

APOLLO 5 MISSION

PUBLIC INFORMATION

QUICK REFERENCE INFORMATION

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All figures used in the mission portion of this reference are subject to change

1.1 MISSION PROFILE

Apollo 5 has as its primary purpose the launch and test of Lunar Module 1 in the program to man-rate the LM. The flight is unmanned and will be conducted in earth orbit. All subsystems will be installed, although not all will be operating, particularly those associated directly with flight crew support and lunar landings. The flight profile and tests are designed so that conditions similar to those expected during a lunar mission will be experienced. These conditions include LM staging and operation of the Descent Propulsion System (DPS) and the Ascent Propulsion System (APS).

Two DPS and two APS burns are planned. DPS burn No. 2 will simulate the powered lunar landing maneuver. This second maneuver will have essentially four phases: the first two will simulate the braking and approach, and the last two will consist of a pre-programmed random throttling profile and control of DPS shutdown with a subsequent fire-in-the-hole (FITH) APS burn, simulating an abort. The second APS maneuver will simulate a lunar launch profile with the exception that the general thrust direction will be essentially normal to the orbital plane. The primary mission will be satisfied after a flight duration of approximately $6\frac{1}{2}$ hours; however, data will be acquired for two additional revolutions.

1.2 TEST OBJECTIVES

- a. Evaluation of LM staging

b. Verification of the operation of the APS, DPS and structural subsystems.

c. Verification of uprated H-I engine performance.

1.3 LAUNCH VEHICLE AND SPACECRAFT

The uprated Saturn I will be the launch vehicle for Apollo 5. It consists of an S-IB first stage, and S-IV second stage and an Instrument Unit. The mission payload consists of the Lunar Module, and aerodynamic shield (nose cone), and a Spacecraft/LM Adapter (SLA).

1.4 MISSION FLIGHT PLAN

The LM-I spacecraft will be launched from Pad B, launch complex 37 on a launch azimuth of 72 degrees. Following lift-off, scheduled at 8 a.m. EDT, the S-I engines will burn for about $2\frac{1}{2}$ minutes, after which staging and S-IVB engine ignition will occur. The S-IVB engine will continue to operate until the spacecraft/S-IVB combination reaches orbital velocity. Orbital insertion will be into an 88 x 123 nautical mile (132 x 102 statute miles) orbit with a period of 88 minutes.

During the first revolution the nose cone will be jettisoned, the SLA panels will be deployed and the LM will be separated from the S-IVB/SLA combination, the separation occurring about 54 minutes after lift-off. The spacecraft will be allowed to coast for approximately 2 revolutions before the first DPS burn is initiated.

The first DPS burn will be performed during the third revolution near the Carnarvon tracking station. The burn will impart a delta V of approximately 160 ft/sec to the LM, resulting in an elliptical orbit of 118 nautical miles perigee. This orbit will place the LM in optimum position for Manned Space Flight Network tracking during the second DPS burn.

The second DPS burn will be performed during the latter part of the third revolution and first part of the fourth revolution. The duration of the burn will be approximately 12 minutes, and will impact a delta V of about 7,000 ft/sec to the LM, most of it out-of-plane to optimize MSFN coverage of the second APS burn. Upon completion of the burn, the LM will be in an orbit having a predicted apogee of 186 nautical miles, perigee of 168 nautical miles, and a period of 91 minutes.

The FITH abort test will be initiated immediately upon completion of the random throttling phase of the second DPS burn with simultaneous DPS shutdown, LM staging, and first APS ignition. Upon separation of the LM, the spent descent stage will have a maximum estimated lifetime of 47 days.

After a first APS burn of 5 seconds, the ascent stage will continue in orbital coast until near the end of the fourth revolution when the second APS burn will be initiated. The burn will last approximately 7 minutes, until APS propellant depletion, and will be directed largely out of the orbital plane. The orbit dimensions at the end of this burn are such that the spent stage will reenter within 12 days.

The spacecraft testing will be essentially complete at the end of the second APS maneuver; however, tracking by the MSFN will continue for an additional 2 revolutions to provide data for any additional spacecraft testing.

