JUSHI®

High Performance "E6® Enhanced Glass Fiber"
Will Promote the Progress of Composites.

E6® Enhanced Glass Fiber

— High Performance Environment-friendly Fiberglass

— Compliant with ASTM D578 and ISO 2078 Standards

— An Optimal Combination of Boron-free E-glass and E-CR Glass

中国巨石股份有限公司
CHINA JUSHI CO., LTD

COMPANY PROFILE

China Jushi specializes in the production of glass fiber. The company has attained the leadership position in the global glass fiber industry in terms of Output, Technology, R&D, Quality and Market Share. Jushi Group is a Chinese national, key high technology enterprise, operating a distinguished Post-Doctoral program.

Jushi always adheres to its fundamental Management principles:

- "Apply science and technology for development,
- Build the brand name to expand market share,
- Emphasize management to improve efficiency and
- Employ talented people to enable future growth".

The company owns proprietary, world-class core technologies for large E-glass fiber furnaces, C-glass fiber furnaces and clean production recycling furnaces. The company has its own core technology of world-class and achieved certifications to ISO9001, ISO14001, ISO18001, ISO12001 and ISO17025. Its testing center has been certified by both China National Accreditation Board for Laboratories (CNAS) and Germanischer Lloyd (GL) . The glass fiber rovings and chopped strand mats under the "Jushi" brand have been listed as "China Top Brand" products and the trademark "JUSHI" has been recognized as "China Famous Trademark". The principal products of Jushi have been approved by China Classification Society (CCS), DET NORSKE VERITAS (DNV), Lloyd's Register (LR), Germanischer Lloyd (GL) and Attestation De Conformité Sanitaire (ACS).

Jushi produces E-glass and C-glass glass fiber products including rovings, chopped strands, chopped strand mats, woven rovings and electrical yarns and fabrics in over 20 product categories and 1000 specifications. The products are sold in all provinces in China and exported to over 100 countries. The key regions include North America, Middle East, Europe, Southeast Asia and Africa with export accounting for 50% of the total sales volume.

Jushi people adhere to our core values of "Behavior, Innovation, Responsibility, Learning, Enthusiasm" to build the company into an international group with leading manufacturing scale, advanced technology, talented team, excellent management, powerful execution, great achievements and fast growth. China Jushi strives to lead the modernization of China's glass fiber industry and maintain the leadership position in the global glass fiber industry through endless pursuit of innovation and excellence.

GOALS

Enhance Product Performance

Expand Applications

Minimize Environmental Footprint

Increase Customer Satisfaction

With the rapid development of new applications, the design of fiberglass composite parts is becoming more and more demanding, requiring composite materials to deliver better performance, including increased strength, lighter weight, and enhanced corrosion resistance. Manufacturers and end users want products with long-term consistency and reliability.

To meet these demands, as well as to achieve clean production and minimize environmental footprint, Jushi Group initiated the development of **E6® Enhanced Glass Fiber** in July 2006. The development was successfully completed in 2008 and was commercially available in 2009. Compared with traditional E-glass fiber, Jushi **E6® Enhanced Glass Fiber** improves composite properties and has less impact on the environment during manufacturing.

Jushi **E6® Enhanced Glass Fiber** is a new E-glass fiber, with enhanced properties. It combines all the benefits of E-glass fiber with technical breakthroughs in improved strength, elastic modulus, temperature resistance and acid corrosion resistance, thus meeting the requirements of the most demanding applications. **E6®** provides Jushi Group with a complete new technology platform on which new solutions are developed for a wide range of applications for different end-use markets.

E6 Enhanced Glass Fiber

REVOLUTIONARY NEW GLASS FIBER

Expands the Scope of Composite Applications

Compared with typical E-glass fiber, Jushi E6®offers the following unique benefits:

- **Higher tensile strength,** up to 20% higher than E-glass fiber
- **Higher softening temperature,** about 60℃ higher than E-glass fiber
- **Raw materials containing no boron and no fluorine,** to ensure clean production

E6®is especially suitable for high pressure and high temperature applications. In addition, E6®maintains excellent electrical properties, including dielectric constant and volume resistivity of E-glass.

