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ENVIRONMENTAL TEST OF NIKE APACHE ROCKET NASA 14.111 GT

BY
J. A. STERHARDT

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NASA

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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SUMMARY

A Nike Apache rocket, NASA 14.111 GT, was fired from Wallops Island, Virginia on 31 October 1963 at 2117 Z with a special instrumented payload in order to obtain actual environmental data of a Nike Apache payload during launch and flight. The test was initiated by the Test and Evaluation Division of Goddard Space Flight Center, to obtain vibration, shock and thermal data during launch and flight. The Sounding Rocket Branch added instrumentation to obtain roll, yaw and pitch data, the determination of the stresses in the payload housing shell, and qualification test of a PPM telemetry unit. All test instrumentation functioned perfectly. This report summarizes the data obtained during launch and flight.

APPENDICES

ENVIRONMENTAL TEST OF NIKE APACHE ROCKET
NASA 14.111 GT

INTRODUCTION

The Nike Apache is a two stage solid propellant, unguided, fin stabilized rocket. It is made up of a four finned Nike M5-E1 first stage and a four finned Apache TE 307 Mod II second stage. The Nike is ignited at launch and burns for 3.5 seconds, after which it drag separates from the second stage by differential drag forces. The Apache ignites 20 seconds after the first stage and burns for about six seconds. The Apache remains attached to the payload throughout the remainder of the ballistic flight. Figure 1 shows rocket 14.111 GT installed on the military launcher at Wallops Island, ready for firing. The individual weights, centers of gravity and dimensions of the rocket are shown on Figure 11.

Payload Instrumentation

The instrumentation was installed in a standardized Nike Capache payload housing, Type I, GCA dwg. 3038A4001. The payload housing consisted of an adapter ring, to attach the payload to the Apache motor headcap, an antenna section, with four turnstile antennas, an instrumentation rack, a payload shell, and a nose cone with a stainless steel nose tip. The nose tip was modified to accommodate a Giannini Controls Corporation Ogive Transducer No. 2519, see Fig. 12. A pair of quadraloop antennas were installed on the payload shell at approximately station 42. The following instrumentation was installed in the instrumentation rack and payload shell:

Thermocouples (3)	Copper – Constantan (TC1, TC2, TC3)
Thermistors (20)	Transonic – No. 1375B
Strain Gauges (6)	Baldwin-Lima-Hamilton-No. FAB 25-50-S13
Accelerometers (6)	Kistler-Model 303-M10-1
Accelerometers (6)	Endevco No. 221C
Pitch-Yaw Ogive (1)	Giannini – Model 2519
Magnetometers (4)	Heli Flex RAM-3

Altitude Switches	Carmac Co. ES-4 series
"G" Switch	Model 1654
FM/FM Telemetry (1)	231.4 Mc/s – 2 watts
FM/FM Telemetry (1)	240.2 Mc/s – 2 watts
PPM Telemetry (1)	244.3 Mc/s – 35 watts

The instrumentation installation is reported in ref. 6. The installation of the instrumentation in the rack is shown in Figures 2, 3, 4, 5, 6, 7, 9, and 10. The strain gages were calibrated by applying a load on the payload shell, as shown in Fig. 8. The location of the strain gages and thermistors is shown on Figures 25, 27, 28 and 29. The complete payload was balanced to obtain a residual unbalance of 2.0 ounce-inch static and 90.8 ounce-inch^2 dynamic. The roll moment of inertia was 0.14 slug/ft.^{2} and the transverse moment of inertia was 5.39 slug/ft.^{2}

FLIGHT DATA

Rocket Data

NASA rocket 14.111 GT was fired from Wallops Island, Virginia in accordnace with GSFC Flight Plan (appendix (A)), Wallops Test Directive (appendix (B)), Wallops Flight Safety Plan (appendix (C)) and Wallops Ground Safety Plan (appendix (D)). The results of the flight were reported in NASA Report of Sounding Rocket Launching (appendix (E)) and NASA Sounding Rocket Post Flight Summary (appendix (F)).

The Nike fins were set at an angle of 25 minutes to obtain a roll rate of 2 RPS clockwise looking forward. Wedges were added to the trailing edges of the four Apache fins to obtain a roll rate of 5 RPS clockwise looking forward, at the estimated velocity at Apache burnout. The wedges were attached to the trailing edges of all four Apache fins, and the height of the wedges, .201 inches was determined in accordance with (appendix G). The actual alignment of the Apache fins is shown on ARC Inspection Report (appendix H).

PERFORMANCE

The performance of the rocket motors was satisfactory. However, the peak altitude was approximately 9% below predicted, possibly caused by the high coning angle after 40 seconds of flight. The rocket roll rate was not satisfactory.

The roll rate reduced to near 2.0 RPS after hitting a peak of 7 RPS at Apache ignition. A reduction in roll rate has been observed on other Nike Apache flights but the minimum is generally not as low as observed on this flight. A comparison of the actual performance of the rocket with the estimated performance is tabulated below:

	Estimated	Actual
Booster Burnout		
Time	3.5 sec.	3.5 sec.
Altitude	5,399 ft.	5,339 ft.
Velocity	3,195 ft./sec.	3,195 ft./sec.
Apache Ignition		
Time	20 sec	21.95 sec.
Altitude	39,506 ft.	40,967 ft.
Velocity	1,511 ft./sec.	1,382 ft./sec.
Apache Burnout		
Time	26.4 sec.	28.95 sec.
Altitude	61,576 ft.	64,154 ft.
Velocity	5,659 ft./sec.	5,801 ft./sec.
Apogee		
Time	191.2 sec.	185.12 sec.
Altitude	90.7 st. mi.	83.3 st. mi.
Impact		
Time	374.4 sec.	361.5 sec.
Range	84.4 n. ni.	73.1 n. mi.

The actual performance curves obtained from radar and telemetry data are plotted on Figures 13 through 17. The Wallops Island final status report is in appendix I, their range instrumentation log is in appendix J, and the weather forecast is in appendix K.

RESULTS

Instrumentation

The instrumentation and the three telemetry systems functioned perfectly throughout the flight. An occasional signal dropout of the PPM telemetry is attributed to the large coning angle of the rocket after 40 seconds, however, good useable data were obtained. The large coning angle and possible roll-pitch coupling introduced loads on the payload-motor shell combination which was theoretically in excess of the design loads. The structure, however, showed no signs of distress during the complete trajectory.

Acceleration and Vibration

The acceleration and vibration data were reduced and analyzed by the Test and Evaluation Division and are reported in ref. 5. This report concludes that high level transient vibrations occurred at ignition of first and second stage motors with low levels between these events and that the spectral analysis of the data revealed significant levels at frequencies below 1000 cps. The maximum longitudinal steady state acceleration of the vehicle was 36.7 g during first stage burning, and 36.5 g during second stage burning. The resonant frequency was 135 cps at lift-off. The level of this resonance was 36 g peak at the bottom of the payload and 42 g peak at the top. All vibratory levels were transient in nature and decayed to insignificant levels in 0.2 seconds.

STRAIN GAGES

Instrumentation

The payload cylinder and the antenna housing were instrumented with strain gages, as shown in Fig. 25. Each instrument location consisted of four SR4 500 ohm strain gages arranged in the configuration shown in Fig. 25(c). These four gages were wired to act as the four legs of a wheatstone bridge, Fig. 26(d). This configuration gives good temperature compensation and an output signal equal to 2 $(1 + \mu)$ times the output of a single active gage.

During the calibration tests, the payload was cantilevered horizontally from the test stand and loaded in the axial and lateral directions to simulate the strains expected in the payload, see Fig. 8. Of the several calibration tests conducted, only the last test proved to be any value. A ratio of stress voltage of 4,830 psi/volt was obtained by averaging the slopes of the plotted curves from all the runs made. The accuracy of this value is estimated to be about 50 percent.

Flight Test Results

Output signals indicating strain were recorded from gages S1, S2, and S4. Gage S6 gave no indication of strain. The traces of gages S1, S2 and S4 show the same general pattern. This pattern was also noted in the trace of the lateral acceleration and in the plot of the angle of attack, see Fig. 26. A plot of $\alpha \cos \theta$ is also included in Fig. 26, where α is the angle of attack and θ is the angle between the axis through the gages and the angle of attack.

An oscillation of approximately 7 cps appears in the traces during the first two seconds. The spin rate during this time interval is between one and two revolutions per second. Maximum strain was indicated at about 3.65 seconds, followed by a dampening oscillation of approximately 7.5 cps. The maximum output signal was about .8 volts, which corresponds to a stress level of about 3,900 PSI, but in general, the output signal did not get over .2 volts during the remainder of the flight. This low signal resulted in poor accuracy in reading the traces. Tension is indicated in all gages during the initial two seconds, which is contrary to what was expected. The strains then became compressive after about 2.5 seconds. No reason was found to suspect a zero shift in the voltage.

Due to the low accuracy of the calibration tests and the measured strains, only a rough estimate of the maximum strain level in the payload can be made. The maximum strains do not appear to have been greater than half the yield strength of the material of the housing. An apparent similarity exists in the traces of the strain gage outputs, the lateral accelerometers, and the angle of attack. Future flight tests with improved instrumentation would be helpful in determining the exact strain levels.

TEMPERATURE

Twenty thermistors, Transonic No. 1375 B, were installed in the payload housing shell and instrumentation rack in order to obtain actual temperature profiles during rocket flight. The locations of the thermistors in the payload are shown in Figure 27. Curves of the reduced temperature data vs. time obtained from telemetry records are shown on Figure 30 for the outside and inside skin temperature of the payload housing and nose cone. The temperatures at Nike burnout and Apache burning are shown on Figures 28 and 29. An increase in temperature of 75° was observed in the vicinity of the quadraloop antennas at Nike burnout and during Apache burning. The inside skin thermistors did not indicate this increase in temperature, as shown in Figure 31.

The temperatures measured on the top deck were below 75°F during Nike and Apache burning, and were only 90°F during the entire flight. The bottom deck and deck No. 5 temperatures were about 80° during Nike and Apache burning. The bottom deck temperatures increased to 177°F at T + 150 seconds and stabilized at that temperature for the remainder of the flight. The temperatures on deck No. 5 increased to 92°F maximum at T + 150 seconds.

It is unfortunate that the thermistor, T14, malfunctioned at T + 3 seconds. The temperatures at this point were of particular interest since it is in high stress region of the payload housing shell. However, the measured temperatures did not exceed the computed temperatures, except near the quadraloop antennas, at station 45 of the payload. The design bending moment at this station is less than 20,000 inch pounds and the shell is designed for a bending moment of 55,800 inch pounds at station 75. The margin of safety at station 45 with a temperature of 280°F is adequate.

AERODYNAMIC LOADING

The trajectory characteristics up to T + 31 seconds are shown on Figure 20 as obtained from radar velocity and altitude measurements. The rocket weight history is shown on Figure 18. The moments of inertia of the payload in pitch and roll were measured after the payload was balanced. The total moments of inertia of the payload and the Apache motor are shown on Figure 19. The center of gravity of the payload and the Apache and Nike motors were measured at Wallops Island, this C. G. history vs. time up to T + 30 seconds is shown on Figure 19. The center of pressure locations along the Apache and payload were obtained from the Nike Apache Performance Handbook, Reference 1. The C. P. history to T + 30 seconds is shown on Figure 19. The axial force and bending moment histories at Sta. 75 are shown on Figure 21 and were obtained by combining the aerodynamic characteristics from reference 2 and the trajectory characteristics of Figure 20.

ROCKET ROLL HISTORY

The rocket roll rate vs. time is shown in Figure 22. The roll rate at Nike burnout was near the predicted 2 rps. The roll rate increased to a peak of 7 rps at Apache ignition, then dropped to 2 rps just prior to burnout. On most Nike Apache flights the roll rate is normally observed to increase again at this point and level off at 5 to 6 rps. On this flight, however, the minimum was low enough to cause pitch-roll coupling shortly after 26 seconds. The roll rate then continued to decrease as would be expected if it were in a locked-in condition. The increase in roll rate again near forty seconds, accompanied by an increase in coning angle may be attributed to breaking out of the locked-in condition.

PITCH AND YAW HISTORY

The pitch and yaw angles of the rocket during flight are shown on Figure 23. The attitude of the rocket was normal through Apache burnout. The rocket developed a large coning angle, 20° half angle, at approximately 41 seconds. This large coning angle continued to 63 seconds, when the recording stopped. The complex angle of attack, α, is shown on Figure 24.

The static stability of the rocket and payload should have been adequate to assure a stable flight. The C. G. was closest to the center of pressure at Apache burnout, 3.4 calibers forward. (See Fig. 19). The distance between the C. G. and C. P. increased after Apache burnout, thus increasing the stability. The large coning angle appears to have been caused by pitch roll coupling of the rocket near burnout of the second stage.

CONCLUSION

The flight of rocket 14.111 GT gave excellent shock, vibration, temperature and rocket performance data. The data obtained from the strain gages did not give any information which could be used for future design purposes. The measured angle of attack of the nose cone at Nike burnout was 4°, the design angle of attack for the standardized payload housing is 8°. The maximum stress level indicated by the strain gages was only 3900 psi which is considerably below the design level of 15,000 psi at Sta. 75.

The shock and vibration data obtained from the flight of 14.111 GT provided the required parameters for the specification test of Apache payloads. The temperature data obtained will be useful for design purposes of Apache payloads. Additional tests would be desirable to obtain actual structural loads and to investigate the roll rate and excessive coning problems of the Apache motor and payload.

ACKNOWLEDGMENTS

The assistance and cooperation of the following persons, who provided the data for this report is gratefully acknowledged:

Mr. J. S. O'Brien – Engineering Section
Mr. Howard Galloway – Flight Performance Section
Mr. E. E. Mayo – Flight Performance Section
Mr. John Cameron – Instrumentation Section
Mr. Lloyd A. Williams – T & E, Structural Dynamics Branch
Mr. C. M. Hendricks – Vehicles Section

REFERENCES

1. Reed B. Jenkins, Nike Apache Performance Handbook, NASA X-616-62-103

2. Spring, D. J., The Static Stability Characteristics of Several Cone-Cylinder-Flare-Cylinder Configurations at Mach Number 0.4 to 4.5, Redstone Arsenal Report No. RF-TR-63-14.

3. Memo by Mr. E. Mayo, Flight Performance Section to Mr. R. Rogers, Engineering Section, Subject: Flight 14.111 Payload Aerodynamic Axial Load and Bending Moment Histories.

4. Memo by Mr. Rogers to Mr. J. S. O'Brien – Engineering Section, Subject: Results of Strain Gage Instrumentation on Nike Apache 14.111 GT.

