Flying Hot Air Balloons

An Instructor and Student's Guide
or
A suggested guide to earning a LTA Private Pilot Certificate

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Flying Hot Air Balloons – An Instructor and Student's Guide

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A Short History of Hot Air Ballooning

On November 5, 1782, in Avignon, France, Joseph Montgolfier, while watching smoke rise from a fire, and carrying with it pieces of ash, thought that if he could capture enough smoke in a container of some sort, that it may be able to lift some weight. After some simple experiments, with folded pieces of paper placed above the fire, confirmed his suspicions, he wrote to his younger brother, Etienne, in Annonay to "prepare a large quantity of taffeta and string. I will show you the most astonishing thing in the world!"

Their family owned a wallpaper manufacturing business, and had plenty of material with which to experiment. When Joseph returned to Annonay, he and his brother began their experiments. On June 4, 1783, after many trials with encouraging results, they organized the first public exhibition. A balloon about 36 feet in diameter was filled with smoke and heat from a fire of straw and wool reaching an internal temperature of 189.5 degrees before Joseph instructed the eight men holding it to let go. It slowly rose to 590 feet and traveled two kilometers in the rain before gently returning to the earth.

. . . a ram, a duck and a chicken?

The Academy of Sciences in Paris, upon hearing of the Montgolfier experiments, invited them to demonstrate their new invention at an exposition in Versailles. The brothers began work on their largest balloon yet, to be display on September 19, 1783 before King Louis XVI. The "Martial" was elegantly decorated and stood 57 feet high. Suspended from the balloon in a cage were a ram, a duck and a chicken, who were to be the first three aeronauts in history.

After filling the balloon with thick black smoke from a huge fire pot built in the center of a platform and beneath the balloon, they attached the cage containing the first three aeronauts. When they released the ropes that were restraining the balloon, it rose to 1,650 feet and then gently descended a little less than two miles away. Most references of the event report that the passengers landed unharmed. Although one version reports that the chicken had a broken wing but goes on to say that the mishap was the result of the ram stepping on it and had nothing to do with the balloon. The report also points out that the three animals lived out a long life in Marie Antonettes' Royal Zoo.

. . . first manned balloon flight

On October 15, 1783, the French physicist, Jean–Francios Pilatre de Rozier, who was the curator of the Museum of Natural History, offered his services and became the first human passenger in a tethered balloon hot air balloon. This was again repeated on October 17th and 19th with longer ropes and additional passengers.

Finally, on November 21, 1783, at Mouette Castle in the woods of Boulogne, the first manned free flight of a hot air balloon took place. The Montgolfiers had built a beautiful new balloon for the occasion. It stood 69 feet high, was 46 feet in diameter and weighed 1,595 pounds fully loaded. This balloon had a fire pot or burner suspended in the center of the mouth with a large gallery surrounding it which held the straw or hay and wool fuel and water. The two aeronauts were seated on each side to maintain balance. The beautiful balloon was made of cotton cloth soaked in alum to make it less porous and more flame retardant. It was elegantly decorated with the royal insignia and astrological symbols. Pilatre de Rozier was joined by Marquis de Arlandes, leader of the armed forces, at the order of King Louis XVI. After a short tethered "test flight", which resulted in some damage to the envelope due to the wind, and the repair which took less than two hours, the balloon

majestically lifted from the ground in front of an estimated crowd of 500,000 spectators, among them Benjamin Franklin. It ascended to over 2,950 feet as it crossed the Seine. When it began to descend the two aeronauts fed the fire with more hay and wool. Despite large holes burned in the balloon from sparks and the fire, they again rose and eventually landed, unharmed, in the countryside near Coulbarbe Mill, twenty–five minutes and five miles from where they first ascended.

Over the next half century, many “smoke balloon" flights took place in many different countries but this mode of transportation, although quite intriguing, was not very practical and slowly died out due to the lack of a controllable heat source. The science was still quite new and many of the early experimenters attributed the “magic” lift to the smoke and not the heat resulting in the frequent references to "smoke balloons." The open fire pot in the middle of the platform with its hot embers and rising ashes and sparks resulted in holes being burned in the balloon envelope and was also quite dangerous on a windy day, especially when landing in a dry grassy field. One can only imagine some of the unfortunate flights and incidents, now lost in history, of burning fields, stampeding livestock and irate farmers.

. . . rebirth of hot air ballooning

On October 10, 1960, Ed Yost lifted off the ground in Bruning, Nebraska in a hot air balloon powered by a propane burner marking the beginning of the modern hot air balloon. Yost had worked with gas balloons for many years in government programs and had attained the knowledge and expertise necessary to develop and expand the science. He founded Raven Industries in 1956 with 3 partners to further the science. Between 1965 and 1968, Ed Yost, with the assistance of Don Piccard and Tracy Barnes, researched and developed hot air balloon designs which were standardized for FAA certification marking the beginning of the hot air balloon industry in the United States. England closely followed with Don Cameron founding Cameron Balloons.

Ballooning

The first steps

What regulations apply to hot air balloons?

- Several FAA Regulations apply to hot air balloons. Those that apply include:
  Part 61: Pilot Licensing *(see "What are the FAA license requirements" below)*
  Part 91: Flying regulations *(same as for light planes).*
  Part 43: Aircraft maintenance

What are the FAA license requirements?

- A student pilot's certificate is needed before commencing flight training. To gain a student certificate, the applicant must be at least 14 years of age, be able to read, speak and understand the English language, and must certify that s/he has no medical defect that makes him/her unable to pilot a free balloon.
  The successful completion of flight training leads to a **private** pilot certificate, lighter–than–air category with an airborne heater class rating. With more experience and training, the pilot can attain a **commercial** license, which enables the pilot to fly for hire or to instruct others to fly.
- **Private**:
  Minimum age 16 years
  10 hours balloon flight experience including:
  6 balloon flights under the supervision of an instructor.
  One solo flight.
  One flight to at least 2,000 above the take off point.
  Two flights of at least 1 hour each with 60 days prior to application for the rating.
  A written knowledge exam.
  Check ride with a Designated Examiner consisting of an oral test and a flight test.
- **Commercial:**
  Minimum age 18 years.
  35 hours flight time including:
  20 hours in balloons.
  10 flights in balloons.
  Two flights in balloons as the pilot in command.
  One flight to at least 3,000 above the take off point.
  10 hours of training including 10 training flights.
  A written knowledge exam.
  Check ride with a Designated Examiner consisting of an oral test and a flight test.

How expensive is training?

- Costs vary by instructor. There are a number of excellent instructors in the area. Training in your own balloon would be the least expensive.

What equipment do I need, aside from a balloon?

- A trailer, van or pickup truck, an inflation fan, and 2–way radios. Aircraft radio may be required depending on the areas you will be flying in. Other equipment may be needed depending the specific aircraft and the local requirements.

How do I decide what balloon to buy?

- Some of the many considerations include the size of balloon suitable for receiving instruction, ease of getting service, insurability, type of equipment needed for local flying conditions, warranty, and resale value.

What about insurance costs?

- That depends on the type, size, and brand of balloon and how it will be used. Average annual premiums for a private pilot range from $800 to $1,300 depending on the aircraft and pilot experience.

Lesson 1 – Introduction to Balloon Flight

Objective:

- To introduce the student to balloon flight

Elements:

- Flight Planning
- Balloon Layout and inflation
- Fundamentals of level flight
- Ascents and descents
- Normal approach to landing
- Post–flight discussion

Equipment:

- Balloon Flight Manual
- Airworthy balloon

Instruction's Action:

- Before flight, discuss lesson objective by using preflight lesson plans for Flight Planning, Use of Blast Valve, Layout and Inflation, and Fundamentals of Level Flight.
- Demonstrate all elements of planning, layout, inflation and flight allowing student to perform after each demonstration and coach student practice
- Post–flight critique of student performance and make study assignment

Student's Action:

- Student should observe instructor's demonstrations and practice activity with coaching from instructor.

Flight Planning

- Weather briefing – FSS
- Observe surface winds – PiBal
- Select launch site – landowner permission
- Plot flight path
- Weight and pressure

FLIGHT PLANNING

Objective Elements:

- To develop the students skill in planning a flight
- Observe wind and weather conditions from the weather channel, radio and visually by use of PiBal
- Call flight service station for weather briefing
- Select launch site

Equipment

- Weather information form
- Sectional chart and road map
- Plotter
- Compass
- PiBal

Instructor

- Discuss lesson objective
- Obtain weather information
- Observe surface winds with PiBal

- Determine launch site
- Locate launch site on chart
- Draw dead reckoning line in direction of flight and mark off distance or time on the line
- Suggest landmarks to verify position in flight
- Airspace considerations
- Critique plan

Student's Actions

- FSS Weather Recording Form
- Obtain weather briefing from Flight Service Station (FSS)
- Recommend launch site based on accurate weather information recorded form
- Draw flight plan approved by instructor

Completion Standards

- Student should demonstrate ability to obtain complete weather briefing from the FAA Flight Service Station and correlate this information with observed weather conditions
- Locate launch site on chart
- Draw proposed course with time tricks on dead reckoning line
- Understands need for flexibility to adjust flight plan
- Selects landmarks in flight to verify position

Blast Valve Operation

Objective

- How blast valve functions
- Use of blast valve for altitude control
- Economy of blast valve operation
- Safety considerations

Equipment

- Balloon system ready for preflight function check
- Cross section drawing of blast valve

Instructor

- Pre–flight discussion of how blast valve operates including use of "O" ring(s) to create seal.
- Best operation is all the way on or all the way off. Short frequent fifing is more efficient than long firing bursts Explain oxygen starvation at surface and at high altitude
- When blast valve is locked open, pilot's hand should not let it go, nor should the pilot use the blast valve as a hand hold in flight and especially on landing

Student's Actions

- Demonstrate actual blast valve operation on ground
- Discuss construction of blast valve and possibility of an "O" ring leak
- Discuss safe and efficient operation

Completion Standards

- The student should demonstrate knowledge of blast valve operation by operating blast valve in simulated flight and by oral quiz

Layout and Inflation

- Check–list
- Crew briefing
- Layout direction
- Attach cables and install burner
- Fuel system check
- Fuel quantity
- Inflation restraint
- Instruments – calibrate to elevation or pressure
- Attach envelope
- Cold inflation–fan operation
- Walk around inspection
- Recheck weather and weight
- Failed Inflation https://www.youtube.com/watch?v=8zgVjJYMj_A
- False Lift & Failed Abort of Takeoff https://www.youtube.com/watch?v=Ydpi3TQDr1s
- Who else is around? https://www.youtube.com/watch?v=7N7smaD6lk0
- Checklist–hot inflation
- Hot inflation

Objective

- To develop the student's skill to prepare the balloon for flight and its inflation

Elements

- Launch site selection
- Crew briefing
- Layout and assembly
- Cold inflation
- Hot inflation

Equipment

- Balloon to be prepared for flight
- Balloon Flight Manual
- Checklists

Instructor's Actions

Provide student with complete checklist covering all procedures through lift off.

Discuss elements of launch site selections including:

1. Time of launch
2. Surface wind
3. Condition of the field surface
4. Hazards in vicinity of field
5. Access to field with landowner approval
6. Flight planning considerations

Discuss elements of crew briefing including:

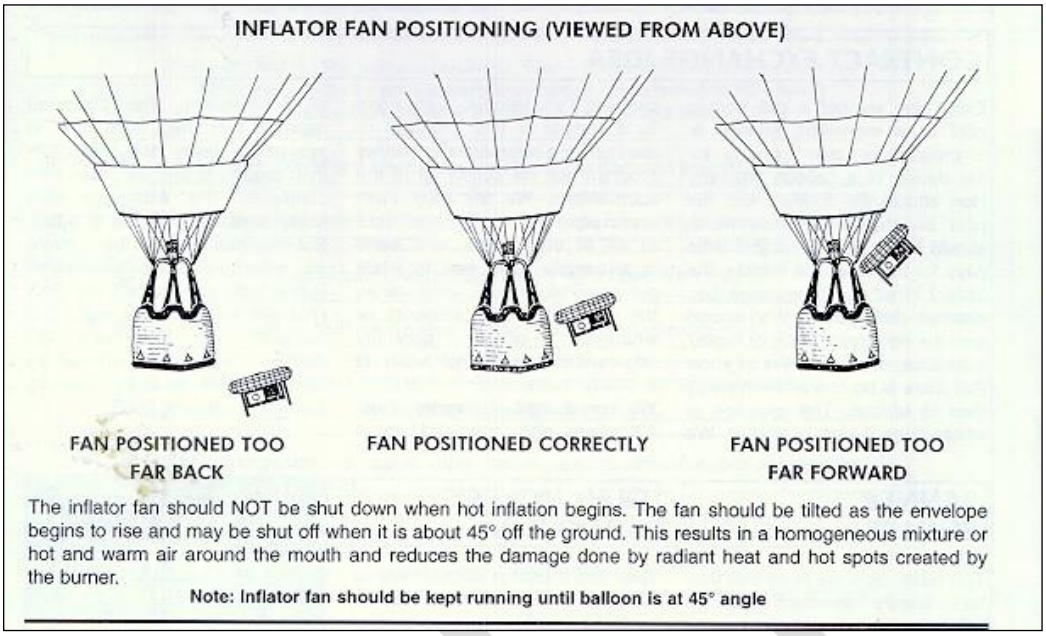
1. Assign and explain duties to crew and designate crew chief (see appendix B)
2. Supervise crew activities and Tips for the Crew
3. Set up means to communicate with crew (Radio and Cell Phone Backup)
4. Explain flight plan to crew
5. Lost balloon arrangement

Discuss elements of layout and assembly, visual inspection including:

1. Use Checklist to assemble balloon
2. Lay out balloon for direction of surface wind
3. Configure, put together, basket and install burner
4. Check all connections and valves for leaks
5. Check fuel supply and pressure
6. Fire all burners, test all fuel tanks and clear fuel lines safely
7. Attach inflation restraint securely
8. Attach envelope cables, temperature cable and vent line
9. Determine weight and altitude limits
10. Check basket, documents and instruments
11. Extra igniters and other required equipment
12. Final crew briefing
13. Recheck wind and weather conditions
14. Note any discrepancy and determine whether the balloon is safe for flight or requires maintenance

Discuss elements of cold–inflation including:

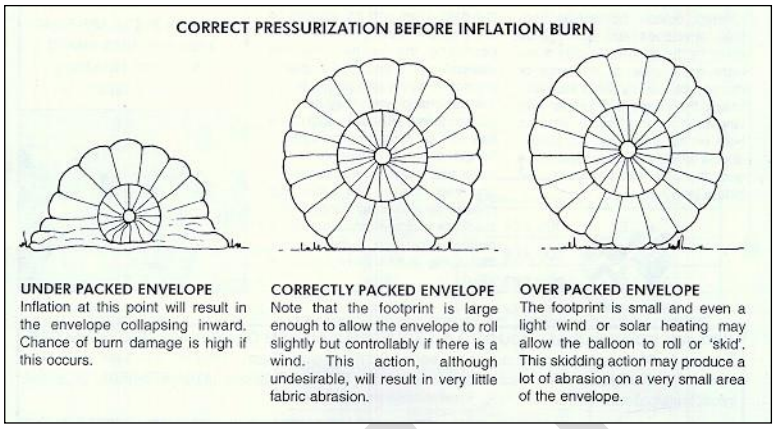
1. Placement and safety inspection of inflation fan; fuel requirement



- The operator of the fan should not wear lose clothes or ties that could tangle in the fan
- Always be sure you understand the hand signals of the Crew Chief and/or Pilot
- My preference is to place the fan on the left side of the basket, as opposed to the right side as shown above. The On/Off Switch is easily reachable by the pilot during Hot Inflation
- On Final Point. The fan needs to be pulled away from the basket after inflation, if not the basket could swing into the fan by wind thus causing the fan to tip over and dump gasoline on the hot engine thus causing a fire

2. Inspect fabric and load tapes
3. Install top
4. Cold inflate until envelope is fully packed

Proper Inflation



- The operator of the fan should not wear lose clothes or ties that could tangle in the fan
- Always be sure you understand the hand signals of the Crew Chief and/or Pilot
- Normally the pilot instructs the Fan Person to turn off the Fan as the Bottom of the Balloon lifts off the Ground

This diagram copied from "The Fireflyer – Firefly Balloon Gazette 2002"

Discuss elements of hot inflation including:

1. Complete walk around inspection
2. Recheck weather
3. Use checklist before hot inflation
4. Rapid and smooth hot inflation
5. Abort inflation if necessary
6. As balloon comes to the upright position, all crew weight on
7. When balloon stabilizes, attach crown line and start checklist for launch

Student's Actions

- Perform each element of an inflation in accordance with the Balloon Flight Manual and checklists
- Windy Inflation https://www.youtube.com/watch?v=ZP6Gkfd3ePI
- Windy Inflation https://www.youtube.com/watch?v=uNat4WyCoTs
- Windy Inflation https://www.youtube.com/watch?v=DL1N8xaDQ9Q

Completion Standards

- Using a student developed checklist. The student should demonstrate a complete inflation performing it smoothly with the outcome never seriously in doubt.

