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THE BALLOON BUILDERS' JOURNAL

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Paul Brockman has provided other balloon builders with various computer models for a number of years. He finally took the plunge. Paul discusses his first efforts at building a balloon.

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Page 6: Laying Out Multi-Panel Envelopes

This article presents details about building multi-panel envelopes. We review the common types, discuss use of The Gore Pattern Spreadsheet for their design; review general techniques for lay-up of patterns and cutting fabric.

Up and Coming

In our next issue we will continue the discussion on envelope styles and pattern design. The focus is on vertical gore patterns, their design, layout and fabric panel fabrication. We will also present a summary chart which compares the merits of vertical and multi-panel envelopes from the viewpoint of the builder.

In a future issue we will develop methods to determine the envelope to basket cable lengths. We will also begin a series of articles on seam types and seam systems; sewing machines, their selection, use and maintenance.

On to advanced topics: We are developing a series of articles on building of light balloons, both envelopes and baskets. We invite readers who have used light weight materials to share their experiences with us.

Notices To Readers

So you paid for a four issue subscription? Good news. You will receive six issues instead.

Our readership has reached the 50 subscribers we consider necessary to continue publication. Revenues appear sufficient to fund publication of three issues beyond this edition. In keeping with the promise made in our first issue, all revenues will be returned to the readership in the form of services. Extending subscriptions to cover an entire year appears the best way to return these funds to you.

Financial Summary: Total revenues received are $611, with expenditures to date of $262.37, leaving a balance of $348.63. Our current circulation is 55 issues.

The next issue will include a roster of subscribers.

If you wish your name to be excluded from the roster please drop us a post card to that effect. At this time no one has asked to be excluded. We need your card by 12/15/1993.

Building a Bag That Flies

By Paul Brockman,
15325 SW 178th St., Renton WA 98058

For a number of years Paul has provided design data for fellow balloon builders. He finally decided to build for himself. He describes his experiences as a first time builder.

It began as an intellectual excursion. A way to exercise my interest in computer programming. Since I had been a balloonist for several years at that time, it had in retrospect, a logical and inevitable outcome. I wrote computer programs for the satisfaction of seeing a workable balloon design come to life at the press of a key. By the late 1980's I had design files for several variants, most with "natural" shapes and one with a "special" shape, in fact, an ice-cream cone. The key feature of each program was that any size of envelope could be selected with the same basic pattern.

The ice-cream cone was the simplest program to write since it was based upon only three basic geometric shapes: a cone, a sphere and a torus.

The "natural" shape proved to be more of a challenge. First, I modeled the required shape on the computer and derived a series of circumferences, placed at intervals along the vertical "surface" of the envelope. I used these numbers as the core of my program where they are cut and diced to produce an envelope with sixteen, twenty or twenty-four gores.

Initially, the capacity of the envelope was unlimited, ranging from the sublime to the ridiculous. Later I limited the size to certain minimum and maximum limits in deference to reality. For a given set of materials, a balloon that is too small cannot lift is own weight. A balloon that is too big has its own peculiar problems, not the least of which is that the ground crew is in a perpetual state of rebellion at the prospect of lifting the thing.

In addition to the shape design programs I wrote color pattern generators to be used as "coloring books" for the purpose of choosing likely-looking color combinations for the envelope.

With these tools I provided designs to several local balloonists and had the extreme pleasure of seeing some of them translated into real flying machines. After that it was only a small step to the *Big Decision.* In December of 1992 I decided that the time had come. Taking a deep breath, I ordered nine hundred yards of rip-stop nylon. The last, and by far the greatest, stage in the journey had begun.

To those who would follow the path that I trod, I can offer you nothing but "but blood, tears, toil and sweat," but in the end it is all definitely worth every moment of effort. There is a lot of repetitious, error-prone work involved. Certain tools, if not absolutely essential, do make the job much easier. They include a good industrial, dual-needle sewing machine, a large cutting table (the larger, the better), a pair of high quality scissors, straight

A pretty multi-panel envelope shows the result of 18 weeks of determined effort.

edges of various lengths and a surgical quality scalpel (and an oil-stone to sharpen it).

Design Criteria

My first step was to choose a size for the envelope. This would be determined by the required payload and worst-case flight conditions that I wanted to cater for. I wanted to be able to lift about 350 pounds of payload (people) to a height of 10,000 ft MSL on a "standard" day. In addition, I wanted to minimize fabric wastage in the cutting process.

