National Aeronautics and Space Administration

NASA

ORION

SUMMER HEATS UP WITH SAFETY FIRST

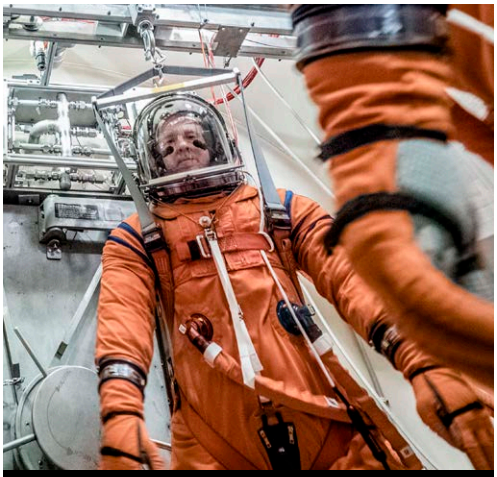
JUNE 2017

ORION'S MONTHLY HIGHLIGHTS

LAUNCH ABORT MOTOR TEST

PARACHUTE TESTING

AIRBAG TESTING



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ORION KICKS OFF SUMMER WITH **SERIES OF SAFETY TESTS**

Engineers working on NASA's Orion kicked off summer with a series of important tests for critical safety systems needed for deep space exploration. From the Utah desert, to the skies over Arizona to one of the world's largest indoor pool in Texas, the team is making sure Orion is safe from launch to splashdown.

LAUNCH ABORT MOTOR TEST

Orbital ATK, Lockheed Martin and NASA Orion team members involved in making the test fire a success.

BELOW: Orbital ATK Technicians prepare abort motor for the test.

At the Promontory, Utah, facility of Orion subcontractor Orbital ATK, engineers successfully tested the abort motor for Orion's launch abort system on June 15, firing the 17-foot-tall motor for its full five-second burn. The motor was fastened to a vertical test stand with its nozzles pointed toward the sky for the qualification test. It produced enough thrust to lift 66 large SUVs off the ground.

The launch abort system is positioned on top of the Orion crew module and will play a critical role protecting future crews traveling to deep space destinations. The abort motor is responsible for propelling the crew module away from the Space Launch System rocket in case of an emergency, and one of three total motors that will send the crew module to a safe distance away from a failing rocket and orient it properly for a safe descent into the Atlantic Ocean if such a situation ever occurs.

The test verified the motor can fire within milliseconds when needed and will work as expected under high temperatures.

PARACHUTE TESTING

The team developing and building Orion's parachute system that ensures the crew module can safely descend to Earth evaluated how the parachutes perform during a scenario in which an abort while on the launch pad is necessary. When Orion returns to Earth from deep space missions beyond the moon, the system will customarily deploy 11 parachutes in a precise sequence to help slow the crew module down from high speeds for a relatively slow splashdown in the Pacific Ocean. But the parachutes must also be capable of sending the crew module to safety if it were to be jettisoned off a failing rocket without time for the full deployment sequence to occur.

In a June 14 test at the U.S. Army Proving Ground in Yuma, Arizona, engineers dropped a mock Orion capsule out of a C-17 airplane at 25,000 feet in altitude to test how the system will fare when only Orion's three main orange and white parachutes deploy. The test evaluated performance when the parachutes experience a low altitude and low dynamic pressure.

Orion's parachutes are in the midst of being qualified for flights with astronauts and put through a variety of normal and failure scenarios over the course of eight total tests to ensure the parachutes can safely help the crew module and the astronauts inside safely descend.

