

## The Classic Yacht Symposium™ 2014



# Manufacturing: The Quissett 12 1/2 Spars

**Alec E. Brainerd**  
Artisan Boatworks,  
Rockport, ME



### INTRODUCTION/ BACKGROUND

On January 4, 2012 a storage building at the Quissett Harbor Boatyard in Falmouth, MA, was gutted by fire. Thankfully no one was injured and only three boats were lost. Unfortunately, the most serious damage was in the spar loft where the spars for Quissett Harbor's entire fleet of Herreshoff 12 1/2s were destroyed.

This paper discusses how Artisan Boatworks replaced those spars in a timely and cost effective manner.

### THE CONTRACT

The contract between Quissett Harbor Boatyard and Artisan Boatworks Inc., dated barely a month after the fire on February 12, 2012, read as follows:

*ARTISAN to supply Sitka spruce spars and oak boom crutches for Herreshoff 12 1/2s and other boats as listed in the following specifications.*

*Masts: 35 Doughdish, 8 Herreshoff, and 1 Cape Cod. Fitted with masthead cones or shoulders for spliced shrouds, throat halyard blocks, fiberglass chafe bands,*

*goosenecks, heel tenons, spinnaker pole rings or track, topping lift block and jam cleats.*

*Booms: 34 gaff-rigged and one marconi-rigged Doughdish (9 w/stainless track). 8 gaff-rigged and one marconi-rigged Herreshoff (7 with bronze or ss track). 1 Cape Cod, and one Haven (both with stainless track). All booms fitted with gooseneck cheeks, sheet blocks, and outhaul blocks & cleats and/or holes for outhauls as required.*

*Gaffs: 34 Doughdish (8 with stainless track), 8 Herreshoff (7 with bronze track), and 1 Cape Cod with stainless track. All gaffs to have laminated, riveted oak jaws, throat toggles to match track, and 3 wooden peak halyard thumbs. After ends rounded, with holes for outhauls. All gaffs with track to have full-length spruce riser. Gaffs without track to have wooden keeper for peak halyard eye splice.*

*Jib Clubs: 34 Doughdish (8 with stainless track), 9 Herreshoff (8 with bronze track), 1 Cape Cod with stainless track, 1 Haven with stainless track, and 2 S-Boat. All jib clubs fitted with forward end sockets and sheet block/bales. After ends rounded with holes for outhauls.*

*Spinnaker poles: 45 octagonal Doughdish/Herreshoff, 2 S-Boat, and 1 Ensign. All Spinnaker poles to have end fittings at each end, and 2 pad eyes in middle.*

*Boom Crutches: 35 Doughdish oak scissor type, 6 Herreshoff oak scissor type, 3 teak Bullseye post type, 4 mahogany Herreshoff post type, 1 S-Boat oak scissor type, and 1 teak S-Boat post type. Scissor type to have hooks riveted to feet.*

*All materials and workmanship are to be of the highest yacht quality. Spars to be of close, straight grain Sitka spruce, solid except for masts, which will be glued in two halves. Spars and crutches shall be delivered to Quisset Harbor Boatyard on or before June 1st, 2012. Spars and crutches to have 8 coats of varnish, all hardware installed, be labeled with boat or owners name, and be ready for rigging. Hardware is to be supplied by Quisset Harbor Boatyard. Specific details, as shown on scale drawing supplied by Artisan Boatworks, and as pertains to individual boats, may be changed as required.*

## **THE CHALLENGE**

Quisset Harbor Boatyard owner Weatherly Dorris was intent that her loyal customers receive not only better quality spars than they had lost, but that the new spars be rigged exactly as before, and that those customers not miss a single day of their upcoming season which began in only four months.

Without going into details, I will acknowledge that it was a fixed price contract. It was a challenge to estimate what efficiencies might be gained in such a large production, as well as a bit of a worry if things didn't go exactly according to plan.

## **WOOD**

Another challenge for us, and ultimately a primary reason we were awarded the project, was our ability to obtain the required wood.

Many of the spars lost in the fire were those belonging to fiberglass Doughdishes built by Bill Harding and Eddy & Duff, the spars for which were built from Northern White Spruce. Although less expensive than Sitka spruce, it is not nearly as strong, and is readily available in boards pre-planed to 1 1/2" thick. Therefore, although Herreshoff specifies a maximum mast diameter of 3 3/8", most Doughdish masts measure just 3" at the partners.

Weatherly specified Sitka Spruce for the new masts, a wood that has the highest strength-to-weight ratio of any wood (other than bamboo), which is why it was used extensively in the early wood-framed airplanes.

