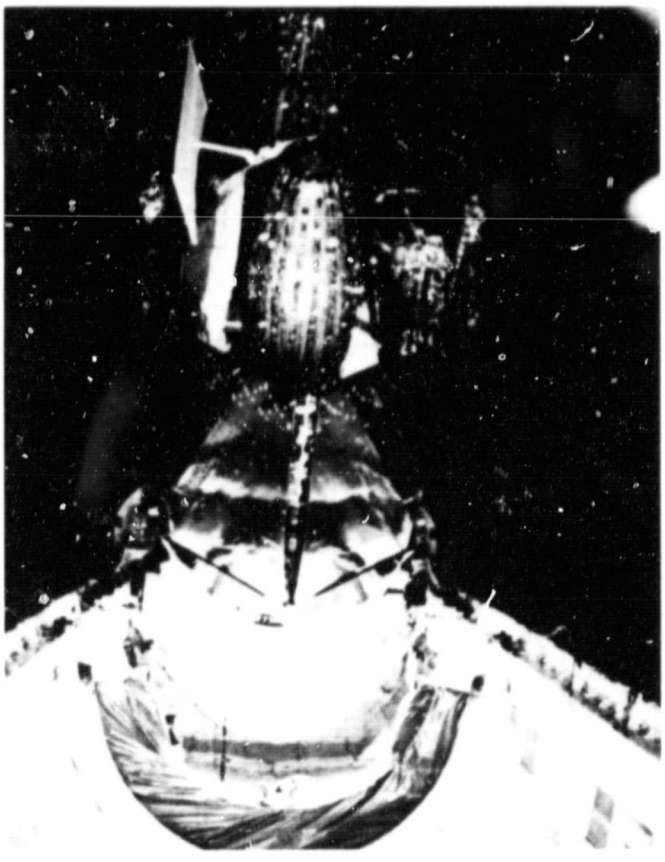
NASA
National Aeronautics
Space Administration

Mission Report

MR-006

Second Shuttle Joins NASA's STS Fleet

Challenger Launches First New Tracking Satellite



The Tracking and Data Relay Satellite (TDRS), attached to its Inertial Upper Stage (IUS) booster, is poised in *Challenger's* open cargo bay April 5, ready for spring-actuated ejection into space.

NASA made a major stride in readying a second delivery vehicle for its Space Transportation System (STS) fleet with the perfect landing of Shuttle Orbiter *Challenger* at Edwards Air Force Base, California, April 9, 1983.

Besides being the first flight test of *Challenger's* performance, the mission marked the orbiting of the first spacecraft in NASA's new Tracking and Data Relay Satellite System (TDRSS). The new family of orbiting space communications platforms is essential to serve future Shuttle missions. Although the Inertial Upper Stage (IUS) second stage engine firing failed to place TDRS in its final 35,888-kilometer (22,300-mile) geosynchronous orbit, its release from the orbiter cargo bay went as planned. Launch officials were confident they can achieve its planned orbit in a matter of weeks.

First U.S. Space Walk in 9 Years

Other mission chores included a spacewalk in which crew members practiced using tools and equipment-handling techniques in the cargo bay. These procedures are preparatory to making repairs to an ailing Earth satellite next year.

Challenger glided to a landing at 1:53 p.m. EST, April 9. The orbiter needed only 7,300 feet of the paved landing strip at Edwards Air Force Base, coming to a halt with its nose wheel precisely on the center line.

More than 100,000 people welcomed the new spacecraft back to Earth after its maiden space voyage, completing 80 orbits and 2.2 million miles in space. The flight required 5 days, 0 hours, 23 minutes and 42 seconds.

TDRSS Removed for Cleaning

Technicians and engineers had been frustrated by launching delays that kept the launch of *Challenger* about 10 weeks behind schedule because of a series of gas leaks associated with the orbiter's

three high-pressure liquid oxygen and hydrogen engines. All three engines were repaired and reinstalled. The leaks had been repaired and agency officials were hoping for an early March launch when severe winds on February 28 lashed the launch area, breaching the weather seal between the changeout room and the orbiter. Fine dust particles and other impurities were deposited on the TDRSS communications satellite already stowed in the orbiter's cargo bay. Following a check which indicated contamination, TDRS-A was removed March 14 for cleaning and inspection—and finally returned to *Challenger* on the launch pad, March 19.

