

# FABRIC FOILS

## The Journal of Sailmaking

### Industrial Sewing Machines for the Sailmaker / Part I

by Jim Grant

There are so many types and makes of sewing machines available that one can easily become very confused when he begins his shopping. The volume of work done by the clothing industry has led to the development of machines that are highly specialized. Unfortunately, much of this specialization renders the machines quite unacceptable for sailmaking. If you contact a company with apparently excellent credentials and a large inventory of machines, you may very quickly discover that, although they are well-prepared to serve the average garment factory, they are quite unfamiliar with your needs.

The fact is that sailmaking is a minutely small part of the textile fabrication market. Few equipment companies are familiar with its needs. Unfortunately, I have encountered several such companies that are unwilling to admit this.

As a result, I have been led astray several times in making machine purchases. Hopefully my mistakes can be of some use to you. In what follows I want to consider the ways in which machines can vary and what you should look for in making your purchases.

Machines can vary in feed mechanism, bobbin design, stitch type, and ancillary modification. Let us consider each in turn.

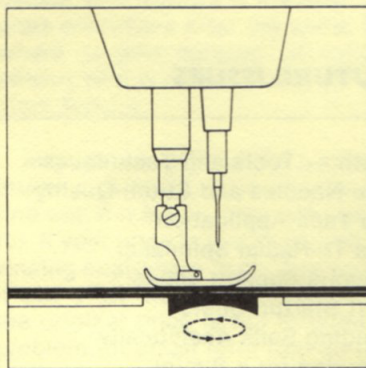
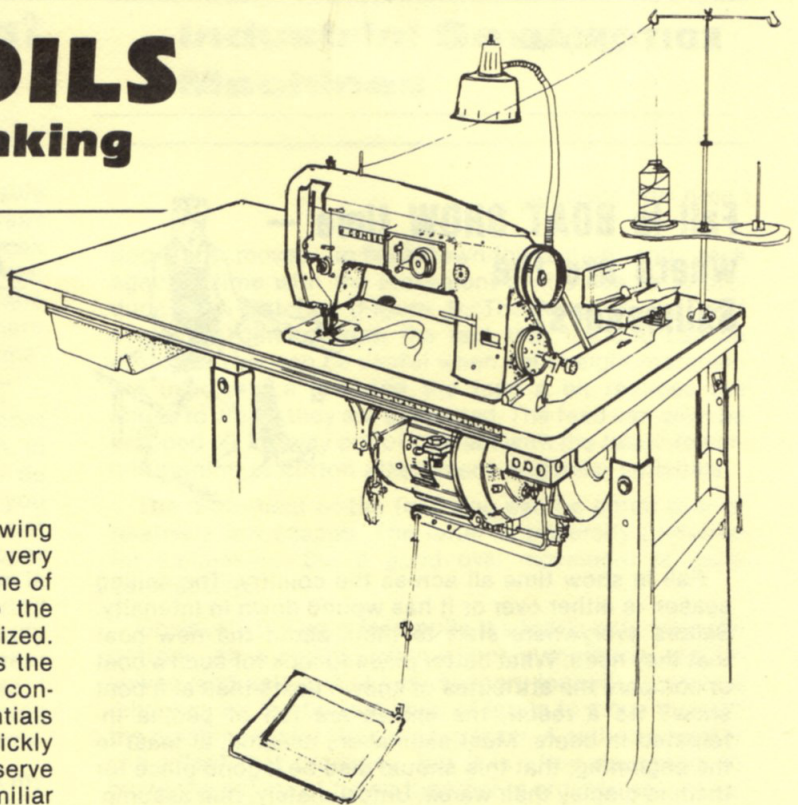


Figure 1:  
The Drop Feed  
System

#### Feed Mechanisms

At the risk of oversimplifying the matter, let me state at the outset that there are four ways in which fabric can be pulled through the machine: (1) from the bottom—this is the normal method employed on most dressmaker's machines; (2) with the movement of the needle when it is in the material—obviously a foolproof



method of feeding fabric; (3) from the top—this is most often used in conjunction with the bottom feed; and (4) from the back of the machine—usually with a top or bottom driven roller. The four most common feeding systems employ one or more of these four techniques. Now let's take up a consideration of each system and its place in the sailmaker's loft.

The **drop feed** (Figure 1) is the most common feed system employed. A presser foot which slides along the top surface of the fabric keeps it in contact with a feed

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## EDITORIAL

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### Fall is BOAT SHOW time — where are the Sailmakers?



Fall is show time all across the country. The sailing season is either over or it has wound down in intensity. Sailors everywhere start to think about the new boat that they need. What better place to look for such a boat or compare the attributes of known boats than at a boat show? As a result, the shows are full of people interested in boats. Most sailmakers assume, at least in the beginning, that this should also be a good place for them to display their wares. Unfortunately, that assumption has led many of them to waste money and labor needlessly. Shows are general **not** good for sailmakers. Indeed, a booth **may** actually do harm to a loft's image and business.

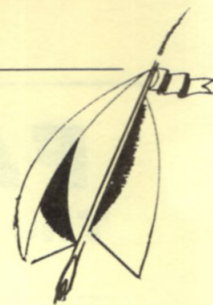
The fact of the matter is that most people come to shows intending to look at boats rather than sails. If they buy a boat at the show, they generally buy it with working sails only and those are usually part of the sale package. They may come over to talk to you about other sails that they could use, but, having never sailed the boat, they cannot be sure about what they will really need. It takes a very good salesman to convince them unless they have had other boats and understand the need for specialty sails already.

"Yes," I can hear you say, "but there are also many boat show voyeurs who come looking for equipment and accessories that they can add to their current boat." Sure there are. And these people spend a good deal of money at the shows. But the mere fact of their experience makes them difficult customers for sailmakers. They have often already shaped their opinions concerning sailmakers. And what can we offer at a show that will change their opinions? We may have several sails that demonstrate our capable workmanship. And we may have some brochures with race results that show how competitive our sails are. And, of course, we have our booth staffed with personable people who show how dedicated we are to pleasing our customers.

But all this is seldom enough, in my experience, to cause the customer to sign on the dotted line. People often want to feel that they have a personal relationship with their sailmaker. They want to think that they have his full attention when they talk sails. And they want assurance that the loft will be available to them if there is any problem or service required. Shows simply do not make any of this easy.

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### IN FUTURE ISSUES

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Edge Tape Application  
Lofting a Tri-Radial Spinnaker  
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Leather -- Its Uses in Sailmaking  
Lateral Resistance and Center of Effort in Sail Design  
Sail Insignia and Large Scale Designs



## Editorial: Where are the Sailmakers?

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So you will sell very little at a show — probably nothing at all. But can the exposure lead to future sales? This is a difficult question. Under some circumstances the exposure is probably beneficial. If the potential customer recognizes your loft name and needs sails soon, the booth may be helpful. He will find out where you are and you may be able to provide some information that will aid him in making a decision.

On the other hand, however, keep in mind that most boat show visitors are hurrying from booth to booth. In addition, they are probably very weary. There may be four or five people at once asking questions. Even if you have your best people in the booth (and this is often not possible), they will find it difficult to convey the proper impression of your loft. Just the opposite impression is more likely. I can remember years ago wandering through a show thinking that the sailmakers there really showed little concern for my needs. They seemed either unable or unwilling to answer my questions. Indeed, I believed that they actually cringed a bit when I would walk up to ask the inevitable "How much...?" questions.

Now that I have staffed over 30 shows, I know that my belief was justified, and I also know that the cringe itself was justified. You have to give prices at shows. And you have to give them quickly. The best prepared lofts will have a counter book with all the prices printed in it. This gives legitimacy to any quotes made. But it is just about impossible to have every boat's specifications and sail prices close at hand. To admit ignorance to the potential customer is probably to lose him as a customer. To fabricate a price off the top of your head is dangerous — you will suffer if too high and also if too low and neither price is likely to result in an order.

And, even if your price is just right and "looks right" (out of a book), the boat show customer may find someone who is a good deal lower at the show. This often leads him to believe that both prices are "wrong." He just does not have the information he needs at a show to decide which quote is the best for him. So he waits and goes elsewhere after the show. He goes to a loft office where he gets personal attention by a knowledgeable person who is representing the obviously busy and efficient facility.

In brief, it is difficult for a small loft to present a good image at a show. If your price is high, customers will find out. If it is low, they will suspect the service you offer. If your price is just right, you will have difficulty convincing customers to choose you over your competition. If you offer discounts, potential buyers will wonder if the original price is not inflated — this is especially a problem for small lofts that do not have a printed price book or a national reputation.

And if this were not enough, shows are very, very expensive. The booth space may cost only \$200 to \$500, but staffing it is likely to run \$150 per day per person. And hotel and food bills will be nearly that. Add the lost business and production caused by an understaffed loft. There will also be expense for travel. Is it any wonder you see very few sailmakers at shows? ■

## Industrial Sewing Machines

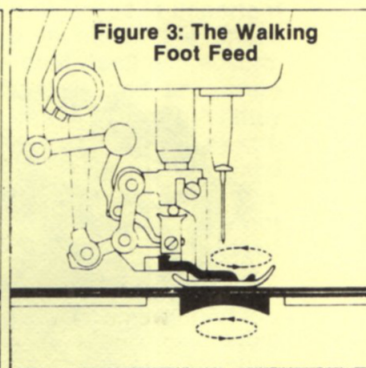
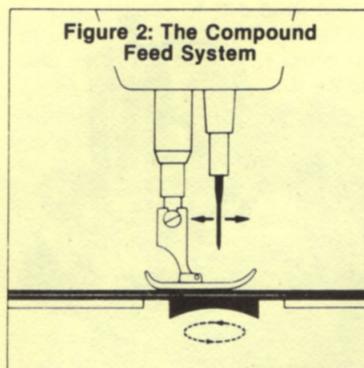
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dog that moves up-back-down-forward-up and back again in time with the movement of the needle to produce even stitches (Figure 1). The name of the feed system is derived from the fact that the dog can be dropped. This can be useful when lightweight materials are used, since lowering the feed a bit reduces the abuse to which they are subjected. The feed can even be dropped all the way out of contact with the fabric to permit darning or button attachment or similar activities.

The movement of the feed dog can be either oval or relatively box-shaped. The latter is generally preferred for sailmaking, but a good oval movement is quite satisfactory.