UPRIGHTING SYSTEM

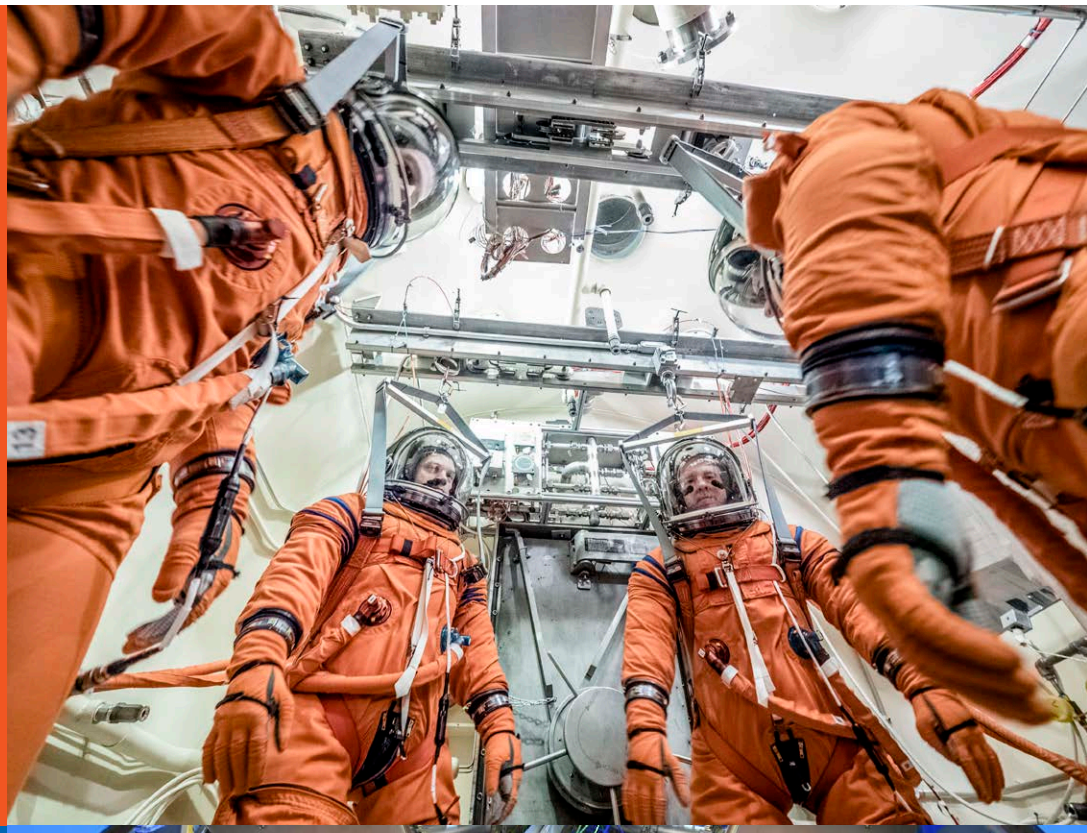
In June the Orion team also evaluated an updated design to the crew module uprighting system, the system of five airbags on top of the capsule that inflate upon splashdown. In high waves or wind over the ocean, the uprighting bags are responsible for turning Orion right side up if the capsule lands upside down or turns over when it returns to Earth. Engineers have retooled the design of the bags after several didn't properly inflate during Exploration Flight Test-1.

The testing took place at the Neutral Buoyancy Lab at Johnson Space Center in Houston, where the team is performing eight tests evaluating the bags during both normal inflation and failure scenarios to validate computer models. The testing in the calm waters of the pool helps the team prepare for a late-summer complement of uprighting system tests in the Gulf of Mexico off the coast of Galveston, Texas.

NASA is building a flexible, reusable and sustainable capability and infrastructure beyond the moon that will last multiple decades and support missions of increasing complexity. Beginning with launch of the first integrated mission of SLS and Orion, this new deep space exploration system will create a capability from which future generations will benefit.

