CARBONICS

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GMT

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Carbon Fiber Spars for Cruising Boats

There's a revolution afoot in the sailing world and it has begun behind the shop doors of G M T. The well proven benefits of composites are finally being applied to cruising boat masts - a location where they'll do the most good. Six carbon fiber spars are under construction, not for high budget racing machines, but for prestigious builders of cruising boats. Carbon fiber has been the material of choice for the aerospace and aircraft industry for years. Today, carbon is part of our everyday world. Almost any sporting product you pick up is made in part from carbon fiber. Tennis racquets, heel supports in athletic shoes and shafts of carbon for golf clubs are just a few examples.

During the past seven years, G M T has been a leader in applying composite technology to marine products such as pre-preg carbon rudder posts, blades, booms and spinnaker poles. Now, as the price of composites drops, their use in weight sensitive parts such as spars becomes more cost effective. G M T has undertaken the research, development and testing program to position itself as an authority in the composite spar field.

New Composite spars are half of the weight of equivalent aluminum sections, tipping the balance towards comfort and performance.

Hinckley, Cherubini and the future cruising sailboat.

The Hinckley Company and Cherubini Boat Company are the first U.S. boat builders to realize the benefits of carbon fiber cruising spars. Hinckley has equipped two Hinckley 59's with carbon fiber 'Stoway'® furling spars. Cherubini, in conjunction with Rigging Services Inc of Chestertown, Maryland, has commissioned a new 48 foot schooner with carbon main and fore masts. In sailing trials, these five composite spars have produced noticeable improvements in performance. At a time of

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Bermuda 40 carbon spar retrofit

Today, cruising sailors have new priorities. Performance, comfort and safety have become inseparable prerequisites for cruising boats. Recently, George Carter, a Bermuda 40 owner from Gloucester, Massachusetts ordered a carbon spar from G M T for his nineteen year old boat. He had singlehanded this boat to Europe last summer and wanted to improve stability and upwind performance.

"The conversion to carbon has given us the best of both worlds. We expect to improve performance on all points of sail and increase our margin of safety as well. It's like having your cake and eating it too !"

George Carter, Bermuda 40 owner

An increase in ballast or draft would have meant costly modifications to the hull and would compromise the downwind or light air speed. The new carbon spar (weighing in at 148 pounds), saved 122 pounds aloft which means a gain in stability of at least 6 per cent. Describing the recent changes to his classic boat, George says "The conversion to carbon has given us the best of both worlds. We expect to improve performance on all points of sail and increase our margin of safety as well. It's like having your cake and eating it too!"

George will be sailing "Windswept" with her new carbon spar off Gloucester, Massachusetts this June.

G M T Weight Loss Program Breathes Fire Into Racers & Cruisers

Anyone who has swung a tennis racquet or golf club made of carbon will realize how much less energy it takes to complete the shot. A sailboat feels the same sense of relief when you remove weight, especially from the extremities; bow, stern and aloft. The light weight high strength of composite parts such as carbon spinnaker poles and composite rudder shafts and blades will take weight out of critical areas of the boat without compromising strength or safety.

Carbon fiber spinnaker poles mean lighter work for the boat as well as the foredeck crew . Sets, gybes, and drops happen with lightning speed with a pole that weighs 10 pounds rather than 25 pounds. The handling of the spinnaker pole is of special concern aboard maxi cruisers where crew are few. G M T recently supplied a pre-preg carbon spinnaker pole for the 95 foot cruising boat "Gitana IV". The 35 foot long pole, expertly built by G M T craftsman, Andrew Wichelns, weighed 84 pounds compared to the aluminum pole of more than 200 pounds. The table below shows a comparison between carbon and aluminum spinnaker poles.

Typical G M T Pre-preg carbon spinnaker pole weights

	IMS 40	CRUISING 50'
Pole length	15.0 ft	23.0 ft
Carbon	10.0 lbs	21.0 lbs
Aluminum	23.0 lbs	45.0 lbs
Weight saving	13.0 lbs	24.0 lbs

Despite the tone of this newsletter, carbon is not the only composite material we work with. The sensational new IMS 40' design from Bill Tripp that dominated this year's Key West Race Week, was equipped with a G M T "S" Glass rudder post.

