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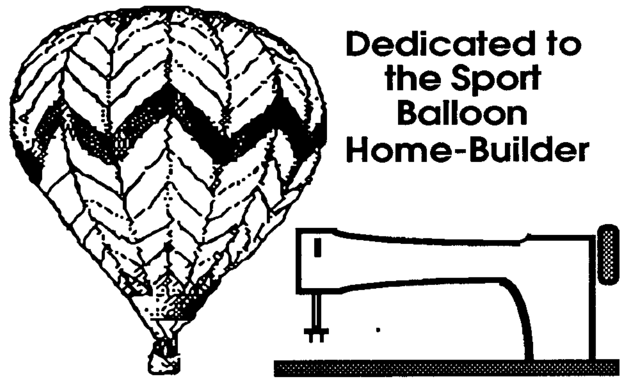

Dedicated to the Sport Balloon Home-Builder

THE BALLOON BUILDERS' JOURNAL

July-August 1993

Editor's Comments

By Bob LeDoux

This newsletter is dedicated to those of you who believe that designing and building sport balloons is fun and rewarding.

I remember my first experience at balloon building. For me the move from airplane building was traumatic. The macho skills of welding steel and riveting aluminum were replaced with sewing and basket weaving. The airplane engine was replaced by a propane burner. But the greatest challenge came from the lack of balloon building information. As an airplane builder I could choose from dozens of plans and kits with a myriad of instructional and informational sources. But as a balloon builder I found almost nothing. The only relevant material was from a few balloon books written for the popular press; the balloon repair manuals produced by the various manufacturers; and conversations with repair station operators. I still remember how I learned to sew folded fell seams from a Raven promotional video tape. A few seconds of tape showed a seamstress operating a sewing machine. I played those few seconds over and over again before trying the seam on a sewing machine.

Today there is still a lack of builder's information. Repair manuals have gotten better, but most information is shared by word-of-mouth. Little is written with the builder in mind.

This seems strange considering the economics of our sport. We recently built a new 77,500 cubic foot envelope with a complex south-west Indian blanket pattern design. That envelope cost us about $2,800. Today, when a new balloon very easily costs $20,000 the builder can just as easily put together a sport balloon system for a third of that price.

This newsletter is intended to fill the information void; to provide a forum for the exchange of ideas, and to share the efforts of individuals who have undertaken the building their own balloons. We ask readers to contribute in two ways. If you have been successful in building a balloon, share your experiences with others. Write up your experiences for submission to this newsletter. Secondly, help defray costs for this newsletter with a small contribution. To test the market for this newsletter I am prepared to commit to four issues for the cost of $12. These four issues will feature my perspective on the basic information required to design and construct a balloon envelope. As you will note some of this is not light reading matter. Some material requires study. But it reflects the tools and knowledge I feel one has to develop as a novice balloon builder. I hope tools that worked for me will prove useful to you.

The Novice Builder: Part 1, Gore Pattern Computer Spreadsheet

By Bob LeDoux

Create this computer spreadsheet, a basic tool of the home-builder. Enter three numbers; volume, number of gores and seam allowance to create an envelope of any desired volume.

The following material is not light reading. But the concepts are really quite simple. With a little study you can develop a basic tool for balloon design.

A most basic tool used by the balloon home builder is a "gore layout program." This program creates the pattern which the builder uses to cut out the fabric gores for an envelope. If the builder is interested in copying an envelope of standard size and design, he or she can go to a repair manual to get this information. For example, the Aerostar *Instructions for Continued Air Worthiness* manual displays gore patterns. Using this information one can construct a replica of a factory produced aircraft. But if the builder wants to design an unusual balloon size, or perhaps vary the number of gores from a manufacturer's specification, then a gore layout program is an essential tool.

