National Aeronautics and Space Administration

STS-114 Return to Flight

Marshall's Shuttle Propulsion Office: Lifting Discovery to orbit

By Lynnette Madison

Each time the Space Shuttle climbs to orbit it's powered by the combined 7.3 million pounds of thrust of its Main Engines, Solid Rocket Boosters, Reusable Solid Rocket Motors and External Tank, the elements managed by Marshall's Space Shuttle Propulsion Office.

"This is an exciting time as we send Discovery on its STS-114 Return to Flight Mission," said Mike Rudolphi, manager of Marshall's Space Shuttle Propulsion Office. "Our team has worked hard for more than two years to make this the safest Space Shuttle launch in NASA's history."

Though emphasis has been placed on improvements and modifications to the Space Shuttle's External Tank, time also has been devoted to testing, analyzing and making improvements on each of the propulsion elements managed at Marshall, said Rudolphi.

"Each of our propulsion elements has undergone a top-to-bottom assessment," he said. "From those assessments, we worked to ensure the reliability of each element, raising the bar to make the Shuttle system safer."

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Photo by NASA/MSFC

Marshall team: Making a difference

By David King
Marshall Center Director

It is an exciting time to be a part of America's space program. The entire NASA team has been working very hard to get to this point — Return to Flight. We have faced many challenges together, and I appreciate the many sacrifices of the workforce and the support of the public during this crucial journey. The work we have accomplished over the last two years will affect the future; its importance cannot be understated or underestimated.

King

Preparing to return the Space Shuttle to safe flight has been all-encompassing, requiring a commitment to remain steadfast while working through many difficult issues. Your dedication to ensure the Shuttle fleet, its propulsion elements and launch facilities are the safest ever will reap great personal and professional rewards.

I want to commend you not only on your hard work, but also on your earnestness toward improving our safety systems and leadership skills. The difference it has made is noticeable and encouraging, and I am proud of your willingness to learn new ways of looking at things — we are better for it.

The Shuttle is an iconic vehicle, recognized around the world as a symbol of the pioneering spirit that compels exploration. I am very proud that Marshall's propulsion elements lift this amazing reusable launch vehicle into low-Earth orbit, and I am very proud of all the Marshall civil servant and contractor hands that have played a role in that responsibility.

Shuttle inspection, Station resupply highlight mission

The Return to Flight Space Shuttle mission takes America's flagship spacecraft back into orbit for the first time in more than two years. A dramatic display of smoke, fire and sound, the launch fulfills a promise made to the families of the Columbia astronauts: that NASA would honor their memory by continuing their quest for knowledge.

The mission debuts and tests new designs incorporated into the Shuttle's External Fuel Tank and processes that eliminate the likelihood that future Space Shuttle flights could suffer damage similar to Columbia. New cameras are photographing the tank during launch and after it is jettisoned from the Shuttle to allow engineers to evaluate the performance of those new designs.

The mission introduces a variety of new techniques to ensure that the health of the Shuttle heat shield can be confirmed in space. The top priority of the flight is to inspect all of the Reinforced Carbon-Carbon heat protection material on Discovery's wing leading-edge panels.

New ground and flight camera and sensor systems observe the Shuttle environment during launch and in orbit. New techniques will be used for in-flight inspection. New methods under development for repair of the Shuttle's heat-shielding Thermal Protection System will be tested. Also, Discovery will deliver to the Space Station a pressurized cargo container full of supplies, and a replacement for one of the Station's control gyroscopes that the Shuttle crew will install during one of the mission's three spacewalks.

The mission, STS-114: Space Shuttle Return to Flight, itself goes by many names. STS stands for "Space Transportation System" — an early moniker for the Space Shuttle Program — and its number refers to the order in which the mission was planned. It also happens to be, in order of flight, the 114th mission in the history of the Space Shuttle Program.

Because of its role in supplying the International Space Station, the mission also is referred to as LF-1, or Logistics Flight 1. Discovery also has a second name: NASA engineers often refer to it as OV-103, or Orbiter Vehicle-103.

But for all of us, it is the Return to Flight mission of the U.S. Space Shuttle.

'Moving vans' help deliver Space Station supplies

On the Space Shuttle Discovery mission's fourth day, the crew will use the Station's robotic arm to lift an Italian-built cargo module named Raffaello, a Multi-Purpose Logistics Module, out of the Shuttle cargo bay and attach it to the Station. They then will transfer several tons of supplies and equipment to the Station.

This is the third trip to the Station for Raffaello, the second of three such cargo carriers to be put into service. Raffaello flew aboard Endeavour on STS-100 and STS-108 in 2001. The fleet of "moving vans" is managed by the Space Systems Programs/Projects Office at the Marshall Center.

