National Aeronautics and
Space Administration

ORION

NOVEMBER 2017

ASCENSION TO SAFETY

NASA MOVES UP CRITICAL SAFETY TEST

NASA's Orion spacecraft is scheduled to undergo a flight test in April 2019 of its launch abort system (LAS), which is a rocket-powered tower on top of the crew module built to quickly get astronauts safely away from the launch vehicle if there is a problem on the pad or during ascent.

This full-stress test of the LAS, called Ascent Abort Test-2 (AA-2), will see a booster, provided by Orbital ATK, launch from Cape Canaveral Air Force Station in Florida, carrying a fully functional LAS and a 22,000 pound Orion test vehicle to an altitude of 32,000 feet at Mach 1.3 (over 1,000 mph). At that point, the LAS' powerful reverse-flow abort motor will fire, carrying the Orion test vehicle away from the missile. Timing is crucial as the abort events must match the abort timing requirements of the Orion spacecraft to the millisecond in order for the flight test data to be valid.

NASA is accelerating the timeline of the test to provide engineers with critical abort test data sooner to help validate computer models of the spacecraft's LAS performance and system functions.

The test will verify the LAS can steer the crew module and astronauts inside to safety in the event of an issue with the Space Launch System (SLS) rocket, when the spacecraft is under the highest aerodynamic loads it will experience during a rapid climb into or beyond orbit for deep-space missions. Engineers at several NASA centers already are building the Orion test article that has many of the design features and the same mass as the capsule that will carry crew.

Because the test is designed to evaluate Orion's launch abort capabilities, the crew module used for AA-2 will not deploy parachutes after the abort system is jettisoned, nor will it have a reaction control system with thrusters that help orient the capsule for a parachute-assisted descent and splashdown after the LAS is jettisoned.

In 2010, an earlier version of Orion's LAS was successfully tested to evaluate the performance of the system during the Pad Abort-1 Flight Test at the White Sands Missile Range in New Mexico. For Exploration Mission-1, NASA's first integrated flight test of Orion atop the powerful SLS – the abort system will not be active because the test flight is uncrewed.

Read more: http://bit.ly/AA2MovedUp

EXPLORATION MISSION UPDATE

NASA provided an update on the first integrated launch of the Space Launch System (SLS) rocket and Orion spacecraft after completing a comprehensive review of the launch schedule. This uncrewed mission, known as Exploration Mission-1 (EM-1) is a critical flight test for the agency's human deep space exploration goals. EM-1 lays the foundation for EM-2, the first crewed flight of SLS and Orion, and future missions around the Moon and beyond.

The review followed an earlier assessment where NASA evaluated the cost, risk and technical factors of adding crew to the mission, but ultimately affirmed the original plan to fly EM-1 uncrewed. The majority of work on NASA's new deep space exploration systems is on track. The agency is using lessons learned from first-time builds, such as Orion's Exploration Flight Test-1, to drive efficiencies into overall production and operations planning.

To address schedule risks identified in the review, NASA established new production performance milestones for the SLS core stage to increase confidence for future hardware builds. NASA and its contractors are supporting ESA's (European Space Agency) efforts to optimize build plans for schedule flexibility if subcontractor deliveries for the service module are delayed.

NASA is using advanced manufacturing techniques on the Orion spacecraft and SLS rocket that have helped to position the nation and U.S. companies as world leaders in this area. For example, NASA is using additive manufacturing (3-D printing) on more than 100 parts of Orion. While building the two largest core stage structures of the rocket, NASA welded the thickest structures ever joined using self-reacting friction stir welding.

SLS has completed welding on all the major structures for the mission and is on track to assemble them to form the largest rocket ever built and complete the EM-1 "green run," an engine test that will fire up the core stage with all four RS-25 engines for a full duration, eight and a half minute burn.

NASA will reuse avionics boxes from the Orion EM-1 crew module for the next flight, Exploration Mission-2 (EM-2). Avionics and electrical systems provide the "nervous system" of launch vehicles and spacecraft, linking diverse systems into a functioning whole.

For ground systems, infrastructure at NASA's Kennedy Space Center in Florida is intended to support the exploration systems including launch, flight and recovery operations.
The center will be able to accommodate the evolving needs of SLS, Orion, and the rockets and spacecraft of commercial partners for more flexible, affordable, and responsive national launch capabilities.

