

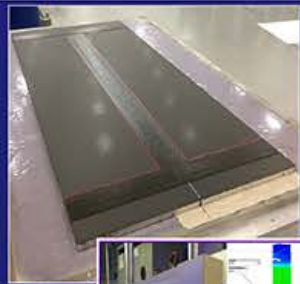


**Space Technology Mission Directorate**  
Game Changing Development Program

# Composite Technology for Exploration (CTE)

*Maturing, reducing risk and increasing confidence in composite bonded joint technologies*

The CTE project is developing and demonstrating weight-saving, performance-enhancing composite bonded joint technology by incorporating materials characterization studies into the design, manufacturing, and testing of light-weight composite bonded joint concepts for SLS-scale applications. The project is advancing current high-fidelity analysis tools and standards for improvements in the prediction of failure and residual strength of bonded joints.



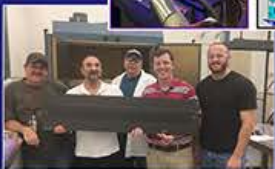
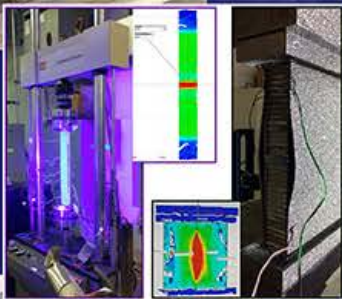
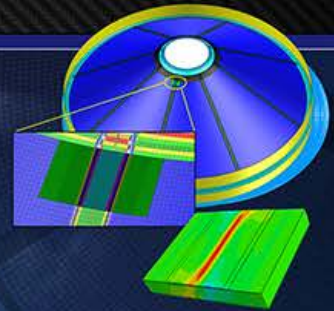
Light Weight

Composite Bonded

# JOINTS

High-Fidelity Analysis Tools

Failure Prediction



Joint concept designs, manufacturing and testing is in progress using SLS flight like loading conditions. Processes developed based on concept designs are used to manufacture the bonded joints. Detailed designs are modeled with various analysis tools to predict bonded composite joint test failure. These models will be evaluated, updated, and correlated with test data to improve analyses tools for longitudinal bonded lap joints and will be the basis for future circumferential joints being designed now.

Testing confirms NASA's ability to design and manufacture repeatable, predictable and reliable lightweight bonded composite joints.

**Material Testing**

- Automated tape placement equivalency tests
- Adhesive non-linear property tests
- Strain energy release rate tests

**CTE Longitudinal Joint Sub-element testing**

- Hoop EWC, Axial EWC, Hoop Tension
- Buckling tests and combined loads tests

**CTE Circumferential Joint Sub-element testing**

- 3D weave material characterization
- Joint strength testing

The CTE composite joints technology development potential benefits include weight savings, cost savings, and improved performance with increased reliability compared to metallic structures/joints. The project will enable the technology infusion of lightweight composite joints into future exploration missions.

The SLS Payload Adapter team directly applied the CTE-developed bonded joint manufacturing processes to the Manufacturing Demonstration Article. The Payload Adapter team was able to demonstrate the manufacturability of longitudinal bonded joints on a full-scale article in a short period of time due to the foundation created by the CTE team.