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DATA BOOK FOR ENVIRONMENTAL TESTING AND SPACECRAFT EVALUATION

Prepared By

TEST AND EVALUATION DIVISION

GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

PREFACE

The purpose of this data book is to keep Test and Evaluation Division engineers abreast of pertinent current developments in NASA programs and provide an up-to-date reference book for environmental testing and spacecraft evaluation.

VOLUME 1

Sections I and II present the current status of Goddard satellite and NASA launch vehicle and sounding rocket programs.

Section III summarizes currently effective levels for Goddard environmental testing of Spacecraft and sounding rockets. This Section also contains a bibliography of reports on past and current Goddard environmental test programs.

VOLUME 2

Sections IV and V summarize scientific and engineering data on the space and launch environments, respectively, which Goddard spacecraft encounter. Section VI will summarize data on the pre-launch environment when completed.

As the NASA Environmental Design Criteria documents now under preparation at various NASA centers are completed and approved, Section IV will be revised as indicated by the contents of these papers. Preparation of Section VI likewise will take advantage of these documents.

Appendix A is a glossary containing definitions of common space terms as well as definitions which particularly apply to environmental test and evaluation activities. It has the specific purpose of providing standardized definitions for terms commonly used in reports and specifications which originate in the Test and Evaluation Division.

Appendix B consists of an international log of space launches which contains key data on all launches since the first Soviet shot on October 4, 1957.

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SECTION I

GODDARD SPACE PROJECTS

UNIT

1 COMMUNICATIONS
2 METEOROLOGY
3 SCIENTIFIC

UNIT 1

COMMUNICATIONS PROJECTS

(Status as of March 1966)

ECHO

RELAY

SYNCOM

EARLY BIRD

ECHO

SPACECRAFT

Vertical Shots
Application Vertical Tests (AVT–1 and 2)

Orbital Shots
Echo I and II

MANAGEMENT

Orbital Spacecraft System (Balloon and Canister), Echo II
Goddard Space Flight Center

Spacecraft System (Balloon and Canister) for Application Vertical Tests (AVT) and Echo I
Langley Research Center

Tracking and Data System
Goddard Space Flight Center

Beacons
Goddard Space Flight Center

Thor Launch Operations for Application Vertical Tests (AVT)
Goddard Space Flight Center

Thor-Agena B for Orbital Launch, Echo I
Marshall Space Flight Center

Thor-Agena B for Orbital Launch, Echo II
Lewis Research Center

CONTRACTORS

G. T. Schjeldahl Co., Northfield, Minnesota
Fabrication of inflatable sphere (Echo II)

Grumman Aircraft, Long Island, New York
Balloon canisters

Aero-Geo-Astro, Alexandria, Virginia
Tracking beacons for orbital mission

Douglas Aircraft, Santa Monica, California
Design of (97 lbs) ejection capsule for AVT Thor (first stage of launch vehicle)

Lockheed (Lockheed Missile and Space Division, Sunnyvale, California)
Agena B (Injection stage of launch vehicle)

Space Recovery Systems Inc.
Data capsules

D. B. Milliken Co., Arcadia, California
Motion picture camera in ejection capsule

RCA (Astro-Electronics Division, Princeton, New Jersey)
Telemetry beacon for AVT

Siegler Corp. (Hallamore Electronics, Anaheim, California)
Television monitoring camera in booster

OBJECTIVES

Development and demonstration of a passive communications satellite

Data acquisition and tracking studies

Communications experiments

EXPERIMENTS

Determination of environment inside spacecraft with temperature and pressure sensors

Ground station to ground station transmissions reflected off spacecraft, conducted by Air Force, Bell Telephone Lab, and others

Television coverage from Agena of deployment of Echo II sphere

SPACECRAFT DESCRIPTION (ECHO II)

WEIGHT

Approximately 550 lbs balloon
Total about 750 including canister, shroud, and adapter

MOMENT OF INERTIA

Lateral (Launch Mode): 17.42 slug-ft^2

CONFIGURATION

135-foot diameter rigidized laminated aluminum-mylar sphere

TELEMETRY

2 beacons, using 136.020 Mc and 136.120 Mc respectively, each transmitting temperature and pressure data at 25 milliwatts on subcarrier IRIG channels 2, 3, and 4

POWER SUPPLY

Solar cells and nickel cadmium storage batteries

LAUNCH VEHICLES

Application Vertical Tests
Modified Thor

Orbital Launch
Thor-Agena B

LAUNCH RANGE

Application Vertical Tests
Cape Kennedy

Orbital
Pacific Missile Range, California

ORBIT (ECHO II)

Altitude – About 750 miles in circular orbit
Inclination – 82°
Period – 109 minutes
Lifetime – 2 years

TRACKING

Worldwide Minitrack network

ENVIRONMENTAL TEST PROGRAM

ECHO II BALLOONS

Static inflation tests were accomplished at NAS, Lakehurst, New Jersey, in June and December 1963, to determine optimum balloon pressure and rigidity characteristics.

CANISTERS

Canister environmental testing (consisting of vibration, acceleration, and leak tests) has been completed at Grumman Aircraft.

Testing of an Echo II Canister with a balloon packed inside was accomplished at Grumman, followed by partial deployment of balloon at GSFC, in a vacuum chamber in July, October, and December 1963.

PROJECT HISTORY

May 1960
First operational launch unsuccessful (Echo I)

August 1960
Completely successful operational launch (Echo I)

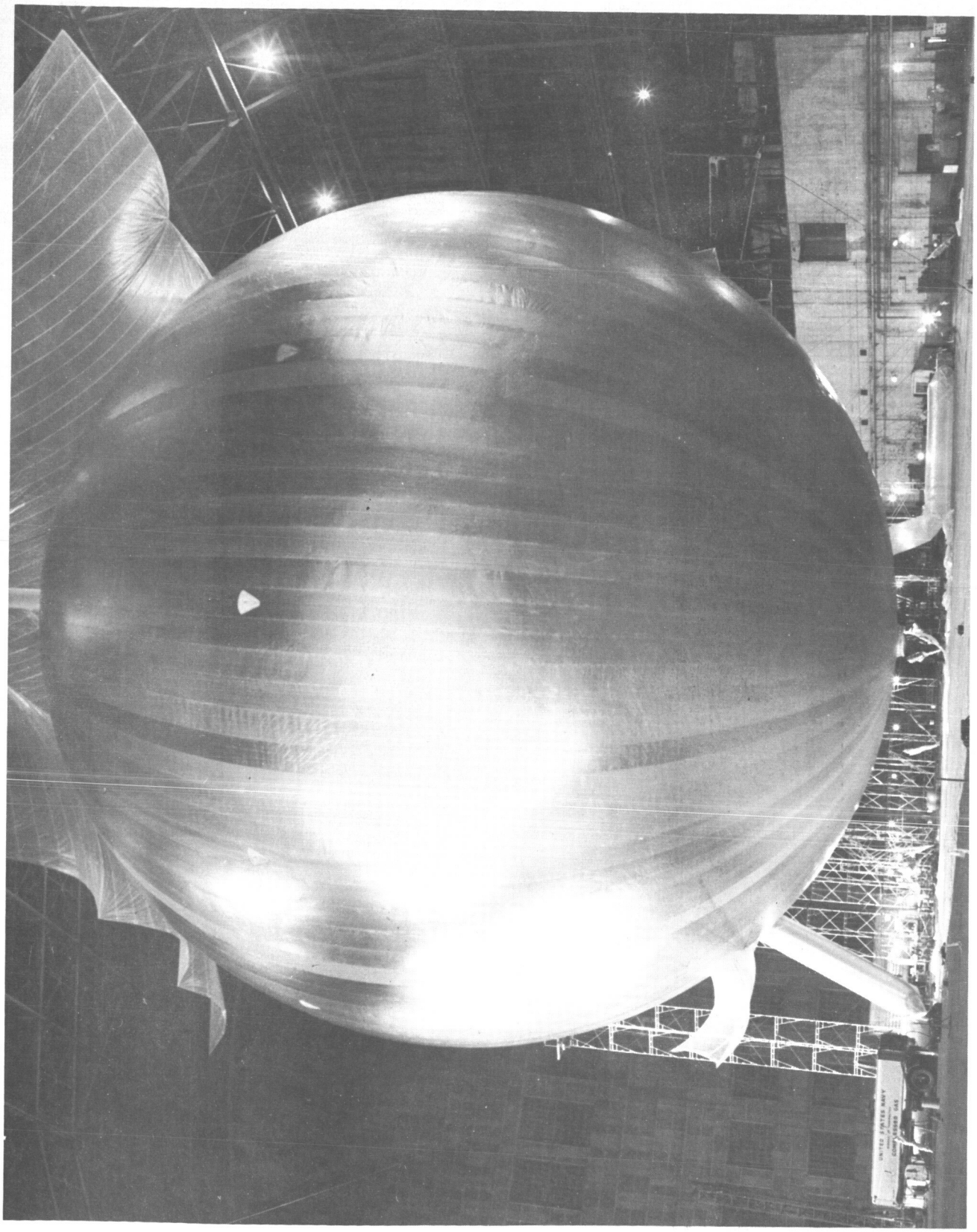
January 1962
First Application Vertical Test (AVT–1) launch; balloon ejected at 950-mile altitude, but split apart at seams

July 1962
Second Application Vertical Test (AVT–2) launch; balloon ejected and inflated to nearly spherical shape but with less than sufficient pressure to yield the aluminum in order to rigidize the sphere.

January 25, 1964
Echo II launched into orbit

COMMENT

New techniques in design have resulted in the fabrication of inflatable spacecraft which should remain relatively smooth and spherical for several years. This improvement plus an increase in the diameter of Echo II from 100 to 135 feet should produce greater reflectivity and result in a higher signal level. A controlled rate of inflation has been developed to prevent a rapid inflation which could be damaging.



ECHO II
(Static Inflation Test)

RELAY

SPACECRAFT

Relay I and II

MANAGEMENT

Spacecraft System
Goddard Space Flight Center (GSFC)

Tracking and Data System
GSFC

Launch Vehicle System
GSFC

CONTRACTORS

Astro-Electronics Division, RCA, Princeton, New Jersey
Fabrication of spacecraft

Space Technology Laboratories, El Segundo, California
System study, analysis, and coordination required for experiments

OBJECTIVES

1. To investigate long-range wideband and narrowband communications between distant ground stations via an instantaneous active communications repeater aboard a low-altitude orbiting spacecraft.

2. To measure effects of space environment on the system, including extent of radiation damage to critical components such as solar cells and density of radiation at orbital altitudes.

3. To obtain experimental estimates of component life-time by correlation of above radiation findings with measurements of integrated flux and energy levels of protons and electrons.

EXPERIMENTS

COMMUNICATIONS

1. Investigate feasibility of using Relay for TV transmissions by transmitting TV pictures and test patterns between the United States and Europe with the audio portion of signal carried by an aural subcarrier inserted at baseband above the television signal.

2. Investigate telephone transmission feasibility and quality with testing one-way and two-way messages.

3. Measure RF power received by ground station and correlate with expected power, in order to obtain data on the effects of weather, spacecraft attitude, spacecraft aging, and antenna-pointing accuracy.

4. Measure frequency variations caused by the Doppler shift to obtain data for compensation of its effects.

5. Participants

United States
- AT&T Company
- IT&T Company

Great Britain
- General Post Office

France
- Centre Nationale des Etudes de Telecommunication

Brazil

Italy

West Germany

Japan

6. Ground Stations

Wideband
- Rumford, Maine
- Pleumeur-Bodon, France
- Goonhilly, England
- Weilhelm, West Germany

Narrowband
- Nutley, New Jersey
- Rio de Janeiro, Brazil

Test
- Mojave, California
- Wallops Station, Virginia

RADIATION

1. Measure extent of radiation damage to solar cells and other silicon semiconductor devices in the environment of the inner Van Allen radiation belt.

2. Measure amount of radiation, thus providing overall mapping of space radiation in the spacecraft orbit.

3. Monitor attitude of the spacecraft by means of a solar-aspect indicator which provides data for computing attitude in earth's coordinates.

SPACECRAFT DESCRIPTION (RELAY I AND II)

WEIGHT

Relay I – 171.9 lbs
Relay II – 183.5 lbs

MOMENT OF INERTIA (Thrust Axis)

Relay I – 124.5 lbs-ft^2
Relay II – 132.4 lbs-ft^2

DIMENSIONS

29.8 in. diameter
32.7 in. long

TELEMETRY

Transmitter #1 – 136 Mc
Transmitter #2 – 137 Mc
Command Receiver – 150 Mc

STABILIZATION

Inertial; spin rate of 150 rpm ±10% imparted at injection

ATTITUDE CONTROL SYSTEM

Magnetic

Multi-turn coil about periphery of spacecraft, horizon scanner, and sun angle sensor

COMMUNICATIONS SUBSYSTEM

Reception

One-way

1725 Mc at power level of -80 to -40 dbm

Two-way

1723.333 Mc and 1726.667 Mc at power level of -60 to -40 dbm

Transmission

One-way

4170 Mc at minimum power of 5 watts

Two-way

4165 Mc and 4175 Mc at minimum of 2 watts each

Tracking Beacon

4080 Mc at 40 milliwatts

POWER SUBSYSTEM

Batteries

Nickel cadmium cells connected in series to provide 28V DC

Power Drain

Continuous – 10.4 watts
Telemetry – 7.27 watts
Communications – 84.5 watts
Radiation Experiment – 5.52 watts

Solar Cells

P-on-N cells covered by 60-mile glass shields (Relay I)
N-on-P cells (Relay II)
Area normal to sun line – 5 square ft

LAUNCH VEHICLE

Three-stage Delta

LAUNCH RANGE

Atlantic Missile Range

ORBIT (RELAY I)

Apogee – 4624 miles
Perigee – 818 nautical miles
Inclination – 47.48^{o}
Period – 185 minutes
Nodal regression rate – 1.3 to 1.5 degrees per day
Lifetime – 1 year (minimum – 1 month)

ORBIT (RELAY II)

Apogee – 4600 miles
Perigee – 1325 miles
Period – 195 minutes

TRACKING

VHF Minitrack System

ENVIRONMENTAL TEST PROGRAM

LOCATIONS

Astro-Electronics Division, RCA, Princeton, New Jersey
Fine Balance

Grumman Aircraft, Bethpage, Long Island, New York
Acceleration (Relay I)

SCHEDULE

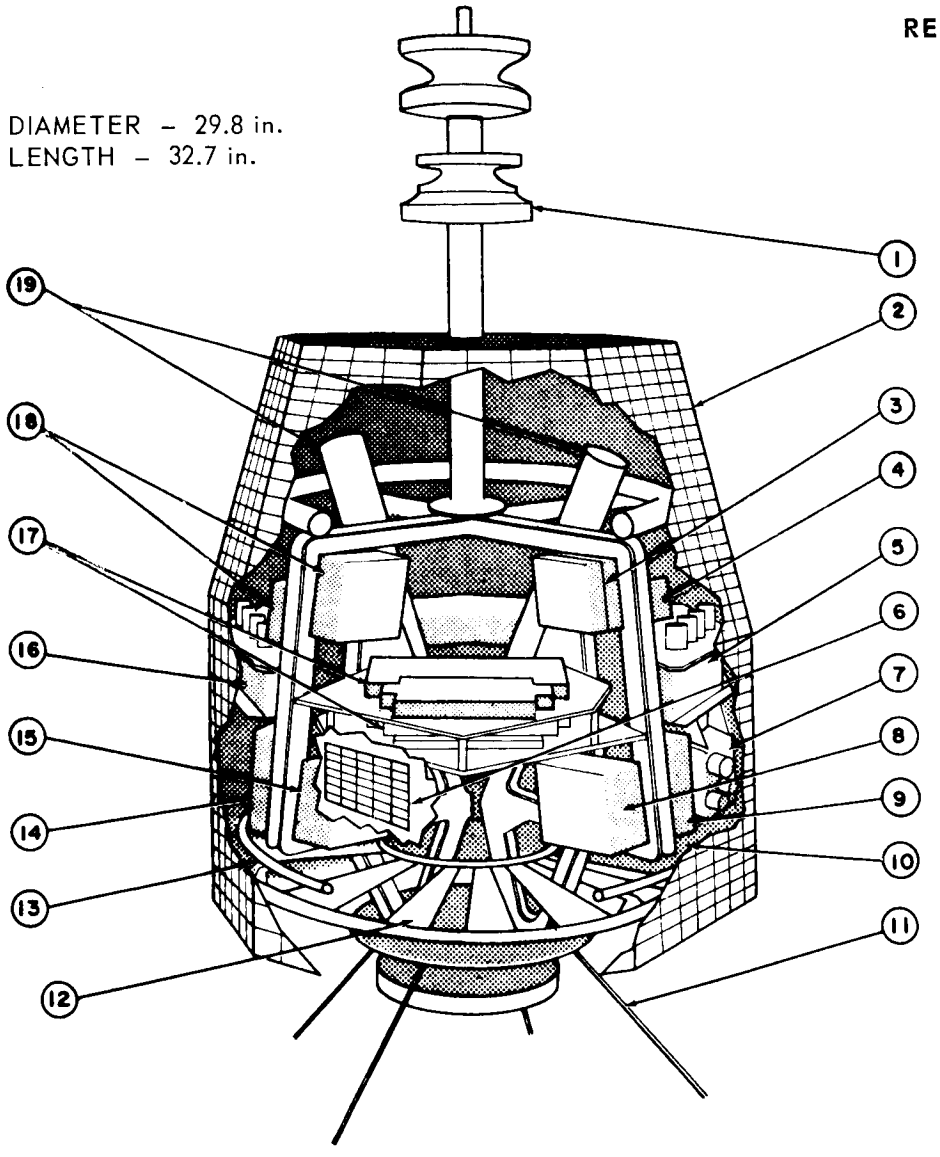
The prototype spacecraft completed design qualification tests in October 1962. Acceptance testing of Relay A-16 was completed in the latter part of 1963.

PROJECT SCHEDULE

Relay I was launched December 13, 1962

Relay II was launched January 21, 1964

DIAMETER – 29.8 in.
LENGTH – 32.7 in.



1. WIDEBAND ANTENNA
2. SOLAR PANELS
3. TELEMETRY TRANSMITTERS
4. BATTERY CHARGE CONTROLLER
5. BATTERY BOX
6. RADIATION-DAMAGE PANEL
7. SOLAR-ASPECT INDICATOR & HORIZON SCANNER
8. COMMAND CONTROL
9. RADIATION DETECTOR
10. RADIATION MONITOR (HIDDEN)
11. TT&C ANTENNA
12. THERMAL CONTROLLER
13. TWT POWER SUPPLY (HIDDEN)
14. HEAT CONTROLLER
15. COMMAND RECEIVERS
16. BATTERY BOX
17. WIDEBAND RECEIVERS
18. COMMAND DECODERS
19. TRAVELING-WAVE TUBE

Relay

SYNCOM

SPACECRAFT

Syncom I, Syncom II, Syncom III

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

CONTRACTOR

Hughes Aircraft Company, (Space Systems Division, El Segundo, California)
Spacecraft

OBJECTIVE

To place spacecraft with active communications repeaters in synchronous orbit. Syncom I is limited to a single telephone channel relay.

SPACECRAFT DESCRIPTION

WEIGHT

Syncom I - 149.88 lbs (at separation from booster)
Syncom II - 146.92 lbs (at separation from booster)
78.81 lbs (final orbital condition)
Syncom III - 145.29 lbs (at separation from booster)
73.73 lbs (final orbital condition)

MOMENTS OF INERTIA

Launch Mode (Roll)

Syncom I - 1.76 slug-ft^2 at separation
Syncom II - 2.27 slug-ft^2 at separation
Syncom III - 2.19 slug-ft^2 at separation

Final Orbital Condition

Syncom II - 1.84 slug-ft^2
Syncom III - 1.67 slug-ft^2

CONFIGURATION

Syncom I

Syncom I is a 28-inch diameter spacecraft, spin-stabilized, incorporating electronic, propulsion, and control elements, plus an electrical power supply and structure. A nitrogen and a hydrogen peroxide jet control system is used.

Syncom II

Same as Syncom I except:

1. The two telemetry transmitters will operate concurrently on two frequencies. An additional battery is provided to power one of these transmitters (and the associated encoder) directly during apogee motor firing.
2. The range filter has been removed since it is not essential to the circuitry.
3. An accelerometer and associated circuitry has been added to obtain telemetry information on acceleration, vibration, and nutation during orbit.
4. The spacecraft wiring harness has been modified to decrease the probability of failure, and to provide further assurance that failure in one portion of the harness or circuitry will not affect other portions.
5. The three year timer was deleted.
6. The JPL starfinder apogee motor replaced the Thiokol motor.
7. The ground plane finish was changed to raise the overall spacecraft temperature by 10°F.
8. Nitrogen pressure was reduced from 3670 psi to 3000 psi nominal.

Syncom III

Same as Syncom II except:

1. The nitrogen control unit was replaced with a hydrogen peroxide control unit. The spacecraft now has two redundant hydrogen peroxide units.
2. The apogee motor timer has now been deleted. The motor is now fired by command only.
3. Four temperature sensors are provided, replacing the previous two sensors.
4. The stand-by battery has been eliminated.
5. Type N-P solar cells replaced type P-N solar cells.

DIMENSIONS

Diameter - 28 inches
Height of Solar Panels - 15½ inches
Height from exit plane of apogee motor to separation plane - 31 inches
Height from end of communications antenna to ends of tracking and command antennae - 43½ inches

COMMUNICATIONS

The communications system is a redundant, frequency-translation, active-repeater system with the receivers operating at approximately 7400 Mc and the repeater transmitter operating at approximately 1800 Mc. Syncom III narrow-band transponder, which previously had a 500-Kc bandwidth, was changed to a bandwidth of 10 Mc with a capability of changing to a 50-Kc bandwidth on command.

LAUNCH VEHICLE

Syncom I and II - Delta
Syncom III - Thrust-Augmented Delta with X-258 Third Stage

LAUNCH RANGE

Atlantic Missile Range
Cape Kennedy, Florida

ORBIT

Period - 24 hours
Planned Altitude - 23,381 nautical miles in circular orbit

TRACKING

The spacecraft are tracked in orbit by the minitrack network and the communications ground stations.

COMMUNICATIONS GROUND STATIONS

Syncom I and II

Located aboard the USNS Kingsport anchored in Lagos Harbor, Nigeria; Lakehurst, New Jersey; Johannesberg, South Africa; Fort Dix, New Jersey; and Camp Roberts, California.

Syncom III

Stations will be located aboard the USNS Kingsport anchored at Guam, Mariana Islands; Lakehurst, New Jersey; Fort Dix, New Jersey; Camp Roberts, California; Clark Field in the Philippines; and Adelaide, Australia.

ENVIRONMENTAL TEST PROGRAM

LOCATION

Hughes Aircraft Company, Culver City and El Segundo, California

SCHEDULE

Prototype
October 1962 to January 1963
June to July 1963

Syncom I
Flight Acceptance - November 1962 to January 1963

Syncom II
Flight Acceptance - June to July 1963

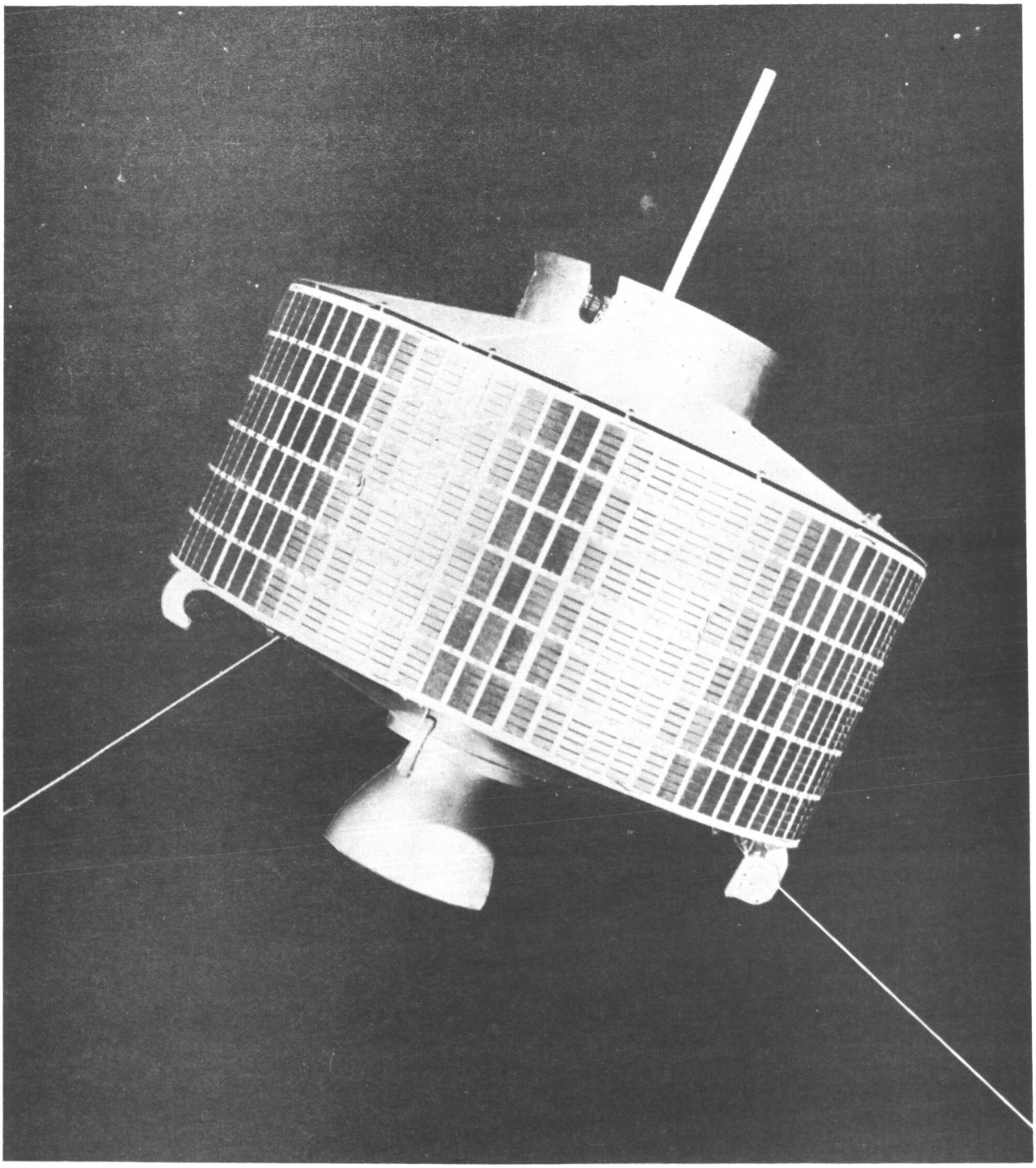
Syncom III
Flight Acceptance - Mid-March to mid-April 1964

PROJECT SCHEDULE

February 14, 1963
Launch placed Syncom I in synchronous orbit, but loss of command link prevented experimental communications.

July 26, 1963
Launch of Syncom II resulted in successful communications.

August 18, 1964
Successful launch of Syncom III.



DIMENSIONS:
Diameter – 28 inches
Height (antennae extended) – 43½ inches

SYNCOM

EARLYBIRD

SPACECRAFT

Earlybird I, Earlybird II

MANAGEMENT

Spacecraft
Communications Satellite Corp.
Technical Advisors to FCC
GSFC

CONTRACTOR

Hughes Aircraft Co. (Space Systems Division, El Segundo California).

OBJECTIVE

Place a fully functional spacecraft in a synchronous equatorial orbit that will provide 240 two way voice channels for 3 years

S/C DESCRIPTION

Weight (lbs) - Earlybird I and II
150.0 - Separation from booster
78.7 - Final orbit condition

Moment of Inertia roll slug-ft^2

2.42 Separation from booster
1.90 Final orbit condition

APOGEE MOTOR

JPL solid propellant
Weight -71.0 lbs
Max thrust - 1120 lbs
Burning time - 19.7 sec

CONTROL SYSTEM

Liquid propellant, H_2O_2 fuel. Two independent systems, 4.9 lbs each. Each system is approximately 59% full pressurized to 200 psia.

COMMUNICATIONS

Two independent frequency transtation mode transponders. Redundant 6.0 watt traveling-wave tube power amplifiers

4 db cloveleaf receiving antenna

9 db collinear array transmitting antenna

6 KMC ground-to-spacecraft signals

4 KMC spacecraft-to-ground signals

TELEMETRY

Two 1.8 watt transmitters in 136-MC band telemetry also transmitted on transponder 4 KMC beacon signals
Two encoders, PAM/FM

COMMAND

Commands injected into spacecraft through transponder receivers. Two decoders.

ELECTRICAL POWER

45 watt, N-on-p solar cell array; 36 watt - hour rechargeable nickel-cadium batteries.

DIMENSIONS

Diameter - 28 in.
Height - 23.25 in.
Height including apogee motor nozzle - 31.0 in
Length of communications antenna 16 in.

LAUNCH VEHICLE

Earlybird I - TAD

LAUNCH RANGE

AMR

ORBIT

24 hour period
Alt - 23, 381 N.M.

GROUND STATIONS

Command, operation and monitoring of the spacecraft is performed at Andover, Maine. Minitrack stations can receive telemetry only.

ENVIRONMENTAL TEST PROGRAM

LOCATION

Hughes Aircraft Company, El Segundo, California

SCHEDULE

Earlybird I	December 1964 to March 1965
Earlybird II	December 1964 to March 1965
	November 1965 to January 1966

PROJECT SCHEDULE

April 6, 1965
Launch placed Earlybird I into synchronous, equatorial orbit

Earlybird II will not be launched unless Earlybird I fails.

UNIT 2

METEOROLOGY

PROJECTS

(Status as of March, 1966)

TIROS

NIMBUS

TOS

TIROS

SPACECRAFT

TIROS A, B, C, D, E, F, G, H, I, J, and K

Operational TIROS (OT)
OT 1, 2, and 3

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

Tracking, Command, Data Acquisition, IR Experiments
GSFC

Operational Use of Data
National Environmental Satellite Center (NESC)
formerly U. S. Weather Bureau

Research Use of Data
GSFC and NESC

CONTRACTOR

RCA (Astro-Electronics Division, Princeton, New Jersey)
Fabrication and testing of spacecraft

OBJECTIVES

To launch satellites for observing atmospheric conditions with television camera and radiation sensors in order to provide meteorological data for ESSA until an operational meteorological satellite system can be developed.

To assist GSFC in the study of atmospheric physics and in the development of an operational meteorological satellite system.

SPACECRAFT DESCRIPTION (TIROS E, F, G, H, I, & OT-1 OT-3)

WEIGHT

281 lbs (TIROS F)
300 lbs (TIROS G)
260 lbs (TIROS H)
300 lbs (TIROS I)
288 lbs (TIROS OT-1)
304 lbs (TIROS OT-3)
283 lbs (TIROS OT-2)

MOMENT OF INERTIA

Launch Mode

Thrust - 168.05 lbs-in-sec^2 (OT-2)
Transverse - 116.47 lbs-in-sec^2 (OT-2)

Orbital

Thrust - 165.44 lbs-in-sec^2 (TIROS OT-2)
Transverse - 115.69 lbs-in-sec^2 (TIROS OT-2)

CONFIGURATION

Shaped like a drum, top and sides covered with solar cells.

DIMENSIONS

Diameter - 42 inches
Height - 22 inches

SPACECRAFT SUBSYSTEMS (TIROS E, F, G, H, I, & OT-1, OT-3, OT-2)

CAMERAS (With 1/2 in. vidicon tubes)

1. Wide-angle Elgeet lens to cover 900 miles on a side from altitude of 400 miles (E, F, G, H, I, & OT-1)

2. Medium-angle Tegea lens to cover 550 miles on a side (E, F)

3. Automatic Picture Transmission Camera, 1 inch vidicon, giving 800 line picture

SPACECRAFT SUBSYSTEMS AND SUPPORT

IR Horizon Scanner
North Indicator
Despin Weights
Spin-up Rockets
Magnetic Attitude Control Coil
9260 Solar Cells
63 Nickel/Cadmium Batteries
Two Tracking Beacons
Four Telemetry Antennas
One Receiving Antenna
Three IR Experiments (Disconnected in TIROS E because of failure in test)
Spin Control Coil
Quarter Orbit Magnetic Attitude Control (QOMAC)

LAUNCH VEHICLE

Thor-Delta

ORBIT (NAUTICAL MILES)

TIROS F

Apogee	-442 miles
Perigee	-425 miles
Inclination	-58.3°
Period	-98.7 minutes
Designed Life*	- 5 months
Status	-inactive

*TIROS E was active for 10.5 months.

TIROS G

Apogee	- 350.8 miles
Perigee	- 333.5 miles
Inclination	- 58.5°
Period	- 97.4 minutes
Designed Life	- 5 months
Status	- active

TIROS H

Apogee	- 412 miles
Perigee	- 374 miles
Period	- 99.3 minutes
Inclination	- 58.5°
Status	- active

TIROS I

Apogee	- 1392 miles
Perigee	- 386 miles
Period	- 119.1 minutes
Inclination	- 96.4°
Status	- active

TIROS OT-		TIROS OT-3	TIROS OT-2
Apogee	- 458 n miles	463 nm	763 nm
Perigee	- 400 n miles	379 nm	731 nm
Inclination	- 98.63°	100.22 min	113.42 min
Status	- active	97.893°	101.003°
		Active	Active

TRACKING

Minitrack Network
Primary Command Stations
Wallops Island, Virginia
PMR (San Nicolas Island, California)

Auxiliary Command Station
Santiago, Chile

Ground Stations
Princeton, New Jersey
Fairbanks, Alaska
Wallops Island, Virginia

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA (Astro-Electronic Division, Princeton, New Jersey)
Spacecraft

PROJECT HISTORY

Launches - 12
Satellites in Orbit - 12
Time of Launches
TIROS A - April 1, 1960
TIROS B - November 23, 1960
TIROS C - July 12, 1960
TIROS D- February 8, 1962
TIROS E- June 19, 1962
TIROS F- September 18, 1962
TIROS G- June 19, 1963 (active)
TIROS H- December 21, 1963 (active, but APT camera degraded)
TIROS I- January 22, 1965 (Active)
TIROS OT-1 - July 2, 1965 (Active)
TIROS OT-3 February 2, 1966 (Active)
TIROS OT-2 February 28, 1966 (Active)

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA (Astro-Electronic Division, Princeton, New Jersey)
Spacecraft

SCHEDULE

TIROS OT-1

Spacecraft Flight Acceptance testing to be completed in 2nd quarter, 1965

TIROS OT-3

Spacecraft Flight Acceptance testing 50% complete as of January, 1965. Remainder scheduled for 3rd quarter, 1965.

PROJECT HISTORY

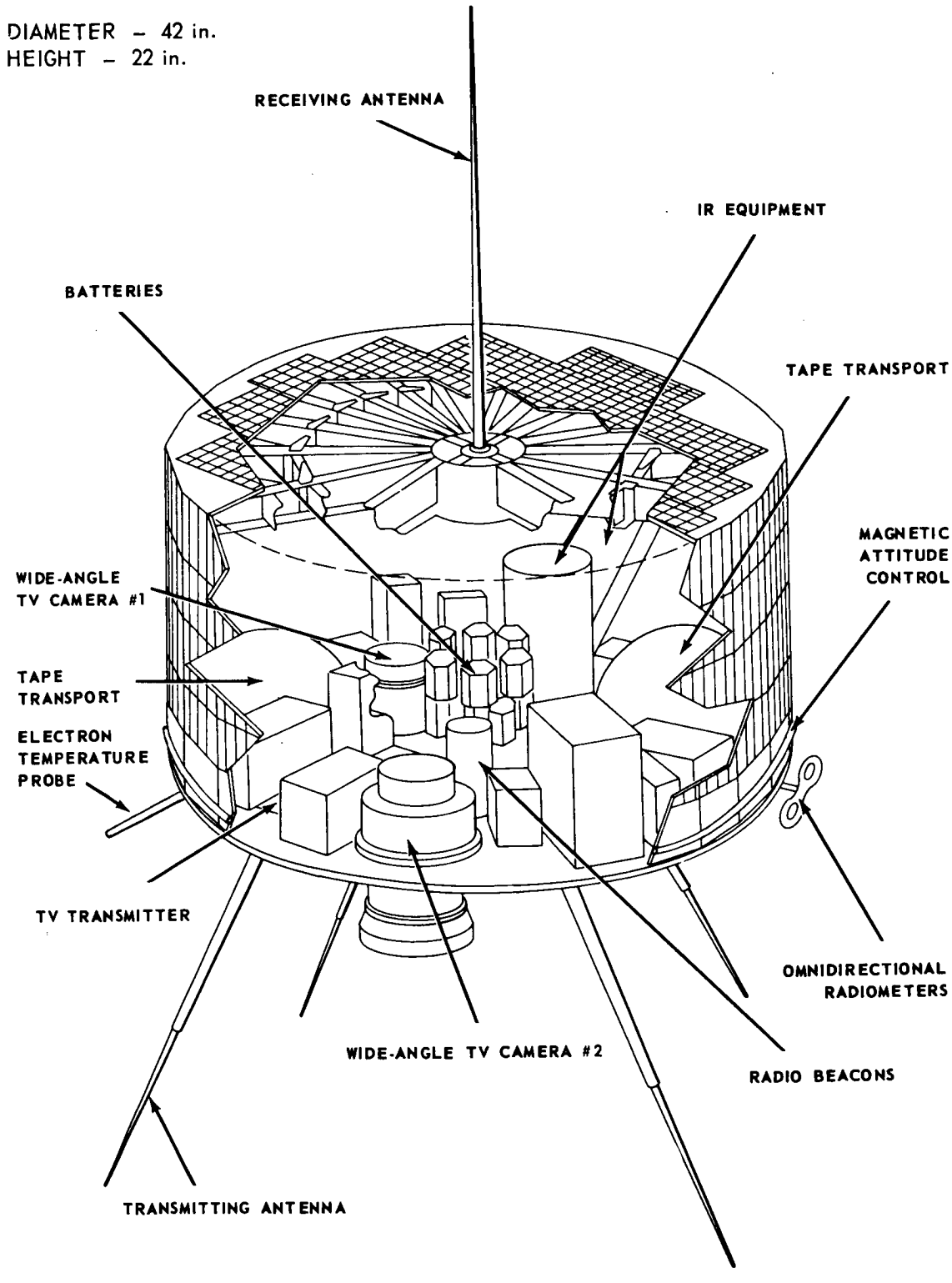
Launches - 9
Satellites in Orbit - 9
Time of Launches
TIROS A - April 1, 1960
TIROS B - November 23, 1960
TIROS C - July 12, 1960
TIROS D - February 8, 1962
TIROS E - June 19, 1962
TIROS F - September 18, 1962
TIROS G - June 19, 1963 (active)
TIROS H - December 21, 1963 (active, but APT camera degraded)
TIROS I - January 22, 1965

PROJECT SCHEDULE

3rd Quarter, 1965 - TIROS OT-1
4th Quarter, 1965 - TIROS OT-3
1st Quarter, 1966 - TIROS OT-2
2nd Quarter, 1966 - TIROS K

UNSCHEDULED LAUNCHES PENDING

J and L missions



TIROS
(Standard Configuration)

CURRENT STATUS OF OT-3*

The eleventh in the TIROS series, TIROS OT-3, will be the first of the TOS series of operational meteorological satellites. It will be launched from the Eastern Test Range (ETR) by a Delta vehicle in the first quarter of calendar year 1966. It will have a nominal 400-nm circular, near-polar sun-synchronous orbit, 81.64 degrees retrograde, with an orbital period of 99.6 minutes. After launch TIROS OT-3 will be spin-stabilized and magnetically torqued to a wheel attitude, so that the spin axis will be normal to the plane of the orbit and the cameras will view the earth radially, once during each revolution. The orbital plane will precess easterly about 1 degree a day at the same rate as the earth-sun line. The launch will occur at approximately 0800 GMT so that the spacecraft will view the equator at 1430 pm local time and acquire maximum solar power. TIROS OT-3 will take pictures of the entire earth each day. The 305-pound spacecraft will have two 1/2-inch vidicon TV cameras, canted 26.5 degrees to each side of the plane of rotation.

TV and spacecraft engineering data will be acquired by command and data-acquisition (CDA) stations located at Wallops Station, Va. (WALACQ) and at the GSFC-operated NASA data-acquisition facility (DAF) at Gilmore Creek, Alaska (GILMOR). The data will be sent by data link and teletype to the appropriate users. GSFC will process the beacon telemetry and station events and will determine the spacecraft attitude daily. Video data for research and meteorological operations will be transmitted from the CDA stations to the National Environmental Satellite Center (NESC) at Suitland, Md.

*Extracted from "Tiros Mission Operation Plan" (X-482-66-4, January 1966)

NUMBUS

SPACECRAFT

R AND D

Nimbus A, B, and C

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

Launch Vehicle
Lewis Research Center, Cleveland, Ohio

CONTRACTORS (NIMBUS A & C)

RCA (Astro-Electronics Division, Princeton, New Jersey)
1. Power supply including solar paddles, batteries, and associated electronics
2. Advanced Vidicon Camera System (AVCS)
3. High Resolution IR Tape Recorder
4. Clock (Command) Receiver
5. Automatic Picture Transmission System

ITT (Industrial Labs, Fort Wayne, Indiana)
High Resolution IR Radiometer

General Electronics Lab., Silver Spring, Maryland
S-Band AVCS Transmitter

Aero-Geo-Astro, College Park, Maryland
Medium Resolution IR Electronics

GE (Missiles and Space Vehicle Department, Valley Forge, Pennsylvania)
1. Structure, integration, and testing
2. Control Subsystem

California Computer Products, Anaheim, California
Clock

Hughes (Research Division, Santa Barbara, California)
Medium Resolutior IR Radiometer

Lockheed Electronics Division, Edison, New Jersey
MRIR Recorder

ITT Federal Laboratories, Nutley, New Jersey
S-Band Transmitter

Hughes, (Culver City, California)
Beacon Transmitter

Radiation, Inc., Melbourne, Florida
PCM Telemetry System

Texas Instruments, Dallas, Texas
Medium Resolution IR Transmitter

Raymond Engineering, Middletown, Connecticut
Medium Resolution Tape Recorder and PCM
Tape Recorder

CONTRACTORS (NIMBUS B)

RAC
1. Power Supply including solar paddles, batteries, and associated electronics

ITT (Industrial Labs, For Wayne, Indiana)
1. High resolution 1A Radiometer
2. Image Disector Camera System

GE (Missiles and Space Vehicle Dept. Valley Forge, Pa.)
1. Structure integration and testing
2. Control subsystem

California Computer Products, Anaheim California
1. Command clock
2. MRIR Electronics

Radiation Inc. Melbourne, Florida
1. PCM Telemety System
2. Interrogating Recording and Location System

Texas Instruments, Dallas, Texas Interferometer

Adcole
Monitor of Solar Ultra Violet Energy

Brown Engineering, Huntsville, Ala.
S-Band Transmitter

To be Awarded
High Data Rate Transmission System

AEC & Martin Company, Baltimore, Maryland
RTG/SNAP 19

Santa Barbara Research Corp.
MRIR Radiometer
SIRS Optical Unit Sensing Electronics

Weather Bureau
Spacecraft IR Spectrometer

Gulton Albuquerque, N. M.
SIRS on Board Analog Digital System
SIRS output demodulator
SIRS Control Unit Module

Gulf Electronics, Dallas, Texas
SIRS Instrument Power Supply

Sperry, Great Neck, N. Y.
Yaw Rate Position Sensor

OBJECTIVES

To place in orbit a meteorological satellite to provide television coverage of daytime cloud cover of the entire earth and data concerning night cloud cover, reflected radiation, and the heat balance of the earth.

EXPERIMENTS (NIMBUS B)

High Resolution IR Radiometer
Medium Resolution IR Radiometer
Interferometer
Spacecraft IR Spectrometer
Interrogating Recording and Location System
Monitor of Solar Ultra Violet Energy
RTG/SNAP 19 (Radioisotape Thermal Generator)
Image Disector Camera System
Yaw Rate and Position Sensor

EXPERIMENTS (NIMBUS C)

Advance Vidicon Camera Subsystem
High Resolution IR Radiometer
Automatic Picture Transmission
Medium Resolution IR Radiometer

SPACECRAFT DESCRIPTION

WEIGHT

Nimbus A - 832 lbs (Structure - 108 lbs, Solar Platform - 125 lbs, Control System - 150 lbs)
Nimbus C - 1062 lbs
Nimbus B - 1246.6 lbs

STABILIZATION

3 axes earth-oriented

CONFIGURATION

Overall Dimensions - 10 ft x 10 ft
Sensory Ring - 54 in. x 13 in.
Control Housing - 17.25 in. x 33.28 in.
Truss Separator - 48 in.
Solar Paddles (each) - 3 ft x 8 ft

POWER (average) (A&C)

200 watts

POWER (maximum) (A&C)

400 watts

POWER SOURCE (A&C)

Solar cells

POWER SOURCE (B)

Solar cells
RTG/SNAP 19

TRANSMISSION FREQUENCIES A&C

Tracking and Telemetry - 136 Mc
AVCS and High Resolution IR, multiplexed (nominal) - 1705 Mc
Automatic Picture Transmission - 136 Mc
Medium Resolution IR - 136 Mc

SENSORS

Medium Resolution IR - 30 miles
High Resolution IR - 5 miles

TELEVISION

Resolution - ½ mile

LAUNCH RANGE

Pacific Missile Range
Vandenburg AFB, California

ORBIT

Period	- 102 minutes
Altitude	- 500 nautical miles
Type	- 80° retrograde polar orbit
Satellite life	- Six month

TRACKING

Minitrack Network Command Station
Fairbanks, Alaska

ENVIRONMENTAL TEST PROGRAM

LOCATION

GE (Missile and Space Vehicle Department (MSVD),
Valley Forge, Pennsylvania)
Spacecraft testing

SCHEDULE

Nimbus C
January 1966 - Completion of prototype tests
February 1966 - Completion of flight spacecraft tests

PROJECT SCHEDULE

Nimbus A
August 28, 1964 - Launch date
Status - Inactive

Nimbus B
4th Quarter 1967 - Launch

Nimbus C
2nd Quarter 1966 - Launch

CURRENT STATUS

Vibration testing of structural model spacecraft completed at GE (MSVD) 4th quarter 1962. All sensory subsystems assembled in prototype sensory ring by April 1963. Electrical system tests of sensory ring started April 1963. Prototype control subsystem underwent environmental testing January - Completed April 1963. Flight Unit No. 1 structure's fabricatio

in July 1963. Solar cell program redirected from P/N cells to N/P cells in December 1962. As of April 1963, N/P solar cell modules were being evaluated and tested as components.

The Weather Bureau withdrew funding of Nimbus Operational System (NOS) in November 1963.

Work is continuing at GE on the integration of the C spacecraft in preparation for a 1966 launch. Documentation, test programs and philosophies are being developed for Nimbus B. Subsystems' hardware as well as a structural spacecraft are being built as of October 1965.

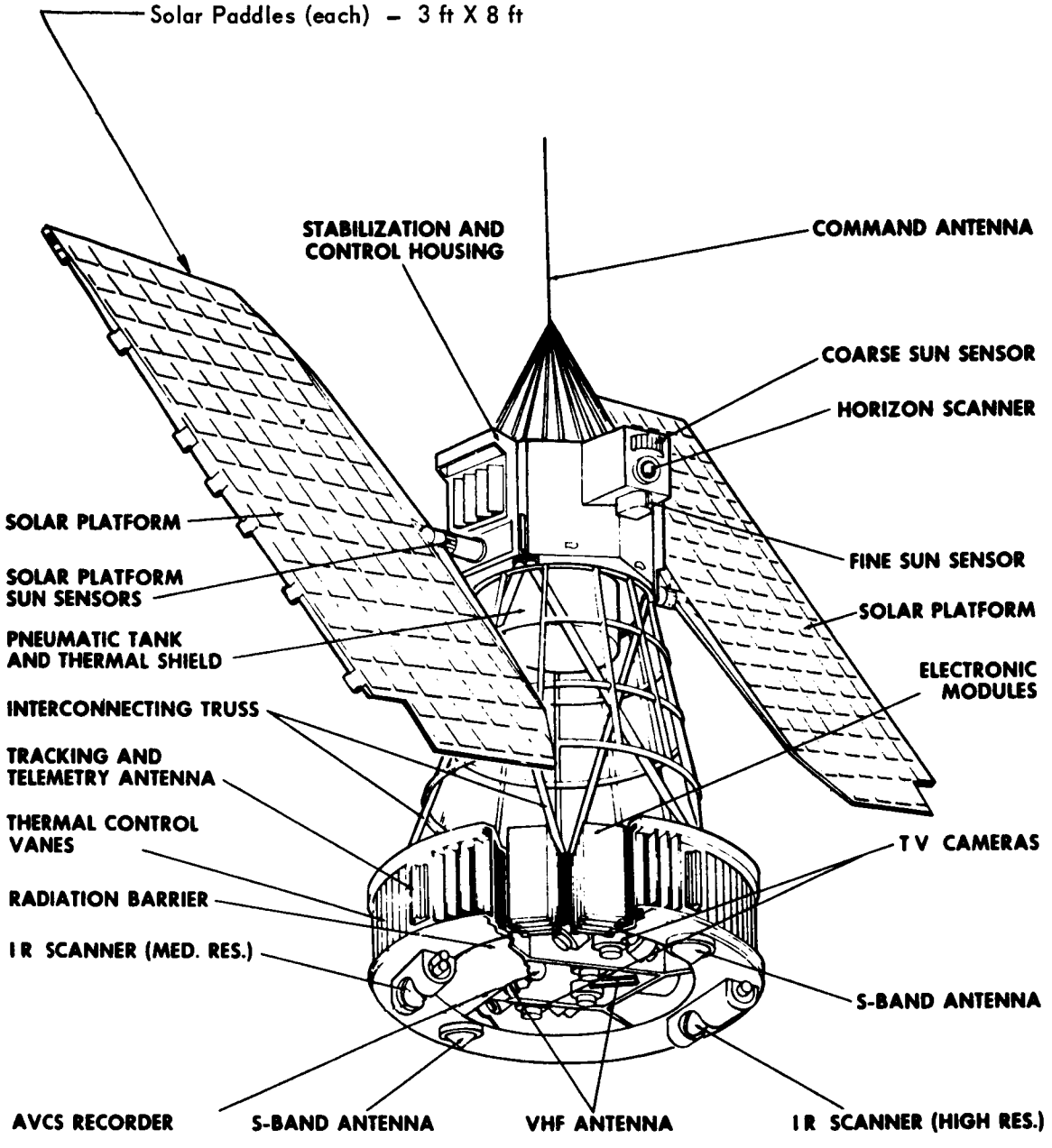
The Nimbus C has completed environmental testing and is ready for launch. The spacecraft will be shipped to PMR on March 27, 1966.

The Nimbus B Structural model has completed model survey and design vibration testing at GE and is now undergoing acceleration on the NOL centrifuge, March 1966.

Unit No. 1 structure's fabrication completed in July 1963. Solar cell program redirected from P/N cells to N/P cells in December 1962. As of April 1963, N/P solar cell modules were being evaluated and tested as components.

The Weather Bureau withdrew funding of Nimbus Operational System (NOS) in November 1963.

Work is continuing at GE on the integration of the C spacecraft in preparation for a 1964 launch. Documentation, test programs and philosophies are being developed for Nimbus B.



Overall Dimensions with Paddles out – 10 ft X 10 ft

Nimbus
(Deployed Configuration)

TIROS OPERATIONAL SYSTEM

(TOS)

SPACECRAFT

TOS A, B, C, and D

MANAGEMENT

Spacecraft
Environmental Science Service Administration (ESSA)
Goddard Space Flight Center (GSFC)

Tracking, Command, Data Acquisition, IR Experiments
GSFC, ESSA

Operational Use of Data
National Environmental Satellite Center (NESC)

Research Use of Data
GSFC and NESC

CONTRACTOR

RCA (Astro-Electronics Division, Princeton, New Jersey)
Fabrication and testing of spacecraft

OBJECTIVES

To launch satellites for observing atmospheric conditions with television cameras and radiation sensors in order to provide meteorological data for U. S. Weather Bureau.

SPACECRAFT DESCRIPTION (TOS A, B, C AND D)

WEIGHT (Approximate)

310 pounds (TOS A)
285 pounds (TOS B)
310 pounds (TOS C)
285 pounds (TOS D)
310 pounds (TOS E)
285 pounds (TOS F)
310 pounds (TOS G)
285 pounds (TOS H)

MOMENT OF INERTIA

Not known

CONFIGURATION

Shaped like a drum, top and sides covered with solar cells.

