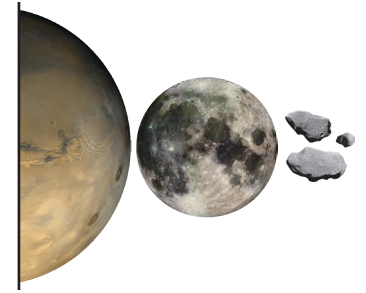


**MONTHLY  
ACCOMPLISHMENTS**  
September/October  
2013

# Orion



## Orion spacecraft comes to life



NASA's first-ever deep space craft, Orion, has been powered on for the first time, marking a major milestone in the final year of preparations for flight.

Orion's avionics system was installed on the crew module and powered up for a series of systems tests at NASA's Kennedy Space Center in Florida last week. Preliminary data indicate Orion's vehicle management computer, as well as its innovative power and data distribution system - which use state-of-the-art networking capabilities - performed as expected.

Throughout the past year, custom-designed components have been arriving at Kennedy for installation on the spacecraft -- more than 66,000 parts so far. The crew module portion already has undergone testing to ensure it will withstand the extremes of the space environment. Preparation also continues on the service module and launch abort system that will be integrated next year with the Orion crew module for the flight test.

Read more about the countdown to Exploration Flight Test (EFT-1) launch at: <http://1.usa.gov/1ghqU00>

# Astronauts practice launching in NASA's new Orion spacecraft

NASA Astronauts Rick Linnehan and Mike Foreman recently experienced what it will be like to launch into space aboard the new Orion spacecraft during the first ascent simulations since the space shuttles and their simulators were retired. The pair had an opportunity to try out a prototype display and control system inside an Orion spacecraft mock-up at Johnson Space Center's Space Vehicle Mock-up Facility during an Orion ascent simulation on Sept. 26.

Ascent simulations are precise rehearsals of the steps a spacecraft's crew will be responsible for — including things that could go wrong — during their climb into space. They can be generic and apply to any future deep space mission, or very specific to a launch that's been planned down to the second. For now, Orion's simulations fall into the first category, but practicing now helps ensure the team will have the systems perfected for the astronauts in any future mission scenario.

Designing a spacecraft's cockpit for ease of use and efficiency is no easy task. Each space shuttle had 10 display screens,

more than 1,200 switches, dials and gauges, plus hundreds of pounds of procedures printed on paper. Orion, which is designed for deep-space exploration and autonomous or piloted rendezvous and docking, will use new technology to distill all of that down to just three computer screens, each the size of a sheet of paper.

It will take about eight minutes for Orion to get from the launch pad at Kennedy Space Center to the altitude where the rocket's main engines will cut off, the milestone that marks the spacecraft's arrival in space. In that time, if everything goes as planned, the commander and pilot will have few actions to perform; if anything goes wrong, that quickly changes, and the crew must be able to quickly access all the relevant procedures and displays they need.

Over the course of two weeks, 10 crews of two astronauts apiece performed two normal launch simulations and two launch abort simulations inside the Orion mock-up. As they made their way through the various actions they were called on to perform, engineers took careful notes of comments and question asked. That data will be evaluated as engineers continue to fine-tune the design and build requirements for the displays and controls.



# Successful integration tests move Orion closer to launch



On September 25-26, NASA's Johnson Space Center's Mission Control Center (MCC) and the Lockheed Martin Exploration Development Lab successfully executed an Orion Software Integration Test. This test used the Exploration Flight Test (EFT-1) flight software version 9.2. The MCC team sent many nominal and contingency commands. Most notable is a nominal file transfer command that will be required during the flight. The team also tested several contingency commands, like switching cooling loop pumps in case of an in-flight failure. These tests and others to follow will assist in the verification of flight software loads in the MCC environment and exercise the joint NASA and Lockheed Martin flight control teams that will monitor the EFT-1 mission.

On October 22, recorded Orion telemetry was successfully transmitted between MCC-Houston and the White Sands communication facility in New Mexico. NASA's White Sands Test Facility serves as the communication hub between MCC Houston and the Tracking and Data Relay Satellite System (TDRSS) that will be used during the EFT-1 flight to receive and retransmit the Orion spacecraft telemetry. This is the first time that Orion-formatted data has been sent via this link. This test paves the way for future tests that will have Orion spacecraft telemetry and commands flow between the vehicle at Kennedy Space Center, White Sands, TDRSS, and MCC-Houston.

## Honeywell completes deliveries for Orion EFT-1 flight

With the acceptance of the second Orion Inertial Measurement Unit (OIMU), Honeywell Aerospace has successfully completed all of its deliveries for the Exploration Flight Test (EFT)-1.

Designed and manufactured in Clearwater, Fla., the OIMU provides the inertial measurement data to the vehicle's guidance and navigation system. This information, augmented by data from the GPS receiver, is used to determine the spacecraft's precise location in space.

The OIMU is a critical component in the guidance and navigation control of the vehicle that will be used throughout all of the mission phases. The OIMU's electronics, including the gyro electronics, are hardened against radiation and designed to survive the radiation levels expected in the mission environment.

In addition to the OIMU and the spacecraft's avionics, Honeywell's contributions to the Orion program include the power data unit cards, network interface cards, GPS receiver, vehicle management computer and barometric altimeter.

