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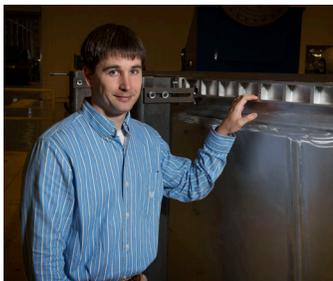
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Adapter 'Flips' for Progress toward 2014 Exploration Flight Test

By Megan Davidson

Engineers at NASA's Marshall Space Flight Center recently flipped an adapter -- no easy feat when you're talking about 1,000 pounds of aluminum -- furthering progress toward Exploration Flight Test (EFT)-1 in 2014 and providing early experience for Space Launch System (SLS) hardware ahead of the rocket's first flight in 2017.

The flip is an important step in finishing the machining work on the adapter, which will attach NASA's Orion

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The structural test article adapter is flipped at Marshall testing facility Building 4705. The turnover is an important step in finishing the machining work on the adapter, which will undergo tests to certify subsequent flight units to attach the Orion spacecraft to a Delta IV rocket for its 2014 Exploration Flight Test-1. (NASA/MSFC)

Mighty Eagle Gets a New View

By Shannon Ridinger

The Mighty Eagle, NASA's robotic prototype lander managed out of NASA's Marshall Space Flight Center, recently completed a test series to monitor its systems functionality after coming out of winter storage. This latest series included a test flight that was recorded by the Quad-Copter -- a small vehicle also developed at Marshall that was equipped with a video camera allowing for never-before-seen footage of the Mighty Eagle.

The Mighty Eagle, nicknamed after one of the characters in the popular Angry Birds game, is a three-legged prototype vehicle. It is 4 feet tall, 8 feet in diameter and weighs about 700 pounds when fueled. It is a green vehicle, fueled by 90 percent pure hydrogen peroxide, and is guided by an onboard computer that activates the thrusters to power the craft's movements.

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Marshall Picnic June 8 is 'All About the People;' Set to Include Rides, Sports, Games

By Rick Smith

Marshall Space Flight Center organizers say tickets are selling well for the annual Marshall Center Employee Family Picnic, set for June 8 and open to all civil service employees, retirees, badged contractors and their families. The event will be held from 10 a.m. to 3 p.m. in and around buildings 4315 and 4316 -- the Wellness Center and Activities Building.

"The picnic is a longstanding tradition that dates back to the early days of the Marshall Center," said Marshall Center Director Patrick Scheuermann. "It's a great reminder that our mission is ultimately all about the people who accomplish it and the families who support them."

The picnic is organized and sponsored by the Marshall Exchange, with key support from the center directorates. Organizers still seek volunteers to help with activities and food distribution during the event. Marshall team members are encouraged to visit [ExplorNet](#) to sign up; every volunteer will receive a free T-shirt to commemorate the event.

Lunch will be catered by Lawler's Barbecue. Meal tickets must be pre-purchased. Tickets are available from Marshall administrative officers through May 31, and from the Space Shop in Building 4203 through June 7. Each \$5 meal ticket includes a choice of barbecued pork or turkey and bun, potato salad, beans, cole slaw and a canned Pepsi product or bottled water. Hamburgers, hot dogs, snow cones, funnel cakes, fresh lemonade and other refreshments also will be available for purchase, as well as beer for those aged 21 and up.

Children and adults will be treated to a variety of activities, including carnival midway-type games, a video gaming truck, miniature train ride, inflatable moon bounces and slides. Bingo -- a big success in years past -- also will be back this year.

Kids can cool off on an inflatable water slide, and are encouraged to bring bathing suits and towels. They won't get wet alone -- Scheuermann and other center leaders will take turns in a dunking booth, inviting team members and other picnic-goers to try their luck at soaking the bosses. *See [Marshall Picnic](#) on [page 4](#)*

Marshallpalooza! Homegrown Talent to Take Stage June 8

Marshall Space Flight Center team members and their families can expect a "Marshallpalooza" of homegrown musical talent during the employee picnic June 8. Multiple acts -- including several comprised of current and former members of the Marshall workforce -- will perform throughout the day's festivities, from 10 a.m. to 3 p.m.

