

Outgas and Vacuum Storage Testing for MAV Hybrid Fuel Grain

Abstract

As a part of the Mars Ascent Vehicle mission, NASA MSFC has formulated a new hybrid fuel grain from a paraffin blend, named SP-7. As a part of the necessary preparation for the mission, this material must be tested for any outgassing behavior or other property changes due to vacuum exposure. This type of testing had not yet been conducted for this material. The goal of this project was to set up and begin automated analysis of this material, which would then run over the course of a year. To accomplish this goal, a few primary objectives were necessary- construction of a vacuum chamber to house the test, implementation of an automated gas analyzer system, preparation of SP-7 samples, and test initialization.

Methods

- Emphasis placed on the reusability of this chamber for future tests
- Additional switches/indicator lights and equipment space added for additional equipment in subsequent uses
- Many of the vacuum chamber parts salvaged from previous projects

Procedure

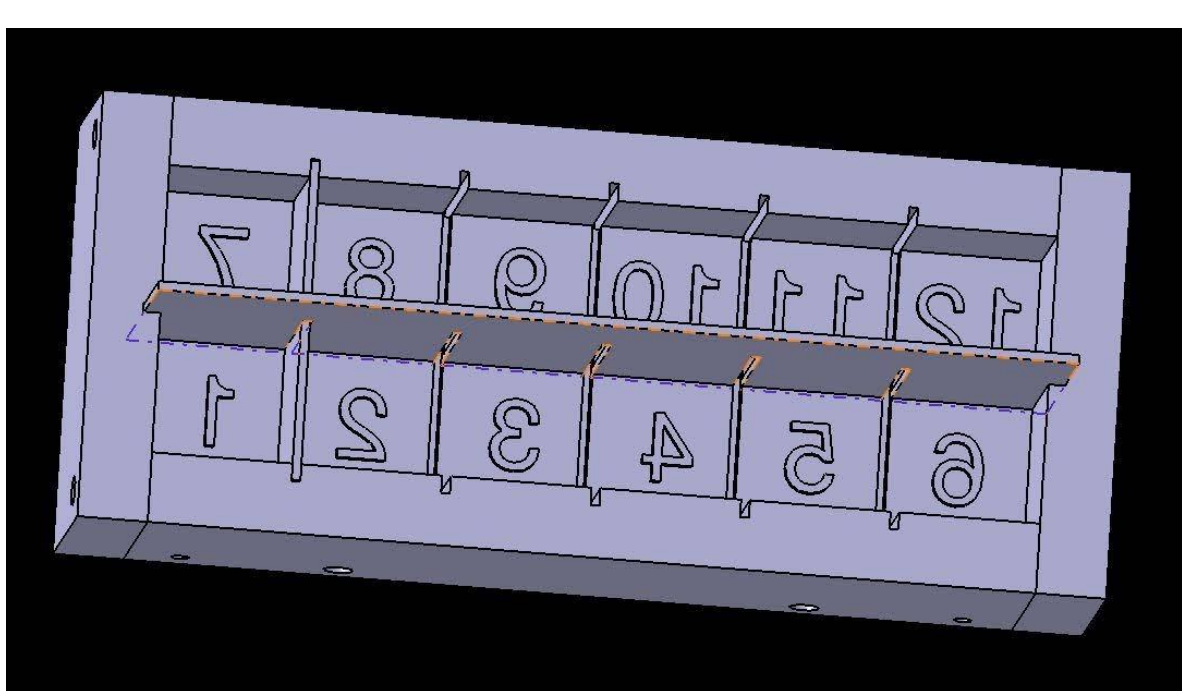
Chamber Preparation

- Construction of a vacuum chamber to house the test
- Removal of previous equipment and cleaning the chamber
- Locating and assembling necessary chamber parts (flanges, conflat, o-rings, etc)
- Hookup of necessary pumps (a roughing pump and a turbo pump)



Test Setup

- Soapy water leak check (determined that a new O-ring needed to be purchased)
- Creation of sample molds
- 60 samples poured (each about 1 cubic inch in volume)
- Setup of an automated gas analyzer system
- Calibration for the specifics of the chamber in use
- Setup of all necessary software for automated data retrieval
- Recording initial weights for the samples