EM-1 will demonstrate safe operations of the integrated SLS rocket and Orion spacecraft, and the agency currently is studying deep space gateway concepts with U.S. industry and space station partners for potential future missions near the Moon.

More: http://bit.ly/Nov17EM1

PARACHUTES PROTECTED… CHECK!

On its next flight, Exploration Mission-1 (EM-1), Orion will come screaming into the atmosphere from the Moon at a whopping 24,700 mph. The aeroshell – composed of critical heatshield and back shell components – protects the capsule from harm during extreme conditions of re-entry.

Then, a series of 11 parachutes deploy 24,000 feet above the ground and carry Orion to a soft water landing. However, in order for that to happen, a portion of the back shell must jettison off at precisely the right time, revealing the drogue parachutes, which slow and stabilize Orion, and the three main, 300-pound parachutes that slow Orion's speed.

This piece of hardware is called the forward bay cover – and this crucial component for EM-1 was recently moved from its home in Denver to the Operations & Checkout Building at NASA's Kennedy Space Center in Florida. There, it will be integrated with Orion in preparation for the spacecraft's 2019 test flight, EM-1.

Parachutes aren't made to withstand the 5,000-degree temperatures that Orion will endure upon re-entry, so the forward bay cover protects them until just the right moment. The forward bay cover is made out of titanium – a material that is the apex of feather-weight and herculean strength. It's perfect for spaceflight, where every additional pound is more costly.

The forward bay cover is affixed above the portion of the back shell that houses the parachutes, and it is attached with fasteners controlled by a mechanism. At the exact altitude when the parachutes must deploy, the mechanism activates and the forward bay cover is jettisoned off in an impressive fashion. This jettison is followed by the parachute deployment sequence, and Orion floats down and gently lands on the ocean's surface.

The jettison mechanism is quick and powerful – generating thrust equal to 26,250 pounds of force, launching the 1000-pound forward bay cover away from the capsule. During separation, the cover accelerates to a speed of almost 30 mph in a little over half a second.

In the greater context of the landing sequence, the jettison and parachute deployment are the last major events to occur before splashdown. Once Orion lands on the ocean's surface, inflatable up-righting bags deploy, orienting the capsule to a stable configuration for crew recovery. All of these are features of the spacecraft's Landing and Recovery System.

Video: http://bit.ly/OrionFwdBay

LAUNCH ABORT MOTORS TESTED AND APPROVED

The team at Orbital ATK's Promontory facility in Utah successfully completed acceptance hydro-testing of the Launch Abort System Qualification Motor-2 abort motor manifold. Each manifold undergoes a hydrostatic pressure test for product acceptance. The test requires a special set of tools developed specifically to impart loads on the manifold similar to those experienced during abort motor operation. A successful test proves that the product performed as designed, is acceptable and within expected parameters. This acceptance paves the way for internal insulation assembly and ultimate preparation for a cold motor conditioning static test firing planned for the end of 2018, which brings Orion another step closer to readiness for Exploration Mission-2.

CREW RECOVERY RAFTS TESTED AT TEXAS A&M

The Orion Crew Survival System team performed two days of wave pool testing at Texas A&M University in College Station, Texas to evaluate a prototype raft and survival equipment. Two life raft designs were tested in high-wind conditions to determine their resilience to gusting winds as well as protecting the crew from sea spray and wind-driven rain effects. Engineers practiced deploying the survival kits and personal equipment, simulating a landing in unexpected conditions, including a need to contact military or civilian rescue forces.

Four test subjects representing the maximum and minimum potential astronaut height and body measurements evaluated their ability to board and deploy overhead exposure canopies. They also had to remove their survival suits in the life raft to simulate landing in a warm climate where crew comfort may be enhanced by getting out of the suits.

Wind testing proved that the team's designs could meet the demanding ocean environment and provided Orion capsule tether line tension data critical to designing and manufacturing several components of the vehicle interior. This testing signifies a cornerstone in detailed and comprehensive hardware design and analysis on the road to flight certification for EM-2, ensuring that astronauts returning from the Moon or Mars will be ready and capable to survive in some of the world's most challenging and dynamic environments.

