



Deep Space Chronicle:

1958–2000

1958

1)

Able 1 / "Pioneer 0"

Nation: U.S. (1)

Objective(s): lunar orbit

Spacecraft: Able 1

Spacecraft Mass: 38 kg

Mission Design and Management: USAF / BMD

Launch Vehicle: Thor-Able 1 (Thor no. 127)

Launch Date and Time: 17 August 1958 / 12:18 UT

Launch Site: ETR / launch complex 17A

Scientific Instruments:

- 1) magnetometer
- 2) micrometeoroid detector
- 3) temperature sensors
- 4) infrared camera

Results: This mission was the first of two U.S. Air Force (USAF) launches to the Moon and the first attempted deep space launch by any country. The Able 1 spacecraft, a squat, conical, fiberglass structure, carried a crude infrared TV scanner. This device was a simple thermal radiation device comprising a small parabolic mirror for focusing reflected light from the lunar surface onto a cell that would transmit voltage proportional to the light it received. Engineers painted a pattern of dark and light stripes on the spacecraft's outer surface to regulate internal temperature. The spacecraft was also disinfected with ultraviolet light prior to launch. According to the ideal mission profile, Able 1 was designed to reach the Moon 2.6 days after launch; then the

TX-8-6 solid propellant motor would fire to insert the vehicle into orbit around the Moon. Altitude would have been 29,000 kilometers with an optimal lifetime of about two weeks. The actual mission, however, lasted only 77 seconds after the Thor first stage exploded at 15.2 kilometers altitude. The upper stages hit the Atlantic about 123 seconds later. Investigators concluded that the accident had been caused by a turbopump gearbox failure. The mission has been retroactively known as "Pioneer 0."

2)

no name / [Luna]

Nation: USSR (1)

Objective(s): lunar impact

Spacecraft: Ye-1 (no. 1)

Spacecraft Mass: c. 360 kg (with upper stage)

Mission Design and Management: OKB-1

Launch Vehicle: 8K72 (no. B1-3)

Launch Date and Time: 23 September 1958 / 09:03:23 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments:

- 1) three-component magnetometer
- 2) two gas discharge counters
- 3) piezoelectric detector
- 4) scintillation counter
- 5) ion traps

Results: The Soviet government approved a modest plan for initial exploration of the

Moon in March 1958. Engineers conceived of four initial probes, the Ye-1 (for lunar impact), Ye-2 (to photograph the far side of the Moon), Ye-3 (to photograph the far side of the Moon), and Ye-4 (for lunar impact with a nuclear explosion). The Ye-1 was a simple probe, a pressurized spherical object made from aluminum-magnesium alloy, approximately the size of the first Sputnik, that carried five scientific instruments. The goals of the mission were to study the gas component of interplanetary matter (using the proton traps), meteoric particles and photons in cosmic radiation (using the piezoelectric detectors), the magnetic fields of the Moon and Earth (using the magnetometer), variations in cosmic ray intensity, and heavy nuclei in primary cosmic radiation. The probe (on its upper stage) also carried one kilogram of sodium to create an artificial comet on the outbound trajectory that could be photographed from Earth. During the first Ye-1 launch, the booster developed longitudinal resonant vibrations on the strap-on boosters of the launch vehicle. The rocket eventually disintegrated at T+93 seconds, destroying its payload.

3)

Able 2 / "Pioneer 1"

Nation: U.S. (2)

Objective(s): lunar orbit

Spacecraft: Able 2

Spacecraft Mass: 38.3 kg

Mission Design and Management: AFBMD / NASA

Launch Vehicle: Thor-Able I (no. 1 / Thor no. 130 / DM-1812-6)

Launch Date and Time: 11 October 1958 / 08 42:13 UT

Launch Site: ETR / launch complex 17A

Scientific Instruments:

- 1) ionization chamber
- 2) magnetometer
- 3) micrometeoroid detector
- 4) NOTS infrared imaging system
- 5) temperature sensor

Results: Although the USAF actually conducted the mission, this was the first U.S. space mission under the aegis of the recently formed National Aeronautics and Space Administration (NASA). The spacecraft was very similar in design to the Able 1 probe.

During the mission, the Thor second stage shut down 10 seconds early due to incorrect information from an accelerometer measuring incremental velocity. The launch vehicle thus imparted insufficient velocity for the probe to escape the Earth's gravity. An attempt to insert the spacecraft into high-Earth orbit at 128,700 x 32,200 kilometers by using its retromotor failed because internal temperatures had fallen too much for the batteries to provide adequate power. The probe did, however, reach an altitude of 115,400 kilometers by 11:42 UT, verifying the existence of the Van Allen belts and returning other useful data before reentering 43 hours 17 minutes after launch. Investigators later concluded that an accelerometer had mistakenly cut off the Able stage because of an incorrect setting of a valve. The mission has been retroactively known as "Pioneer 1."