MEET THE CREW

The crew of seven astronauts assigned to STS-114: Space Shuttle Return to Flight is charged with a busy "to-do" list during their mission, including testing new safety techniques and delivering much-needed supplies to the International Space Station.

But Return to Flight is more than a single mission. It launches a new era of human exploration that's far-reaching but focused, ambitious but affordable. A brief look at each crew member:

Photo by NASA/MSFC

From right to left in orange flight suits are Collins, commander; mission specialists Camarda, Lawrence and Thomas; and Kelly, pilot. In white flight suits, from left, are mission specialists Robinson and Noguchi.

Commander Eileen Collins: A veteran of three space flights, Collins is a second-time commander who has overall responsibility for the on-orbit execution of the mission; Orbiter systems operations; and flight operations, including landing the Orbiter. She will fly the Shuttle in a procedure called the rendezvous pitch maneuver while Discovery is 600 feet below the Station before docking to enable the Station crew to photograph the Orbiter's upper surfaces and underbelly Thermal Protection System.

Mission Specialist Andrew Thomas: A veteran of three space flights, Thomas is the lead Shuttle robotics officer for the inspection of the Orbiter's Thermal Protection System, using a new boom extension outfitted with sensors and cameras. As the Intravehicular Activity crewmember, he will help suit up and choreograph Noguchi and Robinson during their spacewalks. Thomas will move the Shuttle's robot arm and lock it onto the Orbiter Boom Sensor System. He will help maneuver the boom to collect detailed imagery.

Mission Specialist Wendy Lawrence: A veteran of three space flights, Lawrence serves as the lead for transferring supplies from the Shuttle's cargo module to the Station. As a Station arm operator, she also will perform Station robotics duty for thermal protection inspection and the spacewalks, and assist with the rendezvous. She will maneuver her crewmembers and hardware during the spacewalks. At the rendezvous, docking and undocking, she will manage computers, lasers, cameras and the Orbiter Docking System.

Mission Specialist Stephen Robinson: A veteran of two space flights, Robinson serves as the Flight Engineer, adding a second set of eyes on Orbiter systems for the commander and pilot on the flight deck during launch and landing. Robinson also will perform three spacewalks.

Pilot Jim Kelly: Kelly, flying for the second time, is responsible for systems operations and assisting in the rendezvous for docking to the Station. He is both a Shuttle robot arm operator and Station robot arm operator. He will participate in the Orbiter's thermal protection inspection by helping to maneuver the Shuttle robot arm, its Orbiter Boom Sensor System extension and its suite of cameras and sensors. During three spacewalks, Kelly will maneuver the Extravehicular Activity crew and hardware with the Station arm.

Mission Specialist Soichi Noguchi: Noguchi, a Japan Aerospace Exploration Agency astronaut, makes his first venture into space. He is to lead and perform three spacewalks. They will test new techniques for repairing potential damage to the Orbiter's Thermal Protection System. He also will replace one of the large Station gyroscopes that control its orientation and will help install and activate an External Stowage Platform for housing Station spare parts.

Mission Specialist Charles Camarda: Camarda makes his first space flight. His duties include Shuttle robotics, assisting in the external inspection of the Orbiter's Thermal Protection System, photography and television support, and computer operations. Camarda also will be involved in logistics and transfer operations from the Shuttle to the Station. He will operate the robot arm, lasers, cameras and computers, and will downlink the data. At rendezvous and undocking, he will help manage the lasers, cameras, computers and the Docking System.

What does Return to Flight mean...to you?

By Sherrie Super

Scientists, engineers, accountants, writers, contract specialists, and more: Thousands of people across NASA and at the Marshall Center have worked to return the Space Shuttle to flight.

For some, it meant testing Shuttle components to make sure they're safe. For others, it meant making sure the necessary funds and materials are in the right place at the right time. Still others prepared for the onslaught of public and media interest in this critical mission.

We asked people across the Center about their involvement in Return to Flight, and what it means to them. This is what they had to say.

Mian Abbas

Even though I'm not directly involved in this mission, I was involved in two previous Shuttle flights as a mission scientist. The Shuttle is a very crucial means of transportation for launching experiments to space and for supporting our work aboard the Space Station. I think all NASA employees are dedicated to the success of the Return to Flight mission. NASA's reputation hinges on the mission going well and safe and bringing NASA back to full operations.

Pete Allen

As part of the Center Operations team, we're doing all we can to support organizations that are working Return to Flight. From budget-management to test-support, we're making sure people throughout the Center have everything they need to complete their jobs. For me, Return to Flight brings excitement, with a little apprehension. I think everyone will be a little anxious until we confirm we're successful. Mainly, it will be really good for the Agency to get back to doing the business it's here to do — space flight and exploration.