My program showed me that an AX-7 would fit the former requirements and a twenty-gore pattern would accommodate the latter if I used a horizontal pattern scheme instead of a vertical one. The program actually designs a vertical slice of the envelope, but based on the width of a roll of fabric, I decided to build this slice from a set of horizontal components. This would minimize fabric wastage and add to the structural strength of the envelope as it would incorporate many seams, which are stronger than the single thickness of fabric which they replace.

The Design

In my design I have sixteen such panels, each a full gore-width, making up each of the (twenty) gores. As you can see, the number of panels times the number of gores is 320. I decided to dispense with the horizontal load-bands except for one at the mouth and one at the top of the envelope.

The pattern is semi-bulbous when viewed along the vertical axis. Of course, the vertical load-tapes need to run up the "valleys" between the bulges. Given that my panels were full-width, and that I assembled each gore first, it seemed logical to set the load-tapes in the middle of each gore rather than adopt the more customary procedure of fitting them at the edges. This decision worked out well as I found it much easier to attach a tape to the center of each assembled gore than to try to fit it to the junction of two gores as I joined them together. It made for a two-step operation but I found that each individual step was easier than the effort required to combined the two steps into one. It was necessary to carefully mark a line up the center of each gore to act as a guide when running the gore through the sewing machine. A white grease pencil was used for all such marks as it wipes off with a damp rag.

I opted for a parachute type of deflation port as it is easy to build and, had or me, the advantage of familiarity. I had decided upon a fairly large vent with a pulley system for the actuating mechanism. The pulley provides some mechanical advantage to the operator (typically about 1.7:1).

Building the Envelope

Having constructed a cutting table from particle-board and sawhorses, I began by preparing a paper template for each of the panels which make up a gore. Thus, I made sixteen paper panels, each the same size as the panel it represented, but with an additional inch on each edge to provide a seam allowance (the fabric folder on the sewing machine that I used folds to one inch.)

For the actual fabric cutting I used a straight-edge and a scalpel. It was necessary to "dither" the position of the panels on the table prior to cutting to avoid making "tram-lines" on the surface which the blade would tend to follow. In practice this was not an onerous task since the fabric seldom rolled out to exactly the same position twice.

When all 320 panels had been cut, rolled and moved to a temporary storage area, I turned my attention to the sewing machine. I had been advised to practice with scrap material until I was completely happy with the results before committing the precut panels to the machine. What good advice this turned out to be. We have come to expect that machines will take the drudgery out of repetitive labor, and we should believe that sewing machines will do no less, right? Well, yes and no.

Sewing machines have a mind of their own. After many attempts to persuade the beast to behave, we arrived at a compromise: the machine would do what was expected and join my fabric together in an orderly fashion as long as I watched it like a hawk. If my concentration wandered for an instant, the thing would break my thread, tie it in knots, or take off at an alarming rate, ripping my fabric thorough the gate in unexpected directions. There was no dominating it, nor was there any doubt about who was in charge. On more than one occasion, after making spaghetti of my thread, I swear I heard the thing chuckle.

Having achieved an uneasy truce with the machine I moved on to the task of joining the panels together to produce the completed gores. This was the most time-consuming part of the whole operation. Attaching the load tapes to the center of the gores came next. With the help of a home-made tape dispenser, this process was simple and quite quick.

Joining the gores together was, at first, a relatively simple matter. When building the

gores, I hash marked the panels to ensure alignment. For the joining of the gores I dispensed with this step and, instead, used the horizontal seams as my hash marks. In practice I was able to achieve a maximum vertical error of less than a quarter inch and, in most cases, less than this.

As the number of joined gores increased, the sheer volume of the fabric became a problem due to the space required to contain it (or in my case, the lack of space.) That, however, was the least of my concerns, since the trickiest part of the whole operation was fast approaching. Having joined all the gores so that I had one very large piece of fabric, I was now faced with the task of joining the two "ends" to complete the envelope proper.

Before starting this procedure I sat and looked at the vast mountain of fabric and at the very small aperture which it would have to feed through. I came to the conclusion that it could not be done and that no sane person would even attempt it. Sanity notwithstanding, it had to be done. And done it was, but I still do not know how I managed to feed that particular camel through the eye of that particular needle.

The top ends of the load tapes were looped around an eight-inch seamless aluminum load ring and joined back upon themselves using an eight-point stitch pattern on a twelve inch fold. V-rings were attached to the bottom ends of the load tapes using a similar pattern but with a reinforcing tape placed around the V-ring to act as an anti-fray device.

