

The following piece was written by CLAS member Jim Ellis; and has been converted from HTML to PDF as we migrated to our new website.

Launching a Hot Air Balloon

How would you like to fly an aircraft where you have to arise an hour-and-a-half before sunrise to check on the weather? To fly an aircraft which can only fly safely if surface winds are little more than light and variable... Which needs a minimum crew four but can only carry two or three... An aircraft which can be badly damaged just getting ready for takeoff if one isn't careful... An aircraft which has no real steering capability, which rarely flies more than ten miles on a normal flight, which takes over 30 seconds to respond to control inputs, and which can rarely land where it takes off? From a fixed wing pilot's perspective, this aircraft probably sounds like some odd joke. But these are just some facets of one of the most subtle, beautiful, and yes, even addictive forms of flying... Hot Air Ballooning!

Did you ever go out to the airport for what you thought was an early morning flight, and see balloons flying somewhere off in the distance for only a short time? Or maybe you just saw some in the evening... but never at midday. There's a good reason... smart balloonists only fly within two hours of sunrise and sunset. Midday thermals can cause a balloon's airfoil-like sides to bring the balloon to a stop over one point. And that's big trouble if the point is a bare-earth clear strip containing powerlines marching through a green forest or a factory's roof or a road with typical small but still potentially deadly powerlines. To a balloonist, thermals can be much nastier than just the cause of an annoying bumpy ride.

So, what's it like flying these mystical-looking beasts? Get up at 4:00 a.m.? Three hours before the tower comes to life at most airports? Yes, and that not really too early to get everything done you have to do. Go outside and make sure the leaves on the trees aren't moving, and then call Flight Service or get on your computer and check DUAT. Beyond obvious things like rain or fog, a balloonist's primary concerns are surface winds and winds aloft gradients. Flying a balloon will give you a whole new outlook on what "windy" means. You may even start talking about whether it's "balloon windy" or "airplane windy". Light surface winds to the airplane pilot may look "windy" to the aeronaut! And the gradients in the atmosphere are of more concern too. Are the local forecasts and winds aloft reports predicting calm at the surface but 25 knots at 3000 feet? Then there's going to be a hell of a shear somewhere, and it could be right above the trees ready to "suck you down" when you want to land! Or the winds might get awfully quick down low before you get a chance to land.

Still unsure about whether or not you should go after checking the weather? Call your old instructor across town if you're sure he was planning on flying today, and get his opinion. Still a go? Call your crew and get them awake and moving, then get dressed yourself, make sure you've got everything (which includes little things like the bottle of champagne for the landowner whose you field will land in on up to not-so-little

things like making sure the trailer with the balloon is attached when you drive away in an early-morning daze) and head for the launch field.

At the Launch Field

Balloon launch fields can be anything from farm pastures to school athletic fields to large backyards to yes, even airports! Your launch field may have been selected from one of several the balloonists in your area fly from, with the selection criteria for the morning being which field is upwind of the best landing sites. Launch surfaces vary from dusty, dry desert in the Southwest to nice new-mown lawns in New England. Paved parking lots will scrape up the basket's wood and wicker and are generally avoided. Take off from an airport? Sure, if the airport owner welcomes you. But the grass out in front of his parking lot may look better to you (and to the owner and his fixed-wing clientele) than the runways or taxiways. No matter where the launch field is located, conscientious aeronauts will be sure to ask for permission prior to launch, especially if they ever plan to use the fields again.

As you pull into your launch field, you look around nervously until you spot your crew. Unlike flying a small airplane, where you can just untie it, and "kick the tires and light the fires" all by yourself, as an aeronaut-pilot you will need a crew of two to four others to get your craft into the air. And even more unlike airplane flying, part of your crew is not going to be in the aircraft when you take off! As soon as you're sure your whole crew has arrived, you brief them on the weather and your flight intentions, and assign crew positions. You fill a toy balloon (a "pibal", for purists) with helium and release it, noting it's direction of flight, velocity, and changes of direction as it rises (shears!). Pay attention, because unless the gentle morning breezes change in the next 15 or 20 minutes, you're going where it just went! You also need to pay attention to any subtle breezes near the ground, as these will determine the direction in which you will lay out the balloon. You really don't want it to be rolling around as you do the inflation!

