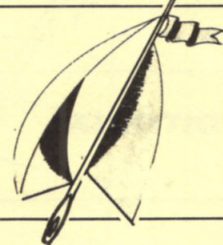


# FABRIC FOILS

## The Journal of Sailmaking



## From Landscaping To Sailmaking — The First Year!

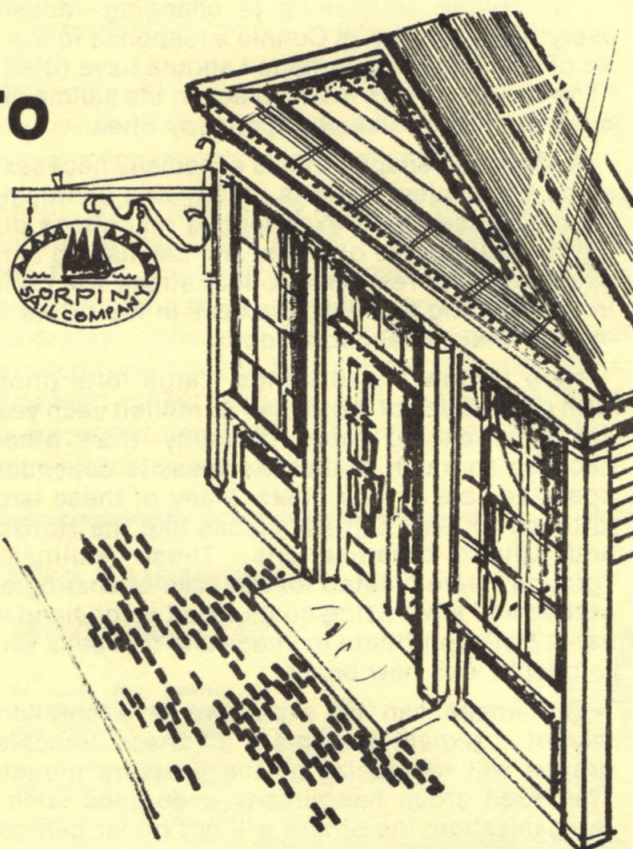
Barbara and Dick Orpin had built up a very successful landscaping business in Mashpee, Massachusetts. But they were tiring of that business. And, just as important, they were eager to get involved in something more related to their love of sailing. The Sailwright Academy provided a way for them to learn quickly the art of sailmaking and, at the same time, test whether they had an aptitude for it.

They worked their way through all four units in the Sailmaker's Series during the winter and early spring of 1982. They were excellent students, so I was pleased when they wrote to let me know how their new business was progressing. The lessons of their experience should be of use to all beginning sailmakers. For that reason, I reproduce their letter in full below:

**W**e opened our loft April 1, 1982, in the village of Osterville on Cape Cod. We picked Osterville because it is a busy sailing area. There is a harbor and two boat yards. Also, there are no close lofts to offer serious competition. The nearest is at Falmouth 14 miles away, with a second some 20 miles away in Harwich.

"We put an ad in the three local weekly papers. There is a daily paper but we decided that we would receive more exposure in the weeklies. We also erected a sign in front of our shop on Main Street. And, of course, there was a listing in the phone book—but we used the cheapest listing offered by the phone company. This was the extent of our advertising efforts.

"The first month started slowly. But, to our great surprise, we found ourselves burdened with all the business we could handle by the end of that month. We purchased a second sewing machine and hired our daughter to help out. Business remained brisk right up to the end of August. There was then a lull of just under a month. But that was all!



"Indeed, we have come to feel very much a needed part of this community. Customers constantly express their pleasure over the presence of a local loft. They tell us again and again how frustrating it is to have to take or send their sails to distant lofts. Very soon we came to realize that the vast majority of our customers were coming to us on the recommendation of their friends who had stumbled across our sign on Main Street. Very few had seen our ads or the phone book listing.

Continued on Page 6

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## EDITORIAL

### The Business of Sailmaking is Changing

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"Of course sailmaking is changing—doesn't everything!" That was Connie's response to the title of this editorial. Perhaps I should have titled it "The change that is taking place in the sailmaking business." But I like short, snappy titles.

A short and snappy title is especially necessary since the subject itself is cloudy and confusing. All businesses have experienced real stress during the last couple of years, and sailmaking is no exception. Our response to that stress will go far in determining business success in the future no matter what the economy does.

Here is how I read things. Large lofts (those with gross sales of more than \$1 million each year) are experiencing more difficulty than others because so much of their business is dependent upon the sale of new boats. Many of these large lofts are loosely knit franchises like the Horizon and Ulmer organizations. These sailmaker "groups" were created for the sake of sharing expertise and advertising costs. The two go hand-in-hand. Both contribute to image and that sells sails to people with new boats.

But image can be expensive in a shrinking market. I expect that many of these franchise groups will reorganize as the pressure mounts. The Hood group has already undergone such a reorganization; the others will not be far behind.

Although the new sail market is shrinking, the repair and replacement market is booming. The problem is that this market is not reached by the ads that large lofts can place in the sailing magazines. That market tends to respond to local and word-of-mouth advertising. Image is not important and, indeed, it can prove a serious problem if the customer is price conscious. True or not, lofts with an "image" are perceived as more expensive than those not so well known.

So what is the lesson to be learned here? The future belongs to small and medium sized lofts that can hold their fixed expenses to a minimum. In spite of all that is said about spending money on advertising while things are bad so that a firm basis can be built for the eventual turn-around, sailmakers should be cautious. There is reason to doubt that new boat sales will ever reach the level that characterized the last ten years. People generally recognize that the automobile market has been fundamentally changed in recent years—it is only a matter of time before they see that the same thing has happened to the sailboat market.

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## FABRIC FOILS

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January 1983

Volume I, Number 2

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#### IN THE NEXT ISSUE

Sailcloth Finishes

Computer-Aided Sail Design

Leech Cut Sails

Pricing Sails and Repair Work

Industrial Machines for Sailmaking



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The future, as I read it, will rest with small lofts which cater to a primarily local market which is highly diverse. Some medium sized lofts which focus primarily on inexpensive replacement sails will also be quite successful. A few large lofts with expensive image budgets will also survive, but it will require careful management.

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# choosing proper cloth

by Bob Bainbridge  
of Howe and Bainbridge

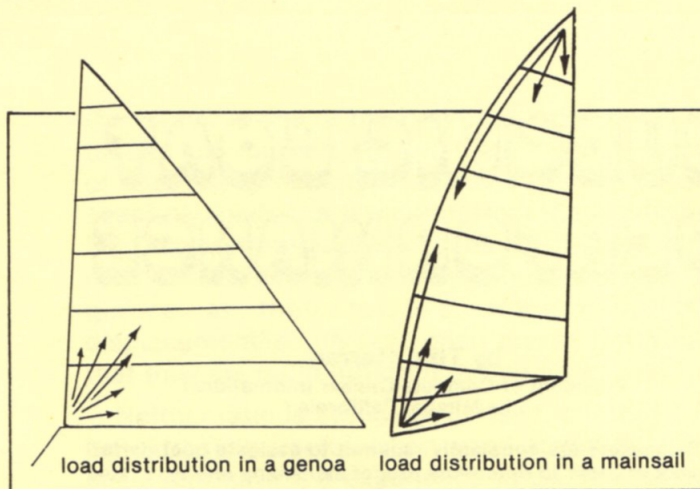
In the last few years, Bainbridge has assembled the biggest, most capable group of sailcloth engineers in the world, and the research and development which has resulted in a short period of time has been phenomenal. We have had more new products in a three-year period than in the previous ten years. Considering the number of fabrics now available, it is time to offer a guide to their selection.

All Bainbridge Dacron, or "polyester," sailcloth can be placed in one of five categories or "lines." Each line will include cloth with similar properties and exactly proportionate constructions. But within each line, several finishes or finishing techniques are available which fine-tunes the cloth for a particular application. All that is necessary to choose the proper sailcloth is an understanding of the needed cloth construction or "line" and the most appropriate finish for its intended use. The purpose of this article is to explain differences in cloth construction — the reasons for the five lines. In the next issue, we will take up finishing processes.

Three of the five lines can be ranked in terms of their fill strength. The "high aspect mainsail line" offers the greatest fill strength of any woven Dacron material for its weight. The "high aspect genoa / low aspect main" line walks the center line offering excellent fill strength while developing very good bias stretch resistance. The "genoa" line offers the best bias strength while sacrificing some fill strength in doing so—this fabric has a very balanced stretch distribution.

The other two lines are "general purpose" and "Bermuda." These lines are intended as "production" fabrics. The emphasis here is upon economy, consistency, and high tear-strength.

