



# ESD

## Exploration Systems Development

Combined Monthly Report April 2016

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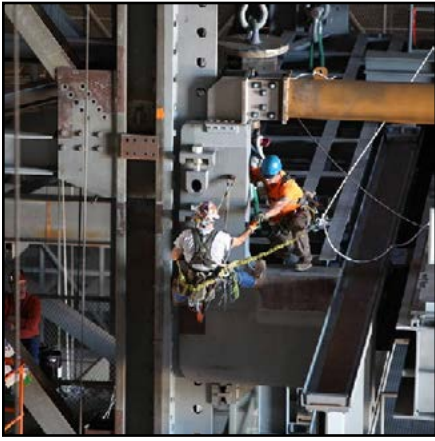
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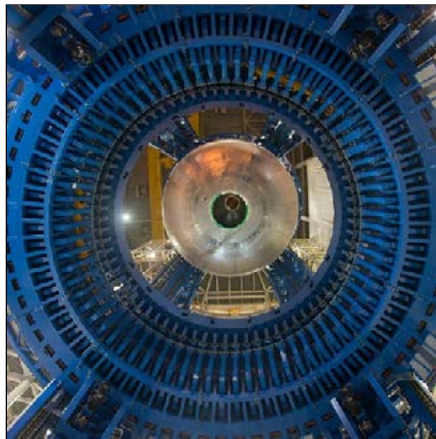






NASA has made a splash on the popular social network, Instagram. Check out these incredible photos from Orion, SLS, and GSDO.

@explorenasa



explore nasa  
on Instagram





# TEST AND VERIFICATION SUPPORTING EM-1

Bill Hill, Deputy Associate Administrator for Exploration Systems Development

One of the most fundamental elements of developing deep space exploration systems is not always the most obvious. That element is testing, which ensures that our extraordinarily complex systems will integrate and work as designed. We test these systems because we must have confidence that they will work in harsh environments and under the worst circumstances, and to anchor our computer models against the performance of the actual hardware.

To prepare for EM-1, we oversee a test network of over 40 major NASA and contractor test facilities in the United States alone. Combined, they will complete the most comprehensive space flight verification effort in more than a generation.

The Space Launch System (SLS) and Orion programs are accelerating their test efforts in 2016. This year, SLS is firing flight engines in Mississippi as well as the second of two booster qualification motors in Utah. Structural test articles for the Interim Cryogenic Propulsion System, Launch Vehicle Stage Adapter, and Core Stage are in production and scheduled for tests in Louisiana and Alabama.

Orion will be subjecting the European Service Module structural test article to vibration, acoustic, electro-magnetic interference, and thermal vacuum tests at the Plum Brook Facility in Ohio. Orion Crew Module drop tests in Virginia

will continue to characterize splashdown loads, and the EM-1 Crew Module is undergoing pressure and outfitting tests in Florida.

Meanwhile, Ground Systems Development and Operations (GSDO) continues the massive effort to prepare for first integration of all elements of EM-1 at Kennedy Space Center. A dedicated Launch Equipment Test Facility is one of many facilities that will ensure that the Vehicle Assembly Building, Launch Control Center, Mobile Launcher (which alone has over 800 individual systems), and offline processing facilities are ready to receive and process arriving flight hardware.

These highlights are the tip of an integrated campaign that only begins to touch on the thousands of hardware component tests, facility modifications, and data transfers between Orion, SLS, and GSDO, all of which need to be delivered on time to launch EM-1 in the fall of 2018. Everyone in ESD plays a critical role in ensuring the success of this unprecedented effort. The scale of what we do for exploration is incredible, and unmatched anywhere on Earth.



National Aeronautics and  
Space Administration



# ORION

APRIL 2016

# SPLISH SPLASH!





# ORION SPLASHDOWN TEST SERIES UNDERWAY

Engineers at NASA's Langley Research Center in Hampton, Virginia, launched a series of nine drop tests with a full-scale Orion crew capsule outfitted with crash test dummies inside to understand what the spacecraft and astronauts may experience when landing in the Pacific Ocean after deep-space missions. The high-fidelity capsule, coupled with the heat shield from Orion's first flight in space, was hoisted approximately 16 feet above the water and vertically dropped into Langley's 20-foot-deep Hydro Impact Basin during the inaugural test on April 6. The crash test dummies were instrumented to provide data and secured inside the capsule to help provide information engineers need to ensure astronauts will be protected from injury during splashdown. Each test in the series simulates different scenarios for Orion's parachute-assisted landings, wind conditions, velocities and wave heights the spacecraft may experience when touching down in the ocean.



Water-impact testing will help NASA evaluate how the spacecraft may behave when landing under its parachutes in different wind conditions and wave heights. Langley has already conducted dozens of splash tests with a less sophisticated capsule mockup, but this is the first time it will assess the higher fidelity Orion ground test article.

► [Watch video of the first drop test in the series](#)





# THESE DUMMMIES ARE SMARTER THAN YOU THINK!

Dummies can actually teach engineers a thing or two. When outfitted with tiny sensors, these mannequins are able to collect data to help Orion engineers better understand and prepare crew members for various splashdown scenarios.

Two test dummies – one representing a 105-pound woman and the other a 220-pound man to assess the impact on different-sized people – were installed in the crew seats of the Orion crew module mockup.

For the initial round of tests, the dummies were not equipped with suits and helmets. After the third test, the dummies were outfitted with spacesuits and helmets to simulate fully suited crew members returning from a deep-space mission. After four

vertical drop tests are completed, the capsule will undergo a series of five swing tests with the mock crew.

Collecting data on the dummies with and without suits allows engineers to make comparisons, which will aid in the computer modeling of Orion's splashdown.

Water-impact testing is one of many steps required to ensure Orion will meet the demands of sending humans to deep space for the first time and in the future on the journey to Mars.

► [Read the full story](#)

# ORION'S SOUND CHECK GETS INTENSE

Orion engineers blasted an Orion service module test article with forceful sound and pressure in the Reverberant Acoustic Test Facility (RATF) at NASA Glenn Research Center's Plum Brook Station in Sandusky, Ohio, during a series of acoustic tests that began in April.