DIMENSIONS

Diameter - 42 inches
Height - 22 inches

SPACECRAFT SUBSYSTEMS (TOS A, B, C, AND D)

CAMERAS

Advanced Vidicon Camera System, 1 inch vidicon, 5.7 mm Tegea lens (TOS A and C)

Automatic Picture Transmission Camera, 1 inch vidicon, giving 800 line picture with 108° Tegea lens (TOS B and

SPACECRAFT SUBSYSTEMS AND SUPPORT

Decoder/Programmer
Command-Distribution Unit
V-Head Attitude Sensor
Orthogonal Horizon Sensor
Solar-Aspect Sensor
Nickel/Cadmium Batteries (TOS A and C, 42 apiece) (TOS B and C, 63 apiece)
9260 Solar Cells
Two Tracking Beacons
Command Receiver Unit
Single-Dipole Antenna
Crossed-Dipole Antenna
Spin Control
Quarter Orbit Attitude Control
Precession Dampers
De-Spin Weights
Picture Time Clock (TOS A and C)
Tape Recorder (TOS A and C)

LAUNCH VEHICLE

Improved Thrust Augmented Delta

ORBIT (NAUTICAL MILES)

Apogee	750 miles
Perigee	750 miles
Inclination	101.4°
Period	113.5 minutes

TRACKING

Minitrack Network

Primary Command Station

Wallops Island, Virginia
Ulaska, Fairbank, Alaska

Auxiliary Command Station
Santiago, Chile

Ground Stations
Princeton, N. J.
Fairbanks, Alaska
Wallops Island, Virginia

ENVIRONMENTAL TEST PROGRAM

RCA (Astro-Electronic Division, Princeton, New Jersey)
Spacecraft

SCHEDULE

TOS A

Spacecraft Flight Acceptance Testing to be completed in 2nd quarter 1966

PROJECT SCHEDULE (LAUNCHES)

TOS A	2nd quarter 1966
TOS B	1966
TOS C	1966
TOS D	1966

UNIT 3

SCIENTIFIC PROJECTS
(Status as of March, 1966)

SERB
STUDY OF THE ENHANCED RADIATION BELT

EPE-D
ENERGETIC PARTICLES EXPLORER-D

OSO
ORBITING SOLAR OBSERVATORY

AOSO (CANCELLED)
ADVANCED ORBITING SOLAR OBSERVATORY

OAO
ORBITING ASTRONOMICAL OBSERVATORY (S-18)

DME-A
DIRECT MEASUREMENTS EXPLORER-A (S-30A)

IE-A
IONOSPHERE EXPLORER-A (S-48)

EGO
ECCENTRIC ORBITING GEOPHYSICAL OBSERVATORIES

POGO
POLAR ORBITING GEOPHYSICAL OBSERVATORIES

UK-C
ARIEL II (INTERNATIONAL SATELLITE - UK-2/S-52)

UK-E
UNITED KINGDOM INTERNATIONAL SATELLITE (S-53)

S-66
POLAR IONOSPHERE BEACON

IMP AND IMP F, G, & I
INTERPLANETARY MONITORING PLATFORM

ANCHORED IMP
ANCHORED INTERPLANETARY MONITORING PLATFORM

RAE
RADIO ASTRONOMY EXPLORER

ISIS
INTERNATIONAL SATELLITES FOR INOSPHERIC STUDIES

ESRO I & II
EUROPEAN SPACE RESEARCH ORG'N SATELLITES

FR-1
FRENCH VLF SATELLITE

GRS-A
GERMAN RESEARCH SATELLITE

ATS
ADVANCED TECHNOLOGICAL SATELLITE

AE-B
ATMOSPHERE EXPLORER - B

STUDY OF THE ENHANCED RADIATION BELT (SERB)

SPACECRAFT

SERB or S-3b

MANAGEMENT

Spacecraft and Experiments
Goddard Space Flight Center (GSFC)

Tracking and Data
GSFC

Launch Vehicle and Launch
GSFC

OBJECTIVES

To obtain more information about the trapped radiation resulting from the high-altitude nuclear test explosion of July 9, 1962.

EXPERIMENTS

Electron Energy Distribution
Bell Telephone Labs (BTL)

Omnidirectional Detector
University of California, San Diego (UCSD)

Angular Distribution
BTL

Directional Detector
UCSD

Ion-Electron Detector
GSFC

Magnetic Field
University of New Hampshire

Solar-Cell Damage Experiment
BTL

SPACECRAFT DESCRIPTION

WEIGHT

99.6 lbs (Subsystems – 69.6 lbs, Miscellaneous – 30.0 lbs)

CONFIGURATION

See Figure A.

SPACECRAFT SUBSYSTEMS

Experiments – 15.3 lbs
Power Supply – 31.6 lbs
Electrical – 19.6 lbs
Telemetry (136.101 Mc) – 3.1 lbs

LAUNCH VEHICLE

Delta

LAUNCH RANGE

Atlantic Missile Range

ORBIT (actual)

Perigee – 306 km
Apogee – 17,608 km
Inclination – 17.8°
Period – 314.7 minutes
Planned Lifetime – 60 days

TRACKING

Minitrack network

PROJECT SCHEDULE

September 5, 1962 – Project Initiation
4th Quarter, 1962 – Two Flight Models Complete
October 27, 1962 – Launched

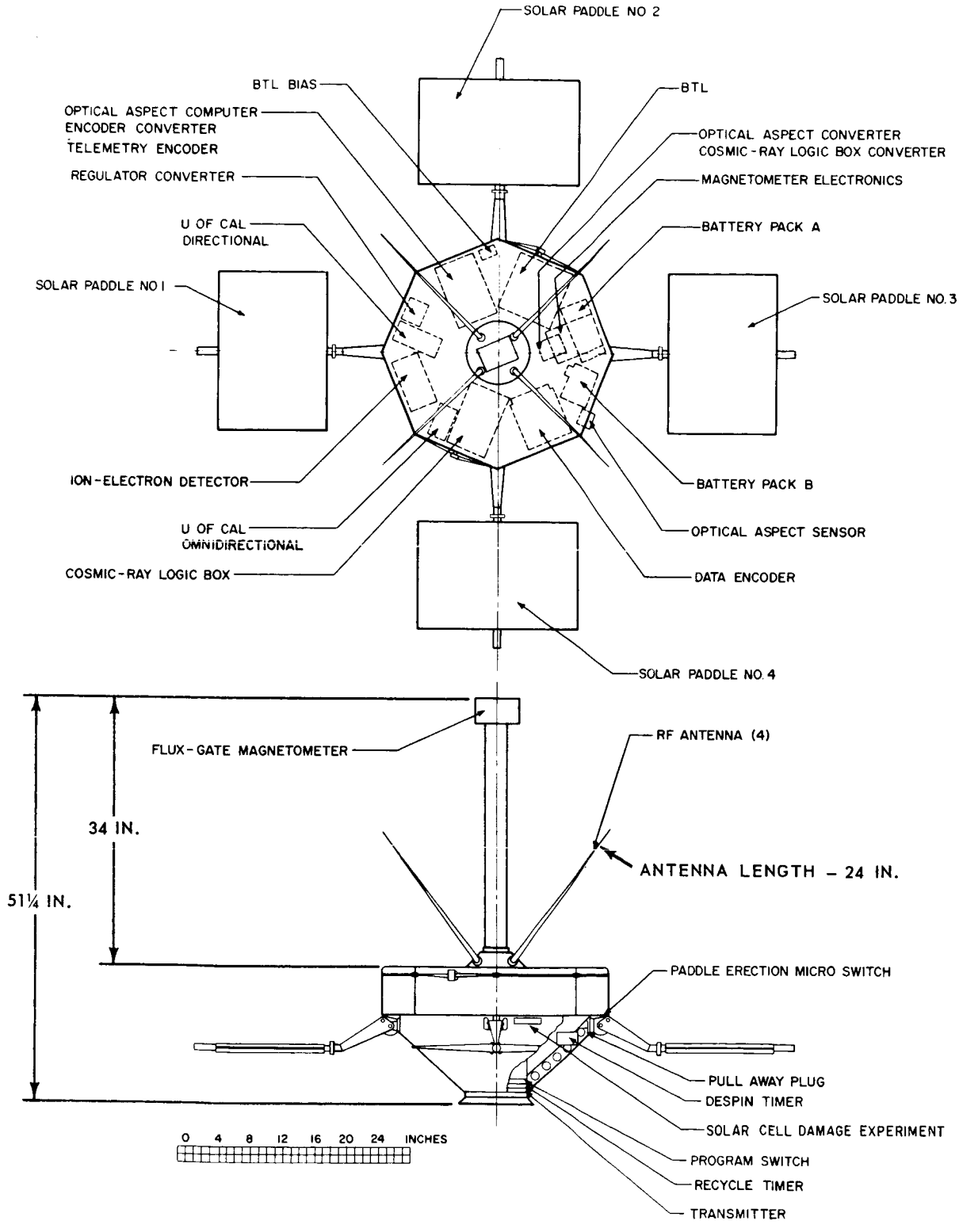


Figure A. Study of Enhanced Radiation Belt
(SERB or S-3b)

ENERGETIC PARTICLES EXPLORER-D
(EPE-D)

SPACECRAFT

EPE-D and Engineering Test Spacecraft (for testing flight-spare subsystems)

MANAGEMENT

Spacecraft and Experiments
Goddard Space Flight Center (GSFC)

Tracking and Data
GSFC

Launch Vehicle and Launch
GSFC

OBJECTIVES

To study the injection, trapping, and loss mechanisms of the trapped radiation belts (natural and artificial), the energy spectrum and the pitch-angle distribution of the particles as a function of the distance from the surface of the earth at the geomagnetic equator are to be monitored for a period of one year. These measurements will be correlated with data from the onboard magnetic field experiment. A solar cell damage panel experiment and two nutation dampers will also be flown.

EXPERIMENTS

Electron Energy Distribution
Bell Telephone Labs (BTL)

Omnidirectional Detector
University of California, San Diego (UCSD)

Angular Distribution
BTL

Directional Detector
UCSD

Ion-Electron Detector
GSFC

Magnetic Field
University of New Hampshire

Nutation Dampers
GSFC

Solar Cell Damage Panel
GSFC

SPACECRAFT DESCRIPTION

WEIGHT

101 lbs, approximately (Subsystems - 70 lbs; Miscellaneous - 31 lbs)

CENTER OF GRAVITY (from separation plane)

Paddles Extended - 11.41 in. above separation plane
Paddles Folded - 8.45 in. above separation plane

MOMENTS OF INERTIA

Roll - Paddles Extended: 5.41 slug-ft^2
Paddles Folded: 2.14 slug-ft^2

Pitch - Paddles Extended: 3.95 slug-ft^2
Paddles Folded: 4.90 slug-ft^2

DIMENSIONS

Overall Measurements (with paddles extended) - 74-1/8 in. x 60-7/8 in.
Across the flats - 26-3/4 in.
Paddles (each) - 20-1/8 in. x 13-1/8 in.
Length of antennas (each)- 24 in.

ORBITING SOLAR OBSERVATORY (OSO)

OBSERVATORIES

OSO-1 (S-16), OSO-2 (S-17), OSO-C (S-57), OSO-D, and OSO-E

MANAGEMENT

Observatory
Goddard Space Flight Center (GSFC)

CONTRACTORS (OSO-1, OSO-2, OSO-C, OSO-D, OSO-E)

Ball Brothers Research Corporation, Boulder, Colorado
Complete spacecraft, experiment integration, and initial launches.

Douglas Aircraft
Launch Vehicle

OBJECTIVES

1. To construct a detailed plot of the sun in the ultraviolet light over the broad spectrum of 75 to 1500 Angstrom(Å).

2. To monitor bursts of solar X-ray emission in the ranges from 8 to 60 Å.

3. To repetitively map the X-ray sources on the sun in two wavelengths by scanning the solar disc.

4. To scan the solar corona in ultraviolet light.

5. To monitor the direction and intensity of polarized zodiacal light.

6. To measure the direction and arrival of cosmic gamma ray radiation in the high-energy range of 50 to 1000 Mev.

7. To measure the direction and arrival of cosmic gamma ray radiation in the low-energy range of 0.1 to 3.0 Mev.

8. To perform an all-sky survey of ultraviolet light sources.

EXPERIMENTS

OSO-1 (S-16)

Pointed

Solar soft X-ray spectrometer: 10 to 400 Å - GSFC

Gamma ray detector: 0.150 Mev - GSFC

Solar X-ray detector: 20 to 100 Kev - GSFC

Solar X-ray ion chambers - 1 to 8 Å - GSFC

Dust particle detector - GSFC

Wheel

Solar radiation flux detector: 3800 to 4800 Å - GSFC

Solar ultra-violet ion chamber: 1100 to 1250 Å - GSFC

Solar gamma ray detectors: 0.2 to 1.5 Mev - GSFC

Solar gamma ray detector: 50 Kev to 3 Mev - University of Minnesota

Neutron monitor: University of California

Proton-electron detector: electron energies > 60 Kev and proton energies > 2 Mev - University of California, Lawrence Radiation Laboratory, Livermore, California

Emissivity stability detectors: Measures thermal radiation characteristics of surfaces to determine emissivity stability of spacecraft temperature - control coatings - Ames Research Center

High energy solar gamma ray detector: 100 to 500 Mev - University of Rochester

OSO-2 (S-17)

Pointed

Ultraviolet Spectrometer - Spectroheliograph 300 to 1400 Å - Harvard University

Monitor solar X-ray bursts: 2 to 8 Å and 8 to 20 Å and 44 to 60 Å and map X-ray sources - NRL (TAC)

White light Coronagraph - Spectroheliograph solar scan in Lyman Alpha 1216 Å, HeI-584 Å and the HeII-304 Å lines - NRL (RT)

Wheel

Monitor intensity and direction of polarized light from interplanetary space - University of Minnesota

Measure arrival direction and energies of primary cosmic gamma rays: 100 Mev to 1 Bev

Detect gamma rays and analyze their energy spectrum: 0.1 to 0.7 Mev - GSFC (Frost)

Ultraviolet stellar and nebular spectrophotometer: 1500 to 2600 Å - GSFC (Dr. Hallam)

Measurement of thermal-radiation characteristics of surfaces to determine emmissivity stability of spacecraft temperature - control coatings - Ames Research Center

OSO-C

Pointed

Solar spectrometer: 1 to 400 Å - GSFC

Ultraviolet monochromator: 250 to 1300 Å - Air Force Cambridge Research Laboratory

Wheel

Cosmic ray charge spectrum detector: Measurement of intensity of the nuclear component of primary cosmic radiation and of high energy gamma radiation > 100 Mev from the sun and the galaxy - University of Rochester.

Solar X-ray experiment - 8 to 20 Å - University of Michigan

Experiment to measure Albedo of the earth between 3200 and 7800 Å - Ames Research Center

Directional radiometer to measure reflected sunlight and earth temperature on the dark side of the earth in the range of about 1 to 30 microns to supplement the Ames Albedo experiment. Mounted on the Albedo experiment - Ames Research Center.

Measurement of thermal radiation characteristics of surfaces to determine emissivity stability of spacecraft temperature - control coatings - Ames Research Center.

Solar X-ray telescope - detection of X-rays with energy levels between 7 Kev and 190 Kev and anti-coincidence events at 100 Kev and 2.5 Mev levels - University of California, San Diego.

Celestial gamma ray detector: 100 Mev and greater - Massachusetts Institute of Technology

Wheel Back-Up

Proton electron detector: Electron energies > 60 Kev and proton energies > 2 Mev. This experiment is similar to the experiment on OSO-1 and OSO-D - University of California, Lawrence Radiation Laboratory, Livermore, California.

OSO-D

Pointed

Solar X-ray telescope: Spectrum analysis 8 to 20 Å, above 20 Å and below 8 Å possibly and map the sun in X-rays - American Science and Engineering, Inc.

Bragg crystal X-ray spectrometer: 1 to 8 Å - NRL

Improved normal incidence 300 to 1300 Å scanning spectrometer - Spectroheliograph - Harvard University

Wheel

Measurement extra solar X-radiation: 0.1 to 10 Å, possibly to 50 Å - American Science and Engineering, Inc.

Distribution of total solar X-ray emission over a wide band: 1.2 to 3.6 Å, 3 to 9 Å, 6 to 18 Å, 44 to 55 Å, and 44 to 70 Å - Leicester University and University College, London

Study of the solar He II resonance emission: 304 Å - University College, London

Proton-electron detector: electron energies > 60 Kev and proton energies > 2 Mev - University of California, Lawrence Radiation Laboratory, Livermore, California

X-ray ion chamber monitoring: four chambers 0.1 to 1.6 Å, 0.5 to 3 Å, 2 to 8 Å, and 8 to 16 Å - NRL

Lyman-Alpha night sky glow: monitor 1050 to 1350 Å which includes the Alpha Line at 1216 Å - NRL

OSO-E

Pointed

X-ray spectroheliograph: 3 to 9 Å and 8 to 18 Å - University College, London and University of Leicester

Extreme ultraviolet solar spectroheliograph: This is an improved version of the spectroheliograph portion of the experiment being flown on OSO-2 - NRL

Continuation of the studies of the solar spectrum: 1 to 400 Å. Continuation of the studies previously started on OSO-1 and will be an improved version of the instrument to be flown on OSO-C - GSFC

Wheel

Measurement of the self-reversal of the solar Lyman-Alpha line - University of Paris

Solar X-ray radiation ion-chamber photometer, monitoring experiments: 0.1 to 1.6 Å, 0.5 to 3 Å, 2 to 8 Å and 8 to 16 Å. Duplication of the experiment to be flown on OSO-D - NRL

Observations of the sun in the low energy gamma ray region: 5 Kev to 150 Kev. These data will supplement measurements to be made on OSO-2 - GSFC

Dim-light monitoring experiment measuring intensity and polarization of the light from the air-glow layer. Similar to OSO-2 experiment - University of Minnesota

Solar far ultraviolet radiation monitoring in three EUV bands: 280 to 370 Å, 465 to 630 Å and 760 to 1030 Å for effect upon ionization rates in the earth's upper atmosphere (F and E layers) - University of Colorado

SPACECRAFT DESCRIPTION (OSO-2)

WEIGHT

547 lbs

CENTER OF GRAVITY

12.08 inches above attach fitting (arms down)
12.90 inches above attach fitting (arms up)

MOMENTS OF INERTIA

Launch Mode

Spin - 23.1 slug-ft^2
Transverse - 19.6 slug-ft^2

Orbital

Spin - 19.31 slug-ft^2 (wheel only - arms down)
26.5 slug-ft^2 (wheel only - arms up - bottles full)
3.8 slug-ft^2 (sail)

CONFIGURATION

See illustration. (max allowable in Delta Bulbous Shroud)

DIAMETER

Wheel - 44 inches
Overall (with arms extended) - 96 inches

HEIGHT

38.3 inches

TELEMETRY SUBSYSTEM (PCM/FM digital)

Data Storage
Stored sequentially in digital form by tape recorder

Data Readout
Five munutes during each orbit

POWER SUPPLY

Twenty-six watts average during orbit available from nickel cadmium batteries. Regenerated by solar cell array with power output of about 33 watts.

ATTITUDE CONTROL

Uses principle of gyroscopic properties of a spinning body for stability: wheel spins, spin rate maintained by gas jets; sail is maintained normal to sun during daylight by gas jets in pitch axis and servomotor in azimuth; pointed experiments aimed at sun in elevation by servomotor.

LAUNCH VEHICLE

Delta
1st stage - Thor with Rocketdyne MB3 Engine
2nd stage - Aerojet - General AJ-10-118 Liquid Propellant
3rd stage - ABL-X-258-B1 Solid Propellant

LAUNCH RANGE

Cape Kennedy

ORBIT (OSO SERIES)

Altitude - 300 nautical miles in circular orbit
Inclination - 33°
Period - 95 minutes

TRACKING

Worldwide Minitrack network (with the exception of Fairbanks, Alaska; East Grand Forks, Minnesota, St. Jchns, Newfoundland; and Winkfield, England)

TELEMETRY RECORDING STATIONS

PRIMARY

Antofagasta, Chile
Blossom Point, Maryland
Fort Myers, Florida
Lima, Peru
Quito, Ecuador
Santiago, Chile

SECONDARY *

Mojave, California
Woomera, Australia
Johannesburg, South Africa

*Secondary stations to be used during early orbit phase and during occasions when conflict develops and no primary station is available to command and record the telemetered data.

ENVIRONMENTAL TEST PROGRAM

LOCATION

Ball Brothers Research Corp., Boulder, Colorado
Complete integrated observatory

SCHEDULE

OSO-E1
1st and 2nd Quarters, CY 1966 - Flight Model

OSO-D
3rd and 4th Quarters, CY 1966 - Flight Model

OSO-F
4th Quarter, CY 1967 and 1st Quarter CY 1968 - Flight Model

OSO-G
3rd and 4th Quarter CY 1968

OSO-H
2nd and 3rd Quarter CY 1969

PROJECT HISTORY

OSO-1 (S-16)
Launched March 7, 1962

OSO-2 (S-17)
Damaged during pre-ignition of a Delta third stage at Cape Kennedy April 14, 1964. Refurbished observatory for this mission launched February 3, 1965.

OSO-C

Launched August 25, 1965 but pre-ignition of the Delta 3rd stage prevented attainment of orbital velocity and resulted in loss of observatory.

PROJECT SCHEDULE

OSO-E1
Second Quarter CY 1966 - Launch

OSO-D
4th Quarter CY 1966 - Launch

OSO-F
1st Quarter CY 1968 - Launch

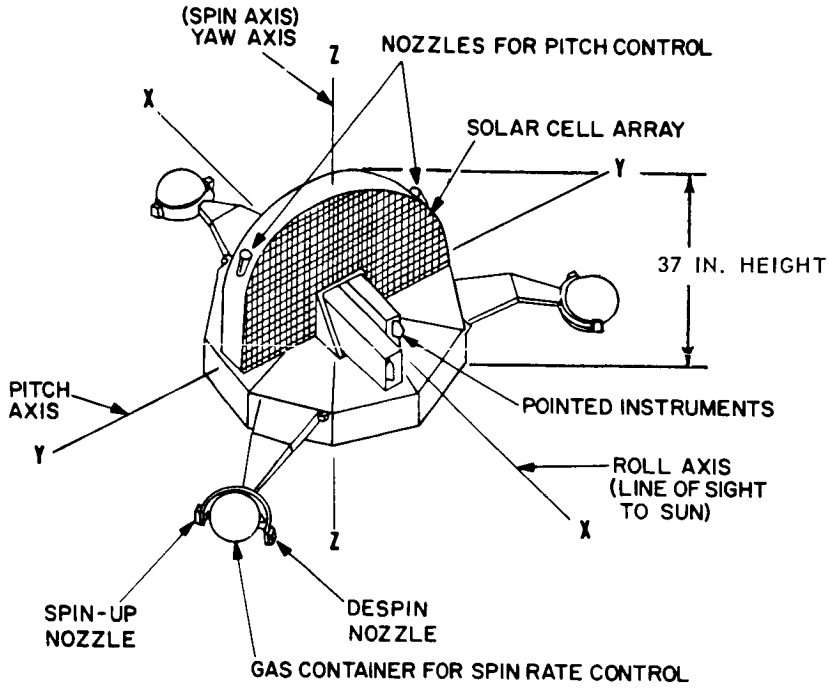
OSO-G through OSO-H
4th Quarter CY 1968 - Launch

OSO-H
3rd Quarter CY 1969 - Launch

OSO-I through OSO-N
Tentative planning only at this time

Total
Sixteen launches to cover an 11-year sun spot cycle

WHEEL – 44 IN. DIAMETER



OVERALL DIAMETER (with arms extended) – 92 IN.

Orbiting Solar Observatory
(OSO)

ORBITING ASTRONOMICAL OBSERVATORY
(OAO, S-18)

OBSERVATORIES

OAO-A1, OAO-A2, OAO-B, OAO-C, OAO-D, OAO-E

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

Experiments
OAO-A1 - University of Wisconsin and three secondary Experiments (GSFC, MIT, LMSC)
OAO-B - GSFC
OAO-C - Princeton and University College London
OAO-A2 - University of Wisconsin and Smithsonian Astrophysical Observatory

CONTRACTORS

PRIME CONTRACTOR

Grumman
Spacecraft

SUB-CONTRACTORS

IBM
Data Processing

General Electric
Stabilization and Control

Hughes
Transmitter and Tracking Beacon

Gulton Industries
Batteries

Radiation, Inc.
Experiment Data Handling

Engineered Magnetics
Power Conversion

AVCO
Command Receiver

RCA
Television Optics and Electronics

Dorne and Margolin
Antennas

Dalmo Victor
Magnetometer and Electronics

Hazeltine
Command Control Junction Box

Kollsman
Domeless Star Trackers

ITT
Bore-sighted Star Tracker and Electronics

Spectrolab
Solar Array

Bendix
Battery Charge and Sequence Controller

OBJECTIVE

To make precise telescope observations from the earth's atmosphere with satellites under control from the ground. The area of interest is that of the emission and absorption characteristics of the sun, stars, planets, nebula and interplanetary and interstellar media in the relatively unexplored infrared, ultraviolet, X-Ray and gamma ray regions of the spectrum.

EXPERIMENTS (OAO-A2)

Wisconsin
Multicolor photometry of stars in the ultraviolet range

Smithsonian

Map the whole sky in four ultraviolet colors

POWER SUBSYSTEMS

SYSTEM COMPONENTS

1. Solar cell array
2. Three nickel cadmium batteries
3. Battery charge and sequence controller
4. Voltage regulator-converter
5. Voltage inverter

TOTAL POWER DEMANDS

Operation	Average Power (watts)
Launch	142.5
Initial Stabilization	336.1
Transmitting	419.9
Transmitting and Slewing	445.9
Fine Control	306.7
Complete Orbit	317.8
Restabilization	419.1

COMMUNICATIONS SUBSYSTEM

Radio Command

148.260 Mc - provides ground control of spacecraft subsystems and experiments.

Radio Tracking Beacon

136.400 Mc - continuous transmission to permit ground tracking.

Narrow-band Telemetry

136.260 Mc - transmits digital data which includes: spacecraft sub-system data; environmental data; echo of commands for verification; data from experiments' data handling equipment, data storage, or command storage.

Wide-band Telemetry
400.550 Mc - transmits analog data from experimenters' package or from stellar television camera. Digital data from experimenters' data handling equipment.

OBSERVATORY DESCRIPTION (OAO-A)

WEIGHT

Experiment Package	947 lbs
Spacecraft Structure	864 lbs
Stabilization and Control	761 lbs
Data Processing and Instrumentation	345 lbs
Communications	39 lbs
Power Supply	694 lbs
Booms and boom weights	117 lbs
Thermal Balance	54 lbs
Total	3,821 lbs

MOMENT OF INERTIA (Estimated Orbital)

Maximum - 1471 slug-ft^2
Minimum - 1453 slug-ft^2

CONFIGURATION

Octagonal-shaped aluminum structure with hollow central tubular area to house experiment.

DIMENSIONS

Length - 118 in.
Width (across flats) - 80 in.
Diameter (central tube) - 48 in.
Area (solar paddles) - 111.5 sq. ft.
Overall width (solar paddles extended) - 194 in.

LAUNCH VEHICLE

Atlas-Agena D

LAUNCH RANGE

Air Force Eastern Test Range

ORBIT

Approximately circular - 500 ± 25 miles
Inclination - 31°
Period - 105 minutes
Lifetime - 1 year

ENVIRONMENTAL TEST PROGRAM

LOCATIONS

Grumman
Structure, Spacecraft with Integrated Observatory

G. E.
Stabilization and Control System

Subcontractor
Subsystems and Components

SCHEDULE (OAO-A1)

July 1964 to July 1965
Prototype Spacecraft

March 1965 to November 1965
Flight Spacecraft

PROJECT SCHEDULE

Early 1966
OAO-A1 arrived at ETR

ORBIT

Approximately circular - 500 ± 25 miles
Inclination - 31°
Period - 105 minutes
Lifetime - 1 year

ENVIRONMENTAL TEST PROGRAM

LOCATIONS

Grumman
Structure, Spacecraft with Integrated Observatory

G.E.
Stabilization and Control System

Subcontractors
Subsystems and Components

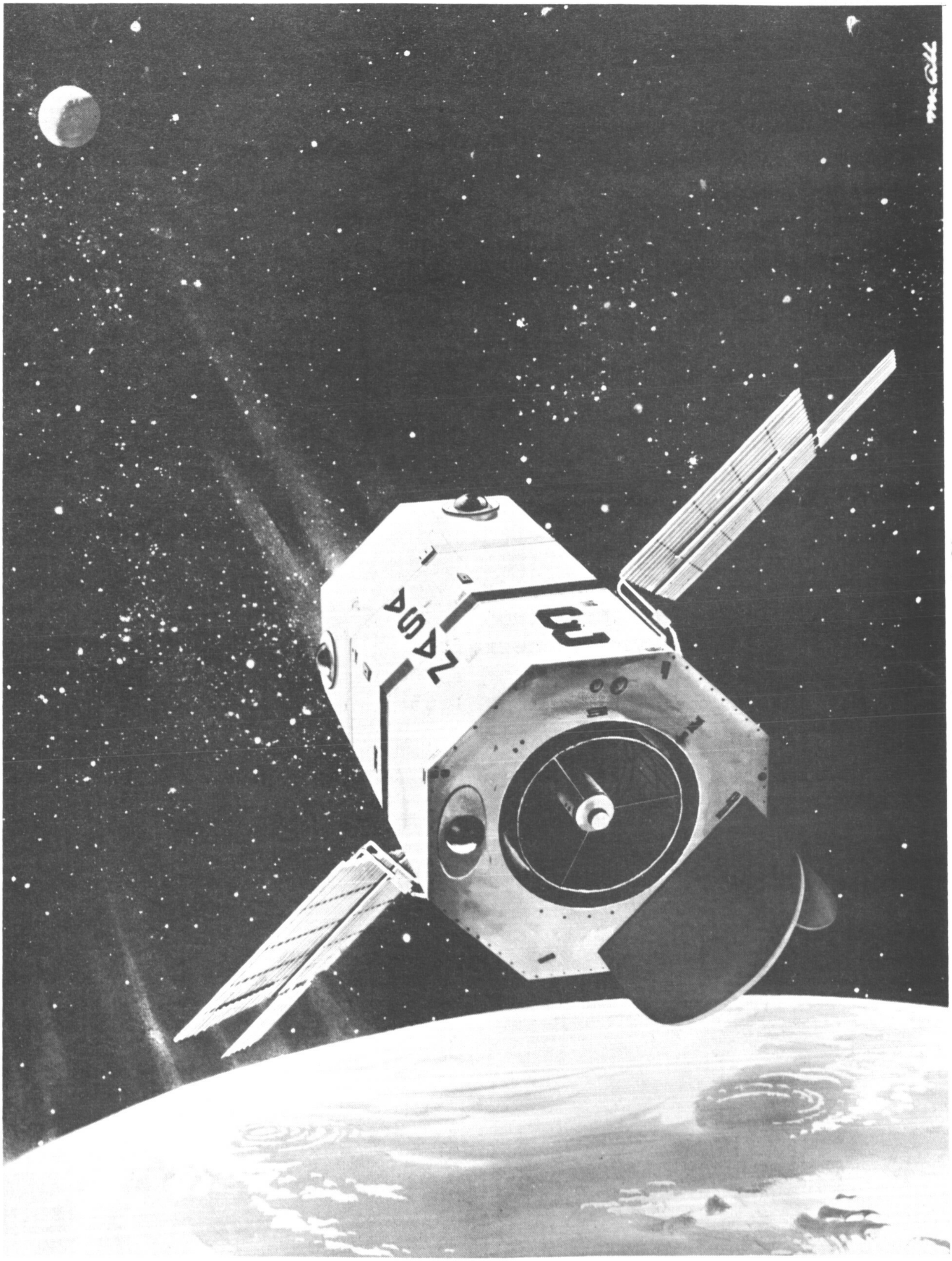
SCHEDULE (OAO-A1)

July 1964 to July 1965
Prototype Spacecraft

March 1965 to November 1965
Flight Spacecraft

PROJECT SCHEDULE

Late 1965
OAO-A1 scheduled to arrive ETR



Orbiting Astronomical Observatory
(OAO)

DIRECT MEASUREMENTS EXPLORER-A (DME-A)

SPACECRAFT

Direct Measurements Explorer-A (DME-A)

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

Tracking and Data Acquisition
GSFC

CONTRACTORS

Applied Physics Laboratory (APL) of the Johns Hopkins University
Spacecraft

OBJECTIVES

The objective of the DME-A program is to obtain direct measurements of the ionosphere including electron temperature, Ion temperature, Ion Mass, Temperature Equilibrium determination, and simultaneous measurements in conjunct on with Alouette-B (S-27A).

EXPERIMENTERS

GSFC

Thermal Ion and Electron Experiment
Energetic Electron Current Monitor Experiments (2)
Electrostatic Probe Experiment

Naval Research Laboratory, Washington, D. C.
High Resolution Magnetic Ion Mass Spectrometer

University College, London
Electron Temperature Experiment
Spherical Ion Mass Spectrometer

SPACECRAFT DESCRIPTION

QUANTITY

One structural model of spacecraft
One protoflight spacecraft to be available for launch

WEIGHT

218.4 lbs

MOMENTS OF INERTIA

Roll - 6.07 slug-ft^2
Pitch - 5.81 slug-ft^2
Yaw - 5.71 slug-ft^2

CONFIGURATION

Right octagonal prism 30 inches across the flats by 25 inches high

SOLAR CELLS

Less than 15% of total surface area

TRANSMISSION FROM SPACECRAFT

PCM Telemetry
Approximately a 9 kilo-bit system, 2 watts, 9 bits/word, 32 word/frame

Telemetry at 136 Mc
To provide Minitrack data and spacecraft performance data

POWER SYSTEM

Power Source
780 N on P Solar cells mounted on the spacecraft outer shell charging nickel cadmium batteries

Batteries

Main	- 8 "F" size
Redundant Main	- 8 "D" size
Command Receiver	- 8 "C" size

Voltage

Initial average power is 3.5 watts

Requirements

Continuous operation of all spacecraft systems for 70 minutes and Telemetry Transmitter operation for at least one full orbit.

LAUNCH VEHICLE

Thor-Agena

LAUNCH RANGE

Western Test Range

ORBIT

Type	- Elliptical
Altitude	- 500 km to 2500-3500 km
Inclination	- 80° prograde
Satellite Lifetime	- 1 year

TRACKING

GSFC Minitrack
APL Network
Canadian Stations
British Stations

ENVIRONMENTAL TEST PROGRAM

LOCATION

Applied Physics Laboratory

SCHEDULE

October 31, 1965

Completion of protoflight unit tests

PROJECT SCHEDULE

January, 1964
Start systems design

Fourth Quarter, 1965
Launch

COMMENT

The DME-A is a part of the ISIS program. It was successfully launched as a piggyback spacecraft to Alouette-B (S-27A), on November 29, 1965 and designated Explorer XXXXI. The combination of the two spacecraft is designated ISIS-X.

Other satellites which have engaged in ionospheric studies are Explorer VIII, P-21, P-21a, S-51, S-48, S-52, BE-B, BE-C, and Alouette I (S-27).

IONOSPHERE EXPLORER-A (IE-A)
Formerly
FIXED FREQUENCY IONOSPHERE TOPSIDE SOUNDER (S-48)

SPACECRAFT

IE-A Topside Sounder

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

CONTRACTOR

Airborne Instruments Lab, Melville, Long Island, New York
Prime for spacecraft

OBJECTIVES

PRIMARY

To examine the ionosphere from above by measuring electron distribution in space and time between the maximum electron density altitude of the F-2 layer, 300-400 km (162-216 nautical miles), and the height of the satellite orbit, 1000 km (541 nautical miles).

SECONDARY

To deduce from spherical ion mass spectrometer data, the ion and electron densities and temperatures at the satellite and to estimate the cosmic noise level in the 2 to 7 Mc frequency range.

EXPERIMENTERS

PRINCIPAL

National Bureau of Standards
Central Radio Propagation Lab, Boulder, Colorado

OTHER

Goddard Space Flight Center
Radio Research Station, Slough, England

University College
Ion measurement by mass spectrometer, London, England

SPACECRAFT DESCRIPTION

WEIGHT

98 pounds

DIMENSIONS

Diameter - 26 inches
Length - 32.5 inches
Overall Length - 46.5 inches

MOMENT OF INERTIA (Flight No. 1 Spacecraft)

Thrust Axis - .62 slug-ft^2

Pitch Axis - 1.61 slug-ft^2

Yaw Axis - 1.61 slug-ft^2

CONFIGURATION

Two truncated cones mounted on either side of a short cylinder. Solar cells on curved surfaces. Ion probe experiment mounted on top of spacecraft.

ELECTRICAL POWER

Required

140 watt-hours to provide 4 hours of data acquisition per day

Supply

2400 P/N solar cells and nickel cadmium storage batteries (23 size "F" cells)

TELEMETRY

FM 2 watts at 136.350 Mc
for sounder and spectrometer data on command

PM 200 mw at 136.680 Mc
for housekeeping and aspect data on command. Also serves as tracking CW beacon at 75 mw

SOUNDING

Antennas (Dipole)

Two 60 ft antennas, forming set 122 ft long
Four 30 ft antennas, forming two sets 62 ft long

Transmitters

Six 8- to 45-watt transmitters pulsed on in sequence

Frequencies

1.5, 2.0, 2.85, 3.72, 5.47, and 7.22 Mc

Signal

Pulse duration
100 microseconds

Pulse spacing
15 milliseconds

Pulse sequence
6 pulses (one for each sounding frequency). The seventh 15-millisecond interval contains a calibration pulse and ion-probe data.

LAUNCH VEHICLE

Scout (X-258)

LAUNCH RANGE

Pacific Missile Range

ORBIT

Period - 103.8 minutes
Perigee - 865 km
Apogee 1011 km
Inclination - 79.9°
Lifetime - One year

TRACKING

Minitrack network (STADAN)

TELEMETRY RECORDING STATIONS

Resolute Bay, NWT
College, Alaska
St. Johns, Newfoundland
E. Grand Forks, North Dakota
Ft. Myers, Florida
Quito, Ecuador
Santiago, Chile (launch phase, only)
South Atlantic
Winkfield, England
Singapore
Blossom Point, Maryland
Boulder, Colorado
South Point, Hawaii

Additional stations such as PMR, Malagasy Republic, and Johannesburg, South Africa, will probably be used during launch and injection into orbit.

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center
Spacecraft

SCHEDULE

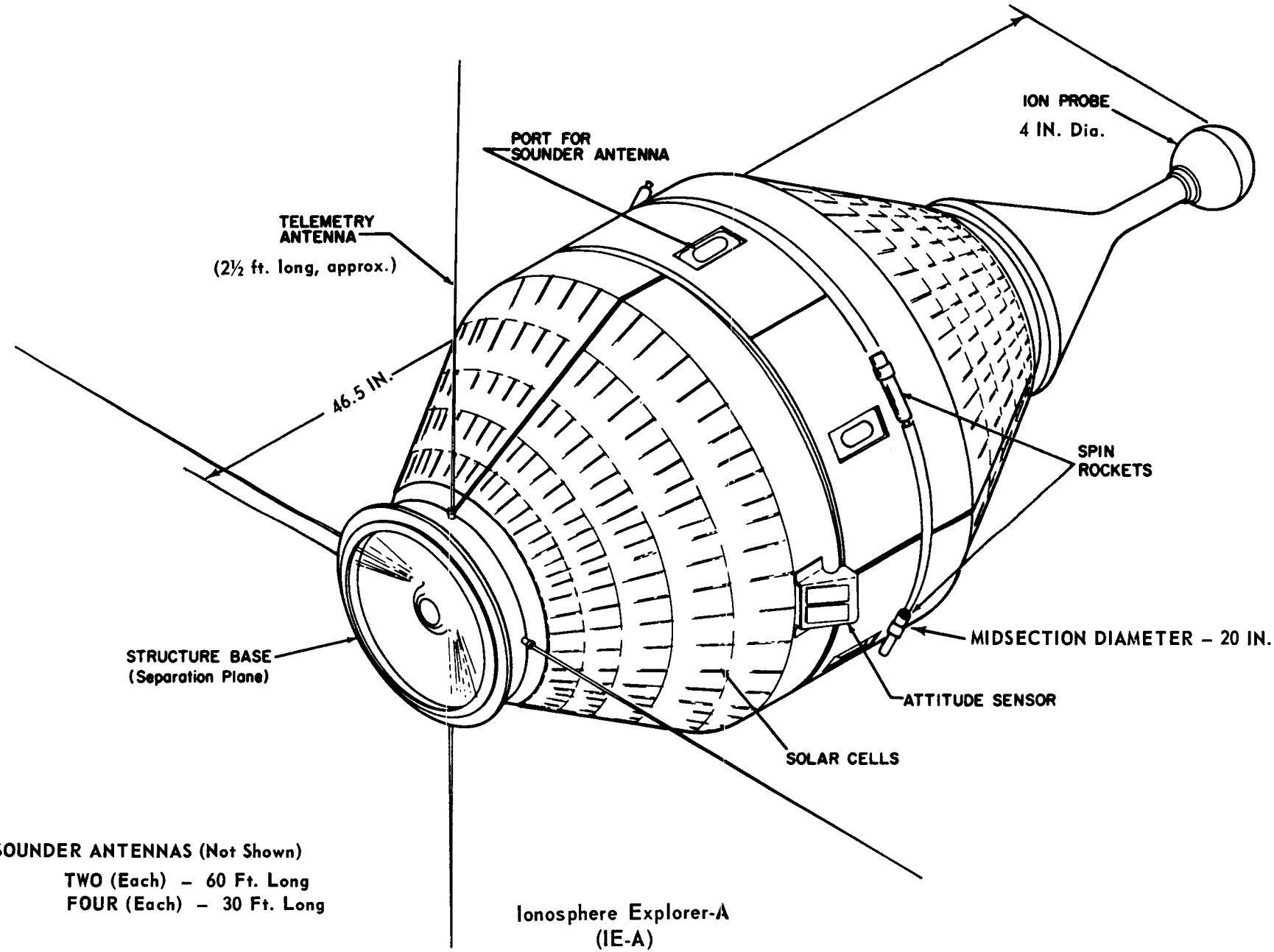
June and July 1964

Environmental retests on Flight Spacecraft Nos. 1 and 2 because of spacecraft repairs and elapsed time since completion of previous environmental test series in September 1963. Prototype Spacecraft subjected to an acceleration retest because of switch to X-258 top stage rocket motor.

PROJECT HISTORY

August 25, 1964 - Successfully launched Flight Spacecraft No. 1

March 12, 1965 - Spacecraft still performing satisfactorily.



SOUNDER ANTENNAS (Not Shown)
TWO (Each) – 60 Ft. Long
FOUR (Each) – 30 Ft. Long

Ionosphere Explorer-A
(IE-A)

ECCENTRIC ORBITING GEOPHYSICAL OBSERVATORIES (EGO or OGO)*

OBSERVATORIES

OGO-I, OGO-B, OGO-E, OGO-G, OGO-I, OGO-K

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

Observatory System
GSFC

Tracking and Data System
GSFC

Vehicle System
Lewis Research Center

CONTRACTORS

TRW Systems, Redondo Beach, California
Spacecraft

General Dynamics (Astronautics Division, San Diego, California)
Atlas Booster

Lockheed Missiles and Space Division, Sunnyvale, California
Agena Second Stage Vehicle

OBJECTIVES

PRIMARY

Conduct large numbers of significant, diversified geophysical experiments for making scientific measurements about the Earth.

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*EGO and POGO comprise the OGO program.

SECONDARY

Development and operation of a standard observatory-type oriented spacecraft consisting of a basic structure and subsystem design, which can be used repeatedly to carry large numbers of easily integrated scientific experiments in a wide variety of orbits.

EXPERIMENTS (OGO-I and OGO-B)

Solar proton flux, 10-90 Mev, energy and variations, scintillation counter - University of California

Solar plasma flux, energy and direction, electrostatic analyzer - Ames Research Center

Solar plasma flux, energy and direction, Faraday cup - Massachusetts Institute of Technology

Search for positrons and solar gamma ray flux and spectrum, scintillation counters - GSFC and Institute for Defense Analysis

Geomagnetically trapped electron and proton flux, energy and direction, phosphor scintillation counter - GSFC

Galactic and solar cosmic ray flux, charge and energy, dE/dx vs E scintillation telescope - GSFC

Galactic and solar cosmic ray flux, charge and energy, dE/dx vs E and range detector - University of Chicago

Geomagnetically trapped electron and proton flux and energy, omnidirectional Geiger counters and solid state detector - State University of Iowa

Geomagnetically trapped electron energy and flux, and total ionization - University of Minnesota

Electron density by R.F. propagation, 40 and 360 Mc transmitter - Radio Standards Laboratory, National Bureau of Standards, Boulder, Colorado

Thermal charged particle density, energy, and composition, spherical ion and electron trap - Air Force Cambridge Research Laboratory, Massachusetts

Thermal charged particle density, energy and composition, planar ion and electron trap - GSFC

Atmospheric composition, 1-48 amu, Bennett R.F. mass spectrometer - GSFC

Magnetic field strength and direction, Rubidium-vapor and flux-gate magnetometer - GSFC

Magnetic field low frequency variations, .01-1000 cps, triaxial search coil magnetometer - Jet Propulsion Laboratory

Micron dust particle velocity and mass, time-of-flight and momentum detector - GSFC

Solar and Jovian radio-noise burst frequency spectrum, 2-4 Mc receiver - University of Michigan

VLF terrestrial noise, solar particle emissions, and cosmic noise frequency distribution and strength, 0.2 - 100 Kc receiver - Stanford University

Geocoronal Lyman-alpha intensity and location of scattering layer, ion chambers - Naval Research Laboratory

Gegenschein intensity and location, scanning photometer - GSFC and University of Illinois

OBSERVATORY DESCRIPTION

WEIGHT

1125 lbs, including 195 lbs for experiments

MOMENTS OF INERTIA

Launch Mode

Roll - 285 slug-ft^2
Thrust - 65 slug-ft^2
Yaw - 285 slug-ft^2

Orbital

Roll - 665 slug-ft^2
Thrust - 340 slug-ft^2
Yaw - 910 slug-ft^2

DIMENSIONS

Overall (paddles and booms extended) - 50 ft X 20 ft
Body - 32 inches X 72 inches
Solar paddles (each) - 8 ft X 6 ft

POWER SUBSYSTEMS

REQUIREMENTS (Average)

Spacecraft - 200 watts
Experiments - 50 watts

SUPPLY

Batteries (12 amp/hrs)
Nickel Cadmium (OGO-I and B)
Silver Cadmium (Thereafter)

Solar Cells
32,256 solar cells mounted on solar-oriented arrays furnishing approximately 650 watts (Initially)

TELEMETRY AND TRACKING SUBSYSTEMS

WIDEBAND TELEMETRY (PCM/PM)

Two 4-watt, 400 Mc, RF Transmitters (redundant)
Two Data-Handling Units
Two High Capacity Tape Recorders (12 hrs. @1000 bits/sec each)

SPECIAL PURPOSE TELEMETRY (FM/PM)

One 500 mw, 400 Mc, RF Transmitter
One Signal Combiner and AGC Unit

RADIO COMMAND

Two Command Receivers and Combiner
Two Digital Command Decoders
One Tone Command Decoder

TRACKING

One 10-watt, 136 Mc Beacon (Apogee Tracking)
Two 100 mw, 136 Mc Beacons

SPACECRAFT CLOCK

Accumulates elapsed time for 1 year in 1-second increments. Used with Data Processing System.

LAUNCH VEHICLES

Atlas-Agena B (OGO-I and B)
Atlas-Agena D (OGO-E, G, I, and K)

LAUNCH RANGE

Eastern Test Range

ORBIT (OGO-I actual initial orbit)

Perigee	- 175 nautical miles
Apogee	- 92,827 nautical miles
Inclination	- 31.1°
Period	- 63.98 hours

ENVIRONMENTAL TEST PROGRAM

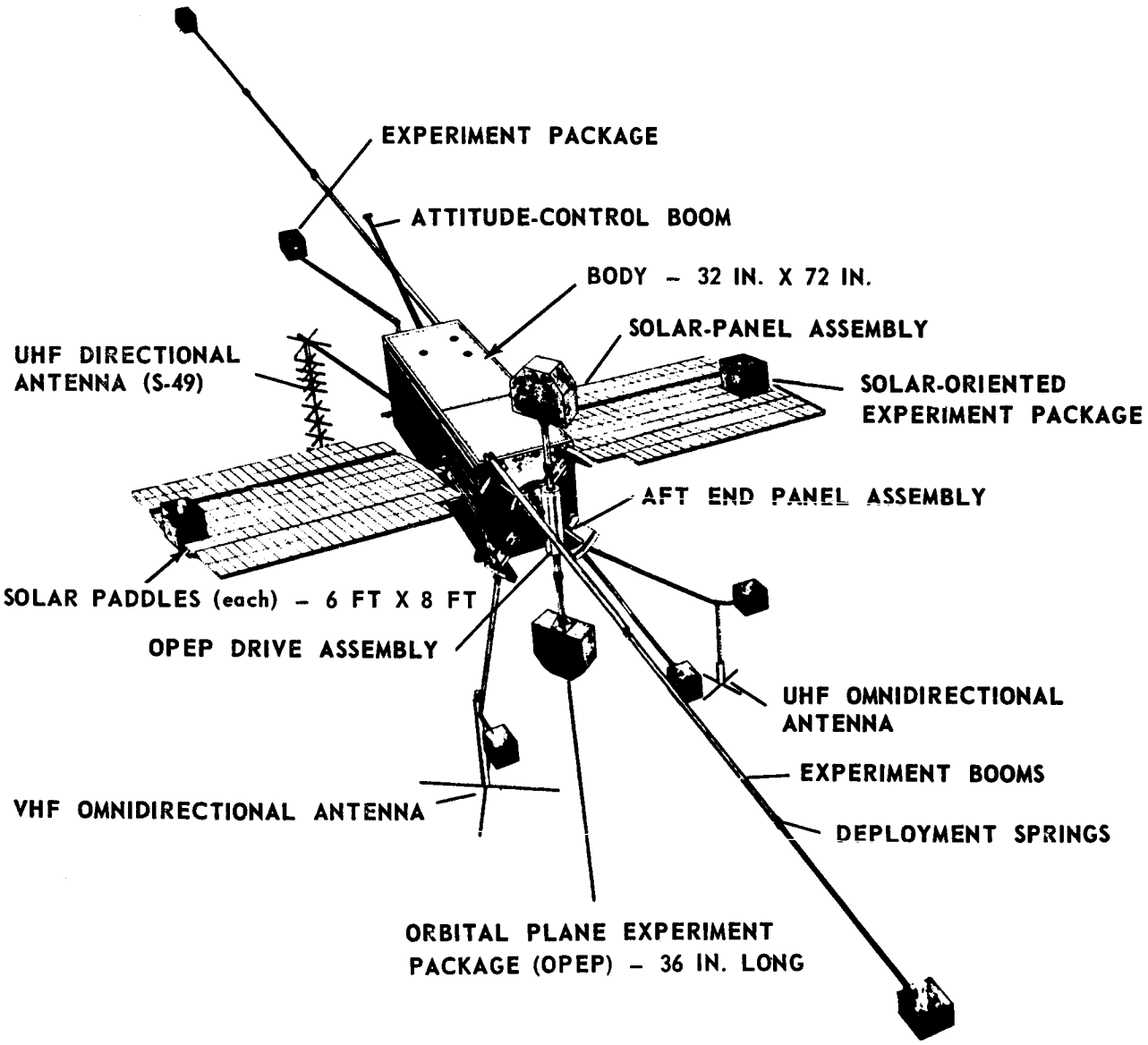
LOCATIONS

TRW Systems
- Observatories (except OGO-B)
- Spacecraft subassemblies and subsystems beginning with OGO-E)
- Some of Experiments

Goddard Space Flight Center
- Observatory (OGO-B only)
- Some of Experiments (beginning with OGO-E)

PROJECT SCHEDULE

September 4, 1964	- OGO-I Launch
1966	- OGO-B
1967	- OGO-E
1969	- OGO-G
1970	- OGO-I
1972	- OGO-K



OVERALL DIMENSIONS (paddles and booms extended) – 50 FT X 20 FT

Orbiting Geophysical Observatory
(OGO)

POLAR ORBITING GEOPHYSICAL OBSERVATORY

(POGO or OGO)*

OBSERVATORIES

OGO-II, OGO-D, OGO-F, OGO-H, OGO-J

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

Observatory System
GSFC

Tracking and Data System
GSFC

Vehicle System
Lewis Research Center

CONTRACTORS

TRW Systems, Redondo Beach, California
Spacecraft

Douglas
Thrust Augmented Thor (TAT), Booster

Lockhead Missiles and Space Company, Sunnyvale, California
Agena D, Second Stage Vehicle

OBJECTIVES

PRIMARY

Conduct large numbers of significant, diversified geophysical experiments for making scientific measurements about the Earth.

*POGO and EGO comprise the OGO program

SECONDARY

Development and operation of a standard observatory-type oriented spacecraft, consisting of a basic structure and subsystem design which can be used repeatedly to carry large numbers of easily integrated scientific experiments in a wide variety of orbits.