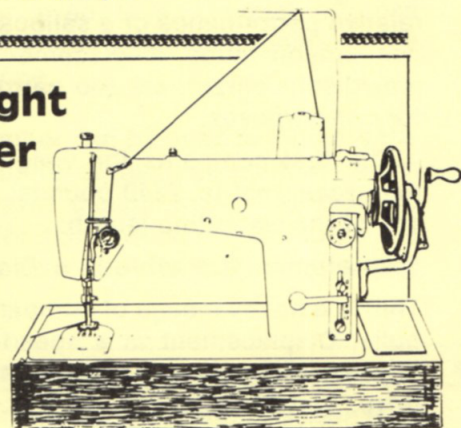
There is good reason for offering each of the distinct lines. The loads in a sail will vary a good deal depending upon its use and its aspect ratio. Consider two extremes: a low aspect ratio genoa and a high aspect ratio mainsail. The latter has the primary load in the leech direction with only modest loading through the mid-section of the sail (in the bias direction across the cloth). In a low aspect ratio genoa, on the other hand, the



sheet angle practically bisects the clew. This results in significant loads on the bias as well as the leech. The cloth requirements for these two sails are, as a result of these varying loads, considerably different. The genoa requires great stretch resistance in both fill and bias directions. The high aspect ratio mainsail, on the other hand, requires outstanding fill strength and not as high bias strength. Continued on Page 4

## 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 . . . . . \$895.00

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.



# JUDGING BOAT PERFORMANCE

by Tom Herren

President of Computa-Cruiser International  
La Mirada, California

Sailmakers are constantly required to evaluate boat performance in order to determine proper sail shape and type. This evaluation is normally just a simple guess based upon years of experience. For those without that experience and for those who want to be more consistent in their evaluation of boat performance, Tom Herren of Computa-Cruiser has developed a "basic design index." This is a simple rating system that measures relative performance better than many more complex ones. It is derived quite simply from two common measurement ratios.

Those of us who buy boats and build sails for them have been saddled with boat comparison techniques developed by boat designers. We need a single number that can indicate the likely relative performance of a sailboat. The traditional comparison ratios, displacement/length and sail area/displacement, are too narrow and exclusive for our purposes.

The first compares the weight of the boat (in long tons, that is, 2240 pounds) with the cube of 1% of the water line length:

$\text{Displacement}/(\text{Length}/100)^3 = \text{Displacement Ratio}$

This is a handy means of comparing any two boat hulls. Displacement is a speed-reducing factor. That is, as boats get heavier they are harder to drive. Waterline length, on the other hand, is a speed-producing factor. The longer the waterline, the lower the height of self-generated waves. This makes it easier to drive the boat to a given speed. The displacement ratio relates these two variables. A hull with a high displacement ratio will be slower than one with a lower ratio if all other things are equal. The list of boats below with their displacement/length ratios should help in understanding this index:

Boat Name	Disp/Length Ratio
Mariner 40 .....	431
Westsail 32 .....	418
Cape Dory 30 .....	375
Downeaster 38 .....	357
Flicka 20 .....	335
Catalina 30 .....	291
Islander 36 .....	266
Cal 40 .....	242
Ericson 35 .....	240
Petersen 44 .....	232
Newport 30 .....	228
Tartan 10 .....	152
Santa Cruz 27 .....	97
Venture 25 .....	86

It is helpful to know where a hull stands in relation to another, but this is not sufficient in itself for sailmakers. The reason is that sail rigs and areas will vary a good deal. And boat performance is just as much influenced by these factors as it is by displacement and length. Boats cannot be compared in terms of their hulls alone.

For this reason, we often turn to another ratio—the sail area to displacement ratio. This ratio is the result of dividing the "rated" sail area (that of the basic mainsail triangle and of the foretriangle) by the displacement of the boat (represented as the weight of the boat in pounds divided by the weight of a cubic foot of water—64.05 lbs.—raised to the power of  $2/3$ ):

$$\frac{\text{Rated Sail Area}}{(\text{Boat weight}/64.05)^{2/3}} = \text{Sail area to displacement ratio}$$

In automotive terms, this ratio would be the power to weight ratio. Most sailboat designers suggest that this ratio be in the range of 15.5 to 17



Continued from Page 3

Some interesting things become apparent from examining the theoretical load distributions in sails. One is that high aspect ratio genoas and low aspect ratio mainsails place very similar demands on the sail cloth. Both require very good fill strength as well as excellent bias control. It was through examining these general types of load diagrams that the first three lines of Bainbridge sailcloth were conceived.

One, the genoa line, provides maximum bias strength with relatively high fill stretch, that is, as close as possible to equal stretch in all directions. The next line, mainsail, has outstanding fill strength combined with slightly higher bias stretch. And the third, high aspect genoa / low aspect main, has a fill strength almost as good as mainsail and a bias almost as good as genoa cloth.

It is, quite simply, impossible to have minimum elongation characteristics in both the fill and the bias directions simultaneously in a woven material. Let's examine this assertion.



for general cruising. Racing boats can go into the higher 20's or even higher. Heavy displacement cruisers tend to fall under 15 on this continuum.

Here are some examples to provide a "feel" for this ratio:

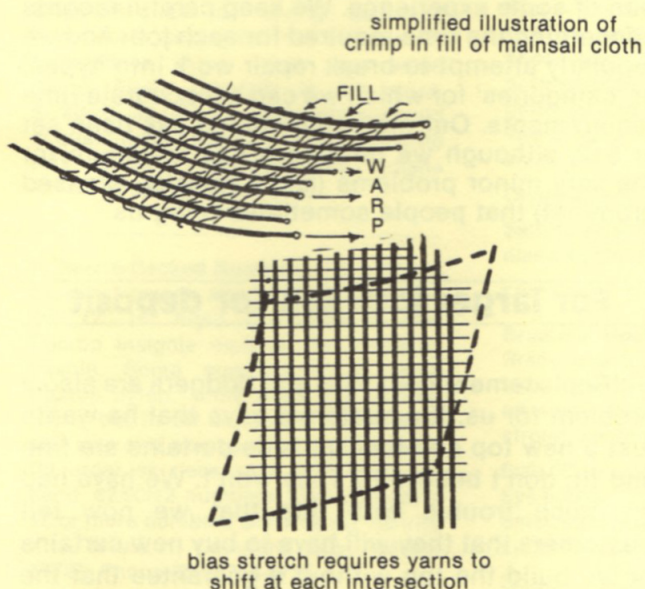
Boat	SA/Disp
Flicka 20 .....	14.68
Catalina 30 .....	15.00
Cape Dory 30 .....	15.07
Mariner 40 .....	15.78
Islander 36 .....	16.29
Downeaster 38 .....	16.54
Westsail 32 .....	16.64
Ericson 35 .....	16.64
Petersen 44 .....	16.76
Newport 30 .....	16.77
Tartan 10 .....	22.92
Venture 25 .....	27.01
Santa Cruz 27 .....	30.47

Note that the Westsail 32 and the Ericson 35 have identical sail area/displacement ratios. Yet

the former is one of the first production boats intended just for cruising. And the Ericson 35 is one of the few production sailboats that has successfully made the transition from the old Cruising Club of America rule into the IOR rule era. This ratio makes them look very similar in type. A glance at their relative position in the displacement/length ratio chart makes it obvious that they are quite different in hull form.

Neither ratio is sufficient in itself, but they can be extremely useful when used together. Boat designers have the experience to do this almost automatically. Those of us, however, who work infrequently with such ratios need a single index that summarizes both of them. Such an index can be provided by dividing the displacement/length ratio by the sail area/displacement ratio. This calculation performed for a few boats reveals a definite trend. Heavy displacement cruisers have numbers from the middle 20's to the high 30's. Light displacement racers (and most trailerables) tend to have numbers from about the middle teens down to one or even less. General purpose cruisers fall right where one would expect—in the middle of this range.

This single number can be used to indicate the performance potential of the boat. For that reason I call it the "basic design index" or BDI. To develop a feel for the new index, compare the sailboats listed below in order according to their BDI:



There are many variables in designing a cloth weave, but the four major ones are the weight of the warp yarn, the weight of the fill yarn, the count of the warp, and the count of the fill. These four variables control the distribution of crimp in the warp and the fill as well as the weight of the fabric and its stretch characteristics. The twist in the yarn, the type of loom used, and the techniques used in weaving are also very important, but the four variables above are primary.

