ORION

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A Promising Future for Orion

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A PROMISING FUTURE FOR ORION

On February 12, at NASA's Marshall Space Flight Center in Huntsville, Alabama, Acting NASA Administrator Robert Lightfoot shared insight on the fiscal year 2019 budget proposal for the agency. The administration's confidence in NASA leadership points to America leading the way back to the Moon, and on to Mars.

While the budget has not been finalized, the current proposal focuses NASA on its core exploration mission. Reinforcing emphasis on human spaceflight and deep space exploration will increase NASA's ability to return value to the U.S.

By continuing funding and focus on Orion, the Space Launch System (SLS), and Exploration Ground Systems (EGS), NASA is strengthening the nation's economy by relying on support of small businesses and contractors who are responsible for different parts of each component. This centering also strengthens relations with other nations, such as the partnership between ESA (European Space Agency) and NASA on the European Service Module, crucial for mission success and astronaut safety on Orion.

With the administration's support, NASA's ability to provide solutions to tough problems and inspire the next generation places the U.S. once again in the forefront of leading a global effort to advance humanity's future in space. It also points to America's ability to lead the efforts in aeronautical breakthroughs and cutting-edge sciences crucial to surviving beyond our own atmosphere. Developing technology to explore deep space enables discoveries to be made that increase the knowledge and technology used on Earth.

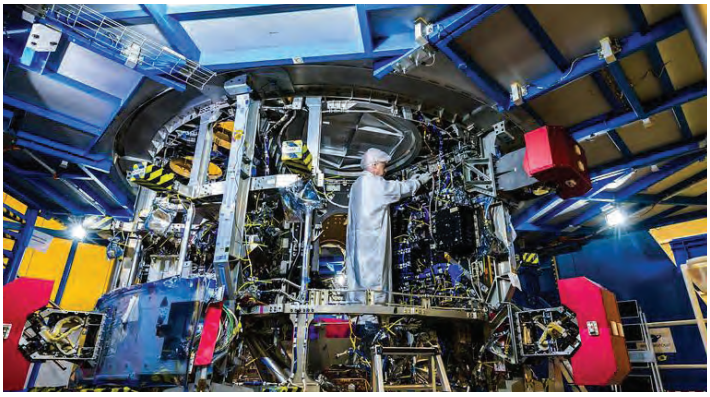
While Orion, SLS, and EGS are once again primary focuses for NASA's future, the budget also points to strengthening commercial crew for low-Earth orbit and robotics exploration to the Moon, Mars and other planets beyond.

Lockheed Martin engineers at NASA's Michoud Assembly Facility in New Orleans, weld the cone section for the Orion spacecraft which will carry humans beyond the Moon on Exploration Mission-2.

With NASA's funding and the president's Space Policy Directive-1, which charges NASA to lead exploration back to the Moon and on to Mars, things are looking good for Orion, SLS, and EGS on their journey towards Exploration Mission-1.

As part of the budget proposal, NASA and partners are planning to build the Lunar Orbital Platform-Gateway in the 2020s. The gateway will provide the foundation for human exploration deeper into the solar system, drive our activity with commercial and international partners and help us explore the Moon and its resources, according to William Gerstenmaier, associate administrator, Human Exploration and Operations Mission Directorate, at NASA Headquarters in Washington. "We will ultimately translate that experience toward human missions to Mars," he said.