EXPERIMENTS (OGO-II and OGO-D)

Low-energy trapped radiations: electrons, 10-100 Kev; protons, 100 Kev - 4.5 Mev; phosphor scintillation counter - GSFC

Total ionization over polar regions, ionization chamber - California Institute of Technology and Jet Propulsion Laboratory

0.3 - 30 Mev nucleons, scintillation telescope - University of Chicago

Net downflux of corpuscular radiation in auroral zones and over polar caps, Geiger counters - University of Iowa

Energy spectrum and charged-particle composition of galactic and solar cosmic rays, Cerenkov detector - University of Minnesota

Ionospheric charged particles, planar retarding potential analyzer - GSFC

Neutral - particle and ion measurements: 0-6 atomic mass unit (amu) and 0-40 amu, Paul massenfilter mass spectrometer University of Michigan

Neutral - particle density, Bayard-Alpert density gauge - GSFC

Atomospheric composition 1-45 amu, Bennett R. F. mass spectrometer - GSFC

Micrometeorites: mass, velocity, charge; time-of-flight and momentum detector - GSFC

World Magnetic Survey, Rubidium - vapor magnetometer - GSFC

Magnetic field fluctuations, 1-1000 cps, triaxial search coil magnetometer - university of California at Los Angeles and Jet Propulsion Laboratory

Radio-astronomy measurements of galactic emission at 2.5 and 3.0 Mc/s, radio receiver - University of Michigan

VLF measurements at 0.2 - 100 Kc, VLF receiver - Stanford University

VLF emissions and whistlers between 0.5 and 10 Kc/s VLF receiver - Dartmouth College

Measurements of airglow: 1100 Å to 3400 Å, Ebert U. V. spectrometer - Jet Propulsion Laboratory and Yerkes Observatory

Airglow in the UV and at 3914 Å, 5577 A and 6300 Å, photometers - University of Paris and GSFC

Solar emission in the 200-1600 Å region, scanning spectrometer - Air Force Cambridge Research Laboratory, Massachusetts

Solar X-ray emissions in the 0.5 - 3 Å, 2 - 8 Å, 8-16 Å, and 44-60 Å bands, ionization chambers - Naval Research Laboratory

Lyman-alpha and for UV airglow between 1230 Å and 1350 Å, ionization chambers - Naval Research Laboratory

OBSERVATORY DESCRIPTION

WEIGHT

1200 lbs, including 260 lbs for experiments

MOMENT OF INERTIA

LAUNCH MODE

Roll 295 slug-ft^2 Thrust 66 slug-ft^2 Yaw 295 slug-ft^2

Orbital

Roll - 670 slug-ft^2
Thrust - 400 slug-ft^2
Yaw+ - 970 slug-ft^2

DIMENSIONS

Body - 32 inches X 72 inches
Solar Paddles (each) - 6 ft X 8 ft
Overall (Paddles and Booms Extended) - 50 ft X 20 ft

POWER SUBSYSTEMS

REQUIREMENTS (Average)

Spacecraft - 200 watts
Experiments - 50 watts

SUPPLY

Batteries
Silver Cadmium - 12 amp/hrs

Solar Cells

32,256 solar cells mounted on solar-oriented arrays furnishing approximately 650 watts (Initially)

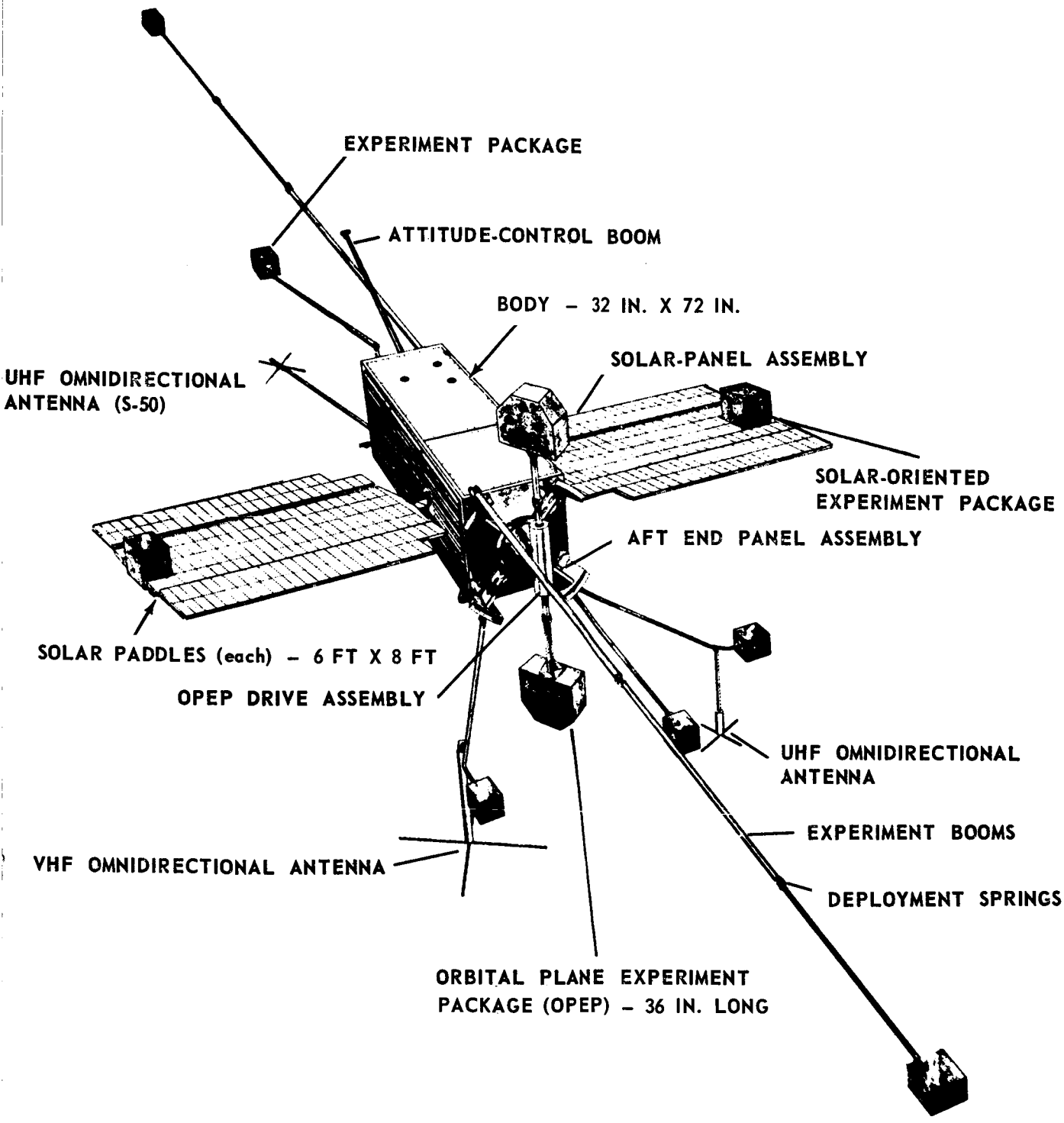
TELEMETRY AND TRACKING SUBSYSTEMS

WIDEBAND TELEMETRY (PCM/PM)

Two 4-watt 400 Mc RF Transmitters (Redundant)
Two Data-Handling Units
Two High Capacity Tape Recorders (12 hrs @1000 bit/sec each)

SPECIAL PURPOSE TELEMETRY (FM/PM)

One 500 mw 400 Mc RF Transmitter
One Signal Combiner and AGC Unit



OVERALL DIMENSIONS (paddles and booms extended) – 50 FT X 20 FT

Orbiting Geophysical Observatory
(OGO)

ARIEL II (UK-C)
FORMERLY
INTERNATIONAL SATELLITE (UK-2/S-52)

SPACECRAFT

UK-C

RESPONSIBILITIES

UNITED STATES

Spacecraft
Goddard Space Flight Center (GSFC)

Launch Vehicle
Langley Research Center

UNITED KINGDOM

Experiments

Data Reduction and Analysis

Tracking and Data Acquisition
(Jointly with US)

CONTRACTORS

Air Arm Division of Westinghouse Electric Corporation, Baltimore, Maryland
Spacecraft

Ling-Temco-Vought (Chance-Vought Division, Dallas, Texas)
Launch Vehicle

OBJECTIVE

The objective of this program is to continue the joint space research initiated by the United States and United Kingdom in the UK-1/S-51 project.

EXPERIMENTS

1. Measurement of galactic radio noise in the frequency range 0.75 Mc to 3.0 Mc.

2. Measurement of vertical distribution of atmospheric ozone.

3. Measurement of the micrometeoroid flux.

SPACECRAFT DESCRIPTION

WEIGHT

165 lbs, including 15 lbs for the separation mechanism

MOMENT OF INERTIA (Thrust)

Launch Mode – 2.39 slug-ft^2
Orbital – 46.6 slug-ft^2

DIMENSIONS

Spacecraft Diameter – 23 inches
Height of Midsection – 13.9 inches
Solar Paddles (each) – 16½ in. X 12 in.

POWER SUBSYSTEMS

Requirement

Approximately 5.5 watts continuously

Supply

Batteries – Nickel Cadmium
Solar Cells – 4,000 in four fixed arrays, furnishing about 30 watts

TELEMETRY AND TRACKING SUBSYSTEMS

Continuous real-time data is transmitted from the galactic noise and micrometeoroid experiments in the normal mode with the following exceptions:

1. Data from ozone experiments is gathered during satellite sunset and sunrise to the exclusion of other data.
2. Upon command, low-speed (real-time/48) data from the ozone and galactic-noise experiments, stored in the tape recorder, may be transmitted at 48 times the recorded rate, giving same bandwidth characteristics as real-time transmission.

TELEMETRY TRANSMITTER

Frequency – 136 to 137 Mc band
Type Transmission – PFM/PM
RF Power Output – 0.25 watt

LAUNCH VEHICLE

Scout

LAUNCH RANGE

Wallops Island

ORBIT

Perigee – 150 nautical miles
Apogee – 810 nautical miles
Inclination – 51°
Lifetime – 1 year

ORBIT

OGO-II (Actual initial)

Perigee - 231 nautical miles
Apogee - 850 nautical miles
Inclination - 87.5° prograde
Period - 105.1 minutes

OGO-D (Planned)

Perigee - 141 nautical miles
Apogee - 500 nautical miles
Inclination - 88° prograde
Period - 97 minutes
Lifetime - 1 year

ENVIRONMENTAL TEST PROGRAM

LOCATION

TRW Systems, Redondo, California
- Observatories
- Subsystems
- Some of experiments (beginning with OGO-F)

Goddard Space Flight Center
- Experiments
- Some of experiments (beginning with OGO-F)

SCHEDULE

November 1965 to end of 1966
- Flight Observatory (OGO-D)

PROJECT SCHEDULE

October 14, 1965 - OGO-II launch

1966 - OGO-D
1968 - OGO-F
1969 - OGO-H
1971 - OGO-J

TRACKING

The telemetry transmitter carrier signal is used for tracking by the Minitrack system.

ENVIRONMENTAL TEST PROGRAM

LOCATIONS

GSFC
Spacecraft

Langley Research Center
Dynamic Test Unit (Functional Tests)

Westinghouse Electric (Air Arm Division)
Some Subsystems

United Kingdom
Experiments

SCHEDULE

August 4, 1962 to Mid-December 1962
Functional Tests

Mid-July 1962 to August 31, 1962
Structural Model Tests

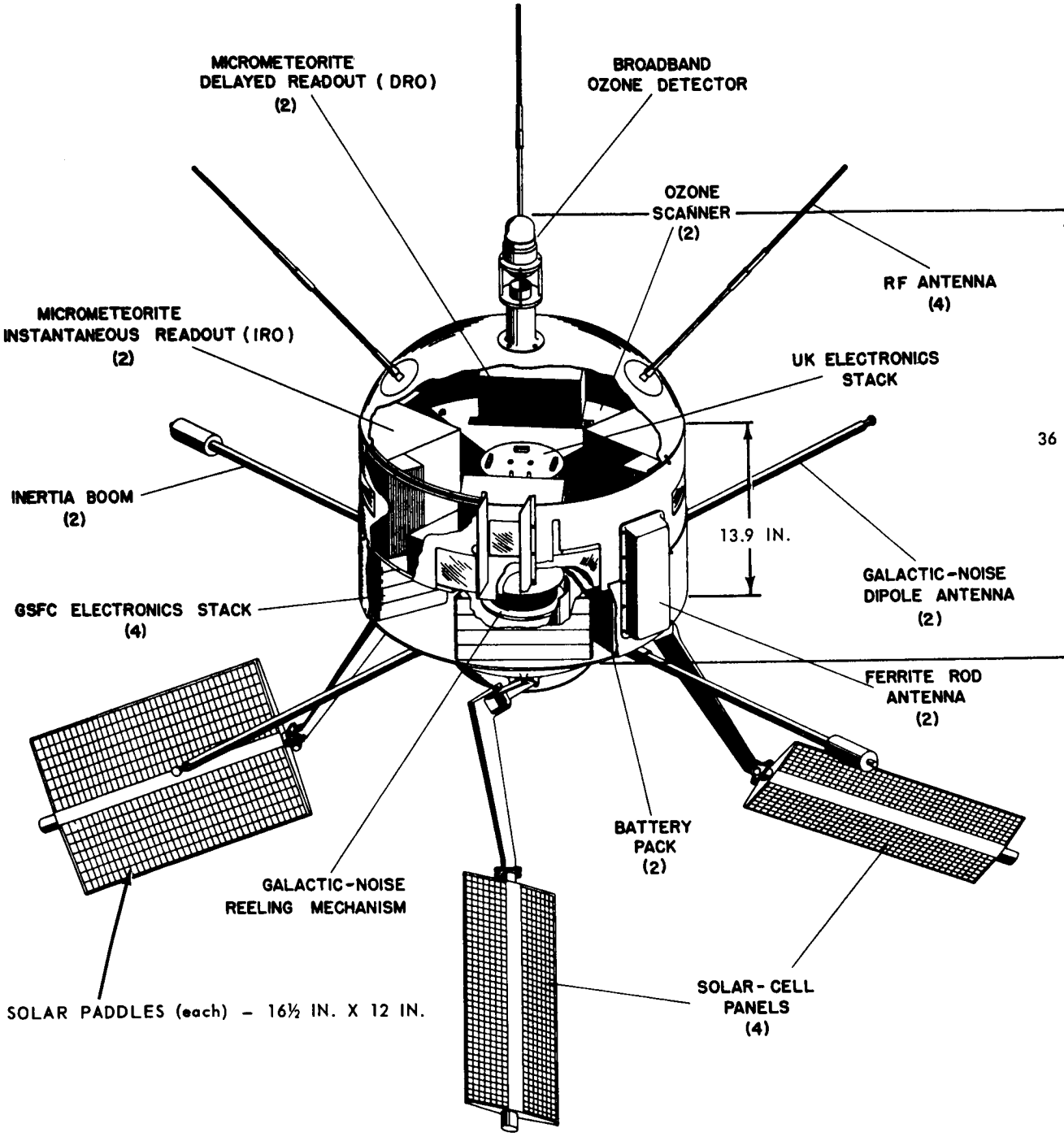
February 27, 1963 to August 15, 1963
Design Qualification Tests

July 18, 1963 to October 11, 1963
Flight Acceptance Tests (Flight Unit #1)

November 1963 to February 14, 1964
Flight Acceptance Tests (Flight Unit #2)

PROJECT SCHEDULE

Launched March 27, 1964



Spacecraft Diameter – 23 inches
Dipole Antenna – Not extended

Ariel II
(UK-C)

UNITED KINGDOM INTERNATIONAL SATELLITE
(S-53/UK-E)

SPACECRAFT

UK-E - Flight Model
UK-F - Backup

RESPONSIBILITIES

UNITED STATES

Project Management
Goddard Space Flight Center (GSFC)

Tracking and Data Acquisition
GSFC

Launch Vehicle
Langley Research Center

UNITED KINGDOM

General Management
British National Committee for Space Research
(Space Research Management Unit)

Spacecraft
Royal Aircraft Establishment, Farnborough

Data Reduction and Analysis
Radio Research Station, Slough, and Atomic
Weapons Research Establishment (AWRE)

CONTRACTORS

British Aircraft Corporation, Stevenage
Spacecraft

Ling-Temco-Vought (Chance-Vought Division, Dallas, Texas)
Launch Vehicle

OBJECTIVE

The objective of this program is to continue the joint space research by the United States and the United Kingdom with a British-built satellite launched by a U. S. vehicle.

EXPERIMENTS

1. Measurement of the vertical distribution of molecular oxygen in the earth's atmosphere, Meteorological Office, Brackwell

2. Mapping large-scale noise sources in the galaxy, University of Cambridge

3. Satellite investigation of VLF radiation, University of Sheffield

4. The continuous measurement of ionization density and temperature, University of Birmingham

5. Terrestrial radio noise equipment, Radio Research Station, Slough

SPACECRAFT DESCRIPTION

WEIGHT

180 lbs, including separation mechanism

LAUNCH VEHICLE

Scout

LAUNCH RANGE

Western Test Range, California

ORBIT

Circular - 550 km
Inclination - 60°
Lifetime - 1 year

TRACKING

The telemetry transmitter carrier signal is used for tracking by the STADAN system.

ENVIRONMENTAL TEST PROGRAM

LOCATION

Royal Aircraft Establishment facilities in England

SCHEDULE

September 1964 - Structural test model
February 1965 - Electrical test
October 1965 - Prototype spacecraft
May 1966 - Flight Unit UK-E
May 1966 - Flight Unit UK-F

PROJECT SCHEDULE

Late 1966 - Delivery of Flight Units to the United States
Late 1966 or early 1967 - Launch

BEACON EXPLORER
(S-66)

SPACECRAFT

Beacon Explorer A, B, and C

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

Tracking and Data Acquisition
GSFC

Launch Vehicle
GSFC-Beacon Explorer A
Langley Research Center - Beacon Explorer B and C

CONTRACTORS

Applied Physics Laboratory (APL) of the Johns Hopkins University
Spacecraft

General Electric (Missile and Space Vehicle Division, Philadelphia)
Fabrication of reflector assembly and prototype ground transmitter and sensor for Laser Experiment.

OBJECTIVES

The objective of the S-66 program is to conduct worldwide ionospheric measurements which are to serve as a basis for plotting the structure of the ionosphere and for describing its behavior under varying conditions of solar radiation.

IONOSPHERE OBSERVING STATIONS

STATIONS USED BY PRIME EXPERIMENTERS

State College, Pennsylvania
Huancayo, Peru
Adak, Alaska
Baker Lake, Canada
Houghton, Michigan
Urbana, Illinois
Palo Alto, California
Honolulu, Hawaii
Boulder, Colorado
College, Alaska
Blossom Point, Maryland
Johannesburg, South Africa
Wallops Island, Virginia

INTERNATIONAL

100 ground stations throughout world (voluntary participation)

SPACECRAFT DESCRIPTION

QUANTITY

One prototype spacecraft. One flight-acceptance spacecraft was available for first launch. The back-up spacecraft was prepared for second launch. The prototype was used for the third launch.

WEIGHT

124 pounds (132 lbs, including separation mechanism)

MOMENTS OF INERTIA (Thrust Axis)

Launch (antennas folded) - $2.05 \pm .3$ slug-ft^2
Orbital (antennas extended) - 19.41 ± 2.0 slug-ft^2

CONFIGURATION

Right octagonal prism approximately 18 in. across flats by 12 in. high.
Overall Length (blades extended) - 88 in. (approximately)

SOLAR BLADES

Quantity - 4
Dimensions - 10 in. x 70 in. (approximately)
Total Solar Area - 16 sq ft (approximately)

TRANSMISSION FROM SPACECRAFT

Four Phase-Locked Transmitters
Operating on 20, 40, 41, and 360 Mc

Two APL designed transmitters
Operating on 162 and 324 Mc for precise tracking by APL tracking stations

Telemetry at 136 Mc
To provide Minitrack data and spacecraft performance data

POWER SYSTEM

Power System
Solar cells mounted on four solar blades charging a bank of 17 nickel cadmium batteries

Voltage
24 volts (unregulated)

Requirements
10 watts (nominal)

LAUNCH VEHICLE

Thor Delta - Beacon Explorer A
Scout - Beacon Explorer B and C

LAUNCH RANGE

Eastern Test Range - Beacon Explorer A
Western Test Range - Beacon Explorer B
Wallops Island - Beacon Explorer C

ORBIT

BEACON EXPLORER A AND B

Type - Circular
Altitude - 1000 km (539 nm)
Inclination - $80^{\circ} \pm 2^{\circ}$
Satellite Lifetime - 3 years

BEACON EXPLORER C

Type - Elliptical
Altitude - 1000 km X 1500 km prograde
Inclination - 41°
Satellite Lifetime - Over 1 year

TRACKING

GSFC Minitrack
Operating on 136 Mc telemetry

APL Network
Operating on 162 and 324 Mc telemetry

Laser Tracking Experiment
New optical tracking system to be used for tracking and geodetic studies.

ENVIRONMENTAL TEST PROGRAM

LOCATION

Applied Physics Laboratory

SCHEDULE

April 11, 1963
Completion of prototype tests

February 24, 1964
Completion of flight spacecraft tests for first launch-BE-A

August 6, 1964
Completion of flight spacecraft tests for back-up launch-BE-B

March 4, 1965
Completion of flight spacecraft tests-BE-C

PROJECT SCHEDULE

May 1, 1962
Start of Engineering Design

March 19, 1964
1st Launch Unsuccessful (thor Delta)

October 9, 1964
2nd Launch (Backup) successful (Scout). Designated Explorer 22.

April 30, 1965
3rd Launch Successful. Designated Explorer 27

COMMENT

The S-66 supplements the Swept-Frequency Topside Sounder (S-27) which is investigating the polar ionosphere and the Fixed-Frequency Topside Sounder (S-48) which has the mission of studying cross sections of ionosphere along the 75°W meridian.

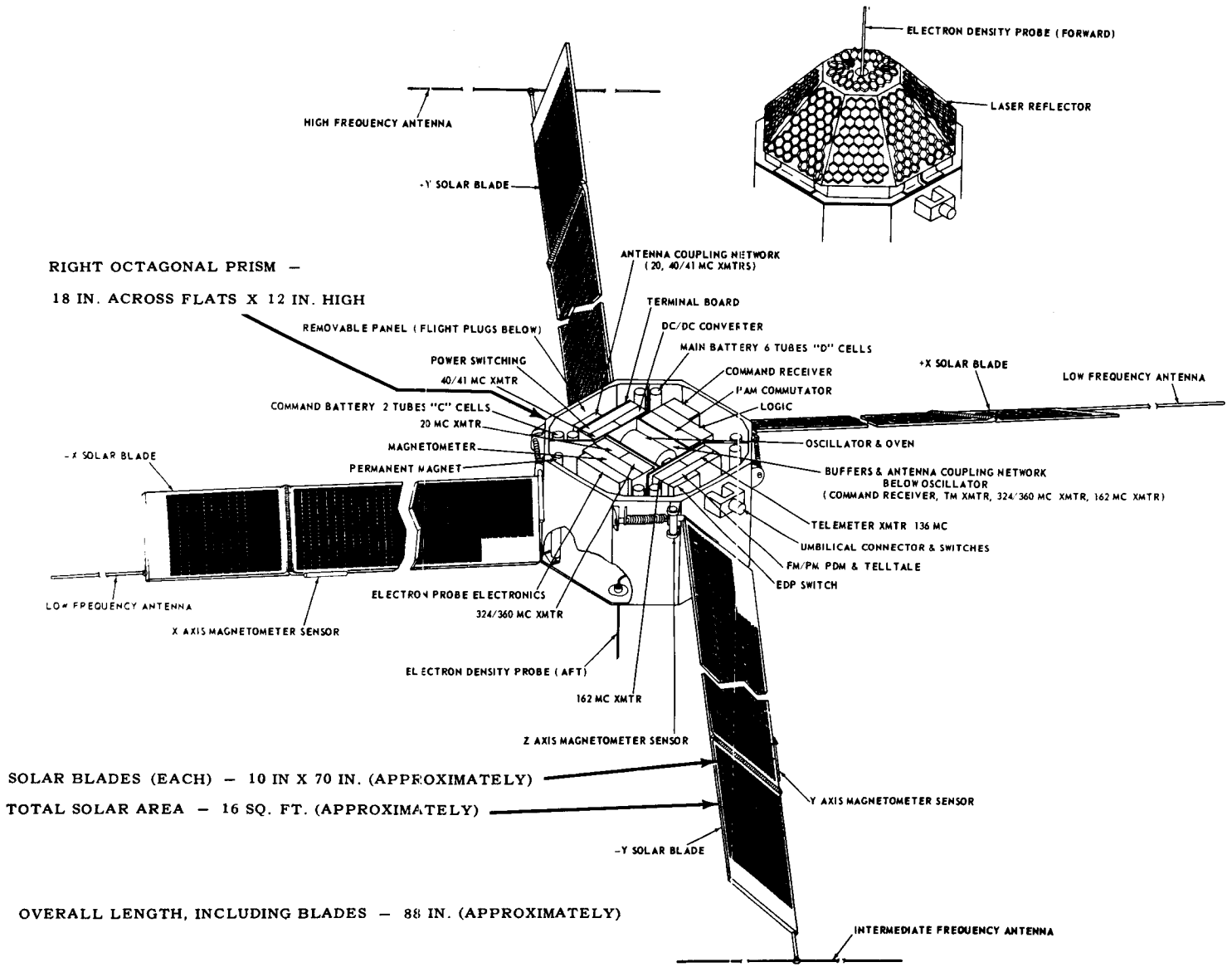
Other satellites which have engaged in ionospheric studies are Explorer VIII, P-21, P-21a, S-51, and Alouette I (S-27).

The program will be continued with Alouette B (S-27a) and Direct Measurements Explorer as part of the International Satellites for Ionospheric Studies (ISIS) program.

The first launch of S-66 was attempted at the ETR on 19 March 1964 using the Delta #24 vehicle. The spacecraft failed to achieve orbit due to failure of the 3rd stage (X-248).

The second launch BE-B was successful at the WTR on October 9, 1964 using the Scout vehicle.

The primary purpose of BE-C is for studies in dynamic geodesy. The secondary purpose is to conduct ionosphere measurements on a worldwide basis. The third launch BE-C was successful at Wallops Island on April 30, 1965.



Polar Ionosphere Beacon
(S-66)

SECTION II

LAUNCH VEHICLES AND SOUNDING ROCKETS

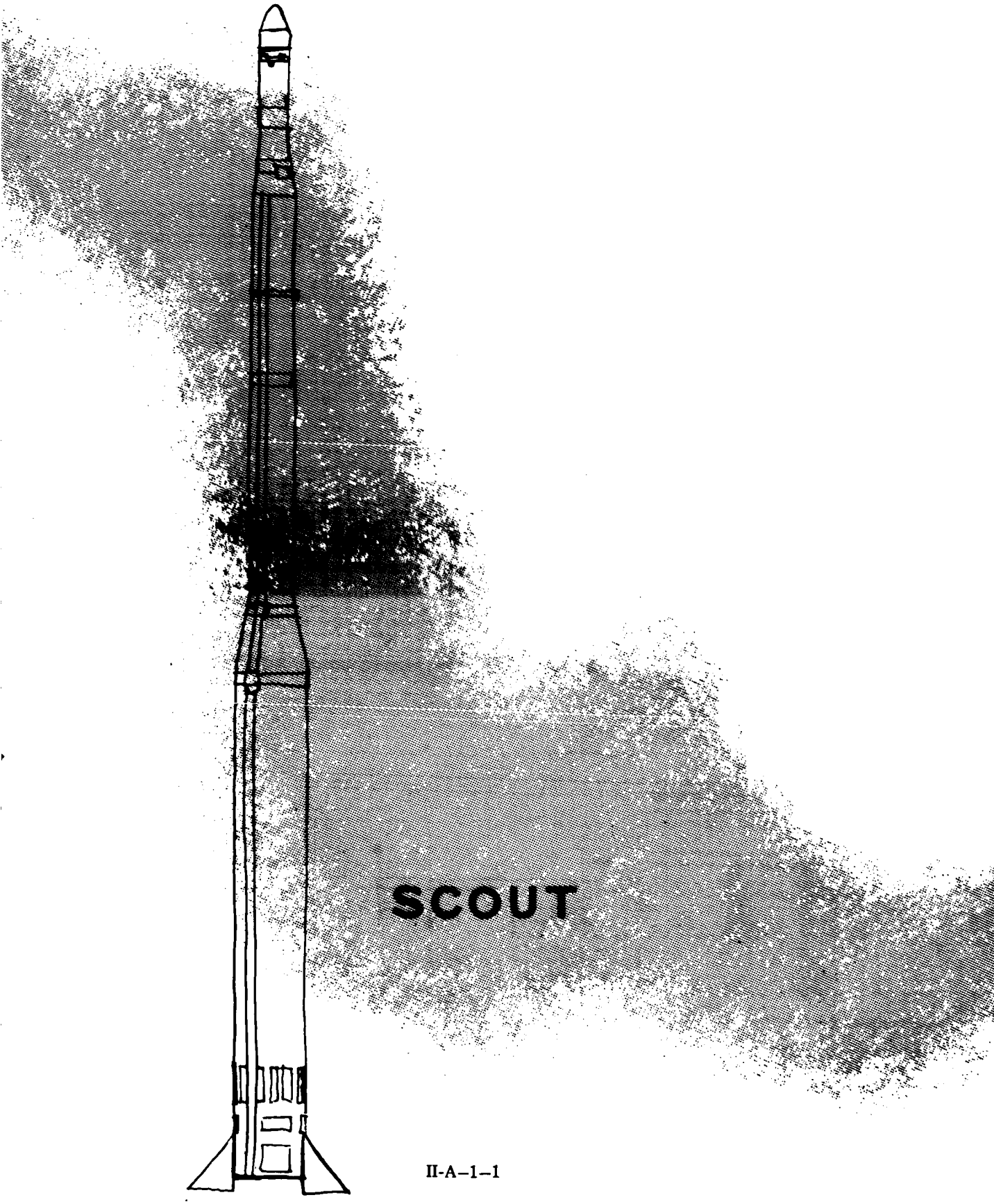
SECTION II-A LAUNCH VEHICLES

SECTION II-B SOUNDING ROCKETS

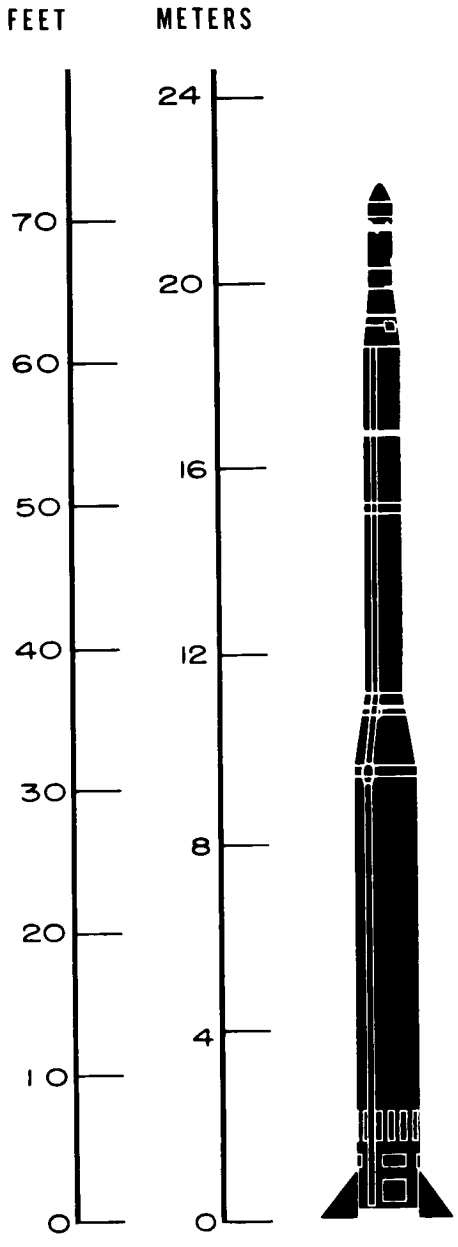
UNITS

LAUNCH
VEHICLES

1 SCOUT
2 DELTA
3 THOR-AGENA
4 ATLAS D
5 ATLAS-AGENA
6 ATLAS-CENTAUR
7 THRUST AUGMENTED DELTA
8 TITAN II
9 TITAN III
10 SATURN I
11 SATURN I-B
12 SATURN V
13 NOVA



SCOUT



SCOUT

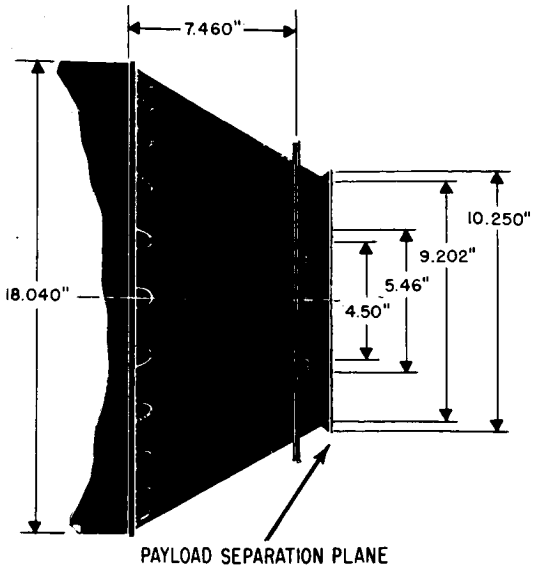
(Status as of February 1964)

SCOUT is an all-solid-propellant launch vehicle developed to provide NASA with a low-cost (less than one million dollars per mission), relatively simple 'work horse' for small scientific satellites, high altitude probes, and high-velocity re-entry testing. SCOUT uses a simple inertial guidance system with spin stabilization. Launch facilities and ground support equipment for SCOUT are now located at NASA's launch site at Wallops Island, Virginia, and at the Pacific Missile Range.

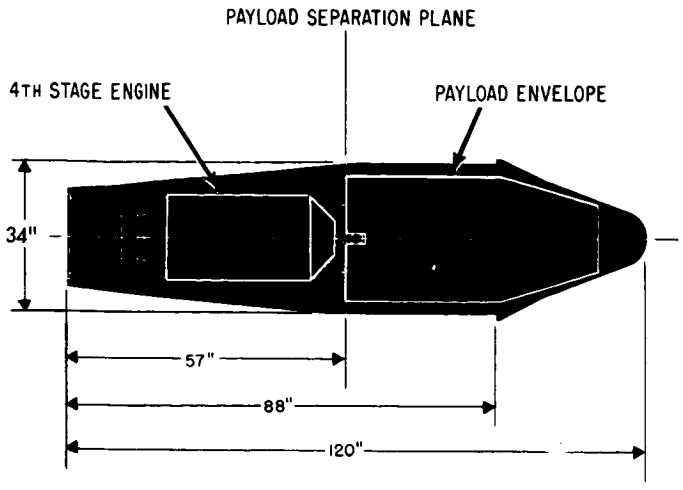
The SCOUT development program, which was concluded in March 1962, included a number of successful orbital and probe shots of relatively small payload. The Explorer 9, shot in February 1961 and the first satellite successfully launched from Wallops Island provided much valuable information on the density of the near space regions. The later Explorer 13 and P-21 shots were primarily concerned with micrometeoroid and ionospheric studies respectively. Future SCOUT missions include the S-48 Fixed Frequency Topside Sounder, the S-52 International Program (UK-2) and other international and U. S.-sponsored geoprobes.

STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE	ALT. 4th STAGE
STAGE DESIGNATION	ALGOL 2A	CASTOR	ANTARES	ALTAIR (X-248)	X-258
HEIGHT m	9.2	6.1	3.0	1.5	1.5
HEIGHT ft	30.0	20.0	10.0	5.0	5.0
DIAMETER m	1.0	0.8	0.8	0.5	0.5
DIAMETER ft	3.3	2.6	2.5	1.5	1.5
ENGINE	XM-68	XM-33-E5	X-259	X-248	X-258
ENGINE MANUFACTURER	AEROJET	THIOKOL	ABL	ABL	ABL
NUMBER OF ENGINES	1	1	1	1	1
THRUST PER ENGINE kg	47,400	28,200	9,900	1,300	2,600
THRUST PER ENGINE lb	104,500	62,200	21,900	2,800	5,800
TOTAL THRUST kg	47,400	28,200	9,900	1,300	2,600
TOTAL THRUST lb	104,500	62,200	21,900	2,800	5,800
PROPELLANT	SOLID	SOLID	SOLID	SOLID	SOLID

OVERALL VEHICLE DATA	
LIFTOFF THRUST kg	47,400
LIFTOFF THRUST lb	104,500
HEIGHT LESS SPACECRAFT m	19.8
HEIGHT LESS SPACECRAFT ft	65.0
MAXIMUM DIAMETER m	1.0
MAXIMUM DIAMETER ft	3.3
PAD WEIGHT kg	16,400
PAD WEIGHT lb	36,000
NUMBER OF STAGES	4
PRIME CONTRACTOR	LTV
PAYLOAD PERFORMANCE:	
300 MILE ORBIT (POLAR) kg	95
300 MILE ORBIT (POLAR) lb	210
300 MILE ORBIT (EAST LAUNCH) kg	118
300 MILE ORBIT (EAST LAUNCH) lb	260
ESCAPE kg	45
ESCAPE lb	100

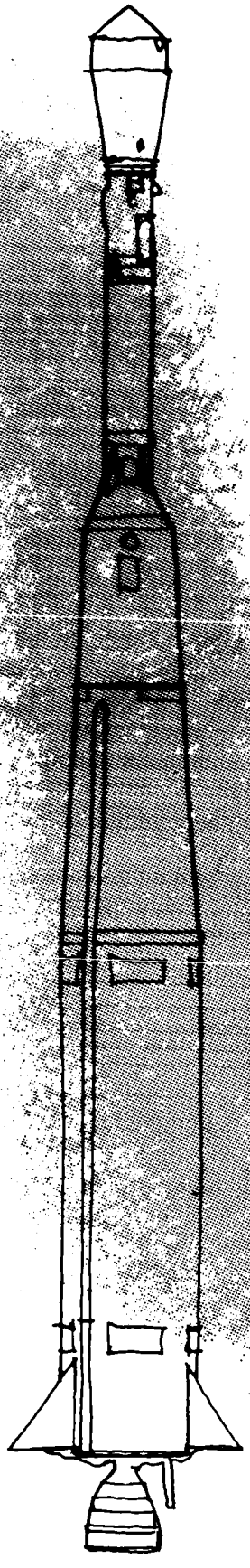


PAYLOAD ADAPTER

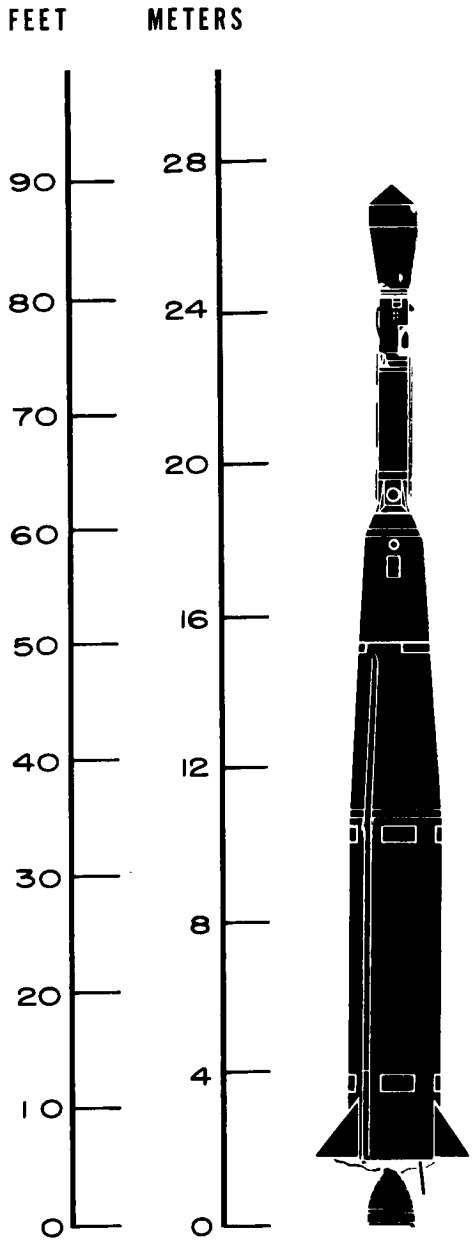


PAYLOAD SHROUD

PROJECT	DATE	AGENCY	PAYLOAD (kg)	PAYLOAD (lb)	LAUNCH SITE	ORBITAL DATA PERIOD (MIN.)	ORBITAL DATA PERIGEE (MI.)	ORBITAL DATA APOGEE (MI.)	ORBITAL DATA INCL'N (DEG.)	STATUS
SCOUT 3	12– 4–60	NASA	39	87	W.I.	--	--	--	--	Failed to orbit
EXPLORER 9	2–16–61	NASA	8	17	W.I.	118	395	1605	39	In orbit--silent
EXPLORER S-55	6–30–61	NASA	85	187	W.I.	--	--	--	--	Failed to orbit
EXPLORER 13	8–25–61	NASA	85	187	W.I.	97	175	606	36	Reentered 8–28–61
P–21 PROBE	10–19–61	NASA	43	94	W.I.	--	--	--	--	Attained planned altitude
MERCURY-SCOUT 1	11– 1–61	NASA	68	150	AMR	--	--	--	--	Failed to orbit
P–21A PROBE	3–29–62	NASA	68	150	W.I.	--	--	--	--	Attained planned altitude
EXPLORER 16	12–16–62	NASA	101	222	W.I.	--	466	733	--	In orbit--active
TRANSIT 5A	12–18–62	USN	—	135	PMR	99	430	458	91	In orbit
4 LAUNCHES	1963	USAF	—	—	PMR	—	—	—	—	————
GEOPHYSICAL RESEARCH SATELLITE	6–28–63	USAF	—	—	WI	102	257	810	50	In orbit
EXPLORER 19	12–19–63	NASA (LRC)	—	135	PMR	—	319	1300	78.1	In orbit



DELTA



DELTA

(Status as of February 1964)

The three stage DELTA vehicle is one of the family of launch vehicles based on the Thor booster and various combinations of the upper stages of Vanguard. The family includes Thor-Able Star, Thor-Able, and Thor-Delta, the last being the only one still in use. DELTA is a distinct improvement over its predecessor Thor-Able primarily because of an improved attitude control system and the provision for a 15-minute coast period capability after second stage burnout. Additionally, the DELTA vehicle has a more advanced autopilot and guidance system for the first two stages and, for enhanced stability at the end of the coast period, a spin-up system on the third stage. From the point of view of payload capacity DELTA falls between the less powerful Scout and the more powerful Thor-Agena vehicle. DELTA vehicles are launched from the Atlantic Missile Range.

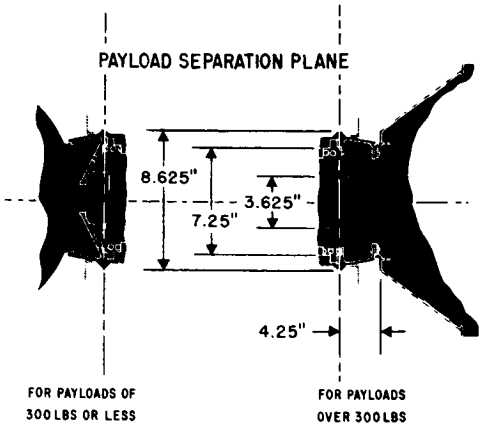
At the outset the DELTA program was envisioned as providing NASA with a vehicle capable of fulfilling its launch requirements for medium-sized satellites in the 1960 to 1962 period. The plans were then to phase out the DELTA vehicle as the new and more powerful Centaur and Saturn vehicles became operational. However, due to DELTA's high reliability, the extension of the TIROS program, and the emergence of the NASA and commercial communications satellite programs, the use of this vehicle has been extended several years.

The first launching of an operational DELTA vehicle took place in May 1960, and ended in failure. Since then DELTA has had an outstanding record in launching satellites for the Echo, Tiros, Explorer, Syncom, and Relay programs.

For the launch of IMP I in November 1963, the X-258 engine first was used in place of the X-248 engine for the third stage. The X-258 is to become the standard third stage, but the X-248 will be available for particular missions.

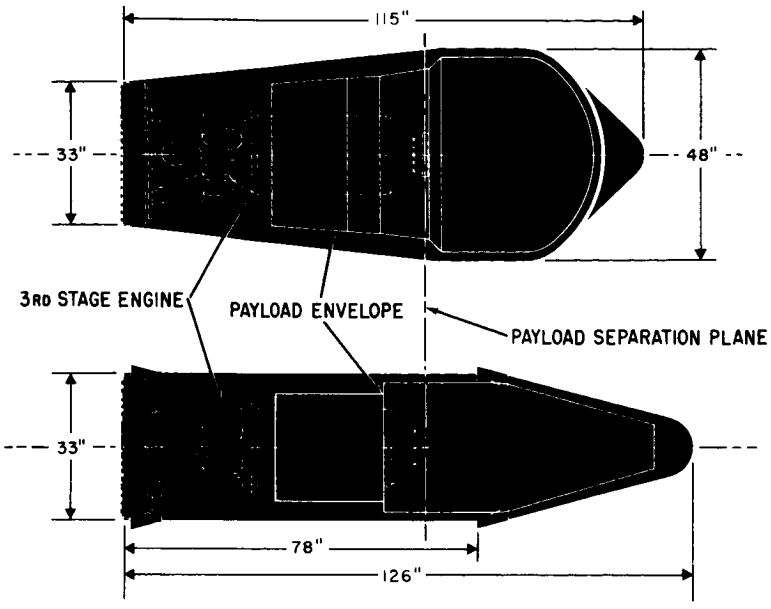
STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	ALT. 3rd STAGE
STAGE DESIGNATION	THOR (DM-21)	AJ10-118	X-258	ALTAIR (X-248)
HEIGHT m	18.2	7.0	1.0	1.0
HEIGHT ft	59.7	23.1	3.2	3.2
DIAMETER m	2.4	0.8	0.6	0.6
DIAMETER ft	8.0	2.8	1.5	1.5
ENGINE	BLOCK 2	AJ10-118	X-258	X-248
ENGINE MANUFACTURER	ROCKETDYNE	AEROJET	ABL	ABL
NUMBER OF ENGINES	1	1	1	1
THRUST PER ENGINE kg	78,100	3,420	2,770	1,250
THRUST PER ENGINE lb	172,000	7,550	6,100	2,760
TOTAL THRUST kg	78,100	3,420	2,770	1,250
TOTAL THRUST lb	172,000	7,550	6,100	2,760
PROPELLANT	LOX/RJ-1	IRFNA/UDMH	SOLID	SOLID
STAGE CONTRACTOR	DOUGLAS	DOUGLAS	DOUGLAS	DOUGLAS

OVERALL VEHICLE DATA		
LIFTOFF THRUST	kg	77,100
	lb	170,000
HEIGHT LESS SPACECRAFT	m	26.2
	ft	86.0
MAXIMUM DIAMETER	m	2.7
	ft	8.8
PAD WEIGHT	kg	51,300
	lb	113,100
NUMBER OF STAGES		3
PRIME CONTRACTOR		DOUGL
PAYLOAD PERFORMANCE (X-248):		
300 MILE ORBIT	kg	400
	lb	900
ESCAPE	kg	50
	lb	110
PLANETARY	kg	
	lb	



PAYLOAD ADAPTER

BULBOUS PAYLOAD SHROUD

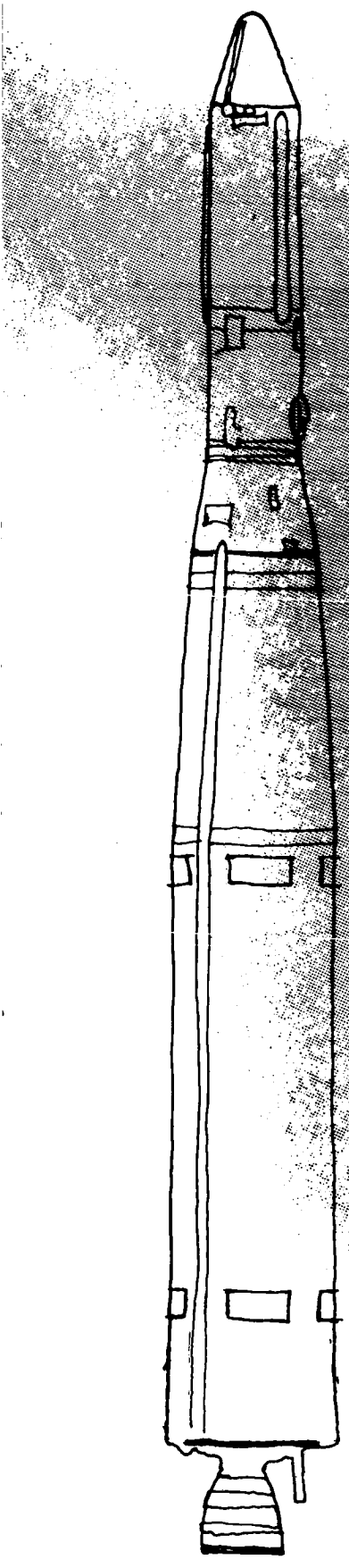


LOW DRAG PAYLOAD SHROUD

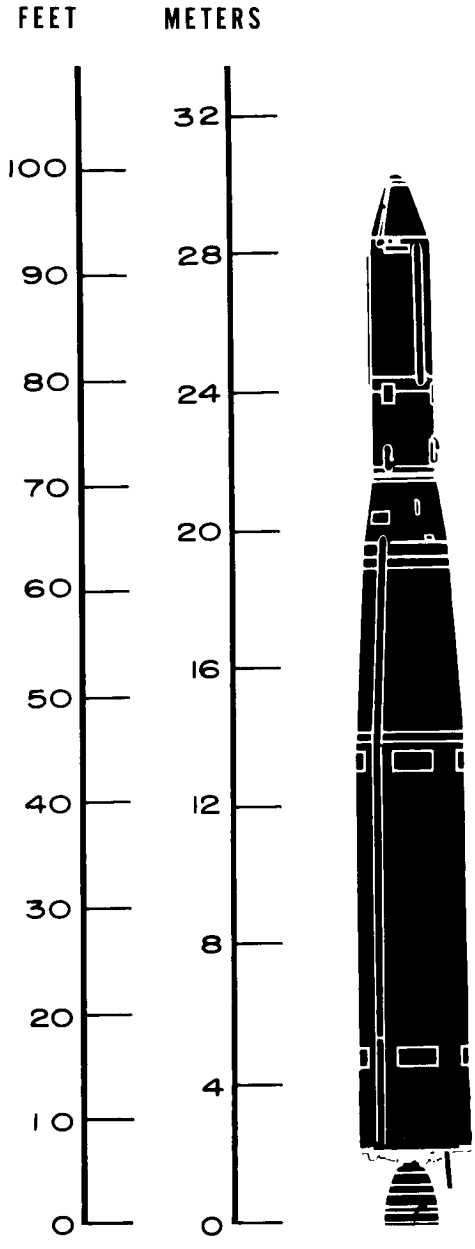
PAYLOAD SHROUD

PROJECT	DATE	AGENCY	PAYLOAD (kg)	PAYLOAD (lb)	LAUNCH SITE	ORBITAL DATA PERIOD (MIN.)	ORBITAL DATA PERIGEE (MI.)	ORBITAL DATA APOGEE (MI.)	ORBITAL DATA INCL'N (DEG.)	STATUS
ECHO	5–13–60	NASA	60	132	AMR	--	--	--	--	Failed to orbit
ECHO 1	8–12–60	NASA	75	166	AMR	118	941	1052	47	In orbit--silent
TIROS 2	11–23–60	NASA	127	280	AMR	98	387	452	48	In orbit--silent
EXPLORER 10	3–25–61	NASA	36	79	AMR	6720	100	145000	33	Uncertain
TIROS 3	7–12–61	NASA	129	285	AMR	100	461	506	48	In orbit--silent
EXPLORER 12	8–15–61	NASA	38	83	AMR	1585	180	47800	33	Uncertain
TIROS 4	2– 8–62	NASA	129	285	AMR	100	441	525	48	In orbit--active
OSO 1	3– 7–62	NASA	208	458	AMR	96	344	370	33	In orbit--active
ARIEL	4–26–62	NASA	60	132	AMR	101	242	754	54	In orbit--active
TIROS 5	6–19–62	NASA	130	286	AMR	100	367	604	58	In orbit--active
TELSTAR 1	7–10–62	AT&T	77	170	AMR	158	593	3503	45	In orbit--silent
TIROS 6	9–18–62	NASA	128	281	AMR	99	423	444	58	In orbit--active
EXPLORER 14	10– 2–62	NASA	40	89	AMR	2184	174	61190	33	In orbit--active
EXPLORER 15	10–27–62	NASA	44	98	AMR	312	194	10760	18	In orbit--silent
RELAY 1	12–13–62	NASA	78	172	AMR	186	819	4612	47.5	In orbit--active
SYNCOM 1	2–13–63	NASA	39	86	AMR	1426	21268	22974	33.5	In orbit--silent
EXPLORER 17	4–2–63	NASA	184	405	AMR	96	158	570	57.6	In orbit--active
TELSTAR 2	5–7–63	AT&T	79	175	AMR	225	604	6713	42.7	In orbit--silent
TIROS	6–19–63	NASA	134	297	AMR	97.4	383	407	58.2	In orbit--active
SYNCOM 2	7–26–63	NASA	35.8	78.8	AMR	1440	22,300	22,300	33	In orbit--active
EXPLORER 18	11–26–63	NASA	61	135	AMR	9180	119*	122800	----	In orbit--active
TIROS 8	12–21–63	NASA	122	265	AMR	99.3	447	468	58.5	In orbit--active
RELAY 2	1–21–64	NASA	78	172	AMR	195	1325	4,600	46.3	In orbit--active

* *2nd orbit: Perigee to gradually increase.*



THOR-AGENA



THOR-AGENA

(Status as of February 1964)

The THOR-AGENA is a two-stage launch vehicle using a THOR booster. The AGENA has its own guidance system and the ability to restart in space. Its payload capability of 730 kilograms in a low circular earth orbit places THOR-AGENA next on the lifting power scale to THOR-DELTA in the NASA stable of launch vehicles. These vehicles are launched from the Pacific Missile Range and have been used primarily for satellites with polar orbits.

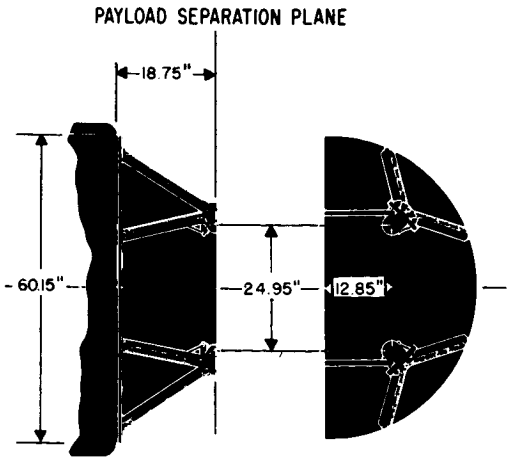
THOR-AGENA was originally developed for the Air Force DISCOVERER satellite series. Between February 1959 and October 1960 some fifteen DISCOVERER shots were made using THOR-AGENA A. Then on October 16, 1960, the first of the THOR-AGENA B vehicles was launched in the unsuccessful DISCOVERER 16 shot. Since then more than seventeen additional DISCOVERER satellites have been successfully launched.

The DISCOVERER 36 shot in December 1961 carried OSCAR as a piggyback. This success was followed in June 1962 with OSCAR 2, which is still in orbit and actively transmitting data. In September 1962 the THOR-AGENA B was successfully employed to place the Canadian ALOUETTE in orbit. THOR-AGENA D became operational in 1963.

Future NASA plans for the THOR-AGENA cover the next five to seven years. The ECHO 2 passive communications satellite has been launched, and numerous NIMBUS and Polar Observatory shots will utilize the THOR-AGENA vehicle.

