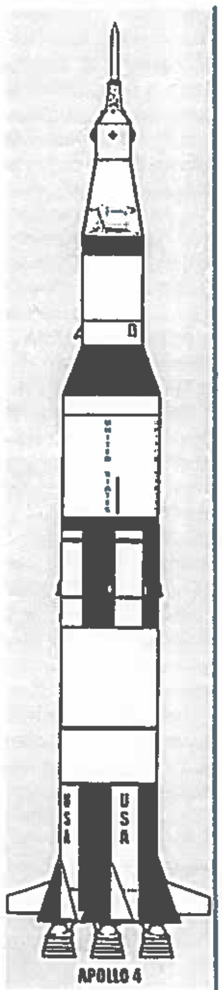
APOLLO 4 (AS-501) FLIGHT SUMMARY

GENERAL
Spacecraft: CSM-107, LTA-10R
Launch Vehicle: SA-501
Launch Complex: 39A
Launch Time: 7:00:00 a.m. EST, November 9, 1967
Launch Azimuth: 72°
Apogee: 9767 NM
Perigee: 100 NM
Revolutions: 3
Mission Duration: 8 hrs 37 mins 08 secs
Time of Landing: 3:38:09 p.m. EST, November 9, 1967

SPACE VEHICLE AND PRE-LAUNCH DATA
Spacecraft delivered to KSC:
Command/service module: Dec. 1966
Lunar module test article: Sept. 1966
Launch vehicle delivered to KSC:
First stage (S-IC): September 1966
Second stage (S-II): January 1967
Third stage (S-IVB): August 1966
Instrument unit (IU): August 1966
Spacecraft weight at liftoff: 93,700 lb.
Space vehicle weight at liftoff: 6,121,466 lb.



MISSION PRIMARY OBJECTIVES
(All Objectives Accomplished)
1. Demonstrate the structural and thermal integrity and compatibility of the launch vehicle and spacecraft. Confirm launch loads and dynamic characteristics.
2. Demonstrate separation of:
a) S-II from S-IC (dual plane).
b) S-IVB from S-II.
3. Verify operation of the following subsystems:
a) Launch vehicle: propulsion (including S-IVB restart), guidance and control, and electrical system.
b) Spacecraft: CM heat shield, (adequacy of Block II design for entry at lunar return conditions); and selected subsystems.
4. Evaluate performance of the space vehicle EDS in an open-loop configuration.
5. Demonstrate mission support facilities and operations required for launch, mission conduct, and CM recovery.

DETAILED TEST OBJECTIVES PRINCIPAL OBJECTIVES
Launch Vehicle:
1. Demonstrate the S-IVB stage restart capability.
2. Demonstrate the adequacy of the S-IVB continuous vent system while in earth orbit.
3. Demonstrate the capability of the S-IVB auxiliary propulsion system during S-IVB-powered flight and orbital coast periods to maintain attitude control and perform required maneuvers.
4. Demonstrate the S-IVB stage propulsion system, including the propellant management systems, and determine inflight performance parameters.
5. Demonstrate the S-II stage propulsion system, including programmed mixture ratio shift and the propellant management system, and determine inflight performance parameters.
6. Demonstrate the S-IC stage propulsion system, and determine inflight system performance parameters.
7. Demonstrate S-IC/S-II dual plane separation.
8. Demonstrate S-II/S-IVB separation.
9. Demonstrate the mission support capability required for launch and mission operations to high post injection altitudes.
10. Demonstrate structural and thermal integrity of the launch vehicle throughout powered and coasting flight, and determine inflight structural loads and dynamic characteristics.
11. Determine inflight launch vehicle internal environment.
12. Demonstrate the launch vehicle guidance and control system during S-IC, S-II, and S-IVB powered flight; achieve guidance cutoff; and evaluate System accuracy.
13. Demonstrate launch vehicle sequencing system.
14. Evaluate the performance of the emergency detection system in an open-loop configuration.
15. Demonstrate compatibility of the launch vehicle and spacecraft.
16. Verify prelaunch and launch support equipment compatibility with launch vehicle and spacecraft Systems.