1.5 ABORTS AND ALTERNATE MISSIONS

In the event of a failure of either launch vehicle stage prior to orbital insertion, several courses of action are possible. The course of action will depend upon the nature of the failure and the point in the launch trajectory at which the failure occurs. In all possible cases, action will be directed toward achieving at least the minimum mission objectives.

Since no Launch Escape System is installed on LM-1, no abort action which will accomplish mission objectives can be taken during the early powered-flight regime. In this regime, abort action is primarily intended to minimize hazards to personnel and property, and one of two courses of abort action would be taken:

- a. If the possibility exists that the launch vehicle/spacecraft could fall on land, the Range Safety Officer (RSO) would destruct the assembly.
- b. After the projected impact point has passed beyond the coast line, and prior to 2 minutes 44 seconds g.e.t., the assembly would be allowed to free fall without requiring destruct action.

Prior to staging at 2:25 g.e.t., the assembly will consist of the complete launch vehicle and spacecraft; after staging, the assembly will consist of the S-IVB, Instrument Unit and spacecraft.

At 2:44 g.e.t., the dynamic pressure will have decreased so that the nose cone can be jettisoned, and the SLA panels opened to allow the LM to separate from the S-IVB. An abort after this time, with a successful separation of the LM from the S-IVB, is designed to permit a reduced LM propulsion sequence.

Beginning at 8:59 seconds g.e.t. the LM performance capability exists to achieve orbital insertion with a DPS burn of 500 seconds or less. This maximum burn duration insures that a second DPS ignition can be achieved for subsequent alternate mission.

1.6 LAUNCH WINDOW REQUIREMENTS

Since there is no recovery, there is no launch window requirements except those which are dictated by safety.

1.7 TURNAROUND FROM SCRUB

It is possible to delay the launch for 24 hours excluding built-in holds prior to lox loading. If the 24 hours have been expended at T-3 hours and the count is prior to LOX loading, the turnaround time is 30 hours. If the count reaches T-1 hour and the tanks are wet, the turnaround time is 48 hours. All times are from time of scrub to next T-0 excluding built-in holds.

1.8 WEATHER RESTRICTIONS

Launch of the LM-1 requires an 8,000 feet ceiling with 4 miles visibility. The critical wind direction is 65 degrees with a profile applicable to 30 kilometers altitude.

2.1 LUNAR MODULE CHARACTERISTICS

Dimensions (legs extended)

Overall height	22 ft. 11 in.
Overall width	14 ft. 1 in.
Diameter (diagonally across landing gear)	31 ft.
Ascent stage height	12 ft. 4 in.
Descent stage height	10 ft. 7 in.

General data (LM-1)

Earth launch weight	31,530 pounds
Ascent stage dry	4,613
RCS prop.	614
Ascent stage H ₂ O	82.4
Ascent stage Nitrogen	.02 (LOX tanks)
Ascent stage helium	13.0
RCS helium	2.1
Water glycol	35.4
Descent stage dry	3,353
Descent stage helium	48.1
Water glycol	1.7

USE PRESS KIT NUMBERS

2.2 LUNAR MODULE SUBSYSTEMS

Propulsion

Descent: throttleable, gimbale, hypergolic, ablative rocket engine; approximately 10:1 thrust range; 10,000 lb. thrust, max.

Ascent: hypergolic, ablative rocket engine; fixed (3500 lb.) thrust

Fuel: 50/50 hydrazine and UDMH (aerozine 50)

Oxidizer: nitrogen tetroxide

Reaction Control (RCS)

Sixteen, 100-lb-thrust, hypergolic, radiation-cooled rocket engines, deployed in four quads for control of rotation and translation in six degrees of freedom.