Continuing orbiter engine checkout, repairs, and verifications paralleled the cleaning and reinstallation of TDRS and its attached IUS.

Planned launching of Spacelab I in late September 1983 and the communications requirements of Landsat - 4, and Space Telescope later, in the mid-1980's, made launch of the first TDRS imperative on the STS-6 flight. Without this new tracking satellite system in orbit, the programs would be rendered ineffective or they would be delayed.

Earliest STS-6 plans called for only a two-day shakedown mission for the primary purpose of orbiting TDRS 1. But the mission was extended to five days to permit the testing of the Shuttle space suits which had been plagued with technical problems during the STS-5 mission. A ventilating fan in one suit malfunctioned and pressure failed to come up to the required levels in the other suit during their initial flight tryouts in November 1982.

Launch Begins On-time Flight

Challenger's first flight proved that the confidence of her technical handlers wasn't misplaced. The orbiter set new records for an on-time launch by lifting off the pad at 1/800th of a second after the scheduled 1:30 p.m., April 4, 1983.

Commanding the mission was Paul J. Weitz, 50, who flew on Skylab; Col. Karol J. Bobko, 45, USAF, pilot; and mission specialists Dr. Story Musgrave, 47; and Donald K. Peterson, 49. If space agency technicians had wanted to entrust their often-delayed spacecraft to a crew seasoned by age, they could scarcely have done better. *Challenger's* crew boasted the oldest average crew age for an American spacecraft to date—48 years and three months.

Only a 15-minute launch window was available for *Challenger* to leave the launch site for orbit, marking the first afternoon launch for a Shuttle mission. (The flight originally was set for January 20 at 9:00 a.m.)

Launch of the TDRS from the *Challenger* was accomplished on time and without incident. It is one of three tracking and data spacecraft scheduled to be orbited within 11 months. The new tracking satellites will relay communications for United States spacecraft for the next 20 years.

TDRS Released into Orbit

After the spring-actuated release of TDRS-A and its IUS booster, the orbiter backed off and waited for the first stage IUS burn, lasting 2 minutes and 31 seconds. The first stage was jettisoned as planned. After 6 a.m., April 5, the scheduled upper stage IUS burn of 1 minute and 43 seconds had continued for a little more than 70 seconds when communications with the IUS/TDRS were lost. With the TDRS and IUS apparently tumbling at a high rate, engineers and technicians were unable to contact the satellite.

Unless the IUS upper stage separated from TDRS 1 and the solar arrays and communications antennas had deployed, the spaceborne communications center was in imminent danger of remaining permanently deaf to Earth signals. If it had no Sun-generated electrical supply, its batteries would fast approach exhaustion. NASA antennas at the Goldstone tracking site in the Mojave Desert were used to transmit full power commands to the tumbling TDRS/IUS combination, urging them to "separate". Then, just after 9 a.m., NASA received the message that the spacecraft had separated from its IUS booster. Other messages confirmed that TDRS had extended its solar panels and no longer depended solely on batteries.

With the satellite back under control, the apparent misfiring of the IUS upper stage had placed TDRS-A in a highly elliptical orbit 24,359 kilometers (21,950) miles above the Earth at its high point, and 20,908 kilometers (13,450 miles) high at its lowest point. Instead of being in the plane of Earth's equator, the satellite crosses the equator at an angle of 2.4 degrees. NASA and Air Force officials have convened an investigation into the case of the IUS misfiring.

Tracking Satellite Awaits Orbit Change

Robert O. Aller, the tracking satellite program director indicated that as much as several weeks would be required to check out TDRS performance.

Then, in a careful series of selected burns of the satellite's small adjustment rockets, placement of TDRS in its planned 35,888 kilometer (22,300-mile) geosynchronous orbit would be attempted.

