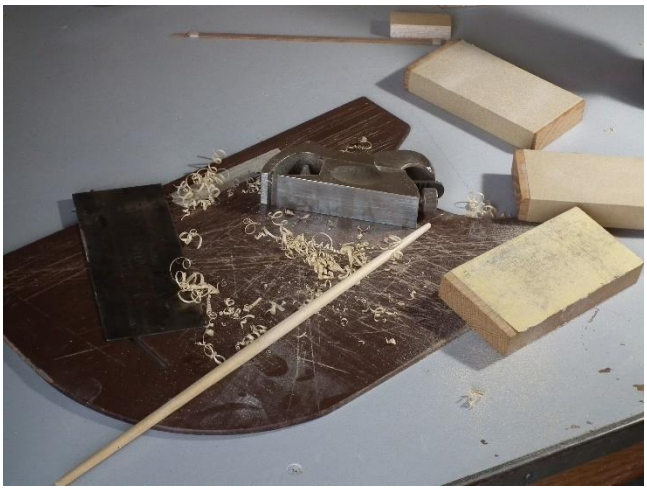
Sail-Making with Cloth
By Jack Bowers
May 15, 2021

[Photo 00 - the Cutty Sark in full sail, the way I want my sails to look]

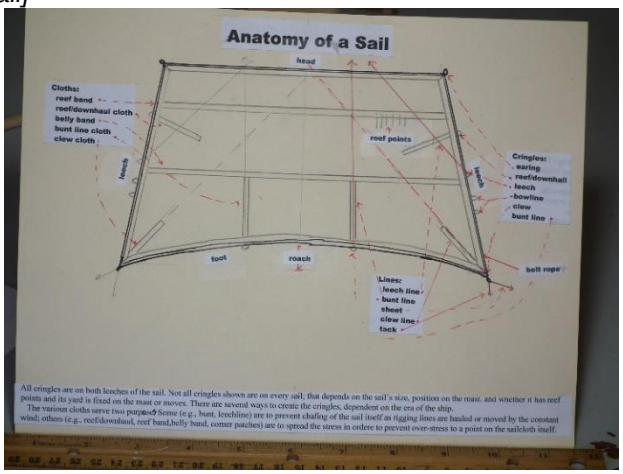
My purpose in using cloth to make my sails is to get a realistic look, especially a realistic 'belly' to the sail. In a canvass sail the force of the wind stretches the threads somewhat causing something of a 'belly' at the lower leewardcenter of the sail where the force of the wind comes most to bear. That belly allows the sail to capture more of theforce of the wind than a flat sail could. My purpose is not to capture wind, but to look more realistic, and more graceful as well.

[Photo 01 - shaped spar]



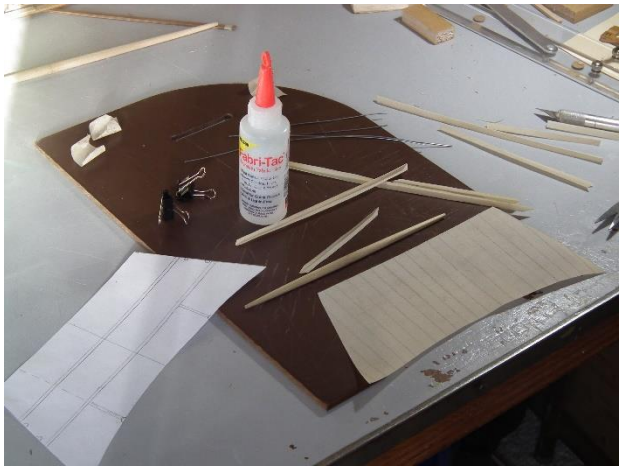
The Spar: I shape my spars from doweling with woodworker's tools (bull-nose plane, cabinet scraper, sanding blocks), then paint, and affix basic hardware (but not blocks and eyebolts for the running rigging which I'll putin exact position after the sail is laced to the yard).