Two fully redundant systems from helium supply to engines, with propellant crossfeed capability and interconnect from ascent propellant supply

Fuel: 50/50 hydrazine and UDMH

Oxidizer: nitrogen tetroxide

Guidance & Navigation (G & N)

Primary: a complete closed-loop system containing an inertial platform, computer, optics, and displays; operates with landing and rendezvous radars

Abort Guidance: a three-axis, strapped-down, inertial system governed by a 4096-word-memory digital computer capable of abort and return only

Stabilization & Control (S & C)

Implements the thrust, translation, and attitude commands of the crew and G & N Subsystem, via the RCS and main Propulsion Subsystem

Communications

S-band (UHF) for transmission of PCM telemetry, TV, voice, emergency key, and range data between LM and earth

VHF linking LM and CM, and LM and astronaut on the lunar surface

EVA (Extravehicular Astronaut) link to earth, via VHF S-band relay

VHF telemetry from LM to CSM -- on far side of moon

Environmental Control (ECS)

Provides potable water, temperature- and pressure-controlled oxygen atmosphere in LM cabin and crew suits, and temperature control for LM equipment; supplies the portable life support system

Instrumentation

Monitors various quantities, such as temperature, pressure, voltage, current, and flow rates, for display and telemetry

Informs the crew of a system malfunction, via the Caution and Warning Subsystem

PCM telemetry converts data to digital form for S-band and VHF transmissions to keep ground stations informed of vehicle status

Electrical Power (EPS)

Six silver-zinc batteries (four descent, two ascent) provide 28-volt d-c power

Two inverters individually provide 115-volt 400-cycle power

Explosive Devices

Landing gear release/deployment

Separation of ascent and descent stages

Explosive Devices (Cont)

Helium pressurization of RCS and Propulsion Subsystem

Descent Propulsion Subsystem venting on the lunar surface

Controls & Displays

Integrates crew into the mission; permits the crew to take manual control action, protective or remedial action, and provides them with the knowledge to make a decision to continue, abbreviate, or abort the mission

Because of their prime importance, navigation and guidance readouts and data entry panel, propulsion, environmental control, flight control, and stabilization and control subsystems panels are either shared or duplicated at both crew stations

Only those parameters are displayed for which there are potential human responses (i.e., control action)

2.3 LUNAR MODULE MILESTONE EVENTS

June 23, 1967 -- LM-I arrived at KSC

July 11 -- First mate, ascent and descent engines

August 16 -- Demated -- change ascent engine. Leak repairs.

September 7 -- Remate

September 12-13 -- Mission simulation (plugs in test)

September 13-14 -- Polarity tests

September 15-17 -- Plugs out tests

September 19-20 -- Demate

September 22 -- LM hardware (tank, plumbing, etc) shipped to Bethpage for work

October 12 -- Descent stage in hypergolic test area for MDOP
(Maximum design operating pressure) test

October 28 -- Remate

October 30 -- Reverification

November 7 -- Rerun of mission simulation (plugs in)

November 10 -- Cabin leak tests

November 14 -- Pyrotechnic installation (several days) at integrated test area 2.

November 19 -- Mechanically mated with booster at LC 37.

3.1 APOLLO 5 LAUNCH VEHICLE (Up-rated Saturn I)

PHYSICAL CHARACTERISTICS

	Diameter	Height	Weight
Overall Vehicle		180.9 ft	156,600 lb (dry) 1,285,000 lb (approx) (total liftoff)
S-IB Stage	21.4 ft	78.0 ft	85,317 lb (dry)
S-IVB Stage	21.7 ft	60.6 ft	30,300 lb**
Instrument Unit	21.7 ft	3.00 ft	4,600 lb
Spacecraft L/M Adapter	21.7 ft (at max)	28.0	3,950 lb
Nose Cone	12.8 ft (at max)	11.3 ft	1,067 lb
Lunar Module (inside L/M adapter)			31,325 lb

**Including 6,654 lb aft interstage

PROPULSION SYSTEMS

S-IB Stage -- Eight bipropellant H-1 engines developing 1,600,000 lb thrust
RP-1 Fuel -- 271,000 lb (40,390 gal)
LOX -- 614,500 lb (64,550 gal)

S-IVB Stage -- One bipropellant J-2 engine developing 225,000 lb thrust (max)
LH₂ -- 35,000 lb (58,920 gal)
LOX -- 189,400 lb (19,850 gal)

CAPABILITY

S-IB Stage -- Operates approximately 2.4 minutes to reach an altitude of 38.1 miles at burnout.

S-IVB Stage -- Operates approximately 7.5 minutes to achieve orbital speed and altitude.