Aller explained that TDRS has some 500 kilograms (1,300 pounds) of hydrazine fuel in its tanks—for adjusting its position in orbit during its 10-year design life. Satellite engineers estimate that more than 385 kilograms (850 pounds) of the fuel can be used in efforts to move the satellite to its planned geosynchronous orbit. The satellite has many redundant features that make control personnel confident that its planned orbit can be achieved.

Payload is Heaviest to Date

TDRS is the heaviest payload released into orbit by a Shuttle spacecraft to date. Each satellite weighs about 2,268 kilograms (5,000 pounds), and, deployed in orbit, has two solar panels extending 17.4 meters (57 feet) from tip to tip and a pair of communications antennae, each 4.9 meters (16 feet) in diameter. The IUS unit, spring-ejected with TDRS from *Challenger's* cargo bay, is 5.18 meters (17 feet) long and 2.7 meters (9 feet) in diameter. It weighs 14,515 kilograms (32,000 pounds) and its NASA version contained 13,247 kilograms (27,000 pounds) of solid fuel propellant.

The TDRSS satellites, largest and most advanced yet developed, will be positioned 130 longitude degrees apart in equatorial geosynchronous orbits. The first is scheduled for a station above Brazil at 41 degrees west longitude. Later in 1983 the second will be positioned southwest of Hawaii at 171 degrees west longitude. The in-orbit spare is destined for a position at 79 degrees west longitude over the Pacific Ocean off South America. In their geosynchronous orbits they will remain over the same Earth locations as their rotations keep pace with the planet.

TDRSS data will be relayed to a central ground terminal at White Sands, New Mexico, then transmitted to Goddard Space Flight Center, Greenbelt, Maryland, where communications for many of NASA's unmanned satellites are controlled; and to Johnson Space Center, Texas, which monitors all NASA manned flights.

The TDRSS is being leased for the next ten years from the Space Communications Company (SPACECOM), owner, operator of this service for the space agency.

The Shuttle is Lighter, More Powerful

Despite its first-glance resemblance to *Columbia, Challenger* journeyed into space on its first flight incorporating many significant improvements over its predecessor. The newest orbiter's throttleable engines operated at 104 percent of *Columbia's* rated power output. This extra thrust gave *Challenger* an added 1,804 kilograms (4,000 pounds) of payload capacity—1000 pounds for each percentage point added.

Not only do the new spaceship's engines develop added power, it is lighter and stronger, without alterations in its basic dimensions.

When launched on its fifth mission on November 11, 1982, *Columbia* carried a payload of 14,554 kilograms (32,093 pounds). On its first flight into orbit, *Challenger* lifted an additional 6587.17 kilograms (14,522 pounds) for a total of 21,140 kilograms (46,615 pounds).

By eliminating stiffeners and brackets to simplify the structure and mountings for the huge main fuel tank, engineers were able to trim more than 4,536 kilograms (10,000 pounds). By redesigning the solid-fuel boosters' engine casings, another 3,628 kilograms (8,000 pounds) were eliminated. The new lighter, recoverable casings are interchangeable with the heavier earlier version which will still be useable.