The following gore layout program is a computer spreadsheet which utilizes envelope design factors generated by Justin Smalley back in 1963[1]. Dr. Smalley was associated with General Mills, which at that time was involved in stratospheric research utilizing high altitude balloons. As I understand it Smalley's research was part of a greater body of research on balloons at that time. His focus was on development of an envelope shape which would minimize the stress loads in the horizontal or circumferential direction and concentrate these loads in the vertical direction. By doing so it was thought that the strength reserve of the envelope would be improved. His work led to the development of the *natural shape* envelope commonly used by balloon manufacturers today.

[1]Justin H. Smalley, Determination of the Shape of a Free Balloon: Balloons with Zero Superpressure and Zero Circumferential Stress. General Mills, Inc., Electronics Division. Report No. 2500. Contract AF 19(628)2783. Scientific Report No. 2 (December 31, 1963).

The development and use of this computer spreadsheet covers most of this newsletter. Included in this issue are this article which describes the spreadsheet in general terms and also discusses how the gore pattern is laid out and its relationship to the overall envelope. The reader will also find a sample spreadsheet and a table which provides detail instructions on how to create the spreadsheet. In future issues we will build on the concepts presented here as we take on the building of an envelope.

The spreadsheet will accurately size a pattern for any convenient envelope volume. To achieve the desired gore pattern, the builder must enter three values; the desired envelope volume in cubic feet, the number of gores in the envelope, and the seam allowance required for sewing. Detailed instructions for making this worksheet are shown in Table 1. What follows is a brief discussion about the worksheet and its use.

Considerable analysis and numerous comparisons have been made using this program. Your editor has designed and built a balloon using this tool. Castaway has been described in a couple of nationally published articles.[2] Competition pilot Bill Arras recently used this spreadsheet to complete an AX-6 with which he has flown in a number of foreign countries. The envelope design has a very pleasing line. When compared to other manufactured balloons, like the Aerostar "S" series of envelopes, the shape the manufactured balloon very closely follows the lines created by the computer spreadsheet. The computer spreadsheet creates an envelope slightly thinner at the equator and a bit longer.

To The New Spreadsheet User

Let's begin by reviewing the spreadsheet which is shown as table 2, on page 8. The example was generated in Microsoft *Excel* for

[2]Photos of both of the authors' home-built balloons can be found in “Have You Tried a Small Balloon?”, *Balloon Life*, April 1992, Volume 7, No. 4, pages 42-45.

the Macintosh. It can be converted to an IBM compatible DOS machine if the reader so wishes. For readers who don't wish to generate their own spreadsheets, we offer computer disks at reasonable cost in both the Macintosh and PC formats.

In typical convention, each row of the worksheet is numbered and each column is lettered. An individual cell in the sheet can be identified by a number and letter. For example we find the title "Gore Length" in cell G3. Following the *Excel* convention a block of cells can be identified using the colon ":". For example the highlighted row of cells corresponds to the block A32:H32.

In **bold text** at the upper left of the sheet are the only three numbers which must be entered to generate the desired envelope pattern:

User Entries

The *Volume* is in cubic feet. Our example uses 125,860 cubic feet because it creates a

