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THE BALLOON BUILDERS' JOURNAL

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In This Issue

Up and Coming

As promised in past issues, we will report on a simple, and relatively inexpensive envelope temperature gauge.

Change in Print Schedule

As I start the fourth year of publication, I have to thank my patient wife for the many undone 'honey-do' projects.

The fact remains I do need to find a bit more time to commit to home responsibilities. That, and the increasing cost of postage and printing have forced me to reduce my annual publication rate by one issue per year.

Those readers who have already made payment will continue to receive their subscriptions to the agreed upon expiration date. For example, if you are currently paid up to issue number 24, (look at your mailing label) you will receive issues up to 24.

Beginning with Issue number 20, (September-October 1996), all new subscribers and all renewals will be at the rate of 5 issues per year for $12.

You may renew or extend your subscription , up to issue number 26, at the old rate of $2 per issue, until to August 15, 1996.

Design Considerations for the Builder: Basic Testing

By Bob LeDoux, Editor,

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In this, our second article on design considerations, we look at some basic structural integrity tests, with a special emphasis on baskets

The views presented here should be considered as personal opinions. These ideas are not offered as professional engineering opinions. Any reader choosing to apply these ideas must assume full responsibility for their application and consequences.

Introduction*

This article is the second in a series of discussions concerning design and construction standards for the amateur balloon builder. The first article in this series, published in issue number 16 of *The Balloon Builders Journal*, discussed 'features, equipment and operation limits which are important to safe balloon function'. This article expands on that first discussion. In this article we discuss balloon structural testing with an emphasis on basket safety.

These articles developed out of the contributions of two readers. One of these readers was Mike Gross. Mike and his family recently completed construction of a lightweight balloon based on a Boland basket and envelope. Mike sent me a binder of logs, photos and receipts which documented the construction of his basket.

After completing the construction of the basket Mike decided to perform a series of strength tests on the system. *Figure 1* is one photo from a series of tests the Gross family performed. In this photo an asymmetric load of 450 pounds has been placed on one end of the hanging basket floor. Then Mike and his son climbed on the other end of the basket loading the base to about 900 pounds. The floor took the load without problem.

Bruce Comstock is the second person I would like to credit for encouraging me to develop this article. Sometime back, Bruce sent me the following e-mail:

"I think most balloon manufacturers are more capable than most amateur builders of designing safe light-weight balloons. That it is possible to design safe balloons lighter in weight than the manufactured ones does not imply that this is easy to do. The price of a design error in weight-reducing a balloon could easily be someone's life. I think anyone designing balloons weaker than the manufactured balloons has a great responsibility to assure that the design is safely strong. This should be done through competent stress analysis backed up by strength testing. To me, actual strength testing of assemblies is more reliable proof than analysis, because analysis allows too much possibility of undetected error. I recently loaded a new little basket ... to more than 1200 pounds, and suspended it, to demonstrate its strength before I flew it. Doing these exercises has made me wonder how much testing most amateur builders are able to do."

Both Mike and Bruce are addressing safety concerns which impact the future of the balloon building movement. We have experienced a very good safety record among amateur balloon builders. But with the recent growth in building, the risk of a serious accident is growing. Some current generation builders aren't just recreating copies of proven factory balloon designs. As we demonstrated in our previous article, some builders are creating entirely new kinds of systems, constructing baskets and envelopes, while using materials and techniques of an unproven nature.

Like Bruce, I believe testing provides much more confidence as to the safety of balloon components than depending on calculated values. As one well known aerospace engineer once put it "One test is worth 10,000 expert opinions." (or calculations).

So we are again faced with the basic question for the balloon designer. "How can the amateur builder go about designing a safe system and confirm the structural integrity of that new system?

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* I would like to thank Bruce Comstock for offering suggestions to improve this article. However, the comments made here, except for the direct quotes attributed to Bruce, do not necessarily represent his opinions.

In the following discussion we will make constant reference to *FAR Part 31*, which is the airworthiness standards which are applied to type-certified (factory produced) balloons in the United States.

Many builders have limited need for balloon testing programs. The majority of construction projects utilize amateur-built copies of type-certified envelopes flying over type-certified basket systems. These projects enjoy many of the benefits of all the testing and flying experience associated with type-certified aircraft. Even builders building kits, like Brian Boland's products, enjoy some of these benefits.

