



# ESD

EXPLORATION SYSTEMS DEVELOPMENT

COMBINED MONTHLY HIGHLIGHTS

JUNE 2014

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ORION

SPACE LAUNCH SYSTEM

GROUND SYSTEMS DEVELOPMENT & OPERATIONS

**MONTHLY  
ACCOMPLISHMENTS**  
June 2014

# Orion



## Orion stacks up for first flight!



With less than six months until its first trip to space, NASA's Orion spacecraft continues taking shape at the agency's Kennedy Space Center in Florida. Following the completion of the heat shield installation, the NASA/Lockheed Martin team stacked the Orion crew module on top of the service module.

The stacking took place inside the Final Assembly and System Test cell inside the Operations and Checkout building at Kennedy Space Center in early June. The stacked modules will undergo electrical, avionic and radio frequency tests in preparation for Orion's first flight in December. During that flight, the uncrewed spacecraft will launch on a Delta IV Heavy rocket

and will travel 3,600 miles above the Earth - 15 times farther than the International Space Station. That same day, Orion will return to Earth at a speed of approximately 20,000 mph for a splashdown in the Pacific Ocean.

The flight will provide engineers with data about systems critical to crew safety - including heat shield performance, separation events, avionics and software performance, attitude control and guidance, parachute deployment, and recovery operations - to validate designs of the spacecraft before it supports human exploration missions to new destinations in deep space.

# Parachutes hit no snags in most difficult test



More than 5,000 space enthusiasts around the world viewed a Google+ Hangout live during the drop test, and another 10,000 have watched the video on YouTube. Orion program experts Stu McClung and Molly White provided play-by-play explanations throughout the test and answered questions from viewers. <http://bit.ly/1qcnPjz>

On June 25, NASA completed the most complex and flight-like test of the parachute system for the agency's Orion spacecraft.

A test version of Orion touched down safely in the Arizona desert after being pulled out of a C-17 aircraft, 35,000 feet above the U.S. Army's Yuma Proving Ground. It was the first time some parachutes in the system had been tested at such a high altitude. Engineers also put additional stresses on the parachutes by allowing the test version of Orion to free fall for 10 seconds, which increased the vehicle's speed and aerodynamic pressure. After Orion's free fall, its forward bay cover parachutes deployed, pulling away the spacecraft's forward bay cover, which is critical to the rest of the system performing as needed. The forward bay cover is a protective shell that stays on the spacecraft until it has reentered Earth's atmosphere. The parachutes that slow Orion to a safe landing speed are located under the cover, so the cover must be jettisoned before they can be unfurled.

Engineers also rigged one of the main parachutes to skip the second phase of a three-phase process of unfurling each parachute, called reefing. This tested whether one of the main parachutes could go directly from opening a little to being fully open without an intermediary step, proving the system can tolerate potential failures.

The test also marked the last time the entire parachute sequence will be tested before Orion launches into space in December on its first space flight test.

Orion's next parachute test is set for October and will test the combined failure of one drogue parachute and one main parachute, as well as new parachute design features. It is one of three remaining tests needed to demonstrate the system's capability for human missions, but does not need to be completed before Orion's first flight later this year.

## Orion makes headlines with news media



NASA and Lockheed Martin Orion program managers have been in demand with the news media as excitement and interest in Orion's first space flight builds. More than 25 reporters attended the NASA press briefing in the Operations and Checkout building at Kennedy Space Center on June 18. NASA Administrator Charles Bolden, Kennedy Space Center Director Bob Cabana, NASA Orion Program Manager Mark Geyer and Lockheed Martin Orion Program Manager Cleon Lacefield provided statements to the press and conducted interviews. Lockheed Martin's Jim Crocker and Larry Price also participated, along with Astronauts Rex Walheim and Doug Hurley. The event aired live on NASA TV.

**News 13 Orlando:** <http://bit.ly/1zktwSL>

NASA's Orion test flight is paving the way to Mars

**Florida Today:** <http://on.flatoday.com/1jZMC6S>

Bolden at KSC: Orion flight this year 'a big deal'

**Space.com:** <http://bit.ly/1tgz5ku>

December Test Flight Huge for NASA's Next Manned Spacecraft

## Additional Orion features this month:

**KHOU-TV Houston:** <http://bit.ly/1lo0Gek>

NASA unveils new mission into space

**KPRC-TV Houston:** <http://bit.ly/1IPcebG>

NASA: How to land an asteroid

Lockheed Martin provided Aviation Week with an artist rendering of an Orion Lunar sample return concept featured on the cover of the June 23 issue. The covered package titled "Paving the Way to Deep Space" features five articles about deep space exploration. Lockheed Martin's Jim Crocker, Larry Price and Josh Hopkins were all quoted.

