NEWS

NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

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**FOR RELEASE:** Sunday
June 13, 1971

RELEASE NO: 71-99

# PRESS KIT

**PROJECT:** Planetary Atmosphere Experiments Test (PAET)

## contents





6/4/71

NEWS

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## PAET LAUNCH SCHEDULED

The National Aeronautics and Space Administration will launch no earlier than June 16, 1971, a probe vehicle that will plunge back into the Earth's atmosphere at 15,000 miles an hour.

The experiment will investigate means of determining the structure and composition of an unknown planetary atmosphere.

The Planetary Atmosphere Experiments Test (PAET) is one step in providing the technical base necessary for advanced planetary exploration to Mars, Venus, and eventaully the outer planets. These planetary missions will require measurements of atmospheric properties.

PAET will be launched from the NASA Wallops Station, Wallops Island, Va. and will splash into the Atlantic Ocean about 702 miles (1,130 kilometers) down range and 98 miles (158 km) northeast of Bermuda. Total flight time is approximately 14 minutes.

Launch vehicle is the NASA Scout, a four-stage solid propellant rocket. The first two stages provide boost and coast to a maximum altitude of 234 miles (377 km) some 287 miles (462 km) down range. The Scout heat shield is separated just after reaching this altitude.

The third and fourth stages then accelerate the 137-pound entry vehicle back into the atmosphere at a speed of 22,000 feet per second (15,000 miles per hour). Separation from the fourth stage occurs 612 miles (985 km) down range at an altitude of 91 miles (146.5 km).

Instruments in the probe vehicle will be subjected to deceleration forces peaking at about 80 Gs (80 times the force of gravity) as the craft slows to 140 feet per second (95 mph). Speed at splashdown is approximately 80 fps (55 mph).

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The PAET entry vehicle is 36 inches (91.44 cm) in diameter and 25.2 inches (64 cm) long. The nose is a blunted, flattened cone and the afterbody is hemispherical in shape. The circular center section of the nose is made of beryllium, and a silicon elastomer ablator covers the aluminum structure of the remainder of the nose. The beryllium section protects a radiometer quartz window and a mass spectrometer inlet from being contaminated by ablation products. The afterbody structure is fiberglass honeycomb with a silicone elastomer ablator for thermal protection.

Experiments aboard the PAET spacecraft will investigate means of determining planetary atmosphere structure and composition. Objectives of the atmosphere structure experiment are to determine the pressure, temperature, and density changes with altitude changes and the mean molecular weight of the encountered gas, or atmosphere. Accelerometers, pressure sensors, and temperature sensors are included in the instrument package.

By looking through a quartz window in the nose of the spacecraft, a radiometer will gather data on the composition of the atmosphere by measuring emissions from the hot shock layer created in front of the craft. The amount of oxygen, nitrogen, and carbon dioxide will be determined by detection of radiation.

In a separate, secondary experiment using two of the radiometer's nine channels, the amount of water vapor present in the Earth's atomsphere will be determined by measuring the absorption of infrared radiation in sunlight reflected from the surface of the Earth.

During entry, atmospheric samples will be drawn into the spacecraft through an orifice in the nose where a mass spectrometer will determine the gas composition present.

Primary data gathering station for the PAET mission is Bermuda. The Apollo Tracking Ship USNS Vanguard, the Wallops telemetry ship Range Recoverer, and two telemetry aircraft will provide additional support. Wallops Station will track from launch to entry. Bermuda tracking will acquire soon after first stage burnout and continue into the entry period. The USNS Vanguard will also be used to insure post blackout tracking.

Recovery of the spacecraft is not required.

The PAET is the responsibility of NASA's Office of Advanced Research and Technology. The spacecraft and most of the instrument systems were designed, fabricated and tested by the NASA Ames Research Center, Mountain View, Calif. The Mass Spectrometer Composition instrument was supplied by the NASA Goddard Space Flight Center, Greenbelt, Md. The Scout Launch Vehicle program is managed by the NASA Langley Research Center, Hampton, Va.

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(END OF GENERAL RELEASE: BACKGROUND INFORMATION FOLLOWS)

## GENERAL BACKGROUND

The current NASA planetary exploration program includes missions to Mars and Venus that will require survivable atmospheric entry. The exploration of Jupiter and Saturn will also require atmospheric entry during later missions to these planets.

A major objective of these earlier missions to Mars and Venus, and the later entry missions to the outer planets will be to make measurements of atmospheric properties. By measuring the motion of the planetary entry vehicle and measurements obtained from on-board instrumentation, the structure and composition of the unknown atmosphere can be determined.

For the past eight years, Ames Research Center has conducted research on atmospheric measurements from entry probes. This program has included analysis of various techniques for determining atmospheric characteristics from measurements made during entry; the development of special instrumentation to make the measurements; determination of the characteristics which an entry vehicle must incorporate to carry out the experiments with maximum accuracy, and finally, low-speed flight tests of an atmosphere structure experiment using payloads launched from high altitude balloons. This last effort demonstrated the capability for accurately determining the atmospheric structure from measurements of acceleration, pressure and temperature.

Goddard Space Flight Center has been engaged in developing atmospheric composition measurement techniques using mass spectrometers and has been conducting measurements of the Earth's atmosphere by both rocket and satellite using the instruments. In addition, there has been a parallel program specifically oriented toward the development of mass spectrometers for atmospheric composition measurement during planetary entry. The development has emphasized reliability, light weight and efficient data transmission.

PAET will extend this technology and experience by demonstrating in the Earth's atmosphere selected planetary entry experiments and instrumentation. PAET is a project of the Entry Technology Office of NASA's Office of Advanced Research and Technology which has the major responsibility for planetary entry probe technology.

Several secondary experiments are planned. The problem of planetary relay communications will be studied by investigation of VHF radio transmission through the wake of the spacecraft and the effect of planetary probe motion on signal acquisition and bit synchronization. Atmospheric water vapor profile with changing altitude will be determined from absorption measurements of reflected sunlight in the infrared.