Another important consideration for spar stock was dryness. Sitka Spruce nearly doubles in strength when dried from green to a 12% moisture content. And, once dried, any twisting, warping, checking, and splitting will have already occurred, insuring stability of the finished product.

Sitka Spruce grows in a relatively narrow band along the Pacific Northwest coast, and once cut, requires three or four weeks in a kiln to properly dry. Most lumber suppliers who deal regularly with boatbuilders maintain only a limited supply of "spar grade" Sitka, but Luckily, Richard Simon at America's Wood in Washington, ME, was able to locate a large batch of sixteen to twenty foot long Sitka Spruce planks, rough cut to two inches thick and from six to eight inches wide—and it was about to emerge from the kiln.

Rich ordered about 10,000 board feet, which was shipped from Washington State, sorted for size and quality, and delivered to Artisan Boatworks on February 28<sup>th</sup>. Ultimately, 2,123 board feet of Sitka Spruce was used in this project.

## **TOOLING**

When considering making many similar parts, one immediately thinks machine. We were aware of spar lathes having been successfully employed by other boatbuilders, and I was looking forward to designing and building one myself. Bernie Shaw (a well-known builder

of fiberglass production sailboats such as the Dark Harbor 20 and Wianno Senior) had such a lathe. His shop is located just south of here in Thomaston, so we paid him a visit.

Bernie's lathe consisted of a router mounted on a 30' long sliding rail whose depth of cut was controlled by a curved tapered plywood pattern screwed to the wall behind it. The wooden "blank" was pre-cut eight-sided and set up with an intermediate bearing which spun on skateboard wheels. The ends of the lathe were from a standard wood turning lathe, and powered by an industrial sewing machine motor which provided a slow and variable speed.

The spar lathe at Shaw Yachts had proven itself to be an impressive timesaver, but we needed to build two hundred and twenty seven spars in ninety-two days—all fully varnished with hardware installed. We did the math, and determined that a lathe would be great if we didn't have the time crunch, but in our case, many hands and a well-refined system was the answer.

## PRODUCTION

We began by building a laminating table four feet wide by sixteen feet long (the length of a mast) and 30" high. The masts were to start out as blanks, sixteen feet long and four inches square, glued up in two halves. The dimensions of the table allowed us to glue up ten mast blanks at a time, which were clamped together with closely-spaced plastic-covered 2X4 cross-pieces placed across the ten blanks and secured by eight-inch screws driven through the gaps between mast blanks and into the table.



In a typical morning, once a batch of mast blanks had been glued up, two "shapers" would go to work with oversized worm-drive Skil-Saws and power planes, atop the raised surface created by the glued up masts. We made full-size tapered patterns from quarter-inch plywood

for the outside shape which would be laid upon the blank, traced with a ball point pen, and then the taper would be cut to within a sixteenth of an inch with the Skil-Saw whose big blades allowed us to cut through the entire 4 inches in a single cut.

The taper on the first two opposing sides was completed with the power plane, then the spar was rotated ninety-degrees, and the process was repeated. This resulted in a square, tapered blank. Eight siding followed and was laid out using a conventional eight-siding jig (see *Wooden Boat Magazine* # \_\_\_ ) and cut with another Skil-Saw set to forty-five degrees—again cut within 1/16" of the line. As with the tapering, a power plane did the finishing.

Sixteen-siding also was done with a power-plane, but by eye, and the final rounding was accomplished with hollow-soled wooden-bodied hand planes. One person could go from a glued-up square blank to a round tapered spar, ready for sanding, in about an hour. With this technique, two people were gluing up and shaping ten masts per day.



Once the masts were planed round, they were passed on to a crew of four "sanders" who pushed custom-shaped Styrofoam longboards all day every day for a month. These guys would make the final rounding and smoothing with 36 grit sandpaper, then go to 60, and finally to 120 grit.



Efficient material handling was of utmost importance because of our limited space. We made several sixteen-foot-long sawhorses with padded cradles that could be moved to accommodate the length of the spar as it was being shaped and sanded. As batches of spars were finished, they were stacked in custom made racks like cordwood. Once all of a particular type of spar was sanded round, the tenons were cut and the masthead cones were fitted as a group.

While two guys were shaping and four were sanding, we had two additional carpenters laminating the gaff-jaws, making boom crutches, cutting the tenons, and generally completing the woodworking. Forty-three gaffs require eighty-six gaff-jaws. To make these, we made up four laminating jigs, and glued up four jaws per day for twenty-two days so that they would be ready in time for assembly.



