

= STS @-@ 8 =

STS @-@ 8 was the eighth NASA Space Shuttle mission and the third flight of the Space Shuttle Challenger . It launched on August 30 , 1983 and landed on September 5 , conducting the first night launch and night landing of the Space Shuttle program . It also carried the first African @-@ American astronaut , Guion Bluford . The mission successfully achieved all of its planned research objectives , but was marred by the subsequent discovery that a solid @-@ fuel rocket booster had almost malfunctioned catastrophically during the launch .

The mission 's primary payload was INSAT @-@ 1B , an Indian communications and weather observation satellite , which was released by the orbiter and boosted into a geostationary orbit . The secondary payload , replacing a delayed NASA communications satellite , was a four @-@ metric @-@ ton dummy payload , intended to test the use of the shuttle 's " Canadarm " remote manipulator system . Scientific experiments carried onboard Challenger included the environmental testing of new hardware and materials designed for future spacecraft , the study of biological materials in electric fields under microgravity , and research into space adaptation syndrome (also known as " space sickness ") . The flight furthermore served as shakedown testing for the previously launched TDRS @-@ 1 satellite , which would be required to support the subsequent STS @-@ 9 mission .

= = Crew = =

This mission had a crew of five , with three mission specialists . It was the second mission (after STS @-@ 7) to fly with a crew of five , the largest carried by a single spacecraft up to that date . The crew was historically notable for the participation of Guion " Guy " Bluford , who became the first African @-@ American to fly in space .

The commander , Truly , was the only veteran astronaut of the crew , having flown as the pilot on STS @-@ 2 in 1981 and for two of the Approach and Landing Tests aboard Enterprise in 1977 . Prior to this , he had worked as a capsule communicator for all three Skylab missions and the Apollo @-@ Soyuz mission . Brandenstein , Gardner and Bluford had all been recruited in 1978 , and been training for a mission since 1979 . The mission had originally been planned for a crew of four , with Thornton added to the crew as a third mission specialist in December 1982 , eight months after the crew was originally named . As with Truly , he was an Apollo @-@ era recruit , having joined NASA in 1967 . His participation on the mission included a series of tests aimed at gathering information on the physiological changes linked with Space Adaptation Syndrome , more commonly known as " space sickness " ; this had become a focus of attention in NASA , as astronauts succumbed to it during Shuttle missions .

The orbiter carried two EMUs for use in case of an emergency spacewalk ; if needed , they would be used by Truly and Gardner .

= = Mission plan and payloads = =

An early plan for STS @-@ 8 , released in April 1982 , had scheduled it for July 1983 . It was expected to be a three @-@ day mission with four crew members , and would launch INSAT @-@ 1 @-@ B , an Indian satellite , and TDRS @-@ B , a NASA communications relay satellite . However , following problems with the Inertial Upper Stage (IUS) used to deploy TDRS @-@ A on the STS @-@ 6 mission , it was announced in May 1983 that the TDRS was not going to be flown . It was replaced in the manifest by the Payload Flight Test Article . After re @-@ development of the IUS , TDRS @-@ B was eventually re @-@ manifested for the STS @-@ 51 @-@ L mission , and was lost along with the Space Shuttle Challenger and its crew when the launch failed in January 1986 .

The primary element of the STS @-@ 8 mission payload was INSAT @-@ 1B . It was the second in a series of multi @-@ purpose weather and communications satellites to be operated by the Indian Space Research Organisation (ISRO) ; the first , INSAT @-@ 1A , had been launched by a Delta rocket in April 1982 , but had to be shut down shortly afterwards due to a failure of the

onboard reaction control system . The satellite was carried in the rear of the shuttle 's payload bay , and was boosted into a geosynchronous transfer orbit by a Payload Assist Module (PAM @-@ D) , a small solid rocket upper stage , after its release from the orbiter . The satellite , with its upper stage , massed a total of 3 @,@ 377 kg (7 @,@ 445 lb) , with the cradle massing another 1 @,@ 102 kg (2 @,@ 429 lb) , and had cost around \$ 50 million .

