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Reducing Hazards of Propulsive Secondary Payloads by Implementing a Post Launch Pressurization System

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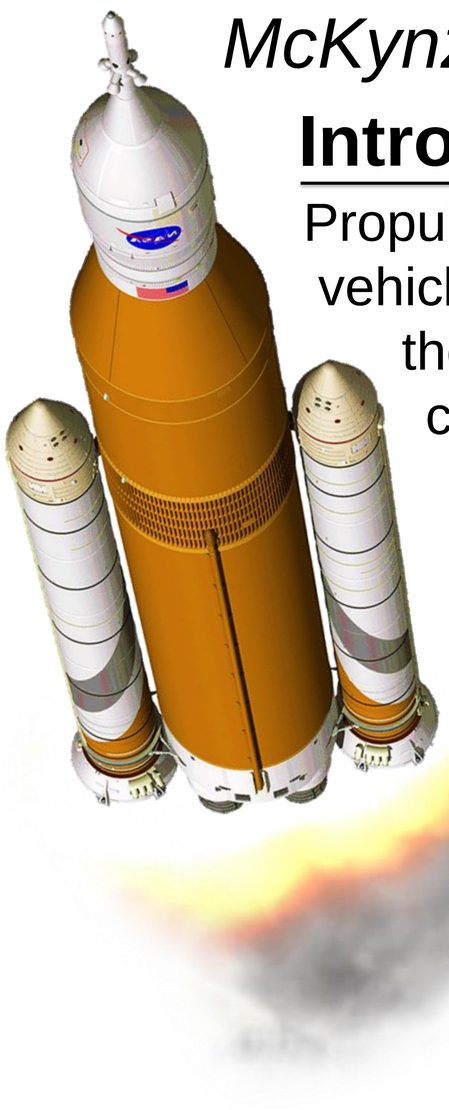
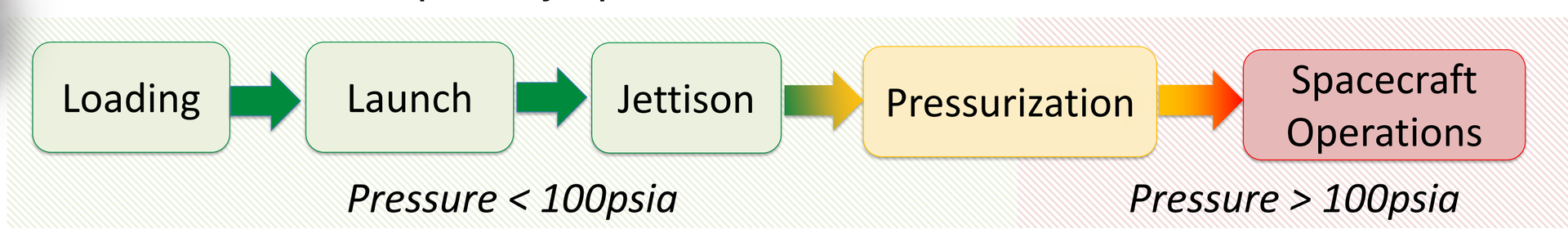


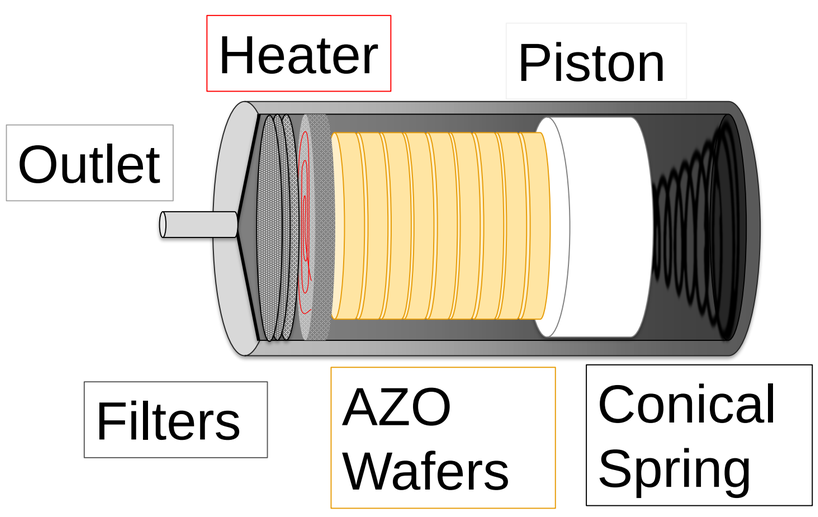
Introduction

Propulsion systems on SmallSats and CubeSats are becoming more common as launch vehicles begin providing rideshares to destinations outside of low earth orbit. Whil these spacecraft are a solution to achieve advanced science objectives at lower cost, they are often subjected to rigorous standards, such as NASA STD-5019, due to the high pressures within their propulsion systems at launch. A Post Launch Pressurization System allows a spacecraft to be launched at low pressure through the controlled decomposition of a solid reactant into gaseous products after the spacecraft has been jettisoned from the launch vehicle. This increases the safety of the secondary spacecraft, and effectively mitigates risks to the launch vehicle and primary spacecraft.



Design Concept

Azodicarbonamide (AZO), a chemical used in foam production and industrial bread making, decomposes at 200° C with a gas volume production of 215-230 mL/g. This makes it an ideal reactant in the system . Decomposition occurs by a spring pushing pressed AZO powder into a coiled wire heater.



Testing

Many aspects of the system have been characterized in the 3 previous phases of design maturation, including reaction and packing efficiencies. The goal of early testing during phase 4 is to qualify the mechanical design, which is unlike any previous designs. During open air decomposition testing, this system has rapidly created significant amounts of gas. Further testing will refine the piston mechanism and work to optimize reaction efficiency, restart capability, and packaging.

Impact

Post Launch Pressurization allows small spacecraft to implement a propulsion system while avoiding fracture critical designation, driving down cost and development time. This allows for greater access to low cost platforms to complex in-space research by student and research groups, and reduces risk to ridesharing primary spacecraft.

Acknowledgements

Daniel Cavender, mentor and PI; NASA Marshall Space Flight Center; and others who have contributed to previous design maturations of the system.

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