5. Goddard T&E Report of Nike Apache, 14.111 GT Launch Vibration Data – NASA

6. Instrumentation Report on Nike Apache Flight 14.111 GT

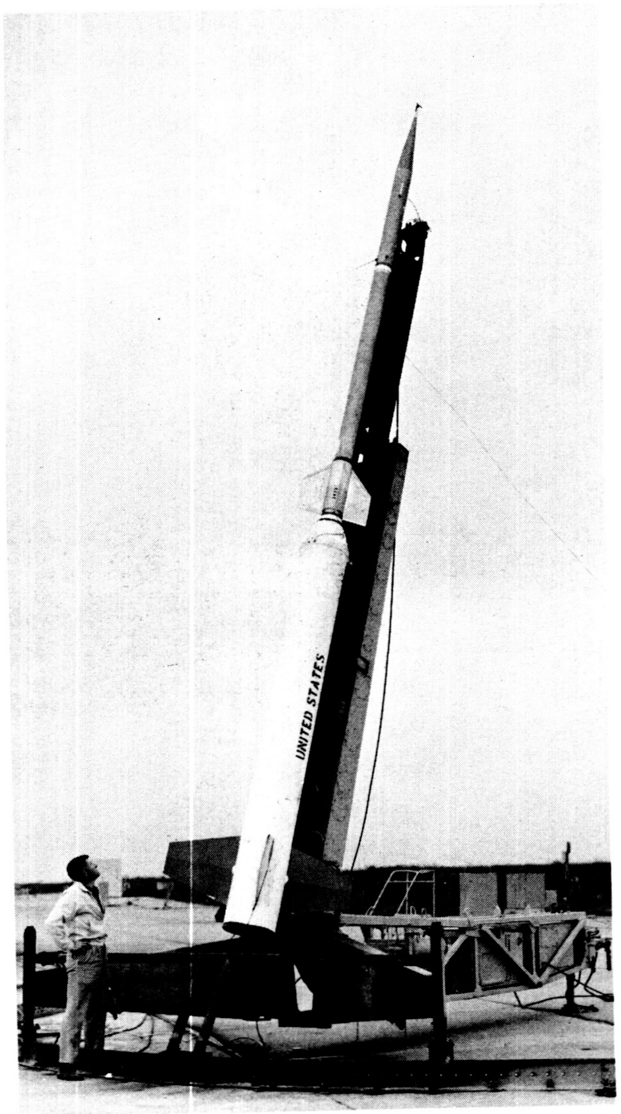


Figure 1–Rocket on Military Launcher

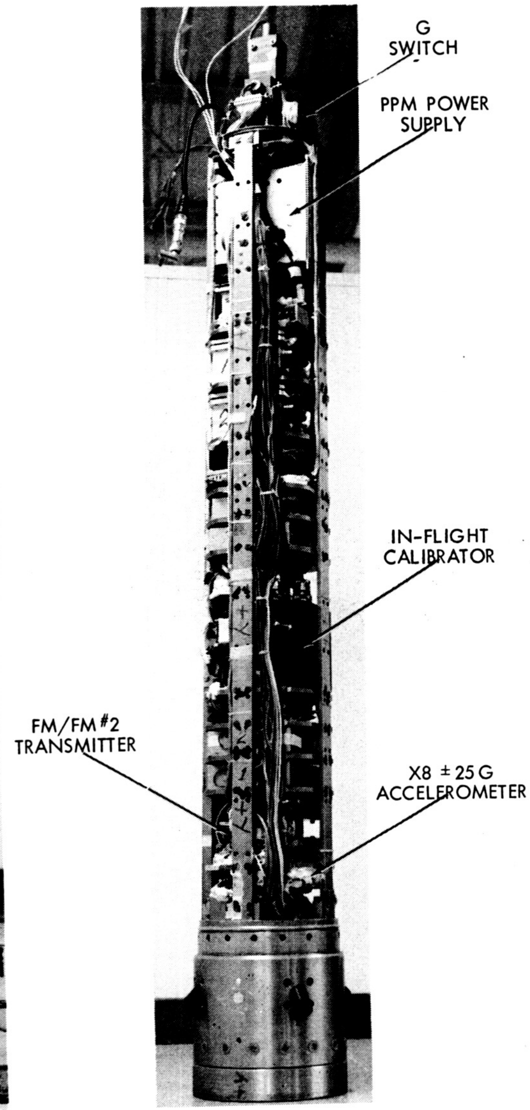


Figure 2–Payload Details

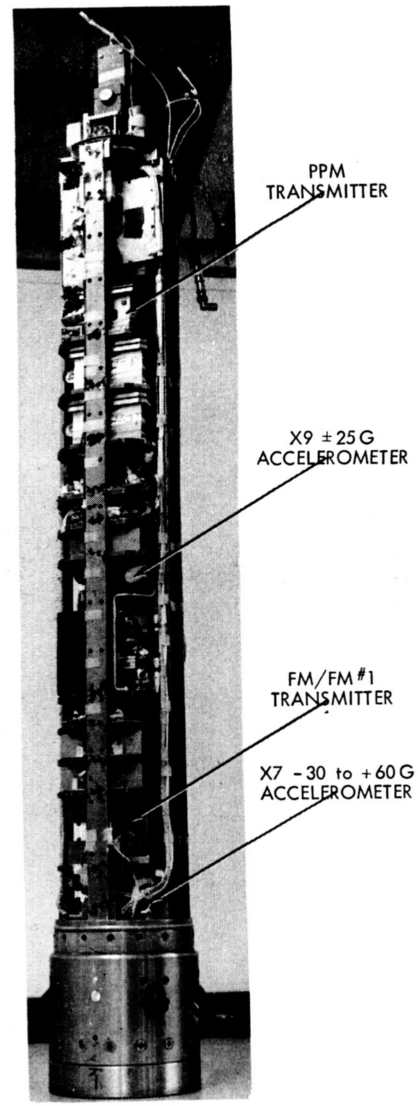


Figure 3–Payload Details

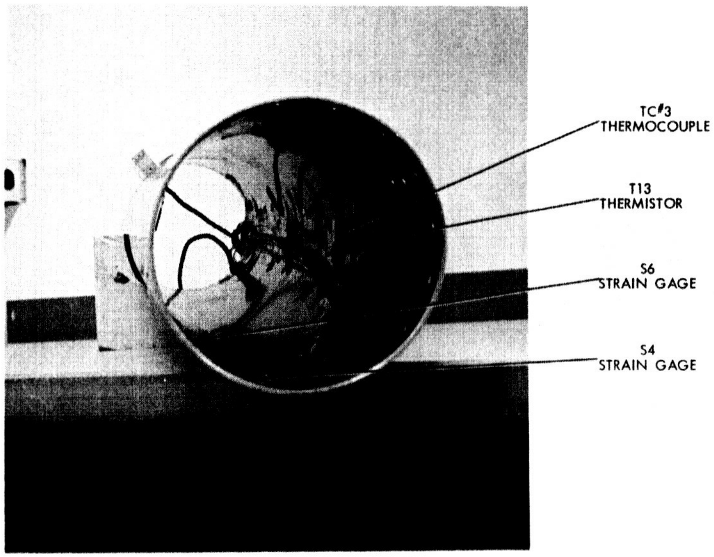


Figure 4–Payload Housing – Thermocouples and Strain Gages

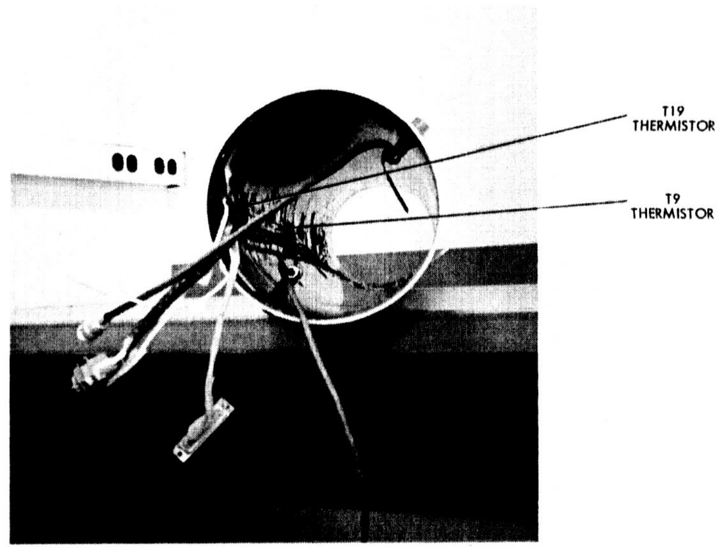


Figure 5–Payload Housing –Thermistors

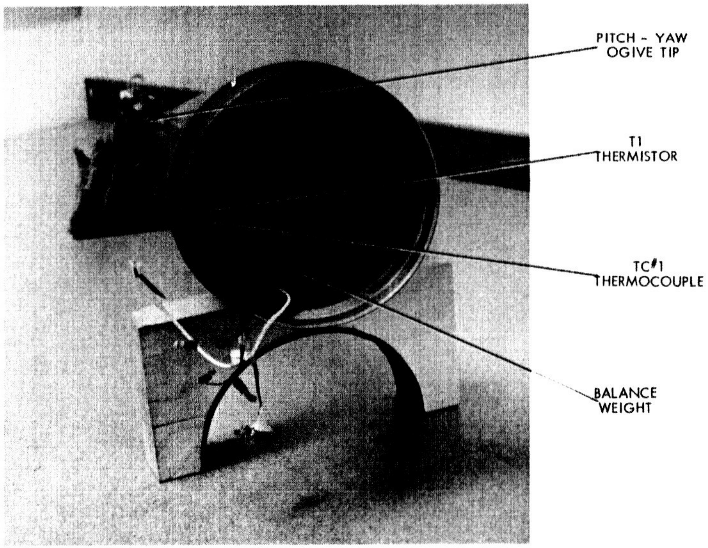


Figure 6–Payload Nose Cone

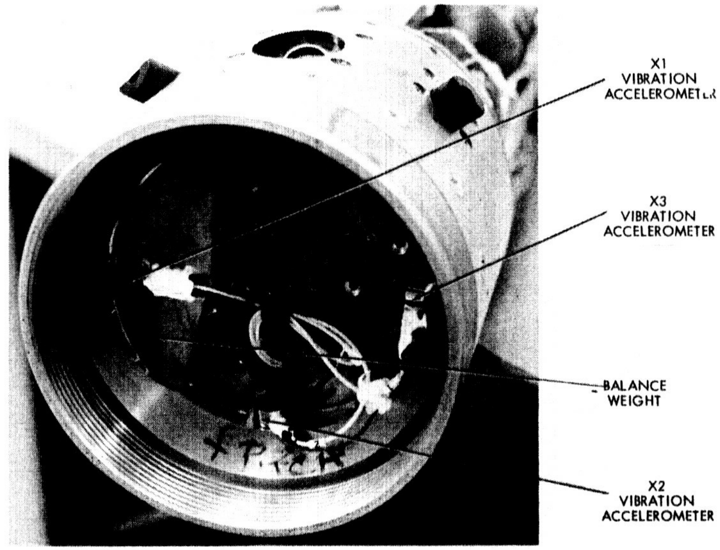


Figure 7–Payload Adapter Section

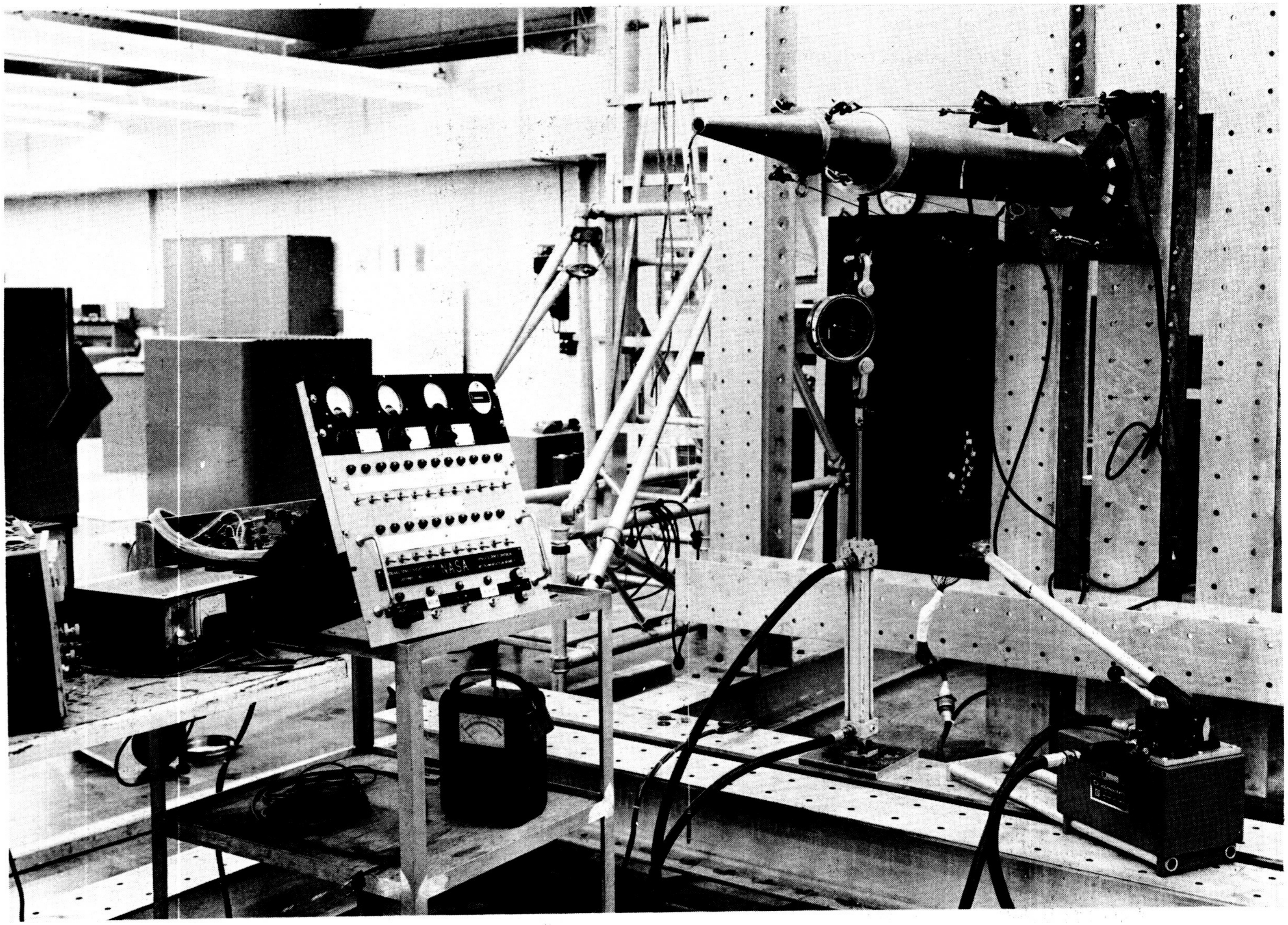


Figure 8—Calibration of Strain Gages

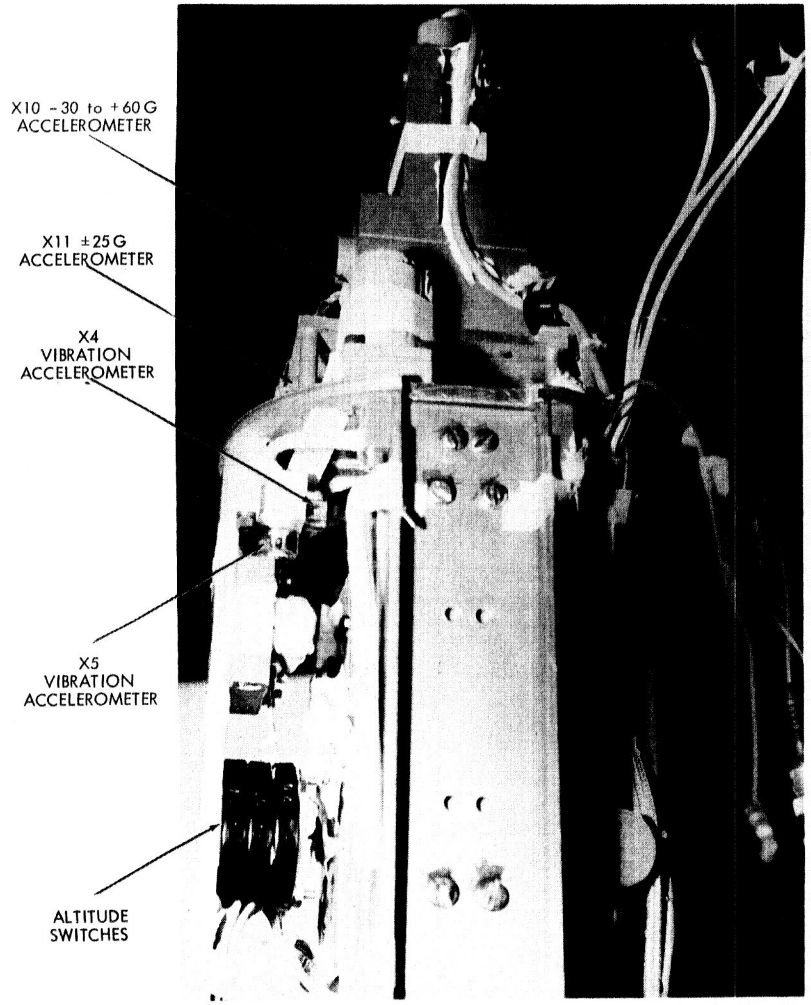


Figure 9–Payload – Accelerometer Installation

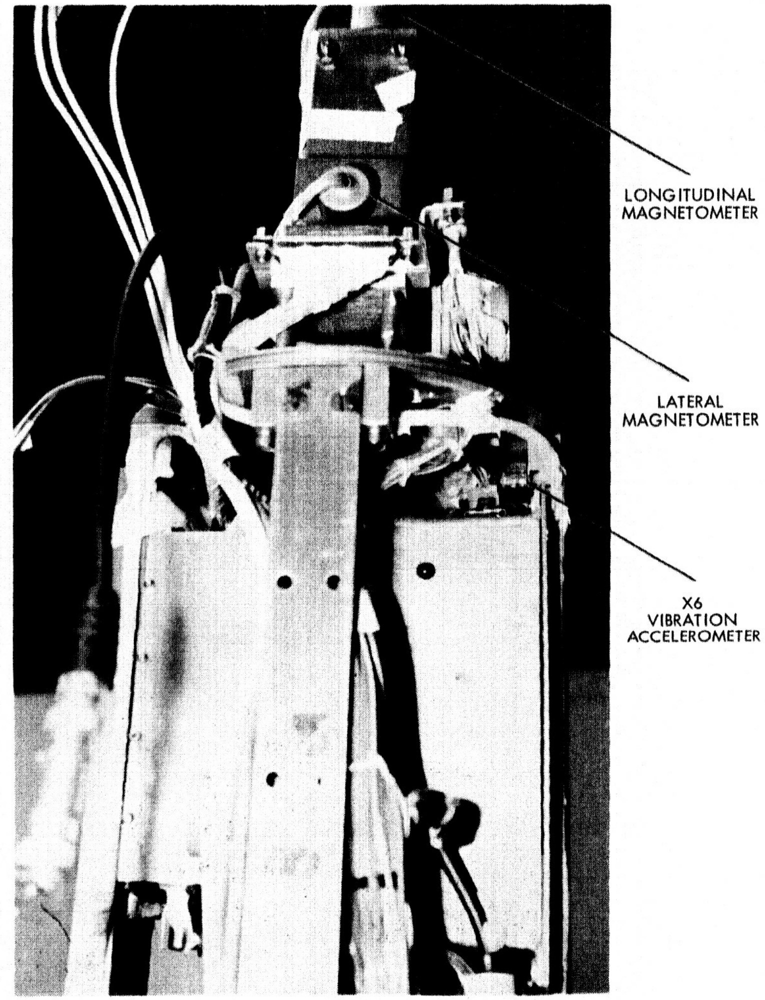
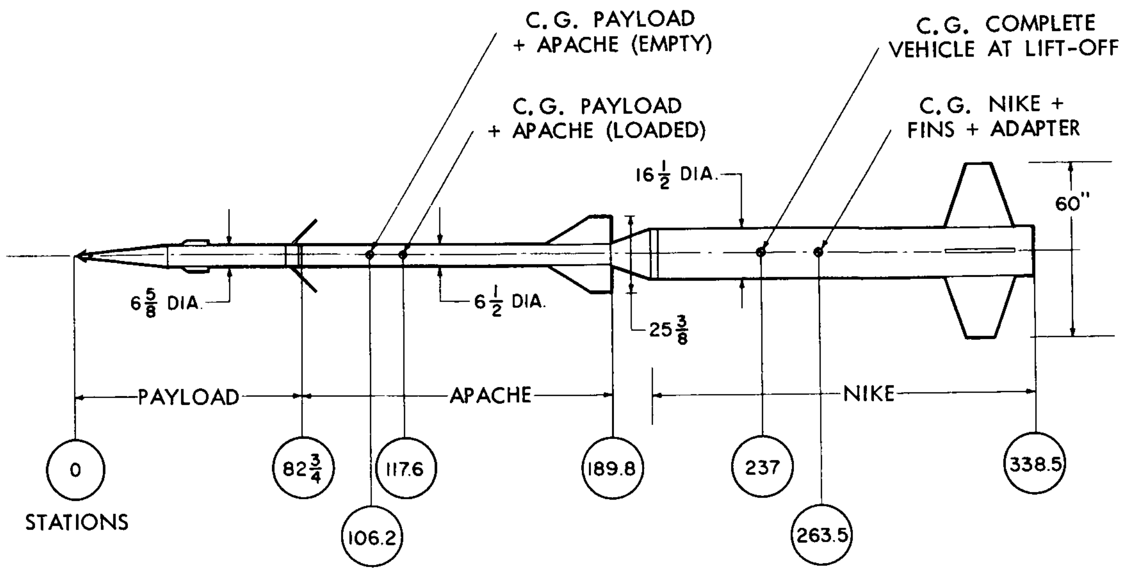
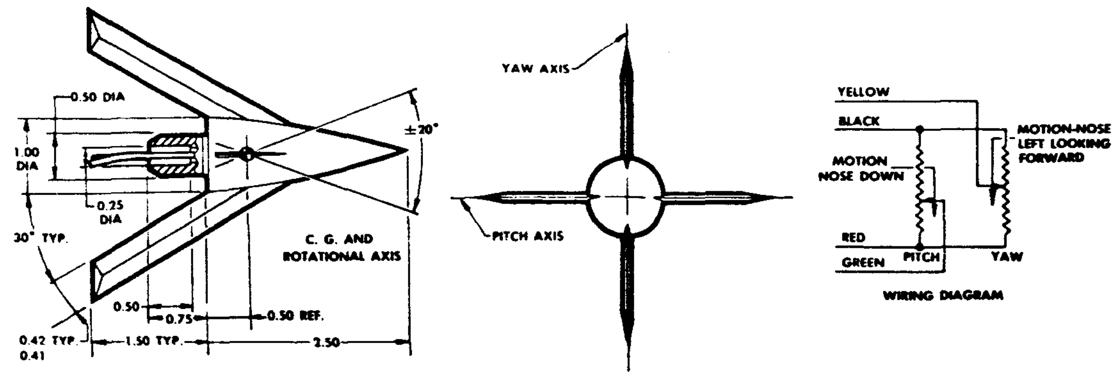


Figure 10–Payload – Accelerometer Installation



	WEIGHT LBS	C.G. FROM STA O	MOMENT
PAYLOAD-ACTUAL WT	77.0	52.32	4029
APACHE MOTOR	60.0	142.74	8564
PROPELLANT	131.0	131.74	17258
APACHE FIN ASS'Y	26.0	181.94	4730
TOTAL AT APACHE IGNITION-ACTUAL WT & C.G.	294.0	117.62	34581
TOTAL AT APACHE BURNOUT	163.0	106.2	17323
NIKE MOTOR + FINS + ADAPTER-ACTUAL WT	1319.66	263.5	347730
TOTAL WEIGHT AT LIFT-OFF	1613.66	237.0	382312

Figure 11–Rocket Weight and C. G. Tabulation



OUTPUT

RANGE: See Table

RESISTANCE: See Table

RESOLUTION: ±0.2° angular variation will produce a change in output

NATURAL FREQUENCY: 30 to 170 cps for Mach numbers between 1.6 and 2.9

LINEARITY: See Table

FRICTION: Torque required to move the head with a longitudinal load of 1 pound on the bearings will not exceed 0.15 ounce-inches

REPEATABILITY: ±0.2°

CROSSTALK: ±0.2°

INPUT

POWER RATING: 0.1 w

ENVIRONMENT

TEMPERATURE: 4.5 C to 121 C; range can be extended to −65 C and 260 C

ALTITUDE: Sea level to 60,000 ft

VIBRATION: Meets performance requirements during 0.02-in. peak-to-peak vibrations at 8 to 55 cps

ACCELERATION: 40 g

STRUCTURE

STOPS: Mechanical stops limit travel to ± 20° (−0.0° +2.0°) angular displacement; electrical continuity is maintained throughout mechanical limits

INSULATION RESISTANCE: 10 megohms min at 500 v dc

WEIGHT: 0.19 lb max

ORDERING INFORMATION

Many special modifications of this standard unit available on request. For additional information, contact your nearest Giannini Controls Corporation Sales Office.

