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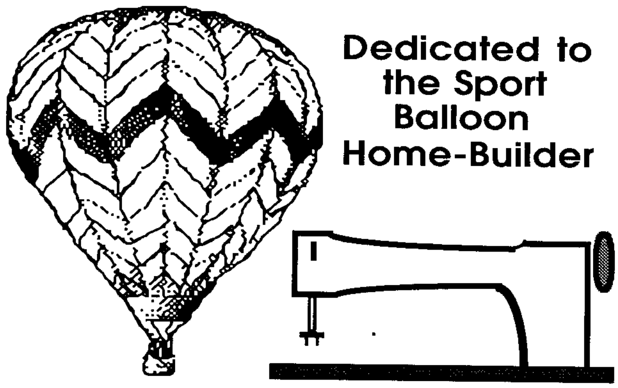

Dedicated to the Sport Balloon Home-Builder

THE BALLOON BUILDERS' JOURNAL

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In This Issue

Up and Coming

We re-visit gore layout pattern making and expand on the ideas present in the first issue of *BBJ*. We also introduce a curve fit algorithm for the mathematically inclined.

Availability of Back Issues

It is the policy of *The Balloon Builders Journal* that back issues remain available so that new readers may enjoy the material printed in older issues. These issues remain available for $2 each.

Because of this policy extra issues are printed to meet the anticipated demand.

The *BBJ* you are reading is issue number 21, which means I have an inventory of the preceding 20 publications.

Unfortunately, the inventory on some of my early issues is becoming quite small, and reprinting costs are quite expensive.

In order to continue to meet demand for past issues, I will provide back issues as photocopies when the current stock becomes depleted.

These copies will be produced on $8^1/_2$ by 11 paper rather than on the current 11 by 17 stock. The quality of photographs may not match the quality found in the original printings.

A Simple Envelope Temperature Gauge

By Bob LeDoux, Editor

2895 Brandi Lane, Jefferson, OR 97352

In this article we layout the construction of a temperature gauge which is within the technical skill and pocketbook of the typical balloon builder

Introduction

In this article we will discuss the construction of a low cost envelope temperature gauge. Let's start with a bit of history.

My *Castaway* balloon started life with a hanging, five inch diameter Weston (so called 'meat thermometer') envelope temperature gauge. The hanging gauge had a number of shortcomings. At first I hung the gauge on a loop sewn in the middle of my parachute top. So far away, the temperature was quite difficult to read. I painted my indicator needle black, and the never exceed range red so I could make out the readings from the basket. Even then binoculars were necessary to get a clear indication of the meter reading. I was also reading the meter through the parachute lines which added to the difficulty.

To improve the gauge readability I decided to move it closer. So I hung the gauge at the point where the parachute lines were joined to the rope which ran down to the basket. Because the thermometer hung directly above the burner, the heat flume caused considerable fluctuations in the meter reading. The meter reading also did not represent the true average envelope as the temperature in the core of the balloon typically averages 20°F to 50°F higher. This meant re-calibrating the meter to more accurately approximate the average envelope temperature.

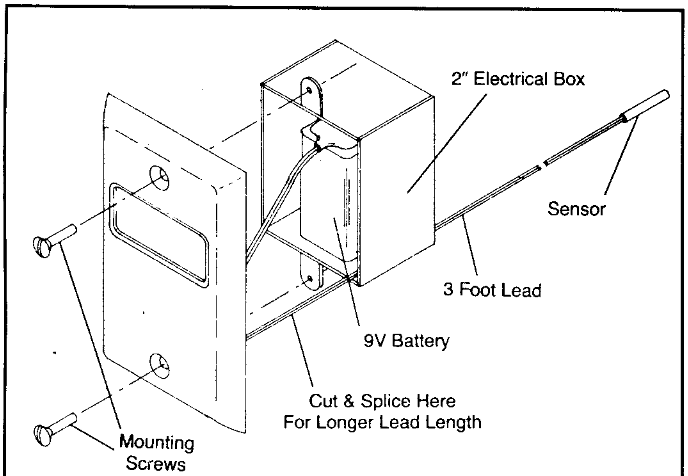


Figure 1: This is a factory drawing showing how the digital thermometer can be mounted on a standard house electrical wiring box.

Introducing the Check-It™ Thermometer

Because of these shortcomings I started looking around for a reasonably priced alternative. One day, while considering the construction of a 220 volt inflator fan system, I was looking through the *Grainger* industrial supply catalog when I came across the Check-It™ Electronics Digital Thermometer Model 603. (The *Grainger* part number is 2T323.)