**Aviation Week:** <http://bit.ly/TZ08kq>



NASA Public Affairs Officer Michael Curie interviews Scott Wilson, manager of Orion production operations, about preparations for Orion's first flight on the June 17 episode of Space Station Live.

<http://bit.ly/TgHXG0>



Members of the NASA and Lockheed Martin management team pose in front of the Orion crew and service modules at the Operations and Checkout Building at Kennedy Space Center, Florida. Left to right: Scott Wilson, Mark Geyer, Jules Schneider, Roger McNamara, Jim Crocker, Larry Price, Paul Cooper and Cleon Lacefield. Front row, left to right are astronauts Rex Walheim and Doug Hurley.



Exploration Systems Division: All Systems Go!

Check out NASA's latest music video of Exploration Program progress.

<http://bit.ly/118ctso>

## Orion participated in The Ultimate Science Street Fair



On June 1, NASA's Orion program participated in The Ultimate Science Street Fair at Washington Square Park in New York City. The fair was part of the World Science Festival, a year-round celebration of science that brings together great minds in science, business, government and the arts. The five-day festival featured more than 50 programs, including public outdoor events that attracted more than 170,000 visitors. The events offered an immersive experience in science through interactive experiments and installations, games and performances, all designed to entertain and inspire people of all ages.



## Orion and Navy team train at NBL



U.S. Naval divers attended a training session at NASA's Neutral Buoyancy Lab in Houston, Texas during the first week in June to prepare for recovery operations after Orion's first flight. The divers got an overview of the Orion thermal protection system hardware. Procedures for installing the back-up horse collar fixture for a well deck recovery as well as the contingency basket lifting straps were worked out during the training. Divers also rehearsed an end-to-end operation of the baseline attachment approach using upgraded hardware as well as a forward bay cover "flip" operation so that it can be recovered and placed right side up on the ship during recovery operations.

# NASA / Lockheed management visit KSC-area suppliers



Lockheed Martin's Paul Cooper, Jeff Quinn and Clay Bergquist visited with the Titusville Tool team on June 18.



Lockheed Martin's Orion Deputy Program Manager Larry Price met with employees at Coastal Steel in Cocoa, Florida, on June 17. The 36-year-old, family-owned business fabricates structures for the Orion and Space Launch System programs.



NASA's Orion Program Manager Mark Geyer and Lockheed Martin Orion Deputy Program Manager Larry Price paid a visit to EMF Inc. in Merritt Island, Fla. on June 18. EMF has built many of the tools used in Orion's assembly and production at Kennedy Space Center. They are also manufacturing components for some of the launch pad modifications needed for NASA's future deep space exploration missions.

## ESD team presents to small business leaders



On June 9, Orion Assistant Program Manager Paul Marshall gave an overview of the Orion program to an audience of nearly 200 small business industry leaders at an Exploration Systems Development (ESD) Update event in Huntsville, Alabama. During the event, top managers from ESD provided an update on the latest accomplishments and future plans. Other Exploration Systems Development speakers included Dan Dumbacher, deputy associate administrator for Exploration Systems Development, Todd May, SLS program manager and Mike Bolger, Ground Systems Development & Operations program manager.

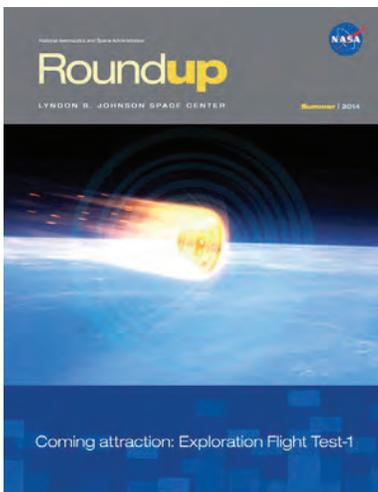


The NASA and Lockheed Martin Launch Abort System team participated in the "NASA Day on the Square" event in downtown Huntsville on June 21. The event was an outreach to the local community to let the public know about the work being done by NASA and its partners. The team, which represented the Orion Program for the day, answered questions about Orion from a very responsive public.