The test article was lambasted with more than 150 decibels and 20-10,000 hertz of sound pressure and vibration to simulate the intense sounds the Orion service module will be subjected to during launch and ascent into space atop the agency's Space Launch System (SLS) rocket. This series of tests will verify the structural integrity of Orion's service module for Exploration Mission-1, the spacecraft's first flight atop SLS that will venture to the far side of the moon and back to Earth during a three-week, uncrewed mission in 2018.

Provided by ESA (European Space Agency) and built by Airbus Defence and Space, the service module will power, propel and cool the spacecraft

and also supply Orion's crew with air and water. The first crewed mission for Orion and SLS is scheduled to launch as early as 2021.

The Orion service module for EM-1 was delivered by Thales Alenia Space to the Airbus Defence and Space facility in Bremen, Germany, for final assembly and integration work. It will be shipped to the United States for further integration with the other elements that make up Orion at the beginning of next year.

Media coverage of the testing included:

- ▶ [Sandusky Register](#)
- ▶ [SpaceFlight Insider](#)
- ▶ [ESA Blog](#)



Pictured above: The service module test article sits in the RATF at Glenn's Plum Brook Station ahead of testing. The blue structure sitting on top of the test article is a mass simulator that represents the Orion crew module.



# ORION'S NEW YORK STATE OF MINDS

Students of all ages shared their excitement and enthusiasm for space exploration at a variety of schools and events where they were able to meet astronauts and engineers working on the Orion spacecraft. The Orion team representatives also met with regional suppliers as well as the New York Legislature while visiting the Empire State in mid-April. Nearly 100 companies across the state have contributed to the future of deep-space exploration by providing critical elements for NASA's Orion and Space Launch System programs.

Media covering the visit included: ► Utica OD ► Times Telegram



Astronaut Lee Morin is presented with photos from two student winners in a Herkimer County Schools district-wide art competition, Aiden Davies and Brynn Shepardson. Nancy Wilson, also pictured, oversaw the art competition.



Orion's Scott Wilson and Astronaut Lee Morin (pictured here) presented to the Herkimer County, New York, legislature.



Scott Wilson with students from Gregory B. Jarvis Middle School in Frankfort, New York.



NASA's Scott Wilson and Bob Ess, along with members of the Orion communications team visited with girls from the Emma Willard School in Troy, New York.



NASA's Scott Wilson speaks at his former alma mater, Frankfort Schuyler Central High School in Frankfort, New York. Shown with Scott are (left to right)- Craig Ferretti, Camden Elementary principal; Nicholas Ferretti; Joseph Cantales, instructor; Scott Scherer, Herkimer County undersheriff; Christopher Farber, Herkimer sheriff; and Michael Stalteri, Frankfort Schuyler Central High School principal



Lockheed Martin's Paul Anderson and NASA's Bob Ess pose with students from St. Martin de Porres Marianist School, following a presentation at Cradle of Aviation Museum in Plainview, New York.





# ORION PROGRAM APPLAUDS NEW YORK SUPPLIERS

Key members of NASA's Orion team came together on April 11 to thank employees of Cobham Semiconductor Solutions for their support of the program that will eventually carry a crew to deep space and back. Cobham is a key supplier of microelectronics, motion control and valve systems used by Honeywell Aerospace, which is a member of the avionics integrated product team led by Lockheed Martin. Honeywell is handling Orion navigation hardware and software design and development, as well as production of the navigation avionics and the command and data handling system.

More than 120 Cobham employees attended a meeting to hear about the latest program progress from NASA's Bob Ess, Orion avionics, power and software manager; Astronaut Lee Morin; Paul Anderson, Lockheed Martin Orion avionics director; and Steve Mayers, Honeywell's Orion lead engineer. The event was hosted at the company's Plainview, New York, facility.

The speakers recognized the Cobham team's contributions to the successful Exploration Test Flight-1 mission in December 2014 and for their continuing work as NASA prepares for Exploration Mission-1 in 2018.





# ORION STARS SHINE AT RNASA STELLAR AWARDS

The Orion team made a stellar showing at the 30th annual Rotary National Award for Space Achievement (RNASA) awards. The winners were announced at the RNASA banquet held April 29, at the Houston Hyatt Regency hotel in downtown Houston.

RNASA recognized 137 Stellar Award nominees from 16 states for their outstanding contributions to advance space exploration toward the future and honored 23 individuals and seven teams with Stellar Awards. The government and corporate nominations were evaluated by the RNASA 2016 evaluation panel comprised of aerospace legends Dr. Glynn S. Lunney, Colonel Eileen Collins, Arnold D. Aldrich and former Johnson Space Center Director Michael Coats. The 2016 Stellar Awards were presented by Astronauts Stephanie Wilson and Rex Walheim. This year's Orion individuals and teams recognized included:

**Larry Price**, Lockheed Martin, for outstanding leadership and international collaboration to take the Orion Program from development to spaceflight vehicles for NASA's human explorations missions.

**Bruce Sommer**, Lockheed Martin, for outstanding human spaceflight contributions for improving crew safety and ensuring mission success for the International Space Station and Orion spacecraft.

**Judith C. "Charlie" Blackwell-Thompson**, NASA Kennedy Space Center's EM-1 Launch Director, for exemplary and sustained contributions to manned spaceflight launch planning and execution.

**Orion EM-1 Critical Design Review Team**, Lockheed Martin, for excellence in preparation, execution and follow through of the Orion Exploration Mission Critical Design Review that resulted in NASA's authorization to proceed to spacecraft production. Brian Jones accepted for the team.

**Orion EFT-1 Propulsion Team**, Aerojet Rocketdyne, for outstanding team dedication and attention to detail during development, production, flight readiness and flight, resulting in significant achievement on Orion EFT-1 and paving the way for advanced future space activities. Janine Cuevas accepted for the team.

**Pendulum Test Team**, NASA Johnson Space Center, for outstanding team effort in mitigating the Orion pendulum motion anomaly. Yasmin Ali accepted for the team.