The characteristics of this thermometer were very promising: accuracy and resolution are good to 1°F. The sensor range is -150°F to 300°F. It operates off of a single 9 volt battery which provides over 1 year of battery life even without an 'off' switch. The display includes a 'low battery' indicator. Readings are updated 1.5 times per second. The sensor can be placed up to a 1,000 feet away using regular copper wire.

The instrument retails for $85 and can be purchased from any dealer who has the *Grainger* Catalog. Many hardware stores and electric motor shops buy from *Grainger*.

As *figure 1* shows, the Check-It™ thermometer has the general appearance and size of a light switch cover. Instead of the switch, it has a clear panel which displays the temperature reading. The electronics are mounted on a flat circuit board which mounts to the back of the 'switch plate.' The whole assembly is very shallow, about $^3/_8$ of an inch deep. Two wires come out of the back. One wire is actually a pair of wires which ends in a standard 9 volt battery connector. The other wire is actually a pair of wires, about three feet long, which is a Teflon™ coated assembly ending in the temperature sensor.

The unit is designed to mount in a standard 2 inch house electrical wiring box. The sensor is located at the desired point, a battery is attached to the battery connector.

Figure 2: This photo shows the Castaway instrument box and temperature sensor test.

• A standard aircraft altimeter and rate of climb meter are seen in the top of the box. The temperature gauge is mounted on the front of the instrument box. All the electronics for the temperature gauge are mounted on the back of the metal plate, thus none of the instrumentation is contained inside the box.

• In the top of the pack is the optional power switch for the temperature gauge. Behind it are the phono plug and jack hookup for the sensor wire. In the background is my reel of Teflon wire, with my wire harness wrapped around it.

• This photo was taken while the sensor was being tested for accuracy. In the boiling water bath it shows a temperature of 209°F, which is recorded through a 55 foot long harness. The length of the wire harness in no way changed the reported temperature. Before mounting the instrument I tested its readout with only 3 feet of sensor wire. Even then, the meter reported 209°F.

• As displayed here, the temperature gauge is fully functional. I plan to replace the phono plug hookup with a stereo connector as explained in the text. This change will remove the grounded connector from the sensor wire.

The battery is set inside the box and the meter is screwed in place. Then once every year or two, the two screws are removed to gain access to and replace the battery. This unit is very popular for monitoring the temperature in walk-in refrigerators and freezers.

One disadvantage to the unit is its size. While the instrument is not deep, it does take up a fair amount of surface area. The plate is about 2.75 inches by 4.5 inches in dimensions. Thus, it would take up a large area in a typical instrument package. The unit is quite sturdy, and one option would be to mount it in a pocket in an envelope skirt. The digital display is large enough that it could be read at a distance.

Installing the Thermometer

My *Castaway* instrument pack is fairly large, consisting of a wood box holding a classic mechanical altimeter and rate of climb. I decided to mount the temperature gauge on the front of the instrument pack as seen in *figure 2*. I also chose to break the battery line and insert an 'off' switch.

Mounting was very simple. Two screws, through rivets in the metal plate, mounted the instrument on the instrument case. A small hole was drilled in the instrument pack to allow passage of the two wire sets into the box. I mounted a small switch, which is optional, between the altimeter and rate of climb for the 'on-off' function. A 9 volt battery was attached to the interior instrument case wall using self sticking Velcro™. An electrical connector was mounted in the top of the instrument pack to hook up the temperature sensor wire. More about that later.

Considering Sensor Wire

My next task was to consider the remote sensor wire. If you have ever priced balloon sensor cable you know about sticker shock.

Most sensor cables are a shielded pair of wires, which means two insulated wires run inside a metallic cover which is either a copper braid or a solid wrap which looks like aluminum foil. That shield is then covered with a plastic cover. Shielded cable isn't that expensive until you add an additional requirement: it has to take high temperature. This means the insulation over the individual wires and over the entire assembly must be of a high temperature plastic such as Teflon™.

This makes the wire a specialty item and the price really jumps to over $2 per foot. Just look at the cost of a typical factory balloon 'sensor assembly.' It consists of a length of wire, with a sensor on one end, and an electrical connector on the other. Typical cost is $200 to $300.

