

Rocket Motor Component Additive Manufacturing Design

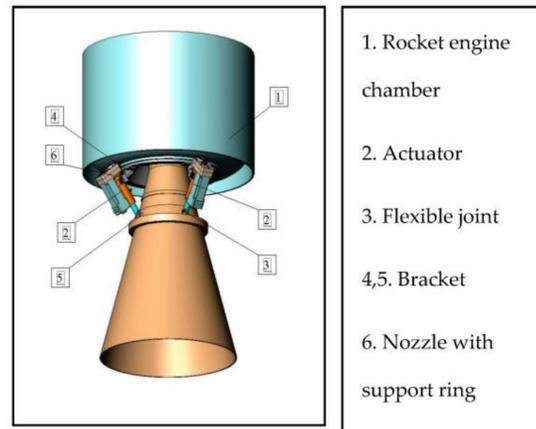
Project Description

Determine benefits of 3D printing Rocket Motor Attachment Ring.

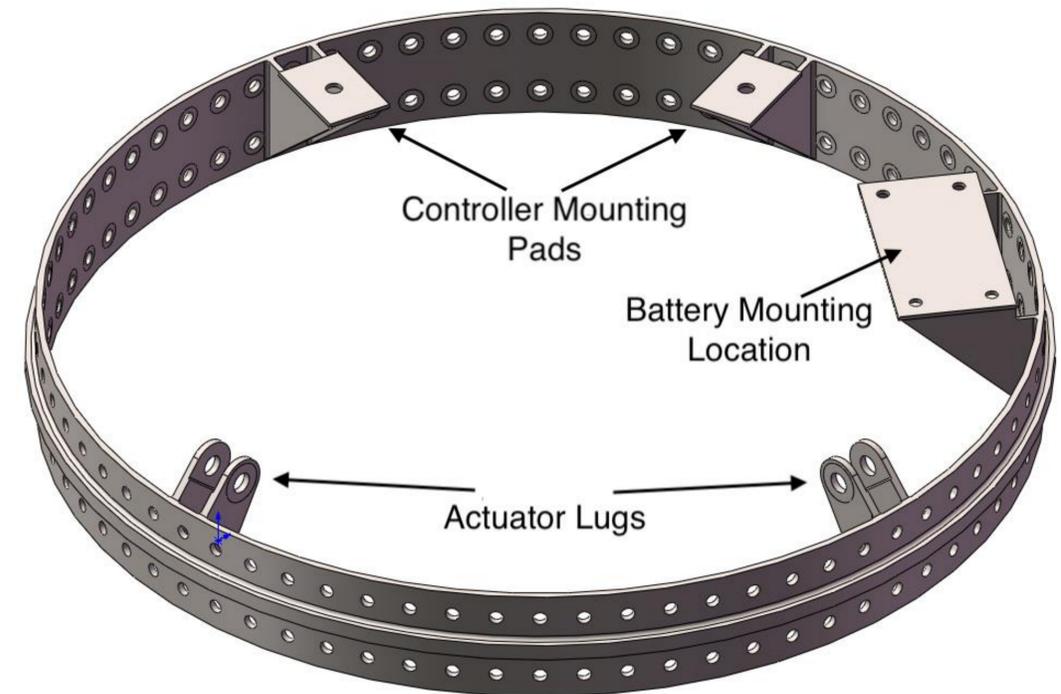
- Determine performance of 3D printed material (Titanium)
- Consider time and weight savings vs current methods

Constraints/Requirements

- Overall mass below 18 lbs
- Fit Northrop specified geometric envelope
- Withstand 4000 lbs lug actuator design load
- Withstand vibration loads

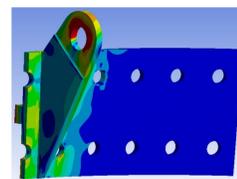
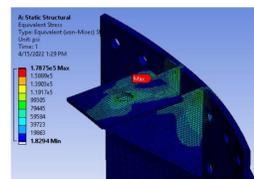
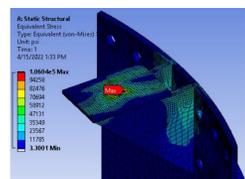
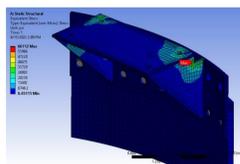


Design Description



Performance Review

- The NASA Structures Manual provided equations for Hand Calculations to find stresses and loads due to loading.
- ANSYS simulation software was used to confirm hand calculations before testing.
- Northrop Grumman facilities were used to test the part in: flight loads, failure loads and intermediate loads.
- Predicted Failure Load: Between 35,000 – 40,000 lbs



Conclusion

- How well did the design meet the requirements?
 - Printed ring manufacture time was 4 months for section print. Full ring was unable to be printed.
 - Printed ring weight is 15 lbs, (saved 3 lbs.)
 - Ring design met geometric envelope determined by Northrop Grumman.
 - Design test withstood lug actuator loads.
 - Actual Failure Load: Within 2% of predicted failure. Therefore, simulations and calculations appear correct
- Lessons Learned
 - Add ribs or gussets instead of thickening lug ear design
 - Design to printer's capabilities
- Recommended Future Work
 - Print full ring design.
 - Static test fire
 - Flight test