Spacecraft:
1. Verify operation of the guidance and navigation system after subjection to the Saturn V boost environment.
2. Verify operation of the guidance and navigation system in the space environment after S-IVB separation.
3. Verify operation of the guidance and navigation/SCS during entry and recovery.
4. Gather data on the effects of a long duration SPS burn on spacecraft stability.
5. Demonstrate SPS no-ullage start.
6. Determine performance of the SPS during a long duration burn.
7. Verify operation of the CM RCS during entry and throughout the mission.
8. Verify operation of the heat rejection system throughout the mission.
9. Verify operation of the EPS after being subjected to the Saturn V launch environment.
10. Verify operation of the primary guidance system (PGS) after being subjected to the Saturn V launch environment.
11. Verify operation of the EPS in the space environment after S-IVB separation.
12. Verify operation of the PGS in the space environment after S-IVB separation.
13. Verify operation of the EPS during entry and recovery.
14. Demonstrate the performance of CSM/MSFN S-band communications.
15. Demonstrate satisfactory operation of CSM communication subsystem using the Block II-type VHF omnidirectional antennas.
16. Obtain data via CSM-ARIA communications.
17. Demonstrate CSM/ SLA/ LTA/ Saturn V structural compatibility and determine spacecraft loads in a Saturn V launch environment.
18. Determine the dynamic and thermal responses of the SLA/CSM structure in the Saturn V launch environment.
19. Evaluate the thermal and structural performance of the Block II thermal protection system, including effects of cold soak and maximum thermal gradient when subjected to the combination of a high heat load and a high heating rate representative of lunar return entry.
20. Verify the performance of the SM RCS thermal control subsystem and engine thermal response in the deep space environment.
21. Verify the thermal design adequacy of the CM RCS thrusters and extensions during simulated lunar return entry.
22. Evaluate the thermal performance of a gap and seal configuration simulating the unified crew hatch design, for heating conditions anticipated during lunar return entry.
23. Perform flight test of low density ablator panels.
24. Determine the force inputs to the simulated LM from the SLA at the spacecraft attachment structure in a Saturn V launch environment.
25. Obtain data on the acoustic and thermal environment of the SLA/simulated LM interface during a Saturn V launch.
26. Obtain data on the temperature of the simulated LM skin during launch.
27. Determine vibration response of LM descent stage engine and propellant tanks in a Saturn V launch environment.
28. Evaluate the performance of the spacecraft emergency detection system in the open-loop configuration.
29. Verify operation of the ELS during entry and recovery.
30. Measure the integrated skin and depth radiation dose within the CM up to an altitude of at least 2000 NM.
31. Determine the radiation shielding effectiveness of the command module.
32. Determine and display, in real time, Van Allen Belt radiation dose data at the Mission Control Center.
33. Obtain motion pictures for study of entry horizon reference, boost protective cover jettison, and orbit insertion; obtain photographs for earth landmark identification.

SECONDARY OBJECTIVES
Launch Vehicle:
1. Determine launch vehicle-powered flight external environment.
2. Determine attenuation effects of exhaust flames on RF radiating and receiving systems during main engine, retro and ullage motor firings.

UNUSUAL FEATURES OF THE MISSION
1. First launch from LC-39.
2. First flight of Saturn V vehicle.
3. First flight of S-IC stage.
4. First flight of S-II stage.
5. First flight of a lunar module test article (LTA).
6. First orbital restart of S-IVB.
7. First SPS no-ullage start.
8. First simulated Block II heat shield.
9. First lunar return velocity CM reentry.

10. First command and communication system flight test.
11. First use of Apollo Range Instrumentation Aircraft (ARIA).
12. First use of Apollo-configured ships.

Spacecraft differences from previous Block I flights:

* The EDS system operated in open-loop configuration.
* Block II thickness, thermal coating, and manufacturing technique for the CM heat shield ablator was used.
* A simulated Block II umbilical was added on CM in addition to active Block I umbilical.
* An Apollo Mission Control Programmer with special interface equipment for operation with CSM subsystems was installed in CM in place of crew couches.
* All S-band transmissions and receptions were performed by four S-band omnidirectional antennas modified to reflect Block II configuration.
* Flight qualification tape recorder and associated equipment for R&D measurements were added.
* Couches, crew restraints, crew provisions, instrument panel (partial), SCS (partial), and ECS (partial) were deleted from Block I configuration.
* CM hatch window was replaced with instrumentation test panel containing simulations of flexible thermal seals designed for the developmental quick operating hatches.
* Selected ECS water-glycol joints were armor-plated to evaluate their behavior during a space vehicle launch.
* The CM cabin was filled with gaseous nitrogen (GN2). at liftoff to preclude the possibility of cabin fire.
* CM underwent extensive inspection and rework of its wiring to provide better wiring protection. The lunar module test article (LTA-10R) was a "boilerplate" LM test article instrumented to measure vibration, acoustics, and structural integrity at 36 points in the spacecraft-LM adapter (SLA). Data was telemetered to the ground stations during the first 12 minutes of flight. The LTA-10R used a flight-type descent stage without landing gear. Its propellant tanks were filled with water/ glycol and freon to simulate fuel and oxidizer, respectively. The ascent stage was a ballasted aluminum structure containing no flight systems.

Launch vehicle differences from lunar mission configuration:

* The second stage (S-II) did not have the light weight structure to be used for the lunar mission.
* The F-1 and J-2 engines were not uprated versions.
* The EDS system was in open-loop configuration.
* The O2H2 burner, used as helium heater on S-IVB, was not installed.

RECOVERY DATA
Recovery Area: Pacific Ocean
Landing Coordinates: 30°N, 172°W.
Recovery Ship: USS Bennington
Spacecraft Recovery Time: 5:52 p.m. EST, November 9, 1967