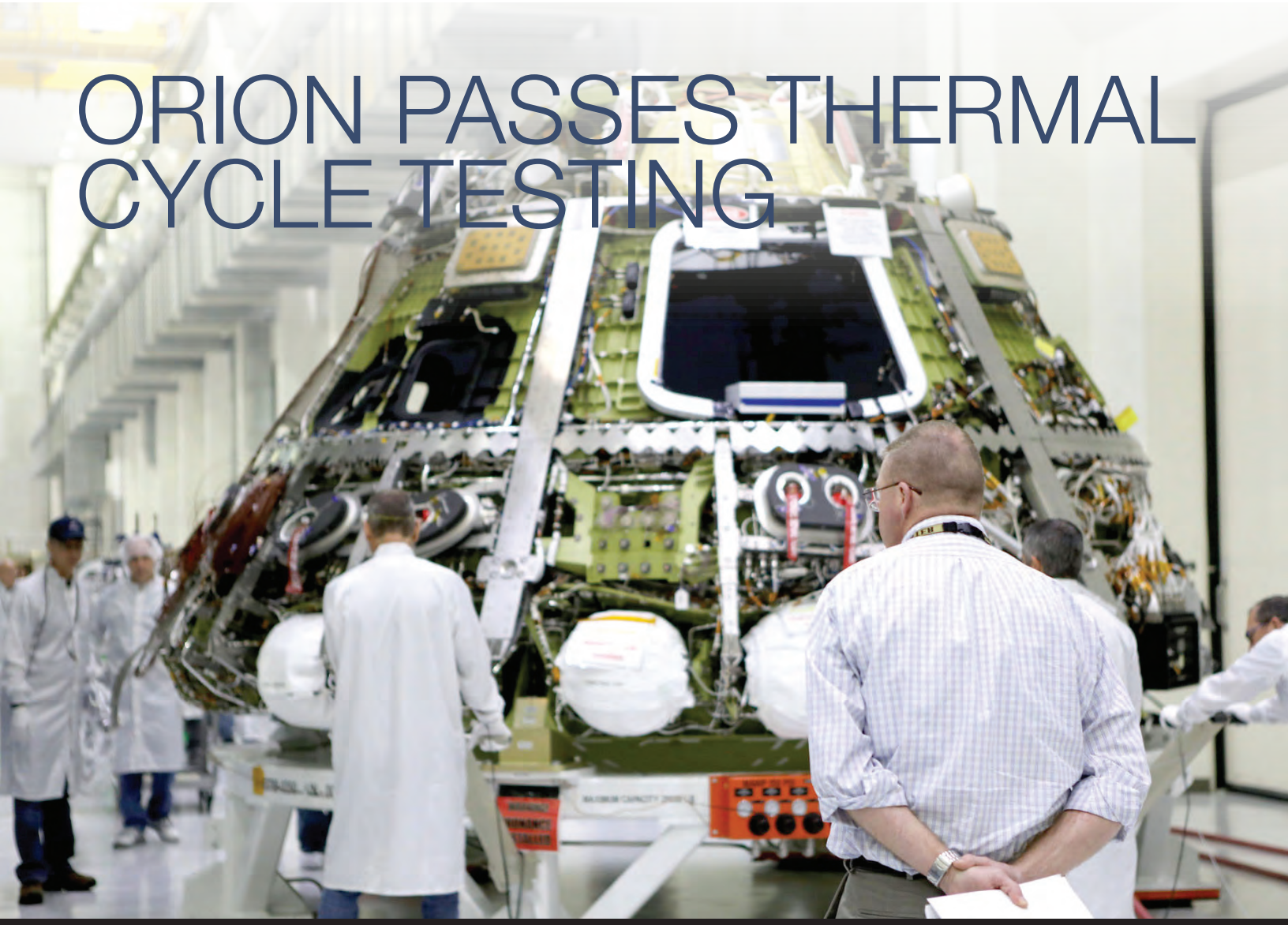
See Lightfoot's remarks: **go.nasa.gov/2oKEL8y**



A technician works on the European Service Module that will propel Orion into space and provide air, water and electricity for future crews. ESA and its contractor Airbus Defense & Space are providing the service module for NASA's first two exploration missions of Orion and the powerful Space Launch System rocket.

The team is conducting development tests for the Orion Crew Module Uprighting System (CMUS) using the PORT test article, a full-scale mockup of the Orion crew module, in the Neutral Buoyancy Laboratory at NASA's Johnson Space Center in Houston.

