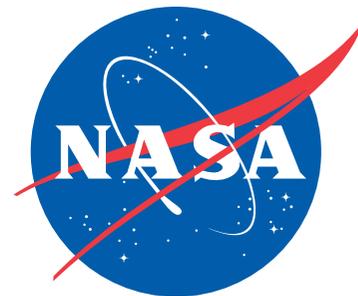


# Spaceport News

John F. Kennedy Space Center - America's gateway to the universe



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## SpaceX tests engines for station mission

*By Steven Sicheloff  
Spaceport News*

Space Exploration Technologies, or SpaceX, of Hawthorne, Calif., on Wednesday updated the launch status for the company's upcoming demonstration mission to the International Space Station. A statement from the aerospace company said, "At this time, a May 7 launch appears unlikely. SpaceX is continuing to work through the software assurance process with NASA. We will issue a statement as soon as a new launch target is set."

This follows a launch dress rehearsal April 30 by the SpaceX launch team that concluded with a brief engine firing to verify the company's Falcon 9 rocket is ready to launch. The practice countdown also tested some of the systems on the Dragon spacecraft that will fly to the space station.

"Woohoo, rocket hold down firing completed and all looks good!" reported Elon Musk on his Twitter account. Musk is the owner and chief designer for SpaceX. The company's engineers are reviewing data from the test, SpaceX reported.

SpaceX is preparing for its second Commercial Orbital Transportation Services, or COTS, demonstration flight to show that private industry can build and launch spacecraft on regular cargo resupply missions to the station. This rocket and spacecraft will not carry



CLICK ON PHOTO

NASA/Jim Grossmann

Workers mate SpaceX's Dragon capsule to the second stage of the company's Falcon 9 rocket on April 26 in a processing facility at Space Launch Complex-40 on Cape Canaveral Air Force Station. For more on SpaceX and Dragon's mission to the International Space Station, click on the photo.

people, but will have about 1,200 pounds of supplies on board for the six astronauts and cosmonauts working on the space station.

The flight is an ambitious test for the company and the agency as they work through a new spacecraft and rocket, and rework the fundamental approach to spaceflight. Even if problems develop on this particular mission, NASA officials say the agency will keep the effort going and work to resolve any issues.

Mission plans call for an extensive set of tests in space requiring the Dragon spacecraft to show that it can move precisely in orbit and approach the space station carefully. Only after these tests are successful will the spacecraft be allowed to approach the orbiting laboratory close enough to be grappled and berthed by the station's robotic arm.

Originally, this mission was to include only

the launch and tests in orbit rather than physically connecting to the station. If the Dragon is unable to complete its tests successfully, NASA expects to work with SpaceX to resolve whatever issues develop and accomplish a rendezvous and docking on the third demonstration mission. That would not set back any of NASA's plans for future cargo missions to the station because it would be following the parameters the agency originally established for the COTS contract with SpaceX.

As SpaceX continued its launch preparations at Space Launch Complex-40 at Cape Canaveral Air Force Station, the static test firing gave the launch team a good indication of its readiness. The ignition for the static fire test took place at 4:15 p.m., about 45 minutes after a last-minute technical issue scrubbed the first attempt. After troubleshooting, the

launch team recycled the countdown. While good practice for a launch scenario, the issue would have scrubbed the day's opportunity on a real launch day because the rocket has an instantaneous window in order to catch the space station.

The Falcon 9 is powered by nine Merlin engines, and SpaceX reports that all nine were lit and run at full power for two seconds during the test. The rocket's second stage is powered by a Merlin vacuum engine, which runs on refined kerosene and liquid oxygen, the same fuel and oxygen combination that was used on NASA's Saturn V moon rocket first stage.

The SpaceX mission will be a landmark for the privately run company that used the same rocket and spacecraft combination in December 2010, to become the first private organization to launch and recover a spacecraft from Earth's orbit.