The Payload Flight Test Article (PFTA) had been scheduled for launch in June 1984 on STS @-@ 16 in the April 1982 manifest , but by May 1983 it had been brought forward to STS @-@ 11 . That month , when the TDRS missions were delayed , it was brought forward to STS @-@ 8 to fill the hole in the manifest . It was an aluminum structure resembling two wheels with a six @-@ meter long central axle , ballasted with lead to give it a total mass of 3 @,@ 855 kg (8 @,@ 499 lb) , which could be lifted by the " Canadarm " Remote Manipulator System ? the Shuttle 's " robot arm " ? and moved around to help astronauts gain experience in using the system . It was stored in the midsection of the payload bay .

The orbiter carried the Development Flight Instrumentation (DFI) pallet in its forward payload bay ; this had previously flown on Columbia to carry test equipment . The pallet was not outfitted with any flight instrumentation , but was used to mount two experiments . The first studied the interaction of ambient atomic oxygen with the structural materials of the orbiter and payload , while the second tested the performance of a heat pipe designed for use in the heat rejection systems of future spacecraft .

Four Getaway Special payloads were carried . One studied the effects of cosmic rays on electronic equipment . The second studied the effect of the gas environment around the orbiter using ultraviolet absorption measurements , as a precursor to ultraviolet equipment being designed for Spacelab 2 . A third , sponsored by the Japanese Asahi Shimbun newspaper , tried to use water vapor in two tanks to create snow crystals . This was a second attempt at an experiment first flown on STS @-@ 6 , which had had to be redesigned after the water in the tanks froze solid . The last was similar to an experiment flown on STS @-@ 3 , and studied the ambient levels of atomic oxygen by measuring the rates at which small carbon and osmium wafers oxidized .

Finally , in cooperation with the US Postal Service , the mission also carried 260 @,@ 000 postal covers franked with \$ 9 @.@ 35 express postage stamps , which were to be sold to collectors , with the profits divided between the USPS and NASA . Two storage boxes were attached to the DFI pallet , with more stored in six of the Getaway Special canisters .

A number of other experiments were to be performed inside the orbiter crew compartment . Among these was the Continuous Flow Electrophoresis System , being flown for the fourth time . This separated solutions of biological materials by passing electric fields through them ; the experiment aimed at supporting research into diabetes treatments . A small animal cage was flown containing six rats ; no animal experiment was carried out on the flight , but a student involvement project was planned for a later mission which would use the cage , and NASA wanted to ensure it was flight @-@ tested . The student involvement project carried out on STS @-@ 8 involved William Thornton using biofeedback techniques , to try to determine if they worked in microgravity . A photography experiment would attempt to study the spectrum of a luminous atmospheric glow which had been reported around the orbiter , and determine how this interacted with firings of the reaction control system .

The mission was also scheduled to carry out a series of tests with the TDRS @-@ 1 satellite which had been deployed by STS @-@ 6 , to ensure the system was fully operational before it was used to support the Spacelab 1 program on the upcoming STS @-@ 9 flight . The orbiter furthermore carried equipment to allow for encrypted transmissions , to be tested for use in future classified missions .

= = = Support crew = = =

John E. Blaha
Mary L. Cleave
William F. Fisher

Jeffrey A. Hoffman
Bryan D. O'Connor (ascent CAPCOM)

== Crew seating arrangements ==

== Mission summary ==

== Launch preparations ==

Preparation for the mission began on June 3 , with the assembly of the shuttle 's solid rocket boosters (SRB) on the Mobile Launcher Platform . The boosters were stacked on June 20 , 1983 , and the external tank mated to the assembly on June 23 . Challenger arrived at Kennedy Space Center on June 29 , and was transferred to the Orbiter Processing Facility on June 30 . After post flight maintenance and preparation for the new mission , including the installation of most flight payloads , the shuttle was transferred to the Vehicle Assembly Building on July 27 , and mated to the booster / tank stack . The stack was checked out on July 29 and 30 , and moved to Launch Complex 39A on August 2 , 1983 . INSAT 1B was loaded into the orbiter when on the pad ; the overall processing time from Challenger arriving at KSC to being ready for launch was only sixty two days , a record for the program at the time .