## iViva Orion!

Honeywell employees in Puerto Rico participated in the "I'm on Board" banner campaign on June 12.



New Roundup highlights Orion's first test flight

Read about the top five things we will learn from Exploration Flight Test-1 in the summer edition of Johnson Space Center's Roundup magazine.

<http://1.usa.gov/1jcl1xn>



Read more about Ellen Ochoa, center director for NASA's Johnson Space Center: <http://on.fb.me/1mctVMA>

Coming up in July:

- Orion Crew/Service Module functional tests
- Backshell panel installation
- Renaming ceremony for Operations & Checkout Building at Kennedy Space Center



# Space Launch System

## Highlights

June 2014



## NASA Turns Down the Volume on Rocket Noise through SLS Scale Model Acoustic Testing



A 5-percent scale model, including solid rocket motors, of the SLS is ignited to test how low- and high-frequency sound waves will affect the rocket on the launch pad. The data collected from the tests will be used to help direct and verify the design of the rocket's sound suppression system. For the full story and videos, click [here](#).  
(NASA/MSFC)

## SLS Model Undergoes Wind Tunnel Testing at NASA Langley



The aerodynamics team at NASA's Langley Research Center recently tested a model of the 70-metric-ton SLS. The model was tested in Langley's Transonic Dynamics Tunnel, where engineers measured unsteady aerodynamic pressures and forces exerted on the SLS vehicle. Wind tunnel testing will help engineers at NASA's Marshall Space Flight Center fine tune the performance of the vehicle to better understand how it will fly on its first flight. (NASA/Langley)

## SLS Team Says Farewell to NASA Leader Dan Dumbacher



Dan Dumbacher, left, deputy associate administrator for Exploration Systems Development at NASA, addressed SLS team members at a farewell event held in his honor June 18 at the Marshall Center. Dumbacher left NASA to take a faculty position at Purdue University in West Lafayette, Indiana. "It has been an honor to work with all of you," Dumbacher said. "You guys will get SLS in place and take us all beyond low-Earth orbit." (NASA/MSFC)

## Spaceflight Partners: Cytec Industries Inc.

*EDITOR'S NOTE: Every month, SLS Highlights turns the spotlight on one of the industry partners helping to create the largest rocket ever built for human space exploration. In this issue, we profile Cytec Industries Inc. of West Paterson, New Jersey.*

NASA's Space Launch System (SLS) will be the most powerful rocket ever built and will provide a heavy-lift capability enabling a variety of missions to deep space. Cytec Industries materials are used by ATK to manufacture the nozzles of its solid rocket boosters that provide the initial boost for the first two minutes of the rocket's ascent into space.

SLS and the Orion spacecraft will provide astronauts with the ability to embark on a wide variety of missions, including to an asteroid and ultimately to Mars.

ATK is planning a static firing of the full-scale five-segment motor later this year, which will demonstrate a number of things, including the precision of the Cytec materials used in the nozzle.



Cytec Industries Inc. materials are used by ATK in the manufacture of the nozzles of its solid rocket boosters that provide the initial boost for the first two minutes of the rocket's ascent into space. (ATK)

**I am building SLS**

**Ashley Lee**  
Project Lead Engineer



 To find out more about the people who are building SLS, click [here](#).

# Welding Tools Being Put to Work at Michoud



A barrel is lifted off the Vertical Weld Center (VWC) at NASA's Michoud Assembly Facility in New Orleans. The VWC is a friction-stir-weld tool for wet and dry structures on the SLS core stage. It will weld barrel panels together to produce whole barrels for the two pressurized tanks, the intertank, the forward skirt and the aft engine section. (NASA/MAF)



A completed dome on a holding fixture at the Plug Weld Tool (PWT). The PWT is a friction-stir-weld tool used to complete circumferential friction stir welds in the production of dome assemblies for SLS core stage cryogenic tanks. (NASA/MAF)



Technicians at NASA's Michoud Assembly Facility in New Orleans lower a qualification ring for the SLS core stage. The ring was made using the Segmented Ring Tool, which uses a friction-stir-weld process to produce segmented support rings for the core stage. The rings connect and provide stiffness between domes and barrels. (NASA/MAF)

## SLS On the Road...



SLS Program Manager Todd May shares progress on the rocket June 9 at the Exploration Systems Development (ESD) Update at the Huntsville Museum of Art. (NASA/MSFC)



The inflatable SLS was a “home run” at the annual Congressional Baseball Game June 25 at Nationals Stadium in Washington. (NASA/MSFC)



