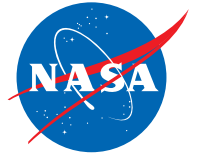


National Aeronautics and
Space Administration



EXPLORATION SYSTEMS DEVELOPMENT

COMBINED MONTHLY REPORT
JANUARY 2017



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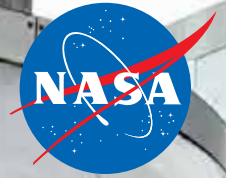
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National Aeronautics and
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ORION

JANUARY 2017

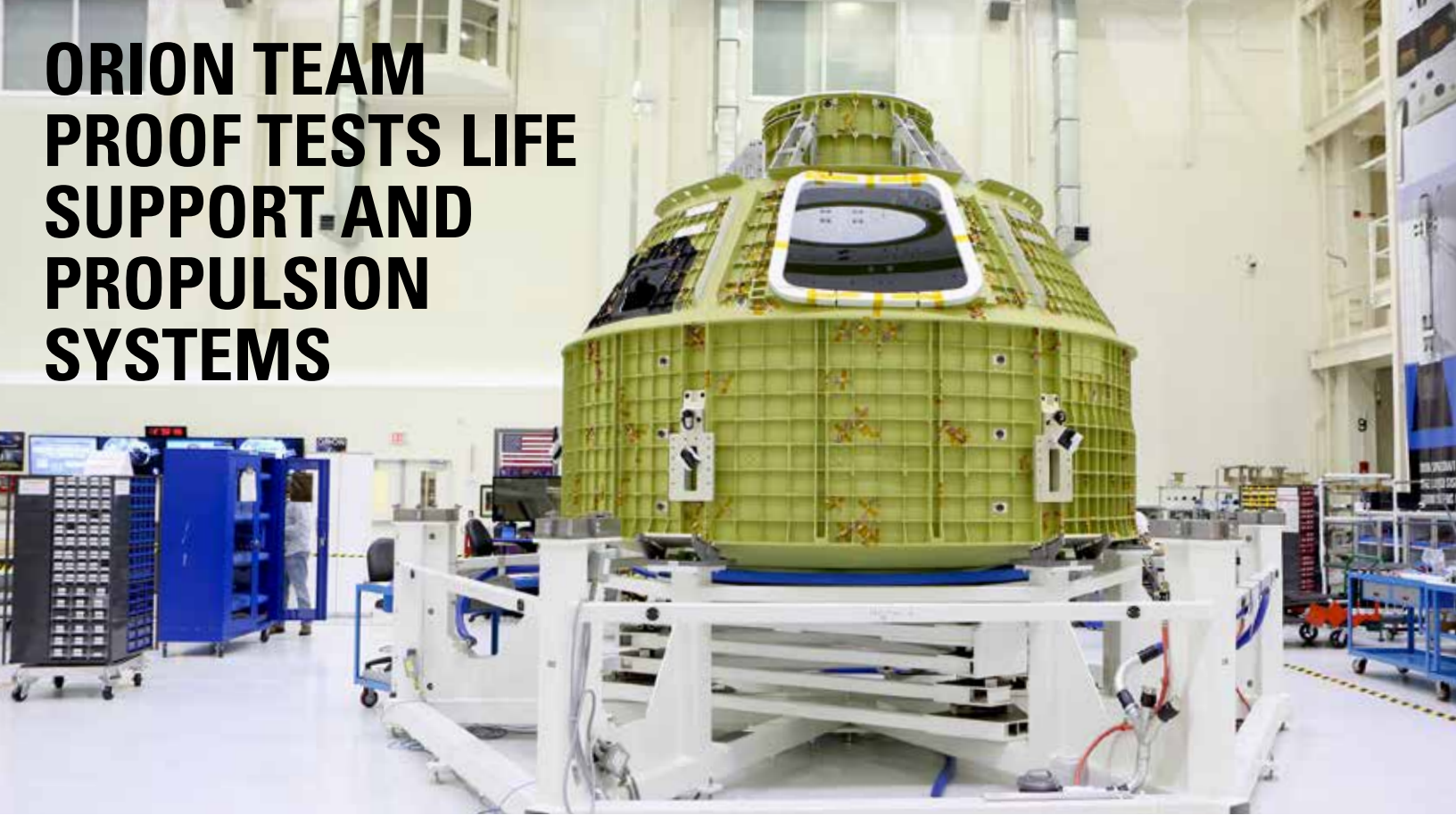
ORION LAUNCH OPERATIONS SIM SHAKES THINGS UP FOR CREW

In a lab at NASA's Johnson Space Center in Houston, engineers simulated conditions that astronauts in space suits would experience when the Orion spacecraft is vibrating during launch atop the Agency's powerful Space Launch System rocket on its way to deep space destinations. A series of tests occurring at Johnson will help human factors engineers assess how well the crew can interact with the displays and controls they will use to monitor Orion's systems and operate the spacecraft.

Test subjects wore modified advanced crew escape suits that are being developed for astronauts in Orion, and sat in the latest design of the seat atop the crew impact attenuation system. This was the first time this key hardware was brought together to evaluate how launch vibrations may impact the astronaut's ability to view the displays and controls. Engineers are hard at work performing all the necessary evaluations to make sure the spacecraft is ready for crewed missions.

