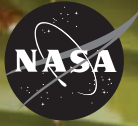


National Aeronautics and  
Space Administration

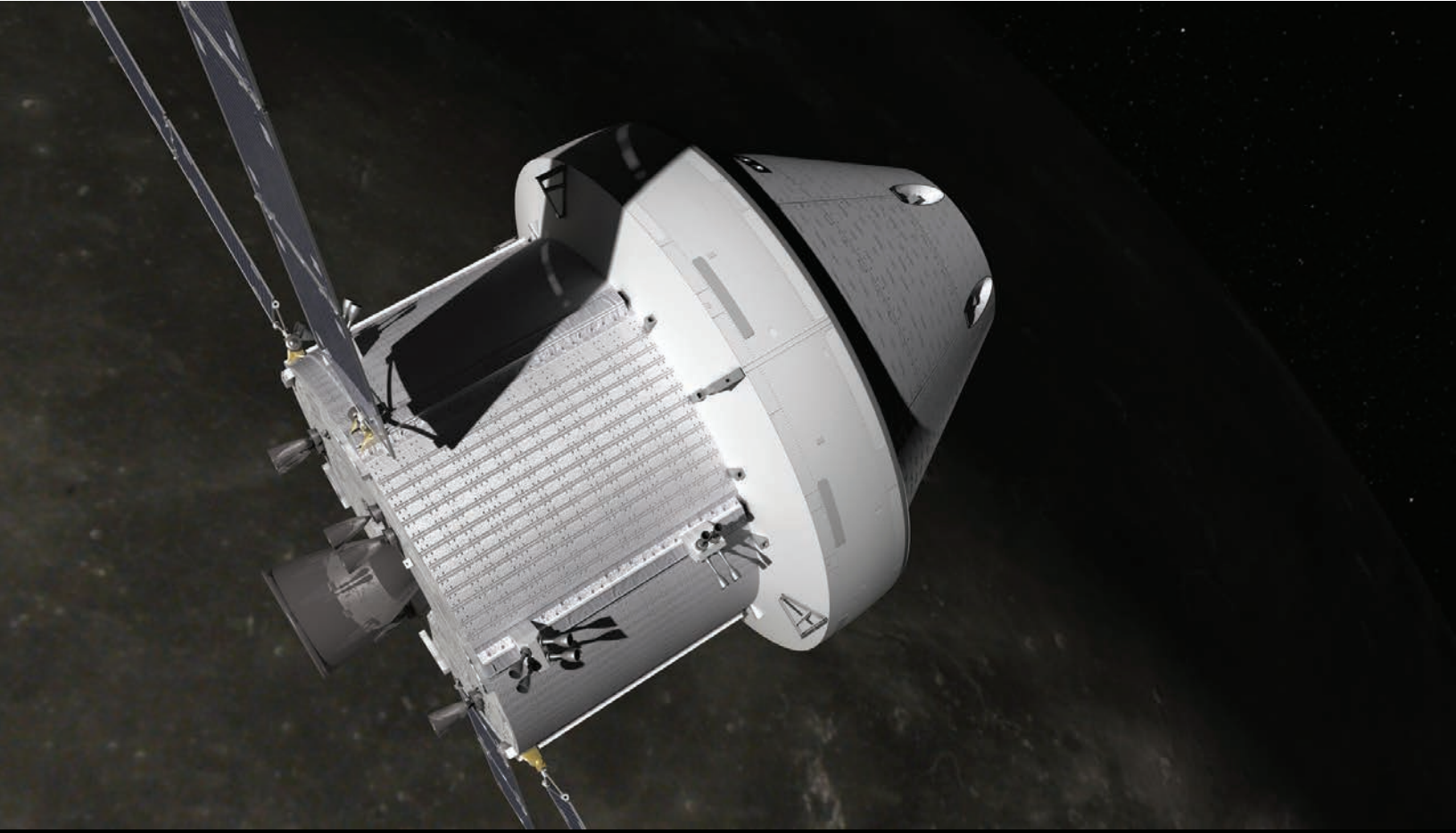


# ORION

OCTOBER 2015

# PROCEEDING TO PRODUCTION





# ORION PROGRAM MARKS PROGRESS WITH CRITICAL DESIGN REVIEW

On Oct. 21, NASA held a Critical Design Review to evaluate the design readiness of the Orion spacecraft being developed to send astronauts to deep space destinations, such as asteroids and eventually Mars. The results of this review will be briefed to agency leaders in the coming months.