Pop/rock cover band Just Like Grady -- featuring Marshall engineer Andrew Smith, retired Marshall engineer Ed Ricks and their bandmates -- plays simple arrangements filled with rich piano sounds and driving bass beats.

Marshall engineer Wayne Gamwell, who won third place in the Marshall Exchange "Three Minute Talent Show" earlier this year, will perform a mix of acoustic country, folk and blues on guitar.

Rock-and-roll cover band Brown Noise Brigade -- featuring Marshall engineers Lawrence Jones, Ravi Purandare, Andrew Smith and Alex Thomas -- plays a span of music from classic rock and metal to '90s alternative and modern rock.

Headlining the day's event are the Back Road Sinners, which performs a high-energy mix of music from the likes of The Allman Brothers Band, Lynyrd Skynyrd, Jason Aldean, George Strait, The Charlie Daniels Band and more.

Music for the Marshall picnic is organized by the MARS Music Club. Marshall engineer Lawrence Jones, club president, is pleased so many performers have volunteered their time to be part of the celebration.

"The club is pleased to help share great music and great local talent with the Marshall family," Jones said. "Come out and support your local musicians!"

Additional acts are expected to be announced in coming days. Watch [ExplorNet](#) and [Heads Up Marshall](#) for further details.

Mighty Eagle *Continued from page 1*

“We were approached by the Mighty Eagle team to film the vehicle in flight, and we thought it would be a great collaboration,” said Garrick Merrill, a member of the Aero-M team and a computer engineer in the Space Systems Department at Marshall. “It gave us an opportunity to test the copter in a flight situation, and we were really pleased with the results. It really was a win-win situation for both teams -- giving us both important data we can use on future flights.”

The Quad-Copter is an achievement in itself. The vehicle was designed and built by the Aero-M team at Marshall as part of the 2012 Unmanned Aerial Systems, or UAS, competition between various NASA centers. The Marshall team was made up of young engineers from across the center who were tasked with designing a vehicle that could perform an autonomous search and rescue mission to locate people after a small plane crash. The Quad-Copter is built with off-the-shelf, hobbyist-grade parts and uses an open-source flight computer. The initial design of the vehicle uses



The Mighty Eagle takes flight with the entire demonstration recorded by the Quad-Copter. (NASA/Todd Freestone)

a two-megapixel IP camera, but for the Mighty Eagle flights the IP camera was removed and a GoPro video camera was attached to provide high-definition video.

“Working with the Aero-M team has been great,” said Jason Adam, flight manager for the Mighty Eagle. “The data we have been able to get from seeing the flight in a way we’ve not before will be really helpful as we

*See **Mighty Eagle** on page 5*

Marshall Center Recognized for Exceeding Small Business Goals

By Jena Rowe

NASA’s Marshall Space Flight Center received the NASA Small Business Prime Socioeconomic Goal Achievement for fiscal year 2012 from NASA Office of Small Business Programs Associate Administrator Glenn Delgado. This award recognizes NASA centers that meet all of their prime socioeconomic goals for the previous fiscal year.

Not only did the Marshall Center meet its projected goals, but significantly exceeded all goals except the service disabled veteran-owned small business goal.

Every two years the Office of Small Business Programs issues a call to all NASA centers requesting a submission of their two-year projected small business goals. In May 2011, Marshall Center small business specialists performed a comprehensive analysis of the center’s planned direct and prime contractor/subcontracting activities for fiscal years 2012 and 2013. Projections were forwarded to the NASA Office of Small Business Programs in June 2011 and represented the best estimate based on procurement data.

“The model currently utilized for projecting the center’s

small business goals has proven most beneficial for projecting center goals each fiscal year,” said David Brock, small business specialist at Marshall. “During this time, Marshall Center has achieved all goals 16 of the 17 years since implementation of the model in 1996.”

In fiscal year 2012, Marshall hit high marks in its small and small-disadvantaged business categories despite a more than \$400 million decrease in overall procurement dollars from fiscal year 2010 to fiscal year 2012. In 2012, \$257 million in obligations to small businesses and \$101 million to small-disadvantaged businesses were awarded in procurement dollars. “Anticipated growth should continue in most small business goal categories in FY 2014 and 2015 based on current projections,” said Brock.

