National Aeronautics and Space Administration

# Space Launch System
## Highlights

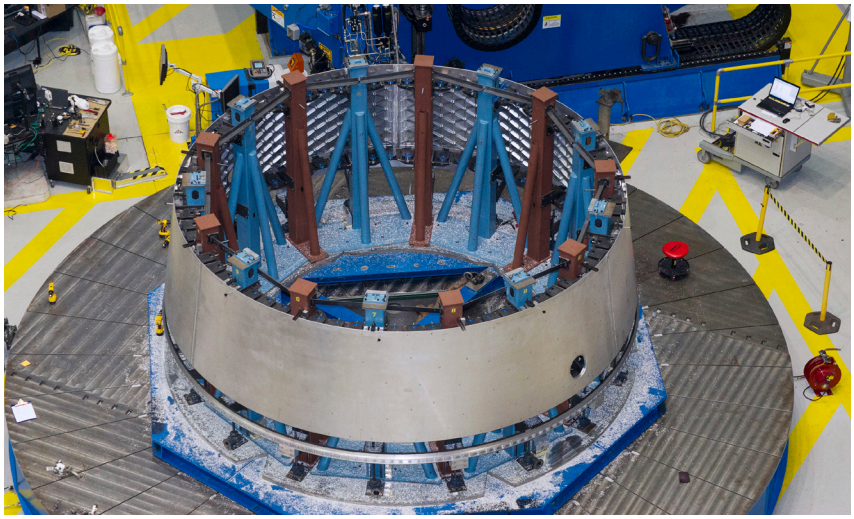
March 2013

## NASA Turns Up the Heat on Construction of the SLS

Welding engineers at NASA's Marshall Space Flight Center in Huntsville, Ala., have had an extremely busy winter assembling the adapter that will connect the Orion spacecraft to a United Launch Alliance Delta IV rocket for Exploration Flight Test-1 (EFT-1) in 2014. For future flights, the adapter will attach Orion to NASA's Space Launch System, or SLS, a new heavy-lift rocket managed and in development at Marshall that will enable missions farther into space than ever before. The 2014 flight test will provide engineers with important data to inform design decisions, including about the adapter's performance before it is flown on SLS beginning in 2017 on Exploration Mission-1.

In a high bay of Marshall's Building 4755, expert welders using state-of-the-art friction stir welding machines worked on two separate adapters. For each adapter, a vertical welding machine stitched panels together to form a conical cylinder, then a circumferential welding machine attached a thicker structural support ring at the top and the bottom.

"While the adapters are identical and are considered flight articles, only one will actually be used for EFT-1," said Brent Gaddes, Spacecraft & Payload Integration Subsystem manager. "The other will undergo strenuous structural testing to ensure quality, while its twin will make the trip to NASA's Kennedy Space Center in Florida for integration into the rest of the test vehicle for launch."



An adapter that will connect the Orion spacecraft to its rocket for EFT-1 is under construction at NASA's Marshall Space Flight Center in Huntsville, Ala. The same design will be used for the flight test of the full-size Space Launch System rocket in 2017. *(Image: NASA/MSFC)*