[Photo 02 - Anatomy of a square sail]

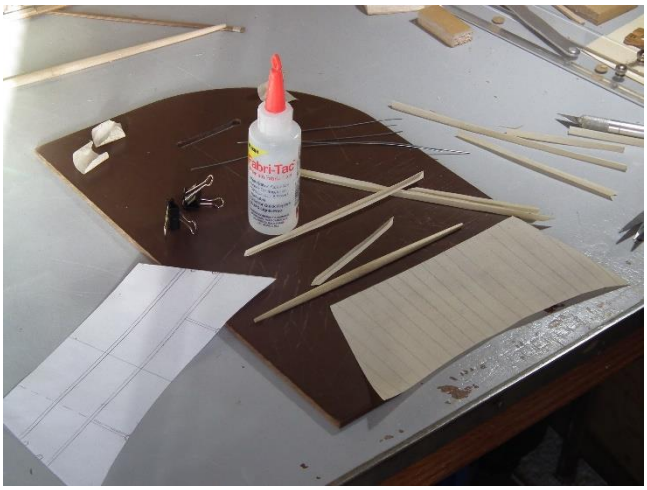


[Photo 03 - paper pattern, the raw cloth sail, the edge cloths, and the wire]

Paper Pattern: Taking dimensions from the yards themselves, I make a paper pattern of this sail, check it inplace, then a second pattern, incorporating necessary adjustments. (Note: the sail is smaller in dimension thanthe yard itself; allowance must be made for head and rigging of sheets. The roach (the upward curve of the foot)must be carefully calculated to keep it from chafing against any of the standing rigging. I make note onto thatpattern all rigging points for later reference: cringles for bunt/spill-line, reef/down-haul tackle (note that the reef/downhaul cringle was a little lower on the leech than the reef-band itself) and bowline;and cloths for leech,belly, reef band, reef-cringle, and clew, and for other stress points (e.g., corners).

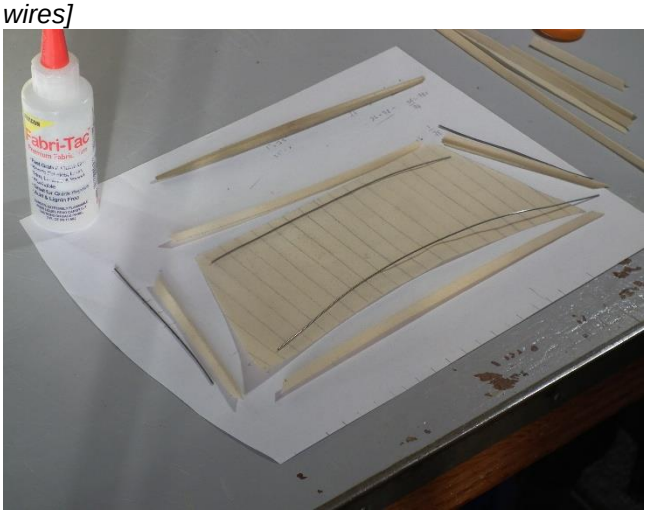


The Cloth: I use muslin (sheerer and with a higher thread count than the usual kit-provided material, so somewhat closer to scale and much more pliable). First step is to dye it. I use a cuppa black unsweetened coffee.(strong black tea yields a slightly different color). Let it dry thoroughly and then iron flat. Next it must be sized,i.e., painted with thinned glue to stiffen it so it will hold its shape and be workable. I use Titebond wood gluethinned 1:1 with water; I'm told any white glue such as Elmer's will work, but Titebond I have on hand in quantity. I tape the material tautly to a frame with masking tape (to which the glue does not adhere) and paintit evenly with the thinned glue so that it is saturated but not dripping i.e., an even coat absorbed by the material,but not pooling. Allow it to dry thoroughly on the frame. Dried it has the texture of vellum or thick parchmentpaper, substantial and workable. When storing, keep dry and flat.