Load Cables

Fabrication of the load cables was an exercise in three-dimensional geometry. I found that the most expedient method of determining the length of the cables was to build a jig. I extrapolated the length of the load tapes to a point and set a thirty-inch beam, which represented the distance between the two load fittings on the basket, into the V thus formed. All of this was done on paper. I then measured the distance from the center of the beam to the mouth station along the vertical axis of the envelope. Armed with this information, I built a post and "yardarm". The yardarm was 15 inches long (half the length of the beam).

Erecting this contraption in the middle of my garage floor (which is quite flat) I drew a semi-circle on the floor, centered on the post. Since I was to use a two-point suspension system (a restored Raven "Promotional basket), the cables would be symmetrical about a line drawn across the center of the mouth, thus it was only necessary to measure half of the cables and duplicate them for the other side. I marked distances equal to the panel-width at the mouth around the semi-circle and measured from them to the end of the yardarm (I had a load block attached to the yardarm, set at the required angle for exact measurement.)

Fabrication of the cables was straightforward. A matter of banging nails into a plank at the required distance from a fixed load-block. I swaged my cables (7*19 high carbon stainless steel $^1/_8$ inch) with double copper swages at the mouth end and single swages at the load-block end (where the cables merely feed through the block and no cable end is involved.)

I kept the vent valve as simple as possible. Since it was to be all of one color it was fabricated from a circle of ripstop nylon, made up of five separate panels laid side-by-side. Fifteen percent extra radius was allowed to provide overlap to the top aperture.

The Vent and Lines

The valve centering line and load lines were cut from $^1/_8$ inch Samson cord. Kevlar was considered but rejected as too expensive. I made the mistake of buying the Samson cord from Cameron. Not that anything is wrong with Cameron material, but the very same cord can be obtained from marine suppliers for about a tenth of the price.

It is very important to pre-shrink the cord. I discovered by experimentation that Samson cord shrinks about twelve percent when heated. It is touted as low stretch but they don't say anything about shrinkage. Pre-shrink before cutting! The method I adopted was to boil it in water for about an hour and then air dry it. When measuring and cutting the centering lines I remembered an adage that my woodwork instructor told me many years ago: keep your material as long as you can, for as long as you can. This is a good plan when building almost anything and is well applied to the parachute lines. The parachute centering and excursion are best adjusted during the first few inflations so it is well to keep the lines long until the final dimensions are known.

I obtained rope for the crown and vent lines from a marine outfitter. $^1/_4$ inch polyester line was selected as adequate for both purposes.

In selection of a drop-line I had to decide between rope and tape. Personally, I prefer tape. Pound for pound it is stronger than rope and occupies less space. My ground crew, however, voted for rope, and since they are the ones who use it the most, they had the final say.

I constructed a drop-line bag into which the rope just fits with no free space. I pack the line into it progressively and evenly without coiling (first leaving a free end for attachment to the basket.) I then close the bag with a large Velcro patch, invert the bag (flap down) and hang it from the outside of the basket. When the time comes to deploy the line, a pull on the flap causes the rope to drop "clean" without knots or tangles.

To finish the envelope, I made a ripstop nylon scoop which occupies about fifty percent of the mouth circumference. Nomex would have been nice of course, but what the heck, I have lots of spare nylon.

The Result

I worked for eighteen weeks to complete the project. That's not long really, is it? Not even a whole winter (not around here anyway). The result of my labors is a 72,000 cubic foot balloon of pleasing shape and a satisfying color combination which flies like a dream come true. All in all, a highly recommended experience.

Editor's comments: The following points were clarified in a telephone conversation with Paul.

Samson cord is a braided polyester line available through marine supply outlets. Paul used size #4 which sells for about $16 for a 500 foot roll. I believe this material is used to make fishing nets. It has a rated breaking strength of about 400 pounds., While a number of companies produce this cord, Paul chose to use a product of The Samson Cordage Works.

As Paul used a borrowed sewing machine to build his balloon, He was reluctant to make adjustments to it. This probably contributed to the "sewing machine as monster" image conveyed in his article. While double needle sewing machines can be finicky, when working well they are a marvelous machine to behold.

A Homebuilder's Tip: More than one potential builder has commented on the fear of closing up the envelope. There is this perception on the part of some, that last seam is some terrible event which requires putting all the fabric under the arm of the sewing machine. The following is one technique to make this process a breeze:

Start by piling all of the balloon behind the sewing machine. Then, assuming you close up of the gore from the top of the envelope down, locate the top edge of the deflation port. Slide your hands along the deflation port until each vertical gore edge of the fabric is located. This first step is performed to keep from sewing the envelope up into a giant mobius strip. (Yes, Martha, you can look *mobius* up in a dictionary.) Have an assistant hold each of the two edges of fabric to be sewn together and seat yourself in front of the sewing machine. Grab the left fabric edge in your left hand and bring it around the left hand side of the sewing machine. Reach through the arm of the sewing machine to grab about two feet of the right fabric edge and pull it though the arm. Fold the beginning of your seam and begin to sew. As you finish sewing the two feet of right hand fabric continue to pull a couple of feet of fabric through the arm. The finished seam goes out the back as the unsewn edges are brought together. A helper may be needed to free up the pile of fabric behind the machine. Its that simple.

