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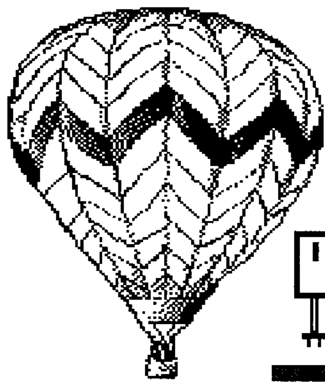

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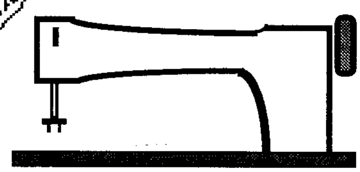

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THE BALLOON BUILDERS' JOURNAL

January-February 1995

In This Issue

Up and Coming

Brian Mehosky describes cable length calculations on a cad/cam system. We also follow-up on additional cable length considerations. Look for an article on balloon instrumentation for the builder, including ideas for home-brew envelope temperature gauges.

Notices To Readers

Back Issues

Just a reminder that **ALL** back issues are available for $2 each. Mail us a check and identify the number of each issue you need to finish your collection.

In Order to Make Article Submission Easier...

Many of our readers are accomplished builders–but they are not writers. In an effort to make it easier to contribute articles to *Balloon Builders Journal* we have instituted a new program. Under this program, we will help you write your article. Through information taken from one or more telephone conversations, we will prepare the text for your article, subject to your review. Your article will appear as a regular article, not as a question and answer interview.

Building the Bassett Burner, the article which starts on page 2, is our first attempt at this approach. We think our first effort was very successful. We hope this program will expand the variety of articles published.

If you have material for an article contact *BBJ*.

Current Readership

Currently, there are 152 subscribers to *The Balloon Builders Journal*

Building the Bassett Burner

By Bill Bassett,

14710 168th. Ave NE, Woodinville, WA 98072

Few builders undertake burner construction. But Bill demonstrates that a professionally built product is possible by the mechanically talented amateur.

A Caution

This is not a correspondence course on burner construction. I think very few homebuilders have the skills or determination to build a burner. To build a burner requires a general understanding of, and skill in a variety of metal working techniques. It also means having access to a good metal working shop. Constructing a burner coil requires exceptional skill in tube bending

A burner is an assembly of precision parts which must operate reliably and without leaks while passing a very flammable liquid at high pressure. There is no room for poor construction techniques or materials. At one moment the burner coils can be -44°F as liquid propane passes through them. The next instant the coils can be heated to an orange color of about 1800°F. That's demanding a lot from an assembly of metal parts. If your envelope develops a small tear or hole, making a safe landing is generally a simple matter, but if your burner develops a small hole, there is real potential for an unanticipated landing or worse, an onboard fire.

My Background

I am not a professional metal worker. I studied metal shop in high school and a welding course in a technical college. Over the years I have developed practical metal working experience through a variety of projects including two hot air balloon burners and three balloon baskets. I built this latest burner while a student in an automotive class on electronic controls. That class allowed me to rub shoulders with other students who were in metal work. They actually constructed many of the parts based on my mechanical drawings.

I built the burner because I learned to fly in Balloon Works products and have always admired the Balloon Works burner. It is simple, light weight, reliable and expensive. The burners in my price range were the older multiple can systems from the early 1970's. I decided if I was going to have a Balloon Works type burner, I was going to have to build it. Looking back on the project, I could have bought a used burner for the time and money spent in building one.

Study

I carefully studied a Balloon Works burner, dissembling it many times to understand the components, how they work and how they fit together. Balloon manufacturers spend a great deal of time and money to make their products work well. I wanted my burner to be just as good as any factory product. So my design followed a proven factory design, including the use of accepted components like valves and fittings.

Early in the process I realized that bending up the coils and assembling them into a complete burner unit would be a real challenge. I took a Balloon Works burner home and spent night after night studying the coil assembly. I color coded the individual coils so each could be individually picked out. It gave me a good visualization of what I was going to do. I realized that I wasn't going to be able to farm out construction of the coils. If I wanted the bending done right, I was going to have to do it myself.

Making the Coils

The burner coils are made from .020 wall thickness tubing with an outside diameter of $^3/_8$ inches. Most of the manufacturers are using a type 321 stainless steel for their coils, and it has worked out well We rarely see a burner which has a coil failure. I have seen a Balloon Works inconel coil failure. The coil opened up due to a manufacturing defect in the tubing. The problem was with the original tube manufacturing and not with the Balloon Works.

I've seen burner coils heated to an orange color by the Fire II flame. That can't be good for the metal. Inconel is a good choice because it doesn't suffer intergranular failures during the hot to cold cycles. Inconel is composed of about 75% nickel, with 15% chromium and the rest, iron.

