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National Space Science Data Center Header

Gemini 8

NSSDC/COSPAR ID: 1966-020A

Description

Gemini 8 was the sixth crewed Earth-orbiting spacecraft of the Gemini series, carrying astronauts Neil Armstrong and David Scott. The primary mission objectives were to perform rendezvous and four docking tests with the Agena target vehicle and to execute an ExtraVehicular Activity (EVA) experiment. Other objectives included parking the Agena in a 410 km circular orbit, performing a rerendezvous with the Agena, conduct systems evaluation, evaluating the auxiliary tape memory unit, and demonstration of controlled reentry. Ten technological, medical, and scientific experiments were carried on board.

Mission Profile

Gemini 8 was launched from Complex 19 at 10:41:02 a.m. EST (16:41:02.389 UT) on 16 March 1966 and inserted into a 159.9 x 271.9 km orbit at 11:47:36. Over the next six hours the spacecraft performed 9 maneuvers to rendezvous with the Gemini Agena Target Vehicle (GATV), which had been launched earlier (at 9:00 a.m. EST). The rendezvous phase ended at 4:39 p.m. EST, with the spacecraft 45 meters apart with zero relative motion. Stationkeeping and other maneuvers were performed for about half an hour, and then Gemini 8 moved in and docked with the GATV on the 5th revolution at 5:14 p.m., the first docking ever to take place in space.

About 27 minutes after docking at 5:41 p.m. the combined vehicle began to go into a violent yaw and tumble. Armstrong disengaged the Gemini capsule from the GATV causing it to roll, pitch, and yaw even more rapidly than when it was connected to the GATV, approaching and possibly exceeding a rate of one revolution per second. Armstrong and Scott managed to deactivate the OAMS and in a final attempt to counteract the violent tumbling all 16 reentry control system (RCS) thrusters were utilized to damp out the roll. This manuever succeeded in stabilizing the spacecraft at 6:06:30 p.m. but ended up using 75% of the RCS fuel. It was then discovered that one of the 25-pound Orbit Atitude and Maneuver System (OAMS) roll thrusters (roll thruster no. 8) on Gemini 8 had been firing continuously, causing the tumbling. Apparently it

had short-circuited while being used to maneuver the Gemini-GATV combination and had stuck open.

Due to the premature use of the reentry control system an immediate landing was required by Gemini safety rules, so the planned EVA and other activities were cancelled. Retrofire took place on the 7th revolution at 9:45:49 p.m. on 16 March, just over 10 hours after launch, and the spacecraft splashed down in the western Pacific Ocean about 800 km west of Okinawa at 25.22 N, 136.00 E, 2 km from the target. The time was 10:22:28 p.m. EST, but was during the day at the splashdown site. USAF frogmen parachuted from a C-54 rescue plane within minutes and affixed a flotation collar around the spacecraft. The crew was picked up by the recovery ship U.S.S. Mason 3 hours later (1:28 a.m. EST, 17 March) and the spacecraft at 1:37 a.m. Total mission elapsed time was 10:41:26.

Early termination of the mission precluded achievement of many mission objectives, but the rendezvous and docking was accomplished, as was the evaluation of the auxiliary tape memory unit and demonstration of controlled reentry. Of the six scientific experiments only the Agena micrometeorite collection was successful. The others -- (1) zodiacal light photography, (2) frog egg growth, (3) synoptic terrain photography, (4) nuclear emulsions, and (5) spectrophotography of clouds -- were incomplete. The Agena Target Vehicle remained in orbit and maneuvers were performed by ground command, including successfully placing it into circular orbit.

Spacecraft and Subsystems

The Gemini spacecraft was a cone-shaped capsule consisting of two components, a reentry module and an adaptor module. The adaptor module made up the base of the spacecraft. It was a truncated cone 228.6 cm high, 304.8 cm in diameter at the base and 228.6 cm at the upper end where it attached to the base of the reentry module. The re-entry module consisted of a truncated cone which decreased in diameter from 228.6 cm at the base to 98.2 cm, topped by a short cylinder of the same diameter and then another truncated cone decreasing to a diameter of 74.6 cm at the flat top. The reentry module was 345.0 cm high, giving a total height of 573.6 cm for the Gemini spacecraft.

The adaptor module was an externally skinned, stringer framed structure, with magnesium stringers and an aluminum alloy frame. The adaptor was composed of two parts, an equipment section at the base and a retrorocket section at the top. The equipment section held fuel and propulsion systems and was isolated from the retrorocket section by a fiber-glass sandwich honeycomb blast shield. The retrorocket section held the re-entry rockets for the capsule.

The reentry module consisted mainly of the pressurized cabin which held the two Gemini astronauts. Separating the reentry module from the retrorocket section of the adaptor at its base was a curved silicone elastomer ablative heat shield. The module was composed predominantly of titanium and nickle-alloy with beryllium shingles. At the narrow top of the module was the cylindrical reentry control system section and above this the rendezvous and recovery section which holds the reentry parachutes. The cabin held two seats equipped with emergency ejection devices, instrument panels, life support equipment, and equipment stowage compartments in a total pressurized volume of about 2.25 cubic meters. Two large hatches with small windows could be opened outward, one positioned above each seat.

