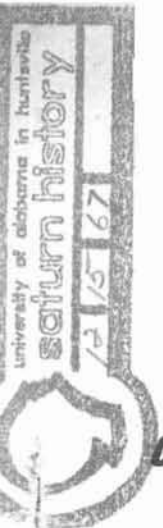


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TECHNICAL INFORMATION SUMMARY

APOLLO 5 (AS-204/LM-1)

APOLLO SATURN 1B FLIGHT VEHICLE

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



AS-204/LM-1

TECHNICAL INFORMATION

SUMMARY

This document is prepared jointly by the Marshall Space Flight Center Laboratories R-AERO-P, R-ASTR-S, and R-P&VE-VN. The document presents a brief and concise description of the AS-204/LM-1 Apollo Saturn Space Vehicle. Where necessary, for clarification, additional related information has been included.

It is not the intent of this document to completely define the Space Vehicle or its systems and subsystems in detail. The information presented herein, by text and sketches, describes launch preparation activities, launch facilities, and the space vehicle. This information permits the reader to follow the space vehicle sequence of events beginning a few hours prior to liftoff to its journey into space.

1. Mission Purpose:

The basic purpose of the AS-204/LM-1 mission is to launch and test an unmanned Lunar Module (LM) for verification of crew safety items and to verify the launch vehicle's systems performance in preparation for subsequent operational manned space vehicle missions.

2. Mission Objectives:

Mission Objectives Categories:

The objectives listing is according to the objective category (primary vs. secondary).

Primary Objectives - Are those which are mandatory. Malfunction of launch vehicle systems, ground equipment, or instrumentation which would result in failure to achieve these objectives will cause a "hold" or mission cancellation until the malfunction has been eliminated.

Secondary Objectives - Are those which are desirable but not mandatory. Malfunctions, which would result in failure to attain these objectives, may cause a hold or mission cancellation as indicated in the Mission Rules.

Mission Primary Objectives - AS-204/LM-1 - As listed in the Flight Mission Assignments Document:

- a. Verify operation of the following LM subsystems:
 - Ascent Propulsion System (APS).
 - Descent Propulsion System (DPS) (including restart).
 - Structure.
- b. Evaluate LM staging.
- c. Evaluate S-IVB/IU orbital performance.

Detailed LV Primary Objectives:

Evaluate S-IVB/IU orbital performance.

Specifically:

- a. Evaluate the LV attitude control and maneuvering capability.
- b. Verify the S-IVB LH₂ and LOX tank boiloff characteristics.
- c. Demonstrate nose cone separation from the S-IVB/IU/SLA.
- d. Evaluate the operational adequacy of the launch vehicle systems; including guidance and control, electrical, mechanical and instrumentation.

Launch Vehicle - Secondary Objectives:

- a. Evaluate S-IVB forward skirt in-flight panel flutter.
- b. Evaluate V-2 engine crossover duct temperature experiment.
- c. Evaluate S-IVB LH₂ and LOX propellant dump experiment.
- d. Evaluate Launch Vehicle orbital coast lifetime capability.

3. Mission Profile:

The Apollo Saturn-204/Lunar Module-1 will be launched at Cape Kennedy, Launch Complex 37, Pad B. Vehicle will be launched on a 90° E of N launch azimuth and will be rolled to a flight azimuth of 72° E of N by the launch vehicle control system based on signals from the control computer. The S-IB phase utilizes a preset time-tilt program to produce a gravity turn trajectory. Guidance commands, during the S-IVB portion of the ascent-to-orbit, will be generated in the Iterative Guidance Mode (IGM) which will navigate and guide the S-IVB/IU/SLA into an 85 x 120 nautical mile elliptical orbit. Insertion should occur 10 seconds after guidance cutoff or 602.26 seconds after liftoff.

Resulting Orbit will be:

Inclination --- 31.6143°
Period --- 88.2785 min.
Apogee --- 123 nautical miles
Perigee --- 88 nautical miles
Velocity --- 7828.77 m/sec.