► **More information about other Stellar Award nominees from Orion**



Pictured left to right: Rex Walheim (presenting), Andrew Zarechnak (OA-4 Return to Flight Team of Orbital ATK), Seth Lacy, Corey Duncan (Automated Navigation and Guidance Experiment for Local Space Program Team), Debbie Sharp (ISS Hardware Recovery Team), Carolyn Gernux (Fan/Pump/Separator Bearing Corrosion Anomaly Resolution Team), Yasmin Ali (Pendulum Team), Janine Cuevas (EFT-1/Orion Aerojet Rocketdyne Propulsion Team), Brian Jones (Orion EM-1 Critical Design Review Team), Stephanie Wilson (presenting)

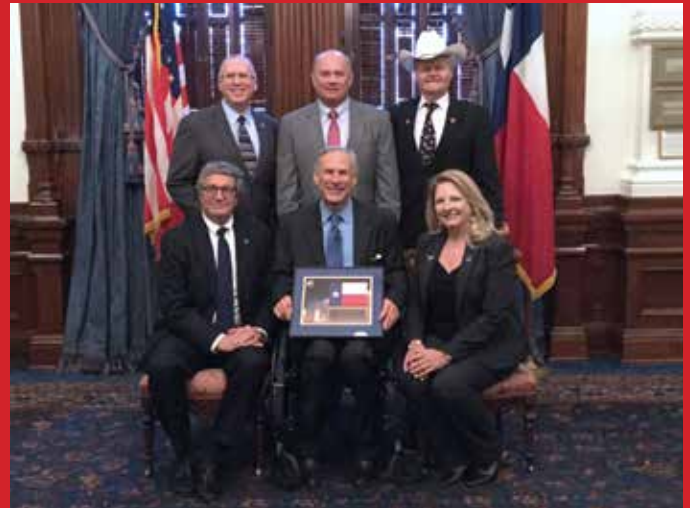


# HIGH FLYIN' FLAGS EARN SPECIAL PLACE BACK ON EARTH

As Orion development and progress continues with full steam toward Exploration Mission-1, the story of our Journey to Mars has continued to be told through special recognition events, news features and presentations to many of the suppliers, business partners and community leaders who support the future of space exploration. Several states where many Orion engineers and technicians work have been presented with their respective state flags that flew in space aboard Orion during its first flight in 2014. The presentation items will be proudly displayed in state capitol buildings across the country. Eventually, all the state and U.S. territory flags flown aboard Orion will reside back in their home states.



Lockheed Martin's Joe Rice (left) and Amber Gell presented the Arizona state flag to Governor Doug Ducey and Senator Andrew Sherwood (right) at the State Capitol in Phoenix.



Lockheed Martin and Bay Area Houston Economic Partnership representatives presented the Texas state flag to Governor Greg Abbott at the State Capitol in Austin. Pictured on the front row are Larry Price, Governor Greg Abbott and Linda Singleton; on the back row are Joe Mayer, Bob Mitchell and Texas Rep. Charles "Doc" Anderson.



Lockheed Martin's Larry Duncan presents the state flags flown in space to Connecticut Governor Dannel Malloy (left) and Colorado Governor John Hickenlooper.



Right: Lockheed Martin's Joe Rice presents state flags to Wisconsin and Ohio state delegations.



# APRIL FESTIVALS INSPIRE THE MARS GENERATION



The weekend of April 16 brought the excitement of Mars exploration to thousands of visitors at the Washington, D.C. Convention Center. At the U.S.A. Science and Engineering Festival Lockheed Martin unveiled the company's Generation Beyond campaign—a STEM initiative that brings deep space exploration to classrooms across America.

During the next weekend, on April 23, Smithsonian Magazine's The Future is Here Festival™ in Washington, D.C. brought out a great selection of innovative futurists. Lockheed Martin's Chief Technologist of Exploration Systems, Tony Antonelli, spoke on paving the way for human exploration of deep space and the Journey to Mars.

## THE MAKING OF A MARS GENERATION

In addition to building spacecraft that will travel farther into space than ever before, the Orion team volunteers a great deal of their time inspiring future generations of scientists, explorers, engineers, technicians and designers who will continue to build and support the Journey to Mars and beyond for generations to come.

Aimee Crane, Orion Program communications team member and 2005 Fredericktown High School graduate, visited Fredericktown Elementary School in Ohio to talk with 600 K-5 students of the Mars generation about the future of NASA. In the evening, Crane visited with the Fredericktown Cub Scout Pack 350 as well as members of the Knox County Eclipse Space Balloon Project. Following Crane's presentation, the pack launched rockets made from large pop bottles fueled by compressed air and water.

► [Read the full story](#)





# CNN'S RACHEL CRANE TAKES US WAY UP THERE

CNN's Rachel Crane examined the future of space exploration in a seven-part series which included a look at NASA's deep space exploration efforts.

Series Teaser/Overview:

▶ **CNN space series explores the future of space travel**

▶ **All seven episodes here**



The Orion/SLS piece is titled, *How will humans get to deep space?* Image credit: CNN

## MAKING SPACE

Meet musician and acoustic engineer Aron Hozman. Aron is part of the team at NASA Glenn Research Center's Plum Brook Station in Ohio that gives Orion a thorough sound check. He is in charge of blasting Orion with more than 150 dB of sound, louder than an AC/DC concert, so engineers can fine tune the spacecraft's structural integrity to keep astronauts safe during deep-space exploration missions throughout our solar system. The series of acoustics tests are conducted to make sure Orion can withstand the trip to space atop NASA's powerful Space Launch System rocket before its next mission beyond the moon in 2018. Aron is one of many dedicated rocket scientists and engineers across the country who are making space exploration of the future possible today.