Its important to remember that minimum strength requirements are not black and white. Bruce put this notion better than I can: "For any balloon system there exist sets of circumstances at which the balloon structure will fail. The fact that a balloon has been flown for many hours without failure only means that those circumstances have not been encountered."

"Designs which meet the requirements of *Part 31* and have flown many hours of operation are more likely to tolerate these unusual circumstances than balloons which are new and innovative designs, regardless of the testing performed on these new designs."

Thus testing is critical to proving the safety of a new balloon, but it is only the first step. One of the key advantages to purchasing type certified (factory) balloons is that these aircraft are flown by many different owners.

These many owners, exhibiting a broad range of skills and techniques, which place the aircraft into unusual sets of circumstance, prove the overall balloon system integrity. (Of course, there is the occasional pilot whose skills and techniques would make the balloon factory president, chief engineer and company lawyer turn green at his antics.)

When a builder constructs a new system, or copies an uncertified system many of these protections do not exist. While testing can remove many of the doubts about the system uncertainty will still remain. This does not mean the balloon is unsafe, only that it has **not** been proven convincingly to be safe.

The previous comments are not intended to discourage builders from testing, only to encourage recognition of the limits provided by testing. To encourage confidence in construction, and to eliminate basic shortcomings to design and construction,

Figure 1. The Gross basket is hung by its vertical support cables. An asymmetric test load consisting of 450 pounds of sand has been loaded on one end of the basket.

designers and builders should give consideration to *load testing* their projects.

To this end, let's look at some of the provisions of FAR part 31:

Sec. 31.25 Factor of safety.

(c) ... The primary attachments of the envelope to the basket, trapeze, or other means provided for carrying occupants must be designed so that failure is extremely remote or so that any single failure will not jeopardize safety of flight.

This is a good design standard for the builder. This represents the FAA's experience and understanding about redundancy of systems to promote safety. Certainly, any balloon design which depends on a single attachment point between the envelope and the basket requires special design and construction considerations. The safer approach is to use multiple attachment points, like those commonly found on most factory baskets, which employ three or four corner attachment points.

Bruce Comstock offered the following comment on redundancy: "One of the more important realizations I have had regarding reliability is that redundancy is the cheapest and easiest way to make something reliable. If a particular device is likely to fail once in a thousand uses, then a design which incorporates *two* of the devices, *in parallel,* is likely to fail only once in a million uses! With the devices in parallel, *both* must fail for the structure to fail. This is admittedly an oversimplified example to make the point."

Structural Proof Testing

A key safety consideration in any new design is the basket strength reserve. The FAR offers the following for testing of a new design:

Sec. 31.14 Weight limits.

(a) The range of weights over which the balloon may be safely operated must be established.

(b) Maximum weight. The maximum weight is the highest weight at which compliance with each applicable requirement of this part is shown...

To put these regulations into a real world example, let's assume we have designed an innovative basket, the integrity of which we seek to validate. This basket happens to be modeled after a Balloon Works carriage, is woven from rattan, is triangular in shape, and carries its main loads, including its fuel tanks on the interior floor.

In our design, at variance to Balloon Works policy, we choose steel cables attached to a metal plate in the basket bottom, to transfer loads up to a burner support ring. Lets further assume the maximum load carried by the basket is 600 pounds. This weight includes the entire basket assembly, pilot, passengers, and fuel. This basket weight could also be defined as the maximum gross aircraft weight less the weight of the envelope.

The Load Limit Test

The FAR's provide the following sections regarding our testing of this basket:

FAR 31.21 Loads:

Strength requirements are specified in terms of limit loads, that are the maximum load to be expected in service...

FAR 31.23 Flight load factor

In determining limit load, the limit flight load factor must be at least 1.4.

Sec. 31.27 Strength.

(a) The structure must be able to support limit loads without detrimental effect.

This is to say that Part 31 assumes the maximum loads encountered in service are 1.4 times the static loads at maximum permitted gross weight. Our basket must be able to take 1.4 times its gross weight of 600 pounds, or 840 pounds without damage. Because the major loads are all carried on the basket floor a basic test of structural integrity can be proposed: distribute over the basket floor, enough ballast so that the result is a total basket weight of 840 pounds. Now, suspend the basket by the vertical cables running up to the burner ring. There should be no damage to the basket structure when left in this position over a reasonable period of time

If the basket passes this test, the pilot has achieved **only** a minimum level of assurance that it is at least **barely safe** to fly.