You put your crew to work taking the balloon out of its resting place in the chase vehicle, and start to "lay it out". The wicker balloon basket, with its propane tanks and burner assembly, is laid on its side on the ground. The envelope of rip-stop nylon or Dacron is partially unpacked and the supporting cables are attached to the basket, along with control lines and the wire to the balloon-top temperature sensor. Two crew members pick up the sides of the heavy bag and run away from the basket, the envelope streaming out of its storage bag like a huge parachute.

The Inflation

Two of the crew hold the balloon mouth open as the sound of the lawnmower engine driven fan pierces the still morning air and the balloon begins to come to life. A third crewperson at the far end of the balloon envelope holds a crown line to steady the envelope against random wind gusts as it fills with cold air. You begin your preflight with a walk around the rapidly growing balloon looking for any rips and tears in the

fabric, adjusting the parachute top or pull-testing the Velcro top. Then it's time to check the balloon by poking your head in through the top vent and checking the vent and rip lines.

Now it's time for one of the most challenging and rewarding parts of being a hot-air balloon pilot. Nothing you have ever done will ever fully prepare you for your first balloon inflation, or hundreds of others in the coming years. You may have asked yourself earlier why you would get up at such an ungodly hour. Now, adrenaline flowing, you know why! The anticipation, nervousness, tension, intense concentration, and finally, exhilaration of controlling a ten-to-fifteen foot long flame shooting out of a 12 million BTU per hour burner with a noise like a small rocket engine is something that must be experienced to be believed. If it isn't dead calm, the balloon may be rolling slowly from side to side like a huge beached whale. If your crewperson on the crown line lets up tension on the line too quickly, the balloon can rise prematurely with the sides collapsing inward!

ONE MOMENTARY LAPSE IN CONCENTRATION, EVEN ONE SMALL MISTAKE, AND THERE IS ONE VERY LARGE HOLE IN YOUR BEAUTIFUL BALLOON! But when you keep your wits about you, and as you adjust for the inevitable small problems, the exhilaration is fantastic as the balloon rises majestically over you at your command and becomes a proud and beautiful flying machine!

Flying a Hot Air Balloon

With the balloon upright, it's time for one last set of preflight checks before you launch. First, you check the burner once again for any propane leaks and adjust the pilot light. If you have a second burner, you light it now if you haven't already. You could do this the conservative way by lighting the pilot light with the piezo or with the sparker you carry with you, but if you have two burners it's a lot more fun to open the pilot light and then pull down on both blast valves and let the first burner light the second "with one hell of a roar"! You check your control lines for free and easy movement, but instead of leading to ailerons or elevators it's a vent line leading to the side vent or the parachute top. If you have a spring-top Aerostar, you check to make sure your red rip-line is free and accessible, but you DO NOT pull it unless you want to try the inflation sequence all over again. Other important items... Champagne on board? Check. Radio communications check between balloon and chase vehicle. Check. Canvas bag on board for packing up the balloon envelope (so you have something to keep you busy if your chase crew doesn't find you immediately!). Check. And certainly last but not least, are the keys to the chase vehicle in its ignition or are they in your pocket? Check!

Like the airplane pilot, the aeronaut has to be concerned with weight and density altitude. Balance pretty much takes care of itself in a balloon, unless you have a big basket and one very big passenger standing at one end of it. But most balloonists rarely consult their owner's manuals for weight figures each time they fly. (Come to think of it, there aren't many fixed wing pilots that do either!) With all the variables including temperature, humidity, and, as the balloon ages, porosity, it's easier and more accurate just to do a good "weigh-off".

A balloon's primary load limitation is the temperature at the top. A balloon has a yellow arc and a redline, but they're related to top temperature. Flying in the yellow too often and too long can weaken the fabric and shorten its life due to increased porosity and decreased fabric strength. Fly in the red, and you risk catastrophic failure (the top melting out, which can bring you out of the sky almost as fast as the wing coming off an airplane).

