0 | 17645 | 14.54 | 493.0 |
| 1025 | 4.90 | 167.0 | 85392 | 5.93 | 201.0 | 3743 | 7.89 | 268.0 | 1800 | 9.39 | 318.4 | 3783 | 15.76 | 534.4 |
| 7618 | 4.94 | 167.5 | 1538 | 6.00 | 203.4 | 1568 | 7.97 | 270.0 | 7523 | 10.85 | 368.0 | 1583 | 16.10 | 546.0 |
| 1557 | 5.13 | 174.0 | 7628 | 6.00 | 203.0 | 1142 | 8.33 | 282.4 | 2523 | 11.01 | 373.3 | 7544 | 17.63 | 598.0 |
| 7626 | 5.17 | 175.3 | 1528 | 6.03 | 204.0 | 7781 | 8.5 | 288.0 | 1523 | 11.26 | 381.8 | 2025 | 18.0 | 610.3 |
| 1526 | 5.30 | 180.0 | 76281 | 6.03 | 204.4 | 1543 | 8.52 | 289.0 | 1527 | 11.80 | 400.0 | 7587 | 19.81 | 672.0 |
| 7533 | 5.46 | 185.1 | 7629 | 6.20 | 210.2 | 7725 | 8.55 | 290.0 | 162 | 11.96 | 405.5 | 1584 | 25.13 | 852.0 |
| 3733 | 5.48 | 186.0 | 138 | 6.53 | 221.4 | 6781 | 8.64 | 293.0 | 1564 | 12.07 | 409.2 | 3784 | 25.53 | 866.0 |
| 7624 | 5.49 | 186.1 | 1014 | 6.60 | 223.0 | 1581 | 8.66 | 294.0 | 332 | 12.36 | 419.1 | 3884 | 26.43 | 896.1 |
| 7531 | 5.50 | 186.5 | 7642 | 6.69 | 227.0 | 26781 | 8.71 | 295.3 | 1188 | 12.36 | 419.1 | 1597 | 36.69 | 1244.0 |
| 1680 | 5.57 | 189.0 | 2532 | 6.79 | 230.2 | 17781 | 8.74 | 296.3 | 1530 | 13.20 | 448.0 | 3788 | 49.74 | 1686.5 |

## Fiberglass Fabrics Thickness Index

| Style | Weight (osy) | Weight (gsm) | Style | Weight (osy) | Weight (gsm) | Style | Weight (osy) | Weight (gsm) | Style | Weight (osy) | Weight (gsm) | Style | Weight (osy) | Weight (gsm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 0.7 | 0.02 | 6080 | 1.9 | 0.05 | 112 | 3.4 | 0.08 | 1165 | 3.8 | 0.10 | 24629 | 4.5 | 0.11 |
| 1037 | 1.0 | 0.03 | 1078 | 2.0 | 0.05 | 220 | 3.4 | 0.09 | 1675 | 3.8 | 0.10 | 1131 | 4.6 | 0.12 |
| 1067 | 1.0 | 0.03 | 1299 | 2.0 | 0.05 | 1125 | 3.4 | 0.09 | 1167 | 4.0 | 0.10 | 1557 | 4.6 | 0.12 |
| 20095 | 1.1 | 0.03 | 108 | 2.1 | 0.05 | 2114 | 3.4 | 0.08 | 1677 | 4.0 | 0.10 | 21522 | 4.6 | 0.12 |
| 1035 | 1.2 | 0.03 | 4180 | 2.4 | 0.06 | 2116 | 3.4 | 0.09 | 2165 | 4.0 | 0.10 | 1562 | 4.7 | 0.12 |
| 1071 | 1.2 | 0.03 | 1609 | 2.5 | 0.06 | 116 | 3.5 | 0.09 | 1633 | 4.2 | 0.11 | 1688 | 4.7 | 0.12 |
| 104 | 1.4 | 0.04 | 2113 | 2.5 | 0.06 | 1628 | 3.5 | 0.09 | 1652 | 4.2 | 0.11 | 1694 | 4.9 | 0.12 |
| 1076 | 1.4 | 0.03 | 1620 | 2.7 | 0.07 | 1658 | 3.5 | 0.09 | 1681 | 4.2 | 0.11 | 1695 | 4.9 | 0.12 |
| 106 | 1.5 | 0.04 | 1669 | 2.8 | 0.07 | 120 | 3.6 | 0.09 | 1659 | 4.3 | 0.11 | 24527 | 4.9 | 0.12 |
| 6060 | 1.5 | 0.04 | 2313 | 2.8 | 0.07 | 1610 | 3.6 | 0.09 | 1161 | 4.4 | 0.11 | 1522 | 5.0 | 0.13 |
| 1070 | 1.6 | 0.04 | 3313 | 2.8 | 0.07 | 117 | 3.7 | 0.09 | 1521 | 4.4 | 0.11 | 1634 | 5 | 0.13 |
| 1297 | 1.7 | 0.04 | 2112 | 2.9 | 0.07 | 1674 | 3.7 | 0.09 | 1636 | 4.4 | 0.11 | 16550 | 5.1 | 0.13 |
| 1080 | 1.9 | 0.05 | 3070 | 2.9 | 0.07 | 2117 | 3.7 | 0.09 | 1632 | 4.5 | 0.11 | 1692 | 5.2 | 0.13 |
| 1280 | 1.9 | 0.05 | 2025 | 3.0 | 0.08 | 3118 | 3.7 | 0.09 | 1676 | 4.5 | 0.11 | 4527 | 5.2 | 0.13 |