Physical and Electrical Properties of E-glass and E6® Fibers:

Property	Testing method	Unit	E	E6®
Density	ASTM C693	g/cm^3	2.60	2.62-2.63
Refractive Index	ASTM C1648	/	1.566	1.566
Expansion Coefficient	ASTM D696	$10^{-6}\ K^{-1}$	6.1	6.0
Softening Point	ASTM C338	℃	838	898
Elastic Modulus	ASTM E1876	GPa	72	81
Dielectric Constant (23℃,1MHz)	ASTM D150	/	6.7	7.1

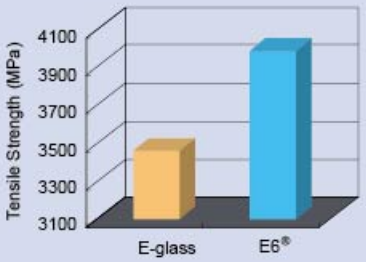
E6®glass fiber is produced with a unique glass formulation, providing significant improvement in chemical corrosion resistance in neutral, acidic or alkaline solutions. The improvement in corrosion resistance is especially significant in the acidic environments

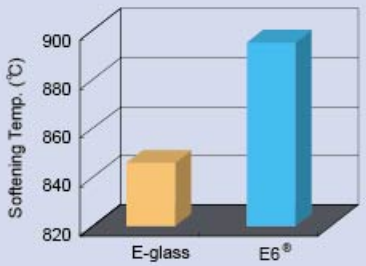
E6®is therefore particularly suitable for the applications in corrosive environments, such as the environmental control devices and chemical, oil and desalination process pipes and tanks.

Item	Testing method	Unit	E	E6®
Weight loss in acidic solution	Soaking in 10%HCl solution at 23℃ for 24 hours	%	18.39	0.08
Weight loss in alkaline solution	Soaking in 0.025M Na_2CO_3 at 23℃ for 24 hours	%	0.16	0.24
	Soaking in 0.5M NaOH solution at 23℃ for 24 hours	%	0.46	0.43
Weight loss in boiling water	Boiling in water at 100℃ for 24 hours	%	0.53	0.39

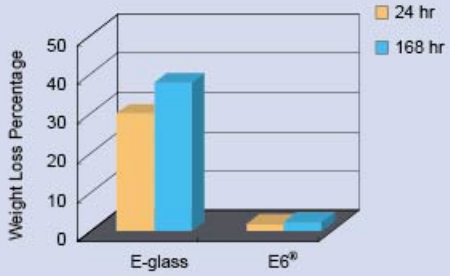
Note:The above tested products have a uniform filament diameter.

Property Comparison between E-glass and E6®Fibers

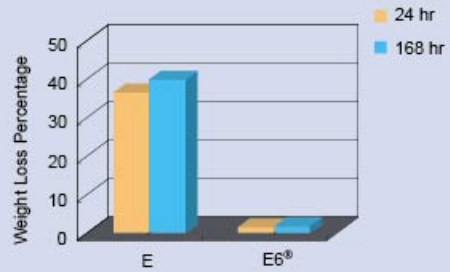




Weight loss comparison of E-glass and E6® fibers soaking in 10% HCl solution at 96℃ after 24 hours and 168 hours



Weight loss comparison of E-glass and E6® fibers soaking in 10% H_2SO_4 solution at 96℃ after 24 hours and 168 hours



E6® REINFORCEMENTS

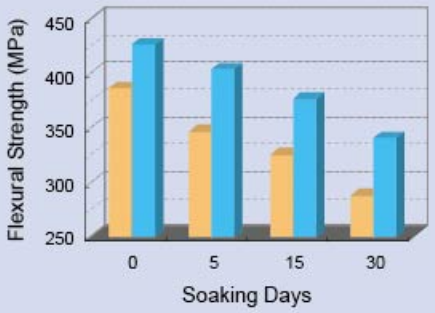
Open A New Era for Composites

Performance Comparison of Laminates Soaked in Acid Solution

E-glass E6®

Comparison of longitudinal tensile strength of laminates soaked in 5% H_2SO_4

Comparison of longitudinal flexural strength of laminates soaked in 5% H_2SO_4



Superior mechanical properties

The use of E-glass reinforcements allows customers to design high performance composites beyond the limits of the polymer material itself. Jushi E6® glass fiber enables even higher composite performance. Compared with E-glass, composites based on E6® reinforcements have better mechanical properties including: tensile strength, elastic modulus, flexural strength, flexural modulus, shear strength and compressive strength. E6® Enhanced Glass Fiber has wide application fields in high performance composites, including: wind energy, high pressure vessels, geo-grids and sucker rods.

