iQ™ technology

Intelligent sail design.

Quantum Sail Design Group has elevated the art and science of sail making to a new level, resulting in the fastest and most efficient sail shapes and structures possible. It's called iQ Technology™ and simply stated, it is the most intelligent system in the industry for making custom membrane sails.

Whereas some companies rely on off-the-shelf tools, Quantum's iQ Technology™ is a fully integrated, proprietary approach honed over 20 years by people with vast knowledge and expertise in sailing and the complexities of engineered structures. iQ Technology™ integrates state-of-the-art design and manufacturing methods with on-the-water testing in a systematic process that ensures outstanding sail performance, consistency and repeatability.

Using computerized 3D modeling, complex mathematical computations, and virtual testing, Quantum designers begin by analyzing each element of a membrane sail's aerodynamic performance and structural requirements. Precise construction specifications of the refined sail design are then transferred to the manufacturing team where sails are made following meticulous manufacturing procedures with tolerances measured in millimeters. At the most demanding levels of the sport, sail performance is further optimized through rigorous, on-the-water validation and refinement.

iQ Technology™ informs the making of every Quantum sail. Sailors who choose Quantum sails can take pride in knowing their sails are made using the same high standards and manufacturing methods developed for Quantum's high-end, Fusion M sails used in the most demanding environments. Our investment in technology is driven by our ambition to create a better sailing experience for all customers, at every level of sailing.

DESIGN

A balance between aerodynamic pressure and surface tension — the classic engineering problem called aero elasticity — determines the optimal flying shape of a sail. Quantum's sail designers address this challenge with computational fluid dynamic (CFD) calculations to assess the aerodynamic forces and finite element analysis (FEA) to evaluate elasticity. The first step is to determine the sail shape.

Sail Shape

Using our own 3D design program, actual boat specifications, and our extensive database of boat and sail types, the size and geometry of the sail are defined and a mold shape created. Sophisticated editing tools allow for the highest levels of accuracy and refinement.

Aerodynamic Analysis

Using a virtual prototype of the sail shape and computational fluid dynamic (CFD) calculations, designers compute and visualize aerodynamic forces, wind angles and velocities, and the distribution of air pressure on each side of the sail. The resulting images and data help predict performance.

Structural Analysis and Fiber Mapping

Using finite element analysis (FEA), Quantum designers visualize where the sail bends and twists and the distribution of stress and strain within the membrane. The virtual sail is attached to a rig model that takes into account the properties of the running and standing rigging and longitudinal and transverse stiffness. Data gained through in-house materials testing is added to the equation to evaluate the effects of different fiber types, amounts, and placement leading to the development of a custom fiber map.

The integration of 3D modeling, CFD and FEA allows designers to assess and refine varying elements of the sail design leading ultimately to the optimal size, shape, structure, fiber type, and fiber layout of the finished product. Quantum's expertise in using these tools is particularly valuable when applied to large sailing yachts, which present unique challenges due to variable weight placement and heavy loads.

Performance Optimization

When collaborating with boat design teams, Quantum designers also use a velocity prediction program (VPP), to assess a sail's impact on boat performance in different wind conditions by linking aerodynamic to hydrodynamic performance — in other words balancing hull and sail forces. The impact of rig position, rake, heel, rudder angle and other variables can be modeled and evaluated. Conversely, sail shapes can be optimized for the hull characteristics of specific designs.

MANUFACTURING

Quantum's membrane sails are built in new, state-of-the-art manufacturing centers using technically advanced methods developed by the company over the last decade for laminating and shaping the membrane. Written standards for every detail of the finishing process ensure the highest levels of quality and reliability. Quantum maintains links to industrial and academic partners throughout the world as part of its commitment to continuous improvement in manufacturing quality, consistency, and efficiency.

Lamination

The membrane is a laminate composed of a custom fiber map sandwiched between sheets of very thin Mylar® film. Quantum membrane sails are designed with more cross fiber in the base scrim than other sail brands creating a more efficient structure that is easier to trim due to a wider effective wind range, increased durability, and better shape retention.