NASA wants private industry to deliver cargo to the orbiting laboratory on a regular basis. The agency awarded COTS Space Act Agreements to SpaceX and Orbital Sciences Corp. of Dulles, Va., to help them develop their rockets and spacecraft.

NASA engineers and flight controllers are closely working with SpaceX ahead of this flight to coordinate the intricate approach, rendezvous and birthing plans needed for this historic demonstration mission to the International Space Station.



# Commercial Crew Program manager hosts Tweet Chat

By **Rebecca Regan**  
Spaceport News

**N**ASA's Commercial Crew Program Manager, Ed Mango, hosted a Tweet Chat on April 27 to give the program's Twitter followers from around the world an opportunity to ask questions about the agency's efforts to get astronauts to the International Space Station aboard American rockets and spacecraft. Mango stuck to the social networking service's 140 character limit and answered dozens of questions.

Here's a re-cap of the program's first Tweet Chat . . .

**@rocketjohnnyk:** @Commercial\_Crew #AskCCP will tourism be allowed to fly to ISS via CCP? Will sponsors be allowed to defray costs, or is that not allowed?

**@Commercial\_Crew:** Right now, our focus is to use CCP capabilities to get NASA crews to and from the ISS to perform critical research. @rocketjohnnyk #AskCCP

**@SpaceKSCBlog:** #AskCCP @Commercial\_Crew This summer, will the CCiCap rewards result in reducing the number of candidates?

**@Commercial\_Crew:** All I can say about CCiCap is "stay tuned." @SpaceKSCBlog #AskCCP

**@rcktman816:** #AskCCP Do you



NASA/Gianni Woods

Ed Mango, NASA's Commercial Crew Program (CCP) manager, answers questions during a live Tweet Chat on April 27. At left, is Brittani Sims, a member of the CCP team. For more on the CCP, click on the photo.

have any cool videos?

**@Commercial\_Crew:** I really like this new video about the challenges engineers face in developing launch abort systems [@rcktman816](http://go.nasa.gov/ISh7to) #AskCCP

**@Commercial\_Crew:** More Commercial Crew-related videos can be found here: [@rcktman816](http://go.nasa.gov/Io09SQ) #AskCCP

**@georgiadog:** @Commercial\_Crew Are any of @NASA's Commercial Crew Program assets being constructed in Georgia, USA? #AskCCP

**@Commercial\_Crew:** Not yet, but there are at least 63 companies working in 26 states to get Americans into space on US-led vehicles. @georgiadog #AskCCP

**@astroroach:** How will NASA man-rate commercial launchers or spacecraft without getting so far in

the weeds they end up doing the engineering? #AskCCP

**@Commercial\_Crew:** NASA and CCP developed a collaborative process of insight to provide support to our commercial providers. @astroroach #AskCCP

**@Commercial\_Crew:** We've already outlined high-level requirements for our partners to meet before they begin flying our astronauts. @astroroach #AskCCP

**@rocketjohnnyk:** #AskCCP should all launch vehicle development be moved out of NASA and over to Commerce to separate Science versus ride funding fights?

**@Commercial\_Crew:** NASA's 50 yrs of human spaceflight is critical to making future systems safe for crews to reach ISS for research. @rocketjohnnyk #AskCCP

**@memoAtNYC:** #AskCCP Having gone over NASA Human Rating standards...how much of a challenge is it? expensive? how long?

**@Commercial\_Crew:** It's very challenging! NASA has published its top-level safety & performance requirements. @memoAtNYC #AskCCP

**@Commercial\_Crew:** Companies will flow down those requirements to their design parameters. Cost will depend on the design used. @memoAtNYC #AskCCP

**@Commercial\_Crew:** CCP plans to have a transportation capability

certified around mid-decade. @memoAtNYC #AskCCP

**@WBTVCamMan:** @askccp With the shuttle Enterprise touching down @JFK this morning, when can we, as Americans, expect to head back into space?