Common Student Errors:

The instructor should anticipate the common student errors associated with

a. Launch site selection

- Inability to properly assess size and surface condition of site
- Failure to consider site accessibility and obstacles
- Failure to properly determine direction of flight and suitable landing areas based on launch site selection

b. Crew briefing
- Failure to designate a crew chief
- Failure to brief crew

c. Layout and assembly
- Failure to observe wind direction, surface and hazards
- Improper assembly of burner and fuel system
- Improper layout and attachment of envelope, cables and lines

d. Visual inspection
- Failure to use checklist
- Inability to recognize discrepancies
- Distractions that interrupt a visual inspection

e. Inflation
- Failure to use a checklist
- Improper positions or operation of fan
- Not understanding cold air inflation
- Incorrect procedures during initial ignition and heating
- Failure to reach equilibrium and stabilize balloon
- Improper tie–off procedure

f. Pre–launch
- Acceptance of inadequate burner pressure
- Failure to review launch conditions
- Failure to conduct final coordination with crew
- Improper recognition of equilibrium and adjustments required
- Failure to use a checklist

NOTE: The hot inflation, when done correctly, is a thing of beauty. A fully cold–air–packed envelope, taut envelope cables, the right pressure on the crown line and a well–timed bum by the pilot make the task look easy. Sometimes the conditions make the inflation more difficult. These include a crowded or uneven launch field or variable or high wind conditions. Your student should experience these conditions. Patience is the key to success.

The instructor should do a walk around inspection before the student starts the hot Inflation. He should check the security of the tie–off and the quick release mechanism.
If this is the first inflation for the student, the instructor demonstrates the back step into the basket before the inflation. The student should be warmed to burn only when he is looking at the burner and mouth of the envelope. The mouth should be round not oval from excess crew handling. Sometimes to get the round opening, the throat crew actually has to move towards the center of the throat and not pull away from it.

The instructor positions himself alongside the student just outside the uprights on the side with the deflation line. The fan is placed on the opposite side. The instructor crouches down next to the student. Because of the noise of the fan and burner, a positive hand signal is needed to stop a burn. This can be a hand on the shoulder of the student.

Before the pilot light is lighted, a checklist is needed. The purpose is to check the balloon integrity by starting with the inside crown of the envelope and following the envelope rigging to the basket connections. The student extends his/her arm and points to each cable connection and announces secure, deflation line attached, valve secure, cables taut and instrument wire attached. This is the moment when a pilot's concentration is broken due to the excitement of the hot inflation. If you stop for a checklist, it gives the pilot time to think. Now light the pilot light.

The best inflation is a quick one. A half inflated balloon can be troublesome, so a continuous burn is most efficient. If the student stops burning during the inflation prematurely, the envelope will rise with the basket still flat on the ground. At this point, burning the bottom of the throat becomes a possibility. The Instructor will have to lift the up rights to position the burner to continue the inflation.

Having crew lift the uprights is sometimes an indication of a poor inflation. Either the crown line was not held firm enough or the pilot did not burn continuously. A continuous burn will not be harmful to your fabric if the flame is directed to the center of a well–packed envelope.

Students have a habit of taking their eyes off the burner flame when back stepping into the basket as it rises. The pilot should have a continuous, uninterrupted motion from the crouch or kneeling, to standing, to back stepping and into the upright basket position. All this is accomplished without taking your eyes off the round target (the mouth) into which the burner is firing.

Launch

- Passenger Check List
- Equilibrium–launch checklist
- Weigh–off
- Controlled ascent

Check List For Passengers

You should ask your passengers these types' of questions as they complete your insurance waiver. Risk management is your responsibility. Ideally this should be done before you prepare the balloon for launch:

Do you have any physical ailments?

1. Are your pregnant?
2. Have you had any recent surgeries?
3. Do you have any problems with your:
   - Ankles?
   - Legs?
   - Back?
   - Arms?
   - Neck?

Dress Recommendations

1. In winter dress with layers
   - Layers will do fine.
   - No high heels or sandals
2. In summer
   - Regular casual clothes not loose flowing garments
   - No high heels or sandals

What can you expect?

1. If the is nice and calm a flight at whatever height you would like and you will:
   - Be a precipitating crew member
   - Have a safe flight
   - Have a great time
   - Have a brief ceremony after we return to the field.
   - Enjoy Snacks
   - Please note: I can only take two people and myself so for larger groups we will try to do hops.
2. If the weather is nasty, to windy etc.
   - We do not fly.

Please remember if you come out it does not mean you have to fly. If you do not feel comfortable we can do it another time. Ballooning is fun not a chore.

Fundamentals of Level Flight

- Recognizes vertical direction
- Level flight–relation to ground
- Level flight–with instruments
- Ascents and descents with instruments
- Use of winds at various altitudes to steer
- Navigation
- Normal approach and landing

Fundamentals of Level Flight

Objective

- To develop the student's understanding of level flight as the basic balloon flight skill

Elements

- Recognition of vertical movement
- Depiction of level flight as a continuous sine curve line and not a straight line
- Recognition of change in ascent and descent rate
- Development of burning rhythm

Equipment

- Chalkboard for pre–flight discussion and display of sine curve flight line

Instructors Actions

- Discuss the basic flight skill required of a balloon pilot to fly level
- Define level flight as the process of recognition of vertical movement. Up or down?
- In flight, require student to announce vertical movement (up, down or level) before firing the burner
- Discuss a consistent firing rate (generally one or two seconds in sport size balloons) to create even power
- Discuss relationship of firing rate, propane pressure, ambient temperature and various gross weights

Student's Actions

- Able to identify locations along sine curve flight line where burner is to be fired and where to let the envelope cool

Completion Standards

- Student should recognize vertical movement, further recognize changes in rates of descent and ascent to identify when to fire the burner to fly level, and understand the benefits of a firing rhythm.

Common Student Errors:

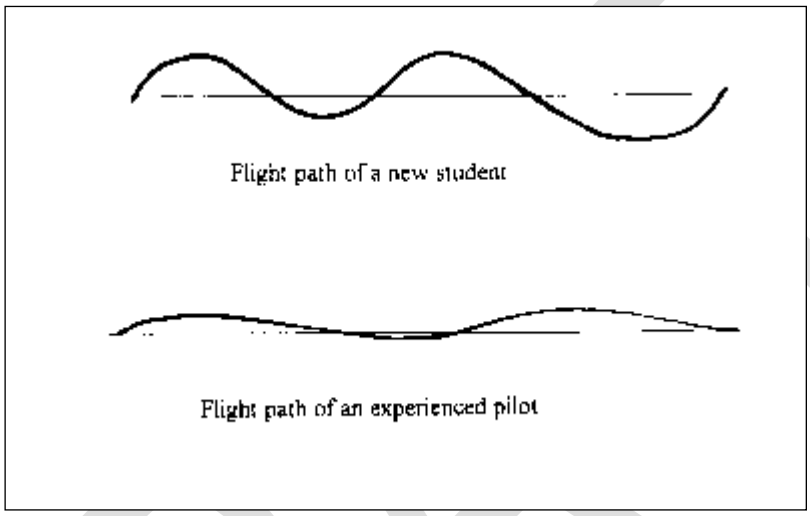
The instructor should anticipate the common student errors associated with:

- The fundamentals of flight
  1. Inability to recognize vertical movement
  2. Failure to coordinate bums with heat loss; and
  3. Excessive cooling and/or over–burning
- Ascents and descents
  1. Improper transition from level flight to ascent
  2. Failure to level off at specified altitude– and
  3. Exceeding performance limitations of the balloon

Rapid ascents and descents

- Exceeding design limitations of the balloon
- Improper response to envelope distortions, and
- Failure to monitor envelope temperature

NOTE: The most basic flight operation is level flight and it takes an average of five flights before most student pilots can do it smoothly. It is helpful for the instructor to draw a sine wave to represent the path of the balloon in relation to the ground. By placing the balloon along the sine wave (ascending, top, descending or bottom) the instructor can explain that (a) this is the actual track of any balloon and the student will eventually flatten the wave; (b) before pulling the blast valve, the student must first recognize if the balloon is ascending or descending; and (c) fire the burner in uniform length short burns of one or two seconds.



Once the flight begins, set the balloon up in level fight and challenge the student to determine the direction (up or down) of the balloon.

It is a natural reaction for a pilot to hit the burner, if in doubt about anything. If the instructor says, "Do you see those power lines three miles ahead?" A student will always hit the burner even if the balloon is already ascending. To cure this kind of knee jerk reaction, have the student report the attitude of the balloon first. Some students just won't offer any comments on their own so the instructor will just have to repeat, "Are you going up or down?"

Normal Landing

Purpose

To develop the student's skill in planning and making a normal landing.

Discussion

A landing is similar to flying level except you are descending at some controlled rate.

There are a number of landing types (approaches) but the three that come to mind are; stair step approach, steep approach, and approach over obstacles.
Of a primary concern to landing is safety of pilot and passengers. The passengers should be briefed to face the direction of travel, bend knees, and hang onto something other than the flight controls of the balloon and obstacles should be noted and avoided.

Procedures

A) Stair Step Approach

Site identification – wires, trees, animals, crops, and miscellanies items.
Approach – descending some predetermined altitude and then leveling out, repeat this and then continue decent until the flight culminates at ground level.
The approach is normally used in open spaces where there is adequate space.

Burner & Vent Controlling

- At the beginning of the descent the vent may be used to start the process or the balloon can be left to cool and begin the descent.
- The burner is used in long blasts to slow the descent and overcome downward movement.
- Once the balloon has stopped falling then the pilot can repeat the same process until ground level is contacted.
- As the balloon alights on the ground the vent line should be held open to assure that the forward move will be stopped.

B) Steep Approach

Site identification – wires, trees, animals, crops, and miscellanies items.
Approach – descend towards ground in a high angle allowing the balloon to fall until close to the ground and then burn with long burn to stop but the momentum and speed.

Vent immediately – as to avoid the balloon rebounding because of too much heat.
The approach is used in tight landing places or if landing in an immediately goal.

Burner & Vent Controlling

- At the beginning of the descent the vent may be used to start the process or the balloon can be left to cool and begin the descent.
- The burner is used in long blasts to slow the descent over and overcome downward movement.
- Once close to the ground the vent line must be open to assure that the balloon will no rebound.
- As the balloon alights on the ground the vent line should be held open to assure that the forward move will be stopped.

C) Approach over obstacles

Site identification – wires, trees, animals, crops, and miscellanies items.
Approach – fly level over obstacle and immediately before clearing start decent process. Once in clearing use short burns to control rate of descent.
Vent immediately before touching ground to assure balloon will not rebound.
The approach is used in tight landing places.

Burner & Vent Controlling

- At the beginning of the descent the vent may be used to start the process or the balloon can be left to cool and begin the descent.
- The burner is used in short blasts to slow the descent over and overcome downward movement.
- Once close to the ground the vent line must be open to assure that the balloon will no rebound.
- As the balloon alights on the ground the vent line should be held open to assure that the forward move will be stopped, rip out if necessary.

Conclusion

The student should be able to demonstrate the correct method for landing a balloon in various situations.

Deflation

- Landowner relations
- Supervise crew

Refueling

Refueling

Objective

- To develop the student's skill and knowledge of refueling techniques and developing the highest safety standards while handling propane.

Elements

- Propane Facts

  Propane is:

  - Heavier – than air in its vapor form
  - Is lighter than water in liquid form
  - Weighs 4.2 to 4.3 pounds per gallon
  - Vaporizes (boils) at 42 degrees below zero
  - Has an odorant (ethyl mercaptan) added so we can smell it
  - Has a vapor pressure directly proportional to its temperature
  - Is nasty stuff (cold) so we wear gloves when handling it
- **Range of Flammability**
  - The range of percent of gas, in an air–gas mixture at atmospheric pressure that will support combustion. For propane: 2.15% to 9.60%

Properties of Propane

- One volume of liquid propane will produce 272 volume of propane gas.
- For perfect combustion propane vapor in an air gas mixture should be 4%
- Air needed for combustion of one gallon of liquid propane is 6,528 gallons of air
- Total air–gas mixture is 6,528 gallons of air + 272 gallons of gas = 6,800 times the original propane volume
- A pint of liquid propane yields 272 pints of vapor or 4.5 cubic feet of propane vapor. This pint will yield 1,134 cubic feet of combustible mixture – a box measuring 5'x5'x5'.
- There are 120 pints in a 15–gallon stainless steel fuel tank
- An average basket contains about 45 cubic feet. At 4% propane gas, less than a cup is required for a combustible mixture in a basket
- An enclosed trailer (4'x8'x5') contained roughly 160 cubic feet. At 4% propane gas, less than 3 cups is required for a combustible mixture
- An average one–car garage contains about 1,964 cubic feet. At 4% propane gas, about 2 gallons is required for a combustible mixture

Abnormal Propane Sources

- Overheated tank relieving pressure – in a garage or trailer
- Bleeding raw propane after landing
- Small spurt during refueling
- Leaking fuel fitting
- The propane tank and its components
- Filling methods
- Safety considerations

Instructor's Actions

- Discuss the properties of propane including specific density as gas and liquid, expansion due to temperature change, boiling point – compare to water, and other information in the BFA Propane Manual.
- Demonstrate the function of all components of a propane tank and the importance of information listed on the tank
- Demonstrate filling method and how to determine when tank is safely filled
- Discuss safety factors

Student's Actions

Demonstrate knowledge of the properties of propane to include:

- Specific gravity of liquid is .509 and its importance
- Specific gravity of gas is 1.52 and its importance
- Temperature change of 1 degree F equals 17 degree increase in volume
- Why propane is better than butane
- Pressure versus temperature
- Weight of one–gallon propane is 4.2 – 4.3 pounds
- Why ice forms on valves and hoses and the need for burner preheating coils
- What happens when tanks are heated?
- What happens when tanks are nitrogen charged?

Demonstrate the function of component parts of a propane tank

- Vapor service valve
- Vapor regulator
- Liquid service valve
- Pressure relief valve
- The pressure relief valves are different for different size fuel tanks, a 10 gallon tank is set for 375psi and if there are no contaminates in the tank, the valve usually shuts down and seals automatically
- Fixed liquid level gauge (spit valve)
- Tare weight
- Other information on label
- O–Ring and its purpose
- Volume of tank versus safe volume of fuel
- Tank warmer

Demonstrate filling propane tanks after a flight

- Connect and reconnect hoses
- Operation of valves
- Know when tank is full by weight and/or volume
- Wears gloves
- Knows difference between pressure and quantity gauges

- Refers to flight manual to determine minimum fuel need to launch

Demonstrate safety factors to include–

- Removal of strikers
- Pooling of propane gas on floor of confined area, pickup or trailer
- Protective clothing
- Fuel from outside basket
- Limit number of crew at fueling
- Nylon and static electricity
- Danger when propane tank goes hydrostatic
- At what pressure will pressure relief valve open on your tanks? Will it close automatically?
- The sniff test and the use of soapy water to test for a leak

Completion Standards

The student will have knowledge of the properties of propane, propane tanks and how their components work. The student will be able to safely fill a propane tank and recognize the hazards associated with handling propane.

