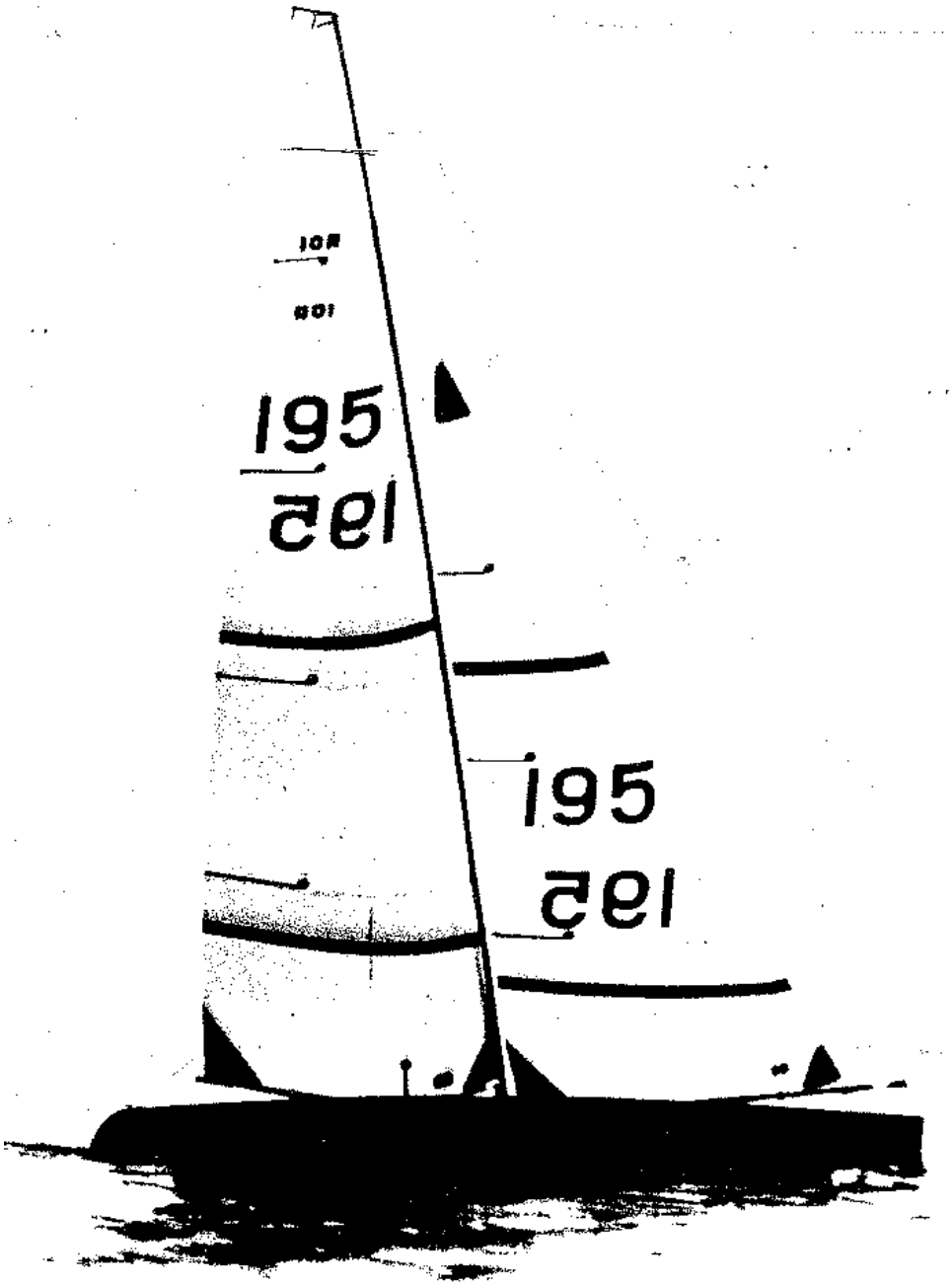
2020

SAILSetc

TECHNICAL INFORMATION – TI 20



SAILMAKING NOTES

September 2020

Introduction

These notes introduce the basic sail making process and give guidance concerning the materials, tools and methods used and practical hints and tips which will be valuable to anyone having a go for the first time.