ORION PASSES THERMAL CYCLE TESTING



When NASA's Orion spacecraft launches into space atop the agency's Space Launch System rocket on its first uncrewed integrated flight, Exploration Mission-1 (EM-1), it will travel thousands of miles beyond the Moon and return to Earth for splashdown in the Pacific Ocean. While traveling to deep space, Orion will experience extreme hot and cold temperatures, with re-entry temperatures nearing 5,000 degrees Fahrenheit.

Before Orion is exposed to the harsh conditions of launch, deep space and re-entry, it is being prepared and tested inside the Neil Armstrong Operations and Checkout Building high bay at NASA's Kennedy Space Center in Florida.

The Orion Program successfully completed a thermal cycle test on the Orion crew module inside a specially constructed thermal cycle chamber in the airlock of the high bay. Over the next five days, the crew module was rapidly cycled between hot and cold temperatures to thermally stress the hardware and ensure the workmanship of the crew module's critical hardware and its subsystem operations. The cycle of temperatures for the initial thermal test ranged from 29 to 129 degrees Fahrenheit during 105 hours of testing.

NASA and Lockheed Martin engineers in three different areas conducted and monitored the test, including the team in the high bay near the chamber controls, the ground test instrumentation readout area, and the Test and Launch Control Center, where system managers powered on and monitored the crew module's subsystems.

A thermal cycle test of Orion's integrated crew and service module, along with electromagnetic interference and compatibility testing, is scheduled for early next year at NASA Glenn's Plum Brook Station in Sandusky, Ohio. While testing at Kennedy helps ensure Orion is ready for EM-1, Plum Brook facilities can simulate more extreme conditions and will help validate the integrated spacecraft design for future missions. The service module is the powerhouse of the spacecraft, providing it with the electricity, propulsion, thermal control, air and water it will need in space.

During EM-1, the Orion crew module structure will reach temperatures ranging from minus 300 degrees Fahrenheit to plus 250 degrees Fahrenheit depending on the Sun's angle on its way to the Moon.

LANGLEY HANDS ORION AA-2 CREW MODULE OFF TO JOHNSON

Technicians at NASA's Langley Research Center in Hampton, Virginia, have been building the Orion crew module structure for the Ascent Abort Test-2 (AA-2), modifying a previously built Orion to reflect changes to the vehicle. The team working on the spacecraft is taking a lean approach to development of the flight test elements to minimize cost and schedule. Using a boilerplate structure that doesn't need to be recovered and having existing hardware provided a head start.

After building the structure, it was transported to Joint Base Langley-Eustis Jan. 26, where it was painted with specific black and white markings that will allow cameras to accurately track the vehicle during the flight test and allow for attitude and trajectory data collection during launch. In February, researchers conducted mass property testing by lifting and rotating the crew module on its side to determine its weight and center of gravity or balance. The test fixtures for the measurements were built in-house to accommodate the 22,000-pound structure and will be reused as well. To get accurate results during the uncrewed flight test planned for April 2019 and launched from Cape Canaveral Air Force Station in Florida, this simplified crew module will have the same outer shape and approximate mass distribution of the Orion crew module that astronauts will fly in, on future missions.

Following testing, the crew module was shipped to NASA's Johnson Space Center in Houston where engineers are adding the avionics and other onboard computers and software. Work at Langley supporting AA-2 is continuing with fabrication of the separation ring that connects the crew module to the booster and provides space and volume for separation mechanisms and instrumentation.

MOON, MARS AND WORLDS BEYOND

Vice President Mike Pence returned to NASA's Kennedy Space Center in Florida on Feb. 20, this time to chair a meeting of the recently re-established National Space Council.

The primary focus for the vice president's trip was the second meeting of the National Space Council on Feb. 21 in the high bay of the center's Space Station Processing Facility. The event's theme was "Moon, Mars and Worlds Beyond: Winning the Next Frontier" and included testimonials from leaders in the civil, commercial and national security sectors about the importance of the United States' space enterprise.