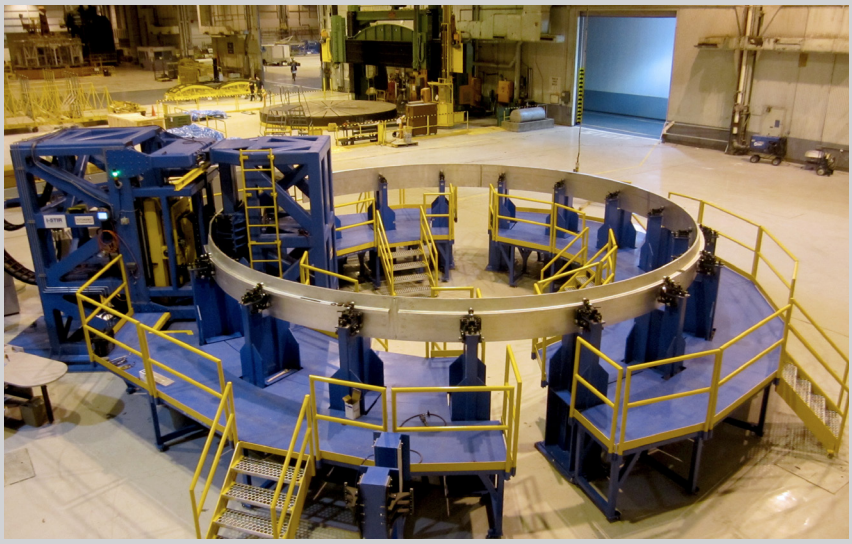
United Launch Alliance, which makes the Delta IV rocket in nearby Decatur, Ala., will deliver a full-size section of the rocket later this spring that will allow engineers to test the fit of the adapter.

# Spaceflight Partners: Futuramic

*EDITOR'S NOTE: Every month, SLS Highlights turns the spotlight on one of the industry partners helping to create the largest rocket ever built for human space exploration. In this issue, we profile Futuramic Tool & Engineering of Warren, Mich., north of Detroit.*

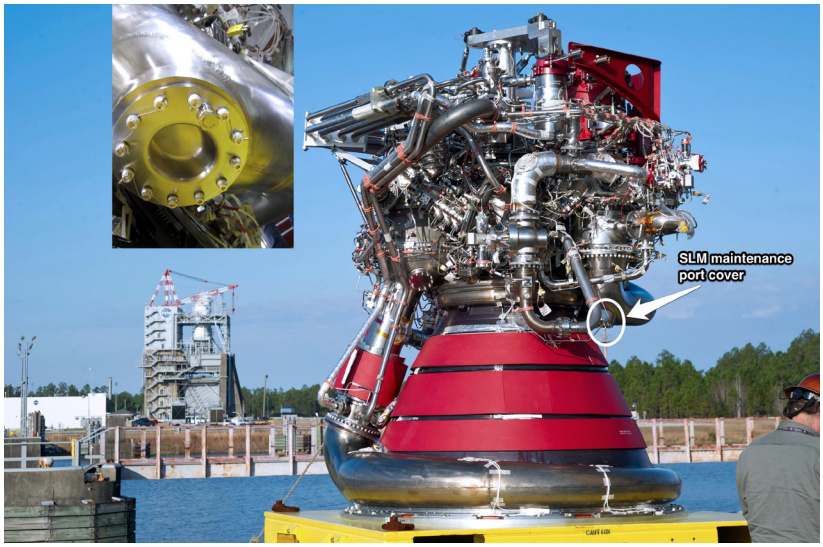
Futuramic Tool and Engineering Co. was commissioned by Boeing of Huntsville, Ala., to design and build tooling for friction stir welding to assist in the construction of the Space Launch System core stage at NASA's Michoud Assembly Facility in New Orleans. The company made large capital investments and equipment upgrades at their Michigan location to accommodate manufacture of the massive tooling in support of the space program.

Founded in 1955, Futuramic designs and manufactures quality checking fixtures and inspection gauges. A full-service design and build company, Futuramic specializes in taking a customer's requirements and processing them through design, build, inspection, and installation to create a wide variety of engineered and machined parts.



The Segmented Ring Tool will use a friction stir weld process to produce segmented support rings for the SLS core stage. *(Image: Futuramic)*

For NASA's Space Launch System, Futuramic has delivered the Segmented Ring Tool, and is in the process of building the Girth Weld Tool, the Circumferential Dome Weld Tool, and the Plug Weld Tool. Essentially, they build the bits for the massive drill that is friction stir welding.




The J-2X engine before installation at the Stennis Space Center. The engine's new turbo pump exhaust port cover (detailed inset) was recently built by Pratt & Whitney Rocketdyne of Canoga Park, Calif., using a pioneering manufacturing process called Selective Laser Melting. *(Image: NASA/SSC)*

# The Future of Exploration Starts with 3-D Printing

The latest in cutting-edge manufacturing is already making a significant impact in the future of space exploration.