For more information about the NASA Socioeconomic Goal Recognition, visit [here](#).

Rowe, an Analytical Services Inc. employee and the Marshall Star editor, supports the Office of Strategic Analysis & Communications.

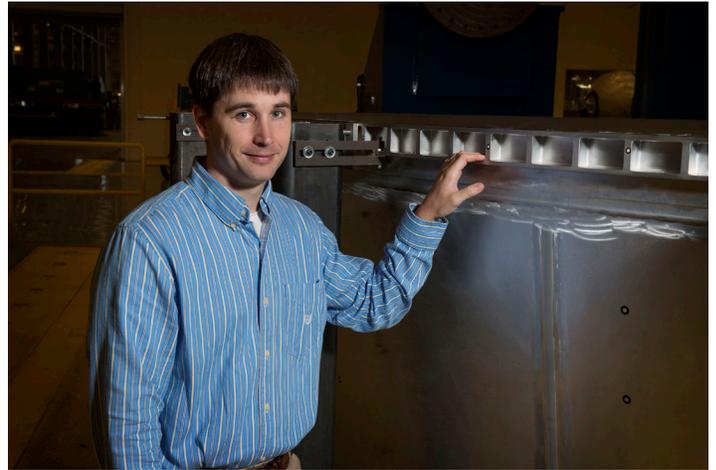
Marshall at Work: Design for SLS Adapters all in the Drawings of Engineer Jonathon Walden

By Megan Davidson

When a scholarship to the University of Alabama in Huntsville opened the door to an engineering degree for Jonathon Walden, it opened another door for him as well -- a job at NASA's Marshall Space Flight Center, designing a crucial piece of flight hardware for the Space Launch System (SLS).

Walden, who was a contractor for six years in Marshall's Spacecraft & Vehicle Systems Department before accepting a civil service position in 2012 in the same office, is the sole designer for the Multi-Purpose Crew Vehicle Stage Adapter (MSA). The MSA will attach the Orion spacecraft to a Delta IV rocket for its 2014 Exploration Flight Test-1 (EFT-1). It also will provide early flight experience for SLS's first flight in 2017.

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Jonathon Walden is the lead designer for the Multi-Purpose Crew Vehicle Stage Adapter (MSA), being manufactured at the Marshall Center. The MSA will attach the Orion spacecraft to a Delta IV rocket for its 2014 Exploration Flight Test-1 (EFT-1). It also will provide early flight experience for SLS's first flight in 2017. (NASA/MSFC/Fred Deaton)

Marshall Picnic *Continued from page 2*

Bob Devlin, deputy director of Marshall's Office of Center Operations, said this year's picnic also revives a classic Marshall tradition -- integrating and celebrating the center's fitness and social clubs.

Scheuermann agreed. "Our clubs are a key component of our quality of life," he said. "They ensure everyone maintains a healthy life balance and a sense of good-natured competition."

The MARS Music Club will provide live music throughout the day's events (see "Marshallpalooza" sidebar), and the Marshall Exchange sports leagues and clubs will host a variety of games and activities, including:

- **Bike rodeo:** The MARS Team Redstone Alliance for Cycling, or MTRAC, will host a bike rodeo to test children's bike-riding skills as they weave through cones, navigate past obstacles and demonstrate how to properly start, stop and accelerate on a bike. Bikes and safety helmets will be provided.
- **Softball tournament:** The MARS Softball Club will host a best-of-five tournament between a NASA all-

star team and a Redstone Arsenal all-star team.

- **Basketball "hotshot" contest:** The MARS Basketball Club will host this contest demonstrating the shooting and free-throw abilities of players in a variety of age groups.
- **Toddlers run:** The MARS Running Club will host a race among toddlers over a 20- to 30-yard course, while parents, grandparents and siblings cheer them on.
- **Fishing:** The MARS Fishing Club will host a fishing game in the midway area, including a large tank for viewing live fish, and numerous fishing-related games with prizes.
- **Volleyball games:** The MARS Volleyball Club will host this game for all those interested, and will also host a clinic to teach volleyball skills.
- **Golfing:** The MARS Golf Club will host chipping and putting activities in the midway.
- **Shortwave radio for beginners:** The MARS Amateur Radio Club will demonstrate how to operate a shortwave radio

Scheuermann encourages everyone to come out and join the fun. "We all get focused on deadlines and project goals and the work of our own groups or departments," he said. "This is a great chance for everyone to come

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Adapter 'Flip' *Continued from page 1*

spacecraft to a United Launch Alliance (ULA) Delta IV rocket that will send Orion to space during EFT-1.

