

National Aeronautics and
Space Administration



ORION

APRIL 2015

**ORION SPACECRAFT
DEVELOPMENT
PROGRESSES
TOWARDS
EXPLORATION
MISSION-1**



A Battery Charge Control Card cycles through the pre-heat phase during a connector solder operation using a single-point solder machine.

Front Page: A Backplane Interface Card proceeds through “touch up” after completing frame bonding, which used a new automated adhesive dispensing process.

BUILDING ORION FOR EXPLORATION MISSION-1

While the Orion team analyzes and assesses data from the successful Exploration Flight Test-1, the production, testing and qualification for the next test flight, Exploration Mission (EM)-1 is underway. EM-1 will demonstrate the Orion spacecraft's capability to safely transport humans to the far side of the moon and then back to Earth.

The Orion team is working with our European Space Agency partner and prime contractor, Airbus on mass savings, subsystem designs and procurements in support of EM-1 and EM-2. The team completed the Preliminary Design Review last fall and is scheduling the Critical Design Review for later this year.

Additionally, the crew module team has successfully completed structural qualification testing to support EM-1 design and mass savings for Orion's backbone, aft bulkhead to backbone interface and thermal protection system.

High-thrust testing on the launch abort system Attitude Control Motor valves was completed to further advance the emergency crew escape system.

Parachute drop test data led to design enhancements resulting in savings to cost, mass and schedule on the development of Orion's parachute system.

Ammonia tanks for the service module are in early fabrication and testing stages. Avionics systems have been delivered, including more than 16,000 cells for the solar cell hardware.

A structural test article has been fabricated for the Service Module testing to be conducted at NASA's Plum Brook Station facility in Ohio. Pathfinding operations during the crew module adaptor test article manufacturing refined the processes for the flight hardware assembly, including the use of 3-D printing for simple drill plates.

Near-term EM-1 testing includes a single spacecraft adapter separation test planned for June at Lockheed Martin's Sunnyvale, California, facility. In addition, the Lockheed Martin Integrated Test Laboratory at the Waterton facility in Colorado is being completely modified and remodeled for exploration mission equipment and avionics testing starting this summer.

ORION'S WINDOWS PROVIDE NEW OUTLOOK FOR SPACECRAFT'S FUTURE

When astronauts travel to an asteroid and toward Mars in NASA's Orion spacecraft, they'll get a tremendous view of their deep space destinations and of Earth through the spacecraft's windows. NASA engineers are making sure those windows will be more structurally sound, lighter and cheaper than on previous spacecraft.

On spacefaring vehicles like the space shuttle and the International Space Station that have enabled humans to push the boundaries of exploration, windows have typically been made of multiple panes of glass. Orion is being developed to include interior panes of an acrylic plastic material, a change that is improving the windows' integrity.

During the early stages of Orion development, a polycarbonate material was considered for some of the interior window panes, but it didn't have the demanding optical properties needed for high resolution imagery. The acrylic material that has since been chosen for the spacecraft was selected because it provides a clear view and also has an inherent strength that can be quantified.

Acrylic panes flew in space during Orion's first flight test in December 2014, and engineers will further test the thermal integrity of acrylic panes this year to determine whether Orion can move to windows made of two acrylic panes and one glass pane.

The work being done to incorporate acrylic panes into Orion is also helping to make the spacecraft lighter. Because the structural integrity is enhanced, and an inadvertent scratch or other damage to it won't jeopardize its strength, a multitude of panes isn't needed to provide redundancy. Reducing the number of panes in the Orion windows not only reduces the collective weight, but the acrylic material also is half as dense and doesn't weigh as much as glass.

► [Read the full story](#)

Orion Program Manager Mark Geyer, third from the right, receiving the RNASA 2015 Late Career Award.



ORION PROGRAM EARNS NATIONAL RECOGNITION FOR TECHNICAL EXCELLENCE, COMMUNITY OUTREACH

The Orion Program was honored by several national organizations in April for excellence in technical innovation, program leadership and community outreach efforts that helped reignite the world's excitement in human exploration of deep space.