I required three lengths or 60 feet of the inconel. It cost me about $3.50 per foot, which I thought was very expensive. A company, in Woodinville, WA, put me in contact with a supplier in Kent, WA, which ordered the tube. It had to be shipped up from California. I still remember waiting about four weeks for delivery and taking those three precious 20 foot lengths home inside a cardboard tube tied to the side of my Dad's pickup.

While I was waiting for the tube delivery, I constructed my bending jig (see *figure 2*). It was welded on a pipe to a truck rim base with the benders mounted at mid-chest height.

The jig consisted of two simple tube benders (Ridgid model 456-44852), which had been purchased for about $24 each. I set up the first bender as a stationary clamp. It held the previous bend and held the metal tube quite rigidly. Mounted a fixed distance from this bender was the second bender which actually formed the bend in the tube. This bender was moveable to allow the tube to be released from the jig after a bend was completed. The combination of the fixed distance between benders, and the clamping action of the first bender allowed me to bend a consistent coil.

Figure 1: This close-up shot emphasizes the burner can and coil details. The repair sleeve, discussed in the text, can be seen on the vertical length of coil. The screen-type pilot light and piezo igniter are also clearly visible. For another detail picture of this burner, look at Issue #9, of *The Balloon Builders Journal,* page 8.

I knew bending would be a one-shot deal. I couldn't afford to make mistakes and ruin one of those pieces of tubing. So I practiced using cheap, automotive brake tubing until I was comfortable with the process. Brake tubing had a bit thicker wall so I knew my inconel might not bend exactly the same. I was concerned about flaring on corners. I knew that wrinkles would form on the inside of each corner, and that the tube would tend to flatten out on the outside of each corner.

The coils were bent up without problem. My 3 year old nephew held the free end while I operated the bender. After each corner was completed, the coil was removed from the jig and reset for the next bend. With each bend, I was creating a curlicue which wound around the base of the bender. There was some flex in the coil, much like the flex in a coil spring, which would help me put together the final coil assembly.

In retrospect, I don't think I could have found a more complex coil to bend up than The Balloon Works coil. If I had it to do again, I might make up a square or round burner coil system. The complex bending did contribute to lighter weight and fewer fittings in the burner system.

Manifold Concerns

In my study of the Balloon Works burner I discovered a heat problem. The burner coils lead to a brass manifold which sits down in the bottom in the middle of the burner can. I've looked at a number of burners and it appears that these manifolds get so hot that they begin to melt. I've seen several burners with what appear to be little rivulets of melting metal. Because of this I decided I wanted to use a different material for my manifold.

I live a short distance from one of the Boeing aircraft factories. Boeing has a surplus yard in which they sell surplus materials and tools. I went searching and purchased a piece of titanium. A friend who owed me for some auto body work turned the piece on a lathe for the manifold. It is light weight and very resistant to heat.

If I had chosen to use an aluminum manifold, I could have purchased it locally. Air tool dealers sell an aluminum manifold which is used to connect three air tools to a single air hose. It costs about $7 and would do the same job. Even the holes are machined at the right angle.

Making the Burner Can

I always liked the Adam's burner can, in spite of the fact it is a square burner. So I adapted it to the triangular form. The Balloon Works burner can seems to be quite flimsy. They curl the top edge to add extra stiffness, but it still buckles under the heat of operation. To eliminate the buckling I chose to make my can from 20 gauge type 321 stainless steel.

Can construction was simple and required only basic metal working tools. I constructed a model from heavy Kraft paper. This model was given to a sheet metal worker who created templates from a heavy shoe box-type cardboard. The actual can consists of three individual sides which are screwed together in the completed burner. The curve edges were made by punching out a circular hole, then cutting out the extra metal with a bandsaw. I used a file to finish these edges. Polishing completed the individual pieces.

The bottom of the burner can was cut from the same material as the sides. A box and pan folder was used to roll up the edges. A finger brake could also have been used.