The launch had originally been scheduled for August 4 , 1983 , and was later rescheduled for August 20 . The requirement to conduct testing with the TDRS system required a delay of ten days for the system to be ready , during which the stack remained on the launch pad . During the pad delay , Hurricane Barry (1983) hit the Florida coastline , making landfall just south of the Kennedy Space Center on the morning of August 25 . The storm had only been identified two days earlier , and there was no time to roll Challenger back from the pad ; the decision was made to secure the launch stack and ride out the storm .

== Launch ==

Challenger finally launched at 06 : 32 UTC (02 : 32 EDT) on August 30 , 1983 , after a final 17 minute delay due to thunderstorms near the launch site . The launch window extended from 06 : 15 to 06 : 49 . The countdown to launch was called by Mark Hess , public information officer .

The launch , which occurred in pre dawn darkness , was the first American night launch since Apollo 17 , and was watched by several thousand spectators . The unusual launching time was due to tracking requirements for the primary payload , INSAT 1B ; the program would not have another night launch until STS 61 B in 1985 . The crew had attempted to prepare for it by training in darkened simulators so as to keep their night vision , but in practice it was discovered that the light of the solid fuel rocket boosters made the immediate area around the launchpad virtually as bright as a day launch .

The launch was the first to use a newly developed high performance motor for the solid rocket boosters , which gave approximately 7 % greater thrust , and the second last to use the original standard mass steel casings for the boosters . These had been replaced by a thinner case , saving some 1 , 800 kilograms (4 , 000 lb) , on STS 6 and STS 7 , but because of safety concerns the next two flights used the conventional cases .

== Orbital operations ==

After a successful insertion into a circular orbit at 296 kilometers (160 nmi) , the first experiments began ; the first two samples were run through the Continuous Flow Electrophoresis System , and measurements were taken for the atmospheric luminosities study . A hydraulic circulation pump failed , but this was worked around and it proved to have no impact on operations .

The major event of the second day (August 31 , 1983) was the successful deployment of the INSAT @-@ 1B satellite , which took place at 7 : 48 UTC , with Challenger then maneuvering to avoid the firing of the booster motor forty minutes later . Other experimentation continued , though telemetry through TDRS was lost for around three hours , requiring manual intervention . A fire alarm sounded in the morning , indicating signs of a fire in the avionics compartment , but a second alarm remained silent and it was eventually determined to be a false alarm .

On the third and fourth days (September 1 and 2 , 1983) , work began with the Canadarm Remote Manipulator System and the payload test article , and communications testing through TDRS continued . The former was successful , but the latter lost contact on a number of occasions , due to problems at the White Sands ground station . As a result , the crew had to be awakened early on September 1 in order to deal with the problem . A minor cabin pressure leak on September 2 was traced to the waste management system , and quickly controlled . The orbiter performed an Orbital Maneuvering System firing on September 2 to place itself in a lower orbit , where the air density was higher and the oxygen interaction experiments would work more effectively .

On the fifth day (September 3 , 1983) , testing of the Canadarm continued , including a number of optional " shopping list " tests , and the TDRS tests were carried out with more success . A live press conference was held late in the day , the first in @-@ flight press conference since Apollo 17 . On the sixth day (September 4 , 1983) , experiment runs were completed and the crew prepared to deorbit . Two systems failures were recorded on this last day , the most serious of which involved a synchronization failure in one of the onboard computers .

While on orbit , Challenger made a number of altitude and attitude adjustments , in order to test the behavior of a Shuttle orbiter and to perform some experiments in different thermal conditions . By exposing or shading areas from the sun in an unusual way , it was possible to induce particularly warm or cold conditions and observe any resulting problems .

