

Purpose: CalVisitor

Flight Date: March 4, 2023

Launch Vehicle: High Bear Nation

NO FLY CONDITIONS:

- Parachutes packed too tightly that they will not come out
- Altimeters fail to beep correctly: check batteries and wiring
- Failure to have on hand all of the items listed above including but not limited to correctly sized parachutes, proper shock chord, altimeters, fresh batteries
- Weather conditions: high wind, rain, etc.

NOTE:

- **(RL)** - Must have Recovery Lead verify after completion of step.
 - **(SL)** - Must have Safety Lead verify after completion of step.
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MATERIALS:

- ☐ Main parachute tube
- ☐ Drogue parachute tube
- ☐ Avionics bay
- ☐ 2 Perfectflite Stratologger CF Altimeters
- ☐ Wires (preferably more than 20 ft total)
- ☐ 4 small screws for altimeter mounting
- ☐ 4 nuts for altimeter mounting
- ☐ 2 9-volt batteries (new)
- ☐ 1 old 9-volt battery for ground ejection test
- ☐ Shock cord for appropriate parachutes
- ☐ 144" main chute
- ☐ 48" drogue chute
- ☐ 2 Parachute bags
- ☐ 5 MJG Firewire initiators (e-matches)
- ☐ Black powder (2-3g for each parachute deployment) and black powder vials x6
- ☐ Masking tape
- ☐ Small screwdriver for altimeter mounting
- ☐ Electrical screwdriver
- ☐ Electrical Tape
- ☐ Allen key
- ☐ Scale for black powder or appropriately sized vials

❑ Alligator Wires for ground test

GROUND TEST

1. Accept main parachute tube, avionics bay, drogue chute tube, and booster from Airframe
2. Obtain 4 long lengths of wire (around 3 ft in length). 2 red and 2 black
3. Feed 1 red and 1 black through the hole in the main side coupler and through the corresponding bulkhead into the main parachute section.
4. Carefully tape the ends of the wires to the outside of the airframe ensuring they do not touch
5. Prepare two black powder charges with the appropriate amount of black powder (2.0g for drogue and 3g for main).
 - 5.1. Move away from the main rocket location and move all unnecessary personnel away from the area.
 - 5.2. Ensure all necessary personnel have the appropriate PPE: face shields required.
 - 5.3. Pour black powder into the appropriately sized vials.
 - 5.4. Insert one end of the e-matches (ends should be stripped) into the vial. While doing this ensure that the leads on the other end is fully separated and not touching.
 - 5.5. Carefully add silicone sealant to the top of the vial until full ensuring that no black powder can leak out
 - 5.6. Close the vial and clean off extra sealant.
6. Carefully attach the end of an ematch to the end of the 3ft wire (through terminal blocks) that is in the drogue parachute tube.
7. Feed 1 red and 1 black wire through the hole in the drogue side coupler ensuring they do not touch.
8. Carefully tape the ends of the wires to the outside of the airframe.
9. Slides the 2 alignment rods from top bulkhead, and put the bottom bulkhead on with the 2 rods going through the alignment rod holes.
10. Screw 2 wing nuts on alignment rods and 5 #6-32 screws on bottom bulkheads small holes.
11. Feed the 3ft wires through the wiring holes on the bottom bulkhead and secure them in a terminal block.
12. Carefully attach the end of a second ematch to the end of the 3ft wire (through terminal blocks) that is in the main tube.
13. Parachute deployment system assembly:

NOTES: Main parachute has 144 inch diameter
 Drogue parachute has 48 inch diameter

 - 13.1. Verify that bulkheads are airtight by looking for cracks of light/air/silicone
 - 13.2. Pack the main parachute into a parachute bag (olive green) such that none of the shroud lines are tangled or exposed and the parachute can be easily pulled out.

- 13.3. Fold the drogue parachute neatly and pack into a parachute bag (olive green) such that none of the shroud lines are tangled or exposed and the parachute can be easily pulled out.
- 13.4. Attach the main parachute to the quicklink in the middle of the shorter shock cord (32 ft).
- 13.5. Attach either end of the 32 ft shock cord to main chute tube and av-bay ubolts with the parachute located closer to the av-bay section. Make sure the shock cord runs through the main parachute tube.
- 13.6. Attach the long strap at the end of the parachute bag to the quicklink located on the avionics bay side.
- 13.7. Attach the drogue chute to the quicklink in the middle of the longer shock cord (54 ft).
- 13.8. Attach either end of the 54ft shock cord to the payload tube and av-bay ubolts with the parachute located closer to the avionics bay. Make sure the shock cord runs through the drogue tube.
- 13.9. Fold Parachutes: **See Appendix A**
- 13.10. Visually inspect the parachutes and shroud lines are protected from the black powder explosion.
14. **(RL)** Obtain all lengths of the rocket and assemble them for ground test.
15. Send someone to get Jenya (mentor) to verify the ground test.
16. Bring safety goggles, 9V battery (can be used), and extra wire (at least two 3 ft lengths or so).
17. Move assembled rocket to a secure area, and ask everyone to steer clear, especially from the path of direct line (in line with the rocket) of fire.
 - 17.1. Send one representative (typically lead/deputy) with correct PPE (personal protective equipment eg. safety goggles) with the 9V battery.
 - 17.2. Untape the leads one at a time, and if necessary, tie extra wire extensions to ensure the person is standing far away enough from the launch vehicle. Make sure the tips of the wire extensions also do not touch each other.
 - 17.3. Once ready, ask for verbal confirmation from the mentor and rest of the team that everything is a go.
 - 17.4. To initiate drogue deployment sequence, touch the end of one wire to one of the leads, and countdown... 3, 2, 1, touch the end of the other wire to the other lead of the battery.
 - 17.5. If successful, there should be separation of the three sections of the launch vehicle. Prepare the rocket for launch by following the entire checklist again from top to bottom. Make sure to remove the used vials and ematches.
 - 17.6. If unsuccessful, repeat entire checklist and troubleshoot.