The Ultimate Load Test

The FAR's go on to establish a second level of testing:

FAR 31.21 Loads:

Strength requirements are specified in terms of limit loads, ...and ultimate loads, that are limit loads multiplied by prescribed factors of safety.

Sec. 31.25 Factor of safety.

(a) Except as specified in paragraph... (c) of this section, the factor of safety is 1.5.

A Simple, Informal Test Procedure

The testing procedures described in this article are relatively simple, but they still require a formal test setup. What about a simple, spur of the moment test? If for example, you are invited to fly a unknown balloon system, how might you check its structural integrity?

Here is a simple test approach: This test makes use of the 'spring' that exists in a balloon system. 'Weigh off' and ascend to about 2 feet above the ground. Bounce up and down by flexing your knees. Repeat this bounce in time with the basket making the entire balloon spring up and down with increasing force. Increasing the intensity of your bounce will create significant loads throughout the entire balloon. Additional shock loads can be created if the basket can be made to strike the ground during this process.

(c) A factor of safety of at least five must be used in the design of all fibrous or non-metallic parts of the rigging and related attachments of the envelope to basket, trapeze, or other means provided for carrying occupants....

Sec. 31.27 Strength.

(b) The structure must be substantiated by test to be able to withstand the ultimate loads for at least three seconds without failure....

Our basket employs a 'metallic' structure to transfer the loads from the basket floor to the burner ring. Thus the ultimate load is the load limit (1.4) times the factor of safety (1.5) which equals 2.1. According to *FAR 31.27*, the basket should be able to support 1,260 pounds (600 pounds gross weight x 2.1) for at least three seconds without failure.

This standard allows a test like the test above. This time the basket is loaded to a total weight of 1,260 pounds after which it should support that weight for at least three seconds without damage.

Because the load is greater than the test above, the potential for damage is greater. Depending upon the strength reserve built into the basket, great care may be required to ensure that the load is first carefully added and then removed from the basket structure. Failure to properly perform this test may result in some damage even though the basket is sufficiently strong to pass the test.

What if this ultimate load test damages your brand new basket? While you are rebuilding the failed parts to greater strength, consider how fortunate you are to have identified these weaknesses without hurting anyone.

One method of performing these tests is to physically raise the basket off the ground using a crane or hoist. Another method involves setting the basket on a moveable platform. The basket is loaded, and while sitting on the platform is attached to an overhead system of supports. To perform the test, the platform is lowered, allowing the basket to hang by its supports. After the specified period of time the platform is then raised taking the load off the basket.

Regardless of the method used to load the basket, the *ultimate* test provides an additional measure of testing beyond testing only to the load limit as presented above.

These tests are admittedly simple and provide increasing evidence as to the basket strength. But these simple tests may not be sufficient to prove a basket is safe.

Special Test Considerations

Depending upon your design there are likely other considerations which must be met to prove the basket is safe. Here are a few examples which justify additional testing:

• Suppose the basket employs ropes (textiles) rather than steel cables for the suspension system. The *FAR* states the following:

Sec. 31.25 Factor of safety.

(c) A factor of safety of at least five must be used in the design of all fibrous or non-metallic parts of the rigging and related attachments of the envelope to basket, trapeze, or other means provided for carrying occupants.

According to this FAR, a higher strength reserve is required when ropes and other non metallic parts are used for the suspension system. Presumably this is because the strength of fibrous or non-metallic parts is not as predictable as that of metallic parts, and these materials tend to degrade in a less predictable way.

• The fuel tank support system should be subject to its own testing. The basket in our example has the tanks mounted on the interior basket floor, thus the floor carries their weight. Typically, straps around the basket structure, the rattan, secure the tanks. But the straps and the rattan structure must be adequate to provide continued tank security under any foreseeable set of conditions.

I tested my *Castaway* basket (see last issue) by strapping 150 pound cylinders into the tank positions. I then turned the basket over on its side to see if the assembly would remain intact. These cylinders represented an approximate load factor of about two times the weight of the standard, filled, 10 gallon Worthington tanks. There was considerable flexing of the rattan reed, but no failure of the rattan or the tanks straps. I felt this test was warranted because my basket was constructed from reed which was weaker than the rattan than found in other baskets of similar design.