Edwina Bressette

As the Human Resources representative for the Shuttle program at Marshall, I accommodate Shuttle requests for personnel actions such as reassignments, promotions, staffing plans and position descriptions. I believe that getting the Shuttle back in the air will be a morale boost for all of us, and I'm looking forward to it pulling us back together as an Agency.

Rickey Clements

As a quality assurance specialist, I monitor test activities related to Return to Flight. I make sure all aspects of test procedures are complied with. Return to Flight means a great deal to me personally. I was the quality assurance specialist for Mechanics of Granular Materials, an experiment on Columbia, and I took the loss hard. It's true that our vehicles are no longer brand-new, so to see all the people on our Center and other Centers pull together as one-NASA to make sure the Shuttle is a safe and reliable vehicle for a long time gives me a lot of pride to know that I'm a part of such a tremendous effort by so many.

Poppy Dennis

As a contract specialist, I support the Solid Rocket Booster element for the Space Flight Operations Contract. I coordinate with the Johnson Space Center and the United Space Alliance at Kennedy Space Center to execute the needed contract changes, whether they pertain to Return to Flight or routine day-to-day activities. Obviously, Return to Flight is very important to everyone here at the Center. We're very eager to fly again, but safety is our number one priority.

Rodney Grubbs

With others across Marshall and the Agency, I'm working to provide the Shuttle program with better imagery during the Space Shuttle's ascent and re-entry. If we can give the engineering analysis teams better imagery, more quickly, then the program managers will have the ability to make more-informed decisions. As far as this Return to Flight mission, I'm just glad to be playing one of many roles in helping to make the Shuttle system safer. And it will be good to see the Shuttle flying again.

Joni Haas

I support the budget analysts who handle expenditures related to Return to Flight. We distribute and monitor funds for materials and tasks being performed, such as tests on the Solid Rocket Booster. I'm eager to see us Return to Flight, because all our futures rest on our space involvement, and we Americans get so much out of the space program. I think too often it's not visible, so getting back to flying is extremely important.

Judi Hollingsworth

As a Freedom of Information Act officer, I handle public and media requests for government documents such as Shuttle schematics and pre-flight briefings. This Shuttle mission is a very high-profile one, so it will likely generate a lot of interest. I'm working to make sure we have the means and capacity to respond to requests. Even though I have such a small part in Return to Flight, I certainly admire the work that's being done, and I'm proud to be part of our Agency. It means we're getting back to work on what we're here to do. We're flying again.

Mindy Niedermeyer

As a materials engineer, I'm working to enhance the safety of the Shuttle's wing-leading edge. We're working on an on-orbit, crack-repair material that will be tested for certification on the Return to Flight mission. To me, the whole effort for Return to Flight has personified NASA people doing what they do best. It's been a refocusing for the entire agency, and specifically for the engineering work done at Marshall.

Pat Patterson

As a payload operations manager in the Payload Operations Center, I've been anxiously awaiting Return to Flight. Our Center supports International Space Station payload operations, which is ongoing 24 hours a day, seven days a week, 365 days a year. With the Shuttle returning to flight, we will be able to carry more payloads to orbit, which will enhance the activities aboard the Space Station.

John Pea

I'm the export control representative for Shuttle. That means I monitor data being presented, such as during flight-readiness reviews, to make sure nothing proprietary is revealed to someone who doesn't need to know. I help protect our trade secrets and technology advances. Return to Flight is an exciting time, a crucial time, not only for our Center, but for the Agency. The excitement level is high throughout the project, and everybody's working vigorously toward a safe return.

Shawn Reagan

I'm the project manager for the Multi Purpose Logistics Module (MPLM). It's flying on the Return to Flight mission and the following mission, so we're preparing the module, making sure it's ready to go and in top shape to fly. With the MPLM flying, of course there's a lot of personal involvement. I've worked on it for six or seven years, so seeing it fly will be gratifying. But also in this post-Columbia time, I think it's important to get back to flying. It's going to be good to see the Shuttle flying again, period, whether MPLM is on it or not.

Richard Sheppard

As the lead engineer for External Tank integration, I work integration issues between the External Tank and other elements such as the Orbiter, Solid Rocket Booster, and the ground. Return to Flight is an exciting time. We've been down from flight for over two years now, and we're ready to get back into space operations. We're ready to go.

The writer, an ASRI employee, supports the Public and Employee Communications Office.

Photo by NASA/MSFC

Astronauts Scott Parazynski, left, and Stephen Robinson watch a TV monitor at Marshall for a close-up view of repair work on Shuttle reinforced carbon-carbon. Johnson Center engineer Dina Barclay, responsible for tools used during spacewalks, gathers more information on how the tools will be used.

Marshall may hold key to repairing Shuttle cracks in future

By Lynnette Madison

How will future astronauts repair a small crack if one appeared on an Orbiter wing's leading edge?