Houston Chronicle article:
http://bit.ly/NASA_VibeCrew

ORION TEAM PROOF TESTS LIFE SUPPORT AND PROPULSION SYSTEMS



Engineers and technicians with NASA and Orion manufacturer Lockheed Martin are preparing the Exploration Mission-1 crew module for a series of proof pressure and leak tests to confirm the welded joints of the propulsion and Environmental Control and Life Support Systems (ECLSS) tubing are solid and capable of withstanding launch, re-entry and landing. The work test series will take place at the Neil Armstrong Operations and Checkout Building at NASA's Kennedy Space Center in Florida.

The Orion propulsion system includes the propellant and thrusters which support deorbit and re-entry of the spacecraft from deep space while the ECLSS provides cooling for interior and exterior components on the crew module throughout a long-duration mission.

For its uncrewed flight test, Orion will be outfitted with most of the systems needed for a crewed mission during its first flight atop the agency's Space Launch System rocket from Launch Pad 39B at Kennedy.



ORION AND SPACE LAUNCH SYSTEM EXHIBIT FEATURED AT CES 2017

NASA hosted a booth at the Consumer Electronics Show in Las Vegas on Jan. 5-8. NASA's Bob Floyd and Jared Daum participated as Orion subject matter experts, talking with visitors about the latest progress on the Orion spacecraft during this event, which drew more than 175,000 industry professionals.

ORION'S EUROPEAN SERVICE MODULE TEAM MARKS MAJOR MILESTONES

Avionics Acceptance Testing: The first set of the European Service Module (ESM) avionics equipment was shipped to the Lockheed Martin Integrated Test Lab (ITL) in Littleton, Colorado on Jan. 4. This initial delivery of avionics controllers and electrical support equipment have completed their development and integrated testing at the Airbus Defence & Space facility in Les Mureaux, France. These components will be installed in the ITL, and once the post-ship checkouts are completed, an Acceptance Review will be held. After acceptance by ESA (European Space Agency) and NASA, Lockheed Martin will begin integration and testing with U.S. equipment. Once all components are fully integrated, the ITL will be able to emulate ESM spacecraft functionality, and enable integrated Command-Service Module subsystem and mission testing.



PQM Final Assembly: The European Service Module Propulsion Qualification Module (PQM) underwent final assembly at OHB Sweden prior to being shipped to NASA's White Sands Test Facility in New Mexico for propulsion testing. The PQM is expected to arrive to White Sands in mid-February.



E-STA Hardware Handover: ESA Airbus Defense and Space, NASA and Lockheed Martin have successfully completed the formal handover of the European Service Module Structural Test Article (E-STA), transferring ownership of the Airbus built hardware from ESA to NASA.

The test article was built in Turin, Italy, and shipped to the U.S. in November 2015 for a comprehensive series of rigorous tests at NASA Glenn Research Center's Plum Brook Station in Sandusky, Ohio. A little over five meters in diameter and four meters high, the service module weighs 13.5 tons. Over the last year, the item has been shaken to reproduce the vibrations of launch and put in the acoustic chamber to verify it can withstand the extreme sounds of a rocket launch.



The review board, led by NASA European Integration Office Manager Susan Motil, approved the Acceptance Data Package and agreed to accept the test article. Ownership was then passed to Lockheed Martin. Lockheed Martin will utilize the E-STA in further Orion vehicle testing, including a Direct Field Acoustic test at NASA Glenn Research Center's Plum Brook Station and the Orion Structural Test Article tests after assembly at NASA's Kennedy Space Center.

Read the ESA story: http://bit.ly/ESA_SMTestComplete

Read the Spaceflight Insider story: http://bit.ly/SM_TestComplete

Anthony Byers, Lockheed Martin ESA Service Module Integration Manager; Scott Numbers, Glenn Research Center Safety and Mission Assurance; Susan Motil, and Philippe Deloo, ESA Service Module Project Manager.



Photo Credit: collectSPACE.com/Robert Pearlman

NASA, PARTNERS HOST FUTURE FLIGHT FAN EXPERIENCE AT SUPER BOWL LIVE

NASA, in collaboration with the Houston Super Bowl Host Committee and six aerospace partners (Lockheed Martin, Aerojet Rocketdyne, Orbital ATK, Raytheon Company and Northrop Grumman Corporation), hosted a space-themed Future Flight fan experience sharing NASA's vision for the incredible journey to Mars and beyond.