Post–Flight Discussion

- **Planning the next flight using a comprehensive checklist**
- **Completion of pilot and aircraft logs**

Log Books

Record all inflated time in the balloon system logbook. The record should show total time the balloon was buoyant, regardless of whether it was held on the ground, tethered, or in free flight.

There is the question of accurate times in the logbook. When I first started logging times I used to log to the minute. So a flight would be 1:02 (1 hour and 2 minutes). If you think about it that is next to impossible to be that accurate. I have found that logging to the tenths of an hour is much easier. Example: I flew for 1 hour and 8 minutes give or take a minute or two. I enter it in the logbook as 1.2 hours.

Let us not forget that you are logging into two different books. One is the pilot logbook and the other is the balloon logbook. I use the same recording scheme for both.

One final point concerning the balloon logbook: it is balloon owner's responsibility to make sure that all repairs are correctly entered in the logbook.

Completion Standards

Student should have a general understanding of a balloon flight and be aware of what standards will be required to be a competent pilot

Lesson 2 – Basic Flight Maneuvers

Objective

- To practice the three basic flight maneuvers of level flight, ascents and descents

Elements

- Familiarization with all components of burners and tanks
    - Dual flight to learn basic flight maneuvers
    - Weigh–off
    - Ascents and descents
    - Level flight in relation to instruments
    - Level flight in relation to ground
    - Contour flight
    - Monitor weather conditions
    - Fuel management
    - Refueling
    - Post–flight discussion

Equipment

- Balloon Flight Manual
- Airworthy balloon

Instruction's Actions

- Before flight discuss lesson objective by using pre–flight lesson plans for Weigh–off, Level Flight in Relation to Instruments and Level Fight in Relation to Ground, Fuel Management and Refueling
- Discuss function of fuel systems valves, gauges, and serial numbers; determine fuel quantity on board
- Supervise performance and coach student through each maneuver

Student's Actions

- *Perform each maneuver as directed*
    - Practice selected maneuvers previously introduced.
    - Flight planning
    - Layout and inflation
    - Ground crew instruction
    - Weigh–off
        - Handhold weigh–off
        - Inflation restraint weigh–off
        - False Lift considerations (See Appendix D)
        - Establish minimum ascent rate
        - Monitor envelope temperature

Weigh Off

Objective

- To develop the student's skill in launching with a hand held weigh or inflation restraint release

Elements

- Use of weigh off procedure to control ascent rate and false lift during launch

Equipment

- In–flight maneuver

Instructors Actions

- Pre–flight discussion of launch procedure including use of inflation restraint, equilibrium, safe ascent rate, and effect of false lift
- Bring balloon to equilibrium. Rocking basket will indicate equilibrium approach. In calm condition release inflation restraint. All crew clear of basket. One crew person applies 20 pounds downward pressure on pilot's outstretched hand. With basket clear of ground the 20 pounds excess weight will allow the balloon to ascent at 100 fpm.
- Discuss ascent rate. Ideal rate is 100 fpm. Or rate necessary to clear obstacles. Slow ascent rate is necessary for safe multiple balloon operation and not to alarm first time passengers.

Student's Actions

- Perform handhold and inflation restraint weigh off
- Discuss the cause of false lift

Completion Standards

- Student should demonstrate smooth launch procedures with controlled ascent rates and be able to explain the cause of false lift

Common Student Errors

The instructor should anticipate the common student errors associated with:

- Weigh off
  - Recognition of equilibrium
  - Failure to direct ground crew
  - Failure to coordinate tie–off quick release line; and
  - Poor control of ascent rate
- Launch over obstacles
  - Failure to determine height of obstacle and presence of false lift
  - Improper selection of launch site relative to obstacle and wind conditions– and
  - Failure to act decisively in order to clear obstacle safely

Level Flight in Relation to Instruments

Objective

- To fly in level flight solely by reference to the instruments

Elements

- Sole use of VSI, altimeter, and envelope temperature gauge to maintain level flight

Equipment

- In–flight maneuver at various altitudes

Instructor's Actions

- Pre–flight discussion of lesson objective and distinguish between level flight solely by reference to the ground
- Bring balloon to level flight at stated altitude and request student to hold that altitude ±100 feet by use of the instruments (commercial – +50 feet)
- Demonstrate that pilot can determine at low altitude changes in vertical direction before using instruments due to lag in instruments

- Emphasize that the instruments are not useful within I 00 feet of the ground due to lag
- Use VSI as primary instrument, altimeter as secondary instrument and envelope temperature as alternate instrument to maintain level flight
- Determine equilibrium temperature at given altitude and request student maintain temperature to attempt level flight

Student's Actions

- Demonstrate ability to fly at various altitudes solely in relation to the instruments their relative importance
- Demonstrate knowledge of use of instruments, and contrast with use of pilot observation of ground reference

Completion Standards

- The student should demonstrate competency to maintain altitude within ± 100 feet with use of the instruments (commercial – ±50 feet)
- Be able to discuss the limitations on the use of instruments and the danger of instrument fixation.

Level Flight in Relation to the Ground

Objective

- To fly in level flight solely by reference to the ground (contour flying)

Elements

- Use of ground references to control level flight

Equipment

- In–flight maneuver from surface to 300 feet AGL

Instruction's Actions

- Pre–flight discussion of lesson objective
- Have student hold arms straight out with one index finger one foot away from eyes and the other two feet away. Move the arms up and down slowly to simulate a near and far object as altitude changes
- In flight observe near and far trees or hills and how far object appears to move up when balloon is ascending and down when balloon is descending
- Discuss ability of human eye to discern distance by paratactic action to 20 feet or less. Perception of depth is by relative size of objects, perspective, and past experience
- Discuss use of pennant on crown line as vertical movement indicator
- Use instruments only as back up to verify level flight

Student's Actions

- Demonstrate ability to fly at various attitudes solely in relation to the ground
- Demonstrate techniques to determine vertical movement by ground observation

Completion Standards

- The student should demonstrate competency to maintain altitude within ± 2 feet AGL solely by reference to the ground
- Demonstrate continuous scanning technique to observe the surface at low altitude.

Common Student Errors

The instructor should anticipate the common student errors associated with contour flying.

- Improper use of controls to maintain desired altitude
- Over burning or over venting– and Lack of division of attention

Fuel Management

Objective

- To allow the student to develop a fuel management plan

Elements

- Concept of fuel management to monitor fuel quantity and pressure
- Maintain redundancy

Equipment

- Balloon Flight Manual
- Diagram of fuel system showing all tanks, hoses, gauges, valves and burners
- In–flight maneuver

Instructor's Actions

- Pre–flight discussion of fuel system tracing flow of fuel through system and importance of redundancy
- Selection of order of fuel tanks to be used
- Discussion of amount of fuel to remain before switching to new tank and the time interval to check fuel remaining
- Demonstrate pilot light adjustment if available
- Calculation of fuel consumption
- Method to reroute fuel if a malfunction occurs
- Discuss the fuel pressure changes when fuel remaining **is** 20% or less
- Demonstrate reduction in burner output and burner tone when tank is near empty
- Explain fuel requirements in approach to land checklist

Student's Actions

- Trace out fuel system and explain all functions of components
- Explain how to maintain a redundant fuel system
- Develop a fuel management system and compare its logic with the instructor's
- Explain the relationship of burner power to temperature of fuel and quantity remaining in tank

Completion Standards

- Student will demonstrate frequent and timely monitoring of fuel usage and pressure. Has a consistent method of fuel management. Can explain operation of all fuel system components.

Completion Standards

The student should demonstrate the preflight inspection with a comprehensive checklist, ground crew instruction, inflation with some coaching, weigh–off, recognition of vertical direction with improving performance at level flight, able to interpret instruments, knowledge of the fuel system, blast valve and demonstrates safe refueling procedure.

Lesson 3 – Maneuvers and Venting

Objective

- To develop proficiency in all previously introduced ground and flight procedures
- Use of the maneuvering vent
- Performance and limitations
- Minimum altitude regulation and airspace
- Introduction to aircraft radio use

Elements

- Dual flight to gain proficiency in previously introduced procedures
- Launching Over Obstacles

Launch Over Obstacles

Objective

- To develop the student's shill in launching a hot air balloon over an obstacle.

Motivation

- This type of launch will allow you to comfortable setup your system before a launch to assure that you will safety launch over obstacles.

Overview

The appropriateness of any launch site involves much more than its physical size and absence of obstructions, even though these are important considerations. Of equal or greater importance is the direction the balloon will track following the launch. Any site selection made should include consideration of local winds as determined by PiBal, smoke, trees, or other physical indications; forecast and reported winds aloft; and local phenomena peculiar to the specific site determined by personal knowledge or by consulting with local balloonists.

Explanation & Demonstration

Pilots should take careful consideration about obstacle clearance during lift off and climb out from a launch site. The rule of thumb for computing the minimum distance between the launch point and obstacles downwind is as follows: multiply the wind speed expressed in miles per hour by 100, (a balloon will travel 88 feet per minute if the wind is blowing at 1 MPH. The 100 are 88 feet rounded up). The results of this calculation are the suggested minimum horizontal distance in feet from the obstacle that the balloon should be positioned for launch. The product of 100 times the wind speed is the distance that the balloon is expected to travel during the first minute of flight.

It is suggested establishing an initial rate of climb by adding the height of the obstacle plus a minimum desired clearance to arrive at an initial rate of climb. Thus, a 100–foot obstacle and 200 feet of desired clearance over the obstacle totals 300 feet. Upon takeoff, establish an initial rate of climb of 300 feet per minute.

In is also suggested an allowance for errors in distance estimation and changes in surface wind or other unforeseen occurrences. It is suggested that a landmark be selected halfway to the obstruction. If it should appear that the balloon would not achieve a minimum of half the clearance altitude by that halfway point, immediately terminate the flight by activating the deflation port (Smart Vent) before reaching a critical altitude (usually about 20 feet above the surface.

Application

Example: "The wind speed is 4 mph and there is a 75– foot line of trees downwind at the end of the field. Using the formula as described above, multiply the wind speed by 100 (4 X 100 = 400). In order to pass 100 feet over the trees after takeoff, add 100 feet of the tree height of 75 feet, resulting in a total of 175 feet. Lay the basket at least 400 feet upwind of the treelike. Upon takeoff, establish a minimum initial rate of climb of 175 fpm. The balloon should pass 100 feet over the trees."

Critique & Evaluation

Review the formula using different wind speed and obstacle heights and discuss the various variations that can be used.

Summary

Applying this formula during your setup and launch sequence will assist you in avoiding obstacles downwind during launch. But consideration also must be accounted for false lift during takeoff.

Additional Study Material

While this formula might work well for low obstacles, those under 100 feet, additional considerations in wind speed and direction must be considered for taller obstacles. For a more detailed discussion of launch consideration read *Box Canyon* (avoiding radio/TV towers) in the February, 1991 issue of *Balloon Life*.

Equipment

- Balloon Flight Manual
- FAR/AIM book
- Airworthy balloon
- Aircraft radio

Instructor's Actions

1. Pre–flight discussion of previous lesson plans and the pre–flight lesson plans on Use of Vent, Performance and Limitations, and Normal Landing
2. Demonstrate use of the vent
3. Discuss and review notations chapter in *Balloon Flight Manual*
4. Demonstrate weight and density altitude calculations
5. Review 14 CFR Part 91 and use of sectional chart
6. Demonstrate use of aircraft radio
7. Supervise performance of normal landings
8. Critique proficiency in maneuvers

Student's Actions

1. **Pre–flight discussion**
   a. Use of maneuvering vent
   b. Clearing Obstacles https://www.youtube.com/watch?v=QFeuuraIQ0U
   c. Mondail Fast Landings https://www.youtube.com/watch?v=HXzCT3XZPMg

Use of Maneuvering Vent

Objective

- To develop the student's skill in the operation of the vent

Elements

- Use of the vent for altitude control and landing
- Safety factors using the vent

Equipment

- Balloon Flight Manual
- In–flight maneuver

Instructor's Actions

- Discuss limitations and proper operation of vent in *Balloon Flight Manual*
- Demonstrate use of vent emphasizing maximum permissible opening
- Only allow the student to hold the vent line in hand when on final low level approach or under direct supervision of instructor. (Do not assume that a student will completely release the vent line in–flight or on the ground after normal operation.)
- Discuss envelope throat closure as a result of over–venting or wind shear and the remedy to open the throat

Student's Actions

- Pre–flight review of Balloon Flight Manual
- Perform venting maneuvers as requested
- Review https://www.youtube.com/watch?v=qL0ypmjH4w4&feature=youtu.be

Completion Standards

Student should demonstrate safe operation of the vent and explain its limitations

d. Performance and Limitations

Performance and Limitations

Objective

- To develop the student's skill in determining performance and limitations

Elements

- Use of flight manual as source of information on operational characteristics, loading, performance and notations

Equipment

- *Balloon Flight Manual*

Instruction's Actions

- Discuss the *Balloon Flight Manual* as the student's most important source of information on the aircraft
- Discuss operational characteristics, loading, performance and limitations including the adverse effects of exceeding the limits
- Compute operating weight and use of load charts taking into consideration seasonal and atmospheric conditions– age and condition of balloon
- Compute fuel pressure requirement
- Discuss minimum or required equipment list
- Discuss maximum continuous envelope temperature; never exceed envelope temperature, location and purpose of temperature tabs
- Discuss the effects of density altitude, wind and terrain on balloon performance
- Discuss maximum rates of ascent and descent for a student at 300 fpm or less
- Discuss the rule of thumb: limit descents to 500 fpm above 500 feet AGL, 400

fpm above 400 feet AGL, 300 fpm above 300 feet AGL, etc.
- Discuss altitude required to arrest excessive rates of descent
- Discuss fuel quantity and endurance

Student's Actions
- Read and be knowledgeable about each chapter of the *Balloon Flight Manual*
- Listen, take notes and ask pertinent questions

Completion Standards
- The student should demonstrate by oral quiz that he understands the performance and limitations of the aircraft and the consequences of exceeding them.
- Calculate weight and pressure limitations by use of charts and other data for a student flight.
- Density altitude calculations.
- Demonstrate competency to maintain safe ascent and descent rates and the dangers of exceeding them.

2. **Perform each maneuver as directed**
   a. Flight planning – draw proposed flight track
   b. Inflation
   c. Launch over Obstacles
   d. Launch with False Lift considerations
   e. Maneuvers previously introduced
   f. Observes minimum altitude and air space regulations
   g. Uses proper aircraft terminology and procedure
   h. Normal Approach & Landing
   i. Monitor progress of flight on sectional
   j. Post–flight discussion

Completion Standards

Student demonstrates through oral quizzing and sample problems that he/she is familiar with the use of load and pressure charts and the information in the *Balloon Flight Manual*; proficiency in all previously practiced maneuvers, the proper and safe use of the maneuvering vent, normal approaches and landings, observes minimum altitude and airspace regulations during flight and demonstrates proper radio procedures and terminology.