The PAET flight test will be conducted under conditions that provide a simulation of the entry conditions for a planetary mission. Exact simulation is not necessary since the principal effect of varying trajectory conditions is to change the range of the quantities to be measured. For example, peak deceleration during the PAET flight will be about 80 Gs (80 times the force of gravity), whereas the Viking vehicle will experience approximately 15 Earth Gs during Mars entry. A Venus probe could experience decelerations as high as 400 Gs. In each case, however, the same technique can be used to determine atmospheric characteristics from these accelerations.

## MISSION PROFILE

The first two stages of the Scout provide the PAET spacecraft with boost and coast to a peak altitude of about 1,236,000 feet or 234 miles (376,700 meters), some 287 miles (462 km) down range.

Just after reaching the maximum altitude the Scout heat shield is separated and the third stage ignition occurs. After third stage burnout, the Scout guidance system will pitch the vehicle about 60 degrees nose down to the flight path. The Scout then provides spin-up to about 150 revolutions per minute, separation of the third stage and ignition of the fourth stage.

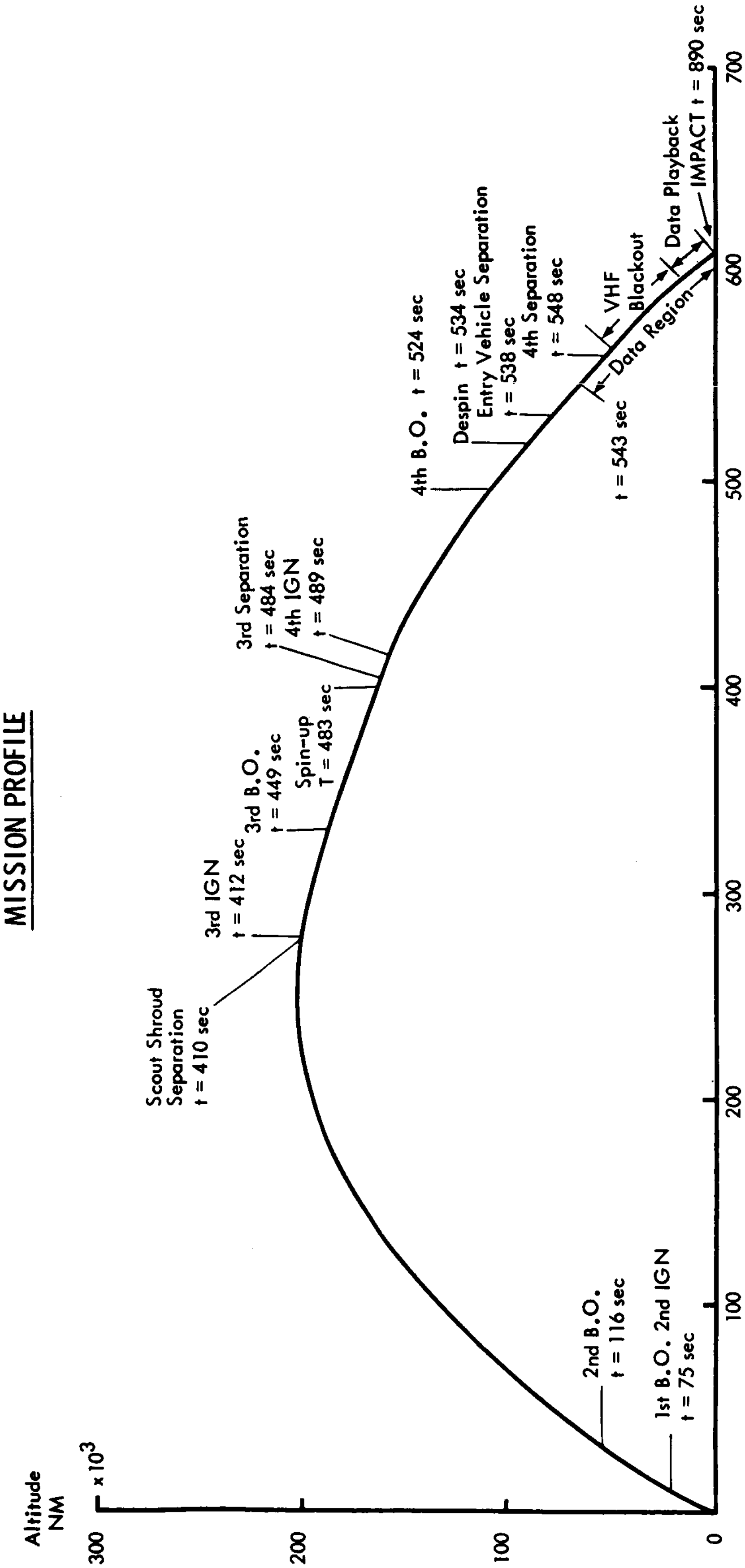
At fourth stage burnout, the spacecraft attitude will be 30 degrees nose down to the flight path. Then the spacecraft despin system will reduce the spin rate of the fourth stage-spacecraft configuration to 30 rpm.

Entry vehicle separation will occur at an altitude of about 478,500 feet or 91 miles (146.5 km), velocity of about 15,000 mph (22,000 fps, 6.7 kilometers per second) and about 612 miles (985 km) down range.

The splash point will be 702 miles (1,130 km) down range and 98 miles (158 km) northeast of Bermuda.

Entry vehicle recovery is not required, but may be attempted. If it does not break on impact, the spacecraft could float for as long as a half hour. A dye marker to aid visual sighting will be deployed and the VHF telemetry system will continue to give off a signal acting as a homing beacon.

## MISSION PROFILE



## PAET SPACECRAFT

The PAET spacecraft consists of two major assemblies, the entry vehicle and the entry vehicle separation system. Combined weight of the spacecraft is 296 pounds (134 kilograms).