These notes are not intended to be a complete guide to model sail making. Such a guide would fill many more pages than these notes and take much more time to prepare than is available.

The book 'Making Model Yacht Sails' by Larry Robinson is recommended reading for anyone wanting to learn how to make competitive rc yacht sails – it describes the mould method of shaping sails used by the top sailmakers and is a contemporary masterclass in its own right. It is stocked by SAILSetc, item BK-38

Sail making materials are listed in the SAILSetc catalogue and in our list of additional and surplus sail making materials (Supplementary Price List - GOODBUYS Cloth) which is updated from time to time. There is a link to this document on the SAILSetc website – www.sailsetc2.com

Choice of Cloth

Fore and aft sails are made from woven Polyester based materials in almost all cases. Dacron, Tetoran, Tergal are all analogous with Polyester (cloth). Polyester, Hostaphan, Melinex, are all analogous with Mylar (film).

Woven sailcloth

Woven sailcloth is generally available in soft, medium and hard finishes. It is easier to use medium and hard finish cloth because of the greater diagonal (bias) stability and stretch resistance which is imparted by the finishing process. This may entail heat setting the fibres (partially melting them), or bonding them together with resins, or a combination of the two. An advantage of this material, compared to film, is that it is durable and resistant to damage. It is ideal for the sails of boats where class rules require a single mast making it necessary to remove sails from the boat before a replacement sail can be rigged.

Laminate cloths

Laminate cloths (cloths made by laminating a film of non woven film to a woven cloth) have higher stability and stretch resistance for a given weight but will be more difficult to work with due to their high inherent stiffness. There may also be a lack of symmetry caused by the laminating process itself and the lack of symmetry in the cloth construction. Symmetrical laminate cloths do exist – either a sandwich of woven cloth inside two films, or a sandwich of film inside two woven layers. These are generally far too thick for our purposes and also relatively costly. Laminate cloths are also durable and relatively resistant to damage.

Film

Mylar film in its pure form as become the material of choice for almost all sails for small classes, IOM, Marblehead and Ten Rater classes. It is readily available and inexpensive. A significant technical advantage is that stretch resistance is similar in all directions giving the sail high stability of shape. Disadvantages are that creases tend to be conspicuous and small cuts or punctures in the sail may quickly become catastrophic tears.

Cloth Weight

The weight of sailcloth is given in several different units. The best unit and easiest to understand is weight in grams per square metre. This figure is closely related to thickness which can easily be checked with the aid of a micrometer or good quality Vernier gauge.

- The weight of woven cloth in grams/m^2 is 900 times the thickness in millimetres (+ or - 10%).
- The weight of laminate cloth in grams/m^2 is 550 times the thickness in millimetres (+ or - 20%).
- The weight of film in grams/m^2 is 1400 times the thickness in millimetres (+ or - 10%).

Whereas woven cloth and laminate is specified by its weight it is normal to categorise film by its thickness measured in microns (μ). A micron is 1/1000th of a millimetre. SAILSetc sells films of 35, 50 75 and 125 microns.

Film thickness grams per square metre

35μ 50
50μ 72
75μ 108
125μ 180

Suggested materials are as follows.

Film (microns, m)	65	95	IOM	M	10R	6M	A
No 1 (A) suit	<35μ/35μ	50μ	50μ	50μ	50μ	50/75μ	75μ
No 2 (B) suit	35/50	50	50/75	75	75	75	75/125
No 3 (C) suit	50	50	75	75	75	-	-
Lower suits	-	-	-	75	75	-	-
Laminate (grams/m^2, gsm)							
No 2 suit	-	-	-	-	-	100-120	100-140
No 3 & lower suits	-	-	-	-	-	100-140	120-160

Cutting Cloth, Laminate & Films

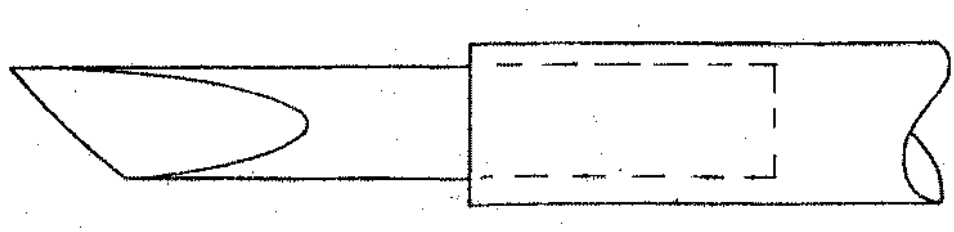
Medium and hard finish cloths and some laminates can be cut with sharp scissors and without heat sealing the edges. Fraying will occur eventually but not immediately. Some laminates contain fibres that are much more difficult to cut).

