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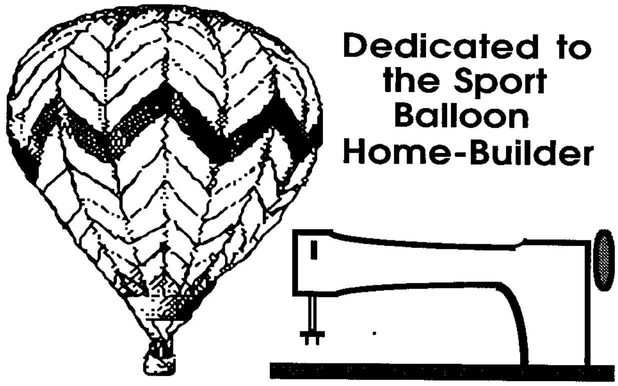

Dedicated to the Sport Balloon Home-Builder

THE BALLOON BUILDERS' JOURNAL

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Feb-March 1997

In This Issue

Up and Coming

In a continuation of our *Gore Pattern Spreadsheet* discussion, we present a curve fit algorithm and discuss some ramifications of this equation. Also, Ken Kennedy shares with us his burner load ring design.

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Balloon Builders Journal has always sought to provide information at minimal cost for ballooning enthusiasts who might not otherwise have the financial means to participate in our exciting sport.

In keeping with that policy, I continue to maintain a supply of back issues at reasonable prices.

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Revisiting The Gore Pattern Spreadsheet

By Bob LeDoux, Editor

2895 Brandi Lane, Jefferson, OR 97352

We address reader questions about designing one's own envelope fabric cutting patterns and some design implications

Why This Article?

A number of readers have asked questions about the *Gore Pattern Spreadsheet* which was presented in Issue #1 of *The Balloon Builders Journal.* Some readers found the original presentation a bit too abstract to follow. This article will attempt to remedy that shortfall. I will review the basic concepts behind that spreadsheet and will examine the relationship between envelope size and volume. This article will also address some reader concerns about the concept of a 'natural shaped' envelope.

The Gore Pattern Spreadsheet is a computer spreadsheet which allows a builder to create fabric cutting patterns to build a 'natural shape' envelope of any desired size.

My original spreadsheet was developed using the natural shape envelope factors developed and published by Justin Smalley in the 1960's. On page 8 is a spreadsheet which includes those shape factors. For those readers, who do not have the original Gore Pattern Article, the original *BBJ* Issue as well as the computer diskette remains available. See the note at the end of this article for more details.

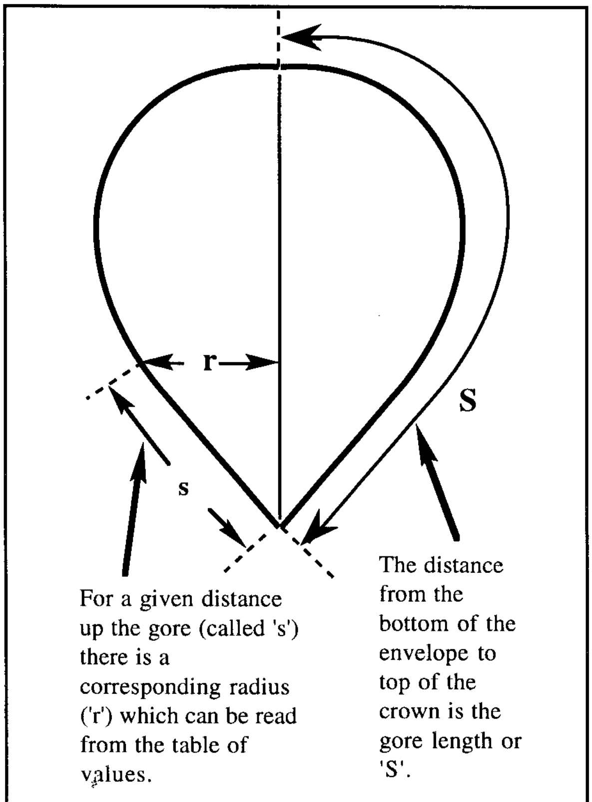


Figure 1: Graphical representation of the Smalley factors.

The Smalley Layout

The Smalley envelope is represented as a closed, three dimensional surface, as shown in *Figure 1.* As a closed surface, the envelope comes to a single point at the top, thus the top has no opening to vent air. The envelope comes to a closed point at the bottom, so there is also no opening for the mouth. (The mouth and deflation port openings are generated by the builder as additional design considerations.)

Figure 1 shows the relationship of the Smalley factors, as printed in columns A and B on page 8. A capital 'S' represents the total length of the envelope surface from the center of the envelope top to the bottom point.

While 'S' represents the total envelope length, it is also divided into 2% (0.02) increments which are labeled as 's' or 'small s'. At each of these 2% stations, the envelope has a corresponding radius which as shown in the column labeled 'r' (column B) on page 8. For example at a point representing 56% up the total length of the gore, the radius of the envelope is 32.691% of the total gore length. (This row of values is highlighted on page 8.)