▶ **Watch the video**



## 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/NASAO Orion](https://facebook.com/NASAO Orion)
- Flickr ..... [Flickr.com/NASAO Orion](https://flickr.com/NASAO Orion)
- Google+ ..... [Plus.Google.com/+NASAO Orion](https://plus.google.com/+NASAO Orion)
- Tumblr ..... [nasaorion.tumblr.com](https://nasaorion.tumblr.com)

## MAY:

**Crew Module Proof Pressure Testing at KSC**

**EM-1 Flight Structure Arrival in Bremen**

**National Space Day, May 6th**

**Glenn Research Center's 75th Anniversary**





APRIL 2016

# SPACE LAUNCH SYSTEM HIGHLIGHTS

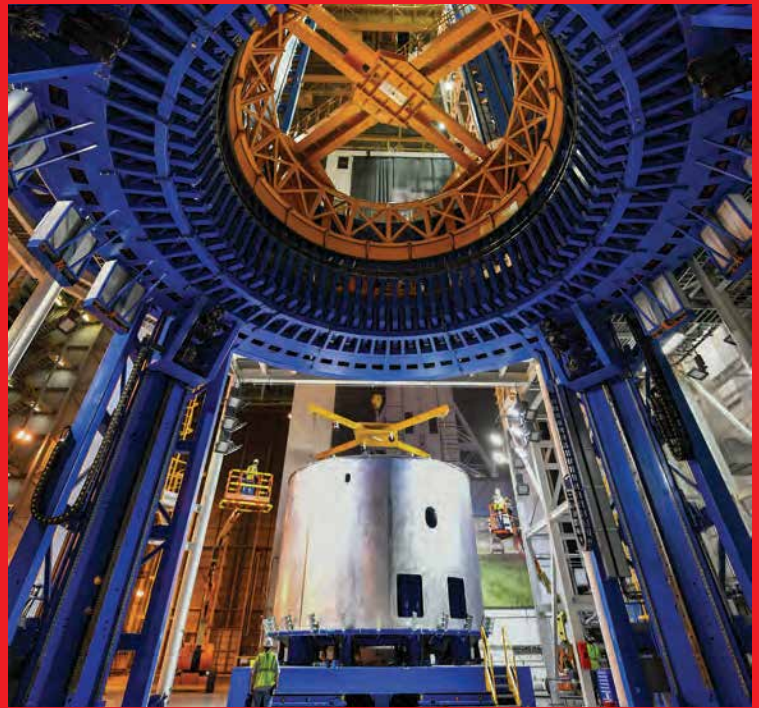
**FLIGHT  
HARDWARE  
IN  
PRODUCTION**





# WELDING WONDER COMPLETES HARDWARE FOR FIRST FLIGHT OF SLS

Flight hardware for the SLS core stage finishes final welding and is moved off the 170-foot-tall Vertical Assembly Center at the agency's Michoud Assembly Facility in New Orleans. The hardware is for the engine section and is the first major SLS flight component to finish full welding on the Vertical Assembly Center. The engine section is located at the bottom of the rocket's core stage and will house the four RS-25 engines for the first flight of SLS with NASA's Orion spacecraft in 2018.



## DATE SET FOR SECOND SLS BOOSTER QUALIFICATION GROUND TEST

*A full-scale, test version of the SLS booster will fire up for the second of two qualification ground tests June 28 at prime contractor Orbital ATK's test facility in Promontory, Utah. The test will provide NASA with critical data to support booster qualification for flight. The first, [full-scale booster qualification](#) ground test was successfully completed in March 2015, which demonstrated acceptable performance of the booster design at high-temperature conditions. The second test will measure the booster's performance at a cold motor conditioning target of 40 degrees Fahrenheit -- which is the colder end of its accepted propellant temperature range. Testing at the thermal extremes experienced by the booster on the launch pad is important to understand the effect of the temperature range on the ballistic performance of the propellant. (Orbital ATK)*





## SLS AVIONICS GET IN THE RING FOR THE JOURNEY TO MARS

Ratana Meekham, a Qualis Corp. engineering technician at NASA's Marshall Space Flight Center in Huntsville, Alabama, helps install approximately 5 miles of cable on a half-ring structure being used to test the avionics system that will guide SLS on deep-space missions. [Qualification testing](#) began March 30 and is an important next step in ensuring the system is "go for launch" for the first flight of SLS in 2018. During testing, the avionics team can troubleshoot any problems with subsystems and make sure the units communicate together as they are designed to do. It took technicians 11 months to assemble the avionics ring and install the cables for qualification testing, but [watch this time-lapse video](#) to see all that hard work happen in just 60 seconds.

## FLIGHT SLS BOOSTER SEGMENT ANSWERS 'CASTING' CALL

The first of 10 flight segments for the two SLS solid-rocket boosters has been cast at Orbital ATK's facility in Promontory, Utah. Casting involves filling the insulated metal case with propellant and allowing it to solidify or "cure" for several days. The hardware, which is the aft segment, will eventually be integrated with four other segments to make up one of the two, five-segment solid rocket boosters for the first flight of SLS in 2018. (Orbital ATK)





# GREETINGS FROM CALIFORNIA

In April, SLS and Orion had the opportunity to tour facilities across California and thank employees for their hard work on the next generation of vehicles for spaceflight.



NASA Astronaut Doug Wheelock thanks employees who “make it happen” for SLS flight hardware at Votaw Precision Technologies in Sante Fe Springs, California.

**LEFT:** Representatives from NASA check out the SLS forward skirt panel, built by AMRO Fabricating Corporation of South El Monte, California. The panel will be used for the first flight of SLS in 2018.

## NEW TEST STRUCTURES WILL HAVE SLS ROCKET HARDWARE FEELING THE FORCE

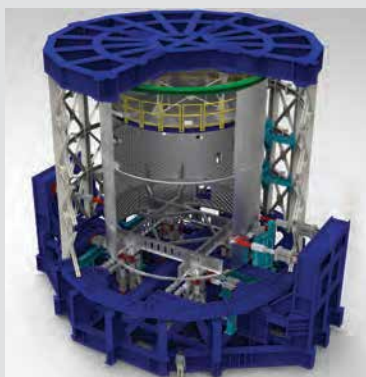
If walls could talk, Building 4619 at NASA’s Marshall Space Flight Center in Huntsville, Alabama, would have a lot to say about testing rockets.

The multipurpose, high-bay test facility has been a hotbed for all types of testing, including loads, acoustics, vibration, extreme temperatures, high-and-low pressures, and environments that simulate the cold, black conditions of outer space. More recently, it served as the hub for a series of large-scale “[can-crushing](#)” tests to study buckling in structures with the purpose of building lighter, more efficient and affordable launch vehicles.