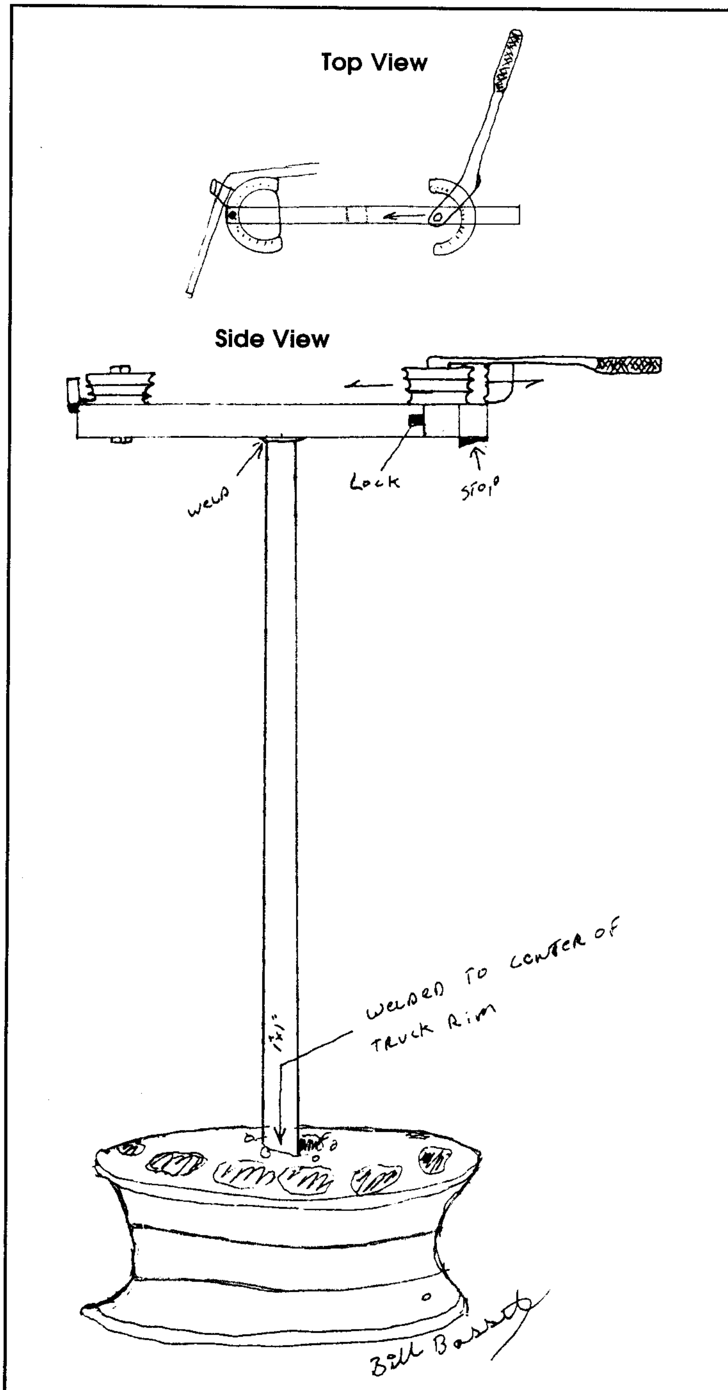

Figure 2: The tube bending jig. Two benders are mounted on the cross frame. The bender on the left acts as a clamp. The bender on the right performs the actual bending. To release the tubing after a bend, the bender on the right is moveable. As the bends are made, the coil is formed in a curlicue around the vertical support.

Some aircraft builders would create this type of piece by hammering the metal around a form block. But the result doesn't have the nice sharp edge that I was looking for, so the segmented bending brake was the way to go.

The Balloon Works puts a dimple in the bottom of their burner can. This collects water which is then dissipated using a slurper. The slurper is nothing more than a simple tube which operates to pick up the water using the venturi principle. I didn't put this dimple in my burner because I didn't have a bumpout form to make the dimple.

Constructing the Pilot light

While it wasn't my intent, most of my development time was spent working on the pilot light. Originally I was going to use a Balloon Works type pilot light. I ordered a set of orifices for the light from *Bernzomatic,* the company which makes the Balloon Works pilot light orifices and other propane torches. The orifices I received were much different than the ones in the Balloon Works burner. They also told me the ones in the Balloon Works burner, model JT684C, are no longer in production.

I made my pilot light exactly like the one in Balloon Works burners. I played and played with the pilot light system and could never get it to work properly. At best I could only get one of the pilot lights to deliver the proper blue flame. I suspect that alignment of the orifices was off, or perhaps air was getting into the system from some other source. I eventually gave up and decided to go with a simpler system

After playing around with a number of different configurations I went to *Go Lightly,* my local balloon repair station. They gave me an Aerostar pilot light assembly out of their parts drawer. It uses a vapor feed system with a stainless steel mesh. The mesh allows the fuel to collect and burn in an area protected from the wind. I added a bend to the pilot light stem to centralize it in the fuel column. I also added an older Balloon Works style kill valve at the base of the pilot light. With a simple flick of the finger, the pilot shuts off. A piezo igniter completed the assembly. It was easy to adjust the igniter spacing in a darkened room.

Assembly

The coils are mounted to vertical supports called struts. My struts were made out of $^1/_4$ inch by $^1/_2$ inch copper. The coils are mounted to the struts using buglehead screws. Like the Balloon Works, I chose 'grade 8' steel screws for assembly. I originally thought that stainless steel screws would have been a better choice. I suspect the steel screws were used because of their coefficient of expansion. I still wonder how the coil support screws manage to stay in place. They don't seem to loosen up but they are subject to considerable expansion and contraction due to heating. All the Balloon Works burners I've seen have corrosion around the screws that mount the coils.