To make a good job of cutting and heat sealing cloth (and film) in one action it is worthwhile modifying a soldering iron. We use a Weller 75, or 120, watt soldering iron and modify the tip by straightening it out, cutting it off to 30-40 mm long and filing on a knife edge. Some laminates contain fibres that are much more difficult, or even impossible, to melt).

Cut along a steel or aluminium straight edge on a heat proof surface. Kitchen work top material is excellent e.g. Formica or Beaumel, although the kitchen may not be the best place to carry out the work! If you are using a less powerful soldering iron you may find that too much heat is lost to a metal straight edge. In this case try using a straight edge made from a piece of 3 mm plywood. Alternatively use a very thin layer of metal to give a hard cutting edge bonded to a thicker layer of wood to provide support.

Cut films using traditional craft cutting knives guided by a steel straight edge. Safety edges are preferred to protect your fingers. The knives with small 'snap off' blades are generally better as the cutting blade can be replaced frequently and the exposed cutting blade is relatively small thus minimising the risk to yourself.

Cutting mats are available from better craft material suppliers and have a surface that is resistant to damage. Buy the 904 (36") x 629 (24") mm size.



Tip of soldering iron modified to cut woven cloths.

Marblehead & IOM SAILS - Standard (Non-Panelled) Sails

Planning

Rather than work directly onto sailcloth it is usually more economical to do the initial design work full size on paper. Parcel wrapping paper in roll form (Kraft paper) or wall paper (lining paper) are both ideal.

Mainsails

Mark out the main triangle formed by the luff, leech and foot dimensions. Then add on the estimated roach profile as shown on the second drawing. High accuracy is not essential at this stage.

Next, mark on the luff curve which allows the sail to match the curve formed by the mast when the rigging is tensioned. Use a long wooden or plastic batten held down with tins of food or other heavy objects.

Allow a curvature of 5 mm per metre of luff length. Allow an extra 50 to 100% if the mast is deck stepped to cope with the extra mast bend, and 30% less if the mast is to be very stiff and supported by a lot of rigging (or for light airs suits of sails).

For fractionally rigged boats the point of maximum curvature should be positioned 60% up the luff from the foot of the sail if the mast is un-tapered. For mast head rigged boats the point of maximum curvature will be lower. More heavily tapered masts than what is normal for M and 10R class may require the position of maximum curvature to be as much as 75% up the luff.

Ensure that the luff curve is a fair even curve from the bottom to the top by sighting along the batten before marking.

Divide the leech to obtain the cross width measurement points (see class rules for details) and check the cross widths. Adjust these up or down to get the maximum permitted area. If a bolt rope (for GROOVY mast) is to be added to the sail, the cross widths should be 2 mm below the maximum permitted figures. If a small pocket for a luff wire will be added then the cross widths should be 3 mm below the maximum permitted.

Mark the foot roach with a straight edge (One Metre) or a fair even curve.

Headsails

Proceed as for mainsails but mark the luff straight or with a slight hollow of 1 to 3 mm per metre of luff length. Stiffer masts will permit a straighter luff to be used. Deck stepped masts will require most hollow. Place the position of maximum hollow at mid luff.

