P66 10041

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NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546
TELS. WO 2-4155
WO 3-6925

FOR RELEASE: THURSDAY P.M.
February 17, 1966

RELEASE NO: 66-32

PROJECT: APOLLO/SATURN 201

(To be launched no earlier than February 23, 1966)

N66 35326

(ACCESSION NUMBER) (THRU) /

(PAGES) 53 (CODE)

(NASA CR OR TMX OR AD NUMBER) (CATEGORY) 31

FACILITY FORM 602

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NEWS NASA

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FIRST APOLLO
SPACE TEST
SET FOR FEB. 23

The unmanned Apollo mission to be launched by the National Aeronautics and Space Administration from Cape Kennedy, Fla., Feb. 23 will be the first test in space of the craft which will send Americans to explore the moon.

The new, two-stage Saturn IB launch vehicle, the most powerful yet developed by NASA, will produce 1.6 million pounds thrust when it boosts the 45,900-pound Apollo spacecraft from the Earth. The payload is the heaviest so far launched by the Agency.

The Apollo/Saturn space vehicle is the largest ever mated on a Cape Kennedy launch pad. It stands 224 feet high. Lift-off weight will be slightly more than 1,300,000 pounds.

The spacecraft will not orbit the earth. However, the flight of about 39 and a half minutes is programmed to verify performance of the launch vehicle and most of the major spacecraft systems, including the ablative heat shield during re-entry into the atmosphere.

The spacecraft will fly about 5,500 miles and impact in the South Atlantic east of Ascension Island. Peak altitude will be approximately 300 miles.

The spacecraft command module will be recovered for technical evaluation.

Saturn IB's second stage, powered by a single 200,000-pound-thrust engine, will be the largest high energy liquid hydrogen-liquid oxygen propellant stage ever flight tested.

The 1,922 measurements to be taken by telemetry systems during the flight will make it the most highly instrumented space vehicle ever launched by NASA. Of the total, 545 measurements will be on the Saturn first stage, 470 on the second stage, 300 on the Saturn instrument unit and 607 on the spacecraft.

Two recoverable movie cameras will film separation of the two vehicle stages and ignition of the second-stage engine.

The second-floor control room at the Mission Control Center, NASA Manned Spacecraft Center, Houston, will be utilized for the first time.

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The mission introduces automatic computer checkout equipment at Launch Complex 34 which will be used throughout the Apollo program.

The mission is the first of three or more unmanned Apollo/ Saturn IB tests prior to manned orbital flights up to two weeks duration in 1967.

At the launch site, the 83-foot spacecraft mated to the (141-foot) Saturn IB appears identical to that which will carry explorers to the moon before 1970. However, a 7.5 million pound thrust Saturn V, the launch vehicle for the lunar landing mission, is about twice the height of Saturn IB.

The spacecraft consists of four segments:

Launch Escape System - a safety device which can hurl the spacecraft and three-man crew from the Saturn in the event of a catastrophic malfunction. Weight is 8,300 pounds.

Command Module - a cone-shaped craft in which astronauts will leave the earth and return. It is the only segment which returns from space. Weight is 11,000 pounds.

Service Module - a cylinder containing propulsion systems for space operations, electrical power supply and other equipment to support the command module. Weight is 22,800 pounds.

Lunar Excursion Module Adapter - a metal case connecting the Saturn instrument unit and service module which will house the lunar excursion module. This module will carry two men to the lunar surface, but will not be flown on this mission.

Specific Mission Objectives are:

1. Demonstrate structural integrity and compatibility of the launch vehicle and spacecraft and confirm launch loads.

2. Demonstrate separation of the launch vehicle stages, instrument unit, and segments of the spacecraft in the programmed sequence.

3. Verify operation of the launch vehicle propulsion, guidance and control, and electrical systems.

4. Verify operation of the command module heat shield for reentry into the atmosphere from low earth orbit. Evaluate shield at heating rate of about 200 Btu per square foot per second at velocity of more than 18,000 mph. (Temperatures up to 4,000 degrees F.)

5. Verify operation of the service module propulsion system, including restart of the main engine in the weightless environment.

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6. Verify operation of the spacecraft environmental control system, reaction control system, launch escape system, recovery system and partial operation of the communication and electrical power systems.

7. Evaluate the emergency detection system during unmanned flight.

8. Demonstrate mission support facilities required for launch, mission operations and recovery.

The following spacecraft systems will not be flown on this unmanned mission: Guidance and navigation system, fuel cell electric power system (power will be supplied by storage batteries), S-band communication system, astronaut couches and crew provisions.

(END OF GENERAL RELEASE - BACKGROUND INFORMATION FOLLOWS)

APOLLO MISSION

The Apollo/Saturn IB will be launched from Complex 34 on an azimuth of 100 degrees east of north, an east-southeast direction from Cape Kennedy. The vehicle will be held on the pad for about three seconds after the eight first-stage engines ignite, to assure stable combustion.

After lift-off the vehicle will roll into an azimuth of 105 degrees and begin to pitch or tilt in the direction of the flight path.

The first-stage engines burn for 2 minutes, 26 seconds and then the stage is separated. The second stage ignites, the launch escape tower is jettisoned, and the recoverable cameras are ejected.

The second-stage engine burns for about 7 minutes, 20 seconds. After burnout the stage and the instrument unit remain attached to the spacecraft for about 4 minutes. Attitude control rockets on the second stage orient the spacecraft so the apex of the command module is pointing toward the Earth.

During the pitch maneuver a signal from the Saturn IB instrument unit activates the control programmer in the spacecraft.

About 13 minutes and 53 seconds after launch the second stage and instrument unit separate from the spacecraft.

The command and service modules coast to a peak altitude of 310 miles above the Earth about 2,750 miles down-range from the launch pad.

Approximately two minutes later, in the early phase of the descending flight, the reaction control system rockets in the service module fire for 30 seconds which will increase the speed of the spacecraft a few miles per hour. During weightlessness this acceleration will force liquid propellants to the bottom of the storage tanks and insure ignition of the service module main propulsion engine. It is called an ullage maneuver.

The main propulsion engine ignites and burns for three minutes, adding about 3,100 mph to the spacecraft's velocity. After a five-second coast another ullage maneuver is performed and the service module propulsion engine reignites and burns for 10 seconds.

These maneuvers increase the spacecraft velocity to more than 18,000 mph, which is greater than reentry speed during Apollo orbital missions.

A few seconds later the spacecraft pitches over from command module-forward to service module-forward so the blunt end of the command module faces Earth when the modules separate. The service module reaction control engines ignite to separate the modules. These engines continue to thrust the service module away from the command module until the fuel is depleted.

After separation the command module pitches and rolls to reentry attitude and reenters the atmoshpere (400,000 feet above the Earth) about 25½ minutes after life-off. A two minute communication blackout begins 30 seconds later.

About four and a half minutes after blackout drogue parachutes are deployed to stabilize the spacecraft at 25,000 feet. The three main parachutes deploy less than a minute later at about 12,000 feet.

Splashdown is programmed 39 minutes, 28 seconds after lift-off approximately 5500 miles from Cape Kennedy and some 200 miles east of Ascension Island.

Department of Defense recovery forces will retrieve the spacecraft.