Since I am in an experimental mode, I was looking for a lower cost option. I started looking at aircraft electrical wire. Traditional aircraft airframe electrical wire was produced to Mil-W-5086A. This standard calls for a tinned copper conductor rated at 600 volts and handling temperatures up to 105°C. Under this standard, the typical wire was covered with PVC insulation. In the past few years, this wire has been eliminated from new aircraft construction because PVC will generate toxic fumes during a fire or as a result of overheating due to an electrical 'short.'

There is a new standard called Mil-W-22759/16 which eliminates the PVC insulation. Meeting this new standard is a wire insulated with a new plastic cover called Tefzel™ which has a maximum temperature rating of 150°C, or about 300°F. Thus, this new wire appears suitable for use in our envelope systems.

Wire to this new standard can be purchased from *Aircraft Spruce and Specialty* (Box 424, Fullerton, CA 92632). It costs about 10 cents per foot in 22 gauge size (unshielded) and weighs about 0.42 pounds per 100 feet. The same wire, with a shield of tin plated copper braid costs 35 cent per foot and weighs about 1.1 pounds per 100 feet.

Other Sensor Wire Sources

If you have access to a local Experimental Aircraft Association (EAA) flyin, you might look there for wire. Each summer I attend the Arlington, WA, Flyin and there are always a number of suppliers selling ends and remaining stock. Last summer I found reels of size 22 two wire shielded cable with Teflon insulation for $1.50 a pound.

Amateur radio 'Hamfests', which often take place during the winter months, is another good place to go looking for useful goods including specialized wire. That's where I found the Teflon covered wire I used in this project.

For the reader with a real experimental bent, try using copper motor rewind wire. This can be purchased, quite reasonably priced, from your local electric motor rewinding shop.

It comes with a very hardy varnish cover which is typically rated for temperatures well above those found in a balloon envelope. Because the wire is annealed, it takes bending (envelope packing) quite well. Eventually, the varnish will crack due to heat and aging, causing a short which will require wire replacement.

I have no idea what the life of this wire would be, but if it does short out, the loss of the envelope temperature reading is typically not critical, and replacement costs are fairly low. If you try motor rewind copper wire, report your experiences to *BBJ*.

Making *Twisted Pair* Wire

While it would have been nice to use a shielded double wire, I know most builders don't have access to a reasonably priced source for this material. Instead I chose to make my own sensor wire by taking a single length of Teflon insulated wire, and winding it to make a 'twisted pair of wire.' The process is straight forward:

I took a piece of wire twice the distance of the completed harness, with a couple of feet added on for good measure. I doubled this wire in half and looped the bend over the eye of a eye-bolt mounted in my electric drill. See *figure 2* for details.

Mari grabbed the two loose ends and we stretched the wire pair out between us, suspended horizontally above the ground. I then ran the drill to twist the two wires together until there was a twist about every 2 inches.

We then rolled the twisted wire onto a reel. The wire, depending on its temper and insulation may be quite 'springy' making it difficult to coil into a loop. So a reel of some sort may be a good idea.

Installing the Sensor Wire

The next step was to solder the sensor to the end of the sensor lead. I cut the sensor off the temperature gauge, at the midpoint of its wire. The sensor has a pair of Teflon covered wires, one with black and one with white insulation. Over these wires is an additional red Teflon insulation. The Teflon insulation is tough, stripping the insulation was not easy. I stripped back the black and white insulation to reveal about one inch of bare copper wire. Heat shrink covering, available at any *Radio Shack*, was placed over the twisted pair and the sensor leads were soldered to the twisted pair of wires. The heat shrink insulation was then shrunk to insulate the solder joints.

I had to sew a sensor cable sheath in my envelope. The sheath was a piece of balloon fabric, about 3 inches wide and about 10 feet shorter than the length of my balloon envelope. This was doubled over and stitched to the interior of the envelope down a vertical load tape, creating a small diameter tube running down the envelope.

I ran my sheath from about 10 feet below the deflation port down to the mouth. This can be a tricky sewing challenge. This task required moving a lot of fabric under the arm of a sewing machine. I simplified the process by sewing from the middle of the envelope to each end.

Threading the sensor wire down the balloon was simple. The envelope was stretched out on the ground. The load tape with the wire sheath was stretched out on the top of the envelope.

I created a *fid* by cutting out a length of plastic from a plastic clothes hanger. The loose ends of the sensor wire, the mouth end, were taped to the fid and it was threaded down the sheath, starting from the top of the envelope. All this took place from the exterior of the envelope.