**@Commercial\_Crew:** Americans are in space right now aboard the International Space Station. @WBTVCamMan #AskCCP

**@Commercial\_Crew:** Currently, we're using Russian Soyuz to get to ISS. @WBTVCamMan #AskCCP

**@Commercial\_Crew:** We can expect to see Americans launching aboard American vehicles near the middle of the decade with CCP's help. @WBTVCamMan #AskCCP

**@Rebexster:** In layman's terms what is CCP and why should Americans care if it succeeds? #AskCCP

**@Commercial\_Crew:** The Commercial Crew Program is about developing US led systems to carry NASA astronauts into space and to the ISS #AskCCP

**@Commercial\_Crew:** Americans should care because a US-led system will enable high-tech, innovative jobs here at home. #AskCCP

To connect with the program social, check it out on facebook at [www.facebook.com/NASACommercialCrew](http://www.facebook.com/NASACommercialCrew) and twitter at [www.twitter.com/commercial\\_crew](http://www.twitter.com/commercial_crew).

## Kennedy keeps coveted Voluntary Protection Programs STAR status

By **Steven Sicheloff**  
Spaceport News

**A**n intense focus on workplace safety and health earned NASA's Kennedy Space Center the Voluntary Protection Programs coveted Star status this week. A team of auditors surveyed the center before bestowing the award.

"Thanks for your commitment to safety and keeping

employees safe," VPP officials said. "Thanks for opening your house showing us your paper, explain what you already know to us. You have done a great job."

The award, given by the federal Occupational Safety and Health Agency, or OSHA, confirms the steps Kennedy's work force has taken to prevent injuries and to adequately report hazards and problems to have them resolved. It also notes the

center's track record in executing its mission safely, particularly in operating in the environment of launching spacecraft.

Bob Cabana, Kennedy director, said the center works hard to keep improving conditions and educate workers and management, but it takes different people looking in from the outside to show results.

"It is a continuous process," Cabana said. "We

need audits with new eyes on our job."

The audit team included interviews with center officials and workers. The people interviewed knew how to handle an incident and the auditors reported a strong safety culture committed to resolving problems.

Kennedy earned its first VPP Star honor in 2003 and it was certified again in 2007. Recipients are recerti-

fied every three-to-five years and do not have to undergo any of OSHA's programmed inspections as long as they maintain their status.

The award encompasses numerous factors, including an employer keeping its injury rate below the national average. According to the VPP, the average Star recipient has an injury rate of less than half the national average.



# Orion ground test article arrives at Kennedy

By Linda Herridge  
Spaceport News

NASA's first Orion spacecraft, the ground test vehicle, arrived at Kennedy Space Center on April 20, after traveling more than 1,800 miles from Lockheed Martin's Waterton Facility near Denver.

The vehicle is one of the key components that will help NASA move forward to future exploration missions beyond low Earth orbit. Orion will carry up to four astronauts on deep space missions to asteroids, the moon and eventually Mars.

"Orion's arrival at Kennedy marks the start of something new for the center," said Scott Wilson, who is manager of Orion Production Operations. "Although the center has always played a major role in the integration and launch of spacecraft, start of work on the Orion ground test and Exploration Flight Test (EFT-1) vehicles represents the first time full spacecraft assembly and production will be performed here."

After it was delivered to the Operations and Checkout Building high bay, Lockheed Martin and United Space Alliance workers uncrated the spacecraft from its transportation fixture, removed its coverings and transferred it to an air-bearing pallet. The specially designed pallet enables a small crew to effortlessly maneuver spacecraft and hardware across the 90,000-square-foot factory



CLICK ON PHOTO

NASA/Charisse Nahser

NASA's Orion ground test vehicle sits in the Operations and Checkout Building at Kennedy Space Center on April 21. The vehicle traveled more than 1,800 miles from Lockheed Martin's Waterton Facility near Denver where it successfully completed a series of rigorous tests that simulated launch and spaceflight environments. For more information, click on the photo.

floor during assembly, production and testing.