SERVICE MODULE PROPULSION READY TO GO

Felix Rettig (PDE Project Manager) and one of the PDE flight models in front of the Orion European Service Module.

Propulsion is one of the key functions of Orion's service module, as its 33 engines will ensure Orion's safe travel to the Moon, beyond and back to Earth.

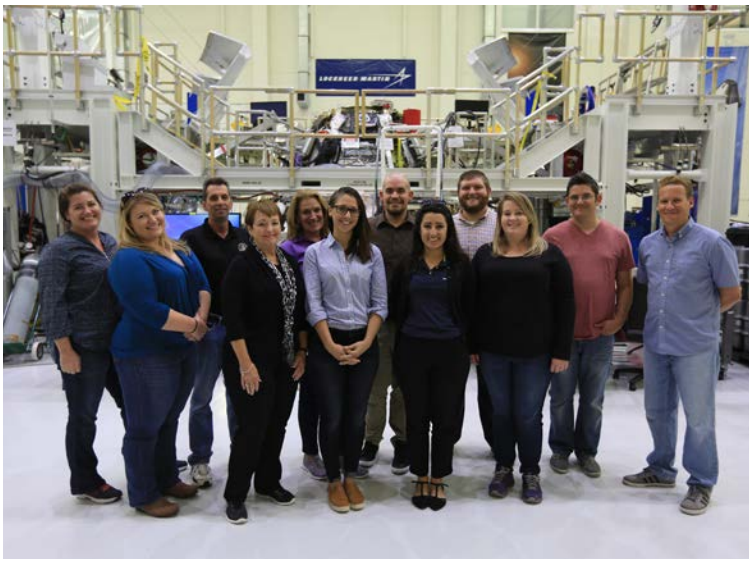
To operate this complex propulsion system smoothly, the propulsion drive electronics (PDE) play a vital role. They have been designed, developed and built by the Avionics Engineering and Design department of Airbus Defense and Space in Bremen, Germany.

The service module will be equipped with two PDE boxes for required redundancy and failure tolerance. They will be connected to the vehicle management controller, located in the Orion crew capsule, and form part of the whole propulsion system together with the engines, tanks, pipelines and sensors.

The PDE's software has been developed to the highest level of ESA and NASA standards to ensure extreme failure tolerance, which ensures mission success and astronaut safety.

FLORIDA CONGRESSIONAL DELEGATION VISITS ORION

The district directors of the Florida congressional delegation for the U.S House of Representatives and Senate pause for a photo in front of the Orion crew module during a tour of the high bay in the Neil Armstrong Operations and Checkout Building at NASA's Kennedy Space Center in Florida. Orion is undergoing processing to prepare it for its first uncrewed integrated flight atop the Space Launch System rocket on Exploration Mission-1. Twelve directors attended the tour, including Sean Beaudet, constituent advocate for Senator Bill Nelson; Patrick Gavin, district director for Congressman Bill Posey; and Dale Ketcham, chief of Strategic Alliances for Space Florida.



SMITHSONIAN: STEM IN 30

How are we going to get astronauts to Mars and back safely? How many crew will be making this trip? And how big will this rocket have to be? These questions and more are answered as STEM in 30 looks at Orion, a spacecraft built to take humans farther than they have ever gone before.

View: http://s.si.edu/2nxHBiZ

SUPPLIER SPOTLIGHT

AMRO Fabricating Corporation

Out in Southern California, AMRO Fabricating Corporation has met two major milestones worthy of celebration. This small business in Historically Underutilized Business Zones (HUBZones) with locations in South El Monte and Moreno Valley, completed the first part of the Exploration Mission-2 crew module, and also celebrated its 40th Anniversary in November. AMRO is currently led by CEO Mike Riley, who is the third generation to lead the company his family started.

Using precision machining, complex forming, heat aging and processing, AMRO manufactures critical primary structures which form the top portion of the Orion crew module. Previously, AMRO contributed primary structures for other NASA programs, such as the Space Shuttle Program. The company is also currently contributing to the development of the Space Launch System rocket by building all 80 core stage barrel panels.

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

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DECEMBER

EM-2 crew module first weld at Michoud

Colorado Supplier Visits

2017 Orion Employee Recognition

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