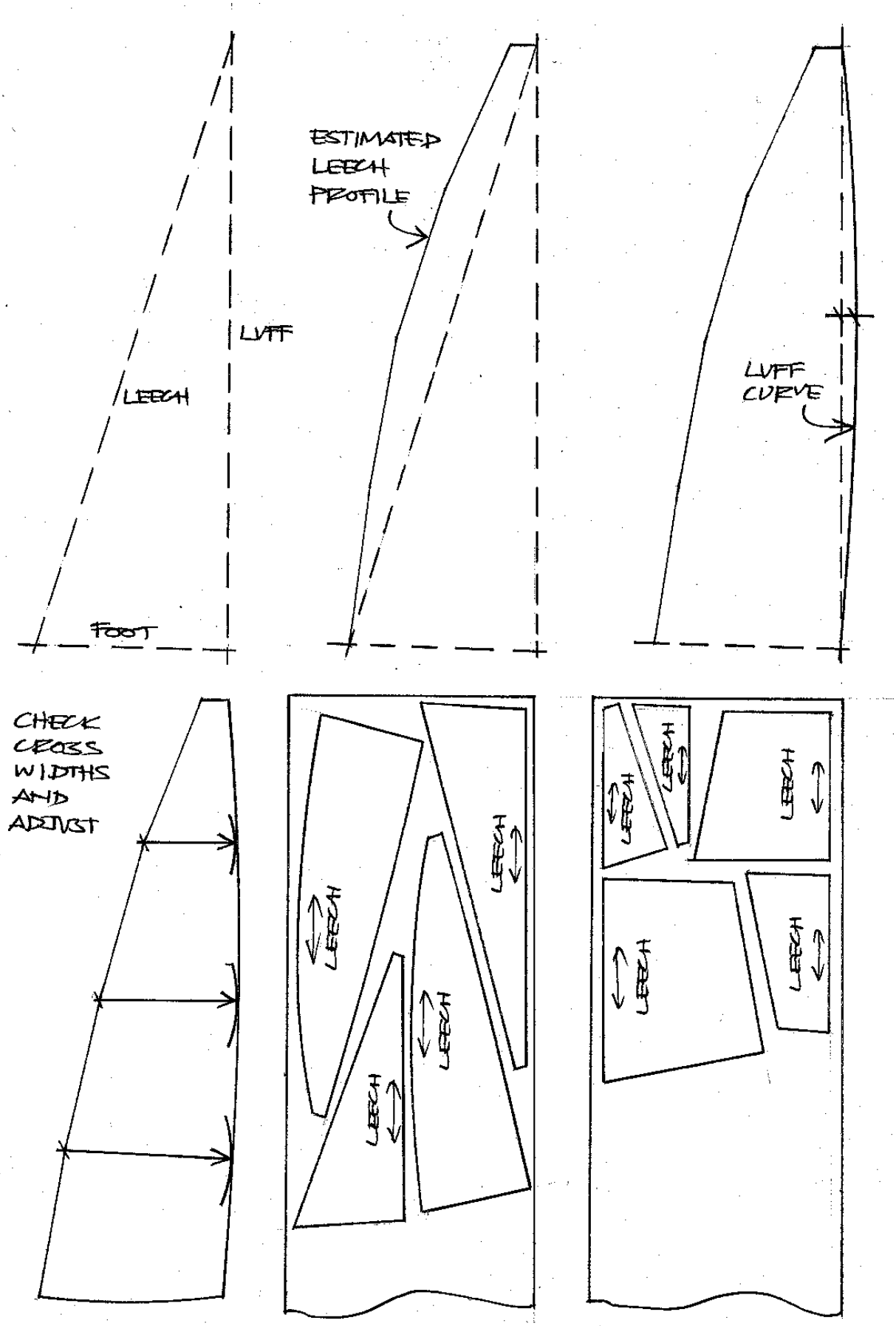
Transfer to the Cloth

Accurately cut the sail profiles from the paper and place onto the cloth. The leech of the sail should always run along the warp (length) direction, Do not be tempted to economise on cloth by tilting the sail from the optimum angle.

Carefully transfer the profile of the sail patterns onto the cloth and re-draw the profile. When you are sure that the dimensions are correct, go ahead and cut out the sails using the hot knife soldering iron and straight edge. Curved edges can be cut free-hand or may be managed as a series of short straight edges. Alternatively make a pattern of 3 mm plywood to the required curvature.

Other Classes - Standard (Non-Panelled) Sails

The profile shape of Ten Rater and 36R Class sails is not restricted in any way, so you have complete freedom with regard to roach shape. Otherwise proceed as for M and One Metre sails.



Set out the profile of the sail, mark the estimated leech shape, add the luff shape, then check the cross widths and adjust. The leech of all sails and panels should be aligned with the warp of the cloth.