According to Orion Production Lead Ed Stanton, this test vehicle will remain at Kennedy for about a year while technicians perform tests and prepare it for transfer to Langley Research Center in Hampton, Va. At Langley, the test spacecraft will undergo splashdown tests.

Glenn Chin, the NASA Orion production operations deputy manager for the Orion Program Office said that this ground test vehicle is important to the program since it's the first completely assembled Orion used for structural testing and pathfinder operations.

"We will continue to utilize the test article at Kennedy to learn and understand what improvements the team can make to be more efficient and effective for the next mission, which is the EFT-1," Chin said.

While the test vehicle is at Kennedy, technicians will perform a pyrotechnic device test to assess how the connector from the crew module would separate from the launch abort system and the type of damage that may occur to the capsule's tiles. The test will be conducted at Kennedy's Launch Equipment Test Facility.

The heat shield on the bottom of the crew module will be removed and replaced with a more flight-like

heat shield that was built by Lockheed Martin and will be shipped to Kennedy for installation. The test vehicle will then be in its vehicle configuration for the splashdown test at Langley.

"I'm excited that it's here. We've followed it around the country for the last three years," Stanton said. "These are the first steps in the process to get to future exploration missions on NASA's Space Launch System."

Prior to its arrival at Kennedy, Orion already had been put through the paces of a series of acoustic and vibration tests. Not including the test vehicle, the Orion Program also has tested landing parachute validation, launch abort system verification and water impact tests to simulate landing conditions, at various NASA facilities.

"It is an exciting start to a new era of exploration," Wilson said.

NASA's EFT-1, built at the repurposed Michoud Assembly Facility in New Orleans, will arrive at Kennedy in June. It is scheduled to launch on top of a Delta IV heavy in 2014.

EFT-1 will produce critical flight data needed to develop a spacecraft capable of surviving re-entry speeds great than 26,000 miles per hour and safely return astronauts to Earth. NASA and its contractor teams will be able to focus on real-world flight test objectives, reduce or eliminate risks to crew, and move forward on Orion core systems development.

## Space shuttle manager receives esteemed Debus Award

By Frank Ochoa-Gonzales  
Spaceport News

Patty Stratton, associate program manager at United Space Alliance (USA), was awarded the 2012 Dr. Kurt H. Debus Award by the National Space Club on April 21 in the Debus Conference Facility at the Kennedy Space Center Visitor Complex.

"This award really is recognition for our entire space family at Kennedy," Stratton said. "Together we safely completed the space shuttle missions and made history along the way. In our hearts we will always

be part of the space shuttle team."

The Debus Award was created by the National Space Club Florida Committee to recognize significant achievements and contributions made in Florida to American aerospace efforts. It is named for Kennedy's first director, Dr. Kurt Debus.

Patty Stratton, whose aerospace career spans 30 years, has spent the last 17 years at USA in a variety of management and leadership roles, most recently as the associate pro-



Patty Stratton

gram manager for Ground Operations at Kennedy. Stratton was responsible for directing integration of all space shuttle processing activities, as well as managing the operations of all facilities and more than 3,800 workers who processed the shuttles from landing to launch.

Prior to her current role, she served as director of orbiter operations, which involved managing 1,400 employees in the orbiter horizontal processing flow that began at landing and ended with launch.

Stratton began her aerospace career in 1982 as a member of the project office with United Space Boosters, maker of the solid rocket boosters. In 1983, she began working for Lockheed Space Operations in operations planning and graduated from there to management roles with increasing levels of responsibility.

The Debus Award was conceived and first presented in 1990.

"The Space Club is proud to honor Patty for this esteemed award," said National Space Club Chair Steve Griffin. "Patty's dedication and influence were key to the Space Shuttle Program's success."



