CO2 Ejection System

Overview

- Precision Machined Aluminum Powder Measure Vials
- Assembly Lube
- Two 23gm & Two 35gm CO2 ctgs
- Extra O-rings, Disassembly Punch, Puncture Piston Assembly & Return Single and Dual Charge Cups
- Precision Machined Aluminum Pyro E-match Potting Putty & O-ring seals to 85 grams. Comes with:
- Many CO2 cartridges ranging in size from 20 to 50 grams. Comes with:
- Precision Machined Aluminum Mounting Cap (With housing hardware)
- Single and Dual Charge Cylinders (With oxy
- E-mash Pasting/Plural Corp Ozing wets
- Pressure/Proof/Return Assembly
- Assembly Line
- Extra O-rings, Disassembly Punch, Cartoon Straps
- Powder Measure Vials
- Two Ultra & Two Ultrag CO2 capsules

Existing Solutions

The RAPTOR is another CO2 ejection system designed and manufactured by us. It is lightweight, compact and reliable. It is designed to be easy to use and works with many CO2 cartridges ranging in size from 20 to 50 grams. Comes with:
- Precision Machined Aluminum Mounting Cap (With housing hardware)
- Precision Machined Aluminum Pyro E-match
- Single and Dual Charge Cylinders (With oxy
- E-mash Pasting/Plural Corp Ozing wets
- Pressure/Proof/Return Assembly
- Assembly Line
- Extra O-rings, Disassembly Punch, Cartoon Straps
- Powder Measure Vials
- Two Ultra & Two Ultrag CO2 capsules

Design Decisions

- A rocket enters its recovery phase when it reaches apogee, the highest altitude it will achieve on its flight path.
- During the recovery state a mechanism in the ejection system is able to pop open the nose cone and deploy the chutes for a successful recovery of the rocket.
- Traditional ejection systems use black powder charges which have two potential risks:
  - Black powder experiences combustion issues at elevations exceeding 20,000 ft.
  - We designed an ejection system for UCI's liquid rocket project that uses compressed CO2 as the pressurizing agent.

Prototype

- Final Design
- Components:
  - Housing - Main body of ejection system. Encases the pin puncture system, has a female threaded port for CO2 cartridge, and vent holes. Mounts onto bulkhead.
  - Puncture Pin - Rod sharpened to a point on one end. Rod is actuated by black powder detonation to puncture the CO2 cartridge. Ozing - Seats pin and creates airtight seal.
  - Spring - Acts to return ejection system to firing position. Spring force at max compression: 23.72 lbf
  - E-mash - Ignites black powder to trigger actuation of ejection system.

Analysis & Performance

- Performance test was a success
- System Overview
  - Function of system verified
- Test proved that housing must be made of a stronger material

References & Acknowledgements

- UCI Rocket Project: Pressure Calculations

Final Design

Component Details

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  - E-mash - Ignites black powder to trigger actuation of ejection system.

Component Details

- Analytic Mass of Black Powder Required to Actuate System:
  - Two 23gm & Two 35gm CO2 ctgs
  - Pressure required for pin to overcome spring force:
  - Spring force at max compression: 23.72 lbf
  - Required black powder mass:
  - Pressure required for pin to overcome spring force:
  - Spring force at max compression: 23.72 lbf

Prototype

- Housing

Future Recommendations

- Current System
  - Create housing with a denser infill (20%) vs current prototype of 20% infill
  - Create housing out of metal, 41-6061 T6 is a great option
  - Explore different pin tip geometries for a larger puncture area which will increase mass flow of CO2
  - Explore different housing geometry to reduce material and weight while maintaining structural integrity

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  - Explore different pin tip geometries for a larger puncture area which will increase mass flow of CO2
  - Explore different housing geometry to reduce material and weight while maintaining structural integrity
  - Find viable solutions that are lighter and pin puncture happens more concentrically

References & Acknowledgements

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