CHICAGO 3, Illinois
8 South Michigan Avenue, ANdover 3-5272

NEW YORK 1, New York
Empire State Building, CHickering 4-4700

PASADENA, California
2275 East Foothill Blvd., SYcamore 3-2101

PALO ALTO, California
Town & Country Village, Room 261, DAvenport 1-6537

WASHINGTON 16, D.C.
5228 Westpath Way, OLiver 6-6556

DAYTON 19, Ohio
2600 Far Hills Avenue, Rm. 12, AXminster 9-7383

TYPE	PITCH AND YAW RANGE (DEGREES)	TOTAL RESISTANCE (OHMS)	LINEARITY % FULL RANGE
40/40 - 20/20	±20.0 to ±22.0	2000^{+300}_{-0}	1.0
30/30 - 15/15	±15.0 to ±16.3	1500^{+75}_{-0}	1.0
20/20 - 20/20	±10.0 to ±11.3	2000^{+300}_{-0}	2.0
20/20 - 10/10	±10.0 to ±11.3	1000^{+150}_{-0}	2.0
15/15 - 7.5/7.5	±7.5 to ±8.8	750^{+110}_{-0}	2.0
10/10 - 20/20	±5.0 to ±6.0	2000^{+200}_{-0}	2.0
10/10 - 5/5	±5.0 to ±6.0	500^{+75}_{-0}	2.0