MAIN FLIGHT PREPARATION

ASSEMBLY OF AVIONICS BAY

18. Unscrew wing nuts from bottom bulkhead and remove the av-bay axially. Keep the wing nuts in a secure location.
19. Ensure that both batteries are completely fresh. If not, replace them with two fresh 9-V batteries.
20. Screw batteries into the battery holders
21. Verify that both Perfectflite Stratologger CF altimeters are secured onto the av-bay with four 2-56 screws and nuts together.
22. Verify that both 9V batteries are secured in the appropriate battery holders, and confirm that they are secured onto the av-bay.
23. Connect appropriate wires to altimeters. Connect the battery leads to batteries. After connecting, VERIFY that they are the correct wires by checking that the ports correspond to the tape labels.
24. **(RL)** Tug on every wire to ensure that they are all securely fastened.
25. Crimp appropriate crimps onto the leads that go to the black powder carefully ensuring two ends do not touch until ready.
26. **(RL)** Check wire connector connectivity (crimps) by pulling to see if it is easy to disconnect.
27. **(RL)** Check altimeters for functionality: (be careful not to move av-bay around!)
 - 27.1. Check main parachute altitude on both by listening for the corresponding beeps (1000 ft and 800ft).
 - 27.2. Check drogue delays (1 second) on both using the data cable located in the ziploc bag and a laptop.
 - 27.3. For both of the StratologgerCFs, switch it on. Numbers are read off through the beeps on the altimeter (1 long beep to signal a number, pause, then it will beep out each digit, 10 beeps represent 0)
 - 27.3.1. Wait for it to sound off the 1-digit preset (should be the number 4)
 - 27.3.2. 2 second pause
 - 27.3.3. Ensure the 3-digit number representing the main parachute deployment altitude is 1000 ft on altimeter 1 (top switch) and 800 ft on the altimeter 2 (bottom switch).
 - 27.3.4. 2 second pause
 - 27.3.5. Listen for the previous flight's altitude readout (eg. 2 beeps, 3 beeps, 3 beeps, 6 beeps = 2336ft above ground level)
28. Slide the av-bay back into the coupler. Make sure that the switch wire is not tangled or bent.
29. **(RL)** Check switches to verify that they work and correspond to the correct on/off mode. Turn switch off afterwards.

30. **(RL)** Verify that the pressure port holes are present and have a clear passage (no burrs).
31. Secure av-bay to bulkhead with the wing nuts.

PARACHUTE DEPLOYMENT SYSTEM ASSEMBLY: (can be done in parallel to avionics bay assembly)

NOTES: Main parachute has 144 inch diameter
Drogue parachute has 48 inch diameter

32. Verify that bulkheads are airtight by looking for cracks of light/air/silicone
33. Pack the main parachute into a parachute bag (olive green) such that none of the shroud lines are tangled or exposed and the parachute can be easily pulled out.
34. Fold the drogue parachute neatly and wrap it in a nomex blanket (bright orange).
35. Attach main parachute to the quicklink in the middle of the shorter shock cord (32 ft).
36. Attach either end of the 32 ft shock cord to main chute tube and av-bay ubolts with the parachute located closer to the av-bay section. Make sure the shock cord runs through the main parachute tube.
37. Attach the long strap at the end of the parachute bag to the quicklink located on the avionics bay side.
38. Attach the drogue chute to the quicklink in the middle of the longer shock cord (54 ft).
39. Attach either end of the 54 ft shock cord to the payload and av-bay ubolts with the parachute located closer to the avionics bay. Make sure the shock cord runs through the drogue tube.