Obviously the drop feed pulls the fabric only from the bottom. As a result, when slippery materials are involved (and sailcloth is very slippery indeed), there is a tendency for the bottom layer of fabric to move through the machine faster than the top layer. A skilled operator can offset that tendency, but it is often necessary to baste the panels of fabric together in order to assure accuracy when the drop feed alone is used.

Since basting is a time-consuming procedure, many professional sailmakers mate the drop feed with one of the other pulling techniques to insure greater seaming accuracy. The **compound feed** (Figure 2) is one possibility open to them. This feed system makes use of the drop feed coupled with a moving needle that moves back and forth in time with the feed dog. The compound feed is very popular with producers of heavy canvas and leather goods, since it makes possible neat, even stitches in even the heaviest and hardest materials. It is, however, not particularly fast, and the machines that compound feed are relatively complicated, expensive, and difficult to service. So these machines are not common in sail work.



The **walking foot** system (Figure 3) couples a feed dog in or around the presser foot with the bottom feed dog to pull the fabric through from the top as well as the bottom (see Figure 3). The walking foot is an excellent system for sewing difficult materials like linen and synthetics—especially when they are to be sewn in tight spots with great accuracy. Such feeds are used frequently to attach linings to jersey or heavy overcoat

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# Industrial Sewing Machines

Continued from page 3

material. Overfeeding of plies and puckering are practically eliminated. The walking foot is quite common in sail lofts on straight stitch machines intended for canvas work such as covers and dodgers.

Zigzag walking foot machines are not common. The Consew 146RB is just about alone here. The machine is excellent for seaming operations, but the necessary width of the presser foot assembly makes it prone to skip stitches whenever material thickness varies (the thinner portion is not held flat against the throat plate). And the needle cannot be brought close to a zipper, boltrope, or webbing. As a result, lofts using the walking foot feed usually reserve it for seaming work only.

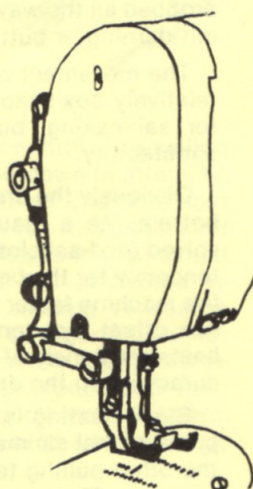


Figure 4: The Consew zigzag walking foot

The most popular feed in sail lofts is a **rear-mounted puller** to supplement the normal drop feed mechanism. These pullers are relatively inexpensive and easy to maintain.

These pullers are often supplied by manufacturers other than those who produce the machine. They are available in many different designs. But there are

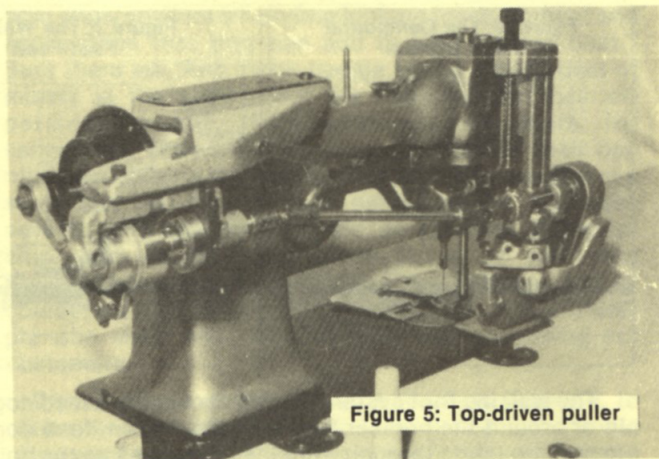


Figure 5: Top-driven puller

\*It would be wise just to mention the **unison feed** which combines the walking foot and the moving needle of the compound feed. Then there are various combinations of **differential bottom feeds** (Figure 6) which gather material and **variable top feeds** or **variable "walking feet"** which accommodate the new stretch knits very nicely.

basically two types: those with the driving roller underneath the seam and those with it on top. My own preference is for the **top-driven puller** (Figure 5) since the feed dog can do a pretty fair job of pulling through the lower panel in a seam, but since the stitch locks the cloth layers together it probably matters very little whether the puller acts from the top or the bottom.

There are other feed systems in addition to the four considered here,\* but they are seldom of any use at all in a sail loft so I will not devote any time to them.

## Bobbin Mechanisms

The second major distinction among sewing machines is their bobbin mechanisms. There are two basic designs. In one case the hook (that catches the loop of thread carried down from the top of the machine by the needle and inserts the thread from the bottom of the machine into it) oscillates back and forth through an arc of roughly 180°. In the other case that hook rotates completely and continuously. The first mechanism is designated an **oscillating hook** while the second is a **rotary hook**.

Because the rotary hook carries the thread all the way around the bobbin case, it is a bit more reliable at high speeds. It also runs just a bit more smoothly than the oscillating hook. For these reasons almost all industrial machines are of the rotary hook design.

There are, nevertheless, some advantages on the side of the oscillating hook that should be mentioned. It tends to install a "straighter" straight stitch since the bobbin thread is not thrown so radically from side to side. It also tends to be a less demanding mechanism. That is, tolerances do not have to be so precise with the oscillating hook mechanism as they do with the rotary mechanism. As a result, the oscillating machines tend to be quite a bit cheaper than rotary ones. And in slow speed operation the oscillating hook is perfectly reliable. Thus, many machines designed for home use will have the oscillating bobbin.

There are distinctions in the orientation and location of the hook mechanism which could be made—some are horizontal, some are vertical, and of the vertical ones

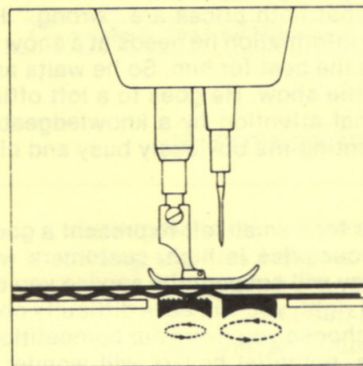


Figure 6: Differential bottom feed

some are mounted axially and some transversely. Although relevant for some highly-specialized sewing functions, these distinctions do not affect the capability of the machine from the sailmaker's standpoint, so I will skip over them here.

## Stitch Type

Machines should also be distinguished in terms of type of stitch installed. There are chain stitch and lock stitch machines. The chain stitch is used in applications

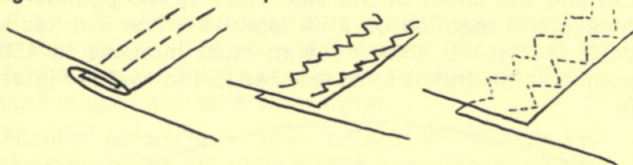
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where production speed is more important than product durability. It is an extremely fast stitch because there is no need for frequent stops to renew the bobbin thread supply. Unfortunately, when this stitch is broken at any point along its length, it very quickly comes undone along its whole length. Needless to say, sailmakers do not use chain stitch machines.

But it is not enough to simply indicate that all sailmakers use lock stitch machines. There is a great variety of the lock stitch patterns available. Sailmakers, however, really need to know about just three of the available patterns: (1) the straight, (2) the zigzag, and (3) the three-step zigzag (see Figure 7).

Figure 7: Three lockstitch patterns



The straight stitch is most useful in canvas work (covers, bags, awnings, harnesses, etc.). It is neat and attractive while also quite strong so long as it is used with "finished" or folded cloth edges. Most sailmakers use a rather long straight stitch—between four and six stitches to the inch. This increases production speed at very little cost in the strength of the finished item since the materials which are being sewn are generally rather heavy and course (and thus able to withstand localized stress quite well).

The zigzag stitch is, of course, the most common stitch used in sailmaking. It has two big advantages. First, it distributes stress well inside the often unfinished edges of the fabric. Second, it is easily and quickly ripped out if any errors are made. The first of these advantages is the more important. Sailmakers used the straight stitch until the introduction of synthetic materials made flat felled seams with carefully folded fabric edges impractical. The simple overlapping seam used with synthetic sailcloth necessitates a zigzag stitch.

Once again, a rather large stitch is justified. Military specifications call for between five and eight stitches to the inch.

The three-step zigzag is a combination of the straight and zigzag stitches. It is really nothing more than a series of three straight stitches in a zigzag pattern. It is certainly more resistant to chafe damage than a simple zigzag and is also stronger. But it does require more time for installation and is far harder to rip out than either the straight or the zigzag stitch.

One can obtain machines that will install both straight and zigzag stitches. It is even possible to purchase a machine that will do the three-step as well. While many professionals find that it is best to buy a machine that is especially set up to do just one type of stitch and thereby increase production efficiency, this is a luxury that a small loft cannot afford. It should be emphasized here that one machine can be used to perform all of the essential tasks that a sailmaker will encounter, even though some compromises in efficiency may be necessary. ■

[In the next issue, I will consider particular machines — their advantages and disadvantages for sailmaking.]

# Choosing Cloth Weight

Bob Bainbridge wrote excellent articles in Issues 2 and 3 of *Fabric Folds* about the sailcloth available from Howe and Bainbridge. I want here to build upon Bob's work. It is obvious that a good deal of thought has gone into the design of sailcloth. The same kind of attention to detail should be given cloth selection by sailmakers. It may not be possible to develop hard and fast rules to guide every decision a sailmaker must make, but we can at least attempt to render our decisions in a consistent and considered way.

When it comes to deciding upon cloth weight, for example, there are a set number of variables that should be considered:

1. What is the weight of the boat?
2. How tender is it?
3. What point of sail will be primary?
4. What are the likely minimum and maximum wind velocity ranges?
5. What are the characteristics of the fabric — its stretch ratios and tear strength?

Each of these will have an impact upon the choice of cloth weight. That impact may not be easily measured or defined, but it can be understood.

The weight of the boat and its stiffness is important since this will determine how much of the shock delivered by a gust of wind the boat itself will absorb. Light, tender boats will heel quickly and accelerate rapidly, thus dampening strain on the sails. Thus, they do not require sailcloth as strong, i.e., as heavy, as stiffer boats. Trimarans, catamarans, iceboats, and land sailers, however, even though all very light, require increasingly heavy cloth due to their stiffness. It is not unusual for 40 square foot land sailer sails to be made of eight-ounce sailcloth.