# Scenes Around Kennedy Space Center



CLICK ON PHOTO NASA/Dimitri Gerondidakis

Former NASA astronaut Neil Armstrong, who in 1969 became the first man to set foot on the moon, sits in the commander's seat of space shuttle Endeavour in Orbiter Processing Facility-2 at Kennedy Space Center. Endeavour is being prepared for public display at the California Science Center in Los Angeles. Over the course of its 19-year career, Endeavour spent 299 days in space during 25 missions. For more information, click on the photo.



NASA/Robert Markowitz

Space shuttle Enterprise, mounted atop a NASA 747 Shuttle Carrier Aircraft (SCA), is seen as it flies near the Statue of Liberty and the Manhattan skyline April 27 in New York. Enterprise was the first shuttle orbiter built for NASA to perform test flights in the atmosphere and was incapable of spaceflight. Originally housed at the Smithsonian's Steven F. Udvar-Hazy Center, Enterprise will be demated from the SCA and placed on a barge that eventually will be moved by tugboat up the Hudson River to the Intrepid Sea, Air and Space Museum in June.



CLICK ON PHOTO NASA/Jim Grossmann

At the Astrotech payload processing facility near Kennedy Space Center, probe A and probe B of the Radiation Belt Storm Probes (RBSP), are on test stands for their upcoming processing activities on May 3. RBSP will lift off aboard a United Launch Alliance Atlas V from Cape Canaveral Air Force Station's Space Launch Complex 41. In tandem, the two spacecraft will speed through the Earth's radiation belts at about 2,000 mph to help scientists understand the dynamic region and better design spacecraft that can survive the rigors of space. To learn more about RBSP, click on the photo.



NASA/Jim Grossmann

A bobcat on the causeway between Kennedy Space Center and Cape Canaveral Air Force Station in Florida pauses to check out the photographer who chanced upon it during the hunt for its next meal. The cat is seldom observed during the day unless scared from its daytime shelter. It is the last large mammalian predator remaining on the center. Kennedy and the Merritt Island National Wildlife Refuge mutually reside on 140,000 acres on central Florida's east coast. The area's coastal dunes, saltwater estuaries and marshes, freshwater impoundments, scrub, pine flatwoods, and hardwood hammocks provide habitats for more than 1,000 species of plants and animals, including about 331 species of birds.



## Senior Secretary Team hosts Spring Social

The Kennedy Space Center Senior Secretarial Team hosts the annual Senior Secretary Team Spring Social to celebrate 2012 Administrative Professionals Day on April 26 in the Operations and Checkout Building's Mission Briefing Room.

Photos by NASA/Dimitri Gerondidakis



# DuPont continues to inspire students to pursue STEM

By **Brittney Longley**  
Spaceport News

Sometimes it's difficult to relate science to real world experiences. It's a challenge that seven students met during the 2012 DuPont Challenge science essay competition.

They used personal experiences to write about topics such as asthma, heart problems and environmental issues, and were honored with an award at the Kennedy Space Center Visitor Complex's Educator Resource Center on April 27 for their work.

"It was a big step to even consider to apply," said Kelvin Manning, associate director of Business Operations at Kennedy. "You did it not only for the opportunity



CLICK ON PHOTO

The winners of the 2012 DuPont Challenge science essay contest celebrate in the Kennedy Space Center Visitor Complex's Educator Resource Center on April 27. To learn more about the competition, click on the photo.

NASA/Amanda Diller

to learn something but to share that passion."

Roshni Sethi, a student from Plainview, NY, for example, wrote about her father having a heart attack the day before her mother was scheduled to give birth

to her. In her essay, she talks about how doctors saved her father's life, which prompted her to focus her essay on a new science that may eradicate heart failure by using nanowires.

The challenge, now in its 26th year, reaches out

to students from grades seven through 12 from all 50 states and Canada. It aims to inspire students to excel and achieve in scientific writing and pursue careers in science, technology, engineering and mathematics (STEM).