We Need Your Input

A number of readers have been asking about alternative seam systems. I understand the concern. I look at my commercial double needle sewing machine: its big, bulky, heavy, expensive, and not the most pretty of furniture. It requires regular oiling, some of which ends up on fabric or the floor. Our readers, faced with such a purchase look at their home sewing machines or sergers and ask why can't these be used to build a balloon?

I am aware that some balloons have been built with single needle sewing machines. But most of these builders used folded fell construction and passed the fabric through the machine twice for each seam.

If I had the time I would make and test a system that may hold promise: It is an overlap seam in 1.1 ounce fabric using a zig-zag stitch of size 30 thread sewn on a home sewing machine. The idea for this system comes from a review of Balloon Works construction techniques.

Have you tried a different seam system? By different I mean any seam other than an overlapping or folded fell sewn with a double needle machine. Have you built a balloon using a single needle sewing machine? If you have tried something different, please share your experiences with our readers.

The Novice Builder: Part 3, The Multi-Panel Envelope: Design, Layout, and Pattern Making

By Bob LeDoux

This article follows up on Paul Brockman's experiences. We review multi-panel envelopes, discuss layout of patterns and some techniques for cutting out the fabric.

In the following is discussed three related topics: As a follow-up to Paul Brockman's article we will review a number of common envelope gore types useful to the builder. Secondly, we will modify The Gore Pattern Spreadsheet from our first issue to create gore patterns for these different envelopes. Finally, we will describe some approaches to making these paper patterns and actually cutting out the envelope fabric.

Natural shape hot air balloon envelopes can be divided into two general families. In the first family the envelope is constructed with the length of the fabric (the *warp*) running in the vertical direction. Aerostar envelopes ("S" series and Rally) and Cameron "N" envelopes are this construction style.

The second general family consists envelopes where the length of fabric panels run either horizontally or diagonally. Avian, Head, Galaxy, and Cameron "A" envelopes display this construction style. In this article we will address this second family of envelopes which we will call "multi-panel envelopes." Discussion of the vertical panel envelopes will occur in the next issue.

A Review of Gore Types

Figure 1 displays three common types of balloon gore patterns. In a typical balloon 8 to 24 of these gores are sewn together, side-by-side to create an envelope. The number of gores in the completed envelope depends on the type of gore pattern, envelope volume and the width of the completed gore.

In these figures, the line width denotes type of seam construction. The heavy lines note vertical load tapes. If these heavy lines fall on the curved gore edge, this load tape is generally applied when the two adjacent gores are sewn together. The light lines indicate edges of fabric panels which are sewn together with simple seams. For our discussion we will assume these seams are either simple overlapping or folded fell seams. The light, vertical dotted lines down the middle of each gore are symmetry lines and do not represent seams. For simplicity none of these patterns show horizontal tapes like those found in the deflation port or mouth of the envelope. Horizontal "rip stopping" tapes are also not shown. These tapes are normally added after all the gores are sewn into a complete envelope. These horizontal tapes are not important to our discussion of gore patterns.

Figure 1a is a typical multi-panel style of construction. The warp of the fabric runs in the horizontal direction and each gore consists of a series of panels sewn together side by side. The horizontal fabric edges are normally parallel to each other; in other words, the panels do not taper in the horizontal direction. Depending on the size of the envelope, width of the fabric and the style of construction, the number of panels in these envelopes number in the hundreds and can exceed 1,000.

Construction of these envelopes entails sewing a load tape to the "stretchy," bias cut, curved edge of the gore. This gore style can be challenging to the beginner. If inconsistent tension is applied to the fabric as the vertical tape is attached, different vertical seam lengths can result. This could result in a misshapen envelope with the potential of uneven stress on the balloon surface.

