

ORION



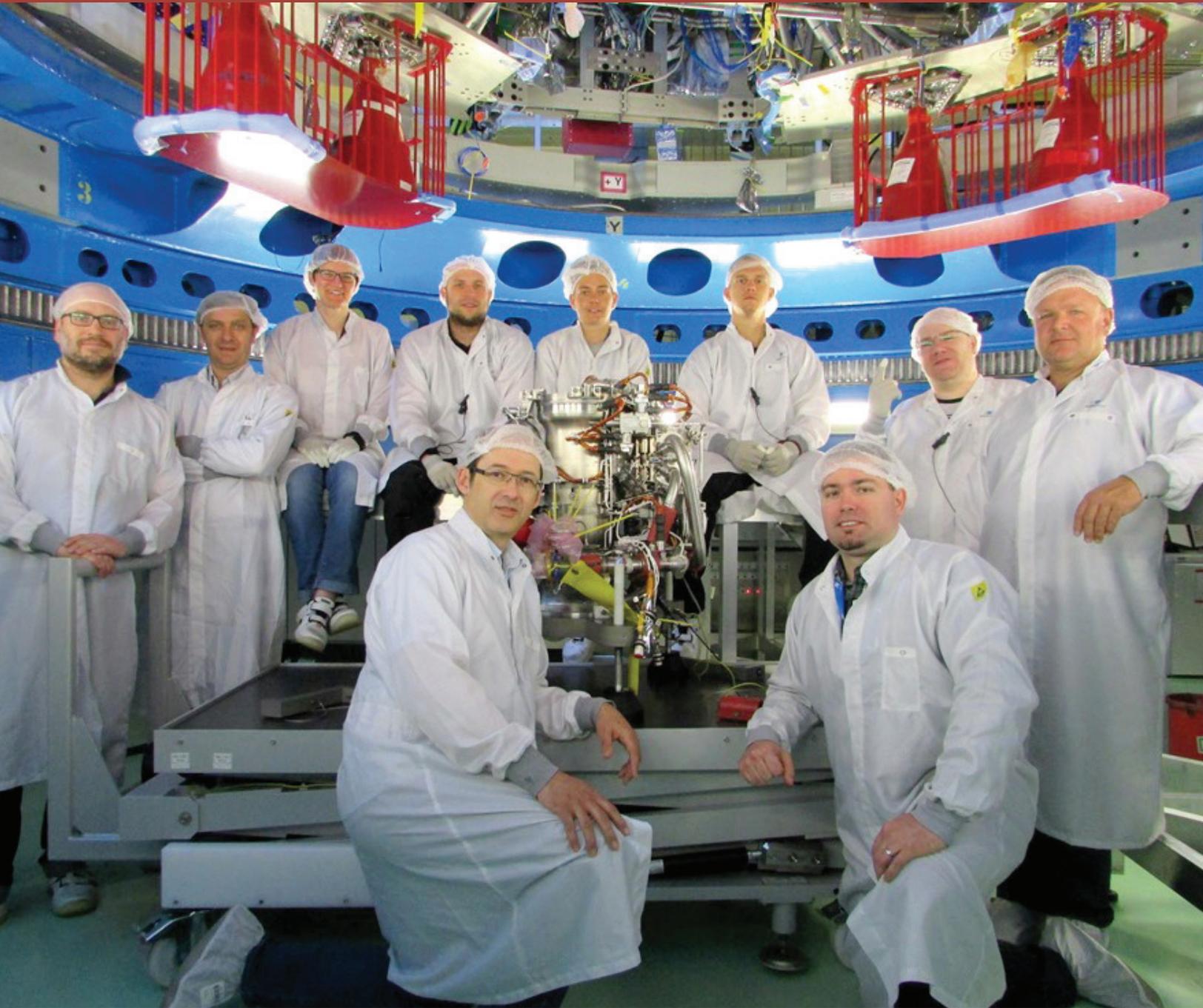
MAY 2018



A Perfect Coupling

Orion's OMS engine gets hitched to the EM-1 service module in Bremen, Germany.

A PERFECT COUPLING



A very special union took place at the Airbus cleanroom in Bremen, Germany.