Because my twisted pair of wire was quite springy, Mari, standing at the deflation port of the envelope, unrolled the twisted pair from the reel as the threading proceeded. This kept the wire from developing kinks or loops.

Where the wire exits the mouth of the balloon it required additional protection both to keep it from untwisting and to protect it from burner heat. I chose to encase this area of the wire in fiberglass sheathing. This material is available at motor rewind shops for about 30 cents per foot. It is the same material that Aerostar used to place over their old pyrometer sensor lines.

I mounted my sensor to the side of the envelope by bending the wire end with the sensor into a 'U' shape, about 3 inches long. The 'U' was then stitched by hand into the side of the envelope, through the vertical load tape, leaving sensor about 1.5 inches from the stitching. Once completed, I bent the wire to place the sensor end about an inch from the surface of the fabric.

Thoughts about the Electrical Connector

I gave some thought to the wire connector at the instrument pack. Elegant Mil-Spec connectors are found on *Ball* balloon instrument packs. These connectors are quite expensive, typically about $20 for both male and female connectors, when purchased from an electronics supply house. They are more expensive when purchased from the balloon manufacturer. I wanted a connector which was low in electrical resistance and provided some strain relief. After considerable thought I created a hookup using a standard phono jack and plug.

Care has to be used in this hookup because the phono hookup grounds the outside wire,

Figure 3: This photo shows the process for making a 'twisted pair' wire assembly. The length of wire is doubled in the middle at which point the bend is set in an eye-bolt in an electric drill. An assistant holds the loose wire ends and the wire is stretched horizontally about the ground. The drill is run until the wire is twisted every one to two inches.

the shield. Thus it is possible to inadvertently build a short into the meter system if you don't know what your are doing.

After one year of operation with the phono plug, I am planning to convert to a stereo plug. A stereo plug has a grounded exterior, or common lead, and two inside connectors, one for each of the left and right channels. I plan to use the interior connectors for my hookup, leaving the grounded lead unconnected. I will report on the success of this modification in a future issue of *BBJ*.

Other Tidbits of Note

Here are some additional notes of use to the builder:

• If the meter develops a problem the reading on the meter indicates the kind of fault that might exist in the circuit. If the meter shows a positive number, greater than 300, then there exists a short circuit between the meter and the sensor.

On the other hand, a large negative number means an open circuit exists. During soldering its easy to forget which wire goes to which side of the sensor. If this happens to you just give it a try. If you get a crazy meter reading, reverse your leads. You won't damage the meter with a reversed hookup.

• According to the manufacturer, adjusting the temperature reading is simple. The unit is turned over on its back and the little calibration sticker is removed to reveal two holes. These holes cover a pair of potentiometers (pots).

The sensor is placed in a container of ice water and the lower pot is adjusted to a meter reading of 32 degrees, the freezing point of water. The sensor is then placed in boiling water and the upper pot is adjusted to a meter reading 212 degrees, the boiling point of water. This set of adjustments minimizes the error in the instrument between the two extremes.

My own instrument was within 2 to 3 degrees at boiling, as delivered, and I felt no need to correct for this amount of error. I tested my instrument with the short 3 foot long sensor provided with the gauge, and again later I had inserted my 55 foot long line in the envelope. There was no change in the meter reading between the two sensor wire lengths.

• The temperature gauge really quite simple. The sensor is a glass silicon diode. A silicon diode exhibits a particular trait. When a voltage is passed though the diode in one direction, the voltage drops across the diode by about 0.6 to 0.7 volts at normal room temperature. This voltage drop gets smaller as the temperature climbs. This temperature to voltage drop relationship is quite linear. The instrument effectively measures the change in this voltage drop and converts it to display as temperature.

• While it is possible to use one instrument between different sensors, there will be some error in the measurement. Each silicon diode has its own, unique voltage/temperature curve. This will result in error unless the gauge is re-calibrated each time a different sensor is used.

There are techniques to minimize these errors through the use of series and parallel resistor in the sensor wire, but those techniques are beyond the scope of this article. These techniques can be found in basic electronics text books.

•Sensor response time can be adjusted by the user. Most temperature gauges display some lag between the actual temperature and the reading. The sensor which comes with this instrument has a fairly slow (15 seconds) time lag.

This is in response to many of the Check-It™ commercial customers. This meter is commonly used to read the temperatures inside refrigerators and freezers. Customers were complaining that the temperature would change each time the door was opened. So the manufacturer placed a fairly thick, foam sensor cover on the silicon diode sensor which reduced the response time.