## Fiberglass Fabrics Thickness Index

| Style | Weight (osy) | (gsm) | Style | Weight (osy) | (gsm) | Style | Weight (osy) | (gsm) | Style | Weight (osy) | (gsm) | Style | Weight (osy) | (gsm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1162 | 5.3 | 0.13 | 138 | 6.6 | 0.17 | 27533 | 8.0 | 0.20 | 1142 | 9.8 | 0.25 | 7523 | 13.0 | 0.33 |
| 1680 | 5.3 | 0.13 | 1039 | 6.6 | 0.17 | 7581 | 8.3 | 0.21 | 7791 | 10.0 | 0.25 | 17645 | 13.4 | 0.34 |
| 880 | 5.5 | 0.14 | 1528 | 6.7 | 0.17 | 1025 | 8.4 | 0.21 | 1014 | 10.5 | 0.26 | 1527 | 14.0 | 0.35 |
| 1614 | 5.5 | 0.14 | 7533 | 6.8 | 0.17 | 7635 | 8.5 | 0.22 | 7500 | 11.0 | 0.28 | 1530 | 14.4 | 0.37 |
| 1617 | 5.5 | 0.14 | 7629 | 6.8 | 0.17 | 17781 | 8.5 | 0.22 | 1800 | 11.2 | 0.28 | 3783 | 16.0 | 0.41 |
| 2157 | 5.8 | 0.15 | 1538 | 7.0 | 0.18 | 2532 | 8.6 | 0.22 | 1188 | 12.0 | 0.30 | 1568 | 16.5 | 0.42 |
| 7510 | 5.8 | 0.15 | 7624 | 7.0 | 0.18 | 7781 | 8.6 | 0.22 | 1523 | 12.0 | 0.30 | 1583 | 17.0 | 0.43 |
| 7626 | 5.8 | 0.15 | 7628 | 7.0 | 0.18 | 6781 | 8.8 | 0.22 | 1582 | 12.0 | 0.30 | 7544 | 18.6 | 0.47 |
| 128 | 6.0 | 0.15 | 3743 | 7.3 | 0.19 | 7532 | 8.9 | 0.23 | 2523 | 12.2 | 0.31 | 3784 | 23.1 | 0.59 |
| 6580 | 6.1 | 0.15 | 7531 | 7.3 | 0.19 | 7725 | 9.0 | 0.23 | 3582 | 12.5 | 0.32 | 1584 | 24.0 | 0. 61 |
| 1526 | 6.2 | 0.16 | 85392 | 7.3 | 0.19 | 26781 | 9.0 | 0.23 | 332 | 12.7 | 0.32 | 7587 | 24.0 | 0.61 |
| 7618 | 6.2 | 0.16 | 7715 | 7.7 | 0.19 | 16781 | 9.1 | 0.23 | 7645 | 12.8 | 0.33 | 3884 | 25.7 | 0.65 |
| 3733 | 6.4 | 0.16 | 1581 | 7.8 | 0.20 | 7637 | 9.5 | 0.24 | 162 | 13.0 | 0.33 | 1597 | 36.9 | 0.94 |
| 76281 | 6.4 | 0.16 | 1543 | 7.9 | 0.20 | 7642 | 9.7 | 0.25 | 1564 | 13.0 | 0.33 | 3788 | 45.2 | 1.15 |

# ASTROQUARTZ ® PRODUCTS

Astroquartz ® is a registered trademark of JPS Composite Materials

JPS has been weaving the 99.99% pure silica fabric since 1964. Astroquartz ® is used in many of the world's most advanced composite applications. This includes usage in the manned and unmanned space programs, as stealth supporting materials, as radomes for superior signal integrity, and internet connectivity on commercial airliners. Astroquartz ® is the leader when it comes to low dielectric, high strength, and high thermal reliability composite reinforcements.

## Astroquartz II® & Astroquartz III® Properties

Astroquartz®, Astroquartz II® and Astroquartz III® are composed of identical raw materials. Astroquartz® has been discontinued in favor of Astroquartz II® and Astroquartz III®. Improved manufacturing and handling technologies have allowed Astroquartz II® and Astroquartz III® to become more robust and cost effective. All represent unparalleled quality, purity, and performance. JPS and Astroquartz® innovation gives new flexibility to your design opportunities.

### Properties of Astroquartz® Fibers

Tensile Strength -
Virgin Single Filament..... 6.0 GPa (870 ksi)
Tensile Strength - Impregnated Strand on 20 End Roving
(ASTM D-2343) ..... 3.6 GPa (530 ksi)
Young's Modulus ..... 72 GPa (10 msi)
Poisson's Ratio..... 0.16
Density.....2.2 g/cm
Silica Content (exclusive of yarn binder) ..... 99.99%
Fiber Diameter - Astroquartz II®..... 9µm
Fiber Diameter - Astroquartz III®..... 14µm



## Physical Properties of Fused Quartz

### Mechanical Properties

Density.....2.2 g/cm$^3$ or 0.79 lb/m$^3$
Hardness (Mohs Scale)..... 7

### Electrical Properties

Dielectric Constant (Dk) - 1 MHz..... 3.70
Dielectric Constant (Dk) - 10 GHz ..... 3.74
Dissipation Factor (Df) - 1 MHz ..... 0.0001
Dissipation Factor (Df) - 10 GHz ..... 0.0002

### Thermal Properties

Linear Expansion Coefficient.....0.54 x $10^{-6}$
Specific Heat @ 20ºC (J/gK) ..... 7.5 x $10^2$
Thermal Conductivity (W/mK)..... 1.38
Strain Point (Log n = 14.6) ..... 1070ºC (1958ºF)
Annealing Point (Log n = 13)..... 1220ºC (2084ºF)
Softening Point (Log n = 7.6)..... 1700ºC (3092ºF)
Note: n = Viscosity in Poise

### Optical Properties

Refractive Index @ 15ºC ..... 1.4585
Dispersion..... 67
Field of Transparency (µm) ..... 0.2 to 4.0

## Astroquartz® Applications and Design Considerations

Astroquartz® fabrics offer better solutions when high strength, low dielectric loss and high heat resistance is required.

The aerospace industry relies on Astroquartz® fiber products made from pure fused silica (99.99% $SiO_2$) to produce an outstanding, reproducible reinforcement material.

There are five basic design variables to consider when choosing Astroquartz® fabrics:

# Astroquartz® Applications and Design Considerations (cont.)

### Thickness
Quartz and composite fabrics are available in thicknesses ranging from 0.003” to 0.027” (0.13-0.69 mm).

### Weight
The weight for Astroquartz ® fabrics range from 2.0 to 19.5 ounces per square yard (68 to 660 gsm).

### Construction
Construction is the number of warp and fill yarns per inch (machine and cross-machine direction) and the fabric pattern. This helps determine the thickness, weight, drapability, and overall performance of the fabric.

### Yarn Size
Yarn size is a major factor in determining the weight and thickness of the fabric. The yarn size, twist and ply counts will also play a large role in determining the overall strength of the woven fabric. For specific applications, one yarn may be selected over another to the advantage of the performance characteristics.

### Finish
The Astroquartz® fabrics can be coated with a coupling agent, called the finish, to assist resin wet out and to improve the strength of the fiber to resin interface. This has the effect of improving the mechanical, thermal and electrical performance characteristics of the final part. Please contact JPS technical or customer service for assistance in choosing the correct fabric finish for your application.



# Astroquartz® II & III Fabric Finishes

A partial list of the available finishes is presented, for additional finishes or to develop an application specific finish, please contact JPS.

| Finish Name | Functionality: Primary | Secondary | Notes |
|---|---|---|---|
| S-928 | Epoxy | | Epoxy functional silane |
| 1059 HT<br>2059 HT<br>3059 HT | Polyimide | Thermo-plastic matrices | Formulated for high temperature and moisture resistance |
| 9779 | Epoxy | Bismaleimide<br>Cyanate Ester | Amino-silane |
| 9827<br>2827<br>3827 | Epoxy | Polyimide,<br>Bismaleimide | Recommended for electronic and aerospace applications |
| 9836<br>2836<br>3836 | Epoxy | Bismaleimide | Scoured fabric to to remove most organic binder components |
| 9837<br>2837<br>3837 | Polyester | Vinyl Ester<br>Epoxy,<br>Cyanate Ester | Recommended for resins cured by vinyl addition |

# Astroquartz II® Chopped Fiber

Astroquartz II® chopped fiber is made by cutting continuous filaments of high purity, extremely fine quartz to a predetermined length. Fiber composition is 99.99% $SiO_2$(silica) exclusive of binder.