Such a test may be warranted in a 'one-time' design by an amateur builder. There's little question that a tank breaking loose during a high wind landing could cause considerable injury to the basket occupants. If pressurized hoses or fittings were to fail under these conditions, the potential for a catastrophic accident is very real.

• Our test example above removed the burner support ring from the test. In each of our examples, the basket is hung from the support cables which run from the basket floor to the burner ring. Removing the burner ring is warranted because it simplifies the test mechanism. A simple overhead support beam may be adequate for our testing purpose.

Testing gets more complex when the load ring is included. This is because the test mechanism must replicate the angles in the cables created by the open mouth of a balloon envelope. This calls for a more complex assembly for hanging the basket. Some basket assemblies may require this more complex testing arrangement. For example, baskets which make use of aluminum uprights, like those found in Aerostar-type designs may not be suitable for hanging from simple vertical supports.

• The testing becomes more involved if significant loads are carried at points other than on the floor. For example, where will the drop line be attached? Its common to carry a drop line with a breaking strength equal to the basket gross weight. A typical 'hard point' for attachment of the dropline is the burner ring. But under windy, or tether conditions, wind loads on a drop line attachment point could be significantly higher than the loads endured during normal flight. Unless the burner ring has proper strength reserves, the potential for wind triggered deformation or failure exists.

• Exterior mounted tanks are another example of placing significant loads off the floor. In the Boland basket design, for example, the fuel tank is hung from the basket framework. Under these conditions the basket sidewall becomes a structural assembly. At the very least, the sidewall should be capable of carrying at least 2.1 times the fully fueled tank weight.

Designing Only to Pass Part 31 May Be a Mistake

The fact that a basket will pass a load test doesn't provide *carte blanche* assurance that the design is safe. Let's describe a basket which can pass the ultimate load test but which is still patently unsafe:

Our example test basket, described above, is triangular in shape with a vertical support cable in each corner. How heavy a cable would be required to pass the load test at ultimate load?

A $^1/_{16}$ inch diameter (7 x 7) steel aircraft cable has a breaking strength of 480 pounds. In our triangular basket the breaking strength of the three cables would be 1,440 pounds. Its likely that our basket with a $^1/_{16}$ inch diameter cable in each corner would be capable of supporting the gross weight of 1,260 pounds required by our test. But I, for one, would be reluctant to fly such a system. After all, $^1/_{16}$ inch cables are sometimes used to retain basket assembly 'pip' pins, like those found on some Aerostar baskets.

Real basket loads are typically not applied in a symmetrical pattern. A basket corner with a tank has a higher load than a corner without a tank. Catching a basket corner in a tree, or hitting a rock on a hard landing can place major loads on to one part of the basket. Thus I personally want a much higher strength reserve in my vertical support members than required by the FAR.

My minimum standard calls for the vertical support member or cable, in each corner, to be able to carry the ultimate test load of 2.1 times the basket gross weight. At no time would I use a cable of less than $^1/_8$ inch diameter. This diameter aircraft cable has a typical a breaking strength of about 2,000 pounds. My *Castaway* basket, with a basket gross weight of about 500 pounds, employs $^5/_{32}$ inch diameter cables in each of its four corners. These four cables have a combined breaking strength of about 12,000 pounds.

Inspections: Critical to Continued Safety

The fact that a basket will pass the strength test, today, doesn't necessarily mean its structural integrity will be retained over time. Hard landings, or other forms of abuse can

How about Envelope Testing?

Bruce offered this idea for basic testing of an unproven envelope design: "The envelope I'm currently building has some unusual features that introduce questions of stress concentration. Although I have done all the strength calculations to *Part 31* minimums, before I fly the envelope I plan to inflate it in strong surface wind on an inflation restraint and let it beat itself around a bunch. The stresses to which it will be subjected by this experience are probably greater than it could encounter in flight. This is perhaps a useful test also for the load ring and parts of the basket structure."

result in reductions to the basket strength reserves. This is one of the reasons why balloon manufacturers make equipment that seems ridiculously overbuilt to some amateur builders.

In order to ensure continued safety, routine inspections are the second element of our testing standard. The nature and frequency of the inspections depends very much on the aircraft design and the flight history. A newly designed basket may require an in-depth inspection after every flight until confidence builds regarding its structure.