The DuPont Challenge is sponsored by its namesake, the DuPont company in collaboration with NASA, NBC Learn, Britannica Digital Learning, the Walt Disney Resort, National Science Teachers Association (NSTA) and A+ Media. The winning students, parents and teachers were invited to tour Kennedy and attend the award ceremony.

After the students and teachers were presented the awards they each had a few moments to reflect on

their experience during the competition.

"I've had a lot of time to reflect on my essay, but never had a chance to say thank you to anyone for their support during this time," said Sethi, who wants to become a neurologist in geriatrics.

"Each of the students here took personal experience and used that view to look at science in a different way," said Patricia Simmons, president of the National Science Teacher's Association.

"These essays were very well developed, it speaks to the kind of power you can tap into in science," Manning said. "We need all of you to keep this going, the teachers and most of all the students, to keep the STEM project focused."

# CST-100 parachute system put through paces

By **Rebecca Regan**  
Spaceport News

Before a vehicle can rocket humans into orbit, engineers must make sure they can return safely to the Earth's surface. During two parachute drop tests over the Delmar Dry Lake Bed near Alamo, Nev., The Boeing Company worked to demonstrate the parachute system that would provide those safe landings.

On May 2, an Erickson Air Crane helicopter lifted Boeing's CST-100 boilerplate crew capsule to about 10,000 feet, initiating a drogue parachute deployment sequence that was followed by deployment of the main parachute. The capsule descended to a smooth ground landing, cushioned by six inflated air bags. This test demonstrated the performance of the entire landing system.

The tests are part of Boeing's partnership with NASA's Commercial Crew Program (CCP) under a funded Space Act Agreement to develop commercial crew transportation capabilities that will ferry U.S. astronauts to and from the Interna-



Image Courtesy Boeing

Boeing's CST-100 boilerplate crew capsule is dropped over the Delmar Dry Lake Bed near Alamo, Nev., on May 2 to test its parachute landing system.

tional Space Station, reducing the amount of time America is without its own system.

"Boeing's parachute demonstrations are a clear sign that NASA is moving in the right direction of enabling the American aerospace transportation industry to flourish under this partnership," said CCP Manager Ed Mango. "The investments that we're making now are enabling this new path forward of getting our crews to low Earth orbit

and potentially, the International Space Station, as soon as possible."

The CST-100 is designed to be a reusable capsule-shaped spacecraft capable of transporting up to seven people, or a combination of people and cargo. HDT Airborne Systems of Solon, Ohio, designed, fabricated and integrated the parachute system, which included the two drogue parachutes added to complete the landing system. ILC Dover of Fredericka, Del., designed and fabricated

the landing air bag system.

"This second parachute drop test validates Boeing's innovative system architecture and deployment plan," said John Mulholland, vice president and program manager of Boeing Commercial Programs. "Boeing's completion of this milestone reaffirms our commitment to provide safe, reliable and affordable crewed access to space."

The first test, on April 3, was performed to validate Boeing's parachute system architecture and deployment scheme, characterize pyrotechnic shock loads, confirm parachute sizing and design, and identify potential forward compartment packaging and deployment issues. The company then inspected and re-packed the full parachute system for the second test.

Boeing has scheduled additional tests to be performed in the next few months to gather more data on key functional elements of the spacecraft design, including another landing air bag test series, a forward heat shield jettison test, and an orbital maneuvering and attitude control engine hot fire test.



## Remembering Our Heritage

# Endeavour's engines fired before first launch 20 years ago

By Kay Grinter  
Reference Librarian

It's déjà vu for NASA this spring as the much-anticipated SpaceX launch for NASA's second Commercial Orbital Transportation Services, or COTS, demonstration flight approaches from Space Launch Complex-40 on Cape Canaveral Air Force Station. Twenty years ago, a similar launch campaign was under way on Launch Complex 39 at Kennedy Space Center for space shuttle Endeavour's first launch.

