



PICO-BALLOON

Launch Procedure

ABSTRACT

This procedure includes selecting a launch location and the best time to launch, adding the correct amount of lifting gas and sealing the balloon, preparing the launch location, and launching the balloon.

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Pico-Tracker

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Part 1 – Tools used:

Exacto Knife

Scissors

Postage Scale

Impulse Sealer

Balloon Regulator

Part 2 - List of materials:

Q-tips

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Acetone or Lacquer thinner

¼" Drinking Straw

Tyvek Tape

8lb braided fishing line

Contact adhesive

Assembled Pico-Tracker

Hydrogen or Helium Gas

Gas regulator

Part 3 – Selecting a Launch Location

The ideal launch location has a large, open area free of tall obstructions downwind of the launch site. Any tall structure upwind from the launch site can block the wind during launch. The launch surface needs to be at least 40 feet long, be paved, gravel, or sand, and free of anything that could snag the antenna wires, such as grass, weeds, or twigs. The lighter the wind at the time of launch, the less open area you will need downwind of the launch site. The balloon will rise at about 3-4 feet per second. In a 10mph wind, the balloon will move horizontally at 15 feet per second.

Part 4 - Launch Weather Requirements

Ideal launch conditions are sunny skies and winds less than 5mph. You can launch in stronger winds (5 to 10mph) if you have a large open area. Sunlight is needed to test the transmitter immediately before launch. The balloon can pass through thin clouds, but don't launch with large cumulus clouds or thick cloud cover. Condensation can form on the balloon and bring it down.

Part 5 – When to Launch

The best time to launch is early in the morning. The winds are usually lighter, and the sky is more likely to be clear. Check the weather and plan a launch window with favorable conditions. The balloon will take about four hours to reach full altitude. Launching early in the day gives you time to track your progress before daylight is lost.

Part 6 – Prepare Payload Simulation Weight

Start by weighing your payload on a postage scale. Then add 1.6 grams for the antenna wire and fishing line. Finally, add the free lift that you require. Greater free lift causes the balloon to ascend faster, but lowers your final float altitude. Higher free lift also increases the risk of bursting at float altitude. The maximum free lift depends on the balloon but is usually between 5 and 8 grams. Make

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a clip-on weight from binder clips by weighing different combinations of clips until you achieve the correct weight. Try to get within 0.2g of your desired weight.

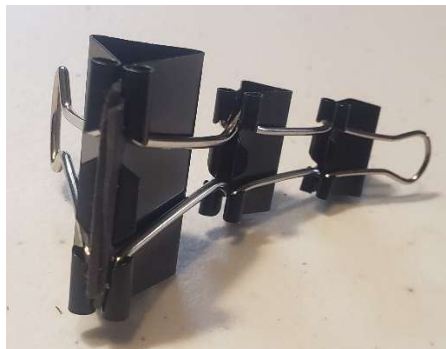


Figure 1. Assorted binder clips

Part 7 – Prepare Balloon for Lifting Gas

Clean any coatings from inside the balloon fill port using acetone or lacquer thinner and a Q-tip. This allows sealing the balloon after filling with lifting gas. Remove all air from the balloon by sucking it out using an aquarium pump.

Part 8 – Filling the Balloon

Slowly add 99% pure hydrogen or helium to the balloon using a balloon regulator for Helium or a low-pressure regulator and blow gun for hydrogen. If filling with hydrogen, you will need to adapt the fill tube used to stretch the balloon to your pressure regulator using a leak-free blow gun. If not using a balloon regulator, vent any air from the fill lines before inserting the line into the balloon.

Fill the balloon until the envelope begins to rise above the fill port. Once the balloon is vertical, begin checking for neutral buoyancy with the payload simulation weight. Do this by removing the fill tube from the balloon and clipping the weight to the fill stem. With the correct amount of gas, the balloon and simulation weight should hover or gradually rise or fall (less than 6 inches per second). Continue adding small volumes of gas until you reach neutral buoyancy. If you overfill, gas can be removed with a drinking straw or the fill tube by sucking or squeezing out the excess gas.