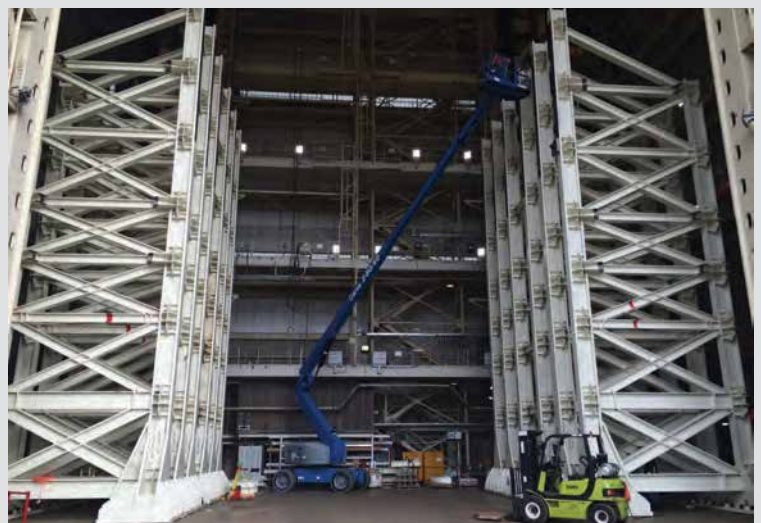
Today, teams are breathing new life into the 4619 load test annex for the next era of space exploration with [SLS](#). Construction is underway at the facility on steel reaction towers and fixturing that will be used for structural loads testing on the [SLS core stage](#) intertank and engine section. Read the [full story](#).



This artist concept depicts the 62-foot-tall intertank test structure under construction at the Marshall Center. The intertank for the SLS will undergo thermal conditioning and structural loads testing in the Marshall Structural Test Laboratory.



This artist concept shows the 50-foot engine section test structure under construction at the Marshall Center. The engine section for the SLS will be put inside the structure and subjected to millions of pounds of force -- similar to vehicle loads experienced during launch.



Twelve main tower panels, built and delivered by Weldall Manufacturing Inc. of Waukesha, Wisconsin, for the intertank test structure have been installed at Marshall’s Building 4619 load test annex. The two test towers, shown here, attach to the intertank test article and simulate the force created by the solid rocket boosters during launch, flight, and booster separation.



# STEEL 'FLIES' AS SECOND NEW SLS TEST STAND 'TOPS' AT NASA MARSHALL



**LEFT:** Before being welded into place, the "topping out" beam was signed by members of the Marshall Center Operations, SLS, and other teams involved in the test stand's design and construction, including the U.S. Army Corps of Engineers; general contractor Brasfield & Gorrie; architects Goodwin Mills and Cawood; architects Merrick & Company; NAFCO Fabrication; and LPR Construction. The same group of government and contractor teams recently topped out Test Stand 4697 at Marshall, where similar tests will be conducted on the SLS liquid oxygen tank.



**RIGHT:** A steel beam is "flown" by crane into position on the 221-foot-tall Test Stand 4693 during "topping out" ceremonies April 12 at the Marshall Center. When construction is completed later this year, dozens of hydraulic cylinders at the stand will push and pull on the giant liquid hydrogen tank of NASA's Space Launch System, subjecting it to the same stresses and loads it will endure during liftoff and flight. Topping out is a builders' rite traditionally held when the last beam is placed on top of a structure during building.

## SPACEFLIGHT PARTNERS: KT Engineering



LVSA



### LOCATION:

Madison, Alabama

NUMBER OF EMPLOYEES: 11

### WHAT THEY DO FOR SLS:

KT Engineering does work for Teledyne Brown Engineering of Huntsville, Alabama, in the Mechanical Design of the Launch Vehicle Stage Adapter (LVSA) structures and Ground Support Equipment (GSE).



# GO, BULLDOGS! SLS VISITS MISSISSIPPI STATE UNIVERSITY

In early April, SLS visited schools and took part in Mississippi State University's Engineering Week -- talking with students and faculty about SLS, the importance of technical careers, and NASA's goals and missions, including the journey to Mars. Bring SLS to your classroom with these educational materials.



SLS's D.K. Hall, a graduate of the university, talks to students about the future of space exploration with SLS.

# FOOD NETWORK'S ALTON BROWN 'EATS UP' SLS



Food Network Host Alton Brown checks out a model of the SLS during an April 11 tour of the Marshall Center. Brown also got a first-hand look at the new SLS test stands being built for core stage structural loads testing.

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

- NASA SLS Rocketology Blog.... [blogs.nasa.gov/Rocketology](http://blogs.nasa.gov/Rocketology)
- Twitter..... [Twitter.com/NASA\\_SLS](https://twitter.com/NASA_SLS)
- Facebook..... [Facebook.com/NASASLS](https://facebook.com/NASASLS)
- Flickr..... [Flickr.com/NASASLS](https://flickr.com/NASASLS)
- Google+..... [Plus.Google.com/+NASASLS](https://plus.google.com/+NASASLS)
- Tumblr..... [nasasls.tumblr.com](https://nasasls.tumblr.com)

## COMING IN MAY:

**RS-25 engine installed in A-1 test stand at Stennis**

**LVSA structural test article completed**

**Liquid hydrogen tank qualification article build finish**





**GSDO**  
GROUND SYSTEMS  
DEVELOPMENT & OPERATIONS

EXPLORATION BEGINS HERE



PROGRAM HIGHLIGHTS • MAR/APR 2016

At NASA's Kennedy Space Center in Florida, the Ground Systems Development and Operations (GSDO) Program Office is leading the center's transformation from a historically government-only launch complex to a spaceport bustling with activity involving government and commercial vehicles alike. GSDO is tasked with developing and using the complex equipment required to safely handle a variety of rockets and spacecraft during assembly, transport and launch. For more information about GSDO accomplishments happening around the center, visit <http://www.nasa.gov/groundsystems>.

## NASA's 'Spaceport of Future' Reaches Milestone

NASA recently completed a major milestone on its journey to Mars and is ready to begin another phase of work on its spaceport of the future, where the next generation of astronauts will launch to Mars and other deep-space destinations.