One approach to this problem is to index mark the load tape and the fabric panels. By

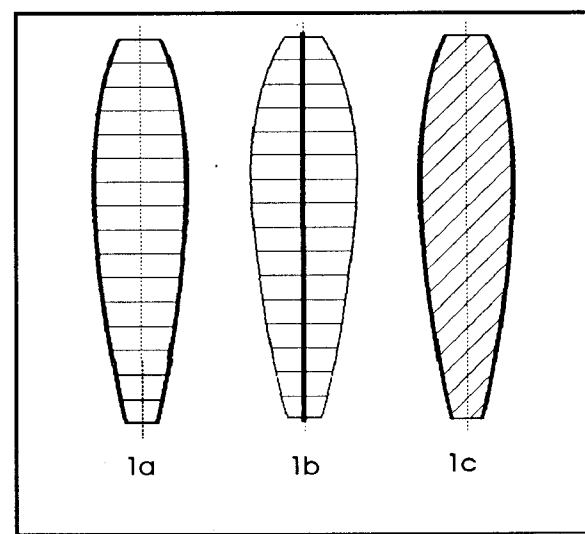

Figure 1. Three common multi-panel gore patterns of use to the builder.

marking each component every couple of feet, the accuracy of sewing can be monitored. Avian uses a technique which might improve consistency. The envelope panels are first sewn together using a folded fell seam. The vertical load tape is then attached over the completed seam with a zig-zag stitch. This requires two different types of sewing machines.

Figure 1b is identical to the 1a with one exception. Here the curved, vertical, edge seams are not covered with tape. Instead the vertical tape is sewn down the middle of the gore. There is no fabric seam under this tape. This is the gore style Paul Brockman used in his balloon. I understand that Semco used to make balloons in this manner. This gore pattern may be better for the beginner because it does not require matching load tape to a bias cut edge, as is required in figure 1a. This design might be superior for its rip stopping abilities as the application of center tape over the fabric breaks up the gore into more, smaller panels.

The downside of this pattern is that there is no fabric buffer between the load tape and the fabric. The seam under the tape in figure 1a tends to disperse the stress between the load tape and fabric. There may be greater tendency for style 1b to develop stress indicators like elongated stitch holes, particularly near the mouth of the balloon. Whether this design improves or diminishes the rip stop capabilities of the envelope depends on who you talk to.

Figure 1c displays the diagonal style of multi-panel construction. Avian, creates envelopes in this style. Diagonal panels create vertical gore edges with extreme amounts of "bias." Sewing this style of envelope together requires considerable patience and skill. I do not recommend this type of construction for the first time builder.

Because multi-panel gore styles do not run fabric in the vertical direction, the completed gore width is not limited by the width of the fabric. Envelopes constructed with these designs often have fewer gores than vertical panel balloons. Envelopes with 12 to 18 gores are common. Because these are "flat panel" constructions, You might not want to build envelopes with fewer than 12 gores unless a "boxy" looking envelope appeals to you.

Some Gore Design Considerations

Before beginning pattern construction some thought is due the *real* width of fabric. Most builders use nylon with a nominal width of 60 inches. Unless the fabric is premium yard goods, it will have a selvage edge. The fabric might be as wide as 62 inches. Sometimes the width of the fabric varies at different points in the roll. Also note that the coating on the fabric may not go all the way to the selvage edge. These factors can affect layout of the patterns.

Many builders prefer to leave the uncoated selvage edge intact but fold it into a seam, thus exposing only coated fabric. Some yardage may display "wads" of coating on the edge

Creating The Modified Gore Pattern Spreadsheet for Multi-Panel Construction

A simple modification to The Gore Pattern Spreadsheet from issue 1 of *The Balloon Builders Journal* permits creation of horizontal and diagonal panel envelope styles.

The original Gore Pattern Spreadsheet was designed to create patterns for vertical half gore envelopes with seam allowances on the center of the gore and on the curved panel edge. While we will measure multi-panel envelopes patterns from the center of the gore out, only one seam allowance, on the edge is required.

You might want to make the following change to a copy of your spreadsheet so you can keep both versions in your library.

Begin by referring to cell H10 in the spreadsheet. That cell should have the following formula:

=G10+(2*C4)

This instruction says that "the cut width of the pattern at this station is equal to the sewed width plus two seam allowances" (in C4). Modify this formula to remove one of these seam allowances by changing the "2" in the formula to a "1" as shown in the following:

=G10+(1*C4)

Now copy this formula down to cells H11 through H60.

This modified worksheet can be used to generate any gore pattern where the seam allowance occurs only on the outside edge of the gore. The distances shown in column "H" are from the center of the gore out to the curved vertical edge.

which makes it difficult to fold the seams for sewing. Trimming this edge may be preferable. If the fabric varies in width it is probably best to trim to width as the panels are cut. Consider these factors before cutting out patterns. Confusion about the real width of fabric or the quality of fabric edge could force the builder to re-make patterns.