Mainsail cloth will have a heavy fill yarn relative to the warp yarns. It is considered an "unbalanced" construction. The relative size of the fill

Boat Name	BDI	Boat Name	BDI	Boat Name	BDI
Rafiki 35 .....	38	Pearson 35 .....	23	Peterson 44 .....	14
Fantasia 35 .....	37	Freeport 36 .....	23	Hunter 37 .....	14
Westsail 28 .....	34	Westsail 42 .....	22	Cal 40 .....	13
Downeaster 32 .....	34	O'Day 30 .....	21	San Juan 34 .....	12
Gulf 32 .....	33	Crealock 37 .....	20	Ericson 33 .....	11
Mariner 40 .....	27	Ericson 35 .....	18	New York 36 .....	8
Cape Dory 30 .....	26	Tayana 37 .....	17	Tartan 10 .....	7
Niagara 35 .....	24	C&C 34 .....	16	Santa Cruz 50 .....	2
Watkins 36 .....	24	O'Day 25 .....	15	Hobie 33 .....	2

In summary, one-design and ultra light displacement boat BDI's are usually eight or less. These boats should have relatively flat sails with a good deal of curvature forward in the foil. The aspect ratio of the sails for these boats should be very high. At the other extreme are offshore and long distance cruising boats with BDI's of more than 20. Here full sails with aft draft and low aspect ratio are required. Using this index, it will be possible to build a meaningful record of sail designs. Research on sails for one boat can easily be applied to those for other boats. All sail design must be built upon the lessons of experience. But this easy-to-use index will make limited experience go much farther. ■

Continued on Page 19



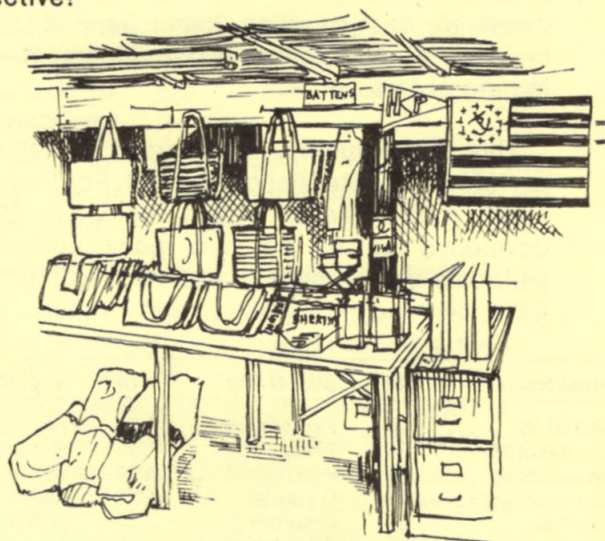
## From Landscaping to Sailmaking

Continued from Page 1

Sailors form such a closely-knit community that it may not be necessary to spend very much money at all in order to reach them—at least not if there is little local competition.

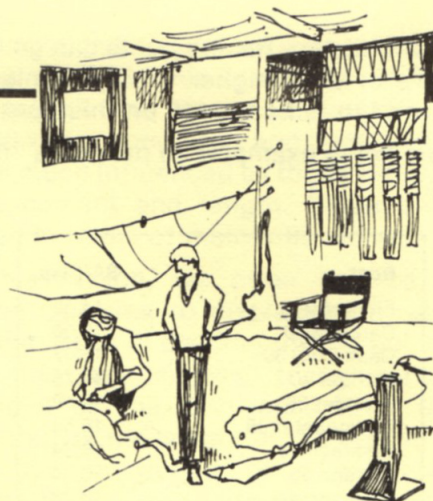
### How much advertising is enough?

"Obviously some advertising is necessary. But it is easy to spend too much money here. Some of our early ads offered 15% or 20% discounts. There was very little response. Next year we will settle on simple 2 by 4 or 1 by 2 inch ads with no more copy than necessary—we just want to present our name and address to let people know where we are. Although word-of-mouth will be our primary reliance, we will supplement that with a couple of trips around the harbor in a dinghy dropping off brochures in zip-lock bags. We did this a couple of times this year and found it fun as well as effective!



### There is always a variety of work

"One thing that we learned very quickly about a small loft, there is always a great variety of work coming through the door. In the seven months that we have been in business, we have made boat covers, sail covers, boat tops, dodgers, flags, cushions, lee cloths, hatch covers, bags, sun awnings, automobile covers, pick-up truck bed covers, pool covers, and tennis court screens as well as sails. We have also been confronted with just about every possible repair problem: frayed or worn luff reinforcement, torn out grommets and headboards, torn sails (and beach chairs), ripped batten pockets, etc. And, finally, there has been a continuous stream of 'upgrade' work like installation of continuous support tapes, zippers, windows and such.



"There have been some aspects of business that our training at the Academy did not prepare us for. Our most difficult task was estimating repair prices. For finished sails we had the guidance of the Sailwright Pricing System, but repairs simply defy any 'system.' Most customers will want at least a ball park price on any job. We decided to set a \$20 hourly rate. But we found our time estimates completely unreliable. The only solution to this problem has been the accumulation of some experience. We keep careful records concerning the time required for each job. And we regularly attempt to break repair work into 'types' or 'categories' for which we can set accurate time requirements. Our minimum charge has been set at \$12, although we do ignore this minimum for the very minor problems (like a missing pressed grommet) that people sometimes bring us.

### For larger jobs ask for deposit

"Replacement boat tops and dodgers are also a problem for us. If a customer says that he wants just a new top and that the side curtains are fine and fit, don't believe it! They won't. We have had so much trouble with this that we now tell customers that they will have to buy new curtains or we build the top without a guarantee that the old curtains will fit. Indeed, 'fit' is a serious problem with all boat tops and dodgers. We have learned to draw complete pictures of the finished product in front of the customer complete with as many dimensions as possible. All time estimates should include at least three trips to the boat for measurements and fittings. Frankly, we don't enjoy making these items and hope in the future that our sail business will be strong enough to eliminate them.

Continued on Page 19





## CONNIE'S CORNER



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.  
3/8-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.

**Brummel Hooks, Discontinued Stock.**

Brand new brummel hooks. There is no better way to secure sheets and halyards on small boats! These hooks are fast, strong, secure, and very light.

Size 00 — working strength of 500 lbs.  
Eye hooks ..... \$2.00 ea.  
Small bail swivel hooks ..... 5.00 ea.  
Large bail swivel hooks ..... 7.00 ea.

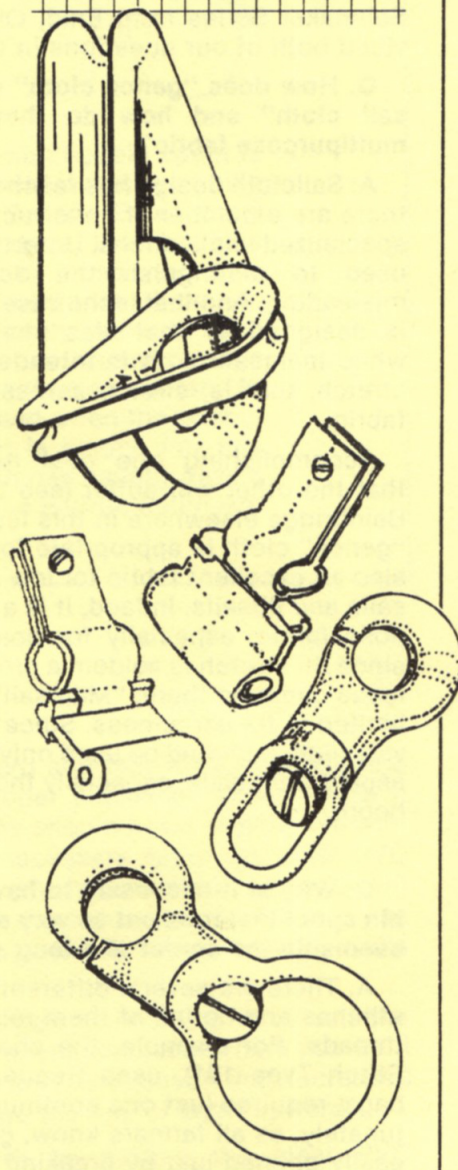
Size 0 — working strength of 1000 lbs.  
Eye hooks ..... \$3.00 ea.  
Small bail swivel hooks ..... 6.70 ea.  
Large bail swivel hooks ..... 7.50 ea.

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

**EZ Splice Kits.** Tools and instructions for splicing 5/16-inch braid-on-braid or 1/4-inch hollow braid line. Discontinued item. \$1.45 each, sent postpaid. Sailrite Kits, Route 1, Columbia City, Indiana 46725. Phone (219) 244-6715.

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.

# Fllove'em out!



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





??????????????????!