The Raw Cloth Sail: From the paper pattern I draw the sail outline on the sized muslin cloth. I prefer to usea pencil, ruler and square rather than carbon paper, drawing the outline only, and being careful that the grain ofthe muslin lies exactly along the run of the sails' cloths. (On square sails the cloths always run vertical, and fromthe mid-line outward. On fore-and-aft sails the cloths run parallel to the longest edge; so, on stays'ls start fromthe luff, and on gaff-rigged sails start from the leech.) Before cutting the sail out I simulate the seams of the sailcloths by drawing them lightly with a hard lead pencil on both sides so that the lines are the same on both sides.Sail cloth was usually 36 inches wide, sewn together with a hemmed overlap so that in fact there would be twoseams on both sides; drawing those to scale would be nigh impossible. (I am simulating here, not replicatingin scale.) I use a navigator's parallel ruler so that the lines are exactly parallel and scrupulously equally spaced. That done I cut the sail out with a shape knife edge and ruler rather than scissors (the sized muslin cuts very cleanly), along the outline, leaving no margin or excess.

[Photo 04 - Spar, sail, edge cloths, wires]



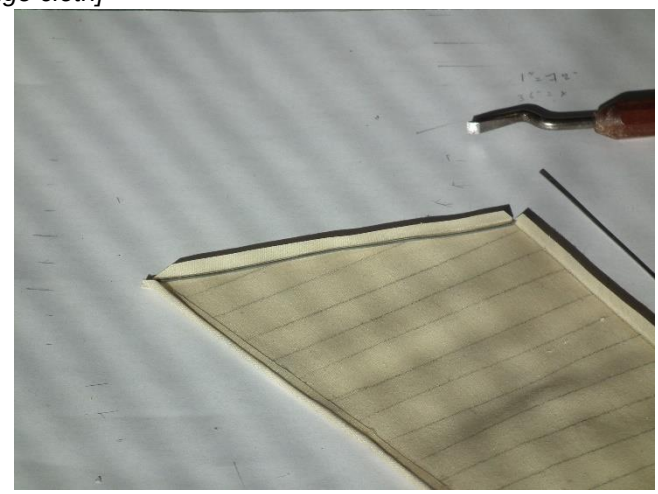
- **Edge Cloths:** The outer edges of the sail are protected and strengthened with an edging. That was either a whole width of cloth or a half width, folded evenly over the edge and sewn onto it. To simulate that I cut cloth-wide strips of sized muslin (actual width depends on scale, but to try to work with a half-width at 1:78 was alittle more demanding than I am willing to undertake) along the grain of the sized cloth, which I then folded carefully in half lengthwise (a dicey but do-able job), and just as carefully cut (with scissors) to fit each edgeof the sail, with mitered corners.

- **Wire:** At the same time, I cut the lengths of wire to incorporate into each of the edges of the sail so that I cancurve the leeches and foot of the sail. I use a 22-gauge steel wire which is thin enough to be fairly inconspicuousand malleable, but strong enough to hold the shape). Lay the wires aside for the moment.

[Photo 05 - sail with edge cloths glued to front]

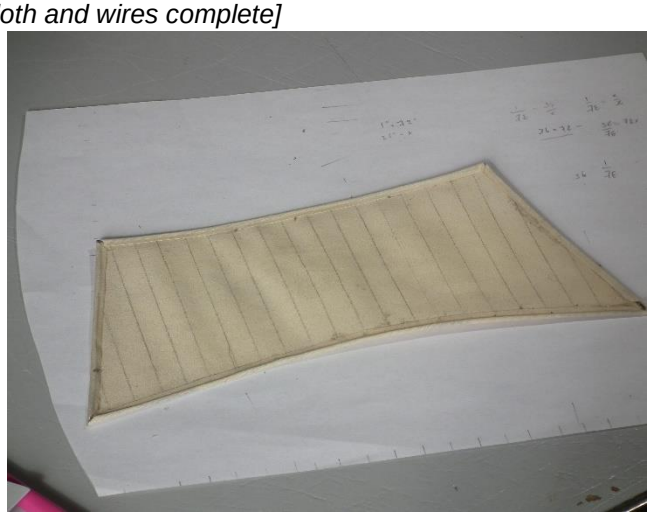
- **Initial Fabrication:** Using fabric glue (available at Joanne's Fabrics, I use Beacon Fabri-Tac, a fairly invisibleand fast setting rubber glue), applying a thin bead down the center of the length of the front half of the edge clothonly, I glue each of the edge cloths onto the front side only of the sail (starboard on fore-and-afts), leaving theaft half of the edge cloth free. As I did, I put the edge of the sail snugly into the fold of the edge cloth, leavingthe other half is free and clean of any glue. Glue all four edges and allow that glue to set and cure.