A proven Orbital Maneuvering System (OMS) engine was mated with ESA's (European Space Agency) European Service Module (ESM) that is currently being assembled in Bremen. This engine will provide the main thrust during Orion's journey to the Moon. It is one of 33 engines that have been installed to date. In addition to the OMS engine, there

are eight auxiliary thrusters and 24 attitude control thrusters. The engine has flown on 19 space shuttle missions and is now prepared for its last mission to lunar orbit.

With this final assembly, all engines are now integrated into the ESM. Pictured here are the combined Assembly, Integration & Test team members from Airbus, ArianeGroup and NASA during the integration of the engine.

EXPLORATION MISSION TESTING & PRODUCTION



Orion teammates from NASA and Lockheed Martin gathered for a picture with the Ascent Abort-2 (AA-2) capsule being outfitted at NASA's Johnson Space Center in Houston for the upcoming flight test of the Launch Abort System.



Lockheed Martin technicians at NASA's Michoud Assembly Facility in New Orleans, Louisiana, completed the forward structure to cone weld on the Exploration Mission-2 crew module pressure vessel.



The Orion Rapid Prototype Lab (RPL) team recently conducted the fifth in a series of "mini-sims" with NASA astronauts and a small team of flight controllers. The team designed and executed complex and innovative simulations of the newly prototyped Orion crew on-orbit burn display formats and electronic procedures. The RPL team gained valuable experience using these displays and procedures in a more realistic scenario with crew members and the ground control team. These evaluations will help to validate or identify areas needing updates to ensure key changes can be made earlier and more economically in the software development cycle. The team consisted of members from Aerospace Applications North America, Barrios Technology, Ames Research Center and interns from NASA and SGT.

AIRBUS TEAM GETS THUMBS UP TO START EM-2 SERVICE MODULE ASSEMBLY



The structure for Europe's second service module for NASA's Orion spacecraft recently arrived at the Airbus clean room in Bremen, Germany.

Technicians are now working to install nearly 7.5 miles of cables, fuel, water and air tanks, computers, engines and other components needed to support astronauts as they venture farther from Earth than any human being has been during Exploration Mission-2 (EM-2).

The European Service Module is a crucial element of Orion, providing support to the crew module that will house up to four astronauts. The crew will travel more than 600,000 miles during EM-2 and fly around the Moon before returning to Earth.

The module provides structural rigidity to the Orion spacecraft much like the chassis of a car. It absorbs the vibrations and energy from launch and protects the crew from micrometeoroids and space debris.

By connecting the crew module to the launcher, it also absorbs the vibrations from NASA's Space Launch System rocket that has the equivalent thrust of 34 jumbo jets – holding everything together for the wild ride into space.

The service module for the first mission – without astronauts – is nearing completion and is set to ship to the U.S. this summer. The production schedule for the service module is going at full speed with Airbus technicians working in shifts 24 hours a day.

The Orion spacecraft is built by NASA with ESA providing the service module. The arrangement stems from the international partnership for the International Space Station.

Read more: bit.ly/ESM2_Arrival

SHAKE, SHUDDER AND SHOUT; TAKING ORION TO THE BRINK



The second uncrewed test flight of NASA's Orion, called Exploration Mission-1 (EM-1), is the first time the Orion spacecraft and the Space Launch System rocket will undergo an integrated launch and travel beyond the Moon. During launch, the rocket engines and solid rocket boosters ignite creating 8.8 million pounds of thrust, producing deafening sound and vibration that shakes the vehicle. It's this intense environment that Orion engineers have studied and worked to mitigate when designing the spacecraft. Before Orion flies on EM-1, the limits of the spacecraft's structures are being taken to the brink in a series of tests at the Lockheed Martin facility near Denver.

An Orion test structure, called the structural test article (STA), was built and is undergoing punishing tests throughout the year that will deliberately take the vehicle's structure to the edge of its design. The tests will simulate the raucous launch and harsh space environment throughout the approximately three-week EM-1 mission that physically affect the structures of the Orion spacecraft. While the STA in Denver is being tested, the Orion for the EM-1 mission is nearly complete and is being assembled in Florida at NASA's Kennedy Space Center in the Operations and Checkout Building.