To determine if you can carry one passenger or two on a warm summer afternoon, you have your maximum number of passengers (usually two plus the pilot in a typical medium AX-7 balloon) get in the basket. With your ground crew on the tether ropes to keep you over your takeoff point, you fire the burner until the balloon starts to ascend, and you check the temperature. With a temperature of 250 degrees F as the bottom of an Aerostar's yellow arc, most pilots will want a maximum weigh-off temperature of no more than 220 degrees to allow margin for maneuvering climbs out of wind shears. Cautious, conservative, non-commercial balloon owners may even opt for an envelope-saving 50 degree margin. Being extra cautious, however, may mean having to be cold-hearted enough to tell one of you bright-eyed enthusiastic

passengers that they have to get out of the basket and fly another day. Not an easy task!

After making sure you are well-clear of powerlines (at least 100 feet in the direction of any powerlines for each 1 mph of surface wind), takeoffs are usually straightforward. Since your visibility up is nil, you have your crew check to make sure that no other balloons are passing over you, and then you fire your burner and lift off leisurely. But there are special cases where you have to contend with "false lift", a phenomenon similar in its effect on the balloon to trying to take off in an overloaded airplane in ground effect. If you are in a sheltered area and a wind is blowing above nearby treetops creating a wind shear, the curved top of the balloon can act as an airfoil and pull the balloon up to just above treetop level. Without enough heat to go higher, the balloon may clear the takeoff field and like an airplane taking off in ground effect, climb no further or even begin settling back toward the ground. Into the trees! What's the answer? In an airplane, you build up extra airspeed if runway length allows. In a balloon, you have your chase crew hold the balloon down until you have enough heat for extra buoyancy, and then you signal them to let go and you pop right up through the shear layer well clear of the trees.

Floating On Air

Once you are up in the air, you quickly learn that a balloon takes 30 seconds or more to respond to any control inputs, which of course are limited to adding heat with the burner or by letting out heat with the vent. Levelling off precisely at a given altitude requires backing off your takeoff climb rate at least 500 feet before the desired altitude, and using either short burns or more widely spaced long burns to "hit your altitude". And even then the low-time balloon pilot is likely to overshoot by 200 feet or more!

Straight-and-level flight requires developing a rhythm, a sense of timing of when and how often and how long to fire the burner. For the student pilot, it also means paying attention and not getting sidetracked by the beauty of the earth below and other balloons nearby. An instructor's kick in the shins or a poke in the ribs will quickly break your reverie, of course!

You don't sit in the left-front seat in a balloon. You stand... in the front of the basket. Of course, there is no defined front. You could hang a little sign on one end saying "front", but it won't do you any good. Front is the side of the basket that's getting there first, and the balloon may spin slowly in ascents or descents, requiring you to constantly be changing ends of the basket to stay "in front".

You are out in the open air and one with nature, your reverie broken only by your intermittent burner blasts. A leisurely hour flight of only five or six miles can be an incredibly beautiful experience as you drift along just above and sometimes in the treetops. You see rabbits and geese and foxes in the woods... foliage colors are accentuated as you see them from above at a slow enough pace to appreciate them.

Over ponds you look down and see the reflection of your beautiful balloon, getting larger as you descend to try a water landing!

Sharing the Sky

Balloonists don't like to fly alone. Maybe it's because balloonists are forced to be more sociable than most fixed-wing pilots. If they weren't, their chase crews might just drive to breakfast and leave them stranded! Maybe it's because balloons are beautiful, mystical, fascinating... and you never get to see your own! But there's a practical reason, too. The only lateral control you have over your balloon's flight path is by catching wind shifts as the wind changes at different altitudes. If more balloons are up with you, you can compare their ground tracks and altitudes with yours. Of course, you can always try different altitudes yourself, but that wastes time and fuel and turns a beautiful drifting flight into a bit of a chore. Airspeed and distance also varies with altitude. Generally, the higher you go, the faster you go. Low flying is generally leisurely, hopefully, since the wind above the ground is going to be your touchdown speed when you land. The optimum situation is to have winds of about 10 mph at 2,000 feet, decreasing to light and variable on the ground. Total calm all the way up to several thousand feet is no blessing. Being becalmed over trees or a lake and hopelessly watching your fuel gauges sink toward zero is no fun either!