It may be with a simple repair process — using a specialized material — that engineers with the Marshall Center's Materials and Processes Laboratory helped develop.

The technique will be tested in orbit on Space Shuttle Discovery's STS-114: Return to Flight mission.

The Marshall engineers, working jointly with their colleagues at Johnson Space Center in Houston and the Huntsville Operations side of ATK Thiokol Inc., have worked in the laboratory for more than a year to refine and prove the Reinforced Carbon-Carbon On Orbit Crack Repair (ROCR) technique.

The repair technique uses a specialized material, dubbed "NOAX" for non-oxide adhesive experimental, made of a pre-ceramic polymer resin that contains silicon carbide and other ceramic powders. It is similar in consistency to peanut butter and grayish-brown in color.

So, if the test succeeds, how will astronauts of the future use NOAX to repair cracks on an Orbiter's wing leading edge?

They'll use a dispenser, similar to a caulk-gun, to fill any cracks. Then, a trowel and sponge-like tools, resembling those sold at most hardware stores, will be used to work the NOAX into the crack. As the Shuttle reaches the extreme temperatures of reentry — about 3,000 degrees Fahrenheit — the material cures and becomes a ceramic.

"The process has been called 'low-tech' because of the simple equipment being used," said Dr. Frank Ledbetter, Marshall's technical lead on the project. "But it is far from low-tech. The challenge of developing a material that can be applied in the vacuum of space — in a microgravity environment — and capable of withstanding extreme cold and heat cycles has been tremendous."

To certify the material and to develop the repair technique, Marshall's Engineering Directorate used its full resources: from simulating the vacuum of space in a thermal vacuum chamber to computed tomography — a specialized X-ray imaging technique that uses a computer to collect images from multiple angles — to chemical analyses.

All disciplines have come together to provide an integrated answer to the problem of repairing such a crucial part of the Shuttle on orbit, said Ledbetter.

The writer, an ASRI employee, supports the Public and Employee Communications Office.

Modifications to Bolt Catcher make it stronger than ever

By Lynnette Madison

Simple design changes to the bolt catchers that hold the Solid Rocket Boosters securely to the Space Shuttle Discovery's External Tank will make the equipment stronger and more reliable than ever — an assessment and accomplishment that exceeds the recommendation made by the Columbia Accident Investigation Board.

Each Shuttle flies with two bolt catchers fixed to the forward, or top, area of the tank where the booster attaches to the tank. The canister-like catchers are designed to "catch" the 40-pound separation bolts – moving 70 feet per second — when they are severed as the boosters separate from the tank, approximately two minutes after launch. The other half of the bolt remains with the booster, secured within the forward skirt thrust post.

"The new design is simple but safe," said David Martin, manager of the Solid Rocket Booster Project Office at the Marshall Center. Although the bolt catcher is mounted on the External Tank, it is considered part of the Solid Rocket Booster element design.

Modifications included changing the bolt catcher from a two-piece welded design to a one-piece machined design, made with a stronger aluminum alloy, and increasing the wall thickness from .125 to .25 inches. The efficiency of the energy-absorbing material inside the bolt catcher also was improved, the size of the bolts that hold the catcher in place was enlarged, and the outside thermal protection material was changed from a "melt-away" coating to machined cork covered with a protective paint finish.

"Changing the catcher to a single piece of forged aluminum eliminates a weld and makes the design stronger," Martin added.

Marshall's Booster Project Office modified and tested the bolt catcher to assure the hardware meets the required NASA factor of safety of 1.4. The factor of safety refers to the strength of the design — the ratio of the maximum amount of stress a part can withstand to the maximum amount of stress estimated it will endure in the use for which it is designed.

Martin said extensive testing of the bolt catcher at Marshall — tests that replicated the loads, or the forces — led to a better understanding of the catcher and what it could withstand during launch.

The redesigned bolt catcher is built by General Products of Huntsville and insulated by United Space Alliance at the Kennedy Space Center at Cape Canaveral, Fla.

Photo by NASA/MSFC

Engineer Steve Brewster readies an aft separation bolt for a test firing in Marshall's Pyrotechnic Test Facility.