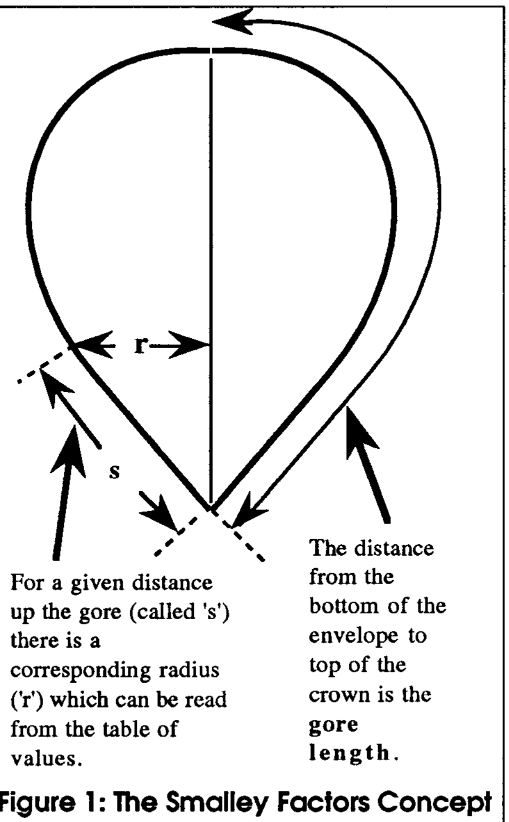

Figure 1: The Smalley Factors Concept
For any given envelope volume there is a unique gore length. That gore length then defines a set of values for 's' and 'r'.

sample gore length of 100 feet. This value simplifies an explanation of the spreadsheet. The gore length is the value which appears in cell G4. It is calculated from the desired volume by the following equation. "Gore length is equal to the cube root of the envelope volume divided by the number .12586".

The *Seam Allowance* is in inches. This is the amount of fabric which is lost as each seam is sewn. For our example, we have chosen 1.00 inches to simplify explanation. Aerostar, for example, constructs their envelopes using a folded fell seam with a seam allowance standard of $1^1/_8$ inches or 1.13 inches.

The *Number of Gores* denotes the number of vertical gores. This spreadsheet applies the style of envelope seen in the Aerostar "S" series construction which uses two half-gores for each gore. For convenience, 24 gores are used in this example, which means 48 half-gores are actually required. More detail about this is presented later.

Overview

To understand how the spreadsheet and Smalley factor's work look at figure 1. The Smalley factors describe an envelope which is closed both at the top and bottom. The total gore length is equal to the distance from the bottom of the envelope to the top of the crown. Based on this length, the Smalley factors define the radius (r) of the envelope at points (s) along the gore length.

From high school math we remember "radius" from our study of circles. Since balloons are round, in the horizontal plane, we can use the radius to determine the distance around or the circumference of the balloon. The diameter of the balloon is twice the radius. Then the circumference is equal to the diameter times pi or 3.1416. Our "cutting out" gore pattern is generated by simply dividing the circumference into a number of equal segments. That's it in a nutshell.

Each row of data on the spreadsheet corresponds to a point on the gore length and the radius of the envelope at that point. The points along the gore length (s) are shown in column A of the worksheet while column B shows the radius (r) of the envelope at the corresponding gore length.

As previously mentioned we have assumed an envelope volume of 125,860 cubic feet (in cell C3) because this volume generates a gore length of 100 feet. For our explanation we have chosen row 32 of the worksheet. That row of numbers is identified in **bold** print for easy reference. In column A is the value ".56" which refers to a point up from the bottom of the envelope 56% of the total length. This refers to a point 56 feet up the gore which is 100 feet long. At this point, the envelope has a radius of ".32691" (in column B) or a radius of 32.691% of the gore length of 100 feet. The radius is 32.691 feet at station .56.

These values of 56 feet up and the radius of 32.69 feet are actually seen in cells C32 and D32, respectively. Because a gore length of 100 feet was chosen, each value in column C or D is 100 times as big as the value on the row in columns A or B, respectively. Thus, by changing the total gore length from 100 feet to a different value a proportionately larger or smaller set of envelope stations and radii are generated in columns C and D, respectively.