Astroquartz II® chopped fibers are widely used in reinforced plastics, molding compounds and ceramic composites. The chopped fibers add thermal resistance and improved ablation to the final part.

## Type 556 Chopped Fiber

Fiber Lengths* from 1/8" to 1" — Astroquartz II® chopped fiber with an aminosilane binder. Compatible with epoxy, phenolic and some polyimide resins.

* Due to the nature of the cutting process, cut lengths may vary slightly.

## Standard Packaging

1 lb packages loosely in clear polyethylene bags.

## Order Requirements and Lead Times

Please contact JPS to confirm availability and lead time.

Depending on available inventory the minimum order requirement is approximately 60 lbs. Please allow 8-12 weeks for processing.

**Astroquartz® Fabrics**

| Style # JPS | Weave | Count Warp | Count Fill | Yarn | Yarn | Fill | Weight (osy) | Weight (gsm) | Thickness (mils) | Thickness (mm) | Strength (lb/in) Warp | Strength (lb/in) Fill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 503 | Plain | 50 | 40 | QCG 300 1/2 | QCG 300 1/2 | | 3.35 | 114 | 4.5 | 0.11 | 165 | 140 |
| 507 | Plain | 27 | 25 | QCG 300 1/2 | QCG 300 1/2 | | 2.10 | 71 | 3.8 | 0.10 | 80 | 60 |
| 523 | Plain | 50 | 38 | QCG 300 1/2 | QCG 300 1/0 | | 2.78 | 94 | 3.7 | 0.09 | 220 | 100 |
| 525 | Plain | 50 | 50 | QCG 300 1/0 | QCG 300 1/0 | | 1.94 | 66 | 2.7 | 0.07 | 112 | 96 |
| 527 | Plain | 42 | 32 | QCG 300 2/2 | QCG 300 2/2 | | 5.76 | 195 | 8.0 | 0.20 | 270 | 250 |
| 557 | Crowfoot | 56 | 31 | QCG 300 2/2 | QCG 300 1/0 | | 5.0 | 170 | 5.9 | 0.15 | 410 | 55 |
| 570 | 5H Satin | 38 | 24 | QCG 300 2/8 | QCG 300 2/8 | | 19.5 | 661 | 25.0 | 0.64 | 825 | 650 |
| 581 | 8H Satin | 57 | 54 | QCG 300 2/2 | QCG 300 2/2 | | 8.40 | 285 | 9.9 | 0.25 | 400 | 375 |
| 593 | 5H Satin | 49 | 46 | QCG 300 2/2 | QCG 300 2/2 | | 7.46 | 253 | 9.5 | 0.24 | 400 | 400 |
| 4503 | Plain | 38 | 32 | 125 1/0 QS13 | 125 1/0 QS13 | | 3.32 | 113 | 4.5 | 0.11 | 115 | 100 |
| 4581 | 8H Satin | 47 | 44 | 125 2/0 QS13 | 125 2/0 QS13 | | 8.67 | 294 | 9.5 | 0.24 | 370 | 330 |

# Astroquartz ® Mat Style No. 550

## Specifications

Length.....1000 mm (39.37 in)
Width .....500 mm (19.69 in)
Area ..... 0.5 m per sheet (5.38 ft )
Thickness .....5 mm (0.2 in)
Weight .....78 g/m (2.3 oz/yd )
Density.....0.016 g/cm (1 lb/ft - approx.)

## Handling

Astroquartz ® s/550 mat is impregnated with a polyvinyl alcohol binder in the manufacturing operation. This provides a stable mat which can be handled, cut, or fabricated to exact dimensions and can be installed with ease. The binder can be removed by heating to 900ºF for 1 hour, or at 500ºF for 24 hours. Binder content on the Astroquartz mat is between 4% and 5% by weight. Cut sheets of approximately 500 mm x 500 mm (20 in x 20 in) are also available with an area of approximately 2.8 ft per sheet.

# Astroquartz® II Roving

Astroquartz II® roving is made from continuous filaments of pure fused silica nine microns in diameter. Fiber composition is 99.99% $SiO_2$ (silica) exclusive of binder. Standard 20 end roving equivalent to 20 ends of 150 1/0 contains 4800 nine micron diameter filaments. The fiber density is 2.2 g/cm$^3$. Astroquartz II ® roving has a fiber tensile strength of 0.5 MSI*

## Property Data**

| Type | End Count• | Binder•• | Yds/Lb† | Strength†† |
|---|---|---|---|---|
| 552 | 20 | 9779/9989 | 750 | 65 lbs |
| 552 | 12 | 9779/9989 | 1250 | 40 lbs |
| 552 | 8 | 9779/9989 | 1875 | 25 lbs |
| 552 | 6 | 9779/9989 | 2500 | 20 lbs |

* Test Method - ASTM D-234 ** Test Method - ASTM D-578 • +0-1
••0.3%-0.6% LOI † ±10% †† Tensile, min. avg., uncoated roving



# Astroquartz® Roving (cont.)

Astroquartz II® roving is available with an end count less than 20, please consult JPS for details. Other finishes are also available.

## Standard Packaging

Inside Diameter .....3 in
Length.....11 in
Traverse .....10 in
Waywind ..... Ratio
Wind Direction ..... Forward
Type Build..... Straight
Maximum OD.....7 in

## Approximate Net Weight

9779 Binder .....2.2 lbs

# Astroquartz II® Sewing Thread

Astroquartz II® sewing thread is made from high purity, extremely fine, continuous filaments of pure fused silica; capable of extended exposure to 2000ºF. Fiber composition is 99.99% $SiO_2$(silica) exclusive of binder. Astroquartz II® sewing threads are supplied coated with PTFE.

**With 9855 Teflon Coating (20±4%)**

| Type | Approx. Diameter | Breaking Strength* | | | Approx. Yield** |
|---|---|---|---|---|---|
| | (in) | Typical (lb) | Minimum | Uncoated | Coated |
| Q-12 | 0.014 | 15 | 12 | 3660 | 2925 |
| Q-18 | 0.017 | 24 | 19 | 2440 | 1950 |
| Q-24 | 0.022 | 3 | 25 | 1830 | 1460 |
| Q-27 | 0.024 | 30 | 25 | - | 900 |

* Test Method - ASTM D-578

** ±10%

## Standard Packaging

Astroquartz II ® sewing thread is typically available in 0.5 kg spools. Please contact JPS for price and delivery lead times.

# Astroquartz® Yarn

Astroquartz® yarn is made from extremely fine continuous filaments of 99.99% pure fused silica, exclusive of binder, capable of extended heat exposure to 2000ºF.