And the velocity of the wind is also very important. The weight of a cubic foot of air is .0765 pound/cubic foot. Its "mass" is the energy which this cubic foot has when in motion. Newton discovered that this mass could be represented as weight divided by acceleration due to gravity (32.2 feet per second squared). Mass or "density" times one half of the square of the wind's velocity (in feet per second) gives the pressure in pounds per square foot over a surface:

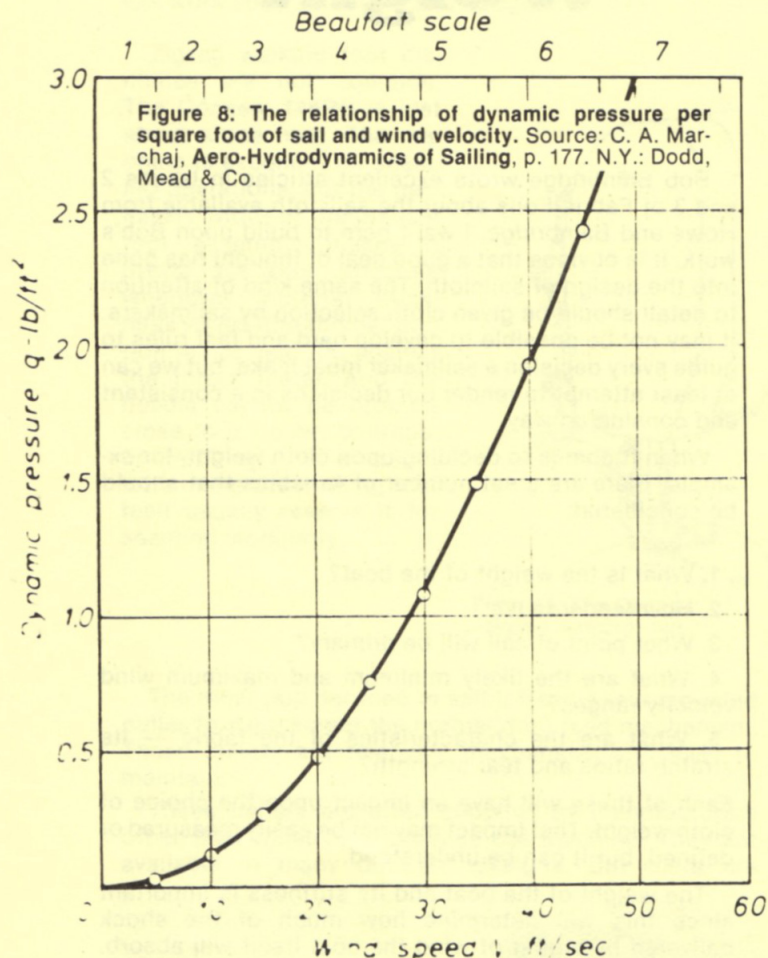
$$\text{Dynamic Pressure} = \frac{1}{2}(.0765) \times 32.2 \times \text{Velocity}^2$$

$$\text{Dynamic Pressure} = .00119 \times V^2$$

Continued on page 6



In short, the pressure on a sail increases as the square of the velocity of the wind (see Figure 8). Thus, cloth strength must increase as the square of the wind velocity for which it is intended. A cloth for 16-knot winds must be 16 times as strong as cloth for 4-knot winds. A cloth for 36-knot winds must be 36 times as strong as a cloth for 6-knot winds. **Note that this does not mean that the weight of the cloth must be increased to this extent. Light air sails are usually stronger than they "need" to be and cloth strength increases quite rapidly as its weight is increased, so the weight increase required is not so great as one might at first think.**



The point of sail for which the sail is intended is also critical. We don't worry about spinnakers as the wind increases. Yet drifters made of the same fabric must be taken down quickly. The reason is to be found in the physics of fore-and-aft sail rigs.

There are two considerations. First, as Marchaj points out very well in Chapter 1 of *Sailing Theory and Practice*, the dynamic pressure of air flowing over a sail will increase when the surface is used as a foil with an angle of incidence of from 15 degrees to 40 degrees. This increase in pressure is very important — it explains why fore-and-aft rigs work. For our purposes, however, it is a rather minor consideration since the increase (which, by the way, varies depending upon the shape of the sail and its sheeting angle) is relatively minor.

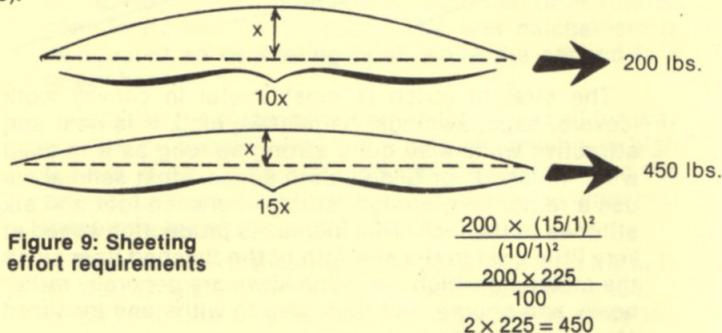
More important for a determination of cloth weight is the force required to make the sail take on a given shape

to maximize its effectiveness on any given point of sail. When sails are permitted to take on a full, "baggy" shape on a broad reach or a run, the only restraint necessary is that required to offset the force of the air on the sail. In a 530 square foot spinnaker, this will be roughly 60 pounds per corner in a 10-knot wind.

$$530 \times .00119 \times 16.9 \text{ ft./sec.}^2 = 180.13 \text{ lbs.}$$

Since there are three corners, this total can be divided by 3 to yield the 60 pound figure above.

When it is necessary to flatten the sail, however, the effort required increases rapidly. The flatter the sail, the greater the force across the sail must be. Indeed, the force required increases as square of the inverse of the ratio between its draft along the chord line of the sail (its LP) and the chord of the sail. Thus, if 200 pounds of pressure is required on a jib lead when the sail has a draft of 1 to 10, that pressure must increase to 450 pounds if the draft is to be reduced to 1 to 15 (see Figure 9).



Obviously the weight of cloth necessary to withstand the strain of beating must be much heavier than that for a running sail.

But the characteristics of the cloth itself cannot be ignored in choosing a proper weight. There are different "lines" of cloth. Some of these entail rather expensive weaves and finishes that reduce stretch to a minimum (at the cost of reduced tear strength). Others make use of larger denier yarns that increase tear strength usually at the cost of less controlled stretch ratios. In most cases, tear strength is not a serious problem with modern Dacron sails. Even the firmest fabrics are "strong enough" in this regard. Thus, it is stretch ratios that must be given primary attention in choosing cloth weight.

The heavier the cloth, the lower the stretch for any given stress. As a result, racers often select a rather heavy cloth — this also increases the tear strength of the sails although that is a minor consideration. And when cruisers select the "Bermuda" line of cloth, Bainbridge suggests that they, too, increase the normal weight a bit in order to bring stretch ratios into line with more expensive fabrics. And, of course, there are racers who attempt to reduce the weight of their sails as much as possible to keep weight aloft to a minimum. It must be recognized that this can only be done if special weaves and finishes are used to reduce stretch as much as possible.

It is not possible to specify a given cloth weight in any particular situation as the "right" one. The 1983 Sailrite Catalogue provides some rough guides in the form of charts for each line of cloth. This article is intended as a means by which those charts can be fine tuned for any given job. ■



## Cleaning Sails

It is unfortunate that sails get dirty since **any** cleaning process will tend to break down the integrity of the cloth finish and abrade the fibers. Even so, there are some procedures that are relatively safe. The first of these is to simply rinse the sail with fresh water and hang it up to dry before folding it for storage. For more serious cleaning, a detergent solution can be used. Stubborn spots can be scrubbed with a brush. I have not found any of the proprietary sail cleaners to be any more effective than common laundry detergents. Test any cleaner on a small portion of the sail before general use (Figure 10).

For stains the following cleaners are appropriate:

**Rust** — Soak the affected area in a 5% solution of oxalic acid dissolved in hot water. Follow this with a 2% solution of hydrochloric acid in warm water and, finally, rinse the spot well with clear water.

**Number Adhesive** — Soak the area in cleaner's benzene or any of the proprietary spot removers with a benzene base. Rub the adhesive away with a rag when it is softened.

**Oil, Tar, or Varnish** — Use trichloroethylene either by itself or in solution with a liquid detergent.

**Mildew** — Soak the affected area in a 1% solution of chlorine (household bleach will do) and cold water. This technique has been known to yellow Dacron with a melamine finish if it has been exposed to the sun for any length of time, so be careful! A solution of vinegar and water will do a fairly good job without this danger.

Complete removal of stains is usually not possible — don't expect a perfectly clean sail.

## Batten Pocket Traps

There are a number of different techniques for securing battens in their pockets. I want to describe three here that are frequently used:

### The Leech Triangle Trap

The leech triangle trap (Figure 11) is described in my sailmaking manuals. It entails adding a wedge of fabric to the aft end of the pocket that is 25% of the length of the pocket in length and the width of the pocket high. The batten is inserted through this triangle — it is left open on the leech. A short length of closely spaced stitches can be used to lock the batten into the pocket below the triangle. Note that there should be a short length of elastic in the forward end of the pocket so the batten can be forced forward of the stitches and then held back against the leech of the sail.

### The Open Pocket Trap

The open pocket is usually made up of a single length of Dacron tape as shown in the Figure 12. There is an opening in this tape about one inch forward of the leech. The batten is inserted through this opening and pushed forward against the elastic band in the front of the pocket. This elastic pushes the batten back past the opening to lock it in place inside the pocket.

Those who use this method argue that it is "cleaner." That is, there is less distortion of air flow over the leech of the sail since the pocket is narrower at its end. The advantage is a minor one but perhaps worth consideration.

??????????!

*Ask Jim*

There are a number of questions that seem to come up regularly. How are sails properly cleaned? What batten pocket traps are best? Can helm balance be improved by changing sails or adding new sails to the inventory?