A Practical Example

In order to put a real world spin on the discussion lets set up a realistic situation. Assume we are building an envelope which will have a volume of 51,000 cubic feet, a reasonable volume for a basic two person balloon. Let's see how the Smalley factors allow the design of such an envelope:

The first task is to compute the dimension for the total gore length, the value of 'S'.

For V, which is envelope volume in cubic feet; gore length, S, in feet is given by the following equation:

$$S = \sqrt[3]{\frac{V}{.12586}} \qquad \text{(Equation 1)}$$

In English this equation says, 'the total envelope gore length, S, is equal to the cube root of the quantity: volume divided by .12586.' If this formula is entered into a computer or calculator the accuracy can be tested as follows: a volume of 125,860 cubic feet, entered for V should generate a value for S of 100.00 feet.

For our two person balloon, 51,000 cubic feet should generate an S value of 74.00 feet.

Based on this value we can now calculate the actual gore values for 's' and 'r'. These values are shown as columns C and D in the spreadsheet on page 8. Each value in column, C, for example, is simply the gore length of 74 feet times the value shown in column A, of the same row. In like manner, the radius, in feet, shown in column D is simply the corresponding value in column B times 74 feet. Simple, so far?

To determine the shape of the fabric surface we need to determine the circumference (c) or the distance around the envelope using the 50 values of radius in column D. We use the formula we all learned in basic high school mathematics:

$$c = 2\pi r \qquad \text{(Equation 2)}$$

where π is the Greek letter pronounced 'pi'

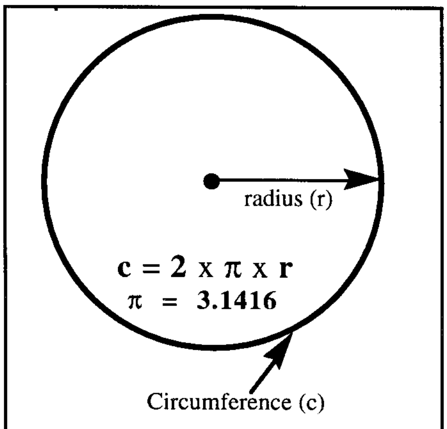


Figure 2: Graphical representation of the relationship of radius to circumference of a circle.

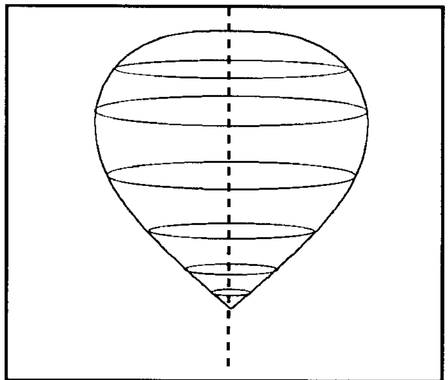


Figure 3: Graphical representation of the circumference at 6 different points in an envelope.

which has a value of 3.1416. This equation says, 'the circumference of a circle is equal to two times pi times the radius.' This relationship is graphically demonstrated in *Figure 2.*

In *Figure 3* I have shown an envelope with the circles representing the circumference at each of six different points up the gore length.

By performing this same calculation at each of the 50, 2% station points in the Smalley table, the circumference of the balloon can be calculated at each of these 50 points up the gore length. This is shown as column E in the spreadsheet. Each value in column E is equal to the value in column D times 2 times 3.1416.

Introducing, *the Gore*

In balloon construction, the envelope is typically constructed from equally sized vertical segments called 'gores.' The shape of each and every gore can be determined by dividing the circumference, at each station, 's', by the number of gores. For example, lets assume our envelope design consists of 8 gores. If this inflated envelope is unrolled, it will look like *Figure 4*, (next page). At this point we see each gore taking on the 'banana shaped' segment which is a characteristic of envelope construction.

Column F, on page 8, is created by taking each value in Column E and dividing it by the number of gores. This gives the dimension of each gore in feet. That result is then multiplied by 12 to convert the feet into inches. The values in column F are dimensions of each gore, actually the sewn gore width in inches.

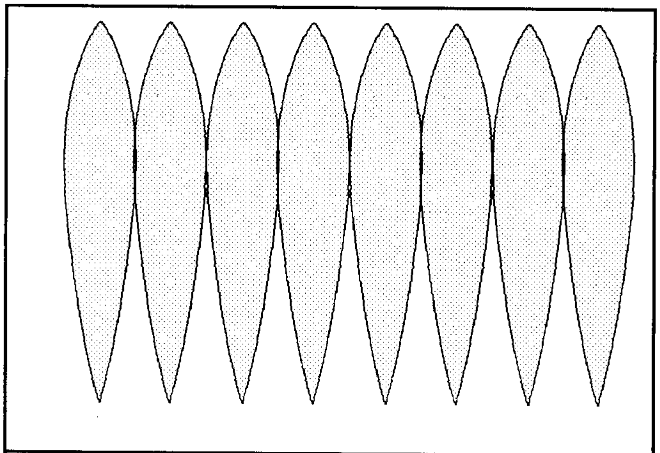


Figure 4: If our envelope were unrolled, evenly sized pieces of fabric, commonly called 'gores' would appear.