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FLIGHT PLAN

Time (Min. & Sec.)	Event
00:00	Lift-off
00:10	Pitch and roll maneuver initiated
00:15	Roll terminated
01:18	Maximum dynamic pressure (altitude 7.7 miles, 2.9 miles downrange, velocity 1,000 miles per hour)
02:16	Pitch terminated
02:20	First stage inboard engines cutoff
02:26	First stage outboard engines cutoff (altitude 37 miles, 39 miles downrange, velocity 4,300 mph)
02:27	Second stage ullage rocket ignition
	First stage separates
	First stage retro rocket at ignition
02:31	Second stage ignition
02:52	Launch escape system jettison
02:57	Camera capsules eject
09:53	Second stage engine cutoff (altitude 52 miles, 990 miles downrange, velocity 15,000 mph)
10:03	Second stage-spacecraft pitch initiated
11:54	Second stage-spacecraft pitch terminates
13:53	Second stage separates from spacecraft
13:54	LEM adapter separates from command and service module
17:53	Apogee (altitude 310 miles; 2,750 miles downrange)
19:31	Service module reaction control rocket ullage maneuver

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Time	Event
20:01	First service module main engine ignition increases velocity about 3,100 miles per hour
23:00	Service module engine cutoff
23:05	Second service module ullage maneuver
23:20	Second service module engine ignition, increases velocity about 60 mph
23:30	Service module engine cutoff
23:34	Spacecraft pitch to separation attitude
24:04	Command and service module separate
24:16	Command module pitch to reentry attitude
24:29	Roll lift vector up
25:32	Reentry into atmosphere (400,000 feet)
26:00	Command module enters blackout
26:10	15 G
28:00	End blackout
32:38	Drogue parachutes deploy (25,000 feet)
33:15	Main parachutes deploy (12,000 feet)
33:23	Main parachutes open
33:25	Residual fuel in service module reaction control system burnout
39:29	Command module touchdown

ABORT SEQUENCE

An abort of the launch escape system can take place anytime between liftoff and 22 seconds after separation of the first stage. After that the service module propulsion system will be used for an abort maneuver. For this mission aborts will be performed by ground command but during manned flights they are executed by the crew or automatically upon signal from the emergency detection system.

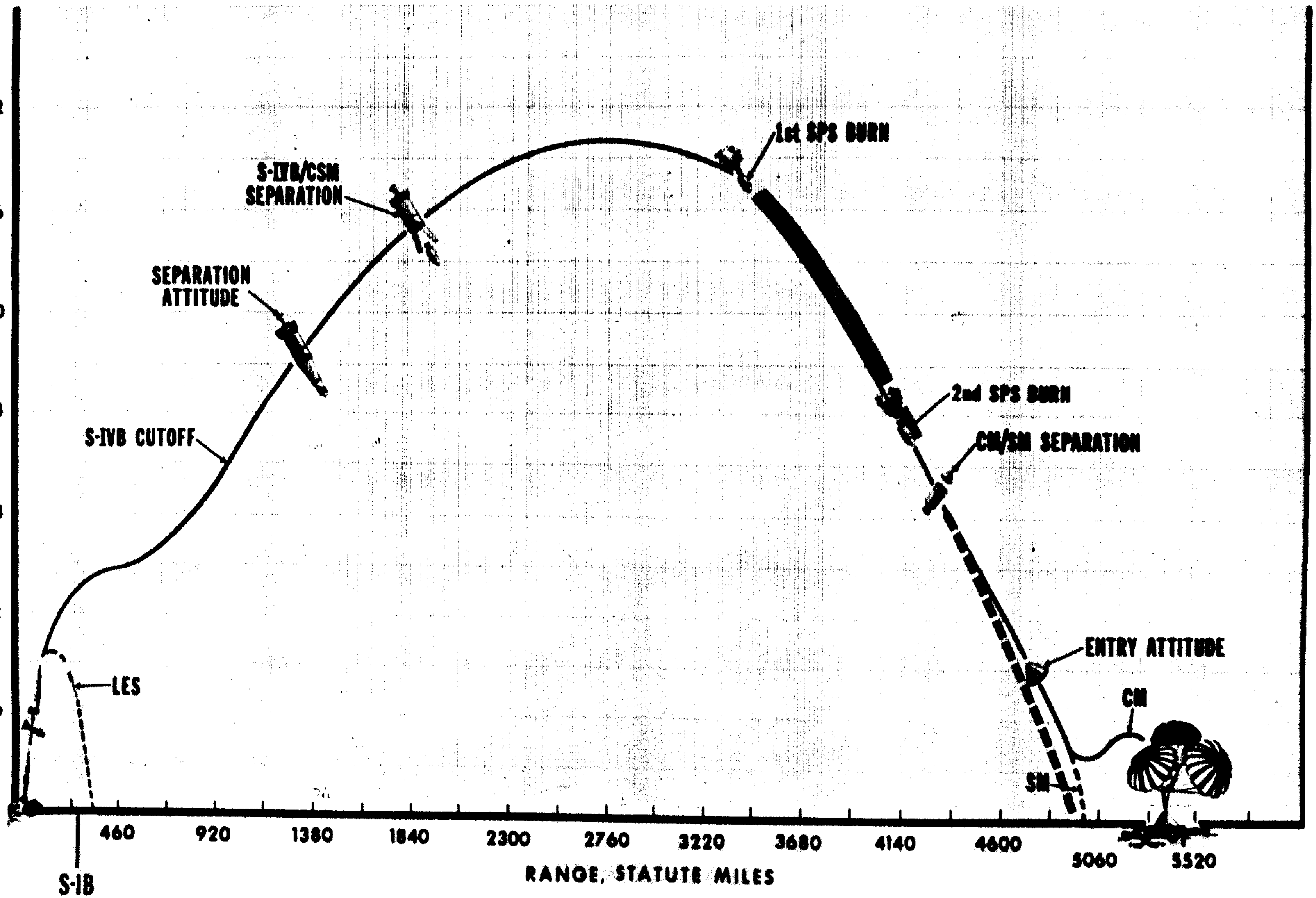
Launch Escape System Abort

Event	Low Altitude 0-12,000 ft.	Medium Altitude 12,000-200,000 ft.
Abort Initiation	Abort +0 sec.	Abort +0 sec.
Deploy canards	Abort +11 sec.	Abort +11 sec.
Jettison LES	Abort +14 sec.	25,000 feet
Jettison forward heat shield	Abort +14.4 sec.	15,000 feet
Deploy drogues	Abort +16 sec.	25,000 ft. + 3 sec.
Release drogues	Abort +28 sec.	12,000 feet
Deploy pilot and main chute	Abort +28 sec.	12,000 feet

Service Module Propulsion System Abort

Upon command from the ground, an abort timer in the spacecraft control programmer starts, attitude gyros are uncaged, service module reaction control engines perform an ullage maneuver, and the command and service modules separate from the second stage.

APOLLO FLIGHT PROFILE



The main propulsion engine fires for 10 seconds to drive the spacecraft away from the vehicle stage the command and service modules separate and the command module reenters normally.

MISSION CONTROL AND TRACKING

The second floor Mission Operations Control Room at the Manned Spacecraft Center, Houston, is being used for the first time. It will be staffed by flight controllers and support personnel during the mission in much the same way as have manned Gemini flights with the exception of the flight surgeon's console. No astronauts will be assigned at consoles for this mission, and only one shift will be on duty.

Real-time in-flight analysis of the mission will be accomplished through the Air Force Eastern Test Range and NASA Manned Flight Network facilities including the Rose Knot tracking ship.

Control of the Apollo mission will be at Houston from liftoff through recovery. In case of a communications failure, or in the event that time does not permit direct and detailed control from Houston in the final stage of the flight, control responsibility will be delagated to the command communicator on the ship.