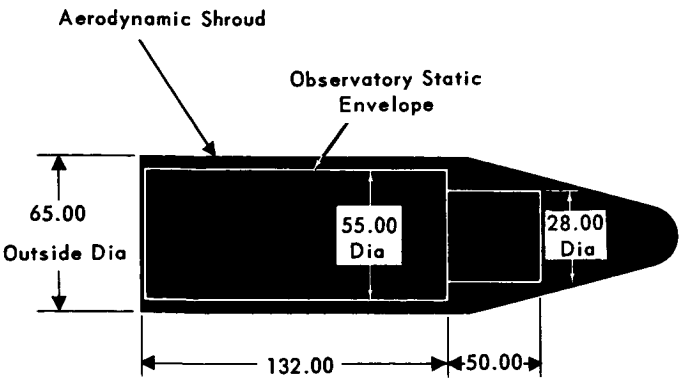
STAGE DATA	1st STAGE	2nd STAGE
STAGE DESIGNATION	THOR (DM-21)	AGENA B
HEIGHT, m	17.1	7.0
HEIGHT, ft	56.0	23.0
DIAMETER, m	2.4	1.5
DIAMETER, ft	8.0	5.0
ENGINE	MB-3, BLOCK 2	BELL 8096
ENGINE MANUFACTURER	ROCKETDYNE	LOCKHEED
NUMBER OF ENGINES	1	1
THRUST PER ENGINE, kg	77,400	7,300
THRUST PER ENGINE, lb	172,000	16,000
TOTAL THRUST, kg	77,400	7,300
TOTAL THRUST, lb	172,000	16,000
PROPELLANT	LOX/RP	IRFNA/UDMH
STAGE CONTRACTOR	DOUGLAS	LOCKHEED

OVERALL VEHICLE DATA	
LIFTOFF THRUST, kg	77,400
LIFTOFF THRUST, lb	172,000
HEIGHT LESS SPACECRAFT, m	24.4
HEIGHT LESS SPACECRAFT, ft	80.0
MAXIMUM DIAMETER, m	2.4
MAXIMUM DIAMETER, ft	8.0
PAD WEIGHT, kg	56,000
PAD WEIGHT, lb	123,000
NUMBER OF STAGES	2
PRIME CONTRACTOR	DOUGLAS
PAYLOAD PERFORMANCE: 345 MILE ORBIT, kg	730
PAYLOAD PERFORMANCE: 345 MILE ORBIT, lb	1,600
ESCAPE, kg	--
ESCAPE, lb	--
PLANETARY, kg	--
PLANETARY, lb	



PAYLOAD ADAPTER

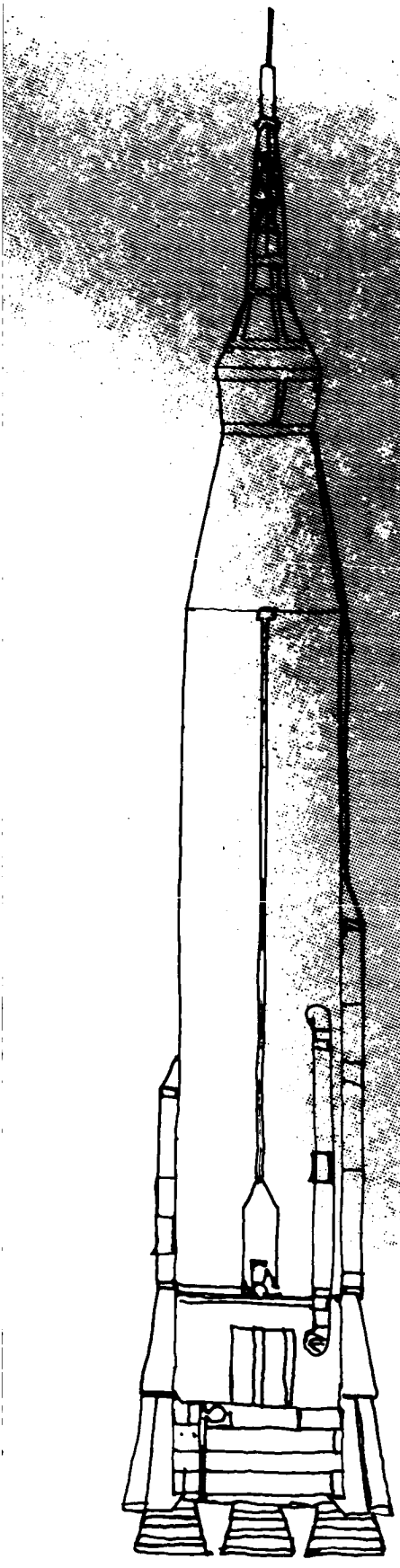
(For OGO)



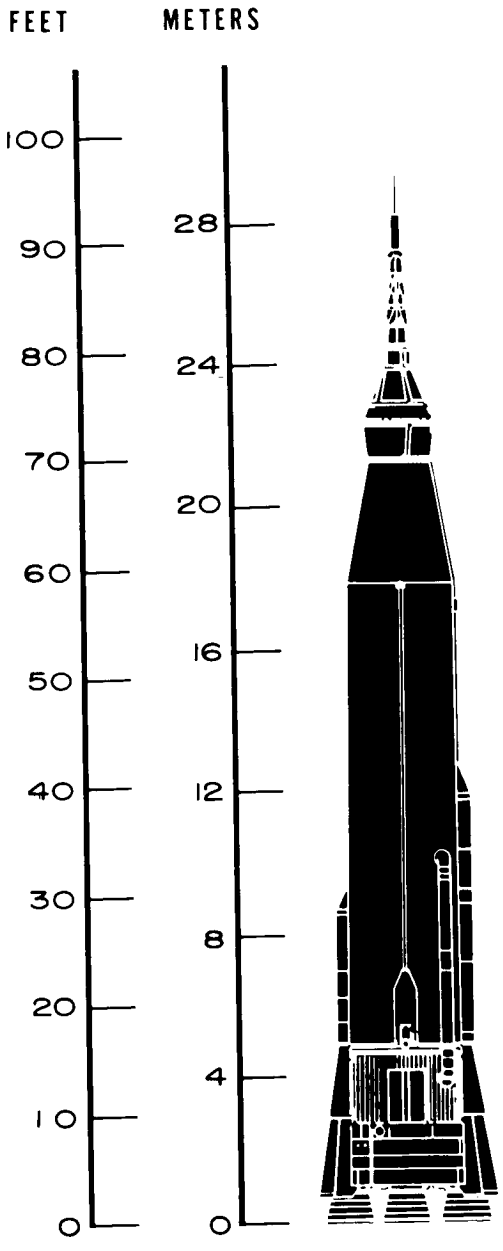
PAYLOAD SHROUD

(Agena D for GSFC Missions)

PROJECT	DATE	AGENCY	PAYLOAD (kg)	PAYLOAD (lb)	LAUNCH SITE	ORBITAL DATA PERIOD (MIN.)	ORBITAL DATA PERIGEE (MI.)	ORBITAL DATA APOGEE (MI.)	ORBITAL DATA INCL'N (DEG.)	STATUS
DISCOVERER 16	10–26–60	USAF	953	2100	VAFB	--	--	--	--	Failed to orbit
DISCOVERER 17	11–12–60	USAF	953	2100	VAFB	96	113	614	82	Reentered 12–29–60
DISCOVERER 18	12– 7–60	USAF	953	2100	VAFB	94	143	426	81	Reentered 4–2–61
DISCOVERER 19	12–20–60	USAF	953	2100	VAFB	93	128	390	83	Reentered 1–23–61
DISCOVERER 20	2–17–61	USAF	1112	2450	VAFB	95	177	486	80	Reentered 7–28–62
DISCOVERER 21	2–18–61	USAF	953	2100	VAFB	94	149	659	81	Reentered 4–20–62
DISCOVERER 22	3–30–61	USAF	953	2100	VAFB	--	--	--	--	Failed to orbit
DISCOVERER 23	4– 8–61	USAF	953	2100	VAFB	101	126	882	82	Reentered 4–16–62
DISCOVERER 24	6– 8–61	USAF	953	2100	VAFB	--	--	--	--	Failed to orbit
DISCOVERER 25	6–16–61	USAF	953	2100	VAFB	91	139	251	82	Reentered 7–12–61
DISCOVERER 26	7– 7–61	USAF	953	2100	VAFB	95	146	503	83	Reentered 12–5–61
DISCOVERER 27	7–21–61	USAF	953	2100	VAFB	--	--	--	--	Destroyed by safety office.
DISCOVERER 28	8– 3–61	USAF	953	2100	VAFB	--	--	--	--	Failed to orbit
DISCOVERER 29	8–30–61	USAF	953	2100	VAFB	91	140	345	82	Reentered 9–10–61
DISCOVERER 30	9–12–61	USAF	953	2100	VAFB	92	154	345	83	Reentered 12–11–61
DISCOVERER 31	9–17–61	USAF	953	2100	VAFB	91	152	255	83	Reentered 10–26–61
DISCOVERER 32	10–13–61	USAF	953	2100	VAFB	91	147	246	82	Reentered 11–13–61
DISCOVERER 33	10–23–61	USAF	953	2100	VAFB	--	--	--	--	Failed to orbit
DISCOVERER 34	11– 5–61	USAF	953	2100	VAFB	97	134	637	83	In orbit--silent
DISCOVERER 35	11–15–61	USAF	953	2100	VAFB	90	147	173	82	Reentered 12–3–61
DISCOVERER 36	12–12–61	USAF	953	2100	VAFB	92	148	280	81	Reentered 3–8–62
AND OSCAR			5	10		91	146	258	81	Reentered 1–31–62
DISCOVERER 37	1–13–62	USAF	953	2100	VAFB	--	--	--	--	Failed to orbit
DISCOVERER 38	2–27–62	USAF	953	2100	VAFB	90	208	308	82	Reentered 3–21–62
UNNAMED	4–17–62	USAF	--	--	VAFB	90	119	178	73	Launched
OSCAR 2	6– 2–62	USAF	5	10	VAFB	90	129	240	74	Reentered 6–21–62
ALOUETTE 1	9–28–62	Canada	145	320	VAFB	105	620	638	80	In orbit--active
16 LAUNCHES	1963	USAF	—	—	—	—	—	—	—	—
ECHO 2	1–18–64	NASA	—	—	—	—	—	—	—	In orbit



ATLAS D



ATLAS D

(Status as of February 1964)

ATLAS, the primary booster for many of our space programs, is essentially a modified ATLAS ICBM. When it is used as the first stage of a multistage vehicle, such as the ATLAS-AGENA or ATLAS-CENTAUR, the upper neck section is strengthened and an interstage adapting structure is fitted. The D version, which is now in use, utilizes a radio-inertial guidance system.

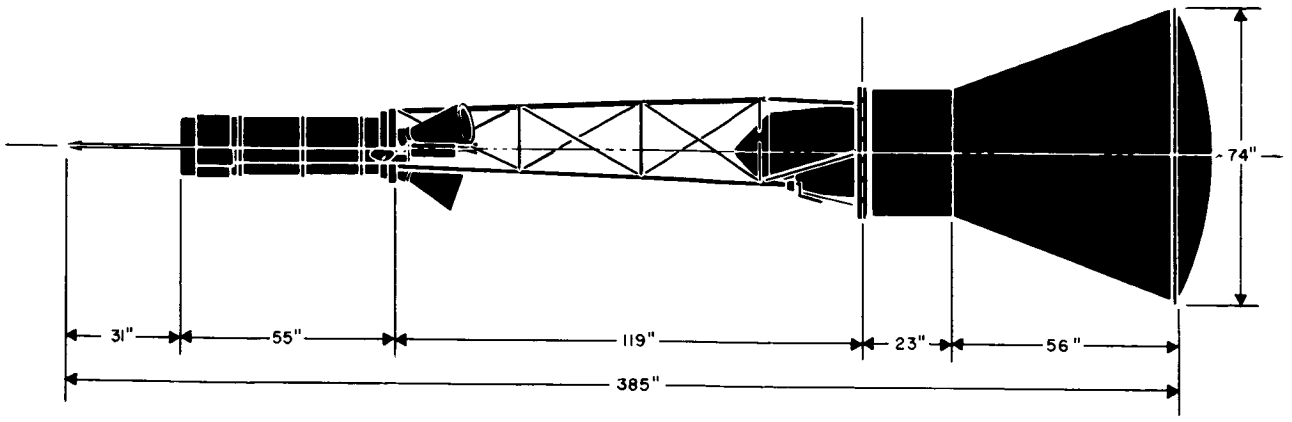
As a single-stage launch vehicle ATLAS is presently being employed in NASA's MERCURY-ATLAS man in space program. The 1,225 kilogram MERCURY-ATLAS capsules have been launched from the Atlantic Missile Range on various missions since July 1960. Manned orbital flight was first attained when ATLAS boosted the MA-6 vehicle in a successful three-orbit mission on February 20, 1962. Since then, another three-orbit mission of MA-7, the six-orbit mission of MA-8, and the twenty-two-orbit mission of MA-9 have been satisfactorily launched by the reliable ATLAS booster.

The perfection of all aspects of the MA-9 launch indicates that the development of the ATLAS D can now be considered complete and that it can be used on a routine basis in future space programs.

Future nonmilitary use of the ATLAS booster is planned for at least another five to seven years. In addition to the MERCURY-ATLAS program, this vehicle will act as the first stage for the now operational ATLAS-AGENA space programs as well as the ATLAS-CENTAUR programs now in the development stage.

STAGE DATA	1st STAGE	
STAGE DESIGNATION	ATLAS D	
HEIGHT m	21.9	
HEIGHT ft	72.0	
DIAMETER m	3.0	
DIAMETER ft	10.0	
ENGINE	MA-5	
ENGINE MANUFACTURER	ROCKETDYNE	
NUMBER OF ENGINES	2	1
THRUST PER ENGINE kg	70,000	26,000
THRUST PER ENGINE lb	154,500	57,000
TOTAL THRUST kg	166,000	
TOTAL THRUST lb	366,000	
PROPELLANT	LOX/RP-1	
STAGE CONTRACTOR	GD/ASTRONAUTICS	

OVERALL VEHICLE DATA	
LIFTOFF THRUST kg	166,000
LIFTOFF THRUST lb	366,000
HEIGHT LESS SPACECRAFT m	21.9
HEIGHT LESS SPACECRAFT ft	72.0
MAXIMUM DIAMETER m	3.0
MAXIMUM DIAMETER ft	10.0
PAD WEIGHT kg	118,000
PAD WEIGHT lb	260,000
NUMBER OF STAGES	1
PRIME CONTRACTOR	GD/ASTRO
PAYLOAD PERFORMANCE:	
345 MILE ORBIT kg	1,200
345 MILE ORBIT lb	2,700
ESCAPE kg	
ESCAPE lb	
PLANETARY kg	
PLANETARY lb	

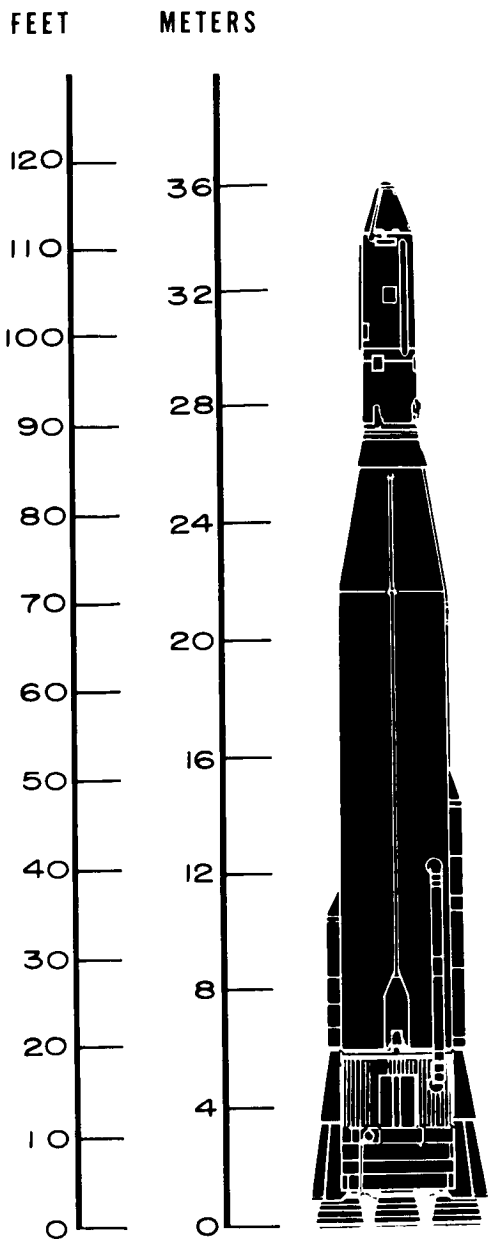


MERCURY SPACE CAPSULE

PROJECT	DATE	AGENCY	PAYLOAD (kg)	PAYLOAD (lb)	LAUNCH SITE	ORBITAL DATA PERIOD (MIN.)	ORBITAL DATA PERIGEE (MI.)	ORBITAL DATA APOGEE (MI.)	ORBITAL DATA INCL'N (DEG.)	STATUS
MERCURY-ATLAS 3	4–25–61	NASA	908	2000	AMR	--	--	--	--	Destroyed by safety officer
MERCURY-ATLAS 4	9–13–61	NASA	1226	2700	AMR	89	100	159	33	Spacecraft recovered 9–13–61
MERCURY-ATLAS 5	11–29–61	NASA	1317	2900	AMR	88	100	148	32	Spacecraft recovered 11–29–61
MERCURY-ATLAS 6	2–20–62	NASA	1356	2987	AMR	88	100	163	32	Spacecraft recovered 2–20–62
MERCURY-ATLAS 7	5–24–62	NASA	1351	2975	AMR	88	100	167	32	Spacecraft recovered 5–24–62
MERCURY-ATLAS 8	10– 3–62	NASA	1362	3000	AMR	89	100	176	32	Spacecraft recovered 10–3–62
MERCURY-ATLAS 9	5–15–63	NASA	1362	3000	AMR	89	100	166	33	Spacecraft recovered 5–16–63

ATLAS-AGENA

ATLAS-AGENA



(Status as of February 1964)

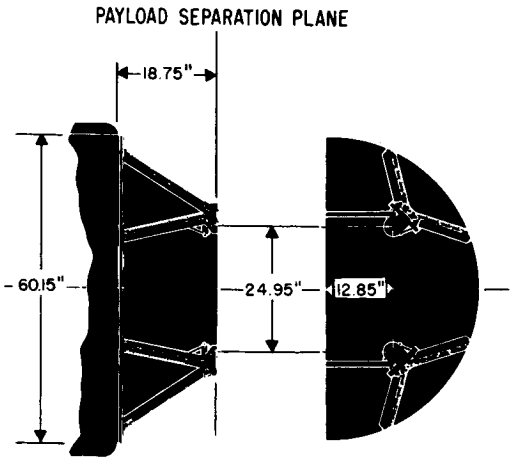
The two-stage ATLAS-AGENA launch vehicle is composed of a modified ATLAS ICBM booster topped by an AGENA second stage. At the present time this vehicle by virtue of its capability of placing 2,270 kilograms in a low earth orbit or sending 340 kilograms on an escape mission represents our most powerful operational launch vehicle. The versatility of the vehicle is greatly enhanced by the restart capability of the AGENA stage.

ATLAS-AGENA B was developed by the Air Force. NASA's interest in the AGENA B resulted from a need for a powerful launch vehicle capable of orbiting EGO satellites and launching RANGER and MARINER interplanetary probes. The Air Force's relative success with this vehicle was not reflected in the early stages of its use by NASA. The first RANGER launches by NASA in August and November of 1961 were failures; the third RANGER shot was a partial success. Not until the RANGER 4 shot in April 1962 was complete success achieved using the ATLAS-AGENA B vehicle; the mission terminated when the spacecraft impacted on the far side of the moon on the 26th of April. Since then the Air Force and NASA have conducted a number of launches using this vehicle: three unnamed Air Force spacecraft, one unsuccessful MARINER shot, and the successful MARINER 2 Venus probe. ATLAS-AGENA D became operational in 1963.

Future use of the ATLAS-AGENA vehicle for NASA space missions will continue for a number of years. In addition to the programs already mentioned, NASA plans to use this vehicle in its GEMINI rendezvous experiments, the APOLLO reentry tests, and EGO, SYNCOM, OAO, RELAY, and OSO projects.

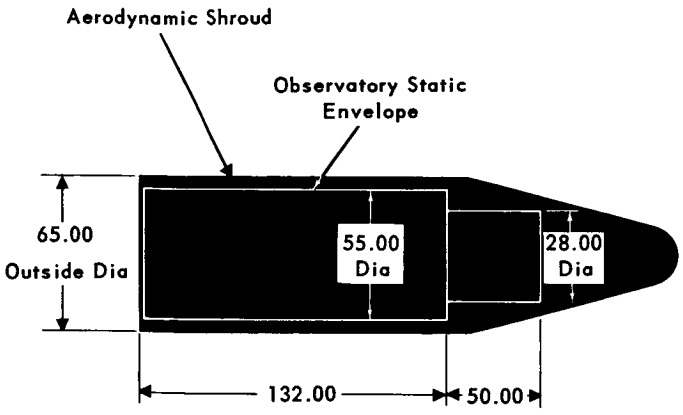
STAGE DATA	1st STAGE	2nd STAGE
STAGE DESIGNATION	ATLAS D	AGENA B
HEIGHT m	21.9	7.0
HEIGHT ft	72.0	23.0
DIAMETER m	3.0	1.5
DIAMETER ft	10.0	5.0
ENGINE	MA-5	BELL 8096
ENGINE MANUFACTURER	ROCKETDYNE	LOCKHEED
NUMBER OF ENGINES	2 1	1
THRUST PER ENGINE kg	70,000 .. 26,000	7,300
THRUST PER ENGINE lb	154,500 _ 57,000	16,000
TOTAL THRUST kg	166,000	7,300
TOTAL THRUST lb	366,000	16,000
PROPELLANT	LOX/RP-1	IRFNA/UDMH
STAGE CONTRACTOR	GD/ASTRONAUTICS	LOCKHEED

OVERALL VEHICLE DATA		
LIFTOFF THRUST	kg	166,000
	lb	366,000
HEIGHT LESS SPACECRAFT	m	29.9
	ft	98.0
MAXIMUM DIAMETER	m	3.0
	ft	10.0
PAD WEIGHT	kg	125,000
	lb	275,000
NUMBER OF STAGES		2
PAYLOAD PERFORMANCE:		
345 MILE ORBIT	kg	2,300
	lb	5,000
ESCAPE	kg	360
	lb	800
PLANETARY	kg	--
	lb	



PAYLOAD ADAPTER

(For OGO)



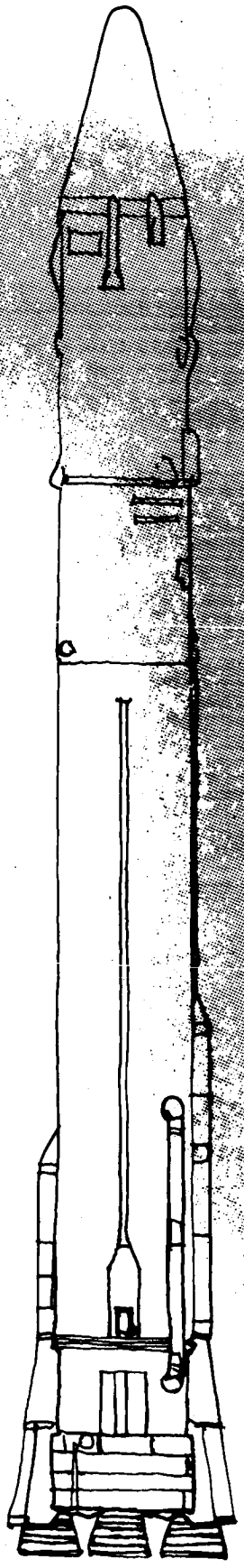
PAYLOAD SHROUD

(Agena D for GSFC Missions)

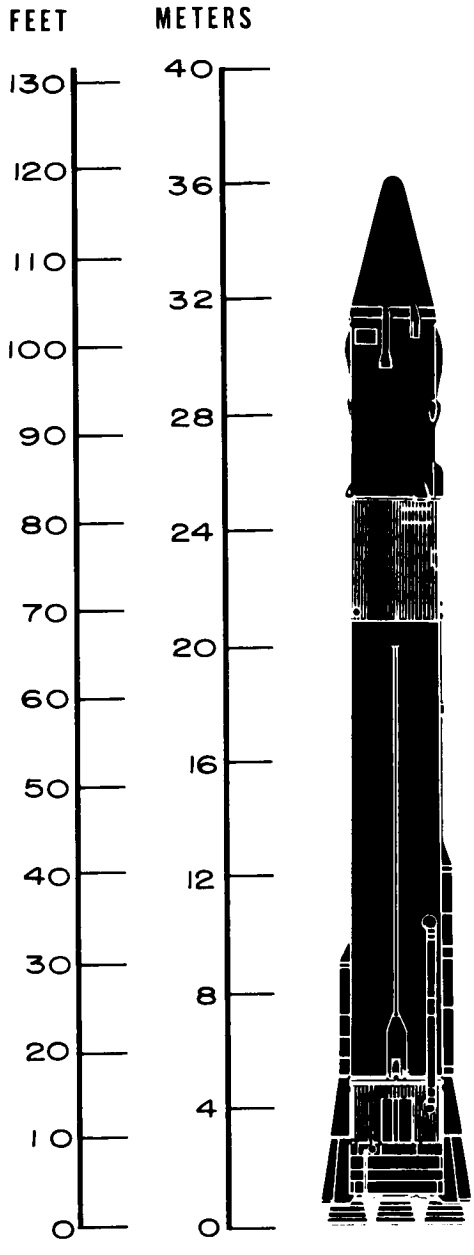
PROJECT	DATE	AGENCY	PAYLOAD (kg)	PAYLOAD (lb)	LAUNCH SITE	ORBITAL DATA PERIOD (MIN.)	PERIGEE (MI.)	APOGEE (MI.)	INCL'N (DEG.)	STATUS
NONE	7–12–61	USAF	1589	3500	PA	160	1850	1850	91	In orbit
RANGER 1	8–23–61	NASA	306	675	AMR	91	105	312	33	Reentered 8–30–61
NONE	9– 9–61	USAF	1907	4200	PA	--	--	--	--	Failed to orbit
NONE	10–21–61	USAF	1589	3500	PA	172	2182	2324	95	In orbit
RANGER 2	11–18–61	NASA	306	675	AMR	88	98	147	33	Reentered 11–18–61
UNNAMED	12–22–61	USAF	--	--	PA	92	134	336	90	Reentered 8–14–62
RANGER 3	1–26–62	NASA	330	727	AMR	2438	.9839*	1.163*	.399**	In solar orbit--silent
UNNAMED	3– 7–62	USAF	--	--	PA	94	149	382	91	In orbit
NONE	4– 9–62	USAF	--	--	PA	153	1668	2027	87	In orbit
RANGER 4	4–23–62	NASA	331	730	AMR	--	--	--	--	Impacted moon 4–26–62
UNNAMED	4–26–62	USAF	--	--	PA	90	106	218	73	Successfully launched
MARINER 1	7–22–62	NASA	202	446	AMR	--	--	--	--	Destroyed by safety officer
MARINER 2	8–26–62	NASA	203	447	AMR	--	--	--	--	Venus probe--in solar orbit
RANGER 5	10–18–62	NASA	343	755	AMR	--	--	--	--	Lunar probe--in solar orbit
NONE	11–11–62	USAF	—	—	PA	—	—	—	—	Decayed 12–3–62
NONE	12–17–62	USAF	—	—	PA	—	—	—	—	Failed to orbit
NONE	5–9–63	USAF	—	—	PA	167	2254	2295	87.4	In orbit
NONE	6–12–63	USAF	—	—	PA	—	—	—	—	Failed to orbit
NONE	7–19–63	USAF	—	—	VAFB	168	2279	2321	88.4	In orbit

*Astronomical units

**From ecliptic



ATLAS-CENTAUR



ATLAS-CENTAUR

(Status as of March 1964)

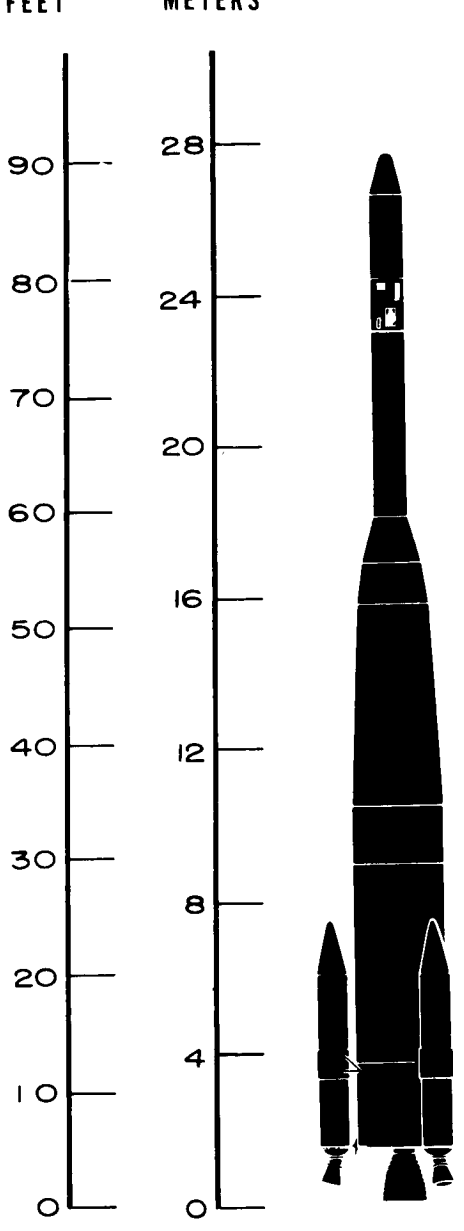
The two-stage ATLAS-CENTAUR is made up of the familiar ATLAS booster and the newly developed CENTAUR second stage. The CENTAUR engine will enable this vehicle to have a substantially increased payload capability compared to the ATLAS-AGENA launch vehicle, 3,850 kilograms versus 2,270 kilograms in a 345-mile circular orbit. Additionally, its versatility is enhanced by its ability to restart itself, almost indefinitely, in space. However, for its earlier missions it will be limited to two or three restarts. It is planned that CENTAUR vehicles will be launched from the Atlantic Missile Range.

ATLAS-CENTAUR was originally developed to satisfy the Department of Defense launch requirements for the ADVENT 24-hour, fixed position, active repeater communications satellite. The vehicle is part of the second generation of multipurpose launch vehicles for United States space programs. The program, to date, has been plagued with delays caused primarily by technical problems with the structure and new and unique high-energy liquid-oxygen, liquid-hydrogen power plant. On its first flight in May 1962 the vehicle exploded fifty-five seconds after liftoff from Cape Canaveral; the failure was attributed to a structural fault in the area of the nose cone-second stage interface.

After numerous design changes, a near perfect launch of the second development vehicle occurred on November 27, 1963. Six additional development flights are planned before ATLAS-CENTAUR becomes operational in 1965. NASA Lewis Research Center, Cleveland, has management responsibility.

STAGE DATA	1st STAGE	2nd STAGE	OVERALL VEHICLE DATA	
STAGE DESIGNATION	ATLAS D	CENTAUR	LIFTOFF THRUST kg	166,000
			lb	366,000
HEIGHT m	18.3	12.8	HEIGHT LESS SPACECRAFT m	32.0
ft	60.0	42.0	ft	105.0
DIAMETER m	3.0	3.0	MAXIMUM DIAMETER m	3.0
ft	10.0	10.0	ft	10.0
ENGINE	MA-5	RL-10	PAD WEIGHT kg	132,000
ENGINE MANUFACTURER	ROCKETDYNE	PRATT-WHITNEY	lb	291,000
NUMBER OF ENGINES	2 1	2	NUMBER OF STAGES	2
THRUST PER ENGINE kg	70,000 26,000	6,800	PRIME CONTRACTOR	GD/ASTRO
lb	154,000 57,000	15,000	PAYLOAD PERFORMANCE:	
TOTAL THRUST kg	166,000	13,600	345 MILE ORBIT kg	3,900
lb	366,000	30,000	lb	8,500
PROPELLANT	LOX/RP-1	LOX/LH	MOON kg	1,050
			lb	2,300
STAGE CONTRACTOR	GD/ASTRONAUTICS	GD/ASTRONAUTICS	PLANETARY kg	660
			lb	1,450

THRUST AUGMENTED DELTA



THRUST AUGMENTED DELTA

(Status as of February 1964)

THRUST AUGMENTED DELTA (TAD) is basically the Thor-Delta vehicle with three Thiokol TX33-52 solid rocket motors added to the first stage as boosters. The liftoff thrust is thus increased by 73,000 kilograms (161,000 lbs) to a nominal total of 151,000 kilograms (333,000 lbs). Developed for the Air Force, this first stage configuration will be used extensively in both Air Force and NASA space programs. This first stage with boosters is designated as the DSV-3D configuration.

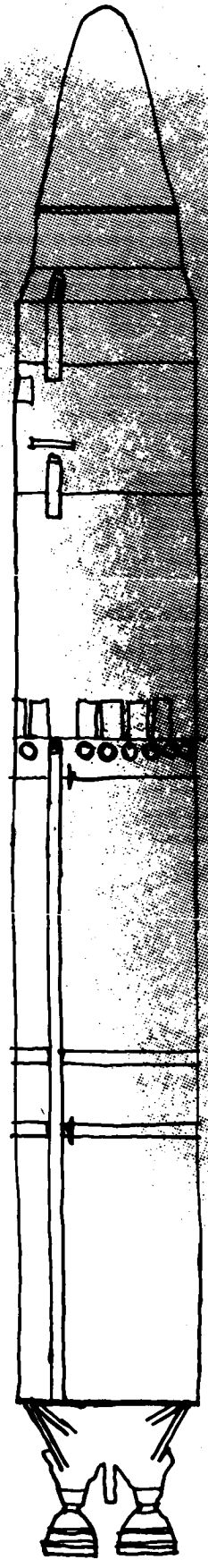
The addition of the solid rocket boosters will improve the Delta orbital capability from 53 kilograms (116 lbs) to 66 kilograms (145 lbs) in a 150-nautical-mile-perigee, 150,000-nautical-mile-apogee orbit. Use of the X-258 third stage instead of X-248 will increase the above orbital capability to 81 kilograms (178 lbs). The solid rocket boosters will provide the additional capability of putting both the second stage and a second stage payload into low orbit.

The simplicity of the alteration to the basic Delta vehicle by the addition of the three solid rocket boosters is such that a downgrading of the inherent reliability of this launch vehicle is not anticipated. Some performance loss is incurred in the Delta vehicle because of the requirement that an impacting second stage must fall short of Africa. With the new DSV-3D booster configuration this loss will be avoided.

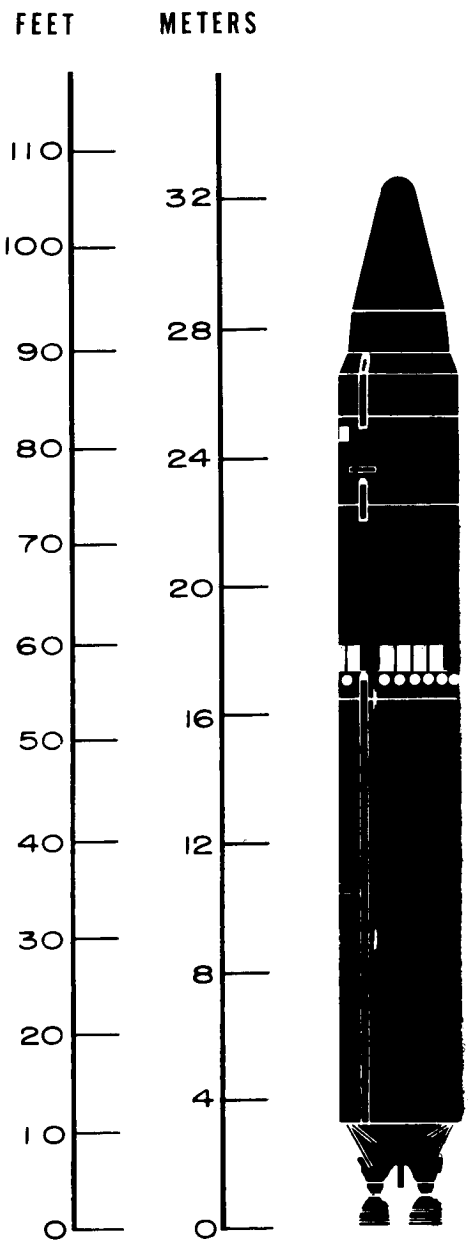
The TAD first stage has been flown once by the Air Force using the Agena D as the second stage. NASA will use the Aerojet AJ10-118 liquid propelled engine as second stage. The ABL X-258 is to be normally used as the third stage, but the ABL X-248 (original third stage for Delta) will be available for particular missions.

STAGE DATA	1st STAGE Boosters	1st STAGE	2nd STAGE	3rd STAGE	ALT. 3rd STAGE
STAGE DESIGNATION	SOLID	THOR (DM-21)	AJ10-118	X-258	ALTAIR (X-248)
HEIGHT m	6.0	18.2	7.0	1.0	1.0
ft	19.8	59.7	23.1	3.2	3.2
DIAMETER m	0.8	2.4	0.8	0.6	0.6
ft	2.6	8.0	2.8	1.5	1.5
ENGINE	TX33-52	BLOCK 2	AJ10-118	X-258	X-248
ENGINE MANUFACTURER	THIOKOL	ROCKETDYNE	AEROJET	ABL	ABL
NUMBER OF ENGINES	3	1	1	1	1
THRUST PER ENGINE kg	24,500	78,100	3,420	2,770	1,250
lb	58,850	172,000	7,550	6,100	2,760
TOTAL THRUST kg	73,300	78,100	3,420	2,770	1,250
lb	161,550	172,000	7,550	6,100	2,760
PROPELLANT	SOLID	LOX/RJ-1	IRFNA /UDMH	SOLID	SOLID
STAGE CONTRACTOR	DOUGLAS	DOUGLAS	DOUGLAS	DOUGLAS	DOUGLAS

OVERALL VEHICLE DATA	
LIFTOFF THRUST kg	151,4
lb	333,5
HEIGHT LESS SPACECRAFT m	26.2
ft	86.0
MAXIMUM DIAMETER m	4.3
ft	14.2
PAD WEIGHT kg	64,7
lb	142,5
NUMBER OF STAGES	3
PRIME CONTRACTOR	DOUG
PAYLOAD PERFORMANCE (X-248)	
300 MILE ORBIT kg	390
lb	860
ESCAPE kg	
lb	
PLANETARY kg	
lb	



TITAN II



TITAN II*

(Status as of March 1964)

The TITAN I ICBM program was begun as an alternate approach to the ATLAS ICBM and provided the foundation for the development of the slightly different TITAN II. This vehicle will apparently play an ever-increasing role in our overall space booster program.

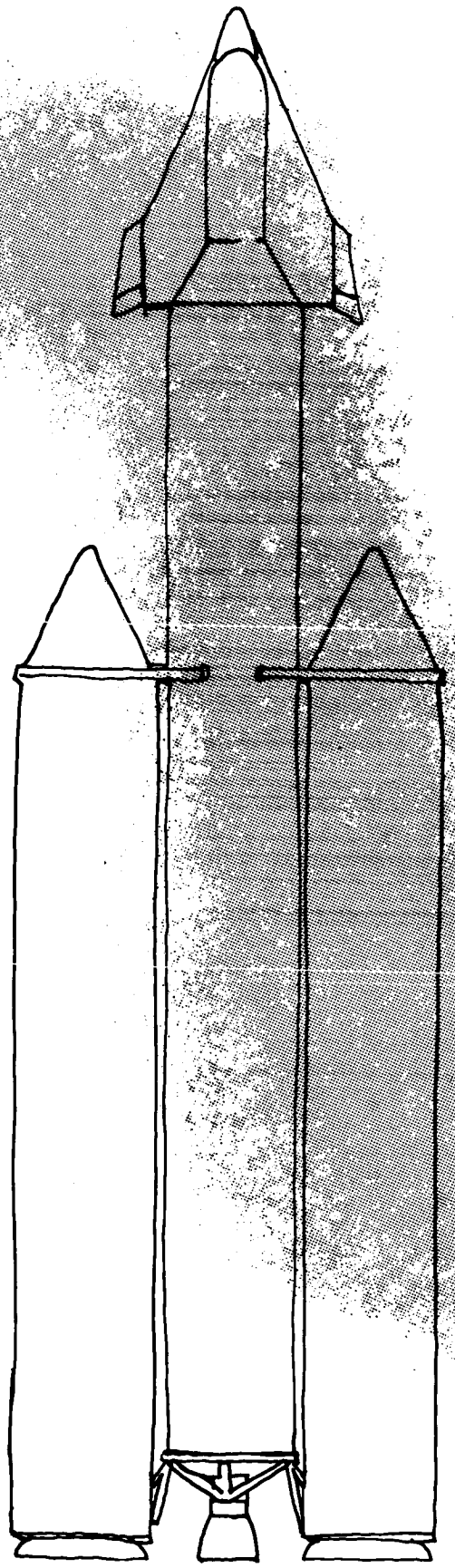
TITAN II has an increased thrust of approximately 45,400 kilograms over TITAN I, is 3.7 meters longer, and has an all-inertial guidance system. One of its most attractive features is the use of non-cryogenic, easily storable fuels; anhydrous hydrazine in combination with unsymmetrical dimethylhydrazine will be used with nitrogen tetroxide as the oxidizer. Optional upper stages will be the improved AGENA D second stage and either CHARIOT or DRACO as the third stage, both of which are under development at this time.

NASA plans to use TITAN II, without a second stage, in its GEMINI (MERCURY II) project. The Air Force plans to use TITAN II-AGENA D vehicles for some of its DISCOVERER series research satellites. Both NASA and the Air Force are also considering more extensive use of this vehicle in their space programs during the next ten years.

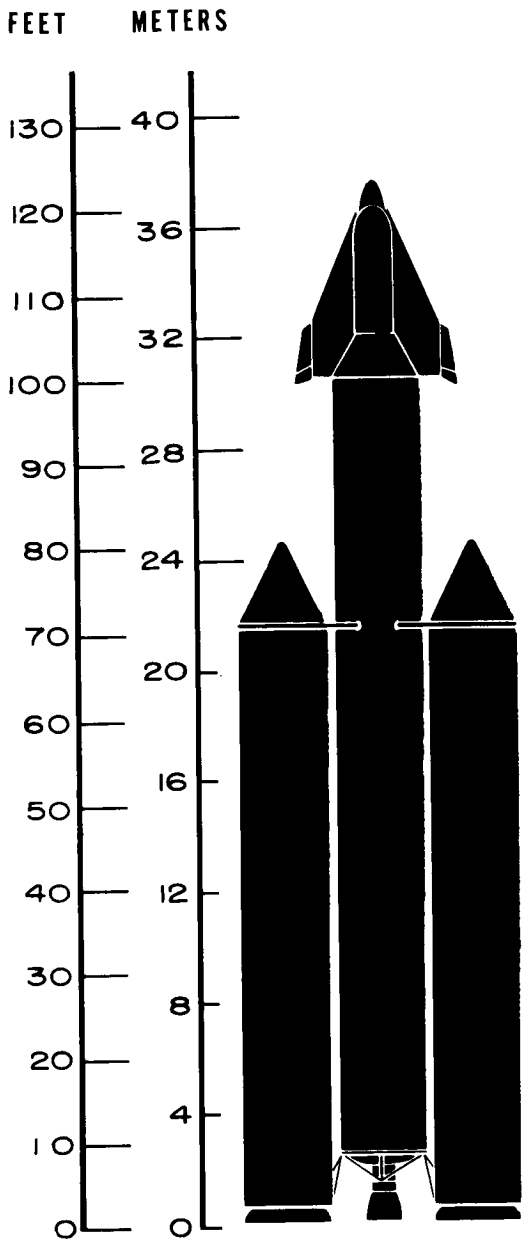
** Factual data based on material contained in Missiles and Rockets Magazine and Defense Marketing Service Intelligence Reports.*

STAGE DATA	1st STAGE	2nd STAGE
STAGE DESIGNATION	LR-87	LR-91
HEIGHT m	19.5	7.9
HEIGHT ft	64.0	26.0
DIAMETER m	3.0	3.0
DIAMETER ft	10.0	10.0
ENGINE	XLR87-AJ5	XLR91-AJ5
ENGINE MANUFACTURER	AEROJET	AEROJET
NUMBER OF ENGINES	2	1
THRUST PER ENGINE kg	97,500	45,400
THRUST PER ENGINE lb	215,000	100,000
TOTAL THRUST kg	195,000	45,400
TOTAL THRUST lb	430,000	100,000
PROPELLANT	HYDRAZINE & UDMH/N_2O_4	
STAGE CONTRACTOR	MARTIN-MARIETTA	

OVERALL VEHICLE DATA		
LIFTOFF THRUST kg	195,000
LIFTOFF THRUST lb	430,000
HEIGHT LESS SPACECRAFT m	27.0
HEIGHT LESS SPACECRAFT ft	90.0
MAXIMUM DIAMETER m	3.0
MAXIMUM DIAMETER ft	10.0
PAD WEIGHT kg	136,000
PAD WEIGHT lb	300,000
NUMBER OF STAGES	2
PRIME CONTRACTOR	MARTIN
PAYLOAD PERFORMANCE:	
345 MILE ORBIT kg	2,700
345 MILE ORBIT lb	6,000
ESCAPE kg	--
ESCAPE lb	--
PLANETARY kg	--
PLANETARY lb	--



TITAN III



TITAN III*

(Status as of March 1964)

TITAN III is the first launch vehicle to be developed by DOD from the outset as a space booster. It may be used by NASA.

TITAN III will be similar to TITAN II but will have a pair of solid propellant rockets attached to the first stage to increase its liftoff thrust from 195,000 kilograms to over 1,000,000 kilograms. Depending upon the other stages used, this vehicle will have the capability of placing a 2,500 to 11,400 kilogram payload in a 100 nautical mile orbit.

The segmented solid rocket boosters are being developed by the United Technology Center and will produce a thrust of approximately 455,000 kilograms each. The fiberglass casing segments of the boosters will be bonded together with epoxy, which makes on-site assembly possible. Their 3.28 meter diameter will increase the overall size of the first stage to about 10 meters across.

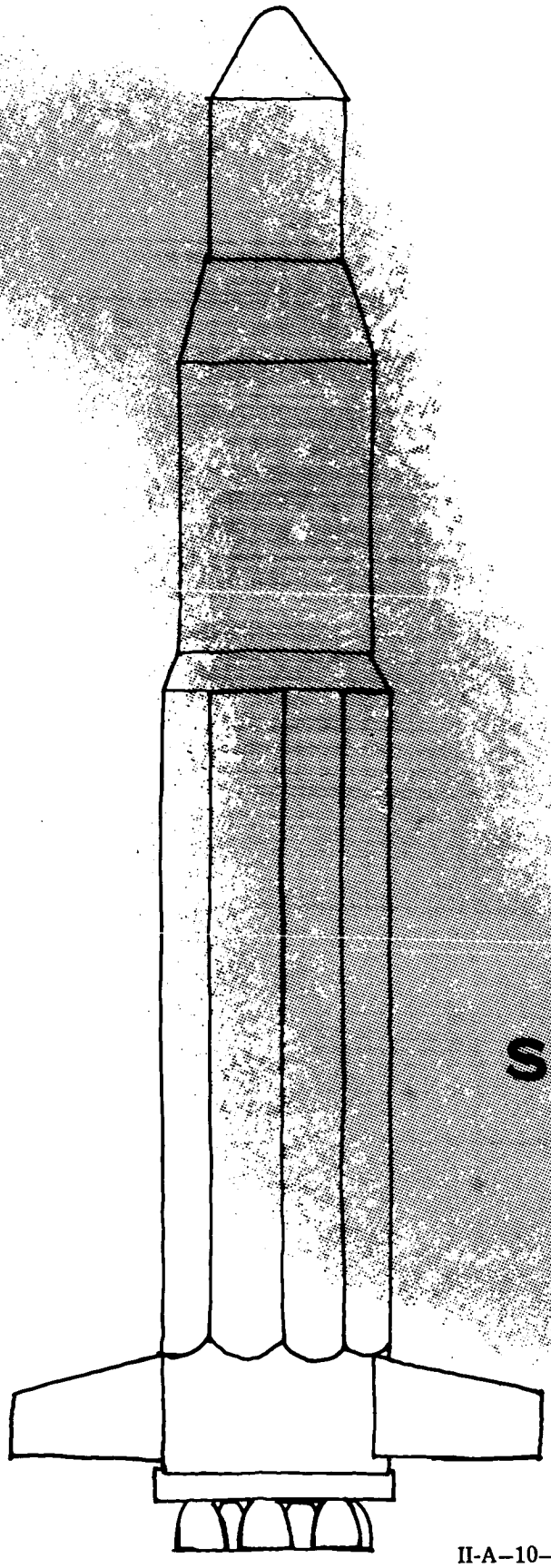
Since the building block approach will be used in the development of this vehicle, it may occasionally be used without the solid propellant boosters, depending upon the job to be performed.

Seventeen development flights are planned starting in late 1964. TITAN III is planned to be operational in the 1965–1970 period. First stage booster engines were fired successfully in July 1963.

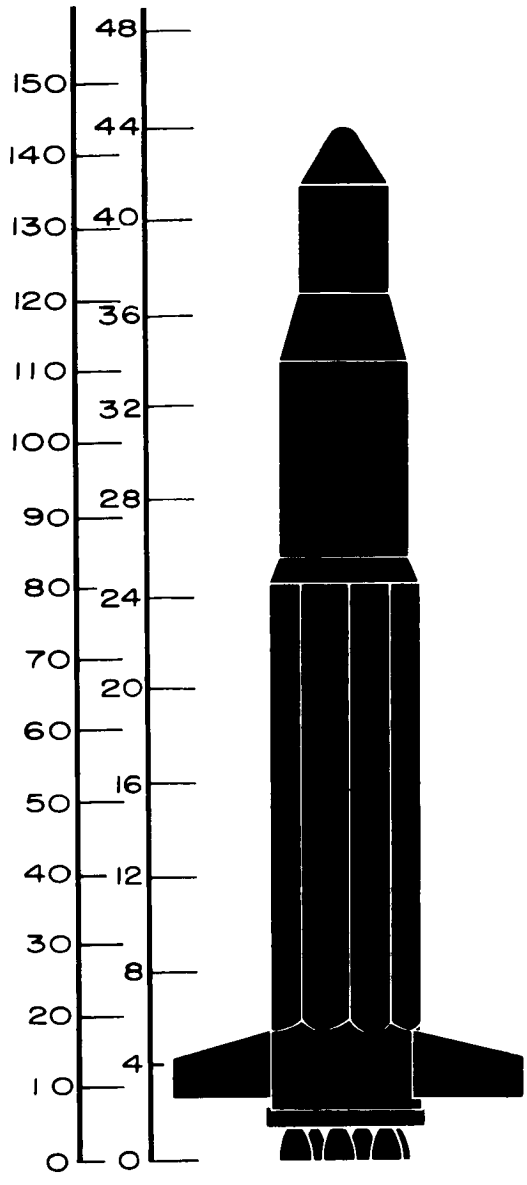
** Factual data based on material contained in Missiles and Rockets Magazine and Defense Marketing Services Intelligence Reports.*

STAGE DATA	1st STAGE Boosters	2nd STAGE	3rd STAGE
STAGE DESIGNATION	SOLID STAGE	XLR-87	XLR-91
HEIGHT (m)	25.9	19.5	7.9
HEIGHT (ft)	85.0	64.0	26.0
DIAMETER (m)	3.0	3.0	3.0
DIAMETER (ft)	10.0	10.0	10.0
ENGINE	SEG. SOLID	XLR87-AJ5	XLR91-AJ5
ENGINE MANUFACTURER	UNITED TECH	AEROJET	AEROJET
NUMBER OF ENGINES	2	2	1
THRUST PER ENGINE (kg)	455,000	97,500	45,400
THRUST PER ENGINE (lb)	1,000,000	215,000	100,000
TOTAL THRUST (kg)	910,000	195,000	45,400
TOTAL THRUST (lb)	2,000,000	430,000	100,000
PROPELLANT	SOLID	HYDRAZINE AND UDMH/N_2O_4	
STAGE CONTRACTOR	MARTIN-MARIETTA		

OVERALL VEHICLE DATA	
LIFTOFF THRUST (kg)	500,000
LIFTOFF THRUST (lb)	1,105,000
HEIGHT LESS SPACECRAFT (m)	32.0
HEIGHT LESS SPACECRAFT (ft)	105.0
MAXIMUM DIAMETER (m)	9.1
MAXIMUM DIAMETER (ft)	30.0
PAD WEIGHT (kg)	—
PAD WEIGHT (lb)	—
NUMBER OF STAGES	3
PRIME CONTRACTOR	MARTIN
PAYLOAD PERFORMANCE: LOW EARTH (kg)	11,400
PAYLOAD PERFORMANCE: LOW EARTH (lb)	25,000
ESCAPE (kg)	
ESCAPE (lb)	
PLANETARY (kg)	



SATURN I



SATURN I

(Status as of March 1964)

The SATURN I is part of the third generation of launch vehicles now being developed for use in our space programs. The two-stage launch vehicle is being developed primarily for use in injecting APOLLO spacecraft into earth orbits. Additionally, it will be capable of carrying a modified CENTAUR, thus transforming it into a three-stage vehicle for use in higher energy mission requirements. All SATURN launches are presently scheduled for the Atlantic Missile Range.