To enable engineers to catch problems on the ground and prevent them from occurring in space, testing on Orion's structural twin will, in some phases, push expected pressure, vibration and shock conditions up to 40 percent beyond the most severe conditions anticipated during the mission to confirm that the craft can weather any environment it encounters in deep space.

Invaluable to the mission, the tests on Orion's twin in Colorado provide a way to validate Orion structurally, and enable engineers to push that structure past design standards, without slowing down the progress of the EM-1 flight vehicle's construction in Florida.

During a typical mission, Orion goes through multiple configurations, so the testing is broken into different states to mimic the flight configuration and conditions; such as launch, Earth reentry and parachute deployment. They're centered on Orion's three main sections, the crew module, launch abort system (LAS) and service module, which are identical to Orion structurally, but are missing critical non-structural items such as the vehicle's computers, propulsion and seats or its "guts"—not required for these tests.

Learn more: lmt.co/2xLD9Cz

MARK GEYER NAMED JOHNSON SPACE CENTER DIRECTOR



NASA Johnson Space Center's (JSC) mission is to lead human space exploration, and that is exactly what former Center Director Dr. Ellen Ochoa did in her 30 years with NASA. As a pioneer not only as an astronaut and the first Latina center director, but also in diversity and inclusion within the center, Dr. Ochoa will be missed. But as she said in her goodbye, she is leaving JSC in good hands. Mark Geyer was named JSC's newest director, the 12th for the center. He began his NASA career in 1990. Since then, he worked in a variety of human spaceflight fields such as the International Space Station

Program and Orion, which he led as program manager from 2007 through Exploration Flight Test-1 in December 2014. Most recently, Geyer served as the acting deputy associate administrator for the Human Exploration and Operations Mission Directorate at NASA Headquarters in Washington. With experience working with international counterparts, coordinating efforts between different centers around the country, and his direct experience with Orion, Geyer looks forward to leading JSC into deep space exploration and furthering NASA's leadership in human spaceflight.

IN A CLASS OF THEIR OWN



NASA'S 2017 astronaut class recently toured NASA's Kennedy Space Center to get an up-close look at launch pads, test facilities and assembly work on the Exploration Mission-1 Orion spacecraft. They were able to learn more about and see progress towards EM-1, which will test all of

the systems and components in preparation for Exploration Mission-2, the first crewed Orion flight which may be taking one of them farther into space than any astronaut has ever gone before.

STELLAR ORION TEAM MEMBERS RECOGNIZED AT RNASA



The Rotary National Awards for Space Achievement (RNASA) Foundation holds an annual event to recognize outstanding achievements in space and create greater public awareness of the benefits of space exploration. This year's event honored former NASA Acting Administrator Robert Lightfoot with the National Space Trophy and actor William Shatner as the 2018 Space Communicator. Orion team members were recognized for the following achievements and contributions towards getting humans out into deep space:

Early Career Stellar Award

Elishabet Lato of Orbital ATK - Outstanding leadership of the Orion attitude control motor energetics development and qualification, and community service through AIAA leadership and STEM activities.

Middle Career Stellar Awards

Jerry Draper of Lockheed Martin - Outstanding technical achievement in inventing the new Orion heat shield block architecture and upgrading the re-entry design for lunar and Mars mission returns.

William E. Green of Orbital ATK - Outstanding leadership, technical excellence and dedication to the Orion Launch Abort Attitude Control Motor Controls team success.

Late Career Stellar Award

Frank Salazar of CACI - Significant engineering knowledge and expertise contributing to the design of numerous human spaceflight pyrotechnic hardware systems, including multiple parachute elements of the Orion Program.

Team Stellar Awards

Orion Launch Abort System Propulsion Team of Lockheed Martin - Outstanding accomplishment in successfully completing two high-visibility hot fire tests to validate solid rocket motor designs for NASA's Orion Launch Abort System.

Orion Spacecraft Test and Qualification Team of Lockheed Martin - Outstanding execution of the Orion spacecraft test program in support of NASA's Exploration Missions EM-1, EM-2 and beyond.