The Critical Design Review was carried out over the past 10 weeks by engineers at NASA and prime contractor Lockheed Martin. Clearing the Critical Design Review means that the Orion design is mature and ready to move ahead with full-scale fabrication, assembly, integration and testing.

The evaluation included a review of common aspects of both spacecraft for Exploration Missions (EM)-1 and 2, such as the spacecraft's structures, pyrotechnics, launch abort system,

guidance, navigation and control and software, among many other elements. Systems unique to EM-2, the first crewed Orion mission, will be addressed at a later critical design review.

Across the country, elements of the Orion spacecraft are coming together for the first integrated mission atop the Space Launch System (SLS) at the spaceport launch complex at the Kennedy Space Center. At NASA's Michoud Assembly Facility in New Orleans, welding began in September on the EM-1 Orion spacecraft. In November, NASA will see the arrival of a test version of Orion's service module, provided by ESA (European Space Agency), for testing and analysis at NASA Glenn Research Center's Plum Brook Station near Sandusky, Ohio.

► [Read the full story](#)



## MARK KIRASICH NAMED ORION PROGRAM MANAGER

NASA has appointed Mark Kirasich to be manager of the agency's Orion Program. Kirasich has been deputy Orion Program manager since 2006, and has been serving as acting director since August, when prior Program Manager Mark Geyer was named deputy director at NASA's Johnson Space Center.

Kirasich is responsible for oversight of design, development and testing of the Orion spacecraft, as well as spacecraft manufacturing already underway at locations across the country and in Europe for ESA.

► [Read the full story](#)

## ASTRONAUTS PRACTICE POST-SPLASHDOWN EXIT STRATEGIES

When astronauts come home in Orion from deep-space missions, they'll need a strategy for a safe and efficient exit. At NASA's Johnson Space Center's Neutral Buoyancy Laboratory (NBL), teams performed a series of tests Oct. 6-8 to evaluate the most efficient way for astronauts to get out of the spacecraft after weeks or months away from Earth.

While engineers around the country are developing and building systems to support crews far from Earth in the harsh environment of space, teams also are continuing to develop techniques to ensure the final phase of the astronauts' journey – getting back to dry land – is successful.

The facility's 6.2-million-gallon pool is primarily used to train astronauts underwater for spacewalks and provides a controlled environment where recovery personnel can practice techniques to assist people getting out of a test version of the Orion crew module. The facility was previously used to develop operations to approach and harness Orion after its first splashdown during Exploration Flight Test-1 (EFT-1), and to develop manual uprighting procedures that may be necessary in the event of an emergency.

During the three-day testing, personnel simulated approaching Orion as if it were floating in the Pacific Ocean and what it would take to assist the crew as they exit. They also evaluated the layout of equipment inside the spacecraft that affects exit and the gear used during the recovery process.

Team members from NASA's Orion and the Ground Systems Development and Operations Programs are demonstrating and evaluating the procedures, and a team from several branches in the Department of Defense specially trained in rescue techniques is providing insight into ways to efficiently get the crew out, including in a case where the crew is incapacitated. The work builds upon the development and execution of recovery procedures and equipment used for the uncrewed EFT-1, which will be modified from lessons learned and used during Exploration Mission-1, NASA's first flight of Orion atop the Space Launch System rocket.

► [Read the full story](#)

► [Watch the NBL video](#)

► [Backstage Pass video with Astronaut Mike Fincke](#)



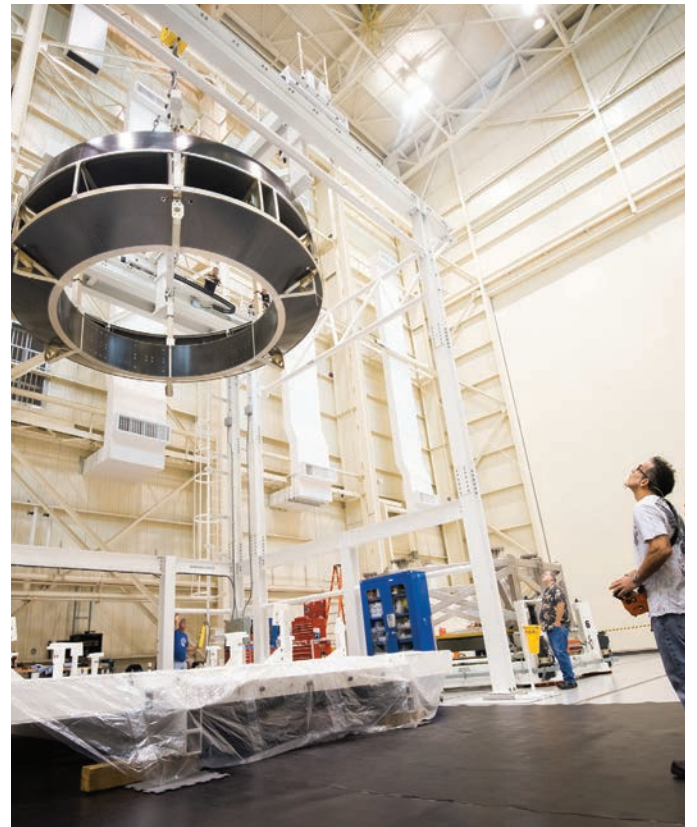
NASA astronaut Suni Williams exits a test version of the Orion spacecraft at the NBL in Houston.