I chose to cut this off, which made the temperature response very fast. In fact it was too fast. As soon as I fired my burner, the heat plume would hit the top of the envelope and roll down the interior of the envelope causing a dramatic rise reported by the temperature sensor. In the matter of a few seconds, the temperature would return to a normal range.

This response convinced me that this temperature rise was real, but was dissipated so rapidly so as to be unrepresentative of the true envelope temperature.

This rapid response curve is of limited interest for day-to day-flying. But the scientist interested in investigating short term burner effects might find this measurement scheme very useful.

I chose to reduce the response time by covering my silicon diode sensor with two layers of heat shrink tubing. The response time is now much more reasonable. Some care should be taken when shrinking the tubing round the sensor. Too much heat could damage it.

• Several people have asked about my use of unshielded cable in my meter. So far I have seen little effect due to the use of unshielded wire in my envelope. My temperature gauge sometimes takes on an erratic reading, but this is associated with proximity to power lines. While I recognize the value of a 'power line locator' in a balloon, a measurement device which requires a long, vertical wire be placed in the envelope would have limited commercial applications.

Readers should remember that an open length of wire, especially a wire in a vertical direction, like an envelope sensor, can generate significant voltage differences across its length. This buildup can develop from atmospheric conditions or from 'man-made' sources such as high tension power lines.

The temperature gauge has been in use for over a year. While I'm considering replacement of the electrical connector that is mentioned above, the meter has otherwise proven quite satisfactory. It has proven to be reliable and accurate. As a low cost alternative to the typical type certified balloon instrument I am quite satisfied with the result.

This has been an enjoyable project. I hope those of you who attempt to replicate it have the same success. Please report your results for publication in *BBJ*.

Thoughts about Albuquerque

By Bob LeDoux, Editor

I managed to steal away from work for four days to enjoy New Mexican food and weather at the Albuquerque International Balloon Festival. Mari and I were part of an excursion, with Mari named as second pilot on an Oregon balloon. As I might have expected, Mari was reluctant to return with us, after the four days were up, so I took the plane back by myself, leaving her to enjoy an additional five days in the sun.

One of my primary goals at Albuquerque was to locate as many *BBJ* readers as was possible. I took my mailing list and located 23 listed pilots. During the course of my stay I spent considerable time looking up readers. While I was reasonably successful, I did miss a few of you. My apologies to those of you I could not find.

On a couple of days the ground winds at launch were challenging, with a number of pilots waiting out the weather hoping it would calm down. On Wednesday, a narrow band of wind, as high as about 20 knots, at 300 feet made for some interesting launches. I noticed a number of natural shaped balloons which entered this shear band at high vertical speed taking on a certain 'special shape' while they adjusted their speed to the wind.

But enough to of the small talk, lets get to the real material.

The preparations for a gas balloon are always worth watching. I arrived early to examine the balloon systems. Most of them had an experimental airworthiness certificates. I was particularly impressed with the ring on Bert Padelt's basket. I've seen rims on $3,000 banjos which didn't show the kind of craftsmanship I found in his work.

Balloon Manufacturers

Balloon manufacturers had their own display area. Three tents were present with Aerostar, Cameron, and The Balloon Works (TBW) displaying their wares. I had the opportunity to spend considerable time talking with representatives of the three companies as represented by Mark West, for Aerostar; *BBJ* reader Andy Baird from Cameron; and Sid Conn from TBW. This was my first opportunity to meet and talk to Sid Conn and I found him very congenial, soft spoken, and willing to share his knowledge of his systems.

Aerostar was displaying their new semi-rigid system which uses cables for the support system, similar to Cameron products. It avoids much of the welding found in the Cameron design, using instead, fasteners and forgings or castings. Basket builders might want to look at this design as providing inspiration for home-brew projects.

The Aerostar stretch Aurora basket, with its 25 gallon tank would make a very nice bottom to fly under a three place homebuilt envelope. Its worth noting that there is little fuel disadvantage when comparing this basket to the older baskets using three 10 gallon Worthington tanks. My Worthington's generally give me a bit less than 9 gallons of fuel before I'm flying on fumes. Thus a 'real' 25 gallon tank is only a gallon or two shy of the fuel found in the aluminum tank systems.

Cameron brought one of their takedown baskets for display. It employs standard rattan construction up to about 12 inches above the ground. Fabric sides, supported by a framework, including nylon uprights, make up the rest of the structure. It looked and felt solid and reliable.