Control, Propulsion, and Power

Attitude control was effected by two translation-maneuver hand controllers, an attitude controller, redundant

horizon sensor sytems, and reentry control electronics, with guidance provided via an inertial measuring unit and radar system. The orbital attitude and maneuver system used a hypergolic propellant combination of monomethylhydrazine and nitrogen tetroxide supplied to the engines by a helium system pressurized at 2800 psi. Two 95 lb translation thrusters and eight 23 lb attitude thrusters were mounted along the bottom rim of the adaptor, and two 79 lb and 4 95 lb thrusters were mounted at the front of the adaptor. Power was supplied by a fuel cell power system to a 22- to 30-volt DC two-wire system. During reentry and post-landing power was supplied by four 45 amp-hr silver-zinc batteries.

Communications

Voice communications were performed at 296.9 MHz with an output power of 3 W. A backup transmitter-receiver at 15.016 MHz with an output power of 5 W was also available. Two antenna systems consisting of quarter-wave monopoles were used. Telemetry was transmitted via three systems, one for real time telemetry, one for recorder playback, and a spare. Each system was frequency-modulated with a minimum power of 2 W. Spacecraft tracking consisted of two C-band radar transponders and an acquisition-aid beacon. One transponder is mounted in the adaptor with a peak power output of 600 W to a slot antenna on the bottom of the adaptor. The other is in the reentry section, delivering 1000 W to three helical antennas mounted at 120 degree intervals just forward of the hatches. The acquisition-aid beacon was mounted on the adaptor and had a power of 250 mW.

Reentry

At the time of reentry, the spacecraft would be maneuvered to the appropriate orientation and equipment adaptor section would be detached and jettisoned, exposing the retrorocket module. The retrorockets consisted of four spherical-case polysulfide ammonium perchlorate solid-propellant motors mounted near the center of the reentry adaptor module, each with 11,070 N thrust. They would fire to initiate the spacecraft reentry into the atmosphere, with attitude being maintained by a reentry control system of 16 engines, each with 5.2 N thrust. The retrorocket module would then be jettisonned, exposing the heat shield at the base of the reentry module. Along with the ablative heat shield, thermal protection during reentry was provided by thin Rene 41 radiative shingles at the base of the module and beryllium shingles at the top. Beneath the shingles was a layer of MIN-K insulation and thermoflex blankets. At an altitude of roughly 15,000 meters the astronauts would deploy a 2.4 meter drogue chute from the rendezvous and recovery section. At 3230 meters altitude the crew releases the drogue which extracts the 5.5 meter pilot parachute. The rendezvous and recovery section is released 2.5 seconds later, deploying the 25.6 meter main ring-sail parachute which is stored in the bottom of the section. The spacecraft is then rotated from a nose-up to a 35 degree angle for water landing. At this point a recovery beacon is activated, transmitting via an HF whip antenna mounted near the front of the reentry module.

Gemini Program

The Gemini program was designed as a bridge between the Mercury and Apollo programs, primarily to test equipment and mission procedures in Earth orbit and to train astronauts and ground crews for future Apollo missions. The general objectives of the program included: long duration flights in excess of of the requirements of a lunar landing mission; rendezvous and docking of two vehicles in Earth orbit; the development of operational proficiency of both flight and ground crews; the conduct of experiments in space; extravehicular operations; active control of reentry flight path to achieve a precise landing point; and onboard

orbital navigation. Each Gemini mission carried two astronauts into Earth orbit for periods ranging from 5 hours to 14 days. The program consisted of 10 crewed launches, 2 uncrewed launches, and 7 target vehicles, at a total cost of approximately 1,280 million dollars.

Alternate Names

- 02105

Facts in Brief

Launch Date: 1966-03-16
Launch Vehicle: Titan II
Launch Site: Cape Canaveral, United States
Mass: 3789.0 kg

Funding Agency

- NASA-Office of Manned Space Flight (United States)

Disciplines

- Astronomy
- Earth Science
- Human Crew
- Life Science
- Planetary Science
- Space Physics

Additional Information

- Launch/Orbital information for Gemini 8

- Experiments on Gemini 8
- Data collections from Gemini 8

Questions or comments about this spacecraft can be directed to: Dr. David R. Williams.

Personnel

Name	Role	Original Affiliation	E-mail

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Dr. William C. Schneider	Project Manager	NASA Headquarters	

Selected References

Gemini summary conference, NASA, SP-138, Wash, DC, Feb. 1967.

Zeitler, E. O., and T. G. Rogers, Gemini program - physical sciences experiments summary, NASA-MSC, TM-X-58075, Houston, TX, Sept. 1971.

Grimwood, J. M., *et al*., Project Gemini technology and operations - A chronology, NASA, NASA SP-4002, Wash., DC, 1969.

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- NASA Official: Dr. Ed Grayzeck
- Curator: E. Bell, II
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