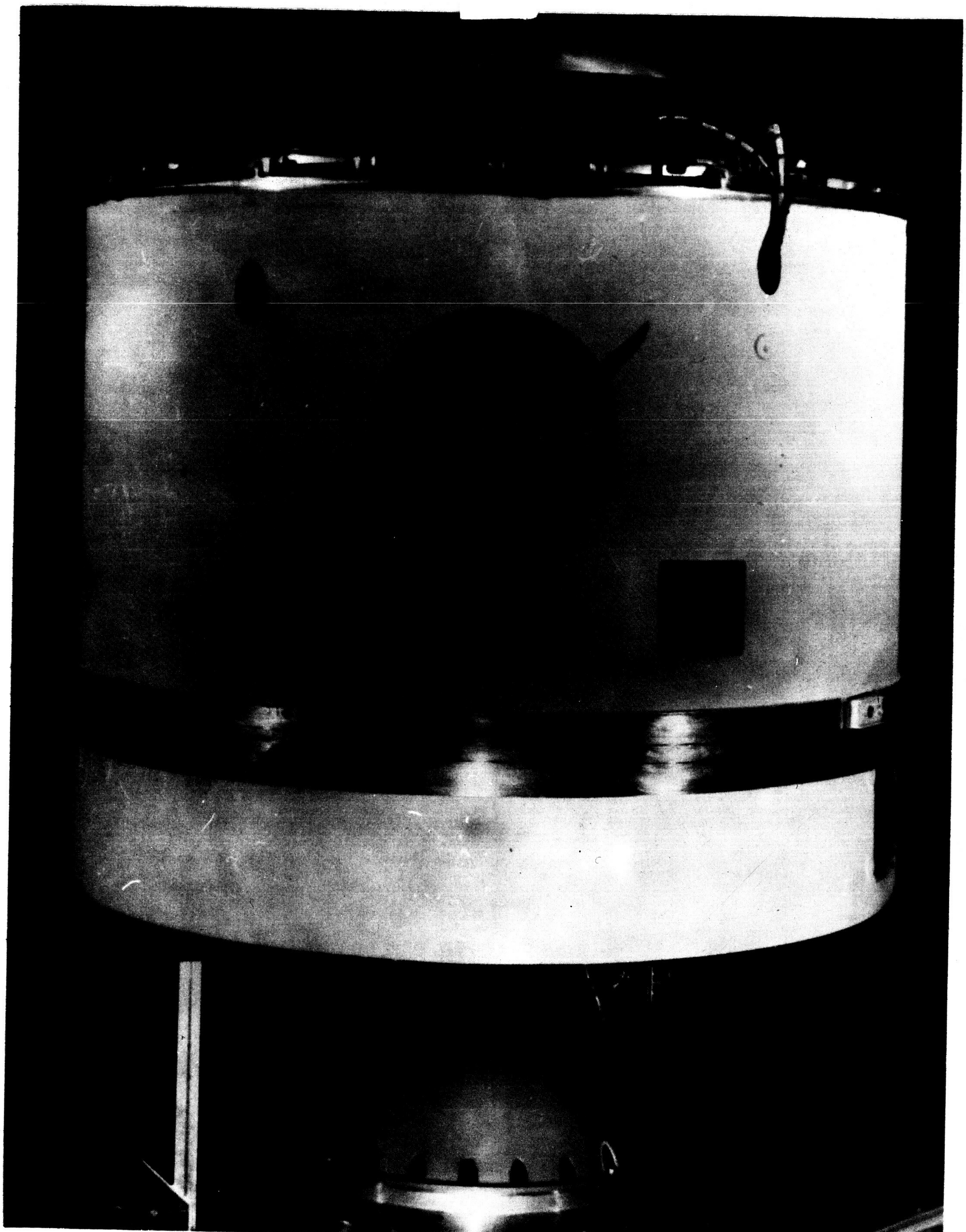
The entry vehicle contains the experiment instrumentation necessary to carry out the mission objectives. At separation it weighs 137 pounds (62 kilograms). The entry vehicle primary structure is a ring-stiffened aluminum shell on which is mounted the experiment instruments, the digital data handling and radio system, engineering data system, C-band radar transponder, pyrotechnic system, rate gyro and power system.

The entry vehicle nose is a blunted, flattened cone and the afterbody is hemisperhical in shape. The spacecraft is 36 inches (91.44 cm) in diameter and 25.2 inches (64 cm) long.