[Photo 06 - installing a wire in the edge cloth]



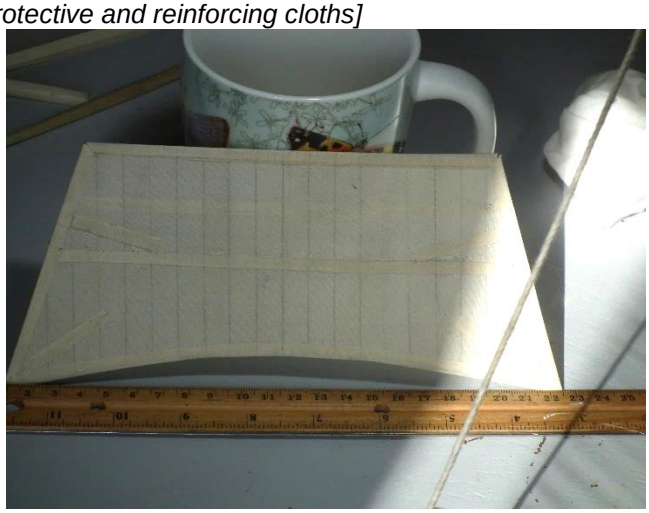
Then, one edge at a time, apply a bead of glue down the center of the length of the free half of the edge-cloth,I laid the wire for that edge deep into the fold, and folding the free edge over, working with my fingernail orother tool to both press the edge-cloth into place to set the glue, all-the-while working with my fingernail toforce the wire all the way to the back of the fold. This step took practice to learn, and I practiced several timeson a dummy. Even then I had to re-make several of my earliest sails because I wasn't satisfied with the result.

[Photo 07 - aft side of sail with edge cloth and wires complete]



With that completed the hard part is done, the rest is just tedious.

[Photo 08 - front of sail showing protective and reinforcing cloths]



Cloths: Before shaping the sail, I glued on the required chafing and stress-dispersing cloths. I used half-widthcloths:

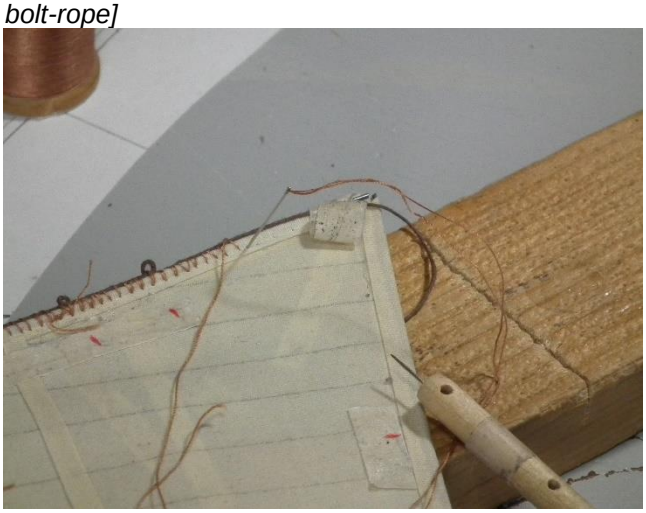
belly band reef point cloth(s) (leech cloths)bowline cloths buntline clothes (clew cloths)

The belly band is usually near halfway up on the sail (at the belly), but that may vary if the sail is reefed. Sailsmay have one, two or more reef bands depending on the size and position of the sail and the particular ship; onlya few of a ship's sails are rigged to reef. The reef band(s) goes on the after side of the sail. Buntline cloths areonly from the foot to the belly band, as the buntline runs free of the sail above its belly. Bowlines are rigged onlyon the fore course. Leech and clew cloths are usually only on larger sails. While the clewline itself runs up theaft side of the sail, its cloth is on the fore side where the stress is. Corner patches are according to era and ship.

