

National Aeronautics and  
Space Administration



# ORION

MARCH 2015

**NASA'S ORION SPACECRAFT  
CONTINUES ON THE AGENCY'S  
JOURNEY TO MARS**





## NASA'S ORION FLIGHT TEST YIELDS CRITICAL DATA AS ENGINEERS REFINE SPACECRAFT FOR NEXT MISSION

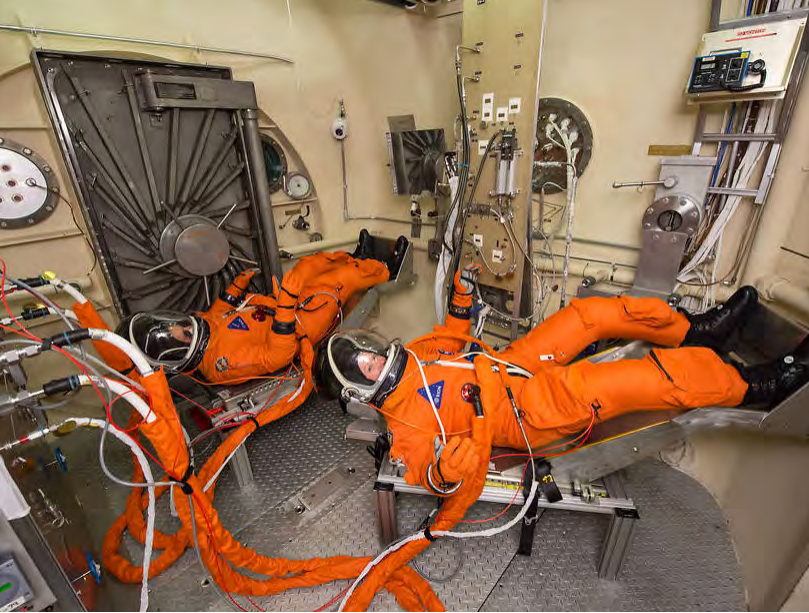
NASA's Orion spacecraft continues on the agency's journey to Mars as engineers analyze data from the spacecraft's December flight test and make progress developing and building the spacecraft for its first mission atop NASA's Space Launch System (SLS) heavy-lift rocket. On future missions, Orion will transport astronauts to an asteroid and onward toward the Red Planet.

At machine shops across the country, elements of the primary structure for the next Orion to fly in space are coming together. Avionics components are being built and simulators for the ESA (European Space Agency) built service module that will house the spacecraft's propulsion and power systems are being delivered. By early next year, engineers plan to have the primary structure for Orion's next mission to NASA's Kennedy Space Center in Florida for processing. Meanwhile, every piece of data and each element of the spacecraft flown in the December test is being analyzed and compared to pre-flight models to improve Orion's design.

In March, the heat shield was delivered to NASA's Marshall Space Flight Center in Huntsville, Alabama, where the ablative material on the heat shield is being removed. From there, the heat shield structure will be shipped to the agency's Langley Research Center in Hampton, Virginia, where it will be reused on a test capsule for water impact testing.

Evaluating how the thermal protection system fared during Orion's reentry wasn't the only critical objective of the flight. The test also provided important insight into key separation events, including whether the Launch Abort System and protective fairings came off at the right times, how effectively the parachutes slowed Orion during descent, and how the operations to recover Orion from the Pacific Ocean progressed. Orion's flight test yielded millions of elements of data, every piece of which is providing unique insight into how to improve the spacecraft's design so that it can safely transport astronauts on their way to Mars and bring them home.

► [Read the full story](#)



# ADVANCEMENTS IN THERMAL PROTECTION MATERIALS CHANGE THE GAME FOR ORION

Just as old clunky ink jet printers from the 1990s evolved into today's state-of-the-art 3-D printers, thermal protection materials used on NASA spacecraft are getting a facelift—a major three-dimensional one.

Engineers used the original material, called two-dimensional carbon phenolic, in the past on the space shuttle to protect it from the rocket flames during launch, on planetary exploration probes and on the 10-inch disc-shaped compression pads on NASA's Orion spacecraft, which flew in space on its first flight test in December 2014.

## ASTRONAUT SPACESUIT TESTING FOR ORION SPACECRAFT

Engineers and technicians at NASA's Johnson Space Center in Houston are testing the spacesuit astronauts will wear in the agency's Orion spacecraft on trips to deep space. On March 17, 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, known as the modified advanced crew escape suit, is a closed-loop version of the launch and entry suits worn by space shuttle astronauts. 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.

This is the first in a series of four tests with people in the suits to evaluate the performance of the spacesuit systems in an environment similar to a spacecraft.