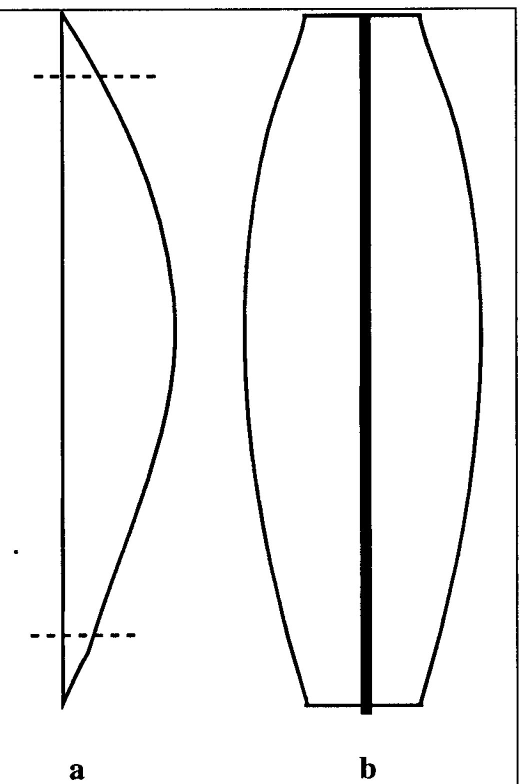

Figure 2: "a" displays the shape of a half-gore created by the spreadsheet. Dotted lines note cutoffs made to create a deflation port and mouth. "b" displays how half-gores are sewn together to create a gore. The heavy line denotes a vertical load tape.

While only columns C and H are required to make the gore pattern layout we have included columns D, E, F and G to simplify spreadsheet construction and to make it easier for the reader to understand the calculations taking place.

Column E generates the diameter of the balloon, in the horizontal plane, using column D. The diameter is twice the radius shown in column D. A radius of 32.69 feet in cell D32 generates a diameter of 65.38 feet in cell E32.

Column F generates the circumference of the balloon in inches. To generate this value, the corresponding value in column E is multiplied by 12 to change the feet to inches. It is then multiplied by pi (π=3.1416) to generate the circumference. (Inches are used because the actual gore cutout pattern will be displayed in "inches" in width and "feet" in length.). In row 32, the diameter of 65.38 feet found in column E calculates a circumference around the balloon in the horizontal plane of 2,464.85 inches, which is shown in cell F32.

We call column G the "Sewn Half Gore" dimension. For each gore, the distance between load tapes consists of the two vertical fabric panels, called half-gores. To convert the circumference of the envelope into half gores, we divide the circumference by the number of gores times 2. For row 32, the sewn half gore dimension in cell G32, (51.35 inches) is calculated by dividing the circumference in cell F32, (2,464.85 inches) by the number of gores (24) times 2 or 48. The number of gores is the value chosen by the spreadsheet user and entered in cell C5. The number in cell G32 (51.35 inches) actually represents the distance between the center of adjacent vertical seams.

Column H displays the actual cutting dimension for the gore pattern. The number in cell H32 is 53.35 inches. This value is equal to cell G32, (51.35 inches) to which is added the seam allowance in cell C4 (1.00 inches) multiplied by 2. We multiply by 2 because each vertical edge of the half gore has a seam allowance.

For our explanation we chose row 32 in the spreadsheet. Every other row from row 10 through row 60 performs the same set of calculations. The actual gore length stations are shown in column C and the width of the gore pattern at each station is shown in column

H. If you actually layout these dimensions on a pattern, you generate the shape shown in figure 2(a). When building a real envelope a deflation port would be created by cutting off the gore at the top, and the mouth of the envelope would be generated by cutting off a portion at the bottom. In our example, building an envelope with a volume of 125,860 cubic feet, we require 48 half gore pieces, each about 86 feet long. At station .56 (row 32 on the spreadsheet), the gore section is at its maximum width of 53.35 inches, which would fit conveniently on a standard width piece of balloon fabric, 60 inches wide.

Before we apply the spreadsheet to actual use, look at how the gore patterns fits into an envelope design.

Figure 2(b) shows a style of construction typified by the Aerostar "S" series of envelopes. Each gore consists of two half gores with the warp (the fabric length) running the full length of the half gore. The selvage edge (the uncut, straight edge) of the fabric is matched to the load tape. Thus our sample balloon would consist of 24 gores, each like the drawing in figure 2(b).