The agency wrapped up a comprehensive and successful review of plans for the facilities and ground support systems that will process the Space Launch System (SLS) rocket and Orion spacecraft at NASA's Kennedy Space Center in Florida.

The Ground Systems Development and Operations Program (GSDO), responsible for processing SLS and Orion for flight and ensuring all systems and facilities are ready, completed its critical design review in December 2015. An independent assessment by a Standing Review Board was completed in January.

In the final step before actual fabrication, installation and testing of Kennedy's ground systems, the GSDO program and review board briefed the results of their assessments to NASA's Agency Program Management Council, led by Associate Administrator Robert Lightfoot.

"The team is working hard and we are making remarkable progress transforming our facilities," said Mike Bolger,



*This artist concept depicts the SLS rocket rolling out of the VAB at NASA's Kennedy Space Center. Image credit: NASA/Marshall Space Flight Center*

GSDO Program manager. "As we are preparing for NASA's journey to Mars, the outstanding team at Kennedy is ensuring that we will be ready to receive SLS and Orion flight hardware and process the vehicle for the first flight in 2018."

The heavy-lift rocket will be stacked in the Vehicle Assembly Building on the mobile launcher and roll out to Launch

Pad 39B atop a modified crawler-transporter. The Orion spacecraft will be fueled with propellants in the Multi-Payload Processing Facility at the center prior to stacking atop the rocket. The launch team will use the new command and control system in the firing room as the clock counts down to liftoff of SLS's first flight.



# Pathfinder Operations Pave Way for SLS Processing

NASA's Space Launch System (SLS) rocket will be the most powerful in the world, and is the vehicle that will launch humans beyond low-Earth orbit and on to deep-space destinations as the agency continues its journey to Mars. The Ground Systems Development and Operations Program at Kennedy Space Center is preparing its workforce, facilities and ground support equipment to handle the processing requirements of the SLS rocket and Orion spacecraft for its launch.

A team of NASA engineers and Jacobs technicians and crane operators on the Test and Operations Support Contract are preparing for Exploration Mission 1 (EM-1) processing activities. Experienced personnel are leading the preparation effort using pathfinders, or test versions, of an aft skirt and two inert segments of a solid rocket booster (SRB) inside the Rotation, Processing and Surge Facility (RPSF) at Kennedy Space Center in Florida.

The aft skirt and booster segments are similar to those that will be used on the Space Launch System (SLS) rocket. At launch, the twin SRBs will provide more than 75 percent of the total SLS thrust and operate for about two minutes before separating from the core stage. The aft skirt is at the base of the booster and contains the system that will steer the booster nozzles.

"The RPSF was used for space shuttle booster segments," said acting NASA Integrated Operations Flow Manager David Diaz. "Upgrades and modification to the heritage test stands and work platforms recently were completed to accommodate the new aft booster assembly, and particularly the longer nozzle."

The pathfinder operations are performed to help verify that the upgrades and modifications completed in the RPSF will support processing requirements for the aft skirt, SRB segments and the integrated aft booster assembly to ensure a smooth liftoff at launch.

"After we've completed pathfinder operations in the RPSF we will continue with additional testing operations in the Vehicle Assembly Building," said Kerry Chreist, project flow manager with Jacobs. "The crane operations in the RPSF will operate the cranes in both facilities."

To read the complete story, visit <http://go.nasa.gov/1SFR0Lz>.



Members of the news media watch March 1 as two cranes are used to lift one of two pathfinders, or test versions, of solid rocket booster segments for NASA's SLS rocket into the vertical position inside the Rotation, Processing and Surge Facility at NASA's Kennedy Space Center in Florida. Photo credit: NASA/Bill White



Inside the Rotation, Processing and Surge Facility high bay at NASA's Kennedy Space Center in Florida, engineers and technicians with Jacobs Engineering on the Test and Operations Support Contract monitor the progress Feb. 25 as two cranes are used in tandem to lift the first of two pathfinders, or test versions, of solid rocket booster segments for NASA's SLS rocket. Photo credit: NASA/Ben Smegelsky



# Custom Equipment Required to Install New Platforms in VAB

A spreader bar weighing thousands of pounds and a wrench that is nearly four feet long are not the usual type of equipment you would carry in a toolbox or store in your garage. But they are among the larger-than-life specialized tools that are used by technicians and construction workers at Kennedy Space Center to prepare and install the giant work platforms in the Vehicle Assembly Building (VAB) for the agency's Space Launch System (SLS) rocket and Orion spacecraft.

In High Bay 3 of the VAB, 10 levels of work platforms, 20 platform halves altogether, will surround the SLS rocket and Orion spacecraft and provide access to process and prepare them for launch to deep-space destinations, such as the journey to Mars. Two sets of work platforms, the K-level and J-level platforms, recently were installed in the high bay, about 86 feet and 112 feet above the VAB floor, respectively.

During one of the platform installations, Allen List, an iron and rig foreman with S&R Enterprises of Harrisburg, Pennsylvania, a subcontractor to VAB general contractor Hensel Phelps, handled the 50-pound, nearly-four-foot-long wrench like a pro as he turned and tightened the large corbel pin locks, or rail bolts, that will keep the platform securely fastened to the structural steel of the high bay.

Along with the wrench, he also wore a tool belt that weighs about 45 to 50 pounds, plus the tether system that all of the construction workers are required to use when performing tasks above the ground level.

Tools such as the wrench and long pry bars were acquired from an industrial tool supplier, but Hensel Phelps and the architect of record, Reynolds, Smith and Hills, created several of the unusual tools specifically for the VAB work project.

"Some tools, like wrenches or pliers, have the same name as those you would find at other construction sites. The difference is the scale of the tools at Kennedy are much bigger," said Rebecca Baturin, VAB project engineer with the Ground Systems Development and Operations Program.

"It's an honor to help contribute to NASA's space program," List said. "Nowhere else in the country would we have the opportunity to contribute to something like the work we are doing in the Vehicle Assembly Building. This is a very exciting time."