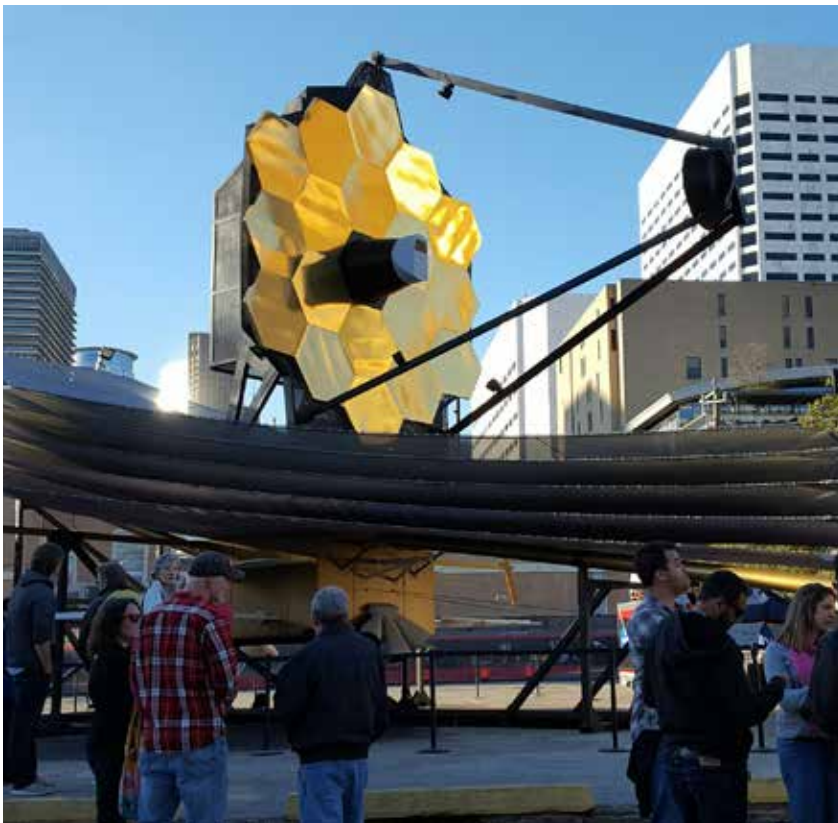
Future Flight was part of the 2017 Super Bowl LIVE fan festival and featured an out-of-this-world virtual reality ride that allowed fans to experience a launch to Mars and a landing back on the Super Bowl LI 50-yard-line on Earth, plus numerous hands-on, space-related exhibits, including the Post-Landing Orion Recovery Test, or PORT mockup, interactive rocket launchers, an RS-25 and RL10 engine and a virtual-reality Mars bus that replicated the Martian terrain and gave riders an interactive adventure simulating a drive on the surface of Mars.

Continued on pages 7 and 8



Learn more about the event with the links below:

- http://bit.ly/NASA_PregameClip
- http://bit.ly/NASA_ChronicleSuperBowl
- http://bit.ly/Marvin_SBReplay
- http://bit.ly/NASA_CollectSpace







ORION AND SLS TAKE CENTER STAGE AT NEW MISSION MARS EXHIBIT

NASA center directors Ellen Ochoa (Johnson Space Center) and Todd May (Marshall Space Flight Center) received a sneak peek preview of the new Mission Mars exhibit during a VIP event at Space Center Houston on Jan. 20. The event was the kickoff to a year-long celebration of the visitor center's 25th anniversary. Mission Mars is an interactive exhibit in which guests experience what it takes to travel to Mars, see the spacecraft that will transport humans to the fourth planet in our solar system, and learn how humans will live on the red planet. KHOU-TV personality Deborah Duncan moderated the event.

<https://spacecenter.org/attractions/mission-mars/>



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

- NASA's Orion Blog [Blogs.NASA.gov/Orion](https://blogs.nasa.gov/orion)
- Twitter [Twitter.com/NASA_Orion](https://twitter.com/NASA_Orion)
- Facebook [Facebook.com/NASAOrion](https://facebook.com/NASAOrion)
- Flickr [Flickr.com/NASAOrion](https://flickr.com/NASAOrion)
- Google+ 2017 [Plus.Google.com/+NASAOrion](https://plus.google.com/+NASAOrion)

FEBRUARY

- ESA Propulsion Qualification Module Arrives at White Sands
- Contract Signing at Airbus for Second Service Module
- Suppliers Conference in Washington, DC