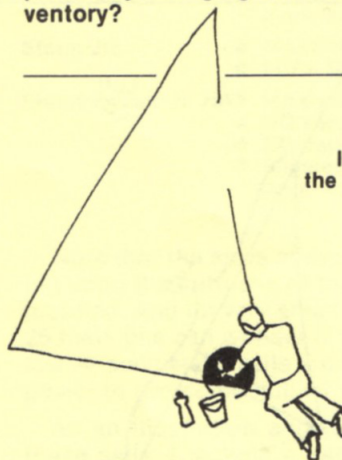


Figure 10: Sail Cleaning Should Start in An Inconspicuous Spot to Test the Cleaner's Effect on the Fabric

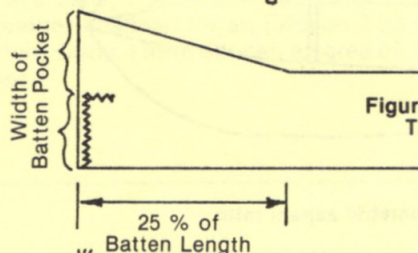


Figure 11: The Leech Triangle Trap

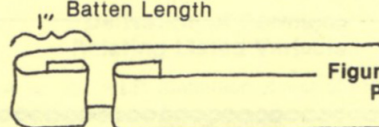


Figure 12: The Open Pocket Trap

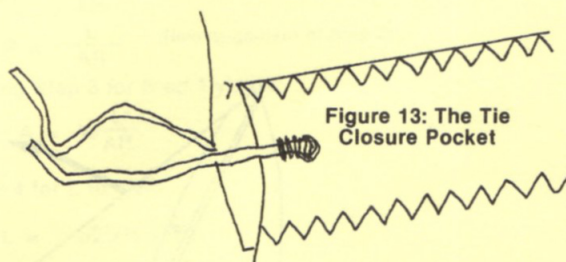


Figure 13: The Tie Closure Pocket

### The Tie Closure

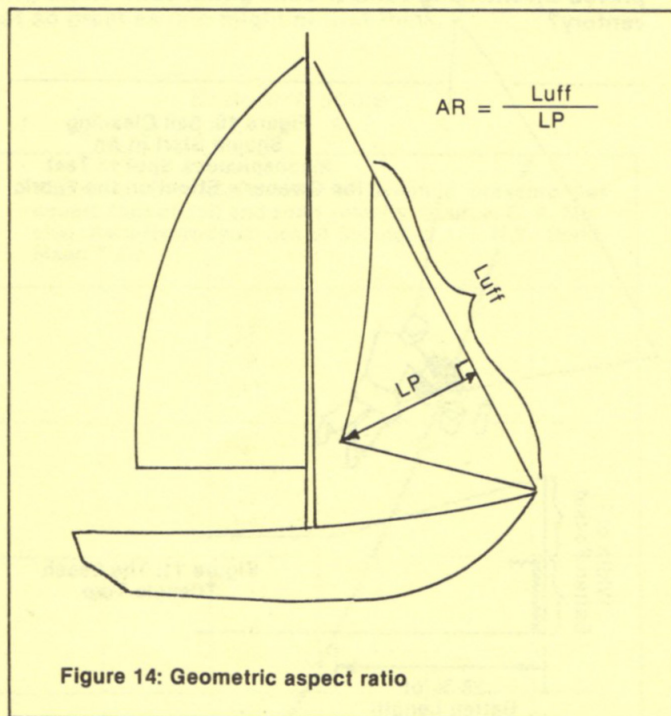
All battens were tied in place until just a few years ago, and many still prefer this method since it is probably the most dependable. It is required for full-length catamaran battens since they must be pushed into the sail in order to develop proper camber—sail shape can be changed by increasing or decreasing pressure on the end of the batten. The disadvantage in this system is that it requires more time to properly install the battens each time they are inserted or removed.

The tie closure pocket (Figure 13) is very simple. A short line is secured to each side of the sail. One of these is run through a hole in the end of the batten and tied to the other line. The lines can either be tied through small grommets on each side of the pocket or sewn in place.

Continued on page 8



# Thoughts on Stormsails



I have finished my first sail, a 35 square foot storm jib ordered as a Sailrite Kit. I found it to be a rewarding experience. Thank you for your patience in answering my questions about sewing machines and putting the sail together. In return I offer the following thoughts about my experience.

My sail (Figure 15) has an aspect ratio of 3.5:1 (this is geometric aspect ratio, i.e. luff to LP). On reflection I would limit myself to 3.0:1 as the maximum on all heavy-weather jibs. The lower ratio accomplishes two things. First, it provides for a slightly wider head which makes the sail stronger with the same patch sizes. Second, it gives better control of the upper 25% of the sail when sailing slightly off the wind as one is likely to do in gale conditions.

In order to do a straight forward design based on any given geometric aspect ratio and area, the following formulas may be used:

$$\text{Luff Length (in feet)} = \sqrt{2 \times \text{AR} \times \text{Area (ft.}^2\text{)}}$$

$$\text{LP (ft.)} = \frac{2 \times \text{Area (ft.}^2\text{)}}{\text{Luff (ft.)}}$$

The derivation of the formulas and a design example are appended here.

Of course, before this design system can be used, the size of the sail must be determined. We can now turn for

Continued on page 9

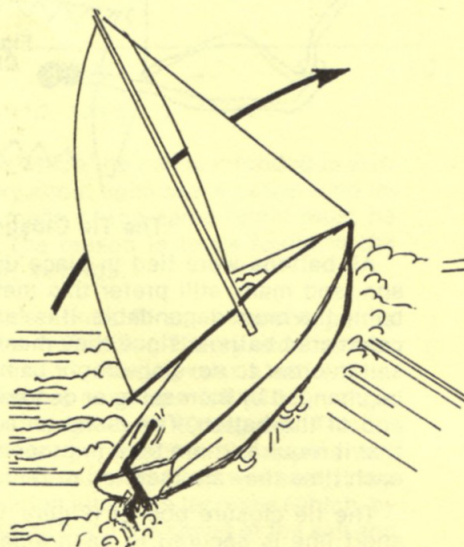


Figure 15: As the boat heels, the sail effort moves out to leeward, tending to pivot the boat to weather. The asymmetrical form of the immersed portion of the hull also contributes to this effect.

Continued from page 7

*Ask Jim*

## CHANGING HELM BALANCE

Sails can improve the sailing characteristics of boats. Many boats, especially some of the new light-displacement models that are rather tender, have a good deal of weather helm when the wind begins to blow. There are three ways to reduce this through modification of sails:

1. Mainsail roach can be reduced or even eliminated.
2. Draft in the heavy weather headsails can be moved forward.
3. The luff length of heavy-weather headsails can be decreased. This lowers the center of effort in the sail and also opens the slot between the headsail and the main up high.

The problem can often be solved more easily by reducing sail. Weather helm is usually a symptom of an overpowered boat. Just changing to a smaller headsail will help. Reefing the main with a genoa in the foretriangle will be even more effective.



# Thoughts on stormsails

Continued from page 15

guidance on this matter to the new revisions to the International Offshore Racing (IOR) which were made at the November 1982 meeting of the Offshore Racing Council. As Jim Grant has pointed out in his books on sailmaking, the rating rules can be of real help even for those who are interested only in cruising, since they are an attempt to develop standards of seaworthiness to limit extreme and perhaps dangerous experiments.

The new rule defines the following sails:

SAIL NAME	MAXIMUM SIZE & CRITERIA
Heavy-Weather Jib	<ul style="list-style-type: none"> <li>● MAXIMUM AREA = <math>.135 \times I^2</math></li> <li>● No reef points</li> <li>● Hoist and secure to stay in same way as largest jib</li> <li>● Provide for alternate means of attachment method if hanks are not used</li> </ul>
Storm Jib	<ul style="list-style-type: none"> <li>● MAXIMUM AREA = <math>.05 I^2</math></li> <li>● LUFF MAXIMUM = <math>.65 I</math></li> </ul>
Storm Trysail	<ul style="list-style-type: none"> <li>● MAXIMUM AREA = <math>.175 P \times E</math></li> <li>● NO headboard</li> <li>● NO battens</li> <li>● Sheeted to a block on rail or deck—not to the boom.</li> </ul>

Note that the sizes above are all maximums. Depending upon the stiffness of the boat, smaller sails may be justified. And for very small boats (with an I of less than 25 feet), one can wonder if the storm jib limit is not too low — such small sails are not likely to provide enough power to overcome hull windage.

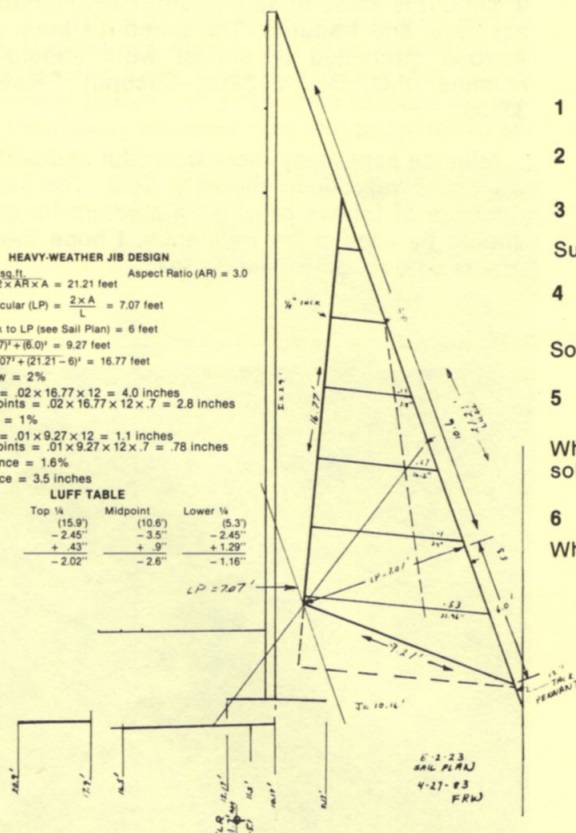
As an illustration and test of my understanding of these sails, I include a design example. It is a heavy-weather headsail for an Ericson 2-23 shoal keel center-board sloop. I have chosen an area of  $.089 I^2$  or 75 square feet.