Figure 12–Giannini Ogive Transducer Data Sheet

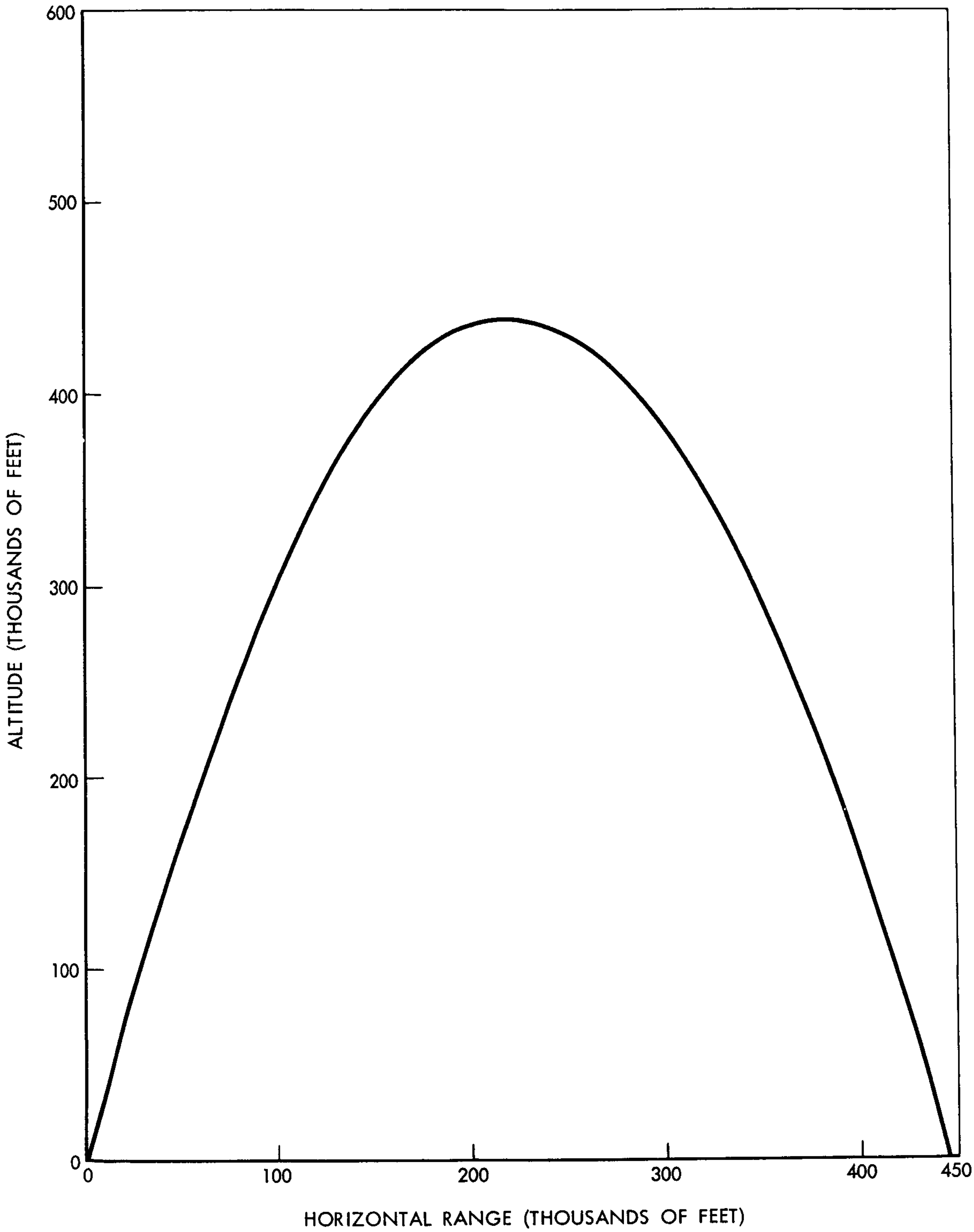


Figure 13–Actual Performance Curve – Altitude vs. Range

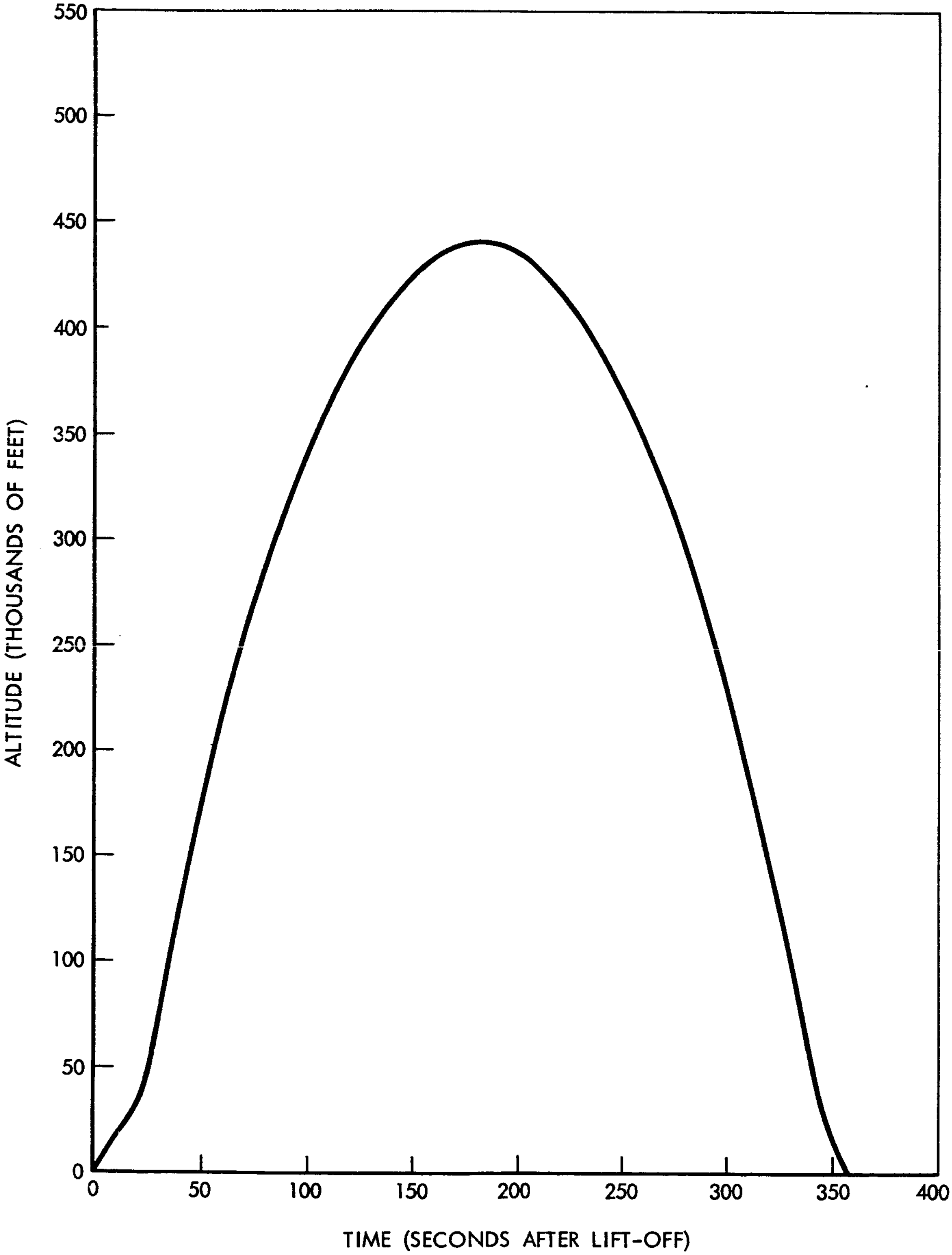


Figure 14–Actual Performance Curve – Altitude vs. Time

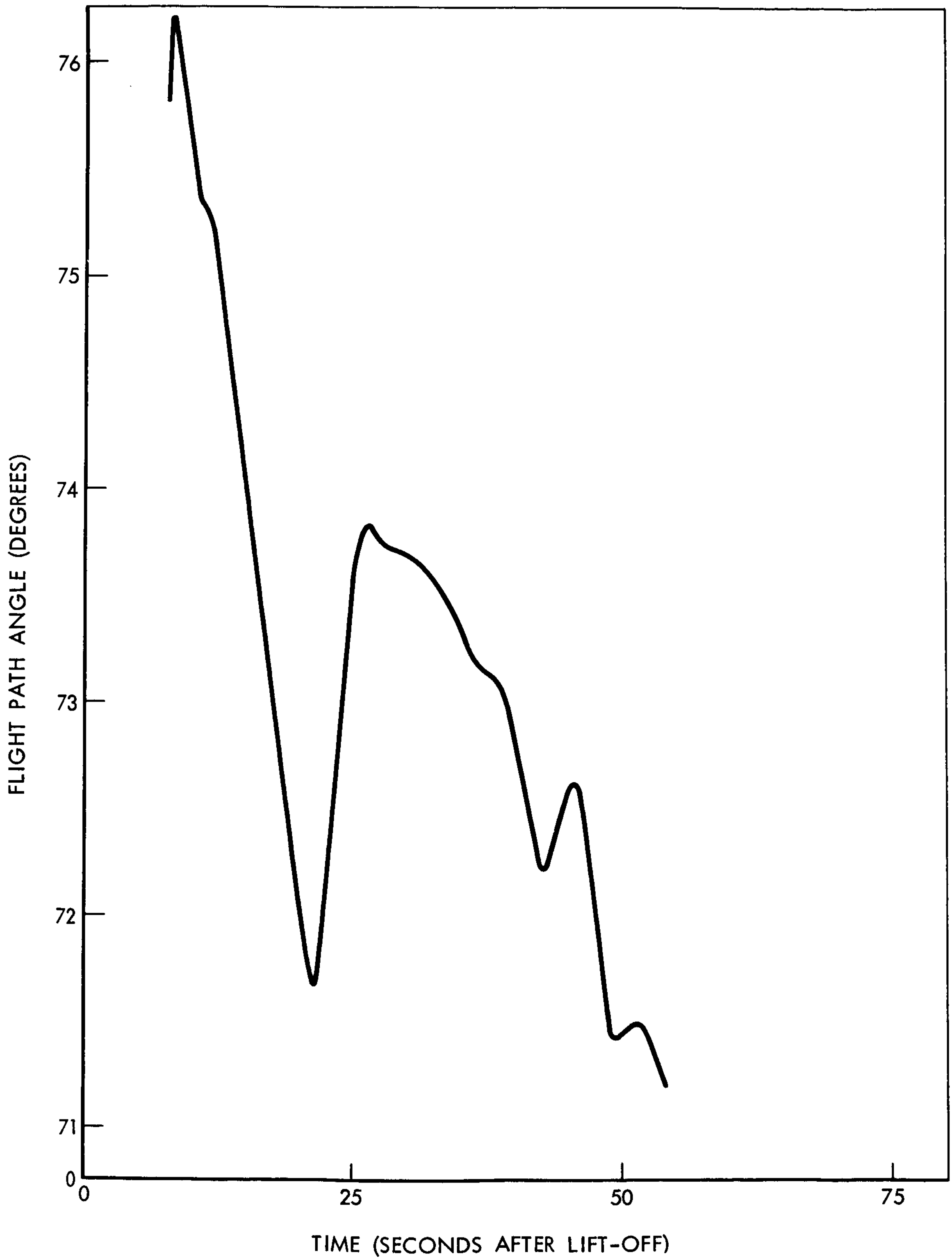


Figure 15–Actual Performance Curve – Flight Path Angle vs. Time

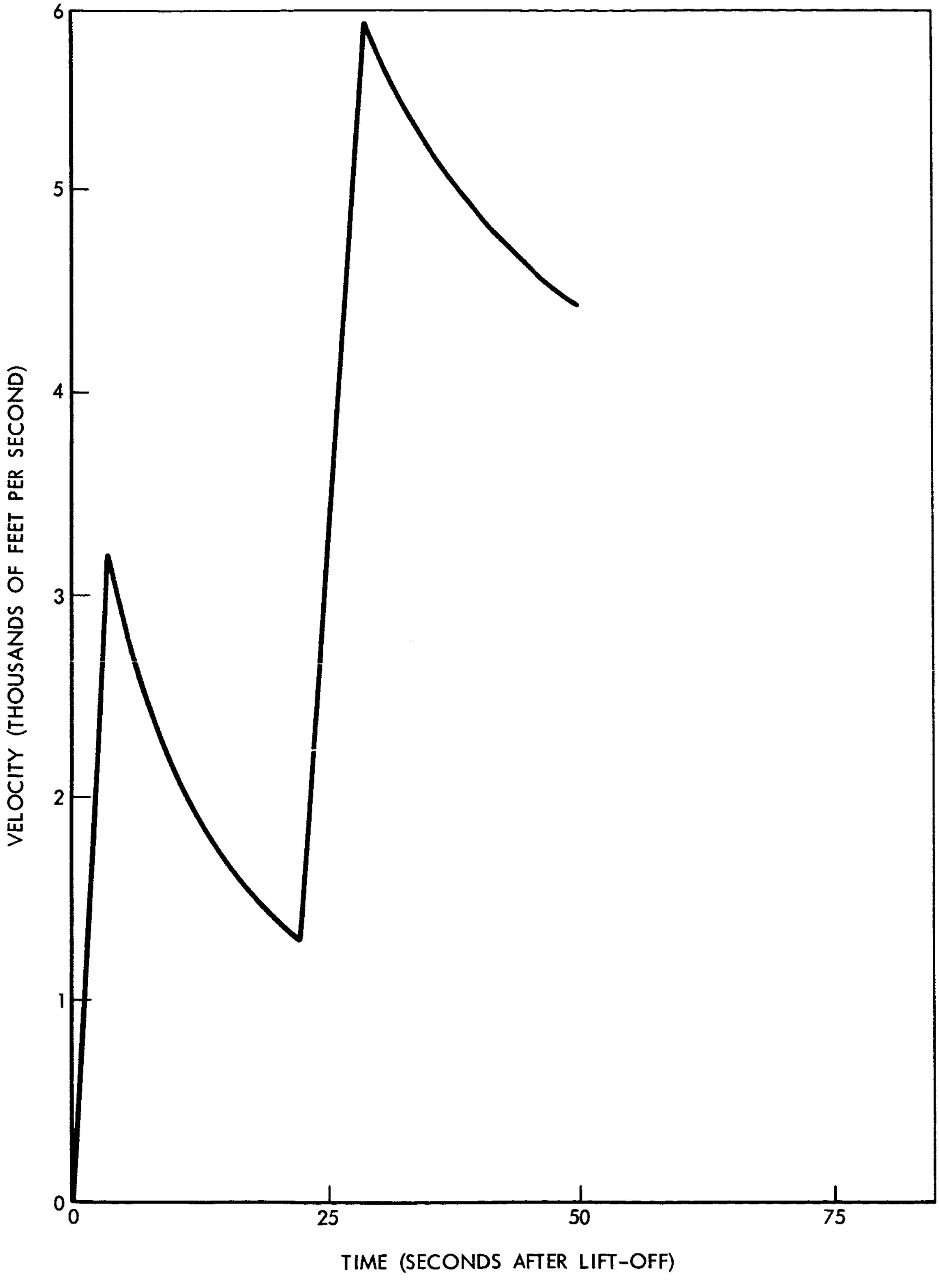


Figure 16–Actual Performance Curve – Velocity vs. Time

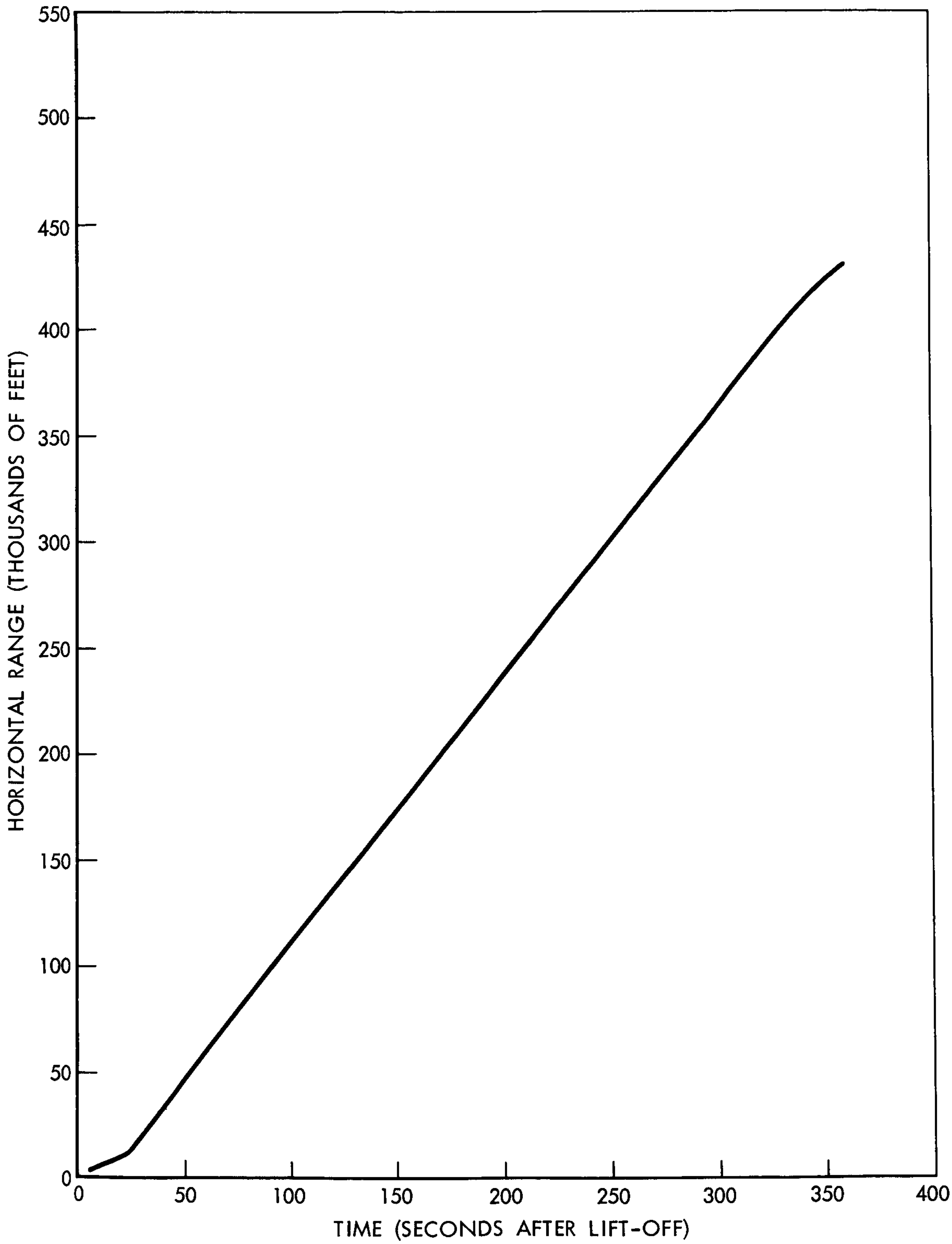


Figure 17–Actual Performance Curve – Horizontal Range vs. Time

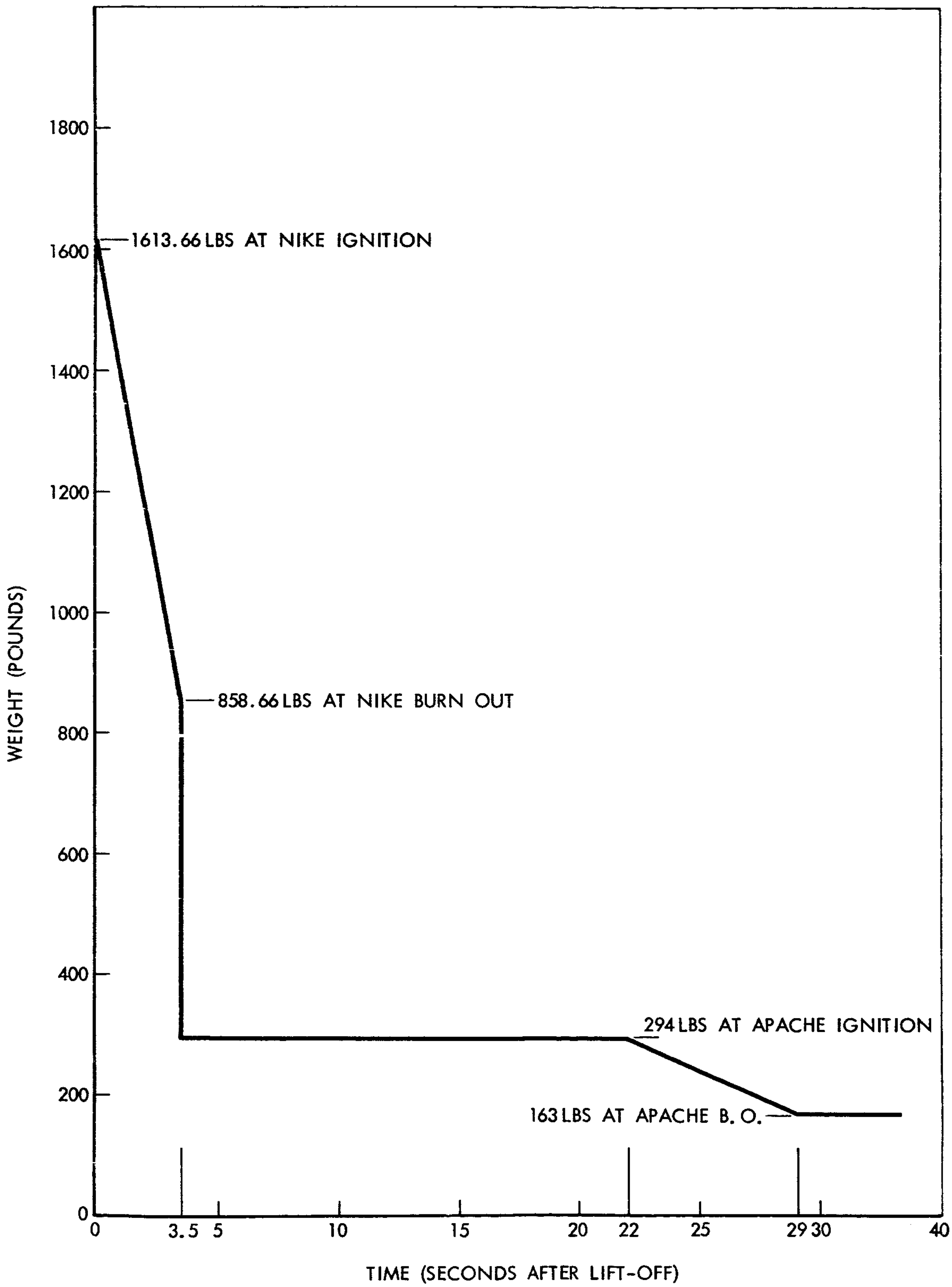


Figure 18–Rocket Weight vs. Time

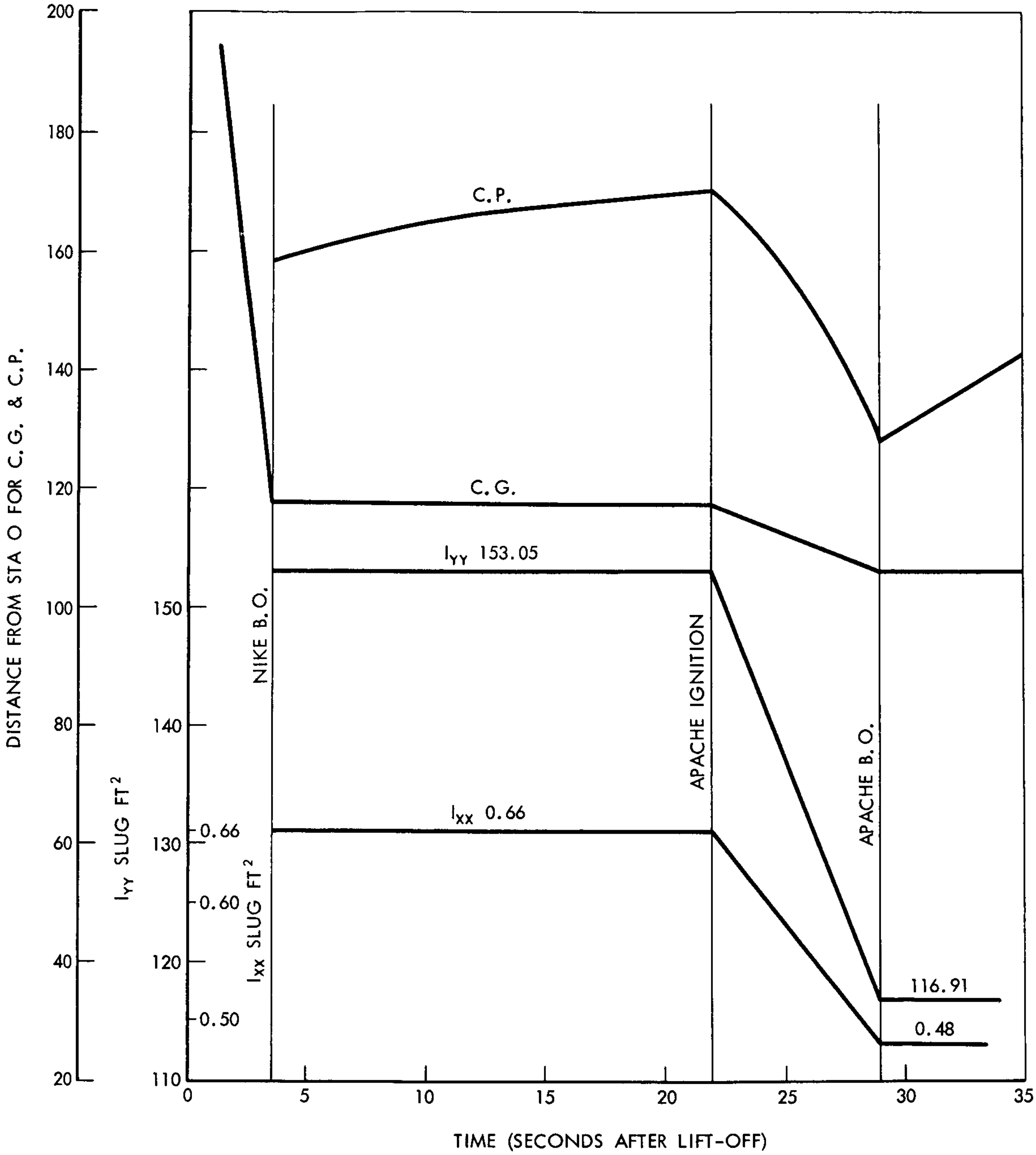


Figure 19–Apache and Payload, C. G., C. P., I_{yy} and I_{xx} vs. Time

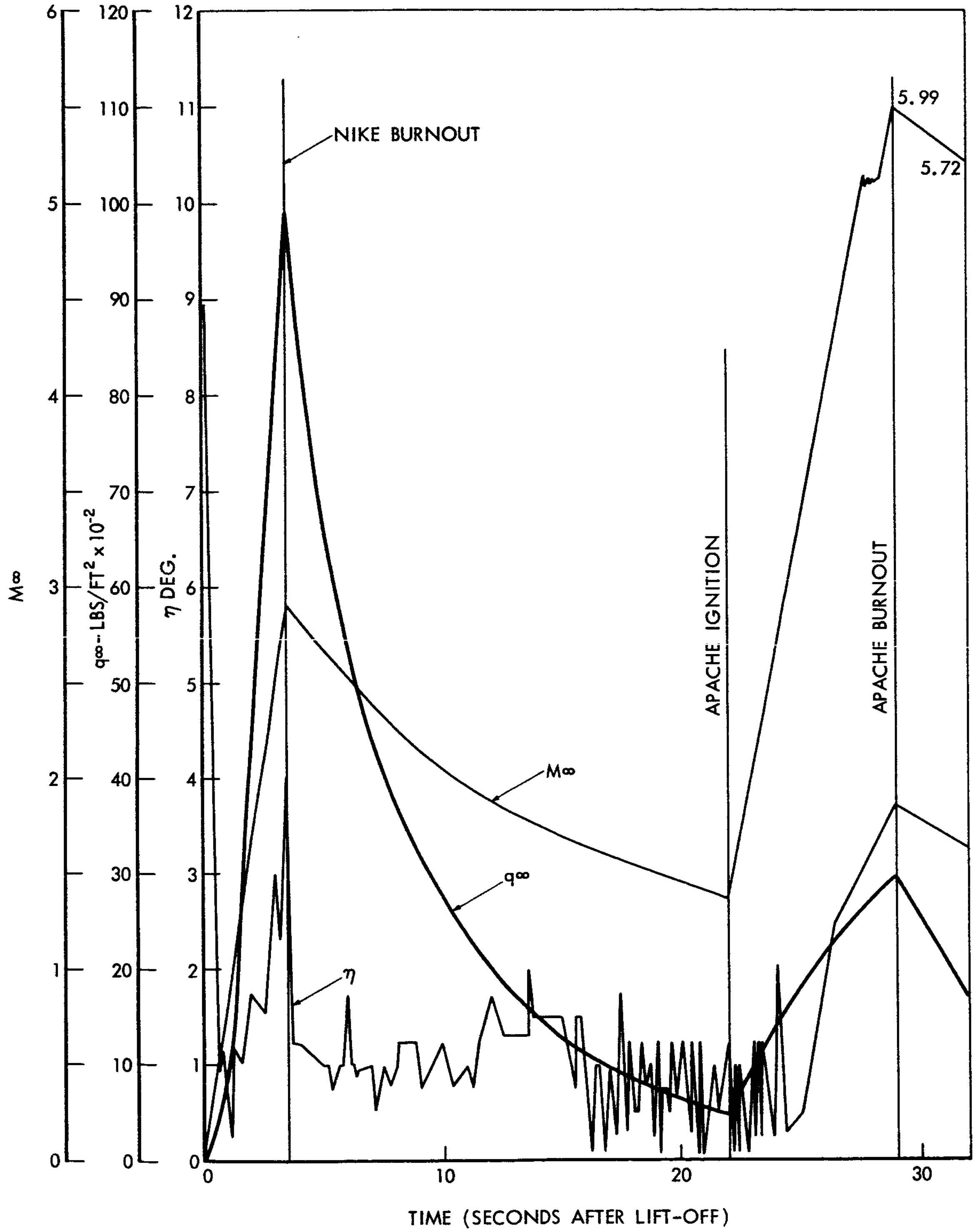


Figure 20–Mach No. and Angle of Attack vs. Time

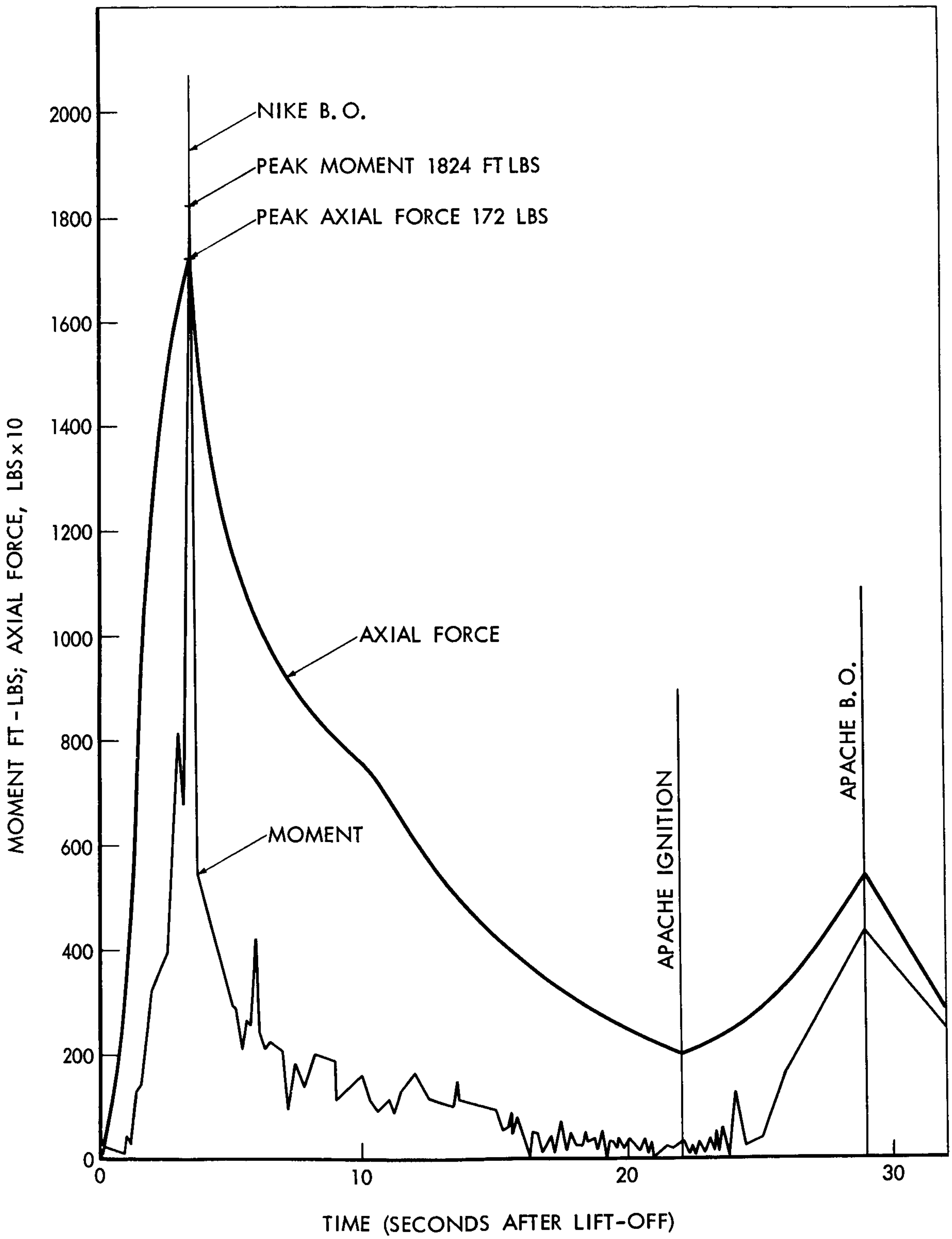