Allowing for Seam Construction

If you have followed the discussion up to this point there is another factor to be considered in creating a cutting pattern. The calculations to give the envelope shape in *Figure 4* provides us with the sewn dimensions. But additional fabric is required, on each fabric edge, for a *seam allowance.* The *seam allowance* is the amount of fabric which is taken up in the construction of each seam. This allowance is typically from 1 inch to about 1-$^{1}/_{2}$ inches when folded fell seams are constructed. This allowance must be added to each edge of the fabric to generate the final cutting pattern. *Figure 5* shows typical seam construction, commonly called *French fell* or *folded fell* seams. The bottom drawing attempts to convey the fabric lost in seam construction, the seam allowance, as the thick line.

Column G, on page 8, creates the cutout pattern by taking column F and adding twice the seam allowance. This gives the final cutting dimensions, for an 8 gore envelope, assuming a seam allowance on each vertical fabric edge.

This, in a nutshell, is the concept behind *The Gore Pattern Spreadsheet.* I hope this discussion makes the calculation sequence clear. If you have followed the steps above, you should be able to take the Smalley factors found in columns A and B on page 8, and create your own envelope calculations using a computer program or even a ledger sheet.

At this risk of providing confusion, I should note one additional difference between the spreadsheet shown on page 8 and the one shown in the original *BBJ* article. I designed the original *Gore Pattern Spreadsheet* to generate a vertical pattern like the Aerostar 'S' series envelopes. In this type of envelope, each gore is constructed from two vertical panels of fabric, often called *half gores.* The seam between the panels creates a line down the center of the gore, and each panel is curved on its outside edge to give the gore shape.

With the 'half gore' method, the maximum width of a half gore is typically limited by the width of the fabric, as it is rolled off the roll. In effect 16 long pieces of fabric would be combined to produce 8 gores.

Gore Length, Surface Area, and Volume

In order to make practical use of the spreadsheet it is worthwhile understanding the relationship between changes in gore length and the size of the balloon. Let's look at how envelope surface area and volume change.

The equation for the gore length, in *Equation 1*, above, can be turned around as follows.

The volume of an envelope, V, measured in cubic feet is a function of the gore length S, measured in feet according to the following equation:

$$V = 0.12586S^3 \qquad \text{(Equation 4)}$$

This says "the volume is equal to the gore length, cubed, times .12586."

In addition to volume its useful to know the surface area of an envelope. The area is

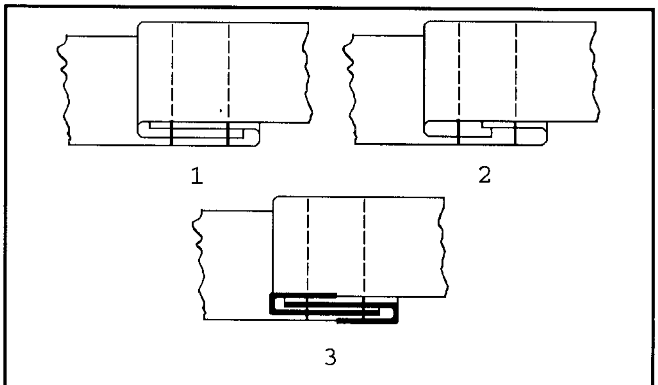


Figure 5: Drawings 1 and 2 show variations in the *French Fell* or *folded fell* seam, commonly used for envelope construction. The highlighted lines in drawing 3 represent the fabric contained within the *seam allowance.*

	Gore Length (in feet)	Surface Area (in square yards)	Envelope Volume (in cubic feet)
For a gore length of 20 feet	20	55	1,007
For a gore length of 40 feet	40	220	8,056
For a gore length of 80 feet	80	880	64,448

Figure 6: Note how the change in gore length impacts surface area and envelope volume. If the gore length is doubled, from 20 feet to 40 feet, the surface area increases times 4, and the volume increases times 16.

If we quadruple the gore length, from 20 feet to 80 feet, the surface area goes up by 16 times and the volume, and lifting force, goes up by 64 times. Clearly, a larger balloon is more efficient in the use of fabric and the lifting force which is generated.

measured in square yards.

The area of an envelope, A, measured in square yards, is a function of the gore length, S, measured in feet, according to the following equation:

$A = 0.13729S^2$ (Equation 5)

This equation says, The Area is equal to the value .13729, times the quantity, gore length, squared.

The table in *Figure 6* shows what happens to envelope surface area and volume as the gore length is changed from 20 feet to 40 feet and then to 80 feet.

This relationship is further detailed in *Figure 7* on page 7, which shows the relationship of surface area and volume for gore lengths from 10 feet through 100 feet.