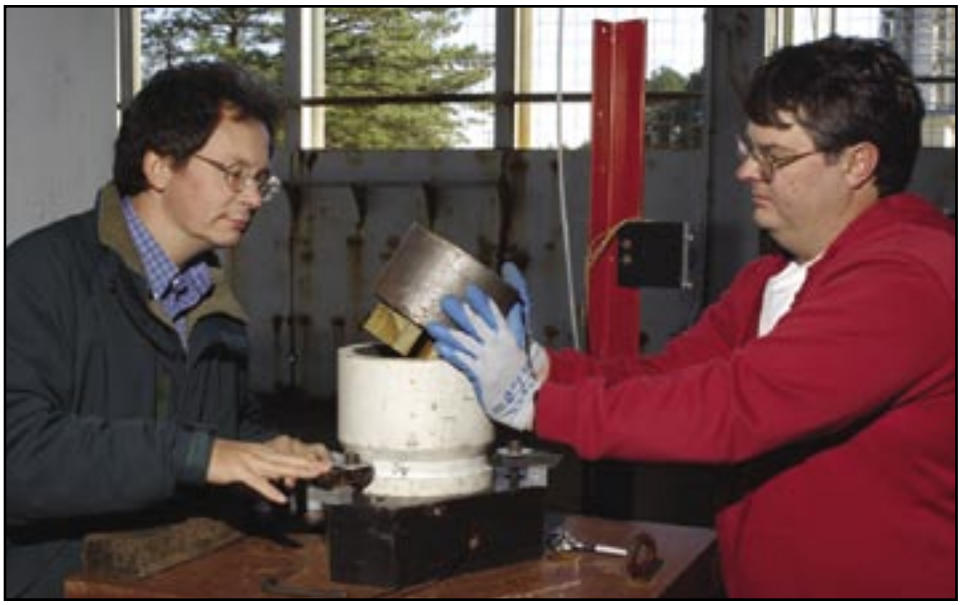


Photo by NASA/MSFC

During testing to qualify the tank's bolt catcher, Joe Gentry, left, and Rodney Phillips inspect the laser measurement system used to measure the bolt velocity as it hits a simulated bolt catcher.

The writer, an ASRI employee, supports the Public and Employee Communications Office.

NASA's safest External Tank launches Discovery

By Lynnette Madison

It has taken two years of missed children's recitals, ballgames and band concerts, and countless hours of work, testing and analyses — from hundreds of dedicated individuals — to build the safest External Tank that NASA has yet flown.

But ask anyone who has been part of the process — whether engineer or support assistant — and each will tell you that it has been well worth it.

"We all wanted to do this in memory of the STS-107 crew," said Sandy Coleman, manager of the External Tank Project Office at the Marshall Center. "This tank is for them. Our goal remains to make the safest External Tank ever flown."

To return the Shuttle to flight safely, the tank project office completed an aggressive top-to-bottom assessment of the tank's Thermal Protection System, or TPS, and reviewed areas on the tank where potential foam and ice debris could be generated. NASA and Lockheed Martin engineers then undertook a comprehensive plan to modify and improve the tank to minimize any debris its Thermal Protection System or any hardware on the tank could potentially generate during launch and ascent.

Since the work began, three modified External Tanks have been completed. External Tank-121 will fly with Space Shuttle Discovery on the STS-114 mission.

So, how does this tank differ?

First, the large insulating foam ramps that flew on STS-107 have been removed from the forward bipod fittings — part of the tank-to-Orbiter attachment structure — and replaced with rod-like heaters to help prevent ice from forming on the fittings. In the original design, the ramps helped to prevent ice buildup on the fittings — a potential debris source. The fittings themselves — each tank has two — are the same basic design as before.

Secondly, a small, flashlight-size camera has been placed in the tank's liquid oxygen fuel line fairing to record any possible debris that might be shed during ascent. The Thermal Protection System on the tank's bellows — joints that allow the tank's fuel line to flex — also has been reshaped to a squared "drip-lip" that allows moisture to run off instead of building. Plus a copper-nickel alloy strip heater, similar to heaters used on the Solid Rocket Motor joints, will keep the bellows area slightly warmer than freezing, about 40 degrees Fahrenheit.

And lastly, the bolts on the tank's liquid hydrogen flange — a bracket that permits one object to attach to another — are being reversed, a sealant is now being applied to the bolt threads, and the final foam spray on the flange area now includes a new process that incorporates a mold to form the foam.

Additionally, NASA has introduced new application procedures for the hand-sprayed insulating foam. Now, technicians who spray the foam are tested periodically for expertise, and also videotaped and observed by colleagues to assure good spraying technique.

The writer, an ASRI employee, supports the Public and Employee Communications Office.