Using the Spreadsheet

To create a gore pattern for the half-gore style of construction begin by entering the desired volume in cubic feet in cell C3 and the seam allowance in cell C5. For the seam allowance, a typical folded fell using a 3/8 inch gauge needle would require an allowance of $1\,{}^{1}/_{8}$ inches or 1.13 inches. (Enter the seam allowance as a decimal not a fraction.) Then choose a number of gores for the envelope and enter this value in cell C4. On a rectangular basket it is generally easier if the count of gores can be evenly divided by 4, like 8, 12, 16, 20 or 24 gores. In like manner an envelope under a triangular basket is easier to fit if the number of gores divides evenly into 3. Cell H32 will display the maximum width of the gore pattern as cut out. If you are using, for example, 60 inch wide fabric, the number in H32 shouldn't exceed 60 inches. If H32 exceeds your maximum fabric width, increase the number of gores in cell C5.

In our Next Issue

In the next issue we will cover a number of considerations I think should be given by the novice builder in selecting a gore pattern. The determination of cutoffs for the mouth and deflation port will also be discussed. If space permits we will look briefly at the diagonal gore system used by The Balloon Works; the multi-panel construction of Cameron; and the tri-gore construction in the Aerostar Rally. With minor changes, the spreadsheet can be modified for each of these gore layouts.

For the Curious

The spreadsheet dynamics make this a very useful learning tool. By performing different "what-if" scenarios the user can learn much about envelope design.

Here are a few questions worth tackling:

If you assume 60 inch wide fabric with a 1.13 inch seam allowance what is the largest envelope you could construct in 12 gores?; How about 16 gores? how about 20 gores?

Assume you want to build a 2,000 cubic foot radio controlled (RC) balloon. What size gore would you need? (We once thought about an RC balloon as a learning project. Our calculations convinced us to go for a full size aircraft from the start.)

Fabric often comes untrimmed so that "60 inch wide" fabric can actually be over 61 inches wide. Assume you have designed a 20 gore balloon using the maximum width of a 60 inch wide fabric. How much more volume would the envelope have if the fabric were actually 60 $^{1}/_{4}$ inches? You'd be surprised how much difference $^{1}/_{4}$ inch makes to overall volume. It can be in the thousands of cubic feet. Of course the gore length would also increase as you use all of the extra width.

TABLE 1: Detailed Instructions to Build Gore Layout Spreadsheet

CELLS	ACTION	EXPLANATION
Open a new worksheet. Select cell range A1:H60	Set Column Width to 8 Set Alignment to "RIGHT" Set Number Format to 0.00 Set Font to Helvetica, Size 10	Set the default values for the spreadsheet. Each cell is set to 8 characters width, all cells align on the right edge, numbers are formatted with two decimal places and font is Helveticia size 10 in plain style. Exceptions to defaults made later as necessary.
A3 A4 A5 D3 D4 D5 G3 A1	Type in: VOLUME Type in: SEAM ALLOWANCE Type in: NUMBER OF GORES Type in: Cubic Feet Type in: Inches Type in: Two half gores make a gore Type in: Gore Length Type in: BALLOON GORE LAYOUT	Type in the titles for the user entered values. After titles are entered, set the Format Alignment for each of these cells to "LEFT."
In cells A7 through H9	Enter column titles as shown on the spreadsheet	After the titles are entered, set the Format Alignment for each of these cells to "CENTER."
C3	Enter the number: 125860. Format the Number to #,##0	This is the volume of the envelope desired in cubic feet. The initial number is for testing purposes. The number is formatted to remove the values after the decimal point.
C4	Enter the number: 1	This is the user entered seam allowance. It is shown in hundredth's of inches.(1.00)
C5	Enter the number: 24 Format the Number to #,##0	This is the user entered number of gores in the envelope. Remember there are two panels in each gore. This value should be shown without decimal points.
A3:C5	Select the range of cells and format the range as Font **Bold.** Set alignment to "RIGHT"	These three numbers are entered to generate the desired envelope specification. After these instructions are completed and the spreadsheet is finalized, no other numbers need to be entered to make the worksheet operate.
G4	Enter the following formula: =(C3/.12586)^(1/3) If you haven't already done so, this is a good time to save the worksheet with a name you feel is appropriate	This formula generates the gore length for any given envelope volume. Once entered, the value "100.00" should appear in cell G4 or the formula has been improperly entered, or cell C3 does not contain the number 125,860. The '^' symbol is a capitol "6" (a caret). The formula actually says that "The gore length of an envelope is equal to the cube root of the quantity: 'envelope volume divided by the number .12586'".
A10:A60	At cell A10 enter the number: 1 At cell A11 enter the formula: =A10-.02 Copy that formula from cell A11 to cells A12:A60	This is a simple way to enter the stations from the top of the envelope down to the bottom. The top cell (A10) represents the top of the envelope crown. Each cell below represents a station which 2% or .02 below the crown. In cell A35, for example, the value of .50 denotes the station half the way between the bottom and top of the envelope. The number in cell A60 should be 0.00
B10:B60	Format the range to 0.00000 and enter the numbers exactly as shown from column B in the example worksheet.	These numbers represent the envelope radius as a function of the total gore length for this station. These number need to be keyed in from the computer keyboard.