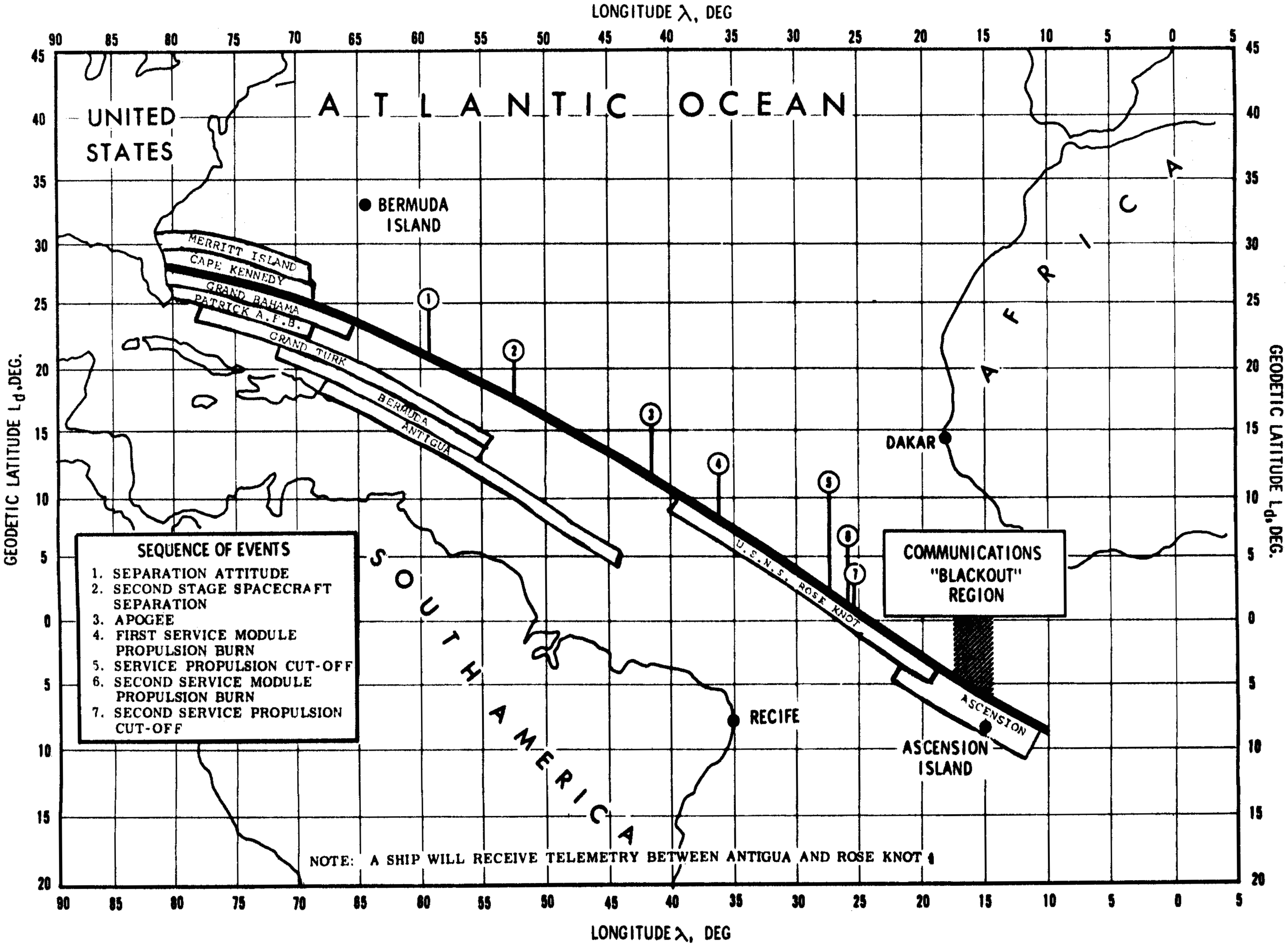
At liftoff NASA stations at Cape Kennedy and Merritt Island, Fla., and Eastern Test Range stations at Patrick Air Force Base, Fla., and Grand Bahama Island will transmit data to mission control.

Downrange stations at Grand Turk, Antigua and Ascension Islands will acquire the vehicle as it flies over the range and send data to mission control via Cape Kennedy.

Data from the NASA Bermuda facility and the Rose Knot will reach mission control via the Goddard Space Flight Center, Greenbelt, Md.

Commands to the Saturn vehicle and/or spacecraft are sent from mission control to the tracking stations for transmission.

APOLLO TRACKING COVERAGE



RECOVERY OPERATIONS

Manned Apollo spacecraft are capable of "flying" back into the atmosphere using the lift capability designed into the command module to a point inside a "footprint" as large as 230 by 1,380 statute miles. This mission, however, will use a primary recovery area of only 46 by 325 miles, since no crews will be aboard to control the spacecraft through the reentry.

The center of the recovery area is at 8 degrees, 37 minutes South, by 10 degrees, 18.5 minutes West about 200 miles east of Ascension Island where the aircraft carrier, USS Boxer, will be on station. The Boxer is a helicopter carrier, called a Landing Platform, Helo (LPH). Four destroyers, an oiler and the Boxer comprise the U.S. Navy's recovery force, with the Boxer the fartherest-downrange vessel. The other ships are stationed along the flight path, 57 miles on each side of the 105-degree azimuth ground track.

Six U.S. Air Force HC-97 aircraft from Bermuda, Ascension and Daker will be on station from Florida to the impact area to account for aborts or an "overshoot."

After recovery the command module will be taken by ship to a nearby port, then flown to North American Aviation's Space and Information Systems Division, Downey, Calif., for post-flight engineering analysis.

Prelaunch Checkout and Countdown

The 1.6-million-pound-thrust S-IB first stage arrived at Kennedy Space Center aboard the NASA barge "Promise" from New Orleans last August. It first was used to check out the modified launch pad in combination with a S-IVB second-stage facilities test vehicle. The two flight stages and instrument units were mated in November.

The Apollo spacecraft, which arrived in October, underwent extensive testing at KSC's Merritt Island Facilities. This included a static firing of the service module propulsion system at Apollo Test Complex 16, Cape Kennedy. The Apollo was mated to the launch vehicle at Pad 34, Dec. 26.

Combined system tests of the spacecraft-launch vehicle configuration followed. A complete countdown demonstration was conducted by the launch team about two weeks before liftoff. This duplicated the final launch count, except that fuel was not aboard the S-IB booster or the spacecraft. During that count, however, the cryogenic propellants--liquid oxygen and liquid hydrogen--were loaded at the proper time. A flight readiness test was the next highlight--during which a portion of the countdown and the flight to Apollo splashdown were simulated.

To achieve a thorough and reliable checkout at a faster pace, automatic checkout will be used as much as possible throughout the Saturn IB program. The extent of automated checkout will be progressive on each of the flights, leading to its optimum use on the Apollo/Saturn V program. A small percentage of the total checkout for this launch vehicle is automated, utilizing two Radio Corporation of America 110-A computers. Primary use of automated checkout for this mission is individual subsystems.

One of the computers is located in the launch control center--the other in the automatic ground control station located beneath the launch pad.

Automatic checkout of the spacecraft is accomplished through a program called ACE/SC (Acceptance Checkout Equipment for Spacecraft). ACE/SC, through the use of computers, display consoles and recording equipment, provides for an instantaneous, accurate method of spacecraft preflight testing. ACE, manufactured by General Electric Co., Apollo Support Dept., Daytona Beach, Fla., is also used at the spacecraft contractor plants and in testing at the Manned Spacecraft Center, Houston.

Computerized checkout of the Saturn IB at the launch pad and the Apollo ACE system at the KSC Manned Spacecraft operations building, Merritt Island, also are tied together by interface instrumentation.

The countdown will start about 45 hours before liftoff. The first part of the count--about 18 and a half hours--deals largely with final checks of the Apollo spacecraft and ordnance installation and mechanical work on the launch vehicle.

The second portion begins about 16 and a half hours before launch. During this period, liquid oxygen is loaded into both stages and liquid hydrogen fuel aboard the S-IVB (the RP-1 fuel in the booster and spacecraft propellants are taken aboard several days prior to launch).

With fueling completed at about T-3 hours, power checks are accomplished, range safety precautions initiated, the doors of the Apollo command module are closed and the spacecraft access arm is retracted. The terminal count begins at T-30 minutes, and at T-2 minutes, 43 seconds, sequencing starts where final checks are made automatically until liftoff.

