Building a Vacuum Chamber for SPEX.

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Abstract

The purpose of creating a vacuum chamber for SPEX is to both teach future engineers how to build hardware for aerospace companies and to create a stepping stone for the eventual development of a cubesat.

Introduction

In early 2018, an engineering group for SPEX formed with the purpose of creating a vacuum chamber. The goal of this project was to be a stepping stone for the eventual development of a cubesat that the club can launch into orbit. However due to complications, the project was ultimately scrapped. But the goal is still what many in SPEX truly want, in order for that to happen our engineers must learn the ins and outs of spacecraft testing hardware.

When it comes to testing new hardware to face the vacuum of space, none can create a simulation of the vacuum of space better than a vacuum chamber. A vacuum chamber is a ridgid airtight enclosure where all are and other gases and removed from the chambers atmosphere creating a low pressure environment like seen in outer space. It is not only indispensable to any space agency public or private but the technology is very simple and easy to work with, provided that the engineers understand the key concepts on how a vacuum chamber works.

Primary Objective

The primary objective of the chamber is to help create hardware that would help in the development of a cubesat in the future. For this to work the chamber would have to fit a 10 x 10 x 10 cm cube, be at least partially visible when in operation and airtight.

Secondary Objective

The secondary objective of the chamber is to help engineering students understand the fundamentals of hardware used for testing in the aerospace industry.

Benefit to SPEX

In order to help SPEX (The space exploration club at RIT) in whatever endeavors it does in the future. I have decided to propose the idea of creating a project within SPEX dedicated to making a vacuum chamber. As someone who is a student in electromechanical engineering technology i feel like i am suitable for the task with experience in projects making physical machines.

Implication Deliverables

Milestones

This project will be expected to take around half a semester to complete. However this might be subject to change due to getting designs reviewed and accepted. canceling meetings will depend on how many people cannot make it to the meeting.

Week 1: Presenting the project to the club and assembling the team and schedule.

During week 1, it is important to get both new and old members of the club to not only get interested in the project, but also join to work on it as well. I could possibly be the team leader. But if one of the more experienced members of the club joins, I will let them take the lead but would still like to be part of leadership. The group is expected to be at least five people, if it is more people then tasks like solidworks designs and writing the report might be divided to just a few people within the group. The first thing to do here is to create a powerpoint explaining the whole project and what the group will have to do in order to complete it. After the presentation, the presenter will hand out pamphlets for more information and to allow the audience to think about joining the team for a few days.

Week 2: Researching and voting on the best possible DIY vacuum chamber design.

Once a sizable group is assembled, the team will look at the various tutorials on how to make a homemade vacuum chamber along with what modifications the group would like to make to the chamber and which ones would have enough space for a 10 x 10 x 10 cm cube. Once the group has seen all of the designs, they will then vote on a final design.

Week 3: Creating the final design and simulations for vacuum chamber.

Once a final idea has been approved, the group will then use solid works to create the vacuum chamber in order to create both edrawings and have simulations on what the vacuum chamber will do. Each member of the group will be responsible for different parts of the project. For example one person will create the box and lid, another person will model the vacuum pump itself while another person works on simulations. These works will also be used to show the public what SPEX does as a club.

Week 4: Gathering Materials

After working on the sketches and simulations, the group will then shop for the materials that they will need (more info on that down below). They will mainly get their materials either from home depot or from amazon.

Week 5: Assembling the chamber

Once all of the materials are assembled, the group will then assemble the vacuum chamber. This process will most likely take around a couple of hours.

Week 6: Testing the chamber and recording results

Once the vacuum chamber is finished, the group will then test out the chamber by running it though some experiments to see how effective the chamber is. The experiment itself will be very simple, with the chamber testing out marshmallows, balloons and shaving cream three times each. During these trials the group will measure how quickly the chamber causes change within its own atmosphere and how well it resists air being sucked in. Once the results are captured, the group will then measure the results.

Week 7: Creating results presentation

After finishing on the results themselves, the group will then organize their results into a report for future SPEX projects and a powerpoint. The group will be split in two for this but will work closely together in order to accomplish the goal.

Week 8: Presenting to class

After the powerpoint and the paper is complete, the group will them select a time in order to present chamber itself and their results to the whole class. Each person will be in charge of covering their own part of the powerpoint. Once the presentation is done the chamber will be donated to the SPEX club.

Externalities
Prerequisite skills

- Classes revolving around Mechanical Engineering/ tech.
- Experience in Packaging Science.
- Interest in working on Aerospace hardware.
- Experience in Autocad, mainly Solidworks.

Funding Requirements

- Asparagus pot: most likely $50
- Polycarbonate Or Acrylic Sheet: $15.98
- Silicone RTV Gasket Maker: $9.99
- 1X 2-1/2" Oil Filled Vacuum Gauge -OEM - 1/4" NPT - Lower Mount - -30 Hg to 0: $9.95
- 2X Female To Male Ball Valve 1/4" NPT: $17.2
- 1/4" NPT Female To Male Ball Valve: $9.98
- 2X Bulkhead 1/4" NPT: $17.99
- 1/4" NPT Bulkhead: $6.50
- 1X Branch Tee 1/4"NPT Female: $22.99
- Tee Fitting: $12.64
- Total: $163.23

The total cost may vary if the group finds some of these components that can be reused.

Faculty Support

The faculty support for the project is unknown at this time, but I am open to suggestions and people to turn too.

Long Term Vision

The long term vision for the project is to establish the hardware necessary to create a cubesat that can b sent into orbit.

Acknowledgments

As of right now, there are no acknowledgments.

Conclusion

The project is easy to complete even for a team consisting of nothing but first year students.Upon its completion it can help in the testing of any future projects relating to building the cubesat. During ImagineRIT it can be used as an attraction and promotion for the club. But most of all it will not only educate both engineers, scientists about how aerospace hardware works.

References

https://www.instructables.com/id/How-to-Make-a-Vacuum-Chamber/

https://www.youtube.com/watch?v=jFUBblZgXwU

https://www.youtube.com/watch?v=ERRMoHfrjAI