# NASA PREPARES TO TEST ORION SERVICE MODULE

NASA is preparing for a series of tests that will evaluate the Orion European Service Module, a critical part of the spacecraft that will be launched on future missions to an asteroid and on toward Mars.

Test engineers will use a large vibration table and acoustic chamber in the Space Power Facility at NASA Glenn Research Center's Plum Brook Station to mimic the shaking and noise the service module will experience during its powerful ascent into space. The testing allows engineers to make sure flight hardware is properly built and will perform to NASA's crew safety and flight requirements. Engineers are using a "building block" approach to testing in which they evaluate each piece as the elements composing the service module are stacked atop each other to validate the module.

Pictured below: Lockheed Martin technicians lift the Orion Crew Module Adapter Structural Test Article at NASA Glenn Research Center's Plum Brook Station. The adapter will connect Orion's crew module to a service module provided by ESA and Airbus Defence & Space.



## SECOND WELD FOR ORION PRIMARY STRUCTURE

Engineers at NASA's Michoud Assembly Facility in New Orleans continue to weld together the primary structure of the Orion spacecraft for Exploration Mission-1. Technicians recently joined the spacecraft's barrel section, which is the round middle part of the spacecraft, to the aft bulkhead, which is the bottom portion of the crew module. Orion's primary structure is composed of seven large pieces that are put together in detailed order. Orion's three cone panels will be welded together next. Once completed, the pressure vessel will be shipped from Michoud to the agency's Kennedy Space Center in Florida, where Orion's systems and subsystems will be integrated and processed in the Neil Armstrong Operations and Checkout Facility before launch atop NASA's Space Launch System rocket.



## LOCKHEED MARTIN UNVEILS TWO NEW LABS FOR EM-1 SPACECRAFT COMPONENTS

Lockheed Martin's Orion team officially opened two new test labs on Oct. 28 near NASA's Johnson Space Center. Mike Hawes, Lockheed Martin Orion vice president and program manager, presided over their ceremonial ribbon cuttings.

The Video and Camera Test Lab (VCTL), pictured above, will develop components that comprise a fully integrated camera and video processing capability for the upcoming Orion exploration missions. The VCTL will also provide component system level testing during the development phase and will support component acceptance and qualification testing of engineering development units and flight level components.

The Hatch Development Test Lab will be used to fully assemble and test the engineering development units

for the Orion crew module side hatch and the Launch Abort System (LAS) hatch. This lab provides space and equipment for subcomponent assembly, subcomponent tests, hatch level assembly and rigging, side hatch installation into a pressure vessel, LAS hatch installation into an ogive panel, hatch functional and life testing and human-in-the-loop testing.

The lab's close proximity to the hatch design team in Houston (pictured below) facilitates development and real-time improvement of assembly procedures, as well as troubleshooting for any design issues that may be identified during testing. The Hatch Development Test Lab will play a crucial role in the accelerated development of a fully functional side hatch and LAS hatch to fly on Exploration Mission-1. This is part of the team's efforts to accelerate systems needed to support crewed missions.