Tarp Head brought one of his demonstrators to Albuquerque. I was intrigued by the look of the leathers on his basket. The leather turned out to be the most luxurious most pleasant feeling cover that I had ever seen. Tarp reported that it was elk hide. It definitely added a special touch to the basket though I don't think it would hold up to abrasion as well as steerhide.

Future Instrumentation

In the course of the demonstrations, I had the opportunity to view a Ball instrument pack which may be the next generation of balloon instrumentation. The system was about the size and weight of a personal data assistant (PDA) like the Apple *Newton*. The face of the instrument, about 3.5 inches square, contained the variometer, altimeter, clock and numerous other readouts. The 'vario' was a pixel approximation of a standard analog meter. I tested the machine by holding it at floor level and then raising it up to the top of my reach. The vario climbed to about 200 feet per minute with a 3 second lag.

This new instrument pack also includes a built in barograph which has a computer readout through an RS-232 port. Ball is interested in eliminating the mechanicals found in current instrument packs. Their experience is that the electronics are more reliable, particularly against shock treatment, and more easily maintained. No price or final delivery date was suggested.

In the course of this discussion I asked the Ball representative about buying their instrument packs for use on homebuilt aircraft. The Ball instrument packs for ultralights and hang gliders can be purchased from commercial aircraft supply houses. The representative said this was not true for the balloon instrumentation. Ball acts as an original equipment manufacturer (OEM) to balloon factories and the certification rests with the factory not with Ball. He said however, that they might be willing to sell to an amateur builder who provided a copy of an airworthiness certificate.

I discussed the question of linear versus digital meters with Bruce Comstock. We were in agreement that, especially for a variometer, a linear gauge is superior to a digital readout because the linear meter provides not only rate of climb but also changes in acceleration information for the reader. In other words, the rate at which the vario needle is climbing or descending is almost as important as its current meter reading.

Textile Availability

As you may know Aerostar has developed close ties with Performance Textiles, the company which is producing the new Aerostar diamond weave pattern envelope fabric. A representative from Performance Textiles was at Albuquerque. I had the opportunity to feel out Performance Textiles and the possibility of establishing a direct purchase program with home builders. I wish I could report some progress on this front, but I cannot. Performance Textiles is concerned about liability as well as safety issues associated with providing their fabrics, especially the second grade textiles, to amateur builders. It appeared to me that Performance Textile depends very much on Aerostar to represent the 'deep pockets' company between them and the balloon consumer.

This means that builders will have to continue to buy their fabric through the 'gray' market and through various brokers.

While talking to the textile industry representatives we learned a number of interesting facts: A typical modern textile factory has 300 looms in an automated system which is watched over by three employees. When weaving balloon fabric, a typical $100,000 loom produces 5 inches of fabric per minute.

The balloon manufacturer's display area was a good place to observe the many balloons as they took off and entered the low level shear band. One scene which still sticks in my mind was an American made balloon with foreign registration. This envelope had obviously received fabric replacement down below the equator. But as it flew over, the remaining fabric on the lower part of the envelope was so thin, that the interior operating lines and even the details of the fabric on the far side were clearly visible through the fabric surface.

Radio Control Balloons

Several Radio Control (RC) balloons were evident at Albuquerque. One very elegant system was demonstrated by a Swiss pilot. The burner looked very much like a miniature version of a current generation balloon burner with a multi-turn vaporization coil and with remote relight capability. I was unable to get much in the way of detail about this system. The interpreter reported that in Europe, RC balloons are competitively flown in much the same manner as we fly the real thing. Pilots free fly their balloons, often using bicycles or cars as chase vehicles and performing classic balloon tasks, like flight to goals.