APOLLO SPACECRAFT

The Apollo spacecraft consists of the command module, service module and a spacecraft-Lunar Excursion Module (LEM) adapter. There will be no LEM on this mission.

Command Module (CM)

The command module is a cone 13 feet across at the base and 12 feet high. It weighs 11,000 pounds and has a habitable volume of 218 cubic feet. It houses the three-man Apollo crew during manned missions and is the only part of the spacecraft which is recovered.

The command module has an inner pressure structure and an outer heat shield structure separated by stringers for structural support and a micro-quartz fiber for thermal insulation. The outer housing limits heating of the pressure structure to less than 600 degrees F. The combined structures keep temperatures inside the spacecraft at comfortable levels and below 200 degrees F. during reentry.

The outer structure is a three-piece heat shield constructed of brazed honeycomb stainless steel to which is bonded an epoxy resin ablative material. Thickness of the ablative material varies from .9 to 2.6 inches according to the anticipated aerodynamic heat distribution over the command module. The three pieces of the heat shield cover (1) the top (apex) of the module, (2) the sides and (3) the blunt end.

The inner structure is made of aluminum honeycomb bonded between sheets of aluminum alloy. It is the primary load-carrying portion of the command module. An access cylinder (exit tunnel), capped by a pressure cover, extends from the crew compartment tc the apex. The space around the cylinder just below the apex is divided into four sections by stiffeners and contains parachutes, pyrotechnics and electronics equipment.

Service Module (SM)

The service module is a cylinder 22 feet high and 13 feet in diameter weighing 22,800 pounds. It contains four service propulsion system (SPS) propellant tanks, the reaction control system (RCS) and its tanks, radiators, batteries and expendables. The spacecraft's main propulsion unit is at the base of the service module.

The service module has a shell of aluminum honeycomb sandwich panels, one inch thick with six radial support beams. Tension ties which attach the service module to the command module are separated explosively to detach the modules prior to reentry.

Spacecraft-LEM Adapter (SLA)

This adapter joins the service module and the S-IVB instrument unit. In future flights it will house the Lunar Excursion Module (LEM), but on this flight an aluminum alloy bracing is included in place of the LEM. The adapter is 28 feet high and tapers from 22 feet at the instrument unit end to 13 feet where it attaches to the service module. It weighs 3,800 pounds. It consists of four aluminum honeycomb panels attached with hinges to the lower end of the adapter. The panels may be separated by explosive charges and opened petal-like to expose the LEM preparatory to CSM-LEM docking on future flights.