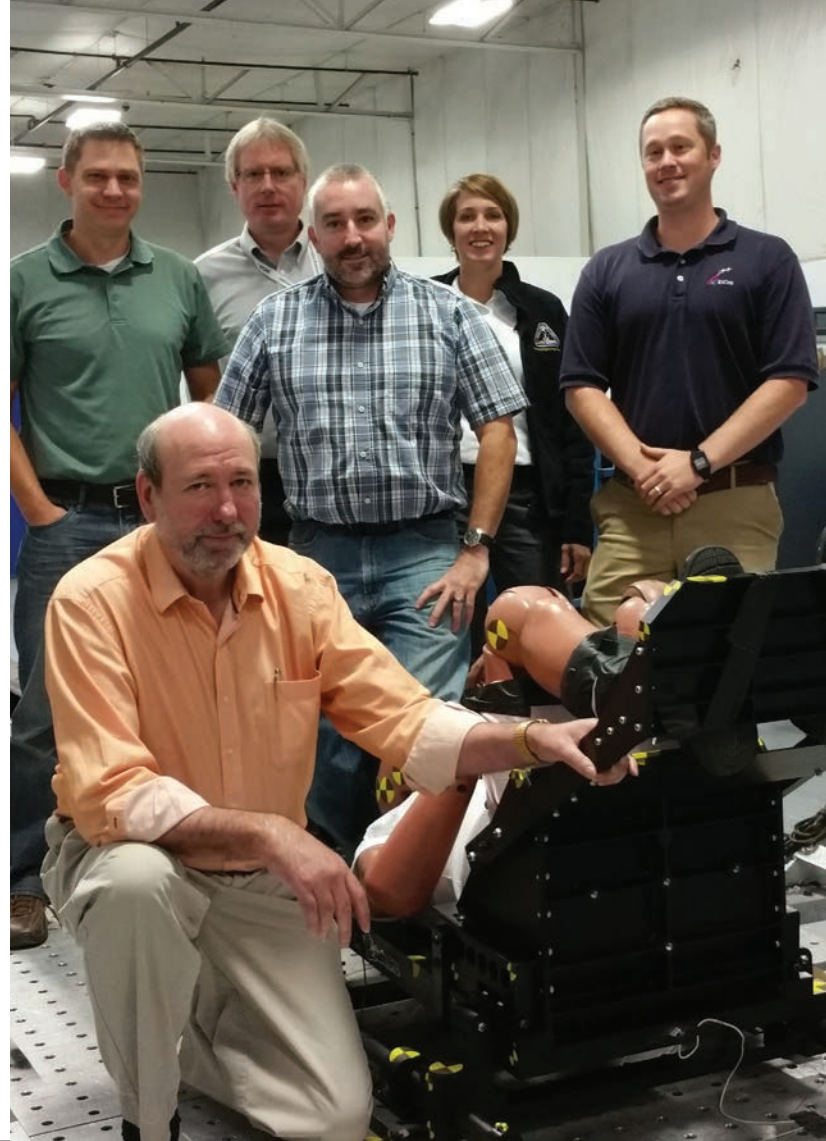


# DYNAMIC TESTING MAKES AN IMPACT

On Oct. 5-6, the Crew Impact Attenuation System (CIAS) team (pictured right) conducted dynamic impact testing on a fully assembled development unit in preparation for the Orion water impact test series and flight development work that will evaluate how the spacecraft endures splashdown in the Pacific Ocean. The test article emulates the Orion crew module interface to the seat pallet that will accommodate the astronauts. This marks the first time the CIAS in a fully assembled configuration has been tested.

Testing was carried out at MGA Research Laboratories in Troy, Michigan, on a high-G sled. Using a simplified crew seat and instrumented anthropomorphic test devices, the team tested the highest acceleration that the Orion test article will experience during the water impact test series, which will be conducted at NASA's Langley Research Center in Hampton, Virginia.

The primary objective of the testing was to characterize the performance of the CIAS engineering development unit design for the test series and assess how well the system performs versus the predicted performance. Through this process, the team will determine how the system will be designed, tested and built for exploration mission flight landing acceleration. Initial examination of the test data shows that the CIAS was successful in reducing loads the crew will experience upon splashdown.



# ASPIRING STUDENT ENGINEERS HELP BUILD ORION SIMULATOR

With guidance and mentoring from experienced Orion engineers, University of Texas at Tyler engineering students will gain valuable hands-on experience in building real spacecraft hardware.

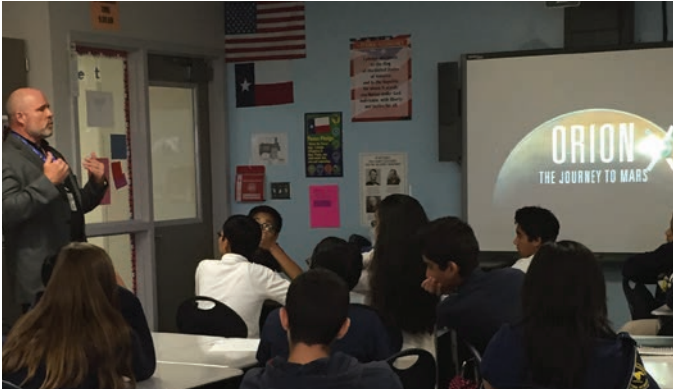
One group of students will design and fabricate display unit back plate mounting surfaces and interface blocks used to position the display in the prototype Orion cockpit. A separate group of students will design, fabricate and integrate a prototype cursor control device into a ground-based mockup seat that will allow users to interface with prototype Orion displays and controls.