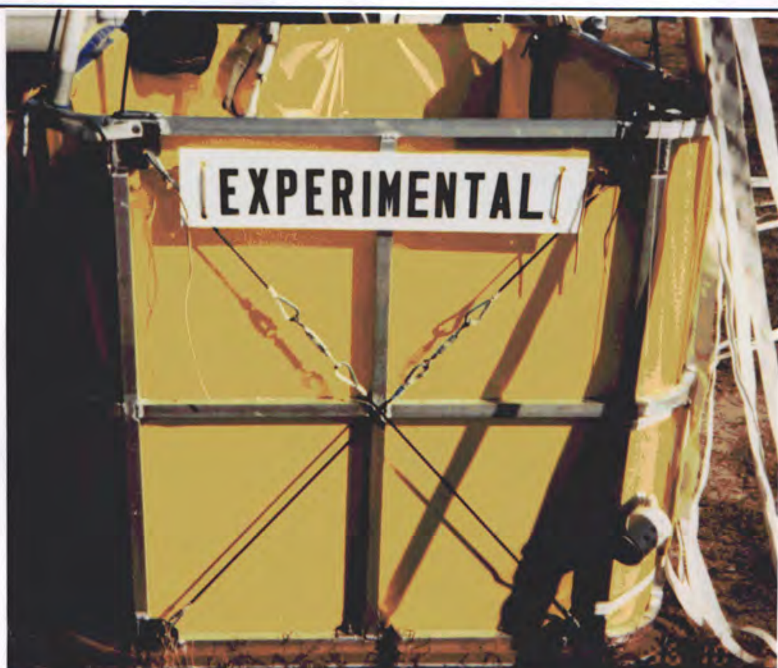
Aerial Images, (P.O. Box 53096, Albuquerque, NM 87153), a company operated by Bernard Smatana, is producing a range of RC balloons. Prices range from $600 to $800 for basic envelope. The gondola with radio and battery pack sells for an additional $600. Thus a complete balloon starts at about $1,400. The demonstrator used two inverted 14.2 ounce propane bottles for liquid feed and a vertical bottle to power the pilot light. The burner included a vaporization coil. The blast valve appeared to be the valve found on Balloon Works pilot light systems. This valve was operated by a large RC servo. The system only required one channel of a four channel radio. For more information contact *Aerial Images* at 505-858-1969 or 505-332-2371.

Trailers & Temperature Gauges

Europeans, with their lighter automobiles, have developed some very nice lightweight trailers for balloons. I saw a couple of examples of clamshell designs in which a fully closed trailer hinges at the trailer front, allowing the trailer top to open up. This technique makes for unlimited head room and allows the crew to load equipment without the need to stoop, as is found is some of the smaller American trailer designs. If such a design fits your need you might want to look at some of the trailer designs found in British Balloon magazines like *Balloons and Airships*.

I had the opportunity to talk shop with a number of people. Andy Baird, from Cameron and I talked about temperature gauges. Andy has an interest in brewing and commented about the temperature monitoring that is performed in the beer making business. He thought that the technology being applied there would also work for balloons. He offered to provide me some material on this subject, which I have just received. I am reviewing it for a possible future article

I spent quite a bit of time with reader Phil MacNutt, from Austin, TX. Phil constructed a digital temperature gauge along the lines of the design presented in this issue of *BBJ*. His meter though, utilized a standard temperature sensor rather than the silicon diode. His project requires soldering of electronic components, but may be produced at a lower cost than the gauge found in this issue.



Details of a gas balloon basket seen at Albuquerque.

Letters to the Editor and Other Bits of Information

A New Homebuilt Balloon

..I made this envelope with the help of Ken Kennedy. It is a 90,000 cubic foot 20 gore envelope flying over an Aerostar Rally basket with a four point hookup. The envelope weights in at 145 pounds. It is made from lightweight Soarcoat™ fabric. We've named it *Mr. Twister.*

Cathy Luenenborg
5023 S. 162 Ave.
Omaha, NE 68135-1205

Cathy Luenenborg's new envelope, *Mr. Twister*

September 5, 1996

Bob,

Do you have an opinion on cord for parachute lines and centering lines? I found some stuff in *Para-Gear* that is 7 strands with an outer sheath. It has a MIL spec, but I don't remember what it is. It cost $22.50 per 100 yards, and is 3/16 diameter. In the catalog, it is the first item on the page with all the cord stuff.

Phil MacNutt
Austin Texas
by Internet: wmacnutt@carbomedics.com

Phil,

Regarding lines for the envelope: The material you described is the standard parachute line commonly used as suspension lines on round canopies. It is constructed under Mil-C-5040 Type III and has a 550 pound breaking strength.

I have seen it used in factory balloons. For your application its a good choice for parachute lines. It takes knots well but is a bit bulky.

Cheap versions of it, often without the inner strands, are often sold as 'parachute cord' in department stores, which I don't recommend for balloon use.

My own preference for parachute and centering lines is #4 braided polyester (Dacron) line. It is sometimes called 'Samson line,' named for one company which produces it. It is commonly used to make fishing nets. With a breaking strength of about 400 pounds, cost is about $17 per 500 feet at commercial fishing supply stores. It has a tendency to shrink when heated, but one can solve that problem by unrolling it and baking it at 250 degrees for about an hour. It is less bulky than the nylon parachute line mentioned above.