Lesson 4 – Unusual Flight and Terrain Conditions

Objective

- To familiarize the student with unusual flight conditions and the associated hazards in dual flight

Elements

- Rough and slope landings
- Short field landings
- Water landings
- Mountain flying
- Hills and rotors
- Cold weather flying
- Wind shears at high and low level
- Windy inflation and use of inflation harness
- Tie Off https://www.youtube.com/watch?v=_MbRBI6biv8
- Operation near power lines
- Approaches over obstacles
- Steep approaches
- High wind landing techniques
- Ride Balloon Slows Down https://www.youtube.com/watch?v=Ph25M_WRSoA
- Fast Landing in Ride Balloon https://www.youtube.com/watch?v=3Geyy9U0GoA
- Fast Landing in a Racer https://www.youtube.com/watch?v=gjKEk1_oHpg
- Failed landing
- Ascent to 2,000 feet AGL (Private & 3,000 Commercial)

Equipment

- Airworthy balloon

Instructor's Actions

- Preflight discussion of unusual flight conditions
- Demonstrate short field landing with emphasis on approach and go/no go decision to land
- Stress extreme danger of operation near power lines
- Demonstrate lack of depth perception over water
- Demonstrate rotor action on the lee side of hills and the effect of wind shears on envelope and burner action to open closed throat

High Wind Landing

Objective

- To develop the student's skill in planning and making a high wind landing

Elements

- Selection of large landing area
- Use of Landing Checklist – BFAVS
- Selection of approach profile
- Use of burner and maneuvering vent
- Rapid deflation technique

Equipment

- Airworthy Balloon
- In–flight maneuver

Instructor's Actions

- Pre–flight discussion of appropriate landing site (large, flat field), the use of shelter as wind break and the danger if only a small or limited landing area is available
- Pre–flight discussion for preparation of hard landing and use of landing checklist
- Pre–flight discussion about preferred flight profile to come down to within five feet above field in level flight before ripping out
- Pre–flight discussion on securing fuel system before touchdown and hazard of pilot lights causing a field fire or damage to envelope on drag landing
- Pre–flight discussion on how a pilot can access burner, pull red line and hold himself securely during a hard landing
- Pre–flight discussion on sudden impending power lines
- Pre–flight discussion of rapid deflation technique to include full deployment of vent line, spinnaker effect from wind and envelope mouth closure
- Pre–flight discussion of horizontal and vertical forces at ground contact to eliminate as much vertical force as possible

Student's Actions

- Demonstrate knowledge of technique for high wind landings including landing site selection, use of landing checklist, special preparation for hard landing, high wind flight profile, holding on and rapid deflation techniques
- Point to Ponder – Normally when the wind is blowing fast you can use this wind to travel a long way until you find a good landing spot.
- Point to Ponder – When looking for a spot I normally get close above the obstacles and then drop in and rip out.
- Explain procedure to use if power lines are suddenly encountered
- Demonstrate high wind landing procedure with 8 knots or more at touchdown in dual flight

Completion Standards

- Student should explain the elements of a high wind landing and demonstrate a high wind landing if encountered during dual training

Common Student Errors:

- The instructor should anticipate the common student errors associated with high wind landings
- Incomplete passenger briefing
- Failure to determine surface wind conditions and hazards in the selected landing area
- Improper use of vent and burner controls
- Failure to deflate balloon in a timely manner after touchdown to minimize ground travel
- Failure to abort approach, if necessary, in a timely manner

Student's Action

- Perform each maneuver as directed
- Practice maneuvers previously introduced
- Short field landing with positive landing (steep approach)
- Observe inaccessible, rough and unsuitable landing sites
- High wind landing technique
- Recognize danger in an approach over power lines
- ABQ Lucky Powerline Strike https://www.youtube.com/watch?v=IUa2ujQRTLw

- Virginia Powerline Strike https://www.youtube.com/watch?v=tSH2XNqqZDU
- ABQ Powerline Strike https://www.youtube.com/watch?v=ubWPPO09xlg
- What happens after https://www.youtube.com/watch?v=Dw1DfQGlRVU
- Do not descend over power lines
- Approach and level flight over still water
- Approach over obstacles
- Understands and uses inflation harness
- Recognition of dangers of mountain flying
- Recognition of danger of river current to submerged basket
- Flight in hilly area to observe rotor and wind shear effects on performance and flight direction
- Flight to 2,000 feet AGL (commercial – 3,000 feet AGL)
- 14 CFR (61.109.h.2.iii & 61.129.h.ii.c)
- Recognize cold weather effect on fuel pressure and fuel system

Winter Flying: The Ice Cold Facts

by Peter Stekel

The colder temperature of winter weather brings certain concerns that the safety conscious pilot should review both at the start of the season and before each flight.

Leaky O–rings

Many pilots are still using burners that require O–rings. The newer burner designs have eliminated these rubber gaskets that caused the space shuttle *Challenger* to explode. Take a lesson from NASA and accept that an O–ring leak is a disaster waiting to happen.

O–ring leaks are caused by the different rates of contraction of the metal housing and the rubber O–rings in the blast valve. Generally these will disappear as the valve is actuated and thereby warmed. If O–ring leaks were a problem last year, you will likely see them again this year. It is wise to have the blast valve serviced by your repair station at the start of the season and the O–rings checked and replaced if needed.

Fuel lines

Cold weather will cause fuel lines to become brittle. This can lead to cracks and leaks. Checking your system with the "sniff and smell" method may not be satisfactory in winter as your senses are less responsive in cold weather. Such things as winter colds and nasal congestion also interfere with your sense of smell. Cold temperatures slow the rate of vaporization from a propane leak so always do a thorough pre–flight check using soap bubbles.

A super–cold morning will cause contraction leaks at the hose fittings and tank connections. Be sure to check and tighten these before each flight, even though you may have flown yesterday and everything was OK.

Using methanol

Winter is a good time to think about adding methanol to your tanks to protect against water contamination. Many authorities feel that the potential for internal tank condensation is greater in the winter due to the great range of heating and cooling from heat tapes and vaporization cool down during flight.

Fuel pressure
Where you may normally fly with 100–160 psi in summer, the freezing and below temperatures in winter cause the pressure in your tanks to drop below 50 psi. This may not be enough to get the balloon airborne. Your options for creating the needed pressure are to heat the tanks or pressurize with nitrogen.

If you use heat tapes, remember that once disconnected from the heat source your tanks will lose some pressure. However, the protective jackets should maintain sufficient heat and pressure for a safe flight. If your drive to the launch site is a long one, think about covering the exposed tank tops with blankets to help retain heat and pressure.

Heat tapes and propane tanks
Give your tapes a good eyeball inspection. Particularly if the tapes haven't been used since last winter, check for loose wires, bad plugs and insulation wear. Bare wires and electrical current do not mix and when you add 15 or 20 gallons of propane you'll have a recipe for disaster.

Always heat and store your tanks outside and away from other flammable materials. A special ventilated storage space is best. Don't overfill the tanks after a cold morning flight since colder temperatures allow you to pack more compressed propane into a tank. When storing propane tanks, be aware that as a cold morning heats up during the day, tank pressure goes up. An overfilled tank and increasing pressure can cause the safety valves to open, venting propane into your storage area. One loose spark or other source of ignition and you've got a fire.

Cold burner coils
Count on colder temperatures to have an effect on the performance of your balloon and the burner. Because the cold causes low vaporization, when you first open the blast valve and run propane through the cold pre–heat coils the fuel will not vaporize. This means you will be burning liquid propane. You can recognize when this happens because liquid propane will burn as a yellow fire ball rather than the thin blue flame that you are accustomed to seeing. Once the coils warm, the fuel will vaporize better and the burner works more efficiently.

The danger is that the yellow fireball can result in a "flame thrower effect," completely filling the mouth of the balloon for the unsuspecting pilot ready to start a hot inflation. Any crew members holding open the skirt and/or throat of the envelope itself could be burned!

To minimize this danger, first test your burner and warm the coils prior to laying the basket over and connecting the cables. Then, make your first inflation burns short and perform test burns to again warm the coils for best performance.

Reaction and response times
The pressure of the fuel system and payload being lifted will affect the performance of the balloon in cold weather. Low fuel pressure means your system is less responsive. Payload affects the amount of heat needed for lift.

Wind speed and pilot skill level are also factors. Slow response time due to low psi

requires greater maneuvering space when approaching an obstacle or attempting to land in a field. As for your skill level, how far ahead of the balloon flight profile can you anticipate? Your experience level with the flight conditions will have a direct bearing on how well you can fly safely with low pressure. Combining these elements together and flying safely takes greater concentration on the part of the pilot. Be aware how they affect your flight profile.

Hard landings

When landing, remember that the ground is probably frozen and it will be like landing on concrete. You may want to consider padding the basket floor to help absorb impact. Keep in mind that any stubble left standing in a field may also be frozen and can damage the envelope or possibly injure a passenger. Whenever possible, try to land as close as possible to the recovery access and if separated from your crew, land near a house, shed or natural outcropping where you and your passengers can seek shelter from the elements if need be.

Propane Pressure Chart

Temp (F)	Pressure
-20	13.5
-10	20.0
0	28.0
10	37.0
20	47.0
30	58.0
40	72.0
50	86.0
60	102.0
70	120.0
80	140.0
90	165.0
100	190.0
110	220.0

Completion Standards

The student should perform the flight maneuvers in unusual flight and terrain conditions with a high degree of understanding and proficiency. Operational control of the balloon should be positive and indicative of good judgment and planning. The student will be able to explain and demonstrate the techniques and precautions involved in each maneuver so that the outcome is never in serious doubt.

Lesson 5 – In–Flight Emergencies

Objective

- To familiarize the student with in–flight emergency procedures and begin the development of automatic pilot responses that will result in a safe correction or landing in an actual emergency

Elements

- Dual flight to recognize in–flight emergencies
- Preplanned responses to emergencies
- Practice previously introduced maneuvers

Equipment

- *Balloon Flight Manual*, Emergency Procedures
- Airworthy balloon

Instructor's Actions

- Pre–flight discussion
- Review emergency procedures in *Balloon Flight Manual*
- Practice selected maneuvers previously introduced
- In–flight demonstration of fuel system emergencies
- In–flight demonstration of envelope and instrument emergencies

Student's Actions

- *Perform each maneuver as directed*
- Practice selected maneuver previously introduced
    - Flight Planning
    - Inflation
    - Launch
    - Level flight
    - Approaches and landings (shallow and steep)
- Respond to instructor's simulated emergency procedures
    - Fuel leak at hose connection
    - Fuel leak at blast valve
    - Fuel leak at tank valve
    - Fuel leak at pilot light shut off at burner
    - Fuel leak at pilot light shut off at tank
    - Pilot light regulator malfunction
    - Pilot light regulator adjustment
    - Fuel exhaustion
    - Water in fuel
    - Fuel system icing
    - Fly on backup system
    - Blast valve stuck open
    - Blast valve stuck closed
    - Relighting pilot light using Balloon Flight Manual procedure (performed on the ground)
    - Fire in the air
    - Fire on the ground
    - Use of fire extinguisher
    - Collision with another balloon
    - Mid Air Collision https://www.youtube.com/watch?v=rVLUDJg–ha8
    - Envelope rip

- Envelope over–temperature
- Partial opening of rip panel
- Parachute valve line failure
- Permitted envelope damage
- Permitted envelope cable damage
- Aircraft instrument failure
- Ill or frightened passenger

In–Flight Emergencies

Objective

- To demonstrate the various ways of controlling the balloon during fuel and related emergencies.

Review of Fuel and Burner System

Note: Fire Extinguisher and Gloves are a must

The fuel and burner system for this balloon are two separate systems with only the Can & Coils shared. Each system works independently of each other

- Tanks – Bleeder valve, Tank valve, check valve in Tank valve connection, Gauge (magnet in gauge)
- Hoses – Hose running to burner, Check valve
- Liquid vs. vapor pilot light

Burner and functions of **burner**

- Pilot light – piezo igniter
- Main valves
- Blast explain path of propane
- Whisper valves explain path of propane

Potential Problems:

Leaks

- Fuel leak in main tank valve – Normally this will leak around the value stem. By turning it all the way off or all the way on it will seal.
    - Fuel leak in hose – Turn it off at main tank valve
    - Fuel leak in blast valve – Turn off at main tank valve
- Fuel leak at pilot light – Turn off at main tank valve or turn off pilot and use other burner to ignite burner
    - Fuel leak at pilot light – shut off at tank

Malfunctions

- Pilot light regulator malfunction – Turn off at main tank
- Blast stuck open – Use main tank value to control
- Blast valve stuck closed – Fly off other burner

Instructor Demonstrates – Student Action

1. Relights
    a. Piezo, then striker in pilot/burner
    b. Aux striker for pilot
    c. Aux striker for whisper
    d. Aux striker for main burner

2. **Fire in the air – extinguisher**
3. **Fire on ground – Get away**

Others:

- Fuel exhaustion – Fly off other tank, land when safe
- Water in fuel – Fuel system icing.

Outcome

Student should be able to handle these emergencies. These procedures should be practiced periodically to maintain and automated response.

Completion Standards

Student demonstrates through oral quizzing and response during flight maneuvers that he/she is familiar with in–flight aircraft system failure, their causes and remedies, and shows improved proficiency performing flight maneuvers previously introduced.

Lesson 6 – In–Flight Emergencies Caused by Unsafe Flight Conditions

Objective

- To familiarize the student with in–flight emergency procedures and begin the development of automatic pilot responses that will result in a safe correction or landing in an actual emergency

Elements

- Dual flight to recognize in–flight emergencies
- Preplanned responses to emergencies
- Practice previously introduced maneuvers

Equipment

- *Balloon Flight Manual*, Emergency Procedures
- Airworthy balloon

Instructor's Actions

- Pre–flight discussion
- Review emergency procedures in *Balloon Flight Manual*
- Practice selected maneuvers previously introduced
- In–flight demonstration of fuel system emergencies
- In–flight demonstration of simulated emergency conditions caused by dangerous thematic and other unsafe flight conditions

Student's Actions

- *Perform each maneuver as directed or explain emergency procedure*
- Practice selected maneuver previously introduced
    - Flight Planning
    - Inflation
    - Launch
    - Level flight
    - Approaches and landings (shallow and steep)
- Respond to instructor's simulated emergency procedures
    - Sudden impending power line
    - Operation over power lines
    - Thermal updraft and downdrafts
    - Thunderstorm
    - Thermal inversion
    - False lift–launch
    - False Lift and Fence https://www.youtube.com/watch?v=6WuVfioiTgc
    - False lift–landing
    - Sudden ground winds
    - Hard landing
    - Hazard of ground assistance
    - Spooked livestock
    - Developing cloud or fog
    - Crown line caught in tree
    - Landing in water
    - Landing in trees
    - Drop line landing
    - Drop line caught in tree

- Throat closure due to sheer or over venting
- Approaching obstacles
- Hypoxia
- Hyperventilation
- Hypothermia
- Vertigo
- Emergency radio communication

Completion Standards

The Student demonstrates through oral quizzing and response during flight maneuvers that he/she is familiar with in–flight emergencies caused by unsafe flight conditions, their causes and remedies, and show improved proficiency performing flight maneuvers previously introduced.

Lesson 7 – Pre–Solo Checkout Flight

Objective

- To evaluate the student's performance and knowledge to insure that he has developed the skills necessary for safe solo flight

Elements

- Completion of the pre–solo written test
- Endorsements necessary for solo flight
- Review of questions missed on the FAA written test, if this taken before your solo
- Dual flight to check all training has been completed to completion standards

Equipment

- Airworthy balloon
- Student Pilot Logbook and Pilot Certificate

Instructor's Actions

- Check that a pre–solo written test has been given to student and review
- Check student's pilot logbook for all endorsements necessary for solo flight if outcome of unit is satisfactory
- Pre–solo aeronautical knowledge
- Pre–solo flight training
- Solo flight endorsement in logbook
- Solo flight endorsement on student–pilot certificate
- Aeronautical knowledge–FAA written test *(Note: Passing the FAA written test is not required but highly recommended as a prerequisite for solo flight)*
- Pre–flight discussion on objective of lesson
- Critique maneuvers and pilot judgment

Student Actions

- Perform each maneuver as directed
- Practice selected maneuvers previously introduced
    - Weather briefing
    - Site selection
    - Flight planning – plot flight path
    - Observe surface winds – PiBal
    - Preflight rigging and inspection – checklist
    - Basket tied off
    - Hot inflation – checklist
    - Pre–launch – checklist
    - Weigh off Ascents (shallow and steep)
    - Level flight
    - Descents (shallow and steep)
    - Direction changes
    - Fuel management
    - Emergency procedures including sudden impending power lines
    - Monitor surface wind
    - Normal approaches
    - Short field approaches
    - Landowner relations
    - Deflation

- Post–flight discussion

Completion Standards

The student will demonstrate proficiency on all flight maneuvers so that the result is never in serious doubt. Good judgment and adherence to notations of his/her skill level and aircraft performance are of primary importance to the instructor in determining approval for solo flight.

Lesson 8 – Student Pilot – Solo Flight

Objective

- To practice normal flight operations and emergency procedures in preparation for the student's ***first*** supervised solo flight. After the student has demonstrated ability to perform normal flight operations and a smooth landing the instructor may exit the basket and allow the student to continue in solo flight.