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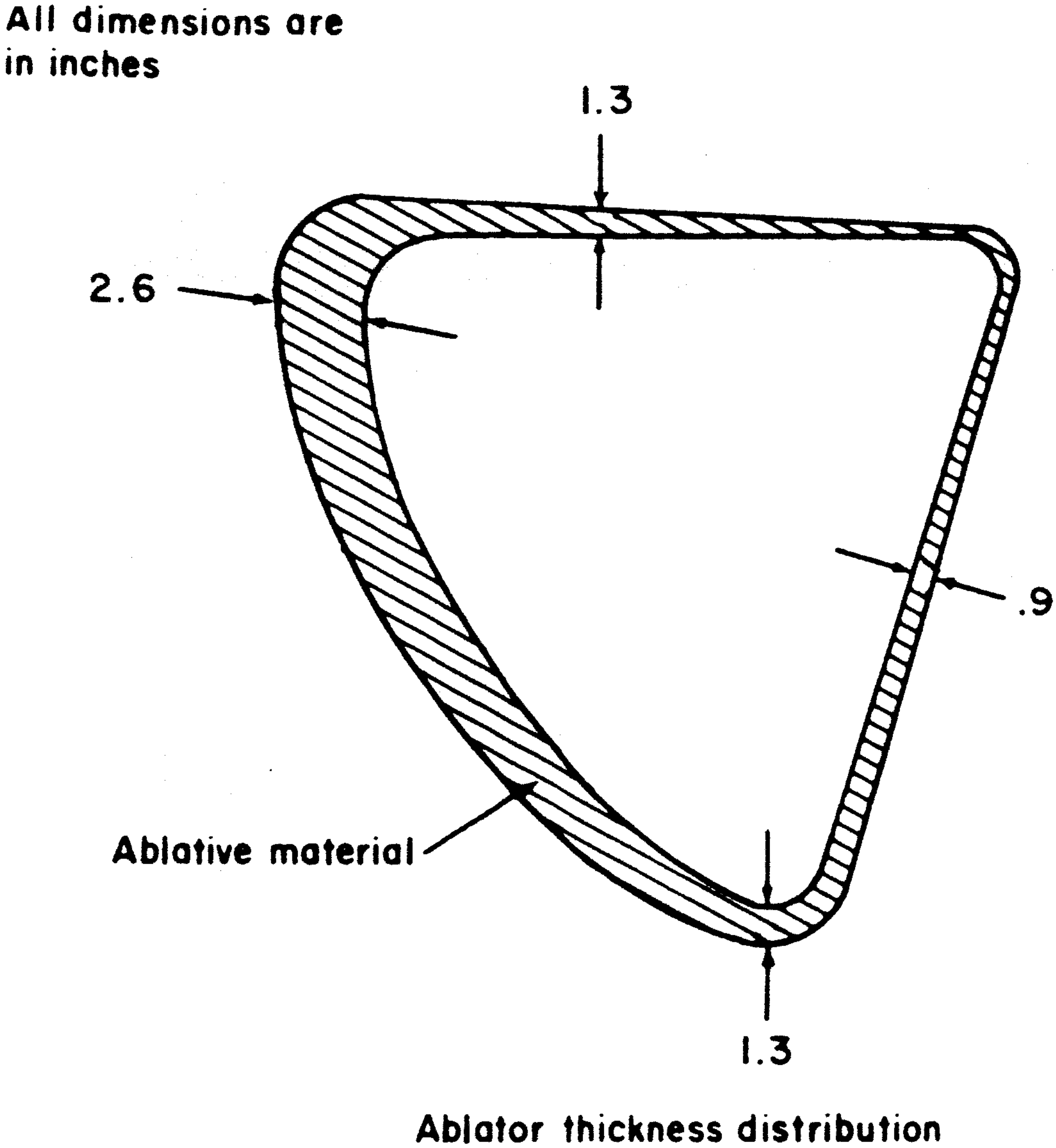
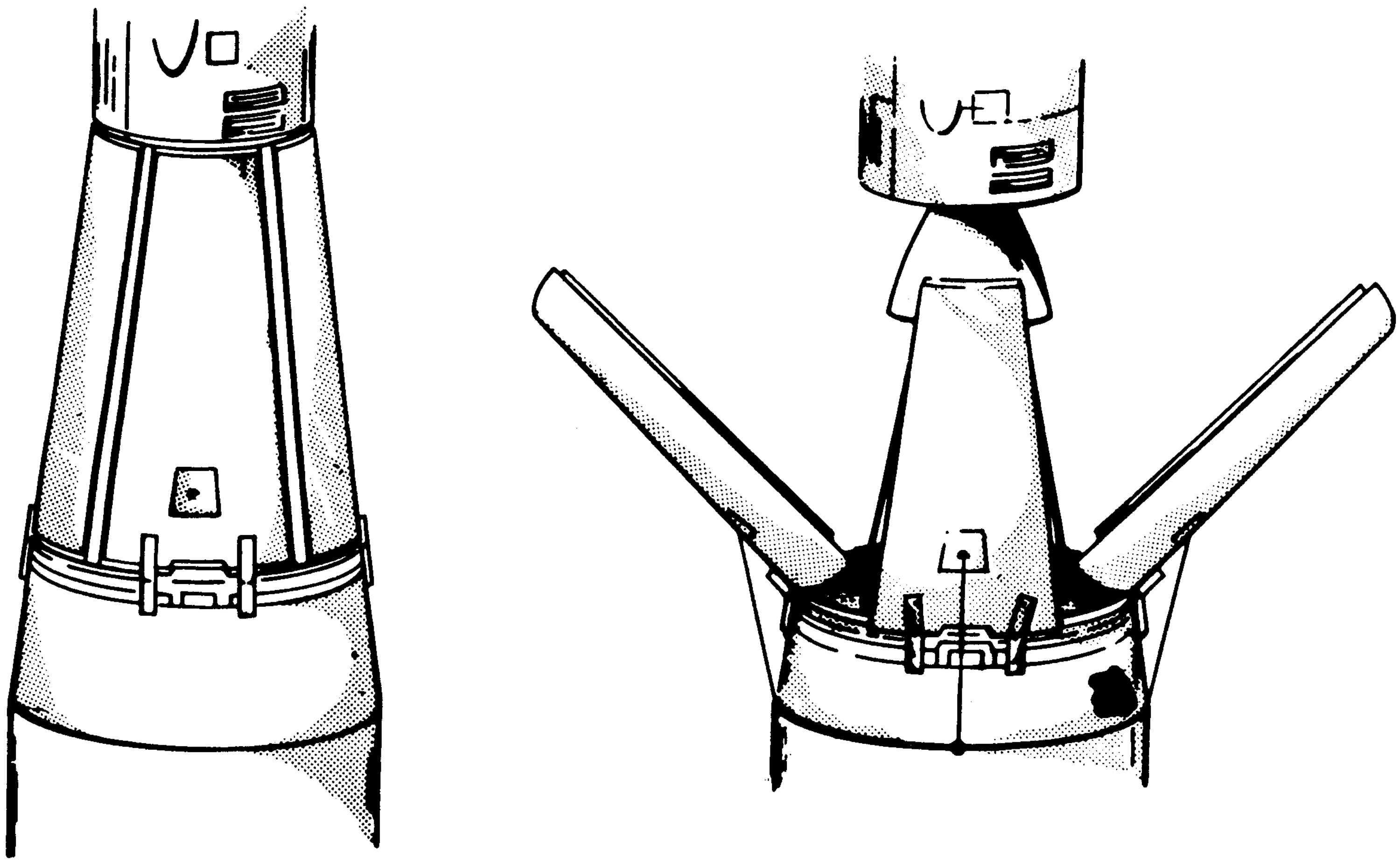
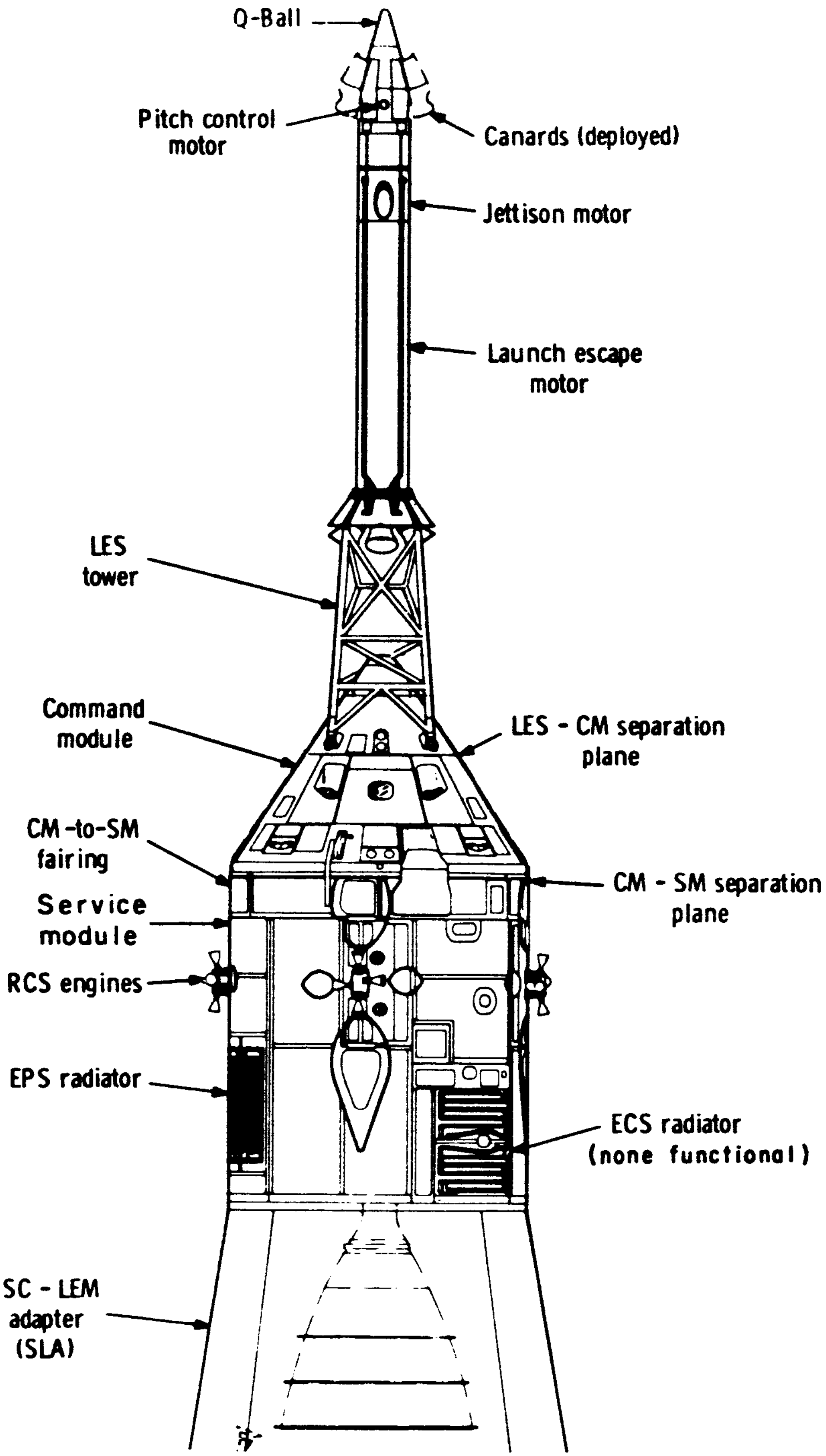


Apollo Command Module
Heat Shield



Apollo Spacecraft LEM Adapter
Left - at lift-off
Right - Service Module Separation



APOLLO SPACECRAFT (without boost protective cover)

MAJOR APOLLO SPACECRAFT SYSTEMS

Boost-Protective Cover (BPC)

The boost-protective cover protects the command module from aerodynamic heating during boosted flight and from heat and soot from the launch escape and jettison motors of the launch escape system. It is made of ablative cork and Teflon-impregnated glass cloth supported by glass honeycomb in the upper portion. It is jettisoned with the launch escape system at 268,000 feet altitude less than three minutes after liftoff.

Launch Escape System (LES)

The launch escape system is 33 feet tall and consists of an escape motor, pitch control motor, tower jettison motor, tower release mechanism, canard subsystem and Q-ball assembly. It weighs about 8,300 pounds.

The launch escape motor is 26 inches in diameter, 15 feet, 3 inches long and burns about 3,200 pounds of solid propellant to provide 155,000 pounds of thrust.

The pitch control motor is nine inches in diamter, 22 inches long, and also burns solid propellant.

The tower jettison motor is 26 inches in diameter, 47 inches long, uses solid propellant and develops about 33,000 pounds of thrust. It removes the LES after the second stage ignition.

The tower release mechanism consists of four explosive bolts which separate just before the jettison motor or escape motor ignites to detach the LES from the command module.

