

Engineering Projects Portfolio

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Pneumatic Vent Valve



Skills Used

SolidWorks, GD&T, fluids systems design, stress analysis

Summary

This pneumatically-actuated valve was designed for the Waterloo Rocketry club to control venting of the flight oxidizer tank in our 2022 rocket. The valve is designed to control venting of nitrous oxide gas at pressures up to 1000 psi.

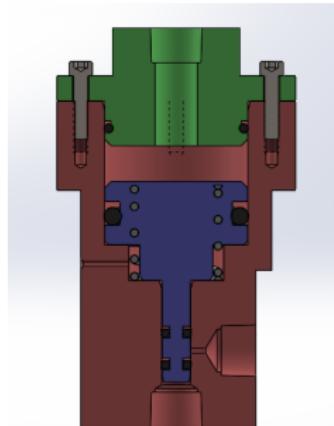
Testing

- Hydrostatic testing
- Water testing to validate cracking pressure for various air pressures
- Flow shutoff test with high-pressure CO₂
- Integrated testing during static fire and WDR

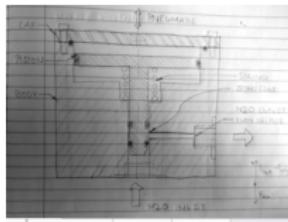
Pneumatic Vent Valve (cont.)

Design

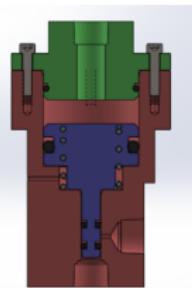
- Air piston bore sized using mechanical force balance
- Valve fails open using a spring if air pressure is lost.
- Elastomer seals on the piston cross side port to shut off flow
- All materials selected to be chemically-compatible with nitrous oxide.
- Pneumatic circuit designed to integrate with existing hardware in rocket.



Pneumatic Vent Valve - Complete project ownership



Name	A	B	Unit	Format
2	P_Air	100	psi	
3	P_Condenser	1000	psi	
4	P_dring friction	0.7488	lbf	
5	rod diameter	0.235	in	
6	safety factor	2		
7	stroke length	0.25	in	
8	area ratio	20		safety factor * P_c/P_a
9	rod face area	0.0434	in^2	pi * rod diameter
10	air face area	0.0074722715	in^2	area ratio * exido
11	piston diameter	1.050951949	in	2 * sqrt air face ar
12				
13				



Design

Fabrication & Assembly

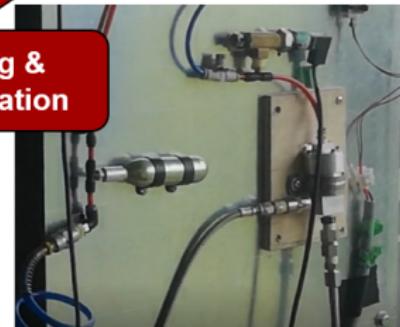


Fabrication & Assembly



Integration

Testing & Qualification



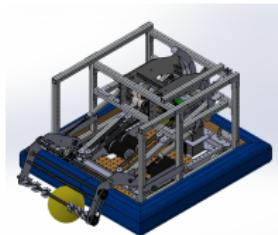
FRC 2020 Season Robot

Skills Used

SolidWorks, machining and hand tools, 3D printing, wiring and routing

Summary

This robot was to compete in the 2020 FIRST Robotics Competition. I was responsible for detailed mechanical design based on the team's overall strategy for the year. I designed the majority of the mechanical, electrical, and pneumatic systems, and integrated these systems on the complete robot.

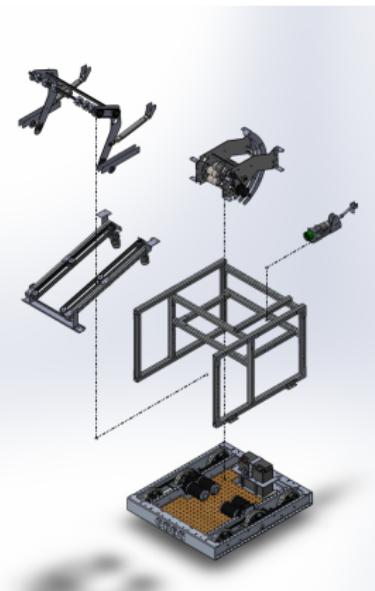


FRC 2020 Season Robot (cont.)

Mechanical Design

Since our team had limited resources and access time to our building space, the robot was designed with ease of assembly, cost, and modularity as main considerations.

- All mechanisms were designed to be mounted only on the superstructure frame, allowing the top and bottom halves of the robot to be assembled in parallel.
- 3D-printing was used to decrease cost, save time, and allow for rapid and continuous design improvements.



Webcast Telemetry OCR

Skills Used

Python, Tesseract OCR, Excel, Video Editing

Summary

After an anomaly led to early engine shutdown and loss of Rocket Lab's 13th mission, I wanted to see if the telemetry could lead to possible insights on its root cause. This project used Python and the Tesseract OCR library to get telemetry data from Rocket Lab's Flight 13 webcast. The following acceleration-time and altitude-downrange distance graphs were generated based off the telemetry data.



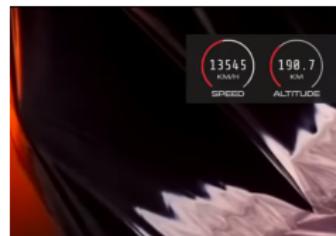
Webcast Telemetry OCR (cont.)

Methodology

Since Rocket Lab uses a unique font to display numbers on their webcast, I had to generate custom boxdata using the Monaco font, which approximated the font used in the webcast adequately.

I then processed the webcast to produce a cropped, high-contrast video for the Python program, which then processed the video and output the telemetry data.

The resulting speed, altitude, and time data sets were then processed in Excel to produce data sets for acceleration, downrange distance, and vertical velocity.



↓
13545
↓
190.7

speed	altitude	frame
13545	190.7	8676

Webcast Telemetry OCR (cont.)