Elements

- Fly with instructor to build confidence prior to start of solo portion of flight

Equipment

- Airworthy balloon

Instructor's Actions

- Observe student's ability to confidently perform flight maneuvers within specified tolerances
- Allow student to continue in solo flight taking into consideration wind speed, availability of landing sites, and flight performance
- Specify length of flight and maneuvers to be performed in solo flight
- Maintain radio contact

Student's Actions

- Perform each maneuver as directed
- Practice selected maneuvers previously introduced
- Inflate and launch with instructor on board
- Ascents, descents and level flight (± 100 fpm for private)
- Normal approach and full landing
- Solo (you are alone)
    - weigh–off
    - Ascents, descents and level flight
    - Normal approaches and landings
    - Deflation
- Landowner relations
- Post–flight discussion

Completion Standards

Prior to solo flight, the student must demonstrate the ability to confidently perform the maneuvers of the pre–solo portion of this lesson plan within specified tolerances.

Lesson 9 – High Altitude/Cold Weather Flights & Terminal Velocity Descent

- To familiarize the student with high altitude/cold weather balloon flight and Maximum Velocity (Terminal) Descent

Elements

- Preparation for high altitude
- Preparations for cold weather
- Observing effects on balloon performance
- Maximum velocity descent

Equipment

- Airworthy balloon
- Cold weather clothing appropriate to temperatures aloft

Instructor's Actions

- Pre–flight discussion for high altitude flight to include maximum altitude, airspace considerations, altimeter setting, wind and temperature aloft forecast, load calculation, density altitude, pilot oxygen requirements, burner oxygen starvation, short blasts best, preparation to relight pilot light
- Pre–flight discussion for cold weather operation to include clothing (especially feet), survival gear, effect of temperature on batteries, advantages and disadvantages of heating fuel versus nitrogen charging, possibility of an 0–ring leak
- Pre–flight discussion for observing effects of high altitude on performance to include ascent at constant rate, record ambient temperature to verify if lapse rate is standard, record envelope temperature at 500' intervals, calculate time for ascent and descent
- Pre–flight discussion on Maximum Velocity Descent (MVD) *Terminal Speed* to include dangers associated with and associated remedial actions, calculate altitude needed to round out MVD, observe rate of descent and temperature during MVD
    - *Terminal Speed* – That speed at which the upward resisting force of the air equals the weight, so that the resulting force is zero and no further acceleration is experienced.

Student's Actions

Perform each maneuver as directed

- High altitude operation
- Knowledge of airspace requirements
    - Setting the altimeter
    - Interpreting wind and temperature aloft forecast
    - Demonstrate knowledge of weight calculation
    - Demonstrate effect of density altitude
    - Knowledge of pilot oxygen requirements
    - Knowledge of oxygen starvation of burner
    - Knowledge of high altitude blast valve operation
    - Demonstrate relighting pilot light on surface
- Cold weather operation
    - Dress for temperature at altitude
    - Knowledge of the effect of temperature on batteries and propane
    - Knowledge of advantages and disadvantages of heating fuel versus nitrogen charging

    - Simulates action if 0–ring leaks on burner or on tank valve
- Effect of high altitude on performance
    - Ascends to 2000 feet AGL (private) at constant rate ± 100 fpm or ascends to 3000 feet AGL (commercial) at a constant rate ±50 fpm without over temping envelope
    - Record ambient temperature at 500' intervals
    - Record envelope temperature at 500' intervals
    - Calculate lapse rate and compare to standard rate
    - Calculate time for ascent and descent
- Maximum (Terminal) Velocity Descent (Commercial Requirement)
    - Descend and recover from a MVD
    - Record envelope temperature at equilibrium
    - Record envelope temperature during MVD
    - Measure altitude needed to round out from MVD
    - Does not use vent during MVD
    - React to wind shears with additional heat
    - Use burner to open throat if closing due to wind shear or excess cooling

Completion Standards

The student should be able to demonstrate his/her ability to establish and maintain a constant rate of climb from launch to planned altitude while maintaining envelope temperature. Demonstrate knowledge of airspace, wind and temperature aloft forecast, weight calculation, effects of cold temperature and high altitude performance and the dangers associated with MVD. Demonstrates a MVD and maintains safe operation during the descent and properly rounds out from the descent.

Lesson 10 – Tether Operations

Objective

- To develop the student's skill in tethered operations

Elements

- Site Selection
- Rigging
- Safety precautions

Equipment

- Airworthy balloon
- *Balloon Flight Manual*
- Tether lines and tie–off points

Instructor's Actions

- Pre–inflation discussion to include weather briefing, analysis of hazards and obstructions, layout and crew briefing
- Discussion of lines for rigging top and/or bottom of balloon, knots, quick releases, harnesses, strength of materials and manufacture's recommendations
- Discussion of safety considerations to include gusts, false lift, time of day, thematic conditions, wind shifts, rapid deflation, free flight and crowd control

Student's Actions

- Tether gone wrong https://www.youtube.com/watch?v=v7CvULBOpwk
- **Perform each operation as directed**
- **Site selection**
    - Obtain weather briefing
    - Analyze hazards
    - Explain difference between drop line and tether line
    - Explain preference for nylon strap and rope
    - Able to tie bowline, figure 8 and directional figure 8 and operate quick releases
- **Rigging**
    - Explains advantages of 3 point tie–off
    - Explains different rigging techniques for flying at tether, ground tether and giving passenger tether rides
    - Selects adequate tie–off points
    - Recognizes relative strength of equipment
    - Instructs crew to take turns around poles or tree trunks if line is to be hand held and the danger of this procedure
    - Rigs and lays out tether lines before inflation
    - Assigns crew to each tether point and explains duties
- **Safety precautions**
    - Inflates and adjusts tether lines to take up slack
    - Adjusts for wind direction change
    - Recognizes effect of false lift
    - Recognizes possibility of sudden gusts on calm days
    - Exchanging tanks during tether
    - Able to control balloon's ascents and descents for passenger rides on tether lines, adjusts for false lift, and keeps balloon over the same location on field
    - Procedure to exchange passengers
    - Crowd control around balloon, lines and property

Completion Standards

The student will have an appreciation for hazards associated with tether operation. The student should be able to brief the crew on their duties and coordinate their efforts as conditions change. The student should be able to explain the various tethering methods and be familiar with the manufacturer's recommended procedures.

Lesson 11 – Navigation

Hot air balloon pilots take pride in their ability to navigate with precision. To execute a flight which follows a predetermined plan directly to a target is a source of real satisfaction. Navigational skill is a required skill needed to participate in competition flying. Every preflight action should include a proposed track that is transferred to a chart. The prime requirement for success in navigation is knowledge of a few simple facts and the ability to exercise good judgment based upon those facts. Balloon pilots are required to know only the rudiments of basic navigation. As more flight experience is gained, especially through long distance flights, more knowledge of navigation will be desirable.

To navigate successfully, a pilot should be able to determine a balloons launch location on his chart. In flight, the pilot verifies his position along his route by pilotage and by dead reckoning. ***Pilotage*** is the use of visible landmarks to verify the aircrafts position. ***Dead reckoning*** is the laying out of a proposed tract on a chart in a known direction and speed.

The basic form of navigation for a balloon pilot is through pilotage. This type of navigation should be mastered first. An understanding of the principles of dead reckoning, however, will enable the pilot to make necessary calculations of flight time and wind shifts.

Aeronautical charts:

The National Ocean Survey (NOS) publishes and sells aeronautical charts of the United States and foreign areas. The types of charts most commonly used by balloon pilots are:

Sectional charts.

The scale of the sectional chart is 1:500,000 (I inch equals 6.86 nm.).

Terminal Area Charts

The scale is 1:250,000 (I inch equals 3.43nm.). Usually only produced for airspace around Class B airports.

These charts are designed for visual navigation and for slow speed aircraft such as a balloon. The topographical information featured on these charts consists of the portrayal of relief and a judicious selection of visual checkpoints used for VFR flight. The aeronautical information on sectional charts includes visual and radio aids to navigation, airports, controlled airspace, restricted areas, obstructions and related data. A "Terminal Area Airspace Chart" is a blowup of the area around a major airport designated as Class B Airspace.

Balloon pilots prefer the Class B Airspace Chart because it is in an easier–to–read scale. If the area to be flown in does not have Class B Airspace, then a Sectional Chart will have to be relied on for navigational and informational purposes. The topographical information on these charts includes cities, towns, principal roads, railroads, distinctive landmarks, drainage and relief. Relief is shown by spot elevations, contours, in radiant color tints.

It is important that the pilot checks the publication date on the aeronautical chart to be used. Obsolete charts should be discarded and replaced by new editions. This is important because revisions include changes in radio frequencies, new obstructions, and changes in designation of airspace.

Because of the relatively short distances that balloons fly, it is appropriate that road maps also be used for navigation. Most highway departments or counties publish county road maps. These are excellent for use in balloon navigation. The difference between a chart and a map is that the chart has a grid in latitude and in longitude.

Sectional Aeronautical Charts:

A chart name and title appear on each chart. The chart legend lists various aeronautical symbols as well as information concerning terrain and contour elevations. Referring to the legend, aeronautical, topographical and observation may identify symbols. Many landmarks, which can be easily recognized from a balloon, are identified on the chart by brief descriptions and symbols marking their exact location.

Relief:

The elevation of land surface, relief is shown on the aeronautical charts by brown contour fines drawn at 250–foot intervals. These areas are emphasized by various tints, as indicated in the color legend appearing on each chart. The closer the contour lines are together on the chart, the more steep the terrain.

Aeronautical Data:

The aeronautical information on the Sectional Chart is explained on the legend section of the chart. Each omni directional radio range (VOR) has a magnetic compass rose around it. Airports and information pertaining to airports having a Control Tower are shown in blue. All other airports and information pertaining to those are shown in magenta adjacent to the airport symbol, which is also in magenta.

The symbol for obstructions is another important feature. The elevation of the top of an obstruction above sea level is given in blue figures (without parenthesis) adjacent to the obstruction symbol. Immediately below this section of figures is another set of light blue figures enclosed in parenthesis, which represents the height of the top of the obstruction above ground level. Obstructions which extend less than 1,000 feet above the terrain are shown by one type of symbol and those obstructions that extend 1,000 feet or higher above ground level are indicated by a different symbol. Specific elevations of certain high points and terrain are shown on charts by dots accompanied by small black figures indicating the number of feet above sea level.

The chart also contains larger bold–faced blue numbers, which denote maximum elevation figures. These figures are shown in quadrangles bounded by tic lines of latitude and longitude and are represented in 1,000s and 100s of feet above mean sea level. These maximum elevation figures are based on information available concerning the highest known feature in each quadrangle, including terrain and obstructions.

Meridians and parallels:

The equator is an imaginary circle equidistant from the poles of the earth. Circles parallel to the equator (lines running east and west) are parallels of latitude. They are used to measure degrees of latitude north or south of the equator. The angular distance from the equator to the pole is 90 degrees.

Meridians of longitude are drawn from the North Pole to the South Pole and are at right angles to the equator. The "Prime Meridian" which passes through Greenwich, England, is used as the zero line from which measurements are made in degrees east and west to 180 degrees.

Any specific geographical point can be located by reference to its latitude and longitude. Each degree of latitude or longitude is divided into minutes and seconds. One minute of one degree of latitude is equal to one nautical mile.

The meridians are also useful for designating time belts. A day is defined as the time required for the earth to make on complete revolution of 360 degrees. Since the day is divided into 24 hours, the earth revolves at the rate of 15 degrees an hour. Noon is the time when the sun is directly above a meridian; to the west of that meridian is forenoon, to the east is afternoon.

The standard practice is to establish a time belt for each 15 degrees of longitude. This makes a difference of exactly one hour between each belt. In the United States there are four time belts – Eastern (75 degrees), Central (90 degrees), Mountain (105 degrees), and Pacific (120 degrees). The dividing lines are somewhat irregular because communities near the boundaries often find it more convenient to use time designations of neighboring communities or trade centers.

When the sun is directly above the 90th meridian, it is noon Central Standard Time. At the same time it will be 1:00 p.m. Eastern Standard Time (EST), 11:00 a.m. Mountain Standard Time (MST), and 10:00 a.m. Pacific Standard Time (PST). When "daylight saving" time is in effect, generally between April and October, the sun is directly above the 75th meridian at noon, Central Daylight Time (CDT). CST is 0600 and CDT is 0700 when it is 1200 Greenwich time.

In most aviation operations, time is expressed in terms of the 24–hour clock. Air traffic control instructions, weather reports and broadcasts are all given in Greenwich Time.

Measurement of Direction:

By using the meridians, directions from one point to another can be measured in degrees, in a clockwise direction from true north. To indicate a course to be followed in flight, draw a line on the chart from the point of departure to the destination and measure the angle, which this line forms with a meridian. Direction is expressed in degrees.

Variation:

To use the compass accurately, correction must be made for magnetic variation. Variation is the angle between true north and magnetic north. It is expressed as east variation or west variation depending upon whether magnetic north is to the east or west of true north, respectively.

The north magnetic pole is about 1,300 miles from the geographic or true North Pole.

The earth is not uniformly magnetized. In the United States the needle usually points in the general direction of the magnetic pole but it may vary in certain geographical

localities by many degrees. Consequently, the National Ocean Survey has carefully determined the exact amount of variation at thousands of selected locations in the United States. The amount and direction of variation, which change slightly from time to time, are shown on aeronautical charts as broken red fines, called isogonic lines, which connect points of equal magnetic variation. (The line connecting points at which there is no variation between true north and magnetic north is the agonic line).

On the west coast of the United States, the compass needle points to the east of true north; on the east coast the compass needle points to the west of true north. Zero degrees variation exists on the agonic line, which runs roughly through Lake Michigan, the Appalachian Mountains, and off the coast of Florida, where magnetic north and true north coincide.

Because courses are measured in reference to geographical meridians, which point toward true north, and these courses are maintained by reference to the compass which points along a magnetic meridian in the general direction of magnetic north, the true direction must be converted into magnetic direction for the purpose of flight. Adding or subtracting the variation, which is indicated by the nearest isogonic line on the chart, makes this conversion. The true heading, when corrected for variation, is known as magnetic heading. To convert TRUE course or heading to MAGNETIC course, note the variation shown by the nearest isogonic line, if variation is west, add; if east, subtract.

Some method should be devised for remembering whether to add or subtract variation. The following may be helpful: When going from true to magnetic, East is least (subtract) and West is best (add). The formula for this is written: True heading + West variation – East variation = magnetic heading. TH±V=MH.

Compass Rose:

If the variation is known, a stick–on compass rose can be placed on the map launch point. Draw a true north fine through the point. Next draw a magnetic north line (east to the right or west to the left) the number of degrees of variation from true north. Affix the compass rose to the map aligned with the magnetic north line.

Sectional Plotter:

A sectional plotter is a combination of protractor and straight edge with distance marked off to the scale of the sectional chart. It is used by laying it over a meridian of longitude at the hole in the center of the protractor. The straight edge is then rotated about the longitude line to match the desired direction. A line is drawn representing the course to be flown. The plotter may be used to mark off the distance to be traveled on the course line.

Deviation:

Deviation is the deflection caused in a magnetic compass by the magnetic influence within an aircraft. These are negligible in a balloon and generally no correction is made for deviation.

Preparation of a Flight Profile:

Setting out a predetermined flight track is a part of preflight preparation and is strongly recommended for all types of aircraft. Most balloon pilots, other than competition pilots, tend to minimize this flight planning process. The emphasis for balloon pilots instead has been placed on their piloting ability to successfully cope with the in–flight variables as they are encountered.

A good habit to form for any student is to always prepare a written flight plan. In its simplest form, it can consist of locating the launch point on the map. Draw a line on the map representing the magnetic direction of the proposed flight. Mark off the time in 15–minute intervals according to the estimated wind speed to be encountered. This is known as a dead reckoning line.

A more sophisticated flight plan will train the student to do the following:

- Interpret meteorological information for different altitudes.
- Precisely calculate a ground track.
- Establish Intermediate landing points and a destination point
- Prepare a written flight profile, which specifies a series of maneuvers in a sequence to maintain the proposed ground track with time estimated for each maneuver and landing at destination.