Astroquartz® yarn has more than five times the yarn yield of high silica leached yarn. This results in higher tensile strength and abrasion resistance. With Astroquartz® high production efficiencies are possible in the production of high temperature flexible insulation.

Astroquartz® yarn is widely used in the form of braided insulation for thermocouple wire, coaxial cables, space separators, hoop wire, and heating elements.

**Property Data**

| Type | Approx. Diameter (in) | Approx. Breaking (lb)* | Approx. Yield (yd/lb) |
|---|---|---|---|
| 300 2/0 | 0.008 | 3 | 15000 |
| 300 2/2 | 0.012 | 6 | 7500 |
| 300 2/4 | 0.018 | 10 | 3750 |
| 300 2/8 | 0.020 | 24 | 1875 |

*Test Method - ASTM D-578

Astroquartz® yarns are available with an amino-silane binder system, compatible with phenolic, epoxy, and some polyimide resins. Heavier or lighter count yarns can also be manufactured. Please consult JPS for price and delivery.

## Standard Packaging

Yarns are available on standard milk bottle packages for plied yarns and double flanged packages for twisted single yarn. Net yarn weights range from a minimum of 1 lb/pkg to a maximum of 2.5 lb/pkg.

**Fiber Characteristics**

| Astroquartz II®* | Astroquartz III®** |
|---|---|
| **Number of Filaments** | |
| 300 1/0 - 120 filaments | 125 1/0 - 120 filaments |
| 300 2/0 - 240 filaments | 125 2/0 - 240 filaments |
| 300 2/2 - 480 filaments | |

* Astroquartz II® filaments are 9 µm in diameter, similar to an ECG filament
** Each filament is 14 µm in diameter, equivalent to an ECK filament.



# Physical Properties of Para-Aramids

**Para-Aramids - Kevlar®*, Twaron®****

## Physical Properties

Density..... 1.44 g/cc
Equilibrium Moisture Level, Kevlar 29 .....4.5%
Equilibrium Moisture Level, Kevlar 49 .....3.5%

## Mechanical Properties

UTS (room temp)..... 2.9-3.0 GPa
Elongation at Break ..... 2.4-3.6%
Young's Modulus .....71-112 GPa
Shear Modulus ..... 26-41 GPa
Poisson's Ratio.....0.36

## Thermal Properties

Shrinkage in Water at 212ºF (100ºC) ..... <0.1%
Shrinkage in Dry Air at 351ºF (177ºC)..... <0.1%
Specific Heat Capacity at 77ºF (25ºC).....1.420 kJ/kg-K
Specific Heat Capacity at 212ºF (100ºC) .....2.01 kJ/kg-K
Specific Heat Capacity at 356ºF (180ºC) .....2.52 kJ/kg-K
Thermal Conductivity.....0.04 W/m-K
Decomposition Temperature in Air.....800-900ºC
Recommended Max Temperature Range
for Long Term Use in air .....149-177ºC
Heat of Combustion.....35x10^6 J/kg

* Kevlar® is a registered trademark of the E.I. DuPont du Nemours
** Twaron® is a registered trademark of Teijin Twaron USA, Inc.
All values approximate. Actual values may vary, for further info contact JPS

# Physical Properties of UHMWPE

**Ultra High Molecular Weight Polyethylene - Dyneem®*, Spectra®****

### Physical Properties

Density 0.97 g/cc

### Mechanical Properties

UTS (Spectra 900)..... 25-30 GPa
UTS (Spectra 1000)..... 35-43 GPa
Elongation at Break (Spectra 900) ..... 3.6-3.9%
Elongation at Break (Spectra 1000) ..... 2.9-3.5%
Young's Modulus (Spectra 900)..... 850-920 GPa
Young's Modulus (Spectra 1000).....1170-1580 GPa

### Thermal Properties

Melting Range .....144-152ºC
Decomposition Temperature in Air.....>300ºC
Advised Lowest Temperature .....No Limit
Advised Long Duration Temperature Limit .....70ºC
Advised Short Duration Temperature Limit
Non-Constrained Fiber .....130ºC
Constrained Fiber.....145ºC
Tensile Strength Relative to 23ºC
at -60ºC .....110%
at 23ºC.....100%
at 60ºC.....80%
at 100ºC.....55%

* Dyneema® is a registered trademark of Royal DSM N.V.
** Spectra® is a registered trademark of Honeywell International Corp.
All values approximate. Actual values may vary, for further info contact JPS



# Advanced Materials Applications

### Advanced Fabrics Nomenclature

High performance fibers are typically designated by denier, tex, or decitex (dtex). Each is described below.

### Denier

The denier system is used internationally to measure the size of textile filaments and yarns. Denier number indicates the weight in grams of 9,000 meters of filament or filament yarn. For example, if 9,000 meters weighs 100 grams, it is a 100-denier yarn. The smaller the denier number, the finer the yarn.
Denier = dtex X 0.9

### Tex and Decitex

The tex system is also applicable to the measurement of filament yarns. It is based on the weight in grams of one kilometer (3,300 feet) of yarn. Decitex (dtex) is defined as ten times tex.

Tex = dtex/10



# Finishes for Advanced Materials

A partial list of the available finishes is presented. For additional finishes or to develop an application specific finish, please contact JPS.

| Finish Name | Description |
|---|---|
| CS-811 | Loom state fabric Greige |
| CS-800 | Scoured aramid fabrics |
| CS-802 | Scoured UHMWPE fabrics |
| CS-892 | Water repellent finish for Spectra and Dyneema fabrics |
| CS-898 | Traditional water repellent finish for Kevlar fabrics |
| CS-899 | Traditional water repellent finish for Twaron fabrics |
| CS-6000 | Engineered aramid water repellent treatment for improved performance |
| LCS | Laminated Composite Substrate |
| ML | Micro-Laminate |
| WRT | Water Repellent Treated |