Essential to this inspection process is the ability to examine the structural components in the system. For example, if the basket employs cables to transfer loads from the envelope to the basket base, each inch of cable should be readily available for inspection. This is especially true if the cables have corners in their paths. Often, covers are placed over these cables. While these serve to protect the wire rope, they also may hide damage. It may be wise to make the covers removable during this testing phase.

After a hard landing, special consideration should be given to the inspection. In particular, each load carrying member, which translates the loads between the basket and the envelope should be carefully examined.

The Drop Test

The following text describes a drop test which is required of type certified balloons. We do not propose this test as a standard for the amateur builder constructing a single basket:

Sec. 31.27 Strength.

(c) An ultimate free-fall drop test must be made of the basket, trapeze, or other place provided for occupants. The test must be made at design maximum weight on a horizontal surface, with the basket, trapeze, or other means provided for carrying occupants, striking the surface at angles of 0, 15, and 30 degrees. The weight may be distributed to simulate actual conditions. There must be no distortion or failure that is likely to cause serious injury to the occupants. A drop test height of 36 inches, or a drop test height that produces, upon impact, a velocity equal to the maximum vertical velocity determined in accordance with Sec. 31.19, whichever is higher, must be used.

This drop test is dependent upon the demonstrated terminal velocity speed of the balloon, which can exceed 1,300 feet per minute. Thus a free fall of more than 9 feet may be required as part of this test.

Its worth noting that many factory baskets are designed to take the drop tests with little or no damage. Thus many of our factory baskets far and way exceed the safety standards required by *Part 31*. Of course, there is a cost to this approach. These baskets tend to be heavier.

There is certainly justification in this approach for a factory balloon. Under current regulations, a pilot could take his aircraft out the day after annual inspection and make a horrendous landing. Under current regulations, that basket actually faces no mandated inspection, by a competent third party, until the next annual inspection or 100 hour inspection becomes due. That fact alone is incentive for factories to build sturdy equipment.

As Bruce put it: "Not all structural failure results from gradual degradation or incremental damage. The extra strength in factory balloons serves to prevent some failures which would occur in weaker baskets. Part of what manufacturers design for is the unknown, the unexpected, the unpredictable. This includes extraordinarily bad weather, extraordinarily bad piloting, extraordinarily bad luck (if there is such a thing as luck). Balloons built by amateur builders are subject to these [same] conditions."

Some Closing Thoughts

Bruce Comstock offered the following thoughts on which I would like to close:

"During the 15 years I was in balloon manufacturing I personally did a lot of certification to *FAR Part 31*. I think *Part 31* is a good guide to anyone building a balloon. I would recommend that no one fly anything until she has reviewed its compliance with the requirements of *Part 31*, paragraph by paragraph. If it doesn't comply, I would want to carefully analyze whether or not it is really safe to fly. This simple exercise could prevent an injury or save a life by drawing attention to a previously overlooked design flaw."

"I personally like to come at critical risk from several different directions. If something can kill or maim me, I want to assess the risk in as many different, independent ways as I can. That I was careful in the design and careful in the construction are not enough. One critical, unnoticed error in either can still result in disaster. This is why I favor review and testing and *FAR Part 31* is as good a guide as I know."

"A design that doesn't comply with *Part 31* can still be a good, safe design. Before flying such a design, though, I would want to think long and hard about why it really is a good safe design despite its not complying to *Part 31* standards. I don't ever want to make that final quick trip to the ground wishing I had taken the time to do my homework."

"As you design and build your balloon, begin thinking about some of the most trying flight circumstances in which you might find yourself. These reality checks will help you make good (conservative) design decisions and do good (craftsmanlike) work. Your balloon may be heavier than many other amateur builders/designers would accept. I have flown enough to know that lugging around whatever bits of additional weight I decided I needed will be worth it when the going gets rough."

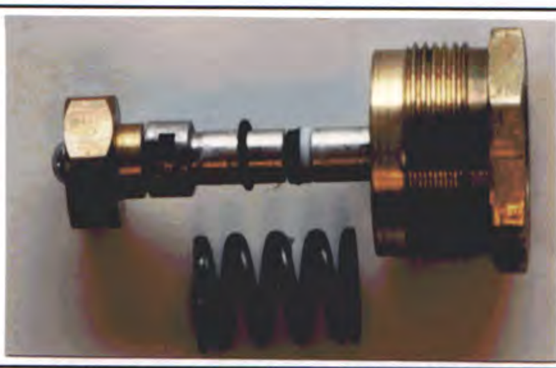
Letters to the Editor and Other Bits of Information

Rego Bonnet O-Ring Problem

The photo below shows a bonnet from a Rego 7553T blast valve as removed from my Aerostar HP-II burner. Time in service for the burner O-ring was 5 seconds. As you look at the bonnet assembly all looks normal except for a little rubber ring around the shank of the valve stem. This little rubber ring represents the exterior of the stem valve O ring which was sheared off as the bonnet was reinstalled into the valve body.