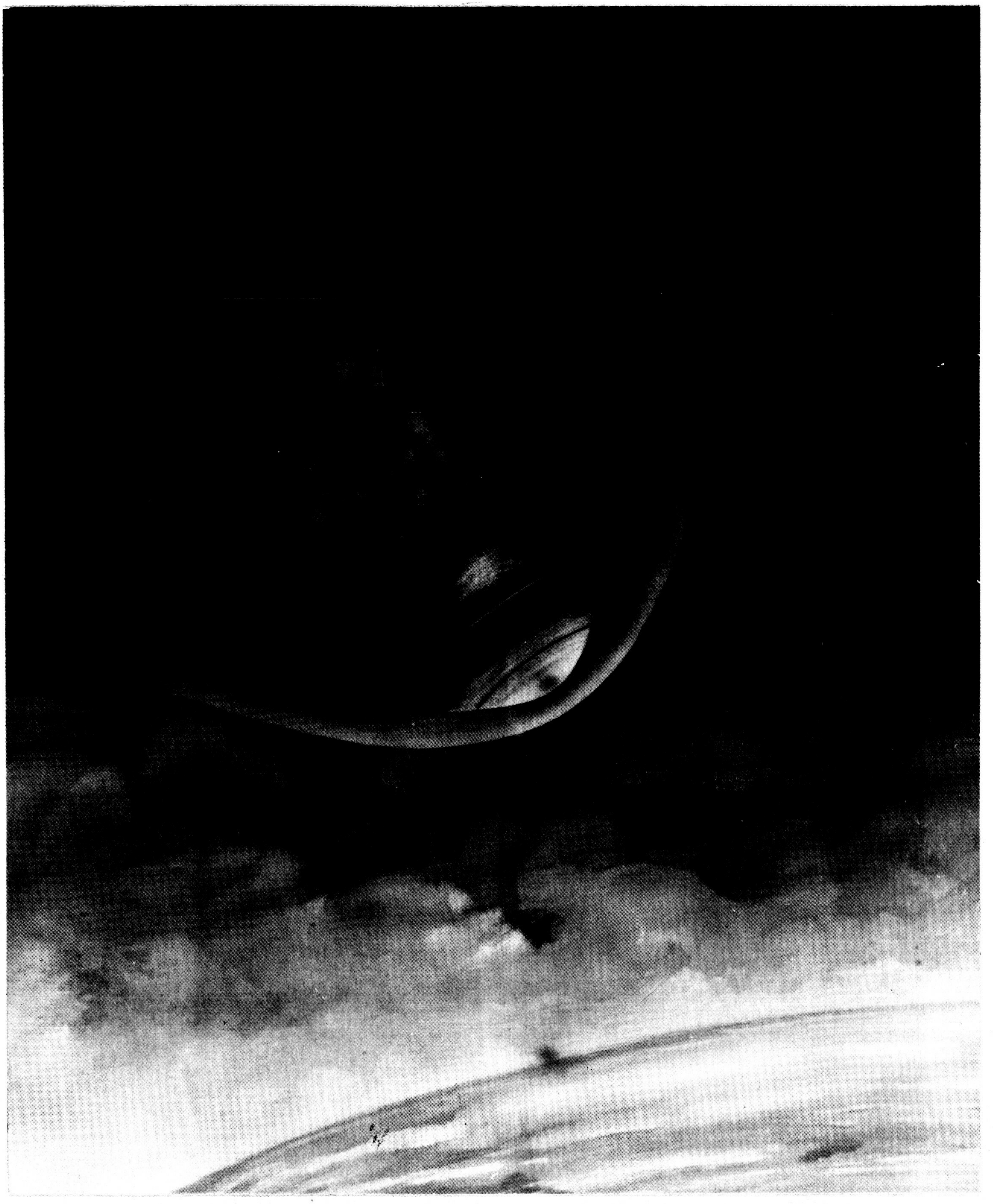
The spherical center section of the nose is made of beryllium to provide a surface around a quartz window for the radiometer and the inlet for the mass spectrometer where measurements can be made free from contamination by ablation products. Two small ports for pressure sensors are also located in the beryllium nose. A silicon elastomer ablator covers the aluminum structure of the remainder of the nose. The afterbody structure is fiberglass honeycomb with a silicon elastomer ablator for thermal protection.

The entry vehicle separation system is designed to hold the entry vehicle in the proper attitude on the launch vehicle throughout the flight to separation; to despin the Scout fourth stage and the attached PAET spacecraft; and finally, to separate the entry vehicle from the fourth stage.

A yo-yo despin system is used to reduce the spin from approximately 150 rpm to 30 rpm. Despin weights are deployed by redundant cable cutters. After despinning, a spring separates the entry vehicle from the Scout fourth stage.