Basic Navigation Calculations

Basic navigation for the balloon pilot consists of time, speed and distance calculations. These problems are simple enough to figure in one's head, with paper and pencil or using a common electronic calculator. The following navigational problems can be used to test the knowledge of a student in this basic area.

Determining en–route time for a flight:
In pre–flight planning, the pilot computes the estimated ground speed based on actual observation or forecast winds aloft. Observed wind speeds are estimated from flags, chimney smoke and such other visual indicators. PiBal are highly recommended for use in pre–flight planning. The pilot records the wind speed and direction at the surface and at higher altitudes until the PiBal goes out of sight. The winds aloft forecast should be relied on for the upper winds. With this information at hand, the pilot will be able to calculate the time of a flight at a given altitude.

Practice problems:

If ground speed of (a) _____ is maintained, how much time will be required to fly a distance of (b) _____?

Determining ground speed during flight: During flight a pilot may wish to determine the actual ground speed. At liftoff, the pilot checks the time and again when passing over a known checkpoint. Distance is measured between the checkpoints on the chart and the length of time taken to fly the distance is noted. With these two figures, ground speed can be determined.

Practice problems:

A balloon flies (a) _____ miles in (b) _____minutes. What is the ground speed?

Converting knots to miles per hour: Since the winds aloft forecast gives the wind in knots, a pilot should be able to convert knots to statute miles per hour, if desired, to determine the correct ground speed. Since knots actually mean nautical miles per hour, the problem is converting nautical miles to statute miles. There are approximately 1.15 statute miles to each nautical mile and .87 nautical miles in one statute mile.

Calculating time to climb: When approaching an obstacle, a pilot must calculate at what point a climb must be started in order to clear the obstacle. The wind speed, proposed ascent rate, current altitude and height of the obstacle must be known. For example, a balloon was flying at 6 knots, at an altitude of 900 feet MSL, and approaching a 2000–foot MSL tower, and the pilot wanted to clear the tower by 1000 feet. At what distance from the tower must the pilot start the ascent at 300 feet per minute?

Solution:

Height of Tower	2000
Clearance	1000
Current Altitude	3000
Height too Climb	2100

At 300 feet per minute climb, it will take seven minutes to climb 2100 feet. Sixty minutes divided into 6 knots equals .1 nautical miles per minute. In seven minutes, the balloon will travel .7 nautical miles per hour. The pilot will have to start the ascent .7 miles downwind of the tower.

Lesson 12 – Prerequisites for Flight Test

Objective

- To review all previous instruction to insure that the student has developed the high degree of understanding and proficiency necessary for safe operation of a hot air balloon under a variety of conditions and to insure the student meets all knowledge and skill requirements of the FAA Practical Test Standards.

Elements

- Discussion of each task required by the Practical Test Standards to insure the student's understanding of the task
- Review of those items which are found deficient
- Dual flight to cover those tasks contained in the Practical Test Standards

Equipment

- FAA Practical Test Standards (PTS) for hot air balloon
- All reference materials and publications listed as authority in the PTS
- Airworthy balloon

Instructor's Actions

- Ground school class to review knowledge required by each task of the PTS
- Dual flight to perform each task listed in the PTS
- Prepare application for student's flight test and make all necessary endorsements in his pilot log book

Student's Actions

- ***Pre–flight Discussion***
- **Respond to instructor's questions**
    - Demonstrate knowledge of PTS tasks and what will be required of you
    - Demonstrate knowledge of those questions and subjects answered incorrectly on the FAA written test
    - Ask questions about subjects on which you need help.
- **Dual flight**
    - Review and practice tasks required by PTS
    - Post–flight discussion

Completion Standards

The student shall demonstrate the knowledge and ability necessary to successfully perform each PTS task within the balloon's performance capability, executing emergency procedures and maneuvers, piloting the balloon with smoothness and accuracy, exercising good judgment, applying aeronautical knowledge and showing mastery of the balloon with the successful outcome of a task never seriously in doubt.

Lesson 13 – 14 CFR Part Subpart E – Private Pilots

Please Note that this is as of a specific date
Refer to the Current 14 CFR/AIM Manual
Sections removed to assist in reading

Sec. 61.102 Applicability.

This subpart prescribes the requirements for the issuance of **private pilot** certificates and ratings, the conditions under which those certificates and ratings are necessary, and the general operating rules for persons who hold those certificates and ratings.

Sec. 61.103 Eligibility requirements: General.

To be eligible for a private pilot certificate, a person must:

(a) Be at least 17 years of age for a rating in other than a glider or balloon.

(b) Be at least 16 years of age for a rating in a glider or balloon.

(c) Be able to read, speak, write, and understand the English language. If the applicant is unable to meet one of these requirements due to medical reasons, then the Administrator may place such operating limitations on that applicant's pilot certificate as are necessary for the safe operation of the aircraft.

(d) Receive a logbook endorsement from an authorized instructor who:
(1) Conducted the training or reviewed the person's home study on the aeronautical knowledge areas listed in Sec. 61.105(b) of this part that apply to the aircraft rating sought; and
(2) Certified that the person is prepared for the required knowledge test.
(e) Pass the required knowledge test on the aeronautical knowledge areas listed in Sec. 61.105 (b) of this part.

(f) Receive flight training and a logbook endorsement from an authorized instructor who:

(1) Conducted the training in the areas of operation listed in Sec. 61.107(b) of this part that apply to the aircraft rating sought; and
(2) Certified that the person is prepared for the required practical test.
(g) Meet the aeronautical experience requirements of this part that apply to the aircraft rating sought before applying for the practical test.

(h) Pass a practical test on the areas of operation listed in Sec. 61.107(b) of this part that apply to the aircraft rating sought.

(i) Comply with the appropriate sections of this part that apply to the aircraft category and class rating sought.

Sec. 61.105 Aeronautical knowledge.

(a) General. A person who is applying for a private pilot certificate must receive and log ground training from an authorized instructor or complete a home–study course on the aeronautical knowledge areas of paragraph (b) of
this section that apply to the aircraft category and class rating sought.

(b) Aeronautical knowledge areas.
(1) Applicable Federal Aviation Regulations of this chapter that relate to private pilot privileges, limitations, and flight operations;
(2) Accident reporting requirements of the National Transportation Safety Board;
(3) Use of the applicable portions of the "Aeronautical Information Manual" and FAA ACs;
(4) Use of aeronautical charts for VFR navigation using pilotage, dead reckoning, and navigation systems;
(5) Radio communication procedures;
(6) Recognition of critical weather situations from the ground and in flight, windshear avoidance, and the procurement and use of aeronautical weather reports and forecasts;
(7) Safe and efficient operation of aircraft, including collision avoidance, and recognition and avoidance of wake turbulence;
(8) Effects of density altitude on takeoff and climb performance;
(9) Weight and balance computations;
(10) Principles of aerodynamics, powerplants, and aircraft systems;
(11) Stall awareness, spin entry, spins, and spin recovery techniques for the airplane and glider category ratings;
(12) Aeronautical decision making and judgment; and
(13) Preflight action that includes—
(i) How to obtain information on runway lengths at airports of intended use, data on takeoff and landing distances, weather reports and forecasts, and fuel requirements; and
(ii) How to plan for alternatives if the planned flight cannot be completed or delays are encountered.

Sec. 61.107 Flight proficiency.

(a) General. A person who applies for a private pilot certificate must receive and log ground and flight training from an authorized instructor on the areas of operation of this section that apply to the aircraft category and class rating sought.

(b) Areas of operation.

*** Parts Removed for Ease of Reading ***

(8) For a lighter–than–air category rating with a balloon class rating:
(i) Preflight preparation;
(ii) Preflight procedures;
(iii) Airport operations;
(iv) Launches and landings;
(v) Performance maneuvers;
(vi) Navigation;
(vii) Emergency operations; and
(viii) Postflight procedures.

Sec. 61.109 Aeronautical experience.

Except as provided in paragraph (i) of this section, a person who applies for a private pilot certificate with an airplane, rotorcraft, or powered–lift category rating must receive and log at least 40 hours of flight time that includes at least 20 hours of flight training from an authorized instructor and 10 hours of solo flight training in the areas of operation listed in Sec.
61.107 of this part, and the training must include at least:

*** Parts Removed for Ease of Reading ***
(h) For a balloon rating: 10 hours of flight training that includes at least six training flights in the areas of operation listed in Sec. 61.107(b)(8) of this part, that includes—
*** Parts Removed for Ease of Reading ***

(2) Balloon with an airborne heater. If the training is being performed in a balloon with an airborne heater, at least—
(i) Two flights of 1 hour each within 60 days prior to application for the rating on the areas of operation appropriate to a balloon with an airborne heater;
(ii) One solo flight in a balloon with an airborne heater; and
(iii) At least one flight involving a controlled ascent to 2,000 feet above the launch site.
(i) Permitted credit for use of an approved flight simulator or an approved flight training device. (1) Except as provided in paragraphs (i)(2) and
(i)(3) of this section, a maximum of 2.5 hours of training in an approved flight simulator or an approved flight training device representing the category, class, and type, if applicable, of aircraft appropriate to the rating sought, may be credited toward the flight training time required by this section, if received from an authorized instructor.

(2) Except as provided in paragraph (i)(1) or paragraph (i)(3) of this section, a maximum of 5 hours of training in an approved flight simulator or an approved flight training device representing the category, class, and type, if applicable, of aircraft appropriate to the rating sought, may be credited toward the flight training time required by this section if the training is accomplished in a course conducted by a training center certificated under part 142 of this chapter.

(3) Except when fewer hours are approved by the Administrator, an applicant for a private pilot certificate with an airplane, rotorcraft, or powered–lift rating, who has satisfactorily completed an approved private pilot course conducted by a training center certificated under part 142 of this chapter need only have a total of 35 hours of aeronautical experience to meet the requirements of this section.

Sec. 61.110 Night flying exceptions

(a) Subject to the limitations of paragraph (b) of this section, a person is not required to comply with the night flight training requirements of this subpart if the person receives flight training in and resides in the State of Alaska.

(b) A person who receives flight training in and resides in the State of Alaska but does not meet the night flight training requirements of this section:
(1) May be issued a pilot certificate with a limitation "Night flying prohibited;" and
(2) Must comply with the appropriate night flight training requirements of this subpart within the 12–calendar–month period after the issuance of the pilot certificate. At the end of that period, the certificate will be suspended until the person complies with the appropriate night training requirements of this subpart. The person may have the "Night flying prohibited" limitation removed if the person—

(i) Accomplishes the appropriate night flight training requirements of this subpart; and
(ii) Presents to an examiner a logbook or training record endorsement from an authorized instructor that verifies accomplishment of the appropriate night flight training requirements of this subpart.

Sec. 61.111 Cross–country flights: Pilots based on small islands.

(a) Except as provided in paragraph (b) of this section, an applicant located on an island from which the cross–country flight training required in Sec. 61.109 of this part cannot be accomplished without flying over water for more than 10 nautical miles from the nearest shoreline need not comply with the requirements of that section.

(b) If other airports that permit civil operations are available to which a flight may be made without flying over water for more than 10 nautical miles from the nearest shoreline, the applicant must show completion of two round–trip solo flights between those two airports that are farthest apart, including a landing at each airport on both flights.

(c) An applicant who complies with paragraph (a) or paragraph (b) of this section, and meets all requirements for the issuance of a private pilot certificate, except the cross–country training requirements of Sec. 61.109 of this part, will be issued a pilot certificate with an endorsement containing the following limitation, "Passenger carrying prohibited on flights more than 10 nautical miles from (the appropriate island)." The limitation may be subsequently amended to include another island if the applicant complies with the requirements of paragraph (a) or paragraph (b) of this section for another island.
(d) Upon meeting the cross–country training requirements of Sec. 61.109 of this part, the applicant may have the limitation in paragraph (c) of this section removed.

Sec. 61.113 Private pilot privileges and limitations: Pilot in command.

(a) Except as provided in paragraphs (b) through (g) of this section, no person who holds a private pilot certificate may act as pilot in command of an aircraft that is carrying passengers or property for compensation or hire; nor may that person, for compensation or hire, act as pilot in command of an aircraft.
(b) A private pilot may, for compensation or hire, act as pilot in command of an aircraft in connection with any business or employment if:
(1) The flight is only incidental to that business or employment; and
(2) The aircraft does not carry passengers or property for compensation or hire.

(c) A private pilot may not pay less than the pro rata share of the operating expenses of a flight with passengers, provided the expenses involve only fuel, oil, airport expenditures, or rental fees.

(d) A private pilot may act as pilot in command of an aircraft used in a passenger–carrying airlift sponsored by a charitable organization described in paragraph (d)(7) of this section, and for which the passengers make a donation to the organization, when the following requirements are met:
(1) The sponsor of the airlift notifies the FAA Flight Standards District Office with jurisdiction over the area concerned at least 7 days before the event and furnishes—
(i) A signed letter from the sponsor that shows the name of the sponsor, the purpose of the charitable event, the date and time of the event, and the location of the event; and
(ii) A photocopy of each pilot in command's pilot certificate, medical certificate, and logbook entries that show the pilot is current in accordance with Secs. 61.56 and 61.57 of this part and has logged at least 200 hours of flight time.

(2) The flight is conducted from a public airport that is adequate for the aircraft to be used, or from another airport that has been approved by the FAA for the operation.
(3) No aerobatic or formation flights are conducted.
(4) Each aircraft used for the charitable event holds a standard airworthiness certificate.

(5) Each aircraft used for the charitable event is airworthy and complies with the applicable requirements of subpart E of part 91 of this chapter.

(6) Each flight for the charitable event is made during day VFR conditions.

(7) The charitable organization is an organization identified as such by the U.S. Department of Treasury.
(e) A private pilot may be reimbursed for aircraft operating expenses that are directly related to search and location operations, provided the expenses involve only fuel, oil, airport expenditures, or rental fees, and the operation is sanctioned and under the direction and control of:
(1) A local, State, or Federal agency; or
(2) An organization that conducts search and location operations.
(f) A private pilot who is an aircraft salesman and who has at least 200 hours of logged flight time may demonstrate an aircraft in flight to a prospective buyer.
(g) A private pilot who meets the requirements of Sec. 61.69 of this part may act as pilot in command of an aircraft towing a glider.

Sec. 61.115 Balloon rating: Limitations.

(a) If a person who applies for a private pilot certificate with a balloon rating takes a practical test in a balloon with an airborne heater:
(1) The pilot certificate will contain a limitation restricting the exercise of the privileges of that certificate to a balloon with an airborne heater; and
(2) The limitation may be removed when the person obtains the required aeronautical experience in a gas balloon and receives a logbook endorsement from an authorized instructor who attests to the person's accomplishment of the required aeronautical experience and ability to satisfactorily operate a gas balloon.
(b) If a person who applies for a private pilot certificate with a balloon rating takes a practical test in a gas balloon:
(1) The pilot certificate will contain a limitation restricting the exercise of the privilege of that certificate to a gas balloon; and
(2) The limitation may be removed when the person obtains the required aeronautical experience in a balloon with an airborne heater and receives a logbook endorsement from an authorized instructor who attests to the person's accomplishment of the required aeronautical experience and ability to satisfactorily operate a balloon with an airborne heater.

Sec. 61.117 Private pilot privileges and limitations: Second in command of aircraft requiring more than one pilot.

Except as provided in Sec. 61.113 of this part, no private pilot may, for compensation or hire, act as second in command of an aircraft that is type certificated for more than one pilot, nor may that pilot act as second in command of such an aircraft that is carrying passengers, or property for compensation or hire.

Lesson 14 – Maintenance

Every hot air balloon is a federally registered aircraft and is regulated by the Federal Aviation Administration (FAA). The regulations concerning the repair and maintenance of a hot air balloon can be found in 14 CFR Part 43 of the Section 14 Code of Federal Regulations, Part 43. In addition to 14 CFR Part 43 each hot air balloon must be maintained in accordance with the "Instructions for Continued Airworthiness" manual. There are several small maintenance items that can be performed by the balloon owner or operator. These items may include replacing batteries in the instruments, cleaning and reconditioning the gondola burners, or envelope, and placing patches on the envelope to repair small holes. These items are considered preventive maintenance. Other repairs not considered preventive maintenance must be performed by an FAA authorized Repair Station. In addition to repairs, all hot air balloons are required to have periodic inspections called Annual Inspections or 100 Hour Inspections whichever comes first.