4)

no name / [Luna]

Nation: USSR (2)

Objective(s): lunar impact

Spacecraft: Ye-1 (no. 2)

Spacecraft Mass: c. 360 kg (with upper stage)

Mission Design and Management: OKB-1

Launch Vehicle: 8K72 (no. B1-4)

Launch Date and Time: 11 October 1958 / 23:41:58 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments:

- 1) three-component magnetometer
- 2) two gas-discharge counters
- 3) piezoelectric detector
- 4) scintillation counter
- 5) ion traps

Results: The second attempt to impact the Moon failed when, again, the probe never left Earth's atmosphere. The launch vehicle exploded at T+104 seconds due to longitudinal resonant vibrations in the strap-on boosters.

5)

Pioneer 2

Nation: U.S. (3)

Objective(s): lunar orbit

Spacecraft: Able 3

Spacecraft Mass: 39.6 kg

Mission Design and Management: USAF BMD / NASA

Launch Vehicle: Thor-Able I (no. 2 / Thor no. 129 / DM-1812-6)

Launch Date and Time: 8 November 1958 / 07:30 UT

Launch Site: ETR / launch complex 17A

Scientific Instruments:

- 1) ionization chamber
- 2) magnetometer
- 3) temperature sensor
- 4) micrometeoroid sensor
- 5) proportional counter
- 6) imaging system

Results: For this third Air Force launch of a lunar orbiter, engineers introduced a number of changes to the Thor-Able launcher. The probe included a new TV scanner and a new type of battery, as well as a new cosmic-ray telescope to study the Cherenkov Effect. Pioneer 2, like its predecessors, never reached its target. A signal from the ground shut down the Thor launch vehicle's stage 2 earlier than planned. Additionally, when the X-248 third-stage engine separated, it failed to fire. As a result, the probe burned up in Earth's atmosphere only 45 minutes after launch. During its brief mission, it reached an altitude of 1,550 kilometers and sent back data that suggested that Earth's equatorial region had higher flux and energy levels than previously thought. The information also indicated that micrometeoroid density was higher near Earth than in space. Investigators concluded that the third-stage engine had failed to fire because of a broken wire.

6)

no name / [Luna]

Nation: USSR (3)

Objective(s): lunar impact

Spacecraft: Ye-1 (no. 3)

Spacecraft Mass: c. 360 kg (with upper stage)

Mission Design and Management: OKB-1

Launch Vehicle: 8K72 (no. B1-5)

Launch Date and Time: 4 December 1958 / 18:18:44 UT

Launch Site: NIIP-5 / launch site 1

Scientific Instruments:

- 1) three-component magnetometer
- 2) two gas-discharge counters
- 3) piezoelectric detector
- 4) scintillation counter
- 5) ion traps

Results: This mission was the third failure in a row in Soviet attempts to send a Ye-1 lunar impact probe to the Moon. The thrust level of the core engine of the R-7 booster dropped abruptly at T+245 seconds, leading eventually to premature engine cutoff. The payload never reached escape velocity. Later investigation showed that a pressurized seal cooling in the hydrogen peroxide pump of the main engine had lost integrity in vacuum conditions. The malfunction caused the main turbine to cease working and thus led to engine failure.

7)

Pioneer 3

Nation: U.S. (4)

Objective(s): lunar flyby

Spacecraft: N/A

Spacecraft Mass: 5.87 kg

Mission Design and Management: NASA / ABMA / JPL

Launch Vehicle: Juno II (no. AM-11)

Launch Date and Time: 6 December 1958 / 05:44:52 UT

Launch Site: ETR / launch complex 5

Scientific Instruments:

- 1) photoelectric sensor trigger
- 2) two Geiger-Mueller counters

Results: This mission was the first of two U.S. Army launches to the Moon. Pioneer 3 was a spin-stabilized probe (up to 700 rpm) whose primary goal was to fly by the Moon. Two special 0.21-ounce weights were to spin out on 1.5-meter wires and reduce spin to 12 rpm once the mission was under way. The spacecraft carried an optical sensor to test a future imaging system. If the sensor received, from a source such as the Moon, a collimated beam of light that was wide enough to pass through a lens and fall simultaneously on two photocells, then the sensor would send a signal to switch on an imaging system (not carried on this spacecraft). In the event, the main booster engine shut down 4 seconds earlier than planned due to propellant depletion. Once put on its trajectory, Pioneer 3 was about 1,030 kilometers per hour short of escape velocity. It eventually reached 102,322 kilometers and burned up over Africa 38 hours 6 minutes after launch. The spacecraft contributed to the major scientific discovery of dual bands of radiation around Earth.