General interest questions from subscribers will be answered in print here. We cannot promise to reply to all questions personally—but we will try. Send your questions with sketches or photos to: Jim Grant, Editor / Fabric Foils / Route 1 / Columbia City, Indiana 46725.

Richard Walsh, a student in Unit I of the Sailmaker Series from Enid, Oklahoma, has provided both of our questions in this issue.

**Q. How does “genoa cloth” differ from “main-sail cloth” and how do these differ from a multipurpose fabric?**

**A:** Sailcloth design has reached the point where there are a number of constructions available for specialized applications. Unfortunately the names used to distinguish the designs are often misleading. And that is the case here. Genoa cloth is designed so that bias stretch is minimized while mainsail cloth is intended to minimize fill stretch, that is, stretch across the width of the fabric.

Accomplishing one goal necessarily means that the other will suffer (see the article by Bob Bainbridge elsewhere in this issue). It is true that “genoa” cloth is appropriate for genoas, but it is also an excellent fabric for low aspect ratio mainsails and jibsails. Indeed, it is a good general purpose fabric, especially for boats under 35 feet, since fill stretch is seldom a problem at the stress loads common there. “Mainsail” cloth is far more limited in its usefulness. Since its bias stretch is very high, it should be used only in large, very high aspect ratio sails, especially those sheeted with a boom.

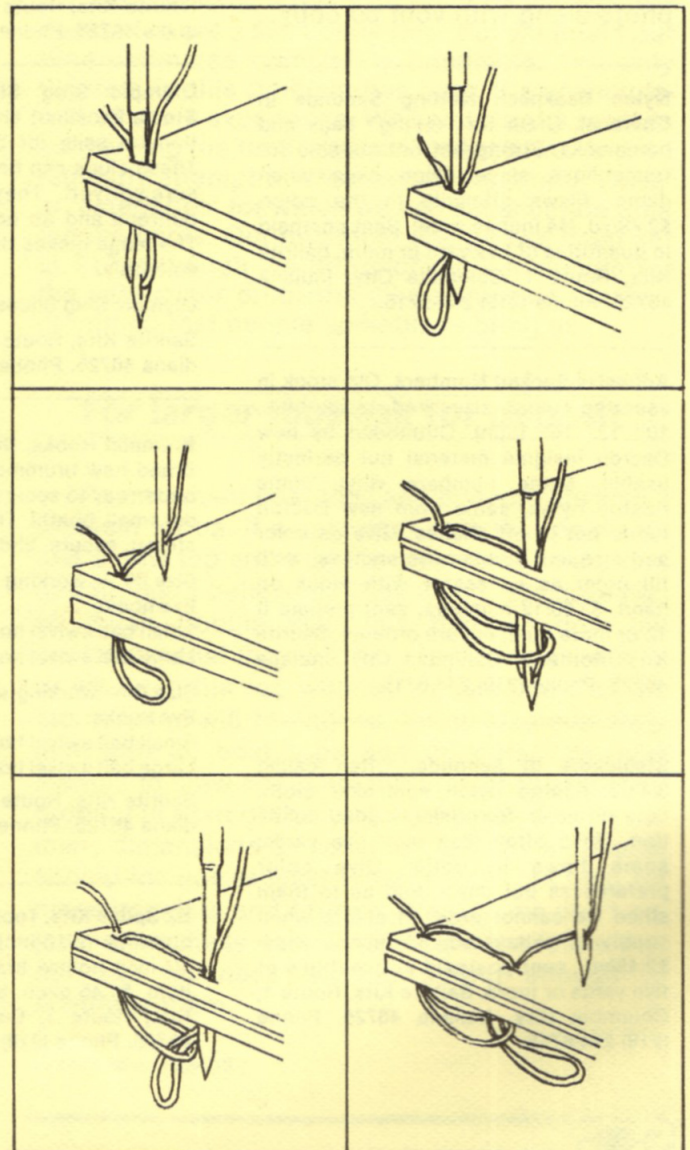
**Q: Why is it necessary to have a separate bobbin spool that runs out so very soon and always, it seems, in the center of a long seam?**

**A.** There are several different types of machine stitches and not all of them require two separate threads. For example, the chain stitch (Federal Stitch Type 101), used frequently to sew grain bags, requires just one continuous thread. Unfortunately, as all farmers know, grain bags are very easily opened just by breaking the thread at one point and pulling — the continuous thread will pull out entirely.

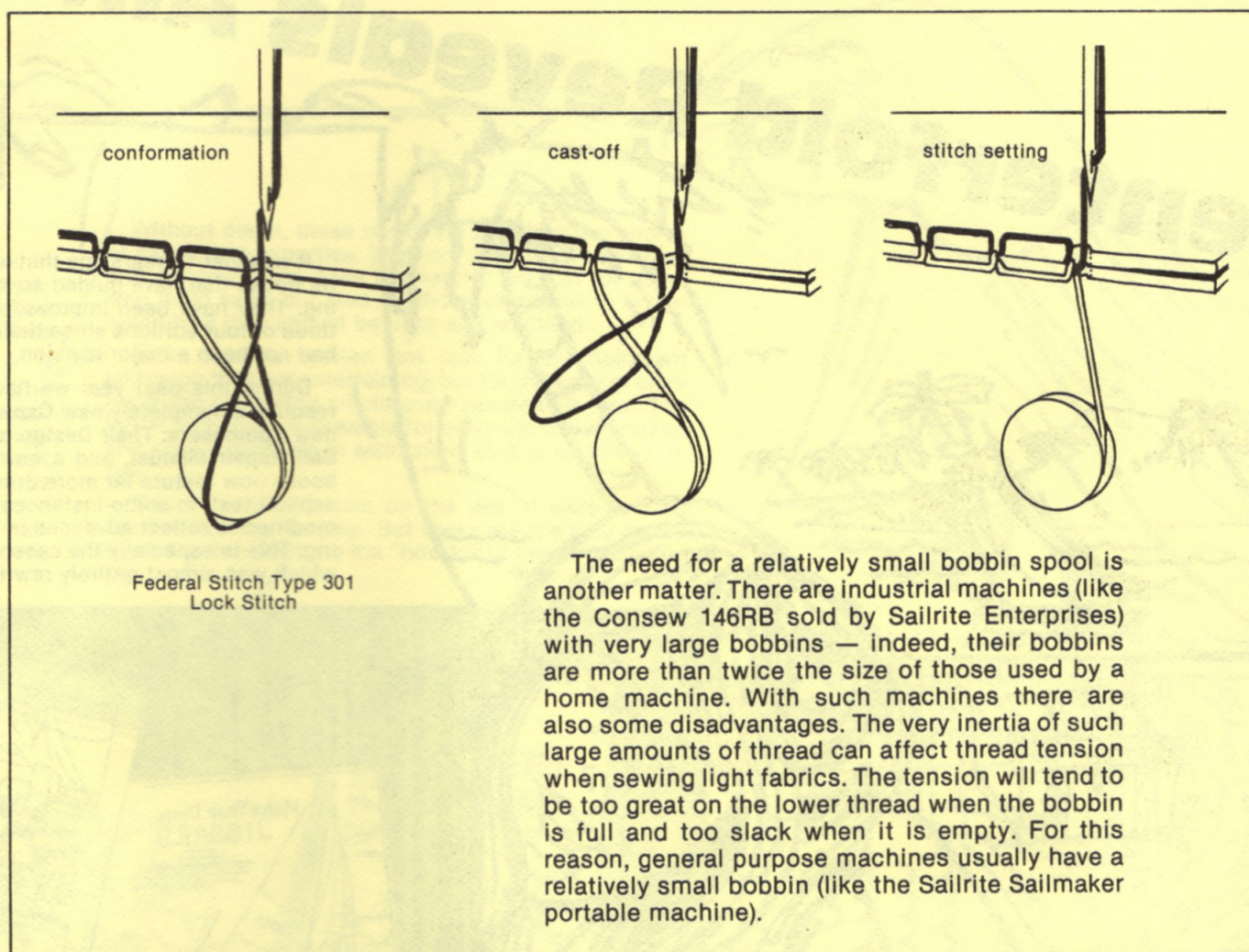
Sails are sewn with a “lock stitch” (F.S.T. 301) which avoids this problem, but it does require two separate threads. The illustrations below should make evident the difference between the chain stitch and the lock stitch.