JANUARY 2017

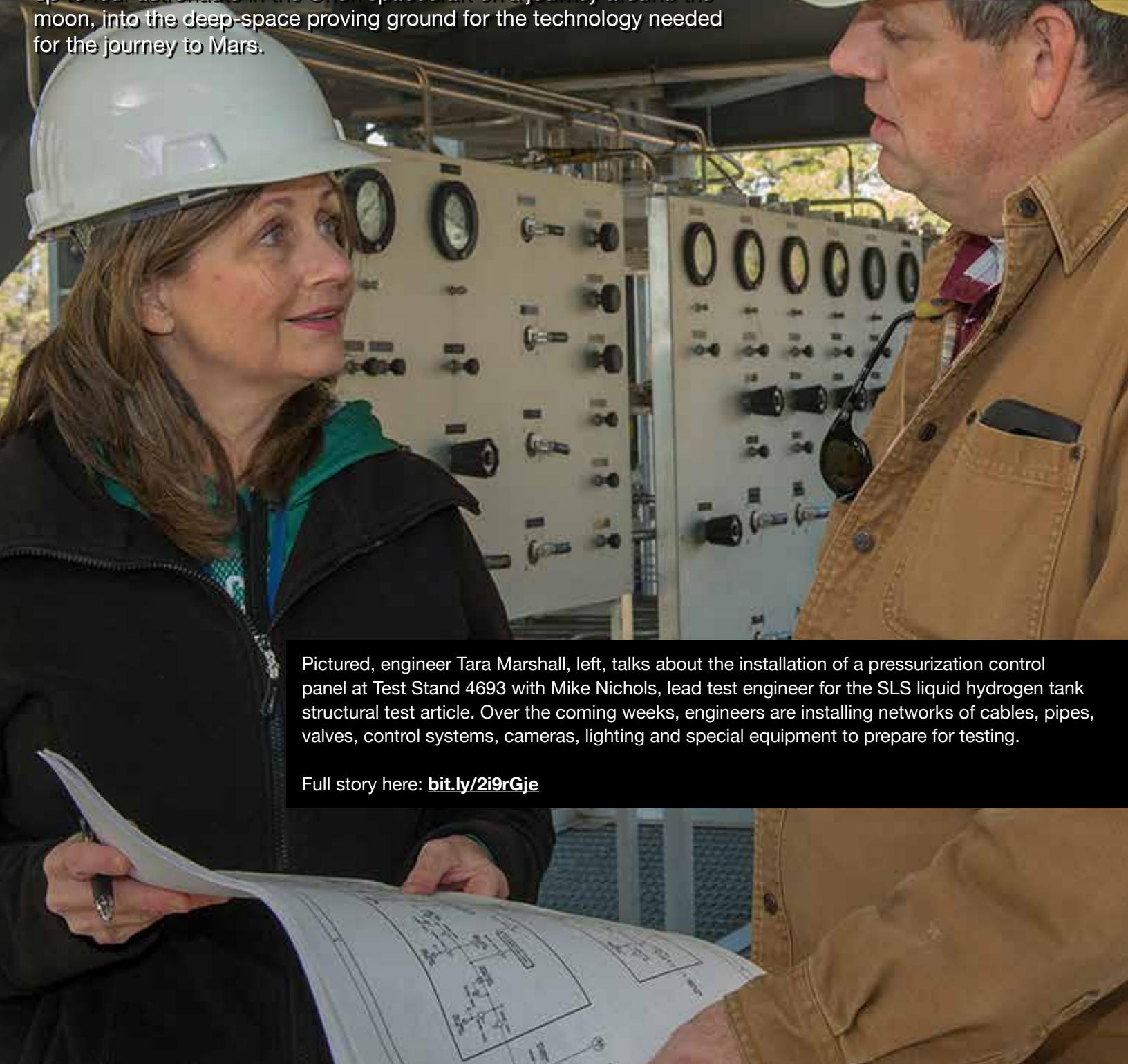
SPACE LAUNCH SYSTEM HIGHLIGHTS

MAJOR CONSTRUCTION COMPLETE ON SLS TEST STAND



CONSTRUCTION COMPLETE: STAND PREPARES TO TEST SLS'S LARGEST FUEL TANK

Major construction is complete on NASA's largest new *SLS* structural test stand, and engineers are now installing equipment needed to test the rocket's biggest fuel tank. The stand is critical for ensuring SLS's liquid hydrogen tank can withstand the extreme forces of launch and ascent on its *first flight*, and later on the *second flight*, which will carry up to four astronauts in the Orion spacecraft on a journey around the moon, into the deep-space proving ground for the technology needed for the journey to Mars.



Pictured, engineer Tara Marshall, left, talks about the installation of a pressurization control panel at Test Stand 4693 with Mike Nichols, lead test engineer for the SLS liquid hydrogen tank structural test article. Over the coming weeks, engineers are installing networks of cables, pipes, valves, control systems, cameras, lighting and special equipment to prepare for testing.

Full story here: bit.ly/2i9rGje

EXPLORATION UPPER STAGE (EUS) PASSES MAJOR REVIEW

NASA has successfully completed the exploration upper stage preliminary design review for the *Space Launch System* rocket. The detailed assessment is a big step forward in being ready for more capable human and robotic missions to deep space, including the *first crewed flight* of SLS and *NASA's Orion spacecraft* in 2021