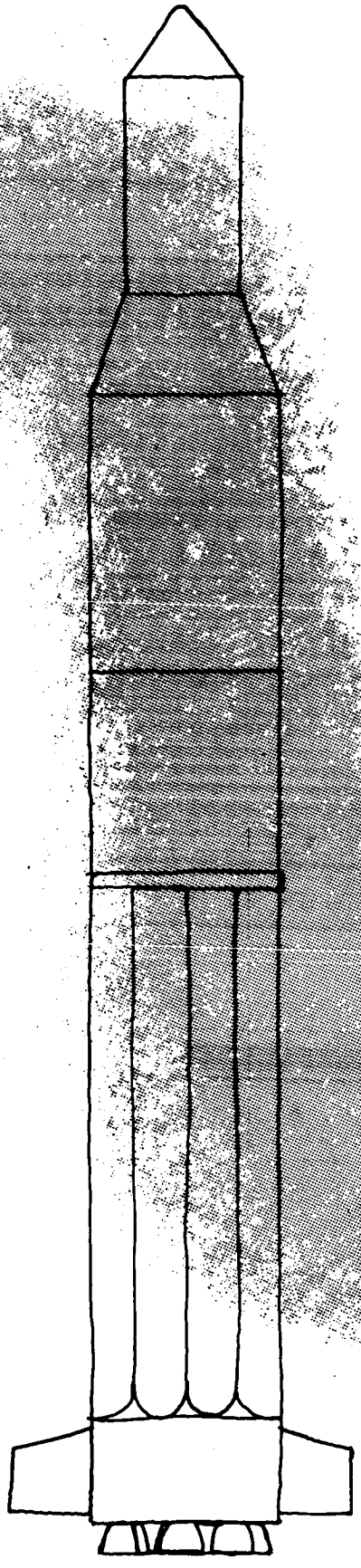
The first SATURN I launch on October 27, 1961, was conducted to test the S-1 first stage, the inert upper stages being filled with water ballast to simulate the weight of the complete vehicle. The test was a complete success. Another similar test was conducted in April 1962. This time the ballasted upper stages were intentionally exploded at an altitude of 40 kilometers to study the effects of releasing 95 tons of water in this near space environment. The third test was equally successful.

The fourth test in the series was a near-perfect launch of the first stage. A maximum altitude of 129 kilometers was reached with a distance traveled of 373 kilometers. One inboard engine was cut off during flight to test engine-out capability with the result that the burning time of the remaining engines was extended by two seconds.

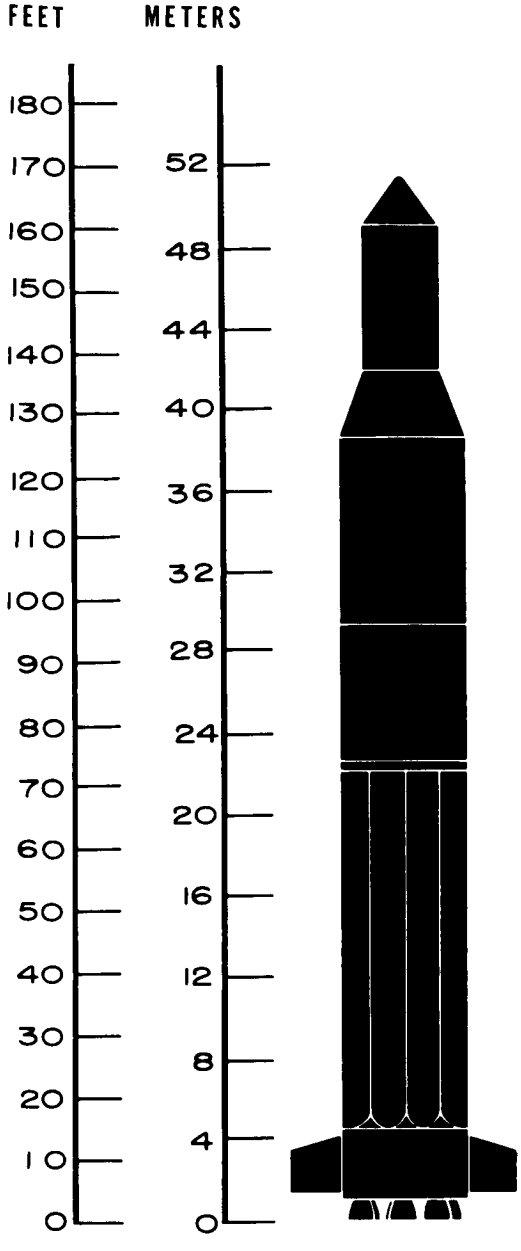
The first flight with live upper stage was successfully launched on January 27, 1964, putting 37,700 lbs into low earth orbit. The sixth SATURN I arrived at Cape Kennedy on February 19, 1964.

STAGE DATA	1st STAGE	2nd STAGE
STAGE DESIGNATION	S-I	S-IV
HEIGHT m	24.7	12.2
HEIGHT ft	81.0	40
DIAMETER m	6.7	5.2
DIAMETER ft	22.0	17
ENGINE	H-I	RL-10-A3
ENGINE MANUFACTURER	ROCKETDYNE	PRATT-WHITNEY
NUMBER OF ENGINES	8	6
THRUST PER ENGINE kg	85,000	6,840
THRUST PER ENGINE lb	188,000	15,000
TOTAL THRUST kg	680,000	41,000
TOTAL THRUST lb	1,500,000	90,000
PROPELLANT	LOX/RP	LOX/LH
STAGE CONTRACTOR	MSFC	DOUGLAS

OVERALL VEHICLE DATA		
LIFTOFF THRUST kg	680,000	
LIFTOFF THRUST lb	1,500,000	
HEIGHT LESS SPACECRAFT m	38.1	
HEIGHT LESS SPACECRAFT ft	125.0	
MAXIMUM DIAMETER m	6.7	
MAXIMUM DIAMETER ft	22.0	
PAD WEIGHT kg	500,000	
PAD WEIGHT lb	1,100,000	
NUMBER OF STAGES	2	
PRIME CONTRACTOR	NASA/MSFC	
PAYLOAD PERFORMANCE: 345 MILE ORBIT kg	9,100	
PAYLOAD PERFORMANCE: 345 MILE ORBIT lb	20,000	
ESCAPE kg	—	
ESCAPE lb	—	
PLANETARY kg	—	
PLANETARY lb	—	



SATURN I-B



SATURN I-B

(Status as of March 1964)

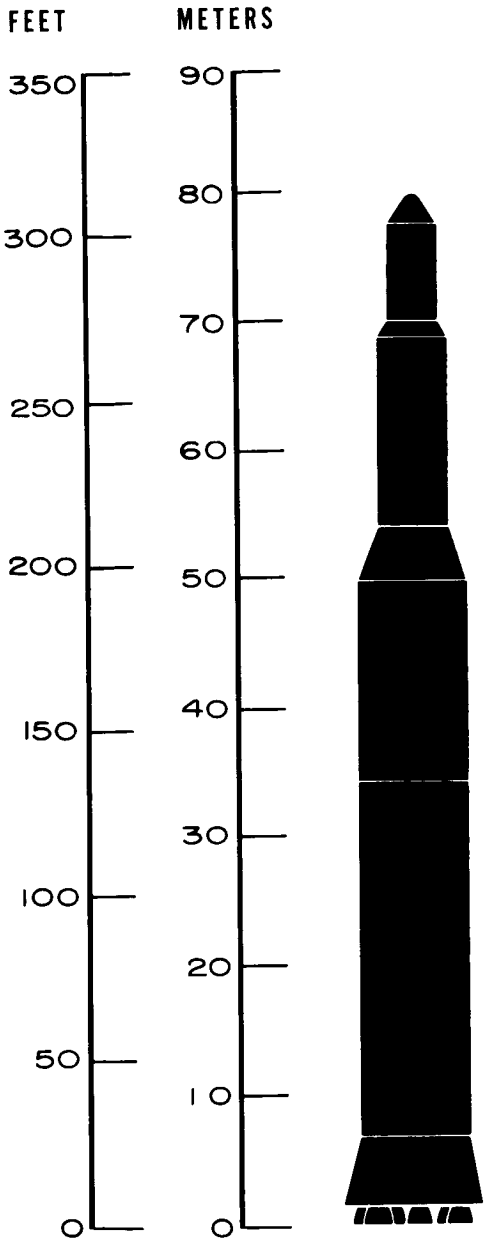
The SATURN I-B, a byproduct of the overall SATURN program, is slightly different from its predecessor, SATURN I. The two-stage launch vehicle utilizes a modified S-1 booster with an S-IV-B second stage with the powerful J-2 engine. The vehicle is being developed for increased capability in manned and unmanned earth orbital missions and supercircular reentry velocity missions with full scale APOLLO spacecraft. With the addition of a suitable third stage, escape missions will be possible. The development program will include a total of four flights, all being launched from the Atlantic Missile Range, starting in 1965.

Present plans call for using the SATURN I-B in the second phase of the APOLLO flight test program. It is intended for this vehicle to place the spacecraft in earth orbit during which lunar rendezvous and docking techniques will be practiced.

STAGE DATA	1st STAGE	2nd STAGE
STAGE DESIGNATION	S-I	S-IV B
HEIGHT m	24.7	18.0
HEIGHT ft	81.0	59.0
DIAMETER m	6.7	6.7
DIAMETER ft	22.0	22.0
ENGINE	H-1	J-2
ENGINE MANUFACTURER	ROCKETDYNE	ROCKETDYNE
NUMBER OF ENGINES	8	1
THRUST PER ENGINE kg	85,000	71,000
THRUST PER ENGINE lb	188,000	200,000
TOTAL THRUST kg	680,000	71,000
TOTAL THRUST lb	1,500,000	200,000
PROPELLANT	LOX/RP	LOX/LH
STAGE CONTRACTOR	MSFC	DOUGLAS

OVERALL VEHICLE DATA	
LIFTOFF THRUST kg	680,000
LIFTOFF THRUST lb	1,500,000
HEIGHT LESS SPACECRAFT m	42.9
HEIGHT LESS SPACECRAFT ft	141.0
MAXIMUM DIAMETER m	6.7
MAXIMUM DIAMETER ft	22.0
PAD WEIGHT kg	500,000
PAD WEIGHT lb	1,100,000
NUMBER OF STAGES	2
PRIME CONTRACTOR	NASA/MSFC
PAYLOAD PERFORMANCE: 345 MILE ORBIT kg	12,900
PAYLOAD PERFORMANCE: 345 MILE ORBIT lb	28,500
ESCAPE kg	--
ESCAPE lb	--
PLANETARY kg	--
PLANETARY lb	

SATURN V



SATURN V

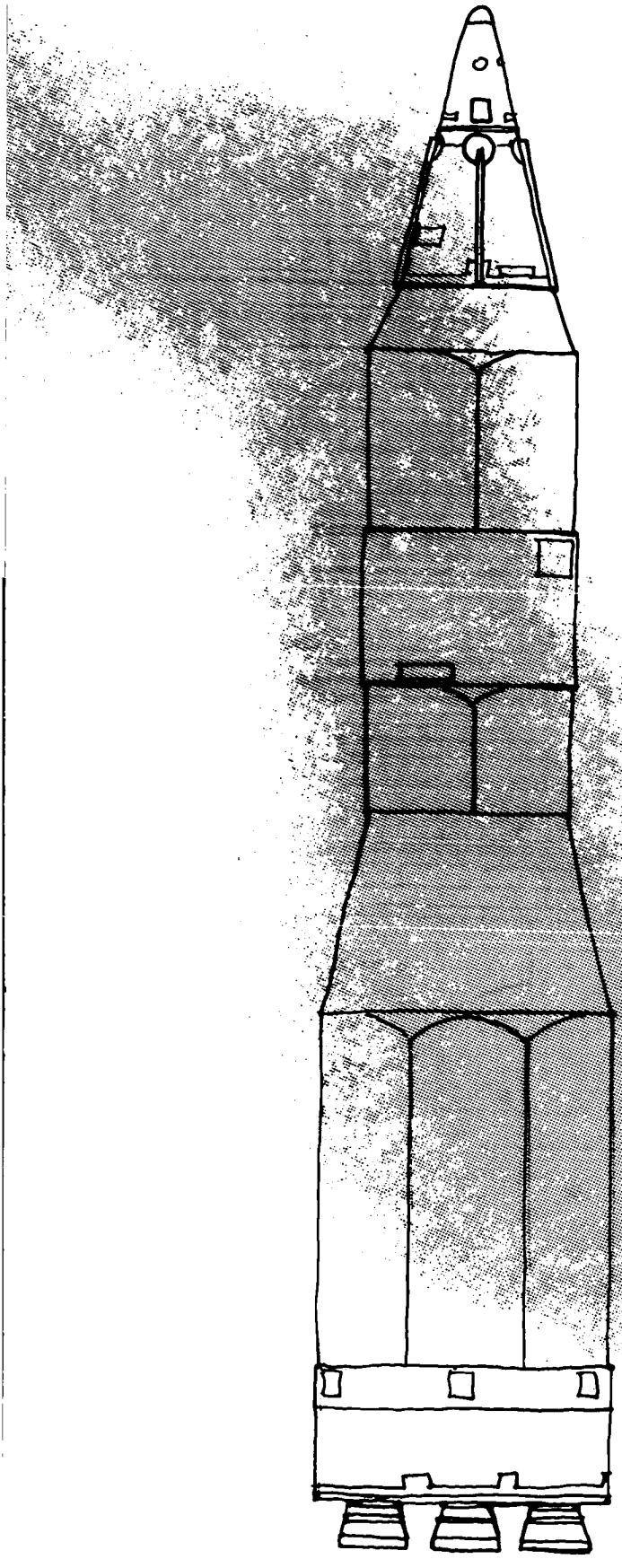
(Status as of March 1964)

SATURN V is the third, most powerful of the launch vehicles being developed in the SATURN program. The three-stage vehicle will be capable of performing manned lunar landing missions using single earth orbit rendezvous techniques, manned circumlunar and lunar orbit missions with APOLLO spacecraft, and unmanned high-energy missions for scientific and application programs. Its capability of placing 100 tons into a low earth orbit and a minimum of 40 tons in the vicinity of the moon will make it our most powerful launch vehicle in the late 1960's when it is to become operational. F-1 engines for first stage are to be delivered, starting August 1964. The first R&D flight is scheduled for 1966.

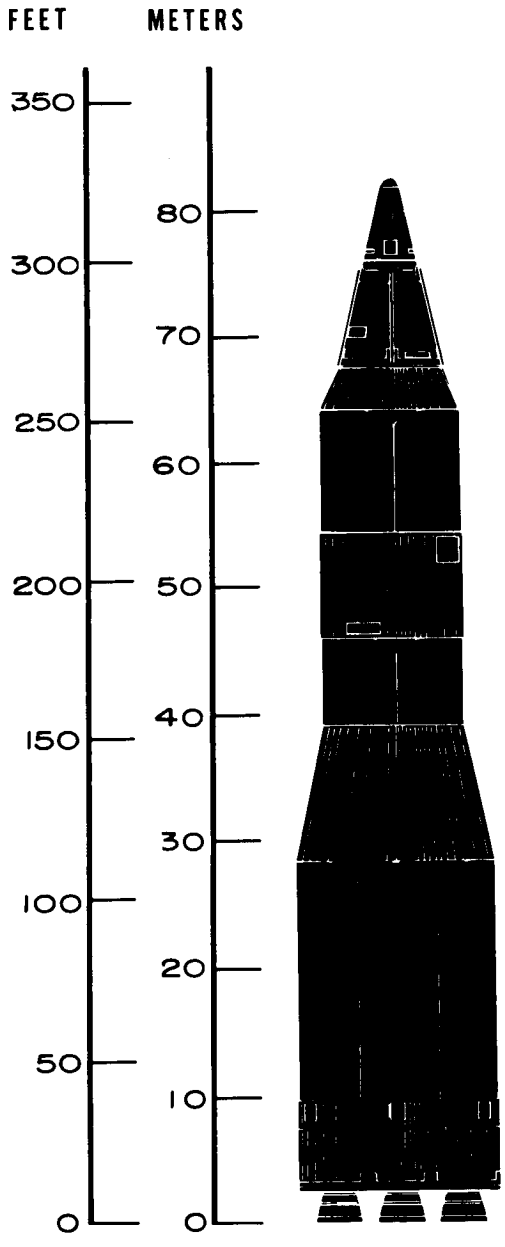
It is planned to start using the SATURN V in the third phase of the APOLLO flight test program. Circumlunar and lunar orbit missions will employ this launch vehicle.

STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE
STAGE DESIGNATION	S-I C	S-II	S-IV B
HEIGHT m	42.1	25.0	18.0
HEIGHT ft	138.0	82.0	59.0
DIAMETER m	10.0	10.0	6.7
DIAMETER ft	33.0	33.0	22.0
ENGINE	F-I	J-2	J-2
ENGINE MANUFACTURER	ROCKETDYNE	ROCKETDYNE	ROCKETDYNE
NUMBER OF ENGINES	5	5	1
THRUST PER ENGINE kg	680,000	91,000	91,000
THRUST PER ENGINE lb	1,500,000	200,000	200,000
TOTAL THRUST kg	3,400,000	454,000	91,000
TOTAL THRUST lb	7,500,000	1,000,000	200,000
PROPELLANT	LOX/RP	LOX/LH	LOX/LH
STAGE CONTRACTOR	BOEING	NAA	DOUGLAS

OVERALL VEHICLE DATA	
LIFTOFF THRUST kg	3,400,000
LIFTOFF THRUST lb	7,500,000
HEIGHT LESS SPACECRAFT m	85.3
HEIGHT LESS SPACECRAFT ft	280.0
MAXIMUM DIAMETER m	10.0
MAXIMUM DIAMETER ft	33.0
PAD WEIGHT kg	2,700,000
PAD WEIGHT lb	6,000,000
NUMBER OF STAGES	3
PRIME CONTRACTOR	NASA/MSFC
PAYLOAD PERFORMANCE: 345 MILE ORBIT kg	91,000
PAYLOAD PERFORMANCE: 345 MILE ORBIT lb	200,000
ESCAPE kg	36,000
ESCAPE lb	80,000
PLANETARY kg	27,000
PLANETARY lb	60,000



NOVA



NOVA

(Status as of March 1964)

Still in the planning stage, NOVA is the backup vehicle for the SATURN V. At present NOVA is envisioned as our largest launch vehicle. Its payload capacity will be somewhere between 250,000 and 500,000 kilograms for earth orbits. Some possible missions include delivery of passengers and cargo to earth orbits for assembly of spacecraft and escape stages for manned interplanetary missions or for supplying large space stations; delivery of passengers and cargo to the lunar surface; and direct escape for interplanetary probes. The basic NOVA will be a two-stage vehicle, but a third stage will be developed for escape missions. Exclusive of the payload, the three-stage NOVA will be about 90 meters high.

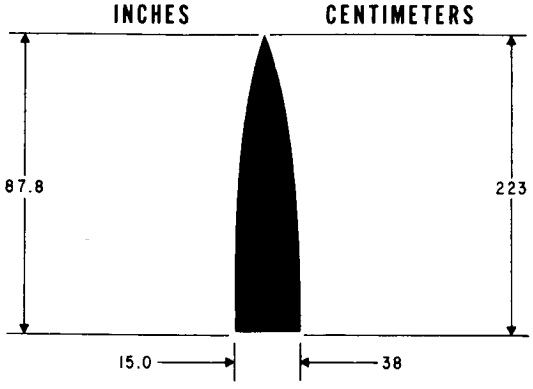
For the first stage of NOVA both solid and liquid chemical propulsion systems are under development. The second stage will possibly employ four M-1 engines using the combination of liquid oxygen and liquid hydrogen as a propellant. Probably the third stage will have one or two J-2 engines also using the liquid hydrogen and liquid oxygen combination for propulsive thrust. When a nuclear propulsion system is developed and available, it may also be used for the NOVA third stage, which is configured to be capable of accepting this form of engine.

UNITS

SOUNDING ROCKETS
(Status January 1, 1965)

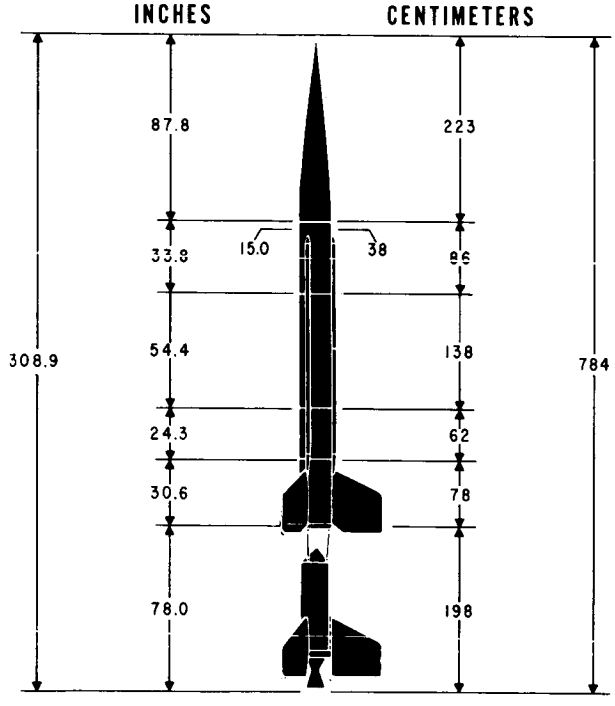
1 AEROBEE 100
2 NIKE-ASP
3 AEROBEE 150-150A
4 IRIS
5 AEROBEE 300-300A (SPAEROBEE)
6 ARGO D-4 (JAVELIN)
7 NIKE-CAJUN
8 ARGO D-8 (JOURNEYMAN)
9 NIKE-APACHE
10 ASTROBEE 1500
11 AEROBEE 350

AEROBEE 100



Aerobee 100 is a two-stage, free-flight sounding rocket with an Aerojet 2.5KS18000 solid propellant first stage and a liquid propellant second stage. The rocket is launched from a vertical tower by remote control with inertial guidance provided by fixed rails. The first stage is ignited at launch and burns for 2.5 seconds, after which it separates from the second stage. One second after launch the second stage motor starts from the hypergolic reaction between a slug of unsymmetrical dimethylhydrazine and the inhibited red fuming nitric acid propellant; JP-4 propellant is also used in this stage. Stability during flight is provided by three fixed fins on the booster and a similar set of fins on the second stage.

TYPICAL PAYLOAD

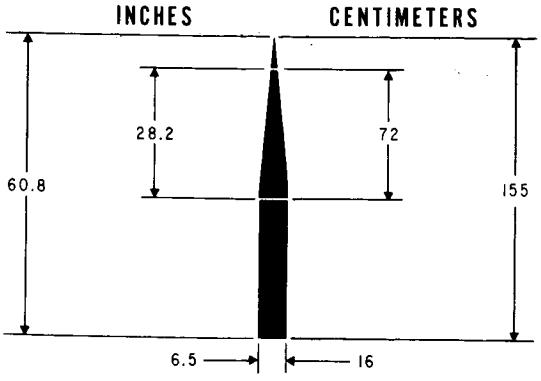


OVERALL VEHICLE DATA

BOOSTER THRUST	kg	8,450
	lb	18,600
MAXIMUM DIAMETER	cm	38
	in	15
WEIGHT LESS PAYLOAD	kg	628
	lb	1,384
NUMBER OF STAGES		2
PRIME CONTRACTOR		Space General
NOMINAL PAYLOAD		22.5 kg (50 lb)
Altitude		75 miles
Acceleration		15g
Spin		132 rpm

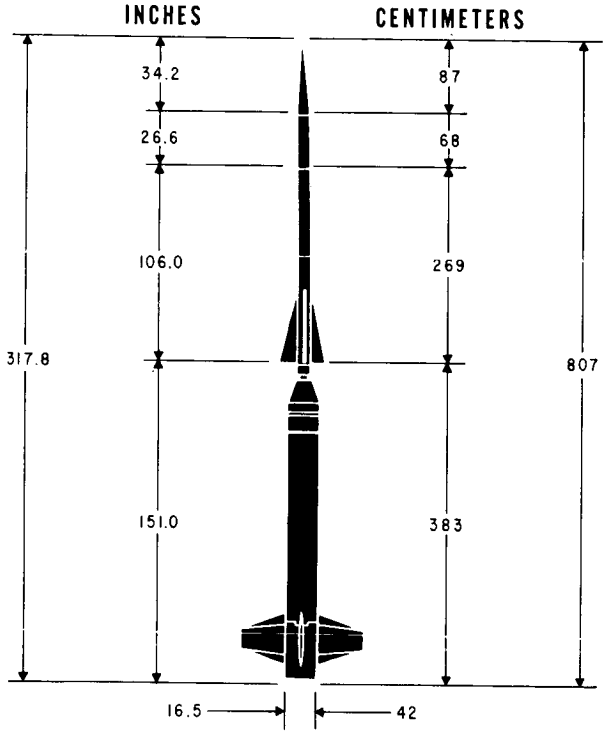
STAGE DATA		1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT	cm	198	364		
	in	78	143		
DIAMETER	cm	34	38		
	in	13	15		
ENGINE		2.5KS18000	AJ10–102		
ENGINE MANUF.		Aerojet	Space General		
AVERAGE THRUST	kg	8,450	572		
	lb	18,600	2,600		
BURNING TIME	sec	2.5	40.0		
PROPELLANT		SOLID	JP-4, IRFNA/UDMH		

NIKE-ASP



Nike-Asp, a two-stage, solid-propellant sounding rocket, consists of a four-finned XM-5 Nike Booster first stage and a four-finned ASP I second stage with adjustable spin tabs. It can be launched from a modified standard Nike launcher, a zero-length launcher, or from a Nike rail-mounted on an A-frame. The first stage burns for 3.5 seconds, after which explosive separation takes place initiated either by an acceleration-sensitive timer or by a ground-fired 4.0 second delay pyrotechnic switch. After separation of the booster the Asp coasts to a height where an altitude sensitive firing circuit ignites it. The Asp burns for about 5.5 seconds, after which it follows a ballistic trajectory. NASA has replaced Nike-Asp with Nike-Cajun and Nike-Apache.

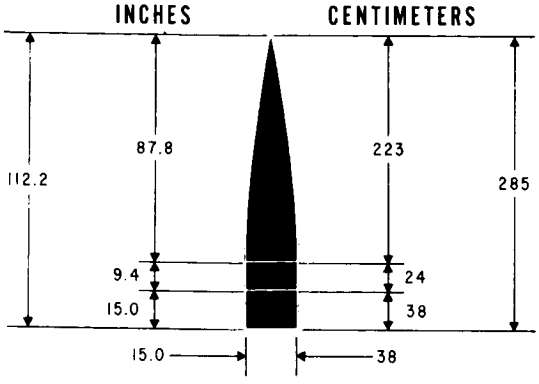
TYPICAL PAYLOAD



OVERALL VEHICLE DATA		
BOOSTER THRUST	kg	22,100
	lb	48,700
MAXIMUM DIAMETER	cm	42
	in	16.5
WEIGHT LESS PAYLOAD ...	kg	700
	lb	1,543
NUMBER OF STAGES		2
PRIME CONTRACTOR		CDD-Marquardt

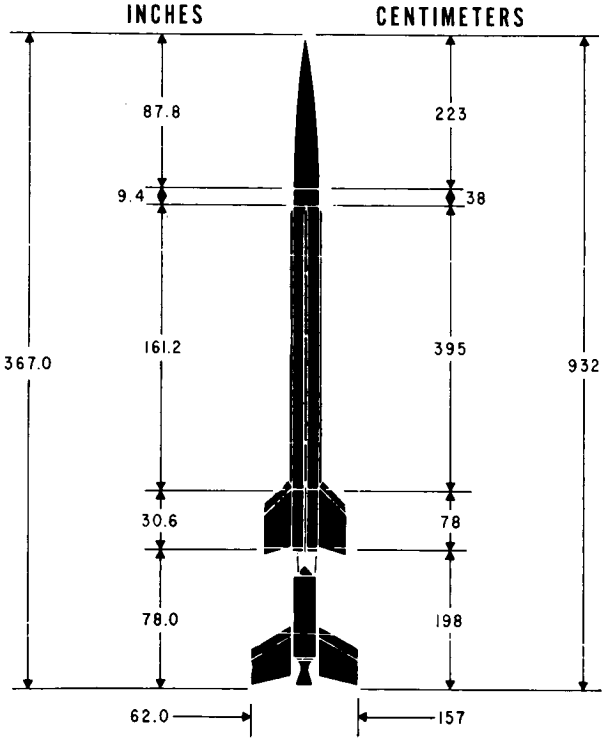
STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT ..... cm	384	337		
in	151	133		
DIAMETER ..... cm	42	16		
in	16.5	6.5		
ENGINE	M5E-1 NIKE	ASP I		
ENGINE MANUF.	Military	CDD-Marquardt		
AVERAGE THRUST .. kg	22,100			
lb	48,700			
BURNING TIME ..... sec	3.5	5.5		
PROPELLANT	SOLID	SOLID		

AEROBEE 150-150A



Aerobee 150A is a four-finned version of the three-finned Aerobee 150, a two-stage, solid and liquid propellant sounding rocket. The first stage is an Aerojet 2.5KS18000 motor which is ignited at launch and burns for 2.5 seconds, falling away by drag separation. The second stage liquid propellant is ignited 0.3 seconds after launch and burns for about 52 seconds. The vehicle is launched at variable angles from a four-rail tower. In the 150A the first step fins are installed at a 2.5 degree angle to impart a controlled roll rate; the second step fins are adjustable from zero angle to 20 minutes to provide a desired roll rate. Aerobee 150A can only be launched at Wallops Island facilities.

TYPICAL PAYLOAD

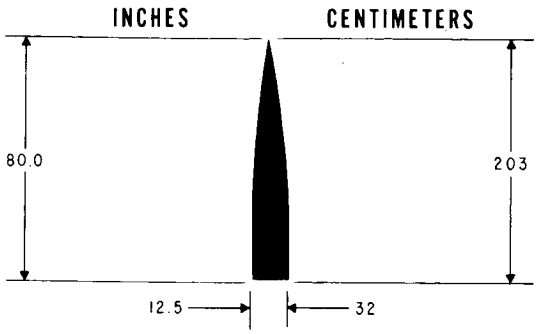


OVERALL VEHICLE DATA

BOOSTER THRUST	kg	8,450
	lb	18,600
MAXIMUM DIAMETER	cm	38
	in	15
WEIGHT LESS PAYLOAD	kg	883
	lb	1,947
NUMBER OF STAGES		2
PRIME CONTRACTOR		Space General
NOMINAL PAYLOAD		67.5 kg (150 lb)
Altitude		150 miles
Acceleration		10g
Spin		132 rpm (108 for 150A)

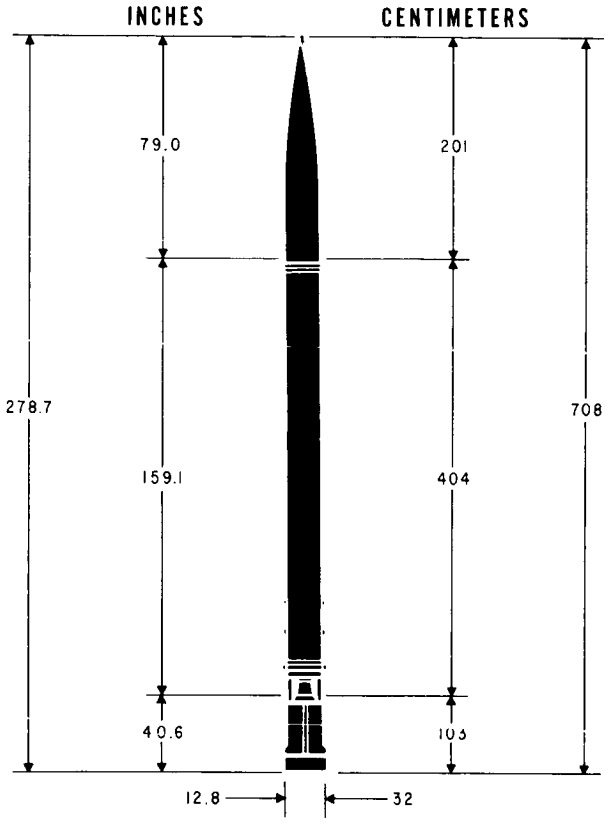
STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT cm	198	487		
in	78	192		
DIAMETER cm	34	38		
in	13	15		
ENGINE	2.5KS18000	AJ11-21		
ENGINE MANUF.	Aerojet	Space General		
AVERAGE THRUST kg	8,450	904		
lb	18,600	4,100		
BURNING TIME sec	2.5	51.8		
PROPELLANT	SOLID	IRFNA/Aniline Furfuryl Alcohol		

IRIS



Iris is a two-stage, solid propellant sounding rocket with a cruciform mounting of four fins on the second stage only. The first stage motor is a 0.8KS18800 and the second stage is a 52KS4375, both built by Atlantic Research. Iris is launched from a 160-foot 4-rail tower at variable angles. The first stage motor consists of seven 4-inch diameter motors and is not mechanically attached to the second stage. It burns for 0.8 seconds and falls away after the rocket exits from the tower. Firing of the second stage is actuated through a time delay relay and has a burning time of about 56 seconds. NASA does not currently use Iris.

TYPICAL PAYLOAD

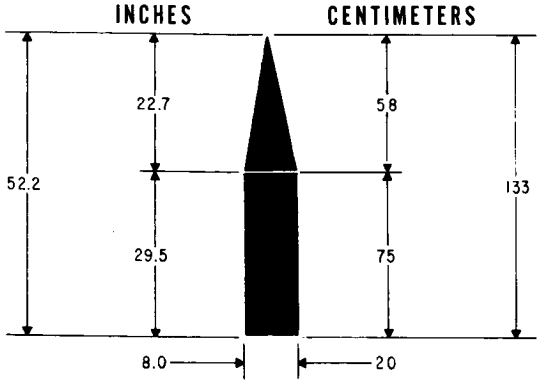


OVERALL VEHICLE DATA

BOOSTER THRUST	kg	8,530
	lb	18,800
HEIGHT LESS NOSE CONE	cm	507
	in	200
MAXIMUM DIAMETER	cm	32
	in	13
WEIGHT LESS PAYLOAD	kg	644
	lb	1,419
NUMBER OF STAGES		2
PRIME CONTRACTOR		Atlantic Research

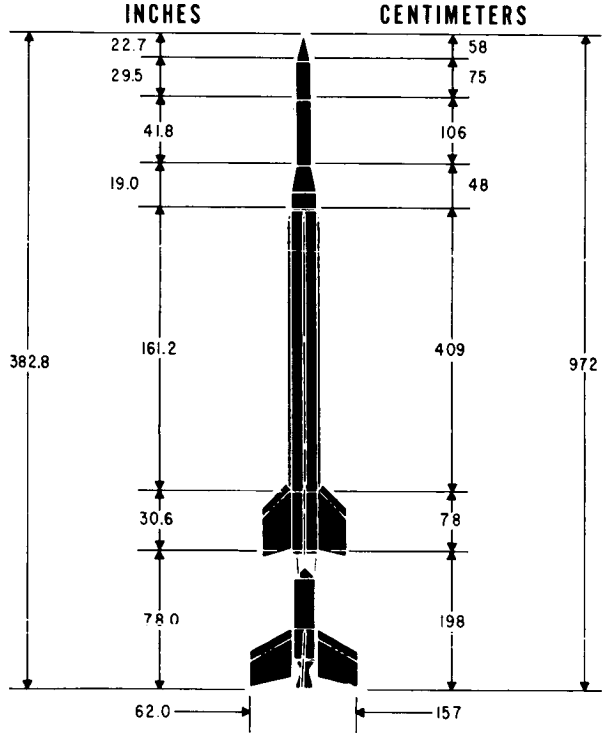
STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT cm	103	404		
in	41	159		
DIAMETER cm	32	30		
in	13	12		
ENGINE	0.8KS18800	52KS4375		
ENGINE MANUF.	Atlantic Research	Atlantic Research		
AVERAGE THRUST kg	8,530	1,980		
lb	18,800	4,375		
BURNING TIME sec	0.8	56		
PROPELLANT	SOLID	SOLID		

AEROBEE 300-300A



TYPICAL PAYLOAD

Aerobee 300A is a four-finned version of the Aerobee 300, a three-stage solid and liquid propellant sounding rocket. The first stage motor is an Aerojet 2.5KS18000 solid propellant rocket which is ignited at launch and burns for 2.5 seconds and falls away. The liquid propelled Aerobee 150A second stage ignites 0.3 seconds after the first stage ignition and burns for 51.8 seconds. When the second step motor burns out and drops off ignition of the third step solid propellant Sparrow 1.8KS7800 motor is actuated which then burns for 1.8 seconds. The vehicle can be launched at variable angles from a four-rail tower. When launched vertically with a minimum 20-pound payload these rockets reach an altitude of 320 nautical miles.

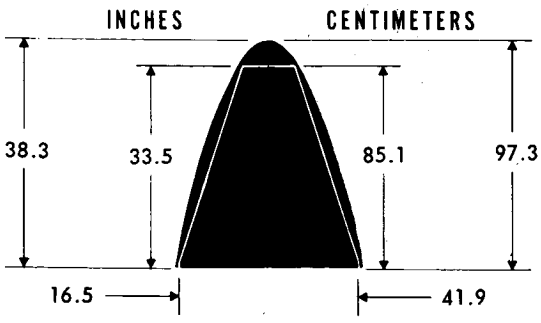


OVERALL VEHICLE DATA

BOOSTER THRUST	kg	8,450
	lb	18,600
MAXIMUM DIAMETER	cm	38
	in	15
WEIGHT LESS PAYLOAD	kg	956
	lb	2,107
NUMBER OF STAGES		3
PRIME CONTRACTOR		Space General
NOMINAL PAYLOAD		38 kg (85 lb)
Altitude		210 miles
Acceleration		57g
Spin		132 rpm

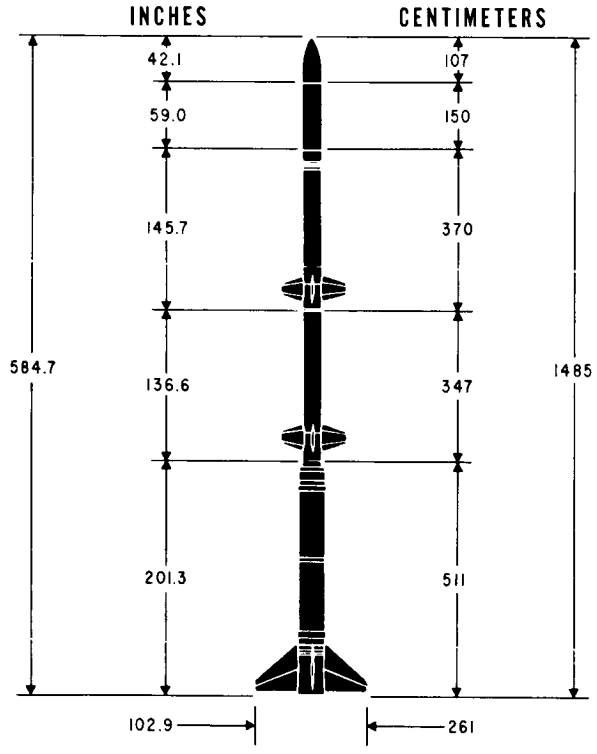
STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT cm	198	487	154	
in	78	192	61	
DIAMETER cm	34	38	20	
in	13	15	8	
ENGINE	2.5KS18000	AJ60–13	1.8KS7800	
ENGINE MANUF.	Aerojet	Space General	Aerojet	
AVERAGE THRUST kg	8,450	904	1,720	
lb	18,600	4,100	7,800	
BURNING TIME sec	2.5	51.8	1.8	
PROPELLANT	SOLID	IRFNA/Aniline Furfuryl Alcohol	SOLID	

ARGO D-4



TYPICAL PAYLOAD

Argo D-4 is a four-stage, solid propellant sounding rocket. It consists of an Honest John M6 as the first stage, Nike Ajax M5 boosters as second and third stages, and the X-248 as the fourth stage. Cruciform fins are fitted on the first three stages to provide stability. The first stage is ignited at launch, burns for 5.0 seconds, and falls away. At 9.7 seconds the second stage ignites, burns for 3.5 seconds, and falls away, lock pins between stages 2 and 3 having been pulled during burning. Stage 3 ignites at 25 seconds, burns for 3.5 seconds, and then stages 3 and 4 coast together for a preset time. When stage 4 ignites, stage 3 is explosively disconnected. After stage 4 burns out the vehicle coasts for a preset time and then the nose cone is ejected.

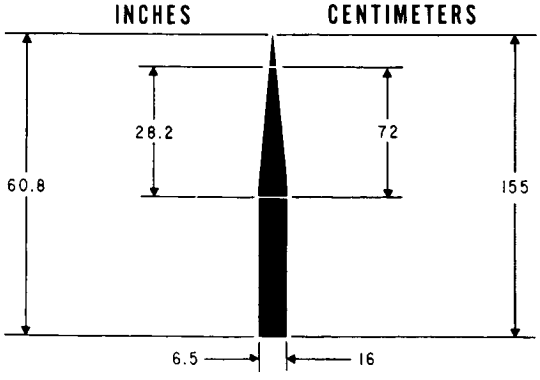


OVERALL VEHICLE DATA

BOOSTER THRUST	kg	36,900
	lb	82,000
MAXIMUM DIAMETER	cm	58
	in	23
WEIGHT LESS PAYLOAD	kg	3,353
	lb	7,392
NUMBER OF STAGES		4
PRIME CONTRACTOR		Aerolab
NOMINAL PAYLOAD		45 kg (100 lb)
Altitude		650 miles
Acceleration		38g
Spin		540 rpm

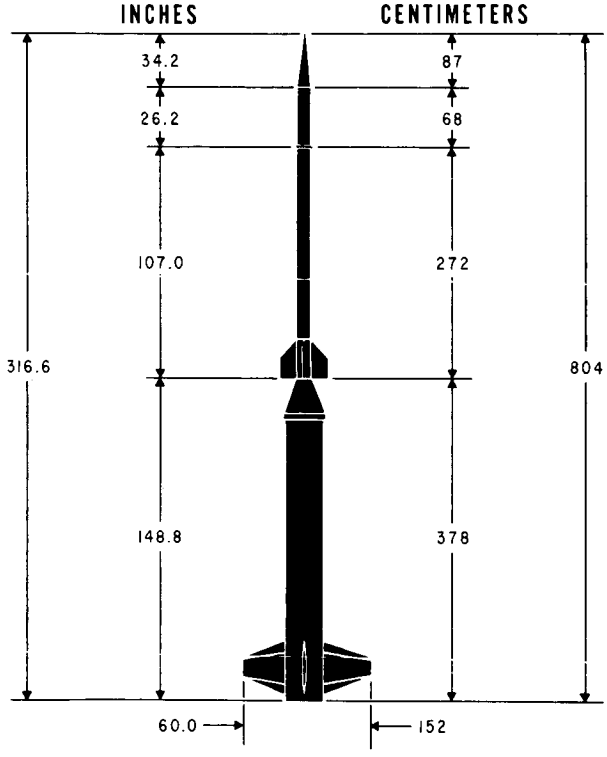
STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT cm	511	347	370	150
in	201	137	146	59
DIAMETER cm	58	42	42	48
in	23	16.5	16.5	19
ENGINE	Honest John	M5E-1 NIKE	M5E-1 NIKE	X-248
ENGINE MANUF.	Military	Military	Military	NPP
AVERAGE THRUST kg	36,900	22,100	22,100	1,430
lb	82,000	48,700	48,700	3,150
BURNING TIME sec	5.0	3.5	3.5	40.0
PROPELLANT	SOLID	SOLID	SOLID	SOLID

NIKE-CAJUN



TYPICAL PAYLOAD

Nike-Cajun, a two-stage, solid propellant sounding rocket, is made up of a four-finned M-5 Nike booster first stage and a four-finned TE-82Mod2 Cajun rocket motor second stage. This rocket can be ground fired from a zero length launcher or from a slightly modified Nike-Ajax launcher. At burnout drag on the Nike stage separates it from the Cajun stage. Ignition of the Cajun motor takes place after separation within a delay time which depends on the pyrotechnic delay squib used. The squib is ignited at launch. After burnout of the Cajun motor the rocket coasts on a ballistic trajectory.

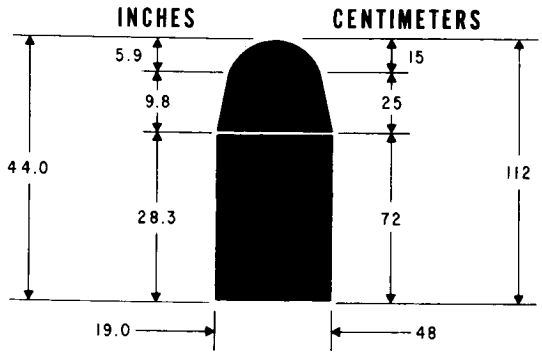


OVERALL VEHICLE DATA

BOOSTER THRUST	kg	22,100
	lb	48,700
MAXIMUM DIAMETER	cm	42
	in	17
WEIGHT LESS PAYLOAD	kg	689
	lb	1,519
NUMBER OF STAGES		2
PRIME CONTRACTOR		None
NOMINAL PAYLOAD		22.5 kg (50 lb)
Altitude		104 miles
Acceleration		60g
Spin		300–360 rpm

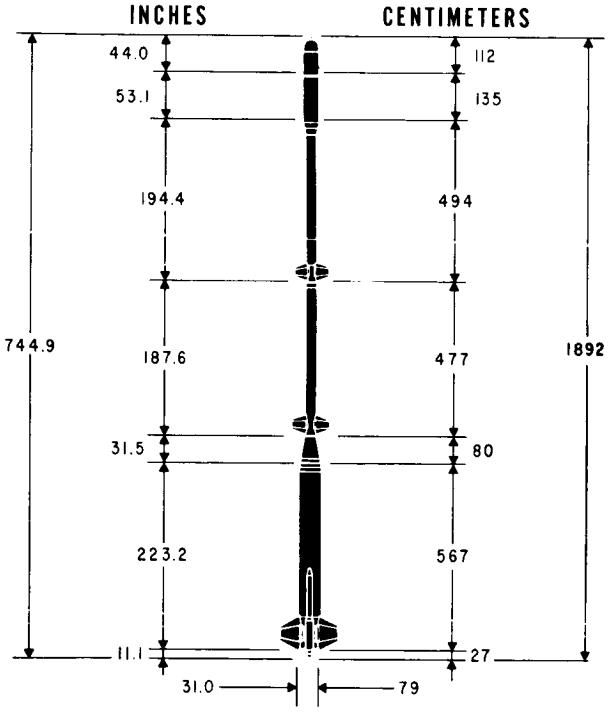
STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT cm	378	272		
in	149	107		
DIAMETER cm	42	16		
in	16.5	6.5		
ENGINE	M5E-1 NIKE	Cajun		
ENGINE MANUF.	Military	Thiokol		
AVERAGE THRUST kg	22,100	3,560		
lb	48,700	7,850		
BURNING TIME sec	3.5	3.4		
PROPELLANT	SOLID	SOLID		

ARGO D-8



TYPICAL PAYLOAD

Argo D-8, Journeyman, is a four-stage sounding rocket vehicle, using solid propellant motors. The motors are XM20 Pollux and two Recruits for the first stage XM45 Lance for the second stage, XM45 Lance for the third stage, and X248-A6 for the fourth stage. The first three stages are fin stabilized, and the fourth is spin stabilized. After complete first stage burnout explosive bolts are activated and drag separation occurs. The second stage is timer ignited and separates after burnout through blowout diaphragm action. Ignition and separation of the third stage are similar. The fourth stage is timer ignited and jettisons its heat shield. After burnout the nose cone is ejected.

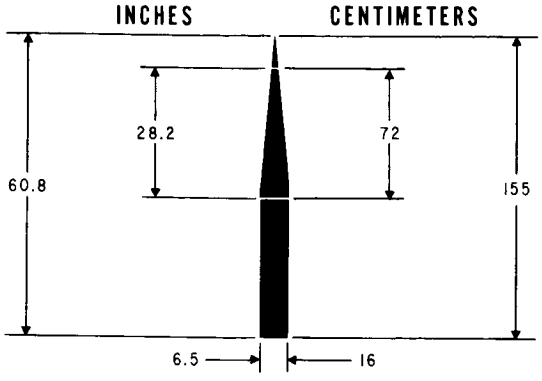


OVERALL VEHICLE DATA

BOOSTER THRUST	kg	53,900
	lb	122,000
MAXIMUM DIAMETER	cm	79
	in	31
WEIGHT LESS PAYLOAD	kg	6,386
	lb	14,079
NUMBER OF STAGES		4
PRIME CONTRACTOR		Aerolab
NOMINAL PAYLOAD		63 kg (140 lb)
Altitude		1,120 miles
Acceleration		30g
Spin		420 rpm

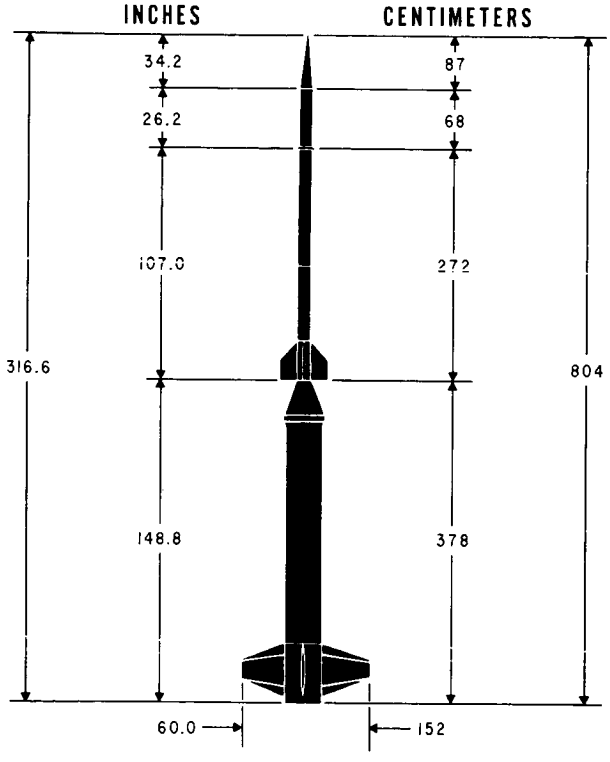
STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT cm	675	477	477	150
in	266	188	188	59
DIAMETER cm	79	38	38	48
in	31	15	15	19
ENGINE	Pollux & 2 Recruits	Lance	Lance	X-248
ENGINE MANUF.	Thiokol	LPC	LPC	NPP
AVERAGE THRUST..kg	53,900	19,800	19,800	1,430
lb	122,000	44,000	44,000	3,150
BURNING TIME sec	27.5 & 1.8	3.8	3.8	40.0
PROPELLANT	SOLID	SOLID	SOLID	SOLID

NIKE-APACHE



TYPICAL PAYLOAD

Nike Apache, a two-stage, solid propellant, unguided sounding rocket, is made up of a four-finned Nike M5-E1 first stage and a four finned Apache TE-307 Mod II second stage. In general configuration and launching characteristics it is identical to the Nike Cajun. The first stage is ignited at launch and burns for 3.5 seconds after which it separates from the second stage by differential drag forces. Ignition of the second stage is normally delayed until about 20 seconds after first stage burnout. The second stage is ignited by a pyrogen igniter, a small rocket motor which operates for about 100 milliseconds. After burnout of the second stage motor the vehicle follows a ballistic trajectory.

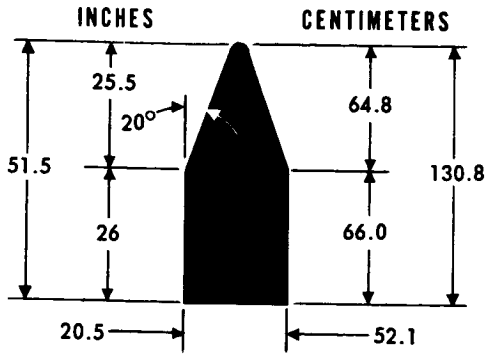


OVERALL VEHICLE DATA

BOOSTER THRUST	kg	22,100
	lb	48,700
MAXIMUM DIAMETER	cm	42
	in	16.5
WEIGHT LESS PAYLOAD	kg	696
	lb	1,534
NUMBER OF STAGES		2
PRIME CONTRACTOR		None
NOMINAL PAYLOAD		27 kg (60 lb)
Altitude		135 miles
Acceleration		38g
Spin		300-360 rpm

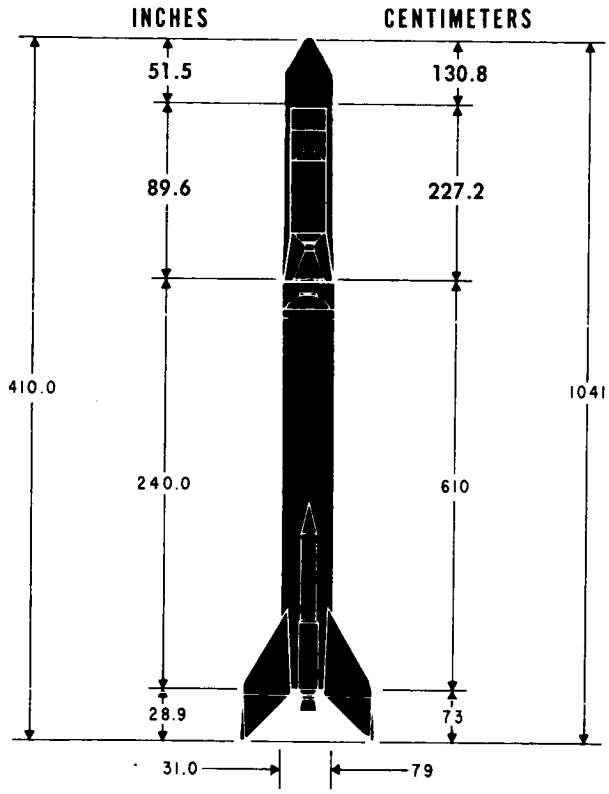
STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT cm	378	272		
in	149	107		
DIAMETER cm	42	16		
in	16.5	6.5		
ENGINE	Nike-Ajax	Apache		
ENGINE MANUF.	Military	Thiokol		
AVERAGE THRUST kg	22,100	2,150		
lb	48,700	4,750		
BURNING TIME sec	3.5	6.0		
PROPELLANT	SOLID	SOLID		

ASTROBEE 1500



Astrobee 1500 is a two-stage, solid propellant sounding rocket with additional first stage boosters. The four-finned Aerojet Jr. first stage is assisted by two Recruit 1.5KS35000 auxiliary rockets. The second stage is an Aerojet 30KS8000 (AJ10-41) rocket which uses conical flare plus minimal spin for near neutral aerodynamic stability. The rocket is boom launched at a nominal five degrees from the vertical. Maximum acceleration with a 75 pound net payload is 38g. With a 50 pound payload Astrobee 1500 can achieve an altitude of 1750 nautical miles.