Figure 2. Payload simulation weights attached to balloon

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Part 9 – Sealing the Balloon

Once the balloon is filled with gas, the fill port is sealed using a two-step procedure. First, place a small amount of contact adhesive into the balloon fill stem using a straw. Do this by squeezing a small drop of glue into the inside of a ¼” drinking straw. The drop should only fill half the width of the straw. Make sure there is no glue on the outside of the straw, and insert the straw 2 inches into the balloon fill stem. Pinch the stem and straw just behind the glue, and while pinching the straw, pull the straw out. This will force the glue from the straw into the stem. By pressing the stem, squeeze the glue further into and across the opening to completely block any gas from escaping.

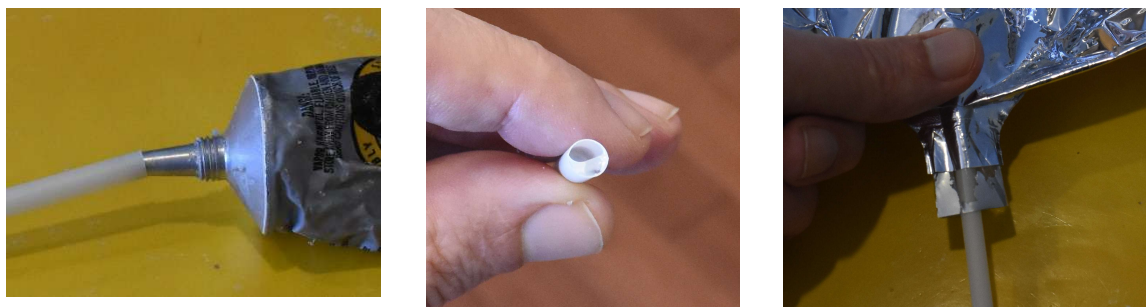


Figure 3. Sealing balloon stem with contact adhesive

Using an impulse sealer, seal the stem several times between the glue and the stem opening. Most impulse sealers work best at a setting of 5 or 6 or slightly above medium heat. Be sure not to seal over the balloon envelope. Only seal on the stem portion that protrudes from the envelope. For the best seal, hold the heat sealer arm in place for 10 seconds when sealing. Reattach the weight to the balloon and add some additional weight to keep it from floating. Keep the weight attached to the balloon until launch.



Figure 4. Sealing the balloon stem with an impulse sealer

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Part 10 – Attaching Balloon Tie Line

This step depends on the balloon type. For balloons with a string attachment hole, proceed to the next paragraph. For balloons without a string attachment tab, you will need to reinforce and extend the fill tab using a piece of Tyvek tape. Start by cutting a one-inch-wide two-inch strip of Tyvek tape. Next, fold over the end of the balloon fill port $\frac{1}{4}$ " from the end and apply the narrow end of the tape to the fill tab, covering the fold. Do not get any tape on the balloon envelope. Fold the tape at the midpoint and tape the other end to the other side of the fill stem. The folded tape should extend beyond the end of the fill stem by about $\frac{1}{2}$ ". Use the tip of a hot soldering iron to make a hole in the tape and the very end of the fill stem for attaching the payload line. This melts the hole and prevents any tearing.



Figure 5. Securing the balloon stem for use as an attachment point

Cut a three-foot piece of braided fishing line, tie it to the balloon attachment tab with a loop knot, and trim the tag end. Do not squeeze the knot tightly around the balloon material, or it will tear. We will also tape the line to the balloon to take pressure off the tie point. Once the line is tied to the balloon, feed the line from the tie point up the tab or stem toward the balloon and tape it to the tab or stem with a small piece of Tyvek tape as shown below. Then feed the remaining line back down the tab or stem and add a second piece of Tyvek tape over the line.



Figure 6. Attaching the balloon payload line

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Part 11 – Transporting the Balloon and Tracker

Wrap the balloon in a bed sheet to protect it and prevent it from flying away in the wind. Place the weighted balloon in the center of a sheet lying on the ground. Then fold the sheet over the balloon with the weighted end and attached fishing line facing the open end of the folded sheet. The fishing line should be accessible while the balloon is inside the sheet.



Figure 7. Prepare the balloon for transport

Transport the tracker and antennas inside a box or tub to prevent any damage or broken antenna wires.