The O-ring had been replaced following normal procedures including the use of Krytox™ grease during the assembly process. The O-ring was the Aerostar factory approved replacement part (Part #52357).

During the typical installation, finger force is sufficient to screw the bonnet into the valve body until the O-ring contacts the bore in the bonnet. Then a socket wrench is required to compress it into the bore, which generally takes about a turn of the bonnet assembly. After the O-ring is compressed the torque required to screw in the bonnet decreases.



This is a Rego 7553T blast valve bonnet assembly. The little ring of rubber around the valve stem was sheared off as the bonnet was reinstalled in the valve body. The problem appears to be the result of lack of chamfer in the bonnet bore. Read the text for more details.

That's the way it was supposed to go. In this valve, the torque remained high without the letup. Thus I was suspicious of the O-ring installation before I even applied the fuel pressure test. Upon applying fuel pressure, I had a copious leak through the valve stem.

I disassembled the unit and examined it. A chamfer at the opening of the bore in the bonnet serves to compress the ring into the bore. When compared to other bonnets I noticed the chamfer on this unit was minimal thus making it ineffective in compressing the oversize Aerostar O-ring. I remedied this situation by enlarging the chamfer with a 45° countersink. Afterward I inspected the chamfer under magnification to ensure there were no sharp edges which could cut the rubber ring. I finished up my modification by polishing the edges of the chamfer with 600 grit silicone carbide paper, taking great care not to impart scratches on the bore of the bonnet. All traces of metal shavings and abrasive were removed using solvent.

After this modification a new O-ring was again installed. It seated properly and is providing good service. As I purchased this burner, used, I suspect the bonnet was a local propane dealer replacement unit which had not passed through Aerostar quality control.

I continue to be pleased with the service I have received from the Aerostar replacement O-rings. When combined with the Krytox™

grease they have proven reliable and leak free.

Submitted by Bob LeDoux

BMRA Seeks Input on Envelope Certification

The following letter was sent by the Balloon Repair and Maintenance Association to U.S. manufacturers of type certified Balloons. A questionnaire was enclosed with the letter:

"George McNeill, FAA, Aircraft Certification, FAA, Washington, DC, has asked BRMA to assist the FAA in establishing a standard procedure for the certification of new replacement envelopes that are installed on existing balloons."

"An important element of this process will be to determine which part of a balloon constitutes the airframe, or the part to which the registration number and ID plate belong. In practice, most FAA offices and balloon manufacturers have treated the envelope as the airframe, however, to our knowledge, the FAA has not officially designated any particular component. Since the envelope is the component that wears out, a good argument can be made for making the basket the airframe, the basket is a long-lived component, that carries pilot and passengers, making it analogous to the airplane or helicopter fuselage which is designated the airframe."

"We agree with McNeill that the first step to take is to determine how the different manufacturers now handle new replacement envelopes, therefore we ask you to complete the enclosed questionnaire and return it to us. Please use additional space, if required, for details or extra comments."

I have mixed emotions about the BMRA action. On one hand I recognize a benefit to treating a basket as the airframe. I have more envelopes than baskets in my stable. Each envelope has an "N" number which requires me to pay a state registration fee for each bag of fabric. Treating the basket as the airframe would simplify my life in that regard.

But there is another side to this issue. Because the envelope carries the aircraft registration, the basket is treated as an accessory. Thus the envelope is more likely to be viewed as the 'majority part' of the aircraft for purposes of qualifying under the amateur built rules. Matching the aircraft registration to the basket could result in greater difficulty in obtaining amateur built airworthiness certificates. This is particularly true for those builders who seek to fly homebuilt envelopes over factory baskets. For these builders, the use of a checklist, like that presented in Issue 16 of Balloon Builders Journal would probably become a necessity.