The Smalley Factors for Height

Again, on page 8 are shown the Smalley factors for gore length and radius in columns A and B of the spreadsheet. I have included an additional set of factors not included in the original Gore Pattern Spreadsheet article. The 'h' factor, in column "I' represents the height at which each of the radii occur. For our application, the most important factor here is the value of .6439. The overall height (H) of the envelope is equal to 64.39% of the gore length.

Because most of my readers are living in the USA, I have chosen to use the "English" measurement system rather than the metric system. I hope my metric readers will forgive me. If you convert the *Gore Pattern Spreadsheet* into metric units, you will have a much easier time of layout. For example, my last envelope had a vertical distance between the 2% (s) stations of 1.395834 feet. Try to convert that into feet, inches and sixteenths of an inch! Its a lot easier when the result is treated as 425.45 millimeters or .42545 meters.

Concerns about Layout Accuracy

A number of readers have written to ask questions about the importance of accuracy in layout and construction of homebuilt balloons. Their basic concern was that small errors in layout, cutting and sewing might result in an envelope which is not 'natural shaped.'

I feel the importance of precision can be exaggerated. While some builders may have the image of a 'natural shape' as representing a single set of proper factors, there are a number of reasons why we have considerable freedom in the application of this theory. To make this a little clearer let's look at a bit of history:

Smalley's work on 'natural shaped' envelopes came about because of problems with stratospheric scientific balloons during the late 1950's. A unacceptably high percentage of these balloons were rupturing during flight, preventing completion of the scientific missions. These balloons sometimes had an envelope volume of several million cubic feet, carried payloads of over 2,000 pounds to altitudes of over 100,000 feet.

Smalley was one of a number of scientists looking for an answer to this problem. Some of these scientists thought there must exist an optimal envelope shape which would minimize the loads across the envelope surface. Application of such a theory should lead to fewer envelope ruptures. In fact, the successful calculation of the natural shape envelope helped contribute to a significant reduction in the envelope rupture rate.

Underlying scientific balloon design was the fact that a small failure rate was acceptable. An occasional balloon rupture was accepted. The tradeoff was one of economics and payload. By designing envelopes with limited strength reserves, lighter, less costly materials could be used in low stress areas of the balloon, allowing the weight savings to be applied to increased payload, reduced helium use, or higher cruise altitude.

This may be true for scientific balloons, but human carrying balloons must always have a 0% failure rate. Sport and recreational balloons, are also required to continue to have a 0% failure rate over hundreds of hours of operation.

Thus our envelopes are constructed with significant strength reserves, and these strength reserves are monitored through routine testing and inspections. Under these design parameters, whether our envelope is a true 'natural shape' contributes less to overall safety.

Providing evidence of this position is the existence of 'special shaped' envelopes. If the natural shape were so critical to safe flying, no castles, nor dragons, nor arks, nor shopping carts would be flying though the air.

(Actually, many special shape envelopes have natural shape structures with extra inflatable bladders to give that special shape.)

Natural Shaped: Not What it Seems to Be

The fact that an envelope is cut to a natural shape does not mean it remains so in flight. Nylon fabric, in particular, has significant elasticity. One nylon fabric I recently purchased was rated for a 25% elongation (stretching) before failure.

The variation in stress upon the envelope surface varies across its face, with vertical forces generally assumed to be highest above and around the equator, and diminishing down towards the mouth. These variations in load result in greater 'stretching' of the envelope in the higher stress areas. These variations result in an envelope shape which is not the same as the theoretical shape from which the envelope was first cut out.

Additional factors impact real envelope shape. For example the amount of payload impacts the envelope shape. Two identical balloons, flying side-by-side, will have different shapes if one balloon has a light load and the other has a heavy load.

This distinction is most evident as we watch a balloon preparing for flight. Immediately after the hot inflation, we witness an elongated envelope with a narrow diameter. Then as the payload is loaded and the balloon is taken to takeoff equilibrium, an entirely different shape is seen. The envelope becomes quite oblate, 'fat' as its were, no longer the 'tall, skinny' shape first witnessed.

Envelopes also alter their shape during maneuvers. Watch an envelope change shape as a balloon makes a rapid ascent or a terminal descent. Clearly the shape of an envelope in flight varies from its cut pattern.

Considerations for the New Builder

This discussion suggests that one can be overly concerned about envelope 'shape.' Practically speaking, there is no, one, perfectly shaped envelope. But for the builder, especially the novice, there are some other ramifications to this position.