But for Orion's next flight and on the journey to Mars, engineers have developed a more efficient material to replace carbon phenolic called three-dimensional multi-functional ablative thermal protection (3D-MAT).

The material was developed by NASA's Ames Research Center in Moffett Field, California, in collaboration with Bally Ribbon Mills in Bally, Pennsylvania, and San Diego Composites in San Diego, California, for NASA's Space Technology Mission Directorate (STMD). STMD funded the incremental maturation of the novel technology from investigation of the basic concept through proof-of-concept performance testing in the severe thermal environment expected for Orion's future missions.

► [Read the full story](#)



# SOCIETY OF WOMEN ENGINEERS HOSTS AEROJET ROCKETDYNE KEYNOTE SPEAKER

Aerojet Rocketdyne's Chief Systems Engineer for the Orion crew and service module propulsion elements, Katherine (Katie) Dommer, was the keynote speaker at the Society of Women Engineers (SWE) region H conference on March 7. As the largest region of SWE, the conference, which was hosted by the University of Notre Dame in Indiana, drew about 500 collegiate and 200 professional SWE engineers from Illinois, Indiana, Iowa, Michigan, Minnesota, North Dakota, South Dakota and Wisconsin.



## SEE ORION UP CLOSE AT SPACE CENTER HOUSTON

Lockheed Martin recently moved a full-scale Orion mockup to Space Center Houston where more than 800,000 visitors each year will have the opportunity to see how astronauts will travel into deep space aboard NASA's new Orion spacecraft and Space Launch System rocket. The crew module mockup is on loan to the visitor center through an in-kind agreement with Lockheed Martin, which used the mockup for crew fit, form and function evaluations as well as other spacecraft testing at the company's Exploration Development Lab in Houston. Plans are currently in work to design and create an exhibit around the crew module that explains the story of how NASA will launch astronauts on a series of human exploration missions throughout our solar system to ultimately establish a human presence on Mars.



## ORBITAL ATK COMPLETES SUCCESSFUL ATTITUDE CONTROL MOTOR HIGH PRESSURE VALVE TEST

On March 4, Orbital ATK completed another milestone in the development of the attitude control motor (ACM) for Orion's Launch Abort System, with the successful test of the high-thrust valve. The motor contains a series of eight fully proportional high-thrust valves which regulate the nozzle flow from the solid rocket motor to safely stabilize Orion in the event of a launch abort. The valve test was part of a design, analysis and test series focused on reducing risk prior to qualifying

the ACM for crewed flight missions. The test was a structural overtest, conducted at 140 percent of the maximum expected operating pressure and was designed to push the limits of silicon carbide-infused carbon-carbon valve components. The initial test data showed the motor fired and responded as predicted.

► [Watch the test video](#)





# TEXAS CAPITOL ENJOYS SPACE INVASION

NASA and aerospace industry partners traveled to the State Capitol in Austin, Texas, March 2-3, for Space Day 2015 events to inform Texas legislators and Capitol guests about Johnson Space Center's (JSC) role in space exploration and its economic impact in Texas.

Representatives from NASA and Lockheed Martin supported events with colleagues from other programs such as the International Space Station, Commercial Crew Program, Engineering, Exploration Integration and Science Directorate and the Strategic Partnership Office.

The Bay Area Houston Economic Partnership members who represent many of the JSC contractor community also scheduled visits with all of the state senate and representative offices for personal briefings with staffers and members.

► [Read the full story](#)



Lockheed Martin representatives participated in statewide Space Day celebrations around the country in Austin, Texas; Tallahassee, Florida; Sacramento, California; Montgomery, Alabama; and Denver, Colorado. These events included exhibits, hands-on demonstrations, presentations on space exploration as well as personal visits with state legislative staffers and members. Pictured here is Joe Mayer in Tallahassee, FL.

## NASA SOCIAL MEDIA WINS SHORTY AWARD FOR BEST IN GOVERNMENT AND POLITICS

In December 2014, NASA hosted one of its biggest social campaigns ever around Orion's flight test. The team hosted a multi-center NASA Social with hundreds participating from nine locations coast-to-coast. To build excitement for the test, the team produced a significant amount of online content – from the "Trial by Fire" video viewed over 700,000 times on YouTube, to a campaign encouraging the public to submit their name to fly on a microchip on Orion's historic flight. The #JourneyToMars hashtag, which helps communicate NASA's

work to send humans to Mars, was used more than 20,000 times on Twitter, a 100x factor over our routine social media posts. There were more than 500,000 tweets inspired by Orion's test the day of launch, reaching a potential 3.7 billion users online, and more than 1 million total online posts in the seven days prior to the test. During the test, Orion trended first in the U.S.