One of the most satisfying atmospheric conditions one can encounter in a balloon is the "box wind". A box wind is a condition where the winds below 1000 feet AGL are going in one direction, and the winds above 2,000-3,000 feet AGL are going in exactly the opposite direction. Normally, a balloonist is going to go "downwind", landing five to ten miles away from where he or she took off. But with a box wind, it is possible with luck and skill to actually return to the field you took off from. One of the reasons Albuquerque has become the unofficial "Ballooning Capitol of the World" is that the morning winds in the Rio Grande River valley often will be going in one direction and the winds a couple thousand feet up heading in the opposite direction. It can make for quite a sight in October with many of the 850 balloons staying more or less in the vicinity of the launch field!

Capricious, subtle shifts in local winds combined with balloons changing altitudes can cause balloons to get quite close and even touch. And at rallies, dozens or even a hundred or more balloons can be sharing the same airspace. Balloons touching ("kissing") fabric-to-fabric is not at all dangerous. Ascending directly into a balloon above or descending directly onto a balloon below can be catastrophic, as the lower balloon's top vent or deflation port can be forced open leading to an uncontrollable descent. One balloon dragging its basket upward or downward along the side of another balloon could also cause a nasty tear in the side of that balloon. Because balloons have excellent visibility downward and none upward, and because a balloon low could be forced into the ground or into powerlines, a strict rule of ballooning is that the lower of two balloons always has the right-of-way.

Landing a Hot Air Balloon

Picking a Spot for a Landing

Learning to judge the descent rate and the time to flare for a smooth landing is no easy task for the neophyte airplane pilot. But the student airplane pilot has it easy compared to the new balloon pilot. At least the student airplane pilot can hit the throttle, pull up the nose, and have a near-instantaneous go-around. And the student airplane driver can have as many attempts at landing at the airport as fuel and daylight allows. The balloon pilot only gets one try per field!

A descent-to-landing in a balloon, or a practice descent to just above the treetops, can be a nerve-racking experience for the new balloon pilot. Until you learn the fine art of flying by adjusting the rate of vertical velocity, and not just the vertical speed itself, the trees or the ground seem to rush up at you until a crash seems imminent. It seems that the balloon is never going to slow its descent, and you keep pulling the blast valve to add more and more heat. Usually, the inevitable result is the student aeronaut (or rusty licensed one) to breathe a sigh of relief as the balloon stops descending 50 feet above the treetops or the ground. But then, muttered curses as all that excess heat so furiously and frantically added takes the balloon up in an increasingly rapid climb. Another missed landing field!

Of course, not adding enough heat to properly slow your descent is interesting too. Your instructor curses this time, blasts the burner (or both of them if you have two in your balloon) and accuses you of attempting to "stuff it into the trees" or even of trying to "brick it into the top of a Volkswagen". (Balloon instructors do seem to have a more interesting way with words than airplane instructors!)

Developing a fine touch for descending and leveling off at a spot in the air one aims for opens up a whole world of possibilities not open to the airplane pilot. Leaf-picking contests are one popular fun contest at eastern rallies. (Westerners have tumbleweed dropping contests!) One soon learns that the tops of trees are generally supple and springy and fun to play in. (One story has it that a pilot-aeronaut used this knowledge to good advantage when the engine quit on his airplane. He calmly landed in the treetops and walked away from the airplane with hardly a scratch.)

Water landings are also avidly sought by balloonists in small ponds, lakes, and even rivers, sometimes resulting in magnificent calendar photos. Proper technique is to just put the bottom inch or two of the basket in the water. Poor technique can be quite effective in cleaning out leaves, twigs, and other debris from around one's propane tanks. Really poor technique can require the assistance of local boaters to retrieve one's very waterlogged balloon!