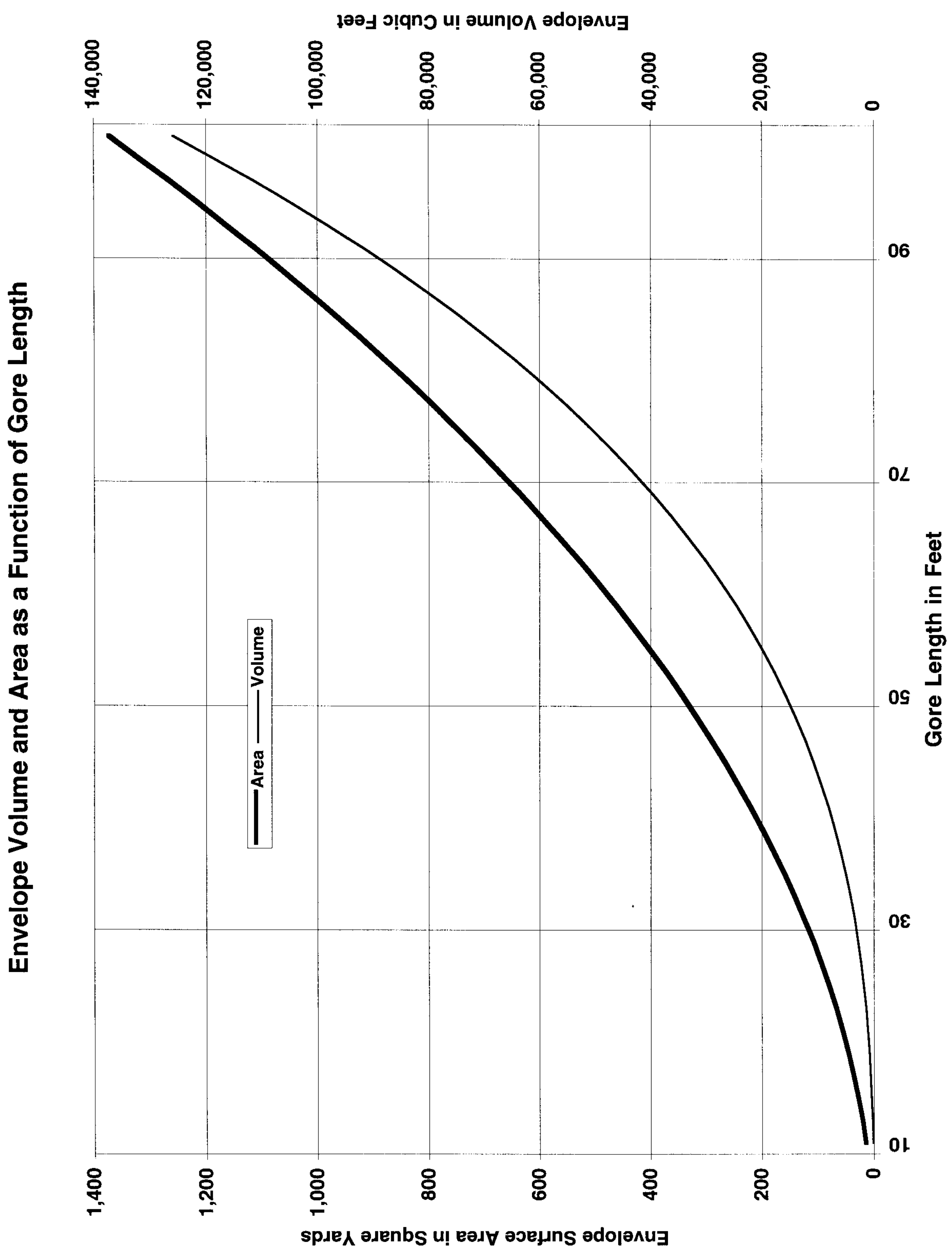
Nylon fabric is probably a better choice for the amateur builder than polyester fabric. Nylon is significantly more elastic than polyester, thus it is able to stretch and change shape, to a greater degree before it fails. This increased flexibility should more effectively negate the cutting and construction inconsistencies likely to occur in amateur construction. Nylon is also less expensive and more readily available.

The fact that there may be no perfectly shaped envelope does not mean a builder can be sloppy in construction techniques. Local disturbances to smooth construction still represent a key for potential failure.

One of the classic articles on this topic was written by engineer and former national champion Dave Schaeffer. His article was "Fabric Strength and Tear Propagation," *Ballooning*, September-October 1981, pages 4-7. Every balloon builder should read this article.

Regarding Issue 1 of BBJ

The original issue of *Balloon Builders Journal,* with the article on the *Gore Pattern Spreadsheet* remains available for $2. For those who wish to avoid creating the spreadsheet, a computer diskette can be ordered, for $5, which has the completed program. These costs include postage.