Under current regulations, the registration number must be permanently mounted on opposite sides of the envelope, near the equator. If the basket holds the registration the "N" numbers would likely be mounted on the basket, but how and where?-Editor

New Burner Airworthiness Standards

If you read other balloon magazines you enjoyed the chuckle prompted by the new rule which requires "a burner...be designed and installed so as to create a fire hazard." Looking beyond the humor the new regulation, a recent change to *FAR Part 31*, may prompt manufacturers to produce lighter weight heat sources for our balloons.

Under the old regulation a burner had to survive a 50 hour endurance test to meet type certification. This required substantial construction as well as copious amounts of propane. The new rule seeks to validate burner airworthiness through a series of tests which better represent the real situations encountered in balloon flying. The overall test period can now be met in 40 hours.

If you are interested in learning more about the new regulation read the *Federal Register* for April 24, 1996. The text begins on page 18220.

Joe Seawright Obtains Airworthiness Certificate

Hi Bob:

I am happy to report that after a nine month war with the FAA, I now have my special airworthiness certificate in my hand! I finally had to go through the Memphis FSDO, and the inspection was performed by a Bruce Willey, a very nice guy and friend of Lyle Alexander's. Bruce initially held a view that building the envelope was not 51%, [majority portion], but after an hour long phone call with Lyle, he changed his opinion. The inspection was done last Friday, May 17, eight months and 28 days after my paperwork was first submitted. Isn't that ridiculous?...

I guess the biggest thing I have learned from this whole episode is that there is virtually no one in the South/Southeast region that knows how to inspect an amateur built balloon, other than Bruce Willey in Memphis. Jackson and Atlanta certainly don't have a clue!

One interesting note. You remember that I had sought the aid of Congressman Sonny Montgomery. His office was instrumental in helping pave the way for this, even though it took nine months. He also talked to the senior Senator from Tennessee, to get the help of the Memphis office of the FAA. When Bruce Willey finally got here (it took six weeks to get them down here), I noticed that the manila folder he brought containing my application documents, and other paperwork, carried a big red sticker on the front that said:

CONGRESSIONAL
Must answer no later than May 17, 1996

A special thanks to you for all your help. The list of balloons you sent me had a major impact, for the Atlanta MIDO chief finally gave up, and in his letter of surrender he admitted that it appeared that a precedent had already been established based on the list of previously certified balloons I submitted. Add my N-number to the list for future applicants!! Thanks again Bob.

Sincerely,

Joe Seawright
N 369RD
"Baby Grand"

Joe also noted that the Atlanta MIDO has a perspective on balloons different than found in some other regions of the country. In particular, they have considered the basket and not the envelope to be the 'major portion' of the balloon when considering amateur built airworthiness certificates. Apparently, this is the influence of counsel provided to the FAA by individuals at The Balloon Works (TBW).

I discussed this issue with BBJ reader Charlie Gardner who is also The Balloon Works Designated Engineering Representative (DER):

Charlie reported that TBW can build an AX-7 (model 7b) envelope in about 2 to 2 1/2 days while it takes almost a week to construct a basket. From TBW's perspective the basket represents a significantly larger portion of the construction.

The bulk of these time savings occur in the envelope, which involves gang cutting of fabric panels and use of four and six needle chain stitch sewing machines to respectively, assemble panels into gores, and assemble gores into an envelope. The six needle sewing machine will completely assemble the Flexnet™ vertical seam, including the load carrying rope in a single pass.

Readers should not assume that the envelope will automatically be treated as the 'major portion'. Builders contemplating construction projects should review past issues of BBJ and plot out a carefully planned set of actions to avoid some of these pitfalls:

In issue #11, page 2, is an article which discusses the paperwork trail required to obtain an airworthiness certificate and repairman's certificate.

In issue #16, page 7, is an article on a Builder's Checklist which can be used to demonstrate you built the 'majority portion'. This article also discusses approaches to take when discussing your project with the FAA.

In Issue #17, page 8, Lyle Alexander discusses arguments for demonstrating that the envelope is the 'majority portion'.

Let's learn from Joe's experience. With careful preparation it should not require congressional action to obtain an amateur built airworthiness certificate!

From Renewal Forms...

Bob,

What happened to the article on the "home-brew low cost envelope temperature gauge?"

If we are going to be safe we need to test our fabrics. How about something on the proper procedures for using a home-made rig for testing tensile and tear strengths?