TABLE 1: Detailed Instructions to Build Gore Layout Spreadsheet (continued)

CELLS	ACTION	EXPLANATION
C10	Enter Formula: =$G$4*A10	This formula generates the length up the gore for this station by multiplying the value of s in column A times the computed overall gore length in cell G4. The dollar signs in the formula note absolute cell value. We copy this formula down later on. A value of 100.00 should appear in cell C10.
D10	Copy the formula in cell C10 into cell D10	This formula generates the envelope radius at this station in feet by taking the total gore length in column G4 and multiplying it by the value in cell B10. The number in cell D10 should be 0.00 and the formula should read =$G$4*B10.
E10	Enter the formula: =D10*2	This formula converts the envelope radius into diameter by multiplying the radius times 2. The number 0.00 should appear in cell E10.
F10	Enter the formula: =E10*12*3.1416	This formula generates the circumference of the balloon at this station in inches by multiplying the balloon diameter times the number π (3.14) times 12. Multiplying by 12 converts feet to inches.
G10	Enter the formula: =F10/(2*$C$5)	This formula determines the seam-to-seam distance for the gores assuming 2 half-gores per gore. The circumference of the envelope is divided by the number of gores times 2 to achieve this value. For this cell, a value of 0.00 is shown.
H10	Enter the formula: =G10+(2*$C$4)	The formula generates the width of the cut half gore at this station. This dimension is equal to the sewn gore distance (column G) to which is added seam allowances for loss of fabric width during sewing on each side on the half gore. The number 2.00 should appear in column H10 which equals the seam allowance of 1.00 inches on each side of a sewn half gore width of 0.00 inches.
C11:H60	Select the row of cells C10:H10 and Edit Copy. Then select the column of cells C11:C60 and Edit Paste	This edit and past copies the row of formulae which we have entered on row 10 into rows 11 through 60. If all the numbers appear the same, then hit the F9 key to recalculate the spreadsheet. Note that the numbers in row 32 will not be in bold print..
C62:H62	For each column create the sum of the numbers for row 10 through row 60. For example, the formula for column C in C62 should be: =Sum(C10:C60) Format each total to the same number of decimal points as the column above it.	These totals are test totals to determine that the numbers and formulae in rows 10 through 60 have been correctly entered. If the value at the bottom of the column is not the same as shown on our sample, then an entry error has been made. Remember all the totals will be the same only if the number in C3=125,860, C4=1.00 and C5=24. The numbers in columns A and B are constants and should not change as numbers in C3, C4 and C5 are changed.