The Space Foundation awarded the NASA/Industry Orion EFT1 Outreach Team the prestigious 2015 Douglas S. Morrow Public Outreach Award, a national honor awarded for significant contributions to public awareness and understanding of space programs. The award was presented at the opening ceremony of the foundation's 31st annual Space Symposium held in Colorado Springs, Colorado, April 13-16.

On April 24, the Orion Program had a stellar night at the 2015 Rotary National Award for Space Achievement (RNASA) awards event held in Houston. The gala honored the 2015 National Space Trophy winner Col. Bob Cabana, Director of NASA's Kennedy Space Center in Florida.

Each year, RNASA presents Stellar Awards for individual and team achievements from the government, military and industry. To ensure recognition of individuals at all stages of their careers, nominations are solicited in four categories: early career, mid-career, late-career and teams. The nominations are reviewed by a panel of distinguished scientists, engineers, managers and academicians who select the winners based on whose accomplishments hold the greatest promise for furthering future activities in space.



Elliott Pulham, CEO of Space Foundation presents the NASA/ Industry Orion EFT1 Outreach Team with the 2015 Douglas S. Morrow Public Outreach Award. Accepting on behalf of the team are Barbara Zelon, NASA Orion Program Communications; Dr. Roosevelt Johnson, deputy associate administrator for NASA Education; Linda Singleton, Lockheed Martin Program Office; and Allison Rakes, Lockheed Martin Communications.

NASA ORION PROGRAM 2015 STELLAR AWARD WINNERS:



Mark Geyer – Late Career winner for exemplary leadership in planning and executing Exploration Flight Test-1, the first beyond earth orbit flight in the nation's new human space exploration program.



Julie Kramer White – Mid Career winner for outstanding technical contributions to human space flight as the Orion Multi-Purpose Crew Vehicle chief engineer.



Orion EFT-1 NASA Management Team of NASA Johnson Space Center (represented by Mark Kirasich) for the successful leadership of the Joint Government-Industry Team to accomplish EFT-1 while advancing management innovations and improving affordability.

LOCKHEED MARTIN ORION PROGRAM 2015 STELLAR AWARD WINNERS:

Frank Bremer - Early Career winner for technical excellence and extraordinary achievement contributing to the development and qualification of the Orion Crew Module propulsion system for NASA's historic Exploration Flight Test-1.

Ismael Gonzales - Mid Career winner for the design, development, and test of the state-of-the-art automated vehicle management system for the Orion spacecraft.

Colin D. Sipe – Mid Career winner for developing cutting-edge composite material for the Orion spacecraft upper aeroshell subsystem, critical for crew protection on future deep-space missions.

Renee Marie Spinhirne - Mid Career winner for technical leadership and successful execution of the integrated test campaign for avionics and system testing for EFT-1.

George E. Cain - Late Career winner for advancing the design and development of liquid propulsion systems for NASA's deep-space human exploration spacecraft achieving significant improvements in affordability and schedule.

Mark Caron of UTC Aerospace Systems – Late Career winner for exceptional technical skills and engineering leadership in developing systems to enable human space travel on-board the International Space Station, Orion, and Boeing CST-100.

Orion Exploration Flight Test-1 Industry Team for the successful spaceflight test of NASA's first interplanetary spacecraft designed for human exploration of our solar system.

Orion Hardware Development Team for innovative development and manufacturing of a new spacecraft design for future deep-space exploration missions.

► [Photos and complete list of 2015 RNASA winners](#)

SHORT FILM DELIVERS FUTURISTIC STORY ABOUT EXPLORATION

On April 22, Lockheed Martin and the New Mexico Film Foundation hosted the debut of ***“Delivery from Earth”*** at the Jean Cocteau Cinema in Santa Fe, New Mexico. The short film is about the first human born on another planet and was produced by filmmaker Michael Becker.

