Title:
Robotic Manufacturing of 5.5 Meter Cryogenic Fuel Tank Dome Assemblies for the NASA Ares I Rocket

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Abstract:
The Ares I rocket is the first launch vehicle scheduled for manufacture under the National Aeronautic and Space Administration's (NASA's) Constellation program. A series of full-scale Ares I development articles have been constructed on the Robotic Weld Tool at the NASA George C. Marshall Space Flight Center in Huntsville, Alabama. The Robotic Weld Tool is a 100 ton, 7-axis, robotic manufacturing system capable of machining and friction stir welding large-scale space hardware. This presentation will focus on the friction stir welding of 5.5m diameter cryogenic fuel tank components; specifically, the liquid hydrogen forward dome (LH2 MDA), the common bulkhead manufacturing development articles (CBMDA) and the thermal protection system demonstration dome (TPS Dome).

The LH2 MDA was the first full-scale, flight-like Ares I hardware produced under the Constellation Program. It is a 5.5m diameter elliptical dome assembly consisting of eight gore panels, a y-ring stiffener and a manhole fitting. All components are made from aluminum-lithium alloy 2195. Conventional and self-reacting friction stir welding was used on this article. An overview of the manufacturing processes will be discussed. The LH2 MDA is the first known fully friction stir welded dome ever produced.

The completion of four Common Bulkhead Manufacturing Development Articles (CBMDA) and the TPS Dome will also be highlighted. Each CBMDA and the TPS Dome consists of a 5.5m diameter spun-formed dome friction stir welded to a y-ring stiffener. The domes and y-rings are made of aluminum 2014 and 2219 respectively. The TPS Dome has an additional aluminum alloy 2195 barrel section welded to the y-ring. Manufacturing solutions will be discussed including "fixtureless" welding with self reacting friction stir welding.