

1968

93)

Surveyor 7

Nation: U.S. (43)

Objective(s): lunar soft-landing

Spacecraft: Surveyor-G

Spacecraft Mass: 1,040.1 kg

Mission Design and Management: NASA JPL

Launch Vehicle: Atlas-Centaur (AC-15 / Atlas 3C no. 5903C / Centaur D-1A)

Launch Date and Time: 7 January 1968 / 06:30:00 UT

Launch Site: ETR / launch complex 36A

Scientific Instruments:

- 1) imaging system
- 2) alpha-scattering instrument
- 3) surface sampler
- 4) footpad magnet

Results: Since Surveyors 1, 3, 5, and 6 successfully fulfilled requirements in support of Apollo, NASA opted to use the last remaining Surveyor for a purely scientific mission outside of exploring a potential landing site for the early Apollo flights. After an uneventful coast to the Moon, Surveyor 7 successfully set down at 01:05:36 UT on 10 January 1968 on the ejecta blanket emanating from the bright Tycho crater in the south of the near side. Landing coordinates were 40.86° south latitude and 11.47° west longitude, about 29 kilometers north of Tycho's rim and 2.4 kilometers from the craft's target. Initial photos from the surface showed surprisingly

few craters, much like the mare sites, although the general area was rougher. About 21 hours after landing, ground controllers fired a pyrotechnic charge to drop the alpha-scattering instrument on the lunar surface. When the instrument failed to move, controllers used the robot arm to force it down. The scoop on the arm was used numerous times for picking up soil, digging trenches, and conducting at least sixteen surface-bearing tests. Apart from taking 21,274 photographs (many of them in stereo), Surveyor 7 also served as a target for Earth-based lasers (of 1-watt power) to accurately measure the distance between Earth and the Moon. Although it was successfully reactivated after the lunar night, Surveyor 7 finally shut down on 21 February 1968. In total, the five successful Surveyors returned more than 87,000 photos of the lunar surface and demonstrated the feasibility of soft-landing a spacecraft on the lunar surface.

94)

no name / [Luna]

Nation: USSR (51)

Objective(s): lunar orbit

Spacecraft: Ye-6LS (no. 112)

Spacecraft Mass: unknown

Mission Design and Management: GSMZ

Lavochkin

Launch Vehicle: 8K78M (no. Ya716-57)

Launch Date and Time: 7 February 1968 / 10:43:54 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments: unknown

Results: During launch to Earth orbit, the third-stage engine cut off prematurely because of an excessive propellant consumption rate via the gas generator. The spacecraft never reached Earth orbit. The goal of the mission was evidently to test communications systems in support of the N1-L3 human lunar landing program.

95)

Zond 4

Nation: USSR (52)

Objective(s): deep space mission

Spacecraft: 7K-L1 (no. 6L)

Spacecraft Mass: c. 5,375 kg

Mission Design and Management: TsKBEM

Launch Vehicle: 8K82K + Blok D (Proton-K no. 232-01)

Launch Date and Time: 2 March 1968 / 18:29:23 UT

Launch Site: NIIP-5 / launch site 81L

Scientific Instruments: unknown

Results: The Soviets decided to send this next 7K-L1 spacecraft, not on a circumlunar flight, but to about 330,000 kilometers into deep space in the opposite direction of the Moon in order to test the main spacecraft systems without the perturbing effects of the Moon (much like the Surveyor model test flights in 1965 and 1966). The spacecraft was successfully boosted on its trajectory and reached an apogee of 354,000 kilometers. During the flight, although a key attitude-control sensor worked only intermittently, controllers managed to aim the spacecraft for a guided reentry back into Earth's atmosphere. Unfortunately, the same sensor failed at reentry, preventing the vehicle from maintaining stable orientation. Instead, Zond 4 began to carry out a direct ballistic reentry for landing in the Indian Ocean. An emergency destruct system, however, destroyed the returning capsule over the Gulf of Guinea to prevent foreign observers from recovering the wayward spacecraft.

96)

Luna 14

Nation: USSR (53)

Objective(s): lunar orbit

Spacecraft: Ye-6LS (no. 113)

Spacecraft Mass: unknown

Mission Design and Management: GSMZ Lavochkin

Launch Vehicle: 8K78M (no. Ya716-58)

Launch Date and Time: 7 April 1968 / 10:09:32 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments: unknown

Results: Luna 14 successfully entered lunar orbit at 19:25 UT on 10 April 1968. Initial orbital parameters were 160 x 870 kilometers at 42° inclination. The primary goal of the flight was to test communications systems in support of the N1-L3 piloted lunar landing project. Ground tracking of the spacecraft's orbit also allowed controllers to accurately map lunar gravitational anomalies in order to predict trajectories of future lunar missions such as those of the LOK and LK lunar landing vehicles. Luna 14 also carried scientific instruments to study cosmic rays and charged particles from the Sun, although few details have been revealed.

