UCI ROCKET PROJECT SOLIDS: AIRCORE

ANH THU TRAN, JENNIFER TANG, KEVIN ANH THAI, KYLE THANH NGUYEN, OMAR KICHI, RYAN CHEN
ADVISOR: PROFESSOR MARK WALTER

UCI Samueli School of Engineering

Executive Summary:

The aim of the UCI AirCore Team is to design and create a payload that is able to sample air at different altitudes between sea level and 10,000 feet above sea level. The main objective of the AirCore system is to compare CH_4 concentrations of the air samples from varying altitudes. This is accomplished by using a CubeSat design with a sectioned coil storage system. The data collected will provide valuable information into the carbon profile and exchanges within the atmosphere.

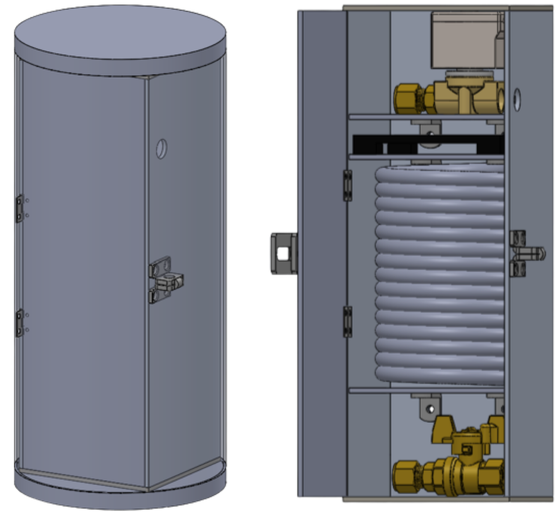
Objectives:

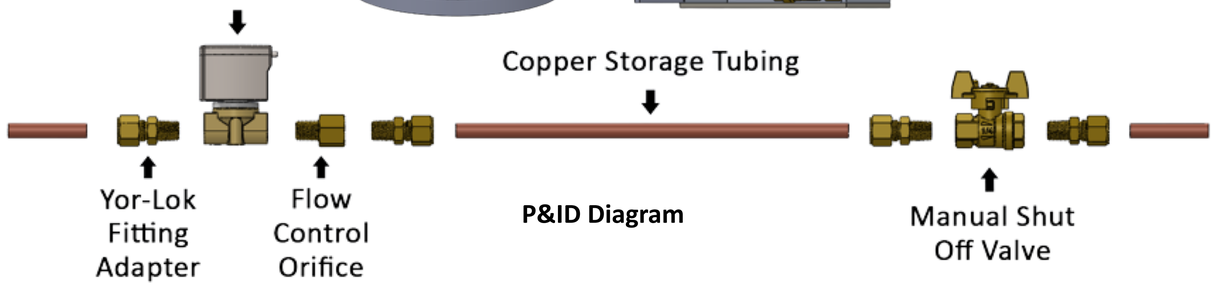
- A CubeStat-structure that houses all components of the system while protecting it from the forces experienced during flight and other environmental factors.
- An avionics subsystem aimed to collect flight data and control the valve conditions to fill air appropriately.
- A CH4 analyzing mechanism that is able to easily connect the AirCore tube and inject the sampled air to the commercial analyzer and yield a valid CH4 concentration readings

Major Requirements:

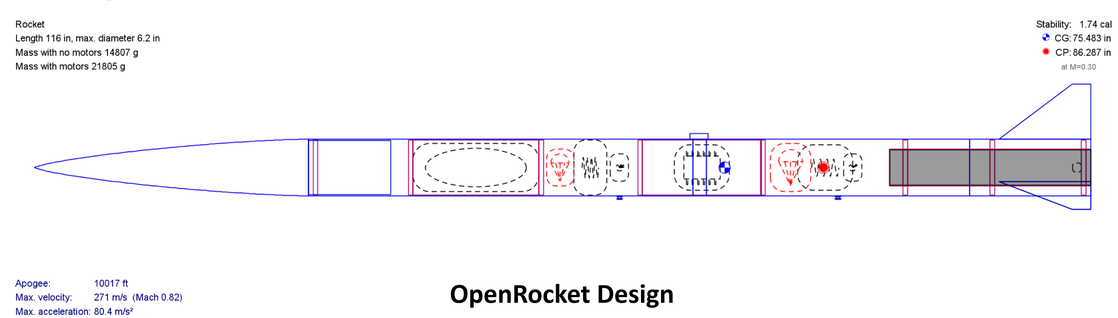
The AirCore must be at least 4 Kg
The AirCore must be a CubeSat Shape
The AirCore must at least be 3Us
The AirCore must contain 4 different samples
The AirCore must store 0.4 L of Air
The AirCore must test CH4 ppm
The AirCore must handle -4C to 47C

Final Design





P&ID Diagram



OpenRocket Design

Analysis:

Flow Rate based on Altitude:

Bernoulli's Equation: $Q = A \cdot (\sqrt{\frac{2(P_1 - P_2)}{\rho}})$

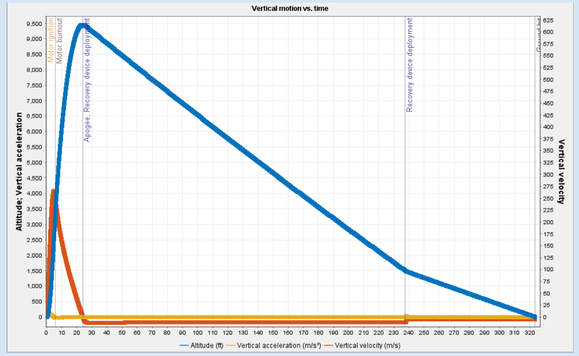
The Orifice Equation: $P_2 = U^2 \frac{\rho(1-\beta^4)}{2} - P_1$

-Inlet Velocity= 0.0397 m/s
-Inlet Flow Rate=0.09 L/s
-Time to fill one sample= 1.11 s

Air Sample Calculations:

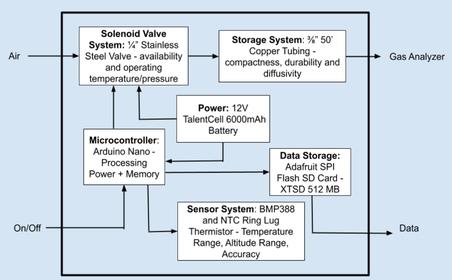
Volume Equation: $V = \pi(\frac{D}{2})^2 L$

-V = 35.325 in^3, 0.579 L



Key Features:

- Valve System
- Storage System
- Microcontroller
- Power System
- Data Storage System
- Sensor System



Shortcomings:

- Was able to only measure CH4 levels in the atmosphere
- Left out the other planned atmospheric measurements of CO2 and CO

Future Improvements:

- Develop real-time monitoring of air samples
- Provide a continuous vertical profile of atmospheric concentrations

Reference:

Karion, Anna, et al. "AirCore: An Innovative Atmospheric Sampling System." *Journal of Atmospheric and Oceanic Technology*, vol. 27, no. 11, 2010, pp. 1839–1853., https://doi.org/10.1175/2010jtecha1448.1.

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