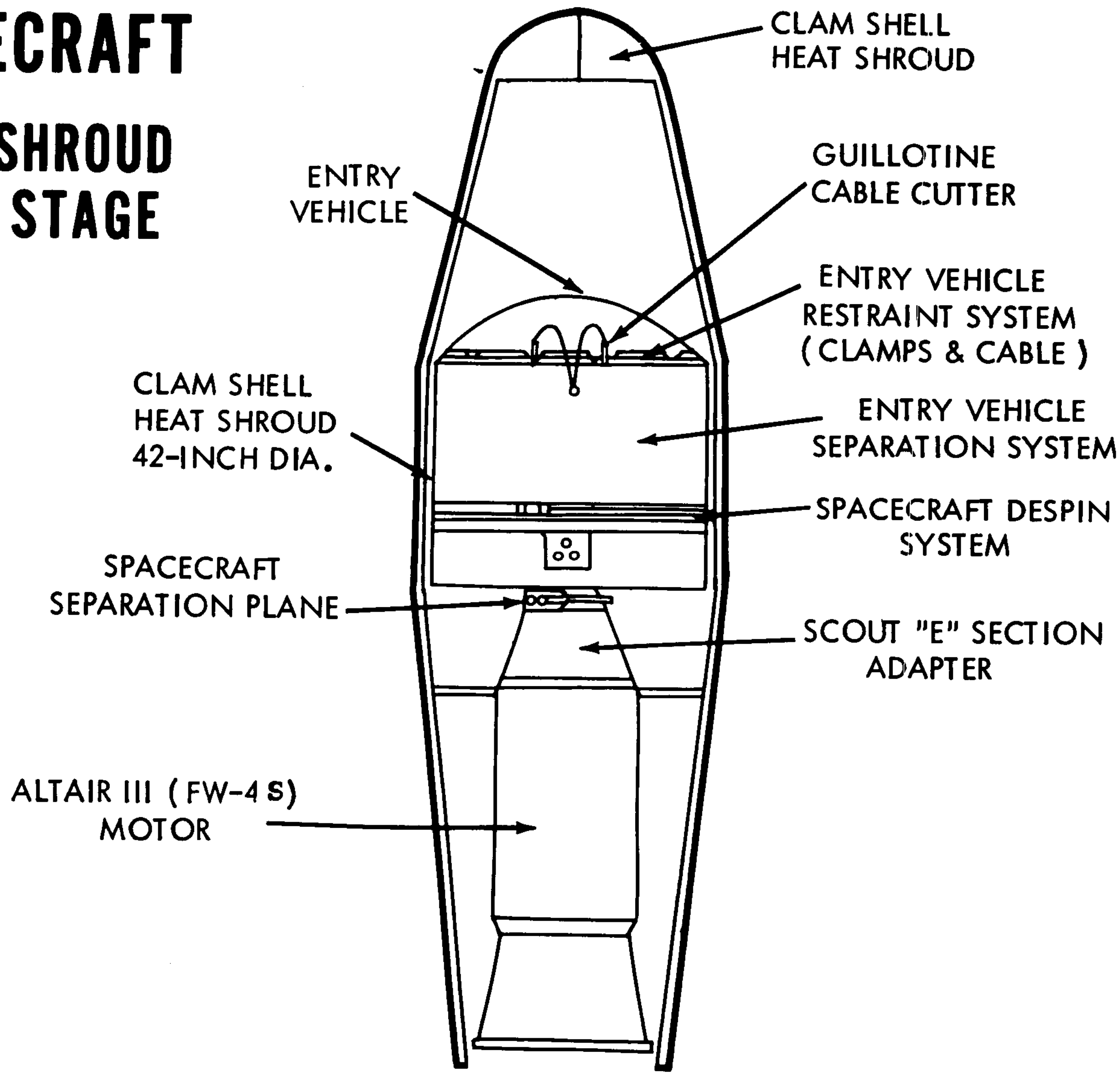
PAET SPACECRAFT

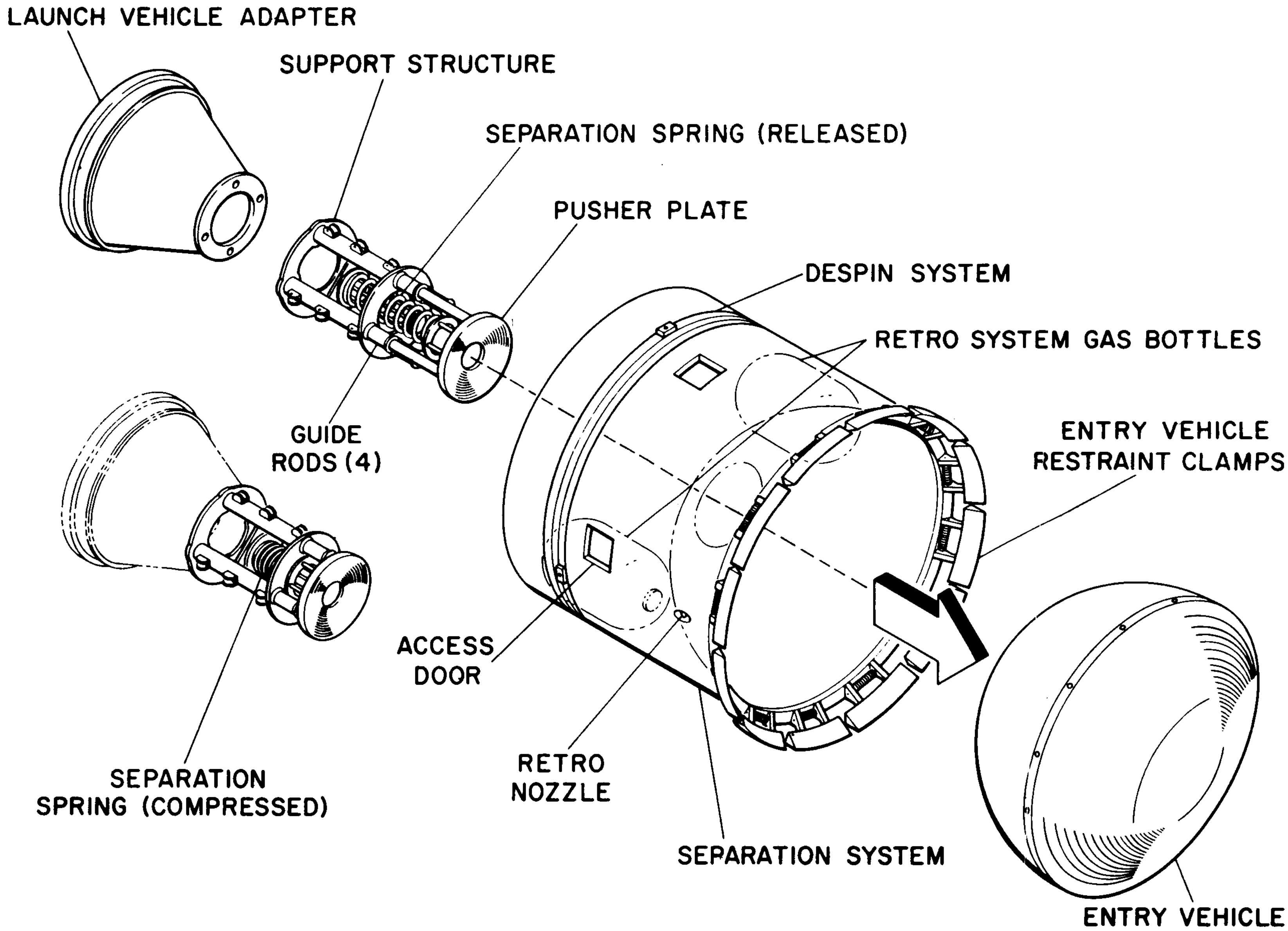


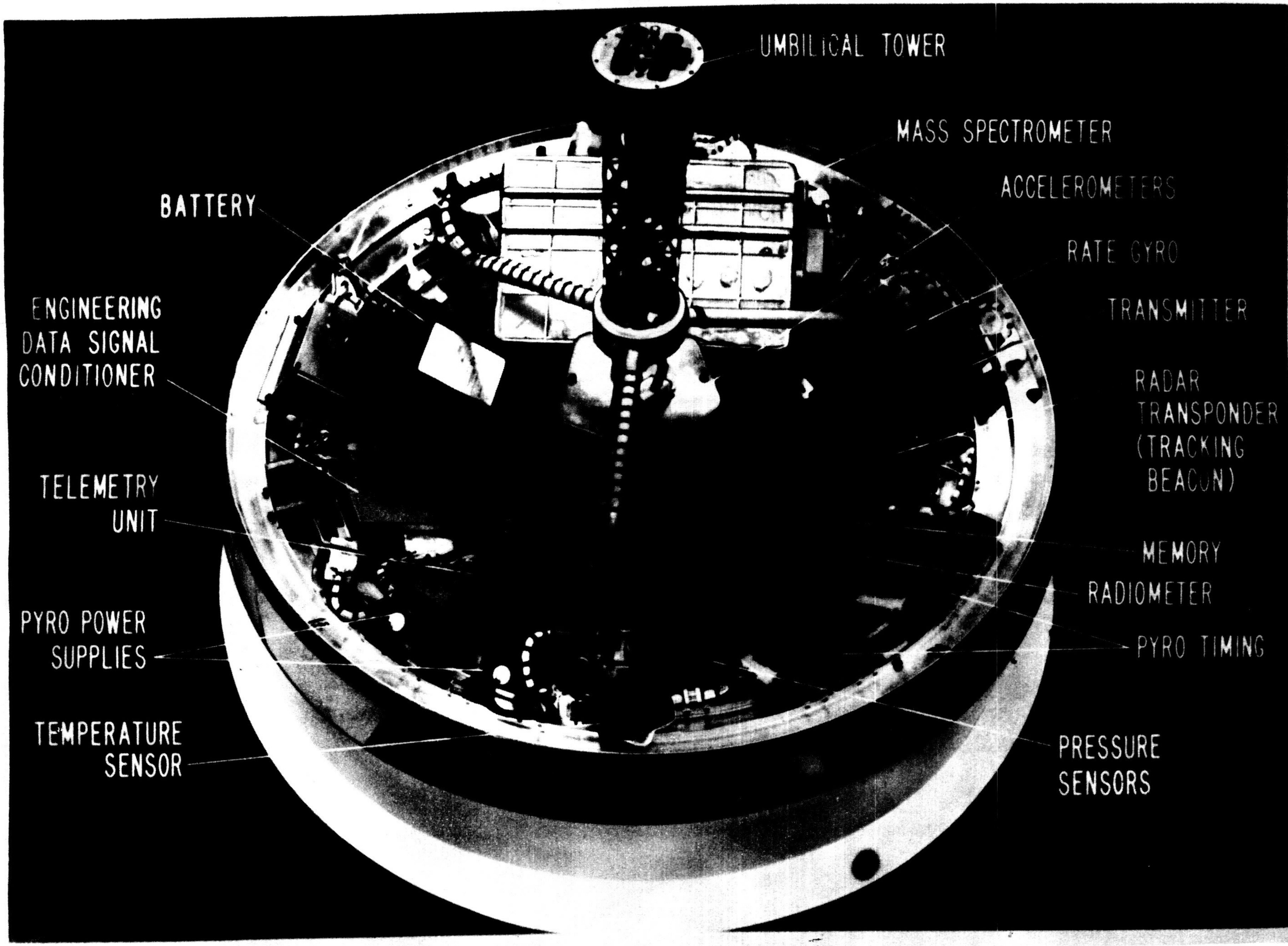
PAET ENTRY VEHICLE

# PAET SPACECRAFT

## WITH SCOUT SHROUD AND FOURTH STAGE




LAUNCH VEHICLE ADAPTER
SUPPORT STRUCTURE
SEPARATION SPRING (RELEASED)
PUSHER PLATE
DESPIN SYSTEM
RETRO SYSTEM GAS BOTTLES
GUIDE RODS (4)
ENTRY VEHICLE RESTRAINT CLAMPS
ACCESS DOOR
RETRO NOZZLE
SEPARATION SPRING (COMPRESSED)
SEPARATION SYSTEM
ENTRY VEHICLE


UMBILICAL TOWER
MASS SPECTROMETER
ACCELEROMETERS
RATE GYRO
TRANSMITTER
RADAR TRANSPONDER (TRACKING BEACON)
MEMORY
RADIOMETER
PYRO TIMING
PRESSURE SENSORS
BATTERY
ENGINEERING DATA SIGNAL CONDITIONER
TELEMETRY UNIT
PYRO POWER SUPPLIES
TEMPERATURE SENSOR

## EXPERIMENTS

### Atmosphere Structure

The objective of the atmosphere structure experiment is to determine the changes with altitude in pressure, temperature and density and the mean molecular weight of the encountered gas, or atmosphere. This is accomplished by measuring vehicle deceleration from atmospheric entry to ocean impact, and pressure and temperature from Mach 2 (twice the speed of sound) to impact.

Stagnation pressure (pressure in front of the spacecraft where the atmosphere diverges to pass on either side) will be measured using Ames-developed vibrating diaphragm sensors. The temperature of the gas flowing around the entry vehicle will be measured with a special temperature sensor developed for the PAET project. The sensor will remain inside the spacecarft until the high heating portion of the entry has passed and then will be deployed into the airstream by actuation of a spring.

### Atmosphere Composition

Data on the composition of the atmospheric gases will be obtained by measuring emissions from the hot shock layer (created directly in front of the spacecraft) in selected wavelength regions. This is done by a nine-channel radiometer observing the shock layer through a quartz window in the nose of the entry vehicle. Each radiometer channel is essentially a narrow-band optical filter passing light on to a silicon photodiode. Electronics are provided in the instrument to process the output signal from the photodiodes.

In a separate experiment using two of the radiometer channels, the amount of water vapor present in the atmosphere will be determined by measuring the amount of absorption of infrared radiation from the Sun reflected from the Earth's surface in the 0.92 micron band and comparing it with a measurement of adjoining micron bands unaffected by water vapor absorption.

### Mass Spectrometer

During atmospheric entry, gas samples will be drawn into the entry vehicle through a tiny opening in the nose and fed into the mass spectrometer to determine the gas species present in the atmosphere. The system employs an adaptive scan characteristic which measures mass concentrations.