Test Sample	Property	Standard	E	E6®
Tensile property of impregnated roving, Epoxy resin	Tensile strength (MPa)	ASTM D2343	1900~2000	2500~2700
	Tensile modulus (MPa)	ASTM D2343	73~75	81~83
1200 g/m^2 UD fabric, (tested in 0° direction), Infusion process, Epoxy resin	Tensile strength (MPa)	ISO 527-5	/	1120.6
	Tensile modulus (MPa)	ISO 527-5	/	42.6
	Fiber Volume Content (%)	ISO 1172	/	53.6
	Tensile strength (MPa)	ISO 14126	/	805.5
	ensile modulus (GPa)	ISO 14126	/	42.9
	Fiber Volume Content (%)	ISO 1172	/	54.3

Excellent environment durability

In the future, end-use composite products will operate in even harsher environments and the end-users will expect enhanced durability. Compared with E-glass fiber, **E6® Enhanced Glass Fiber** reinforced composite materials offer better corrosion resistance and temperature endurance, making composite parts more reliable and cost effective.

Chemical Stability

Degradation (% Loss) after boiling in water for 7 days:

Test sample	Property	Standard	E-glass	E6®
Direct roving (EDR24-2400-386) 800g/m^2 Woven roving Unsaturated polyester Hand laid laminates	Fiber Volume Content (%)	ISO 1172	57.0	57.0
	Tensile strength (MPa)	GB/T 1447	49.9 %	11.6%
	Tensile modulus (GPa)	GB/T 1447	12.4%	2.8%
	Flexural strength (MPa)	GB/T 1449	42.3%	22.5%
	Flexural modulus (GPa)	GB/T 1449	13.2%	2.6%

Comparison of longitudinal tensile modulus of laminates soaked in 5% H_2SO_4

Temperature Resistance

Glass fiber reinforced composites are increasingly used in harsh environments, such as pipes used in oil-field processing or in treatment of high temperature waste gas. Drastic changes in ambient temperature can reduce the strength and thus shorten the operating life of composite materials.

The composite samples tested below were dried for 10 days at 180℃, and then put in an -60℃ environment for another 10 days. The relative loss of properties after the exposure is shown in the Table below.

Sample	Property	Standard	E-glass	E6®
Direct roving (EDR24-2400-386) 800g/m^2 woven roving Unsaturated polyester Hand laid laminates	Fiber Volume Content(%)	ISO 1172	58.0	58.0
	Tensile strength (MPa)	GB/T 1447	11.0%	4.9%
	Tensile modulus (GPa)	GB/T 1447	15.0%	6.8%
	Flexural strength (MPa)	GB/T 1449	19.3%	17.0%
	Flexural modulus (GPa)	GB/T 1449	14.3%	14.0%

Comparison of longitudinal flexural modulus of laminates soaked in 5% H_2SO_4

ENVIRONMENTAL PROTECTION

Become a Model for Clean Production

Jushi Group is committed to improving our environmental footprint. We have invested heavily in the most modern technologies available to reduce pollutants in our air and water, and reduce waste.

E6® Enhanced Glass Fiber, is made with a glass formulation which significantly reduces air pollutants during manufacturing. Improved oxygen firing technology reduces total waste gas emissions from the furnace by 80% and the nitrogen oxide emissions by over 90%. State of the art glass recycling technology ensures zero discharge of process waste glass fiber. Modern waste water purification technology enables zero discharge of industrial waste water from our process.

The Jushi development of **E6® Enhanced Glass Fiber** is consistent with our constant commitment to social responsibility and sustainability. Not only have we achieved the goal of improving our glass fiber products, but we also have improved our environmental footprint at the same time.

CUSTOMER AND TECHNICAL SUPPORT ORGANIZATION

Offer Best Technical Support

Jushi Group possesses world class core technologies and advanced testing and analysis capabilities for glass, organic chemistry, fiberglass and composites. We have established a global network of marketing and technical service professionals to help customers solve problems in materials development and process optimization. We collaborate closely with customers to address market challenges and promote the growth of the composites industry.

We will share with you all the information on **E6®** glass fiber reinforcements as well as our considerable knowledge of compounding and molding technology and processes.

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★All the data given in this brochure is preliminary and China Jushi reserves the right to update or modify the data without notice.

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