Figure 21–Axial Force and Bending Moment at Station 75 vs. Time

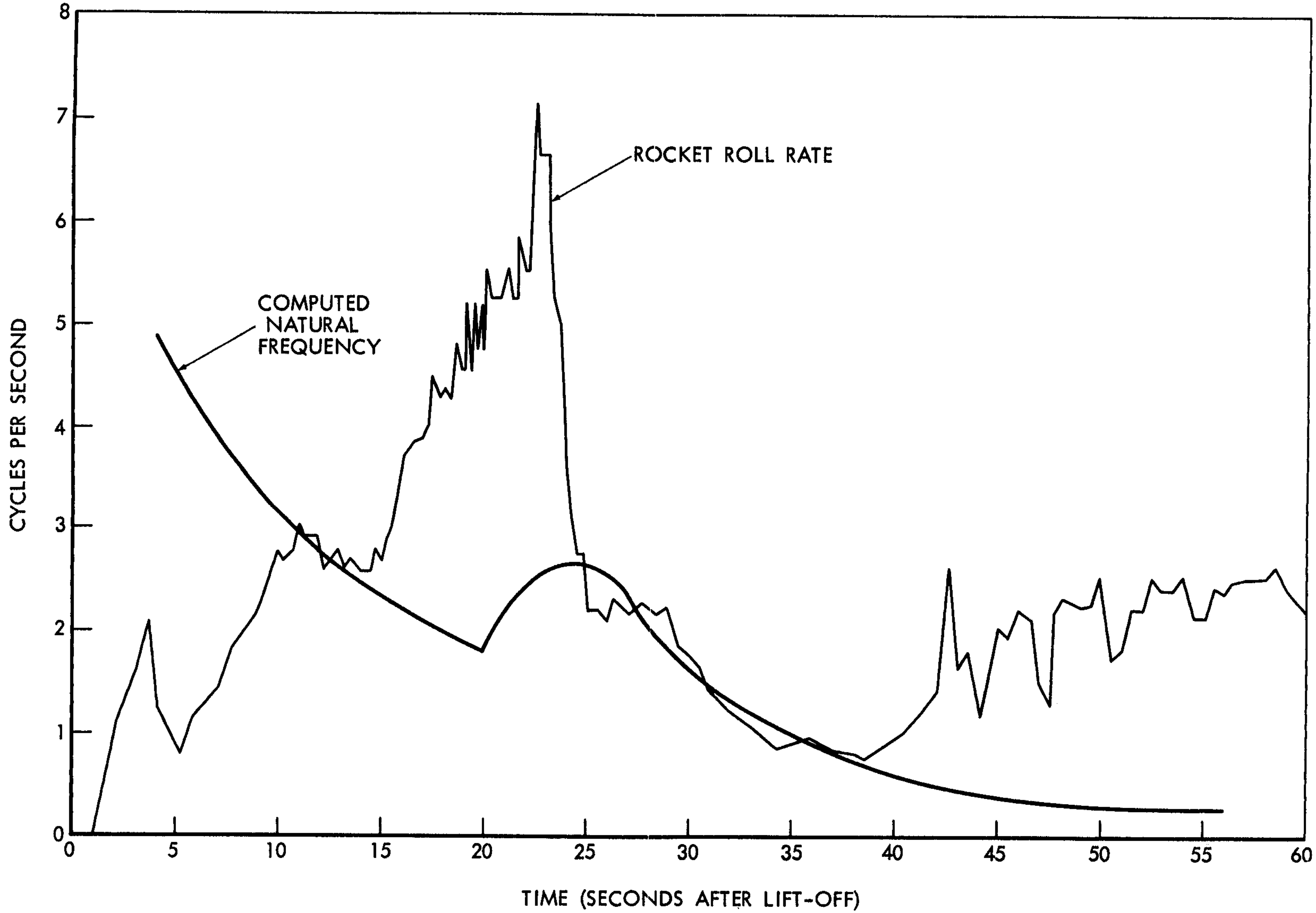


Figure 22–Rocket Spin Rate

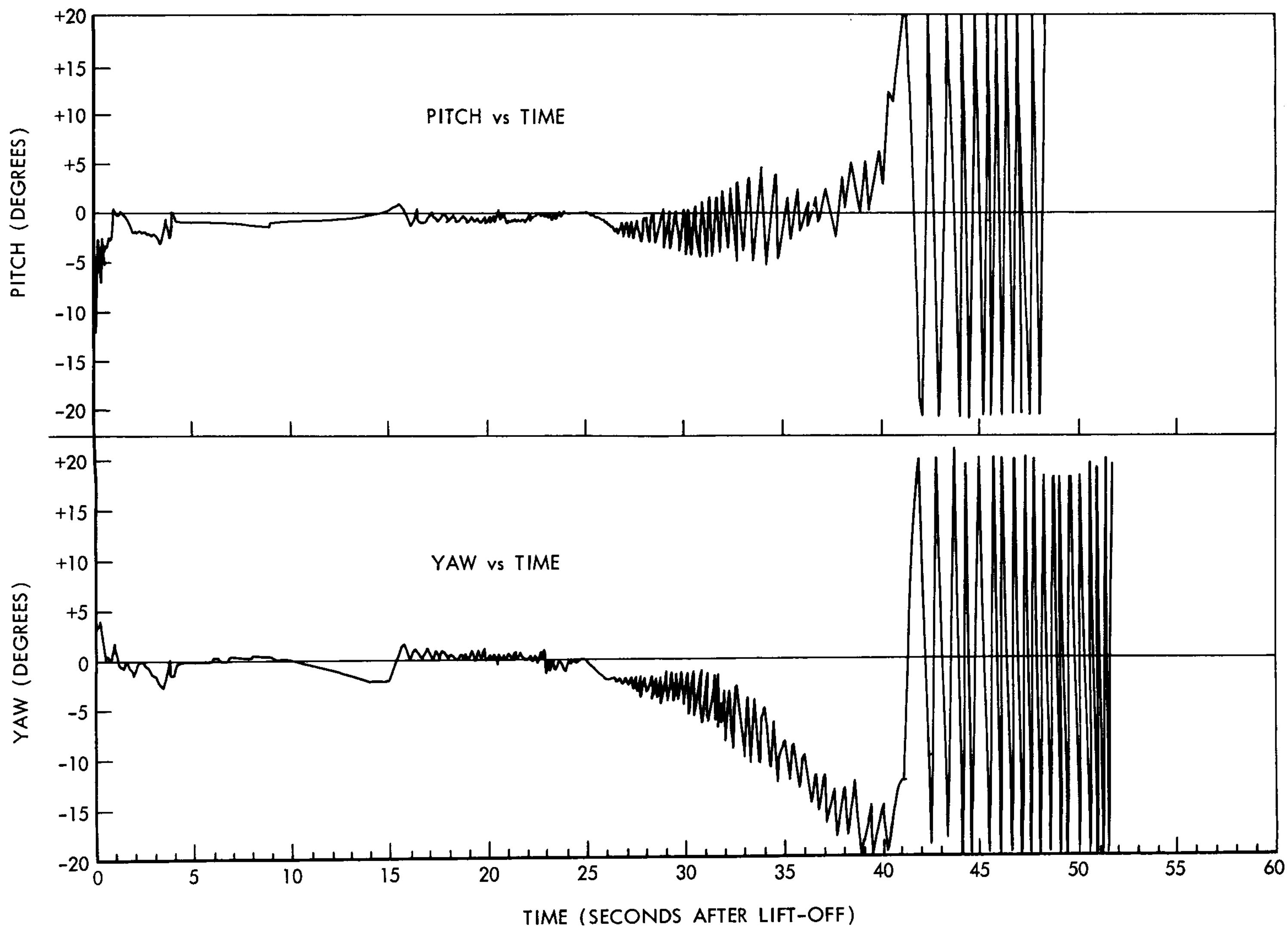


Figure 23–Pitch and Yaw vs. Time

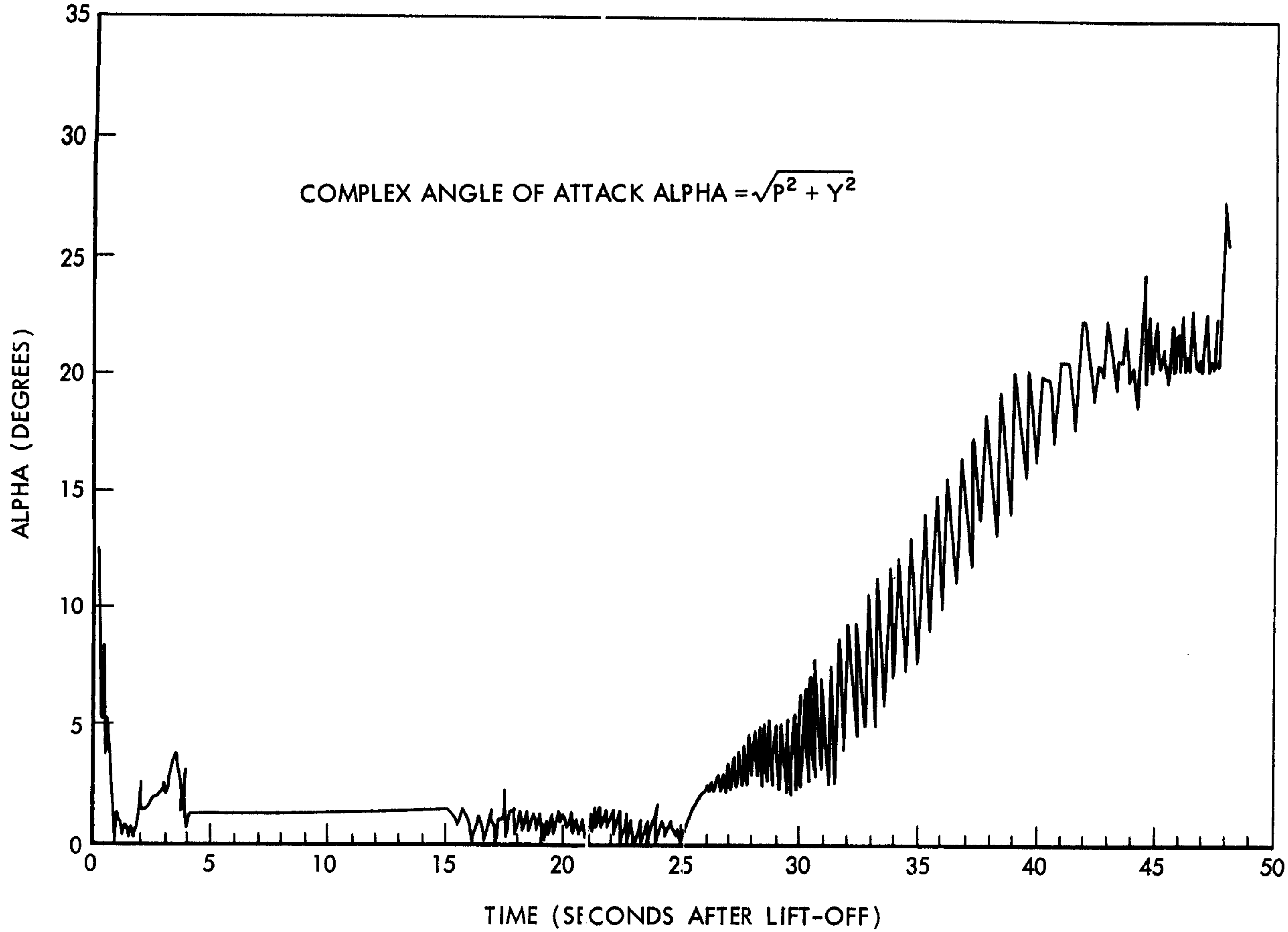


Figure 24-Complex Angle of Attack

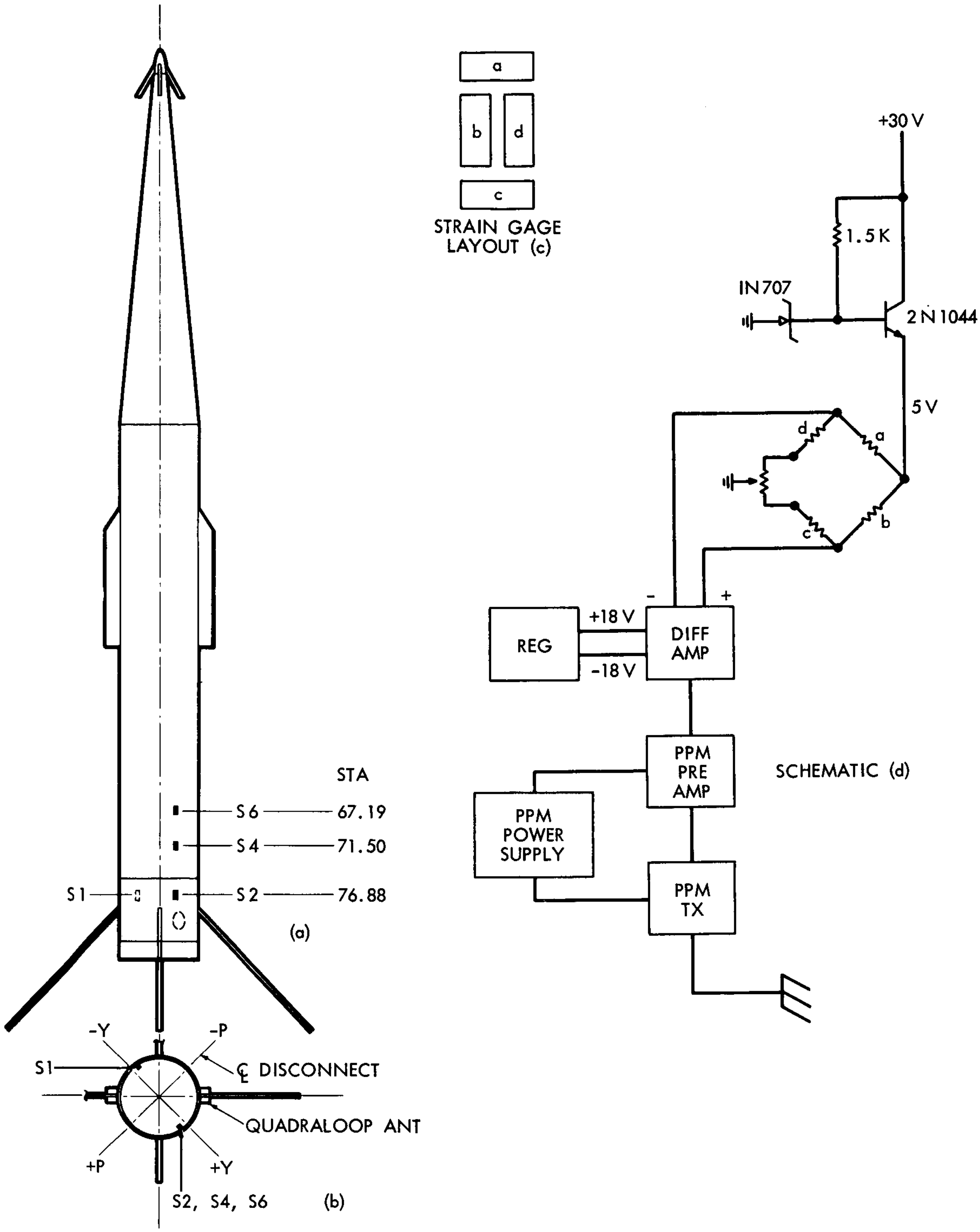


Figure 25–Strain Gage Instrumentation

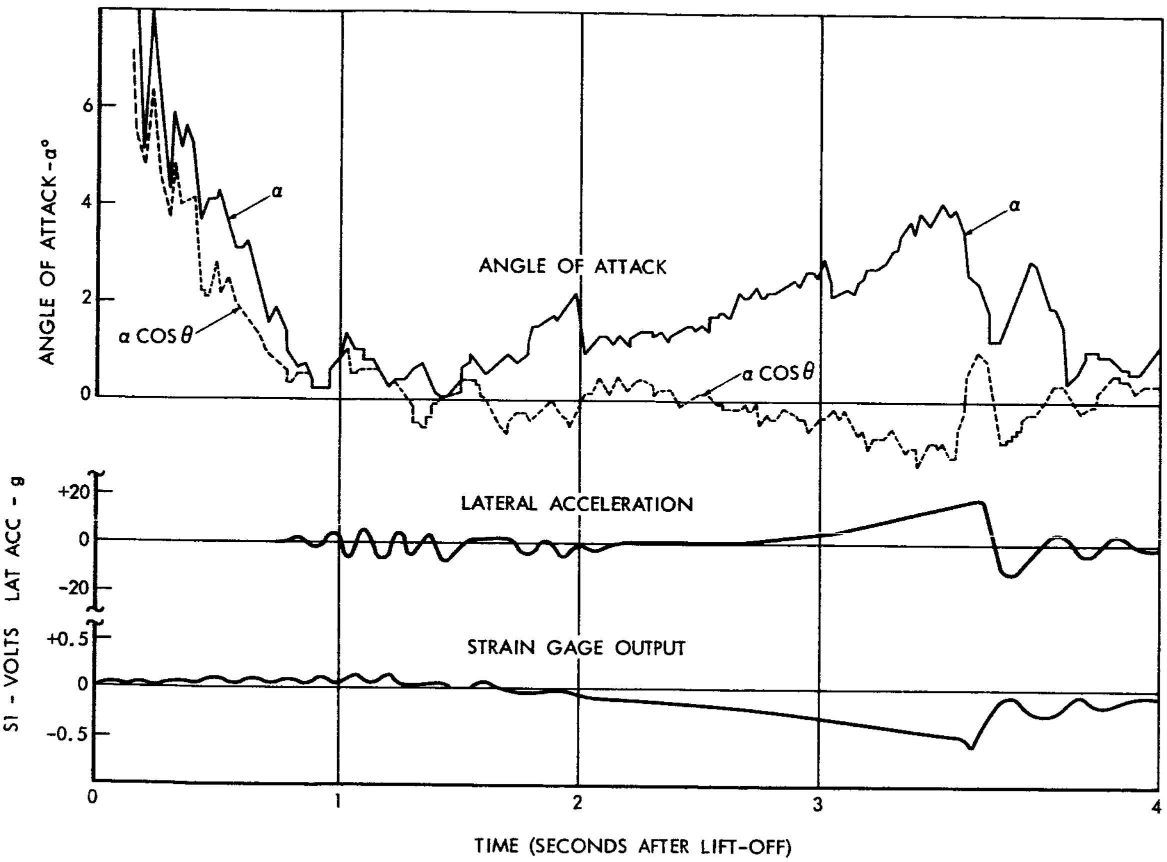
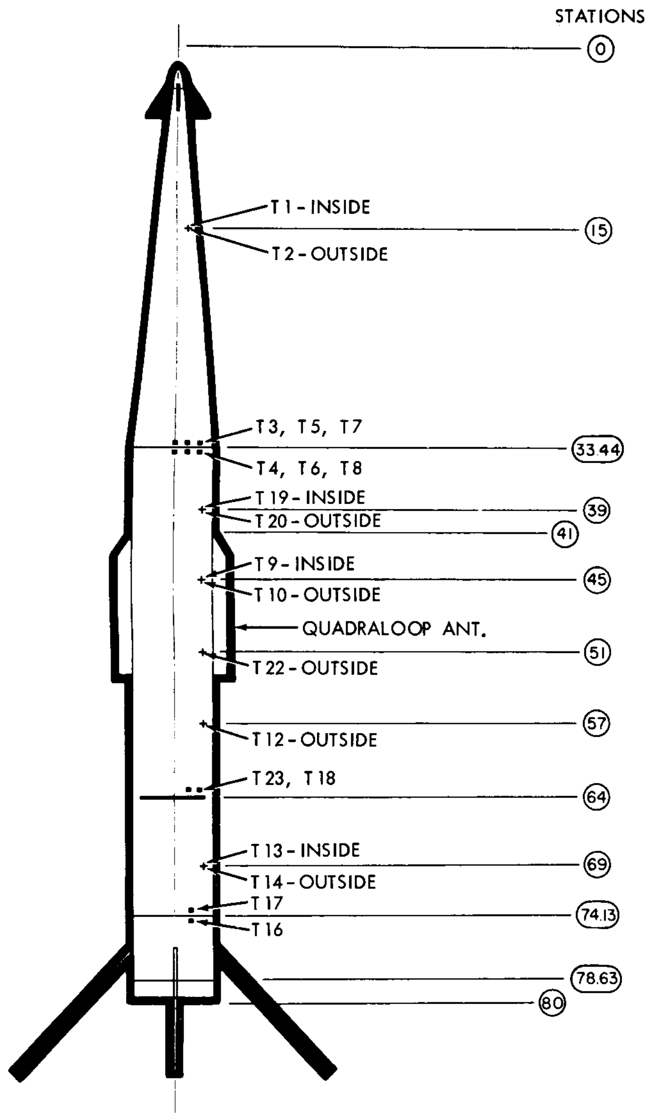


Figure 26–Strain Gage Output Traces



THERMISTOR LOCATION, TELEMETRY UNIT, CHANNEL AND SEQUENCE ALLOCATIONS

THERMISTOR NO.	FM/FM NO.	CHANNEL	SEQUENCE
OUTSIDE SHELL TEMPERATURE			
T2	#1	10	2, 9, 16
T20	1	10	3, 10, 17
T10	1	10	4, 11, 18
T22	1	10	5, 12, 19
T12	1	10	6, 13, 20
T14	1	10	7, 14
INSIDE SHELL TEMPERATURE			
T1	1	10	2, 8, 15
T19	2	10	7, 19
T9	2	10	8
T13	2	10	11
TOP DECK TEMPERATURE-UPPER SIDE			
T3	2	10	1
T5	2	10	2, 17
T7	2	10	3