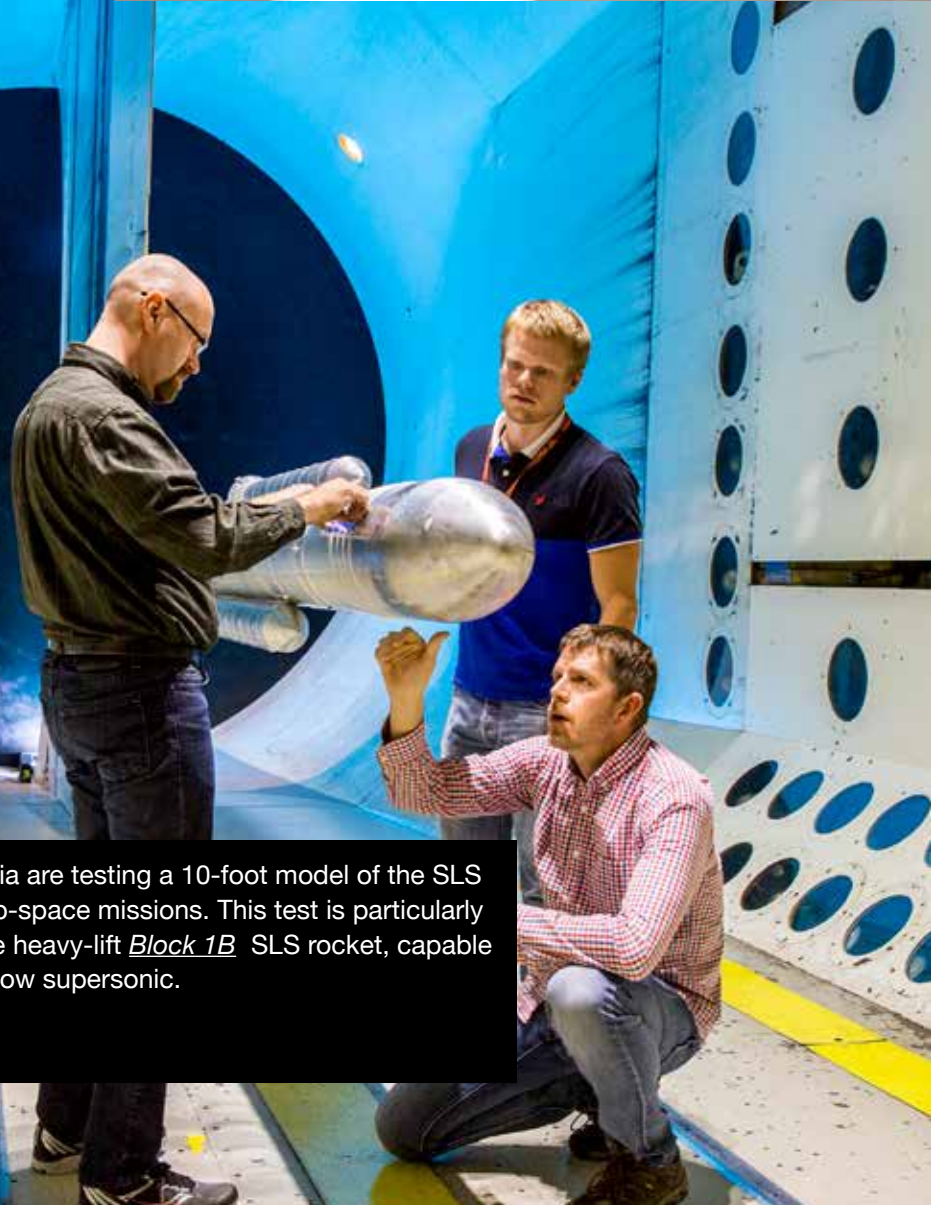
Read the full story – and see animation of the EUS in flight – here:



SLS SHOCKED DURING WIND TUNNEL TESTING TO BETTER UNDERSTAND ROCKET'S TRANSONIC BEHAVIOR

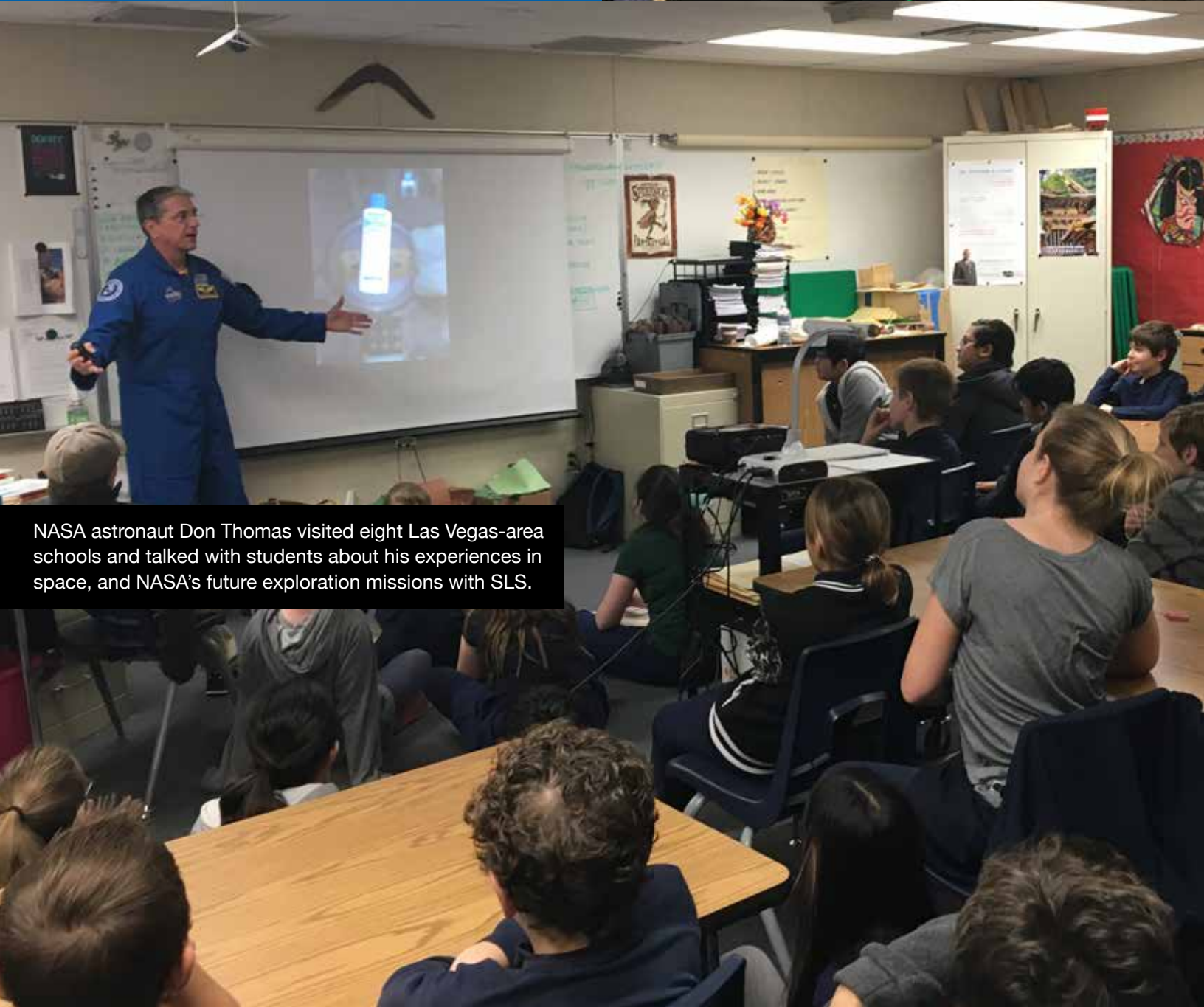
Engineers at NASA's Langley Research Center in Virginia are testing a 10-foot model of the SLS to understand how the rocket may perform during deep-space missions. This test is particularly focused on understanding how the cargo version of the heavy-lift *Block 1B* SLS rocket, capable of lifting 105 metric tons, will behave at speeds just below supersonic.

