NASAfacts

Space Shuttle

The space shuttle has served America's science and research programs for nearly 25 years. The shuttle, which was on the drawing board even before humans first landed on the moon in 1969, was envisioned as a way to deliver humans and cargo to and from a space station. Since budget constraints made it possible to develop only one program at a time, shuttle was chosen as the logical first step to establishing a more permanent human presence in space.

First launched in April 1981, the space shuttle is the only spacecraft capable of delivering and returning large payloads and scientific experiments to and from space. Today, the shuttle fleet is comprised of *Discovery, Atlantis* and *Endeavour*. Shuttle flights have supported both space station Mir and the International Space Station, deployed and visited the Hubble Space Telescope five times, and deployed planetary spacecraft to study Jupiter, Venus and the sun. In the orbiters' onboard laboratories, hundreds of experiments have helped scientists study the effects of microgravity on materials, plants, animals and human beings to benefit life on Earth.

A fully assembled shuttle is 184 feet tall and weighs 4,500,000 pounds. The bay is 15 feet in diameter and 60 feet long; large enough to fit a school bus or 50,000 pounds of payload. The shuttle's velocity on orbit is about 17,500 mph.

The shuttle has three main elements; the orbiter, the twin solid rocket boosters and the external tank. The orbiter and solid rocket boosters can be flown again, but the external tank burns up during reentry into Earth's atmosphere following the shuttle launch.

Thousands of advances in technology and design have been incorporated into the shuttle since its first launch. Most recently, the *Columbia* accident revealed a major problem with the insulating foam that covers the external tank. Investigators found that foam falling off the tank had damaged *Columbia*'s left wing, letting superheated gases inside.

NASA engineers made dozens of changes to the external tank design, including one to a key mechanism that joins the external tank with the orbiter. Jutting from the upper third of the tank, the "bipod fitting" is susceptible to icing due to the ultra-cold fuel the tank contains. Until the *Columbia* accident, the part was protected from ice buildup using thick sheets of foam. The improved bipod design now excludes using foam and instead relies on electric heaters to keep the area clear.

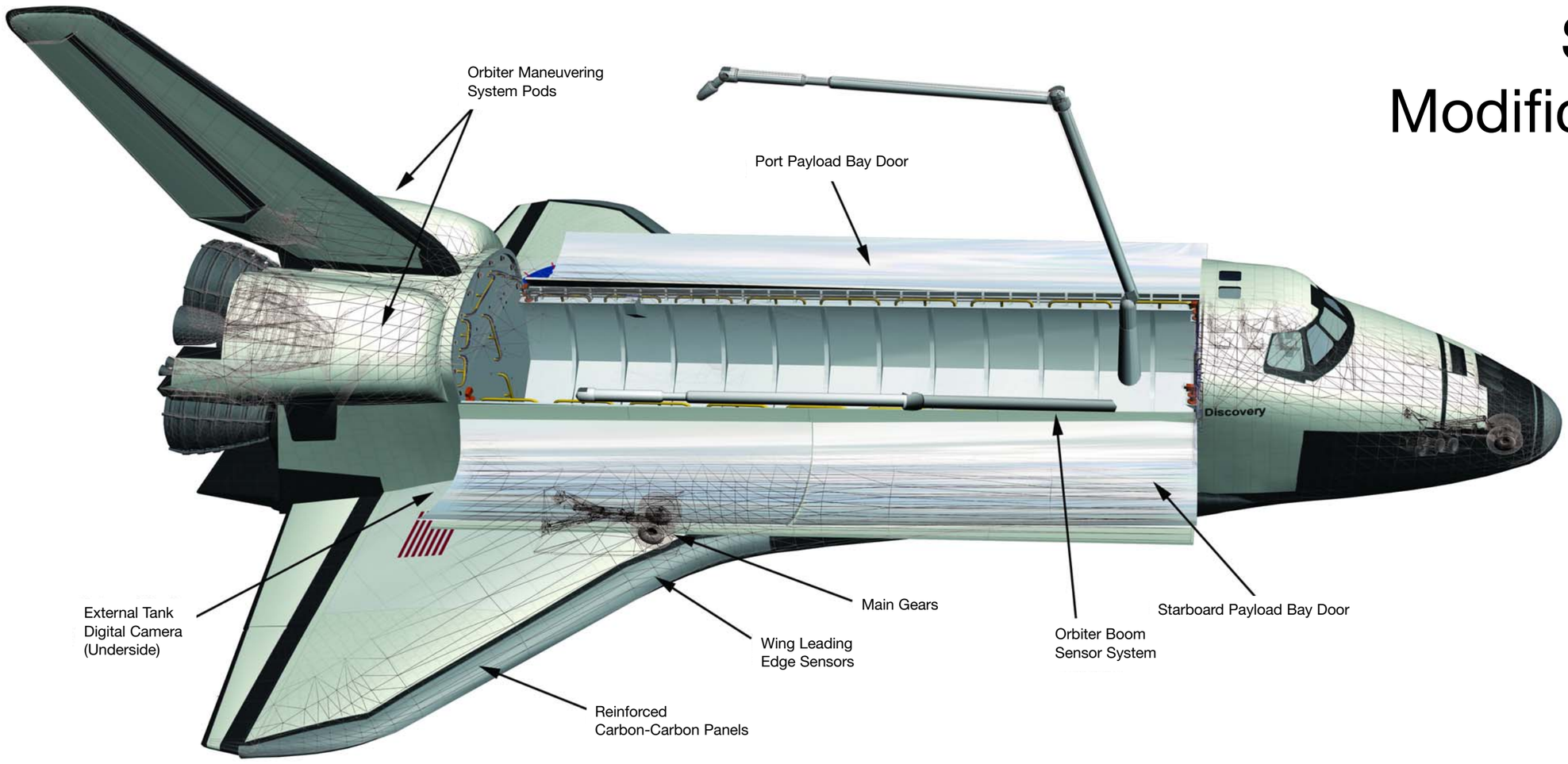
Discovery's STS-114 mission, July 26 – Aug. 9, 2005, tested the new designs incorporated into the shuttle's external fuel tank and processes that minimized the likelihood of shuttles on future missions suffering damage similar to *Columbia*'s. *Discovery*'s first return to flight mission was a mission like no other. It was a unique test flight that serves as a foundation for every space shuttle mission that will follow.