Whether it is with a 4-foot wrench or a 15-ton spreader bar, Kennedy Space Center is well on its way to preparing the VAB High Bay 3 for the SLS rocket and Orion spacecraft and the agency's journey to Mars.

To read the complete story, visit <http://go.nasa.gov/1SFRPnz>.

**View a short video of platform installation in the Vehicle Assembly Building at:**

**<https://www.youtube.com/watch?v=YYgXNT6QCEw>**



*Allen List, an iron and rig foreman with S&R Enterprises of Harrisburg, Pennsylvania, holds a nearly-four-foot-long, 50-pound wrench that he uses to tighten bolts during installation of the large work platforms inside VAB High Bay 3. S&R is a subcontractor to VAB general contractor Hensel Phelps. Photo credit: NASA/Ben Smegelsky*



*A construction worker, wearing safety gear and tethered to safety lines, works on one of the bolts during installation of the second half of the J-level work platforms April 15. Photo credit: NASA/Dimitri Gerondidakis*



# Ground Systems Team Spotlight



**Jody Sills** is the Integrated Processing Solutions Project manager with Aerodyne Industries on the Test and Operations Support Contract (TOSC) at Kennedy Space Center. Her primary responsibilities include developing requirements to configure software products (i.e. TOSC versions of Maximo, Cradle, PeopleSoft and others) based on business processes and user needs, defining the integrated interfaces and user testing, and developing associated business processes.

Sills also is the Solumina functional lead and provides support to all users, including classroom training, and individual support and problem resolution.

Sills began her career at Kennedy in June 1988 on the Space Shuttle Program in flight crew systems engineering, and worked with the Astronaut Office at Johnson Space Center to configure the orbiter crew module for each mission, before moving on to a process integration function. This transition provided her with the skills needed for her job with TOSC supporting the Ground Systems Development and Operations Program (GSDO).

"The coolest part of my job is that it touches a little bit of everything and there is so much opportunity to get involved in different aspects of the program," Sills said. "I go to all of the different facilities, work with many different people, from the shop, to engineering, to upper management."

Sills became interested in aviation when she was a child. Her father was a member of the Experimental Aviation Association and she watched him build a small one-person biplane in their basement.

"I knew that I wanted to do something

in the aviation industry. I didn't know that my career would bring me to the space industry," Sills said. "I remember being riveted to our fuzzy, black and white television, watching an Apollo landing, and the first shuttle launch in high school, so it must have been my destiny."

Sills' hometown is Orange Village, Ohio, a suburb on the east side of Cleveland. She earned a Bachelor of Science in aeronautical and astronautical engineering in 1988 from Ohio State University.

She has been married to her husband, Ed, for 25 years, and they have a 13-year-old son, Jacob. They have two calico cats, Eva and CC (short for Cadillac Coupe deVille).

Her first car was a 1980 blue Dodge Omni. Her dad was an engineer for Chrysler so her family always had Chrysler cars while growing up.

Her hobbies include reading, traveling, needlework, and giving her husband a hard time when he insists on taking her hiking.

"My hopes for NASA are that we keep moving forward to the future when space exploration is a priority for the country and that we can meet our goals for human missions beyond Earth's orbit," Sills said.

**Steve Gersten** is the technical and administrative manager for the Control and Data Hardware Engineering and System Administration organizations on the Engineering Services Contract at Kennedy Space Center.

He manages a team of hardware engineers and system administrators who design, develop, deploy, test and sustain the Launch Control System hardware in the Launch Control Center Firing Rooms, the Multi-Payload Processing System, and the mobile launcher system in support of GSDO.

Gersten began his career at Kennedy 36 years ago as an electrical engineer with Computer Sciences Corp. He moved to Grumman Technical Services in 1983 and then to United Space Alliance in 1996, providing hardware and project engineering services to the Space Shuttle Launch Processing System for each.

"The coolest part of my job is seeing the hardware systems we envision come to fruition, and the team working together to design, procure, assemble and successfully activate these systems," Gersten said.

One of the achievements he is proud of is developing the new systems engineering console enclosures in Firing Room 1 for the Space Launch System. Some of the

consoles from Firing Room 4 were modified and repurposed for FR1, which saved a lot of design time and cost.

He first became interested in space when he was 11, during a family trip to Florida and Kennedy Space Center. That trip and viewing the Apollo 11 moon landing a few years later cemented his attrac-



tion to space exploration.

Gersten's hometown is Columbus, Georgia, just outside Fort Benning.

He earned a Bachelor of Science in electrical engineering in 1979 from Southern Polytechnic State University in Marietta, Georgia, and a Master of Science in technical management in 1994 from Embry-Riddle Aeronautical University in Daytona Beach, Florida.

He and his wife Cindy will celebrate their 36th anniversary in July. They have two daughters, Jennifer, 28, and Michelle, 25. They also have a cat named Jessie.

"She owns the house, but lets us stay there," Gersten joked.