TOP DECK TEMPERATURE-LOWER SIDE			
T4	2	10	4
T6	2	10	5, 18
T8	2	10	6
DECK NO. 5, STA 64 TEMPERATURE			
T23	2	10	2
T18	2	10	16
BOTTOM DECK TEMPERATURE-UPPER			
T17	2	10	15
BOTTOM DECK TEMPERATURE-LOWER			
T16	2	10	16

Figure 27–Thermistor Locations

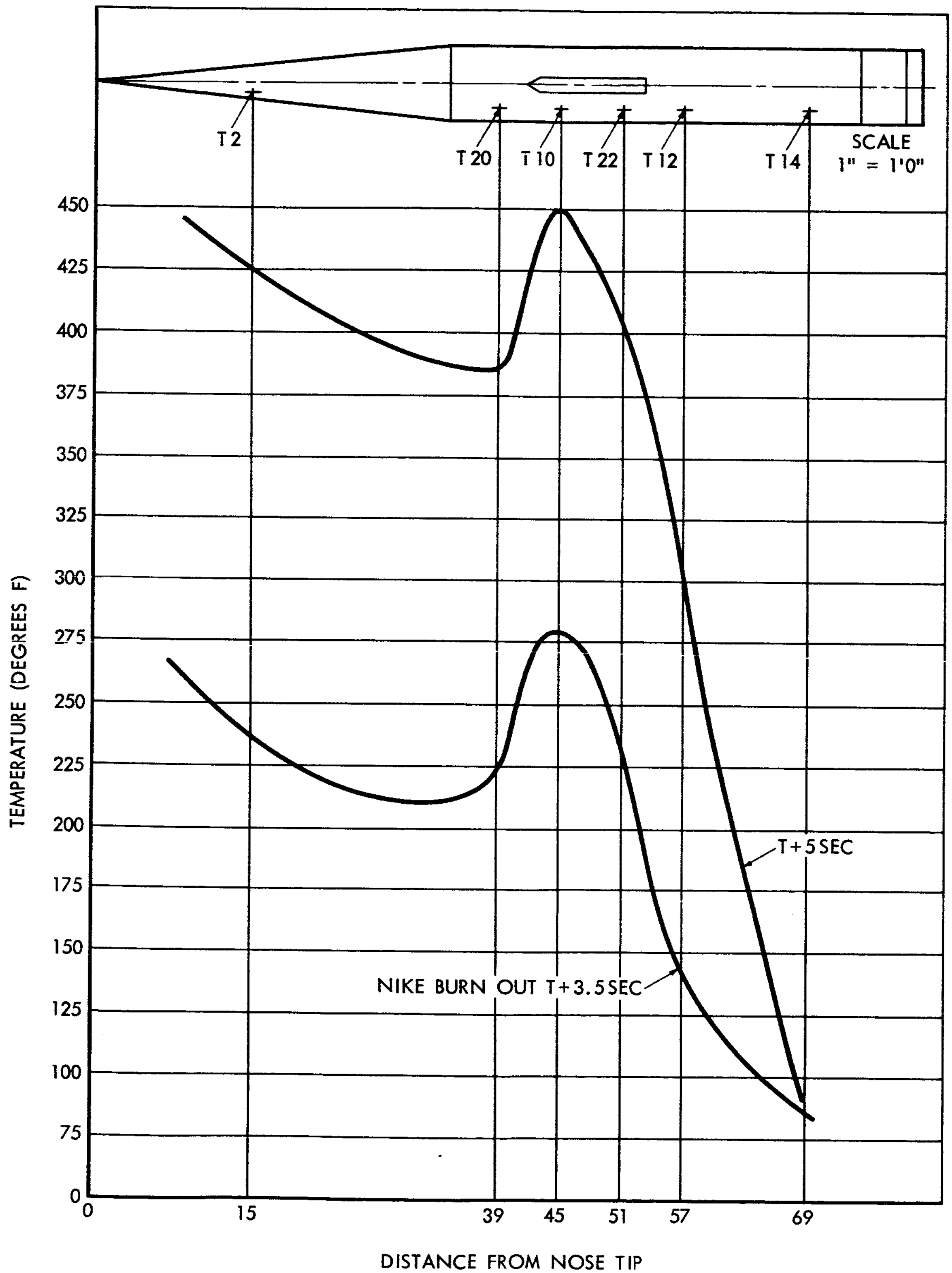


Figure 28—Outside Temperature vs. Payload Station

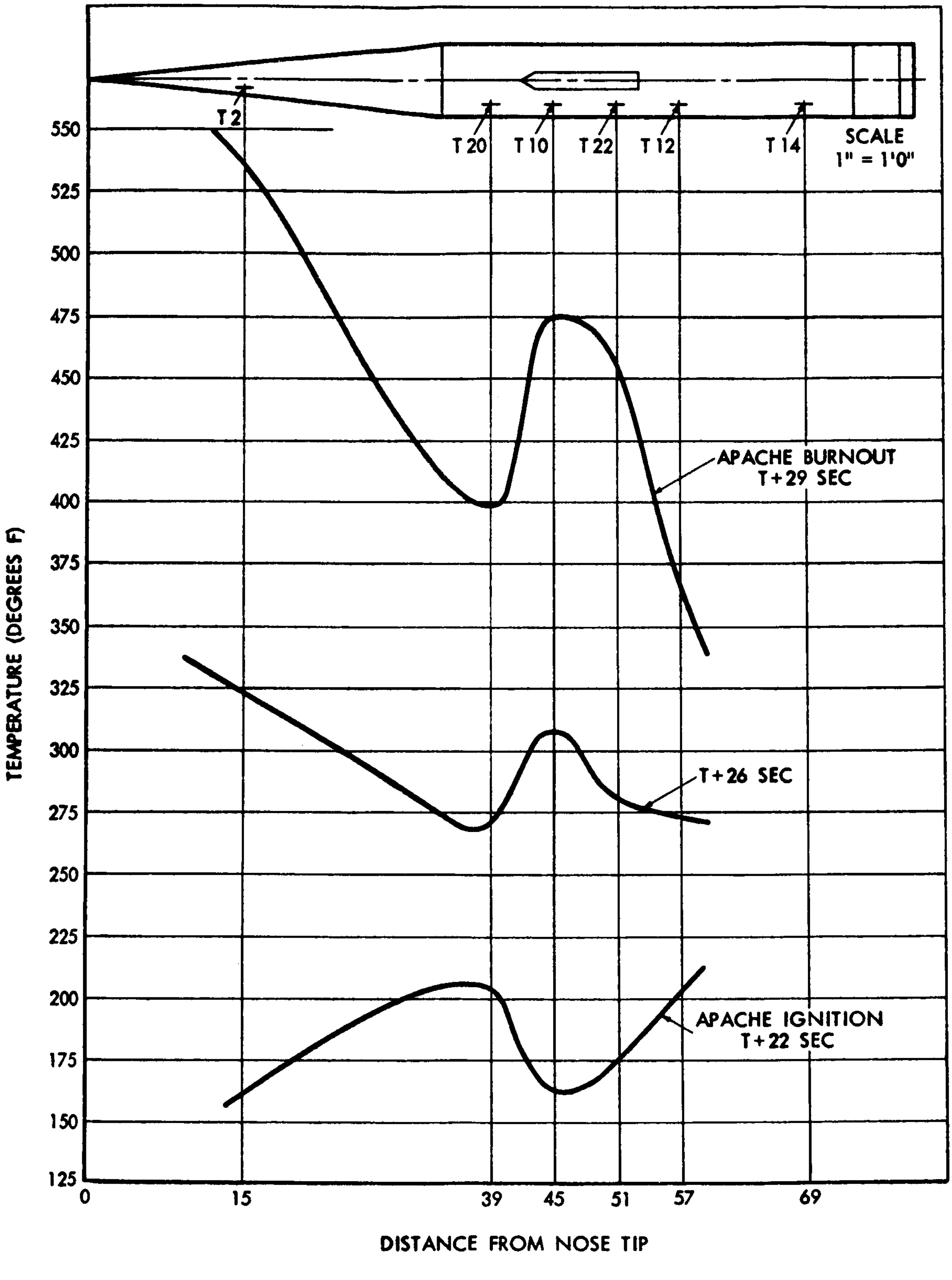


Figure 29–Outside Temperature vs. Payload Station

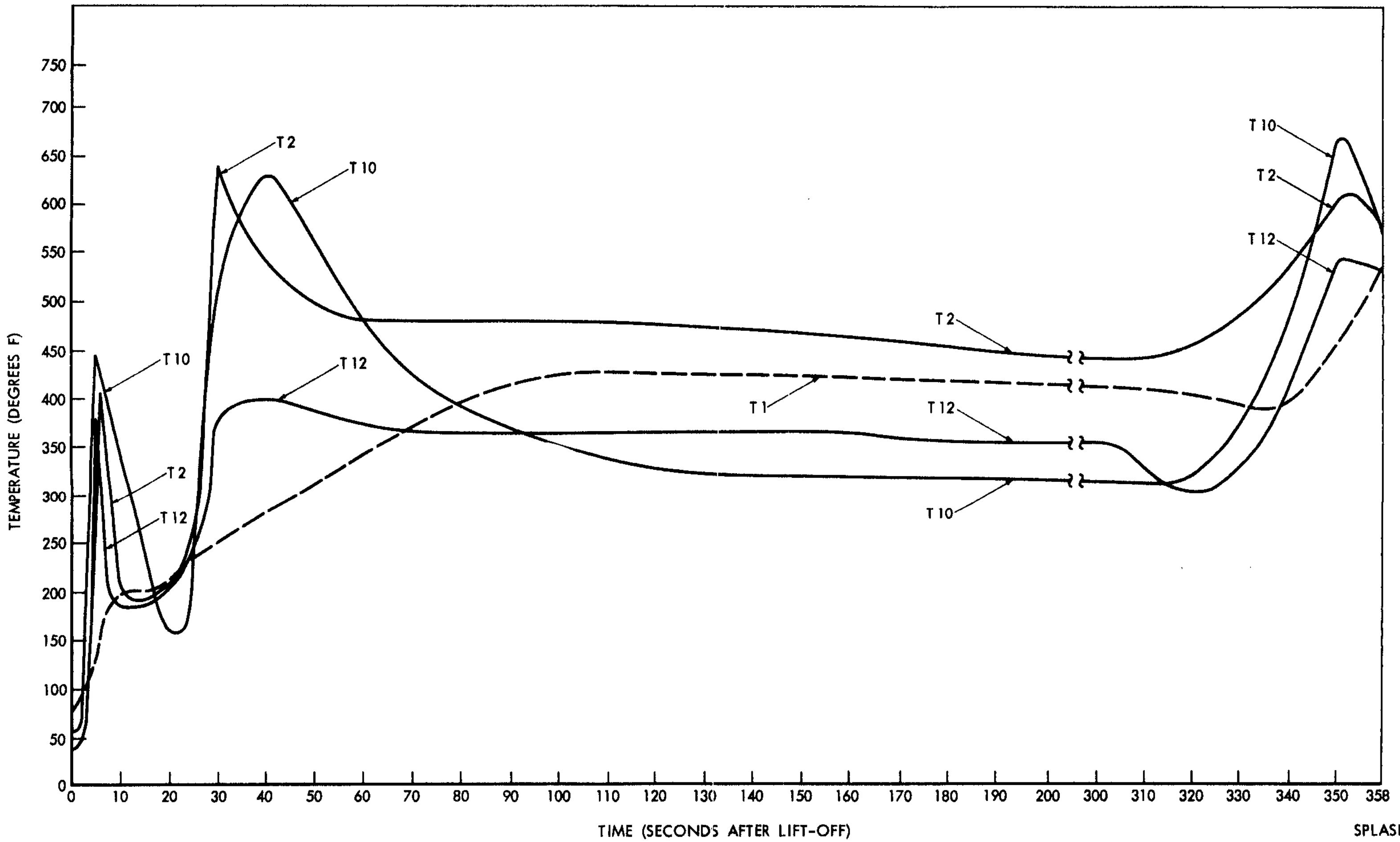


Figure 30–Inside and Outside Temperature vs. Time

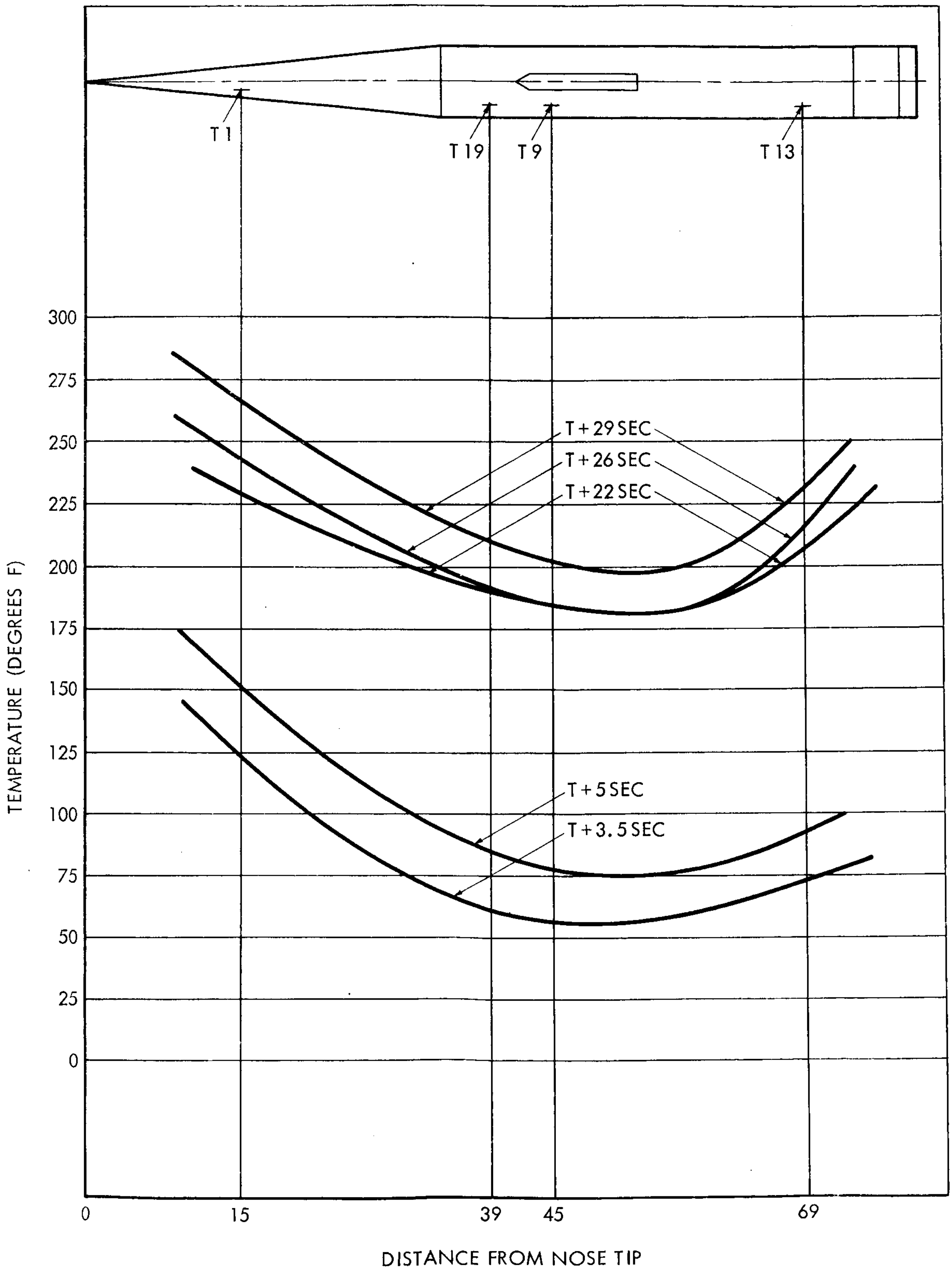


Figure 31–Inside Skin Temperature vs. Payload Station

APPENDIX A

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

May 2, 1963

Mr. Robert L. Krieger
NASA Wallops Station
Wallops Island, Virginia

Dear Mr. Krieger:

Enclosed are copies of the Flight Plan for NASA Nike Apache 14.111 GT for your information.

