NASA USLI Aerodynamics & Recovery

Engineering Expo 2020

06/05/2020

Project Objective

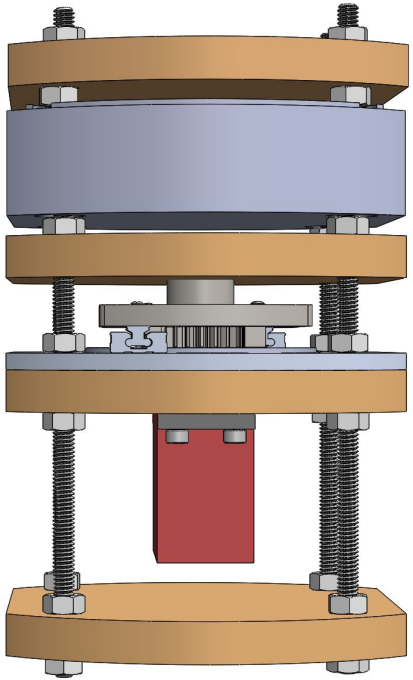
Outline: Achieve 4,000 ft altitude, safely* recover launch vehicle under USLI constraints.

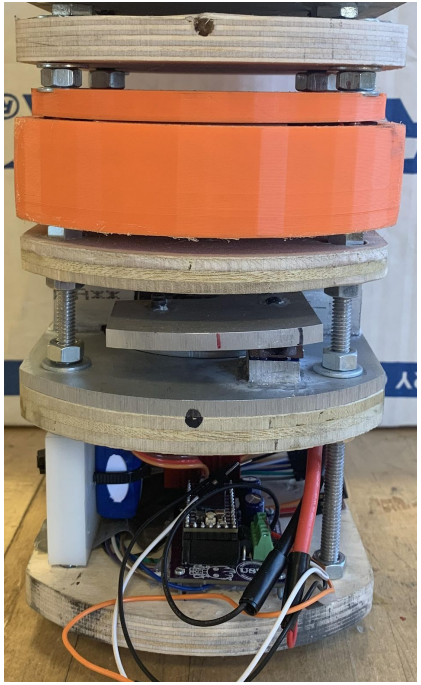
NASA USLI Handbook Recovery Constraints*

1. Landing Energy < 75 ft-lbf
2. Descent Time < 90 s
3. Drogue Deployment < 2s after apogee
4. Main Deployment ≥ 500 ft
5. Drift Radius < 2500 ft (up to 20 mph wind speeds)

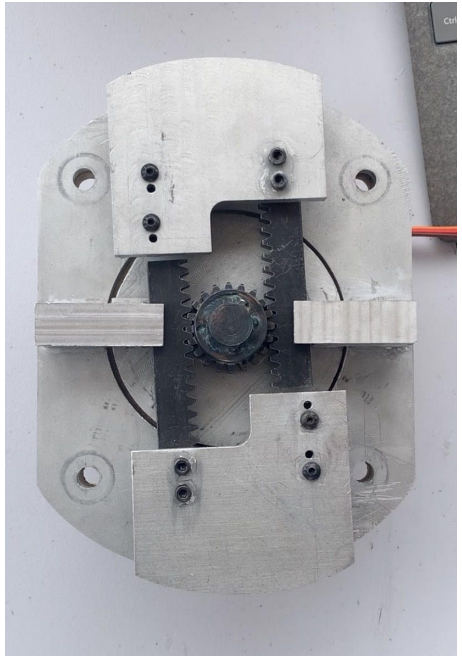
Blade Extending Apogee Variance System (B.E.A.V.S.) 2.0 Final Design

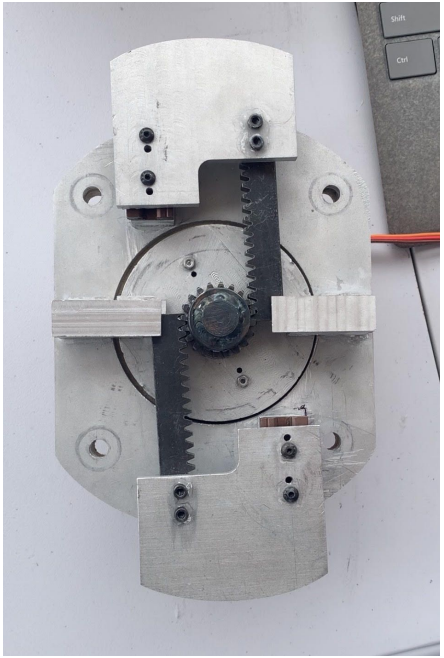
- Rack & pinion design
- Electronics: high torque servo motor, barometric pressure sensor, 9DOF accelerometer
- 16% increase in cross-sectional area