The all composite rudder offers a double edge advantage. First, the "S" Glass post offers a significant weight savings compared to aluminum or stainless steel. Secondly, G M T has installed a computer driven milling machine to automate rudder blade shaping. With this equipment we can guarantee the accuracy and symmetry of the blade shape and save weight be-

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cause virtually no filler is used to fair the blade. Because we are not constrained by round stock geometry, we can offer designers the opportunity to design a thinner more responsive, lower drag rudder.

Rudder Weight Comparisons
IMS 40 footer.

G M T "S" Glass post	12 lbs
Aluminum post	36 lbs
Stainless steel post	51 lbs
G M T post & blade	33 lbs
Production post & Blade	80 lbs

Our rudder blade program is the brain child of Gary Crosby. Gary's computer, design and lofting skills have also placed G M T at the forefront of pattern and tool making for parts with complex geometry such as ship blade propeller patterns.

The combination of a carbon spinnaker pole and composite post and blade will save weight in the ends of the boat where it counts most.

G M T is involved in several new and retrofit rudder projects this spring. Amongst these are a rudder shaft and quadrant for a new Taylor 42 underway at Concordia Custom Yachts, a new rudder for the Swan 44 "Temptress" undergoing modifications at Jamestown Boat Yard and a new "S" glass post and blade for a Seguin 41.

The ultimate test lab

Carbon spars not only provide a performance advantage, they also have a margin of safety beyond that of aluminum. More than half of the competitors in the BOC and "Globe Challenge" solo round the world races were equipped with carbon fiber spars. The ultimate test came when one Globe Challenge competitor broke a critical piece of standing rigging in gale force winds a few days from the finish. Repairs could not be made until conditions improved. The skipper was quoted as saying 'if it had been an aluminum spar, it would have fallen'.

Carbon fiber has very desirable qualities besides a strength to weight advantage. It is better in fatigue than almost any metal including aluminum, stainless, titanium and even fiberglass. Carbon has the ability to bend and flex more without permanent deformation compared to aluminum. The aluminum spar will buckle at yield and not return to its original shape.

Self-sufficiency for the cruiser

Cruising sailors have always been concerned about their ability to be self sufficient, especially when it comes to repairs and maintenance far from the convenience of a boatyard. Aluminum mast repair requires a heliarc welder and considerable skill. Depending on the extent of the damage, carbon fiber can be repaired using simple tools and basic composite techniques. That's certainly more convenient than carrying your own personal heliarc welder!

Hinckley, Cherubini and the future cruising sailboat

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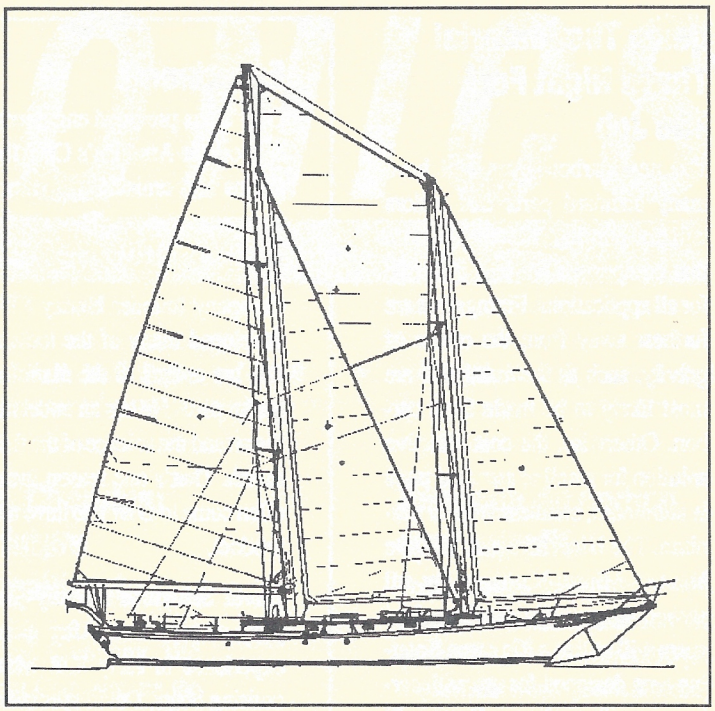
belt tightening in the marine industry, companies like Hinckley and Cherubini see carbon fiber not as an exotic but as a cost effective way to achieve real gains in performance. "The decision to use carbon fiber rather than aluminum was based upon cost efficiency in achieving greater stability and reduced pitching moment while improving the strength, safety and longevity of the rig," said Rig Reese, Director of Marketing for the Hinckley Company. "The paybacks are substantial improvements in comfort and performance on all points of sail...With cruising sailboats where amenities dictate higher displacement and where draft is restricted, carbon fiber spars offer the single best avenue for meaningful gains."