Arnor Larson
RR 1, Site #c, Box 27
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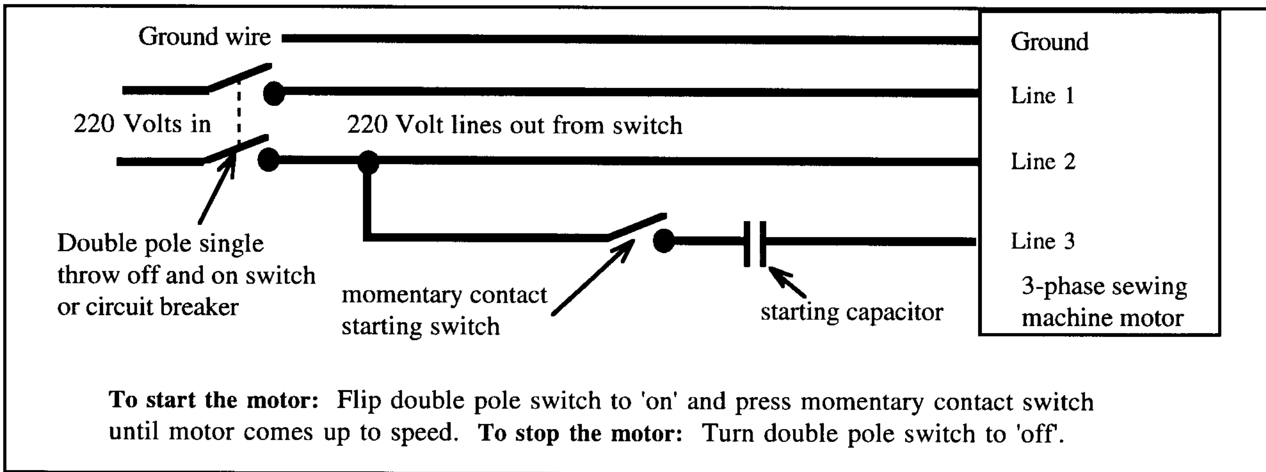
Canada

I have been experimenting with the low cost temperature gauge for about a year. It works well and I will put an article into an upcoming issue.

If you are using a simple fabric pull test system, please share details with us. My own method is very primitive and involves little rubber covered wood blocks which I clamp to



Wiring diagram for a converter to operate a 3-phase sewing machine on household power.

the fabric using standard 'C' clamps. -Editor.

Converting 3-Phase Motors to Single Phase

11/20/95

Hi Bob,

..the main reason for writing is I was able to purchase a Singer 112W $^3/_8$ [inch needle gauge] double needle sewing machine this [last]summer at an auction for a very reasonable price. It has a $^1/_3$ hp 3-phase motor which draws 3 amps. As you probably know, most homes carry only single phase power. Enclosed is a simple, inexpensive way to run the 3-phase motor on single phase power.

According to the local motor repair shop, and the electronics department here at work, the motor should operate efficiently and electrical consumption will be slightly above normal costs when the motor is run on 220 volt 3 phase. For those readers who have no electrical background, the 3 phase motor can be replaced by a 115 volt motor. The local Singer shop sells one brand for $140. The preferred speed is 1725 rpm.

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I misplaced this submission, so please excuse the tardiness for printing it.

One of my crew members, Paul Zimick, operates a motor repair shop. He says Larry's system works very well, but only on 'Wye' or 'Star' wound motors. Don't try to use this system on a 'Delta' wound motor.

Apparently, when running on single phase power, the actual power output is $^1/_2$ to about $^2/_3$ of the motor rating. For balloon construction this lower power output should be sufficient.

The momentary contact start switch should not be held in too long, not more than 3 seconds, or you will 'blow up' the starting capacitor. The starting capacitor can be any standard motor start unit with a rating of 220 to 250 volts and a capacitance of 189-227 MFD, rated for 60 Hz. The unit described above can probably be constructed for about $25.

For readers who prefer to buy a ready made and automated motor adapter, a device called 'Phase-A-Matic' performs all the functions of this circuit and includes a built in electronic start switch. It can be purchased from a commercial motor shop. The only disadvantage to this product is its cost, which is about $126, in the size required for a sewing machine motor. For this same price you can buy a good 120 volt clutch motor for your sewing machine. Editor.

Bob and Mari,

I have an NH_3 [ammonia balloon] under construction and I'll keep you up to date on its progress.

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