Vice President Pence noted that in December 2017, President Donald Trump signed an executive order that makes it a national policy of the United States to return humans to the Moon, put Americans on Mars and bring renewed focus to human exploration in space.

Looking back to 1961, Pence recalled the flight in which Alan Shepard became the first American in space and, only eight years later, Apollo 11 astronauts were the first humans to walk on the Moon. The vice president then took a view ahead to a new era in space exploration.

On June 30, 2017, President Trump signed an executive order re-establishing the National Space Council to streamline and coordinate national space policy. The first meeting of the new National Space Council took place Oct. 5, 2017, at the Smithsonian National Air and Space Museum's Steven F. Udvar-Hazy Center in Chantilly, Virginia. Afterward, Acting NASA Administrator Robert Lightfoot praised the vice president for calling for renewed U.S. leadership in space with NASA helping lead and shape the way forward.

Discussions during the current National Space Council meeting included President Trump's Fiscal Year 2019 budget request of $19.9 billion for NASA. Vice President Pence also noted the expanded role of commercial companies called for in the president's budget. Pence explained that the president has directed NASA to extend its exploration expeditions to the outer reaches of our solar system.

To do that, NASA's Space Launch System (SLS) and Orion continue in development as critical backbone elements for the effort and for moving farther into deep space. SLS is a new heavy-lift rocket that will be capable of sending humans aboard Orion back to the Moon with an eye toward the Red Planet.

Noting the ongoing work at NASA's multi-user spaceport, Vice President Pence praised the men and women who work there.

View recommendations from the meeting:
go.nasa.gov/2oL4QEB

EXPLORATION SUPPLIERS VISIT NATION'S CAPITAL

NASA's deep space exploration industry team held their sixth and largest ever supplier's conference with more than 250 attendees representing over 90 companies from 34 states across the country. Small business owners, corporate executives and NASA leadership took time to meet with one another and get the latest program updates from the Orion, Space Launch System and Exploration Ground Systems program managers. NASA Acting Administrator Robert

Lightfoot and NASA Associate Administrator for Human Exploration Operations William Gerstenmaier provided agency level updates and NASA Center Directors Ellen Ochoa, Bob Cabana, Janet Kavandi, Todd May and NASA Langley Research Center Deputy Director Clayton Turner provided updates on the new infrastructure improvements at each of their centers to support NASA's future human exploration endeavors.

Other special guest speakers who made keynote addresses during the conference included Dr. Harrison Schmitt, Apollo 17 Astronaut & former US Senator; General William Shelton

(ret) former Commander, Air Force Space Command; Scott Pace, Executive Director National Space Council and Congressional representatives John Culberson (R-TX) Chair, House Appropriation, Subcommittee on Commerce, Justice and Science; Ed Perlmutter (D-CO), Members House Science, Space & Technology Committee, Space Subcommittee; and Dr. Brian Babin (R-TX) , Chairman of the House Subcommittee on Space.

Coalition for Deep Space Exploration Executive Director Mary Lynne Dittmar hosted a welcome reception for the suppliers as they arrived in Washington. The Coalition now has over 70 member companies that support NASA's deep space planetary and human exploration initiatives. In addition, the industry team debuted a new video entitled Explore Without Limits that honors the dedication and innovation of the American workforce building the nation's deep space exploration systems.

Explore Without Limits: **bit.ly/ExploreWithoutLimits**

Photo highlights: **bit.ly/SupplierConf18**

ORION MAKES ITS WAY ACROSS THE U.S.A

NASA and industry partners visited Oklahoma City the week of February 20 for Engineers Week, highlighting the work being done across the state to build and supply aerospace components for Orion and the Space Launch System. Orion and SLS team members were part of the groups that visited suppliers to view their facilities and share with them program progress toward Exploration Mission-1. One of these suppliers was Frontier Electronic Systems, a supplier to Orion and SLS. During the week, representatives visited schools and universities encouraging local students to pursue careers in the STEM fields of science, technology, engineering, and math.

