Lessons Learned From Zero Pressure Balloon Construction

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Introduction

Zero pressure balloons are a low-pressure scientific balloon constructed in a way that makes level floats possible through autonomous gas ventilation and eliminates the necessity of an electronic vent to generate neutral buoyancy. The low pressure exerted on the balloon film and the relatively simple construction also allow for the ability to manufacture a balloon in-house

During the summer of 2022, five of the MSGC BORELAIS Interns constructed two zero pressure balloons to understand the value of building a vehicle to enable scientific ballooning

Construction Methods

The construction of a zero pressure balloon features:

- Multiple gores which are sealed together to form the body of the balloon.
- Before the sealing of the body of the balloon, the fill arm is attached to the upper half of the balloon body.
- “Buttons” on the top and bottom seal the open ends together.
- A vent hole is cut into the bottom, approximately 1.5 gores wide.

Process

Cutting gores for the balloon body required hand-cutting 14 gores out of 15 micron-thick plastic film.

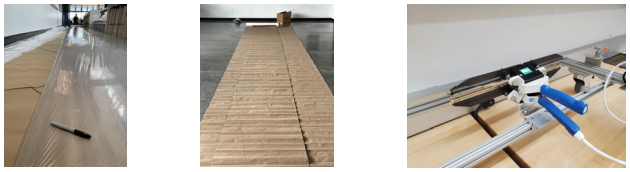

Figure 1: Balloon gores were hand-cut from a predetermined template before being sealed together

The joining of the gores utilized the melting of edges together to form seams using a seam sealer to press, heat, and melt the plastic.

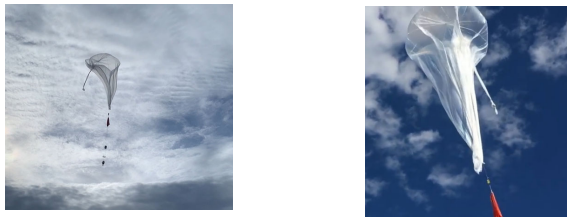

Figure 2: Zero-pressure balloons exhibiting the fill arm hanging off the side of the balloon

When sealing the fill-arm approximately two-thirds of the way to the top of the balloon body proved to be the most challenging process to create a quality balloon that would not leak lifting gas. A good seal was critical for the fill arm because it would hang off the balloon during flight carrying a backup tracker for the balloon.

Figure 3: Untangling a zero-pressure balloon to examine the failure points of the balloon along the seams. Featured are the fingertip stresses and the seam tears incurred during manufacturing and handling processes.

Lessons

Attention to Detail

- Finger stresses/tears from handling created a leakage risk
- Avoid burning holes in the film or failing to melt and seam the film

Responding to Failure and Feedback

- Learning from mistakes if/when balloon fails
- High work quality is not related to low labor hours

Personnel Delegation and Management

- Working with multiple people to follow strict quality control parameters

Conclusion

Due to the labor-intensive nature of constructing a zero-pressure balloon, constructing a balloon in-house does not present a cost and time-affective solution for making a balloon. However, the experience for interns to learn about resource management for the construction of a balloon, the importance of quality control, and the opportunity to teach new interns soft skills such as attention to detail, creative problem solving, and responding to failures makes the construction of a zero-pressure balloon a great opportunity for developing new intern‘s skills and is an effective scientific ballooning outreach activity.

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