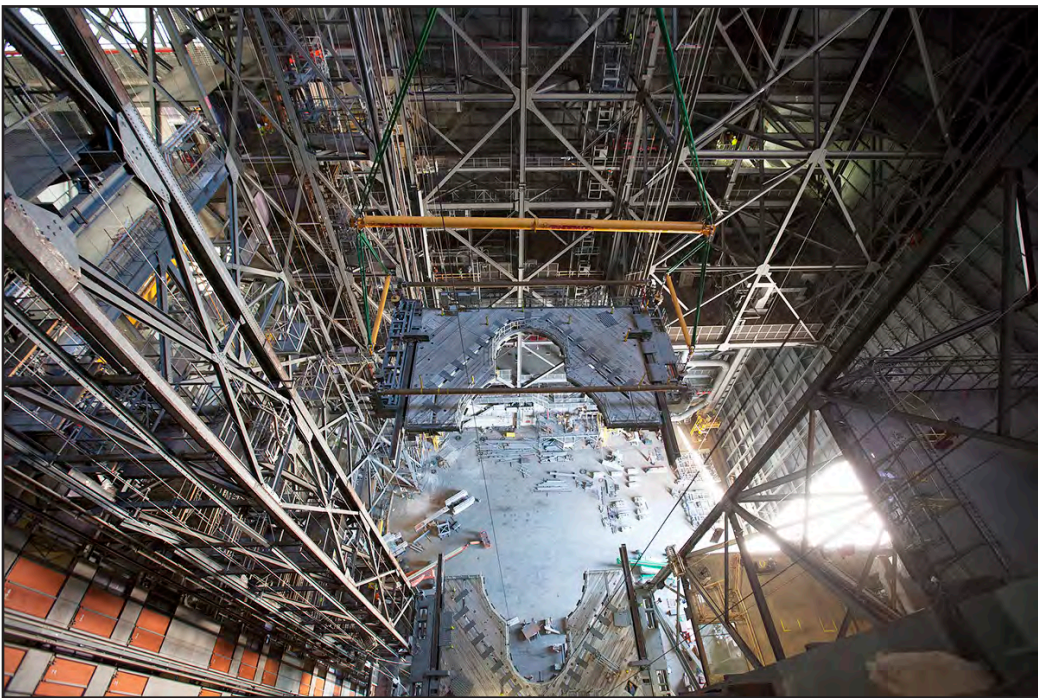
His first car was a 1970 green AMC Gremlin. He installed a CB radio with two co-phased antennas on the roof rack and went by the CB handle "Colorado Kid," even though he had an FCC license ID.

Some of his hobbies include golfing and fly fishing. He and Cindy were lucky enough to attend the final round of the 2016 Masters Golf Tournament.

"My hope for NASA's future is success and renewed national interest in space exploration," Gersten said, "to keep a place at the table as the world leader in space-related technological development and accomplishment."



# Going Up? New Work Platforms Taking Shape in Vehicle Assembly Building



A 250-ton crane is used to lower the second half of the K-level work platforms into High Bay 3 on March 7. The platform was secured about 86 feet above the VAB floor, on tower E of the high bay. The K work platforms will provide access to the SLS core stage and solid rocket boosters during processing and stacking operations on the mobile launcher. Photo credit: NASA/Dimitri Gerondidakis



The first half of the F-level work platforms for NASA's SLS rocket arrived at the VAB on March 8. Photo credit: NASA/Dimitri Gerondidakis

The Ground Systems Development and Operations Program is overseeing upgrades and modifications to VAB High Bay 3 to support processing of the Space Launch System (SLS) rocket and Orion spacecraft. A total of 10 levels of new platforms, 20 platform halves altogether, will surround the SLS rocket and Orion spacecraft and provide access for testing and processing to prepare for Exploration Mission 1 and NASA's journey to Mars.



A view from below, in High Bay 3 inside the VAB shows three work platforms installed for NASA's SLS rocket. The lower platforms are the K-level work platforms. Above them are the J-level work platforms. A crane is lowering the second half of the J-level platforms for installation about 112 feet above the floor, or nearly 11 stories high. Photo credit: NASA/Dimitri Gerondidakis



Platform J-North is moved into the VAB on March 9. Photo credit: NASA



A heavy load transport truck arrives March 29 at the center's north entrance gate, carrying the second half of the F-level work platforms for the agency's SLS rocket. Photo credit: NASA/Ben Smegelsky



A view from high above inside the VAB shows the first half of the J-level work platforms for the agency's SLS rocket lifted by crane April 5 for installation in High Bay 3. Photo credit: NASA/Glenn Benson



# Employee Spotlight - Ed Stanton

Ed Stanton is a systems engineer in the Orion Production Operations group within the Ground Systems Development and Operations Program, and also is part of the Orion Program. The program is responsible for helping Lockheed Martin build the spacecraft.

Stanton has worked at Kennedy Space Center for almost 11 years. He began in the ISS Payload Processing Directorate, focusing on Node 2, and then moved over to the Orion Production Operations group, where he has been since 2007.

“The coolest part of this job is being able to walk out into the Operations and Checkout Building high bay and watch the Orion spacecraft come together,” Stanton said. “Basically, it arrived as an empty shell, and then all the wires, cables and tubes, all the structures and thermal panels are added. It’s an amazing feat. It’s like a puzzle. All the pieces have to go on in a specific order.”

His proudest achievement, to date, is seeing the launch of EFT-1 happen and watching the successful mission unfold.

“It was a great feeling to have been a part of the team that helped make that mission happen,” Stanton said.

“I always wanted to work at Kennedy because this is the place where everything gets launched from. All the action



happens here,” Stanton said.

Stanton is originally from Madison, Connecticut. He moved to Florida in July 2005 and has been here ever since.

He graduated from the University of Southern California in 1990 with a Bachelor of Science in aerospace and from the University of Houston in 1994 with a master’s in mechanical engineering. Then he earned a second master’s degree, in aerospace engineering, from the University of Southern California in 2002.

“My big hope for NASA’s exploration missions is to have humans on the surface of the Red Planet. Then ultimately, an outpost on Mars would be an absolutely amazing feat,” Stanton said.

His first car was a green station wagon that was nicknamed the “vacation-mobile,” because it looked just like the station wagon in the

movie “Vacation.”

He has one son, Austin, 21, who is attending college at the University of Southern California. He also has an Irish terrier named “Sheena.”

Some of Stanton’s hobbies include kiteboarding, windsurfing, wakeboarding, snowboarding, traveling, reading science fiction books and watching science fiction movies.



*NASA’s crawler-transporter 2 (CT-2) began its trek March 22 from the VAB to Launch Pad 39B at Kennedy Space Center to test recently completed upgrades and modifications to support NASA’s journey to Mars. CT-2 moved along the crawlerway at no more than one mile per hour and completed its journey to the pad after numerous scheduled stops along the way to verify the operation of the completed upgrades. The Ground Systems Development and Operations Program oversaw upgrades to the crawler in the VAB. The crawler will carry the mobile launcher with Orion atop the SLS rocket to Pad 39B for Exploration Mission 1. CT-2 is one of two crawlers built in 1965 for the Apollo program and also carried space shuttles for 30 years. CT-1 and CT-2 have travelled more than 5,000 miles during their 50-plus years in service for NASA’s space programs. Photo credit: NASA/ Kim Shiflett*