Good luck

Bob

Some More Ideas for Articles

In the last issue of BBJ we offered some ideas for articles to publish in this journal. We are taking a little space to continue those suggestions.

Balloon Builders Journal is looking for articles of interest to our readers. While we can't pay for submissions, we do offer subscriptions for your contributions. You don't have to be a writer. We can tape record your ideas from a telephone call and create an article in that manner, subject to your final review and approval.

If you have additional ideas for articles, share those ideas with your editor.

Here are a few new ideas for articles that would interest BBJ readers:

Sewing Machine Topics: Most builders rent or purchase a double needle commercial sewing machine. We would like to see an article on the models that are available, especially used models as well as costs. Hints on identifying causes to sewing problems as well as techniques for adjusting and correcting sewing machines would also make a useful article.

Many amateur builders are constructing and flying **lightweight baskets**. We would like to hear about your experiences in these systems. How do they stand up for continued use? Have you been satisfied with the protection provided in windy landings? Have you found flight characteristics in lightweight baskets which are different from more traditional systems?

Envelope Color Selection: With the broad number of colors available to the builder selecting an artistic combination can be a challenge. This is even a greater challenge for the builder who chooses to buy fabric in 'lots'. How can we get these basics across particularly in a journal which doesn't have color printing capability?

Instrumentation for the Builder: In this issue we present a simple envelope temperature gauge. But what about other instrumentation demands for balloon pilots? Are you using or have you developed some unusual instrumentation that might be of interest to others?

Making a Safe First Flight: The builder has a new airworthiness certificate. How do you go about ensuring that first flight will end safely?

Advanced Bibliography: We are always willing to publish a listing of technical sources, be it a new book in print, magazine article or journal presentation.

Historic Notes: The history of the development of the modern hot air balloon is very colorful. But only bits and pieces of this story have been printed. We would like to reserve some space to tell these stories. For example, did you know that Raven (parent company of Aerostar) once developed a balloon which was inflated while it fell from an airplane? It may have been intended as a military alternative to an emergency parachute to rescue pilots from damaged aircraft over hostile territory.

Suppliers Mentioned in This Issue

I've received requests to provide mailing addresses for the sources mentioned in each issue of *BBJ*. The following list is for this issue:

Aircraft Spruce and Specialty is a supplier of components and supplies for certified and homebuilt aircraft. Their minimum order is $10. An extensive catalog costs $5, refundable on a $50 purchase. The mailing address is Box 424, Fullerton, CA 92632. Telephone number is 714-870-7315.

Ball Instruments, Inc produces a broad range of aircraft instrument gauges and packages for sailplanes, ultralights and balloons. Their address is 6595 Odell Place, Suite C, Boulder, CO 80301. Telephone number is 303-530-4836.

Balloons and Airships is a lighter-than-air magazine printed in Great Britain. Produced six times a year it costs $50 for delivery to the USA. Mailing address is Kelsey House, 77 High Street, Beckenham, Kent BR3 1AN, Great Britain.

Check-It™ Electronics produces the *Model 603 Digital Thermometer* used to build the envelope temperature gauge in our feature article in this issue. The company is located at 560 Trumbull Street, Elizabeth, NJ 07206. Telephone 908-354-8236. Retail buyers can purchase this product through the **Grainger** company, listed below.

The Experimental Aircraft Association is an organization devoted to encouraging all aspects of sport aviation, amateur built construction, and defending the access by sport aviation enthusiasts to airspace. Contact the EAA P.O. Box 3086, Oshkosh, WI 54903.

Grainger Industrial and Commercial Equipment and Supplies: This company has numerous local outlets. It is a wholesale supplier to many hardware stores. Contact a local hardware or electric motor shop for retail orders.

ParaGear is a supplier of sport parachuting equipment and supplies. Their minimum order is $25 when using a credit card. They offer an extensive catalog. The mailing address is 3839 West Oakton St., Skokie, IL 60076-3438. Telephone number is 708-679-5905.

Performance Textiles, produces a wide range of fabrics for balloons, parachutes, uniforms and outdoor equipment. The address is 30 Tremont St., Suite 16, Duxbury, MA 02332-5315. Telephone 617-934-7055. This address is a good source for technical information on their products. They will not sell their fabric directly to homebuilders.