Once the jaws were assembled, the gaffs were sent to a local CNC machinist, who shaped the jaws and cut the slots for the throat halyard tangs. With this kind production line operation we were able to complete all of the woodworking in just six weeks.



## VARNISH

Shaw & Tenney of Orono, ME, make canoe paddles and oars that they varnish by dipping them into a large-diameter pipe filled with varnish. Once extracted, they are hung to dry over a sloping metal tray that drains the excess varnish through the dipping hole and back into the pipe. The resulting finish is perfect except for the small drip at the very bottom which easily can be scraped off. This is the same technique used by wooden flyfishing rod makers, but we were unaware of anyone trying it with spars as long as sixteen feet.

The film thickness achieved with dipping is equal to about four brushed-on coats, but we needed to find a varnish that could dry at that thickness in a reasonable amount of time. After considerable research, we settled upon AwlGrip's Awlspar Classic M3131—an extremely fast drying, high-build, no-sand, single-part varnish. Using it, up to four full coats can be applied in a single eight-hour day, leaving the spar ready to sand and re-coat the next day.



All of the boom crutches, spinnaker poles, and jib clubs were dipped in a 4" PVC pipe installed in our loft floor, and then hung to dry. We dipped each spar twice, and then lightly sanded and finished each one with a coat of Epifanes high gloss varnish, which has better ultraviolet resistance qualities than the Awlspar. We learned that an extra drying day was necessary between dips, even with the heat cranked up to 72 degrees. When attempting the second dip without the extra drying day, we discovered that the first coat was not dry enough to withstand the Awlspar solvents, and alligating was the result.

For the longer masts, booms, and gaffs, instead of dipping, two people would place a spar in holders on the varnish bench where it was suspended by screws we'd driven into each end. There it would be varnished, starting in the middle and each person working towards

an end. After the varnishing was complete, the spar was picked up by the screws and set in the drying rack. The process was repeated with the next spar, and the next, etc. By the time the two varnishers got to the last of a batch of 45 spars, the first one was ready for another coat, and in this manner four coats could be applied in a one day, just as with the dipping.

Handling was the key to this operation. Just consider the space that 45 sixteen-foot long masts take up, all of them freshly varnished and suspended.

## HARDWARE



The most labor intensive and time consuming aspect of the Quisset spar project was installing the hardware. Some pieces were easy as long as all 45 boats got the same piece in the same place. However, each boat was slightly different. Some had bronze hardware; some had stainless; some got new; some got hardware recovered from the fire; and most had a combination of new and old. Weatherly had put together a spreadsheet with a line item for each boat and a column describing each piece of hardware and where it was to be mounted. We tried to install as much of it as possible in assembly line fashion, but ultimately it became necessary to complete each rig individually, and surprisingly, the hardware and packaging ended up consuming as many hours as spar building and varnishing.

## PACKAGING

When putting together our bid for this project, it was easy to say "Sure, we'll deliver them for you!" We handle spars for boats of this size all the time, usually transporting them in padded cradles atop the boat, or on the padded roof rack of our truck.

However, packaging 45 individual rigs, each consisting of five spars and a boom crutch, in such a way as to not damage them, proved to be a monumental task. Every spar had protruding hardware, and for three days Artisan Boatworks more closely resembled an Amazon.com shipping warehouse than a boatyard. Using literally thousands of feet of plastic bubble wrap, each spar was individually wrapped, then bundled together and labeled with the boat's name, and stacked on a flatbed trailer.

## CONCLUSIONS

The Quisset spar project at Artisan Boatworks was particularly interesting when compared to the techniques that might have been employed by HMCo. Labor was comparatively inexpensive back then, and labor laws allowed for an average sixty-hour work week. Rather than investing in expensive tooling, as a modern automobile manufacturer does today, HMCo employed systems that allowed many men to work simultaneously on a single project.

ALERA, the first boat of the New York 30 class was built in just \_\_\_\_\_ weeks, and wooden fishing and cargo schooners of that era were known to have been built outdoors in a matter of four to six weeks. These vessels were not built with labor-saving machinery or super-human carpenters, but with many skilled workers and extremely well organized methods.

## ACKNOWLEDGMENTS

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Most of all, thanks to our hardworking crew at Artisan Boatworks for a job well done.

## ABOUT THE AUTHOR:



Alec Brainerd is the president of Artisan Boatworks in Rockport, Maine. Artisan Boatworks is a well-known builder and restorer of classic Herreshoff yachts. Notably, Artisan Boatworks has recently built several wooden

12½ replicas to original specifications.