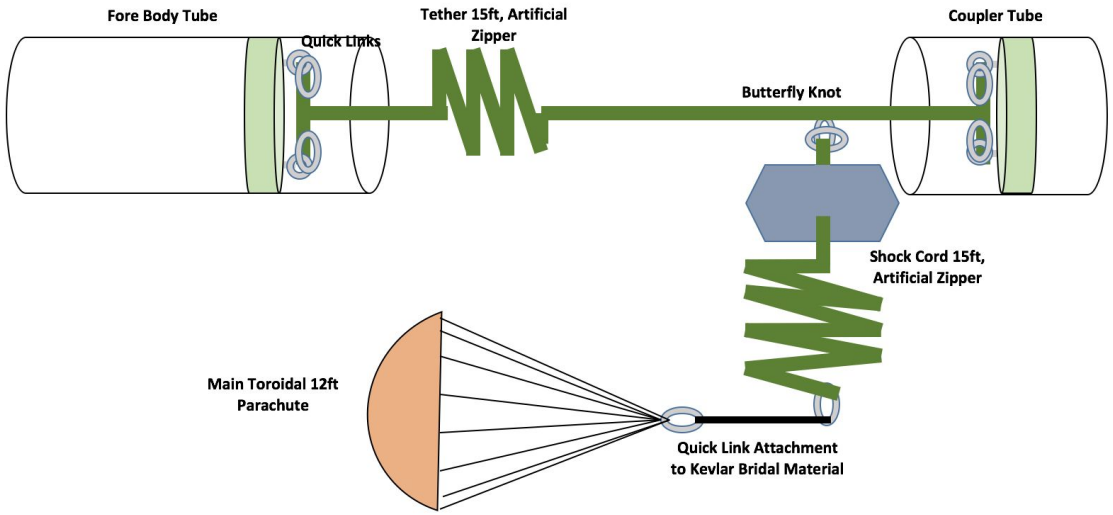


B.E.A.V.S. 2.0 Testing





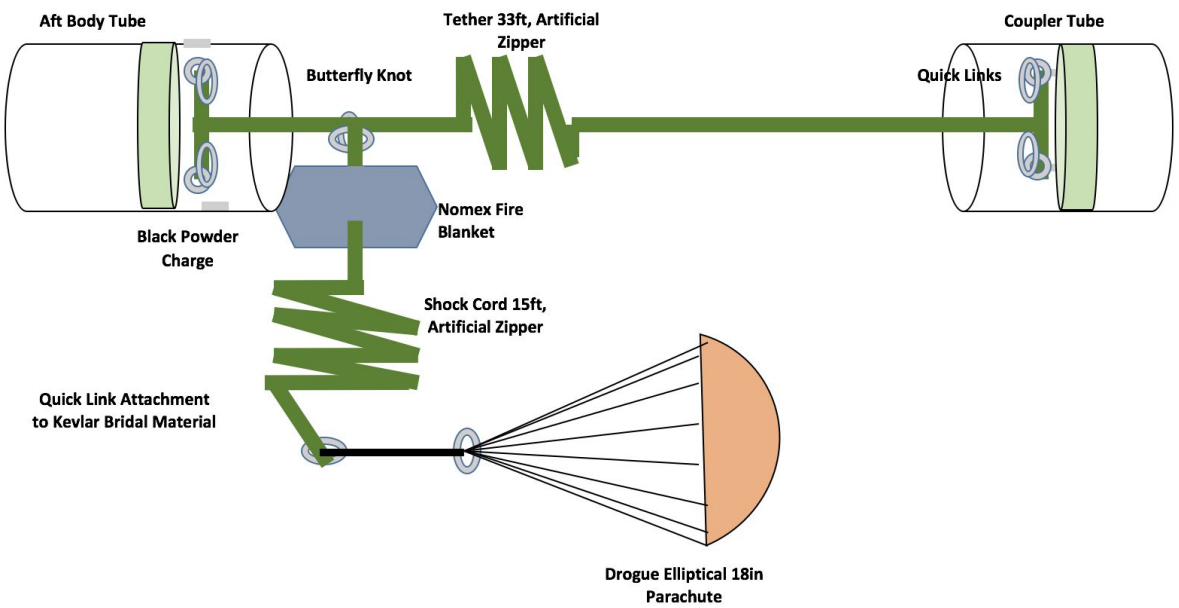
Main Recovery Harness Final Design



Main

- 12 ft Toroidal Parachute
- $C_d = 2.2$

Drogue Recovery Harness Final Design



Drogue

- 36 in. X-Form Parachute
- $C_d = 0.7$

Recovery System Final Parameters

Descent time: 74 s

- NASA Requirement: < 90 s

Main deployment: 600 ft

- NASA Requirement: ≥ 500 ft

Landing energy: 74 ft-lbf

- NASA Requirement: < 75 ft-lbf

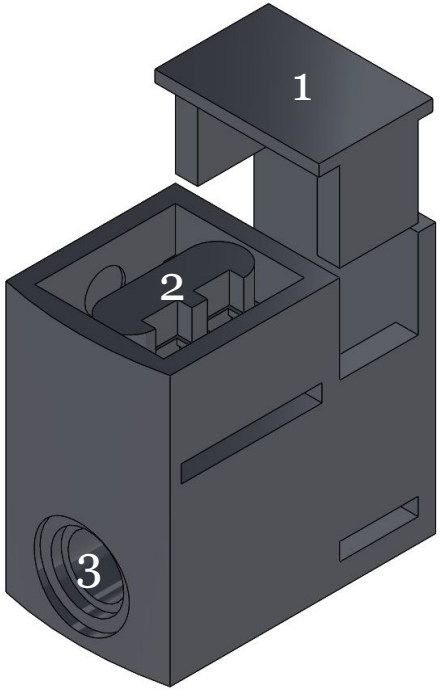
Drift radius (20 mph wind): 1350 ft

- NASA Requirement: < 2500 ft

Testing

BP ground ejection testing helps us test heat resistance and black powder charge sizing

EMBERS Final Design



Energetic Mid-flight Black powder Ejection Reserve System (EMBERS)

Designed to enhance the safety of the parachute ejection system

3 sections:

1. Battery Chamber/Cap
2. Sliding Chamber/Slider
3. Switch Housing

EMBERS Testing