Preparing Gore Patterns for Horizontal Panel Envelopes

An envelope gore pattern is like a dressmaker's pattern. It is a paper image laid over the fabric to permit cutting the fabric to desired size. Balloon gore patterns are made of heavier paper than a dressmaker's pattern because they are larger and are used more times.

The following techniques are "low tech" involving an overlapping layout of pattern paper and cutting to shape. A "high tech" builder with a CAD system, might be able to generate patterns on a computer screen thus eliminating the manual layout.

"Low tech" pattern making requires a few materials. For pattern material I prefer to use heavy Kraft paper. A 660 foot roll of paper 5 feet wide costs less than $40 locally. It is available from paper specialty companies. Other needed supplies are felt tip pens, masking tape, a pair of scissors (not your good fabric scissors), a 50 or 100 foot tape measure, and a straight edge about 5 feet long. To actually draw the curved edge, a piece of straight, clear wood at least 10 feet long is required, and longer is better. This piece of wood should be at least $3/4$ by $3/4$ inch square. If there is difficulty finding this wood purchase a piece of "quarter round" material at a local lumber store. A school gym or other clean, smooth, hard surface floor is needed for a work surface.

Begin by preparing The Modified Gore Pattern Spreadsheet for the final envelope configuration. Enter the number of gores, desired volume and seam allowance in The Spreadsheet. Note the comment above on the number of gores. Having selected the final gore characteristics, print out a copy of The Spreadsheet.

Figure 2 (page 9) summarizes the process. A bed of paper pattern pieces each the width of cut fabric is laid down and the gore pattern is drawn over it. The gore shape is cut out. Separating out the paper pieces creates a set of patterns each of which is used to cut a particular size fabric panel. Each pattern is half width. When laid on doubled over fabric, it cuts out a full width fabric panel.

Lay out the strips of pattern paper. We assume the work surface is a smooth clean surface like a gym floor. Each paper strip should be the same width as the cut fabric panels. Overlap each strip on top of its neighbor by twice the seam allowance. Normally about 1 to $1\,1/8$ inches is lost in width as the seam is folded thus the overlap would be 2 to $2\,1/4$ inches.

Once all the strips of paper are taped down, begin to draw the pattern on the paper. Start by drawing a straight line down one edge of the pattern papers. (If the ends of the papers were aligned against a straight line, this step can be skipped.) Now mark the stations up the length of the paper. These station measures are dimensioned in feet in column C of The Spreadsheet. If the station for the mouth or deflation port cutoff is known, place this station on the seam between pattern papers. (This might reduce the number of patterns by one.)

(Note that for any given envelope volume the distance between station marks is a constant value. But this value increases and decreases as the size of balloon volume is increased and decreased.)

The curved edge is now marked out. At each station, measure across the pattern from the vertical straight edge the distance for that station. On The Gore Pattern Spreadsheet, these distances are dimensioned in inches in column "H." After you have completed marking these points, look down the line of dots to see if they form a smooth, curved line. Dots off line may have been mis-measured and should be checked again. Of course, all your marks should fall on the paper and not on the floor.

Take the long piece of wood and start at one end. With an assistant, shape the wood to touch the dots as evenly as possible. Draw a line through the dots with a felt tip pen. Continue this process down the length of the pattern until the curved line is drawn the entire pattern length. Don't be overly critical about accuracy. The width of a felt tip pen, about $1/8$ of an inch, is close enough for this work. At this time, if a point seems to fall out of line, ignore it and line up on neighboring points.

Mark the lines for the mouth and deflation port cut offs. I generally mark a dotted line as a fold line and add one inch in length as a cutoff line to permit folding the edge under the tape which is sewn into each opening. Mark each

pattern piece so you can determine the pattern edge which rests against the center of the gore. Number each pattern piece so you can determine its order in the series as well as its top and bottom. Now is a good time to cut out the pattern pieces along the curved and straight edges. Many builders actually cut out the pattern with a straight line to approximate the curved edge. This permits using a straight edge to trim fabric pieces to length.

The use of this "half pattern" technique has benefits to builders with limited space. After the pattern pieces are completed, all fabric can be cut in a small room. A cutting table can be constructed from an oversize piece of plywood or pressed board. Panels five feet wide and nine feet long are common. Boards of this dimension are sold for table tennis table tops. You might even find untrimmed panels of a width a bit wider than five feet. Set one of these panels on saw horses or other supports for a cutting table. it makes a table large enough to handle the panels on a 12 gore AX-8 balloon (105,400 cubic feet) . If you follow Paul Brockman's technique and use a knife to cut fabric, a pressed board material would be preferred to plywood as plywood has a grain that will tend to draw a knife off the intended cutting line.