Read more about Frontier Electronics:
bit.ly/FES_Feb18

Orion team members, as well as Astronaut Peggy Whitson, traveled to New York Feb. 23-24 to bring Orion's story to the annual Kid's Week held at the Intrepid Sea, Air & Space Museum. Kid's Week is an event that invites children to engage in activities that explore how science intersects with arts, sports, and nature. Whitson participated in a talk show, gave a presentation about her journey to becoming an astronaut, and signed autographs for those attending. While at the event, kids also had the opportunity to experience a portal into the world of NASA that enabled live video discussions with NASA engineers stationed inside the Orion mockup at NASA's Johnson Space Center in Houston.

Learn more about 2018 Kid's Week event:
bit.ly/KidsWk_Intrepid18

Orion team members attended the 24th annual Space Exploration Educators Conference (SEEC), held Feb. 1-3 at Space Center Houston. The three-day program provided K-12 teachers from around the world with information about, and opportunities to incorporate, space exploration into their respective curricula. Team members spoke with over 600 SEEC attendees about Orion and the Space Launch System. Educators also had the opportunity to explore the historical space artifacts in Space Center Houston and hear from astronauts, rocket scientists and distinguished educators.

Read more about SEEC: **bit.ly/SCH_SEEC18**

On Feb. 6, team members Debbie Korth, Susan Baggerman and Nujoud Merancy represented Orion at an engineering career fair at Clear Lake High School in Houston. By sharing their stories and giving students a glimpse at what goes into building a spacecraft like Orion, team members were able to open students' minds to the possible career choices they could pursue. Engineers from all different disciplines attended and spoke with students about opportunities engineering careers could give them.

ORION SUPPLIER AWARDED SUBCONTRACTOR OF THE YEAR

NASA's Johnson Space Center in Houston selected San Diego Composites (SDC) of San Diego, California, as 2017 Small Business Subcontractor of the Year for its support of NASA's Orion spacecraft and the agency's mission to send humans to the Moon and beyond.

SDC is a subcontractor to Lockheed Martin, NASA's prime contractor for the Orion spacecraft. The Orion Program Office manages development, building and testing of the spacecraft out of Johnson Space Center.