INSTRUMENT UNIT -- Supplies electronic commands for steering, engine ignition and cutoff, and staging operations.

PAYLOAD -- 36,300 lb in earth orbit.

3.2 LAUNCH VEHICLE HISTORY

Launch vehicle for Apollo 5 was originally scheduled to be used on first manned Apollo flight at Complex 34 in February, 1967. Subsequently launch vehicle was demated and reerected at LC 37 for Apollo 5 mission.

April 7 -- S-IB erection

April 10 -- S-IVB erection

April 11 -- IU erection

April 18 -- Facilities verification vehicle of LM was erected with SLA mated on vehicle -- for fit checks, etc. Stayed mated until June 8.

4.1 COMPLEX 37 FACILITIES

Complex 37 includes two launch pads separated by a 1,200 foot-long railway. Each launch pad has a launch pedestal, umbilical tower, and automatic ground control station. Both pads are served by a single service structure and launch control center.

The Launch Control Center is a two-story, dome-shaped building located approximately 1,200 feet from the launch pad. The dome, which provides blast protection in the event of a launch vehicle explosion, is constructed of reinforced concrete and varies in thickness from 7 feet at the top to 41 feet at the base. The building contains 20,968 square feet of space and is designed to withstand blast pressures of 2,188 pounds per square inch.

The first floor is used by personnel involved in tracking, telemetry and closed circuit television communications. Launch control and various monitoring recording consoles are located on the second floor.

a. The Launch Pads

The launch pads at Complex 37 are 300 feet square and have a maximum height of 16 feet above sea level. The pad areas are covered with fire brick to minimize erosion caused by first stage engine ignition. Located at each pad is a steel launch pedestal which provides a platform to support the launch vehicle and certain ground support equipment. Each pedestal is 35 feet high and 55 feet square. An opening in the center of the pedestal, 32 feet in diameter, allows

access to the first stage of the vehicle and permits passage of exhaust to the flame deflector below. Eight holddown arm assemblies are bolted around the opening in the top of the launch pedestal to support the vehicle. These holddown arms hold the vehicle on the pad until all engines are running with full thrust and then release the vehicle for flight.

There are three inverted V shaped flame deflectors, one at each pad and one held in reserve. Each is 21 feet high. They are constructed with a series of steel trusses covered with one-inch thick steel skin, and coated with four inches of special heat-resistant refractory material.

The two umbilical towers are approximately 1,200 feet apart. Each is a 268 foot-high steel-trussed structure. Four swing arms are attached to each tower by hinged joints. Each swing arm carries links between the space vehicle and umbilical tower which lead to ground-based power, air conditioning, hydraulic, pneumatic, fuel, measuring and command systems.

At the 228-foot level of the umbilical is the spacecraft access arm.

Mounted on the umbilical tower is a boom hoist capable of lifting $2\frac{1}{2}$ tons, equipped with a trolley that extends 27 feet from the boom pivot. An automatic ground control station, containing digital computers and checkout equipment, is located at the base of the tower.

The RP-1 storage tank is 67 feet long and 12 feet in diameter. It has a 43,500 gallon capacity; a fast-fill transfer rate of 2,000 gallons per minute,

and a slow fill rate of 200 gallons per minute. RP-1 is used in the vehicle's first stage.

Liquid oxygen is stored and transferred at -297 degrees F. The liquid oxygen facility includes a main tank and storage tank. The main tank has a 125,000 gallon capacity and measures 42 feet in diameter.

The replenish, or storage, tank is 62 feet long and 11 feet in diameter, with a 28,000 gallon capacity. LOX is transferred to the first stage at the rate of 2,500 gallons per minute; second stage transfer rate is 1,000 gallons per minute.

Liquid hydrogen is stored and transferred at -423 degrees. The fuel for the second stage of the Uprated Saturn I is stored in a 125,000 gallon tank which is 38 feet in diameter. Liquid nitrogen is stored in a 125,000 gallon tank and a 35,000 gallon tank.