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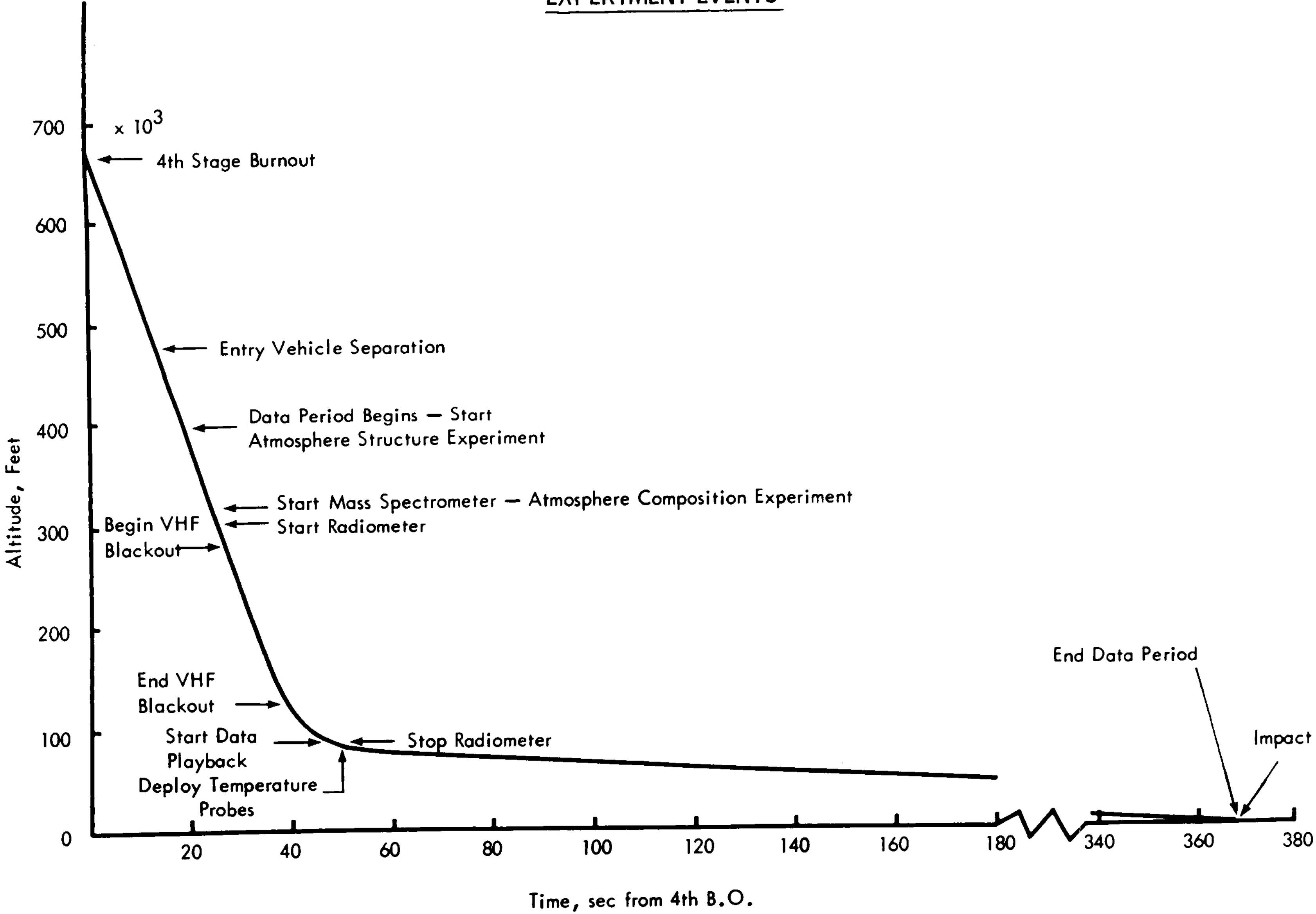
## EXPERIMENT EVENTS



## SCOUT LAUNCH VEHICLE

Scout is NASA's only solid propellant launch vehicle with orbital capacity. The first developmental Scout was launched July 1, 1960. The PAET mission will be the 73rd Scout launch. Since being recertified in 1963, the Scout launch vehicle has attained a 94 per cent success record. The PAET launch follows 17 successive, successful Scout launches.

Scout B is a four-stage solid propellant rocket system. The four Scout motors -- Algol II, Castor II, Antares II, and Altair III -- are interlocked with transition sections that contain guidance, control, ignition, and instrumentation systems, separation mechanics and the spin motors needed to stabilize the fourth stage. Control is achieved by aerodynamic surfaces, jet vanes and hydrogen peroxide jets.

The launch vehicle is approximately 73 feet (22.25 meters) long and weighs about 40,000 pounds (18, 144 kilograms) at liftoff.

The Scout program is managed by NASA's Langley Research Center, Hampton, Va.

The launch vehicle is built by Ling-Temco-Vought, Inc., Dallas.

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TRACKING AND DATA ACQUISITION

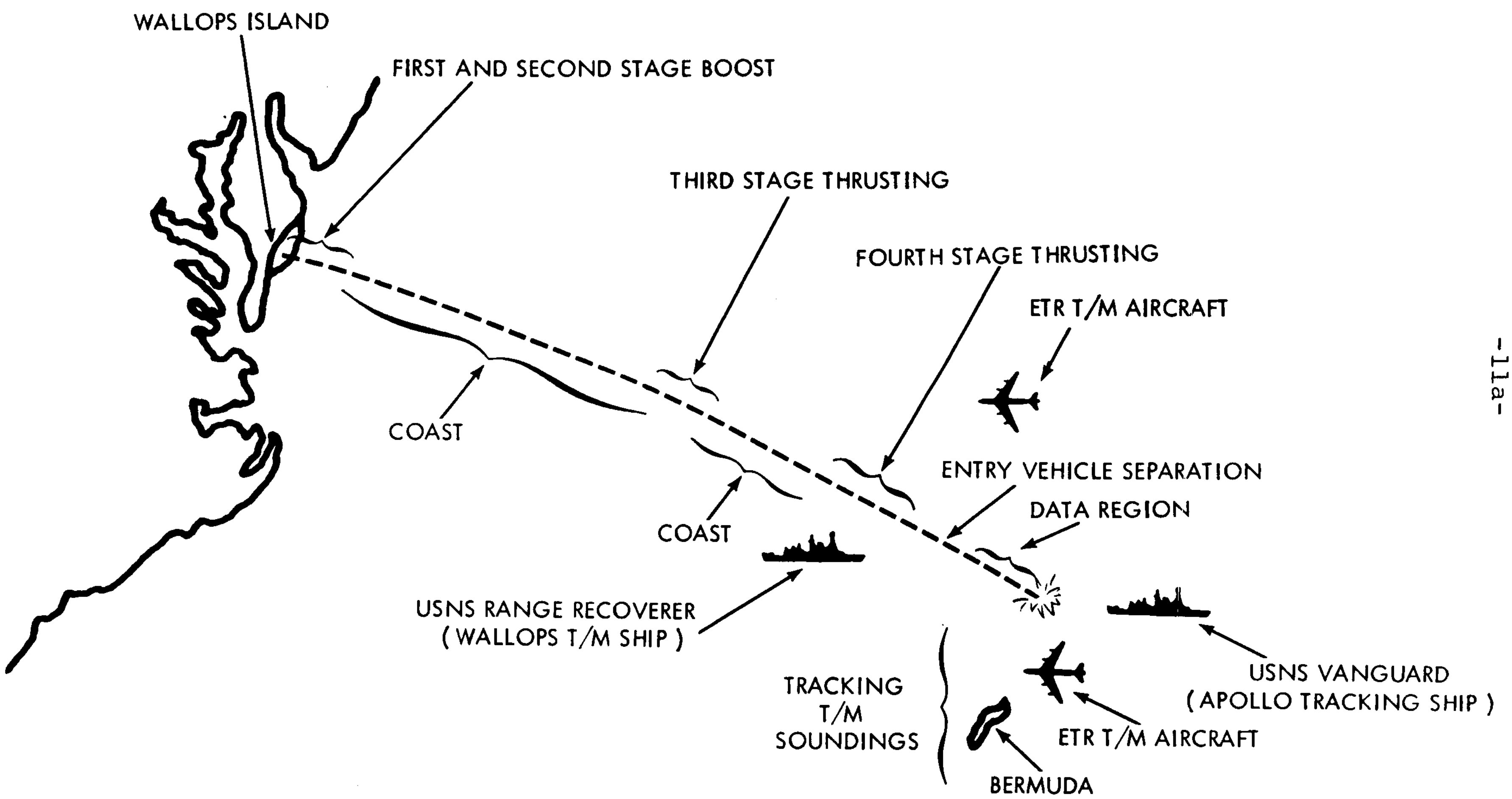
The primary data-gathering (telemetry and radar) station for the PAET mission is the Bermuda station of NASA's Manned Space Flight Network (MSFN). The MSFN Tracking Ship USNS Vanguard and three telemetry aircraft (Advanced Range Instrumentation Aircraft and one Wallops telemetry aircraft) located near the nominal impact area will provide additional telemetry coverage and will be especially important for receiving transmission of stored telemetry data after the entry vehicle has emerged from radio signal blackout.

