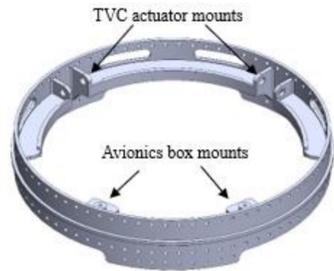
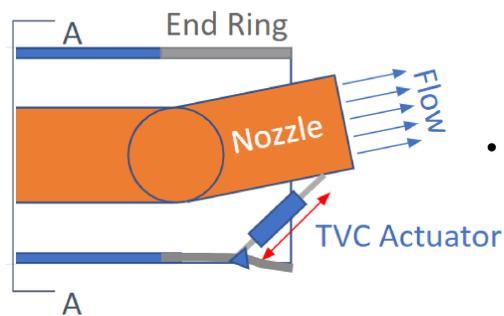


NGC – Rocket End Ring Test Fixture

Additive Manufactured Rocket End Ring



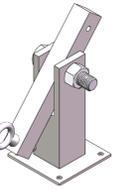
- Northrop Grumman worked with USU seniors last year to create an innovative rocket end ring, manufactured by 3-D printing titanium.
- The properties of this end ring needed to be tested under conditions that simulate the flight of the rocket.
- Our team was tasked to design and build a single custom test fixture that can test any end ring 20-40 in in diameter statically under 7 unique loading conditions, most with forces over 2000 pounds, with 5% or less error



- The rocket end ring provides mounting for the rocket's thrust vector control systems – TVC actuators. The ring's stiffness affects operation of the TVC actuators and is determined through testing.

Test Fixture Design

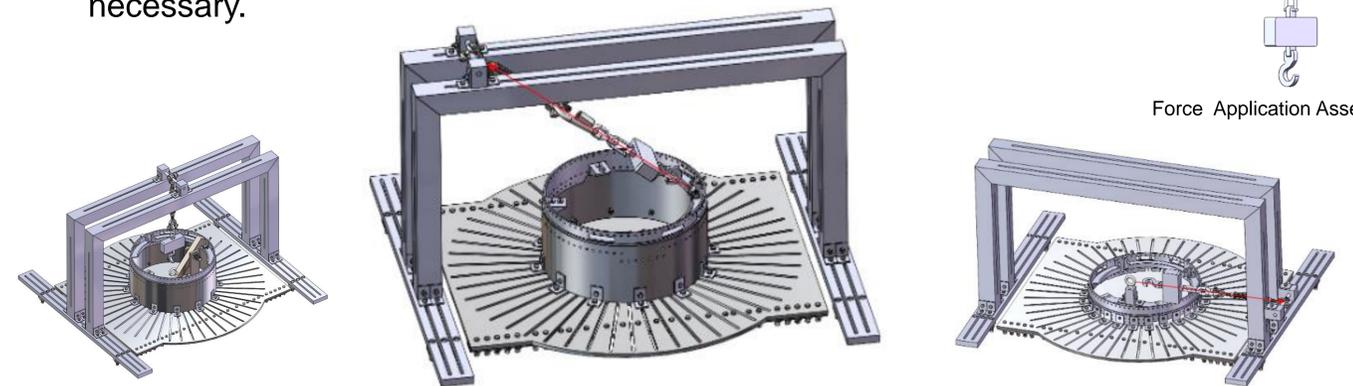
- The test fixture consists of a large aluminum baseplate to hold the ring, a surrounding steel structure to anchor the force, and a force application assembly.
- Force is applied in tension using a turnbuckle, which contracts when torqued.
- The baseplate and the surrounding steel structure are designed with slots that make them able to adapt to various ring sizes, configurations, and loading conditions.
- Tension force is converted to compression using a lever arm when necessary.



Lever Arm Assembly

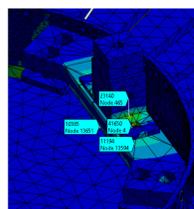
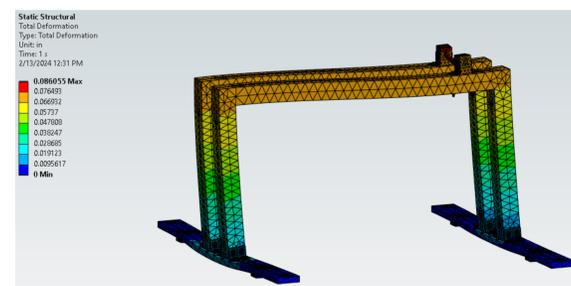
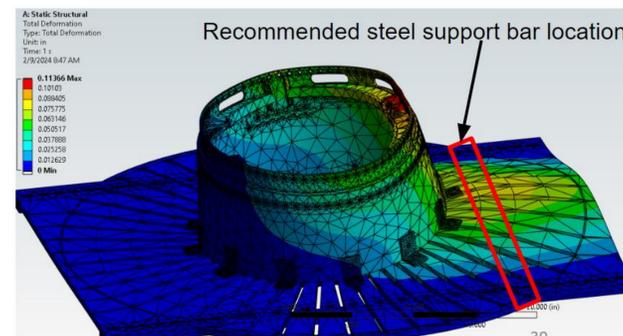


Force Application Assembly



FEA Static Simulation

- To verify that the test fixture would be able to withstand the forces necessary to test the end ring and meet the design requirements, the team ran multiple FEA simulations using Ansys software.
- The simulations allowed our design team to identify weaknesses in the design and correct them. This ensured that our test fixture would work correctly the first time we built it.
- Northrop Grumman is using test data to validate advanced FEA models to predict behavior of the end ring outside of testing scenarios.



Completed Test Fixture

- The completed test fixture completed all test cases of the end ring without failure and met design requirements.
- Northrop Grumman will use our test fixture as they continue the testing campaign on this and other rocket end rings.
- This project was invaluable experience of the entire engineering process for team. We gained skills in project planning, project management, concept generation, design selection, detailed design, FEA analysis, manufacturing, and test engineering.