Helium is stored in the Helium battery which consists of six clusters of vessels each manifolded together. Both the nitrogen and helium batteries supply gas at a pressure of 6,000 pounds per square inch.

b. The Service Structure

The 5,200-ton service structure at Complex 37 provides for vertical erection, assembly and checkout of uprated Saturn I vehicles. It contains work platforms for personnel, cranes for lifting rocket stages and spacecraft into place on the launch pedestal and provides protection from the weather for both the space vehicle and personnel.

The self-propelled service structure is mounted on four trucks that ride rails, and is driven by four 100-horsepower electric motors. The trapezoidal structure is of rigid-truss construction and extends to a height of 300 feet. The base of the service structure measures 120 feet.

There are four elevators in the service structure and a minimum of 10 work platforms at various levels. Each elevator has a 3,000-pound capacity. Access to the service platforms is from individually adjusted platform landings. Weather protection is provided by a hurricane curtain around the launch pedestal which extends from the 35-foot level to the 65-foot level, and split "silo" enclosures that reach to the 248-foot level.

At the launch pad, support points lift the service structure from the trucks and anchor it to the ground. Before the uprated Saturn I is launched, the service structure moves to its parking position at the opposite pad.

4.2 LAUNCH COMPLEX 37 HISTORY

Saturn I	SA-5	1/29/64	
Saturn I	SA-6	5/28/64	
Saturn I	SA-7	9/18/64	
Saturn I	SA-9	2/16/65	(Pegasus I)
Saturn I	SA-8	5/25/65	(Pegasus II)
Saturn I	SA-10	7/30/65	(Pegasus III)
Uprated Saturn I	AS-203	7/5/66	

(ALL LAUNCHES FROM PAD B)

Apollo 5

Personnel and Assignments (PIO)

John W. King (KSC)	Chief KSC Public Information operations and responsible for LCC commentary
Lindy B. Davis (KSC)	News Center Manager and Deputy for KSC Public Information operations
Gatha F. Cottee (KSC)	Communications support coordinator
Charles Hollinshead (KSC)	News Center/Press Site query desk
Mel Snyder (KSC)	Mission status/Industry liaison desk
Ed Harrison (KSC)	Audio-Visual coordinator
Wright Kerns (KSC)	Tours/Interview desk
Darleen Hunt (KSC)	Accreditation/Secretarial support
Diana Boles (KSC)	News Center Secretary
Linda Williams (KSC)	Secretarial support
Al Vela (LTV)	News media/tour escort
Jack Brown (LTV)	News media/tour escort

Reproduction
Room

Interview
Room

Audio Visual
Office

News Center
Manager

Info
Director

Registration

Accreditation

Secretary

Secretary

Secretary

MSC

Industry

MSFC

HQ

GFSC

Photo
Dist.

Query

Query

Interview

DOD

Travel

Kennedy Space Center
News Center

Apollo 5

Personnel Work Schedule (PIO)

	<u>T-3</u>	<u>T-2</u>	<u>T-1</u>	<u>L-Day</u>
King	8 am-4 pm	8 am-4pm	11 am-5pm	4 am-noon
Davis	7 am-7 pm	7 am-7 pm	7 am-noon 6 pm-10 pm	6 am-6 pm
Cottee	7 am-7 pm	7 am-7 pm	9 am-5 pm	midnight-noon
Hollinshead	7 am-7 pm	7 am-7 pm	7 am-4 pm	4 am-noon
Snyder	8 am-4 pm	8 am-4 pm	2 pm-11 pm	6 am-3 pm
Harrison	9 am-6 pm	9 am-6 pm	9 am-6 pm	6 am-2 pm
Kerns	8 am-4 pm	8 am-4 pm	11 pm-midnight	midnight-9
Hunt	9 am-5 pm	9am-5 pm	9 am-5 pm	7 am-3 pm
Boles	7 am-3 pm	7 am-3 pm	7 am-3 pm	6 am-2 pm
Williams	8 am-4 pm	8 am-4 pm	8 am-4 pm	7 am-3 pm
Vela	8 am-4 pm	8 am-4 pm	8 am-4 pm	6 am-2 pm
Brown	8 am-4 pm	8 am-4 pm	8 am-4 pm	6 am-2 pm