The canard subsystem is mounted in the pitch control motor housing near the top of the Launch Escape System. Each of two wing-like canard surfaces is about 18 inches wide and 24 inches long. The aerodynamic surfaces are deployed by explosives 11 seconds after the escape motor fires during an abort. They stabilize the command module blunt end forward prior to drogue chute deployment.

The Q-ball assembly is at the top of the Launch Escape System and contains pressure sensors to determine flight angles of attack and dynamic pressures during launch or launch abort.

Emergency Detection System (EDS)

The emergency detection system senses conditions during powered flight, which can, during manned missions, cause an automatic abort or provide information for the crew to execute a manual abort.

In the spacecraft for this mission the automatic abort circuits are open-loop; that is, an emergency detection system signal to abort would be telemetered to ground control, as are manual abort signals, and the abort would be commanded from the ground.

The spacecraft portion of the emergency detection system is closely integrated with the launch vehicle portion through the instrument unit. Panel displays and controls normally used by a flight crew to monitor the emergency detection system are nearly all omitted in the spacecraft for this mission. Abort can be performed either with the launch escape system or the service module main propulsion.

Loss of thrust in any two of the eight first-stage Saturn engines, excessive angular rates of pitch, roll or yaw causes the emergency detection system to send abort signals over three separate lines to the spacecraft. Two out of three electronic abort indications in the emergency detection system will cause a recommended abort signal to be made on the crew's display panel.

Electrical Power System (EPS)

The electrical power system for Apollo usually consists of fuel cells but on this flight silver oxide-zinc storage batteries supply spacecraft power from lift-off through the post-landing period.

There are two DC power sources: one in the service module providing power from lift-off through command module-service module separation; the other in the command module providing power through the post-landing period. Two 400-cycle inverters are used in the command module to carry DC power to two (redundant) AC busses.

Three 40-amp-hour, 29-volt DC silver oxide-zinc storage batteries are in the lower equipment bay of the command module and three are in the service module.

Two 3/4-amp-hour, 23-volt DC silver oxide-zinc storage batteries are aboard each module; two for operating the service module jettison controller and two for operating command module pyrotechnics, such as parachute deployment mortars.

Environmental Control System (ECS)

The spacecraft will be pressurized with pure oxygen through a regulator in the environmental control system. The cabin pressure regulator will keep pressures within .2 pounds per square inch absolute of 5 psia.

A water-glycol loop cools cabin air and equipment in the command module.

Heat generated by electronic equipment is dissipated by circulating cold water-glycol through a coldplate network. Cabin temperature is controlled by circulating air through the cabin heat exchanger. Heat absorbed is rejected by evaporative cooling in the glycol evaporator, with water supplied from the waste water tank. This tank, which has a 56-pound capacity, contains 10 pounds of water for this mission.

Stabilization and Control System (SCS)

The stabilization and control system uses integrating gyros to provide information for attitude, rate and thrust control and signals the reaction control system and service propulsion system. A control programmer responds to SCS signals aboard the spacecraft as would a crew on a manned mission.

Service Propulsion System (SPS)

The service propulsion system is a single, 21,900-pound-thrust engine, mounted beneath the service module, using a half-and-half mixture of unsymmetrical-dimethylhydrazine (UDMH) and nitrogen tetroxide from tanks inside the module. It is restartable, and on this flight will be ignited twice--once for 180 seconds and once for 10 seconds--to provide a reentry velocity of more than 18,000 miles per hour. The command module will encounter more than 15 Gs and a heat rate of nearly 200 Btu per square foot.

Highest temperature will be approximately 4,000 degrees F.

In orbital flight, the SPS would be used for orbital changes and retrofire, and on a lunar journey would provide midcourse corrections and velocity changes for entering and leaving lunar orbit.

The SPS engine is gimballed by two electrically operated servo-actuators to guide the spacecraft by thrusting through its center of gravity. Propellants are fed to the thrust chamber by helium pressure, and the engine is cooled by ablation. Maneuvers are performed by the reaction control system to insure that the propellants are kept to the bottom of the SPS tanks to allow proper flow to the engine.

Reaction Control System (RCS)

There are reaction control systems aboard all three Apollo spacecraft modules. The ones to be flown on this mission are:

Service Module RCS - Four independent and identical sets of 100-pound thrusters, mounted in fours. All 16 are mounted outside the service module, with tankage (UDMH for fuel, nitrogen tetroxide for oxidizer, and helium for pressure) and associated compoenets contained inside.

The sets are fixed at 90-degree positions around the SM, and the thrusters in each set are mounted at 90-degree angles from each other. This provides thrust for roll, pitch, yaw, ullage, minor orbital and midcourse maneuvers and for docking with the LEM.

<u>Command Module RCS</u> - This system is activated after command module-service module separation, and consists of two sets of thrusters for each axis (roll, pitch, yaw) for reentry. Monomethyl hydrazine (MMH) is used for fuel, nitrogen tetroxide is the oxidizer. The thrusters, 12 in all, are mounted near the base of the module. Each provides about 93 pounds of thrust through ablative chambers. Both systems respond to signals from the stabilization and control system, or from the crew's manual controllers during the manned flights.

<u>Communications and Instrumentation Systems</u>

Communication equipment consists of a VHF-FM transmitter, VHF-AM transmitter-receiver, C-band transponder, VHF recovery beacon and HF recovery transceiver. A VHF multiplexer allows all VHF equipment to operate from a single antenna.

No S-band equipment, television or up-data link equipment is included for this flight.

The VHF recovery beacon and HF transceiver operate for 24 hours after landing. On manned spacecraft equipment will operate for 48 hours.

Data are stored on a 14-track magnetic tape recorder for later analysis (a second recorder is aboard for flight qualification), and measurements also are sent via telemetry links to ground stations. In all, 607 measurements, mostly temperature and structural responses, are recorded in the spacecraft and on the ground. Two telemetry transmitters, one in each module, provide this information from the flight qualification instrumentation.

Other telemetry equipment, part of the operational communications, provides information necessary for abort decisions.

There are four flush-mounted C-band antennas on the command module and two scimitar antennas (one dummy) for VHF. Recovery VHF and HF antennas are deployed just before landing.

Control Programmer

The control programmer consists of a radio command controller, dual sequential timers and an automatic command control, mounted in place of crew couches to perform crew functions.

The radio command controller accepts and processes ground signals to initiate up to 38 commands for system activation.

Sequencers open and close switches to perform events normal to the flight plan, or, in the event of an abort, to initiate system functions in a fixed sequence.

Automatic commands are continuously relayed to appropriate systems from attitude and rate gyros, based on information from the sequential timers.

Other sequencers, those normally flown aboard Apollo even on manned missions, include an RCS fluid control sequencer to dump RCS propellant during a low altitude abort, or to burn propellants after a normal reentry or high altitude abort, and an Earth landing sequence controller to activate events during the landing sequence.

Earth Landing System (ELS)

Besides the sequence controller, the earth landing system consists of two nylon conical ribbon drogue parachutes 13 feet in diameter; three ringslot nylon pilot chutes, seven feet in diameter; and three ringslot, nylon main chutes 83.5-feet in diamter.

At 25,000 feet altitude, after reentry, a barometric switch activate pyrotechnics which jettison the apex heat shield to uncover the "upper deck" and its parachutes.

Two seconds later the drogue chutes are deployed by mortar to stabilize the spacecraft blunt end forward. The drogues are reefed for eight seconds, then fully opened by reefing cutters.

The pilot chutes are deployed at about 12,000 feet, pulling the main parachutes from their containers. The main chutes also are reefed for eight seconds until cutters permit the large canopies to open fully.

Recovery Systems

The VHF recovery and survival antennas and a flashing light are deployed after the main chutes disreef, and the survival and recovery beacons begin operation before touchdown.

If the spacecraft lands with its apex end in the water, the control programmer will signal a pump one minute after splashdown to inflate one of three flotation bags. Five minutes later, if the spacecraft is still not upright, a second pump inflates another bag, and if necessary five minutes later the third bag will inflate.