In addition to the film premiere, Larry Price, Lockheed Martin Orion deputy program manager, presented Keith Gardner, chief of staff for New Mexico State Governor Susana Martinez, the New Mexico state flag which recently flew on the Orion spacecraft’s first flight on Dec. 5, 2014.

“Delivery from Earth” was selected as the winner of a New Mexico Film Foundation competition that awarded a \$5,000 grant sponsored by Lockheed Martin to encourage independent film makers in New Mexico to create a short film about deep space exploration. The foundation and space industry experts, including astronaut Bruce McCandless II who was the first person to walk in space untethered to a space vehicle, evaluated 30 submissions to choose a winner.

The competition was created to inspire nontraditional audiences with the thrill of human exploration in deep space. This creative and compelling film reaches new audiences—exciting them about the endless possibilities that lie ahead as human presence extends throughout the solar system.

► [Watch the film](#)



POEM BY AMERICAN MATRIARCH FLOWN ON ORION PRESENTED TO NASA ADMINISTRATOR

While the Exploration Flight Test-1 mission in December 2014 tested thousands of hardware and software elements, Orion also carried with it several mementos and commemorative items to mark the spacecraft’s march toward enabling human deep space exploration, including poetry written by American poet Dr. Maya Angelou.

Text of Angelou’s poem, *A Brave and Startling Truth* flown on Orion was presented on April 6 to NASA Administrator Charles Bolden during a ceremony at the agency’s Headquarters in Washington.

Angelou was a renowned and influential American voice. She was a celebrated poet, memoirist, educator and civil rights activist, and passed away a few months before Orion’s flight test.

During the ceremony, Bolden was joined by Angelou’s son, Guy B. Johnson, and grandsons Elliott Jones and Colin A. Johnson. Lockheed Martin Orion Program Manager Mike Hawes was also present at the ceremony.

► [Read the full story](#)

ORION PROGRAM SMALL BUSINESSES HIGHLIGHTED IN NEW BOOK

Lockheed Martin's Orion Program Small Business Advocate Michelle Butzke worked closely with NASA's Office of Small Business Programs to produce a booklet released in May entitled "ORION - NASA's Deep Space Human Exploration Spacecraft: A Case for Small Business." This publication highlights the amazing accomplishments and extraordinary efforts of over 800 small businesses located across 47 states that have contributed to the Orion program. These companies have provided an array of products and services to support the program, from heat shields and thermal protection systems, to engineering and procurement services—not to mention fasteners, media converter boxes, radiators, thermal/pressure windowpanes, and forward bay cover thrusters.

Thirty Orion small business subcontractors were selected to be featured as a representation of the numerous high-tech firms that enable NASA to complete its missions. These companies performed well under rigorous standards, and due to their success, have witnessed growth in revenue, personnel, and organizational capabilities. Several of these small businesses have received various awards and recognitions, including NASA's Agency-Level Small Business Industry Awards, the Johnson Space Center Small Business Industry Award, and Lockheed Martin's Rigel Award.

NASA will use this booklet to illustrate the Agency's commitment to small business and show the public the high tech work that they do for NASA. Hard copies of this publication will be distributed by NASA at conferences and Industry Day events.

► [Read online](#)



National Aeronautics and Space Administration



NASA DEEP SPACE HUMAN EXPLORATION SPACECRAFT ORION: A CASE FOR SMALL BUSINESS

Office of
Small Business Programs (OSBP)
where small business makes a **big** difference



Butzke talks with small business representatives at the NASA HBCU/MI (Historically Black Colleges or Universities and Minority Institutions) Industry Day in Huntsville, Alabama.

SITE VISITS TO THANK ORION EMPLOYEES CONTINUE



Kennedy Space Center, Glenn Research Center,
General Dynamics Mission Systems

Paragon Space Development, Textron Defense Systems,
Honeywell Aerospace



On April 29, Lockheed Martin Orion Program Manager Mike Hawes was a featured panelist on human exploration at the Milken Institute Global Conference panel for a discussion entitled: "Expanding our Frontiers: How Manned Spaceflight Can Change Your Future." NASA, Boeing and Aerojet Rocketdyne also had representatives on the panel.