Envelope Volume and Area as a Function of Gore Length
Envelope Volume in Cubic Feet
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
Envelope Surface Area in Square Yards
0
200
400
600
800
1,000
1,200
1,400
Gore Length in Feet
10
30
50
70
90
Area
Volume

	A	B	C	D	E	F	G	H	I
2	**Balloon Gore Layout**								
3									
4	**VOLUME**		**51,000**	Cubic Feet		Gore Length			
5	**SEAM ALLOWANCE**		**1.00**	Inches		74.00			
6	**NUMBER OF GORES**		**8**						
7									
8		Radius	Gore		Circum-	Sewn	Cut		Height
9	s	r	Station	Radius	ference	Gore	Gore		h
10			Feet	Feet	Feet	Inches	Inches		
11	1.00	0.00000	74.00	0.00	0.00	0.00	2.00		0.64390
12	0.98	0.02000	72.52	1.48	9.30	13.95	15.95		0.64388
13	0.96	0.04000	71.04	2.96	18.60	27.90	29.90		0.64368
14	0.94	0.05999	69.56	4.44	27.89	41.84	43.84		0.64316
15	0.92	0.07997	68.08	5.92	37.18	55.77	57.77		0.64215
16	0.90	0.09989	66.60	7.39	46.44	69.67	71.67		0.64048
17	0.88	0.11974	65.12	8.86	55.67	83.51	85.51		0.63800
18	0.86	0.13944	63.64	10.32	64.83	97.25	99.25		0.63456
19	0.84	0.15891	62.16	11.76	73.89	110.83	112.83		0.63001
20	0.82	0.17805	60.68	13.18	82.78	124.18	126.18		0.62422
21	0.80	0.19673	59.20	14.56	91.47	137.21	139.21		0.61709
22	0.78	0.21480	57.72	15.90	99.87	149.81	151.81		0.60854
23	0.76	0.23210	56.24	17.18	107.92	161.87	163.87		0.59851
24	0.74	0.24844	54.76	18.38	115.51	173.27	175.27		0.58699
25	0.72	0.26364	53.28	19.51	122.58	183.87	185.87		0.57400
26	0.70	0.27751	51.80	20.54	129.03	193.54	195.54		0.55961
27	0.68	0.28989	50.32	21.45	134.79	202.18	204.18		0.54391
28	0.66	0.30064	48.84	22.25	139.78	209.67	211.67		0.52705
29	0.64	0.30962	47.36	22.91	143.96	215.94	217.94		0.50919
30	0.62	0.31677	45.88	23.44	147.28	220.92	222.92		0.49052
31	0.60	0.32203	44.40	23.83	149.73	224.59	226.59		0.47123
32	0.58	0.32540	42.92	24.08	151.30	226.94	228.94		0.45153
33	**0.56**	**0.32691**	**41.44**	**24.19**	**152.00**	228.00	**230.00**		0.43159
34	0.54	0.32662	39.96	24.17	151.86	227.79	229.79		0.41160
35	0.52	0.32461	38.48	24.02	150.93	226.39	228.39		0.39170
36	0.50	0.32100	37.00	23.75	149.25	223.87	225.87		0.37204
37	0.48	0.31591	35.52	23.38	146.88	220.32	222.32		0.35270
38	0.46	0.30945	34.04	22.90	143.88	215.82	217.82		0.33378
39	0.44	0.30175	32.56	22.33	140.30	210.45	212.45		0.31532
40	0.42	0.29295	31.08	21.68	136.21	204.31	206.31		0.29737
41	0.40	0.28316	29.60	20.95	131.66	197.48	199.48		0.27993
42	0.38	0.27251	28.12	20.17	126.70	190.06	192.06		0.26301
43	0.36	0.26109	26.64	19.32	121.39	182.09	184.09		0.24659
44	0.34	0.24900	25.16	18.43	115.77	173.66	175.66		0.23066
45	0.32	0.23633	23.68	17.49	109.88	164.82	166.82		0.21518
46	0.30	0.22317	22.20	16.51	103.76	155.65	157.65		0.20012
47	0.28	0.20959	20.72	15.51	97.45	146.17	148.17		0.18544
48	0.26	0.19564	19.24	14.48	90.96	136.44	138.44		0.17111
49	0.24	0.18139	17.76	13.42	84.34	126.51	128.51		0.15707
50	0.22	0.16689	16.28	12.35	77.60	116.39	118.39		0.14330
51	0.20	0.15218	14.80	11.26	70.76	106.13	108.13		0.12975
52	0.18	0.13730	13.32	10.16	63.84	95.76	97.76		0.11639
53	0.16	0.12228	11.84	9.05	56.85	85.28	87.28		0.10318
54	0.14	0.10716	10.36	7.93	49.82	74.74	76.74		0.09010
55	0.12	0.09195	8.88	6.80	42.75	64.13	66.13		0.07710
56	0.10	0.07669	7.40	5.68	35.66	53.49	55.49		0.06418
57	0.08	0.06138	5.92	4.54	28.54	42.81	44.81		0.05130
58	0.06	0.04605	4.44	3.41	21.41	32.12	34.12		0.03846
59	0.04	0.03071	2.96	2.27	14.28	21.42	23.42		0.02563
60	0.02	0.01535	1.48	1.14	7.14	10.71	12.71		0.01282
61	0.00	0.00000	0.00	0.00	0.00	0.00	2.00		0.00000

Letters to the Editor and Other Bits of Information

Gluing Silicone Coated Fabric

Bob:

I want to share with you and the readers of *BBJ* a method I have developed for cementing silicone coated fabrics. These include that unnamable 1.3 ounce double silicone coated rip-stop nylon parachute fabric used by many amateur builders, including me.