## Aramid Fabrics

| Style # JPS | AMS | Weave | Count Warp | Count Fill | Warp Yarn | Fill Yarn | Weight (osy) | Weight (gsm) | Thickness (mils) | Thickness (mm) | Strength (lb/in) Warp | Strength (lb/in) Fill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 310 | | Plain | 36 | 36 | Kevlar LT (400d) | Kevlar LT (400d) | 3.6 | 122.0 | 7.00 | 0.18 | 600 | 600 |
| 311 | | Rip stop | 35 | 35 | Kevlar LT (400d) | Kevlar LT (400d) | 3.6 | 122.1 | 6.60 | 0.17 | 500 | 500 |
| 312 | | Plain | 36 | 36 | Kevlar KM2+ (400d) | Kevlar KM2+ (400d) | 3.5 | 118.6 | 6.60 | 0.17 | 650 | 650 |
| 328 | 328 | Plain | 17 | 17 | Kevlar 49 (1420d) | Kevlar 49 (1420d) | 6.0 | 203.4 | 13.00 | 0.33 | 800 | 800 |
| 348 | 181 | 8H Satin | 50 | 50 | Kevlar 49 (380d) | Kevlar 49 (380d) | 5.0 | 170.5 | 8.50 | 0.22 | 600 | 600 |
| 350 | 120 | Plain | 34 | 34 | Kevlar 49 (195d) | Kevlar 49 (195d) | 1.8 | 61.0 | 3.90 | 0.10 | 200 | 200 |
| 351 | 220 | Plain | 22 | 22 | Kevlar 49 (380d) | Kevlar 49 (380d) | 2.2 | 74.6 | 4.10 | 0.10 | 300 | 300 |
| 5351 | 220 | Plain | 22 | 22 | Twaron 1055 (405dt) | Twaron 1055 (405dt) | 2.2 | 75.0 | 4.60 | 0.12 | 300 | 300 |
| 352 | 281 | Plain | 17 | 17 | Kevlar 49 (1140d) | Kevlar 49 (1140d) | 5.1 | 172.0 | 9.30 | 0.24 | 600 | 600 |
| 353 | 285 | 4H Satin | 17 | 17 | Kevlar 49 (1140d) | Kevlar 49 (1140d) | 5.2 | 176.3 | 9.10 | 0.23 | 600 | 600 |
| 5353 | 285 | 4H Satin | 17 | 17 | Twaron 2200 (1270dt) | Twaron 2200 (1270dt) | 5.1 | 173.0 | 8.80 | 0.22 | 725 | 725 |
| 372 | | 4X4 Twill | 72 | 72 | Kevlar 49 (195d) | Kevlar 49 (195d) | 3.8 | 129.0 | 7.00 | 0.18 | 450 | 550 |
| 431 | | Plain | 31 | 31 | Kevlar LT (400d) | Kevlar LT (400d) | 3.1 | 105.1 | 5.90 | 0.15 | 500 | 500 |
| 705 | | Plain | 31 | 31 | Kevlar KM2 (850d) | Kevlar KM2 (850d) | 6.8 | 231.0 | 13.60 | 0.35 | 750 | 775 |
| 710 | | Plain | 24 | 24 | Kevlar 29 (1500d) | Kevlar 29 (1500d) | 9.4 | 318.0 | 18.40 | 0.47 | 1100 | 1200 |
| 711 | | Plain | 29 | 29 | Kevlar A-200 (600d) | Kevlar 29 A-200 (600d) | 4.5 | 153.0 | 8.50 | 0.22 | 600 | 600 |
| 712 | | Plain | 11 | 11 | Kevlar 29 (3000d) | Kevlar 29 (3000d) | 8.5 | 288.0 | 16.60 | 0.42 | 1200 | 1200 |
| 713 | | Plain | 31 | 31 | Kevlar 29 (1000d) | Kevlar 29 (1000d) | 8.0 | 271.2 | 16.40 | 0.42 | 780 | 1000 |
| 5713 | | Plain | 31 | 31 | Twaron 2000 (1100dt) | Twaron 2000 (1100dt) | 8.1 | 274.9 | 16.30 | 0.41 | 900 | 900 |

## Aramid Fabrics

| Style # JPS | AMS | Weave | Count Warp | Count Fill | Warp Yarn | Fill Yarn | Weight (osy) | Weight (gsm) | Thickness (mils) | Thickness (mm) | Strength (lb/in) Warp | Strength (lb/in) Fill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5719 | | Plain | 20 | 20 | Twaron 2040 (930dt) | Twaron 2040 (930dt) | 4.3 | 143.1 | 7.50 | 0.19 | 600 | 600 |
| 720 | | Plain | 20 | 20 | Kevlar 129 (1420d) | Kevlar 129 (1420d) | 7.3 | 247.5 | 14.20 | 0.36 | 1000 | 1000 |
| 722 | | Plain | 22 | 22 | Kevlar 129 (1420d) | Kevlar 129 (1420d) | 8.2 | 278.0 | 15.80 | 0.40 | 600 | 900 |
| 724 | | Plain | 24 | 24 | Kevlar 129 (1000d) | Kevlar 129 (1000d) | 6.0 | 203.4 | 11.00 | 0.28 | 760 | 780 |
| 726 | | Plain | 26 | 26 | Kevlar 129 (840d) | Kevlar 129 (840d) | 5.7 | 193.0 | 10.00 | 0.25 | 700 | 750 |
| 727 | | Plain | 26 | 26 | Kevlar 129 (1000d) | Kevlar 129 (1000d) | 6.8 | 231.0 | 12.30 | 0.31 | 910 | 980 |
| 728 | | Plain | 17 | 17 | Kevlar 29 (1500d) | Kevlar 29 (1500d) | 6.6 | 223.0 | 1.70 | 0.04 | 900 | 900 |
| 729 | | Plain | 17 | 17 | Kevlar 129 (1420d) | Kevlar 129 (1420d) | 6.5 | 220.0 | 12.00 | 0.30 | 900 | 900 |
| 731 | | Plain | 30 | 30 | Kevlar 129 (1000d) | Kevlar 129 (1000d) | 8.1 | 274.0 | 15.00 | 0.38 | 850 | 950 |
| 5731 | | Plain | 30 | 31 | Twaron 2040 (1100dt) | Twaron 2040 (1100dt) | 8.1 | 275.0 | 16.10 | 0.41 | 850 | 850 |
| 735 | | Basket 2X2 | 35 | 35 | Kevlar 29 (1500d) | Kevlar 29 (1500d) | 13.5 | 458.0 | 23.00 | 0.58 | 1700 | 1800 |
| 740 | | Plain | 40 | 40 | Kevlar 29 (200d) | Kevlar 29 (200d) | 2.1 | 71.2 | 5.00 | 0.13 | 300 | 300 |
| 741 | | Plain | 11 | 11 | Kevlar 29 (3000d) | Kevlar 29 (3000d) | 8.4 | 285.0 | 16.00 | 0.40 | 135 | 130 |
| 5741 | | Plain | 11 | 11 | Twaron 1000 (3360dt) | Twaron 1000 (3360dt) | 8.6 | 291.6 | 15.50 | 0.39 | 1100 | 1150 |
| 745 | | Plain | 17 | 17 | Kevlar 29 (3000d) | Kevlar 29 (3000d) | 13.0 | 440.8 | 24.60 | 0.62 | 1400 | 1150 |
| 5745 | | Plain | 17 | 17 | Twaron 1000 (3360dt) | Twaron 1000 (3360dt) | 13.0 | 440.1 | 24.00 | 0.61 | 1700 | 1800 |
| 747 | | Plain | 10 | 10 | Kevlar 29 (3000d) | Kevlar 29 (3000d) | 7.6 | 257.0 | 14.50 | 0.37 | 900 | 900 |
| 754 | | Basket 2X2 | 21 | 21 | Kevlar 29 (3000d) | Kevlar 29 (3000d) | 14.8 | 502.0 | 30.00 | 0.76 | 2000 | 2000 |
| 755 | | Basket 4X4 | 21 | 21 | Kevlar 29 (3000d) | Kevlar 29 (3000d) | 15.3 | 517.0 | 29.00 | 0.74 | 2000 | 2000 |
| 756 | | Plain | 28 | 28 | Kevlar KM2 (400d) | Kevlar KM2 (400d) | 2.9 | 97.6 | 5.50 | 0.14 | 400 | 400 |