## Ask Jim Grant

Federal Stitch Type 101  
Chain Stitch

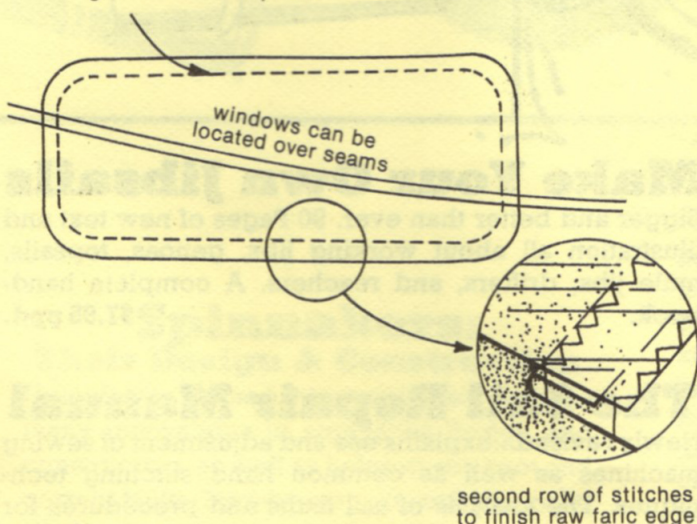






## INSTALLATION OF A SAIL WINDOW

cut cloth on dashed lines after sewing the window in place



There are no hard and fast rules regarding the proper size or proper placement of windows in sails. Certainly one should avoid making the window larger than necessary since the clear PVC material is relatively heavy. Also, since it will stretch somewhat more than Dacron fabric, try to keep the window at least six inches from the sail's edges.

The best procedure in deciding is to sail the boat and have someone mark just where you want to place the window. Remember that increased heeling will change the line of sight upward.

Start your work by cutting the clear PVC material to whatever shape you desire. Do not cut an opening in the sail until the window has been sewn in place. Put strips of #465 adhesive transfer tape all around the edges of the PVC. Smooth it in place over the sail. Use staples at the four corners of the window, if possible, to make sure that it will not break free when you start sewing.

Continued on Page 15

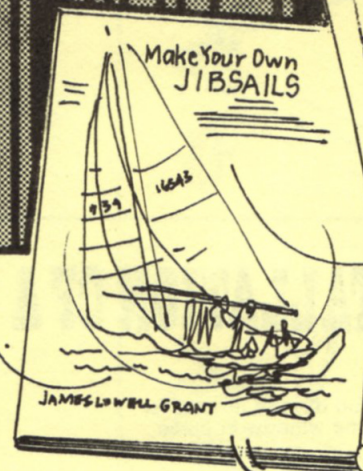


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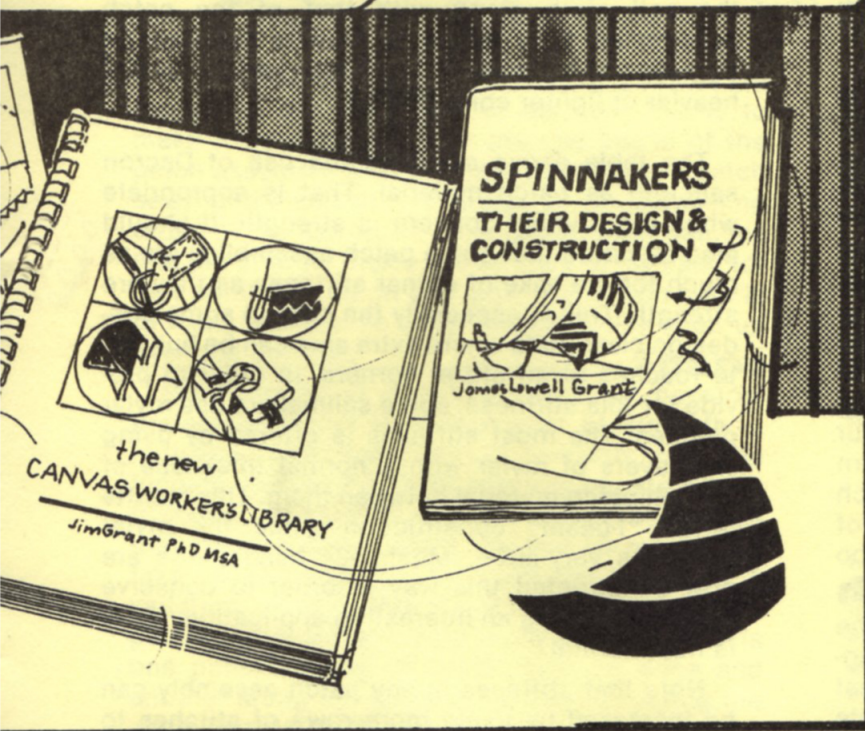
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Without doubt, these books are the definitive source of sailmaking expertise. They are used by professional and amateur alike. They are helpful not just for those who build sails, but also for those who want to understand how they should be used and modified.

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# Corner patch size and shape

Some of the most frequent questions we are asked concern corner patches. How many layers should there be? How large should they be? What fabric is appropriate? Why are they all placed on one side of the sail? What shape should they have? How should they be sewn in place?

This is a good place to answer these questions, at least to the extent that that is possible. One of the reasons for the questions in the first place could be an apparent lack of agreement among sailmakers with regard to patches. You will see similar sails with very different patch assemblies. Some sailmakers use very unusual shapes; some use very heavy fabric; some use many layers of lightweight cloth; some sew the patches in place with many stitches; and some use very few. There can be reasons given for all of these practices, but, even so, there may be some that serve your needs better than others. Let's examine corner patch practices.

## Purpose

The purpose for patches at the corners of a sail is to increase strength where stress is focused over a very narrow section of cloth. The ideal is to increase the strength of the fabric in the corners but only to the point where the patch assembly fails just before the single layer of fabric just inside its edge. This is obviously not easily achieved. Indeed, normal use will cause these portions of the sail to weaken, and there is no way to predict the relative rates of that decline. At least there is a reference point for our efforts. If our sails are coming back with the corner rings torn out, it is time to increase the strength of patch assemblies. If the sails are tearing just inside of the patches, then the patch assemblies are too well made.

## Strength

There are two schools of thought regarding the proper way to build up corner strength. One suggests the use of very heavy Dacron fabric in just two or three thicknesses. This fabric is available under the name "boiler plate," and its hand justifies the name! There are also many sailmakers who use patch fabric similar in weight and hand to the cloth in the sail. They reason that strength will be increased with more layers or plies of cloth even though the total weight may be less than that of two layers of boiler plate.

We recommend the latter approach in our sailmaking manuals primarily because we can send a single bolt of cloth for the sail—odd pieces cut from the basic sail triangle can then be added to the cloth allowance to reduce the "safety factor" that we must build into each kit. The exception to this rule of ours is that sails built of nylon should have Dacron patches. Nylon is so light and

flimsy that the number of patches required to build up a good base for corner grommets require too much time and effort.

This brings up a very good question. What is the "proper" thickness of material for any given sail? The table below will provide some guidance on this matter.

TOTAL WEIGHT OF CORNER ASSEMBLY  
SAIL AREA

SAIL TYPE	Under 100 ft <sup>2</sup>	100-200 ft <sup>2</sup>	200-300 ft <sup>2</sup>	Over 300 ft <sup>2</sup>
Spinnakers	10-12 oz.	12-16 oz.	16-24 oz.	24-30 oz.
Mainsails	15-20 oz.	20-30 oz.	30-45 oz.	
Jibsails	15-20 oz.	20-30 oz.	30-45 oz.	
Genoas	12-18 oz.	18-25 oz.	25-30 oz.	30-40 oz.
Drifters	10-12 oz.	12-16 oz.	16-24 oz.	24-30 oz.
Stormsails	25-35 oz.	35-45 oz.		

Note that the table above includes the weight of the sail cloth along with that of the patch assemblies. It is meant to provide guidance in selection only. There will be cases which warrant heavier or lighter construction.