A key change to the tank involves equipment known as the liquid oxygen (LOX) feedline bellows. The bellows are expansion joints that allow the LOX feedline to expand and contract as it carries fuel from the external tank to the orbiter. Because they move, the bellows aren't insulated with foam, which means ice could build up from the minus-297 degree Fahrenheit fuel, creating a debris risk. NASA added a heater to the area and installed a foam "drip-lip" that prevents condensation from building up and freezing. Another major safety improvement to the space shuttle fleet includes the expanded use of enhanced imaging equipment to record the launch. Making the most of current consumer photography equipment, the orbiter's external tank camera was switched from film to a digital model. Located in the rear underbelly of the orbiter, the camera is similar to a standard 35mm model and snaps a series of photos as the tank separates from the orbiter. With the previous film camera, flight engineers had to wait until the orbiter landed to retrieve the negatives and develop photos. With the simplicity and increased speed of a digital system, the image files are easily transmitted back to Earth shortly after the orbiter reaches space.

In addition to the improvements on the external tank and use of digital photography, each of the wing leading edges is outfitted with 22 temperature sensors to measure how heat is distributed across their spans. Both wings also have 66 accelerometers apiece to detect impacts and gauge their strength and location. The sensors are highly sensitive and take 20,000 readings per second. This new network of sensors running along the wings provides an electronic nervous system that gives engineers a valuable way to monitor their condition.

The shuttle fleet will fly for a few more years to support the assembly and maintenance of the International Space Station, among other missions.

Shuttle Modifications



Space Shuttle Fleet Milestones

First voyage into space

Mission: STS-1
Dates: April 12-14, 1981
Shuttle: *Columbia*
The first space shuttle mission, designed to test the vehicle by sending it to orbit and landing safely. The mission is a success and starts a new era in the U.S. space program.

First scientific payload

Mission: STS-2
Dates: November 12-14, 1981
Shuttle: *Columbia*
The second shuttle mission is the first to carry a scientific payload, a number of Earth sensing devices. It's also the first time the Remote Manipulator Arm is successfully used.

First four-person crew

Mission: STS-5
Dates: November 11-16, 1982
Shuttle: *Columbia*
This mission carries the shuttle's first four-person crew. It is also the shuttle's first operational mission, deploying two commercial communications satellites.

First U.S. woman in space

Mission: STS-7
Dates: June 18-24, 1983
Shuttle: *Challenger*
Sally Ride becomes the first American woman to fly in space. This is also the first shuttle mission to fly with a five-person crew.

First African-American in space

Mission: STS-8
Dates: August 30-September 5, 1983
Shuttle: *Challenger*
The first African-American, Guion S. Bluford, flies in space. This is also the first shuttle mission with a night launch and night landing.

First Spacelab mission

Mission: STS-9
Dates: November 28-December 8, 1983
Shuttle: *Columbia*
The first six-person shuttle mission is also the debut mission of Spacelab, an orbital laboratory housed in the orbiter's cargo bay.

First non-astronaut crewmember

Mission: 41-D
Dates: August 30-September 5, 1984
Shuttle: *Discovery*
Charles D. Walker becomes the first non-astronaut to fly on a shuttle mission, acting as NASA's first shuttle industrial payload specialist.

First seven-person crew

Mission: 41-G
Dates: October 5-13, 1984
Shuttle: *Challenger*
This mission marks a number of milestones – the first seven-person crew; the first shuttle crew to include two women; and the first spacewalk by a female astronaut, Kathryn Sullivan.

The *Challenger* tragedy

Mission: 51-L
Dates: January 28, 1986
Shuttle: *Challenger*
The shuttle *Challenger* explodes 73 seconds after liftoff and kills the entire seven-person crew. One member, Christa McAulliffe, would have been the first teacher in space. The explosion is later determined to be caused by an O-ring failure in the right solid booster rocket. The accident forces an immediate suspension of the shuttle program.

First flight after *Challenger*

Mission: STS-26
Dates: September 29-October 3, 1988
Shuttle: *Discovery*
The first shuttle mission after the *Challenger* explosion launches 32 months after the accident. The five-person crew successfully deploys a satellite and performs numerous experiments.

The *Columbia* tragedy

Mission: STS-107
Dates: January 16-February 1, 2003
Shuttle: *Columbia*
Sixteen minutes from landing, during reentry, searing hot gases seeped into the wing and incinerated the spacecraft. The accident forces an immediate suspension of the shuttle program. The accident was caused by foam insulation that broke off during launch from the shuttle's external fuel tank, striking and cracking a panel on the orbiter's wing.

First flight after *Columbia*

Mission: STS-114
Dates: July 26-August 9, 2005
Shuttle: *Discovery*
The first shuttle mission after the *Columbia* tragedy. The mission demonstrates the success of new in-flight inspection techniques to ensure the fitness of the shuttle.

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