One day a few years ago I was sitting at my desk at Cameron Balloons U.S. thinking about what might stick to silicone coating. At the time I was interested in the general problem of temporarily fastening artwork on Cameron's silicone coated Hyperlast™ fabric.

It seemed that a material similar to the coating itself might molecularly bond to the coating. I didn't have a convenient source for silicone coating material, but it occurred to me that silicone sealant might be close enough.

I bought a tube of *Dow Corning Clear Silicone Sealant* at my local hardware store and set about preparing several test strips.

First, I cleaned each mating surface with tricloroethane (dry cleaning solvent). Second, I applied the Silicone Sealant to each of the mating surfaces. Third, I squeegeed all but a very thin film of the Sealant off each surface. Finally, I pressed the two surfaces together with a one inch overlap, and weighted the joint.

After 24 hours I tested the joint on Cameron's fabric tensile testing machine. The fabric failed just off the end of the overlap, at a tensile strength equal to that of the fabric itself. The second sample did the same.

Subsequently, I determined that about 30 minutes drying time is enough to develop adequate strength for handling.

The bad news is that Dow Corning Silicone Sealant is not intended as an adhesive and is not at all sticky until it dries. So you cannot just smear this stuff on the fabric and stick it together. It simply won't stick. After applying the Sealant, you must carefully position the joint and apply even pressure to the joint while it is drying.

I have used open-cell foam backed up by wood blocks and weights. I recently did such a repair to a balloon I have just built (and ran into a tree landing at sunset flying away from the last road, etc.). The 10"-long rip was at a location in the envelope that would have been a lot of work to repair using traditional methods. I am confident that this repair duplicates the original strength of the balloon knowing the durability of silicone coating.

I hope others find this information useful.

Bruce Comstock
73112.1104@compuserve.com

Thank you Bruce. I am curious about the strength of this system when other variables are considered. For example how do the seams hold up with repeated packings into an envelope bag? Will the seam strength continue to exceed fabric strength after 50 or 100 or 400 hours? How do high temperatures affect the seam strength? The use of adhesive is clearly worth more investigation. -Editor.

Various Topics on Sewing

Reader Phil MacNutt, and your editor had an exchange regarding sewing machine and stitching issues. I thought this information would be of interest to the readership.

24 Sep 96
Subject: Needles

Bob,

[The] new balloon is coming along; parachute finished, with a few gores sewn together.

Sewing question: what needle size have you been using?

I have always used 18, but I am using some 1.9 oz. fabric (first time for me) on the bottom of this balloon, and it is very puncture resistant, and the 18's have a hard time going through. They tend to "deflect" toward the center as they are punching through, and thus, the machine starts skipping stitches (the hook does not come close enough to the needle to pick up the top thread). If I put in size 21 needles, it runs perfect. The problem is that when I transition to the 1.3 oz. fabric, I then feel like I need to swap back to the size 18 needles. I did run some test 1.3 oz fabric using size 21 needles and the stitch looks fine. Do you think there is anything wrong with sewing the whole balloon (i.e. the 1.3 oz seams) with size 21 needles?

Also, do you run your thread over the tops of the pins on the tension discs on your 112W[Singer sewing machine]?

I built my whole first balloon that way, but for some reason now, I am shredding thread on the left side unless I take the thread off the pin and just run it through the discs. I am using thread from a different vendor on this balloon. Paul Stumpf uses a 112W, and he told me that he runs his either on the pins or off, depending on the mood of the machine.

Have you ever have problems such as this?

Phil MacNutt

9/25/96

Phil,

I have been using #18 needles for folded fell fabric seams in both 1.3 or 1.9 ounce fabric. For seams which include a load tape, the 18 continues to work in the 1.3 ounce fabric but I generate loose loops in my top stitch if I don't go to at least a size 19. Typically, a size 21 is appropriate for size 16 thread, and I use size 24 thread (fed spec 'E') or #69 for all of my sewing. I use the size 16 thread, which is fed spec 'F,' typically for 4-point 'W's' in the mouth-cable assembly when replicating to Aerostar specs.

Your machine can be adjusted for a range of needles. Mine, for example, has the hooks set to do a good job of sewing #14 through #19 needles. My right needle will handle #20 needles, but my left hook 'clicks' on the needle–its set too close. Your machine, on the other hand, has a wider spacing between the needle and the hook tips, thus you can handle the larger #21 needles

Be careful you don't confuse the thread size and the needle sizes in the above discussion.

On my Singer 112W sewing machine, I thread according to the original "User and Adjusters Manual." It may answer your questions and helps avoid those expensive visits to a sewing repairman.

My experience is that there can be a number of reasons for fraying of thread. Be certain to buy premium thread. I prefer something like American Thread's Star Ultra D, a bonded polyester thread. I prefer to use bonded rather than soft thread, which is less susceptible to fraying. Threads can be purchased in left or right hand twist. Left hand twist must be used for the needle threads or it will unravel as it is fed. Either thread can be used for the bobbins.