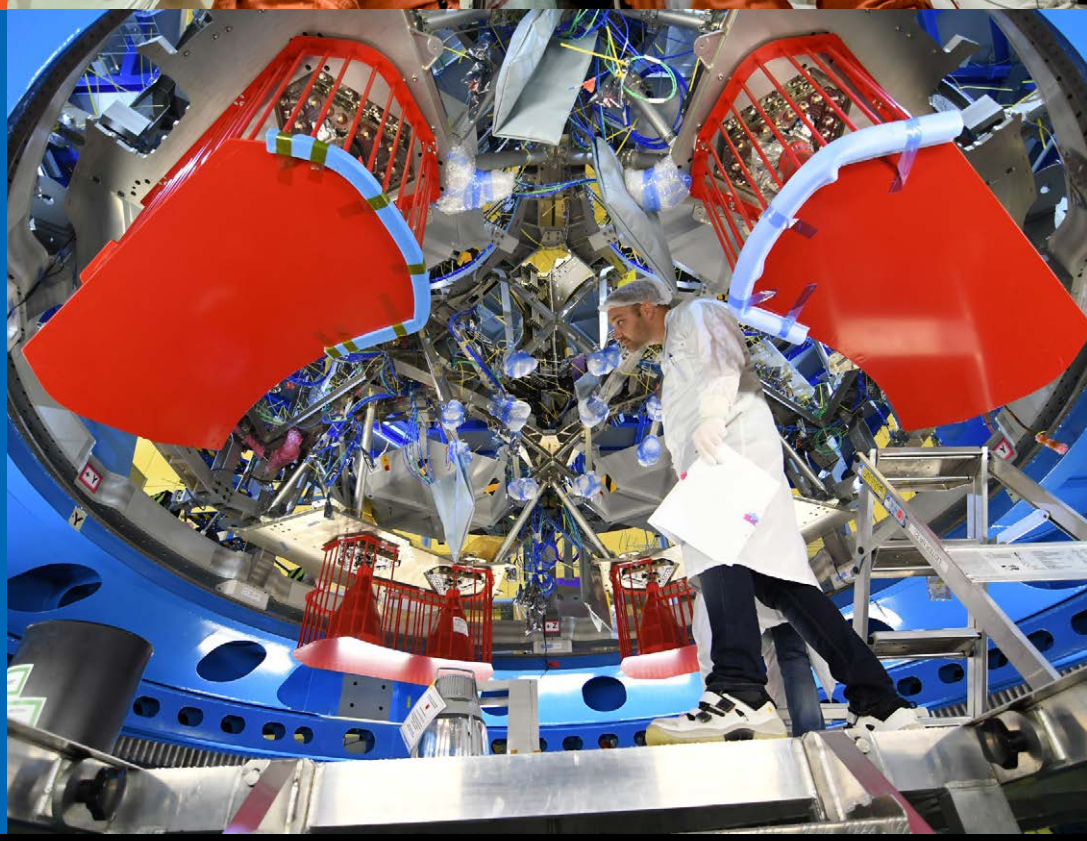
ORION SPACESUITS PUT TO THE TEST

Engineers and technicians at Johnson are testing the spacesuit astronauts will wear in the agency's Orion spacecraft on trips to deep space. On June 22, members of the Johnson team participated in a vacuum pressure integrated suit test to verify enhancements to the suit will meet test and design standards for the Orion spacecraft. During this test, the suit is connected to life support systems and then air is removed from Johnson's 11-foot thermal vacuum chamber to evaluate the performance of the suits in conditions similar to a spacecraft. The suit will contain all the necessary functions to support life and is being designed to enable spacewalks and sustain the crew in the unlikely event the spacecraft loses pressure.



Set to be shipped to the U.S. after the first of the year, European Space Agency's contribution to NASA's Orion spacecraft is taking shape at Airbus in Bremen, Germany. This is no test article—the service module pictured here will fly into space on Exploration Mission-1, past the moon and farther than any other spacecraft built for humans has flown before. The service module will supply electricity, water, oxygen, nitrogen, propulsion and temperature control.

Technicians are working in three shifts a day to complete the service module which will be flown to NASA's Kennedy Space Center in Florida to be mated with the Orion crew module.



ESA PREPARES TO PROPEL **ORION**

TEST VERSION OF ORION CREW MODULE TO VALIDATE SPACECRAFT DESIGN

While flight hardware for NASA's Orion crew module is undergoing work in Florida, near-identical structural test articles for the spacecraft are coming together in a test facility across the country in Colorado. Engineers at Lockheed Martin's Waterton facility near Denver will conduct a series of tests to confirm Orion's design is structurally sound and ensure the spacecraft is ready for deep-space missions.

NASA's Super Guppy aircraft, which carried the Orion test vehicle, arrived at Buckley Air Force Base near Denver on April 26.

Orion's structural test article is comprised of three main elements: a crew module, service module and the launch abort system. Unlike the flight hardware, Orion's structural test articles lack electronics or propulsion systems, except the electronics needed to support testing. During the next few months, the test articles will undergo load, acoustic, vibration, shock and lightning tests. Some tests are done on individual parts, and other parts are tested together to expose the system to stresses expected in flight.

Acoustic testing will simulate the sound the rocket produces and will be used to measure the vibration from the sound to test how it affects Orion. A series of shock tests will ensure shock levels don't exceed what the components have been designed to survive. Simulated lightning tests will monitor how Orion reacts to close or nearby lightning strikes.

NASA is testing Orion to ensure it is ready for its first integrated mission with the agency's new Space Launch System rocket in 2019. During that uncrewed flight test, known as Exploration Mission-1, Orion will travel tens of thousands of miles beyond the moon and return home with a splashdown in the Pacific Ocean.

VICE PRESIDENT PENCE WELCOMES **NEW ASTRONAUT CLASS**

Vice President Mike Pence speaks at NASA's Johnson Space Center in Houston following the introduction of NASA's 2017 astronaut candidate class on June 7. In the front row, from left to right, are Warren Hoburg, Bob Hines, Matthew Dominick, Raja Chari, Zena Cardman, Kayla Barron; back row, from left to right are Jessica Watkins, Frank Rubio, Loral O' Hara, Jasmin Moghbeli, Robb Kulin and Jonny Kim.

Watch the introduction: **bit.ly/2017Astronauts**

President Trump signed an executive order to reestablish the National Space Council, alongside members of Congress, NASA and commercial space companies in the White House on June 30. Vice President Mike Pence will chair the council.

Learn more: **bit.ly/SpaceCouncil**

On June 1, a group of White House guests were taken on a behind-the-scenes tour of the Neil Armstrong Operations and Checkout building (O&C) where payloads are received, assembled and integrated before launch at NASA's Kennedy Space Center in Florida. Participants were informed on the process to ready vehicles and payloads for launch, as well as what Orion experiences on its journey toward Exploration Misison-1.