# Orion hardware ready for pressure testing



The design and fabrication of critical flight hardware that will be used to keep NASA's Orion spacecraft safe during launch was recently completed at Janicki Industries in Hamilton, Wash. The hardware arrived at NASA's Marshall Space Flight Center in Huntsville, Ala., for final preparations before Orion's first mission, planned for September 2014.

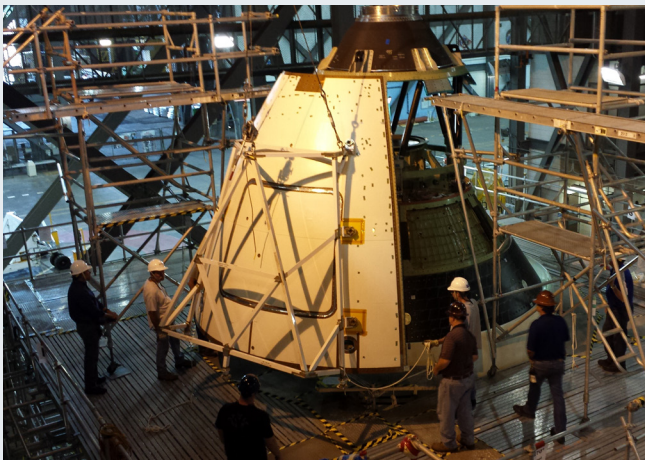
Orion's stage adapter diaphragm serves as a barrier between the upper-stage of the launch vehicle and the spacecraft, preventing hydrogen gas build up from the rocket beneath the spacecraft before and during launch.

The diaphragm, a light-weight composite structure, was designed by a team of engineers at NASA's Langley Research

Center in Hampton, Va., in close collaboration with Marshall. The component is an integral part of the stage adapter that will connect Orion to a Delta IV Heavy rocket during its first mission, Exploration Flight Test-1, and on the first launch of NASA's Space Launch System in 2017.

The diaphragm will undergo pressurized testing at Marshall to certify it for flight conditions before being integrated with the spacecraft's stage adapter.

To learn more about Orion's stage adapter diaphragm, visit: <http://tinyurl.com/ke2qayr>



## Pathfinding operations ongoing for Orion

At NASA's Kennedy Space Center in Florida, the Orion ground test article (GTA) was moved by crane and stacked on top of the service module mock-up in the Vehicle Assembly Building. The GTA is being used for pathfinding operations, including simulated manufacturing, assembly and stacking procedures, and to validate the scaffolding and lift procedures for installation of the launch abort system (LAS) ogive panels. The test is supported by the ground systems contractor with support from Lockheed Martin and NASA Orion personnel, and uses the GTA crew module, LAS GTA motor adapter truss assembly and GTA ogive panels.

# Exploration Design Challenge registers more than 100,000 students



The Exploration Design Challenge has more than 100,000 students from 50 states and 70 countries registered to take the challenge.

NASA, in collaboration with Lockheed Martin and the National Institute of Aerospace, launched the NASA Exploration Design Challenge (EDC) in March 2013 to promote STEM engagement activities tied to the EFT-1.

Students in grades K-12 will research and design ways to protect astronauts from deep space radiation. Students in grades 9-12 can

take the challenge a step further and design a radiation shield with one winning experiment design to be built and flown on EFT-1. The winning team will be flown to Kennedy Space Center to watch their payload launch into space aboard the Orion spacecraft. The names of all participating K-12 students who complete a radiation shielding challenge will be flown on EFT-1, making them the official “virtual crew” members for this mission.

Students can register for the challenge at:  
[www.nasa.gov/education/edc](http://www.nasa.gov/education/edc)



Ukrainian Vice Prime Minister for Ecology, Natural Resources, Energy and Space Yuriy Boyko took time to visit the Orion mock-up at Johnson Space Center’s Space Vehicle Mock-up Facility on Oct. 29 during a tour of JSC. Orion’s John Casper presented an overview of the Orion Program to the dignitary and his entourage during the tour.



Exploration Systems Development has a new quarterly video “Building Momentum” which is featured on the NASA/Orion home page. Watch it here: <http://bit.ly/16pVAXb>



### Orion heat shield presented in Boston

Orion subcontractor Textron Defense Systems (TDS) participated in the Boston Museum of Science’s “Mars & Beyond” event from Aug. 31 to Sept. 1 to share information about the exciting work they are doing on the Orion spacecraft heat shield. The display focused on Orion and TDS’ legacy with Avcoat/Apollo. Textron’s Samantha Zaruba gave a presentation at the museum on the heat shield.



### I am building Orion

Read about Astronaut Nicole Stott at: <http://on.fb.me/17fj8Pg>



### Uniting science and art

Orion launch abort system engineer Leslie Wood recently received national attention for her artwork, which combines art and science. Read more about Leslie at: <http://bit.ly/1aPeVCM>

### Orion engineer receives 2013 Great Minds in STEM award

Dan Baca, systems engineer on the Orion program at Lockheed Martin Space Systems’ Waterton facility near Denver, is the recipient of the 2013 Great Minds in STEM Most Promising Engineer with an Advanced Degree award.

The award program seeks to recognize the achievements of the nation’s top engineers and scientists within the Hispanic community. Award recipients distinguish themselves through professional and academic accomplishments, as well as contributions to STEM and community outreach.

Baca received his award from Rick Ambrose, executive vice president, Lockheed Martin Space Systems Company, during the 25th annual Hispanic Engineer National Achievement Award Corporation (HENAAC) Conference, Oct. 3-5 in New Orleans.

Photo: Lockheed Martin