## Aramid Fabrics

| Style # JPS | AMS | Weave | Count Warp | Count Fill | Warp Yarn | Fill Yarn | Weight (osy) | Weight (gsm) | Thickness (mils) | Thickness (mm) | Strength (lb/in) Warp | Strength (lb/in) Fill |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 758 | | Plain | 16 | 16 | Kevlar 129 (2820d) | Kevlar 129 (2802d) | 11.6 | 394.0 | 21.00 | 0.53 | 1400 | 1400 |
| 760 | | Basket 2X2 | 30 | 30 | Kevlar 129 (1420d) | Kevlar 129 (1420d) | 11.6 | 393.0 | 21.10 | 0.54 | 850 | 600 |
| 5704 | | Plain | 31 | 31 | Twaron 2040 (930dt) | Twaron 2040 (930dt) | 6.7 | 227.2 | 12.40 | 0.31 | 800 | 900 |
| 767 | | Plain | 28 | 28 | Kevlar KM2+ (600d) | Kevlar KM2+ (600d) | 4.3 | 145.1 | 7.80 | 0.20 | 700 | 700 |
| 768 | | Plain | 28 | 28 | Kevlar KM2+ (500d) | Kevlar KM2+ (500d) | 3.6 | 121.4 | 6.30 | 0.16 | 500 | 550 |
| 5768 | | Plain | 27 | 27 | Twaron 2040 (550dt) | Twaron 2040 (550dt) | 3.6 | 122.0 | 6.40 | 0.16 | 500 | 500 |
| 5772 | | Plain | 28 | 28 | Twaron 2642 (550dt) | Twaron 2642 (550dt) | 3.6 | 122.0 | 6.60 | 0.17 | 700 | 750 |
| 5761 | | Plain | 26 | 26 | Twaron 2040 (1100dt) | Twaron 2040 (1100dt) | 6.5 | 220.4 | 11.70 | 0.29 | 760 | 780 |
| 775 | | Plain | 30 | 30 | Kevlar KM2+ (850d) | Kevlar KM2+ (850d) | 6.7 | 229.0 | 13.20 | 0.34 | 600 | 800 |
| 778 | | Plain | 58 | 58 | Kevlar 159 (300d) | Kevlar 159 (300d) | 4.9 | 166.5 | 10.20 | 0.26 | TBD | TBD |
| 779 | | Plain | 70 | 70 | Kevlar 159 (200d) | Kevlar 159 (200d) | 3.0 | 101.7 | 8.20 | 0.18 | 350 | 350 |
| 785 | | Plain | 20 | 20 | Kevlar KM2+ (850d) | Kevlar KM2+ (850d) | 4.4 | 148.0 | 8.40 | 0.21 | 680 | 700 |
| 787 | | Plain | 23 | 23 | Kevlar KM2+ (850d) | Kevlar KM2+ (850d) | 5.0 | 170.5 | 9.50 | 0.24 | 800 | 700 |
| 5930 | | Plain | 27 | 27 | Twaron 2040 (930dt) | Twaron 2040 (930dt) | 5.8 | 197.0 | 10.50 | 0.25 | 800 | 850 |

## Aramid Fabric Weight Index

| JPS Style # | Weight (osy) | Weight (gsm) |
|---|---|---|
| 350 | 1.8 | 61.0 |
| 740 | 2.1 | 71.2 |
| 351 | 2.2 | 74.6 |
| 5351 | 2.2 | 75.0 |
| 756 | 2.9 | 97.6 |
| 779 | 3.0 | 101.7 |
| 431 | 3.1 | 105.1 |
| 312 | 3.5 | 118.6 |
| 768 | 3.6 | 121.4 |
| 310 | 3.6 | 122.0 |
| 311 | 3.6 | 122.1 |
| 5768 | 3.6 | 122.0 |
| 5772 | 3.6 | 122.0 |
| 372 | 3.8 | 129.0 |
| 767 | 4.3 | 145.1 |
| 5719 | 4.3 | 143.1 |
| 785 | 4.4 | 148.0 |
| 711 | 4.5 | 153.0 |
| 778 | 4.9 | 166.5 |
| 348 | 5.0 | 170.5 |
| 787 | 5.0 | 170.5 |
| 352 | 5.1 | 172.0 |
| 5353 | 5.1 | 173.0 |
| 353 | 5.2 | 176.3 |

| JPS Style # | Weight (osy) | Weight (gsm) |
|---|---|---|
| 726 | 5.7 | 193.0 |
| 5930 | 5.8 | 197.0 |
| 328 | 6.0 | 203.4 |
| 724 | 6.0 | 203.4 |
| 729 | 6.5 | 220.0 |
| 5761 | 6.5 | 220.4 |
| 728 | 6.6 | 223.0 |
| 5704 | 6.7 | 227.2 |
| 775 | 6.7 | 229.0 |
| 705 | 6.8 | 231.0 |
| 727 | 6.8 | 231.0 |
| 720 | 7.3 | 247.5 |
| 747 | 7.6 | 257.0 |
| 713 | 8.0 | 271.2 |
| 731 | 8.1 | 274.0 |
| 5731 | 8.1 | 275.0 |
| 5713 | 8.1 | 274.9 |
| 722 | 8.2 | 278.0 |
| 741 | 8.4 | 285.0 |
| 712 | 8.5 | 288.0 |
| 5741 | 8.6 | 291.6 |
| 710 | 9.4 | 318.0 |
| 760 | 11.6 | 393.0 |
| 758 | 11.6 | 394.0 |

| JPS Style # | Weight (osy) | Weight (gsm) |
|---|---|---|
| 5745 | 13.0 | 440.1 |
| 745 | 13.0 | 440.8 |
| 735 | 13.5 | 458.0 |
| 754 | 14.8 | 502.0 |
| 755 | 15.3 | 517.0 |