## HEAVY-WEATHER JIB DESIGN

Area (A) = 75 sq. ft. Aspect Ratio (AR) = 3.0  
 Luff (L) =  $\sqrt{2 \times AR \times A} = 21.21$  feet  
 Luff Perpendicular (LP) =  $\frac{2 \times A}{L} = 7.07$  feet  
 Distance Tack to LP (see Sail Plan) = 6 feet  
 Foot =  $\sqrt{(7.07)^2 + (6.0)^2} = 9.27$  feet  
 Leech =  $\sqrt{(7.07)^2 + (21.21 - 6)^2} = 16.77$  feet  
 Leech hollow = 2%  
 Midpoint =  $.02 \times 16.77 \times 12 = 4.0$  inches  
 Quarter points =  $.02 \times 16.77 \times 12 \times .7 = 2.8$  inches  
 Foot hollow = 1%  
 Midpoint =  $.01 \times 9.27 \times 12 = 1.1$  inches  
 Quarter points =  $.01 \times 9.27 \times 12 \times .7 = .78$  inches  
 Draft allowance = 1.6%  
 Sag allowance = 3.5 inches

### LUFF TABLE

Location	Top 1/4	Midpoint	Lower 1/4
Sag	(15.9)	(10.6)	(5.3)
Draft	-2.45"	-3.5"	-2.45"
Net	+4.3"	+9"	+1.29"
	-2.02"	-2.6"	-1.16"



## Derivation of Formulas Relating Listed Variables

1  $A = \frac{1}{2} L \times LP$  (Definition of area of triangle)

2  $AR = \frac{L}{LP}$  (By definition)

3  $LP = \frac{L}{AR}$  (Rearrangement of Step 2)

Substituting Step 3 for Step 1 yields

4  $A = \frac{1}{2} \frac{L^2}{AR}$

Solve Step 4 for L to yield

5  $L = \sqrt{2 \times A \times AR}$

When L is known use Step 3 to solve for LP or solve Step 1 for LP which gives

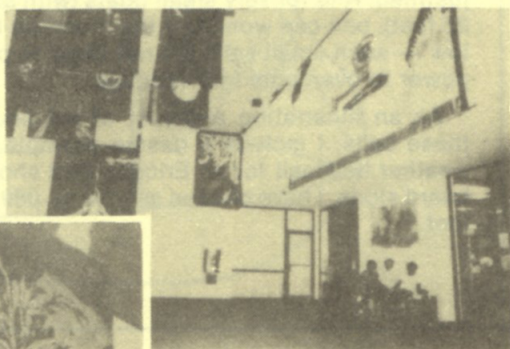
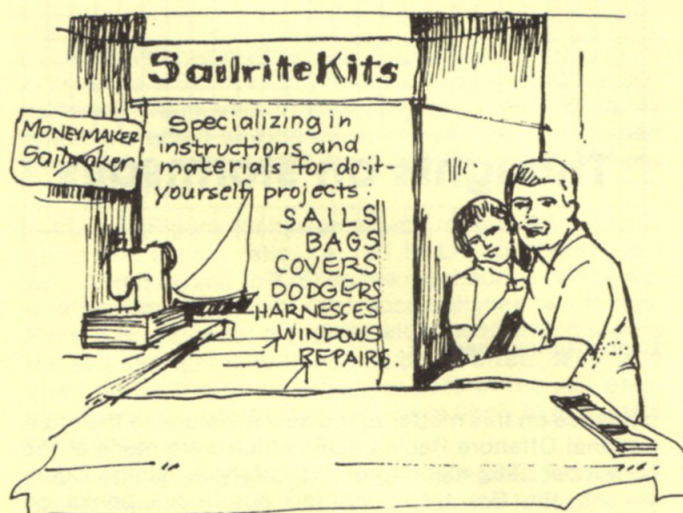
6  $LP = \frac{2A}{L}$

Where: A = Sail base triangle area in square feet  
 LP = Luff perpendicular in feet  
 L = Luff length in feet  
 AR = Geometric aspect ratio expressed as luff divided by luff perpendicular



# on the waterfront

Connie and I will be staffing a booth (and demonstrating our sewing machines) at the Long Beach Sailboat Show from October 21 to October 29. This will be our 12th year at the show. Our growing business makes shows very difficult for us. We have been forced to give up all but this one. Even so, I expect we will be making the trip to California for many more years. Sailrite Kits started in a garage in Pomona, grew up in a storefront on Lincoln Boulevard in Santa Monica, and matured in a building on Venice Boulevard near Marina del Rey. Connie and I consider California our second home. Thus, this show gives us an opportunity to see old friends as well as sell a good many machines — that's a combination hard to beat! Stop by and say "hello!"



Milanne Rehor of Coconut Grove, Florida, is using her Sailwright machine in a unique way. Milanne has created huge fabric tapestries for Planet Ocean Museum in Miami like those in the lobby photo (left). Shown are "S-40 Seaplane," "Blue Moray," and "Volcano II." Milanne reports that Volcano II (closeup also left) was sewn on her new machine in half the time required on a home machine. That piece is 7'8" wide x 9' high. It is made of satin, cotton, nylon, burlap, lame, applique, and trapunto. The purchase price is \$1,500. Anyone interested in similar work should write to Milanne, P.O. Box 330914, Coconut Grove, Florida 33133.

Milanne sent many more beautiful slides that I wish we could reproduce properly here. The texture and richness of fabrics provides a medium for artists that should be used more frequently. I hope there will be others who follow Milanne's lead.

Frank Piezak of Goose Island Sails in Chicago sends this shot of "Pyewacket's" radial head reaching spinnaker (Figure 19). Frank has a new flourishing loft. Not that he is new to this type of work. His family started "American Inc." in 1928 to make coal and ice bags. Just four years ago the primary products had become fabric toys: the cloth tunnels that kids love to crawl through and the "Jumpolones" that they bounce all over. Frank sold that business to concentrate on sails. His production expertise has enabled him to compete effectively with some of the volume lofts in price and quality. He uses the Sailwright computer pricing program to win business from a broad and diversified market. He has tried a tollfree 800 number but found that its cost/benefit ratio was not desirable. Regional advertising and repair work are, in Frank's experience, the best way to build business. His participation in the Sailmaker's Series has, as so often happens, been a benefit not just to him but to us as well.



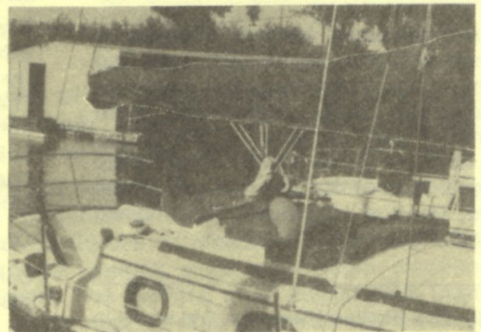




Dr. Bruce Evatt of Atlanta, Georgia, sends these photos of a main, jib, and triradial spinnaker made for his Harmony 22. Bruce devotes most of his time these days finding a cure for herpes and AIDS at the Disease Control Center. But he still finds time to build sails for himself and friends...just the kind of therapy a busy research scientist needs. Indeed, Bruce has "recreated" himself right through a Master Sailmaker's Certificate!

Bruce is the one who first pointed out to me the need to vary broadseaming in spinnakers relative to the girth of the sail. He is responsible for this very important change in the new **Spinnaker Manual**.

Paul Sperry of Grand Terrace, California, sends these photos of a Catalina 22 with appropriate covers and an extremely well-made foredeck bag. Paul is well on his way to a Master Sailmaker's Certificate but is not waiting for that before using his skills to make money! He has a flourishing business now that promises to get even better!



Bob Frazier of Sacramento, California, writes: "We have yet to start sailmaking, and perhaps never will. But want to send along a few snapshots of cover work we have done for our boat... Except for the handrail covers, all this work was hand sewn... I would like to thank you for your service and your helpful books. Please believe that we boost Sailrite every time someone drops by to see a new item." With canvas as creative as this—note the hatch cover with a dowell at the aft end which can be secured under the boom with a length of shock cord to cover the open hatchway when it rains — and workmanship so fine (you just don't see well-done hand stitching anymore)—Sailrite cannot have a more effective booster!





Some of you will remember a Sailrite Newsletter where Connie gathered together all the discontinued and shop-worn items and offered them for sale at very **low** prices. This section of the Fabric Foils is an outgrowth of that. We will use it to keep you informed of the miscellaneous items which we want to get off our shelves.

It is also a good way for you to do the same. Classified ads are **FREE** for current subscribers. The ads are subject to editorial selection and space availability. They are limited to one-of-a-kind opportunities and small lot sales. Standard commercial products are NOT eligible.

Free ads are limited to a maximum of 50 words. The only payment is your current **FABRIC FOILS** mailing label to verify your subscriber status. Photos of items for sale are also printed free — space permitting. Just submit a clear black and white photo along with your ad copy.

**Nylon Backpack Netting Seconds in Charcoal.** Great for "drying" bags and hammocks. Strong but not suitable for trampolines since nylon sags when damp. Flaws primarily in the color. \$2.49/yd. (44 inches wide). Sent postpaid in quantities of five yard or more. Sailrite Kits, Route 1, Columbia City, Indiana 46725. Phone (219) 244-6715.

**Adhesive-Backed Numbers.** Old stock in assorted colors, sizes (red, black, blue, 10" 12" 15" high). Outmoded by new Dacron insignia material but perfectly usable. Some numbers vinyl, some ripstop nylon, some even new Dacron fabric but in off shades. Give us color and size and number preferences; we'll fill order as necessary with stock on hand. \$2.00/12 numbers, sent prepaid if 12 or more numbers are ordered. Sailrite Kits, Route 1, Columbia City, Indiana 46725. Phone (219) 244-6715.

**Stablekote III Seconds.** Often called 3/4-oz. ripstop nylon spinnaker cloth. Lots on hand. Surprisingly good condition. Rolls often less than five yards; some flaws in color. Give color preferences but don't hold us to them since we cannot order in colors when supply is exhausted. 40 inches wide. \$2.45/yd., sent postpaid in quantities of five yards or more. Sailrite Kits, Route 1, Columbia City, Indiana 46725. Phone (219) 244-6715.

**Plastic Thimbles, Discontinued Stock.** Suitable for light-duty applications in rope eyes.

1/4-inch rope thimbles ..... \$ .45 ea.  
1/8-inch rope thimbles ..... .65 ea.

Sailrite Kits, Route 1, Columbia City, Indiana 46725. Phone (219) 244-6715.

**Olympic Slug Slides, Discontinued Stock.** Excellent slug slides for installation on sails for boats under 26 feet. These slugs can be attached with just a screwdriver. They clamp over the boltrope and do not require grommets. The hinge makes these slides work very smoothly.

Olympic Slug Slides ..... \$ .45 ea.