Pratt & Whitney Rocketdyne of Canoga Park, Calif., the prime contractor for the J-2X engine, recently used an advanced 3-D printing process called Selective Laser Melting, or SLM, to create an exhaust port cover for the engine. SLM uses lasers to fuse metal dust into a specific pattern to build the cover, which is essentially a maintenance hatch for the engine's turbo pumps.

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# 3-D Printing

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On March 7, this part was exposed to the strenuous conditions of a rocket engine firing during a test at NASA's Stennis Space Center in Mississippi, and will be a part of the rest of this test series. The J-2X is undergoing rigorous testing in support of the agency's Space Launch System Program managed at NASA's Marshall Space Flight Center in Huntsville, Ala.

"As we pursue America's next heavy-lift rocket, our engineers are proactively looking for methods like SLM that will make the rocket more affordable," said Todd May, SLS Program manager. "For example, the new part cost 35 percent of what it would cost to make the same part using conventional methods."


Andy Hardin, SLS Subsystem manager for liquid engines, compares a rocket engine part created using traditional manufacturing and welding, on right, with one made one using Selective Laser Melting, or SLM, on left. The new z-baffle for the RS-25 engine was created by fusing metal dust with a high-power laser using the machine in the background. *(Image: NASA/MSFC)*

The port cover is exposed to intense temperature and exhaust conditions during the engine firings. After the successful run of the engine, test conductors open the cover to check the torque on the turbo pump and visually inspect the cover itself. Initial conclusions were that it performed exactly as expected.

Marshall also recently proved how this technology may help save on the SLS budget by shaving months off the construction of certain engine parts. One such part is the pogo z-baffle of the RS-25 engine. Four RS-25s will help drive the core stage of the SLS into orbit and the baffles help reduce the potentially violent vibrations the engine experiences during flight.

"Traditionally, the forming, machining, and welding of this baffle would take 9 to 10 months," said Andy Hardin, SLS Subsystem manager for liquid engines. "After creating the part using computer-aided design, we built this baffle with SLM in nine days, obviously significant time and cost savings. The lack of a traditional weld also makes this part more structurally sound."

# Water Tests Won't Dampen SLS Progress

Test conductors at the Marshall Space Flight Center in Huntsville, Ala., test fired small thrusters as a "warm-up" for sub-scale testing of the propulsion elements of the Space Launch System, or SLS. The thrusters stand in for the core stage engines of the SLS rocket at Test Stand 115. A scale model of all the combined propulsion elements, including the boosters and four engines, will be fired to help design the water suppression system for the launch pad facility at the Kennedy Space Center in Florida. In the seconds leading up to launch and for a few seconds after, thousands of gallons of water will pour onto the launch pad to help dampen the massive sound waves generated by the rocket. The hardware used for these thrusters is similar in design to the hardware used for acoustic testing for the Space Shuttle Program. *(Image: NASA/MSFC)*

# SLS On the Road…

Linda Singleton, Lockheed Martin Space Systems outreach manager (far left) and Kimberly Robinson, SLS strategic communications manager, talk to visitors at the Texas State Capitol building during Space Week in Austin. NASA team members visited with state legislators and also set up displays in the state Capitol rotunda to talk to the public about the space agency's many different programs. *(Image: NASA/Orion)*

Members of NASA's Space Launch System leadership team updated the Marshall Center Engineering Directorate's workforce in a special briefing called "SLS 301." From left are SLS Chief Engineer Garry Lyles, SLS Program Manager Todd May, and Director of the Engineering Directorate Chris Singer. "NASA's challenge is to push the frontier and go farther," May told the 150 people gathered for the discussion at the Marshall Center's Activities Building. "The International Space Station is built and doing great things. The shuttle is retired. We are about discovery and SLS is the next step to go beyond." *(Image: NASA/MSFC)*

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