More details of the 2018 RNASA event can be found at: rnasa.org

Pictured above are the 2018 RNASA Middle Career Stellar Award winners.

INSPIRING GIRLS TO PURSUE STEM

Throughout the year, a group of 3rd-5th grade girls from McWhirter Elementary participated in a STEM afterschool program led by Girls, Inc. in partnership with Lockheed Martin Women's Impact Network members in Houston. The students took part in different experiments, using the engineering process to design acoustical devices, catapults, and rocket launch towers out of everyday materials. In addition, the students learned about notable female scientists and engineers, and also took part in team-building exercises. To end the year with a memorable event, Orion team members put together a tour for the girls to see NASA's Johnson Space Center. Not only were the girls able to see spacecraft mockups, Rocket Park and the Mission Control Center; they were able to meet and talk with women STEM professionals to see what their future may hold. The highlight of their tour was meeting JSC Center



Director Dr. Ellen Ochoa, who shared with them her experience as an astronaut and what they can pursue if they want.

OCEANEERING HOSTS HOUSTON SUPPLIERS



Oceaneering Space Systems hosted a space exploration open house for Houston area suppliers to hear program updates on Orion and the Space Launch System rocket led by Lockheed Martin Orion Deputy Program Manager Larry Price, Boeing Program Manager Mark Mulqueen, and Orbital ATK Vice President Brian Duffy.

Congressman John Culberson (R-TX), made a special appearance at the event to tour Oceaneering's precision machining and fabrication shops and thank the employees for their hard work on the nation's space exploration endeavors.

MAINE CELEBRATES SPACE DAY

Exploration Systems Museum Alliance Liaison Patricia Moore shared NASA's deep space exploration story with five rural schools in Maine during an annual National Space Day education initiative that promotes science, technology, engineering and math to thousands of students across the state. The capstone event at Brunswick Junior High School on May 4 was attended by Senator Angus King (I-ME) and Mike Lippold (at right), advanced development manager at Orion supplier Fiber Materials, Inc., who also led three

classroom presentations and shared the work his company is doing to support Orion's efforts.

Fiber Materials Inc. develops and manufactures high temperature materials and composites for use in industrial, commercial and aerospace applications. The company built three different components for the Orion Launch Abort System attitude control motor using carbon-carbon silicon carbide composite material.



DESTINATION IMAGINATION

Orion team members Matt Lemke (NASA) and Trevor Wagoner (Jacobs), along with Marshall Smith (Exploration Systems Development, NASA HQ) helped staff a NASA booth at the Destination Imagination Global Finals in Knoxville, Tennessee, at the University of Tennessee where nearly 8,000 students from approximately 15 countries attend every year. This year's theme for the NASA exhibit was "Past. Present. Future." with NASA's deep space human exploration programs highlighting the Future section. Attendees were able to experience an Oculus Virtual Reality of SLS on the launch pad and the interior of Orion during a countdown, a 30-ft tall SLS inflatable, interactive games to learn more about Orion, and other information to share how NASA is leading the way back to the Moon and beyond.



SUPPLIER SPOTLIGHT

DAMPING TECHNOLOGY, INC.



Founded in 1989 in Mishawaka, Indiana, Damping Technology, Inc. (DTI) is a small business focused on developing, designing and manufacturing noise and vibration control solutions. DTI was selected as Orion's Small Business of the Year for providing outstanding support to the Launch Abort System (LAS) team. After months of collaboration with Orion engineers, DTI developed a constrained layer damping system to reduce ogive fairing vibration and mitigate the high

dynamic environment impacts to the spacecraft during an abort. Program Managers Mark Kirasich (NASA) and Mike Hawes (Lockheed Martin) awarded DTI the Rigel Award at an Orion Program Management quarterly review in March 2018. Every year, Lockheed Martin presents the Rigel Award to a small business that performs above and beyond their Orion-specific contractual commitments.

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NASA'S NEW SPACECRAFT
FOR HUMAN EXPLORATION:

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JUNE 2018

STEM Day at Fenway Park/Boston
Honeywell recognition in Arizona
Supplier events in Tennessee and New Hampshire