The same adapter technology later will connect Orion to SLS -- a new heavy-lift rocket managed and in development at Marshall that will be capable of sending Orion into deep space.

During EFT-1, Orion will travel to an altitude of approximately 3,600 miles above Earth's surface. By flying Orion out to those distances, NASA will be able to see how the spacecraft performs in and returns from deep space journeys. The flight test also will provide engineers with important data about the adapter's performance before it is flown on SLS.

Engineers finished welding on the first of two adapters and flipped it using a Posi-Turner load rotation device

and an Assembly Jig, the ring that connects the Posi-Turner to the bottom of the adapter and rotates it.

"The Posi-Turner and Assembly Jig were repurposed from another program, so we had to modify them a bit to fit our needs to rotate the adapter," said Brent Gaddes, Spacecraft & Payload Integration Adapter Subsystem manager at Marshall. "Our engineers are really good at coming up with creative ways to use existing resources in a cost-effective manner.

"Affordability is crucial when you're talking about building a rocket as big and powerful as the Space Launch System," added Gaddes.

"It's very exciting as a young engineer to be able to work on a piece of flight hardware, and see it go from design to actual manufacturing," said Zenia Garcia, a

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Mighty Eagle *Continued from page 3*

prepare for future flights."

Those future flights include a new test series for the Mighty Eagle in July that will be demonstrating a system fitted on the vehicle for optical hazard avoidance. Roughly 200 tons of dirt from a quarry in the western United States will be brought in by rail to simulate a celestial body. The vehicle will then work through a series of tests to demonstrate the new system's ability to detect hazards that could cause damage to the vehicle during an actual lunar landing situation. The data will be used to develop hazard avoidance systems for potential future small robotic

missions. The Mighty Eagle team intends to collaborate with the Quad-Copter team for a similar flight in July.

The "Mighty Eagle" lander was developed by the Marshall Center and Johns Hopkins University Applied Physics Laboratory in Laurel, Md., for NASA Headquarters' Planetary Sciences Division, Science Mission Directorate. Key partners in this project include the Von Braun Center for Science and Innovation, which includes the Science Applications International Corporation, Dynetics Corp., and Teledyne Brown Engineering Inc., all of Huntsville.

NASA will use the Mighty Eagle and its larger counterpart, the Project Morpheus prototype lander -- being tested at NASA's Johnson Space Center -- to mature the technology needed to develop a new generation of small, smart, versatile robotic landers capable of achieving scientific and exploration goals on the surface of planetary bodies.

For more information on NASA's robotic landers, visit [here](#).

Ridinger is a public affairs officer in the Office of Strategic Analysis & Communications.



The Mighty Eagle is caught in mid-flight by the camera mounted on the Quad-Copter. (Aero-M UAV Team: Garrick Merrill, Adam Kimberlin, Peter Ma, Chris Becker and Robert Parker)

Adapter 'Flip' *Continued from page 5*



NASA Associate Administrator Robert Lightfoot gets a first-hand look at the adapter work underway at Marshall's Building 4705 on May 22. While at the facility, Lightfoot held a press conference to discuss the hardware and answer questions about the status of SLS. (NASA/MSFC/Emmett Given)

Marshall engineer who worked on the design for fitting the adapter to the Assembly Jig and Posi-Turner tooling. "I've had the opportunity to exercise my technical expertise, as well as get hands-on experience on this project. I look forward to seeing that work take Orion, and SLS, to space in the near future."

Now that the adapter is flipped and positioned on a seven-axis mill turntable at one of Marshall's manufacturing facilities, engineers will drill hundreds of holes in it for bolting to the rest of the rocket. ULA, which makes the Delta IV in nearby Decatur, Ala., will

Marshall Picnic *Continued from page 4*

out and reengage with the whole Marshall workforce -- and our way to say thanks to the whole team and their families!"