Cherubini 48
The new G M T carbon fiber spars will increase stability by 19%.

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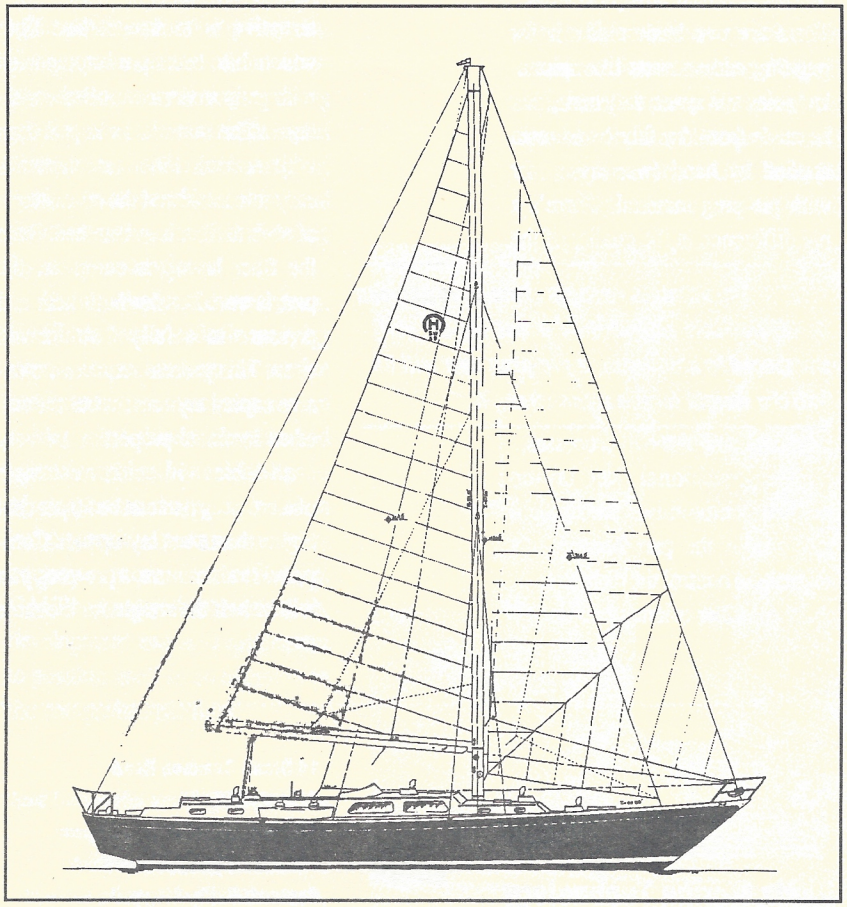
Rig Reese, Director of Marketing for the Hinckley Company.



Hinckley 59
The tapered carbon furling spars provided a 0.5 ft. drop in center of gravity despite a 4.0 ft. increase in rig height.

The spars will be half the weight of comparable aluminum extrusions. Weight savings for the Hinckley 59's will be 400 pounds for the sloop and 530 pounds for the ketch. This represents a 5 per cent increase in righting moment and a 0.5 foot drop in the overall center of gravity – or the equivalent of adding more than 3,000 pounds of lead to the bottom of the keel! This dramatic stability increase opens the door to a number of interesting options. One option that both Hinckley owners have taken is exchanging some of the additional righting moment for taller rigs to enhance light to moderate air performance.