ALL Classes - Panelled Sails

GENERAL

Proceed as for Standard Sails but make the patterns longer on the luff and leech by an amount equal to the number of seams you intend to make multiplied by the width of each seam (normally 11 to 12 mm with 10 mm double sided tape). Then allow an extra 15 mm extra all round the marked out sail before dividing up into panel sized pieces. Keep the seams approximately at right angles to the local leech and, to begin with, keep the number of seams to a minimum. Placing the seams at the batten positions is a distinct advantage as any slight irregularity in your seam shape at the leech will be corrected by the batten.

When placing the panel patterns onto woven cloth or laminate,

- ensure that the local panel leech is aligned along the warp,
- ensure alternate panels up the sail are flipped i.e. they are turned over so that half the panels are cut from one side of the cloth and half are cut from the other side of the cloth. This simple precaution helps minimise any problems caused by lack of flatness in the sail material.

Self Adhesive Double Sided Tape

Several different types are available for sail making. All have their good points, but we prefer to use a less tacky type as this permits more taking apart and re-working of seams before stitching. The seam tape sold by SAILSetc is also extremely thin which provides excellent resistance to shear distortion and adds the least stiffness to the seam. Where the seams will be stitched it is possible to use tapes as narrow as 6 mm. Experience has shown that sails made of film, even lower suit sails, can be joined at the seams using tape only. Use 10 mm wide tape for IOM and larger sails. Use 6 mm wide tape for smaller classes.

Office and artists' supply shops can usually supply 12 mm wide tape. SAILSetc stocks 6 mm and 10 mm.

We have found that using a 6 mm tape with the very thin films commonly causes small wrinkles at the seams when the sail is loaded. Using a 10 mm wide tape helps avoid this.

Assembly of Panels

A good sail shape is produced by assembling the panels so that the camber is 'built in' to the body of the sail. Basically this means fixing one straight panel edge to an adjacent curved panel edge. It is totally unnecessary to make the panel edges themselves curved and it is normal practice to mark on a curved line approximately parallel to the panel edge to which the adjacent straight panel edge is aligned.

The curved edge is drawn a little further from the panel edge than the width of the double sided tape which will be used to fix the panels together with. We use about 8 mm of seam width and 6 mm wide tape. The amount of curvature in the line will be between 1 and 6 mm per metre of seam length. Use more curvature for the upper seams and err on the generous side initially, reducing as you become more proficient. The position of the maximum curvature should be between 40 and 45% back from the luff.

Make several templates from 3 mm plywood to aid marking out these curves. The character of the sail section is dictated by the character of the curve used to draw the curved seam line.

