Aurora: Zero Pressure Balloon Project

Project Managers:
Ethan Harstad and Alex Peters
Project Advisor: Matthew Nelson

Zero Pressure Balloon Project

- Enables longer mission duration
- According to EOSS
  - Very thin (7.5 micron) plastic that is filled with helium and vented to the atmosphere through the bottom.

Shape Considerations

First we decided what shape of balloon we should use for our mission. This was done using the fallowing criteria.

- Volume to surface area
- Difficulty of design
- Difficulty of build – must be simpler than previous attempts

Shape Considerations

- Natural Shape
  - Best volume to surface area
  - Difficult to design
  - Multiple gores of a more difficult shape
- Cylinder Shape
  - Good volume to surface area
  - Simple design using an online template
  - Multiple gores that needed to be overlapped individually to create the full balloon

Shape Consideration

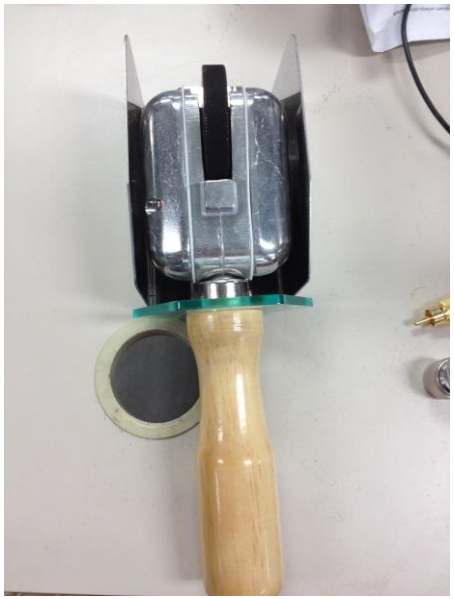
- Tetrahedral
  - Good volume to surface area
  - Simple design
  - Only required 4 seals for shape

Material for Making ZP Balloon

- Must be lightweight but strong enough to hold pressure and weight of payload
- Polyethylene Sheeting was found to be the material used by NASA and other institutions that use ZP balloons
    - Average thickness was 0.0008 inches thick
- The material finally decided on by the group was Painter's Plastic 0.31 mil thick.

Balloon Construction

- Started April 2013
- New heat sealer purchased
- The sides of the Tetrahedron are 41.5 ft long



Building the balloon

- The rectangular piece of plastic was cut into 1 trapezoid and 1 equilateral triangle.
- Each side of the equilateral triangle was sealed to the trapezoid creating the top then the remaining edge of the trapezoid was sealed
- The last step was to seal each edge of the tetrahedron together to spread the load of the payload along the balloon

Payload Considerations

When designing the payload we knew we wanted 3 things

- An altitude of 100,000 ft
- Tracking
- A way to tell if loss of altitude was due to balloon leaking or temperature change

Payload Contents

- AA Lithium Battery pack
- Open Tracker+
- Friendcomm radio (144.390 MHz)
- GPS puck
- Thermistor thermometer

The final payload weight came out to be 1.2 lb.

Calculating Shape and Volume

Iterative method was used to chose design volume

- Compute volume of balloon at float
- Compute surface area for given volume
- Compute mass of balloon and add to payload mass
- Repeat

Conclusion

- Tetrahedron balloons show promise as a simple balloon for long duration flights allowing for more testing of this platform at a much lower cost to our team than buying a premade balloon
- Much has been learned through testing and much is still to be learned.