[Photo 09 - location of cringles marked & sewing on the bolt-rope]

Marking Cringle Locations: With all cloths in place, I applied small bits of masking tape mark along the sidesjust inside the edge cloth, and on those carefully marked the precise location of all cringles.

[Photo 10 - detail of sewing on the bolt-rope]



Bolt Rope: The bolt rope, which runs around the edge of the whole sail and carries the force of the wind to therunning rigging, is sewn to the sail (aft side on squares, port side on fore & afts). In actuality the line was sewn through the bolt rope, skewering it, not around to capture it. At 1:78 scale I judged that to be nigh impossible,so I just sewed it on. I kept the bolt rope atop the hidden wire to hide it even more, sewing with the finest threadon hand, incorporating all the cringles as I sewed (by hand).

I marked the sail edge at 4mm intervals as invisibly as practical just inside the wire (I used a straight pin glued into a dowel handle to prick the markings. and then puncture them.) The hole in the sized muslin whencreated with a pin, pushes fibers aside, not cutting out, so the hole tends to close up quickly. I marked 30 or so4mm pricks at a time, then opened 6 to 10 holes (depending on how quickly the holes tended to close at that particular spot in the sized muslin) 2mm apart using the pin prick and in between those by eye (I found 'by eye'came out more evenly than trying to mark 2mm intervals) with another pin just large enough to allow my needleto pass through readily. I sewed that short stretch before moving on. (If I did more than that, the holes were already closing themselves.)

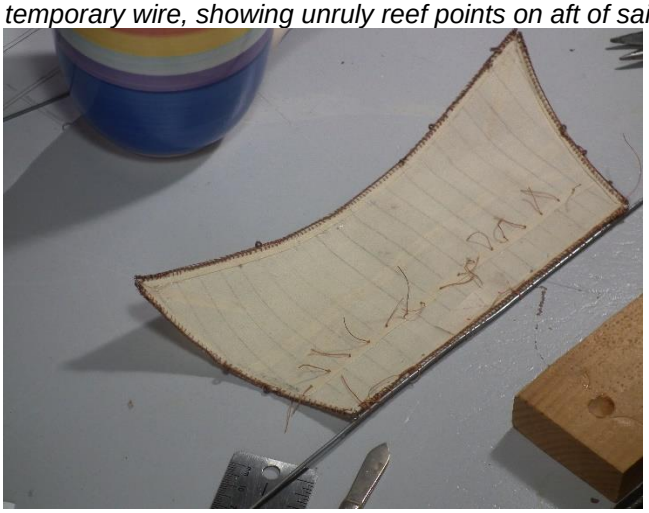
The form of the cringles evolved over time, so one needs to learn the form for that particular ship or era.The earings and clews on the Cutty Sark (1869) were steel rings, and the bolt rope was eye-spiced to the ringat each corner (resulting in four sections of bolt rope). I cut away a small bit of each corner of the sail so thatthe rings fit inside the outline of the sail. The other cringles took many other forms over the ages. For the CuttySark they were formed of short lengths of line sewed in along with the bolt-rope and incorporating a steel thimble to minimize chafing.

Finally, I sealed all bitter ends in place with the slightest touch of ECA glue.All this was tedious work and I could only stay at it for moderate periods.