The Goddard Space Flight Center Project Scientist will be Mr. Lloyd Williams and Mr. R. W. Shapard will be the Goddard Space Flight Center Vehicle Manager.

Sincerely,

John W. Townsend, Jr.

John W. Townsend, Jr.
Assistant Director

Copies to:

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671.3	Mr. E. E. Bissell	10
671.4	Miss E. C. Pressly	4
672	Mr. A. L. Franta	1
673	Mr. F. T. Martin	1
	Lloyd Lohr	2
	Wallops Island, Virginia	
321	Lloyd Williams	10
	Mr. Ed. Kirshman	1
320	Mr. John New	1
300	Mr. L. Winkler	1
321	Mr. L. J. Davis	1
	Mr. W. F. Bangs	1
322	Mr. J. J. Quill	1

TABLE OF CONTENTS

NIKE APACHE ROCKET NASA 14.111 GT

FLIGHT PLAN

NIKE APACHE ROCKET NASA 14.111 GT

SECTION I - GENERAL OPERATIONS

A. Firing Plan

Date	28 May 1963
Alternate Date	29-30 May 1963
Time	1900 Z
Time Span	1900 - 2400 Z

B. Flight Objectives

1. The primary objective of this flight is to define the vibration environment imposed on the payload during launch and flight.

2. The secondary objective is to define the thermal environment and structural integrity of the payload housing during launch and flight.

3. Additional instrumentation is being flown for determining the flight characteristics of the vehicle.

4. This flight will also provide for a qualification test flight of the PPM telemetry system, prior to use on scientific missions aboard high performance vehicles.

C. Flight Information

With an 80 pound payload, 11° nose cone with a pitch yaw ogive tip, four rigid turnstile antennae whiskers, and two quadraloop antennae, the rocket will theoretically be capable of attaining an altitude of 97.7 statute miles (157.2 Km.) if fired at an 80° elevation angle from Wallops Island, Virginia.

SECTION II - ROCKET INFORMATION

A. Rocket

The rocket will be a standard GSFC Nike Apache vehicle with 20 sec. delay head inserted Apache igniter.

B. Performance

Vehicle performance based on an 80 pound payload and an 80° launch angle is estimated to be as follows:

Booster ignition time	0 sec.
Booster burnout time	3.5 sec.
Booster burnout altitude	5278 ft.

Booster burnout velocity	3159.8 ft./sec.
Booster burnout horizontal range	1131 ft.
Booster burnout flight path angle	77.6°
Apache ignition time	20 sec.
Apache ignition altitude	39,005 ft.
Apache ignition velocity	1487.3 ft./sec.
Apache ignition horizontal range	9296 ft.
Apache ignition flight path angle	74°
Apache burnout time	26.4 sec.
Apache burnout altitude	61,434 ft.
Apache burnout velocity	5929 ft./sec.
Apache burnout horizontal range	16,016 ft.
Apache burnout flight path angle	72.9°
Peak Time	197.9 sec.
Peak Altitude	97.7 st. mi.
Peak Altitude horizontal range	54.2 st. mi.
Impact time	387 sec.
Impace range	108.8 st. mi.

C. Recovery is not required

D. Weights and Dimensions

1. Weights

Nike Apache launch weight total	1614.5 lb.
Payload weight	80 lb.
Apache burnout weight	166.5 lb.

2. Rocket Dimensions

Payload length	82 inches
Apache length	107 inches
Second stage	189 inches
Nike stage length	151 inches
Total length	340 inches
Apache body diameter	6.5 inches

E. Modifications

1. Four standard GSFC Turnstile Antenna Whips and two quadraloop antennae will be used for telemetry transmission from launch to impact.

2. A pitch yaw ogive nose tip will be flown to determine angle of attack data.

3. The Apache fins will be fitted with spin tabs to achieve a five (5) RPS spin rate.

F. Installations

1. Pitch yaw ogive
2. Accelerometers (6 high frequency - 6 low frequency)
3. Strain gauges (6)
4. Thermistors (20)
5. Thermocouples (3)
6. Quadraloop antennae
7. PPM Telemetry system
8. FM/FM Telemetry systems (2)
9. Magnetometer

G. Pyrotechnic Installations

None - The payload is designed to remain intact throughout the flight.

SECTION III - EXPERIMENT AND INSTRUMENTATION

The rocket will carry instrumentation to measure mechanical and thermal stresses on the payload and payload housing. There will also be instrumentation aboard for determining vehicle attitude.

SECTION IV - FIRING RANGE

A. Radio Frequencies

FM/FM 231.4 Mc/s - 2 Watts, FM/FM 240.2 Mc/s - 2 Watts, and PPM 244.3 Mc/s - 35 Watts.

B. Range Safety

Normal for Nike Appche firings.

C. Ground Station Support

1. Operation of NASA Wallops Island telemetry ground station and GSFC telemetry ground station located in the Aerobee Blockhouse, and stations "A" and "C" for PPM telemetry will be required for this flight.

2. Complete recording of the receiver video on ½ inch direct recorded magnetic tape with servo control on 17 Kc/s and 100 Kc/s tape speed compensation will be required for this flight. One magnetic tape record shall be sent to Mr. Lloyd Williams, Code 321, and one copy to Mr. R. W. Shapard, Code 671.4.

3. It is requested that complete recording by direct recording oscillograph be made of discriminated subcarrier data on both FM/FM telemetry systems.

These records are to be made at a speed of 10 inches per second until apogee and at one inch per second from apogee to splash.

D. Ionosonde

No requirement.

E. Radar Beacon

None.

F. Meteorological Support

Standard meteorological support as required for launch of this vehicle will be conducted and evaluated by Wallops Island personnel.

G. Ballistic Data

Operation of all available tracking equipment for trajectory data is required. FPS-16, Spandar and MIT radar tracking are particularly desirable. Six copies each of tabulated and reduced trajectory data are to be forwarded to Code 671.4, Goddard Space Flight Center. Distribution to Project Scientist will be made from that office.

H. In-Flight Data

The following information should be provided to the Project Scientist immediately after the flight:

1. Absolute time of take-off.
2. Preliminary radar trajectory plot.
3. Second stage ignition time, alt., and velocity.
4. Second stage burnout time, alt., and velocity.
5. Peak time.
6. Peak altitude.
7. Impact time, range, and azimuth.

I. Communications

No special requirements.

SECTION V - PHYSICAL RECOVERY

None

SECTION VI - FACILITIES AND SERVICES

A. The following services and facilities will be needed during rocket preparation and firing operation:

1. Range instrumentation as described in SECTION IV.

2. Meteoroligical support as described in SECTION IV is required.

3. Rocket preparation, fin alignment, weight and C.G., igniter installation and firing, individual stage weight, C.G., location, and length are to be measured. It is requested that weight, C.G. location, and length be determined from these measurements for the total vehicle before launch and for ignition and burnout of the second stage.

4. Laboratory Space - Use of 200 sq. ft. of assembly and laboratory space in one of the bays adjacent to the Small Scale Shop is required.

5. Photographs - The normal requirement for movies and stills for flight information and documentation will be required. At least three copies each of all stills are required by the Project Scientist.

6. Messing Facilities

No requirement.

7. Nike and Apache motor numbers are to be supplied to the scientific personnel.

8. Facilities to charge flight batteries are required.

9. Machine shop facilities will be required to fabricate spin tabs in accordance with drawing C1394 with an "A" dimension of 0.201 inches.

SECTION VII - PERSONNEL

The following personnel will be present:

Name	Organization	Function
Lloyd Williams	GSFC	Project Scientist
James Nagy	GSFC	Vibration Engineer
Richard Erdman	GSFC	Technician
J. S. O'Brien	GSFC	Mechanical Engineer
John Kite	GSFC	Technician
John Cameron	GSFC	Instrumentation Engineer
R. W. Conrad	GSFC	Telemetry Engineer
Don Tackett	GSFC	Instrumentation Engineer
Ray Stattel	GSFC	Telemetry Engineer
Paul Velgos	GSFC	Telemetry Engineer
R. W. Shapard	GSFC	Vehicle Manager

SECTION VIII - SCHEDULE OF OPERATIONS

23 May 1963	Equipment and personnel arrive at Wallops Island
24 May 1963	Instrumentation check
27 May 1963	Horizontal check
28 May 1963	Fire rocket

SECTION IX - TELEMETERING ALLOCATION

The telemeter channel allocations are as follows:

FM/FM #1 (240.2 Mc/s)

IRIG Band Number	Stimulus
E	Vibration Accelerometer #1
C	Vibration Accelerometer #2
A	Vibration Accelerometer #3
13	High Temperature (0-1000^{o}F)
12	Low Accelerometer #1 - Long. (-30g to +60g)
11	Low Accelerometer #2 - Lat. ($\pm$ 25g)
10	Thermocouple #1
9	Ogive - Yaw

FM/FM #2 (231.4 Mc/s)

IRIG Band Number	Stimulus
E	Vibration Accelerometer #4
C	Vibration Accelerometer #5
A	Vibration Accelerometer #6
13	Voltage Monitor
12	Low Accelerometer #4 - Long. (-30g to +60g)
11	Low Accelerometer #3 - Lat. ($\pm$ 25g)
10	Low Accelerometer #5 - Lat. ($\pm$ 25g)

PPM (244.3 Mc/s)

Channel Number	Stimulus
1	Thermocouple #1
2	Thermocouple #2
3	Thermocouple #3
4	Ogive - Pitch
5	Ogive - Yaw
6	Magnetometer - Lateral
7	Magnetometer - Longitudinal
8	Strain #1 ($\pm$ 1000 u "/")
9	Strain #2 ($\pm$ 1000 u "/")
10	Strain #3 ($\pm$ 1000 u "/")
11	Strain #4 ($\pm$ 1000 u "/")
12	Strain #5 ($\pm$ 1000 u "/")
13	Strain #6 ($\pm$ 1000 u "/")
14	Low Temperature (0-500^{o} F)
15	Voltage Monitor

SECTION X - WIRING DIAGRAMS

The following drawings are attached:

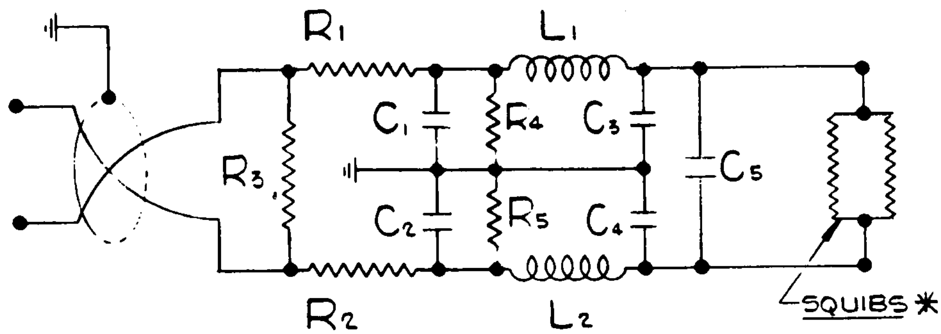
Enclosure 1 - Nike Apache Ignition Circuit.
Enclosure 2 - Altitude vs. Range Curve.

A complete wiring diagram may be obtained from Mr. E. E. Bissell, Goddard Space Flight Center, Code 671.3.

E11067

SYM	NO.	DESCRIPTION	BY	DATE	CHKD

NEXT ASSY	USED ON
E11066	TE-356
E11066	TE-354



R_1, R_2, - 24 Ω 2 WATT CARBON LIMITING RESISTORS (OPTIONAL) 10% OR LESS.

R_3, - 51 Ω 2 WATT CARBON LIMITING RESISTOR.

R_4, R_5, - 0.1 M Ω 1/2 WATT CARBON.

C_1, C_2, C_3, C_4, - 0.001 MFD, CRL, DD102 ± 10% OR EQUIV.

C_5, - 0.01 MFD, DISC CERAMIC CRL, DD1032 ± 20% OR EQUIV.

L_1, L_2, - 19 TURNS, AWG #20 ENAMEL ON 3/16 DIA x 1 1/2 LONG ACRYLIC ROD.

* SQUIBS TO BE FURNISHED ACCORDING TO CUSTOMERS REQUIREMENTS: X-287-DELAY (0 TO 22 SECONDS) OR EQUIV. (REF)

E11067

ITEM NO.	PART NO.	NO. REQD	DESCRIPTION	MATERIAL	SPECIFICATION
1		1	WIRING DIAGRAM	———	———

UNLESS OTHERWISE SPECIFIED:
BREAK ALL EDGES .003—.015"
ALL SMALL FINISHED FILLETS .020—.040 R.
ALL DIMENSIONS ARE IN INCHES
TOLERANCES:
0.000 ± .010; 0.00 ± .030;
ANGLES ± 1 2°, FRACTIONS ± 1/16
FINISHED SURFACES PER MIL—STD—10
TOLERANCES ARE PER MIL—STD—8
THREADS ARE PER FEDERAL HANDBOOK H-28 AND SUPPLEMENT.
WELDING SYMBOLS ARE PER JAN—STD—19.

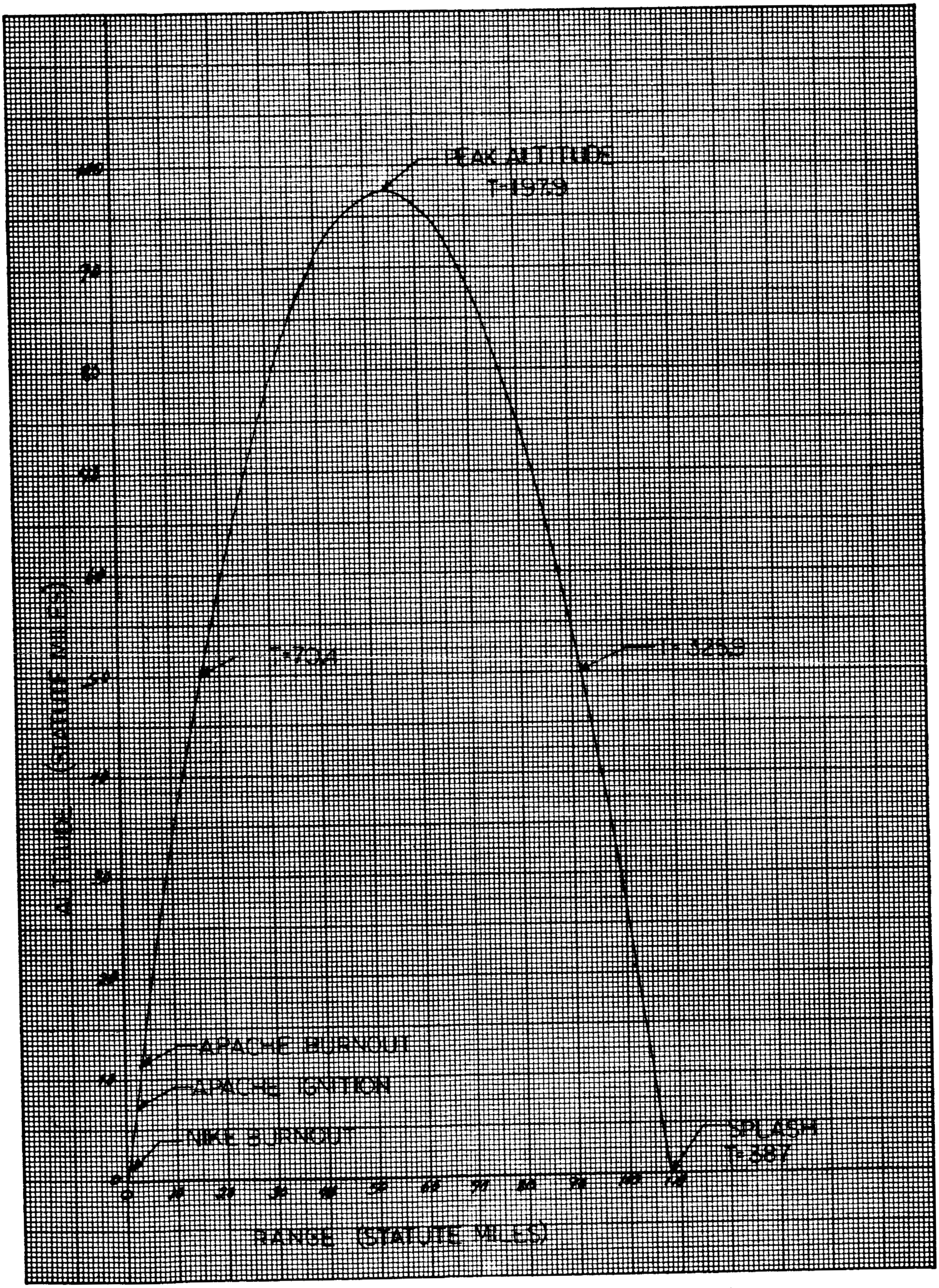
	BY	DATE
DRWN	EWH	10 MAR 61
CHKD	AN	15 MAR 61
ENGR	GFT	15 MAR
ENGR		
USER		
STRESS	L. K.	17 MAR 61
SAFETY		
APPD	[illegible]	20 MAR 61

WIRING DIAGRAM, PYROGEN

Thiokol Chemical Corporation
Elkton Division
Elkton Maryland

~~WEIGHT~~ CALC ACTUAL
SCALE AND AS NOTED: NONE
NEXT ASSY: SEE "USED ON" BLOCK
TE-SEE "USED ON" BLOCK
SIZE: B
E11067

Enclosure 1



PEAK ALTITUDE
APACHE BURNOUT
APACHE IGNITION
NIKE BURNOUT
SPLASH
ALTITUDE (STATUTE MILES)
RANGE (STATUTE MILES)

Enclosure 2

APPENDIX B

TEST DIRECTIVE

for

WALLOPS MODEL G2-1281

Goddard Model Nike-Apache 14.111 GT

PRIMARY LAUNCH TIME 1800Z, October 29, 1963

ALTERNATE LAUNCH TIME 1800Z, October 30, 1963, October 31, or November 1, 1963

WALLOPS JOB ORDER: 004-789

BADGE NO. 9

TEST DIRECTOR MR. ROBERT T. LONG

RANGE SAFETY OFFICER MR. ROBERT L. DELUCIA

ASSISTANT TEST DIRECTOR MR. RALPH D. WELSH, JR.