What is inspected as part of an Annual or 100 Hour Inspection?

During each inspection every component of the balloon is inspected for wear and/or damage that would affect the airworthiness of the balloon. The fabric is tested for strength, porosity and maximum temperature. Portions of the burners are required to be rebuilt at each inspection. Every part of the fuel system including tanks, hoses, and burners are tested for leaks and proper operation. The flight instruments (altimeter, variometer and pyrometer) are checked for accuracy and proper operation. In addition, the aircraft maintenance records are reviewed to insure that each applicable service bulletin and airworthiness directive has been complied with. Every detail of the inspection requirements can be found in the Airworthiness Instruction Manual.

Who can perform the required inspections and repairs on a hot air balloon?

In order for someone to perform an Annual or 100 Hour Inspection and approve the balloon for return to service, they must hold a FAA Repairman Certificate at a certified FAA Repair Station or hold an Inspection Authorization (IA) Certificate issued by the FAA.

To perform repairs, other than preventive maintenance, the person must hold a FAA Repairman Certificate at a certified FAA Repair Station or hold a Mechanic (A&P) Certificate issued by the FAA. Information concerning the requirement and limitations of these certificates can be found in the 14 CFR Part 65. In order for someone to perform repairs that can be considered as preventive maintenance and approve the balloon for return to service, a person must hold at least a private pilot certificate issued by the FAA. Additional information detailing the regulations for maintenance and preventive maintenance can be found in 14 CFR Part 43.

Lesson 15 – Airman Written Test

As part of the requirements for obtaining a balloon pilot certificate, Federal Aviation Regulations require applicants to pass a written test. The FAA publishes the questions for these written tests, but not the answers. The written test books are scheduled for revision every two years and are administered by written test examiners or the FAA.

Qualification to take the test is a statement by a qualified instructor that the applicant has completed a course of study and suitable identification. A simple calculator and sectional plotter is all the equipment needed for the test.

The applicant for a written test is given a selection of questions to be answered. Upon completion of the test the applicant will be given the results, which will list the test score and the subject matter knowledge codes referencing the subjects in whom the applicant is deficient. The original test score sheet must be presented at the time of the flight test or for retesting in the event of written test failure.

The applicant must review the subject areas in which he/she was deficient. A written endorsement from the instructor is needed at the time of the flight test stating that the applicant has satisfactory knowledge of the deficient subject areas. In addition, the applicant may be retested in those subject areas by the designated examiner.

The test may be retaken with an endorsement from an instructor who had given the applicant remedial instruction. Subsequent retesting requires a 30–day waiting period. To be eligible to take a flight test, the written test must have been passed within the prior 24 months.

Airman Practical Test

The culmination of a student pilot's training is taking the FAA check flight. This flight test is more precisely known as the Airman's Practical Test. A FAA designated fight examiner generally administers this test. It incorporates a concept of testing designed to insure that balloon pilots are competent in basic airmanship. The specific procedures and maneuvers used in each pilot operation are selected from the FAA practical test standards by the examiner. The examiner selects enough of these procedures and maneuvers to insure that the applicant is qualified in all pilot operations. The examiner does not inform the applicant in advance which procedures and maneuvers will be required, nor should the examiner allow the test to fall into a pattern recognized by instructors and students, as this will defeat the objective of the testing procedure. An applicant will be evaluated and scored solely on whether or not his performance meets the objectives and standards of the required flight test item.

The examiner will accompany the applicant in the balloon during the flight test; otherwise a letter from the FAA District Office is required to conduct the flight test by ground observation.

Once the flight test starts, the examiner may do one of three things. He may issue a temporary airman's certificate, a notice of disapproval of application, or a letter stating the test was discontinued and may be completed within sixty days. *I encountered this between the oral part the flying part of my test.*

The FAA developed the practical test standards as the test to be used by examiners. The FARs specifies the areas in which the applicant before the issuance of a pilot certificate must

demonstrate knowledge and skill. The examiner must stick to the provisions in the regulations and the practical test.

The *flight instructor* is responsible for training the student to the acceptable standards as outlined in each task. The *flight instructor* must certify that the applicant is able to perform safely as a private or commercial pilot and is competent to pass the required practical test for that certificate.

The examiner who conducts the test is responsible for determining that the applicant meets the standards outlined in each task.

The examiner meets this responsibility by asking the applicant the standards outlined in each task. For each task that involves knowledge only elements, the examiner will orally quiz the applicant on those elements. For each task that involves both knowledge and skill elements, the examiner will orally quiz the applicant regarding the knowledge element and ask the applicant to perform the skill element. The examiner will determine if the applicant's knowledge and skill meets the objective in all required tasks. Oral questioning may be used at any time during the practical test. The practical test standards are broken down into areas of operation. These are phases of flight arranged in a logical sequence. The examiner, however, may conduct a practical test in any sequence that results in a complete and efficient test. Under each task there is a reference to a publication as authority for its correct execution. Applicants should be familiar with all the reference material, which is listed at the end of this chapter.

The FAA requires that each practical test be conducted in strict compliance with the practical to test standards. The examiner must evaluate the applicant's knowledge and skill in sufficient depth to determine that the standards of performance listed for all tasks are met. The examiner may, for any valid reason, elect to evaluate certain tasks orally. Such tasks include those that do not conform to the operating limitations of the balloon or those that are impractical due to the current flight conditions.

Examiners place special emphasis on areas of operation, which are most critical to flight safety. Among these areas are correct balloon control and sound judgment in decision–making. Although these areas may not be shown under each task, they are essential to flight safety and will receive careful evaluation throughout the practical test. If these areas are shown in the objective, additional emphasis will be placed on them. The examiner will also emphasize collision avoidance, winds hear, rotors, and the use of a checklist.

Many accidents have occurred when the pilot's attention has been distracted during various phases of flight. Distractions that have been found to cause problems are:

- preoccupation with situations inside or outside the balloon,
- maneuvering to avoid another balloon,
- maneuvering to clear obstacles during takeoff,
- approaches or landings.

To strengthen this area of pilot training and evaluation, the examiner will provide realistic distractions through the practical test. Some examples of the distractions used by examiners are:

- simulating pilot light out;
- simulating radio tuning and communications;
- identifying a field suitable for emergency landing;
- identifying features or objects on the ground;

- reading the ambient temperature gauge;
- removing objects from tool pouch or map case;
- questioning by the examiner.

The ability of an applicant to perform the required task is based on:

- executing tasks within the balloon's performance capabilities and limitations;
- executing emergency procedures and maneuvers;
- piloting the balloon with smoothness and accuracy;
- exercising good judgment
- applying aeronautical knowledge and showing a mastery of the balloon with the practical test standards, with a successful outcome of a task never seriously in doubt.

If in the judgment of the examiner, the applicant does not meet the standards of performance of any task performed, the associated pilot operation has failed and, therefore, the practical test is failed. The examiner or applicant may discontinue the test at any time after the failure of a pilot operation makes the applicant ineligible for the certificate or rating sought. The test will be continued only with the consent of the applicant. If the test is discontinued, the applicant is entitled to credit for only those tasks satisfactorily performed.

However, during the retest and at the discretion of the examiner, any task may be reevaluated including those previously passed. The tolerances stated in the objective represent the minimum performance expected in good flying conditions. Consistently exceeding tolerances or failure to take prompt corrective action or intervention by the examiner to maintain safe flight is disqualifying.

The examiner is not an instructor during the flight test. He is an observer. He is the applicant's first passenger. Examiners are selected because of their instructing abilities, but this is not their role during the flight test. If the applicant understands this distinction, his prospects of earning his wings will be enhanced.

Lesson 16 – The FAA Designated Flight Examiner

The FAA Flight Standards District Offices (FSDOS) designate pilot examiners to test applicants for hot air balloon pilot certificates. These designees serve without pay from the FAA, but may charge reasonable fees to give private and commercial tests.

The FAA's objective is to provide testing service at convenient locations so applicants do not have to travel more than 50 miles. Pilot examiners are selected on recommendations of their peers. A flight examiner will be retained only as long as there is a need for the additional examiner.

To be selected as a balloon flight examiner you must have a good record as a pilot and flight instructor– hold a commercial pilot certificate; be actively engaged as a flight instructor; be 21 years of age–, have a written recommendation of a FAA inspector; and pass an oral or written pre–designation test. To be eligible as a commercial pilot examiner for free balloons; you must have been a commercial balloon pilot for one year with 200 hours as PIC and have given at least 50 hours of flight instruction in free balloons.

An examiner may conduct flight examinations only in the geographical boundaries of his or her district. The designation of examiner is renewable annually.

The *prerequisites* for renewal of the flight examiner designation are

- a finding that the continuation of the designation is justified to provide service to the public;
- satisfactory completion of a two day course given every other year by the district office (the examiner must have completed the four day initial examiner standardization course in Oklahoma City prior to attending the recurrent course);
- attendance at the annual meeting of designated examiners held by each FSDO, and
- an annual flight check of the examiner by the supervising FAA inspector.

A designated pilot examiner is authorized to accept applications and conduct flight tests; charge each applicant a reasonable fee for services; issue temporary pilot's certificates to applicants who pass the flight test; accept applications and issue student pilot certificates for which a fee may be charged.

A designated examiner may test one of his own students, provided another flight instructor has given the student at least one and one–half hours of flight instruction in a balloon and recommended the student for the test. If the examiner wants to continue as a flight instructor, this rule requires working closely with another instructor to sign each student off for the flight test.

It states in (14 CFR 61.47) that the examiner is not the PIC. The examiner is only an observer – the applicant's first passenger so–to–speak. Even if the examiner gives advice or takes over the burner or valve line in a situation where life or property is endangered, he does not become the PIC.

During the flight test, the examiner should not slip into the role of instructor. If the applicant cannot perform a task, he must fail the test. To learn a maneuver or correct a faulty procedure could take hours of flight instruction. For examiners to attempt remedial training at this time would defeat the purpose of the test. Studies show that it takes over ten times longer to correct a bad habit than it does to have learned the procedure correctly in the first place.

With the initiation of the Practical Test Standards (PTS), the FAA designated examiner is in a unique position to improve the quality of balloon flight instructors. Many applicants are not prepared to perform all the requirements of the PTS. At the option of the examiner, applicant and instructor a pre–test interview can be arranged. At this time the examiner can review the requirements with the applicant and the flight instructor. If the applicant has not been fully prepared, it will become quickly evident during this interview. The flight instructor will also become aware of his deficiencies concerning the PTS. Here the examiner can become the instructor. Each task can be reviewed to explain that the applicant must be prepared to show that knowledge and skill meet the objective of the task.

For example: the flight–planning task. Is your student prepared to draw a dead reckoning he on a current chart showing the proposed direction and distance using the forecast wind? Use the chart during the flight to verify the flight plan by use of landmarks? Identify the limitations of the airspace along the flight path? Know the minimum weather requirements at different altitudes along the flight path? Know how to alter direction to stay on the proposed flight path? If the applicant cannot do all of the above, he will fail the flight–planning task. This is only one of 27 tasks in the PTS for a private certificate.

The following are suggestions from designated flight examiners pointing out perennial problem areas.

- Many applications (FAA Form 8710–1) are submitted without complete information. It is the instructor's responsibility to assure that the application and pilot logbook are complete and accurate. This means that all required endorsements; solo and altitude information is entered in the student's logbook.
- Many flight checks are on calm mornings. It is difficult to evaluate pilot skills on a calm day. Does the student have the skill to make a windy inflation or landing?
- Have the correct number of properly trained ground crew. The applicant is to be observed giving briefings to the crew. The crew cannot lead the applicant. Have all the aircraft documents and equipment available. A current sectional and plotter are often not available.
- Balloon pilots generally know less about airspace, minimum visibility and altitude requirements than other pilots. The flight test requires the student not only to have rote knowledge of these subject areas but also to understand, apply and correlate the material.
- If this is your first student to be signed off for a flight test, ask the designated examiner about the test. Some examiners will go through the test with you and your student to see if the student is prepared to take the test.
- Many commercial/flight instructor applicants have had little or no instruction about the fundamentals of instruction, logbook endorsements, lesson plans or instruction techniques.
- The aircraft used for the flight test must be airworthy, i.e., in annual inspection, no damage, with aircraft documents and logbooks.

The instructor has the responsibility to see that the student brings the following to the test:

1. A completed application to take the test on Form 8710–1
2. Student pilot certificate or other pilot certificate
3. Pilot logbook with all instructor endorsements and flight requirements recorded
4. Airworthy balloon with all documents including aircraft log book
5. Original written test results
6. Personal identification with photo
7. Personal equipment (gloves, strikers, radios)
8. Plotter and current sectional chart
9. Examiner's fee
10. Equipment list with weight calculation
11. Knowledge of each task required by the Practical Test Standards

The designated flight examiners have the job of final inspector in the production of a new pilot. In the final analysis, they are the quality control system of ballooning.

Appendix A – Pilot Logbooks and Endorsements

Part 61 of the 14 Code of Federal Regulations (CFR) requires pilots to keep a reliable record of aeronautical training and experience. This record is to show the completion of the requirements for a new rating and recent flight experience. The logging of other flight time is not required by the 14 CFR but is highly recommended.

The instructor must see that the student obtains a suitable pilot logbook to record training activity. The instructor must also keep a record of ground and flight instruction for three years. This can be done in the instructor's pilot logbook, lesson plans or other written document.

Balloon instructors recommend the following examples for use when endorsing logbooks, which are used to provide written statements for airmen applying for written or practical tests, and when certifying accomplishment of requirements for pilot operating privileges. Each endorsement should include the date, instructor's signature and certificate number. A reference to the appropriate CFR is provided for each endorsement. For more information, see FAA Advisory Circular 61–65C Certification of Pilots and Flight Instructors and 14 CFR Part 61.

Student Pilot Endorsements

A. Endorsement for Pre–Solo Aeronautical Knowledge: 14 CFR §61.87(b)

Mr./Ms. _____ has satisfactorily completed a pre–solo written examination demonstrating knowledge of the portions of 14 CFR Parts 61 and 91 applicable to student pilots, and the flight characteristics and operational limitations for a _____ (Make and model aircraft).

B. Endorsement for Pre–Solo Flight 4 CFR §61.87(k)(1) through (9)

I have given Mr./Ms. _____ the flight instruction required by 14 CFR §61.87(k)(1) through (9) in a _____ (make and model aircraft).

C. Endorsement for SOLO (each additional 90 day period): 14 CFR §61.87(l)(2).

He/She has met the requirements of FAR §61 and is competent to make safe solo flights in a _____ (make and model aircraft).

NOTE: Normally a student balloon pilot does not need to carry a logbook due to the short distances flown; however, any student pilot must carry a logbook on all solo cross–country flights (25 nautical miles or more) as evidence of the required instructor endorsements. Other limitations may be included such as maximum wind/weather conditions, time of day, location or under instructor supervision only.

Private Pilot Endorsements

A. Endorsement foe Aeronautical Knowledge 14 CFR §61.'15(a)(1) and 61 105(b)

I certify that I have given Mr./Ms. _____ the ground instruction required by 14 CFR §61.105(b) (1) through (13).

NOTE: This endorsement is required for both the written and practical flight test. It is usually copied on a separate sheet of paper to be given to the FAA written test examiner by the student.

B. Endorsement for Flight Proficiency – 14 CFR §61.107(b)(8)

I certify that I have given Mr./Ms. _____ the flight instruction required by 14 CFR §61.107(b)(8)(i) through (viiii) and find him/her competent to perform each pilot operation safely as a private pilot.

C. Endorsement to Certify Completion of Prerequisites for a Practical Test: 14 CFR §61.39(a)(6)

I have given Mr./Ms. _____ flight instruction in preparation for a private hot air balloon pilot practical test within the preceding 60 days and find him/her competent to pass the test and to have satisfactory knowledge of the subject areas in which the applicant was shown to be deficient by his/her airman written test.