Special Redstone Arsenal entry guidelines

Organizers want to remind all team members to use Gate 8 (Drake and Goss roads) or Gate 9 (Rideout Road) for access to Redstone Arsenal on June 8.

Non-badged family members planning to arrive unescorted by a permanently badged team member must have a one-day pass prior to arrival. Team members can pick up one-day passes for family members at the security desk in the lobby of Building 4200 June 3-6 from 8 a.m. to 3:30 p.m. Marshall team members must

deliver a full-size section of the rocket in late June for engineers to test the fit of the adapter.

Circumferential welding also was recently completed on a second adapter, which will fly on EFT-1. That adapter will be moved from another Marshall manufacturing facility to the Assembly Jig/Posi-Turner for its own flip and final machining work.

So why have twin adapters?

"It's always important to test something before it actually flies," said Gaddes. "Analysis on the first adapter, which we are using as a structural test article, gives us a good indication of the amount of stress it can handle, and the test verifies that the analysis is correct. We can resolve any issues with the first adapter to perfect the second piece for flight."

The adapters, along with other SLS components, are currently under evaluation at the Spacecraft & Payload Integration Office preliminary design review, which kicked off May 15. The review is a precursor to the overall SLS program preliminary design review, scheduled to kick off June 18-19.

Watch a video of the adapter ring flip [here](#).

Davidson, an Analytical Services Inc. employee, supports the Office of Strategic Analysis & Communications.

provide the name of the family member who will use the pass. Passes should be placed on the driver's side of the windshield, and drivers must present a valid driver's license, vehicle registration and proof of insurance when arriving at a Redstone Arsenal gate.

Marshall team members who wish to attend the event with a spouse, children or grandchildren who are non-U.S. citizens must pre-coordinate their access no later than May 31. Contact Julie Stapp-Rooks in the Protective Services Office at julie.l.stapp-rooks@nasa.gov for more information.

Smith, an Analytical Services Inc. employee, supports the Office of Strategic Analysis & Communications.

NASA's Space Launch System Exhibit Featured at Destination ImagiNation Global Finals May 22-25

Space Launch Systems Communications Coordinator Twila Schneider, an employee of Analytical Services Inc., supporting the External Relations Office within the Office of Strategic Analysis & Communications at NASA's Marshall Space Flight Center, helps 2-year-old Charles Barnes reach the top of a model Space Launch System rocket at the 2013 Destination ImagiNation Global Finals event in Knoxville, Tenn., on May 22-25. Destination ImagiNation is an educational program in which student teams solve open-ended challenges and present their solutions at local and state tournaments. The Global Finals event, with approximately 10,000 students participating and 6,000 adult volunteers, celebrates the teams that advanced through the local and state tournaments. (NASA/MSFC)



Marshall at Work *Continued from page 4*

SLS, NASA's new heavy-lift rocket, is managed and in development at the Marshall Center.

"I really didn't know if I was even going to go to college after I graduated high school, but when I received a scholarship to UAH, I decided I wanted to go into engineering," said Walden, who is currently working on his master's degree in aerospace engineering at his alma mater. "Engineering seemed like a natural choice for me, as my grandfather helped design the Patriot missile. I wanted to follow in his footsteps."

"It's an exciting field of work," he added. "Especially getting to see my designs go from sketches to manufacturing. That's a big deal in the design world. It's not just ideas on paper anymore."

And a lot of pen-to-the-paper concepts are necessary when you're crafting twin adapters -- one to use for a structural test, and the other to actually fly on EFT-1.

Walden has spent countless hours with analysts and other engineers, assessing the design of the adapter, creating models, problem solving for better configurations, reviewing data prior to machining and overseeing each part of the manufacturing process to

make sure design requirements are met at each stage.

"We just flipped the structural test adapter to drill holes in it to connect it to the Delta IV," Walden said. "I make sure any manufacturing we do, like drilling holes and surfacing, follows the design requirements. That's a big part of ensuring we get things right on the second adapter before it flies."

