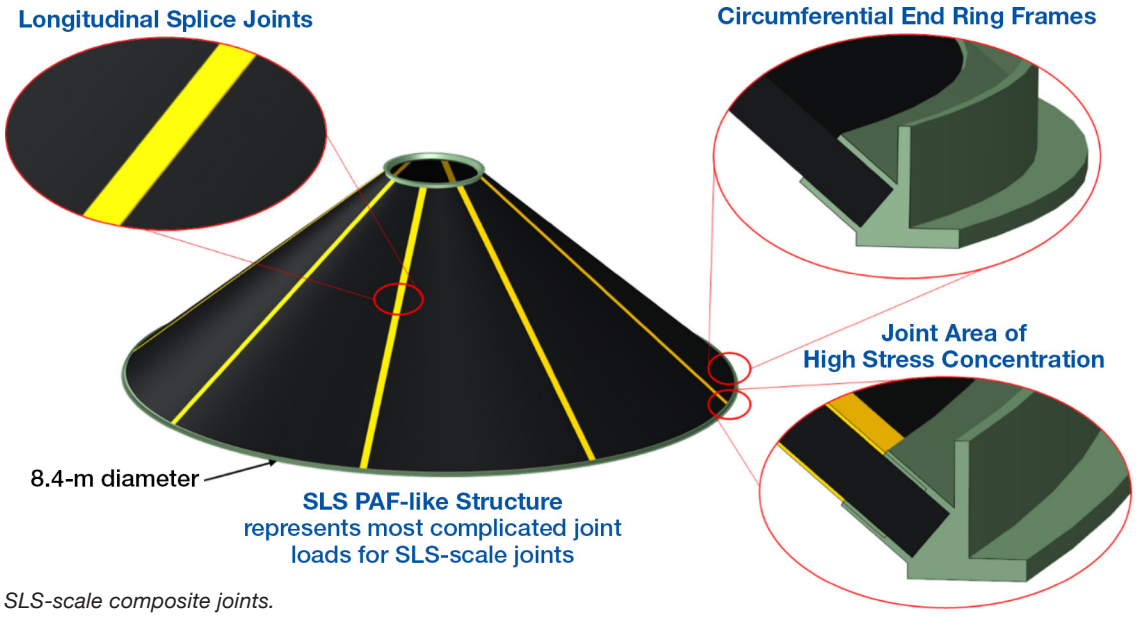
NASA**facts**

Space Technology
Game Changing Development
Composite Technologies for Exploration (CTE)

Composite materials are increasingly used for launch-vehicle structures. When properly designed, composite structures have many potential benefits over traditional metallic structures, including lower mass, better fatigue resistance, lower part count, and reduced life-cycle cost. NASA plans to advance composite technologies that provide lightweight structures to support future exploration missions such as the Space Launch System (SLS). Due to the large 8.4-m diameter of the SLS and the unavailability of large autoclaves for curing composite structures, individual large composite panels must be manufactured separately and then joined together. The state-of-the-art method for joining launch vehicle composite panels and structures is through metallic joints with mechanical fasteners. That approach is heavy and labor intensive. NASA needs to gain experience on developing lightweight composite joints and analysis techniques/tools specifically applicable to large-scale composite structures.

The Composite Technology for Exploration (CTE) project plans to advance composite technologies for future NASA exploration missions with a focus on composite joint technologies for SLS scale hardware. The CTE project will develop and demonstrate weight-saving, performance-enhancing composite bonded joint technology by incorporating materials characterization studies, design, manufacturing, and testing of lightweight composite bonded joint concepts for SLS-scale applications. The project will also advance current high-fidelity analysis tools and standards for improvements in the prediction of failure and residual strength of the selected joints.

The CTE project, led by NASA's Marshall Space Flight Center in Huntsville, Ala., includes active research and development

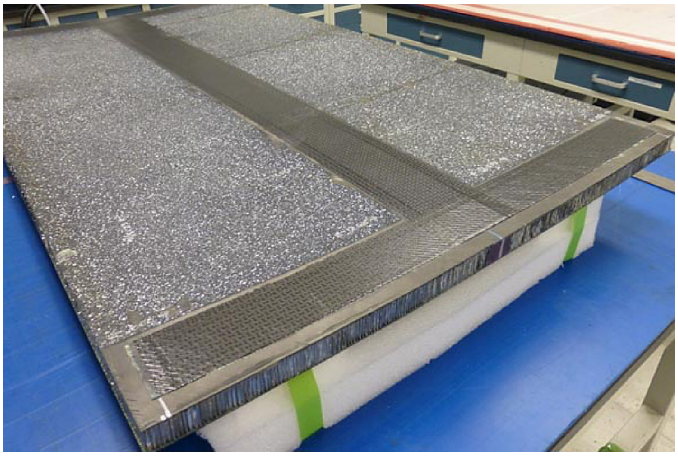


SLS-scale composite joints.

efforts at multiple NASA field centers including Glenn Research Center, Langley Research Center, Goddard Space Flight Center, and Kennedy Space Center. The CTE team is collaboratively performing material characterization studies and developing composite joint designs, manufacturing processes, advanced material models, analysis tools, and analytical methodology that will be validated with joint tests. Composite joint designs will be down selected for advanced studies. Manufacturing studies of out of autoclave cure joints with high reliability surface preparation are being conducted. The selected composite joint design(s) will be manufactured with those repeatable and reliable manufacturing processes applied. After the composite joint concepts are manufactured, they will be tested to failure in various SLS flight-like loading conditions. The CTE team is utilizing enhanced material modeling tools and methodology to more accurately predict material properties and understand the physics of material failure needed for high fidelity analysis tools for joint failure prediction. Detailed analysis models using the analysis tools to predict the failure of the composite joint test articles will be developed, updated, and improved to validate the analysis tools for composite bonded joints.

The CTE project 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. CTE is working to achieve these potential benefits by developing and validating high-fidelity analytical tools and standards for predicting failure and the residual strength of composite bonded joints. This allows for a tailored approach to reducing the safety factor for composite discontinuities while still reducing risks and increasing confidence in composite joint technologies.

The Game Changing Development (GCD) Program investigates ideas and approaches that could solve



Composite bonded longitudinal joint.

Team members prepare panels for bagging/curing during the fabrication process at Marshall Space Flight Center's Composites Technology Center.

significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about GCD, please visit http://gameon.nasa.gov/

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