[Photo 11 - untrimmed reef points showing gauge]

Reef Points: Reef points are straps which pass through a line of grommets in the sail to secure the sail to itsupper spar when it is 'reefed,' i.e., less than fully deployed. Normally there were two reef points evenly spacedin each cloth. At 1:78 scale for my Cutty Sark, fabricating and implanting grommets was beyond my skill level,so I just pricked a hole in the sail in the middle of the reef cloth with my straight pin tool. I then tied a figure-eight knot in my thread sufficiently from the end to give a little more than enough for the strap on the aft side,drew the thread through with a needle so the knot was firmly against the back of the sail, and tied another figure-eight knot tight against the front of the sail holding the simulated strap in place. (Getting it tight to both sideswas very tricky, and for each sail I had to practice on scrap material until I clearly recalled the exact techniquebefore I started installing them. Even then I'd have to take more than a few off and re-do them. But it can be done) Then I cut loose the threaded needle leaving enough to form the fore-end of the strap on the front of thesail. After all the straps are installed, they are cut to the proper length using a gauge for uniformity, front and back. On the Cutty Sark two-thirds of the strap hung to the front and one-third to the after side; but that proportion varied from ship to ship and time to time. Sometimes those were reversed, sometimes ½ and ½. Afterthe sail was completely shaped (next step) I glued the straps loosely to the sail with sizing mixture, but slightlyaskew to look wind tossed. (Unglued they tend to go in every direction like an early-morning, untamed head ofhair.)

[Photo 12 - shaped sail laced onto temporary wire, showing unruly reef points on aft of sail]



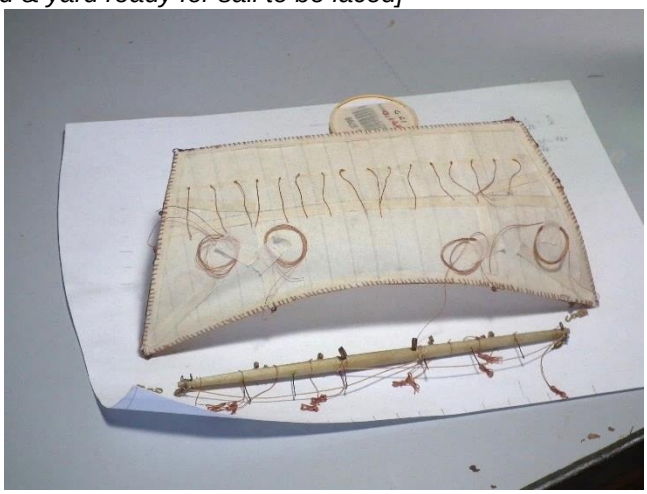
Shaping the Sail: All that completed, the sail is nearly ready to be shaped. First, having marked where thatsail is not laced near the mast-mounting gear, I laced the head temporarily to a rod I keep for this purpose, a surrogate yard. Then I bent the wires in the leeches and foot to the curves I wanted, having in mind how the sailshould look when done. These are not regular curves but more complex. Don't hurry, it may take several triesto get it where you want it. Think in terms of the wind direction being simulated and the stresses that brings tobear on the sail when it is in place and working. The curve of the wires can be somewhat altered even after thenext step. And on one occasion I wet again and flattened a sail to start the shaping all over; this part of the process is forgiving

[Photo 13 - shaped sail on rack to dry]

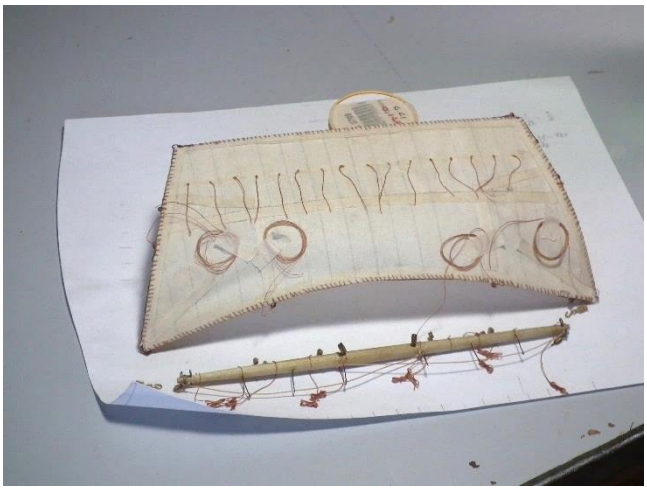
When satisfied I bent heavy threads to the earing and clew cringles and tied it onto a rack I made for thispurpose: a board with a grid of holes into which four rods can be tightly fitted. The rods are set roughly in theshape of this sail, so that each rod is at least an inch away from the earing or clew to which it is tied. I want tosuspend the sail horizontally flat and so as to simulate the pull of the sheets and the head lines on the sail. Note:for some sails the foot should not be at the same height as the head, but needs to be a little lower to get the rightbelly and shape. when satisfied, I then misted the sail to the dripping point to soften the sizing and allow thecloth to stretch a little. I covered the sail with a very thin plastic sheet (Glad Wrap or such) to prevent the sandfrom being glued to it, and carefully teased out all wrinkles and air pockets, and then poured on the clean sand,mostly toward the leeward center, but wherever needed, sufficient to get exactly the shape I want. I carefully setthe whole rig aside and allowed it to dry undisturbed, at least several hours. The sized muslin will re-set to itsvellum consistency but now capturing this shape. There will be no spring-back