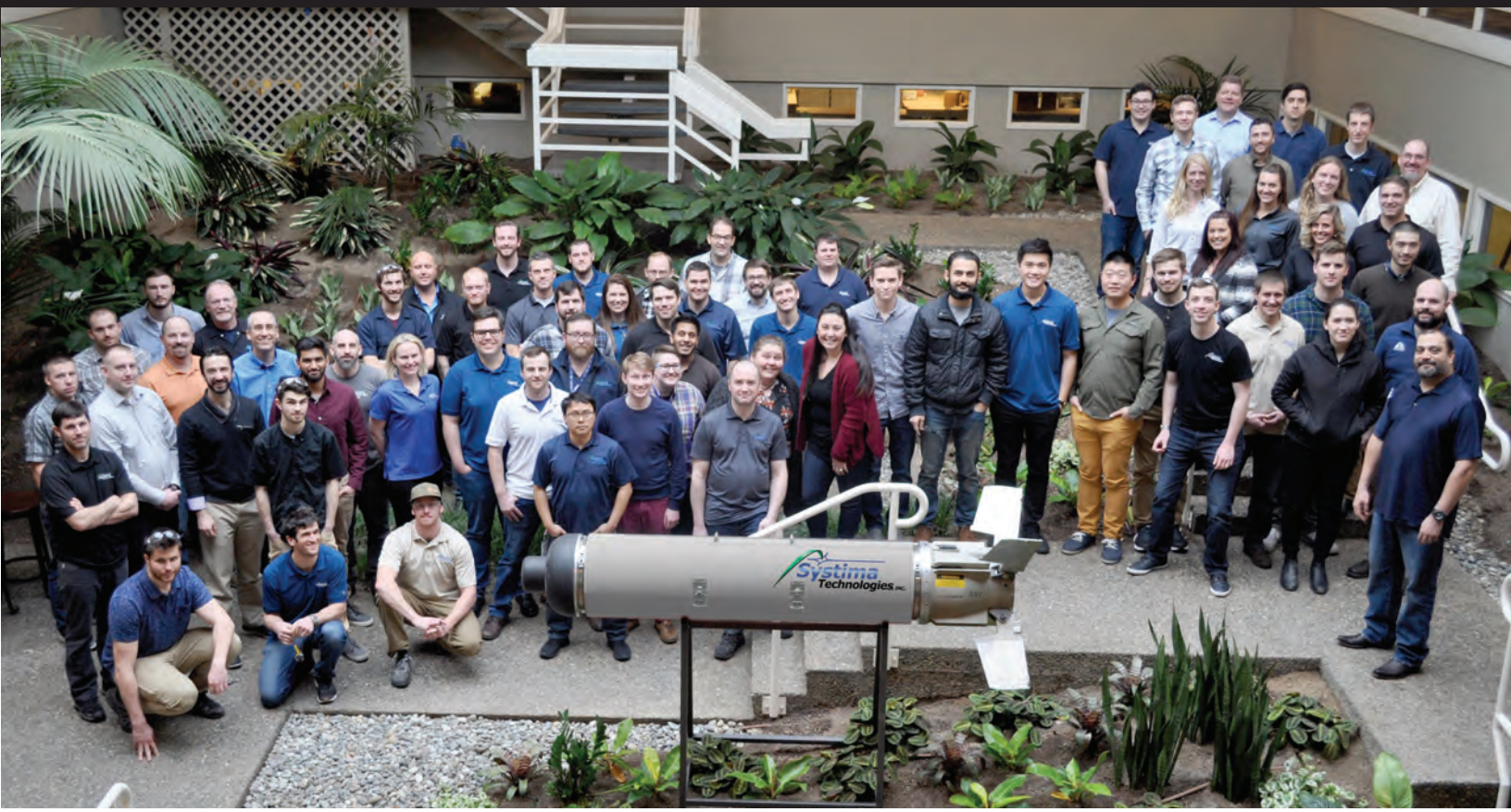
Every fiscal year, the Small Business Industry Awards Program at each NASA center recognizes one small business subcontractor for outstanding efforts. An agency-level award also is given each fiscal year, for which SDC has been nominated.

SDC has been a supplier for Orion since 2009, and is providing several elements for the spacecraft that will fly on Exploration Mission-1, including the ogive and fillet for Orion's Launch Abort System, a safety mechanism that can carry the crew away from a hazardous situation on the launch pad or during ascent to space. The ogive provides a protective shell around the crew module that shields it from environmental conditions during launch, while the cone-shaped fillet connects the abort system to the ogive.

The company also characterizes materials and provides acceptance testing of structural elements for Orion to ensure they meet NASA standards.

San Diego Composites was recently acquired by Applied Composites Holding, LLC and will be continuing work on Orion.

SUPPLIER SPOTLIGHT
SYSTIMA TECHNOLOGIES, INC.



Located in Kirkland, Washington, Systima's 100 employees work to manufacture energetic systems and components, as well as complex integrated systems supporting the defense, space, and commercial markets. Founded in 2002, Systima has grown to support space and defense markets around the country. For the Orion Program, Systima successfully designed, developed, and produced the forward bay cover (FBC) thrusters. The three propellant-actuated thrusters retain the FBC, which will protect the top portion of the crew module during launch and in deep space until re-entry when the parachutes are deployed. The thrusters were successfully tested on Exploration Flight Test-1 in 2014. Systima has also contributed to other NASA programs, developing cubesat launch vehicle integration technologies, advanced green monopropellant technologies, and microthrusters.

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MARCH 2018

AA-2 Crew Module Arrival at JSC

AA-2 Launch Booster Static Fire Test

Project Mars at SXSW