TABLE 2: Sample Balloon Gore Computer Spreadsheet

	A	B	C	D	E	F	G	H
1	Balloon Gore Layout							
2								
3	VOLUME		125,860	Cubic Feet			Gore Length	
4	SEAM ALLOWANCE		1.00	Inches			100.00	
5	NUMBER OF GORES		24	Two half gores make a gore				
6								
7		Radius	Gore			Circum-	Sewn Half	Cut Half
8	s	r	Length	Radius	Diameter	ference	Gore	Gore
9			Feet	Feet	Feet	Inches	Inches	Inches
10	1.00	0.00000	100.00	0.00	0.00	0.00	0.00	2.00
11	0.98	0.02000	98.00	2.00	4.00	150.80	3.14	5.14
12	0.96	0.04000	96.00	4.00	8.00	301.59	6.28	8.28
13	0.94	0.05999	94.00	6.00	12.00	452.32	9.42	11.42
14	0.92	0.07997	92.00	8.00	15.99	602.96	12.56	14.56
15	0.90	0.09989	90.00	9.99	19.98	753.15	15.69	17.69
16	0.88	0.11974	88.00	11.97	23.95	902.82	18.81	20.81
17	0.86	0.13944	86.00	13.94	27.89	1051.36	21.90	23.90
18	0.84	0.15891	84.00	15.89	31.78	1198.16	24.96	26.96
19	0.82	0.17805	82.00	17.81	35.61	1342.47	27.97	29.97
20	0.80	0.19673	80.00	19.67	39.35	1483.31	30.90	32.90
21	0.78	0.21480	78.00	21.48	42.96	1619.56	33.74	35.74
22	0.76	0.23210	76.00	23.21	46.42	1750.00	36.46	38.46
23	0.74	0.24844	74.00	24.84	49.69	1873.20	39.02	41.02
24	0.72	0.26364	72.00	26.36	52.73	1987.80	41.41	43.41
25	0.70	0.27751	70.00	27.75	55.50	2092.38	43.59	45.59
26	0.68	0.28989	68.00	28.99	57.98	2185.72	45.54	47.54
27	0.66	0.30064	66.00	30.06	60.13	2266.78	47.22	49.22
28	0.64	0.30962	64.00	30.96	61.92	2334.49	48.64	50.64
29	0.62	0.31677	62.00	31.68	63.35	2388.40	49.76	51.76
30	0.60	0.32203	60.00	32.20	64.41	2428.05	50.58	52.58
31	0.58	0.32540	58.00	32.54	65.08	2453.46	51.11	53.11
32	**0.56**	**0.32691**	**56.00**	**32.69**	**65.38**	**2464.85**	**51.35**	**53.35**
33	0.54	0.32662	54.00	32.66	65.32	2462.66	51.31	53.31
34	0.52	0.32461	52.00	32.46	64.92	2447.51	50.99	52.99
35	0.50	0.32100	50.00	32.10	64.20	2420.29	50.42	52.42
36	0.48	0.31591	48.00	31.59	63.18	2381.91	49.62	51.62
37	0.46	0.30945	46.00	30.94	61.89	2333.20	48.61	50.61
38	0.44	0.30175	44.00	30.17	60.35	2275.15	47.40	49.40
39	0.42	0.29295	42.00	29.29	58.59	2208.80	46.02	48.02
40	0.40	0.28316	40.00	28.32	56.63	2134.98	44.48	46.48
41	0.38	0.27251	38.00	27.25	54.50	2054.68	42.81	44.81
42	0.36	0.26109	36.00	26.11	52.22	1968.58	41.01	43.01
43	0.34	0.24900	34.00	24.90	49.80	1877.42	39.11	41.11
44	0.32	0.23633	32.00	23.63	47.27	1781.89	37.12	39.12
45	0.30	0.22317	30.00	22.32	44.63	1682.67	35.06	37.06
46	0.28	0.20959	28.00	20.96	41.92	1580.28	32.92	34.92
47	0.26	0.19564	26.00	19.56	39.13	1475.09	30.73	32.73
48	0.24	0.18139	24.00	18.14	36.28	1367.65	28.49	30.49
49	0.22	0.16689	22.00	16.69	33.38	1258.32	26.22	28.22
50	0.20	0.15218	20.00	15.22	30.44	1147.41	23.90	25.90
51	0.18	0.13730	18.00	13.73	27.46	1035.22	21.57	23.57
52	0.16	0.12228	16.00	12.23	24.46	921.97	19.21	21.21
53	0.14	0.10716	14.00	10.72	21.43	807.97	16.83	18.83
54	0.12	0.09195	12.00	9.20	18.39	693.29	14.44	16.44
55	0.10	0.07669	10.00	7.67	15.34	578.23	12.05	14.05
56	0.08	0.06138	8.00	6.14	12.28	462.80	9.64	11.64
57	0.06	0.04605	6.00	4.61	9.21	347.21	7.23	9.23
58	0.04	0.03071	4.00	3.07	6.14	231.55	4.82	6.82
59	0.02	0.01535	2.00	1.54	3.07	115.74	2.41	4.41
60	0.00	0.00000	0.00	0.00	0.00	0.00	0.00	2.00
61								
62	25.50	9.83258	2550.00	983.26	1966.52	74136.08	1544.50	1646.50

