

Toray Composite Materials America, Inc.



CARBON FIBER SELECTOR GUIDE

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TORAYCA[®] CARBON FIBER SELECTOR GUIDE

Toray's TORAYCA[®] carbon fiber is globally recognized for its outstanding performance, quality, and consistency in processing. Used in a wide variety of aerospace, industrial, and recreational applications, the full product portfolio of polyacrylonitrile (PAN)-based carbon fibers includes standard-modulus, intermediate-modulus, and high-modulus fibers with a wide range of properties.



RANGE OF TORAYA® CARBON FIBER TENSILE PROPERTIES

CARBON FIBER CLASSIFICATION

TENSILE MODULUS AND TENSILE STRENGTH

Classification of carbon fibers at the highest level is usually based on the tensile modulus and tensile strength of the fiber. Toray's *T* series carbon fibers typically have high tensile strength and are classified by tensile modulus in standard modulus and intermediate modulus categories. The *M* series carbon fibers have high modulus, with the second-generation *MJ* series having improved tensile strength.

Standard Modulus Carbon Fiber

Standard modulus (SM) carbon fibers typically exhibit a tensile modulus of 33-34 Msi or slightly higher. These are often the most effective of the fibers as measured by tensile strength or modulus per unit cost.

Intermediate Modulus Carbon Fiber

Intermediate modulus (IM) carbon fibers exhibit a tensile modulus of about 42 Msi, with Toray's IM+ T1100 carbon fiber pushing this range up to 47 Msi. A broad range of IM fibers is available with a mix of price and performance characteristics to meet the needs of aerospace, industrial, and recreational applications.

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High Modulus Carbon Fiber

Toray's portfolio of high modulus carbon fiber represents the highest modulus PAN-based carbon fibers available. They have superior tensile and compressive strengths compared to corresponding pitch-based carbon fibers.

TOW ARCHITECTURE

TORAYCA® carbon fibers are manufactured with various tow architectures, given by twist designation and tow size or filament count.

Twist Designation

The original carbon fibers were produced as twisted fibers, and Toray continues to make twisted and untwisted fibers. All of the fibers manufactured in the US are never-twisted, which as the name implies are never twisted even through the fiber manufacturing process. Never-twisted fibers sometimes give better strength performance compared to similar twisted or untwisted fibers.

Tow Size or Filament Count

Tow sizes vary based on the fiber type. Generally, small tows range from 1,000 to 6,000 filaments per tow and are useful for producing woven fabrics and prepregs with tight weave patterns for good drapability. Standard tow sizes produced in the US are 12,000, and 24,000, and 36,000 filaments per tow.

SURFACE TREATMENT & SIZING

After carbonization, TORAYCA[®] carbon fibers are surface treated and sizing is applied to enhance the processability of the tow and ensure compatibility with various resin systems.

Surface Treatment

Surface treatment is the primary means to tune the adhesion properties of the fiber to the resin system used in the composite. This process step adds oxygen functional groups and etches the surface of the fiber. The surface treatment on the TORAYCA[®] carbon fiber varies by product type from standard to aggressive surface treatment. Proper selection depends on the resin matrix properties and desired composite performance areas, such as high tensile or compression properties.

Sizing Type

Sizing is the chemical coating applied to the fiber. The purposes of sizing are to enhance fiber processability and ensure the compatibility of the fiber to the resin matrix. Various sizing types are available with TORAYCA[®] carbon fiber as illustrated in the following table:

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Resin System Compatibility for Various Sizing Types

Sizing Type	Resin System Compatibility*
1	Ероху
3	Ероху
4	Epoxy, Phenolic, BMI
5	General Purpose: Epoxy, Phenolic, Polyester, Vinyl Ester
6	Ероху
7	Ероху
F	Vinyl Ester, Epoxy

*Not an exhaustive list. Contact Sales or Technical Service for more information.

Sizing Amount

The processability and adhesion properties of the fiber can be further tuned based on the amount of sizing applied. Various TORAYCA[®] carbon fiber types are available with various sizing amounts. Typically, a lower sizing amount improves the spreadability of the tow, while higher sizing amount helps protect the fiber in more demanding applications.

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TORAYCA[®] TYPICAL FIBER PROPERTIES (Nominal Values)

FIBER TYPE		Number of Filaments	Sizing Type	Tensile Strength* (ksi) (MPa)		Tensile Modulus* (Msi) (GPa)		Elongation (%)	Yield (g/1000m)	Density (g/cm ³)	Standard Spool Size** (kg)
STANDARD MODULUS		1,000	4,5	512	3,530	33.4	230	1.5	66	1.76	1.0
	T300	3,000	4,5						198		2.0
		6,000	4,5						396		2.0
	T400H	3,000	4	640	4,410	36.3	250	1.8	198	1.80	2.0
		6,000	4						396		2.0
	T700S	6,000	5	711	4,900	33.4	230	2.1	396	1.80	2.0
		12,000	5, 6, F						800		4.0, 6.0, 8.0
		24,000	5, 6, F						1,650		6.0, 8.0
	T700G	12,000	3, 4, 5	711	4,900	34.8	240	2.0	800	1.80	6.0
INTERMEDIATE MODULUS	T800H	6,000	4	796	5,490	42.7	294	1.9	223	1.81	2.0
		12,000	4,5						445		4.0
	T830H	6,000	4	774	5,340	42.7	294	1.8	223	1.81	2.0
	T800S	12,000	5	853	5,880	42.7	294	2.0	515	1.80	4.0
		24,000	1						1,030		4.0
	T910S	36,000	5	880	6,070	40.2	278	2.2	1,615	1.80	4.0
	T1000G	12,000	4	924	6,370	42.7	294	2.2	485	1.80	4.0
	T1100S	12,000	5	1,017	7,000	47.0	324	2.0	505	1.79	2.0
		24,000	5						1,010		2.0, 4.0
	T1100G	12,000	7	1,017	7,000	47.0	324	2.0	505	1.79	2.0
		24,000	7						1,010		2.0, 4.0
HIGH MODULUS	M35J	6,000	5	654 683	4,510	49.8 34	242	1.3	225	1.75	1.0
		12,000	5		4,700		343	1.4	450		2.0
	M40J	6,000	5	640	4,400	54.7	377	1.2	225	1.77	1.0
		12,000	5						450		2.0
	M46J	6,000	5	609 583	4,200	63.3	436	1.0	223	1.84	1.0
		12,000	5		4,020			0.9	445		2.0
	M55J	6,000	5	583	4,020	78.2	540	0.8	218	1.91	0.5
	M60J	3,000	5	554	3,820	85.3	588	0.7	103	1.93	0.25
		6,000	5						206		0.4

Manufactured in the US.

*Measured using the impregnated strand method. This information can be used for material selection purposes only.

** Other sizes available, refer to product data sheet.

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