Read the full story here: bit.ly/2hPwnSg



SLS GOES TO NEVADA

More than 15,000 people got to learn more about the world's most powerful rocket and take part in some really cool NASA interactive exhibits at the Consumer Electronics Show in Las Vegas, Nevada. Here, a CES guest takes a virtual tour of the launchpad where SLS will lift off with NASA's Orion Spacecraft in 2018.



NASA astronaut Don Thomas visited eight Las Vegas-area schools and talked with students about his experiences in space, and NASA's future exploration missions with SLS.



I am *building* SLS

Renee Horton
SLS Metals and Weld Engineer

I AM BUILDING SLS: RENEE HORTON

This NASA engineer is “making history every day” on the rocket for the journey to Mars.

Meet Renee Horton: bit.ly/2ja2pqi

SPACEFLIGHT PARTNERS: *Technetics Group Deland*

Technetics provides Boeing with Naflex seals for SLS liquid hydrogen and liquid oxygen propellant bolted joints. The seals ensure the integrity of critical fluid connections during the stress of launch. The seals experience the extremes of high and low temperatures during the mission.



HIDDEN FIGURES TO MODERN FIGURES: STUDENTS SEE SLS ROCKET AT MICHOU



What do these students have in common with NASA's past?



New Orleans teacher Katherine Michelle Sanders – of St. Peter Claver School – takes her seventh-grade science class on a tour of NASA's Michoud Assembly Facility to see where the Space Launch System – the world's most powerful rocket – is being built. Sanders is the granddaughter of famed NASA scientist Katherine Johnson, who was featured in the book and movie, "Hidden Figures."

Watch the video here: bit.ly/2jU7yq3

NASA ADMINISTRATOR BOLDEN'S FINAL VISIT TO MICHOU



NASA Administrator Charles Bolden saw the liquid hydrogen tank that will be used for the first SLS flight when he visited NASA's Michoud Assembly Facility in New Orleans. The trip marked Bolden's last visit to Michoud before his eight-year tenure as NASA administrator ended Jan. 20.

Details about the visit in the Michoud Messenger: bit.ly/2k0oyuJ

FOLLOW THE PROGRESS OF NASA'S NEW LAUNCH VEHICLE FOR DEEP SPACE:

NASA SLS Blog blogs.nasa.gov/Rocketology

Twitter [Twitter.com/NASA_SLS](https://twitter.com/NASA_SLS)

Facebook [Facebook.com/NASASLS](https://facebook.com/NASASLS)

COMING UP:

RS-25 engine testing

Suppliers' conference

Start of SLS structural testing at MSFC



GROUND SYSTEMS DEVELOPMENT & OPERATIONS

H I G H L I G H T S

JANUARY 2017

FINAL WORK PLATFORM LOWERED INTO PLACE

FINAL WORK PLATFORM INSTALLED FOR NASA'S SPACE LAUNCH SYSTEM

NASA reached a key milestone in the Vehicle Assembly Building (VAB) at the agency's Kennedy Space Center in Florida. A year of platform installations came to conclusion in January as the final work platform, A north, was lifted, installed and secured recently on its rail beam on the north wall of High Bay 3 inside the iconic facility. The installation of the final topmost level completes the 10 levels of work platforms, 20 platforms halves altogether, that will surround NASA's Space Launch System (SLS) rocket and the Orion spacecraft and allow access during processing for missions, including the first uncrewed flight test of Orion atop the SLS rocket.