Considering the Possibilities

The following is an incomplete list of potential topics for future issues. Readers are invited to submit other topics for the list. If you have experience in one or more of these areas, feel free to submit your ideas for publication.

Theory and Design

Burner design and construction: Can the builder bring new technology to burner development? Should builders even consider building their own burners? Is anyone out there working on burner development?

Home builders, defining the latest trends: Among small airplanes, fiberglass composite airplanes designed by small entrepreneurs are replacing aluminum and steel from the traditional Piper, Cessna and Beech factories. Home builders are the source of this innovation. Is the same future in store for ballooning, or will our home built designs continue to follow in the shadow of the balloon manufacturers?

Motion relative to the wind: Consider the safety potential of being able to fly against the wind. Karl Stefan wrote an article on this topic which appeared in *Ballooning* magazine several years ago. His concept employed a side vent as a "jet" to move the balloon sideways. What other possibilities exist?

Applications of non-traditional materials: What about designing special purpose baskets with space age materials? Have you considered very light fabric for your next envelope? The opportunities here are endless.

What does it take to make a successful builder? Are there traits common to people who successfully begin and complete aircraft construction?

What about other flight modes? Is there interest in low cost gas balloons? Is an amateur built blimp anywhere within the realm of practicality?

Construction

The beginner's tool bench: What basic tools should the first time builder have at hand before beginning a balloon project?

Building a basket: Should you consider building your own basket? What alternatives to a traditional wicker basket should a builder consider?

Fabric/seam systems: The folded fell in 1.9 oz. rip-stop nylon is a classic seam system. Is anyone out there building with something else? What about single needle zig-zag construction? What about The Balloon Works style of construction?

Home built pyrometer: For you electronics buffs, the voltage drop across a silicon diode is inversely proportional to temperature. Use a diode as a sensor, add a couple of op-amps and you have a simple and accurate envelope temperature indicator.

A tape feeder: Your editor built a simple tape feeder which feeds from under the sewing machine and permits construction of a seam including load tape in one pass. I will prepare plans for a future issue.

Sewing machine maintenance: Commercial sewing machines are simple and repair shops are expensive. The sport builder should be able to diagnose and repair simple problems and adjust sewing machine timing..

Constructing complex envelope patterns: How does one go about creating complex patterns in a natural shape balloon, or even building a special shape envelope?

Flight Related

How does one go about safely making a maiden flight in a newly constructed balloon?

Comparison of tops: What are the various strength and weaknesses of the different vent and deflation systems currently available?

Measuring Balloon Performance: Can we develop a set of standards to appropriately and objectively compare balloon performance?

Other Topics

Bibliography of material for the builder

A list of sources for the builder

Correspondence to the editor

Classified ads

The strange and the unusual.