► [Read the full story](#)

# THANK YOU FOR YOUR SUPPORT OF EXPLORATION FLIGHT TEST-1

NASA and Lockheed Martin Orion Program managers kicked off a series of visits to NASA centers and Orion suppliers in March to thank employees for their contributions to the successful Exploration Flight Test-1. March visits included Lockheed Martin in Sunnyvale, California; Aerojet Rocketdyne in Sacramento, California and Redmond, Washington; NASA's Ames Research Center in Moffett Field, California; NASA's Jet Propulsion Laboratory in Pasadena, California; Orbital ATK in Commerce, California and Promontory, Utah; Airborne Systems in Santa Ana, California; General Dynamics in Bothell,

Washington (not pictured); Systema Technologies in Bothell, Washington; Janicki Industries in Sedro-Woolley, Washington; NASA's Michoud Assembly Facility in New Orleans; NASA's Marshall Space Flight Center in Huntsville, Alabama; United Launch Alliance in Decatur, Alabama; NASA's Langley Research Center in Hampton, Virginia; NASA's Goddard Space Flight Center in Greenbelt, Maryland and NASA Headquarters in Washington, D.C.



NASA GODDARD SPACE FLIGHT CENTER



NASA HEADQUARTERS





NASA AMES RESEARCH CENTER



AEROJET ROCKETDYNE-REDMOND



NASA MICHOU D ASSEMBLY FACILITY



ORBITAL ATK-COMMERCE



NASA MARSHALL SPACE FLIGHT CENTER



AEROJET ROCKETDYNE-SACRAMENTO



SYSTEMA TECHNOLOGIES

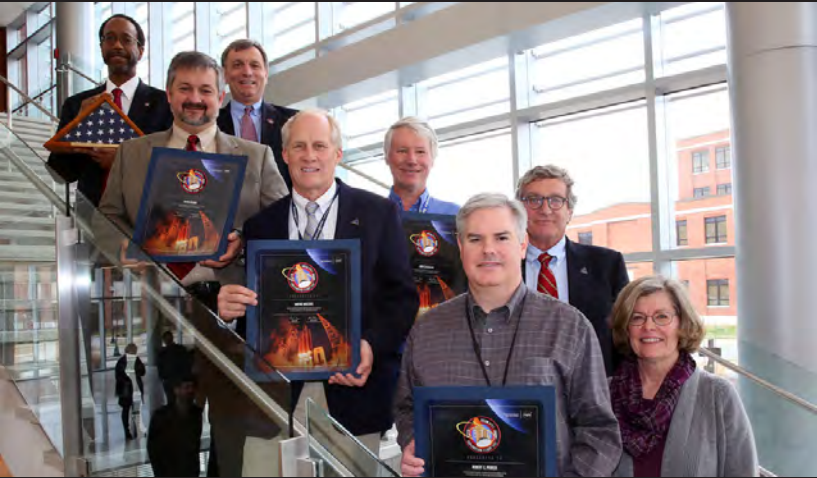




NASA JET PROPULSION LABORATORY



JANICKI INDUSTRIES



NASA LANGLEY RESEARCH CENTER



AIRBORNE SYSTEMS



UNITED LAUNCH ALLIANCE-DECATUR



LOCKHEED MARTIN-SUNNYVALE



ORBITAL ATK-UTAH





Orion engineers Stu McClung and Paul Boehm had the opportunity to mentor a team of NASA Community College Aerospace Scholars (NCAS) during a workshop March 25-27. NCAS gives community college science, technology, engineering and math (STEM) students an authentic NASA experience and encourages them to pursue a NASA-related career.



Orion team members Joe Mayer and Molly White (shown here) staffed the Exploration Systems Development area in the NASA booth at the 2015 South by Southwest Conference in Austin, Texas, March 15-18 and shared the Orion story with hundreds of people from across the country.



On March 19, Johnson Space Center Director Ellen Ochoa presented the Houston Livestock Show and Rodeo with a belt buckle that traveled 63,000 miles on the first flight of NASA's Orion spacecraft. The presentation showed thanks for their support of the Texas Aerospace Scholars Program.



Orion Assistant Program Manager Paul Marshall and Lockheed Martin engineer Cynthia Hudy gave an Orion overview to Texas legislators and staff from the Bay Area and Galveston during their visit to Johnson Space Center's Space Vehicle Mockup Facility on March 6.

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

- NASA's Orion Blog..... [Blogs.NASA.gov/Orion](http://Blogs.NASA.gov/Orion)
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## APRIL:

- Orion recognition events
- Orion spacecraft testing underway for EM-1
- EFT-1 heat shield Avcoat extraction at MSFC
- Mockup of crew module delivery to Denver for testing