When upright, other aids, such as the HF transmitter and flashing light begin operation.

Saturn IB Launch Vehicle

The Saturn IB program builds upon the perfect flight record of the Saturn I. This first flight of the Saturn IB comes 3-1/2 years after initiation of the program.

Saturn IB was developed as a result of the decision in July 1962 to accomplish the Apollo moon landing by lunar orbit rendezvous (LOR). LOR required a vehicle with payload capability greater than the Saturn I for manned Earth orbital missions to perfect techniques of rendezvous and docking the lunar excursion module with the command and service modules.

Saturn IB uses the first stage of the Saturn I, with minor state-of-the-art improvements, the S-IVB third stage and instrument unit from the Saturn V, as well as the facilities for both programs.

Technology gained from the Saturn I second (S-IV) stage made possible early development of the S-IVB stage.

The Instrument Unit used on the Saturn IB and V. was a direct developmental outgrowth from Saturn I instrument unit.

Saturn IB Description

The Saturn IB is approximately 141 feet tall. Total weight at lift-off will be approximately 650 tons.

S-IB Stage: The Saturn I first stage (S-I) was redesigned in several areas and designated the S-IB; however, it remains basically the same vehicle.

Booster weight for this flight is 92,700 pounds, some 12,000 pounds less than the Saturn I first stage. (This weight will be reduced further in later S-IB's.) Weight was decreased by reducing the fin area, removing hydrogen vent pipes and brackets unnecessary to the new design, resizing machined parts in the tail section assembly, modifying propellant tanks, redesigning the spider beam and by reducing weight in the propellant, instrumentation and electrical systems.

The stage is 80 feet long and 21-1/2 feet in diameter.

The stage's eight H-1 engines, developed by the Rocketdyne Division of North American Aviation, Inc., each produce 200,000 pounds thrust. Total thrust of the stage is 1.6 million pounds. H-1 engines on Saturn I, rated at 188,000 pounds thrust each, were improved for the S-IB vehicle.

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The eight engines will burn--in approximately 2-1/2 minutes of operations--41,000 gallons (270,000 pounds) of RP-1 (kerosene) fuel and 66,000 gallons (615,000 pounds) of liquid oxygen, to reach an altitude of some 37 miles at engine cutoff.

There are eight 70-inch diameter propellant tanks (Redstone-type) surrounding a single 105-inch (Jupiter-type) tank. The center tank and four of the outer ones hold liquid oxygen, while the other four outer tanks contain RP-1. The tanks are interconnected at the bottom to provide the capability of completing the mission in case one engine--or in some instances, more than one--fails.

Chrysler Corp. is building the S-IB stages at the NASA-Michoud Assembly Facility in New Orleans. The stages are shipped by barge to the NASA-Marshall Space Flight Center, Huntsville, Ala., for static firings on a modified S-I test stand.

The stage was captive-tested at the Marshall Center for about 30 seconds April 1, 1965 and for a full duration--2-1/2 minutes on April 13, 1965. The booster was returned to the Michoud facility for post firing checkout and then delivered to the Kennedy Space Center in August, 1965.

S-IVB Stage: The S-IVB stage is the second stage of the Saturn IB launch vehicle. It will also be the third (top) stage of the Saturn V, which will launch the Apollo spacecraft to the Moon.

This stage provides the final velocity increment on both vehicles to put the Apollo spacecraft into earth orbit. In its Saturn V application the vehicle's one Rocketdyne J-2 engine will restart in orbit and inject the Apollo into the translunar trajectory.

The S-IVB, being developed by Douglas Aircraft Co. in California under the direction of the Marshall Center, is 21.7 feet(260 inches) in diameter, and 58 feet long. Dry weight of the stage, including the S-IB/S-IVB adapter, is some 29,700 pounds.

The stage is powered by one liquid-hydrogen-fueled J-2 engine developing 200,000 pounds thrust. The stage operates about 7.5 minutes to achieve orbital speed and altitude, but will not orbit on this flight. The J-2 engine will burn approximately 64,000 gallons (38,000 pounds) of liquid hydrogen and some 20,000 gallons (191,000 pounds) of liquid oxygen.

The first S-IVB flight stage was put through a 452-second acceptance test Aug. 8, 1965, at the Douglas Sacramento Test Center.

Instrument Unit: The instrument unit (IU) is the "brain" or "nerve center" of the Saturn vehicle. Commands for engine gimballing, in-flight sequencing of engine propulsion system, staging operations and all primary timing signals originate in the IU.

The IU for Saturn IB was designed by the Marshall Space Flight Center. International Business Machines Corp., Federal Systems Division, is the contractor for fabrication, system testing, and integration and checkout with the launch vehicle.

The structure is 3 feet in height and 260 inches in diameter. The unit weighs some 4,500 pounds.

Components are fastened on panels mounted to the inside circular wall.

Major systems of the unit are the environmental control, guidance and control, measuring and telemetry, radio frequency and tracking, electrical, and emergency detection system.

Launch Complex 34

The Apollo/Saturn IB space vehicle will be launched from Complex 34, Cape Kennedy. The pad, used for the first four Saturn I launches.

The Complex consists of a single, 430-foot diameter launch pad, a mobile service structure, a launch control center and related ground support equipment. Vehicle service systems include RP-1 (kerosene) fuel, liquid oxygen and liquid hydrogen, a high pressure facility for storing gaseous helium and nitrogen used for launch vehicle cooling and pressurization.

Preparations are directed during checkout, countdown and launch from a dome-shaped launch control center located some 1,000 feet from the pad. The control center (blockhouse) is constructed of steel and concrete with a roof designed to withstand a blast of pressure of 2,188 pounds per square inch--well above safety limits for the 300-man crew inside, in the event of an explosion in the pad area.

The mobile service structure is wheeled into place during launch preparations and rolls to a fallback position 680 feet from the pad about 5½ hours before liftoff. It stands 310 feet high and weighs some 3,500 tons. Within the service structure are seven fixed platforms and eight enclosed, retractable working areas. These give the service crews ready access to all sections of the launch vehicle and spacecraft. Hurricane doors, 44 feet tall, provide weather protection for the first stage, and retractable silo sections provide similar cover for the S-IVB, instrument unit and spacecraft.

Following the successful Saturn I series, Complex 34 was modified for the Saturn IB program. The work included installation of doors capable of protecting the first stage from hurricane winds, silos for the upper stages and spacecraft, a new anchoring system for the service structure, reinforcement of structures, frames and propellant systems.

Additional modifications also were made to the swing arms, instrumentation, pneumatics and environmental control system for the Saturn IB.

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Modifications required to "man rate" Complex 34 for the Apollo program included installation of a spacecraft access arm and a high speed elevator in the umbilical tower for the flight crews.

CAMERAS

Two wide angle 16mm Milliken movie cameras will photograph separation of the Saturn IB first and second stages. They have 160 degree lenses and an operating range of 130 degrees. Film speed is 128 frames per second.

The cameras (one with black-and-white film and the other color film) are mounted in the top of the first stage pointing toward the second stage engine.

Camera operation will begin some three ssconds before stage separation. They will be ejected 25 seconds after separation about 300 miles down range.

The cameras are encased in recoverable capsules. Parachutes will open soon after ejection and balloons will keep them afloat. Radio beacons and dye markers will assist an Air Force recovery team to locate the capsules.

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The cameras are expected to operate the first few seconds in total darkness and a few seconds later may be pointing directly into the Sun.

Special black-and-white film is being used to compensate for this expected difference in light. The film has a three-layer emulsion and is expected to provide a wide exposure latitude in the varying light conditions. It will be processed three different times.

Chrysler Corp., assembled and tested the camera packages for the NASA-Marshall Space Flight Center.