I expected assembling the coils to the struts to be a tough job. While I have completely disassembled a Balloon Works burner, I have never taken apart a coil assembly, and not without reason. I once took the back off a mechanical watch to see how it worked. My grandfather reminded me that "there are two kinds of people who take the back off a watch, one is a jeweler and the other is a fool." I felt the same way about disassembling a Balloon Works coil assembly.

The first part of the assembly was to combine the three individual coils into one coil. This involved laying each coil end for end, and screwing each coil into the next, much like you would screw a nut on a bolt.

After this is accomplished, I then screwed a strut to one corner of the coil assembly. I opened up the dining room table, as though installing a table leaf, and I set the coil in the gap. I then manipulated the coil assembly while screwing on the other two struts. In the end, I had one strut which is perfectly centered, and two other struts which were a bit off. But you wouldn't see it just by looking at the burner. This whole process taught me to be a bit more precise in the design of my bending jig, if I ever choose to build a new burner.

I made a bad bend in one of the burner coils. This section was cut out and replaced with a piece of tubing free-hand formed on my jig. The joint was made with inconel sleeve material which is machined to tightly fit over the tubing. This sleeve material was hard to find and expensive. This sleeve can be seen in the vertical tubing of one of the three coils.

The burner was assembled by first mounting the blast valve assembly to the bottom burner can plate. The coil and manifold assembly was then mounted on top of the plate. The two are attached together with a stainless steel pipe nipple, just like that used on Balloon Works burners.

Compression fittings are used to connect the burner coils to the manifold. These fittings are brass, though I made a real effort to find them in stainless steel.

I made a series of leak tests during assembly. Before installing the coils to the manifold, I installed the compression fittings on the manifold and fitted caps on their top ends. The burner assembly was pressurized with compressed air and the burner was placed in a water bath. Careful observation was made to locate any leaks. I found none. After the coils were attached to the manifold I replaced the burner jets with caps and repeated the pressurization test.

The burner can sides were attached. These are screwed on, not riveted like on the Balloon Works burner. I originally used the same grade 8 screws I used to mount the coils. But these corroded so I replaced them with stainless steel screws. The stainless steel screws run through the overlapping burner can sides, and through the coil struts. Segmented locking nuts complete the assembly. Screwing on the nuts was difficult because of the tight fit between the parts inside the burner can. I held each nut in place, with duct tape, on a small ignition wrench, and then reached into the can to start the nut on the screw. I chose nuts instead of rivets to allow maintenance, modifications and cleaning.

Adjustments

I had to experiment with the size of the main fuel jets. Since I used a Balloon Works size coil, I thought I would get by with the same size jets, but it didn't work out that way., I wasn't getting the liquid output I expected. The fuel was over-vaporizing and overheating the coils. So I kept drilling out the jets until I could see the liquid shooting out about 5-6 inches.

It took a while to figure out why the jets had to be larger. Then I realized that my open burner can allows more air into the fuel and thus requires more liquid to keep an appropriate fuel to air mixture. This probably means my burner has a higher output than a Balloon Works burner. I fly my burner under my 40,000 cubic foot envelope, and I have more power than I ever need.

A Balloon Works slurper tube cost me $25, but I haven't installed it. As already noted, I didn't have a way to put a water collection dimple in the bottom of the burner can. So the slurper isn't used. I dump a couple of tablespoons of water out of the can after each flight.

I added a backup "Fire II" type burner assembly. A Cameron whisper valve is tapped into the Rego blast valve. A pipe from this valve runs through a hole in the bottom of the burner can. A black neoprene grommet is mounted in the bottom plate and surrounds the outlet pipe, creating a fairly tight seal. Some high temperature RTV caulking compound around the fuel pipe makes the assembly watertight.

Because of my experimentation with different pilot lights, the bottom of my burner can had a number of extra holes. When I finally completed my experimentation and finalized the current pilot light assembly, I built a new bottom for the burner can. It now has a neat and very professional appearance.

I'm happy with this burner. The entire unit weighs 10 pounds and 6 ounces and has proven dependable and powerful. I would put it up against a Balloon Works T3-017 burner any day.

If I had to build the pilot light system over again, I would probably use a Cameron type liquid pilot. The pilot light has a yellow rather than a blue flame. I think Cameron is using a larger pilot orifice than the other burners. This may result is fewer problems with contaminated fuel.

When it was first introduced, the Balloon Works T3-017 burner was a quantum leap in technology. Twenty years later, it still represents a fine combination of light weight and power. But the other factories have not been sitting idly by. Today, there are many other fine burners on the market, though none of them are as light as the T3 burner.

Where do I go Next?

I have a new balloon burner, new chair system, and a 50 hour envelope so I don't really need any new equipment right now. I'm happy and probably won't be building anything in the very near future.

I would, however, like to play with some ideas using the fluidic amplification concepts found in the Balloon Works Mirage burner system. If I were to build a test burner, I would create three chambers, each canted towards the other two which might provide greater noise reduction and a more concentrated flame than currently found in the Mirage system.