## Aramid Fabric Thickness Index

| JPS Style # | Weight (osy) | Weight (gsm) |
|---|---|---|
| 728 | 1.70 | 0.04 |
| 350 | 3.90 | 0.10 |
| 351 | 4.10 | 0.10 |
| 5351 | 4.60 | 0.12 |
| 740 | 5.00 | 0.13 |
| 756 | 5.50 | 0.14 |
| 431 | 5.90 | 0.15 |
| 768 | 6.30 | 0.16 |
| 5768 | 6.40 | 0.16 |
| 311 | 6.60 | 0.17 |
| 312 | 6.60 | 0.17 |
| 5772 | 6.60 | 0.17 |
| 310 | 7.00 | 0.18 |
| 372 | 7.00 | 0.18 |
| 5719 | 7.50 | 0.19 |
| 767 | 7.80 | 0.20 |
| 779 | 8.20 | 0.18 |
| 785 | 8.40 | 0.21 |
| 348 | 8.50 | 0.22 |
| 711 | 8.50 | 0.22 |
| 5353 | 8.80 | 0.22 |
| 353 | 9.10 | 0.23 |
| 352 | 9.30 | 0.24 |
| 787 | 9.50 | 0.24 |

| JPS Style # | Weight (osy) | Weight (gsm) |
|---|---|---|
| 726 | 10.00 | 0.25 |
| 778 | 10.20 | 0.26 |
| 5930 | 10.50 | 0.27 |
| 724 | 11.00 | 0.28 |
| 5761 | 11.70 | 0.29 |
| 729 | 12.00 | 0.30 |
| 727 | 12.30 | 0.31 |
| 5704 | 12.40 | 0.31 |
| 328 | 13.00 | 0.33 |
| 775 | 13.20 | 0.34 |
| 705 | 13.60 | 0.35 |
| 720 | 14.20 | 0.36 |
| 747 | 14.50 | 0.37 |
| 731 | 15.00 | 0.38 |
| 5741 | 15.50 | 0.39 |
| 722 | 15.80 | 0.40 |
| 741 | 16.00 | 0.40 |
| 5731 | 16.10 | 0.41 |
| 5713 | 16.30 | 0.41 |
| 713 | 16.40 | 0.42 |
| 712 | 16.60 | 0.42 |
| 710 | 18.40 | 0.47 |
| 758 | 21.00 | 0.53 |
| 760 | 21.10 | 0.54 |

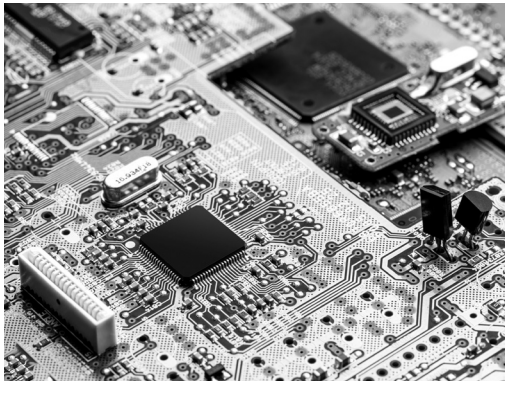
| JPS Style # | Weight (osy) | Weight (gsm) |
|---|---|---|
| 735 | 23.00 | 0.58 |
| 5745 | 24.20 | 0.61 |
| 745 | 24.60 | 0.62 |
| 755 | 29.00 | 0.74 |
| 754 | 30.00 | 0.76 |



## Dyneema Fabrics

| Style | Weave | Count | | yarn | | weight | | thickness | | Strength (lb) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Warp | Fill | Warp | Fill | (osy) | (gsm) | (mils) | (mm) | Warp | Fill |
| 821 | Plain | 32 | 32 | DSM SK 75 | DSM SK 75 | 3.40 | 115.3 | 8.9 | 0.23 | 34 | 34 |





## Spectra Fabrics

| Style | Weave | Count | | yarn | | weight | | thickness | | Strength (lb) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Warp | Fill | Warp | Fill | (osy) | (gsm) | (mils) | (mm) | Warp | Fill |
| 903 | Plain | 21 | 21 | Spectra 900 (1200d) | Spectra 900 (1200d) | 7.00 | 237.3 | 18.5 | 0.47 | 1100 | 1100 |
| 904 | Plain | 34 | 34 | Spectra 900 (650d) | Spectra 900 (650d) | 6.30 | 214.0 | 17.0 | 0.43 | 950 | 900 |
| 951 | Plain | 17 | 17 | Spectra 1000 (650d) | Spectra 1000 (650d) | 2.90 | 98.3 | 9.3 | 0.24 | 700 | 650 |
| 955 | Plain | 54 | 56 | Spectra 1000 (215d) | Spectra 1000 (215d) | 3.30 | 112.0 | 7.8 | 0.20 | 600 | 550 |
| 960 | Plain | 32 | 32 | Spectra 1000 (375d) | Spectra 1000 (375d) | 3.18 | 107.8 | 8.0 | 0.20 | 600 | 550 |
| 961 | Plain | 32 | 32 | Spectra 1000 (375d) | Spectra 1000 (375d) | 3.20 | 108.5 | 8.0 | 0.20 | 600 | 550 |
| 985 | 8H Satin | 32 | 32 | Spectra 1000 (650) | Spectra 1000 (650d) | 5.50 | 186.0 | 13.0 | 0.33 | 1050 | 1000 |
| 956 | Plain | 34 | 34 | Spectra 1000 (215d) | Spectra 1000 (215d) | 1.90 | 67.0 | 5.0 | 0.13 | 400 | 360 |
| 960 | Plain | 32 | 32 | Spectra 1000 (375d) | Spectra 1000 (375d) | 3.18 | 107.8 | 8.0 | 0.20 | 600 | 550 |
| 961 | Plain | 32 | 32 | Spectra 1000 (375d) | Spectra 1000 (375d) | 3.20 | 108.5 | 8.0 | 0.20 | 600 | 550 |
| 984 | Plain | 32 | 32 | Spectra 1000 (650d) | Spectra 1000 (650d) | 5.50 | 187.0 | 14.0 | 0.36 | 1050 | 1000 |
| 985 | 8H Satin | 32 | 32 | Spectra 1000 (650) | Spectra 1000 (650d) | 5.50 | 186.0 | 13.0 | 0.33 | 1050 | 1000 |

## Technical References - English

| Fiber | Density ($lb/in^3$) | Tensile Strength (ksi) | Tensile Modulus (msi) | Strain to Failure (%) | Specific Tensile Strength ($10^6$in) | Specific Tensile Modulus ($10^8$in) | Coefficient of Thermal Expansion ($10^{-6}$/°F) | Decomposition Temperature (°F) |
|---|---|---|---|---|---|---|---|---|
| E-glass® | 0.095 | 500 | 10.5 | 4.0 | 5.28 | 1.11 | 3.00 | 1346 |
| S-2 Glass™ | 0.090 | 665 | 12.5 | 5.5 | 7.42 | 1.40 | 0.90 | 1562 |
| Astroquartz ® | 0.080 | 870 | 10.0 | - | - | - | 0.54 | 3092 |
| Kevlar ® 49, 1420d | 0.052 | 424 | 15.8 | 2.5 | 8.15 | 3.04 | -1.50 | 842 |
| Kevlar ® 29 1500d | 0.052 | 424 | 10.9 | 3.4 | 8.15 | 2.10 | -1.22 | 842 |
| Kevlar ® KM2+ 400d | 0.052 | 520 | 13.6 | 3.8 | 10.00 | 2.61 | -1.22 | 842 |
| Kevlar ® KM2+ 500d | 0.052 | 525 | 10.8 | 3.8 | 10.10 | 2.08 | -1.22 | 842 |
| Kevlar ® KM2+ 600d | 0.052 | 525 | 13.6 | 3.8 | 10.10 | 2.61 | -1.22 | 842 |
| Kevlar ® KM2+ 850d | 0.052 | 512 | 11.8 | 3.8 | 9.85 | 2.27 | -1.22 | 842 |
| Spectra ® 900 650d | 0.035 | 348 | 11.4 | 3.6 | 9.93 | 3.25 | - | 302 |
| Spectra ® 1000 375d | 0.035 | 410 | 14.9 | 3.1 | 11.70 | 4.25 | - | 302 |
| Spectra ® 2000 195d | 0.035 | 465 | 16.4 | 2.9 | 13.27 | 4.68 | - | 302 |
| Twaron ® 1000 | 0.052 | 507 | 9.4 | 3.7 | 9.74 | 1.81 | -1.22 | 842 |
| Twaron ® 2000 | 0.052 | 479 | 12.9 | 3.3 | 9.21 | 2.50 | -1.22 | 842 |
| Twaron ® HM | 0.052 | 507 | 14.7 | 2.1 | 9.69 | 2.85 | -1.33 | 842 |