A future explorer proudly displays his jetpack at “NASA on the Square” in downtown Huntsville, Alabama. The June 21 event showcased programs and projects at the Marshall Space Flight Center, including the SLS and Orion spacecraft. (NASA/MSFC)



SLS Program Manager Todd May, left, speaks to a crowd about NASA’s next great rocket June 19 at the U.S. Space & Rocket Center. The speech was part of the “Pass the Torch” inspiration series, which features professionals from industry, academia and government speaking about their work in space, aeronautics, engineering, science research and other related fields. “We have America’s next great ship,” May said. “It’s called the Space Launch System. And it’s taking shape as we speak.” (NASA/MSFC)

For more SLS news, updates and resources, visit [www.nasa.gov/sls](http://www.nasa.gov/sls)

Follow SLS on:



### SLS on Deck:

- Vertical Assembly Center ready to weld
- Anti-geyser testing
- Boosters critical design review board



# GSDO

GROUND SYSTEMS  
DEVELOPMENT & OPERATIONS

EXPLORATION BEGINS HERE



## PROGRAM HIGHLIGHTS • JUNE 2014

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://go.nasa.gov/groundsystems>.

## GSDO Ops & Planning Prepares for NASA's Space Launch System

NASA's Ground Systems Development and Operations (GSDO) Program is working to transform Kennedy Space Center to support processing and launch of the agency's Space Launch System (SLS) and Orion spacecraft in Fiscal Year 2018. GSDO operations and planning is an integral component to achieving this goal.

Work is primarily distributed across the Analysis and Integration Team and three GSDO Integrated Product Teams (IPTs): Vehicle Integration and Launch (VIL), Offline Processing and Infrastructure, and Command, Control, Communication and Range (C3R). Each has roles in development and operations and also shares their combined efforts with the SLS and Orion Programs and other NASA centers.

VIL is responsible for planning how GSDO will integrate, test and launch the SLS and Orion spacecraft. Using a ground operations planning database, the team is working to determine how best to integrate the boosters, the launch vehicle and the Orion spacecraft.

The Operations Integration Branch is responsible for planning and managing operations which includes performing 3-D modeling of how the launch vehicle will be processed in the Vehicle Assembly Building, transported to Launch Pad 39B and prepared for launch.

C3R is developing the Launch Control System, which is the command and control system, for SLS, Orion, and ground support equipment and its subsystems. The communications systems at Kennedy have been evaluated and are being upgraded as required.

For the complete story, visit <http://go.nasa.gov/1vTd4UU>.



*A computer-aided design image of NASA's Space Launch System and Orion spacecraft being stacked in the Vehicle Assembly Building high bay at Kennedy Space Center.*

# GSDO, Corrosion Lab Test Coatings for Aluminum Ground Support Equipment

Kennedy Space Center continues to transform into a multi-user spaceport of the future, and many of the center's facilities are undergoing upgrades and modifications to support processing and launch of NASA's Space Launch System and Orion capsule in 2017 and beyond.

The Technology Evaluation for Environmental Risk Mitigation (TEERM) Principal Center in NASA's Environmental Management Division has partnered with the Ground Systems Development and Operations Program to investigate alternative coatings that could serve as an option to replace the current hexavalent chromium coatings, also called hex-chrome, on aluminum structures, including large enclosures that house electronics throughout the center.

"It is rewarding to partner with the TEERM team as they continue to successfully research alternatives that benefit the environment and reduce corrosion control costs at the center" said Bill Simmonds, GSDO project manager for Environment and Infrastructure.