To create the laminate, fibers are strung on the base film in a custom pattern according to the design specifications. During application, excess glue is stripped from the fibers to avoid saturation, minimize brittleness, and to achieve the highest strength to weight ratio. After the top layer of film is in place, a vacuum bagging process is used to "shrink wrap" the film around the fibers. The layers are then fused using infrared heat and six to eight tons of pressure to thermo-set the adhesives. This proprietary process squeezes the adhesive down to the thinnest possible layer and induces polymerization — a "cross-linked" molecular structure — which produces a membrane that is four to five times stronger than a laminate adhered with a traditional hot-melt method.

Post-cured Shaping

In a vast improvement over older shaping methods employed by other sailmakers, Quantum's sails are laminated in sections first then cut, shaped, and joined into the final one-piece membrane before the broad seams and luff curve are carefully measured to the millimeter, ensuring precision. Advancements in lamination and seaming techniques have effectively eliminated seam failures and delamination.

The result of this exacting lamination and shaping process is more precise shapes that are exceptionally durable and infinitely repeatable with infinitesimal shrinkage or distortion.

VERIFICATION

The Quantum Racing TP52 program in the Audi MedCup Circuit is a platform for validating technological advancements. This racing circuit — with a professional crew and over 200 hours of sailing in a full range of wind and sea conditions on all points of sail — provides the most controlled way to gather data, verify performance targets, and identify areas for improvement. Following a prescribed process for data collection and sail refinement, the Quantum Racing Team was able to accomplish an impressive 8.6 percent increase in boat speed from the start to the end of the 2008 series. Using this data in the development of new sails for 2009, boat speeds were boosted even further. For racing teams looking to maximize the performance of their Quantum sails, this testing and verification process can be replicated, providing a proven advantage.

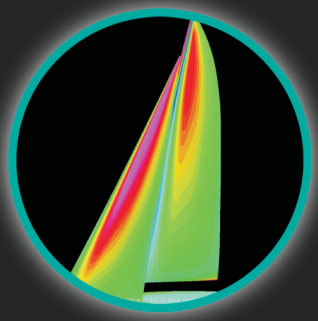
To learn more about Quantum's iQ Technology™, we invite you to contact one of our sail professionals at a loft near you.

QUANTUM™
SAIL DESIGN GROUP

For a complete directory of locations, please visit our website at www.quantumsails.com or call 1-888-773-4889.

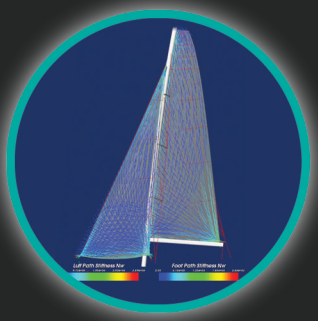
THE PROCESS ›

THE PROCESS



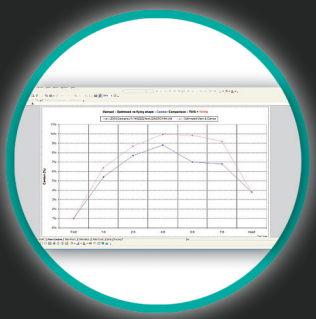
STEP 2 - AERODYNAMIC ANALYSIS

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



STEP 3 - 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.



STEP 4 - OUTPUT DESIGN

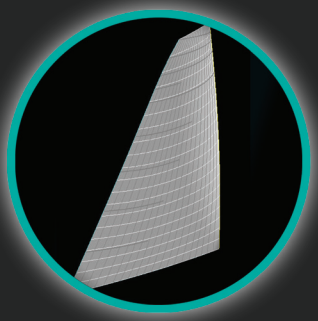
Adjust and refine all elements of the sail design and structure to achieve optimal shape, structure, fiber type, and layout for the finished product. Transfer precise construction specifications to the manufacturing team.

STEP 5 - MANUFACTURING

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

STEP 6 - VERIFICATION

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



STEP 1 - SAIL SHAPE

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

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