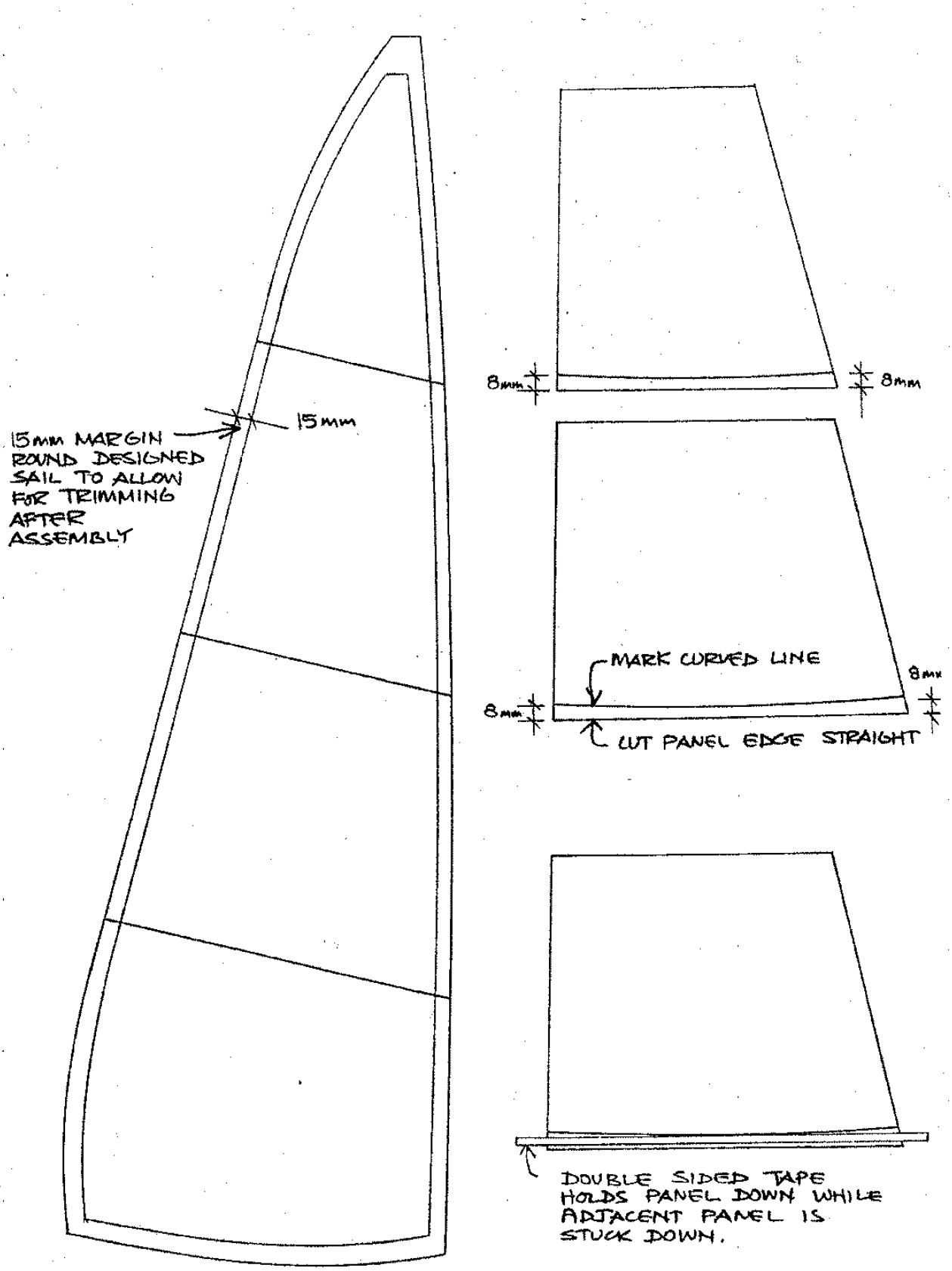
With the marked panel on a flat surface, apply the tape along the edge between the line and the panel edge. Take care not to stretch the tape and overlap the ends by 25 mm or so to keep the panel in place on the work top. Pull off the backing strip from the tape and, starting at the leech, carefully place the adjacent panel straight edge along the marked line. Trim off the excess double sided tape at each end of the seam.

Alternatively see the book 'Making Model Yacht Sails' by Larry Robinson, item BK-38, for a better method using moulds.

When all the sail panels have been assembled, check the sail shape. Do check that the sail sets equally well on each tack. If you have used woven cloth of laminate you will be able to take apart and adjust any seams which are not smooth or symmetrical. If the sail is made of film it is not normally possible to pull the seam apart without damaging the adjacent sail panels. Instead cut the seam along its centreline and, holding the panel edge firmly down on a flat surface with a stiff straight edge, pull off the narrow strips of film and doubled sided tape. As the sail panels are slightly oversize the loss of one or two seams' width should not make the sail un-useable.

When satisfied with the shape each seam can be stitched if required. This will be normal for sails made of woven cloth or laminate. See the stitching notes. Stitching is not necessary for sails made of film. For laminate sails the stitching can be replaced by taping over the seam each side of the sail with Mylar self adhesive tape. The 20 mm wide tape, item TM-20, sold by SAILSetc is perfect for this task. Start stitching at the luff and stitch to the leech. No knot is necessary as hot cutting the leech will seal the stitching.

Once stitched, the profile of the sail should be marked out as for Standard Sails. There is one major difference caused by the built in camber in the sails. Because of this fullness the mainsail luff curves should be bigger by 50 to 100% depending on the degree of camber. More time should be allowed for getting the luff curve fair when the sail is stretched out off the marking board. For the same reason the luff of a panelled jib will normally need to have a straight or slightly convex luff curve when laid flat. Adjust the luff curve until there is a slightly hollow or straight luff when the sail is stretched out off the marking board. Thereafter the finishing process for Panelled Sails is the same as for Standard Sails.



Pattern for the sail should allow a 15 mm margin around all edges. Mark the panel edges with the desired seam shape.