TYPICAL PAYLOAD

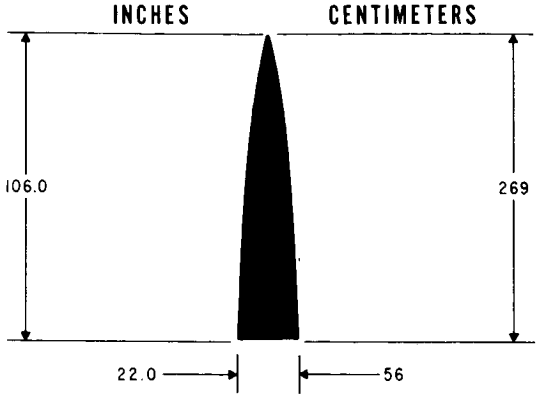


OVERALL VEHICLE DATA

BOOSTER THRUST	kg	54,000
	lb	120,000
MAXIMUM DIAMETER	cm	78
	in	31
WEIGHT LESS PAYLOAD	kg	5,230
	lb	11,500
NUMBER OF STAGES		2
PRIME CONTRACTOR		Space General
NOMINAL PAYLOAD		34 kg (75 lb)
Altitude		1,610 miles
Acceleration		38g
Spin		720 rpm

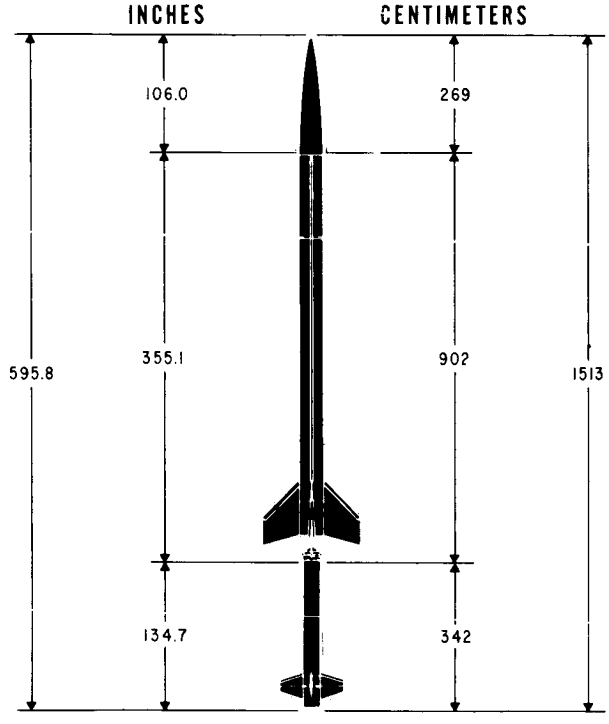
STAGE DATA	BOOSTERS	1st STAGE	2nd STAGE	3rd STAGE
HEIGHT cm	210	670	310	
in	83	264	122	
DIAMETER cm	23	79	55	
in	9	31	22	
ENGINE	1.5KS35000	Aerojet Jr.	30KS8000	
ENGINE MANUF.	Thiokol	Aerojet	Aerojet	
AVERAGE THRUST kg	2X16000	23,000	3,600	
lb	2X35000	50,000	8,000	
BURNING TIME sec	1.5	30.0	30.0	
PROPELLANT	SOLID	SOLID	SOLID	

AEROBEE 350



Aerobee 350 is a two-stage sounding rocket now under development for the NASA Goddard Space Flight Center. Its first stage utilizes a Nike M5E1 solid propellant motor which is ignited at launch and burns for approximately 3.5 seconds. The second stage is propelled by a cluster of four Aerobee 150A thrust chambers which utilize inhibited red fuming nitric acid and a mixture of aniline and furfuryl alcohol as liquid propellants. After about 52 seconds of burning the rocket follows a ballistic trajectory until impact. During the post-burnout period the attitude of the rocket-payload combination may be programmed through a series of maneuvers by the 350's Attitude Control System. The rocket is designed for firing from the four-rail Launch Tower at NASA Wallops Station.

TYPICAL PAYLOAD



OVERALL VEHICLE DATA

BOOSTER THRUST	kg	22,000
	lb	48,700
MAXIMUM DIAMETER	cm	56
	in	22
WEIGHT LESS PAYLOAD	kg	3,000
	lb	6,600
NUMBER OF STAGES		2
PRIME CONTRACTOR		Space General

STAGE DATA	1st STAGE	2nd STAGE	3rd STAGE	4th STAGE
HEIGHT cm	378	874		
in	149	344		
DIAMETER cm	42	56		
in	16	22		
ENGINE	Nike M5E1	4 Aerobee 150 Chambers		
ENGINE MANUF.	Military	Space General		
AVERAGE THRUST kg	22,000	8,200		
lb	48,700	18,000		
BURNING TIME sec	3.5	52.0		
PROPELLANT	SOLID	IRFNA/Aniline Furfuryl Alcohol		

Satellite Lifetime
Minimum of one year

TRACKING

GSFC Minitrack
Canadian and British Stations

ENVIRONMENTAL TEST PROGRAM

LOCATION
Spacecraft tests - GSFC
Experiments and subassemblies - GSFC, DRTE, and contractors.

SCHEDULE

Alouette I
Environmental Tests Complete - August 18, 1962

Alouette II - October 25, 1965

ISIS-A
Environmental Tests Complete - Second Quarter FY 68

ISIS-B
Environmental Tests Complete - Second Quarter FY 69

ISIS-C
Environmental Tests Complete - Second Quarter FY 70

PROJECT SCHEDULE

Alouette I
September 28, 1962 - Launched

Alouette II
November 29, 1965 - Launched

ISIS-A
September 1964, Start Design - Second Quarter FY 68, Launch

ISIS-B
January 1965, Start Design - Second Quarter FY 69, Launch

ISIS-C

January 1966, Start Design - Second Quarter FY 70, Launch

COMMENTS

DME-A was launched as a piggyback spacecraft on Alouette II; it was a U. S. spacecraft whereas the others are Canadian. Other satellites which have or will engage in ionospheric studies include Explorer VIII, P-21, P-21a, S-51, S-52, S-48, S-66, and Alouette I.

INTERPLANETARY MONITORING PLATFORM (IMP)

SPACECRAFT

IMP-A, B, and C

OBJECTIVES

To study the radiation environment of cislunar space by monitoring this region over a significant portion of the solar cycle, and to support Project Apollo. Acquisition of complete and timely information requires a series of launches so that an operational IMP will be in orbit at all times during the Apollo Project.

EXPERIMENTS

COSMIC RAY

1. Energy versus Energy Loss
2. Neher-type Ion Chamber
3. Orthogonal Telescope Array
4. Search for Solar-Proton or Alpha-Flare Events

SOLAR WIND

1. Low-energy Proton Analyzer
2. Plasma Probe
3. Thermal Ion and Electron Experiment

MAGNETIC FIELD

1. Rubidium-vapor Magnetometer
2. Two Fluxgate Magnetometers

SPACECRAFT DESCRIPTION (IMP-A)

WEIGHT

140 lbs

MOMENT OF INERTIA (Estimated)

Launch Mode - 3.6 slug-ft^2
Orbital Mode (Paddles and booms unfolded) - 12.3 slug-ft^2

CONFIGURATION

Octagonal Platform, 28 in. X 28 in. X 12 in.

DIMENSIONS (Tip to Tip)

Solar Paddles - 106 in.
Fluxgate Sensors - 165 in.

APPENDAGES

Solar Paddles

Quantity - 4 Paddles
Dimensions of each - 26 in. X 18 in.
Solar-cell Area (4 Paddles) - 32 sq. ft.

Antennas

Quantity - 4
Length of each - 16 in.

Rubidium Magnetometer

Distance from Spacecraft Interface to Top of 13-in. diameter Sphere:
Support Tube Extended - 83 in.
Support Tube Compressed - 54½ in.

POWER SYSTEM

Source
Solar cells and one 18-volt 5-ampere-hour battery pack

Power
37 watts average - continuous operation

COMMUNICATIONS AND DATA HANDLING

Telemetry
Pulsed Frequency Modulation (PFM)

Transmitter
4 watt output

Encoder
PFM with digital data processor for accumulation and storage of data

LAUNCH VEHICLE

Modified Delta (X-258) with increased 2nd stage fuel capacity

LAUNCH RANGE

Atlantic Missile Range

ORBIT

Apogee - 150,000 nautical miles
Perigee - 110 nautical miles
Period - 150 hours
Injection Point - 14°N, 49°W
Lifetime - One year

TRACKING

STATIONS

Apogee
Johannesburg, South Africa; Rosman, N. C.; Camarvon area, Australia

Perigee
Blossom Point, Md.; Fort Myer, Florida; Goldstone, California

DATA ACQUISITION

Johannesburg, South Africa; Woomera, Australia; Santiago, Chile

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center

SCHEDULE

July 1963
Beginning of Prototype Tests

October 1963
Completion of Acceptance Tests for Flight Unit 1

PROJECT SCHEDULE

June 1, 1963
Completion of Spacecraft Design

November 27, 1963
IMP-A Launched

3rd Quarter 1964
Launch IMP-B

2nd Quarter 1965
Launch IMP-C

INTERPLANETARY MONITORING PLATFORM

SPACECRAFT

IMP-F, G, and I

OBJECTIVES

To study solar and galactic cosmic radiation, the solar plasma, energetic particles within the magnetosphere and its boundary layer and the interplanetary magnetic field. These spacecraft are intended to continue and advance the studies carried out by earlier Explorer and Imp-type satellites. However the experiments and instrumentation of these spacecraft permit more detailed and precise measurements than previously possible.

EXPERIMENTS

Bell Telephone Lab.
Low Energy Telescope

U. of California (Berkeley)
Ion Chamber

U. of Chicago
Range vs Energy Loss

U. of Iowa
Low Energy Proton & Electron Differential Energy Analyzer

Southwest Center for Advanced Studies
Cosmic Ray Anisotropy

TRW Systems
Spherical Electrostatic Analyzer

GSFC & APL
Solar Proton Monitoring Experiment

GSFC & U. of Maryland
Plasma Experiment

GSFC
Low Energy Proton & Alpha Detector

GSFC
Energy vs Energy Loss

GSFC
Magnetic Field Exp.

SPACECRAFT DESCRIPTION

WEIGHT

156.5 lbs

MOMENT OF INERTIA (Estimated)

Launch Mode - 3.93 slug-ft^2
Orbital Mode (Paddles and booms unfolded) - 13.3 slug-ft^2

CONFIGURATION

Octagonal Platform, 28 in. X 28 in. X 10 in. (similar to IMPS A, B, and C but without Rb magnetometer)

DIMENSIONS

Solar Paddles - 110.6 in.
Fluxgate Sensors - 180 in.

APPENDAGES

Solar Paddles

Quantity - 4
Dimensions - 20 in. X 26 in.
Solar -cell Area - 26 sq. ft.

Antennas

Quantity - 4
Length of each - 24 in.

Fluxgate Sensor Booms

Quantity - 2

POWER SYSTEM

Source
Solar cells and one 5-ampere-hour silver cadmium battery

Power
35 watts average - continuous operation

COMMUNICATIONS AND DATA HANDLING

Telemetry
Pulse Frequency Modulation (PFM)

Transmitter
4 watt output

Encoder
PFM with digital data processor for accumulation and storage of data

LAUNCH VEHICLE

Improved Delta Launch Vehicle (DSV-3E)

LAUNCH RANGE

Pacific Missile Range

ORBIT

Apogee - 30 earth radii (110,000 nautical miles)
Perigee - 105 nautical miles
Period - 4 days
Injection - 0°Latitude, 110°N Longitude
Lifetime - 10 months minimum

TRACKING

STATIONS

Apogee
Johannesburg, South Africa; Rosman, N. C.; Camarvon area, Australia

Perigee
Blossom Point, Md; Fort Myer, Florida; Goldstone, California

DATA ACQUISITION

Johannesburg, South Africa; Woomera, Australia; Santiago, Chile

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center

SCHEDULE (IMP F)

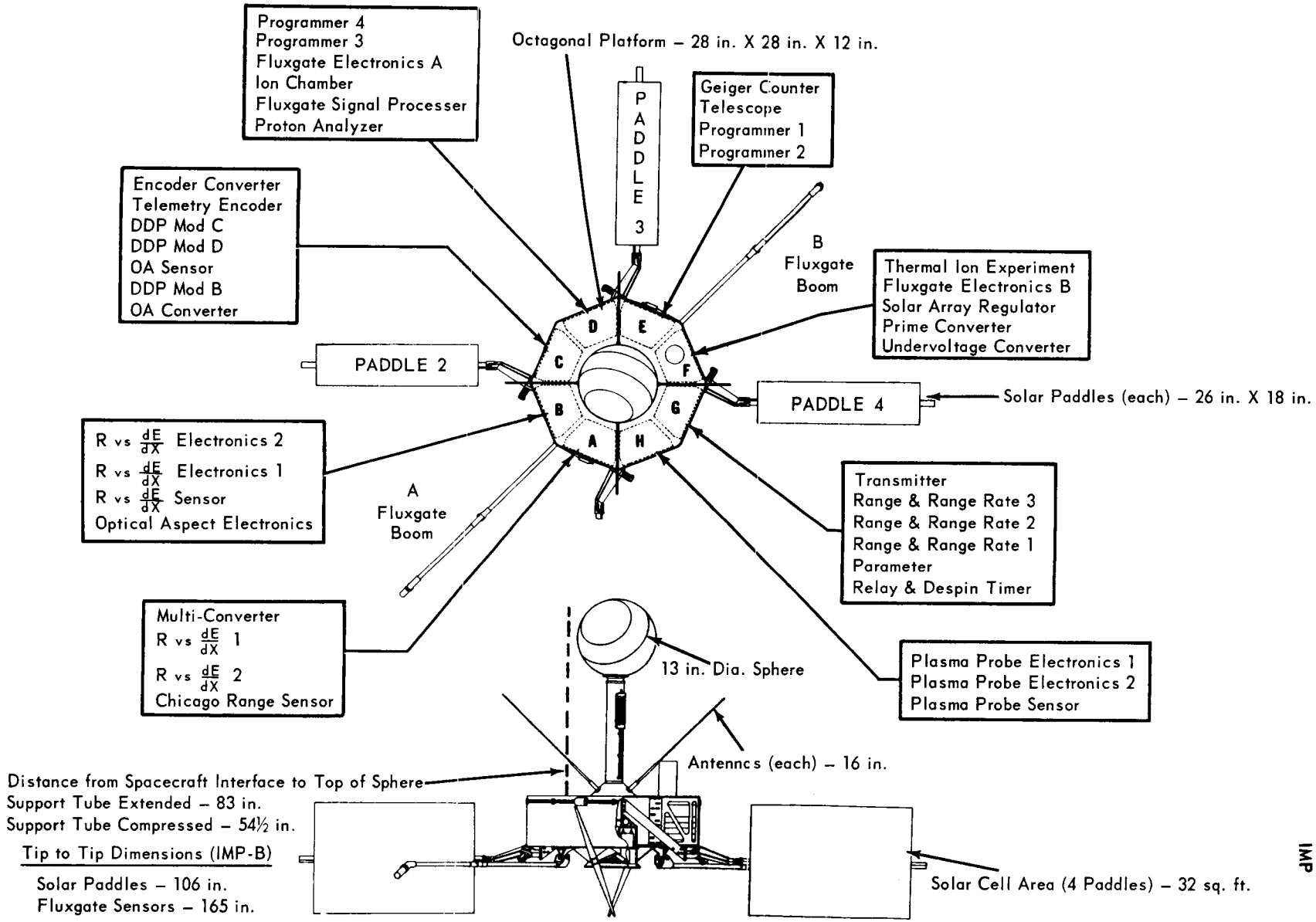
2nd and 3rd Quarter FY 1966

PROJECT SCHEDULE

4th Quarter FY 1966
Launch IMP F

4th Quarter FY 1967
Launch IMP G

4th Quarter FY 1968
Launch IMP I



Interplanetary Monitoring Probe (IMP)

ANCHORED INTERPLANETARY MONITORING PLATFORM (AIMP D, E, H & J)

SPACECRAFT

AIMP D, E, H & J

OBJECTIVES

To place an AIMP-type satellite in orbit about the moon for the purpose of studying space environment in the vicinity of the moon. Interest will be directed toward the measurement of energetic particles, cosmic rays, cosmic dust, and magnetic and gravitational fields.

EXPERIMENTS

ENERGETIC PARTICLE FLUX (University of California)

GM-1 Counter > 50 Kev
Ion Chamber > 17 Mev
GM-2 Counter > 0.5 Mev

ELECTRONS, COSMIC RAYS, SOLAR X-RAYS (University of Iowa)

GM-1 Counter
GM-2 Counter
GM-3 Counter
PNJ Silicon Detector

PLASMA PROBE - PROTON & ELECTRON FLUX (MIT)

Faraday Cup (100 ev to 5 kev)

MAGNETIC FIELDS (Ames Research Center)

Fluxgate Magnetometer (0.2 to 200 gamma)

MAGNETIC FIELDS (Goddard Space Flight Center)

Triaxial Fluxgate Magnetometer (Dynamic range ± 64 gamma)

COSMIC DUST (Temple University & GSFC)

Impact Plate
Acoustical Transducer (312 cm^2)

Main Detector Tube
Thin film condenser
Thin film capacitor
Acoustical transducer

SPACECRAFT DESCRIPTION

WEIGHT

Spacecraft less apogee kick motor - 127.6 lbs
Thiokol retro motor - 84.4 lbs

CONFIGURATION

Octagonal Platform 28 in. X 28 in. X 7¼ in. (similar to IMP satellites without Rb Magnetometer)

APPENDAGES

Solar Paddles

Dimensions of each - 27.60 in. long X 25.25 in. wide

Antennas

Quantity - 4
Length - 16 in.

Retro Motor (Release after lunar orbit is attained)

Thiokol TE 345 retro motor mounted on top of platform

Stabilization

Spin stabilized 150 rpm during launch
Launch configuration - despin 118 rpm
Fully deployed configuration - 25 rpm ± 5 rpm

POWER SYSTEM

Solar cells and one 10 amp hour silver cadmium battery

Voltage

Battery 12 - 19.6 vdc
Converter - 12v, 20v, 28v

COMMUNICATIONS AND DATA HANDLING

Telemetry

Pulse Frequency Modulation (PFM)

Transmitter

6 watts output

Encoder

PFM with Digital Data Processor for accumulation and storage of data.

LAUNCH VEHICLE

DSV-3E, Improved Delta (TAD) with X-258 Third Stage, Fourth Stage - Thiokol Retro Motor

LAUNCH RANGE

Atlantic Missile Range

ORBIT (Desired)

Apo-Cynthion - Less than 30,000 km
Peri-Cynthion - Greater than 300 km
Inclination - 150 - 180°
Lifetime - 6 months minimum

TRACKING STATIONS

Ascension Island (AMR)
Johannesburg, South Africa
Minitrack Stations network (For Range to Range rate)

TELEMETRY RECEIVING STATIONS

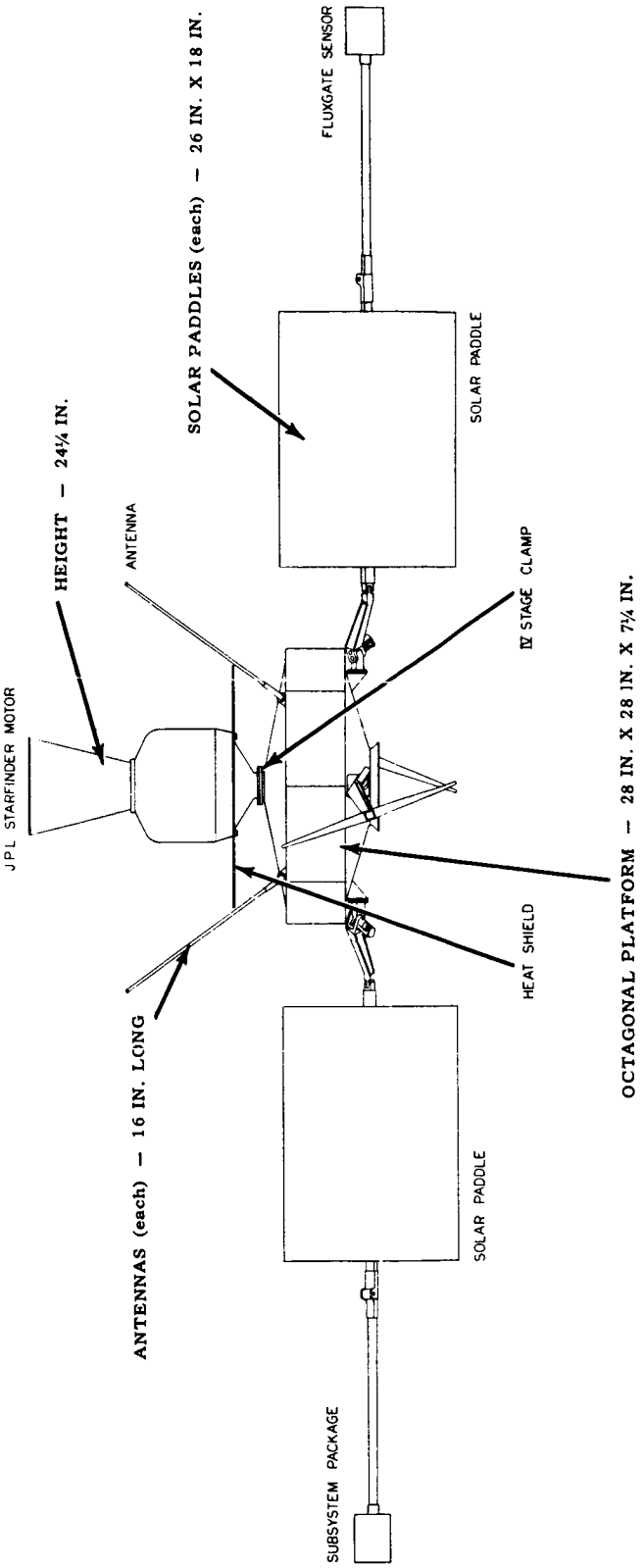
Woomera, Australia
Johannesburg, South Africa
Santiago, Chile

ENVIRONMENTAL TEST PROGRAM (AIMP D and E)

To be performed at Goddard Space Flight Center during second and third quarter of fiscal year, 1966.

PROJECT SCHEDULE (AIMP D and E)

Completion of Spacecraft Design - third quarter, FY 1965
Launch - fourth quarter, FY 1966



Anchored IMP

RADIO ASTRONOMY EXPLORER
(RAE)

SPACECRAFT

RAE-A, B, C, D, E, AND F (A & B funded)

MANAGEMENT

Spacecraft
Goddard Space Flight Center (GSFC)

TECHNICAL ADMINISTRATION

Spacecraft, Experiments, and Environmental Testing
(RAE-A and B)
GSFC

Spacecraft (RAE-C, D, E. AND F)
Out-of-house, not funded, no contractor selected.

SUBCONTRACTORS

Washington Technological Associates (Engr. Model)
Capacitance Probe
Electron Trap

Airborne Instruments Laboratories (Engr. Model)
Burst Receiver

Electronic Research Dorporation (Engr. Model)
Impedance Probe

Adcole (RAE-A)
Solar Aspect

Applied Physics Laboratory (RAE-A)
Magnetic Aspect and Spin Control

Fairchild Hiller (RAE-A)
Structure

OBJECTIVES

Monitor radio signals below 10 Mc. Primary targets are Jupiter, Earth, Saturn, the Sun, Galactic distribution, and Extra Galactic sources.

SPACECRAFT DESCRIPTION (RAE-A AND B)

WEIGHT

577 lbs maximum including Apogee Kick Motor (175 lbs)

MOMENT OF INERTIA

Fully loaded, launch configuration
X-X aixis - 16.98 slug ft^2
Y-Y axis - 18.30 slug ft^2
Z-Z axis - 19.49 slug ft^2

CONFIGURATION

Central body 36 inches across by 31 inches high having four permanently mounted canted solar blades 63 inches by approximately 9½ inches wide attached normally to periphery of the structure. Overall dimensions: 63 inches high by 56½ inches diameter using 18 inch Delta adapter.

TELEMETRY

Two separate PCM systems. The same format and bit rate will be used in each. The prime system will use a tape recorder for data storage. The second system will be on stand by (normally off) for real-time transmission.

SOUNDING

Antennas

Four 750 foot antennas forming a "V" on top and bottom of spacecraft.
One 800 foot (tip to tip) dipole antenna, used as a libration damper boom.

SOLAR CELL BLADES

Number - 4
Dimensions - 63 inches long by 9½ inches wide
Total of 12,096 solar cells with 3024 cells on each paddle
10% efficient gridded n-on-p silicon cells.
The solar cells are covered with 40-mil-fused silica glass for protection against radiation damage.

STABILIZATION

Gravity Gradient Stabilized. Also Nutation Damper, and libration damper boom.

POWER

25 watts at 17 volts

LAUNCH VEHICLE (RAE-A AND B)

DSV-3J-1 (Improved Delta, with Surveyor type 3rd stage) with Apogee Kick Motor (New Motor)

LAUNCH RANGE

Western Test Range

ORBIT

Type	- Circular
Altitude	- 6000 km
Inclination	- 58°
Satellite Lifetime	- 1 year nominal

TRACKING

GSFC

ENVIRONMENTAL TEST PROGRAM

LOCATION

GSFC for RAE-A and B

SCHEDULE

April 1966 - June 1966
Structural Model

May - November 1966
Integration of Proto-Flight Spacecraft (RAE-A)

December 1966 - April 1967
Test RAE-A

1968	1971
RAE-B	RAE-E
1969	1972
RAE-C	RAE-F
1970	
RAE-D	

PROJECT SCHEDULE

April, 1964
Complete Feasibility Study

February, 1965
Project Approved (RAE-A & B)

3rd Quarter, 1967
First Launch

INTERNATIONAL SATELLITES FOR IONOSPHERIC STUDIES (ISIS)

SPACECRAFT

Alouette I (S-27), Alouette II (S-27A), ISIS-A, B, and C
DME-A - Piggyback on Alouette II (See DME-A Project Sheets)
ISIS-X - Combination of Alouette II and DME-A

MANAGEMENT

Spacecraft
Defence Research Telecommunications Establishment (DRTE) Canada
Experiments and Subsystems procured in United States
GSFC
Tracking and Data Acquisition
DRTE, GSFC
Launch Vehicle
Lewis Research Center

CONTRACTORS

RCA, Montreal, Canada

DeHavilland Aircraft, Toronto, Canada

OBJECTIVES

The general objective of the ISIS program is to conduct comprehensive studies of the ionosphere during the interval which includes the minimum and the maximum of the present solar cycle. This involves the making of measurements over a range of heights and latitudes sufficient to determine conditions in the ionosphere and to achieve a full understanding of this region.

EXPERIMENTS (ISIS A)

1. Swept frequency Sounder: Sweep range of 0.1 to 20 Mc/s - DRTE

2. Fixed frequency sounder: 0.25, 0.50, 1.00, 2.00, 4.00, and 8.50 Mc/s - Environmental Science Service Administration and DRTE.

3. VLF receiver - 50 cps to 30 kc/s - DRTE

4. Energetic particle detector:
   Electrons - 3 kev to greater than 200 kev
   Protons - 150 kev to 55 Mev
   National Research Council, Ottawa

5. Soft particle spectrometer:
   Electrons - 10 ev to 10 kev
   Ion flux - 2×10^4 to 5×10^{10}
   Graduate Research Center of the Southwest, Dal

6. Ion mass spectrometer: Ionic composition 1 to 20 a
   Air Force Cambridge Research Laboratories

7. Cylindrical electrostatic probe: Electron temperat
   and density - GSFC

8. Spherical electrostatic analyzer: Ion and electron
   temperature (700 to 4000°K) and density (10 to
   6×10^6 particles/cm^3); flux and energy spectru
   of protons and electrons in 0 to 2 kev range -
   Air Force Cambridge Research Laboratories.

9. 136/137 Mc/s beacon: Total electron content betwee
   satellite and ground station-University of
   Western Ontario

10. Cosmic noise: 1.0 Mc/s to 16.0 Mc/s - DRTE

SPACECRAFT DESCRIPTION

QUANTITY

Alouette I - Two flight spacecraft and one prototype spacecraft
Alouette II - One flight spacecraft and one prototype spacecraft
ISIS-A - Probably one flight spacecraft and one prototype spacecraft
ISIS-B - Probably one flight spacecraft and one prototype spacecraft
ISIS-C - Similar to ISIS-A. Probably one flight spacecraft and ISIS-A prototype, modified.

WEIGHT

Alouette I, II - Approximately 320 lbs.
ISIS A, B, and C - Approximately 470 lbs.

MOMENTS OF INERTIA

Launch Mode

Alouette I - Roll - 8.7 slug-ft^2
Pitch and Yaw - 6.96 slug-ft^2

Alouette II - Roll - 9.18 slug-ft^2 ± 0.9 slug-ft^2
Pitch - 7.24 slug-ft^2 ± 0.7 slug-ft^2
Yaw - 7.42 slug-ft^2 ± 0.7 slug-ft^2

ISIS A, B and C - Roll - 14.99 slug-ft^2
Transverse - 18.01 slug-ft^2 and 18.17 slug-ft^2

CONFIGURATION (Alouette II)

Oblate spheroid 42 in. diameter X 34 in. high

CONFIGURATION (ISIS A)

Truncated orthogonal pyramids, 46 in diam 36 in in height

TRANSMISSION FROM SPACECRAFT (Alouette II)

Sounder - 0.1 Mc to 14.5 Mc
Telemetry - 136.080 Mc
136.590 Mc
136.980 Mc Beacon

TRANSMISSION FROM SPACECRAFT (ISIS A)

Sounder - 0.1 to 20.0 Mc/s
Telemetry - 136.080 Mc/s
136.860 Mc/s
400.750 Mc/s
136.410 Mc/s Beacon

POWER SYSTEM (Alouette II)

Power Source

6480 N-on-P silicon solar cells mounted on outer shell of spacecraft charging five nickel cadmium batteries

Requirement: 50 watts

POWER SYSTEM (ISIS A)

Power Source

11,136 N-on-P silicon solar cells (1 X 2 cm) charging three nickel-cadmium storage batteries connected in active redundancy

Requirements: 100 watts (in major operating modes).

LAUNCH VEHICLE

Alouette I, II - Thor Agena
ISIS A, B. and C - Improved Delta

LAUNCH RANGE

Alouette I, II - WTR
ISIS A, B, and C - WTR

ORIBT

Type

Alouette I - Circular
Alouette II - Elliptical
ISIS A - Elliptical

Altitude

Alouette I - 1000 km
Alouette II - 500 to 3000 km
ISIS A - 500 km to 3500 km

Inclination

Alouette I and II - 80° prograde
ISIS A - 83° retrograde

APPLICATIONS TECHNOLOGY SATELLITE (ATS)

SPACECRAFT

3 Prototypes and 5 Flight Models

MANAGEMENT

Spacecraft
Goddard Space Flight Center

CONTRACTOR

Hughes Aircraft Co., Space Systems Division,
El Segundo, California
Spacecraft

OBJECTIVE

To place several wide-band communication transponders plus a number of scientific and technology experiments into synchronous and non-synchronous, circular orbits.

SPACECRAFT DESCRIPTION

WEIGHT

Prior to apogee motor firing - In excess of 1500 lbs
After apogee firing - In excess of 750 lbs

DIMENSIONS

Spacecraft Minus Booms

Diameter - 58 inch (approximately)
Length - 78 inch (approximately)

Spacecraft Plus Extended Booms

Length - 200 ft
Width - 40 ft

CONTROL

Hydrogen Peroxide and Subliming Solid Reaction Control System

COMMUNICATIONS

Utilizes redundant, frequency translation, active-repeater system in the 4,000 Mc band for spacecraft to ground transmission and the 6,000 Mc band for ground to spacecraft transmissions.

ELECTRICAL POWER

N-P solar array
98 watts for gravity stabilized spacecraft
148 watts for spin stabilized spacecraft

LAUNCH VEHICLE

Atlas-Agena D

LAUNCH RANGE

Atlantic Missile Range

ORBIT

6000 mile circular
24 hour synchronous (spin stabilized)
24 hour synchronous (gravity gradient stabilized)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Hughes Aircraft Co., El Segundo, California
GSFC Magnetic Test

PROJECT SCHEDULE

Development
June 1964 to March 1968

Flights
4th quarter 1966 to October 1968

CURRENT STATUS

During October 1963, the Advanced Syncom project was reprogrammed to the extent that the spacecraft design concept changed from that of a spin stabilized, communications spacecraft to that of a spacecraft family having capabilities for both spin and gravity gradient stabilization, and for housing numerous scientific and technology experiments.

As a result of the above, the mass properties, arrangement of spacecraft subsystems, and many physical characteristics of the original spacecraft are in the process of change.

Formerly Advanced Technological Satellite (ATS). Renamed Applications Technology Satellite (ATS) in September, 1964.

PROJECT SCHEDULE

Development
June 1964 to March 1968

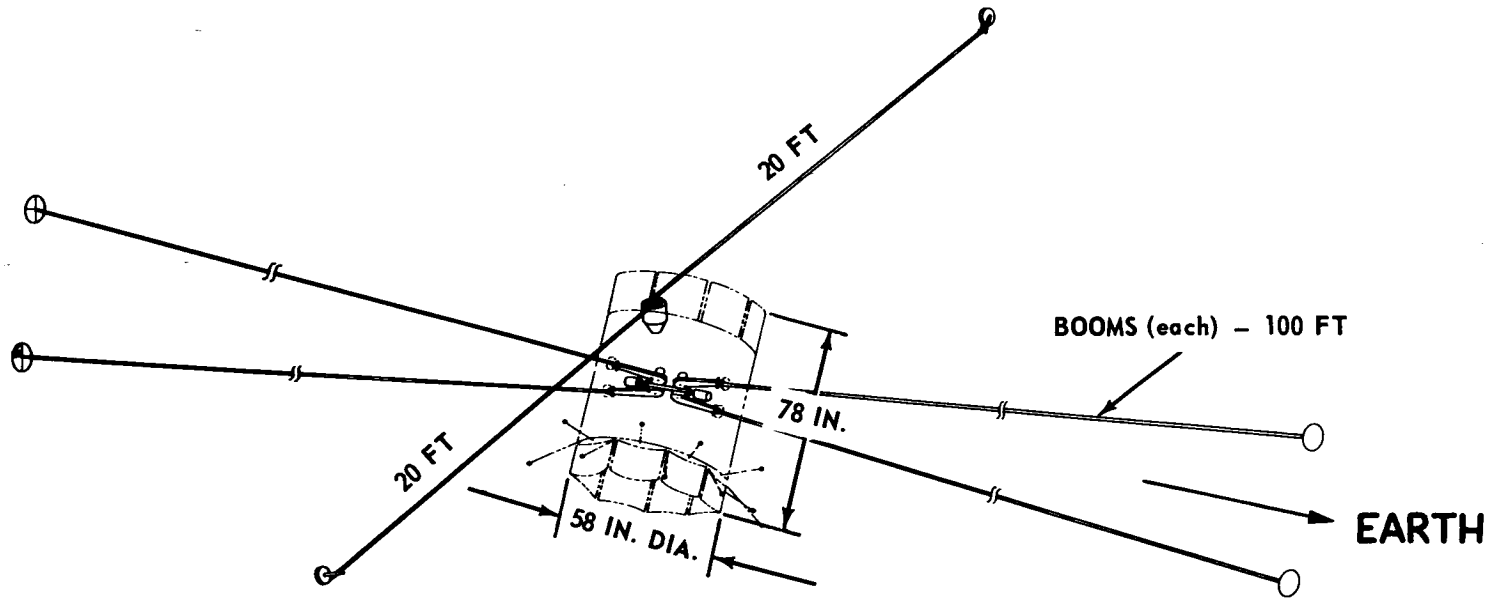
Flights
October 1966 to October 1968

CURRENT STATUS

During October 1963, the Advanced Syncom project was reprogrammed to the extent that the spacecraft design concept changed from that of a spin stabilized, communications spacecraft to that of a spacecraft family having capabilities for both spin and gravity gradient stabilization, and for housing numerous scientific and engineering experiments.

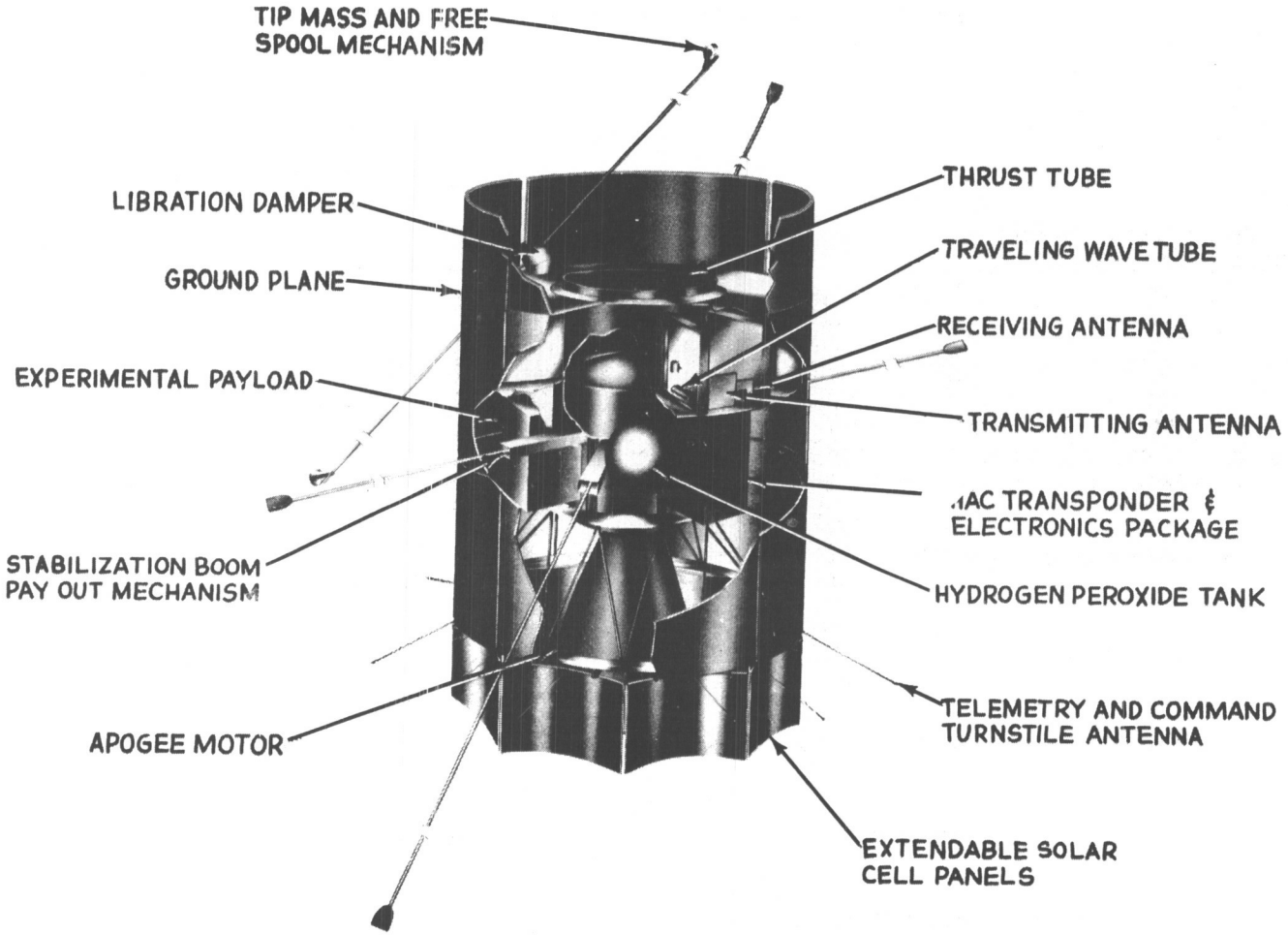
As a result of the above, the mass properties, arrangement of spacecraft subsystems, and many physical characteristics of the original spacecraft are in the process of change.

Formerly Advanced Technological Satellite (ATS). Renamed Applications Technology Satellite (ATS) in September, 1964.

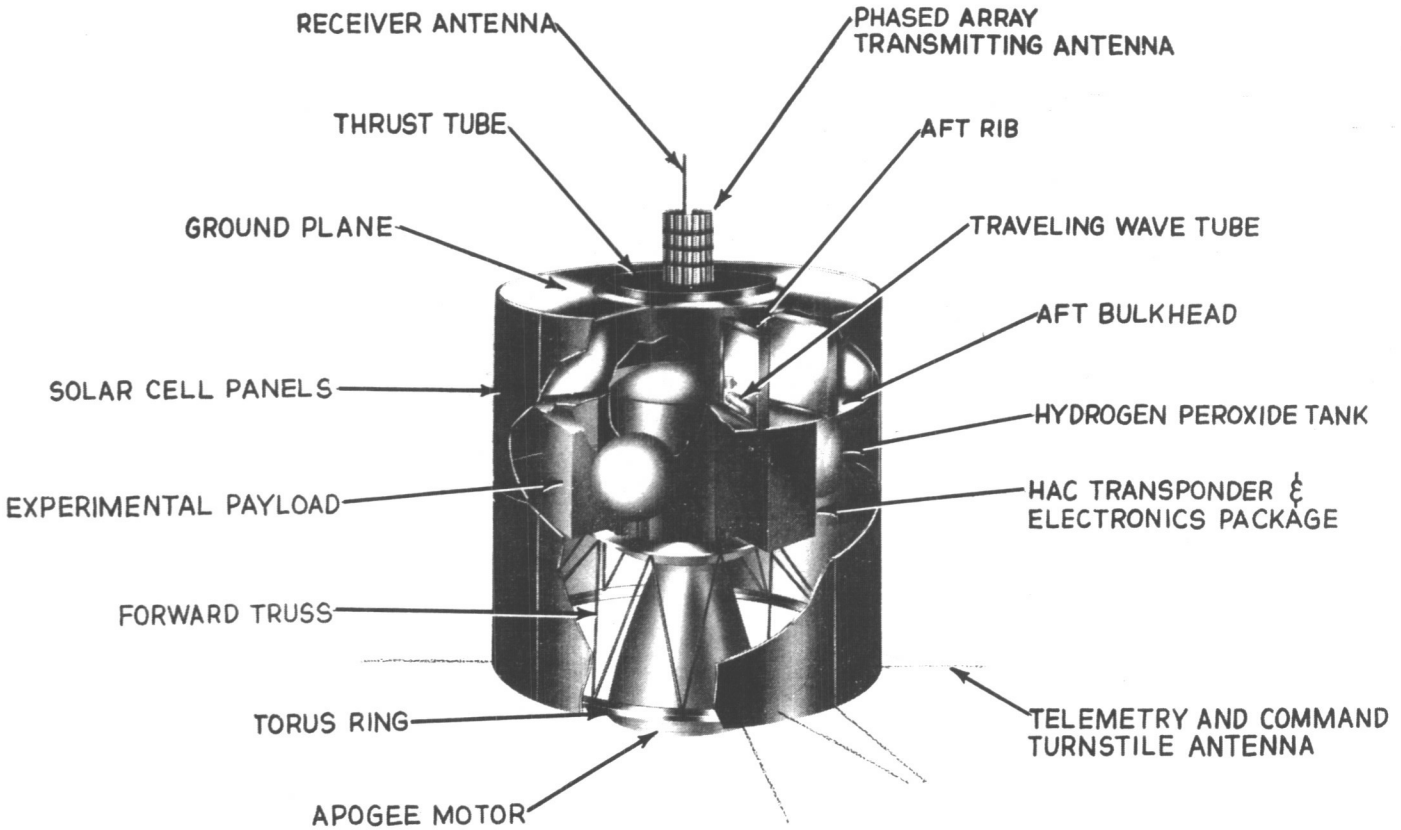


OVERALL DIMENSIONS – 200 FT X 40 FT

Advanced Technological Satellite. – ATS
(Gravity-Gradient Type)



Advanced Technological Satellite – ATS
(Gravity-Gradient Type)



Advanced Technological Satellite – ATS
(Spin-Stabilized Type)

GERMAN RESEARCH SATELLITE
(GRS-A)

SPACECRAFT

GRS-A or 625A-1 (German Designation)

RESPONSIBILITIES

UNITED STATES

Project Management
Goddard Space Flight Center (GSFC)

Tracking and Data Acquisition
Goddard Space Flight Center

Launch Vehicle
Langley Research Center

GERMANY

Spacecraft
Gesellschaft für Weltraumforschung

Experiments
Max Planck Institut fur Stratospharen
Physik und für Extraterrestriche Physik

OBJECTIVES

To study the nature of the inner radiation belt.
To study the aurora zone and polar cap events.
To study the variations of the spectrum of solar particles with time during solar flares.

EXPERIMENTS

1. Measurements of the energy spectrum of protons in the region of about 200 keV to 2 MeV (directional)

2. Measurement of the energy spectrum of protons in the region of about 1 to 100 MeV (directional)

3. Measurement of the omnidirectional fluxes of protons ($6 \geq E \geq 120$ MeV)

4. Measurements of the energy spectrum of protons in the region 75 to 300 MeV (directional and omnidirectional)

5. Measurements of electrons with energies greater than 40 KeV (directional)

6. Measurements of the omnidirectional flux of protons with energies greater than 30 MeV

7. Measurements of the intensity of auroral emissions at 5577A and 3914A

8. Measurement of the earth's magnetic field

SPACECRAFT DESCRIPTION

The spacecraft is in the very early stages of design as of April 1966

LAUNCH VEHICLE

Scout

LAUNCH RANGE

Western Test Range, California

ORBIT

A highly eliptical (> 2500 km apogee), polar orbit

TRACKING

GSFC - STADAN (Space Tracking and Data Acquisition Network).
Germany will build one station for telemetry and telecommand

ENVIRONMENTAL TEST PROGRAM

LOCATION

All environmental tests will be conducted in Germany

SCHEDULE

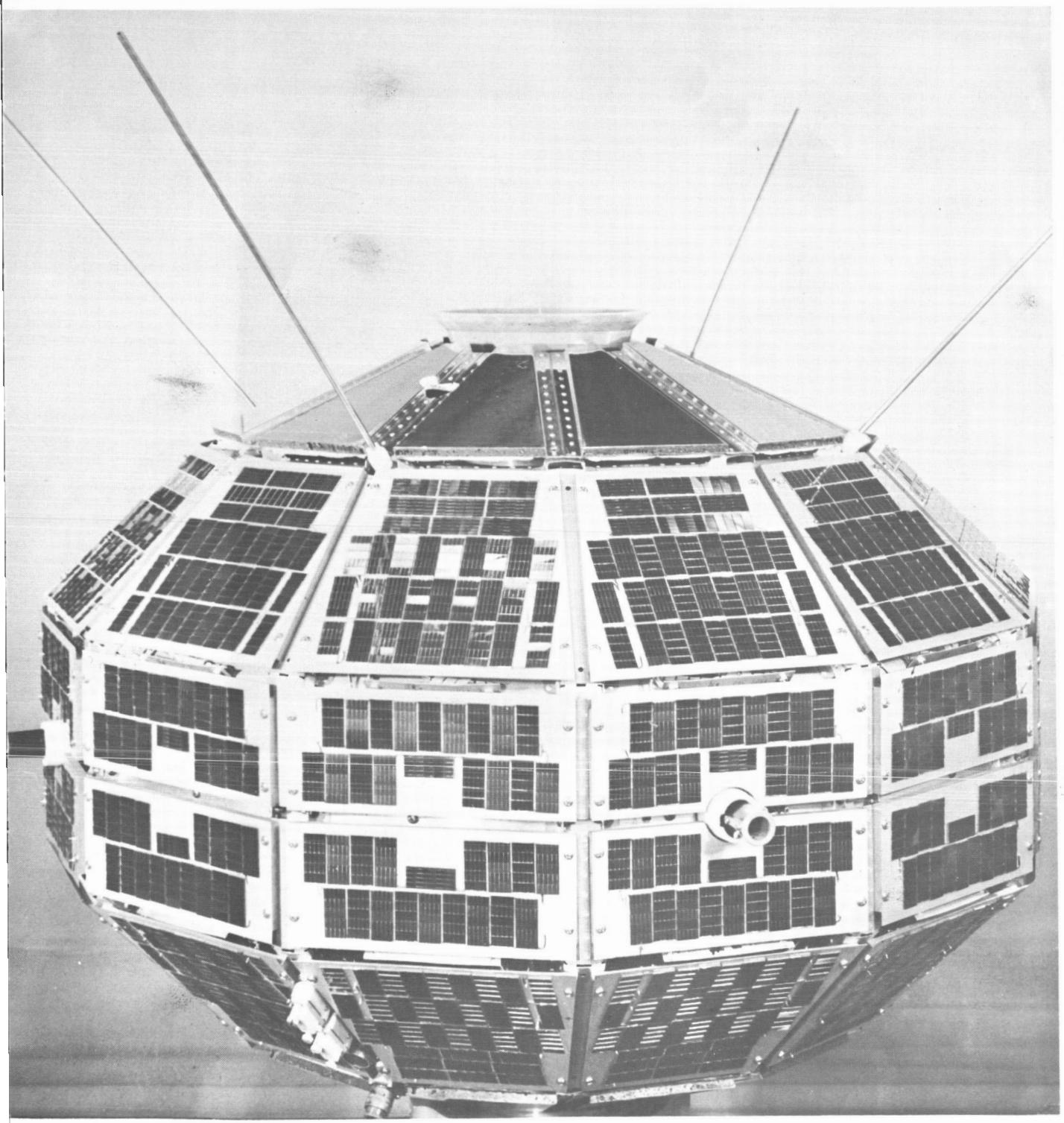
November 1967
Structural Model Tests

May to July 1968
Design Qualification Tests

July to October 1968
Flight Acceptance Tests

PROJECT SCHEDULE

Last Quarter 1968
Launch



42 IN. DIAMETER X 34 IN. HIGH

Alouette I
(S-27)

ESRO I INTERNATIONAL SATELLITE

SPACECRAFT

ESRO I

RESPONSIBILITIES

UNITED STATES

Project Management
Goddard Space Flight Center (GSFC)

Launch Vehicle
Langley Research Center

EUROPEAN SPACE RESEARCH ORGANIZATION (ESRO)

Spacecraft and Experiments

Data Reduction and Analysis

Tracking and Data Acquisition

CONTRACTORS

Laboratoire Central de Telecommunications, Paris
Prime Contract for Spacecraft

Contraves, A. G., Zürich
Spacecraft Structure

Ling-Temco-Vought, Dallas, Texas
Launch Vehicle

EXPERIMENTS

Particle Detectors
Technical University of Denmark and various European institutions.

Auroral Photometer
Professor A. Omholt, University of Oslo and
Professor D. R. Bates, Queens University, Belfast

Langmuir Probes
Dr. A. P. Willmore and Professor R. L. F. Boyd,
University College, London

Beacon Experiment
Professors K. Rawer and E. Vassy, Laboratoire de Physique de L'Atmosphere in Paris

SPACECRAFT DESCRIPTION

WEIGHT

176 pounds, including separation system

STRUCTURE

Cylindrical shape with truncated cones at each end. Central thrust tube with four vertical equipment mounting vanes fixed between the center tube and an equatorial ring (cruciform).

APPENDAGES

Two sensor booms approximately 1 meter long extending normal to longitudinal axis at the base of spacecraft.

One sensor boom approximately 0.5 meter long extending up along the centerline out of the top of the spacecraft.

Four telemetry antennas which snap out to 45° from the top cone when the nose cone is ejected.

POWER SOURCE

Solar cells provide power for the satellite. The cells are divided into two systems, one delivering 12 watts and the other 18.5 watts.

Two Ni-Cad 3AH 14-cell batteries.

TELEMETRY

Real-Time Systems

Low-speed telemetry using 200 mw of power full time. Transmits PCM information at a rate of 320 bits/sec.

High-speed telemetry using 1200 mw for up to 8 minutes per orbit. Transmits PCM information at a rate of 5120 bits/sec.

Tape Recorder

Approximately 2 x 10^6 bit tape recorder with record-to-playback ratio of 1:32. Uses same transmitter as High-speed telemetry, using 1200 mw power for 3 minutes on command.

LAUNCH VEHICLE

Scout

LAUNCH RANGE

Western Test Range, California

ORBIT

Perigee	- 275 Km
Apogee	- 1500 Km
Inclination	- 90° (Polar)
Lifetime	- 6 months minimum

TRACKING

Tracking will be performed by ESRO's own network directed by ESTRAC, Belgium. The network includes tracking and data acquisition stations at Fairbanks, Falkland Islands, Belgium, Spitzbergen, and a station near the auroral zone in Scandinavia.

ENVIRONMENTAL TEST PROGRAM

July, 1966 - Prototype Spacecraft Design Qualification Tests

February, 1967 - Flight Acceptance Tests (Flight #1)

April, 1967 - Flight Acceptance Tests (Flight #2)

PROJECT SCHEDULE

Fall, 1967 - Launch

ESRO II INTERNATIONAL SATELLITE

SPACECRAFT

ESRO II

RESPONSIBILITIES

UNITED STATES

Project Management
Goddard Space Flight Center (GSFC)

Launch Vehicle
Langley Research Center

EUROPEAN SPACE RESEARCH ORGANIZATION (ESRO)

Experiments

Data Reduction and Analysis

Tracking and Data Acquisition

CONTRACTORS

Hawker Siddeley Dynamics Ltd., Stevenage, England
Spacecraft

Ling-Temco-Vought (Chance-Vought Division,
Dallas, Texas)
Launch Vechicle

EXPERIMENTS

Routine monitoring of energetic particle flux
Imperial College, London

Measurement of solar protons and inner
Van Allen belt protons
Imperial College, London

Measurement of the relative intensity variations of cosmic ray protons and Alpha particles having the same magnetic rigidity - Imperial College, London

Measurement of primay cosmic ray flux of high energy B-particles - Physics Department, University of Leeds

Solar Xray counter spectrometer (1-20 Å) - University of Leicester, University College, London

Soft solar X-rays measurement (44-70 Å) - Sterrewacht, Utrecht

Measurement of flux and energy spectrum of solar protons between 35 and 1000 Mev - Centre d' Etudes Nucleaires de Saclay

SPACECRAFT DESCRIPTION

WEIGHT

185 pounds, including separation mechanism

STRUCTURE

The structure is a right, twelve sided prism, 30 inches across the points of the polygon and 29.2 inches high. 48 solar panels make up the outer surface, except for a belt around the center. Experiment sensors are positioned around this center belt as is the despin yo-yo. The 4 telemetry antennas extend down past the Scout "E" Section and are fixed parallel to the longitudinal axis.