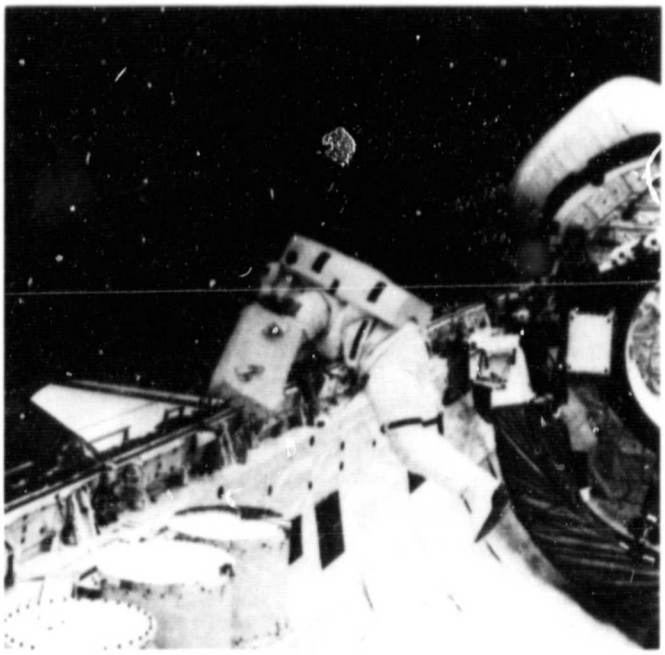
Additional weight reduction measures throughout the spacecraft have saved another 1,128 kilograms (2,486 pounds). Ejection seats and their heavy rails have disappeared from *Challenger's* cabin. They were replaced with lighter, operational seats for this mission's four-man crew. The two orbital maneuvering engines at the rear of the orbiter are now covered with flexible insulation blankets instead of the individual heat-resistant tiles that flew off on the first *Columbia* mission.

Lightweight honeycomb materials have been introduced in the landing gear doors and in portions of the tail structure. Heat shields for the main engines are also lighter and support structures around engine thrust frames have been lightened by simplifying their design or combining them with other structural elements.

A variation of the prompter's displays that assist speakers on television has appeared for the first time on *Challenger's* flight deck. Called "Heads Up Display", images appear on a transparent screen introduced at eye level between the commander and pilot and the front windows. These images show velocity numbers, a view of the runway and the ship's angle of descent, and the leveling-off for touchdown.

If *Challenger* can be serviced and readied for another flight within two months, NASA hopes to meet its commitments to fly four more Shuttle missions during this calendar year. *Challenger's* first flight performance pleased its handlers who noted

only 22 flight plan anomalies—contrasted with 82 on *Columbia's* first flight. Lt. General James A. Abrahamson, NASA Associate Administrator, has set the second week in June 1983 as the tentative date for the spacecraft's next flight.



Clad in his space suit, Astronaut Story Musgrave practices using special latch tools during an extravehicular activity (EVA) April 7, in *Challenger's* open cargo bay.

Astronauts Test Space Suits

In the first spacewalk or extravehicular activity (EVA) by American astronauts in more than nine years, Story Musgrave and Donald Peterson moved out of the *Challenger's* airlock at 4:20 p.m. April 7. Their activities outside the spacecraft cabin were completed during the 51st, 52nd and 53rd orbits at 17,500 miles per hour and 284.8 kilometers (177 miles) above the Earth. They were viewed on television during a pass from the Pacific Ocean to the Gulf of Mexico. As they went about their tasks in the cargo bay the astronauts seemed to move well despite their 50-foot restraining tethers. They attached these lines to fixed guide cables stretched along each side of the open compartment.

Before they left the airlock, Musgrave and Peterson spent three hours breathing pure oxygen to purge the nitrogen from their blood. This procedure is required to avoid the "bends" experienced by divers and space travelers when they undergo compression or decompression too rapidly.

Just before they began their spacewalk, President Reagan had placed a radio telephone call to the spacecraft. "Please know that all of us, the American people, are proud of your service to your country and what you're doing," he said. The President said he would leave space suit activities to Shuttle crews and wished them success.

Peterson and Musgrave were the 28th and 29th Americans to walk in space—the first since February 1974 when astronauts in the Skylab crew "went outside" to retrieve film canisters from some of the orbiting laboratory's optical equipment.

Astronauts Monitor Experiments

In managing on-time completion of more than 95 percent of their assigned tasks, the astronauts tended three small self-contained "Getaway Specials". These included an artificial snow crystal experiment by a Japanese newspaper; a packaged seed collection flown by a South Carolina seed company; and a five cubic foot composite experiment related to metals research, provided by cadets at the Air Force Academy, Colorado Springs.

Continuing investigations repeating other experiments flown on earlier Shuttles included: testing of a continuous flow electrophoresis system; continuing production in space of small monodisperse latex spheres; and more study of lightning associated with thunderstorms observed beneath *Challenger's* flight path.

25th Anniversary
1958-1983

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