Preparing Gore Patterns for Diagonal Panel Envelopes

When building diagonal pattern envelopes like figure 1c, a slightly different process is required. Lay out the set of pattern papers in a diagonal pattern in much the way as described above. This paper must be laid out for the full width of the gore rather than half the width as used above. The gore curve is then marked out on both sides of the vertical center line. Mark index lines every two feet up the edge of each pattern piece side to ensure adjacent panels are sewn together evenly. Cut out the patterns by cutting up each curved side of the gore. Number the pattern sequence in a manner which allows determining the top of each pattern as well as sequence. Do not cut up the center line of the gore. The diagonal builder will probably be better off laying out each gore piece its full length for cutting. This requires more space than needed using the half-gore technique described above.

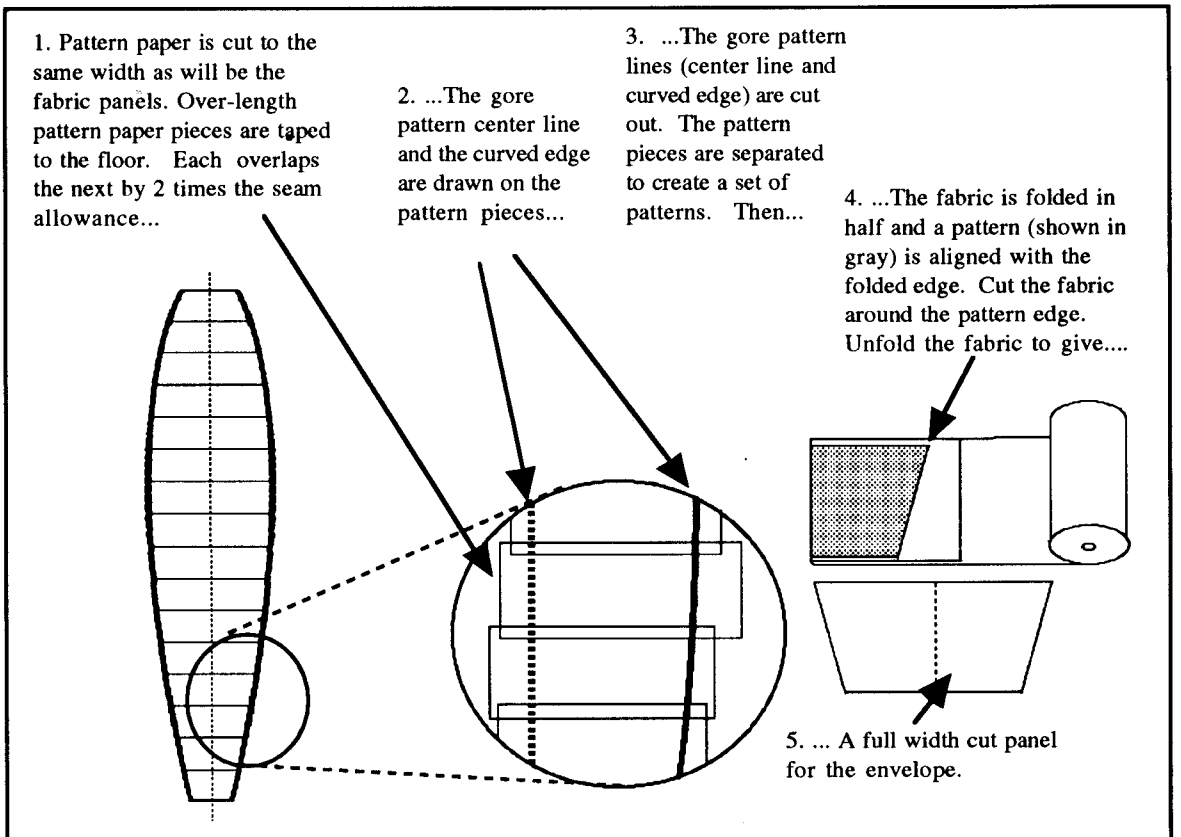

Figure 2: A method of using "half patterns" for construction of multi-panel envelope panels.

Letters to the Editor

Bob,

I've started on a Boland-type 12 gore, 48,000 cubic foot envelope to hang over my old square Rally basket and burner system.

Mike Glasgow
P.O. Box 431
Elk City, OK 73648

Editor's note. I sent Mike a copy of The Gore Pattern Spreadsheet in Lotus 123 WK1, IBM format. He called me to say he did not have Lotus and could not run it. Has anyone transferred The Gore Spreadsheet into a COM or EXE file (Pascal or C?) which could be run independently of other programs? If so please contact me.