POWER SYSTEMS

Solar cells provide power to operate and to charge batteries. A minimum of 15 watts is required to operate and 15 watts to charge the batteries.

TELEMETRY TRANSMITTERS

A low power (200 milliwatts) for real time

A high power (2 watts) for the transmission of the tape recorder playback.

Frequency - 136 to 137 Mc band

Type transmission - PCM/PM

LAUNCH VEHICLE

Scout

LAUNCH RANGE

Western Test Range, California

ORBIT

Perigee	- 350 Km
Apogee	- 1100 Km
Inclination	- 98.22°
Lifetime	- 1 year

TRACKING

The telemetry transmitter carrier signal is used for tracking by ESRO's own network, (SATAN) Satellite Telemetry Acquisition Network. ESRO will also use the facilities of the French CNES Network.

Goddard's STADAN has been asked to track and make orbital computation during the 4 to 14 day period shortly after launch.

ENVIRONMENTAL TEST PROGRAM

RESPONSIBILITY

ESRO installation at Noordwijk, Netherlands

SCHEDULE

July, 1966
Prototype Spacecraft Design
Qualification Tests

October, 1966
Flight Acceptance Tests (Flight #1)

November, 1966
Flight Acceptance Tests (Flight #2)

PROJECT SCHEDULE

March, 1967 - Launch

LAUNCH VEHICLE

Scout

LAUNCH RANGE

Western Test Range, California

ORBIT

Quasi-polar at an altitude of 432 nautical miles

TRACKING

GSFC-STADAN (Space Tracking and Data Acquisition Network), cooperating with the French CNES Network

ENVIRONMENTAL TEST PROGRAM

All environmental tests will be conducted by Societe pour le Perfectionnement des Materiels d' Equipement Aeronautiques (SOPEMEA) a contractor of CNES in France.

SCHEDULE

November 1964
Structural Model Tests

June to September, 1965
Design Qualification Tests

July to October, 1965
Flight Acceptance Tests (Flight #1)

August to November, 1965
Flight Acceptance Tests (Flight #2)

PROJECT SCHEDULE

December 6, 1965
Launched
March 1, 1966
Still operating satisfactorily in orbit

FRENCH VLF SATELLITE
(FR-1)

SPACECRAFT

FR-1

RESPONSIBILITIES

UNITED STATES

Project Management
Goddard Space Flight Center (GSFC)

Tracking and Data Acquisition
Goddard Space Flight Center

Launch Vehicle
Langley Research Center

FRANCE

Spacecraft
Centre National d'Etudes Spatiales (CNES)

Experiments
Centre National d'Etudes de Telecommunication (CNET)

OBJECTIVES

To study the properties of the VLF wavefield in the magnetosphere.

To study the irregularities in the distribution of ionization in the magnetosphere.

EXPERIMENTS

Measurement of the three orthogonal components of the earth's magnetic field.

Measurement of the two orthogonal components of the electric field.

Measurement of noise levels and signal strength at several VLF frequencies.

SPACECRAFT DESCRIPTION

WEIGHT

135 lbs, exclusive of the separation mechanism

STRUCTURE

The main body is made up of three sections; the top and bottom sections are frustums of an octagonal pyramid and the center section an octagonal prism. The distance across the points of the octagon is 28 inches and the height of the main structure is 24 inches. A 30 inch antenna boom extends vertically upward on the spacecraft axis. Four Electric Field Measurement Antennas extend to a 173.3 inch diameter.

POWER SYSTEMS

REQUIREMENT

2.3 watts constant, plus 6.4 watts for 8 minute periods on command

SUPPLY

Batteries
Silver Cadmium

Solar Cells
24 panels (160 cells each), furnishing approximately 19 watts

TELEMETRY

FM/FM system

LAUNCH VEHICLE

Scout

LAUNCH RANGE

Western Test Range, California

ORBIT

Quasi-polar at an altitude of 432 nautical miles

TRACKING

GSFC-STADAN (Space Tracking and Data Acquisition Network), cooperating with the French CNES Network

ENVIRONMENTAL TEST PROGRAM

All environmental tests will be conducted by Societe pour le Perfectionnement des Materiels d' Equipement Aeronautiques (SOPEMEA) a contractor of CNES in France.

SCHEDULE

November 1964
Structural Model Tests

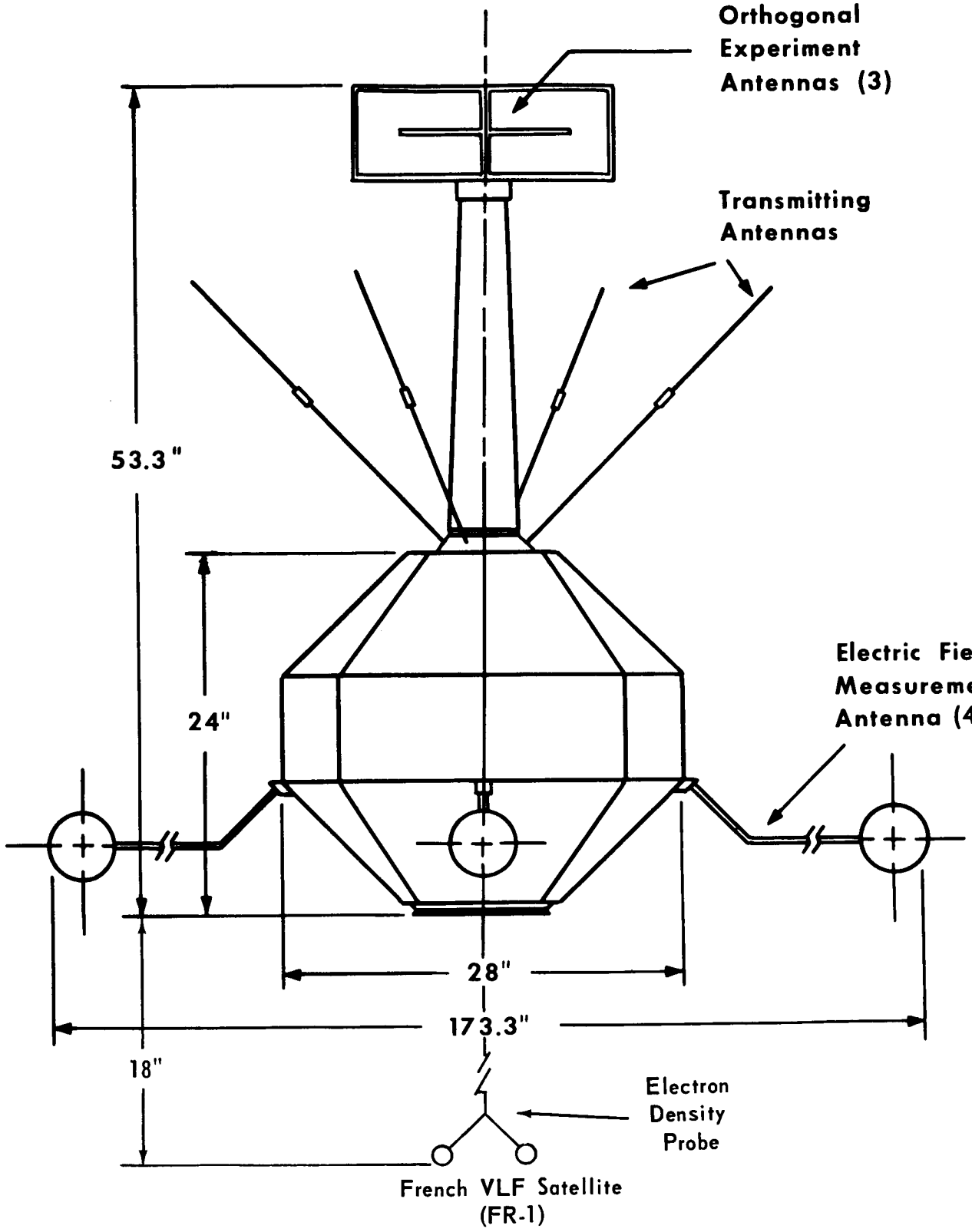
June to September, 1965
Design Qualification Tests

July to October, 1965
Flight Acceptance Tests (Flight #1)

August to November, 1965
Flight Acceptance Tests (Flight #2)

PROJECT SCHEDULE

December 1965
Launch


Orthogonal
Experiment
Antennas (3)
Transmitting
Antennas
53.3"
24"
Electric Field
Measuremen
Antenna (4)
28"
173.3"
18"
Electron
Density
Probe
French VLF Satellite
(FR-1)

ATMOSPHERE EXPLORER-B

(AE-B)

SPACECRAFT

AE-B Flight Spacecraft

MANAGEMENT

Spacecraft and Experiments
Goddard Space Flight Center (GSFC)

BACKGROUND

The AE-B design is based on Explorer XVII (S-6)* design and findings. It resembles S-6 in concept and operations but has additional capabilities:

(1) Limited solar-cell capacity for recharge.
(2) A tape recorder for greater geographical coverage.
(3) Spin-axis orientation system to improve measurement capability.

OBJECTIVES

To provide atmospheric direct-measurement data to aid in the study of the physics of the upper atmosphere.

To provide atmospheric data to help define the structure of the atmosphere on a global basis.

To extend knowledge of solar-terrestrial relationships.

To advance the technology of direct-sampling techniques and instruments for the free-molecue flow atmosphere.

EXPERIMENTS (GSFC)

PARAMETERS

Total neutral particle density and scale height.

*Launched April 2, 1963

Concentration and temperature of atmospheric neutral constituents.

Concentration and temperature of thermal electrons.

Concentration and scale height of ionic constituents.

ARRANGEMENT

Equator of Spacecraft (Nearly equally spaced)

Neutral-particle mass spectrometer

Ion-mass spectrometer

Two magnetron density gages

Two electrostatic probes

One optical aspect system

Spin-axis "top"

Neutral particle mass spectrometer

55-degree off equator, toward "top"

One magnetron density gage

SPACECRAFT

DIMENSIONS

Weight - 465 lbs

Main structure - 35 inches stainless steel spherical shell with internal structure.

Appendages - Canted turnstile antenna, 4-3/8 in. X 30-1/8 in. rods; electron temperature and density probes, 13 in. "wires"

POWER SYSTEM

Supply - Multiple silver - zinc battery pack (10,500 W. H. total)

Voltage - Varies from 3.1 to 21 V

Power - 5 watt (average) solar cell recharge capability on command

COMMUNICATIONS AND DATA HANDLING

Telemetry - Two identical, redundant systems. Pulse code Modulation 8640 bits/sec.

Transmitter - 1/2 watt output approximately 136 Mc.

Encoder - 45 channels at 20 9-bit samples/sec.
64 channels at 0.625 9 bit samples/sec.

Tape Recorder - 2.1×10^6 bit capacity per readout (endless loop)

LAUNCH VEHICLE

Delta DSV-3C

LAUNCH RANGE

Atlantic Missile Range

ORBIT

Apogee - 1200 km (646 nm)

Perigee - 250 km (135 nm)

Period - 100 minutes

Inclination - Approximate polar

Lifetime - 6 months without recharge. 9-12 months with charge at 5 command/day.

GROUND STATIONS

Tracking - Space tracking and Data Acquisition (STADAN) Syste

Data Aquisition - STADAN

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center

SCHEDULE

Flight Acceptance

December 6, 1965 to April 9, 1966

PROJECT SCHEDULE

2nd quarter 1966

Launch AE-B spacecraft

UNIT 1

CURRENT ENVIRONMENTAL TEST LEVELS

(Status as of May 1, 1966)

A. SPACECRAFT

SCOUT - Launched (based on General Environmental Specification for Scout Spacecraft: S-320-S-1, May 20, 1966)

DELTA - Launched (based on General Environmental Specification for Delta Spacecraft: S-320-D-2, June 1, 1965)

AGENA - Launched (based on General Environmental Specification for Agena Spacecraft: S-320-A-1, October 1, 1965)

B. SOUNDING ROCKETS

(Derived from General Environmental Specification for Sounding Rocket Payloads: S-320-SR-1, October 30, 1964)

DESIGN QUALIFICATION
ENVIRONMENTAL TEST PARAMETERS FOR SPACECRAFT LAUNCHED BY SCOUT, DELTA, AND AGENA LAUNCH VEHICLES

TEST/PROCEDURE	SCOUT	DELTA	AGENA
ALANCE*			
1. Static Unbalance	Launch Configuration - Not more than 24 oz. in. Orbital Configuration - Per Detailed Test Spec.	Launch Configuration - Not more than 0.03 in. cg offset from thrust axis Orbital Configuration - Per Detailed Test Spec.	Launch Configuration - Spin-stabilized S/C: .03 in. cg offset from thrust axis Non spin-stabilized S/C: 0.125 in. cg offset from thrust axis Orbital Configuration - Per Detailed Test Spec.
2. Dynamic Unbalance	Launch Configuration - Not more than 400 oz. in.^{2} Orbital Configuration - Varies with S/C	Launch Configuration - Not more than 0.004 radians (Tilt of prin. axis from spin axis) Orbital Configuration - Varies with S/C	Launch Configuration - Not required Orbital Configuration - Spin-stabilized S/C: Not required. Non spin-stabilized S/C: Varies
PIN TEST (Rate)**	1.22 times expected flight values.	1.22 times expected flight values	1.22 times flight values.**
EMPERATURE (Chamber Conditions)			
1. Cold Storage*	-30°C for 6 hours.	-30°C for 6 hours.	-30°C for 6 hours.
2. Hot Storage*	60°C for 6 hours.	60°C for 6 hours.	60°C for 6 hours.
3. Cold Operation (Until S/C Operational Temperature Steady)	10°C below minimum predicted orbital temperature.	10°C below minimum predicted orbital temperature.	10°C below minimum predicted orbital temperature.
4. Hot Operation (Until S/C Operational Temperature Steady)	10°C above maximum predicted orbital temperature.	10°C above maximum predicted orbital temperature.	10°C above maximum predicted orbital temperature.
HUMIDITY (Chamber Conditions)*	30°C at 95% RH for 24 hours.	30°C at 95% RH for 24 hours.	30°C at 95% RH for 24 hours.
SHOCK	Not required unless handling/ transportation to be abnormal.	Not required unless handling/ transportation to be abnormal.	Without Apogee Motor - Not required unless handling/ transportation to be abnormal With Apogee Motor - Varies with S/C

*Spacecraft in non-operational status throughout test/procedure.
**Scout and Delta-launched spacecraft are spin-stabilized and require spin test.
Agena spacecraft may or may not be spin-stabilized and require spin test only when spin-stabilized.

DESIGN QUALIFICATION
ENVIRONMENTAL TEST PARAMETERS FOR SPACECRAFT LAUNCHED BY SCOUT, DELTA, AND AGENA LAUNCH VEHICLES
(Continued)

TEST/PROCEDURE	SCOUT	DELTA	AGENA
VIBRATION			
Sinusoidal - Thrust Axis (2 octaves/minute)	10-53 cps, ±12 in./sec constant velocity 53-100 cps, ±10.5 g 100-2000 cps, ±7.5 g	X-258 3rd Stage & TAD (DSV-3C and 3D) 10-50 cps, ± 3.8 g 10-500 cps, ± 7.5 g 500-2000 cps, ± 21.0 g 3 Stage Improved Delta (DSV-3E and 3F) 10-19 cps, ± 3.0 g 19-25 cps, ± 4.5 g 25-250 cps, ± 3.0 g 250-400 cps, ± 4.5 g 400-2000 cps, ± 7.5 g 2 Stage Improved Delta (DSV-3G and 3H) 10-19 cps, ± 2.3 g 19-25 cps, ± 3.8 g 25-150 cps, ± 2.3 g 150-500 cps, 0.923 in./sec constant velocity 500-2000 cps, ± 7.5 g	Atlas Agena 5-250 cps, ± 2.3 g 250-400 cps, ± 3.7 g 400-2000 cps, ± 7.5 g Thor Agena 10-250 cps, ± 2.3 g 250-400 cps, ± 3.7 g 400-2000 cps, ± 7.5 g 16-22 cps, ± 4.6 g Thrust-Augmented Thor (TAT) Agena 10-150 cps, 2.3 g 150-500 cps, 0.923 inch/sec constant velocity 500-2000 cps, ± 7.5 g 16-22 cps, ± 4.6 g
Sinusoidal - Two Lateral Axes Mutually Perpendicular (2 octaves/minute)	5-150 cps, ± 1.5 g 150-400 cps, ± 3.0 g 400-2000 cps, ± 7.5 g	X-258 3rd Stage & TAD (DSV-3C and 3D) 10-18 cps, ± 3.0 g 18-500 cps, ± 2.3 g 500-2000 cps, ± 4.0 g 3 Stage Improved Delta (DSV-3E and 3F) 5-250 cps, ± 2.3 g 250-400 cps, ± 3.0 g 400-2000 cps, ± 7.5 g 2 Stage Improved Delta (DSV-3G and 3H) 5-250 cps, ± 1.5 g 250-400 cps, ± 3.0 g 400-2000 cps, ± 7.5 g	Atlas, Thor, and TAT Agenas 5-250 cps, ± 1.5 g 250-400 cps, ± 3.0 g 400-2000 cps, ± 7.5 g
Random - Thrust and Lateral Axes (4 minutes, each axis)	20-20,000 cps 0.07 g^2/cps 11.8 g-rms	X-258 3rd Stage & TAD (DSV-3C and 3 D) 20-2000 cps 0.07 g^2/cps 11.8 g-rms 3 Stage Improved Delta (DSV-3E and 3F) 20-150 cps, 0.023 g^2/cps 150-300 cps, increasing by ± 3 db/octave 300-2000 cps, 0.045 g^2/cps 9.23 g-rms 2 Stage Improved Delta (DSV-3G and 3H) 20-150 cps, 0.023 g^2/cps 150-425 cps, increasing by ± 4 db/octave 425-1200 cps, 0.09 g^2/cps 1200-2000, decreasing by - 2 db/octave	Atlas and Thor Agena (9.2 g-rms) 20-150 cps, 0.023 g^2/cps 150-300 cps, increasing by +3 db/octave 300-2000 cps, 0.045 g^2/cps TAT Agena (12.6 g-rms) 20-150 cps, 0.023 g^2/cps 150-425 cps, increasing by +4 db/octave 425-2000 cps, 0.09 g^2/cps

SPACECRAFT SUBSYSTEMS

TELEMETRY

Frequency - 136.275 Mc
Type Transmission - PFM/PM
RF Power Output - 2.0 watts

POWER SUPPLY

Requirements - 16 watts continuous operation
Supply - 13 cell silver cadmium battery, 5 A. H. capacity
Solar Paddles - to supply initially 35 watts of power at 19.5 volts
Prime Converter - 12 to 20 VDC input, regulated outputs ±6.5 VDC, +12 VDC, -17.8 VDC, and +26.2 VAC

LAUNCH VEHICLE

Delta (X-258 third stage)

LAUNCH RANGE

Atlantic Missile Range

ORBIT

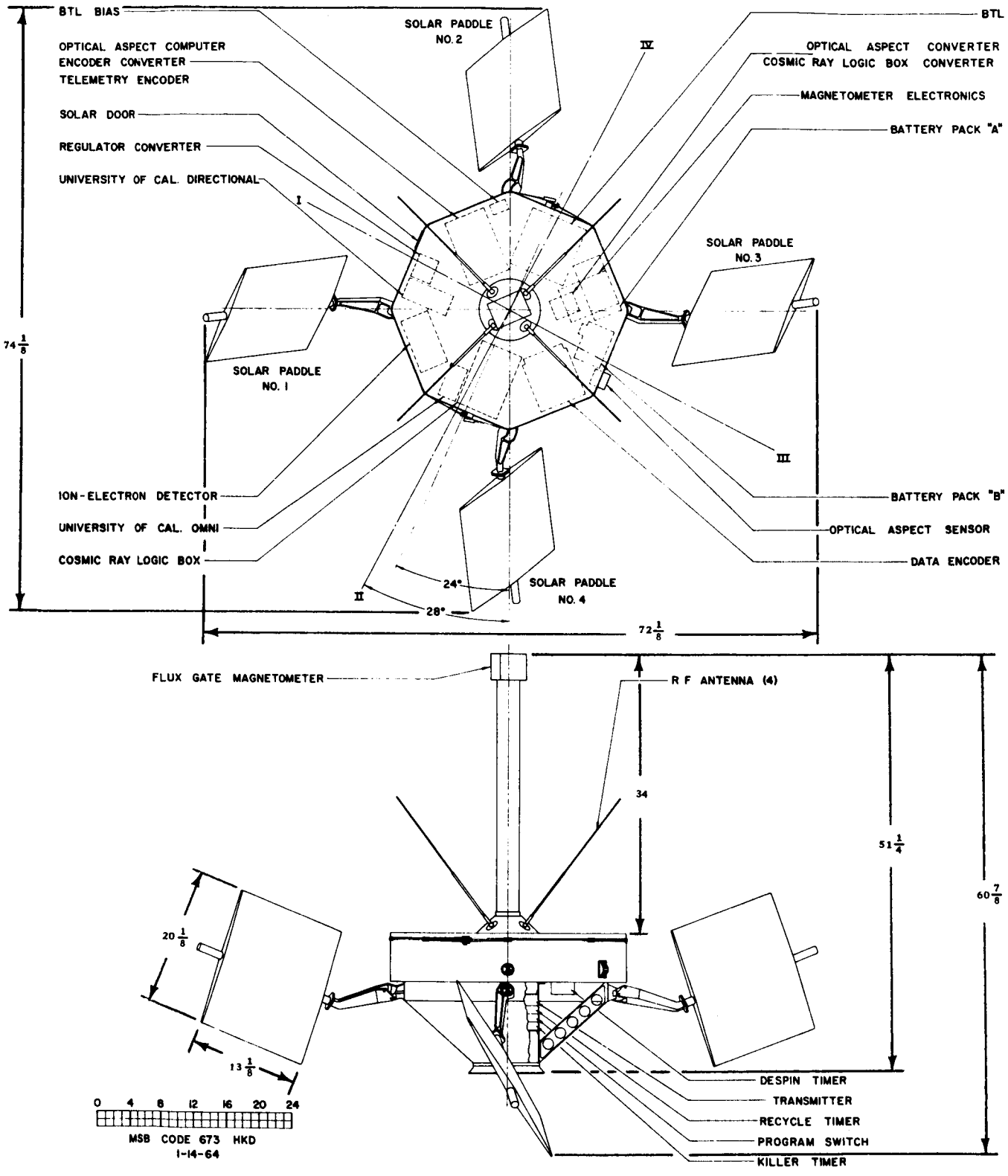
Perigee - 310 km
Apogee - 26,200 km
Inclination - 20°
Solar Aspect Angle - 25° to 155°
Period - 456 minutes
Spin Rate (final) - 25 RPM
Shadow Time Per Orbit - 30 minutes
Planned Lifetime - 1 year

TRACKING

Minitrack Network

PROJECT SCHEDULE

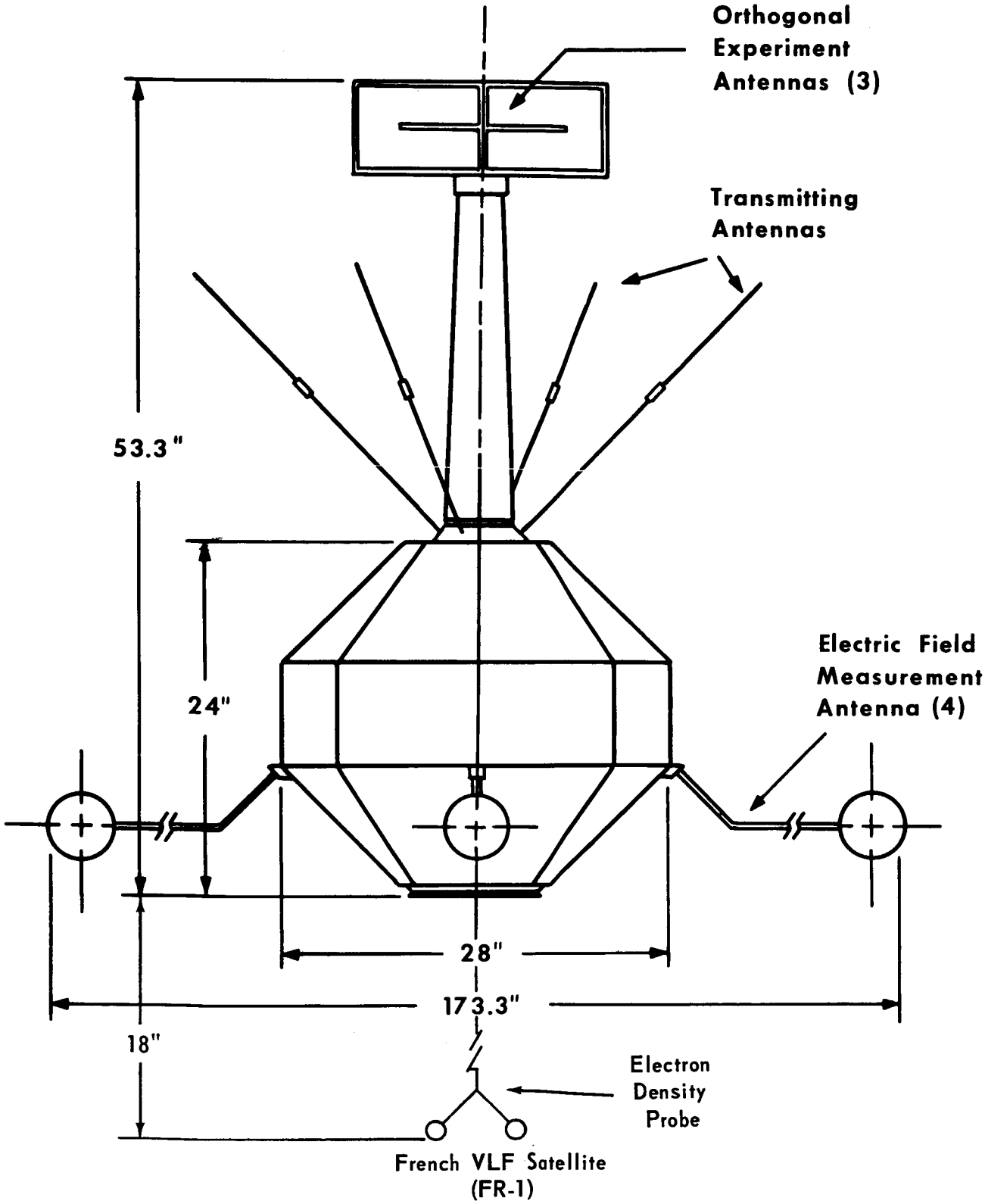
July 9, 1963 - Project Initiation
December 21, 1964 - Launch Date



Energetic Particles Explorer-D
(EPE-D)

DESIGN QUALIFICATION
ENVIRONMENTAL TEST PARAMETERS FOR SPACECRAFT LAUNCHED BY SCOUT, DELTA, AND AGENA LAUNCH VEHICLES
(Continued)

TEST/PROCEDURE	SCOUT	DELTA	AGENA
VIBRATION (Continued) Torsional - Thrust	Not required.	Not required.	Atlas Thor, and TAT (2 octaves/minute) 20-60 cps, 12.9 rod/sec^2 60-150 cps, 25.8 rod/sec^2 Atlas Agena (2 pulses) Resonance point between 60 and 75 cps, or 68 cps if no major torsional resonance, 96.6 rad/sec^2
ACCELERATION (g's vary with S/C weight)	1.5 times max. 4th stage thrust.	1.5 times max. 3rd stage thrust.	1.5 times max. combined thrust and lateral acceleration (2 tests, with lateral acceleration in each test perpendicular to lateral acceleration in other).
THERMAL VACUUM (Chamber Conditions)			
Corona	Pressure: Ambient to $1X10^{-4}$ mm Hg Temperature: Ambient Duration: Launch pressure-time profile desirable.	Same as Scout.	Same as Scout.
Cold Exposure	Pressure: $1X10^{-5}$ mm Hg Temperature: 10°C below predicted cold extreme Duration: 12 hours (longer if needed to complete orbital cycle).	Same as Scout.	Same as Scout.
Hot Exposure	Pressure: $1X10^{-5}$ mm Hg Temperature: 10°C above predicted hot extreme Duration: 12 hours (longer if needed to complete orbital cycle).	Same as Scout.	Same as Scout.
Cold Soak	Same as Cold Exposure except that— Duration: 72 hours	Same as Scout.	Same as Scout.
Hot Soak	Same as Hot Exposure except that— Duration: 120 hours	Same as Scout.	Same as Scout.
THERMAL BALANCE (Chamber Condition)	Pressure: $1X10^{-5}$ mm Hg Energy: Radiation and/or heaters equivalent to energy from 100% sunlight. Duration: Stabilization under 100% sunlight when appropriate for orbit and enough cycles to show repeatable thermal response for sun and shade of orbit.	Same as Scout.	Same as Scout.


Orthogonal
Experiment
Antennas (3)
Transmitting
Antennas
53.3"
24"
Electric Field
Measurement
Antenna (4)
28"
173.3"
18"
Electron
Density
Probe
French VLF Satellite
(FR-1)

SECTION III

SPACECRAFT TEST DATA

UNIT

1 CURRENT ENVIRONMENTAL TEST LEVELS

2 BIBLIOGRAPHY OF TEST AND RELATED REPORTS
(Pertaining to Test and Evaluation Division Flight Programs)

UNIT 1

CURRENT ENVIRONMENTAL TEST LEVELS

(Status as of May 1, 1966)

A. SPACECRAFT

SCOUT - Launched (based on General Environmental Specification for Scout Spacecraft: S-320-S-1, May 20, 1966)

DELTA - Launched (based on General Environmental Specification for Delta Spacecraft: S-320-D-2, June 1, 1965)

AGENA - Launched (based on General Environmental Specification for Agena Spacecraft: S-320-A-1, October 1, 1965)

B. SOUNDING ROCKETS

(Derived from General Environmental Specification for Sounding Rocket Payloads: S-320-SR-1, October 30, 1964)

DESIGN QUALIFICATION
ENVIRONMENTAL TEST PARAMETERS FOR SPACECRAFT LAUNCHED BY SCOUT, DELTA, AND AGENA LAUNCH VEHICLES

TEST/PROCEDURE	SCOUT	DELTA	AGENA
BALANCE*			
1. Static Unbalance	Launch Configuration - Not more than 24 oz. in. Orbital Configuration - Per Detailed Test Spec.	Launch Configuration - Not more than 0.03 in. cg offset from thrust axis Orbital Configuration - Per Detailed Test Spec.	Launch Configuration - Spin-stabilized S/C: .03 in. cg offset from thrust axis Non spin-stabilized S/C: 0.125 in. cg offset from thrust axis Orbital Configuration - Per Detailed Test Spec.
2. Dynamic Unbalance	Launch Configuration - Not more than 400 oz. $in.^2$ Orbital Configuration - Varies with S/C	Launch Configuration - Not more than 0.004 radians (Tilt of prin. axis from spin axis) Orbital Configuration - Varies with S/C	Launch Configuration - Not required Orbital Configuration - Spin-stabilized S/C: Not required. Non spin-stabilized S/C: Varies
SPIN TEST (Rate)**	1.22 times expected flight values.	1.22 times expected flight values	1.22 times flight values.**
TEMPERATURE (Chamber Conditions)			
1. Cold Storage*	-30°C for 6 hours.	-30°C for 6 hours.	-30°C for 6 hours.
2. Hot Storage*	60°C for 6 hours.	60°C for 6 hours.	60°C for 6 hours.
3. Cold Operation (Until S/C Operational Temperature Steady)	10°C below minimum predicted orbital temperature.	10°C below minimum predicted orbital temperature.	10°C below minimum predicted orbital temperature.
4. Hot Operation (Until S/C Operational Temperature Steady)	10°C above maximum predicted orbital temperature.	10°C above maximum predicted orbital temperature.	10°C above maximum predicted orbital temperature.
HUMIDITY (Chamber Conditions)*	30°C at 95% RH for 24 hours.	30°C at 95% RH for 24 hours.	30°C at 95% RH for 24 hours.
SHOCK	Not required unless handling/ transportation to be abnormal.	Not required unless handling/ transportation to be abnormal.	Without Apogee Motor - Not required unless handling/ transportation to be abnormal With Apogee Motor - Varies with S/C

*Spacecraft in non-operational status throughout test/procedure.
**Scout and Delta-launched spacecraft are spin-stabilized and require spin test.
Agena spacecraft may or may not be spin-stabilized and require spin test only when spin-stabilized.

DESIGN QUALIFICATION
ENVIRONMENTAL TEST PARAMETERS FOR SPACECRAFT LAUNCHED BY SCOUT, DELTA, AND AGENA LAUNCH VEHICLES
(Continued)

TEST/PROCEDURE	SCOUT	DELTA	AGENA
VIBRATION			
Sinusoidal - Thrust Axis (2 octaves/minute)	10-53 cps, ±12 in./sec constant velocity 53-100 cps, ±10.5 g 100-2000 cps, ±7.5 g	X-258 3rd Stage & TAD (DSV-3C and 3D) 10-50 cps, ± 3.8 g 10-500 cps, ± 7.5 g 500-2000 cps, ± 21.0 g 3 Stage Improved Delta (DSV-3E and 3F) 10-19 cps, ± 3.0 g 19-25 cps, ± 4.5 g 25-250 cps, ± 3.0 g 250-400 cps, ± 4.5 g 400-2000 cps, ± 7.5 g 2 Stage Improved Delta (DSV-3G and 3H) 10-19 cps, ± 2.3 g 19-25 cps, ± 3.8 g 25-150 cps, ± 2.3 g 150-500 cps, 0.923 in./sec constant velocity 500-2000 cps, ± 7.5 g	Atlas Agena 5-250 cps, ± 2.3 g 250-400 cps, ± 3.7 g 400-2000 cps, ± 7.5 g Thor Agena 10-250 cps, ± 2.3 g 250-400 cps, ± 3.7 g 400-2000 cps, ± 7.5 g 16-22 cps, ± 4.6 g Thrust-Augmented Thor (TAT) Agena 10-150 cps, 2.3 g 150-500 cps, 0.923 inch/sec constant velocity 500-2000 cps, ± 7.5 g 16-22 cps, ± 4.6 g
Sinusoidal - Two Lateral Axes Mutually Perpendicular (2 octaves/minute)	5-150 cps, ± 1.5 g 150-400 cps, ± 3.0 g 400-2000 cps, ± 7.5 g	X-258 3rd Stage & TAD (DSV-3C and 3D) 10-18 cps, ± 3.0 g 18-500 cps, ± 2.3 g 500-2000 cps, ± 4.0 g 3 Stage Improved Delta (DSV-3E and 3F) 5-250 cps, ± 2.3 g 250-400 cps, ± 3.0 g 400-2000 cps, ± 7.5 g 2 Stage Improved Delta (DSV-3G and 3H) 5-250 cps, ± 1.5 g 250-400 cps, ± 3.0 g 400-2000 cps, ± 7.5 g	Atlas, Thor, and TAT Agenas 5-250 cps, ± 1.5 g 250-400 cps, ± 3.0 g 400-2000 cps, ± 7.5 g
Random - Thrust and Lateral Axes (4 minutes, each axis)	20-20,000 cps 0.07 g^2/cps 11.8 g-rms	X-258 3rd Stage & TAD (DSV-3C and 3 D) 20-2000 cps 0.07 g^2/cps 11.8 g-rms 3 Stage Improved Delta (DSV-3E and 3F) 20-150 cps, 0.023 g^2/cps 150-300 cps, increasing by ±3 db/octave 300-2000 cps, 0.045 g^2/cps 9.23 g-rms 2 Stage Improved Delta (DSV-3G and 3H) 20-150 cps, 0.023 g^2/cps 150-425 cps, increasing by ±4 db/octave 425-1200 cps, 0.09 g^2/cps 1200-2000, decreasing by -2 db/octave	Atlas and Thor Agena (9.2 g-rms) 20-150 cps, 0.023 g^2/cps 150-300 cps, increasing by +3 db/octave 300-2000 cps, 0.045 g^2/cps TAT Agena (12.6 g-rms) 20-150 cps, 0.023 g^2/cps 150-425 cps, increasing by +4 db/octave 425-2000 cps, 0.09 g^2/cps

DESIGN QUALIFICATION
ENVIRONMENTAL TEST PARAMETERS FOR SPACECRAFT LAUNCHED BY SCOUT, DELTA, AND AGENA LAUNCH VEHICLES
(Continued)

TEST/PROCEDURE	SCOUT	DELTA	AGENA
VIBRATION (Continued) Torsional - Thrust	Not required.	Not required.	Atlas Thor, and TAT (2 octaves/minute) 20-60 cps, 12.9 rod/sec^2 60-150 cps, 25.8 rod/sec^2 Atlas Agena (2 pulses) Resonance point between 60 and 75 cps, or 68 cps if no major torsional resonance, 96.6 rad/sec^2
ACCELERATION (g's vary with S/C weight)	1.5 times max. 4th stage thrust.	1.5 times max. 3rd stage thrust.	1.5 times max. combined thrust and lateral acceleration (2 tests, with lateral acceleration in each test perpendicular to lateral acceleration in other).
THERMAL VACUUM (Chamber Conditions)			
Corona	Pressure: Ambient to $1X10^{-4}$ mm Hg Temperature: Ambient Duration: Launch pressure-time profile desirable.	Same as Scout.	Same as Scout.
Cold Exposure	Pressure: $1X10^{-5}$ mm Hg Temperature: 10°C below predicted cold extreme Duration: 12 hours (longer if needed to complete orbital cycle).	Same as Scout.	Same as Scout.
Hot Exposure	Pressure: $1X10^{-5}$ mm Hg Temperature: 10°C above predicted hot extreme Duration: 12 hours (longer if needed to complete orbital cycle).	Same as Scout.	Same as Scout.
Cold Soak	Same as Cold Exposure except that— Duration: 72 hours	Same as Scout.	Same as Scout.
Hot Soak	Same as Hot Exposure except that— Duration: 120 hours	Same as Scout.	Same as Scout.
THERMAL BALANCE (Chamber Condition)	Pressure: $1X10^{-5}$ mm Hg Energy: Radiation and/or heaters equivalent to energy from 100% sunlight. Duration: Stabilization under 100% sunlight when appropriate for orbit and enough cycles to show repeatable thermal response for sun and shade of orbit.	Same as Scout.	Same as Scout.

ENVIRONMENTAL TEST PARAMETERS FOR NASA SOUNDING ROCKET PAYLOADS; DESIGN QUALIFICATION

TEST/PROCEDURE	AEROBEE 150-150A	SPAEROBEE	JAVELIN	JOURNEYMAN	NIKE APACHE NIKE CAJUN	ASTROBEE 1500
BALANCE* (Thrust Axis)						
1. Static	8 oz. in.	8 oz. in.	4 oz. in.	4 oz. in.	8 oz. in.	4 oz. in.
2. Dynamic	200 oz. in.^{2}	200 oz. in.^{2}	120 oz. in.^{2}	120 oz. in.^{2}	200 oz. in.^{2}	120 oz. in.^{2}
TEMPERATURE (Chamber Conditions)						
1. Cold	Pressure : Ambient Temperature: 10°C below predicted cold extreme Duration : 6 hours	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.
2. Hot	Pressure : Ambient Temperature: 10°C above predicted hot extreme Duration : 6 hours	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.
VIBRATION						
1. Sinusoidal						
a. Thrust (2 octaves/min except Nike payloads)	cps ±g level 10-60 2.3 60-160 4.5 160-2000 7.5	cps ±g level 10-31 9 in./sec constant velocity 31-120 4.5 120-500 10.5 500-2000 19.5 2000-3000 37.5	cps ±g level 10-50 2.3 50-500 10.5 500-2000 21.0 2000-3000 54.0	cps ±g level 10-50 2.3 50-500 10.5 500-2000 21.0 2000-3000 54.0	cps ±g level 10-16.5 0.5 in. d'ble amplitude 16.5-3000 10.5 g Rate of frequency change: 1/2 octave/minute	cps ±g level 10-12.5 0.5 in. d'ble amplitude 12.5-45 6.0 g 45-55 18.0 g 55-2000 7.5 g
b. Two Lateral Axes Mutually Perpendicular (2 octaves/min except Nike payloads)	10-60 5.4 in./sec constant velocity 60-250 5.3 250-2000 7.5	10-30 0.9 30-150 2.3 150-3000 7.5	10-50 0.9 50-500 2.1 500-2000 4.2 2000-3000 16.5	10-50 0.9 50-500 2.1 500-2000 4.2 2000-3000 16.5	10-144 4.5 in./sec constant velocity 144-3000 10.5 g Rate of frequency change: 1/2 octave/minute	5-31 9.0 in./sec const. vel. 31-300 4.5 g 300-2000 7.5 g
2. Random						
a. Thrust	cps g^2/cps 20-2000 0.056 g-rms : 10.5 Duration: 20 sec	cps g^2/cps 20-650 0.122 650-2000 9.29 db/octave 2000 0.569 g-rms : 22.8 Duration: 2 min	cps g^2/cps 10-200 0.135 200-400 24.3 db/octave 400-2000 0.011 g-rms : 7.23 Duration: 2 min	cps g^2/cps 20-2000 0.625 g-rms : 7.7 Duration: 2 min	None	cps g^2/cps 20-2000 0.157 g-rms : 17.5 Duration: 20 sec
b. Two Lateral Axes Mutually Perpendicular	20-2000 0.113 g-rms : 15.0 Duration: 20 sec/axis	20-650 0.045 650-2000 0.29 db/octave 2000 0.209 g-rms : 13.5 Duration: 2 min/axis	10-25 0.675 25-100 20.3 db/octave 100-2000 0.011 g-rms : 6.37 Duration: 2 min/axis	20-200 0.625 g-rms : 7.7 Duration: 2 min/axis	None	20-2000 0.068 g-rms : 10.6 Duration: 20 sec/axis
3. Combustion Resonance Dwell (Only with X-248 Final Stage)						
a. Thrust	None	None	cps ±g 550-650 84 Duration: .5 min	cps ±g 550-650 84 Duration: .5 min	None	None
b. Two Lateral Axes Mutually Perpendicular	None	None	550-650 14.3 Duration: .5 min/axis	550-650 14.3 Duration: .5 min/axis	None	None

ENVIRONMENTAL TEST PARAMETERS FOR NASA SOUNDING ROCKET PAYLOADS; DESIGN QUALIFICATION

TEST/PROCEDURE	AEROBEE 150-150A	SPAEROBEE	JAVELIN	JOURNEYMAN	NIKE APACHE NIKE CAJUN	ASTROBEE 1500
THERMAL VACUUM (Chamber Conditions) 1. Corona	Pressure : Ambient to $1X10^{-4}$ mm Hg Temperature: Ambient	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.
2. Cold	Pressure : $1X10^{-5}$ mm Hg Temperature: 10°C below predicted cold extreme Duration : 2 hours	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.
3. Hot	Pressure : $1X10^{-5}$ mm Hg Temperature: 10°C above predicted hot extreme Duration : 2 hours	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.	Same as Aerobee.

UNIT 2

BIBLIOGRAPHY OF TEST AND RELATED REPORTS

(Pertaining to Test and Evaluation Division Flight Programs)

SCOUT-LAUNCHED SPACECRAFT

DELTA-LAUNCHED SPACECRAFT

AGENA-LAUNCHED SPACECRAFT

SOUNDING ROCKETS

QUALITY ASSURANCE DOCUMENTS

SCOUT-LAUNCHED SPACECRAFT

P-21
ELECTRON DENSITY PROBE

P-21A
ELECTRON DENSITY PROFILE PROBE

S-48
FIXED FREQUENCY TOPSIDE SOUNDER (IONOSPHERE EXPLORER IE-A)

S-52
ARIEL II INTERNATIONAL SATELLITE (UK-C, UK-2)

SM-A
SAN MARCO

SCOUT
P-21 ELECTRON DENSITY PROFILE PROBE

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – February to July 1961
Flight Unit 1 – August 18 to 28, 1961
Flight Unit 2 – August 30 to September 22, 1961

LAUNCH (Flight Unit 2)

Launch Range – Wallops Island, Virginia
Date – October 19, 1961
Orbital Operation – Became silent October 19, 1961

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Electron Density Profile Probe P-21 (Argo D-4) Prototype and Flight Payload (326.1(RT)P-21-04, 5/18/61)

Test Report on Electron Density Profile Probe P-21 (Argo D-4) Prototype and Flight Payloads (326.1(RT)P-21-04, 6/18/61)

Dynamic Environmental Testing and Transmissibility Study P-21 (321.2(JS)P-21-05, 6/27/61)

Vibration Test P-21 Ionospheric Probe Flight Units 8.09 and 8.10 (321.2(JC)P-21-08, 6/28/61)

Dynamic Environmental Testing and Transmissibility Study (P-21) (321.2(JS)P-21-05, 6/28/61)

P-21-I Flight Unit Vibration Tests (62-109, 10/13/64)

Flight Systems Acceptance Tests P-21 Electron Density Profile Probe (62-112, 12/27/61)

MEMORANDUM REPORTS

Results of Ionospheric Probe, P-21, Prototype, Environmental Tests (320-11-61, 3/6/61)

Results of Ionospheric Probe, P-21, Flight Unit No. 1, Thermal-Vacuum Tests (320-12-61, 3/21/61)

Results of Ionospheric Probe, P-21, Flight Unit No. 2, Thermal-Vacuum Tests (320-13-61, 4/3/61)

Results of Ionosphere Probe, P-21, Flight Units I and II, Thermal-Vacuum Tests (320-28-61, 10/2/61)

P-21-I Flight Unit Vibration Tests (62-109, 10/13/61)

Vibration Experiment of Scout ST-7/P-21 (621-4, 11/27/61)

Response of the P-21 Spacecraft with Two Extensions (621-8, 12/7/61)

In-Flight Temperatures of the Scout ST-7/P-21 Ionospheric Probe (320-34-61, 12/21/61)

Scout ST-9/P-21; Vibration Experiment (621-36, 5/19/62)

P-21 Electron Density Profile Probe. Heating Rates of the Javelin Nose Cone (322-9-62, 8/28/62)

SPECIFICATIONS

Test Program for Continuous Wave Propagation Probe P-21 (326.1, 9/ /60)

SCOUT
P-21A ELECTRON PROFILE PROBE

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Flight Unit – February 13 to March 1, 1962

LAUNCH

Launch Range – Wallops Island, Virginia
Date – March 6, 1962
Orbital Operation – Became silent March 29, 1962

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Ionosphere Probe P-21A; Results of Laboratory Thermal-Vacuum Test (322-7-62, 6/4/62)

Ionosphere Probe P-21A; Flight Temperature Data (322-11-62, 9/25/62)

SCOUT

S-48 FIXED FREQUENCY TOPSIDE SOUNDER (IONOSPHERE EXPLORER IE-A)

ENVIRONMENTAL TEST PROGRAM

LOCATIONS

Goddard Space Flight Center, Greenbelt, Maryland
Bendix, Ann Arbor, Michigan

DATES

Prototype – May 4, 1962 to September 1963
Flight Unit 1 – August 3, 1962 to November 6, 1963
Flight Unit 2 – August 22, 1962 to February 19, 1964

LAUNCH

Scheduled for third or fourth quarter 1964

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Temperature and Humidity Testing of the Prototype S-48 Fixed Frequency Topside Sounder (I-322-63-42, 3/4/63)

The Thermal-Vacuum Testing of the S-48 Fixed Frequency Topside Sounder Satellite (I-322-63-40, 3/4/63)

The Thermal-Vacuum Retesting of the S-48 Fixed Frequency Topside Sounder Prototype Satellite (I-322-63-181, 8/19/63)

MEMORANDUM REPORTS

Preliminary Report on Vibration Test of Prototype S-48 Satellite (521-42, 6/4/61)

S-48 (Fixed Frequency Topside Sounder Rocket Payload); Results of T/V Test of Prototype Unit (320-19-61, 7/11/61)

S-48 (Fixed Frequency Topside Sounder Rocket Payload); Results of Flight Unit No. 1 Thermal-Vacuum Test (320-20-61, 7/13/61)

S-48 (Fixed Frequency Topside Sounder Rocket Payload); Results of Flight Unit No. 1 Spare Thermal-Vacuum Test (320-26-61, 8/30/61)

S-48 (Fixed Frequency Topside Sounder Rocket Payload); Results of Flight Unit No. 3 T/V Test (320-27-61, 9/26/61)

S-48; Results of T/V Test of Thermal Mock-up Unit (320-33-61, 12/5/61)

Thermal-Vacuum Testing of the S-48 Flight Unit No. 1 (632-12, 7/10/63)

Design Qualification and Flight Acceptance Vibration Tests of Three S-48 Spacecraft (632-173, 9/17/63)

Design Qualification and Flight Acceptance Vibration Tests of Three S-48 Spacecraft (631-173, 9/18/63)

Retesting S-48 Fixed Frequency Topside Sounder Satellite (632/30, 11/12/63)

Thermal-Vacuum Test of the S-48 Fixed Frequency Topside Sounder Satellite (642-5, 1/24/64)

SPECIFICATIONS

Test Program for S-48 Fixed Frequency Topside Sounder Rocket (ARGO D-4) Payloads (3/15/61)

SCOUT
S-52 ARIEL II INTERNATIONAL SATELLITE
(UK-C, UK-2)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – April to September 1963
Flight Unit 1 – July 19 to October 1963 (Retests: February 1964)
Flight Unit 2 – November 1963 to February 1964

LAUNCH (Flight Unit 1)

Launch Range – Wallops Island, Virginia
Date – March 27, 1964
Orbital Operation – Active as of June 1, 1964. Programmed spin rate degrading; as a result two of three experiments will be adversely affected 120 days after launch.

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Electronic Test Procedures for the Environmental Design Qualification and Flight Testing of the UK-2/S-52 (X-324-63-113, June 1963)

Electronic Performance of S-52 GSFC Spacecraft Subassemblies Throughout Design and Acceptance Environmental Exposures (X-324-63-241, 6/21/63)

MEMORANDUM REPORTS

Dynamic Tests of S-52 Dynamic Test Unit at Langley Research Center, July 30, 1962 through August 3, 1962 (621-59, 8/10/62)

Shock Measurements Obtained During Dynamic Test of UK-2/S-52 Dynamic Test Unit at Langley Research Center (621-68, 9/24/62)

Dynamic Test of S-52 Engineering Test Unit at Langley Research Center, November 5, 1962 through November 10, 1962 (621-83, 11/16/62)

Results of Vibration Tests of S-52 Broadband Ozone Detector (621-86, 11/23/62)

Vibration Test of S-52 Broadband Ozone Detector with Support Cone (621-113, 2/13/63)

S-52 Dipole Deployment Tests in Dynamic Test Chamber January 29 through February 1, 1963 (621-114, 2/18/63)

Temperature Sensor Locations on S-52 Prototype (322-3-63, 3/5/63)

Failure of Sprague Type 109D Capacitors (633-015, 5/6/63)

S-52 Guillotine Release Mechanism, Results of High Temperature Test Under Simulated Space Conditions (632-5, 5/13/63)

Vibration Test of S-52 Prototype Unit (631-131, 6/7/63)

S-52 Guillotine Release Mechanism, Results of High Temperature Test Under Simulated Space Conditions (632-6, 6/14/63)

Electronic Performance of S-52 GSFC Spacecraft Subassemblies Throughout Design and Acceptance Environmental Exposures (644-003, 7/2/63)

Status of Preparations for S-52 Launch Effort (644-001, August 1963)

S-52 Flight Unit No. 1 Results of Vibration Test (631-167, 8/19/63)

S-52 Launch Phase Separation System Test Set and Test Procedure (644-002, September 1963)

Dynamic Tests of S-52/UK-2 Prototype Spacecraft and Flight Separation Unit – August 10, 1963 (631-171, 9/9/63)

Thermal-Vacuum Design Qualification, S-52/UK-2, International Satellite (632-12, 9/20/63)

Result of Thermal-Vacuum Flight Acceptance Test of the UK-2/S-52 I.I.S. (632-13, 1963)

Electronic Performance of S-52 GSFC Flight Spare Subassemblies Throughout Acceptance Environmental Exposures (644-004, 10/23/63)

Retest of the UK-2/S-52 Boom and Paddle Release Mechanism; Results of High Temperature Test Under Simulated Space Conditions (632-16, 10/25/63)

Second Retest of the S-52 Guillotine Release Mechanisms (632-17, 11/4/63)

Second Retest of the S-52 Guillotine Release Mechanisms (632-22, 11/15/63)

Thermal-Vacuum Test Results of the S-52 Flight System (632-27, 12/20/63)

Results of Thermal-Vacuum Test of S-52 Flight Spacecraft (642-1, 1/20/64)

Electronics Test Procedures for the Environmental Design Qualification and Flight Testing of the UK-2/S-52 (644-113, 2/15/64)

Status of Preparations for S-52 Launch (644-006, 2/26/64)

SPECIFICATIONS

Environmental Design Qualification Specification for the Prototype UK-2/S-52 Spacecraft (S-1-301, 2/21/63)

Environmental Test Plan of the UK-2/S-52 Satellite Program (S-1-501, 5/8/63)

Environmental Acceptance Test Specification for the Flight Model UK-2/S-52 Spacecraft (S-1-401, 5/10/63)

Specification, Environmental Design Qualification Test, Components and Experiments, UK-2/S-52 (S-1-101, 6/26/63)

Specification, Environmental Acceptance Test Components and Experiments UK-2/S-52 (S-1-201, 6/26/63)

SCOUT
SAN MARCO (SM-A)

ENVIRONMENTAL TEST PROGRAM

LOCATIONS

Goddard Space Flight Center, Greenbelt, Maryland
Aerotest Labs, Deer Park, Long Island, New York (under supervision of GSFC and Fairchild Stratos)
Langley Research Center, Virginia

DATES

Prototype – January to February 1963
Flight Unit 1 – March 1963
Flight Unit 2 – June to July 1963

LAUNCH (Flight Unit 1)

Launch Range – Wallops Island, Virginia
Date – April 20, 1963
Vertical Launch – Unsatisfactory

LAUNCH (Flight Unit 2)

Launch Range – Wallops Island, Virginia
Date – August 2, 1963
Vertical Launch – Satisfactory

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Improvements in the San Marco Balancing Operation (I-321-63-174, 8/8/63)

MEMORANDUM REPORTS

Balance of San Marco Satellite Prototype (621-111, 2/8/63)

Vibration Tests of the San Marco Payload – Prototype Model (621-118, 2/28/63)

Trip Report – Vibration Testing of the San Marco Prototype Payload at Aerotest Labs. (621-119, 3/1/63)

Balance of San Marco Flight Unit No. 2 (631-136, 5/8/63)

Final Balance of San Marco Flight Unit No. 2 (631-156, 6/19/63)

San Marco Thermal-Vacuum Test (632-9, 7/10/63)

SPECIFICATIONS

Subsystems Vibration Specification for San Marco Payload (631-124, April 1963)

DELTA-LAUNCHED SPACECRAFT

P-14
EXPLORER X

S-3
EXPLORER XII

S-3a
EXPLORER XIV – ENERGETIC PARTICLES SATELLITE

S-3b
EXPLORER XV – STUDY OF THE ENHANCED RADIATION BELT – SERB

S-3c
ENERGETIC PARTICLES EXPLORER EPE-D

S-6
EXPLORER XVII – ATMOSPHERIC STRUCTURE SATELLITE

S-16
ORBITING SOLAR OBSERVATORY – OSO-1

S-17
ORBITING SOLAR OBSERVATORY – OSO-B

S-51
ARIEL 1, INTERNATIONAL SATELLITE – UK-1

S-57
ORBITING SOLAR OBSERVATORY – OSO-C

S-66
POLAR IONOSPHERE BEACON – BE-A

S-74
EXPLORER XVIII – INTERPLANETARY MONITORING PROBE – IMP

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DELTA
P-14 (EXPLORER X)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – October 18 to November 28, 1960
Flight Unit 1 – November 26, 1960 to March 12, 1961
Flight Unit 2 – December 28, 1960 to January 27, 1961
Flight Unit 3 – First Tested as the prototype. After modification it was flight acceptance tested and launched as EXPLORER X.