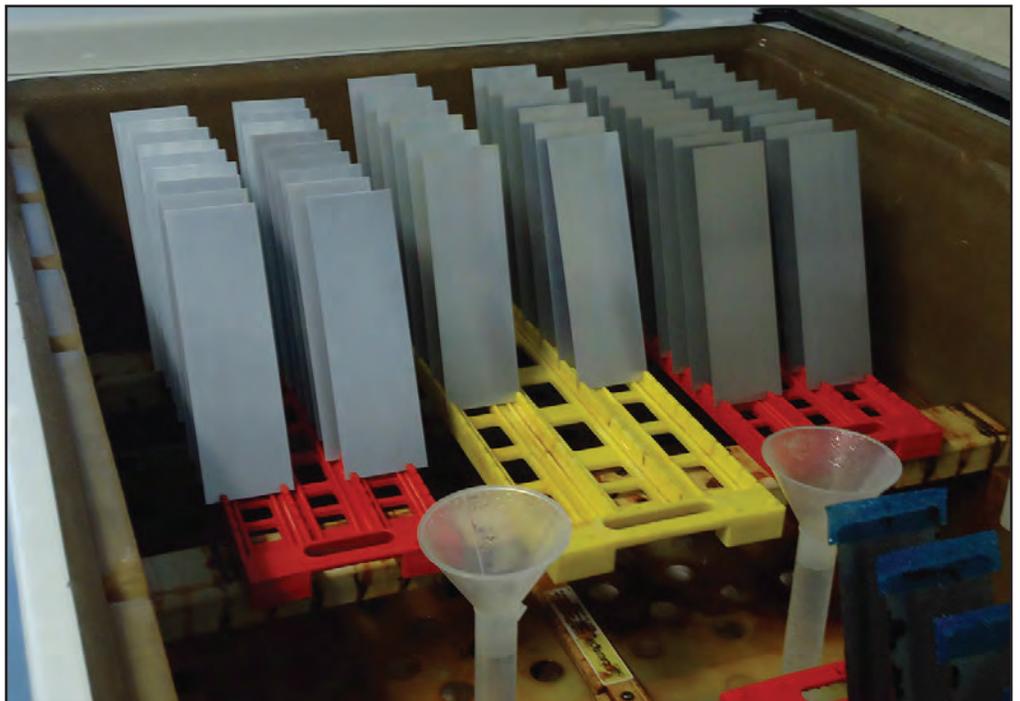
Kurt Kessel, a project manager with ITB Inc. is overseeing the testing of alternative coating samples at the Corrosion Technology Lab in the Operations and Checkout Building and the Beachside Atmospheric Test Facility. The project is a continuation of work begun during the Space Shuttle Program.

"There are many variables that need to be considered when looking at primers and coatings for flight or ground support equipment," Kessel said. "We are gathering test results and sharing them with GSDO on a monthly basis."

Results of the alternative coating tests will be shared with other NASA centers, the U.S. Air Force and other government agencies, and the European Space Agency.



*Three different coating systems were applied to aluminum test panels July 18, 2013, and placed at the Beachside Test Facility at NASA's Kennedy Space Center in Florida. Photo credit: IHA/Kurt Kessel*



*Alternative corrosion control coatings were applied to aluminum test panels Dec. 13, 2012, and placed in a salt spray chamber in the Corrosion Technology Lab at the Operations and Checkout Building at NASA's Kennedy Space Center in Florida. Photo credit: IHA/Kurt Kessel*

**For the complete story, visit <http://go.nasa.gov/1jLVxYZ>.**

# Launch Complex 39B Refurbishment Contract Awarded

NASA has awarded a contract to Precision Mechanical Inc. of Cocoa, Florida, to refurbish the Environmental Control System (ECS) at Launch Complex 39B. The firm-fixed price contract with two options was awarded June 30 and has a maximum value of \$11.23 million with a performance period of 412 days.

The completed ECS will provide conditioned clean purge air to various compartments of the new Space Launch System vehicle. The refurbishment/replacement includes the following components: chillers, large volume blowers, high-pressure ducts, piping, industrial process PLC-based controls, humidifiers and boilers, and associated electrical equipment.

All cooling tower equipment including fill, fans, gear boxes, pumps, valves, piping, grating and handrails will be replaced and the concrete structure repaired or refurbished.

The project also will include two options for the installation of four additional compartment purge circuits and appurtenances from the main distribution plenum to above the pad surface and the replacement of existing post-cooling coils for three cooling chambers.



An aerial view taken May 6, 2013, from the southwest looking toward the northeast, shows the entire Launch Pad 39B area at Kennedy Space Center with the Atlantic Ocean in the background. Photo credit: NASA/Kim Shiflett



Inside Firing Room 4 at Kennedy Space Center's Launch Control Center on June 11, the outer walls and window framing for the four separate firing rooms on the main floor have been completed. Three rows of upper-level management consoles remain and could be used as a fifth firing room. GSDO is overseeing the efforts to create a new firing room based on a multi-user concept. Photo credit: NASA/Daniel Casper



A crane is used to lift a section of the metal structure away from the ML on June 11. The ML is being modified and strengthened to accommodate the weight, size and thrust at launch of NASA's Space Launch System, or SLS, and Orion spacecraft. Photo credit: NASA/Daniel Casper