NOTE: The instructor's signature in the endorsement block on the reverse side of the FAA Form 8710–1, Airman Certificate and/or Rating Application, will be accepted in lieu of the above endorsement provided all appropriate 14 CFR Part 61 requirements are substantiated by reliable records. However, the above endorsement without instructor's signature in the endorsement block of FAA Form 8710–1 is not acceptable.

Commercial Pilot Endorsements

A. Endorsement for Aeronautical Knowledge 14 CFR §61.35(a)(1) and 61.125(b)

I certify that I have given Mr./Ms. _____ the ground instruction required by 14 CFR FAR §61.125(b)(1) through (16).

NOTE – This endorsement is required for both the written and practical flight test. It is usually copied on a separate sheet of paper to be given to the FAA written test examiner by the applicant.

B. Endorsement for Flight Proficiency 14 CFR §61.127(a)

I certify that I have given Mr./Ms. _____ the flight instruction required by 14 CFR §61.127(b)(8)(i) through (xi) and find him/her competent to perform each pilot operation as a commercial pilot.

C. Endorsement to Certify Completion or Prerequisites for a Practical Test: 14 CFR §61.39(a)(6)

I have given Mr./Ms. _____ flight instruction in preparation for a commercial hot air balloon pilot practical test within the preceding 60 days and find him/her competent to pass the test and to have satisfactory knowledge of the subject areas in which the applicant was shown to be deficient by his/her airman written test.

Note: The instructor's signature in the endorsement block on the reverse side of FAA Form 8710–1, Airman Certificate and/or Rating Application, will be accepted in lieu of the above endorsement provided all appropriate 14 CFR Part 61 requirements are substantiated by reliable records. However, the above endorsement without instructor's signature in the endorsement block of FAA Form 8710–1 is not acceptable.

Additional Endorsements

A. Endorsement for Completion of Flight Review 14 CFR §61.56

Mr./Ms. _____ holder of pilot certificate number _____ has satisfactorily completed the flight review required by 14 CFR §61.56 on _____ (date).

NOTE: No logbook entry reflecting unsatisfactory performance on a flight review is required.

B. Endorsement for Completion of Pilot Proficiency Award Program (WINGS) AC 61–91 F and 14 CFR §61.56.

Mr./Ms. _____ holder of pilot certificate number _____ has satisfactorily completed the training requirements outlined in Advisory Circular 61.91 H paragraph 7(d) for lighter–than–air aircraft.

Note: This endorsement will also qualify as a flight review per 14 CFR §61.56(e)

C. Endorsement for Retesting Within 30 Days of First Failure or a Written or Practical Test 14 CFR §61.49.

I have given Mr./Ms. _____ additional _____ (flight/ground) instruction and find him/her competent to pass the _____ (name of the written or practical test) test.

Note: The instructor may also complete the endorsement in the space provided at the bottom of the applicant's airman written test report in the case of a first failure on a written test. The instructor must sign the block provided for the instructor's endorsement on the reverse side of the FAA Form 8710–1 for each retake of a practical test. An applicant may retake either a written or practical test within 30 days of a first failure if he or she has received additional instruction and an instructor's endorsement. For subsequent failures of both practical and written tests, the applicant must wait until30 days after he/she failed the test before applying for retesting.

Appendix B – Crew Positions and Responsibilities

Inflation

Crew Chief

- Communications between pilot and crew
- Watches inflation–anticipates problems and instructs crew accordingly
- May work fan
- Puts top in–matches Velcro tabs by numbers, aligns Velcro tabs exactly

Crown Line Person(s)

- Always holds crow line–watches wind
- Holds balloon down when not completely cold inflated
- Controls roll of envelope
- Maneuvers crown lien to basket when told–stay behind basket after connecting crown line to basket

Throat Persons

- Holds mouth open during cold inflation
- Connects envelope to basket
- Pulls envelope out of envelope bag–pulls at load tape/seam junctions only

Fan Person

- Watches for pilot instructions on adjusting the fan speed
- Pulls fan away after pilot instructs fan be turned off

Chase

Crew Chief

- Directs launch site pack up
- Drives or assigns another person to drive
- Operates radio or assigns another person to operate radio
- Wind–communicates speed and direction

Navigator

- Assign by crew chief
- Follows balloon and reviews map as the chase progresses
- Operates the radio

Chase Crew (includes Crew Chief)

- Secures all equipment in truck
- Watches balloons progress
- Watches for flags, smoke, trees, and other wind indicators

Landing

Crew Chief

- Directs crew–sends crew to assist balloon landing
- Designates crewmember to get landowner's permission
- Directs pack up

Crew

- STAY BEHIND MOVING BASKET
- Weight on when instructed

- Do not weight–off until instructed UNLESS
    - Any part of you is under the basket when basket is not on ground
    - You are begin lifted off the ground by basket
- Clear area of damaging debris
- Pull crown line to bring balloon down when told
- Pack envelope
- Load basket and envelope on truck

CREW TIPS

Inflation

- Check launch field for foreign objects that could damage balloon.
- Handle envelope only by load tapes (Use gloves).
- Keep spectators (especially children) clear of inflator fan.
- No Smoking!
- Don't pretend to understand instructions, ask if you don't know.

Chase

- The driver drives! Others can watch the balloon
- Keep to main roads until landing and obey all traffic laws.
- Maintain visual contact with the balloon; keep radio talk to a minimum.

Launch

- Apply 'weight on' to the basket as balloon comes upright.
- Conduct final checklist; radio working, keys with driver, etc.
- Remove weight as directed by pilot; keep yourself and spectators clear downwind of the balloon.
- Load and secure all equipment.
- Police the area.

Landing

- Advise pilot of any hazards at indicated landing site (locked gate–5 fences, power–lines, livestock, etc.
- Obtain landing and recovery permission from the landowner.
- Assist pilot as necessary with drop–line or high wind landing.

Recovery

- Respect and protect landowner's property. Keep spectators out; do not cut fence or locks.
- Check landing site for foreign objects that could damage envelope before deflation.
- Repack envelope same way every *time.*
- Reload and secure all equipment and police the area.
- Thank the landowner.
- Save post–flight celebrations for appropriate locations (not private property).

Appendix C – Methods of Refueling Propane Tanks

By Tom Hamilton

With Bleed Valve and Pump

Most balloonists use this method of refueling. You go to the local propane dealer and utilize their pump the same way you would fill your vehicle with gasoline. The bleed valve on top of your propane tank is connected to a dip tube which extends into the tank. The end of the tube is at the 85% capacity level for the tank. When the liquid fuel reaches the end of the tube it spills out the bleed valve telling you that the tank has reached the recommended capacity.

1. Connect the hose from the fuel source to the main tank valve.
2. Turn on the pump.
3. Open the vapor bleed valve, the main tank valve and the fuel source valve. The tank will now begin to fill. Although the sequence of these three events can be modified from this example it is important to establish a consistent procedure. The sequence of events is revered for closing.
4. When the liquid propane begins to spurt from the bleed valve, close the fuel source, main tank valve, and the vapor bleed valve.
5. Turn off the pump.
6. If the fueling line has a bleed valve to discharge the fuel in the connector activate it at this time (newer pumps will automatically bleed when the pumping lever is released). If the system cannot be bleed slowly loosen the connection at the tank. The liquid propane in the line between the main tank valve and the fueling line valve will spurt out and vaporize. When the line is completely bled you may disconnect the fuel line and/or fueling adapter. **Warning:** Freeze burns are a hazard during this process so caution should be taken.

By Weight with Pump

Like the prior example you would go to your local propane dealer (or they could come to you with a truck). This time instead of opening the bleed valve and waiting for the liquid to spurt out you fill the tank to a specific weight. As described below the procedure is somewhat more complicated. Since all balloon propane tanks have bleed valves why worry about this method? At least one state, Florida, in the late 80's considered a rule that would require all tanks to be filled by weight. Florida had experienced some problems (not balloon related) where the dip tube, which is screwed in, has come out and fallen to the bottom of the tank. Without this measure the tank will become completely filled before liquid propane comes out of the bleed valve. Read *Overfilling Fires...* beginning on page 18. Likewise should you suspect that this has happened you can check the accuracy of the bleed valve by using this method to refuel.

1. Connect the hose from the fuel source to the main tank valve.
2. Place the tank on a scale.
3. Turn on the pump.
4. Open the main tank valve and the fuel source valve. The tank is now filling.
5. When the tank reaches its full weight, close the fuel source valve and the main tank valve.
6. Turn off the pump.
7. Carefully disconnect the fueling line from the tank/adapter as described above.

The full weight for any Department of Transportation (DOT) certified tank can be calculated from information displayed on the tank. The *water capacity* and *tare weight* (empty tank weight) will be displayed on the tank. Water capacity is the weight of water the tank holds if it is filled to the brim with water. This is displayed on the tank immediately after the letters *WC*. Tare weight is shown on the tank immediately after the letters *TW*.

To calculate the weight of the tank filled, multiply the water capacity by the specific gravity of propane (about .5 at 70 F). Then multiply by .85, since the tank should only be filled to that capacity. This will give you the amount, in pounds, of propane that the tank can safely hold. Add to this the tare weight and you have the total weight when the tank is full (For "10 gallon" vertical aluminum tanks; Full weight = (103.6 x .5 x .85) + 26.5 = 70.5 lbs.).

Bleed Valve and No Pump

This method is sometimes mistakenly called *gravity feed.* What is actually taking place is an equalization of pressure between two vessels. In this case our propane tank and the main fuel source. The method is used whenever a pump is not available such as a remote site or transferring propane from one cylinder to another.

1. Connect the tank to be filled with the fuel source.
2. Open the bleed valve of the tank to be filled, the main tank valve and the fuel source valve.
3. As soon as liquid propane starts to spurt from the bleed valve, close the fuel source, the main tank valve and the bleed valve.
4. Disconnect the fueling line as described above.

This method can be accomplished using either the bleed valve or by weight. Filling a tank by this method will be slow. It works best if the receiving tank's internal pressure can be reduced well below that of the source.

Whenever you are refueling ***always*** wear gloves.

Appendix D – False Lift

Accident Prevention Program
FAA P–8740–39
Balloon Safety Tips–False Lift, Shear, and Rotors

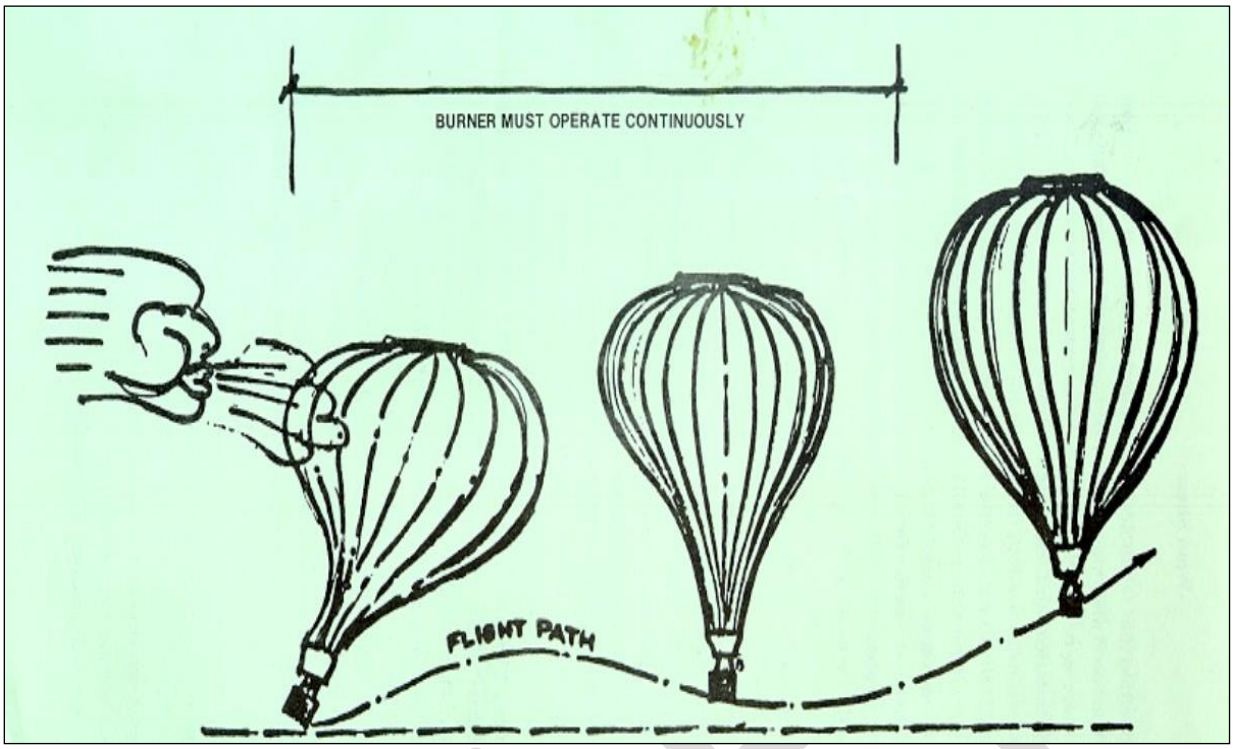
Balloons respond to various air currents to a greater degree than other aircraft. Except for momentary delays wherein inertia of the balloon mass resists the energy of a new air current, the flight path of a balloon in equilibrium exactly mirrors the direction and velocity of the air current in which it is operating. This simple fact of balloon operation holds true for horizontal (the kind we like to fly in), vertical, and rotary air currents (when Mother Nature flies). This article is about flying with Mother Nature and includes a few tips on what to do when Mother Nature's flying becomes too exciting.

False lift is an aerodynamic phenomenon, which occurs during the initial acceleration of the balloon. A balloon standing in the wind acts as an obstacle to normal airflow causing the wind speed to increase on the surface of the balloon. Changing the wind speed causes a pressure conversion to occur (static pressure decreases and velocity pressure increases) which results in false lift. During launch false lift couples with the balloon's normal lifting forces to cause the balloon to take off.

The problem with having false lift is that it quits when the balloon *reaches wind speed*. Ready or not, false lift dissipates rapidly after takeoff causing the pilot to apply heat constantly in order to gain real lift before acceleration is complete. In a practical sense, false lift does not pose any operating problems until the wind speed exceeds approximately 10 mph. False lift is unavoidable in a fast wind making takeoffs a challenge for the balloon pilot. Simultaneously, the pilot must watch burner operation, fabric, control the crew, assess the balloon's physical readiness for flight and judge the lift. The confusion of burner noise, passenger and crew demands, and the physical jolting caused by the gondola dragging across the ground can quickly overload an unprepared pilot. The pilot should carefully prepare, inspect and rig the balloon prior to inflation to minimize the tasks required during inflation and prior to takeoff. This procedure is necessary to insure that the balloon is safe in the event a takeoff occurs unexpectedly. The pilot must always assume false lift is present during takeoff that the envelope lift is inadequate, and continue heating until balloon acceleration is complete and a positive climb rate is established.

During takeoff and acceleration it is not possible to differentiate between real lift and false lift. The best policy is to heat past equilibrium temperature and then vent as necessary to maintain a comfortable rate of climb. False lift is easier to overcome when burner output is high; therefore fuel pressure is the best information available to judge the balloon's ability to overcome false lift. Small burners on big envelopes are obviously a poor choice of equipment for fast wind operation. Obviously the takeoff field is important in fast wind conditions. Obstructions downwind require additional clearance depending on wind speed due to the reduced initial climb rate of the balloon after losing the false lift.

Is a horizontal flow of air over the crown of the balloon, assisting in the lifting of the balloon system. Exactly the same effect that when the rounded back part of a spoon is held freely downward from the fingers, against the vertical flow of water from out of the kitchen sink tap, the spoon is pulled into that flow of water.... Try it with a spoon!



Launching With False Lift

Balloon is Distorted and at Low Volume False Lift is Maximum

Balloon has hot Bubble in Crown

Balloon is Fully Inflated

Balloon is Inhaling Cold Air

Equilibrium has Occurred

False Lift is Diminishing

False Lift is Zero

As the balloon reaches the Speed of the Surrounding Air the False Lift Completely Stops
This diagram copied from "Balloon Safety Tips FAA–P–8740–39"