LAUNCH (Flight Unit 3)

Launch Range – Atlantic Missile Range
Date – March 25, 1961
Orbital Operation – Became silent March 27, 1961

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Analysis of Vibration Exciter System Malfunction (P-14) (61-101, 2/ /61)

Vibration and Shock Testing (P-14) (321.2, 2/3/61)

Test History on P-14 Prototype and Flight Units (3/7/61)

Vacuum Tube Isolator (P-14) (321.2, 4/12/61)

The Environmental Testing of the P-14 Delta Interplanetary Magnetic Field Probe (62-101, 7/20/61)

MEMORANDUM REPORTS

Prototype Humidity and Low Temperature Tests (320-1-61, 12/14/60)

Prototype Thermal-Vacuum Test (320-3-61, 12/19/60)

Flight Unit No. 1 Low Temperature Thermal-Vacuum Tests (320-4-61, 12/28/60 and 320-9-61, 2/26/61)

Flight Unit No. 3 Thermal-Vacuum Test (320-7-61, 1/25/61)

Vibration Exciter System Malfunction (P-14) (61-101, 2/8/61)

Flight Unit No. 2 Thermal-Vacuum Tests (320-6-61, 1/18/61 and 320-8-61, 2/24/61)

SPECIFICATIONS

Test Plan for Javelin P-14 Payload (326.1, 1/ /60)

Test Program for P-14 (321.1, 10/3/60)

TECHNICAL NOTES

The Structure of the Explorer X Magnetometer Space Probe (TN D-1175, April 1962)

DELTA
S-3 (EXPLORER XII)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – March 22 to June 27, 1961 (Shock test performed at NRL)
Flight Unit 1 – May to July 1961
Flight Unit 2 – May to July 1961

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – August 15, 1961
Orbital Operation – Returned radiation, solar wind data until December 6, 1961

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Environmental Vibration Test Prototype System Energetic Particles Satellite, S-3 (321.1(JC)S-3-06, 5/8/61)

Acceptance Test Program for Flight Systems of the S-3 Energetic Particles Satellite (326.3(FC)S-3-05, 5/26/61)

Environmental Vibration Tests Flight Unit I and Flight Spare Energetic Particles Satellite, S-3 (321.2(JC)S-3-13, 7/2/61)

The Thermal-Vacuum Testing of the S-3 Prototype Energetic Particles Satellite (62-103, 8/8/61)

Vibration Tests of S-3 Flight Unit No. 1 and Flight Spare (62-104, 8/18/61)

Thermal-Vacuum Testing of the S-3 Energetic Particles Satellite Flight Spare Systems (62-106, 9/13/61)

The Environmental Test Program and Systems Evaluation of the S-3 Energetic Particles Satellite (X-326-63-10, 1/21/63)

MEMORANDUM REPORTS

Results of Energetic Particles Satellite, S-3 Prototype Temperature Tests (320-16-61, 4/13/61)

Unbalance Control Methods Applied to the S-3 Satellite (621-5, 11/29/61)

Methods of Control and Evaluation of Mass Unbalance as Applied to the S-3 Energetic Particles Satellite (621-5, 12/13/61)

Solar Cell Test, Explorer XII (S-3) Satellite Solar Cell Damage Experiment (322-10-62, 9/17/62)

SPECIFICATIONS

Test Plan for Structural Prototype Energetic Particles Satellite (S-3) (326, 10/24/60)

Environmental Test Plan Energetic Particles Satellite (S-3) (326.1, 2/14/61)

Acceptance Test Program for Flight Systems of the S-3 Energetic Particles Satellite (326.3(FC)S-3-05, 5/23/61)

TECHNICAL NOTES

Use of a Sealed Silver-Cadmium Battery on Explorer XII (TN D-1543, January 1963)

Explorer XII Satellite Instrumentation for the study of the Energy Spectrum of Cosmic Rays (TN D-1698, May 1963)

The Effect of Solar Radiation Pressure on the Spin in Explorer XII (TN D-1855, August 1963)

DELTA
S-3a (EXPLORER XIV – ENERGETIC PARTICLES SATELLITE)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – None. The S-3 prototype was used for thermal-vacuum testing and for RF Compatibility Testing.
Flight Unit 1 – July 2 to September 1962
Flight Spare – August 14 to September 15, 1962

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – October 2, 1962
Orbital Operation – Transmitted until October 8, 1963

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Vibration Test of the S-3a Energetic Particles Satellite (621-53, 7/17/62)

S-3a Prototype Solar Paddle; Test Results of Simulated Orbital Thermal Cycles (322-8-62, 8/27/62)

Vibration Tests of the Flight Spare Subassemblies for the S-3a Energetic Particles Satellite (621-66, 9/7/62)

Magnetic Testing of S-3a Spacecraft (010, 9/18/62)

S-3a Energetic Particles Satellite-Magnetic Test Data (026, 1/7/63)

S-3a Prototype Subassemblies (Program Switch, Recycle Timer and Transmitter) Thermal-Vacuum Test (632-13, 2/28/63)

S-3a Energetic Particles Satellite (632-10-63, 8/14/63)

DELTA
S-3b (EXPLORER XV – STUDY OF THE ENHANCED RADIATION BELT – SERB)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – None
Flight Unit 1 – October 4–14, 1962

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – October 27, 1962
Orbital Operation – Transmitted until February 9, 1963. Excessive spin rate degraded radiation data.

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

S-3b Solar Paddle Erection Tests (621-63, 9/17/62)

Magnetic Tests of the Sub S-3b Spacecraft (014, 10/17/62)

Magnetic Test of Project SERB S-3b Spacecraft (017, 10/22/62)

Mechanical Failure of General Electric Transistor Type 4JX4D545 in S-3b Subassembly (State University of Iowa Encoder) During Vibration Test (633-008, 10/31/62)

SERB Yo-Yo Despin Unit Test in the GSFC Dynamic Test Chamber (621-94, 12/18/62)

Vibration Test of the SERB S-3b Spacecraft (621-102, 1/8/63)

Mechanical Reliability Study of GE Transistor Type 4JX4D545 (S-3b) (633-013, 3/22/63)

Vibration Test of SERB Solar Cell Damage Panel (10/1/63)

Solar Cell Damage Experiment, Temperature and Thermal-Vacuum Tests (632-15, 10/18/63)

Balancing Operations on S-3b and S-3c (621-82, 11/13/63)

SPECIFICATIONS

Environmental Test Plan, Project Serb (S-3b and S-3c) (S-2-501, 9/13/62)

DELTA

S-3c (ENERGETIC PARTICLES EXPLORER-D – EPE-D)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – None
Flight Unit 1 – Began testing May 8, 1964

LAUNCH

Tentatively scheduled for November or December 1964

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Balancing Operations on S-3b and S-3c (621-82, 11/13/62)

EPE-D(S-3c) Solar Cell Damage Experiment Results of Thermal Shock and Cycling Test (642-2, 1/21/64)

Results of Thermal-Vacuum Test of S-3c Encoders (642-10, 2/6/64)

EPE-D Encoder Thermal Shock Test (644-007, 4/2/64)

S-3c Solar Cell Damage Experiment Humidity Test (642-17, 4/16/64)

SPECIFICATIONS

Environmental Test Plan, Project EPE-D (ENERGETIC PARTICLES EXPLORER) (S-2-503, 1/2/64)

Environmental Test Specification Project EPE-D ENERGETIC PARTICLES EXPLORER (S-2-904, 3/20/64)

DELTA
S-6 (EXPLORER XVII – ATMOSPHERIC STRUCTURE SATELLITE)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – June 30, 1961 to January 31, 1963. (On October 18, 1962, the prototype unit exploded; tests with a new prototype shell were performed November 21, 1962 – January 31, 1963).

Flight Unit 1 – February 7 to March 12, 1963

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – April 2, 1963
Orbital Operation – Transmitted until July 10, 1963

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Vibration testing of the S-6 Atmospheric Structure Satellite, Structural Models (62-107, 9/20/61)

MEMORANDUM REPORTS

S-6 Mass Spectrometer (320-14-61, 4/3/61)

S-6 Batteries, 90-Day Life Test (320-22-61, 8/3/61)

Thermal Gradient Test on S-6 Structural Model (320-25-61, 9/5/61)

Corrosive Deterioration of S-6 Prototype Optical Aspect Computer Board (633-001, 7/2/62)

Vibration Survey of Prototype S-6 Satellite (621-58, 8/14/62)

Western Electric 2N1645 Transistor Failures in the S-6 Telemetry Transmitter (633-005, 8/27/62)

Vibration Studies of S-6 Structural Model (621-72, 10/11/62)

Structural Test of S-6 Antenna Range Mast (621-91, 12/11/62)

S-6 Prototype; Vibration Qualification Test Results (621-98, 1/2/63)

Vibration Test of S-6 Flight Unit No. 1 (621-117, 2/23/63)

Failure Analysis of Raymond G-Switch Timer, Model 1060 (S-6) (633-014, 3/29/63)

S-6 (Explorer 17) Summary Report (636-017, 5/13/63)

S-6 Atmospheric Structure Satellite (632-8, 6/28/63)

SPECIFICATIONS

Environmental Test Specification for S-6 Atmospheric Structure Satellite (326.1, 8/20/61)

TECHNICAL NOTES

Response of Modified Redhead Magnetron and Bayard-Alpert Vacuum Gauges Aboard Explorer XVII (TN D-2146, February 1964)

DELTA
S-16 (ORBITING SOLAR OBSERVATORY – OSO-I)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Ball Brothers Research Corporation, Boulder, Colorado

DATES

Prototype – July to September 1961
Flight Unit 1 – December 1961 to January 1962

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – March 7, 1962
Orbital Operation – Transmitted solar flare, radiation data until August 6, 1963.

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Evaluation of Vibration Test Data from S-16 Structural Model Tests (321.1(RH)S-16-09, 5/21/61)

Evaluation of SN510 and SN514 Subminiature Networks Manufactured by Texas Instruments (I-323-63-24, 2/6/63)

MEMORANDUM REPORTS

S-16 High Energy Gamma-Ray Experiment (320-16-61, 3/27/61)

Thermal-Vacuum Test on S-16 Prototype Pointed Experiment (320-17-61, 5/16/61)

S-16 Radiation Detector Package Thermal-Vacuum Tests (320-31-61, 11/29/61)

DELTA
S-17 (ORBITING SOLAR OBSERVATORY – OSO-B)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Ball Brothers Research Corporation, Boulder, Colorado

DATES

Prototype – April 22 to December 1963

Flight Unit 1 – August to December 1963. This spacecraft was demolished in an accident at the Atlantic Missile Range on April 14, 1964.

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Vibration of GSFC Gamma-Ray Experiment for the S-17 Spacecraft (621-74, 10/25/62)

Vibration Tests of GSFC S-17 Spectrophotometer Experiment (621-79, 11/1/62)

Vibration Tests of GSFC S-17 Spectrophotometer Experiment (621-85, 11/21/62)

Vibration Tests of GSFC Gamma-Ray Experiment for the S-17 Spacecraft (621-87, 11/30/62)

Vibration of Electronics for GSFC Wheel Experiments for the S-17 Spacecraft (621-90, 12/6/62)

Vibration Tests of GSFC Gamma-Ray Experiment Detector for the S-17 Spacecraft (621-95, 12/20/62)

Vibration Tests of GSFC UV Spectrophotometer Experiment for the S-17 Spacecraft (621-96, 12/20/62)

Vibration Tests of GSFC Gamma-Ray Experiment for the S-17 Spacecraft (621-99, 1/4/63)

Vibration Tests of GSFC UV Spectrophotometer Experiment for the S-17 Spacecraft (621-100, 1/8/63)

Vibration Tests of GSFC UV Spectrophotometer Experiment for the S-17 Spacecraft (621-104, 1/11/63)

Vibration Tests of GSFC Gamma-Ray Experiment for the S-17 Spacecraft (621-105, 1/11/63)

Vibration Tests of the GSFC Gamma-Ray Experiment Detector for the S-17 Spacecraft (621-128, 4/6/63)

Vibration Tests of the GSFC Gamma-Ray Experiment Detector for the S-17 Spacecraft (621-132, 4/30/63)

Vibration Tests of the T.E.C. Hi-voltage Power Supply of the GSFC UV Spectrophotometer Experiment for the S-17 Spacecraft (631-133, 4/30/63)

Vibration Tests of GSFC UV Spectrophotometer Experiment (Less Azimuth Indexer) for S-17 Spacecraft (631-134, 4/30/63)

Vibration Test of Four Miller Timers (D-10000) for the S-17 and S-57 Spacecraft (631-165, 7/29/63)

DELTA
S-51 (ARIEL 1, INTERNATIONAL SATELLITE, UK-1)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – September 14, 1961 to March 12, 1962
Flight Unit 1 – January 11 to February 27, 1962
Flight Unit 2 – February 8 to March 13, 1962

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – April 26, 1962
Orbital Operation – Active as of March 1, 1964

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Environmental Vibration Test Structural Model No. 1 International Ionosphere Satellite, S-51 (321.2(JC)S-51-11, 6/19/61)

Environmental Vibration Test Prototype Model International Ionosphere Satellite, S-51 (62-111, 12/6/61)

The Temperature and Humidity Testing of the S-51 International Ionosphere Satellite Prototype System (62-113, 12/27/61)

Qualification and Flight Acceptance Vibration Tests of S-51 Spacecraft (I-321-62-57, 5/21/62)

The Thermal-Vacuum Testing of the S-51 International Ionosphere Satellite Prototype System (I-322-62-141, 6/20/62)

The Thermal-Vacuum Testing of the S-51 International Ionosphere Satellite Flight Systems (I-322-63-39, 3/19/63)

MEMORANDUM REPORTS

Automatic Voltage and Current Monitoring System (624-1, 10/4/61)

Operational Tests of S-51 Satellite System and Stretch Yo-Yo Despin Systems conducted in 60 Foot Vacuum Sphere at Langley Research Center (621-6, 11/29/61)

S-51 Dutchman-Separation Mechanism Vibration Tests (621-7, 12/5/61)

S-51 Stretch Yo-Yo System Tests at Langley Research Center, January 22-24, 1962 (621-9, 1/30/62)

S-51 Stretch Tests at Langley Research Center, February 7, 1962 (621-14, 2/12/62)

Structural Test of the S-51 Antenna Attachment Structure (621-20, 3/30/62)

S-51 Solar Paddle Arms; Test of Transistor Heat Sinks (322-003-62, 4/10/62)

Sensor Exciters for Spacecraft Experiments Developed for S-51 (624-2, 5/2/62)

Vibration Experiment of Delta 9 (S-51/UK-1) (621-37, 5/20/62)

S-51 Prototype Balance Operations (621-38, 5/22/62)

Auto-Programmable Scanner for S-51 and Other Spacecraft (018, 11/2/62)

Structural Test of the S-51 Antenna Attachment Structure (631-175, 9/24/63) (Supersedes Report No. 621.20, 3/12/62)

SPECIFICATIONS

Environmental Exposures and Tests for Subassemblies of International Ionosphere Satellite S-51 (326.1, 1/ /61)

Environmental Exposures and Tests for Subassemblies of International Satellite S-51 (326.1, 2/7/61)

Structural Test ETU No. 1, S-51 (326.1(WH)S-51-03,4/18/61)

Test Specification for S-51 Solar Paddles (326.1, 11/15/61)

TECHNICAL NOTES

Ariel One-Evolution of its Structure (TN D-1903, September 1963)

Energy Absorber for the Ariel I Instrument Booms (TN D-1857, February 1964)

Environmental Test Program for Ariel I (TN D-2099, February 1964)

DELTA
S-66 (POLAR IONOSPHERE BEACON – BE-A)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Johns Hopkins Applied Physics Laboratory

DATES

Prototype – March 14 to April 11, 1963
Flight Unit 1 – April 9 to 16, 1963

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – March 19, 1964
Orbital Operation – Failed to achieve orbit because of incomplete burning of third stage.

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Composite Balancing of Scout 4th Stage Including S-66 Spacecraft at the PMR (631-137, 5/9/63)

DELTA

S-57 (ORBITING SOLAR OBSERVATORY – OSO-C)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Ball Brothers Research Corporation, Boulder, Colorado

DATES

Tentative Launch – 4th quarter 1964

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Vibration Tests of the S-57 Orbiting Solar Observatory Spacecraft Structural Model (631-146, 5/27/63)

Vibration Tests of the GSFC Tape Recorder Assembly for the S-57 Spacecraft (631-158, 6/28/63)

Vibration Tests of Three Miller Timers (D-10000) for the S-57 Spacecraft (631-162, 7/18/63)

Vibration Test of Three Miller Timers (D-10000) for the S-57 Spacecraft (631-163, 7/29/63)

Vibration Test of Four Miller Timers (D-10000) for the S-17 and S-57 Spacecraft (631-165, 7/29/63)

Summary Report of Malfunctions and Other Defects Noted During Evaluation of Miller Timer, Model D-10000 (OSO/S-57) (643-006, 11/22/63)

DELTA

S-74 (EXPLORER XVIII – INTERPLANETARY MONITORING PROBE – IMP)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Goddard Space Flight Center, Greenbelt, Maryland

DATES

Prototype – July 15 to October 25, 1963
Flight Unit 1 – September 13 to October 30, 1963

LAUNCH (Prototype)

Launch Range – Atlantic Missile Range
Date – November 26, 1963
Orbital Operation – Active as of March 1, 1964

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Vibration Test of IMP Structural Model (621-18, 3/8/62)

Vibration Test of S-74 IMP Magnetometer (621-31, 5/9/62)

Comments on the General Environmental Design Qualification Tests for IMP Spacecraft Subsystems (621-47, 6/22/62)

Magnetic Tests of University of Chicago Magnesium Samples for IMP (634-008, 8/28/62)

Vibration Test of S-74 Magnetic Action Relays (621-65, 9/6/62)

IMP (S-74) MIT Plasma Probe Experiment (21, 12/10/62)

IMP (S-74) SNAP Power Supply (22, 12/10/62)

IMP (S-74) Magnetic Test Data (024, 1/4/63)

Transmissibility Data Obtained from Sinusoidal Vibration Test of the S-74 IMP, Engineering Test Unit (631-166, 8/12/63)

Evaluation of Sprague Type 136D Capacitors (S-74) (643-001, 9/11/63)

Transistor 2N718, Industro-Transistor Corporation (S-74) (643-002, 9/12/63)

Evaluation of National Semiconductor Corporation NS291 and Texas Instruments, Inc. SMO201A Transistors (S-74) (643-003, 9/17/63)

Dynamic Tests of the S-74 IMP Protoflight Unit in the GSFC Dynamic Test Chamber, October 7, 1963 (631-179, 10/14/63)

Continental Device Diode IN459A (S-74) (643-005, 10/23/63)

Reduced Data, Supplement to Memo Report No. 631-166 (631-180, 11/5/63)

The Dynamic Balancing Operations of the S-74 Prototype Flight Spacecraft (631-181, 12/4/63)

Investigation of Cannon Electric Company Type D Subminiature Connectors (S-74) (643-007, 12/16/63)

IMP Components Cold Survival Test (642-20, 5/21/64)

Results of Thermal-Vacuum Flight Acceptance Test of S-74 (642-22, 5/28/64)

Results of Thermal-Vacuum Design Qualification Test of S-74 (642-23, 5/28/64)

SPECIFICATIONS

Environmental Test Specification IMP Spacecraft System Tests (S-2-903A, 5/26/64)

DELTA
RELAY I (A-15)

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA/AED, Princeton, New Jersey

DATES

Prototype – June 17 to October 1962
Flight Unit 1 – September 18 to November 10, 1962
Flight Unit 2 – October 31 to December 6, 1962

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – December 13, 1962
Orbital Operation – Active, as of March 1, 1964

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Relay A-15; Results of Diode Panel Electronics (Flight Unit No. 2) Thermal-Vacuum Test (322-002-62, 3/26/62)

SPECIFICATIONS

Environmental Qualification Test Specification for Relay Spacecraft (R-20101, 7/11/61)

Environmental Acceptance Test Specifications for Relay Spacecraft (R-20102, 7/11/61)

Solar Simulator for Relay A-15 (325, 11/6/61)

DELTA
RELAY II (A-16)

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA/AED, Princeton, New Jersey

DATES

Prototype – October to December 1963
Flight Unit 1 – October to December 1963

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – January 21, 1964
Orbital Operation – Active as of March 1, 1964

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Implications of Relay II Moment of Inertia Ratio (631-176, 9/29/63)

DELTA
SYNCOM I (A-25)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Hughes Aircraft Company, Culver City, and El Segundo, California

SCHEDULE

Prototype – October 3 to December 1962
Flight Unit 1 – November 18 to December 22, 1962
Flight Unit 2 – December 1962 to January 1963

LAUNCH (Flight Unit 1)

Launch Range – Atlantic Missile Range
Date – February 14, 1963
Orbital Operation – Communication lost at injection into synchronous orbit.

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Apogee Rocket Motor Hot Firing Test in the Syncom I, T-4 Spacecraft (646-020, 7/31/63)

TECHNICAL NOTES

The Range and Range Rate System and Data Analysis for Syncom I (TN D-2139, GSFC, April 1963)

DELTA
TELSTAR I (A-40)*

ENVIRONMENTAL TEST PROGRAM

LOCATION

Bell Telephone Laboratories, Inc., Whippany, New Jersey

DATES

Prototype – March 12 to May 10, 1962
Flight Unit 1 – May 15 to June 23, 1962
Flight Unit 2 – May 23 to June 13, 1962
Flight Unit 3 – June 4 to June 22, 1962

LAUNCH (Flight Unit 2)

Launch Range – Atlantic Missile Range
Date – July 10, 1962
Orbital Operation – Became silent February 21, 1963

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Qualification and Acceptance Environmental Testing of the Telstar TSX-1 Communications Satellite (X-326-62-167, 10/3/62)

*A NASA-assisted project of AT&T.

DELTA
TELSTAR II (A-41)*

ENVIRONMENTAL TEST PROGRAM

LOCATION

Bell Telephone Laboratories, Inc., Whippany, New Jersey

DATES

Prototype – None
Flight Unit 4 – August 15 to September 5, 1962
Flight Unit 5 – September 23 to October 12, 1962, and March 1963
Flight Unit 6 – March 19 to April 16, 1963

LAUNCH (Flight Unit 6)

Launch Range – Atlantic Missile Range
Date – May 7, 1963
Orbital Operation – Silent from July 15 to August 12, 1963; still active as of March 1, 1964

A NASA-assisted project of AT&T.

DELTA
TIROS III (A-3)

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA, Princeton, New Jersey

DATES

Flight Unit F-4 – May 12 to June 22, 1961
Flight Unit F-1 – June to August 1961 (changed to TIROS D)

LAUNCH (Flight Unit F-4)

Launch Range – Atlantic Missile Range
Date – July 12, 1961
Orbital Operation – Became silent December 4, 1961. Transmitted 35,033 cloud photos.

TECHNICAL NOTES

Preliminary Results of Radiation Measurements from the TIROS III Meteorological Satellites (TN D-1338, May 1961)

DELTA
TIROS IV (TIROS D – A-9)

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA, Princeton, New Jersey

DATES

Flight Unit F-1 – Modified to become TIROS IV (TIROS D). November 16, 1961 to January 19, 1962

LAUNCH

Launch Range – Atlantic Missile Range
Date – February 8, 1962
Orbital Operation – Became silent June 19, 1962. Transmitted 32,593 cloud photos.

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Flight Acceptance Environmental Test Program of the TIROS D Meteorological Satellite (X-326-62-22, 4/20/62)

DELTA
TIROS V (TIROS E – A-50)

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA, Princeton, New Jersey

DATES

Flight Unit – April 11 to May 28, 1962

LAUNCH

Launch Range – Atlantic Missile Range
Date – June 19, 1962
Orbital Operation – Became silent May 4, 1963. Transmitted 57,857 cloud photos.

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Flight Acceptance Environmental Test Program of the TIROS E Meteorological Satellite (X-236-62-215, 11/30/62)

MEMORANDUM REPORTS

Vibration Test of TIROS Electron Temperature Probe PEU No. 113 (621-55, 7/23/62)

Shock and Vibration Test of TIROS Electron Temperature Probe Electronics Package PEU No. 114 (621-56, 7/27/62)

Shock and Vibration Test of TIROS Electron Temperature Probe Assemblies (621-57, 7/30/62)

DELTA
TIROS VI (TIROS F – A-51)

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA, Princeton, New Jersey

DATES

Flight Unit – August 1 to August 29, 1962

LAUNCH

Launch Range – Atlantic Missile Range
Date – September 18, 1962
Orbital Operation – Became silent October 11, 1963. Detected 13 hurricanes and transmitted 67,000 cloud photos.

DELTA
TIROS VII (TIROS G – A-52)

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA, Princeton, New Jersey

DATES

Flight Unit – February 5 to May 16, 1963

LAUNCH

Launch Range – Atlantic Missile Range
Date – June 19, 1963
Orbital Operation – Active as of March 1, 1964

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Flight Acceptance Environmental Test Program of the TIROS G Meteorological Satellite (X-326-64-12, 1/17/64)

DELTA
TIROS VIII (TIROS H)

ENVIRONMENTAL TEST PROGRAM

LOCATION

RCA, Princeton, New Jersey

DATES

Flight Unit – October 28 to November 12, 1963

LAUNCH

Launch Range – Atlantic Missile Range
Date – December 21, 1963
Orbital Operation – Active as of March 1, 1964

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Flight Acceptance Environmental Test Program of the TIROS H Meteorological Satellite (X-320-64-68, 3/26/64)

TIROS TECHNICAL NOTES

Angular Motion of the Spin Axis of the TIROS I Meteorological Satellite Due to Magnetic and Gravitational Torques (TN D-571, April 1961)

Preliminary Results of Radiation Measurements from the TIROS III Meteorological Satellites (TN D-1338, May 1961)

The TIROS II Radiation Experiment (TN D-1152, October 1961)

Infrared and Reflected Solar Radiation Measurements from the TIROS II Meteorological Satellite (TN D-1096, November 1961)

Physical Significance of the TIROS II Radiation Experiment (TN D-701, December 1961)

Earth Scan Analog Signal Relationships in the TIROS Radiation Experiment and their Application to the Problem of Horizon Sensing (TN D-1341, June 1962)

Telemetering Infrared Data from the TIROS Meteorological Satellites (TN D-1293, August 1962)

A Radiation View of Hurricane Anna from the TIROS II Meteorological Satellite (TN D-1713, April 1963)

The Automatic Picture Transmission TV Camera System for Meteorological Satellites (NASA TN D-1915, November 1963)

An Analysis of TIROS II Radiation Data Over New Zealand at Night (TN D-1910, March 1964)

AGENA-LAUNCHED SPACECRAFT

S-18
ORBITING ASTRONOMICAL OBSERVATORY – OAO-A

S-27
ALOUETTE I (SWEPT FREQUENCY TOPSIDE SOUNDER – Canada)

S-49
ORBITING GEOPHYSICAL OBSERVATORY – OGO-A (Eccentric)

S-50
ORBITING GEOPHYSICAL OBSERVATORY – OGO-C (Polar)

NIMBUS

A-12 (ECHO-C)
ECHO II

RANGER

MARINER B

AGENA
S-18 (ORBITING ASTRONOMICAL OBSERVATORY – OAO-A)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Grumman Aircraft, Long Island, New York

DATES

Tests tentatively scheduled to start during summer, 1964

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Vibration Acceptance Tests of Three OAO Uvicon Tubes, Serial Nos. S56D, S59D, and S60D (621-81, 11/6/62)

Vibration Acceptance Tests of Two OAO Uvicon Tubes, Serial Nos. S58A and S67A (621-88, 12/3/62)

Vibration Acceptance Tests of Three OAO Uvicon Tubes, Serial Nos. S69A, S73A and S75A (621-92, 12/12/62)

Vibration Acceptance Tests of Three OAO Uvicon Tubes, Serial Nos. S78A, S89A, and S84D (621-101, 1/8/63)

Vibration Acceptance Tests of Four OAO Uvicon Tubes, Serial Nos. S43D, S94A, S97A, and S99A (621.110, 2/1/63)

Optics Samples, GEP Mock-up for OAO, Exposure to Vacuum (632-4, 4/24/63)

Vibration Acceptance Test of Two OAO Uvicon Tubes, Serial Nos. S-108 DYS and 109A (631-131, 4/30/63)

Vibration Acceptance Tests of Three OAO Uvicon Tubes, Serial Nos. S-110D, S-112D, and S-115A (631-139, 5/14/63)

Vibration Acceptance Tests of Two OAO Uvicon Tubes Serial Nos. S-117A and S-118A (631-142, 5/17/63)

Vibration Acceptance Tests of Three OAO Uvicon Tubes, Serial Nos. S-122A, S-123A, and S-124D (631-147, 5/31/63)

Vibration Acceptance Tests of Three OAO Uvicon Tubes, Serial Nos. S-125A, S-12A, and S-128A (631-155, 6/18/63)

Vibration Acceptance Tests of Three OAO Uvicon Tubes, Serial Nos. S-87A, S-88A, and S-89A (631-164, 7/23/63)

Vibration Acceptance Tests of Three OAO Uvicon Tubes, Serial Nos. S-44A, S-105D, and S-107D (631-129, 4/18/64)

SPECIFICATIONS

Environmental Test Specifications for Orbiting Astronomical Observatory (S-18) (326, 3/1/61)

TECHNICAL NOTES

Mathematical Analysis for the Orientation and Control of the Orbiting Astronomical Observatory Satellite (TN D-1668, January 1963)

Ground Operation Equipment for the Orbiting Astronomical Observatory (TN D-1856, December 1963)

AGENA
S-27 ALOUETTE I
(SWEPT FREQUENCY TOPSIDE SOUNDER – CANADA)

ENVIRONMENTAL TEST PROGRAM

LOCATIONS

Goddard Space Flight Center, Greenbelt, Maryland, and in Canada

DATES

Prototype – November 1961 to March 1962 (Retests: August 1962)
Flight Unit 1 – May to June 1962 (Retests: August 1962)
Flight Unit 2 – May to June 1962 (Retests: August 1962)

LAUNCH (Flight Unit 1)

Launch Range – Pacific Missile Range
Date – September 28, 1962
Orbital Operation – Active as of March 1, 1964

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Prototype S-27 (Argo D-4) Payload Topside Sounder (326.1(RT)S-27-01, 4/13/61)

Vibration Test S-27 Javelin Flight System 8.13 and 8.14 (321.1(JC)S-27-12, 6/21/61)

Vibration Test S-27 Javelin Payload Prototype (62-102, 7/26/61)

Prototype Antenna Subassembly Retest and Flight Systems Acceptance Tests, S-27 (Argo D-4) Topside Sounder (62-105, 8/22/61)

The Environmental Test Program and System Evaluation of the Canadian S-27 (Topside Sounder) Spacecraft (X-326-63-82, 4/30/63)

MEMORANDUM REPORTS

S-27 Swept Frequency Topside Sounder (Canada) T-V Test of Flight Units I, II (Javelin) (320-18-61, 6/7/61)

Vibration Test of the S-27 Javelin Flight Units 1 and 2 (621-1, 9/7/61)

Vibration Results of S-27 Spin Table Assembly No. 4 (621-33, 5/14/62)

Flight Acceptance Vibration Tests of the S-27 Flight Units Nos. 1 and 2 (621-51, 7/5/62)

Vibration Retest of the S-27 Flight and Prototype Spacecraft (621-67, 9/10/62)

AGENA
S-49 ORBITING GEOPHYSICAL OBSERVATORY – OGO-A (ECCENTRIC)

ENVIRONMENTAL TEST PROGRAM

LOCATIONS

Goddard Space Flight Center, Greenbelt, Maryland
Space Technology Laboratories, Redondo Beach, California

DATES

Scheduled to start around August 1964

ENVIRONMENTAL TEST DOCUMENTS

Committee Recommendations Goddard Space Flight Center Electrical Ground Support Requirements for EGO S-49A (I-324-63-20, 1/30/63)

MEMORANDUM REPORTS

Vibration Test of EOGO Experiment Module Box (621-24, 4/9/61)

Solar Simulation and Thermal-Vacuum Environmental Exposures for OGO (626-5, 10/12/61)

Magnetic Test of University of Michigan Motor for OGO Experiment (624-3, 3/20/62)

Magnetic Test of OGO (PS-8) Power Supplies (624-4, 3/26/62)

Vibration Test of the Welded and Riveted OGO Door Mounted Experiment Containers (621-29, 5/3/62)

Vibration Test of the OGO Experiment Honeycomb Module Box (621-32, 5/11/62)

Vibration Test of the OGO Rubidium Vapor Magnetometer (621-30, 5/14/62)

Vibration of OGO Rubidium Vapor Magnetometer Bias Coil System (621-46, 6/19/62)

Vibration of OGO Micrometeorite Detector (621-50, 7/3/62)

Vibration Test of OGO Rubidium Vapor Magnetometer Gas Cell Assembly (621-54, 7/18/62)

Magnetic Testing of University of Michigan Receiver (634-001, 7/18/62)

Magnetic Test of OGO Magnetometer Switch (634-002, 7/18/62)

Magnetic Testing of University of Michigan Antenna Assembly for OGO (634-003, 7/24/62)

Magnetic Tests on OGO Power Supplies (634-004, 7/25/62)

Magnetic Testing of University of Michigan Main Body Box for OGO (634-005, 8/2/62)

Vibration of OGO OPEP Scanner (621-60, 8/10/62)

Vibration of OGO Signal Conditioner (621-61, 8/14/62)

Vibration of OGO Image Dissector Tube (621-62, 8/27/62)

Vibration of OGO Films for Dust Particle Experiment (621-63, 8/29/62)

Vibration of OGO Nuclear Abundance Box (621-64 9/19/62)

OGO Experiment No. 14 Pre-Environmental Magnetic Test (634-012, 9/26/62)

Magnetic Testing of OGO Experiment No. 17 (634-013, 10/4/62)

OGO Experiment No. 19 Pre-Environmental Magnetic Test (634-015, 10/17/62)

OGO Sling Test (621-76, 10/29/62)

OGO Experiment No. 3 Pre-Environmental Magnetic Test (634-019, 11/19/62)

OGO Experiment No. 1 (634-020, 12/3/62)

Recommended Revision to the Qualification Vibration Test Specifications for OPEP Mounted OGO/S-49 Experiments (621-89, 12/5/62)

Failure Analysis of OGO Magnetometer Bias Coil Switch (633-009, 12/5/62)

OGO (S-49) Atmospheric Mass Spectrum Experiment No. 15; Solar Simulation Test (322-12-62, 12/7/62)

OGO Experiments No. 3 (634-023, 12/12/62)

Orbiting Geophysical Observatory (S-49) Magnetic Test Data (634-025, 1/4/63)

Recommended Revision to the Qualification Vibration Test Specifications for OGO/S-49 Boom-mounted Experiments (621-103, 1/10/63)

OGO (S-49) Magnetic Test Data (634-027, 1/14/63)

Shock Pulse Tolerances for Environmental Design Qualification Tests of OGO Electronic and Mechanical Assemblies (621-106, 1/23/63)

OGO (S-49) Magnetic Test Data (634-028, 1/28/63)

Recommended Revision to the Acceptance Vibration Test Specifications for OGO/S-49 Boom-mounted Experiments (621-115, 2/11/63)

EOGO Rubidium Vapor Magnetometer (322-1, 2/11/63)

OGO/S-49 Experiment No. 17 (Helliwell) Antenna Inflation Test in the GSFC Dynamic Test Chamber, April 18, 1963 (631-130, 4/18/63)

OGO Experiment No. 8 Solar Simulation (632-7, 7/10/63)

Solar-Vacuum Design Evaluation Test of the OGO-A EP-1 Unit (632-11, 9/17/63)

Solar Simulation of OGO Heppner Experiment No. 2 (632-14, 10/14/63)

Recommended Revisions to OGO Vibration STL Specifications (631-183, 12/3/63)

Revised OGO Experiment Vibration Specifications (631-185, 12/6/63)

Solar Simulation of OGO Heppner Experiment No. 2 Test Results (632-26, 12/17/63)

Technical Justification for Directing STL to Perform 16-22 cps Sweep at 3.2 g-rms Along the Pitch Axis on the OGO Prototype Spacecraft (631-187, 12/27/63)

OGO Van Allen Experiment (642-18, 4/16/64)

TECHNICAL NOTES

The Orbiting Geophysical Observatory, A New Tool for Space Research (TN D-1450, August 1962)

AGENA
S-50 ORBITING GEOPHYSICAL OBSERVATORY – OGO-C (POLAR)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Space Technology Laboratories, Redondo Beach, California

DATES

Tests scheduled to begin first quarter, 1964

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Magnetic Testing of POGO Mass Spectrometer (324-6, 6/26/62)

POGO Magnetometer Testing (634-006, 8/23/62)

Additional Magnetometer Testing of POGO Mass Spectrometer (634-009, 9/18/62)

AGENA
NIMBUS

ENVIRONMENTAL TEST PROGRAM

LOCATION

GE Space Technology Center, Valley Forge, Pennsylvania

DATES

Prototype – September 18, 1963 to May 1, 1964
Flight Unit 1 – Began testing April 24, 1964

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Vibration Test of the Nimbus Clock Receiver (621-26, 4/12/62)

Sine Survey of Nimbus Battery Module 102-A (621-75, 10/26/62)

Design Qualification Tests of Nimbus Battery 107-A (621-77, 10/31/62)

Vibration Test of the Prototype Nimbus Radiometer P-2 (621-107, 2/6/63)

Vibration Test of the Nimbus Paddles on the Structural Model at G. E. (631-153, 6/13/63)

Vibration Test of Nimbus A-4 Paddles on the Structural Model at G. E. (631-168, 9/3/63)

Vibration Test of Prototype Spacecraft (631-177, 10/7/63)

TECHNICAL NOTES

Earth Oblateness and Relative Sun Motion Considerations in the Determination of an Ideal Orbit for the Nimbus Meteorological Satellite (TN D-1045, July 1961)

The Nimbus Spacecraft and its Communication System as of September 1961 (TN D-1422, January 1963)

An Analysis of Errors in the Geographic Referencing of Nimbus Cloud Pictures (TN D-2137, January 1964)

Geographic Grid of Nimbus Cloud Pictures (TN D-2136, February 1964)

AGENA
ECHO II (A-12 – ECHO C)

ENVIRONMENTAL TEST PROGRAM

LOCATION

Grumman Aircraft, Long Island, New York

DATES

Canisters with balloons – May to December 1963
Inflation Tests with three balloons – June to December 1963

LAUNCH

Launch Range – Pacific Missile Range
Date – January 25, 1964
Orbital Operation – As of June 1, 1964, still being utilized for communications experiments.

ENVIRONMENTAL TEST DOCUMENTS

FORMAL REPORTS

Stereo Photography of the Echo II Balloons Nos. 9, 11, and 13 (X-524-63-259, 11/63)

MEMORANDUM REPORTS

Humidity and Acceleration Tests of Pyrotechnic Circuits for Echo A-12 Data Capsule (626-2, 9/28/61)

Echo (A-12) Results of a Paint Volatilization Test on a Transmitter Sample Plate (320-30-61, 11/29/61)

Preliminary Analysis of Echo A-12, Application Vertical Test Number 1 (AVT-1) In-Flight Vibration Data (621-10, 2/2/62)

Echo (A-12) Beacon No. 202 Calibration (324-7, 6/26/62)

Echo (A-12) Beacon No. 202 (634-007, 8/23/62)

Echo (A-12) Beacon No. 201 Calibration (634-011, 9/21/62)

Echo (A-12) Prototype Solar Cell Modules (634-016, 10/18/62)

Vibration Test of Echo A-12 Solar Modules (621-73, 10/22/62)

Investigation of Carlsbad Caverns for Echo A-12 Test Site (636-016, 2/25/63)

Echo Gore Drop Tests in the GSFC Dynamic Test Chamber, March 18-22, 1963 (631-127, 4/15/63)

Echo Gore Drop Tests in the GSFC Dynamic Test Chamber, April 8-12, 1963 (631-135, 5/3/63)

Echo A-12 Balloon Deployment Tests in the GSFC Dynamic Test Chamber July 25, 1963 Through December 19, 1963 (641-3, 1/22/64)

SPECIFICATIONS

Environmental Qualification Test Specification for Subsystems and Components, Echo A-12, AVT-1 (A-12-AVT-100, 7/19/61)

Environmental Acceptance Test Specification for Subsystems and Components, Echo A-12, AVT-1 (A-12-AVT-200, 7/19/61)

Environmental Qualification Test Specification for Television Camera, Echo A-12, AVT-1 (A-12-AVT-101, 8/15/61)

Environmental Acceptance Test Specification for Television Camera, Echo A-12, AVT-1 (A-12-AVT-201, 8/21/61)

TECHNICAL NOTES

Project Echo – Antenna Sterring System (TN D-1137, September 1961) Bell Telephone Laboratories

Project Echo – Boresight Cameras for Recording Antenna Pointing Accuracy (TN D-1138, September 1961) Bell Telephone Laboratories

Project Echo – 960-Megacycle, 10-Kilowatt Transmitter (TN D-1129, October 1961) Bell Telephone Laboratories

Project Echo – FM Demodulators with Negative Feedback (TN D-1134, October 1961) Bell Telephone Laboratories

Project Echo – System Calculations (TN D-1128, November 1961) Bell Telephone Laboratories

Project Echo – Satellite Tracking Radar (TN D-1135, November 1961) Bell Telephone Laboratories

Project Echo – Receiving System (TN D-1130, December 1961) Bell Telephone Laboratories

A Comparison of Theory and Observation of the Echo I Satellite (TN D-1124, December 1961)

Participation of Bell Telephone Laboratories in Project Echo and Experimental Results (TN D-1127, December 1961) Bell Telephone Laboratories

Project Echo – Horn-Reflector Antenna for Space Communication (TN D-1131, December 1961) Bell Telephone Laboratories

Project Echo – The Dual Channel 2390-Mc Traveling-Wave Maser (TN D-1132, December 1961) Bell Telephone Laboratories

Project Echo – Standby Receiver System (TN D-1133, December 1961) Bell Telephone Laboratories

Project Echo – 961-Mc Lower-Sideband Up-Converter for Satellite Tracking Radar (TN D-1136, December 1961) Bell Telephone Laboratories

Flight Shock and Vibration Data of the Echo A-12 Application Vertical Tests (AVT-1 and AVT-2) (TN D-1908, October 1963)

MISCELLANEOUS REPORTS

Final Report Echo A-12 Static Inflation Test No. 2 (11/1/63 – GSFC, Project Office)

Echo A-12 Flight Report (Goddard Launch Operations Branch, Pacific Missile Range, Point Arguello, California, March 12, 1964)

AGENA
RANGER

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Vibration Test of the Ranger Microphone Diaphragm (621-44, 6/15/62)

Vibration Test of the Ranger Binary Module (621-45, 6/21/62)

AGENA
MARINER B

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Planetary Capsule Shock Mitigator Evaluation (621-112, 2/7/63)

SOUNDING ROCKETS

AEROBEE 150-150A (4.00)

AEROBEE 300-300A – SPAEROBEE (17.00)

JAVELIN – ARGO D-4 (8.00)

NIKE-CAJUN (10.00)

JOURNEYMAN – ARGO D-8 (11.00)

NIKE-APACHE (14.00)

ASTROBEE 1500 (16.00)

GENERAL TECHNICAL NOTES

SOUNDING ROCKETS
AEROBEE 150-150A (4.00)

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Vibration Test of the NASA Aerobee 4.68 Flight Payload (621-2, 10/2/61)

Vibration Testing of the Lewis Research Center Aerobee Zero Gravity Payload (NASA 4.40) (621-3, 10/13/61)

NASA 4.18 Ejection Test on TAR 1040 Post-Test Memorandum No. 1 (621-12, 1/25/62)

NASA 4.18 Ejection Test on TAR 1040 Post-Test Memorandum No. 2 (621-13, 1/25/62)

NASA 4.18 (Aerobee) Ejection Test Report (TAR 1040) (621-17, 3/1/62)

4.18 Failure Analysis (621-25, 4/11/62)

Structural Tests of the 4.48 15-Inch Extension (621-34, 4/17/62)

4.18 Failure Analysis (follow-up) (621-27, 4/23/62)

Vibration Experiments of Aerobee, NASA 4.20 and NASA 4.68 (621-35, 5/18/62)

NASA 4.58 Static Bend Tests (631-123, 4/3/63)

NASA 4.96 Nose Cone Separation and Antenna Deployment Tests (631-125, 4/3/63)

NASA 4.97 Nose Cone Separation and Antenna Deployment Tests (631-143, 5/20/63)

Aerobee 150 Fin Impingement Test, Report No. 1 (631-145, 5/23/63)

NASA 4.65 Aerobee Nose Cone Separation Antenna Deployment Tests (631-174, 9/18/63)

TECHNICAL NOTES

Flight Vibration Data of the Aerobee 150A Sounding Rocket (G-526, February 1964)

SOUNDING ROCKETS
AEROBEE 300-300A – SPAEROBEE (17.00)

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

NASA 6.06 (Aerobee 300) Ejection Tests (TAR 2743) (621-84, 11/21/62)

Vibration Testing of the 6.06 Sounding Rocket (621-97, 12/26/62)

SOUNDING ROCKETS
JAVELIN – ARGO D-4 (8.00)

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Javelin Nose Cone Separation Tests (621-19, 3/9/62)

Nose Cone Separation and Boom Deployment Test of NASA 8.19 (631-126, 4/11/63)

NASA 8.19 Nose Cone Separation and Boom Deployment Test (631-140, 5/14/63)

TECHNICAL NOTES

The Javelin Spike Antenna; Radiation Patterns and Voltage Standing-Wave Ratio (TN D-565, January 1961)

SOUNDING ROCKETS
NIKE CAJUN (10.00)

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

UA Payload – Nike Cajun (322-6, 5/16/62)

SOUNDING ROCKETS
JOURNEYMAN – ARGO D-8 (11.00)

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

University of Michigan Radio Astronomy Probe, Argo D-8 (322-4, 5/16/62)

SOUNDING ROCKETS
NIKE APACHE (14.00)

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Nike Apache Neutral Particle Pitot-Static Experiment (NASA 14.19), UA Results of Thermal-Vacuum Tests (322-5-62, 5/16/62)

NASA 14.11 Spacecraft, Strain Gage Applications and Calibration (631-169, 9/5/63)

TECHNICAL NOTES

Nike Apache Performance Handbook (TN D-1699, March 1963)

SOUNDING ROCKETS
ASTROBEE 1500 (16.00)

ENVIRONMENTAL TEST DOCUMENTS

MEMORANDUM REPORTS

Vibration Experiment for Astrobee (621-58, 8/6/62)

Vibration Testing of NASA 16.01 Sounding Rocket Payload (621-109, 1/29/63)

SOUNDING ROCKETS
GENERAL TECHNICAL NOTES

Ionospheric Results with Sounding Rockets and the Explorer VIII Satellite (TN D-1079, August 1961)

Launch Environment Profiles for Sounding Rockets and Spacecraft (TN D-1916, January 1964) (Contract NAS 5-2415)

QUALITY ASSURANCE DOCUMENTS

FAR
FAILURE ANALYSIS REPORTS

QER
QUALITY ENGINEERING REPORTS

PACER
PARTS AND COMPONENTS EVALUATION REPORTS

ALERT REPORTS

QUALITY ASSURANCE DOCUMENTS
FAILURE ANALYSIS REPORTS (FAR)

Corrosive Deterioration of S-6 Prototype Optical Aspect Computer Board (FAR-141-001, 7/2/62)

Mechanical Failures in Sylvania 1N252 and 1N461 General Purpose Silicon Diodes (FAR-751-001, 7/10/62)

Texas Instruments 2N1405 Transistor Failures Encountered in Syncom and Tiros Programs (FAR-752-001, 7/11/62)

Western Electric 2N1645 Transistor Failure in the S-6 Telemetry Transmitter (FAR-752-002, 8/27/62)

Structural Inconsistencies in S-3a Battery Containers (FAR-102-001, 9/26/62)

Mechanical and Thermal Evaluation of the Silicon Transistor Corporation 2N1724/I (FAR-752-003, 10/8/62)

Mechanical Failure of GE Transistor Type 4JX4D545 in S-3b Subassembly During Vibration Test (FAR-752-004, 10/31/62)

Failure Analysis of OGO Magnetometer Bias Coil Switch (FAR-791-001, 12/5/62)

Transistor 2N336, Texas Instruments, Lot Number 980820 (FAR-752-005, 12/7/62)

Transistor, 2N336A, National Semiconductor Corporation (FAR-752-006, 1/22/63)

Failure Analysis of Raymond G Switch Timer, Model 1060 (FAR-811-001, 3/29/63)

Squib Failure (FAR-415-001, 6/6/63)

Transistor, 2N718, Industro Transistor Corporation (FAR-752-007, 9/12/63)

Investigation of Cannon Electric Company Type D-Subminiature Connectors (FAR-201-001, 11/14/63)

Analysis of Failures of Aerovox Type MC80V Cerafil Capacitors (FAR-151-001, 12/3/63)

Failure Analysis of Endevco Corporation Accelerometer, Model 2221C, Serial Number FD-49 (FAR-852-001, 4/17/64)

QUALITY ASSURANCE DOCUMENTS
QUALITY ENGINEERING REPORTS (QER)

Quality Assurance Survey to Requirements of NASA Quality Publication NPC 200-3, and High Reliability Specification for Bourns, Incorporated Relays and Potentiometers (QER-64-24, 3/31/64)

Quality Assurance Survey to Requirements of NASA Quality Publication NPC 200-3, and High Reliability Specification for Babcock Relays (QER-64-23, 4/1/64)

Quality Assurance Survey to Requirements of NASA Quality Publication NPC 200-3, and High Reliability Specification for Gyrex Corporation Resonators (QER-64-26, 4/3/64)

Quality Assurance Survey of Memorex Corporation (QER-64-39, 5/21/64)

Quality Assurance Survey of Aerovox Corporation, Hi-Q Division; and High Reliability Specifications for Aerovox Capacitors (QER-64-41, 6/9/64)

Quality Assurance Survey to Requirements of NASA Quality Publication NPC 200-3, and Review of SHARP (SSPI High Assured Reliability Products) Program of Solid State Products, Inc. (QER-64-36, 6/11/64)

QUALITY ASSURANCE DOCUMENTS

PARTS AND COMPONENTS EVALUATION REPORTS (PACER)

Reliability Study of Miller Research Lab Timers, Model A1006 (PACER-811-001, 12/26/62)

Failure of Sprague 109D Capacitors (PACER-151-002, 5/6/63)

Evaluation of the Sprague Type 136D Capacitors (PACER-151-003, 9/11/63)

Evaluation of National Semiconductor Corporation NS291 and Texas Instruments SMO 201A Transistor (PACER-752-001, 9/12/63)

Summary Report of Malfunctions and Other Defects Noted During Evaluation of Miller Timer, Model D10000 (PACER-811-002, 11/22/63)

Evaluation of Workmanship on Printed Circuit Board Assemblies (PACER-141-001, 12/19/63)

Evaluation of the Unitrode UT242 Rectifier (PACER-741-002, 6/3/64)

Completion of Maturity Test on Miller Timer Model D10000 (PACER-811-003, 4/28/64)

Raytheon Transistors, Type 2N329A (PACER-742-003, 4/28/64)

Radiation Testing of Silicon Transistor Corporation 2N1724/I Transistors Using Cobalt-60 Gamma Rays and 2-Mev Electrons (PACER-742-002, 4/30/64)

QUALITY ASSURANCE DOCUMENTS
ALERT REPORTS

Cannon Connectors (ALERT-201-001, 10/23/63)

Transistor, Pacific Semiconductor Corporation, Type PRT-644A (ALERT-742-001, 3/4/64)

Failure of Type TK21 Rectifiers During SA-9 Static Firing; Purchased from Transistron Electronic Corporation (ALERT-741-002, 5/21/64)

Squib, Hercules Powder Company, Model SD-2A8 (ALERT-415-001, 6/10/64)