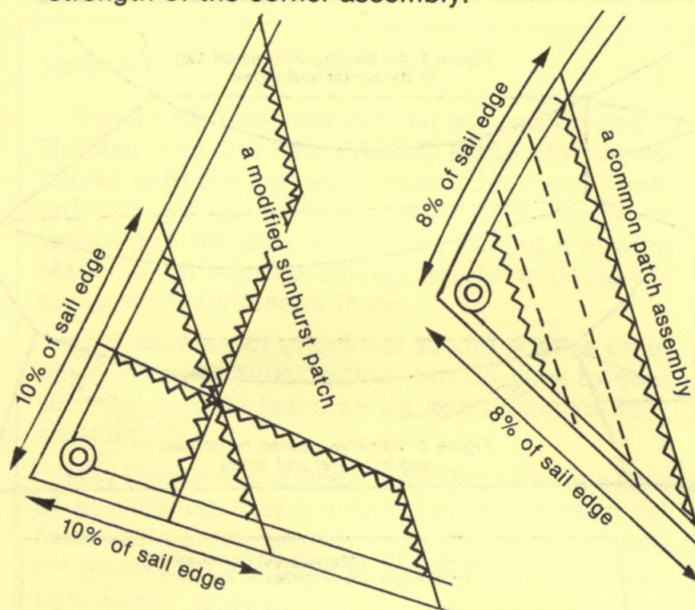
The table above assumes the use of Dacron sailcloth as patch material. That is appropriate when the primary concern is strength. It should also be noted that some patch assemblies are as much for the sake of corner stiffness as they are strength. This is especially the case in some one-design class sails where extra area can be built into roaches given stiffer corners. In order to provide for this stiffness, some sailmakers use mylar patches. The most stiffness is offered by using two layers of mylar with a normal thickness of Dacron patch material between them. This results in an "I-beam" construction since the mylar stretches very little. Most J-24 headboards are now constructed this way in order to conserve weight aloft. It is an interesting application, but it is not "normal."

Note that stiffness in any patch assembly can be increased by using more rows of stitches to hold it in place. Locking the layers together more closely makes them more resistant to bending. Unfortunately there is a tradeoff with strength here. The more independent the layers are, the more likely each one will stretch a bit and share the load with its neighbor. In the days of cotton sails it was normal to sew patches to each other one at a time, starting with the smallest and then to the sail itself with one row of stitches. This distributed stress gradually from the several layered assembly down to the single thickness of the sail.

The inherent strength of Dacron has practically eliminated this practice. Stitches are now usually placed at the inside edge of each patch layer and the entire assembly is sewn to the sail with each



stitch. This practice is quite satisfactory, but be aware that increased stitches do reduce the strength of the corner assembly.



Regardless of the material used, all patches are placed on the same side of the sail. This is to make it possible to cover the raw edges of the patch assembly with the hem of the sail. A patch sewn to the sail with its edges simply paralleling those of the sail looks quite crude. Even patches that are entirely inside the sail like those used for reef points are all on one side; the reason here is to make it easier to keep them properly lined up over one another.

### Shape

Patch shape is mainly a matter of personal preference. From the standpoint of strength, a radiused inner edge would probably rate the highest. But the fastest patches to cut are simple triangles. "Sunburst" patches are fine so long as they are made large enough so that the rays do not take enough stress to cause wrinkles in the sail. A variation on the sunburst shape is to cut the patches so that they do not simply overlap. That is one patch can be oriented along on edge and another along the foot with a third bisecting the angle formed by these two.

### Size

Now to the final question: what size should patches be? Again, there are no hard and fast rules, but the table below will provide a perfectly appropriate size.

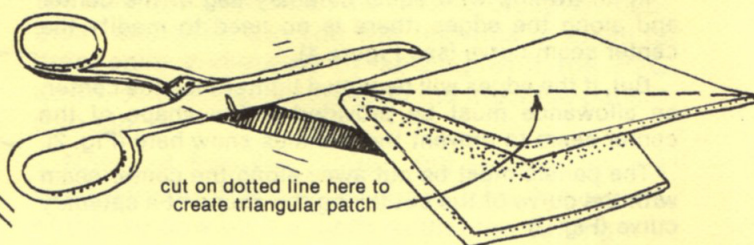
LARGEST PATCH SIZE

Spinnakers	8%-12% of sail edge—minimum 14 inches
Jibsails	6%-10% of sail edge—minimum 12 inches
Mainsails	6%-10% of sail edge—minimum 12 inches
Staysails	5%- 8% of sail edge—minimum 10 inches
Drifters	5%- 8% of sail edge—minimum 10 inches
Stormsails	10%-14% of sail edge—minimum 15 inches

One note on patches at the head of jibsails: I like to make the lower edge of a single triangular patch parallel the seams in the sail. In this case

the length of the patch along the luff will be longer than prescribed above. The leech edges and the slant of the seams will determine that length.

Reef patches are usually cut as diamonds. Two or three layers of cloth are normal here. It is best to increase the size of the diamonds gradually with the larger patches on top. The largest of these patches are generally from two to three inches wide and from three to five inches high. Reef patches can be quickly and accurately cut by folding the fabric in quarters and making one diagonal cut across the folded material. See the illustration below.



Patches are not a sensitive matter. Generally it is possible to simply cut them so that they "look good" to you. Even so, it is reassuring to have some guidelines at hand. This piece is meant to provide those guidelines.

## TIPS

worth passing on...

Clay Proctor, new owner of Sun Coast Sails in Florida, has just completed Units I, II, III, and IV of the Sailmaker's Series in residence. His experience as an upholsterer has provided some valuable tips that we sailmakers can use.

■1. When sewing large panel assemblies, put all of the material at the back side of the machine. Starting at the end of the seam, pull the material through the machine backwards until you are at the point where the stitch can be begun. You will find that it is much easier to feed the fabric having proceeded in this fashion. This tip, of course, does not apply to panel assemblies that can be neatly rolled and moved under the machine easily. It is for the soft, unmanageable fabrics like that used for spinnakers and awnings and covers.

■2. Circles for bag bottoms can be easily formed if holes are drilled at one inch intervals in a wooden yardstick. An awl can be put through one hole and into the floor, then a pencil can be inserted at an appropriate hole along the yardstick and used, as a compass would, to create a very neat circle.

■3. Mylar patterns can be very helpful for sails that are made frequently or for number patterns. Drafting mylar available at most art supply stores is perfectly suited to this work — it can be drawn upon and easily cut, yet it will hold its shape extremely well. The material is available in rolls from 30 to 54 inches wide.



# Catenary Curves

There are many times that sailmakers need to calculate a catenary curve. That is the curve that continuously supported line or cloth edge will take when stressed evenly all along its length. Thus, it is the curve that a straight leech will take when the sail is set.

It is the sag that will take place in a forestay. It is the hollow that will form along the top of an awning stretched fore and aft over the cockpit. If these curves are not properly accounted for, the sagging fabric will surely affect the finished shape of the sail or cover.

In an awning with equal catenary sag at the center and along the edges, there is no need to modify the center seam curve (see Figure 1).

But, if the edges will be pulled tighter than the center, an allowance must be provided in the shape of the center seam to prevent the wrinkles show here (Fig. 2).

The panels must be cut away along the center seam with the curve of the cut taking the shape of a catenary curve (Fig. 3).

In the same way, a genoa leech or luff that is not hollowed properly will sag into the center of the sail in such a way as to either increase or decrease sail draft.

The amount of sag to be expected in any given instance will depend upon a number of factors which are difficult to predict with certainty. But there are rules of thumb which can be used. These are set forth in all the instruction manuals published by Sailrite Kits. What I want to discuss here is the actual shape of the curve—how that can be determined once maximum depth is known.

The problem is to produce a table of offsets from a catenary curve to a straight line parallel to the x-axis in a Cartesian coordinate system such that the offset at the y-axis is a given percentage of the span between the two points where the line intersects the curve.

The formula is:

$$d = (y_1 - \text{CosH}[x_1 - (D/S)]) \times S$$

where  $d$  = the amount of sag at a given point  
 $y_1, x_1$  = Cartesian coordinate points defining one end of the line

$D$  = the distance from the end of the luff line to the sag point in question

$H$  = maximum sag or hollow at center expressed as a percentage of total length ( $L$ )

$x_1 = H/25$

$y_1 = \text{CosH}(x_1)$

$S = \frac{(L/2)}{x_1}$

$$\text{CosH (Hyperbolic Cosine)}(x) = \frac{\text{Exp}(x) + \text{Exp}(-x)}{2}$$