When thoroughly dry, remove from the rack and unlace from the rod. At this point I tamed the awry reefpoints by painting them to the sail with my sizing mixture, thin enough to be invisible when dry, but just strongenough to hold the threads in a fairly decent pattern.

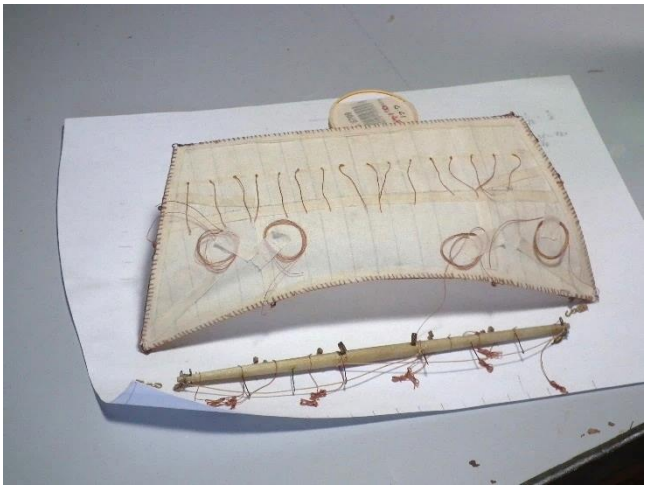
[Photo 14 - sail with lines attached & yard ready for sail to be laced]



Attaching All Lines: At this point I bent or shackled on to the sail all running lines, being sure that each hasenough length to reach as far as it must, with a little excess to prevent shortfalls. I coiled each and temporarilysecured it to the face or back of the sail with bits of masking tape to keep it out of the way until needed: bunt/spill (the bunt line is bent to the bunt cringle, passes up on the front of the sail to its block on the yard andon to its belaying point, the spill line is bent onto the becket of the buntline block, passes down the after sideof the sail through the bunt cringle and up the face of the sail to the bunt block and on to its belaying point), leech, clew, reef/downhaul tackle (either bent to the becket or the thimble of the jewel block, down to the blockhooked into the reef/downhaul cringle, up to the jewel block and down to its belay point on the mail rail), tackand bowlines.

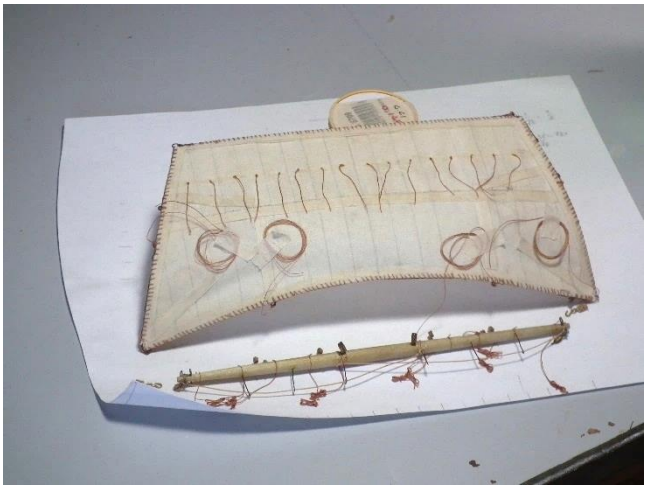


Final Preparation of Yard: I affixed to the yard all eyebolts, blocks and other fixtures which, with sail in handcan now be accurately affixed. I bent on the gaskets (for furling the sail), and the footropes (and Flemish horses).For the footropes I drenched the line in sizing mixture and hung it, weighted, to dry straight. When working withit a small drop of water to a section softens it to malleability for knotting; its re-sets quickly. Also, it's good toream the holes in all the blocks now to make sure they're clear.