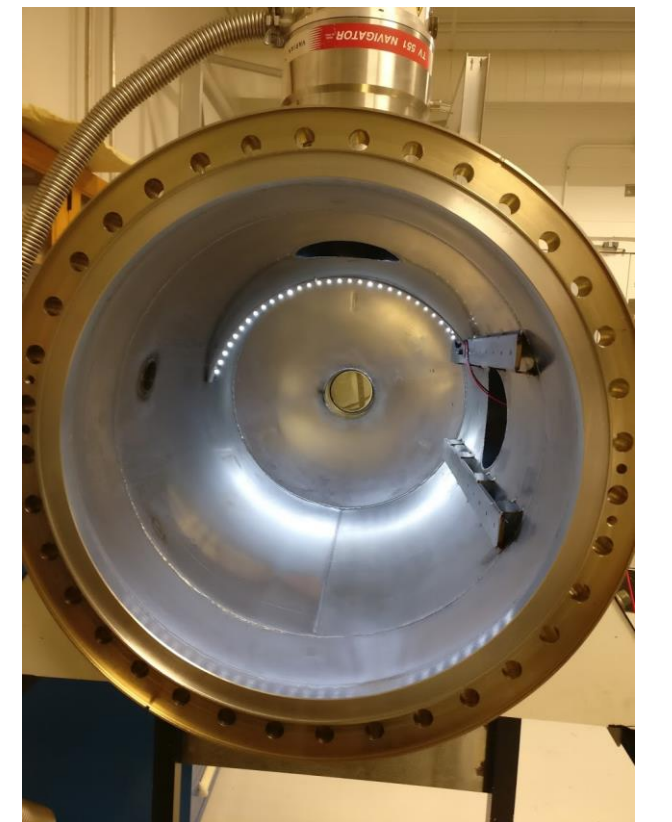
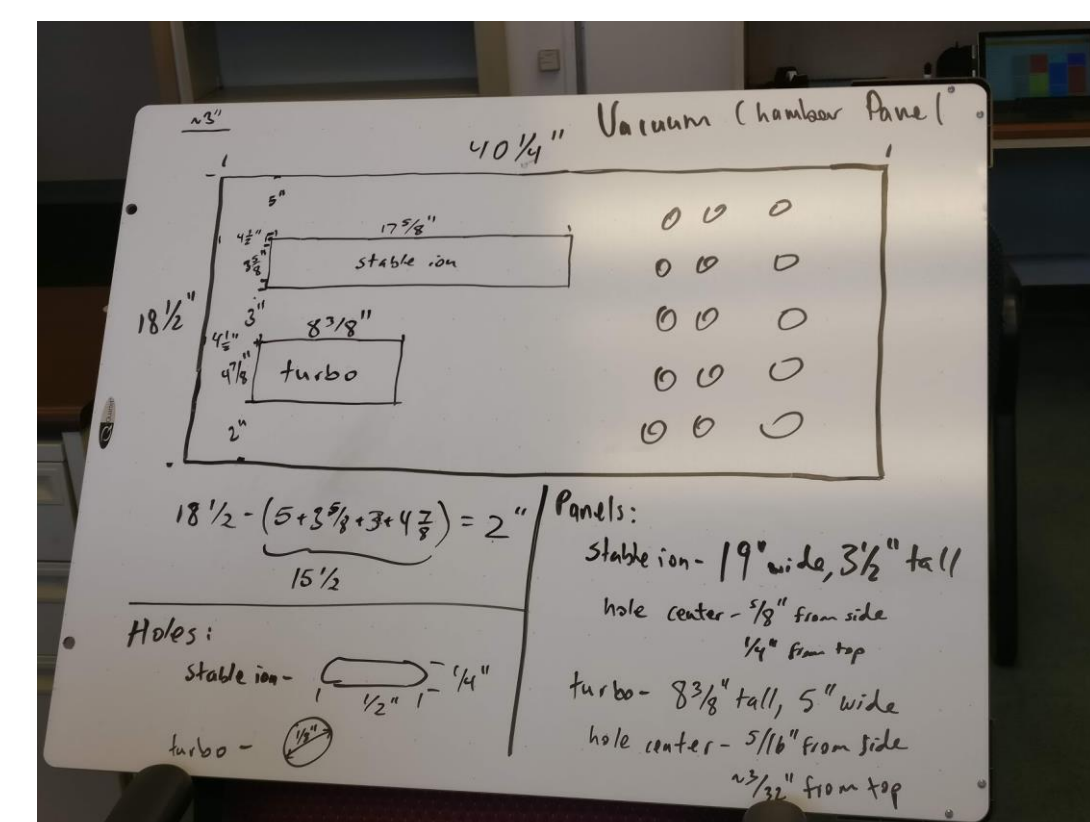


