CubeSat Inflatable Heat Shield

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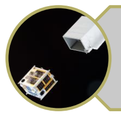
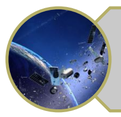
Project Overview

The goal of this project is to introduce re-entry technologies to CubeSats, which could provide a large number of opportunities for their mission capabilities.

Technology Applications



Returning Samples and Materials from ISS and Individual CubeSats

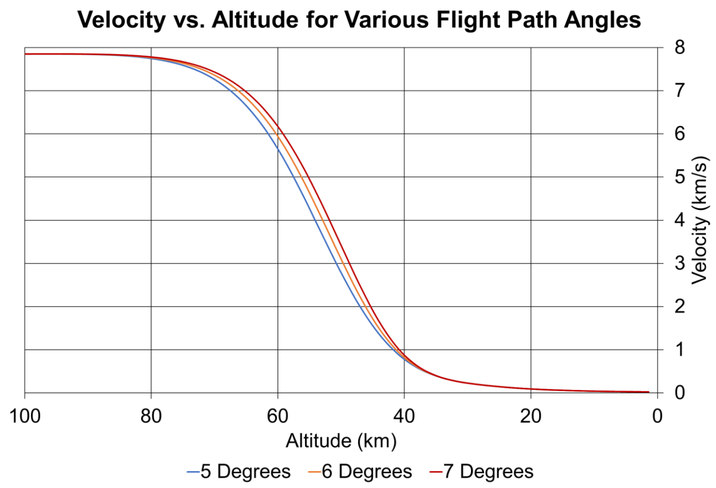


Reducing the Amount of Space Debris in Orbit

Interplanetary Exploration Missions

Re-Entry Condition Simulations

- Re-entry simulation parameters were set for a Low Earth Orbit re-entry of 102 km at 7.85 km/s.
- Flight path angles between 5 to 7 degrees were found to be the most optimal.

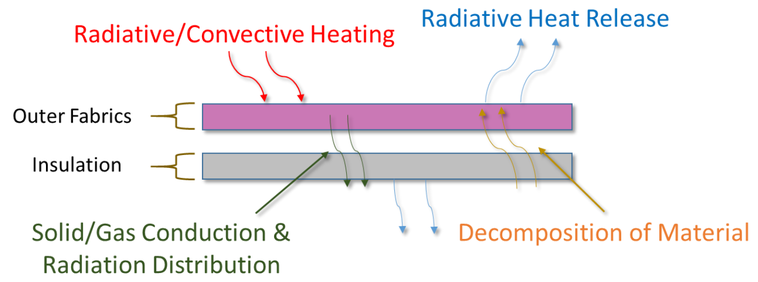


Inflatable Tubing

- Tubes consist of Kevlar-Kapton-Kevlar composite.
- Responsible for allowing the CubeSat to withstand the hypersonic aerodynamic forces experienced during re-entry.

Thermal Protection System

- Protects the CubeSat from high heat flux generated on re-entry.
- Outer fabrics acts against aerodynamic shear and extreme temperatures.
- Insulation manages the heat from the outer fabrics and keeps operational temperature behind it.

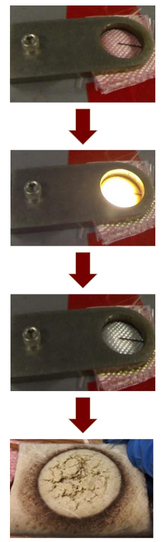


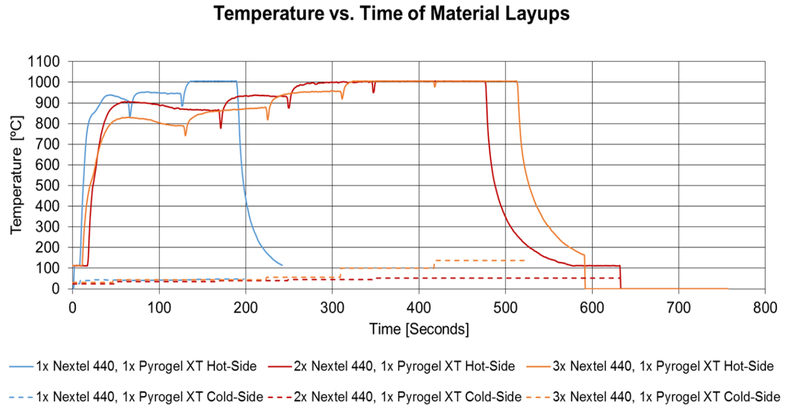
Deployment System

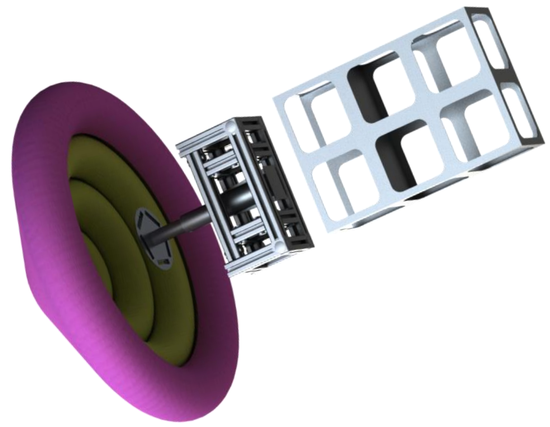
- The satellite's avionics sends a signal to deploy the heat shield prior to re-entry.
- A telescoping mechanism slides the heat shield out of the CubeSat using a nichrome burn wire.
- Tubes then inflate using a cool gas generator, and maintain constant pressure during the entire atmospheric descent.

Laser Heat Flux Testing

- Heat flux testing was conducted at the National Center for Hydrogen Research using a 2.2kW CO_2 laser.
- Layers of thermal protection material were subjected to different ranges of heat flux similar to re-entry conditions.
- Early results have shown the materials to be feasible for the heat shield's design.







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