Now that the twin adapters are going through final machining, and the Spacecraft & Payload Integration Office's (SPIO) preliminary design review is underway, it's back to the drawing board for Walden, who's preparing for the SLS program critical design review, scheduled for 2015. The prototype adapter's structural test is planned for later this fall.

"With every concept, every drawing, we are one step closer to being ready to fly in 2014, and 2017," Walden said. "It's an incredible feeling to know my work is a part of getting us there."

Davidson, an Analytical Services Inc. employee, supports the Office of Strategic Analysis & Communications.

Marshall Team Observes Lunar Impact

By Tony Phillips

For the past eight years, NASA astronomers have been monitoring the moon for signs of explosions caused by meteoroids hitting the lunar surface. “Lunar meteor showers” have turned out to be more common than anyone expected, with hundreds of detectable impacts occurring every year.

Recently, astronomers have seen the biggest explosion in the history of the program.

“On March 17, 2013, an object about the size of a small boulder hit the lunar surface in Mare Imbrium,” says Bill Cooke of NASA Marshall Space Flight Center’s Meteoroid Environment Office. “It exploded in a flash nearly 10 times as bright as anything we’ve ever seen before.”

Anyone looking at the moon at the moment of impact could have seen the flash -- no telescope required. For about one second, the impact site was glowing like a 4th magnitude star.

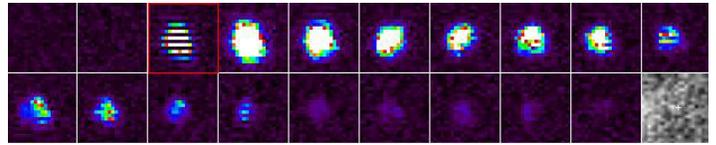
Ron Suggs, an analyst at the Marshall Center, was the first to notice the impact in a digital video recorded by one of the monitoring program’s 14-inch telescopes. “It jumped right out at me, it was so bright,” he recalls.

Initial calculations suggest that the object massed about 40 kg and it hit the moon traveling 25 km/s (56,000 mph). The resulting explosion packed as much punch as 5 tons of TNT.

Lunar meteors don’t require oxygen or combustion to make themselves visible. They hit the ground so fast, with so much kinetic energy, that even a pebble can make a crater several feet wide. The flash of light comes from the thermal glow of molten rock and hot vapors at the impact site.

Cooke believes the lunar impact might have been part of a much larger event.

“On the night of March 17, NASA and the University of Western Ontario’s All-Sky Cameras picked up an unusual number of deep-penetrating meteors right here on Earth,” he says. “These fireballs were traveling along nearly identical orbits between Earth and the



These false-color frames extracted from the original black and white video show the explosion in progress. At its peak, the flash was as bright as a 4th magnitude star. (NASA/Meteoroid Environment Office)

asteroid belt.” So, Earth and the moon were pelted by meteoroids at about the same time.

“My working hypothesis is that the two events are related, and that this constituted a short duration cluster of material encountered by the Earth-moon system,” says Cooke.

One of the goals of the lunar monitoring program is to identify new streams of space debris that pose a potential threat to the Earth-moon system. This would seem to be a good candidate.

Controllers of NASA’s Lunar Reconnaissance Orbiter (LRO) have been notified of the strike. The crater could be as wide as 20 meters, which would make it an easy target for LRO if the spacecraft happens to pass over the impact site. Comparing the size of the crater to the brightness of the flash would give researchers a valuable “ground truth” measurement to validate lunar impact models.

Unlike Earth, which has an atmosphere to protect it, the moon is airless and exposed. “Lunar meteors” crash into the ground with fair frequency.

Since the monitoring program began in 2005, NASA’s lunar impact team has detected more than 300 strikes, most orders of magnitude fainter than the March 17 event. Statistically speaking, more than half of all lunar meteors come from known meteoroid streams such as the Perseids and Leonids. The rest are sporadic meteors -- random bits of comet and asteroid debris of unknown parentage.

“We’ll be keeping an eye out for signs of a repeat performance next year when the Earth-moon system passes through the same region of space,” says Cooke.

Phillips manages Science@nasa for NASA Headquarters.