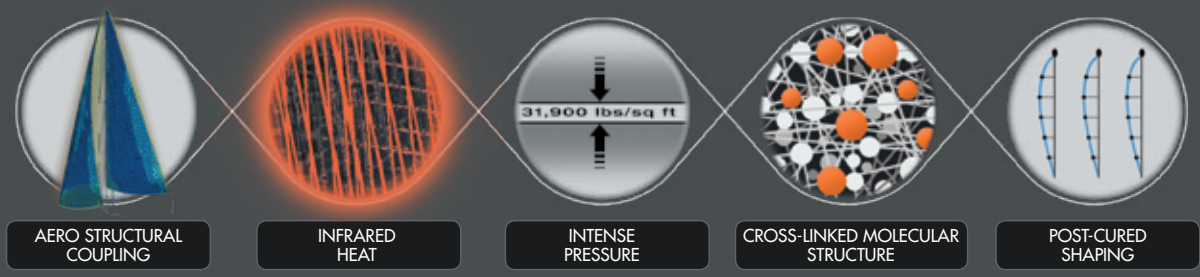
FUSION M® RACING MEMBRANE SAILS

QUANTUM®
SAIL DESIGN GROUP

RACING PRODUCT GUIDE

What Makes Fusion M® Membrane Sails So Great?



Quantum's Fusion M® racing membranes are made using the most technically advanced design, lamination, and shaping methods in the industry. Known as iQ Technology®, this integrated and proprietary process results in sail shapes that are fast, efficient, and infinitely repeatable ... a feat no other sail maker can match.

More Fiber in More Directions

Fusion M® sails are engineered as full-size membranes and are designed with a fully-integrated, custom, fiber network that addresses sail loading equally in all directions rather than along primary load paths only. This fiber map is developed using highly sophisticated finite element analysis (FEA), which recognizes the ever-changing nature of sail loads and the need for adaptability. The resulting fiber-network is complex and very dense, creating a structural system that supports the entire sail because there is consistent stretch in all directions (referred to as "isotropic"). The Fusion M® isotropic fiber matrix prevents any one part of the sail from becoming overloaded or distorted. The net result is a sail shape that lasts longer and is easy to trim through a wide range of conditions because it changes evenly and uniformly.

Superior Lamination

Our two-step lamination process uses vacuum bagging to lock fibers in place between film layers. Infrared heat is then applied and six-to-eight tons of pressure (12,000psi – 16,000psi) to thermo-set the adhesives and produce a membrane four to five times stronger than other laminates. Films are coated with UV inhibitors to insure protection, longevity, and performance.

Post-cured Shaping

Unlike single-step lamination and shaping methods used by other sailmakers, Quantum's sail panels are completely cured before the shaping process begins. Fully-cured lamination eliminates the effects of shrinkage and guarantees repeatability. Quantum's Fusion M® sails have the best initial shape and the longest shape life of any racing sail built today, without sacrificing the durability and reliability that is the fundamental performance requirement of a good racing sail.

Fiber Options to Fit Your Needs

Fusion M® racing sails are built with varying types of fiber, providing a range of options for different size boats and sailing requirements. As illustrated by chart below, fiber properties like initial modulus, tenacity, and UV resistance are key in determining the right fiber for your sail. Quantum's sailing pros can help you make the right selection.

FIBER SELECTION CHART

	Initial Modulus	Tenacity	Flex Life	UV Resistance	Elongation to Break
	The measure of a fiber's ability to resist stretch. This indicates how well the fiber will perform in terms of holding sail shape. The higher the rating the less the fiber will stretch.	The fiber's initial breaking strength. A good measure of a fiber's ultimate tensile strength. The higher the rating the more load it takes to break the fiber.	A measure of strength lost due to bending, folding, or flogging. The fiber's ability to retain its strength after being folded back and forth over several cycles. The lower the rating the better the flex life.	Strength loss from exposure to the Sun's UV rays. This is a measure of the effect of sunlight on the modulus (strength) of the fiber. The higher the rating the better the UV resistance.	A measure of the fiber's ability to resist shock loads; elastic stretch resistance. Analogous to the stiffness in a spring. Higher ratings mean more stretch and resistance to breakage.
RACING FIBERS					
High Tenacity Carbon Fiber	★★★★★	★★★★★	★★★	★★★★★	★★★
High Modulus Twaron®	★★★★	★★★★	★★★★	★★★	★★★★
High Modulus Twaron® Black	★★★★	★★★★	★★★★	★★★★	★★★★
Technora®	★★★	★★★	★★★★★	★★★★	★★★★★