Future Work

- Data will be recorded over the course of a year
- Samples will be measured afterwards for change in weight
- Percentage weight change calculated and compared to standard (< 0.1% change required)

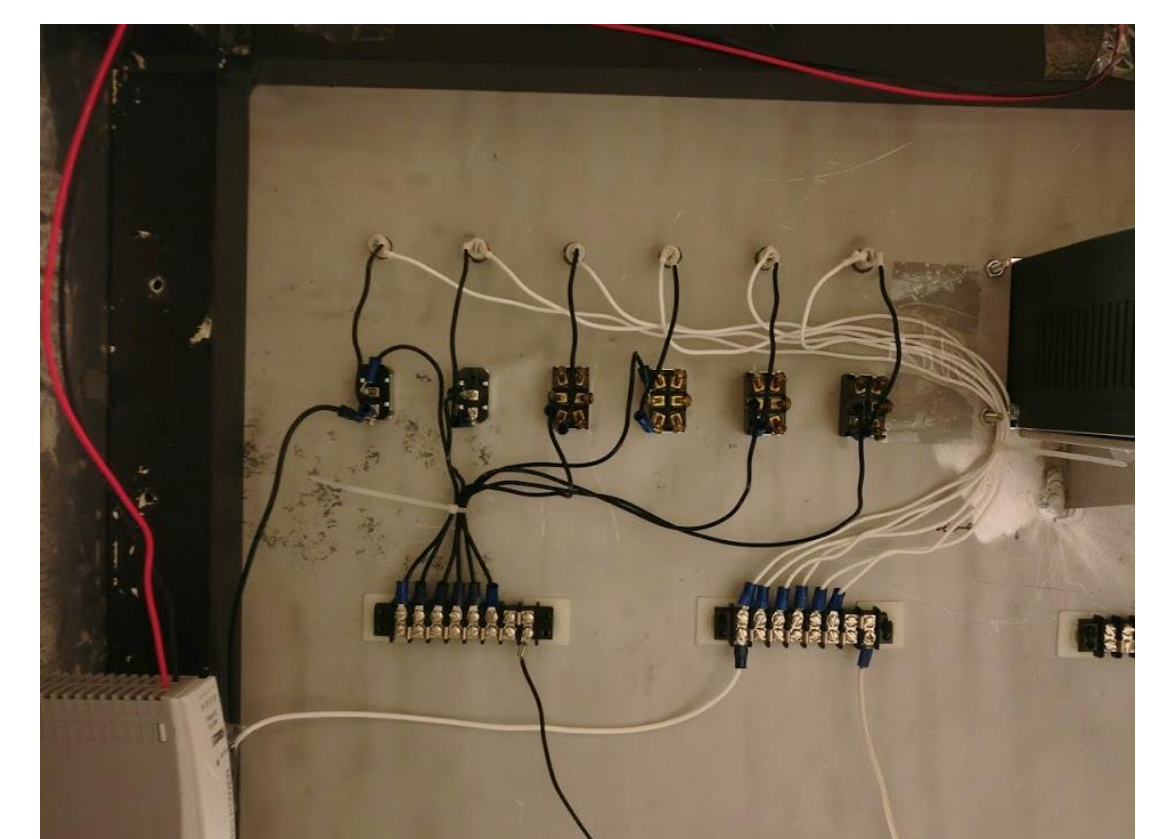
Background

- The goal of the Mars Ascent Vehicle project is to return samples from Mars back to the Earth to analyze. SP-7, a paraffin-based hybrid fuel grain, was developed as a fuel for the rocket that will put these samples in orbit of Mars.
- When in vacuum, materials can evaporate off of a surface- called outgassing.
- This material had not yet been tested to demonstrate that it does not outgas significantly.
- As a necessary criteria for flight, SP-7 must lose less than 0.1% mass while in a vacuum for a year.



Chamber Utilities

- All wiring for the various pieces of equipment, including an Uninterrupted Power Supply, Switches, and Controllers for pumps
- Construction of a shelving unit for the samples to rest on inside the chamber
- Design and construction of an intuitive control panel, cut from a water jet
- Design, assembly, and wiring for a chamber lights system



Test Initialization

- Test preparation and initialization
- Automated data retrieval
- Example mass spectrometry data from a previous experiment shown below