On the Cherubini 48 we'll save 530 pounds aloft with the conversion to carbon spars to gain 19 per cent increase in stability! Unlike most furling spars, the new carbon spars will have tapered topmasts. This will not only improve the esthetic value of the spars but reduce weight and windage as well.

Using The Material That's Right For The Job

The new carbon spars will have many standard parts that sailors will find familiar. We don't believe that composites are cost effective for all applications. Fittings that are furthest away from the center of gravity, such as the masthead, are most likely to be made from carbon. Otherwise, the cost effective solution for small or standard parts is aluminum, stainless steel or titanium. The Hinckley spars will use Navtec Micro Navtang for all shroud tangs while the Cherubini spars will utilize a Riggarna Rotating tang designed for use with carbon spars. Spreaders and bases will be aluminum and stainless steel 'off-the-shelf' parts.

Typical of most composites, carbon fiber should be protected from the sun. Several coats of a linear polyurethane such as Awlgrip or Sterling does the job nicely. Paint sticks well to the composite surface which means that carbon spars won't need expensive stripping and repainting with the frequency of aluminum spars. The compatibility of carbon and stainless steel will mean that the familiar bubbling around fittings that occurs with aluminum spars should not happen with carbon.

G M T Heads For San Diego

When Team Dennis Conner sets sail this spring in the Pacific Ocean off San Diego, several components manufactured by G M T will be onboard. Specialty parts including pre-preg carbon fiber rudder post and blade, quadrant, twin opposed spoke steering wheels, pedestals and spinnaker pole. With well qualified challenges from half a dozen nations, these demanding boats will forge new frontiers of design and technology worth watching. It's shaping up to be one of the most intense America's Cups ever.

Experience.

G M T has provided engineering and design support for America's Cup, IMS, IOR campaigns and cruising sailboats preparing for circumnavigations. The experience and team work that we bring to a project is truly unique.

Company founder **Henry Elliot** has helped developed many of the tools and processes that are unique to the manufacture of composite parts. He has an understanding of both the art and the science of the field that few can match. That's one reason material suppliers often come to G M T to have us evaluate their product.

David Schwartz recently joined the company as a partner. After gaining extensive experience in early IOR Maxi's and large cruising boats, David specialized in the field of engineering research and development. With his program management and engineering skills, G M T can now take responsibility for all phases of a project from inception to on time delivery.

Philip Steggall joined G M T following a sailmaking and professional offshore racing career. His responsibilities include marketing and customer service. Phil's first hand experience with composites aboard high speed multihulls has helped designers and owners understand the full potential of composites for all types of sailboats.

The commitment to excellence and attention to engineering and construction detail of G M T craftsmen like **Mike Pan, Steve Foss, Gary Crosby, Andrew Wichelns, Bill Slabey, Steve Derrah** and **Robin Hand** and the attention to engineering and construction detail are the reason why G M T is at the forefront of the industry today.

Give us a call and see how light, strong, durable parts from G M T will help make your next project a resounding sucess.

Pre-preg versus wet lay-up

There are two basic methods for building carbon parts like spinnaker poles and spars; they can either be made from dry fabric and resin applied by hand (wet lay-up) or with pre-preg material. There's a big difference in the quality of the parts made by the two processes.

".....the ultimate strength of pre-preg part can be 30 per cent higher than a wet lay-up part. Compared to aluminum, a pre-preg part will be half the weight for the same strength."

The traditional wet lay-up method compromises the finished strength of the part because it's difficult to control the resin to fiber ratio and fiber orientation. The alternative is to use carbon fiber which has been pre-impregnated with resin under controlled conditions. The material is kept frozen until needed. Fiber orientation is easy to control and the consistency of resin to fiber is guaranteed. Once the fiber lay-up is complete, the part is cured under both heat and pressure in a fully instrumented oven. This process requires expensive capital equipment but the finished laminate properties are very predictable and the ultimate strength of a pre-preg part can be 30 per cent higher than a wet lay-up part. Compared to aluminum, a pre-preg part will be half the weight for the same strength.

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