Dear Bob,

I am a piano designer/engineer/balloonist and would like to get into designing and building my own balloon and would like to see how your Journal could help.

Joe Seawright, Director of Design
Baldwin Piano & Organ Company
Old Airport Road
Greenwood, MS 38930

Bob,

I have been flying balloons for 12 years. My 10 year old Raven S-55 just failed Porosity. I am not looking for a home built as a replacement. I am interested to learn more about balloon constructing. I may build a small balloon as a hobby in the future.

Darrell Taylor
22811 Ave 184
Strathmore, CA 93267

Dear Bob,

I am a new balloonist. My wife and I have crewed for 4 years; and have had our own balloon for one year, A 54K. I just got my pilot certificate and my wife is working on hers.

I am very interested in building a small one man balloon. I have access to professional help and facilities. Please send me any information you can.

Ron Davis
563 6th. Ave SE
Largo, FL 34641

Dear Mr. LeDoux

I have been fascinated by people who have undertaken such a task [as building a balloon]. I am a hot air balloon pilot with over 250 hours and I have found an experimental "one man" balloon for sale. I would like to purchase it and put a different envelope of my own design and construction on the system. I think your newsletter may give me some help with the design of the envelope as well as getting the necessary FAA certification.

Richard Buckles
6423 Cole St.
Williamson, NY 14589

Editor's note. I have had a number of queries about one person balloons. My wife and I are both pilots and a two balloon family was necessary to keep me off the ground. I built a small balloon, including basket and envelope, which currently has flown 160 hours. It is a prototype and there are things I would do differently next time. But it does work. If you are interested in some information send me a $1 bill for printing and postage and I will send you some material about my design with an emphasis on the basket. The envelope is a basic half gore pattern.

Bob,
I have been building model balloons for several years. Recently I've become interested in building a manned balloon. This newsletter came along at the right time. I'd be willing to share my experience with design and instrumentation of balloons. I have a design program and a crown temperature sensor that are easy to use.

William P. Gnadt
231 Park Dr. Apt 17
Boston, MA 02215-4722

Bill, I think our readers would be interested in these topics.

Bob,

Exciting First issue! The Akron experimental aeronauts are very excited and you can count on our support. A common question among many homebuilders is how to calculate cable lengths when you have the mouth size and load ring or frame size..
You can expect articles in the future from me for possible use in the newsletter.

Mike Emich
1595 Juniata Road
Akron, OH 44305

Mike, The cable article is coming; stay tuned. We'ew looking forward to your articles.

Bob,

I am now working on a 50,000 cubic foot envelope in conjunction with Mike Emich.

Gary Klein
61 E. Streetsboro St.
Hudson, OH 44236

...I'll try to submit some short articles about my project (AX-5) in the near future.

Paul Tavenier
1624 Hazelaar Way
Lost Altos, CA 94024

Bob,

Wow! Great! Computer program is up and running.

Art Bridge
P.O. Box 123
Mukilteo, WA 98275

Hi Bob

..The newsletter is a great idea. I hope to be able to contribute something useful one of these days.

Launa Sever
3635 64th. Ave. W.
Tacoma, WA 98466

Editor's note. For a number of years Luana ran the only certified repair station-Go Lightly-in the Pacific Northwest. I've learned a lot from her. Thanks, Luana.

Bob,

Looking good, Bob! Hopefully the newsletter will encourage not only more home building but also real product development.

Bill Arras
7843 SW 77th.
Redmond, OR 97756

Read about Bill's new balloon in his article, "A Chilly Reception in Chili," Ballooning Journal, Fall 1993, PP. 24-25.

Bob,

I have several questions I would like to get answers to. What would you charge to consult, by the hour on phone or by fax on pages? ...I'm most interested in basket construction, lite-weight materials, methods and new ideas.

Michael Gross
P.O. Box 590302
Orlando, FL 32809

Editor's note. I am willing to share my ideas with anyone who wishes to pay the telephone bill. I am not willing to charge due both to liability considerations and due to the fact that I am not an expert on many phases of design and construction.

Please don't call just for idle chat. But if you have questions or technical ideas to share I am interested in hearing from you. My home number is (503) 327-2907. Like most of you, ballooning is a hobby and not my livelihood. So I am generally home in the evenings, the Pacific Time zone from about 6 pm to 9 pm.

Space does not permit printing all of the backlog of letters. We will set aside space each issue for letters.

Time has been short, but I am trying to respond to each of you who has written to The Journal.