My thread sits on a spool post, which holds three 1 pound thread spools. The threads then run through the little post on top of the machine and into the two little rods above the tensions. The thread can run down, back up and then down through the three holes. Some seamstresses prefer to run the thread down through the first hole, around the rod and down through the last hole.

Fraying suggests the possibility that you have a rough spot somewhere in your thread path, check that out.

Occasionally I run into a reel of thread which is poorly twisted so that it has a tendency to fray. If it becomes a problem, I use that thread for bobbin stock.

This suggests exchanging the spool of thread which is fraying for another spool to see if the problem goes away.

Bob

26 Sep 96
Subject: thanks for response

Bob,

Thanks for taking time to explain needles and thread!

I have figured out why "all of the sudden" my size 18 needles are not working so well. With my new balloon, I am using BONDED 69, instead of standard "Twistlon 69" soft thread which I used on my first balloon (thread provided by Brian). I took the two threads to work and inspected them under a Nikon scope at 40X with a linear .001" reticule.

The bonded 69 averaged about .004" bigger in diameter than the soft 69. This is why I had to go up a needle size and why my tensioning needs changed. Other than the diameter, the two threads looked identical, both left twist and both comprised of three major strands. I called "Threads USA" in Gastonia, NC and asked them about the difference between their Twistlon and bonded thread. They said the bonded has a coating that "is good for applications where abrasion is a factor". Sounds to me like we need to be using bonded...Their price is $15 a pound for white.

Anyway, thanks again, and I'll update you on my materials testing progress.

Phil

9/30/96

Phil,

I know Aerostar calls for soft and not bonded thread. I have always used the bonded because it is apparently less likely to fray. Since about 8 inches of thread have to pass back and forth through a needle for each stitch, that can become a factor in sewing nylon fabric.

I wonder if the soft thread would result in fewer stitch problems in our construction? Smaller needles may be one benefit, and it may form a tighter stitch in the thin fabrics that we sew together.

Bob

22 Oct 96

Bob,

I have some new information on thread. After what I have learned, I think an article on thread would be an excellent idea for a future newsletter. Think you could put something together?

Remember I wrote you about the two threads I had, one was about .004" bigger than the other (both were 69s)? I thought that the small one was soft and the thicker one was bonded. Not true. Both were bonded. I called "Threads USA" and found that my Twistlon was bonded ("bst" on the label instead of "sst"), and that my new thread (also bonded) is probably just not as tightly controlled as far as diameter at the factory.

They said that bonded or not, the threads should be the same diameter. The thicker thread I have feels coarser/rougher and was causing all the problems with my machine (shredding thread, etc.). As soon as I switched back to Twistlon, I could go back to the 18 or 20 needle and everything has run excellent since.

The number "69" is an American number, known as the "ticket size" for the thread. The international standard is called the "Tex" number. For Twistlon 69, the Tex number is "T-70", or just 70. The label on the Twistlon contains the color, color number, Tex number, ticket number, bonded/soft identifier, quantity, and weight.

Threads USA can be reached at (704) 867-7271. They are in Gastonia, NC. If you buy less than 5 pounds, they will refer you to an outlet called "Kaplin". Their number is 800 852-3201. $16 a pound is a pretty good deal from what I have found. They also carry the polyester that you use.

P.S. I performed multiple pull tests on both my threads (the Twistlon and the thick stuff), and they both broke at exactly the same average pull, about 8.5 pounds. I feel that either thread is suitable for building, but the Twistlon just runs better in the machine.

I found that I had to be very careful during the pull to get accurate results. When testing thread like this, you must roll the thread around a cylinder, and then attach the cylinder to the clamps. This holds true for load tapes and any other fabric type materials when doing tensile testing.

01 Oct 96
Subject: Re: bonded thread

Bob,

Since I have emailed you last, I have purchased some size 20 needles, and they seem to be working very well. I also took the plunge and made my first major adjustment to "Emma" (my 112w Singer sewing machine). I found that the hook on the right side (the one that was skipping stitches) was about .010" farther from the needle than the left. I found my "Adjuster's Manual" and with both anxiety and excitement, followed the instructions for setting the hooks. Since then, I have had no problems with the stitch.

Pretty sad when setting sewing machine hooks is exciting...

Anyway, it appears that I will be able to finish the balloon with #20 needles and bonded 69 thread.

I too, like the bonded thread better because of the abrasion resistance (dragging envelopes on parking lots, etc.)

Phil

My basic rule is to use the smallest size needle which provides consistent stitching in my seam system. As noted above, I typically can use a size 18 needle until the fabric/tape combination gets too heavy, then I need to go to the larger size 19 needle. Your experience may be different.

We have yet to do an article on sewing machines, needles and thread. Readers are invited to submit material to be consolidated into an article. Phil,- let's get to work on this article-Editor