NASA INTERIM ADMINISTRATOR VISITS BREMEN,GERMANY

On June 21, a joint NASA/ESA team headed by Robert M. Lightfoot Jr., NASA's acting administrator, and David Parker, ESA director of human spaceflight and robotic exploration programs visited the Airbus site in Bremen. The international team meetings focused on progress made on the European service module for NASA's next generation spacecraft Orion.

Lightfoot emphasized the importance of the work done in Europe for the overall Orion mission during a team briefing session with Airbus employees. Parker focused on how the European partnership benefits from ESA's experience in exploration programs including the International Space Station, Automated Transfer Vehicle, ExoMars and Rosetta.

LEAD ORION ENGINEER INSPIRES GIRLSTART ENGINEERS OF TOMORROW

Lead Orion engineer Julie Kramer-White hosted a webchat with a group of more than 50 female 4th-8th graders participating in Girlstart Galaxy Summer camp on June 6. These students participated in a summer camp which taught them what it takes to launch a satellite, live on the International Space Station, land on the moon, explore deep space and more. Kramer showed them the Orion capsule, talked about what's required for Orion to travel beyond the moon and how they could be the team working on Orion in the future.

ORION'S SERVICE MODULE FEATURED AT PARIS AIR SHOW

ESA hosted a pavilion at the 2017 Paris Air and Space Show which took place June 19-25 in northern Paris, France. The show, which was established in 1909, is the oldest air show in the world. ESA's exhibit showcased European missions and technology that will be used in upcoming and current space-related endeavors.

The ESA pavilion at the show highlighted the international cooperation on Orion and the European service module (ESM). The ESM mockup was part of the display and conveyed the goal of making human deep-space travel a reality in coming years.

ESA Director General Jan Woerner spoke about ESA's Space 4.0 initiative, which is described as an era of space-travel marked by a push for commercialization and building relationships between the private and public sector and also across the globe.

NASA has formed a partnership with ESA to work on the Orion spacecraft. ESA is providing the ESM, which will house critical supplies like air, electricity and propulsion mechanisms necessary for deep-space travel.

The service module evolved from ESA's Automated Transfer Vehicle, which sent supplies to the International Space Station.

SUPPLIER SPOTLIGHT

SAN DIEGO COMPOSITES, INC.

Located in San Diego, California, San Diego Composites, Inc. (SDC) is currently constructing key components for the Orion spacecraft. Since 2009, employees at SDC have been providing over 1,000 unique parts for the module. Everything created for Orion needs to be lightweight, strong and able to withstand extreme temperatures and high forces.

Using state-of-the-art digital fabrication techniques and a new large-scale curing autoclave, SDC designed and manufactured large critical structures for the Orion launch abort system. They also are responsible for Orion's ogive panels: large curved panels that encapsulate the crew module. The panels protect Orion's crew module from high shear wind loads during ascent and the exhaust of launch abort motors.

The Orion team at SDC said they enjoy "being part of the team that is working to put mankind into deep space! If you can't get excited about that…check your pulse."

GENERATION BEYOND MARS BUS TRAVELS TO KENNEDY SPACE CENTER

The Lockheed Martin Mars Experience Bus joins the Summer of Mars at the Kennedy Space Center Visitor Complex in Florida. The first immersive virtual reality vehicle that replicates 200 square miles of Martian landscape, the Mars Experience Bus uses video game technology to take guests on a virtual journey across the surface of Mars, complete with rovers already on the Red Planet and a mockup of what the first Mars base camp could look like. The bus has been on a nationwide tour with 33 stops in 12 cities, and has hosted more than 35,000 riders so far.

The Mars Experience Bus is part of Generation Beyond, Lockheed Martin's national education initiative to bring deep space exploration and STEM education to classrooms and homes across the country.

The bus will be added to the myriad experiences and activities that focus on the future of space exploration and Mars missions that make up the Summer of Mars at the Kennedy Space Center Visitor Complex.

TEACHER EXTERNS EXPERIENCE JOHNSON SPACE CENTER

Houston Orion team members hosted teachers from local schools as part of TEAM NASA's annual Teacher Externship Program June 12-16. The teachers who participated were taken behind the scenes to see the diverse backgrounds and skill sets necessary for a team to successfully execute a program as big as Orion.

After gaining perspective of NASA's Orion Program, teachers are able to develop new lesson plans based upon real-life engineering examples. Implementing these lessons in their 6th-8th grade classes in the upcoming year will increase their students' experience and excitement for STEM fields.

FOLLOW THE PROGRESS OF NASA'S NEW SPACECRAFT FOR HUMAN EXPLORATION:

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JULY

Vice President Pence visits Kennedy Space Center

Water Egress Testing in Gulf of Mexico

Ogive Panel Testing at Plum Brook