National Aeronautics and Space Administration

Composite Cryotank Technologies & Demonstration

SPACE TECHNOLOGY MISSION DIRECTORATE

The Composite Cryogenic Propellant Tank project will develop and ground demonstrate large-scale composite cryogenic propellant tanks applicable to heavy-lift launch vehicles, commercial launchers, in-space propellant storage, and future vehicle and lander systems.

2.4-meter Tank
Non Destructive Inspection

2.4-meter Tank
Arrives at MSFC for testing

5.5-meter Tank
Automated Fiber Placement

Milestones

NASA recently completed a major space technology development milestone by successfully testing a pressurized, large cryogenic propellant tank made of composite materials. The composite tank will enable the next generation of rockets and spacecraft needed for space exploration.

In the past, propellant tanks have been fabricated out of metals. The almost 8-foot-diameter (2.4-meter) composite tank tested at NASA's Marshall Space Flight Center in Huntsville, Ala., is considered game changing because composite tanks may significantly reduce the cost and weight for launch vehicles and other space missions.

Composite cryotanks could lead to rocket propellant tanks that achieve greater than
30% weight savings and
25% cost savings
compared to the state-of-the-art metal tanks.

Changing the Future of Space Exploration

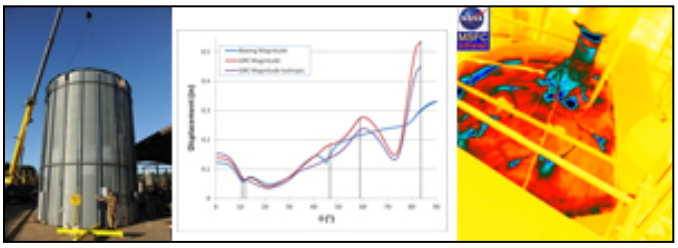
Switching from metallic to composite construction holds the potential to dramatically increase the performance capabilities of future space systems through a dramatic reduction in weight. A potential initial target application for the composite technology is an upgrade to the upper stage of NASA's Space Launch System heavy-lift rocket.

"These successful tests mark an important milestone on the path to demonstrating the composite cryogenic tanks needed to accomplish our next generation of deep space missions," said Michael Gazarik, NASA's associate administrator for space technology at NASA Headquarters in Washington. "This investment in game changing space technology will help enable NASA's exploration of deep space while directly benefiting American industrial capability in the manufacturing and use of composites."

game changing development

2.4-meter diameter Tank Test Summary

Built by Boeing at their Tukwila, Wash., facility, the tank arrived at NASA in late 2012. Engineers insulated and inspected the tank, then put it through a series of pressurized tests to measure its ability to contain liquid hydrogen at extremely cold temperatures. The tank was cooled down to –423 degrees Fahrenheit and under went 20 pressure cycles as engineers changed the pressure up to 135 psi.



2.4-meter tank testing analysis & thermal image

"This testing experience with the smaller tank is helping us perfect manufacturing and test plans for a much larger tank," said John Vickers, the cryogenic tank project manager at Marshall. "The 18-foot (5.5-meter) tank will be one of the largest composite propellant tanks ever built and will incorporate design features and manufacturing processes applicable to a 27.5-foot (8.4-meter) tank, the size of metal tanks found in today's large launch vehicles."

The NASA and Boeing team are in the process of manufacturing the 18-foot-diameter (5.5-meter) composite tank that also will be tested at Marshall next year.

CCTD Accomplishments

- Completed material coupon and joint allowables database
- Built and demonstrated segmented composite tool for 2.4-meter manufacturing
- Completed fabrication of the 2.4-meter composite precursor tank
- Demonstrated Structural Health Monitoring during 2.4 meter fabrication, shipping, and tests
- Completed LH2 cycle testing on 2.4-meter precursor tank (pressure achieved: 135psi)
- Completed 5.5-meter Cryotank CDR
- Successfully fabricated and cured 5.5-meter pressure shell

2.4-meter tank with insulation at MSFC Test Stand

"The tank manufacturing process represents a number of industry breakthroughs, including automated fiber placement of oven-cured materials, fiber placement of an all-composite tank wall design that is leak-tight and a tooling approach that eliminates heavy-joints," said Dan Rivera, the Boeing cryogenic tank program manager at Marshall.

Composite tank joints, especially bolted joints, have been a particularly troubling area prone to leaks in the past. Boeing and its partner, Janicki Industries of Sedro-Woolley, Wash., developed novel tooling to eliminate the need for heavy joints.

"Boeing has experience building large composite structures, and Marshall has the facilities and experience to test large tanks," explained John Fikes, the cryogenic tank deputy project manager at Marshall. "It has been a team effort, with Boeing working with NASA to monitor the tests and gather data to move forward and build even larger, higher performing tanks."

"Game changing is about developing transformative technologies that enable new missions and new capabilities," said Stephen Gaddis, the program manager for the Game Changing Development Program at NASA's Langley Research Center in Hampton, Va**.** "Technological advances like the cryogenic tank can ripple throughout the aerospace industry and change the way we do business."

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