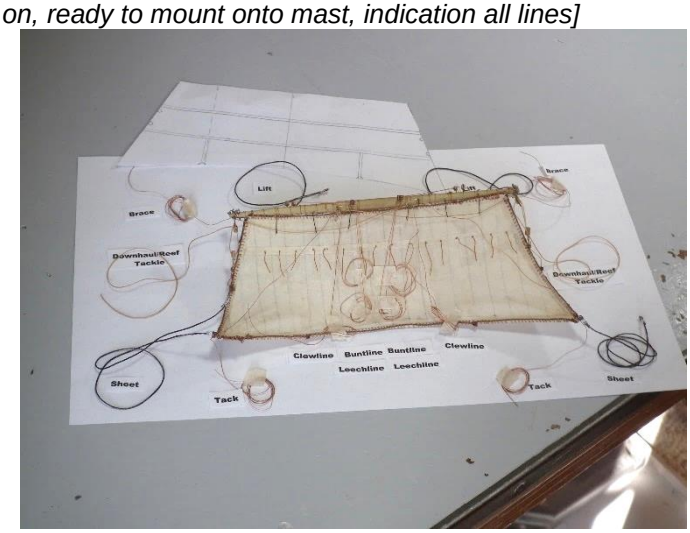
Lacing On: Next the shaped sail must be secured to the yard. On the Cutty Sark this was referred to as 'lacing,' implying a continuous length of line drawn successively through eyelets in the sail head and aroundthe jackstay. In older ships this was done differently. According to the 1819 ***Young Sea Officer's Sheet Anchor***,a pair of 'rope-bands,' one long and the other short, each with an eye spliced on one end were passed througheach other's eye, the long one also passing through a hole in the sail head, and then passed around the yard andbent to the next rope-band with a 'reef-knot' (what I learned to call a 'granny'). On my Cutty Sark model I improvised with a line drawn through the sail head and around the jackstay using a lock stitch at 8mm spacing.Note that the sail is NOT laced at the middle of the yard where the hardware linking the yard to the mast wouldinterfere. And be careful not to entangle the gaskets in the lacing.

Glue the gaskets to the face of the sail with sizing mixture.



Check mast: Finally, I carefully checked the mast to assure all eyebolts, blocks and other fixtures needed forthis particular yard were in place. Invariably I missed one or more; affixing them after the yard is in place is always awkward, and sometimes impossible.

[Photo 15 - yard with sail laced on, ready to mount onto mast, indication all lines]



Mount the Yard on the Mast: This last step is to secure the yard with its sail finally to its mast. Bend or shackle on the braces, lifts, halyards and tye. Mount the yard on the mast. Then draw each of the lines throughits blocks and fairleads to its belaying point on the main rail (first clewlines, then bunt/spill lines, then leechline); reef/downhaul tackle lines are belayed elsewhere on the mail rail. No line should cross another, noranything else that would chafe; all lines must run free through their blocks and fairleads. I belayed each as I went; in hindsight I might try drawing each close to its belaying point, but temporarily tacking it in place withmasking tape, and belay all at once later. Belaying is bloody awkward, tedious, and infuriating.

Tools:

scissors
sharp knife (Xacto)
ruler (inches and millimeters)
sharp lead pencil
metal straightedge
navigator's parallel ruler
wire nippers'
small plier's
fabric glue
sewing needles
straight pin hole-maker
ECA glue
shaping/drying rack
misting bottle clean,
loose sand tweezers
masking tape

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