# Employee Spotlight --- Jeremy Graeber

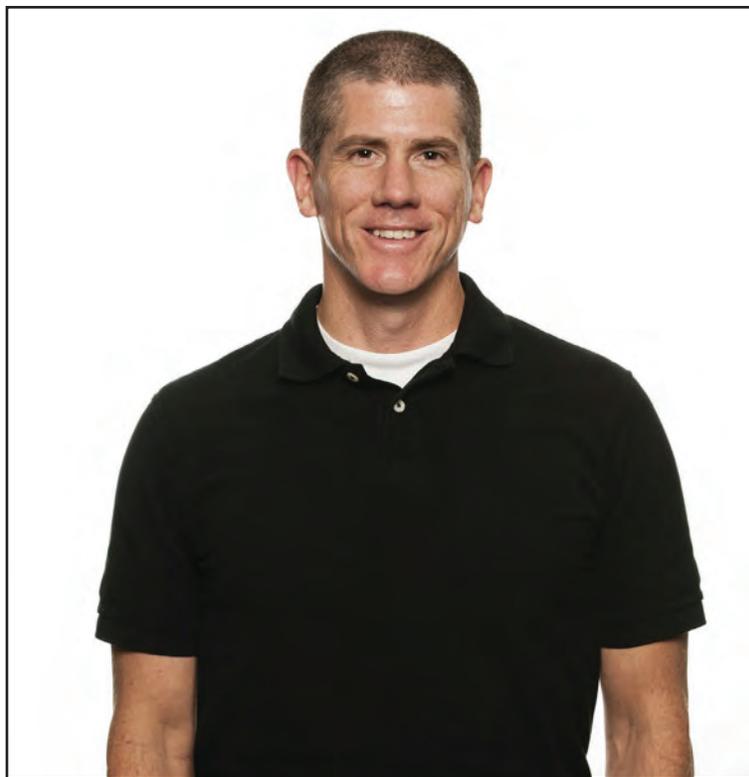
Jeremy Graeber, an engineer in GSDO, recently was assigned as senior operations lead for the Exploration Flight Test-1 (EFT-1) Landing and Recovery Operations. In this role, he will help develop and lead the Operations Team that will recover the Orion spacecraft for EFT-1.

"There are many things I like about this job. The exceptional individuals that I work with make this job very rewarding," Graeber said. "The new challenge that I have been asked to take on with EFT-1 Landing and Recovery is very exciting, and I am looking forward to helping this outstanding team."

Graeber came to Kennedy Space Center about 18 years ago. His first eight years were with United Space Alliance as a fuel cell system engineer for the Space Shuttle Program. His last 10 years have been with NASA in a few different roles, including a NASA Space Shuttle Launch Test Director. He was one of just four certified NASA test directors responsible for leading the shuttle team during the planning, scheduling and execution of the shuttle launch countdown.

As NASA marked T-6 months and counting for EFT-1, Graeber said it's very exciting to see this part of GSDO transition from planning to operations and knowing that the rest of the program will be making the same transition as it gets closer to Exploration Mission-1 on NASA's Space Launch System and Orion spacecraft.

Graeber is an avid triathlete, soccer player and coach (flag football, soccer and volleyball) for his children. His



first car, which he still owns, is a 1967 Datsun 1600 convertible.

Graeber and his wife, Stephanie, have three children, Olivia, 13, Jenna, 11, and Jack, 8. They have a 95-pound boxer and Labrador mix named Stella.



*Charlie Blackwell-Thompson, second from left, chief of the Program Interface Office in the Ground Processing Directorate, and Phillip Meade, chief of Operations and Planning, also in Ground Processing, received recognition from Kennedy Space Center's Technology Transfer Office on June 9 for their patented invention, "Methods and Systems for Advanced Spaceport Information Management." Blackwell-Thompson provides near full time support to GSDO and specifically serves as the lead of the Launch Integration Cross Program Team and the Ground Operations and Launch (GOAL) teams. At right is Kennedy Deputy Director Janet Petro. At left is Kennedy Chief Technologist Karen Thompson.*



# ESD

EXPLORATION SYSTEMS DEVELOPMENT



*More than 5,000 space enthusiasts around the world viewed a Google+ Hangout live during the drop test, and another 10,000 have watched the video on YouTube. Orion program experts Stu McClung and Molly White provided play-by-play explanations throughout the test and answered questions from viewer.*