"Just a year ago, we were meeting the challenges of getting the first half of the first platform installed," said Mike Bolger, Ground Systems Development and Operations (GSDO) Program manager, "It's a great testament to the creativity, persistence and hard work of the team, and it's a terrific indicator that GSDO is on track to process the SLS and Orion flight hardware for the first test mission."

The A platforms will provide access to the Orion spacecraft's Launch Abort System (LAS) for Orion lifting sling removal and installation of the closeout panels. LAS Antenna Testing also is performed on this level.

The platforms were mated with two, 60,000-pound rail beam assemblies that allow the platforms to move toward and away from the vehicle, as well as tie the entire system to the VAB structure. Each platform will ride on four Hillman roller systems on each side — much like how a kitchen drawer glides in and out. The process to lift and install each of the platforms takes about four hours. Each platform weighs more than 300,000 pounds, and measures about 38 feet long and close to 62 feet wide.

"I am very proud of the amount of work that the team accomplished. I am also humbled to have been able to lead this group of amazing people who have been able to complete this very complex and challenging project," said Jose Perez Morales, GSDO VAB Element senior project manager. "I am very pleased with all the work performed by the NASA and contractor team."

Read the complete story at <http://go.nasa.gov/2lotg6y>.

View a timelapse video of platform installation at <https://www.youtube.com/watch?v=IjGUd5VG84>.



The American flag can be seen hanging from the final work platform, A north, as the platform is lifted up by crane from the transfer aisle in the Vehicle Assembly Building on Jan. 12.

Photo credit: NASA/Frank Michaux

MOBILE LAUNCHER VERIFICATION, VALIDATION UNDERWAY

NASA recently took another step forward on efforts to send humans beyond the moon. Verification and validation began on the mobile launcher that will be the starting point for a future crew who will venture into deep space.

The mobile launcher is designed to support the assembly, testing and checkout of the agency's Space Launch System (SLS) rocket and the Orion spacecraft.

"Through this process, our team will verify all the systems are working properly and as designed," said Brett Raulerson, mobile launcher site integration manager for Engineering Research and Consulting Inc. as part of the Test and Operations Support Contract. "We're looking forward to starting this next phase of making sure the mobile launcher is ready to support the SLS."

Original construction was completed in August 2010 and took about two years. In 2013, NASA awarded a contract to J.P. Donovan Construction Inc. of Rockledge, Florida, to install crucial ground support equipment on the mobile launcher.

"Now that installation of the ground support equipment is nearing completion, we'll start dual occupancy to validate that everything meets the design requirements of NASA Engineering and the Ground Systems Development and Operations (GSDO) Program here at Kennedy," Raulerson said. Raulerson explained that the work at the park site, just north of the Vehicle Assembly Building (VAB), is just the first stage of the verification and validation process.

"In the summer of 2017 we will begin phase two when we move the mobile launcher to the VAB," he said. "This will be a multi-element operation, confirming systems on the mobile launcher work together with systems in the VAB."

Photo credit: NASA/Cory Huston





Engineers and technicians gather at the Launch Equipment Test Facility with a banner to mark testing complete on the Core Stage Forward Skirt Umbilical. Photo credit: NASA/Cory Huston

TEST OF LAUNCH UMBILICALS AT HALFWAY POINT FOR MOBILE LAUNCHER SYSTEM

NASA reached the halfway point on testing of the launch umbilicals for its Space Launch System (SLS) rocket and Orion spacecraft at the Launch Equipment Test Facility at the agency's Kennedy Space Center in Florida.

The Core Stage Forward Skirt Umbilical (CSFSU) underwent testing for four months.

A team of engineers and technicians with the Engineering Directorate and the Ground Systems Development and Operations Program, along with support contractors, conducted the tests. The

CSFSU was attached to a Vehicle Motion Simulator at the LETF, and tests confirmed the CSFSU load limits, its ability to disconnect before liftoff and that it is functioning properly and ready to be installed on the mobile launcher.

The CSFSU will be located at about the 180-foot level on the mobile launcher tower, above the vehicle liquid oxygen tank. During processing, the umbilical will be mated to the core stage forward skirt to provide commodities to the SLS rocket, and then disconnect and swing away before launch. Its main purpose is

to provide conditioned air and gaseous nitrogen to the SLS Core Stage Forward Skirt.

The umbilical was transported to the mobile launcher area in December, where it is being prepared for installation on the tower of the mobile launcher.

The other umbilicals, which have been tested at the LETF and are now at the mobile launcher, are the Orion Service Module Umbilical, two Aft Skirt Electrical Umbilicals, two Aft Skirt Purge Umbilicals, and three of the eight Vehicle Support Posts.

GROUND SYSTEMS SPOTLIGHT – PAUL ESPY



Paul Espy is the project manager with Aerodyne Industries on the Test Operations and Support Contract at NASA's Kennedy Space Center in Florida. He received his Project Management Professional certification in 2009.

Since March 2013, his primary responsibility has been to prepare crawler-transporter 2 so that it can carry NASA's Space Launch System rocket and Orion spacecraft atop the mobile launcher to Launch Pad 39B.