## Technical References - Metric

| Fiber | Density ($g/cm^3$) | Tensile Strength (GPa) | Tensile Modulus (GPa) | Strain to Failure (%) | Specific Tensile Strength ($10^6$cm) | Specific Tensile Modulus ($10^8$cm) | Coefficient of Thermal Expansion ($10^{-6}$/°C) | Decomposition Temperature (°C) |
|---|---|---|---|---|---|---|---|---|
| E-glass® | 2.50 | 2.6 | 72 | 4.0 | 13.42 | 2.82 | 1.60 | 730 |
| S-2 Glass™ | 2.48 | 4.8 | 85 | 5.5 | 18.86 | 3.55 | 0.48 | 850 |
| Astroquartz ® | 2.20 | 6.0 | 72 | - | - | - | 0.54 | 1700 |
| Kevlar ® 49, 1420d | 1.44 | 2.9 | 109 | 2.5 | 20.71 | 7.72 | -2.70 | 450 |
| Kevlar ® 29 1500d | 1.44 | 2.9 | 75 | 3.3 | 29.71 | 5.32 | -2.20 | 450 |
| Kevlar ® KM2+ 400d | 1.44 | 3.3 | 94 | 3.8 | 23.39 | 6.64 | -2.20 | 450 |
| Kevlar ® KM2+ 500d | 1.44 | 3.4 | 75 | 3.8 | 24.27 | 5.27 | -2.20 | 450 |
| Kevlar ® KM2+ 600d | 1.44 | 3.4 | 94 | 3.8 | 24.60 | 7.52 | -2.20 | 450 |
| Kevlar ® KM2+ 850d | 1.44 | 3.4 | 81 | 3.8 | 24.27 | 5.76 | -2.20 | 450 |
| Spectra ® 900 650d | 0.97 | 2.4 | 79 | 3.6 | 25.23 | 8.26 | - | 150 |
| Spectra ® 1000 375d | 0.97 | 2.8 | 103 | 3.1 | 29.72 | 10.80 | - | 150 |
| Spectra ® 2000 195d | 0.97 | 3.2 | 113 | 2.9 | 33.71 | 11.89 | - | 150 |
| Twaron ® 1000 | 1.44 | 3.5 | 65 | 3.7 | 24.76 | 4.59 | -2.20 | 450 |
| Twaron ® 2000 | 1.44 | 3.3 | 90 | 3.3 | 23.39 | 6.35 | -2.20 | 450 |
| Twaron ® 2200 | 1.45 | 3.5 | 103 | 2.1 | 24.59 | 7.23 | -2.40 | 450 |

# Selected Conversions and Formulae

| US to SI | SI to US |
|---|---|
| 1 oz/yd$^2$ = 33.91 g/m$^2$ | 1 g/m$^2$ = 0.0295 oz/yd$^2$ |
| 1 oz = 28.35 g<br>1 lb = 16 oz | 1 g = 0.035 oz |
| 1 lb = 0.454 kg | 1 kg = 2.205 lb |
| 1 N = 0.102 kgf<br>1 lbf = 4.45 N | 1 kgf = 9.81 N |
| 1 psi = 6894.76 Pa | 1 ksi = 6.89 MPa<br>1 MPa = 1 N/mm$^2$<br>1GPa = 1000 MPa |
| 1 denier = 0.111 Tex | 1 Tex = 9 denier<br>1 Tex = 496,052 yds/lbs |
| °F = (°C)*(9/5)+32 | °C = (°F-32)*(5/9) |
| 1 in = 25.4 mm = 2.54 cm | 1 cm = 0.39 in |
| 1 lb/ft$^2$ = 4.88 kg/m$^2$<br>1 lb/ft$^3$ = 16.02 kg/m$^3$ | 1 kg/m$^2$ = 0.205 lb/ft$^2$<br>1 kg/m$^3$ = 0.062 lb/ft$^3$ |
| 1 yd = 0.91 m | 1 m = 1.09 yd |
| 1 ft = 0.3048 m | 1 m = 3.281 ft |

1 w.m$^{-1}$.k$^{-1}$ = 0.86 kcal.m$^{-1}$.h$^{-1}$.k$^{-1}$ = 6.9 btu.in/(ft.hr.°F)

**Metric Conversion Chart**

| Fabric | US | Factor | Metric |
|---|---|---|---|
| Length | yd | x 0.914 | = m |
| Width | in | x 2.540 | = cm |
| Weight | oz/yd$^2$ | x 33.906 | = g/m$^2$ |
| Breaking Strength | lb/in | x 1.7513 | = N/cm |
| Thickness | in | x 25.400 | = mm |
| Mullen Burst | lb/in$^2$ | x 0.007 | = MPa |
| Air Permeability | cfm | x 0.508 | = cm/cm$^2$ |
| Area | yd$^2$ | x 0.8361 | = m$^2$ |



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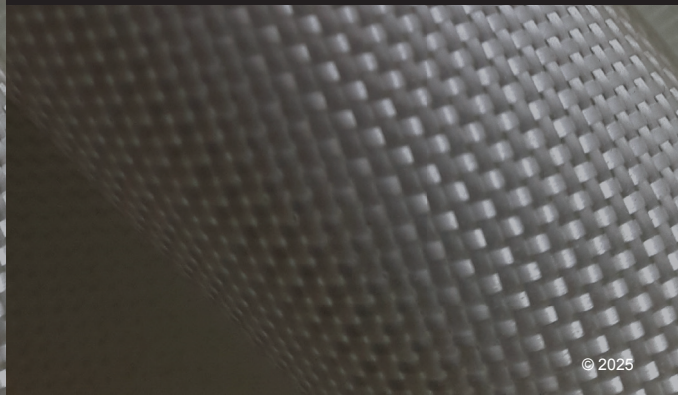


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