Photo by NASA/KSC

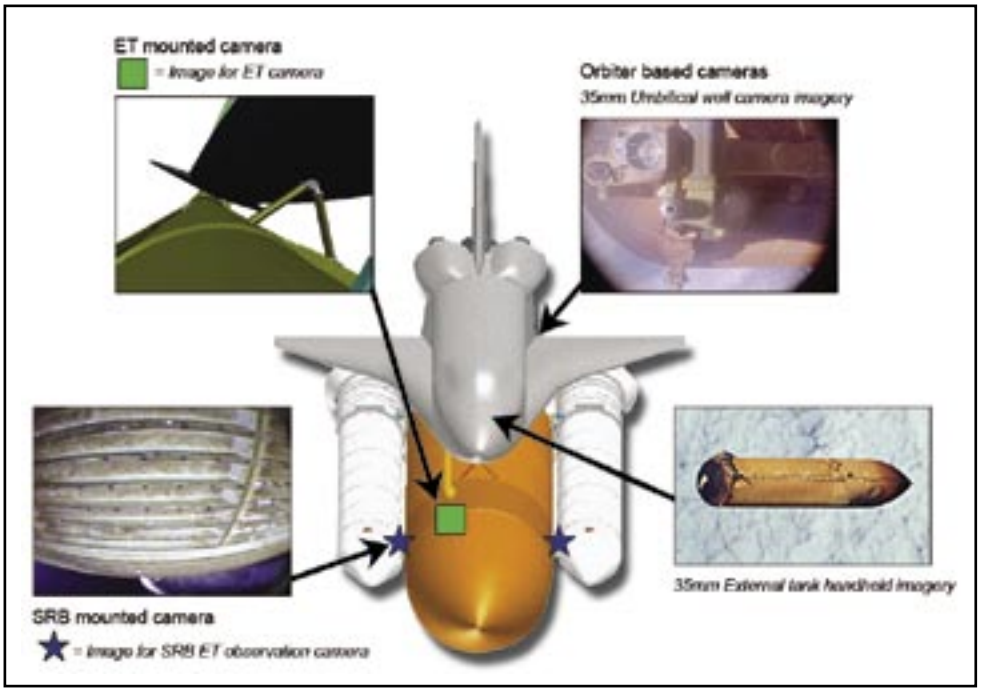
The External Tank to return the Shuttle program to flight is attached to a pair of Solid Rocket Boosters at Kennedy Space Center.

Marshall's eye on Tank, Booster cameras capture launch

By Lynnette Madison

Space Shuttle Discovery's two Solid Rocket Boosters and External Tank have been equipped with a total of three video cameras to help NASA engineers get a better view of what happens as the Shuttle climbs to orbit on its STS-114 Return to Flight Mission.

Improving the imagery taken during Shuttle launches and landings was a recommendation of the Columbia Accident Investigation Board. The images the cameras capture will help NASA detect possible hazardous debris that might be shed or damage that might occur during ascent.



The tank and booster cameras are part of a project known as ELVIS, or Enhanced Launch Vehicle Imaging System, that incorporates several new and modified cameras. The cameras increase NASA's ability to monitor the Shuttle's ascent including determining if there is any possible debris. They will also allow engineers to better evaluate the performance of the redesigned portions of the External Tank and the Orbiter's Thermal Protection System — the materials and technologies that protect both the spacecraft and its occupants.

For STS-114, the External Tank will fly with a Sony XC-999 video camera mounted near the middle of the tank inside the liquid oxygen feedline fairing, a housing on the tank's liquid oxygen fuel line. The camera, which is about the size of two type C batteries laid end-to-end, will activate approximately three minutes before launch and operate for another 15 minutes after liftoff. As the Shuttle lifts off the pad and climbs to orbit, the camera will video the redesigned bipod area, the middle of the tank where the liquid hydrogen tank and intertank flange are connected, and also a portion of the underside of the Orbiter. The intertank is the ribbed, cylinder structure that joins the liquid hydrogen and liquid oxygen tanks. The flange is a joining mechanism on the intertank.

The same type of camera flew on STS-112 in October 2002 in a different location. The new location is expected to reduce the likelihood of views being obscured during the booster separation. During liftoff, the camera's views will be transmitted to the ground communications station on Merritt Island, Fla. — offering almost instantaneous examination by NASA engineers — and be relayed for broadcast on NASA TV.

Two Solid Rocket Booster cameras, one camera on each booster, will fly on STS-114. The cameras are called External Tank Observation Cameras, named because they were originally certified to give NASA engineers a closer look at the insulating foam on the External Tank's intertank. The same type of camera has flown on five previous missions.

The camera system, an off-the-shelf SuperCircuits PC 17 video camera and Sony mini-DV tape recorder, is located near the top of each booster, on its forward skirt. It will offer a close-up view of the Orbiter's nose, the tank's intertank and, at separation, the booster opposite the camera.

Video from the booster cameras will be available for engineering review about 52 hours after launch — 24 hours after the reusable boosters are retrieved from the Atlantic Ocean and arrive on the dock at Kennedy Space Center. It will be sent to Marshall and to the Johnson Space Center in Houston, so a collaborative analysis can be performed.

The writer, an ASRI employee, supports the Public and Employee Communications Office.

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Main Engine turbo-pump improved

The Space Shuttle Main Engine Project Office, led by manager Gene Goldman, has made two improvements to the engine's High Pressure Fuel Turbo-pump, redesigning a sensor that monitors the speed and improves insulation around the pump. The improved sensor design removes a weld from a high-stress area, making the housing stronger because it is now one piece. Better insulation was added to the pump due to the extremely cold temperature of the engine's liquid hydrogen fuel -- minus 423 degrees Fahrenheit.