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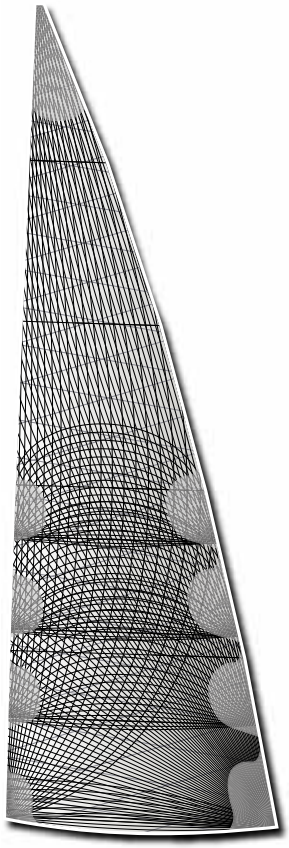
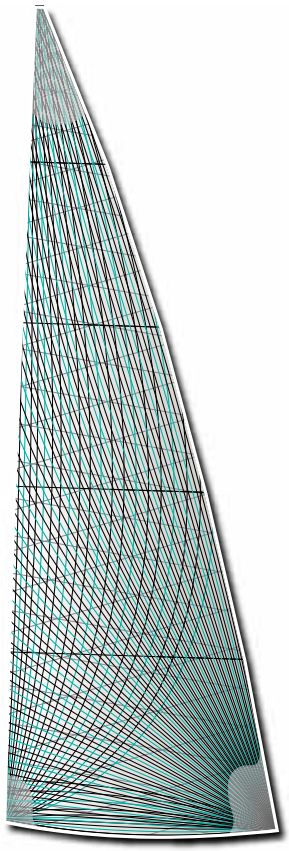
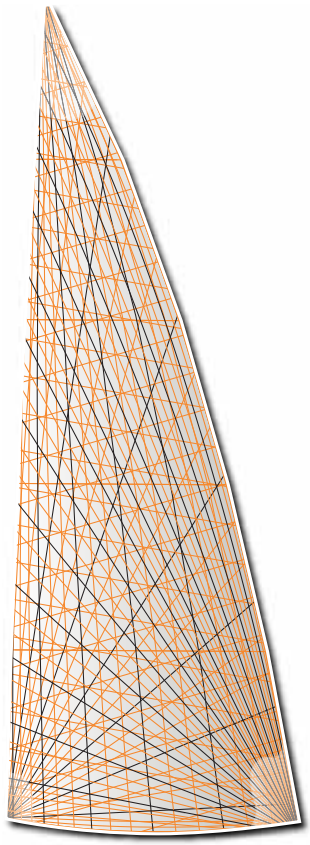
SAIL SELECTION CHART







	9000 Series	7000 Series	5000 Series
Description	These top-of-the-line, Grand Prix sails feature 100% Carbon to deliver superior strength coupled with lightweight, low-stretch performance. Custom string Xply base.	These high-performance sails offer a superior strength-to-weight ratio and stretch resistance for optimal shaping and ease of trim. Excellent heel control and upwind performance. Choose from a blend of Carbon and Aramid fibers or 100% Twaron®.	Designed for mid-size racers, the 5000 series sails offer excellent versatility in a broad range of wind speeds and are easy to trim. Choose from a blend of Carbon and Twaron® or 100% Twaron®.
Boat Size	40-80′	35′ - 80′	25′ - 40′
Material/Fiber	100% Carbon	Carbon/Aramid	Carbon/Twaron®
Sail Color	All black fiber	All black fiber with gold X-ply scrim	All black fiber with gold X-ply scrim
Strength/Weight Ratio	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★
Ease of Trim	★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★ ★
Control of Heel	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★
Upwind Performance	★ ★ ★ ★ ★	★ ★ ★ ★ ★	★ ★ ★ ★
Wind Range Versatility	★ ★ ★ ★	★ ★ ★ ★	★ ★ ★ ★ ★
UV Resistance	★ ★ ★ ★	★ ★ ★ ★	★ ★ ★
Fiber Resistance to Flogging	★ ★ ★ ★	★ ★ ★ ★	★ ★ ★
Durability	★ ★ ★ ★	★ ★ ★ ★	★ ★ ★ ★
Optimal Shape Retention	🕐 🕐 🕐 🕐 🕐	🕐 🕐 🕐 🕐	🕐 🕐 🕐
Cost	$$$$$	$$$$	$$$
Sails in Series	**MR 9000** Boat Length: 40+ Fiber: 100% Carbon	**MR 7600** Boat Length: 40′-80′ Fiber 60% Carbon/40% Aramid **MR 7300** Boat Length: 30′-60′ Fiber: 30% Carbon/70% Aramid **MR 7000** Boat Length: 25′-55′ Fiber: 100% Black Twaron®	**MR 5300** Boat Length: 25′-40′ Fiber: 30% Carbon/70% Twaron® **MR 5000** Boat Length: 25′-40′ Fiber: 100% Twaron®

FIBER KEY

- TWARON
- CARBON
- ARAMID

iQ® technology

Sail Shape

Define geometry of the sail and create mold shape using 3D design program and extensive database of boat and sail types.

Aerodynamic Analysis

Compute and visualize aerodynamic forces, wind angles and velocities, and the distribution of air pressure using computational fluid dynamic (CFD) calculations.

Structural Analysis and Fiber Mapping

Evaluate stresses and strains on the sail, rig and rigging with finite element analysis (FEA) and materials data to determine optimal flying shape and fiber layout.

Output Design

Adjust and refine all elements of the sail design and structure to achieve optimal shape, structure, fiber type, and layout for the finished product. Transfer precise construction specifications to the manufacturing team.

Manufacturing

Build sails following stringent and precise manufacturing standards and propietary procedures for optimal quality.

Verification

Validate advancements in design technology and the iQ process through on-the-water testing.

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