ALL CLASSES - Finishing

Reinforcements

The sail corners take large point loads and have to be reinforced to prevent distortion. Use two or three extra layers of cloth stuck down with a contact adhesive (clear Bostik or Evostick are good). Stitching may not be necessary if the gluing is good. Alternatively use some of the 140 g/m2 (item DP-05) or 250 g/m2 (item SP-05) self adhesive sailcloths listed on the SAILSetc website. Trim the patches to shape with sharp scissors, a cutting knife and straight edge, or a hot knife soldering iron once they have been finally positioned.

Tapes

The luffs of sails have to be reinforced to prevent stretching. Use 25 mm tape folded in half placed over the luff and stitched to hold in place. Alternatively use 12 mm self adhesive tape (item TTM-12 sold in 50 metre rolls) placed along one edge of the luff - this does not need to be stitched. Take care not to tension the tapes when applying as this will tend to introduce puckers into the luff of the sail.

EYELETS for ROUND MAST SECTION

Melt appropriate sized holes for the eyelets using a soldering iron with a pointed tip. Alternatively use a piece of stainless steel rigging wire heated in a flame.

Clench home the eyelets using a metal block as a base on which to hammer the punch. Wrapping the block with carpet material or cork cuts down the amount of noise emitted in the process. Leave a small area on the top uncovered by insulation material. If no metal block is available, another hammer or even a heavy pair of pliers may make a good substitute.

BOLT ROPE or SLIDES for GROOVY MAST SECTION

You can purchase bolt rope ready to stitch onto the mainsail luff. Alternatively cut 30 mm wide tapes of spinnaker cloth and insert the 3 mm diameter bolt rope before adding to the sail luff.

A simple alternative is to add slides to the mainsail luff at 150-400 mm intervals instead. The slides we use are the medium size crimps, item 70-016. Tape these to the luff with small 30 mm x 10 mm pieces of the 140 g/m2 self adhesive Dacron.

Battens/Pockets

Batten pockets can be formed by stitching or gluing narrow tapes of sailcloth. Check the class rules first for the maximum permitted pocket size. Alternatively use double sided tape to attach battens cut from plastic sheet. 0.25 to 0.75 mm thick Plasticard (available in most model shops) makes reasonably good battens. Score it with a sharp knife and snap off the battens after applying the tape rather than trying to cut right through. SAILSetc can supply uni-directional glass/epoxy sheet with a self adhesive backing which will not adopt a permanent bend like the non-reinforced plastics do – items BM-T (thin) and BM-M (medium).

Stitching

It is possible, thanks to the advent of good glues, self adhesive materials and eyelets, to make perfectly good sails without having to stitch. However it is useful to stitch sometimes. It does make seams more resistant to stretching out of shape and gives complete security from failure in strong winds. Zigzag stitch is preferred for horizontal sail seams as it resists stretching loads better. But it is not essential.

Machine

Hand machines are probably easiest to master as there are less controls and they are more controllable. Even so, be prepared for a slow and patience testing initiation into the art of extracting good performance from a domestic machine with sailcloth.

Needles

Use 'leather point' needles which have a broad chisel edge to make a large hole through the cloth. This enables the thread to be pulled through the relatively hard cloth or film without breaking. Use a large size i.e. 100/16. If this type is unavailable use the largest round needle you can find.

If you are using Mylar film then a fine round needle is best.

Thread

Use polyester thread as anything else is likely to break while stitching. In the UK there are several types available 'in the High Street'; one is 'Trylko', another is 'Polysew'. It may be possible to purchase small reels from sailmakers.

Stitch

Use a stitch of about 4 mm length. Use 4 or 5 mm width for zigzag stitch. This may be the maximum for most machines. Use just enough stitch tension to keep the stitches close to the cloth but not so much that the sail seam shape is affected.

Developments

Take the opportunity to have a good look at a large number of sails before you start to have a go yourself. It's surprising how much can be learnt from a little reconnaissance.

Keep notes of how each sail is made so that its replacement can be produced by modifying the original method/shape/dimensions rather than by starting from scratch.

Don't expect to get it right first time, or second or third.....!

Be prepared to waste some materials before you get sails which will perform well.

SAILSetc
Graham & Lorna Bantock 141 high street kelvedon essex england co5 9aa
tel + 44 (0) 1376 570 583 fax + 44 (0) 1376 571 437 sales@sailsetc.com www.sailsetc2.com