A Basic Manual on Ammonia

By John Kugler

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John Discusses ammonia as a lifting gas from the perspective of a balloon flight.

Introduction

It appears that if you use NH_3 (ammonia) as a lifting gas you are certainly going to go to Hell. Balloon flights using ammonia have been a rather uplifting finding to the sport of gas ballooning. In the past two years, more gas flights have taken place in the United States than collectively in the last 5 years. That's a great accomplishment! One that a few helium/hydrogen pilots take offensively.

As with any new idea or concept, knowledge about the subject is of critical importance. Understanding the capabilities, characteristics, and necessary equipment needed when utilizing ammonia in gas balloons is an essential part of piloting gas balloons. It is the intention of this article to scratch the surface of using NH_3 as a lifting gas and increase the pilot's awareness about the gas. The only way to increase your knowledge of the product is to ask questions. There are no dumb questions. It is our collective responsibility to safely expand the sport and share information. A lot of experience has been gained that is available to you through other pilots, don't let these valuable assets be over looked.

Before you begin, I would like to set the record straight-an ammonia balloonist is a gas balloonist. There seems to be this segregation in the BFA gas division...have you ever heard of any one called a hydrogen balloonist? Certainly not! All gases are not created alike; they all have different characteristics; good pilots will familiarize themselves with the natures of all gases; hence they become better pilots. It is your decision how well acquainted you want to become with the characteristics of other lifting gases.

Remember that safety is a key issue when using ammonia in captive gas balloons. **Be Careful**, and enjoy your gas flights!

If you are reading this, I am assuming that you have some experience flying gas balloons, but if you don't, it's not a big deal. Gas ballooning has long been a very expensive sport with little activity in the United States. It was not unusual to spend $3000 to inflate a helium balloon, plus all the travel expenses and related weather-delay fees. Ammonia ballooning is relatively simple and economical, it will not replace helium, but it sure will allow a lot more people to exceed the competency level of the average U.S. pilot rated for gas balloons!

Ammonia has been used for industrial applications since the 1950's with it's most popular use as a source of nitrogen for agricultural fertilizer. NH_3 is also used as a major ingredient in the manufacture of both dry and liquid fertilizer. Since there are numerous distribution points in the Great Plains states, many people involved with agriculture are very familiar with the product. There is a great deal of safety information available in the form of print and video from various trade associations and manufacturers. Another important piece of information are the **Material Safety Data Sheets (MSDS)**. These are available from the supplier and manufacturer. They contain data concerning handling and safety equipment needed. Read them and ask questions! Make sure that you, as the pilot, make yourself aware of the nature of NH_3.

Most industrial uses of NH_3 involve the use of liquid, but when using NH_3 for balloons, vapor is the form which is used. Most safety materials deal with liquid ammonia. Make no mistake, ammonia is a very dangerous material and should be handled with a great deal of respect! Please note that there are laws and regulations that cover all aspects of the types of hoses, valves and storage that must be used. These regulations are in existence to protect the end user. It is up to you to make sure that you comply. Why jeopardize your safety and the safety of those around you?

Launch Site Selection

This is the first of many decisions that you must make **before** you embark on your journey. Obviously, pick a place that is free of obstacles like powerlines, tall structures and any other launch hazard. Make sure that you evaluate the immediate area downwind of the launch site, study the site and determine what effects a wind shift might have. It is important to understand should the bag be ripped out prior to launch, where will the ammonia vapor go! What hazards would it create? Is there a danger to green vegetation? Is there possible danger to humans or livestock? Am I really going to hit that building? These are all questions which must be answered. Ideally, the launch site should be a rural location. If you find it necessary to fly from a fairly populated area, you can reduce your chance of ripping out and releasing ammonia by studying the weather conditions. If you think it's possible the weather is going to change for the worse...why inflate? What is going to happen to you when you land? Use prudent judgment when selecting a launch site. Remember that if the weather is marginal prior to inflation, why not wait for the right conditions? Relax!

Necessary Equipment/Inflation Techniques

There is an abundance of used valves and hose suitable for use with NH_3 vapor to fill your balloon. Manifolds can be constructed to order to aid in quicker inflations. Most pilots have several 1000 gallon nurse tanks delivered by their supplier to the launch site. To facilitate the gas transfer a 100 ft.-200 ft. length of properly rated ammonia hose is attached to the **yellow (vapor)** outlet valve on the nurse tank. On the end of the inflation hose is a PVC diffuser. Since working pressures are between 10 psi and 225 psi, the diffuser can be a very simple arrangement and quite small. The diffuser is then secured in the appendix by use of a Velcro collar. Be sure to get a tight seal. At this point in time, get goggles and gloves on, and prepare for vapor to be transferred from the nurse tank to the gas bag. Stand up wind and turn the **yellow (vapor)** valve on slowly. You will hear the gas flow through the hose and into the bag. If you have a leak at the nurse tank valve or on the gas bag at the diffuser insertion point, turn off the valve and determine where the leak is. Once the problem has been resolved, continue the transfer. Make no attempt to attach or use the **orange (liquid)** valve on the nurse tanks. They should be clearly marked **"liquid"** and **"vapor"**, make no attempt to use the valve marked **"liquid"**. Often the liquid valve will have a hose attached. Be careful! Don't handle any hose by the valve wheel, it may open accidentally. If you have any questions about the valves on the nurse tank, ask the supplier before you start to inflate.