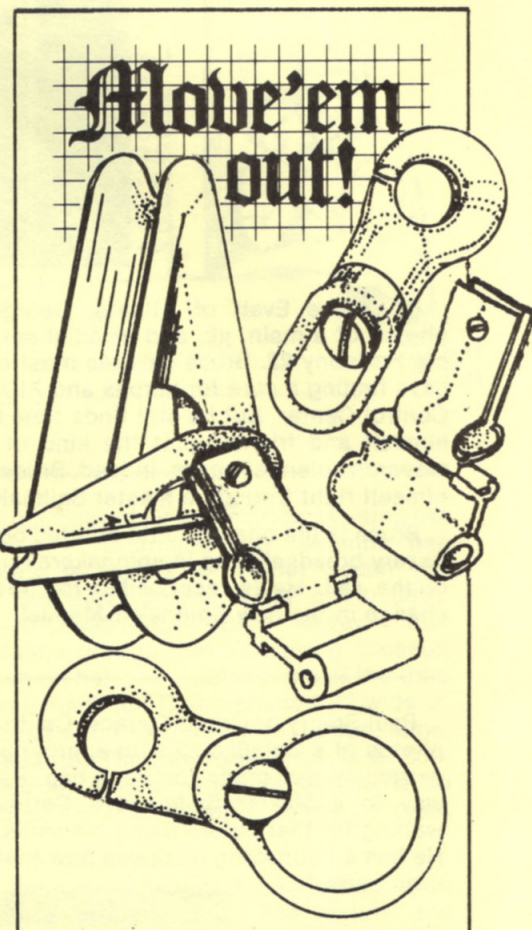
Sailrite Kits, Route 1, Columbia City, Indiana 46725. Phone (219) 244-6715.

**Wanted --** Loft manager with computer experience. Contact Larry French, Johnson Sails, PO Box 20926, St. Petersburg, Florida 33742.

**Free Sail Design Programs --** Programs for mains, jibs and genoas are available only for TI-59 calculators and for PRIME or CDC Computers (until April '84). Contact Ted Andresen, Box 40053, St. Petersburg, Florida 33743. Phone (813) 525-8763

**Wanted —** Used any condition (a) long-arm zigzag sewing machine, (b) wood thickness planer. R.J. Penick, Inc., Custom Boat Building and Marine Hardware, c/o Bob, P.O. Box 94103, Houston, Texas 77018.

The deadline for ads is the 15th of November, February, May, and August. The issues will appear two months after these closing dates, in January, April, July, and October.



## FOR SALE

**Enkes #18 2-speed winch,** aluminum drum, brand new. Asking \$130. Ray Anderson, Island View Rt., Box 543, Ranier, MN 56668. Phone (218) 286-5819.

**Small Canvas Loft.** Contact: Bridget Packer, Ship Shape Canvas, Sausalito, California 94965. Phone (415) 331-2497

## WANTED

**Used In Good Condition:** (a) long arm zigzag; (b) Long arm heavy straight stitch; (c) Nautilus press with accessories. Call collect (617) 999-3535. Olie Craft, Inc., P. O. #H-3081, New Bedford, MA 02741

Write to Connie Grant  
Whitley County Publishing, Inc.  
Route 1  
Columbia City, Indiana 46725





# VIC'S LOFT

Vic Kaminsky

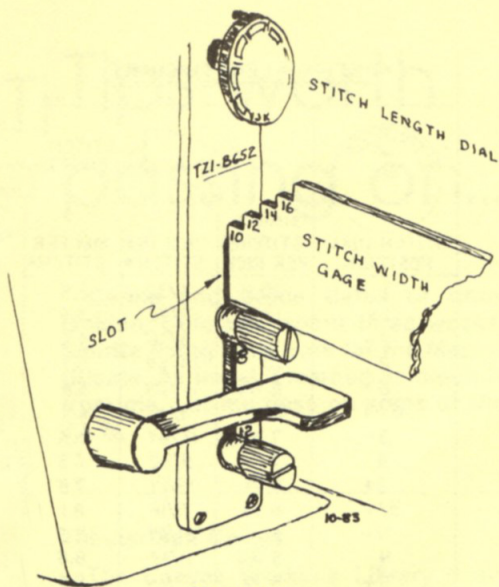


Figure 16a

## STITCH WIDTH GAUGE

Stitch width and length are often changed several times during the course of constructing a sail. Even though dials and levers are marked, it is sometimes difficult to return the machine to its original stitch without a good deal of time-consuming experimentation. This is especially the case with stitch width on the Sailwright Sailmaker. To overcome the problem, I have developed a simple gauge (Figure 16).

The gauge is a small rectangle of wood, plastic or metal about four inches long by 1½ inches high. One end has a series of ¼-inch stair steps that can be used to precisely set the lever that controls the width of the zigzag stitch. Figure 16a shows the gauge in use. It is removed after the stitch width knob is tightened.

In order to calibrate the gauge, a graph indicating stitch width at each gauge step was created (Figure 16b). Steps 1, 3, 5, etc., were left off the scale on the left side of the graph for sake of clarity. This graph will not be perfectly accurate from machine to machine, but it will be very close. For those who don't like graphs, Figure 16c gives the gauge step number and the cor-

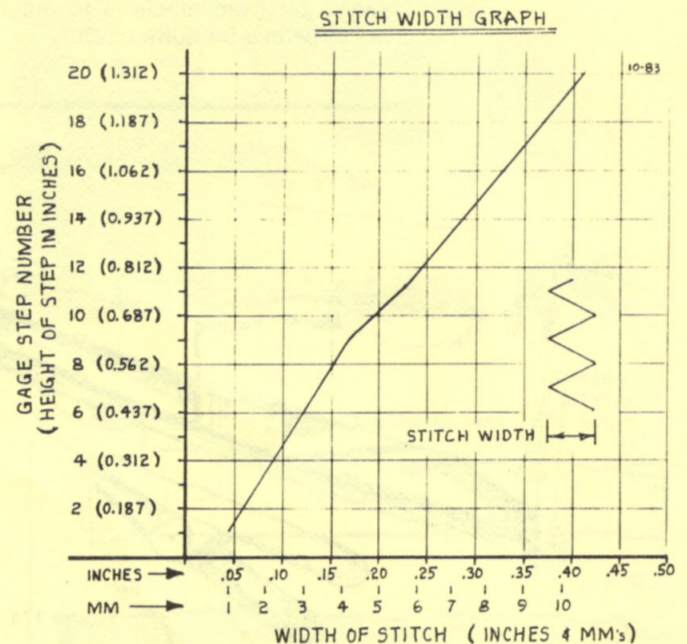


Figure 16b

responding width of the stitch in both fractions of an inch and millimeters. These values are approximate since all were rounded to the closest gauge setting.

To make a gauge, refer to Figure 16d. There is nothing critical about the material used. Aluminum is easy to work with, but Plexiglass or Masonite would work as well. My prototype gauges were made from wooden tongue depressors. The material must not be more than ½-inch thick since that is the width of the sewing machine slot. Scribe the step numbers on a metal gauge or use a marker on other surfaces.

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page 14

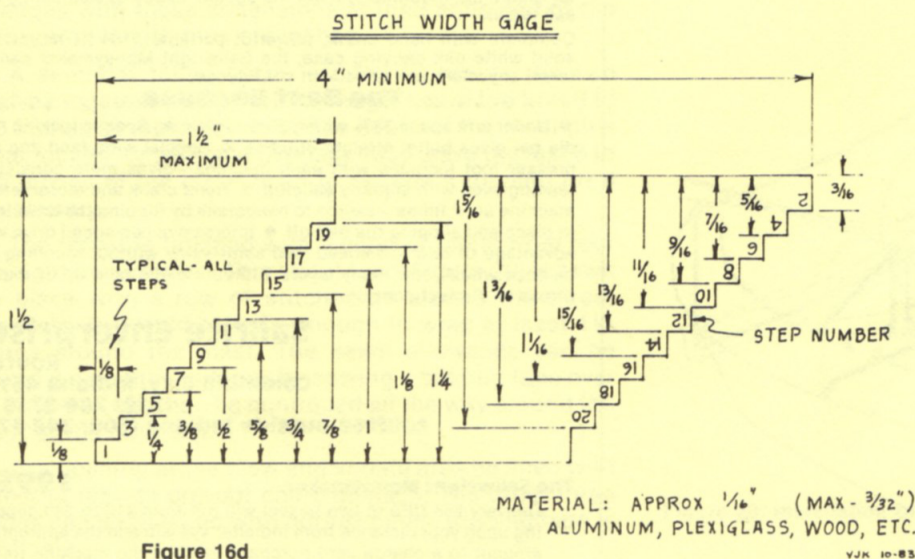


Figure 16d

STITCH WIDTH CHART		
GAGE STEP	WIDTH INCHES	WIDTH MM's
1	3/64	1
2	1/16	-
3	5/64	2
4	3/32	-
5	7/64	-
6	1/8	3
7	9/64	-
8	5/32	4
9	11/64	-
10	13/64	5
11	7/32	-
12	1/4	6
13	17/64	-
14	9/32	7
15	5/16	8
16	21/64	-
17	11/32	9
18	3/8	-
19	25/64	10
20	13/32	-

Figure 16c



Stitch length is not difficult to set and reproduce on the Sailwright machine. But it is handy to have a chart like that in Figure 16e to indicate stitches per length and the length of each stitch. Once again these figures will vary a bit from machine to machine, but they should nevertheless be quite useful.

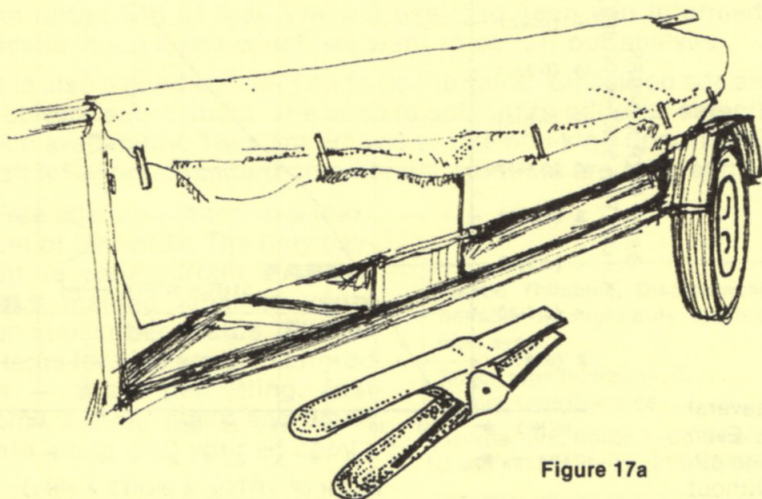


Figure 17a

#### SPRING CLIPS AND MAST SUPPORTS

The spring clips designed for use by welders can be helpful in fitting covers (Figure 17a). Note their use here on a Windmill "mast down" cover.