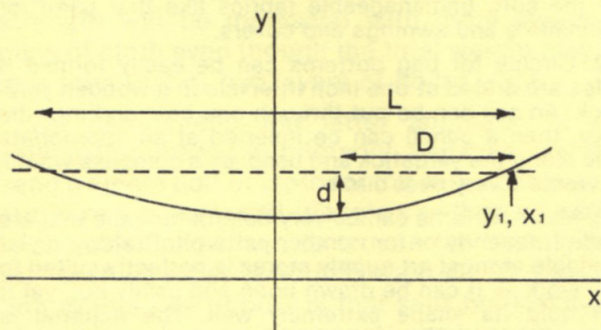


Figure 1: An awning with equal sag in its center and sides

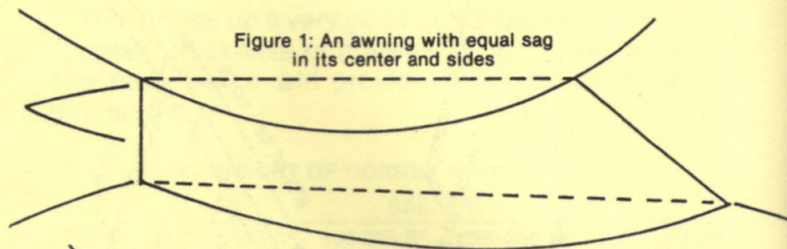


Figure 2: Wrinkles caused by uneven sag in center and sides

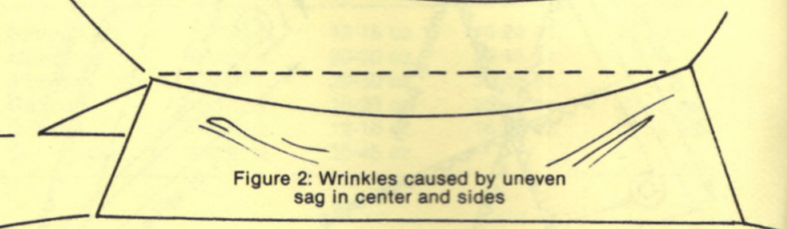
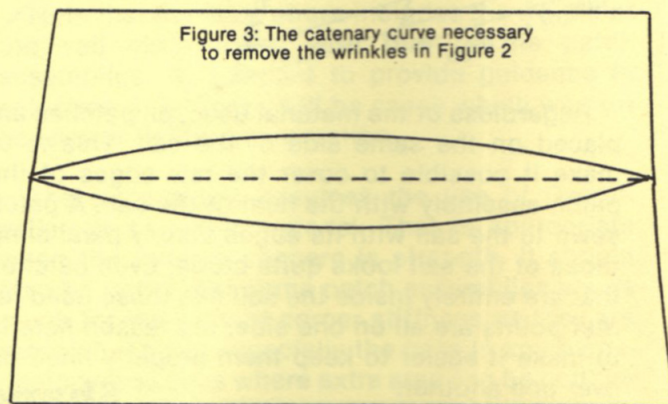


Figure 3: The catenary curve necessary to remove the wrinkles in Figure 2



Thus, if a fabric edge is 20 feet and expected maximum sag is 12 inches (5%), the expected sag at a point six feet from one end would be found as follows:

$$x_1 = \frac{H}{25} = .2$$

$$y_1 = \text{CosH}(.2) = \frac{\text{Exp}(.2) + \text{Exp}(-.2)}{2} = 1.020066756$$

$$S = \frac{20/2}{.2} = \frac{10}{.2} = 50$$

$$x_1 - (D/S) = .2 - (6/50) = .2 - .12 = .08$$

$$d = [1.020066756 - \text{CosH}(.08)] \times 50$$

$$= (1.02 - 1.003201707) \times 50$$

$$= .0168650486 \times 50$$

$$= .8432524294$$

Since "d" is expressed in feet here, it is necessary to multiply it by 12 in order to give the offset in inches. When this is done, the offset at six feet from the end of the 20 foot line with a 12" maximum sag is shown to be just over ten inches (10.119 inches).

The mathematics here can be quite confusing. Fortunately it is possible to use a simple table to find proper offsets for any catenary curve. At given stations along any line, catenary sag will be a certain percentage of the maximum sag in the center of the line.

Line Station	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{5}{12}$	$\frac{1}{2}$	$\frac{7}{12}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{5}{6}$	$1\frac{1}{2}$		
Offset Percentage	0	31	56	75	88	97	100	97	88	75	56	31	0
Gauge of Line													

This table makes the construction of any catenary curve a very simple thing. ■



## Letters to the Editor

Dear Jim:

It was with great interest that we read Volume 1, Number 1 of the new **FABRIC FOILS** that we received with our last assignment. Judy and I both enjoyed the articles and were particularly interested in the article on "Fine Tuning a Sewing Machine." It has proved very helpful in doing the assignment for lesson three.

Enclosed is our check for \$26.00. Please enter our three year subscription, but be sure to start with the second issue as we don't want to miss anything.

May I make one suggestion? Since this is a type of publication that a subscriber would keep for future reference, why not have the margin punch for insert into a three-ring binder, such as "Practical Sailor" does?

Congratulations on an easy reading and informative first issue.

Sincerely,  
Bruce H. Moberg  
St. Cloud, Minnesota

Thanks, Bruce. You will note that we have taken your suggestion to heart. From now on, each issue will be drilled for insertion in a three-ring binder.

Suggestions are especially welcome since **FABRIC FOILS** is very important to us here at Sailrite. We create it on our Wang 2200 LVP computer and typeset it on our Compugraphic Editwriter. The artwork is all done in house, primarily by Allan White. Printing and binding is performed on our own presses and stitchers at Ocean Advertising in downtown Columbia City. And our own Helen McKinney takes charge of the finished pieces to see that they are properly distributed.

Starting a new magazine is not an easy task. But we are dedicated to seeing this one through. And, because all of the work is done "under our own roofs," the job can be properly supervised. Most are surprised by the editorial excellence of Fabric Foils. You can be sure that we are committed to maintaining that quality and to improving it wherever we can.

## Installation

Continued from Page 9

Sew all around the window with a zigzag stitch about 1/8-inch long by 1/8-inch wide. The zigzag stitch is desirable since it distributes stress over a broader area, but it is not absolutely necessary. As you approach the staples in the window's edge with the sewing machine, remove them.

The primary problem which people experience in sewing windows is that the clear PVC tends to stick to the presser foot and, in spite of the staples and the adhesive, the cloth moves through the machine faster than the plastic, creating "bubbles" and wrinkles. You will find this problem is practically eliminated by sewing with the PVC down, so that the feed dog on the machine pulls it through.

Now cut free the Dacron sail underneath the sewn window. It is a good idea to place the outline of the window on the cloth so that the cutting will be accurate. There are two methods of finishing the cloth edges around the window and the outline put down will depend upon which method you choose.

First, you can finish the cloth edge simple by running another row of zigzag stitches around the raw edge of the Dacron. If you choose to do this, cut the sailcloth about one-half inch inside the initial stitching. This method of finishing the window is fine for small sails made of firm cloth. But with larger sails, subject to more stress and often made of softer cloth that can ravel, it is a good idea to use a second finishing method. This entails folding under a 1/4-inch sailcloth hem around the window before running in that last row of stitches. Needless to say, if you choose this method, it will be necessary to cut the sailcloth about 5/8-inch inside the initial stitching so that there will be enough cloth to fold under. You will have to cut slits to ensure a smooth fold at the corners. And, if the window is rounded, it may be necessary to cut radius slits along the rounded edges so that they will fold under properly. ■

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# Learn Sailmaking at Home

Sailmaking has always been taught through apprenticeship. It is an art, and the teaching of any art requires personal interaction which apprenticeship makes possible. Traditional apprenticeship has some real disadvantages. It requires a full-time commitment over an extended period. Apprentices often complain that they are trained in particular tasks and left to perform just those tasks, and as a result they may not learn the work completely.

The **SAILMAKER'S SERIES** retains all that was good in traditional apprenticeship but does so without the disadvantages. Students work under the direct supervision of Jim Grant.

Grant, who has a Ph.D. in Political Science from the University of Chicago, is recognized as Master of the Sailmaking Art. He founded Sailrite Kits in 1970 to make material and instructions in sailmaking more widely available. His five manuals on sail construction have become classics and are used by sailmakers everywhere. Even the largest, most respected lofts like Ratsey and Lapthorn, Hood, and North make use of the books to train new employees. These books are excellent reference texts for professionals working in a loft yet they are also perfectly suited for individuals building just a few sails for personal use. To teach the art of sailmaking fully, however, there must be an interaction between student and master...and this is the purpose of the **Sailmaker's Series**.

The Series is the first attempt to teach sailmaking in a carefully structured and organized way. This instruction is not compromised by any requirements of production efficiency. Moreover, it is possible for students to move at their own pace through the material. Indeed students can even decide for themselves what level of expertise they wish to achieve. The Series is divided into four units.

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**Lesson 6 / Spinnaker Design and Construction:** Covers bloopers as well as horizontal cut, radial, spherical, star cut, and tri-radial spinnakers. Effects of cloth stretch are analyzed.

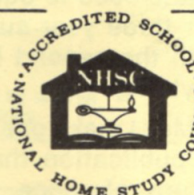
**Lesson 7 / Staysail Design and Construction:** Here the primary focus is on the theory of sail interaction. Design and construction of six distinct staysail types is considered in the light of this theoretical grounding.