In analyzing the above situation, here are a few tips. It is best that you use tanks that are less than 85% full. This reduces the chance of having a slug of liquid going through the vapor feed on the tank and into the bag! While the liquid could possibly harm the envelope; it is of greater concern to human health as any liquid going into the bag will spill out and be a potential hazard! Have the correct style of respirator available in case of a leak. Your supplier should maintain a 5 gallon water tank on the nurse tank, but don't rely on him! You should check that it is full of clean water and flows freely from the hose. Water is your best source of relief from ammonia. **YOU MUST READ THE MSDS ON AMMONIA TO FULLY UNDERSTAND BASIC FIRST AID FOR BURNS OR INHALATION.**

When inflating the bag, vapor is being produced as the liquid rapidly boils. The nurse tank will lose pressure and "freeze up". Ice will form on the tank and valves as the pressure drops below 50 psi, even in the summer. It is a good idea to use two tanks and change tanks when the pressure drops in one. Inflating the bag may be accomplished in as little as an hour if the outside temperature is over 80° F. Be prepared to spend as much as 3 to 4 hours if the temperature is below 40° and you are using only one nurse tank. There are many theories and ideas about how to speed up the process. My theory is to sit back and relax, drink some coffee, eat some donuts and listen to a good radio station or go over some charts. The good things in life just take a little extra time!

Flight Characteristics

There is a distinct difference between flying a hot air balloon and a gas balloon! You have a very powerful source of power to initiate ascent in a hot air balloon. Gassers, on the other hand, are more responsive to minute changes-they fly better when small adjustments are made and the pilot thinks out his actions before they occur! This is done to conserve both ballast and gas.

I have been told that NH_3 flies a lot like methane or coal gas. NH_3 is considered to be a "heavy gas", it has about half the lift of helium. It is still a gas and will be subject to the following laws. Full explanations are given in any standard textbook on physics. Briefly these laws are as follows:

Archimedes' Law: the buoyant or upward force exerted upon a body immersed in a fluid is equal to the weight of the fluid displaced.

Boyle's Law: at a constant temperature, the volume of a gas varies inversely as the pressure.

Charles' Law: at a constant pressure, the volume of a gas varies directly as the absolute temperature.

Dalton's Law: the pressure of a mixture of several gases in a given space is equal to the sum of the pressures which each gas would exert by itself if confined in that space.

Joule's Law: gases in expanding do no interior work.

Pascal's Law: the fluid pressure due to external pressure on the walls of the containing vessel is the same at all points throughout the fluid.

There you have it, gas ballooning made easy! Just kidding...there are some real interesting things that happen to gas balloons in flight. When an atmospheric condition affects the gas in the bag, either through temperature, sunlight and or both, there will be a change in the flight altitude unless corrections are made by the pilot. Please note that all gases react to temperature changes at different rates and vary as to the degree of reaction. I am not expert enough to describe the differences between the gases. My experience is limited to mostly NH_3 with some helium experience.

As the balloon ascends gas will be forced out of the bag via the appendix, this gas, as previously mentioned, is very irritating to the lungs, eyes, and mucus membranes of the human body. **Do Not Panic!** Through proper valving and flying techniques, this period will only last a few seconds and proper use of respirators will alleviate any discomfort. I have flights of several hours in duration and only needed to use a respirator several minutes in the entire flight. When gas is sensed, the pilot needs only to valve gas off for a few seconds to stop the gas flow from the appendix. These are issues that need to be addressed through training. For discussion purposes, the pilot needs to be aware that it is **mandatory** to have gas masks and goggles on board for all occupants. It is also a good idea to have several gallons of water on board, for safety, drinking and ballasting! Water is the only first aid treatment that will relieve burns from ammonia. Please make read the first aid portion of the MSDS for more information.

An excellent technical source of information is *Flammable Gases* by Don Overs. It is published and available through the BFA. This should be a part of your library. There are also some excellent books about early gas balloonists and their experiences available, These books offer a great deal of adventure and information. Again, gaining as much information about the sport of gas ballooning and those involved will only provide you greater edge as a pilot.

Landing Site Selection

It's always nice to land in a very accessible area when ballooning. It makes the chase and recovery easier! This feat can be accomplished even in captive gas balloons using NH_3 as a lifting gas. However, the pilot must take into consideration all the same items that were factors when selecting a safe launch site. Make sure that you evaluate the immediate area downwind of the landing site. It is important to understand that when the bag is ripped out, where the ammonia vapor will go! What hazards will it create? Will it harm green vegetation? Is there possible danger to humans or livestock? Will I attract a crowd of people?