The same cover makes use of the mast as a "backbone." In order to keep the mast well supported itself, I made up two very simple wooden braces (Figure 17b). One of these fits in the centerboard well. The other is on a seat.

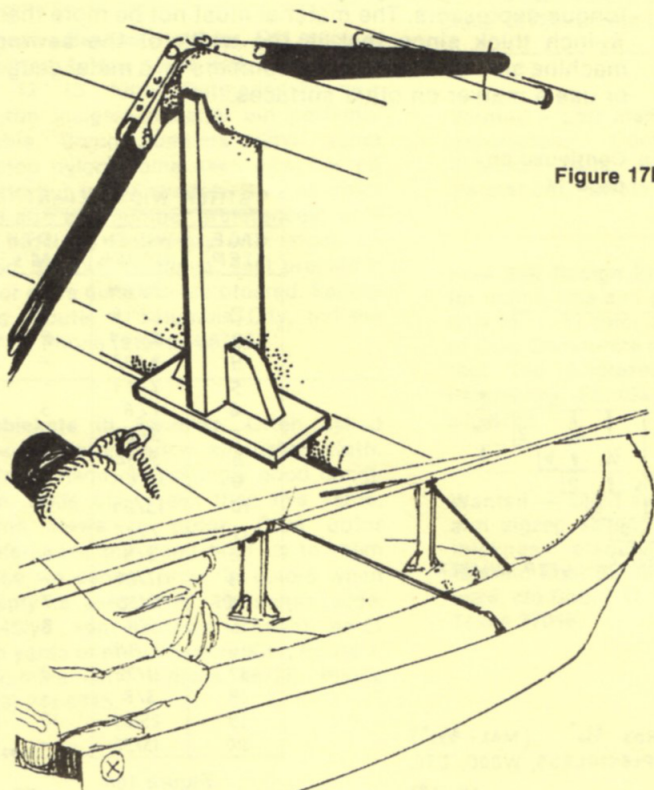


Figure 17b

#### STITCH LENGTH CHART

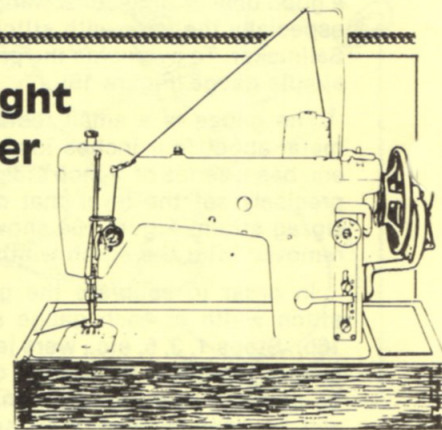
STITCH DIAL POSITION	SINGLE STITCHES PER INCH	INCH PER STITCH*	MM PER STITCH*
1	20	3/32	2.5
1+	13	5/32	3.9
2-	11	3/16	4.6
2	10	13/64	5.1
2+	8 3/4	15/64	5.8
2/3	8	1/4	6.4
3-	7 1/2	17/64	6.8
3	7	9/32	7.3
3+	6 1/2	19/64	7.8
3/4	6 1/4	5/16	8.1
4-	6	21/64	8.5
4	5 3/4	11/32	8.8
4+	5 1/2	23/64	9.2
4/5	5 1/4	3/8	9.7
5-	5	25/64	10.2
5	4 3/4	27/64	10.7

\* REFERENCE THIS DIMENSION AS IT IS EASIEST TO MEASURE.

Figure 16e

## The Sailwright Moneymaker

At last, the sewing machine for you! Until now sailmaking and sail repair have been carried out either with small, lightweight, and often underpowered sewing machines designed for home use or with heavy and ridiculously specialized machines intended for volume commercial work.



Now...the **Sailwright Moneymaker** fits perfectly the requirements of sailor and of small loft. A "professional" machine intended originally for tailors but modified to meet the special needs of sailmaking and sail repair.

Complete with hand crank, powerful portable 110-volt motor and solid white oak carrying case, the Sailwright Moneymaker can be taken anywhere and used with confidence.

#### The Best Because

- Under arm space 33% wider, 20% higher
- Special locking needle bar gives better straight stitches
- Special wide feed dog and presser foot included with each machine—gives more consistent feeding even with slippery sailcloth
- Hand crank and motor left on machine at all times—switch to handcrank by flipping the drive lever in place and slipping the belt off
- Impressive two-speed drive with advantage of new low-speed (300 spm)—sew without touching the balance wheel, sew many layers without needle heat up or melted thread
- Perfect control.

## Sailrite Enterprises

Route 1  
Columbia City, Indiana 46725  
(219) 244-6715 or  
tollfree outside Indiana (800) 348-2769

The Sailwright Moneymaker ..... **\$995<sup>00</sup>**

Delivery (via UPS in two boxes) will run from \$10 to \$40 depending upon your distance from Indiana. We will add the appropriate amount to a charge card purchase or send the machine freight collect if a check or money order is received.



# Tips worth passing on...

Carole and Bruce Bates of Bonnie Lee Sails in Golden, Colorado, spent three weeks in September at Sailrite doing their work for the Master Sailmaker's Certificate. As usual, I learned as much from them as they from me. Let me pass on some of those lessons here. J.L.G.

## Tubular Sail Covers

The **Canvas Worker's Library** describes a common sail cover that is appropriate for mainsails that have sail slides or slugs. There is much more room at the "throat" of the cover to allow for the fact that such sails do not fold all the way down on the boom but stack up on the mast. Smaller boats often make use of a mast tunnel to support the boltrope along the leading edge of the sail. Such sails are taken completely out of the tunnel as they are lowered. The result is that they can be neatly furled on top of the boom or even rolled around it. The large throat in the sailcover is therefore not needed.

The Bates response is to use a "tubular" sail cover design (Figure 18). It is not their creation (one can wonder if there is anything really new in this business), but that makes it no less interesting. The tubular design is fast, requires less cloth, and fits smaller boats better than the traditional design.

There are just three measurements required — an advantage when building covers for small boats since they are seldom worth a trip to the marina for measurements. The owner can measure the overall length of the boom including the thickness of the mast, the girth of the furled sail one foot aft of the mast and its girth one foot forward of the clew end of the boom (Figure 19). That is all that is required.

Divide the two girth dimensions in half and add four inches for seam, hem, and overlap. Then simply cut two wedges with these dimensions at their ends and of the measured length plus six inches:

A semi-flat felled seam is used to secure the two halves together along their top edge. Leave the first 9 to 13 inches of the cover open (the depth of the mast plus four inches for hem and overlap). Also leave the last 6 to 10 inches of the cover open to provide a topping lift if necessary.

The throat is finished with a band of fabric from four to eight inches wide. This "boot top" (Figure 20) is sewn in place with a row of stitches all around the throat opening. It should be long enough to wrap at least  $1\frac{1}{2}$  turns around the mast. The seam allowance can be given a nice finished look by sewing a binding tape over it. And this tape can be continued all the way around the rest of the boot top.

The opening at the clew end should also be lined with binding tape to prevent chafe damage. The other three sides can be finished with normal hems. Binding tape is optional.

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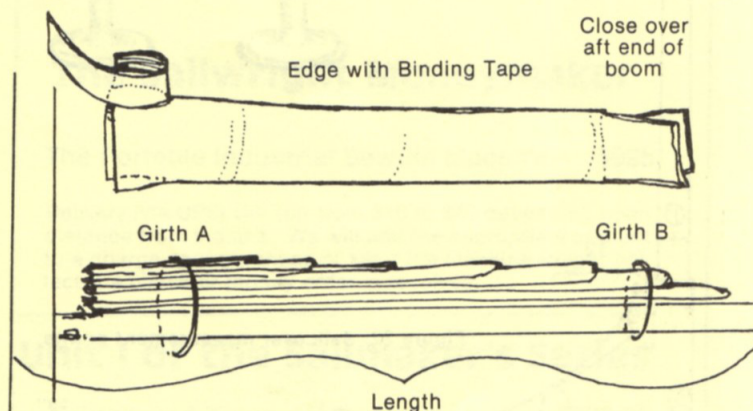


Figure 18: The tubular sailcover

Figure 19: Cutting cloth for a tubular cover

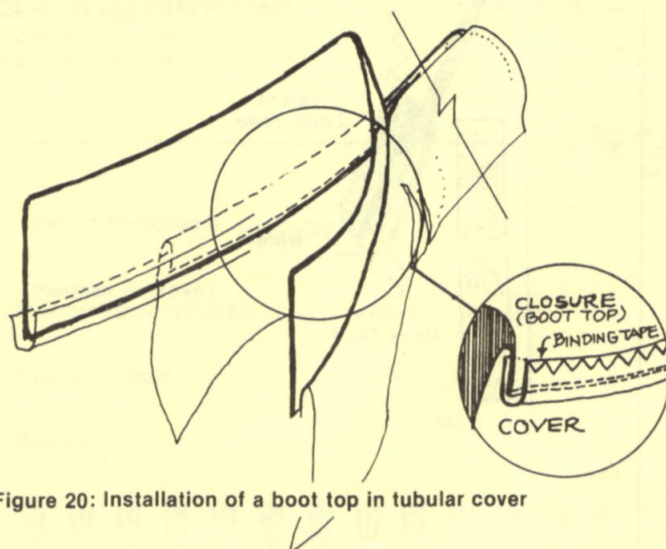
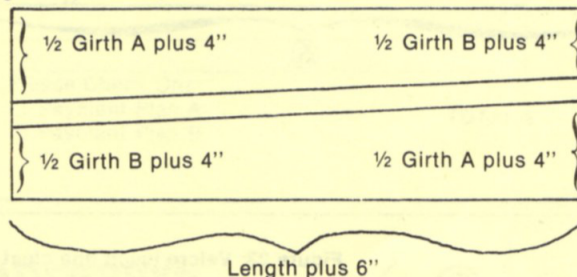
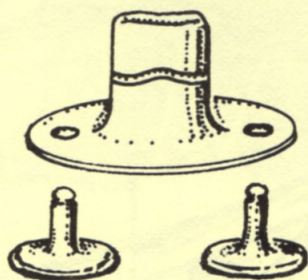


Figure 20: Installation of a boot top in tubular cover



# Tips worth passing on...

Figure 21: Button rivets for common sense fasteners



## Button Rivets and Common Sense Fasteners

In order to avoid the rather unfinished look created by the male cloth-to-cloth common sense fastener when used in a face-to-face closure, the Batses use the surface fastener and rivet it in place with two button fasteners from snap fastener sets (Figure 21).