**Lesson 8 / Stormsail Design and Construction:** Strength and seaworthiness in stormsails are the primary objectives emphasized in Lesson 8.

**Lesson 9 / Sail Repair Work:** The maintenance of sails from a sailmaker's point of view is presented here.

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Upon completion an Apprentice Sailmaker's Certificate will be awarded.



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## Enrollment Agreement for UNIT ONE of the Sailmaker's Series

Please enroll me in Unit One of the Sailmaker's Series. I understand that the entire tuition and materials fee is \$395.00. In addition to ten lesson books, supplies for the construction of model sails, ten assignment papers, and one final examination, this fee includes the following texts:

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The Sailrite Sail Repair Kit .....	35.00
Marchaj's Sailing Theory and Practice .....	20.00
The Best of Sail Trim .....	14.95
The New Canvas Worker's Library .....	25.00

Students who own any of the texts listed above should deduct their value from the total cost of Unit One.

I am considering below the payment plan I prefer and will note it on the order form on **PAGE 17** of this issue:

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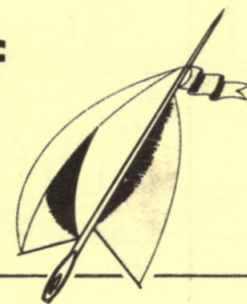
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Whenever possible we ship your order by United Parcel Service (UPS), but we can only direct UPS to a specific address (no P.O. Box or R.F.D. address). There are exceptions, but they do not make the list available. If UPS delivers to your P.O. Box or R.F.D. address, be sure to let us know when you order.

### THE ORDER FORM

Indicate clearly your name, address, and all necessary information concerning the order. Check and money orders can be enclosed without fear. If a charge card is used, enter card information as request. Then fold the form and seal as directed.

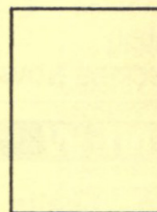
FIRST FOLD ON THIS LINE

THIRD FOLD ON THIS LINE



## FABRIC FOILS

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Columbia City, Indiana 46725



SECOND FOLD ON THIS LINE

FOURTH FOLD ON THIS LINE

### FROM

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TAPE THIS EDGE DOWN



# choosing proper cloth

Continued from Page 5

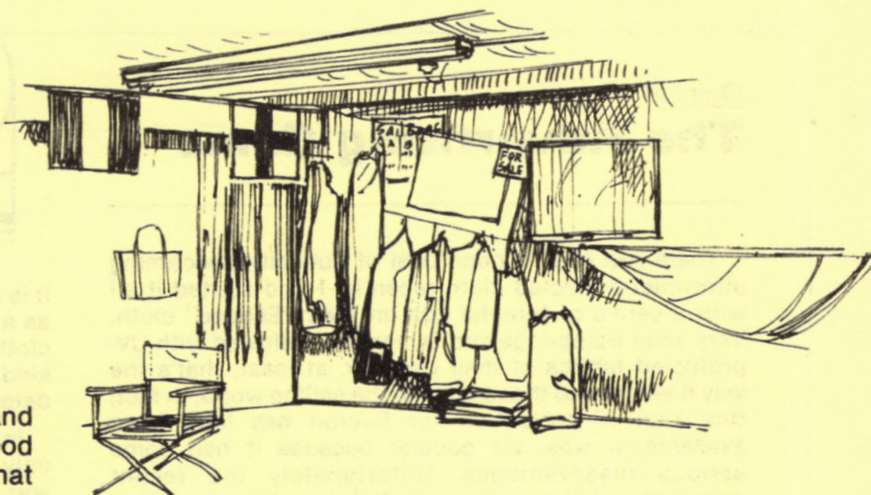
yarn forces the warp yarns to weave back and forth or to "crimp." This increases the likelihood of stretch in the warp direction even beyond what would be expected, given the yarn size differential. That is, some warp stretch will result just from the straightening of the warp yarns. Moreover, because crimp is limited primarily to the warp yarns, there is much greater bias stretch than might be expected. The crossing yarns will pivot more readily when just one of the pair is crimped.

With balanced fabrics like the genoa, general purpose, and Bermuda lines, both fill and warp yarns are crimped. Each yarn crossing is thus interlocked better. This provides the best possible bias stretch resistance.

Even aside from crimp, bias stretch will be improved by a higher density of yarns. The tighter a fabric can be woven and finished, the more inherent bias stability it will have. Lighter weight fabrics, made with finer yarn, will have more yarn crossings per square area and tend to have lower bias stretch than heavy weight fabrics made from large denier yarns. Once again, an unbalanced construction is more susceptible to bias stretch than its balanced counterpart just because of the increased denier of the fill yarns.

It should be clear that no company can build the perfect "all around" sailcloth. The purpose of this article has been to explain the reason for the five construction types or "lines" offered by Bainbridge. With a little care, the discerning skipper can pick the design that will best serve his needs.

**"We can't imagine starting a sail loft without this kind of [Sailrite] training..."**



## From Landscaping to Sailmaking

Continued from Page 6

"Be careful of reliance on boat yards for business. We have attempted to make arrangements with both local yards. The proper assurances and guarantees were exchanged, but very little came of them. The yards will want a percentage from you if they send the work over. They generally ask for 20% or 25% of your normal charge. We believe that it is best to build your business as if the yards don't exist.

"Deposits can be a serious problem. Be sure to get a non-refundable deposit and a signed work proposal on large expensive items such as dodgers, boat tops, awnings, and sails. We required a 30% deposit this year but will increase it to 50% next year. We have had roughly 300 customers this year and only one has refused to pay the last \$50 of a \$200 repair bill. One other has not paid a bill due in May. The boat yards are very slow to pay, but they have eventually come up with the money.

"This list of problems would be much longer were it not for our schooling at the Sailwright Academy. We just can't see anyone starting a sail loft without this kind of training. It could, we're sure, be acquired by working in an existing loft over a number of years, but the Academy does the same in just a matter of months.

"As sailmakers we have no secrets. Indeed, we will be glad to share information with anyone just starting out. All we ask is that you don't open a loft next door!" ■

☆☆☆☆☆

Those who would like to contact the Orpins should write:

Orpin Sail Company  
P. O. Box 206  
Osterville, Massachusetts 02655



## The Advertising Game

There has been a good deal of publicity concerning ultraviolet-protected cloth recently. Hood started it all with a series of forceful ads on their "Eclipse" cloth. Very soon Bainbridge and Dimension followed with UV-protected fabrics of their own. Or, at least, that's the way it seemed to those of us in the sailing world. In fact, this kind of protection for Dacron has long been available. It was not popular because it had some serious disadvantages. Unfortunately the recent popularity of the protected cloth results more from publicity than from any improvements in the technique and the resulting fabric. There are some reasons for considering the UV protection, but a decision should be made only after weighing the disadvantages with the advantages.

Let's consider, first, what can be gained with the protection. There is no doubt that Dacron will deteriorate in sunlight. The loss of strength begins almost immediately and will render sails dangerously weak in as little as 18 months of continuous use in strong sunlight. UV protection can extend this useful life by a factor of four in some cases.

This is impressive, but there are some qualifications that should be understood. The UV protection is provided by coating the fabric with a resinous substance that inhibits the penetration of sunlight to the yarns in the fabric. This coating is heavy—it will generally add an ounce to the weight of each yard of cloth. And, because



it is a coating, it is subject to abrasion and deterioration as a result of flogging. Thus, although the durability of cloth in test conditions might well be quadrupled, this kind of result is not likely in practice. The coating will deteriorate and, as it does, so will its effectiveness.

In actual use you can expect UV-protect sails to last only about 50% longer than unprotected sails unless you are very careful with them. This benefit must be weighed against the extra weight and expense of the coating.

One final point. Modern Dacron sails do not wear out quickly in spite of some of the surprising statistics offered by the ads. Some untreated Dacron, if we are to believe a Hood ad in the January 1981 **SAIL**, loses more than half of its original strength in the second year of use. This is no doubt true of cloth that is continuously exposed. But sails are not so severely exposed in actual use. All of us know that our Dacron sails will give very good service over a period of from five to seven years—even more when used for serious cruising. This kind of testing is far more revealing than the result of a laboratory study.

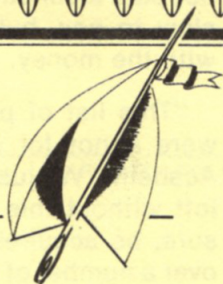
No one in the sailing business, users or builders, will be served by ads that frighten customers. Modern sailcloth is marvelous no matter who makes it. Ultraviolet protection may be justified for some users, but it has no place in the sail inventories of the vast majority of sailors.

20 / January 1983 / FF



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