"'Test as you fly, fly as you test' mentally has always been good to us, test is the best control or mitigation for hazardous conditions that could impact the mission," said Jorge Rivera, Vehicle Integration and Operation chief engineer. "Subsystems that tested fine in isolation may interface with each other in a different way, which could create a bigger problem."

Endeavour was commissioned to replace shuttle Challenger, destroyed in an accident in 1986. Construction began in 1987, and it rolled out of the assembly plant in Palmdale, Calif., in April 1991.

One of the most important milestones leading up to the first launch of any new spacecraft is a test to validate the overall performance of its main propulsion system. In the case of the shuttle, the test was known as a Flight Readiness Firing, or FRF.

"On every FRF that we conducted we learned something new about the vehicle, which made our process and flight hardware better," said Rivera, who was a deputy shuttle processing chief engineer in 1981. "It's definitely a good practice in reducing the risk of the actual flight.



NASA file/1992

Space shuttle Endeavour undergoes a 22 second firing of its three space shuttle main engines at Kennedy Space Center's Launch Pad 39B on April 6, 1992.

The fueled test involved igniting the shuttle's main engines during a launch countdown to verify their performance while operating under the extremes of cryogenic conditions.

The FRF was the first opportunity for the engines to perform in a clustered flight configuration although each had been test fired individually before they were delivered to Kennedy.

The FRF countdown was terminated after 22 seconds. The primary differences between the test and a launch-day countdown were that the two solid rocket boosters were not ignited and no flight crew was on board.

When an FRF was completed, any problems with the ground support equipment were identified, as well, and the launch team had experienced a full-scale dress rehearsal.

During Endeavour's FRF on April 6, 1992, before its first flight, irregularities were detected in two of the three new engines' high-pressure oxidizer turbopumps during the 22-second firing.

A buildup of pressure in one of the engine's pump

preburner was detected just after it was shut down, and a slightly elevated frequency in vibration in the ball-bearing cage was recorded in another.

Although the irregularities would not have been a safety concern if the FRF had been an actual launch, all three of Endeavour's main engines were replaced with ones that had previously flown. The precautionary measure caused no impact to the launch date.

Thanks to the FRF, Endeavour's maiden launch took place when all of its systems were "go," at 7:40 p.m. EDT on May 7, 1992.

On April 30 of this week, Space Exploration Technologies, or SpaceX, one of NASA's commercial partners, conducted a two-second static fire test of the Falcon 9 rocket's nine Merlin engines in preparation for the upcoming COTS launch.

On the first attempt, the exercise was aborted 47 seconds before engine burn because an unspecified technical parameter was set improperly. The problem was addressed, and the test

was successfully completed a little more than an hour later. The data collected will be analyzed before the demonstration flight later this month.

"I'm glad that our commercial partners are following the same customary engine firing test before committing a new vehicle to launch," Rivera said. "I'm sure that is going to be the case for SpaceX as well."

That analysis is invaluable to prevent costly delays and even the loss of the vehicle, Rivera said.

The data collected during the engine firing before Challenger's first flight is a

case in point.

Challenger's main engines were the first qualified to perform at 104 percent of their rated power level.

When an unusually high level of hydrogen was detected in Challenger's engine compartment during its FRF on Dec. 18, 1982, a second FRF was conducted a few weeks later to provide more data to pinpoint the problem.

During post-FRF troubleshooting, technicians found a crack in the main combustion chamber of one engine.

Examinations of the other engines found that some had similar cracks in a 1/2-inch line that carried hydrogen gas into a small augmented spark igniter chamber located in the center of the engines' injector. Chaffing of the line was seen in all the engines that had been run for long durations.

All three of Challenger's engines were removed and repaired in the Vehicle Assembly Building before its carefully monitored liftoff April 4, 1983.

The future holds more variations on the tried-and-true propulsion tests as NASA and its commercial partners get ready to fire up their engines.