Apollo Program Management

The Apollo/Saturn program is directed by Dr. George E. Mueller, Associate Administrator for Manned Space Flight, NASA HQ., Wash., D.C., Apollo Program Director is Maj. Gen. Samuel C. Phillips, USAF, Office of Manned Space Flight. E. E. Christensen is Director of Mission Operations, OMSF Hq.

The Marshall Space Flight Center, Hu..sville, Ala., is responsible for development of the Saturn Launch vehicles. Dr. Wernher von Braun is Director of the Center.

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The Manned Spacecraft Center, Houston, Texas, is responsible for development of the Apollo spacecraft, crew training and in-flight mission control from the Manned Flight Mission Control Center located at MSC. Dr. Robert R. Gilruth is Center Director.

The John F. Kennedy Space Center, Cape Kennedy, Fla. is responsible for Apollo/Saturn launch operations. Dr. Kurt R. Debus is Center Director.

The Goddard Space Flight Center, Greenbelt, Md., is responsible for management of the NASA Manned Space Flight Tracking Network. Dr. John F. Clark is Acting Director.

Mission officials are:

Mission Director - Brig. Gen. C. H. Bolender, USAF, Mission OMSF, HQ., Wash., D.C.

Launch Director - Dr. Kurt H. Debus, Kennedy Space Center, Fla.

Flight Director - Glynn S. Lunney, Flight Operations, MSC, Houston

Dr. Joseph F. Shea - Manager, Apollo Spacecraft Program, MSC, Houston

Lee James - Manager, Saturn IB Launch Vehicle Program, MSFC, Huntsville.

MAJOR APOLLO/SATURN IB CONTRACTORS

SATURN IB

First Stage	Chrysler Corp. Space Division New Orleans
H-1 Engines	Rocketdyne Division North American Aviation, Inc. Canoga Park, Calif.
Second Stage	Douglas Aircraft Co., Inc. Missile & Space Systems Div. Huntington Beach, Calif.
J-2 Engine	Rocketdyne Division North American Aviation, Inc. Canoga Park, Calif.
Instrument Unit	International Business Machines Corp. Federal Systems Division Huntsville, Ala.
ST-124M Inertial Platform in the Instrument Unit	Bendix Corp. Eclipse Pioneer Div. Teteboro, N.J.

Apollo Spacecraft

Command Module, Service Module and LEM Adapter	Space & Information Systems Div. North American Aviation, Inc. Downey, Calif.
(Subcontractors for Major Spacecraft Systems)	
Ablative Heat Shield Material	Avco Research and Development Div. Wilmington, Mass.
Brazed Honeycomb Panels	Aeronca Manufacturing Co. Middletown, Ohio
Command Module Attitude Control and Stabilization Engines	Rocketdyne Div. of North American Aviation Canoga Park, Calif.
Communications & Data System	Collins Radio Co. Cedar Rapids, Iowa

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Control Programmer	Autonetics Div. of North American Aviation Anaheim, Calif.
Earth Landing (Parachute) System	Northrop Corp., Ventura Div. Newbury Park, Calif.
Environmental Control System	AiResearch Div. of Garret Corp. Los Angeles, Calif.
Launch Escape and Pitch Control Motors	Lockheed Propulsion Co., Redlands, Calif.
Service Module Propulsion Engine	Aerojet-General Corporation, Propulsion Div. Sacramento, Calif.
Service Module Reaction Control System	The Marquardt Corp. Van Nuys, Calif.
Stabilization and Control System	Honeywell Inc. Minneapolis, Minn.
Telemetry Data Processing System	Radiation Inc. Melbourne, Fla.
Tower Jettison Motor	Thiokol Chemical Corp. Elkton, Md.

Ground Support Equipment

Apollo Spacecraft Acceptance Checkout Equipment (ACE)	General Electric Co. Apollo Support Dept. Daytona Beach, Fla.
Saturn 110A Checkout Computer and Display Systems	Radio Corporation of America Aerospace Systems Div. Van Nuys, Calif.

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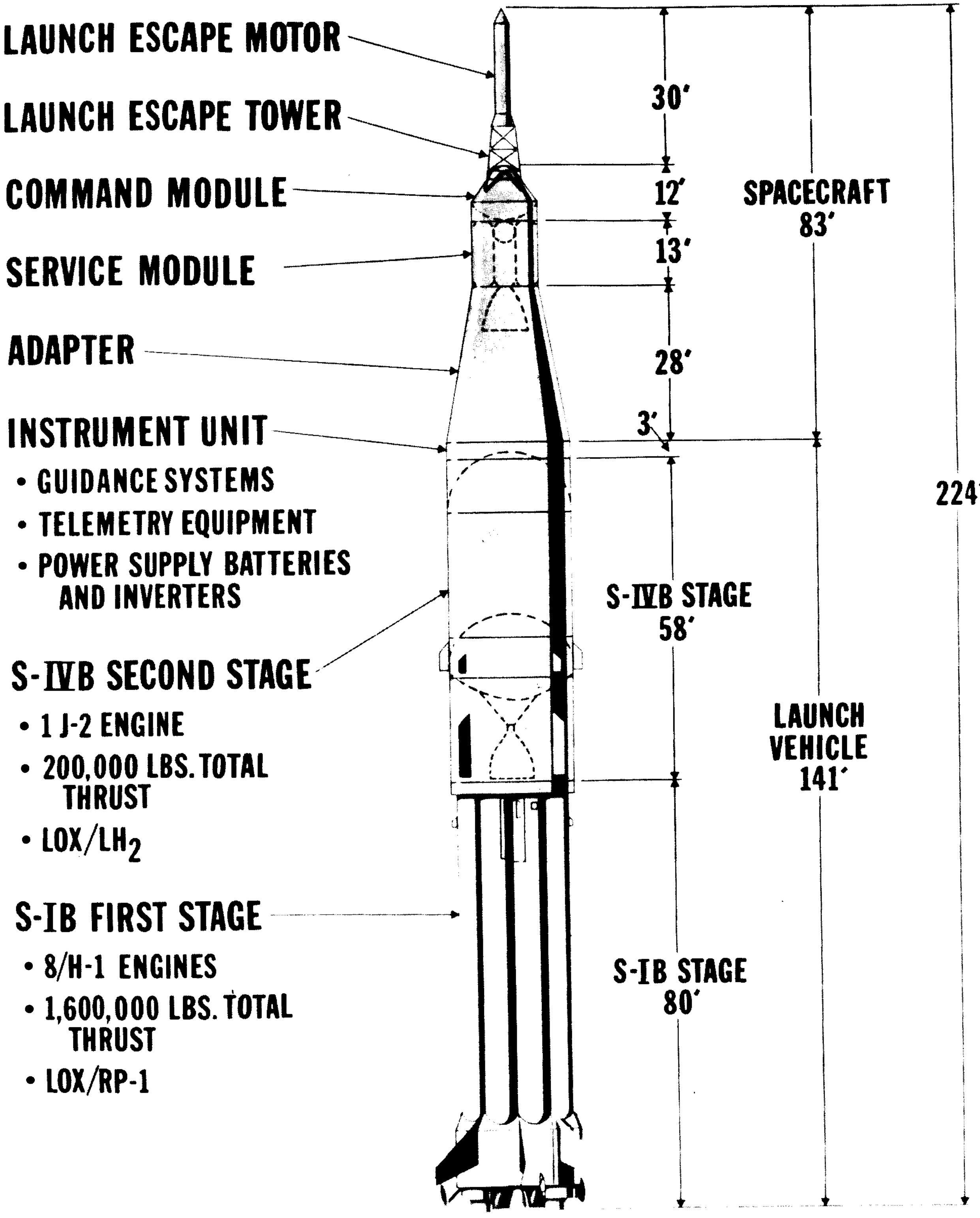
APOLLO/SATURN IB SPACE VEHICLE



LAUNCH WEIGHT 1,304,000 LBS.