Part 12 - Launch Area Preparation

Ensure that the launch pad is clear of any obstacles that the balloon antenna wires could get caught on. You will need to determine the wind direction for the correct tracker layout before launch and ensure that there are no tall obstacles downwind of the launch site. The clear downwind distance needed depends on the wind velocity at launch. In 10mph winds, the tracker will travel 15 feet downwind for every 3 feet of rise.

Part 13 – Launching

13.a Tracker Preparation and Layout

Place the box or tub containing the tracker 25 feet in from the upwind end of your launch area. Remove the tracker and the bottle with the antenna ground wire. Place the tracker with one solar panel facing directly at the sun and wait for the LED to flash. Now, remove the tape from the tracker end of the antenna wire and unspool the wire downwind of the tracker by rotating the bottle. When the wire is unspooled, remove the other piece of tape from the wire end. Next, unspool the balloon line and antenna wire from the other bottle and lay it out on the ground upwind of the tracker. Use tape to hold the loose end of the fishing line to the ground. Now, place the balloon inside the sheet at the end of the fishing line.

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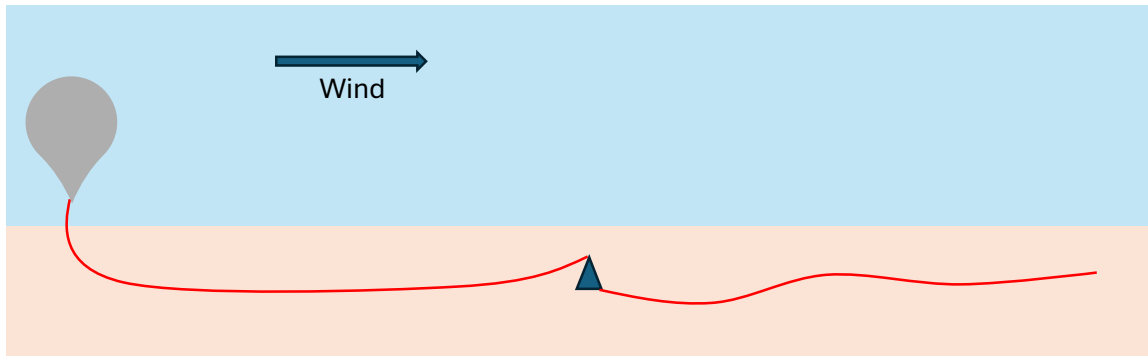


Figure 8. Balloon and tracker launch layout

13.b Attaching the Balloon

Leave the balloon inside the sheet but pull out the loose end of the fishing line to be attached to the tracker's line. Using a double uni-knot or similar, attach the two pieces of fishing line and trim the tag ends with scissors or an edge cutter. Make sure that the tracker is still upright and that there are no tangles in the balloon antenna wires. Verify the GPS antenna is straight and that the fishing line and antenna wire are not wrapped around the GPS antenna. Verify that the balloon line is not under the solar panels and extends straight from the tracker attachment point to the balloon.



Figure 9. Attaching balloon to the payload

13.c Verify Transmitter Operation

Using an HF receiver, wait for the tracker's 20m HF transmission at 14.0956MHz on the minutes ending in zero. If the transmission is a strong tone, the tracker is ready for launch.

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13.d Launching the Balloon

The key to a successful launch is to wait for the right conditions. Wind speed should be less than 10mph and preferably less than 5mph. Ensure that the balloon is upwind of the payload. Then remove the balloon from the bed sheet and remove the clip-on weight. Hold the balloon by the stem or tie tab and wait for a lull in the wind. When the wind is low, walk slowly toward the payload and let out the line, but keep holding on to the balloon line. The balloon should rise directly above as you release the line while walking toward the payload. When the payload is off the ground and at head height, and the balloon is directly above, release the balloon line. If the balloon is at an angle greater than 30 degrees from vertical, do not release. Pull the balloon back in and try again. Releasing at an angle of greater than 30 degrees will cause the payload to swing down and possibly strike the ground. Once it strikes the ground, it pulls the balloon down, and the payload will drag along the ground.



Figure 10. Launching the tracker. A. Remove the balloon from the sheet and remove the weights. B. Hold the balloon by the attachment point until the wind is low. C-E. Let the balloon rise as you walk toward the tracker. F. Release the line when the tracker is at head height. G. Liftoff!