Wind, humidity and temperature will affect the dispersal of ammonia vapor in the atmosphere. Using the quantities that are associated with a 1000 meter balloon, dispersal will be fairly quick unless the humidity is high. During high humidity situations, a white cloud may appear as the vapor bonds with water in the atmosphere. This forms ammonia hydroxide, a gas that is heavier than air. It may not be uncommon, depending on conditions, to detect the characteristic odor of ammonia up to a mile downwind of the release.

Use caution and good judgment when landing in areas that have livestock and green vegetation. Ammonia vapor will halt the growth and seriously injure green plant life in the close proximity of a release. Dormant plants will generally be unaffected.

It would be unwise to fly ammonia in highly populated areas of the United States. Experience will be your best guide; ask a lot of questions. There will never be one blanket answer for all situations!

Packing Up Equipment

There are some gas pilots that would lead you to believe that after a landing is made and you start to pack up your gas bag it would look like Bophal, India after the Union Carbide leak; not so! When all the proper procedures are used, the only problems that you will face is packing the stinky bag back in it's stuff bag...you definitely will need several gas masks, gloves and goggles for this chore! Once the bag is deflated, I know of one pilot who uses a gas-powered blower arrangement to totally evacuate any remaining ammonia vapor from the bag. Nice touch! Most pilots just squeeze the remaining gas out by rolling the bag toward the deflation ports or appendix. Be careful when walking or standing downwind of the gases being squeezed out of the bag. It is easy to get a whiff strong enough to send you gasping for fresh air! Again, take your time and plan how you are going to pack up the bag, and who will be involved. Use protective gear for face, hands and lungs. One point that needs to be made, since ammonia has such a strong affinity for water, people that tend to sweat may feel a prickly, or slight burning sensation during the process of packing up. On a lighter side, I remember wearing shorts on a particularly warm summer day...needless to say the vapor found sweat on every point of my body-even those parts covered with clothing!! At this point in time it is more of a minor inconvenience than health hazard. Be careful.

Conclusion

Ammonia is an interesting alternative gas available to the gas balloonist. During the last two years there have been numerous flights made in a safe manner. There is still a need to educate the ballooning community on the use of ammonia.

This not really a safety manual or an all inclusive document to base scientific information on, but strictly a source of information to pilots inquiring about the use of NH_3 as a lifting gas and give rudimentary ideas about how others have utilized equipment and techniques. It doesn't even address all the hours of satisfaction that have been experienced by pilots across the United States. What's more important is that anyone flying gas balloons and who happens to utilize NH_3 will have the opportunity to fly more hours and gain great levels of experience at a minimal expense. Take and use this guide as a stepping stone in your gas balloon experiences, then share your experiences with others!

Letters to the Editor and Other Bits of Information

Balloon Repair and Maintenance Association (BRMA)

This new association is composed of balloon repair and maintenance professionals. Their interests include issues which are of value to balloon builders. *The Balloon Builders Journal (BBJ)* is a subscriber to the BRMA and will pass on material of interest to our readership. The Association goals include–

•Sharing of expertise, suppliers and sources,

•Working with the FAA to standardize repair procedures and rule interpretation,

•Maintaining a library of material relevant to certification and maintenance,

•Publishing a newsletter on new products, techniques and materials and on service problems, malfunctions and defects.

Readers who are interested in membership to the BRMA should send $30 to BRMA, 1241 High St, Oakland, CA 94061.

BBJ has a number of special interests in this organization :

•Homebuilders make use of a variety of manufactured equipment, much of which is not registered with the original manufacturer. Builders are often ‘out of the information loop’ when Service Bulletins or AD’s are issued,

•A central clearing house on service problems, malfunctions and defects, and parts availability is especially important for equipment no longer in production, such as the Adams Balloon products,

•Application of new materials, and evaluation of new and current materials are important to decisions made by builders,

•Perhaps the BRMA can provide the opportunity for objective comparisons between different types of equipment.

•Builders enjoy the privilege of performing maintenance and condition inspections on amateur-built aircraft. Keeping current on maintenance and repair information is important to retaining these privileges. We work closely with the Experimental Aircraft Association (EAA) to help ensure balloon builders continue to retain these privileges.

Kudos and Congrats

Congratulations to **John Kugler** and **Troy Bradley** on their election as directors to the Gas Balloon division of the BFA. Their election represents some fresh air in the world of gas balloon flying.

Special thanks to Christine Kalakuka at Balloon Excelsior for providing *BBJ* with parts and price lists for the Balloon Works T3-017 burner.