Shortly after insertion the S-IVB attitude control system will execute maneuvers to place the longitudinal axis of the vehicle along the velocity vector and subsequently will maintain that attitude in an

orbital rate mode. The nose cone will be jettisoned and the SLA panels will be deployed after orbital insertion.

The LM will remain attached to the S-IVB/IU/SLA for approximately 45 minutes and the S-IVB/IU will provide attitude stabilization for LM separation.

Approximately 1 1/2 hours after LM separation a S-IVB LOX and LH₂ propellant dump experiment will be performed. This experiment will be completed approximately 4 1/2 hours after orbital insertion.

SA-204/LM-1 S-IVB LOX and LH₂ Propellant Removal Test

The propellant removal test on SA-204/LM-1 will dump LOX and LH₂ propellant through the J-2 engine on the second revolution over Australia during the cold soak of the LM.

At 1 hour and 36 minutes from liftoff, an on-board signal is given which enables this test.

The propellant test does not start for 49 minutes after the on-board signal is given. During this time, the test can be disabled by ground command if necessary.

In preparation for test, (approximately 2 hours and 20 minutes after liftoff), the S-IVB/IU will maneuver to a local vertical attitude - pitch 270°, SLA panels toward earth, yaw 0°, and roll 85°. In order to point the best portion of the IU antenna pattern toward the Carnarvon station, the S-IVB/IU will perform continuous roll during the Propellant Removal Test.

Shortly after 2 hours and 26 minutes into the mission the main-stage control valve in the J-2 engine will be opened and the LOX tank will vent through the engine for 2 minutes. This action will be followed immediately by a similar 3-minute vent of the LH₂ tank. Attitude control in pitch and yaw will be attempted by gimbaling the engine for the first 80 seconds of LOX dump after which it will switch back to APS control.

Approximately 20 minutes after the fuel dump test, while the vehicle is over Hawaii, the Launch Vehicle starts a cold helium dump. This dump continues for 22 minutes during which time the vent valves are also open which depletes the tank pressurization helium supply.

Helium which supplies control valve pressure is dumped 4 and 3/4 hours after liftoff while the vehicle is passing over the United States for the third time.

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LAUNCH VEHICLE GROUND SUPPORT PLAN (SA-204/LM-1)

Mission Description

The Apollo Mission, SA-204/LM-1 will be the first launch of the uprated Saturn I Launch Vehicle with a fully configured Lunar Module.

Primary purpose of the Launch Vehicle is to insert the LM/S-IVB/IU into an elliptical earth orbit having an 85 nm perigee and a 120 nm apogee and to position the LM for unmanned tests of subsystem operations.

A ground projection of the first six revolutions is shown in Figure 15.

Basic Support

Basic mission support required from the global network are; Tracking, Telemetry Recording, Telemetry Real Time Display and Update.

Mission Support Planning

For support planning purposes, the mission can be divided into three phases:

1. The Launch Phase - Liftoff to S-IVB cutoff plus 1.5 minutes.
2. Pre-separation Phase - Begins at the end of Launch Phase and is terminated by the initiation of LM separation sequence.
3. Post-separation Phase - Starts with initiation of the Separation Phase and continues for the duration of the LM system life.

For mission planning purposes, LM System life is assumed to be 10 hours.

The mission's secondary objective is to determine the system life of the Launch Vehicle.

Launch Phase

The Apollo Saturn Vehicle, launched from Pad 37B, will have a launch azimuth of 90° and will roll to a flight azimuth of 72° east of true north.

Pre-separation Phase

Following S-IVB cutoff, approximately 598 seconds after liftoff, the S-IVB/IU and the LM are inserted into their earth parking orbit (85 by 120 nm). The vehicle remains in this phase for about 42 minutes which presents the first opportunity for separation. A second opportunity occurs over the United States on the first revolution.