= = = Landing = = =

The mission plan called for a landing at Edwards Air Force Base , California , at 121 : 28 mission elapsed time . On the original plan , this would have been at 7 : 44 UTC on September 4 , 1983 , before accounting for the last @-@ minute launch delay ; in the event , this was put back by one day to allow for further communications testing , and Challenger touched down at 07 : 40 : 33 UTC (00 : 40 : 33 PDT) , September 5 , 1983 , on Runway 22 at Edwards AFB , on the morning of the seventh day of the mission . As with the launch , this was the first night landing of the program . The Shuttle orbiters had no on @-@ board lights , due to the difficulty of designing landing lights to survive re @-@ entry , and so the runway was lit by high @-@ intensity xenon arc lamps to guide the orbiter in . There was no pressing operational requirement for a night landing , but there was a desire to prove it was possible . Footage of the landing was shown in the 1986 film SpaceCamp .

= = Post @-@ flight safety analysis = =

The launch was carried out with no obvious anomalies , but on September 27 , 1983 , during post @-@ flight inspection of the solid rocket boosters , severe corrosion was discovered in the left @-@ hand booster . The three @-@ inch (8 cm) -thick resin lining protecting the rocket nozzle , which was designed to erode about half its thickness during firing , was found to have burned down to as little as 5 millimetres (0 @.@ 20 in) in places . By some estimations , this left around 14 seconds of firing time before the nozzle would have ruptured , a situation which would have resulted in loss of control and the probable break @-@ up of the spacecraft . It was later determined that this fault was due to the particular batch of resin used on this set of boosters . The burn @-@ through problem was treated as a small mishap by the media , and did not receive significant interest until after the Challenger disaster in 1986 ; the only major contemporary public criticism came from NASA 's Soviet counterparts . As a result of this incident , the flight of STS @-@ 9 was delayed for a month while the nozzles of its boosters were changed .

Post @-@ flight inspection of the thermal protection system tiles found seven major debris impacts

and forty @-@ nine minor impacts , of which three and twenty @-@ six respectively were on the orbiter 's underside . This was the lowest incidence of major tile damage until at least STS @-@ 74 , and compares very favorably with the program average of twenty @-@ three major impacts to the underside . It was the first Shuttle flight with no significant problems reported for the thermal protection system . Three windows were removed from the orbiter due to pitting and hazing .

A total of thirty @-@ three in @-@ flight anomalies were eventually reported . As well as the issues above , STS @-@ 8 's more minor problems ranged from faulty thermostats to an unusually high amount of dust in the cabin .

= = Scientific results = =

Overall , the crew successfully completed all fifty @-@ four of the planned mission test objectives . While the INSAT deployment was a success , the satellite had problems unfolding its solar array once in geostationary orbit , and was not fully operational until the middle of September . Once functional , however , it provided satisfactory service for seven years , returning 36 @-@ 000 images of Earth and broadcasting television to thousands of remote Indian villages . The Payload Flight Test Article evaluation found that the Canadarm remote manipulator system was capable of moving bulky masses with some accuracy , to a precision of 5 cm and one degree of alignment .

The TDRS @-@ 1 program was overall less successful , with the satellite suffering several computer failures and an overall loss of telemetry for several hours . In all , the orbiter was able to use the satellite for 65 of the planned 89 orbits , and could make successful use of the connection on about forty . The Continuous Flow Electrophoresis System equipment functioned as planned , processing several hundred times more material than would have been possible on Earth , and the Asahi Shimbun crystal experiment , flown for the second time , was able to produce snow crystals after the canister was redesigned .

Thornton 's research into space adaptation sickness noted that the STS @-@ 8 astronauts had escaped severe cases , with none suffering loss of motor control ; Gardner suffered a " mild case " , but was still able to manage effectively , while Brandenstein ? who had suffered from induced motion sickness during training operations ? was entirely unaffected . The symptoms were found to abate within three days of launch .

= = Wake @-@ up calls = =

NASA began a tradition of playing music to astronauts during the Gemini program , and first used music to wake up a flight crew during Apollo 15 . Each track is specially chosen , often by the astronauts ' families , and usually has a special meaning to an individual member of the crew , or is applicable to their daily activities .