The Wallops telemetry ship, Range Recoverer, will be about 230 miles (370 km) up range of the impact point to receive information radioed through the wake of the spacecraft. This will provide a simulation of the communications geometry between a spacecraft and a probe that has been released into an unknown planetary atmosphere and which is relaying data back to the spacecraft.

Wallops will track from launch until the PAET entry vehicle enters the data gathering region. Bermuda tracking will acquire soon after first stage burnout and continue through the mission. The USNS Vanguard will be used to insure post blackout tracking.

Meteorological measurements of atmospheric density and temperature in the region of the PAET entry flight. will be made by Arcas-Sonde and Viper-Dart sounding rockets launched from Bermuda before and after the PAET flight. In addition, high altitude weather balloons will be launched from Bermuda and standard weather balloons, radiosondes, will be launched from the USNS Vanguard.

# TRACKING AND DATA ACQUISITION



## MISSION CONSTRAINTS

Launch is restricted to the hours of 1 p.m. to 5 p.m. EDT. The opening time is established on the basis that the Sun should be behind the entry vehicle to maximize the visibility of shock-layer radiation entering the radiometer while minimizing the amount of scattered sunlight observed. Closing time is established in order to assure that an adequate amount of sunlight, reflected from the ocean surface, be admitted to the radiometer channels used in the water vapor experiment.

The Scout launch vehicle requires a 2,000-foot (609.6-meter) ceiling for launch.

The only weather restrictions in the impact area concern the meteorological rockets and balloons. Extremely high winds, lightning, or thunderstorms would affect their launch and subsequently the PAET mission.

## PROJECT OFFICIALS AND PROGRAM MANAGEMENT

The Planetary Atmosphere Experiments Test Project is a part of the program of the Entry Technology Office of the Office of Advanced Research and Technology (OART). The Technology Applications Office of OART has the management responsibility for PAET. Project management has been assigned to Ames Research Center. The Office of Launch Vehicle and Propulsion Programs of the Office of Space Science and Applications (OSSA) is responsible for the Scout Launch Vehicle Project and Scout project management has been assigned to the Langley Research Center. Tracking and Communications are managed by Goddard Space Flight Center for NASA's Office of Tracking and Data Acquisition (OTDA).

Leaders of the PAET Project Team are:

| | | |
|---|---|---|
| W. A. Guild | NASA Headquarters OART | Chief, Flight Projects |
| J. Levine | NASA Headquarters OART | Program Manager, PAET Project |
| J. E. Greene | NASA Headquarters OART | Technical Associate Atmosphere Structure & Radiometer Expts. |
| Dr. R. F. Fellows | NASA Headquarters OSSA | Technical Associate Mass Spectrometer Experiment |
| D. E. Reese | Ames Research Center | Project Manager PAET |
| P. E. Goozh | NASA Headquarters OSSA | Manager, Scout Program |
| R. D. English | Langley Research Center | Project Manager Scout Launch Vehicle |

Principal Investigators of PAET are:

| | | |
|---|---|---|
| N. Spencer | Goddard Space Flight Center | Mass Spectrometer |
| H. B. Niemann | Goddard Space Flight Center | Atmosphere Structure |
| S. C. Sommer | Ames Research Center | Atmosphere Structure |
| E. E. Whiting | Ames Research Center | Radiometric Composition |

## SEQUENCE OF EVENTS

| EVENT | TIME (Sec.) |
|---|---|
| Liftoff | 0.00 |
| First Stage burnout | 75 |
| Second stage ignition | 75 |
| Second stage burnout | 116 |
| Scout Shroud Separation | 410 |
| Third stage ignition | 412 |
| Third stage burnout | 449 |
| Spin-up | 483 |
| Third stage separation | 484 |
| Fourth stage ignition | 489 |
| Fourth stage burnout | 524 |
| De-spin | 534 |
| Entry vehicle separation | 538 |
| Pass through 400,000 feet (121,900 m.) | 544 |
| Begin blackout | 552 |
| End blackout | 564 |
| Splash | 890 |

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