97)

no name / [Zond]

Nation: USSR (54)

Objective(s): circumlunar flight

Spacecraft: 7K-L1 (no. 7L)

Spacecraft Mass: c. 5,375 kg

Mission Design and Management: TsKBEM

Launch Vehicle: 8K82K + Blok D (Proton K no. 232-01 / Blok D no. 15L)

Launch Date and Time: 22 April 1968 / 23:01:27 UT

Launch Site: NIIP-5 / launch site 81P

Scientific Instruments: unknown

Results: During this third attempt at a circumlunar mission, the Proton rocket's second-stage engine spuriously shut down at T+194.64 seconds due to an erroneous signal from the payload. The emergency rescue system was activated, and the 7K-L1 capsule was later recovered about 520 kilometers from the launch pad.

98)

Zond 5

Nation: USSR (55)

Objective(s): circumlunar flight

Spacecraft: 7K-L1 (no. 9L)

Spacecraft Mass: c. 5,375 kg

Mission Design and Management: TsKBEM

Launch Vehicle: 8K82K + Blok D upper stage
(Proton-K no. 234-01 / Blok D no. 17)

Launch Date and Time: 14 September 1968 /
21:42:11 UT

Launch Site: NIIP-5 / launch site 81L

Scientific Instruments:

- 1) biological payload
- 2) radiation detectors
- 3) imaging system

Results: Zond 5 was the first Soviet spacecraft to complete a successful circumlunar mission—after three failures. During the flight to the Moon, the main stellar attitude control sensor failed due to contamination of the sensor's optical surface. Controllers used less accurate backup sensors to perform two mid-course corrections. The spacecraft successfully circled around the far side of the Moon at a range of 1,950 kilometers on 18 September, taking high-resolution photos of the Moon and Earth. On the return leg of the flight, a second attitude-control sensor failed and the spacecraft's three-axis stabilization platform switched off the guided reentry system. As a result, Zond 5 performed a direct ballistic reentry (instead of a guided one) and splashed down safely in the backup target area in the Indian Ocean at 32°38' south latitude and 65°33' east longitude, about 105 kilometers from the nearest Soviet tracking ship. Landing time was 16:08 UT on 21 September. Zond 5 carried an extensive biological payload including two steppe tortoises to measure the effects of circumlunar flight. The tortoises survived the trip and were returned to Moscow.

99)

Pioneer 9

Nation: U.S. (44)

Objective(s): solar orbit

Spacecraft: Pioneer-D

Spacecraft Mass: 65.36 kg

Mission Design and Management: NASA ARC

Launch Vehicle: Thor-Delta E-1 (no. 60 / Thor no. 479 / DSV-3E)

Launch Date and Time: 8 November 1968 /
09:46:29 UT

Launch Site: ETR / launch complex 17B

Scientific Instruments:

- 1) triaxial fluxgate magnetometer
- 2) plasma analyzer
- 3) cosmic-ray-anisotropy detector

- 4) cosmic-ray gradient detector
- 5) radio wave propagation experiment
- 6) electric field detector
- 7) cosmic dust detector
- 8) celestial mechanics experiment

Results: Pioneer 9 was the fourth in a series of probes designed to study interplanetary space from heliocentric orbit. In its 297.5-day orbit at 0.75 x 1.0 AU, the cylindrical, spin-stabilized spacecraft obtained valuable data on the properties of the solar wind, cosmic rays, and interplanetary magnetic fields. The Delta launch vehicle also carried the Test and Training Satellite (TETR-B), which was put into Earth orbit to test ground-based communications systems in support of the Apollo program. NASA maintained contact with Pioneer 9 until 19 May 1983. Subsequent attempts to use Search for Extraterrestrial Intelligence (SETI) equipment to establish contact with the probe on 3 March 1987 failed, and the Agency officially declared the spacecraft inactive.

100)

Zond 6

Nation: USSR (56)

Objective(s): circumlunar flight

Spacecraft: 7K-L1 (no. 12L)

Spacecraft Mass: c. 5,375 kg

Mission Design and Management: TsKBEM

Launch Vehicle: 8K82K + Blok D (Proton-K no. 235-01 / Blok D no. 19)

Launch Date and Time: 10 November 1968 /
19:11:31 UT

Launch Site: NIIP-5 / launch site 81L

Scientific Instruments:

- 1) biological payload
- 2) radiation detectors
- 3) imaging system
- 4) photo-emulsion camera
- 5) micrometeoroid detector

Results: Zond 6 was the second spacecraft that the Soviets sent around the Moon. Soon after translunar injection, ground controllers discovered that the vehicle's high-gain antenna had failed to deploy. Given that the main attitude-control sensor was installed on the antenna boom, controllers had to make plans to use a backup sensor for further attitude control. The spacecraft circled the far side of the Moon at a range of 2,420 kilometers, once again taking black-and-white photographs of

the Moon. During the return flight, temperatures in a hydrogen peroxide tank for the attitude-control thrusters dropped far below acceptable levels. Engineers attempted to heat the tank by direct sunlight, but as they later discovered, such a procedure affected the weak pressurization seal of the main hatch and led to slow decompression of the main capsule. Despite the failures, Zond 6

successfully carried a fully automated guided reentry into the primary landing zone in Kazakhstan. A radio altimeter, not designed for work in depressurized spacecraft, issued an incorrect command to jettison the main parachutes. As a result, the spacecraft plummeted to the ground and was destroyed. Although the main biological payload was lost, rescuers salvaged film from the cameras.