These students will learn about range of motion and adjustments required for varying arm and hand lengths, and how to operate precision milling, drilling and cutting tools, such as mills and lathes, to build the items. When completed and fully inspected, the hardware will be installed in the Rapid Prototype Lab orbit and ascent/entry simulators at NASA's Johnson Space Center.



# ORION TEAM MEMBERS SHARE THE EXCITEMENT OF SPACE EXPLORATION

During October, several Orion team members visited schools and other community organizations to share highlights from Orion's first spaceflight – EFT-1 – as well as progress toward the upcoming exploration missions that will venture beyond the moon and into deep space.



Pictured above, Joe Voor of the NASA Flight Test Management Office presented an overview of Orion flight tests to students at the Briarmeadow Charter School in West Houston, a Houston school that serves K-8th-grade students who are expected to

push themselves academically, intellectually and socially to prepare for leadership roles in society. Also in Texas, Lockheed Martin Orion Deputy Program Manager Larry Price visited the University of Texas at Dallas on Oct. 23 to highlight the Orion program for the Texas Astronomical Society of Dallas, and Orion Crew Module Engineering Deputy Blaine Brown presented an Orion progress update at Rice University in Houston.

Lockheed Martin Orion engineers also made several presentations throughout Colorado. Jennifer Daniel, Doris Hammer, John Marcantonio, Colin Nugen and Blake Watters hosted tutoring sessions for students at Columbine High School in Littleton; Sean O'Dell spoke at Career Day at Rogers Elementary School in Colorado Springs; and Jim Paradise presented an Orion update at the Denver Museum of Nature and Science.

In addition, fellow Lockheed Martin engineers Josh Ehrlich and Chris Homolac participated in the first-ever STEM Wars held in Parker, Colorado, where they spoke to approximately 950 elementary and middle school students on ways to "Use the Force", an interactive experiment that showed kids how magnetic forces impact objects, motion, and energy on Earth and in space.

## CCISD HIGH SCHOOL MASCOT PATCHES FLY HIGH WITH NASA & ORION

Mementos from EFT-1 are now hanging on the walls of high schools throughout Clear Creek Independent School District schools near NASA's Johnson Space Center, thanks to the Center, the Orion Program and Lockheed Martin.

Representatives from NASA (Paul Marshall) and Lockheed Martin (Linda Singleton, Joe LeBlanc and Kara Denny) made special presentations to Project Lead the Way students from all five district high schools, their teachers and principals during the Oct. 15-17 lineup of home football games.

The local aerospace leaders presented plaques featuring patches of each school's mascot which were flown on Orion's first flight last year. The school district's Project Lead the Way program prepares students for post-secondary education and careers in science, technology, engineering and math.

► [Read the full story](#)



Presentations made to Clear Brook and Clear Springs high schools.

## ORION SUPPLIERS VISITED

NASA and Lockheed Martin Orion Program Managers met with the UTC Aerospace Systems team in Windsor Locks, Connecticut on Oct. 6. The team provides critical control systems, including active thermal control, pressure control, power control and switching hardware for Orion. On Oct. 7, Lockheed also toured Teletronics Technology Corp. in Newton, Pennsylvania. The Teletronics team provided 1,200 sensors for the EFT-1 development flight instrumentation.

► [Watch the Fox WXTF-TV Story](#)



## NEWS MEDIA COVER ORION LATEST ACCOMPLISHMENTS

CNBC aired a feature entitled “Meet NASA’s Orion Spacecraft” on Oct. 12. NASA Orion Program Manager Mark Kirasich was interviewed by Janet Shamlian in the Orion mockup at NASA’s Johnson Space Center.

► [Watch the video](#)

NASA Orion engineer Nujoud Merancy is featured in “American Scientist” magazine’s current issue, talking about mission planning for Orion and last December’s EFT-1 mission.

► [Read the full story](#)



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

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## NOVEMBER:

[ESA Structural Test Article Arrival at Plum Brook Station](#)

[Orion Flight Crew Module Cone Panel Welds](#)

[Final Crew Module Pathfinder Closeout Weld](#)

[Space Commerce Conference in Houston](#)