Fold Parachutes:

1. Main Chute: Starts at folded in half in front of you
2. Fold in left and right 1/4 parts towards the center
3. Fold in shroud lines neatly
4. Repeat left and right folds to it desired size (based on parachute deployment bag)
5. Roll parachute up
6. Stuff gently into the parachute bag
7. Drogue Chute: Starts at folded in half in front of you
8. Fold in left and right 1/4 parts towards the center
9. Fold in shroud lines neatly
10. Repeat left and right folds to it desired size (based on parachute deployment bag)
11. Roll parachute up
12. Wrap carefully in orange parachute cloth

Fold shock cords

1. B2M: Take full length, and fold in half. Repeat until the bundle is in 10-12 in. loops, but still neat, tape for now, but will be REMOVED later

2. M2D: Neatly zig zagged into 10-12 in. loops and taped
 3. D2T: Neatly zig zagged into 10-12 in. loops and taped
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40. **(RL)** Turn altimeters to the OFF position. This **IS VERY IMPORTANT**. Verify altimeters are OFF, otherwise the e-match may unexpectedly explode.
 41. **(SL)** Connect two e-matches to two 2g black powder ejection charges for drogue deployment. Ensure they are safely secured into the black powder holder.
 - 41.1. Cut and strip the ends of the e-matches and crimp them to appropriate connectors to interface with crimps on the wires from the avionics bay.
 - 41.2. Check the crimp is secure by tugging on the wire and crimp.
 - 41.3. Use electrical tape to tape both black powder charges to the u-bolt ensuring they are close to the center of the rocket and not close to the outer airframe.
 42. **(SL)** Connect two e-matches to two 3g black powder ejection charges for main deployment. Ensure they are safely secured into the black powder holder, if present.
 - 42.1. Cut and strip the ends of the e-matches and crimp them to appropriate connectors to interface with crimps on the wires from the avionics bay.
 - 42.2. Check the crimp is secure by tugging on the wire and crimp.
 - 42.3. Use electrical tape to tape both black powder charges to the u-bolt ensuring they are close to the center of the rocket and not close to the outer airframe.
 43. Carefully push the deployment system into the parachute tube from the top.
 44. Visually inspect the parachutes and shroud lines are protected from the black powder explosion.
 45. **(RL)** Verify everything is prepped for ground test/launch.
 46. Hand main parachute tube, avionics bay, drogue chute tube, and booster to Airframe for integration

AT LAUNCH PAD

47. While altimeters are turned off, wait until the launch vehicle is vertically upright. Turn on one altimeter at a time using the rotary switch key (lead/deputy only).
 48. Listen for continuity (3 beeps consecutively repeated over and over) for both altimeters. **NOTE** if any of the altimeters don't work, you **MUST** stop and fix.
 49. If both altimeters demonstrate continuity, leave them on and pray for a good flight. Exit the premises.
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POST-LAUNCH

50. Send at least two recovery members **with the altimeter keys, wire cutters, and safety goggles** to retrieve the launch vehicle.
51. **(RL)** At Recovery Site
 - 51.1. Whomever reaches the launch vehicle first, tell everyone else that **2 members** from Recovery need to be there first to deactivate the altimeters.

- 51.2. Listen for beeps of each altimeter. If one is wailing, turn it off using the key switch unless told otherwise by the recovery lead. If beeps are distinguishable, leave one on and listen for altitude reading. The beeps correspond to each digit starting with the highest digit to lowest (see above).
- 51.3. Turn off all altimeters using key switches.
- 51.4. Take photos and videos of evidence.
- 51.5. Inspect the rocket for any remaining black powder charges. If any charge is intact, use wire cutters to cut the leads to the charge.
- 52. At Work Site
 - 52.1. Verify if any damage was done to any components. If so, note them down and take photos.

Appendix A:

APPENDIX A: PARACHUTE FOLDING

1. Ensure that the shroud lines are detangled before continuing. This may be easiest when the parachute is unfolded and catching wind so the lines are taut. Ask Jisoo or Cassie for help since they're the best at it.
2. Start with the parachute folded in half so that it's shaped like a sector of a circle sweeping $\sim 120^\circ$. Each gore (section) on the top half should be directly on top of a gore of opposite color so that each end of the sector has a seam running down it. For a parachute with 12 gores, exactly 6 should be visible.
3. Gently pull the center cord attached to the upper shroud lines so that the upper sound lines become relatively taut. If this is pulled too far, the parachute will start inverting, so be careful to not overdo this step.
4. Position yourself on one end of the circular sector and pull the second seam out from the edge seam towards the edge until it lays directly on the edge seam. The seam in between the two mentioned above will become the center of the fold being made, and as such you may need to reach in and smooth that seam out so it lies in the center of the fold.
5. Repeat the above step until the parachute is only one gore wide. For a parachute with 12 gores the above step will need to be completed a total of 5 times.
6. Fold the parachute along the long axis until it is roughly as wide as its parachute bag. It can also be folded again such that its cross-section becomes u-shaped after the following two steps to fit in the parachute bag better, see step 7.1.9.
7. Fold the top of the parachute down slightly less than the length of the bag, and continue folding down the parachute until reaching the base, making sure to alternate which direction it's folded (up and in to create a valley fold versus down and in to create a mountain fold, this is known as a z-fold when only two such folds are performed).
8. Carefully fold the shroud lines on top of the folded parachute by laying them back and forth along the length of the parachute, until the quick-link/eye at the bottom is laying above the base of the parachute.

9. Slide the folded parachute into its bag so that the top goes in first and base and quick-link/eye are visible at the mouth of the bag. If the parachute is too wide to fit inside the bag, it can be folded again so its cross-section becomes roughly u-shaped. This may also allow it to conform to the curvature of the bag a bit better.
10. Close and secure the flap on the parachute bag by pulling it through the elastic straps at the front of the bag.