NASA Uses Twin Processes to Develop New Tank Dome Technology

December 2 2009, by Kimberly Newton

The spherical tank dome was manufactured from a flat plate "blank" made of the 2195 alloy. The blank was constructed by friction stir welding together two commercial off-the-shelf plates in order to produce a large starting blank. The welded plate blank was then spun formed to create the single-piece tank dome. (MT Aerospace)

(PhysOrg.com) -- NASA has partnered with Lockheed Martin Space Systems in Denver, Colo., and MT Aerospace in Augsburg, Germany, to successfully manufacture the first full-scale friction stir welded and spun formed tank dome designed for use in large liquid propellant tanks.

The NASA and Lockheed Martin team traveled to Germany to witness the first successful aerospace application of two separate manufacturing processes: friction stir welding, a solid-state joining process, and spin

forming, a metal working process used to form symmetric parts.

The twin processes were used by MT Aerospace to produce an 18-foot-diameter tank dome using high-strength 2195 aluminum-lithium. The diameter of this development dome matches the tank dimensions of the upper stage of the ARES I launch vehicle under development by NASA, as well as the central stage of the European Ariane V launcher.

"This new manufacturing technology allows us to use a thinner, high-strength alloy that will reduce the weight of future liquid propellant tanks by 25 percent, compared to current tank designs that use a lower-strength aluminum alloy that weighs more," said Louis Lollar, project lead for the Friction Stir Weld Spun Form Dome Project at NASA's Marshall Space Flight Center in Huntsville, Ala.

A full-scale spherical tank dome measuring 18 feet in diameter was produced from high-strength 2195 aluminum-lithium using twin manufacturing processes.

(MT Aerospace)

The concave net shape spin forming process, patented by MT Aerospace, drastically simplifies the manufacturing of large tank domes and reduces cost by eliminating manufacturing steps, such as machining and assembly welding, that are required when manufacturing traditional gore panel - a pie-shaped section of the tank dome --construction domes.

"The success of this project is proof positive that when innovation, partnership and expertise are brought together, we can deliver new capabilities at lower cost with greater reliability for NASA and the nation's space program," said Jeb Brewster, project manager of the Friction Stir Welded Spun Formed Dome project at Lockheed Martin Space Systems. "This team has pushed the envelope by using existing commercial materials combined with cutting edge technology. The results provide the potential for a significant improvement over the current processes and materials being used today."

The spherical tank dome was manufactured from a flat plate "blank" made of the 2195 alloy. The blank was constructed by friction stir welding together two commercial off-the-shelf plates in order to produce a large starting blank, reducing the cost of raw materials. The welded plate blank was then spun formed to create the single-piece tank dome.

This is the first time this combination of twin manufacturing processes has been successfully applied to produce a full-scale 2195 aluminum-lithium dome.

"This achievement also demonstrates that international cooperation between the United States and Europe can achieve very promising and concrete results with mutual benefits for future space programs," said Judith Watson, program manager at NASA's Langley Research Center in Hampton, Va. "Lockheed Martin and MT Aerospace have set up a very efficient and effective development team."

Two additional, full-scale development tank domes are scheduled for manufacture and testing in coming months as part of the joint, two-year technology demonstration program.

NASA has invested in the Friction Stir Weld Spun Form Dome Project since 2006, which is managed by the Exploration Technology Development Program for NASA's Exploration Systems Mission Directorate in Washington.

Provided by JPL/NASA (news : web)