Before NASA's space shuttles launched from Kennedy Space Center, engineers test-fired their main engines in what's called a Flight Readiness Firing (FRF). Below are the shuttles' FRF stats.

Shuttle	FRF	First launch
Columbia	Feb. 20, 1981	April 12, 1981
Challenger	Dec. 18, 1982 and Jan. 25, 1983	April 4, 1983
Discovery	June 2, 1984	Aug. 30, 1984
Atlantis	Sept. 12, 1985	Oct. 3, 1985
Endeavour	April 6, 1992	May 7, 1992



In celebration of Kennedy Space Center's 50th anniversary, enjoy this vintage photo . . .

# FROM THE VAULT



NASA file/1962

Red Cross Vehicle 4 and Fire Department vehicles No. 17 and No. 2 are parked at Cape Canaveral Air Force Station's Launch Complex 17B during prelaunch preparation of Explorer 14 on Oct. 2, 1962. The spacecraft is sitting atop a Thor-Delta launch vehicle.



NASA file/2011

University students prepare in May, 24, 2011, for last year's Lunabotics Mining Competition at the Kennedy Space Center Visitor Complex in Florida.

## Looking up and ahead . . .

\* All times are Eastern

### 2012

TBD	Launch/CCAFS (SLC-40): SpaceX Falcon 9, Dragon C2/C3 Launch time: TBD
June (Under Review)	Launch/Reagan Test Site Kwajalein Atoll: Pegasus XL, NuSTAR Launch window: TBD
No earlier than June 28	Launch/CCAFS (SLC-37B): Delta IV-Heavy, NROL-15 Launch window: TBD
No earlier than Aug. 23	Launch/CCAFS (SLC-41): Atlas V-401, Radiation Belt Storm Probes (RBSP) Launch window: 4:07 to 4:27 a.m.
Targeted for Sept. 20	Launch/CCAFS (SLC-37B): Delta 4, GPS 2F-3 Launch window: TBD
Dec. 1	Launch/VAFB: Pegasus XL, Interface Region Imaging Spectrograph (IRIS) Launch window: 9:32 to 9:37 a.m.
No earlier than December	Launch/CCAFS (SLC-41): Atlas V, Tracking and Data Relay Satellite-K (TDRS-K) Launch window: TBD

## Third Annual Lunabotics Mining Competition seeks volunteers

The third annual Lunabotics Mining Competition, hosted by Kennedy Space Center's Education Programs Office, will be at the the center's visitor complex May 21-26. Organizers expect twice as many teams as last year, making the event more fast-paced and exciting, but also much more challenging to host. A competition of this size is not possible without the help of the Kennedy work force, so submit your volunteer form and help make this event successful for hundreds of college and university students from around the world. To volunteer, go to <https://sp.ksc.nasa.gov/ex/lunabotics/2012/Lists/Volunteer/NewForm.aspx>, or contact Bethanné Hull at 321-867-9426 or [bethanne.hull@nasa.gov](mailto:bethanne.hull@nasa.gov). For more information about the competition, visit [www.nasa.gov/lunabotics](http://www.nasa.gov/lunabotics).



John F. Kennedy Space Center

## Spaceport News

Spaceport News is an official publication of the Kennedy Space Center and is published online on alternate Fridays by Public Affairs in the interest of KSC civil service and contractor employees.

Contributions are welcome and should be submitted three weeks before publication to Public Affairs, IMCS-440. E-mail submissions can be sent to [KSC-Spaceport-News@mail.nasa.gov](mailto:KSC-Spaceport-News@mail.nasa.gov)

Managing editor . . . . . Candrea Thomas  
Editor . . . . . Frank Ochoa-Gonzales  
Copy editor . . . . . Kay Grinter

Editorial support provided by Abacus Technology Corp. Writers Group.  
NASA at KSC is on the Internet at [www.nasa.gov/kennedy](http://www.nasa.gov/kennedy)  
SP-2012-04-084-KSC