When you decide that it is time for your final landing, you look for an open field ahead of your path which is firm and dry, away from animals and buildings, and one

which is reasonably close to a road where your chase crew can assist in your retrieval. Landing at the nearest airport is rarely an option, and the balloon's slow speed would tend to make it unpopular around an airport pattern except as a random curiosity anyway. A vitally important criteria for a landing site is that there are no power lines downwind of the chosen landing spot. Hitting powerlines is the number one cause of fatalities and severe injuries in ballooning, and a key rule-of-thumb for balloonists is never to descend over powerlines. This obviously can complicate an approach to fields near roads. Even a landing after passing powerlines must be attempted with great caution, as there may be rotor winds below a tree line which can cause a balloon to drift back into powerlines overflowed on the landing approach.

The final landing at the end of your balloon flight may be a nice, gentle stand-up landing (where the balloon and its occupants all end up upright after the landing), or it may be a rip landing. A rip landing, to the uninitiated, may look like a controlled crash. To onlookers who know absolutely nothing about ballooning, it may look like an uncontrolled crash and could result in unnecessary calls to the police. Whether the landing is a stand-up or a rip landing depends on the wind velocity at ground level. In a balloon, you're always landing downwind, and there's no such thing as landing into the wind!

For a stand-up landing with no chase crew assistance, winds at ground level have to be almost calm. It may be possible to find calm conditions in the lee of a stand of trees even when winds above the trees are blowing up to 10 mph. To dissipate forward speed, a balloon pilot may purposely allow the balloon's basket (not the fabric!) to drag through treetops, and then vent out hot air as the balloon breaks loose from the last tree to drop into the field immediately beyond.

If your chase crew is really good and has actually anticipated your intentions and flight path, you may have an additional option at a field that would otherwise be too small to land in. With your chase crew below you, you can throw down a dropline and have them drag you to a stop or even pull you to a field off to the side of your track.

If winds at the surface are more than 5 to 10 mph, a rip landing may be necessary. To make a rip landing, you aim at a spot in the air about ten feet above the ground on the upwind side of a suitable, long open field. With the balloon over this spot, you pull the red rip-line, pulling out the Velcro or spring rip-top or pulling down the parachute top fully, immediately dumping most of the hot air out of the balloon. The landing will be firm, and your passengers must be warned to hang on and to expect to be bounced around a bit. And you had better be sure of your intentions, as a go-around from a rip landing attempt is not possible. With a combination of luck and skill, a rip landing will be firm with little dragging along the ground, and the balloon's envelope will collapse to the ground downwind of the basket. While all this sounds absolutely awful, it can be a great deal of fun, with pilot and crew sprawled all over each other and laughing and cracking jokes when the balloon has stopped!

Packing Up Balloons and Popping Champagne Corks

The ballooning experience doesn't end with the landing. After the landing, it's time to pack up the balloon, hopefully with the assistance of your able and on-the-scene chase crew. Packing up the balloon is physically strenuous work. First, with at least one person on the crown line to guide the balloon's deflation, the burners are turned off and the deflation port (spring-top or parachute top) is pulled open. The balloon's fabric envelope slowly sinks to the ground, as the crew helps the pilot to tip over the basket and keep the skirt fabric off the still hot burners. The envelope must have residual hot air squeezed out of it (a very strenuous task!) The spring top is re-secured, and then the envelope is packed into its bag with two people holding the bag open and two more lifting up the fabric. Getting the balloon out of the field is work too. The envelope in its storage bag weighs two hundred pounds or more, the empty basket may weigh an additional three hundred pounds. A wise and capable pilot will pick a field where the chase vehicle can be backed right up to the packed up balloon!

It's also time for the pilot to seek out the landowners to express his or her thanks for the use of their property and to present them with the traditional bottle of champagne, a tradition going back to the earliest balloonists in France. Most landowners will at worst be ambivalent about your landing on their property, and many, fortunately, will be thrilled and even honored by your presence. For unhappy landowners, the surprise of being presented with the champagne may often change their frowns to smiles.

After all the work is done, it's time to pop the cork on another bottle of champagne to toast another magnificent flight, to welcome first time passengers into the ranks of aeronauts, and to salute your chase crew's valiant efforts.

Champagne or no champagne, it's truly an intoxicating way to fly!