Photo of New Mexico Gov. Chief of Staff with framed New Mexico flag flown on EFT-1 presented to the State of New Mexico by Lockheed Martin. Standing left to right: Scott Norris, Lockheed Martin Business Development; Larry Price, Lockheed Martin Orion deputy program manager; Keith Gardner, NM Gov. chief of staff; Michael Becker, film contest winner; Peter Ives, Santa Fe Mayor Pro Tem; Dirk Norris, President, New Mexico Film Foundation.

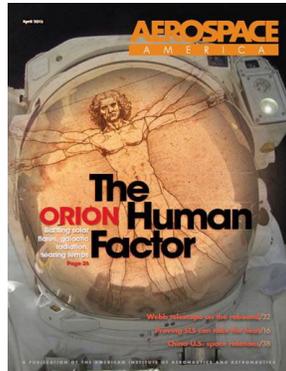
UAE STUDENTS MEET WITH ORION ENGINEERS



Orion's Stu McClung was one of the featured speakers at the 12th Annual Science and Technology Expo on April 24 at the College of Southern Nevada. The event, which saw more than 2,500 attendees, promotes science, technology, engineering and mathematics (STEM) programs to help prepare students for future careers. McClung, along with retired astronaut Col. Lee Archambault, spoke with the students in attendance. Senator Harry Reid (D-NV) commented about NASA's presence at the event.

► Read comments

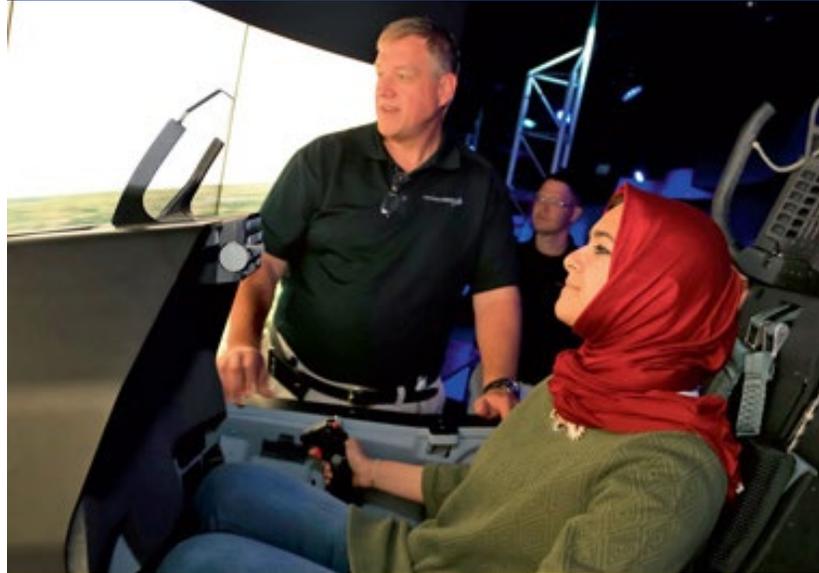
Aerospace America published a cover story highlighting Orion's advanced human factor designs. The article highlights improvements that have been made since the Apollo era.



► Read the full story

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

- NASA's Orion Blog**..... Blogs.NASA.gov/Orion
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Lockheed Martin Space Systems Company supported science, technology, engineering and math (STEM) related activities March 30-April 2 for twelve 19-year-old United Arab Emirates students from the Arab Youth Venture Foundation. The event was coordinated with the Kennedy Space Center Visitor Complex and the Astronaut Memorial Foundation and included an Orion/ Space Exploration Radiation Shielding Engineering Design workshop.

► Read the full story

Congratulations to Orion's Scott Wilson for being recognized by the Herkimer County Legislature for his contributions to NASA.

► Read the full story

MAY:

- First Crew Module pathfinder weld**
- EFT-1 Heat Shield analysis at Marshall**
- Exploration Mission 1 Crew Module machining**
- Orion recognition events continue**
- Comicpalooza in Houston**