Balloon Factories Aren't Alone

Balloon manufacturers have expressed concern about the lack of growth in our sport. Sales are flat and the marketplace may not support the current number of balloon factories. But we are not alone. Production of general aviation airplanes may end out this year as the worst since statistics began in the 1920's. Through the third quarter of 1993 just 342 new piston engine airplanes were produced. 1994 is even worse with only 329 produced through the third calendar quarter.

A Comment on Load Tape

When buying load tape, be aware that tape can be produced either by a shuttle or needle looms. The shuttle loom locks the crosswise threads in a way that fraying will not allow the tape to unravel.

The needle loom threads the fill into the tape by passing a needle through the width of the tape. As its exits the far side of the tape, a chain stitch is created to hold the fill threads in place. If this stitch becomes frayed, the tape can unravel.

Shuttle woven tapes are preferred for critical applications, like balloon load tapes. An experienced eye can determine whether a tape is needle or shuttle woven by folding the tape in half and comparing the tape edges. The shuttle woven tape will display a similar edge on both tape edges. The needle woven tape will display the chain stitch on one edge, but not on the other.

This is Brian Boland's experiment in making a take-down 15 gallon fuel tank from 2 Worthington 10 gallon tanks. the tank halves bolt together at the flanges and are sealed with a lip on one flange and an epoxy gasket compound in a groove on the other flange. The take down feature is intended to allow carrying a burner or envelope inside the tank as airline baggage.

Feedback on Lifting Force Formula.

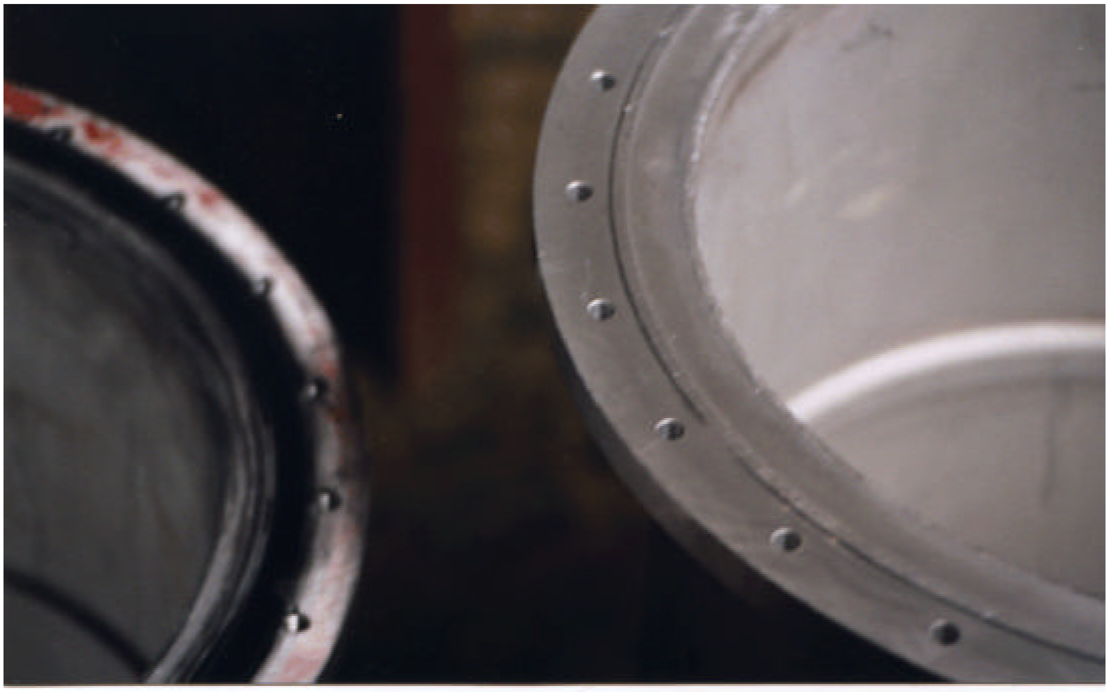
10/21/94
Bob

I've used the P=f(A) formula you published in *Balloon Builders' Journal* issue number 8, to create a nifty program for my HP-42S programmable calculator. It's designed for NH_3. If you enter any four of five variables it calculates the missing one. The variables are size of envelope (ft^3), ambient T (degrees F), gas T (degrees F), altitude (feet asl), and gross lift. The program assumes the envelope is full (the balloon is at its "ceiling" or "pressure altitude". I cross-checked the results your formula produces against a table of the ICAO standard atmosphere and the largest deviation was a pressure result for 20,000 feet, which was off by 3/10,000ths– big deal. Thanks for publishing this. I wish I had had it years ago.

Bruce Comstock
CompuServe 73112,1104

Addendum: The following material was not part of the original publication.

Marianne LeDoux sits in the Bassett single person basket. Construction of the burner was described in an article beginning on page 2 of this issue.



These are construction details of the take-down propane tank shown on page 11 of this issue. The top photo details the flexible seal arrangement between the tank sections. The bottom photo details welding of the tank flange.