Another improvement to the engine will reduce the extreme temperatures the tail end of the engine nozzles endure during the Orbiter's reentry into the atmosphere. An improved ablative – an insulation material that protects even as it is burned away – has been added. The new ablative bonds more strongly to the nozzle's aft manifold, offering greater protection, and increasing the life of the nozzles.

"All of these improvements are upgrades to our system," said Goldman. "Although they were integrated during the past two years, work actually began before the Columbia accident."

Testing the engines to better evaluate performance has been a primary focus for the Main Engine Project, said Goldman.

Solid Rocket Boosters improve safety

The primary focus for Marshall's Solid Rocket Booster Project Office, led by manager David Martin, has been to improve the safety of the Shuttle's bolt catchers. The canister-like catchers are designed to "catch" the 40-pound separation bolts when they are severed as the boosters separate from the tank, approximately two minutes after launch. The project also has mounted cameras on the boosters, so that NASA may better assess any debris released during liftoff.

The project office also has undertaken an extensive testing and analysis program to evaluate the booster's tolerance to ice and foam debris; undertook a complete review of its hardware certification records to ensure the hardware meets NASA standards; tested the External Tank attachment rings which hold the booster to the tank; and tested the Booster Separation Motors to gather additional information on the safety requirements of the mechanisms.

"I'm pleased with the work our team of NASA and United Space Alliance contractors has accomplished these past two years," said Martin. "The testing gives us a better understanding of the boosters, and the modifications we've made give us a safer vehicle."

Photo by NASA/Lockheed Martin

In the early hours of New Year's Eve 2004, the first modified External Tank, ET-120, rolls from its hangar at NASA's Michoud Assembly Facility in New Orleans.

Martin's project also has redesigned the igniter on the booster separation motors. The motors ignite and push the boosters away from the tank and Orbiter about two minutes into the launch. Design changes include beveling the motor's solid propellant grain and changing the motor's adapter to better distribute the pressures during firing.

Ground tests validate Motors

During the past two years, the Reusable Solid Rocket Motor Project Office, led by manager Jody Singer, has expanded its ground test program at Marshall and at its prime contractor site, the ATK Thiokol facility in Promontory, Utah. "Testing gives us the chance to increase our knowledge of hardware, its performance and to demonstrate its integrity and robustness prior to flight," said Singer.

The motor project has tested three full-scale motors, including a Flight Verification Motor — a test to further validate the five-year lifespan of a Reusable Solid Rocket Motor. The project also has been an important member of the Space Shuttle Program debris liberation and verification analysis team, analyzing ice that could impact the motors.

External Tank made safer

Because the Columbia Accident Investigation Board determined the accident was caused by a piece of insulating foam that fell off the External Tank during the climb to orbit, the External Tank Project Office has incorporated significant safety improvements, as detailed in the article " NASA's safest External Tank launches Discovery" on page 8.

The writer, an ASRI employee, supports the Public and Employee Communications Office.

Shuttle propulsion primes, suppliers play important role in Return to Flight

By Sanda Martel

More than 700 companies — many like General Products of Huntsville which builds the rings that attach the Solid Rocket Boosters to the External Tank — produce the components required to build the Shuttle's Main Engines, External Tank and twin Solid Rocket Boosters that hold the Reusable Solid Rocket Motors. The External Tank alone contains approximately 500,000 parts and has more than one-half mile of welds.

These active suppliers — located in 43 states and ranging from large aerospace corporations with hundreds of employees to small "mom and pop" operations with only a few workers — make an important contribution to the nation's space program and have a positive impact on local communities.