The rivets are not easy to set since there is little room provided for the use of the tool, but it can be done with a little care.

## Measuring for Sail Covers

There follows a list of dimensions that Carole and Bruce use to enable their customers to measure their own traditional sail covers. Given these dimensions, it is possible to build a nicely fitting cover without ever visiting the boat.

1. Thickness of mast measured fore-and-aft.
2. Circumference of furled sail and boom measured 12 inches aft of mast.
3. Circumference of furled sail and boom measured 12 inches forward of the boom end.
4. Width of headboard at its top edge.
5. Height of furled sail on mast measured from bottom of the boom.
6. Length to be covered from forward side of mast to aft end of boom (Figure 22).
7. Type of topping lift:
  - a) end of boom
  - b) halyard strap under boom at center
  - c) both of the above.

Figure 22: Sailcover measurement points

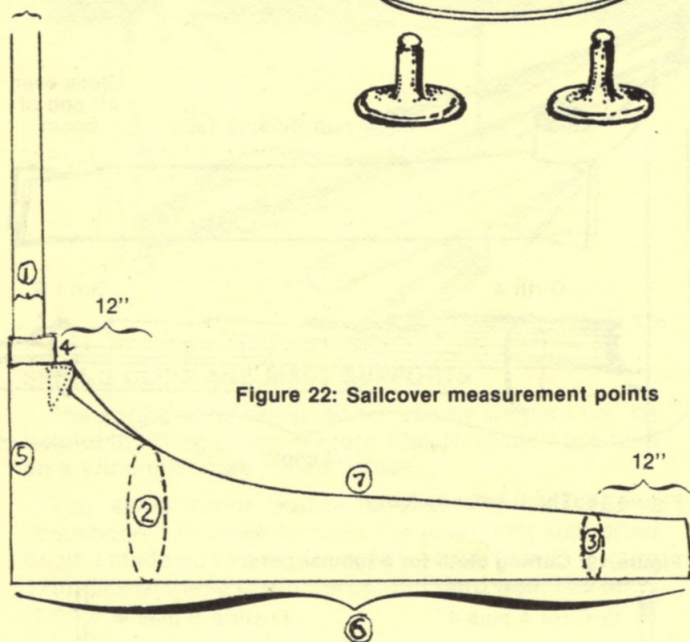
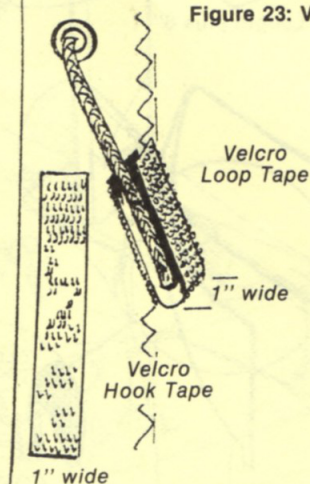


Figure 23: Velcro leech line cleat



## Velcro Leech Line Adjustment

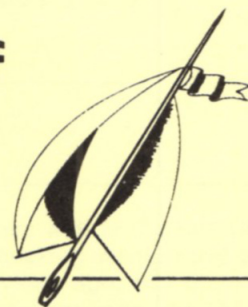
Craig MacKey passes on this leech line cleat idea that he used successfully. Simple sew a 1 x 9 inch long strip of the Velcro "hook" material to the leech below the leech line exit point. Double a 10-inch length of the one-inch wide "loop" tape back on itself and sew this over the end of the leech line (cut the line so that it ends just above the center of the hook strip) (see Figure 23).

This "cleat" is easily and quickly adjustable; it does not chafe the leech line; and it does not snag the shrouds on every tack.





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## LETTERS TO THE EDITOR

Letter received from **Diana Jordan** of Peacock Boat Yard in Wilmington, California: "Thank you for making the purchase of our [Sailwright] machine so easy for us. It is a very fine piece of equipment which will more than pay for itself in the future."

Letter from **Bill Fowler**, Executive Director of the National Home Study Council in Washington, D.C.: "Your student, Roger Miller of Fresno, California, who participated in the National Home Study Council Conference in San Diego, has completed two sets of sails for our O'Day Day Sailer. He first made a new main and jib, which we have used and like; and he has just finished a spinnaker, which is beautiful but which we haven't yet had the opportunity to try. You and Sailwright can be proud of Roger. He not only is a good sailmaker, but he is a nice man and a good businessman, too!"

Continued from page 20

By contrast, according to the ad, radially-headed sails "tend to be 'tubular' in the head, losing area and becoming trickier to trim properly and more difficult to get down."

I'm afraid that all of the above claims should be disputed. The orientation of panels does not "allow" any particular sail shape except to the extent that stretch in the fabric is controlled by that orientation. Shape generation is completely independent of panel orientation so long as seams are randomly distributed so the shape can be properly placed. There is, in other words, no intrinsic reason for radially-headed sails to be "tubular." Nor will horizontally-cut sails like the H.C.S. II be particularly flat in the leech or full in the luff because of their cut alone.

Now it may be easier for the sailmaker to build this shape because of the horizontal cut. Seams may be conveniently placed and cutting may therefore be minimal. Indeed, I think this is the case with the H.C.S. II. Broad-seaming can be introduced easily at both the luff and the leech. Moreover, it can be distributed carefully without major lofting problems. The same is true of vertical panels along the foot. They "allow" easy development of shape. All of this can account for the claim that is found near the end of the ad, almost as though it were an afterthought: "Our sail production system," it says, "keeps the price in line in spite of custom shaping of the sloped panels."

But the major thrust of the ad is to urge that this is a better sail. A new cut will not accomplish that unless it can be shown that it controls cloth stretch better. Unfor-

Roger represented all of us very well at the San Diego conference! A school of sailmaking would have been thought impossible just ten years ago. But thanks to students like Roger and to organizations like the National Home Study Council, the Sailwright Academy is thriving and, more important, setting standards of excellence that benefit the profession as a whole. Bill Fowler and his staff deserve a good deal of credit for our success — our thanks to them and to all our students as well! ■

tunately, this cut is certainly not a breakthrough in that respect. As a matter of fact, it was the limitations of the horizontal-cut which led to radial heads. Bias stretch along the leech of a horizontally-cut sail increases radically as the roach ("projected area") increases. This makes large roaches very difficult to control. The H.C.S. II must be made narrower in the head than a similar sail with a radial head.

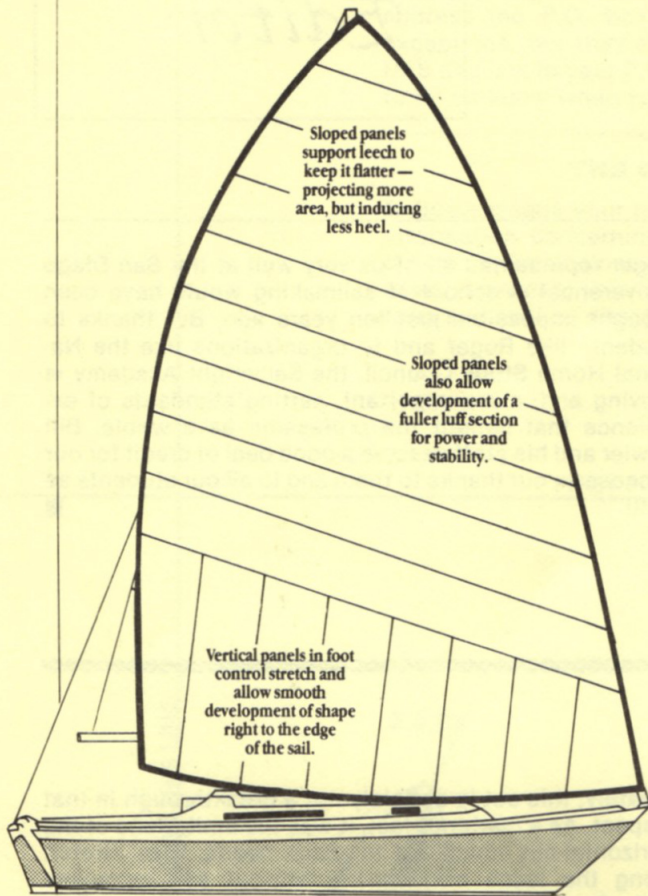
On the positive side, it should be noted that Horizon does not advertise this sail as a "poleless spinnaker" — it is, they say, a "cruising spinnaker." This latter term is much better. The fact is that all of this sail type are most effectively used with a pole even if there are some points of sail where a pole is not actually required. This particular sail will never really benefit from a pole at its tack since its luff must be stretched rather tightly. Even so, a pole to the clew will be most helpful when sailing downwind. ■

## The H.C.S. II from Horizon



## The Advertising Game

# The H.C.S. II from Horizon



The August 1982 issue of **SAIL** has an interesting ad for a new sail from the Horizon lofts. "It will," they claim, "make light air sailing fun, fast and beautiful." The sail can be placed in the generic category "Asymmetrical R/D/S/." R/D/S/ stands for "reacher/drifter/spinnaker." These sails combine the attributes of drifters and spinnakers. The asymmetrical variety is closer to drifters than spinnakers — they are hoisted rather firmly on the halyard so that the luff is almost straight and they are tacked from side to side rather than jibed.

The sail "type" is not new, but the ad does not claim that. It utilizes a rather unique (for this type of sail) cut. Instead of the normal radial head, this sail has the same crosscut design that is characteristic of standard drifters. The foot, however, is made up of vertical panels much like a blooper. As a consequence of this cut, the ad proclaims the following advantages:

1. Allows the development of a fuller luff section for increased power and stability.
2. Permits a flatter leech for greater projected area with less heel.
3. Controls foot stretch while permitting better shape development right to the edge of the sail.

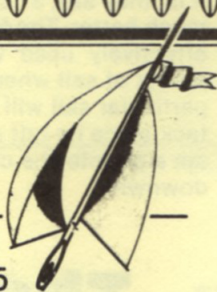
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