Espy began his space career in 1987 when he transferred from the Lockheed Austin Division to the space center as a construction manager to implement Return-to-Flight modifications to Launch Complex 39 shortly after the STS-51L Challenger accident.

He also worked on a variety of construction projects at most of Kennedy's major facilities.

He was responsible for the design and construction of all three clamshell buildings at the Mobile Launcher Parksite, the Logistics Building and the Hypergol Maintenance Facility. He also worked

on the pressure vessels systems certifications for facilities that utilize compressed gases.

"Working on the crawler-transporter upgrades has been pretty cool. It is truly a unique, one-of-a-kind vehicle," Espy said. "Working with the engineers and technicians who carry certifications to maintain and operate this massive vehicle is an honor."

Espy says the achievement he's most proud of so far is the completion of the 20-year life extension upgrades to crawler-transporter 2.

"These upgrades increased the crawler payload capacity from 12 million to 18 million pounds to carry the heavy-lift Space Launch System rocket," Espy said.

Espy first became interested in space in grade school. He was 13 years old when Apollo 11 landed on the moon.

"I would have sought a career in the U.S. Air Force, with the hopes of being an astronaut, if my poor vision hadn't kept me out of the running," Espy said.

Growing up a military brat, it's hard for Espy to nail down a hometown. He typically claims Prattville, Alabama, home, since it is where he graduated from high school. He graduated from Auburn University in 1985 with a Bachelor of Science in civil engineering.

Although he has been contemplating retirement, he will likely remain to see the first crewed flight of Orion. He hopes he will still be alive for NASA's Journey to Mars.

Espy's first car was a 1964 turquoise Dodge Dart convertible with push-button automatic transmission.

His son, Addison, who is 20, is a specialist in the Army. He was recently stationed in South Korea and returned to his home base at Fort Hood in Texas. His daughter, Marrin, is 19, and attends Eastern Florida State College, while teaching dance lessons at the Titusville Ballet and Jazz Center in Titusville. She also travels throughout the U.S. and Canada to develop choreography for other dance studios.

Espy has a 13-year-old cat named Jasmine that came home about a year ago limping as a result of a bullet in her back. "Due to the proximity near her spine, it could not be removed. I'm not sure how many of her nine lives are left, but she has an amazing ability to survive," Espy said.

His hobbies include traveling, camping, hiking, and working around the house.

Kim Carter

21st Century Integrated Product and Strategic Communication manager

Kim Carter is the 21st Century Integrated Product and Strategic Communication manager for the Ground Systems Development and Operations (GSDO) Program at NASA's Kennedy Space Center in Florida.

In her role, Carter manages projects that help transform the center into a multi-user spaceport. She also leads the Strategic Communications initiative for GSDO.

She began working at Kennedy in 2006 in the Cape Canaveral Spaceport Management Office. She served as the contracting office representative for the Joint Base Operations and Support Contract. Carter also worked in Center Operations and the IT Directorate, and transitioned into the GSDO Project Management and Integration Branch in 2014.

Carter completed the Senior Executive Service (SES) Career Development Program in 2016.

"The coolest part of my job is working with so many different people across the agency who are experts in their fields," Carter said.

"Working in the GSDO Program gives me the opportunity to work with center experts as well as partner and collaborate with Space Launch System, Orion and the Human Exploration and Operations Mission Directorate personnel on a really cool mission."

The achievement she is most proud of is recently completing the SES career development program, which included 18 months of opportunity to learn from senior executives across the agency, and complete professional training and coaching.

"An awesome developmental work assignment in the HEOMD Resource Management Office enabled me to gain insight into OMB, congressional committees and several programs within the agency," she said.

"I want to be a part of NASA's next space launch program and the Journey to Mars, and this is a great place to be part of it, at Kennedy Space Center," Carter said.

She first became interested in space when she was in second grade, when her father moved their family to Titusville because he accepted a job with NASA.

She graduated from Tuskegee University in Alabama in 1991 with a Bachelor of Science in electrical engineering and earned a master's degree in industrial engineering from the University of Central Florida in Orlando in 2011.

Carter's first car was a faded gold Datsun B210. She describes it as a very old car, so old that her father had to get replacement parts from the junkyard.

She has been married to her husband, Joe, for 27 years. They have two children, Joseph, 24, and Jhane', 20. They also have one grandchild, Josiah.

Some of her hobbies include sports (football, basketball), shopping, and participating in public service projects, including Habitat for Humanity.

She also volunteers at her church. But, her favorite is working with teenagers and young adults. She mentors and tutors students.

"Promoting science, technology, engineering and mathematics is a focus for me, as well as servicing minorities in my local community and helping them chart out career paths," Carter said.





Before the final platform was installed, the center's Engineering Directorate coordinated a platform beam signing event to celebrate the NASA and contractor team's last several years of study, design, construction and installation of all of the new work platforms for the agency's SLS rocket and Orion spacecraft.

Workers involved in the High Bay 3 platform project had the opportunity to sign one of the beams of the final work platform in the transfer aisle of the VAB.

National Aeronautics and Space Administration

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Kennedy Space Center, FL 32899

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SP-2017-02-141-KSC

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