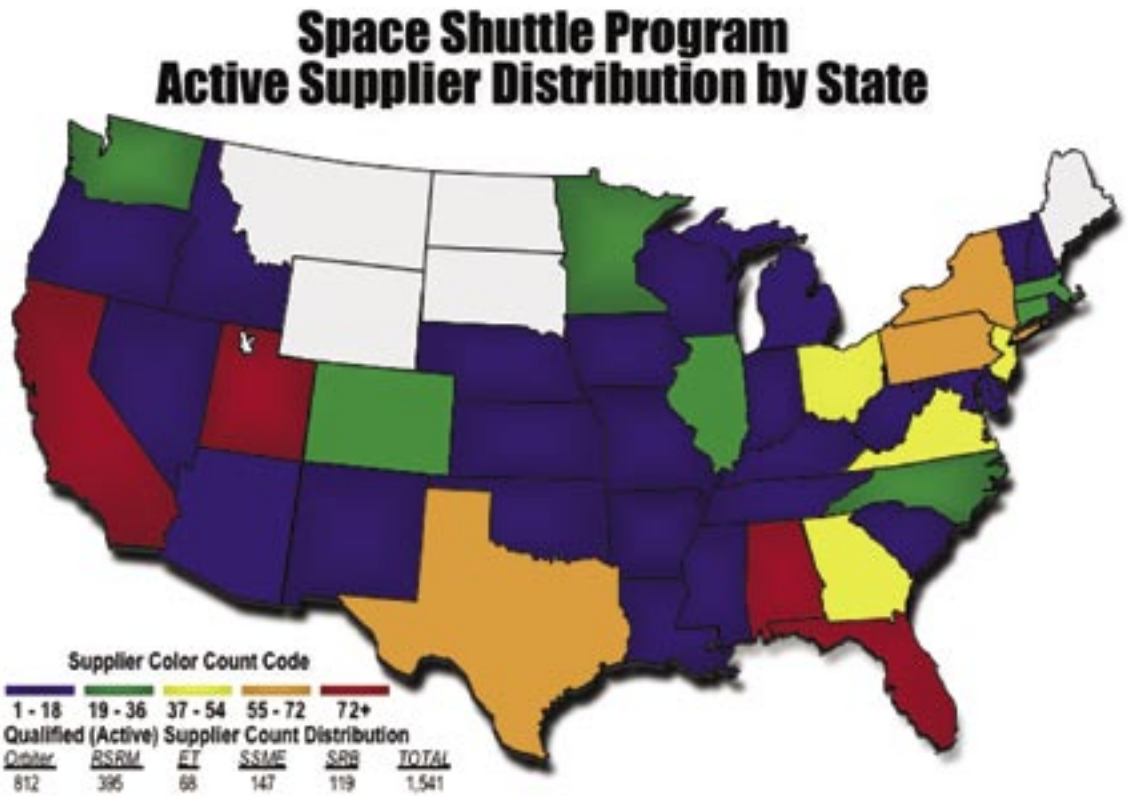
"Our Shuttle propulsion suppliers play a critical role in the nation's space program and in returning the Space Shuttle to safe flight," said Mike Rudolphi, manager of the Space Shuttle Propulsion Office at the Marshall Center.

With the hardware and components provided by suppliers, aerospace prime contractors integrate the propulsion elements into the Space Shuttle system. The propulsion system provides the thrust that launches and accelerates the Orbiter to an orbital velocity of 17,500 mph — 25 times faster than the speed of sound — in just over eight minutes.

The manufacture and assembly of the parts and services required for completion of the Shuttle propulsion system is directed by five prime contractors, which include:

- ATK Thiokol Propulsion of Brigham City, Utah, builds the Reusable Solid Rocket Motor;
- The Boeing Company, Rocketdyne Propulsion & Power, of Canoga Park, Calif., is responsible for development, testing and production of the Main Engines;
- Lockheed Martin Space Systems Company, Michoud Operations, of New Orleans, is responsible for building the External Tank;
- United Technologies Corporation, Pratt & Whitney Liquid Space Propulsion, of West Palm Beach, Fla., builds Main Engine high-pressure fuel turbo-pumps and high pressure oxidizer turbo-pumps;
- United Space Alliance of Houston is responsible for the assembly of the Solid Rocket Booster components at the Kennedy Space Center.

The writer, an ASRI employee, supports the Public and Employee Communications Office.



Marshall's journey to flight

Stack 'em up!

Photo by NASA/KSC

In the first step in "stacking" the Solid Rocket Boosters, the aft skirt and lower segment of the booster rolls into the Vehicle Assembly Building at Kennedy Space Center.

Solid Rocket Motor test

Photo by NASA/ATK Thiokol

One of four Solid Rocket Motor tests at a Utah ATK Thiokol facility which contributed to a safer Return to Flight.

Final Main engine readied for installation

Photo by NASA/KSC

A Hyster lift moves the third Space Shuttle Main Engine into position behind Discovery for installation. Marshall's Space Shuttle Propulsion Office is responsible for the design, manufacturing and flight performance of the main engines.

'Congratulations, team!'

Photo by NASA/KSC

Shuttle Propulsion Manager Mike Rudolphi congratulates employees at Kennedy Space Center's Assembly and Refurbishment Facility for preparing the first Solid Rocket Booster aft skirt on schedule for mission STS-114.

Perfect start for New Year

Photo by NASA/Lockheed Martin

With lots of fanfare and flanked by NASA and Lockheed Martin employees, External Tank 120 — the first tank to be modified for the Space Shuttle's Return to Flight — rolled from its hangar in the early morning hours of Dec. 31, 2004, headed to Kennedy Space Center. From left, External Tank Project Manager Sandy Coleman; astronaut Tony Antonelli; and Ron Wetmore, Lockheed Return to Flight Manager are the "proud parents."