WALLOPS PROJECT ENGINEER MR. RALPH D. WELSH, JR.

GODDARD VEHICLE MANAGER MR. R. W. SHAPARD

GODDARD PROJECT SCIENTIST MR. LLOYD WILLIAMS

SUBMITTED:

Ralph D. Welsh, Jr.

Ralph D. Welsh, Jr.
Project Engineer

APPROVED:

William L. Lord

William L. Lord
Head, Sounding & Aerodynamic Rocket Projects Section

Robert T. Duffy

Robert T. Duffy
Head, Program Management & Liaison Branch

John C. Palmer

John C. Palmer
Chief, Flight Test Division

WI-824 (6-63)

A. GENERAL INFORMATION:

1. The primary objective of this flight is to define the vibration environment imposed on a Nike-Apache payload during launch and flight. The secondary objective is to define the thermal environment and structural integrity of the payload housing during launch and flight. Additional instrumentation is being flown for determining the flight characteristics of the Nike-Apache vehicle. This flight will also provide for a qualification test of the PPM telemetry system, prior to use on scientific missions aboard high-performance vehicles.

2. With a 80-pound payload, this rocket is theoretically capable of attaining an altitude of 79 nautical miles if fired at an effective elevation angle of 80°.

B. COUNTDOWN.

"T"-MINUS Hr-Min-Sec	ITEM	OPERATION
03-30-00	1	Launch corner-reflector type balloon and track to 65,000 ft.
03-00-00	2	Time Count.
02-30-00	3	Vehicle is completely staged and mounted on launcher. (This includes payload installation and lanyard attachments.)
02-10-00	4	Clear launch area for payload instrumentation checks.(240.2, 244.3 &231.4 MC) Vehicle in horizontal position.(See note 8)
	5	Payload external power "ON". (Goddard and Wallops T/M Stations acknowledge signal.)
	6	Payload control send calibrate.
02-05-00	7	Payload internal power "ON". (Acknowledge signal.)
	8	Payload external power "ON".
02-00-00	9	Payload power "OFF". (Payload control announce and verify payload "GO".)
	10	Surveillance aircraft on Station: Frequencies: Primary .... 326.3 MC If needed .... 3105 KC AM
01-40-00	11	Release radiosonde to maximum altitude.
01-30-00	12	Begin releasing theodolites on 15 minute schedule.
01-15-00	13	Photographers take documentary stills.
01-00-00	14	Release chaff-type balloon and track to 6,000 ft.
	15	Clear launch area for payload instrumentation checks.(240.2, 244.3 & 231.4 MC) Vehicle in vertical position.(See note 8)
	16	Payload external power "ON". (Goddard and Wallops T/M Stations acknowledge signal.)
	17	Payload control send calibrate.
00-55-00	18	Payload internal power "ON". (Acknowledge signal.)
00-50-00	19	Payload external power "ON".
	20	Payload power "OFF".

"T"-MINUS Hr-Min-Sec	ITEM	OPERATION
00-45-00	21	Begin releasing theodolites on 5-minute schedule.
00-35-00	22	Fire standard 2.75-inch test rocket with flare.
00-30-00	23	Payload (231.4 and 240.2 MC) external power "ON". (Goddard and Wallops T/M Stations acknowledge signal.) Payload will radiate continuously beyond this point.
00-25-00	24	Begin final launcher settings.
00-20-00	25	Time Count.
00-15-00	26	Time Count.
00-10-00	27	Final launcher settings complete.
00-09-00	28	Time Count.
00-08-00	29	Time Count.
00-07-00	30	Time Count.
00-06-00	31	Time Count.
00-05-00	32	Clear area for launching and make station checks: (Acknowledge) Radar 1 — Blockhouse No. 2 Radar 2 — Payload Control Radar 3 — Goddard Telemetry Station Radar 4 — Wallops Telemetry Station Camera 1 — Launch Supervisor Camera 2 — Range Clearance Camera 9 — Range Control Center
	33	Establish road blocks. (Island gas station and Aerobee tower.)
	34	Payload (244.3 MC) external power "ON".
00-04-00	35	Payload (240.2, 244.3 & 231.4 MC) internal power "ON". (Acknowledge signal.)
00-03-30	36	Telemeter tape recorders "ON"; paper recorders "ON" fast.
00-03-20	37	Payload control send calibrate. (Goddard Station A verify.)
00-03-00	38	Goddard T/M engineer verify payload is "GO".

"T"-PLUS HR-Min-Sec	ITEM	OPERATION
00-03-00 (cont'd)	39	Telemeter tape recorders "OFF"; paper recorders "ON" slow.
00-02-00	40	Pull payload umbilical.
00-01-00	41	Time Count.
00-00-35	42	Telemeter tape recorders "ON"; paper recorders "ON" fast.
00-00-30	43	Hold until pad clear if necessary.
00-00-20	44	Time Count.
00-00-10	45	Time Count.
00-00-09	46	Time Count.
00-00-08	47	Time Count.
00-00-07	48	Time Count.
00-00-06	49	Time Count.
00-00-05	50	Time Count.
00-00-04	51	Time Count.
00-00-03	52	Time Count.
00-00-02	53	Time Count.
00-00-01.5	54	Bomb tone ON.
00-00-01	55	Time Count.
00-00-00	56	Bomb tone OFF.
	57	First stage (NIKE) fires. Second stage ignition delay squib (20 seconds) fired via Maypole circuit.
"T"-PLUS Hr-Min-Sec		
00-00-01	58	Time Count.
00-00-02	59	Time Count.

NIKE-APACHE COUNTDOWN

"T"-PLUS Hr-Min-Sec	ITEM	OPERATION
00-00-03	60	First stage (NIKE) burns out (3.5 seconds) and drag separates.
00-00-04	61	Time Count.
00-00-05	62	Time Count.
00-00-10	63	Time Count.
00-00-15	64	Time Count.
00-00-20	65	Second Stage (APACHE) fires (delay squib).
00-00-21	66	Time Count.
00-00-22	67	Time Count.
00-00-23	68	Time Count.
00-00-24	69	Time Count.
00-00-25	70	Time Count.
00-00-26	71	Second Stage (APACHE) burns out. (26.4 seconds)
00-00-30	72	Time Count.
00-00-40	73	Time Count.
00-00-50	74	Time Count.
00-01-00	75	Time Count.
00-01-30	76	Time Count.
00-02-00	77	Time Count.
00-02-30	78	Time Count.
00-03-00	79	Time Count.
00-03-10	80	Apogee (3 minutes 11 seconds) 79 N. M.
00-03-20	81	Time Count.
00-03-30	82	Time Count.

"T"-PLUS Hr-Min=Sec	ITEM	OPERATION
00-04-00	83	Time Count.
00-04-30	84	Time Count.
00-05-00	85	Time Count.
00-05-30	86	Time Count.
00-06-00	87	Time Count.
00-06-10	88	Impact (6 minutes 14 seconds) 84 N. M.
00-06-20	89	Release radiosonde to maximum altitude.

C. NOTES.

1. The military launcher, in Launch Area No. 2, will be utilized for launching this vehicle.

   Effective firing Azimuth .... 115°
   Effective Elevation Angle .... 80°

2. Vehicle impact distances are as follows:

   First Stage .... 3 N. M.
   Second Stage .... 84 N. M.

3. Vehicle performance based on a 80-pound payload, 80-degree launch angle, 11-degree nose cone with a pitch yaw ogive tip, four rigid turnstile antenna whiskers, and two quadraloop antenna is as follows:

Event	Time (Sec)	Altitude (feet)	Horizontal Range (ft.)	Velocity (ft/sec)	Flight Path Angle
Nike burnout	3.5	5339	1140	3195.5	77.75
Apache Ignition	20	39,506	9329.6	1511	74.3
Apache burnout	26.4	61,576.5	15,813.7	5659.7	73.3
Apogee	191.2	479,000	254,200		
Impact	374.4	0	512,000		

4. The following frequencies will be radiated from the payload:

   231.4 MC   FM/FM Telemeter .... 2 watts
   240.2 MC   FM/FM Telemeter .... 2 watts
   244.3 MC   PPM Telemeter .... 35 watts (peak)

   Data which will be telemetered are from many types of sensors to measure vehicle performance. These include accelerometers, vibration accelerometers, strain gauges, temperature sensors, magnetometers, and a pitch yaw ogive nose tip to determine angle of attack data.

5. The Nike fins on this model are canted at 25 minutes to give a 2 rps (CW) roll rate at Nike burnout. The Apache fins will have a .201-inch wedge attached to the fin trailing edge of all four fins to give the second stage and payload a 5 to 5.5 rps roll rate at Apache burnout.

6. Bomb tone will be transmitted on 3105 KC AM for the purpose of time synchronization.

7. In case of misfire: KEEP LAUNCHING AREA CLEAR AND ALL PERSONNEL REMAIN UNDER COVER UNTIL "ALL CLEAR" IS GIVEN FROM RCC.

8. During horizontal and vertical instrumentation checks, all three frequencies will be switched simultaneously.

APPENDIX C

FLIGHT SAFETY PLAN

VEHICLE NIKE-APACHE

WALLOPS MODEL NO. G2-1281

RANGE USER'S NO. 14.111

LAUNCH DATE July 10, 1963

LAUNCH AREA No. 1 LAUNCHER Military Launcher

LAUNCH: ELEVATION 80° AZIMUTH 115°

IMPACT AND OVERFLIGHT CRITERIA: VIOLATED ____ NOT VIOLATED X

LAUNCH SAFETY REQUIREMENTS TESTED UNDER "INHERENTLY SAFE FLIGHT", VOLUME IV, WALLOPS STATION HANDBOOK ARE: SATISFIED X NOT SATISFIED ____

REASONS FOR NOT BEING SATISFIED ARE ____

FLIGHT TERMINATION SYSTEM: YES ____ NO X

WIND WEIGHTING: COMPUTER ____ MANUAL X

LIMITATIONS

WINDS: BALLISTIC 35 fps SURFACE 30 fps

SETTINGS: ELEVATION +3°; -6° AZIMUTH ± 25° but not less than 77°

VACAPES AREA CLEARED 6A, 13, 14 AB SURVEILLANCE SPS-12; airborne

ASS'T RANGE SAFETY OFFICER Mr. James Atkinson

PROJECT ENGINEER Mr. Ralph Welsh

SUBMITTED:

Robert L. DeLucia

ROBERT L. DeLUCIA
HEAD, GROUND AND FLIGHT SAFETY SECTION

REVIEWED:

Robert T. Duffy

ROBERT T. DUFFY
HEAD, PROGRAM MANAGEMENT AND LIAISON BRANCH

APPROVED:

Loyd C Parker

LOYD C. PARKER
HEAD, RANGE SAFETY BRANCH

Marvin W. McGeogan for

A. D. SPINAK
CHIEF, RANGE ENGINEERING DIVISION

WI-422 (REV. 6-63)

VEHICLE NIKE-APACHE LAUNCH AZIMUTH 115°. DATE July 10, 1963

PAYLOAD 78 lbs. LAUNCH ELEVATION 80°

STAGE		TIME Sec.	V_E ft./sec.	V_I	γ_E Degrees	γ_I	α_E	α_I	ALTITUDE ft.	λ_L	LL	RANGE ft.	IMPACT RANGE	IMPACT λ	IMPACT L	IMPACT TIME
1st.	IGN.	0	0		80				0			0	3 NM			sec. 110
	B.O.	3.5	3195		77.7				5338			1142				
2nd.	IGN.	20.0	1510		74.1				39,480			9380	95.4 NM			390
	B.O.	26.4	5960		73.1				62,076			16,107				
3rd.	IGN.															
	B.O.															
4th.	IGN.															
	B.O.															
5th.	IGN.															
	B.O.															

REMARKS: DISPERSION

	STAGE 1	STAGE 2
1 sigma range	.5	20.0
1 sigma cross-range	.5	20.0

APOGEE:
Altitude: 86.2 NM
Time : 199 sec.
Range : 47.6

WI-282 (12-

APPENDIX D

GROUND SAFETY PLAN

FOR

WALLOPS MODEL G2-1281

NIKE-APACHE 14.111

PRIMARY LAUNCH TIME 1900Z on June 26, 1963

ALTERNATE LAUNCH TIME

RANGE SAFETY OFFICER MR. ROBERT L. DeLUCIA

ASSISTANT RANGE SAFETY OFFICER MR. JAMES H. ATKINSON

TEST DIRECTOR MR. ROBERT T. DUFFY

ASSISTANT TEST DIRECTOR MR. RALPH D. WELSH

WALLOPS PROJECT ENGINEER MR. RALPH D. WELSH

GSFC PROJECT SCIENTIST MR. LLOYD WILLIAMS

GSFC VEHICLE MANAGER MR. R. W. SHEPARD

SUBMITTED:

Robert L. DeLucia
Head, Ground & Flight Safety Section

REVIEWED:

Robert T. Duffy
Head, Program Management & Liaison Branch

APPROVED:

for Loyd C. Parker
Range Safety Branch

A. D. Spinak
Chief, Range Engineering Division

GROUND SAFETY PLAN

GENERAL

LAUNCH VEHICLE NIKE-APACHE

WALLOPS MODEL G2-1281

RANGE USER MODEL 14.111

LAUNCH AREA No. 1 LAUNCHER Military

PRIMARY MISSION To define the vibration environment imposed on the payload, the thermal environment and structural integrity of the payload during launch and flight, to determine the flight characteristics of the vehicle, and to provide qualification test flight of the PPM telemetry system.

VEHICLE DATA

MAIN MOTORS AND IGNITERS

STAGE	MOTOR TYPE	IGNITER TYPE	SQUIB DELAY	SQUIB ACTUATOR
1	Nike	M24	0 sec.	Programmed Ground-firing Circuit
ASSISTS				
2	Apache	Standard Apache	20 sec.	Sustainer Circuit
3				
4				
5				
6				
7				

WI-30 3 (3-62)

IGNITER SQUIB CHARACTERISTICS

IGNITER	SQUIB ARRAY	NOMINAL SQUIB RESISTANCE	MINIMUM SURE FIRE CURRENT	MAXIMUM NO FIRE CURRENT	RECOMMENDED FIRING CURRENT
M24	2 parallel sets of 2 squibs in series	0.75-1.25 ohm	0.55 amps	0.25 amps	2 amps
Standard Apache	2 in parallel				

PYROTECHNICS AND OTHER HAZARDOUS INSTALLATIONS

VEHICLE: None

PRIMARY PAYLOAD: None

SECONDARY PAYLOAD: None

OTHER:

VEHICLE RADIO FREQUENCY TRANSMITTERS:

TYPE	FREQUENCY	POWER RATING
FM/FM Transmitter	231.4 MC	2 watts
FM/FM Transmitter	240.2 MC	2 watts
PPM Transmitter	244.3 MC	35 watts (peak)

CIRCUIT REVIEW

THE LAUNCHING OF ALL VEHICLES FROM WALLOPS STATION IS SUBJECT TO THE APPROVAL OF IGNITER AND PYROTECHNIC WIRING DIAGRAMS. THESE CIRCUITS ARE REVIEWED BY THE RANGE SAFETY SECTION WITH CONSIDERATION TO ESTABLISHED SAFETY CRITERIA.

THE STATUS OF THE WIRING DIAGRAMS FOR THE ABOVE DESIGNATED VEHICLE(S) IS AS FOLLOWS:

- [x] APPROVED
- [ ] APPROVED WITH THE FOLLOWING CHANGES OR REQUIREMENTS: ____________

PAD SAFETY

ASSIGNED BADGE NO. 9

PAD SUPERVISOR Roy Hindle

ALTERNATE PAD SUPERVISOR Jack Hurdle

PRELAUNCH DANGER AREA Launch Area No. 1

LAUNCH DANGER AREA A circle described about the Military Launcher with a radius of 780 feet.

DANGER AREA CLEARANCE REQUIREMENTS

PRE-LAUNCH DANGER AREA: See "Launch Area Operations and Personnel Restrictions" below.

LAUNCH DANGER AREA: All personnel in this area must be inside a reinforced concrete structure between "T" -5 minutes and that time after launch designated by the Pad Supervisor.

LAUNCH AREA OPERATIONS AND PERSONNEL RESTRICTIONS

THE FOLLOWING IS A LIST OF ALL MAJOR LAUNCH AREA OPERATIONS, THE PERFORMANCE LOCATION OF EACH, AND THE STATUS OF THE PRELAUNCH DANGER AREA FOR EACH OPERATION.

DURING CAUTION TIMES, ALL ESSENTIAL PERSONNEL POSSESSING THE PROPER BADGE WILL BE ALLOWED IN THE PRELAUNCH DANGER AREA. DURING A DANGER

TIME I, ONLY ACTIVE ESSENTIAL PERSONNEL POSSESSING THE PROPER BADGE ~~AND WHOSE NAMES APPEAR ON A LIST SUPPLIED TO THE PAD SUPERVISOR~~ WILL BE ALLOWED IN THE PRELAUNCH DANGER AREA. DURING A DANGER TIME II, NO PERSONNEL WILL BE ALLOWED IN THE PRELAUNCH DANGER AREA.

OPERATION	PERFORMANCE LOCATION	PRELAUNCH DANGER AREA STATUS
Delivery of rocket motors to launch area		Caution Time
Staging & Wiring	Launch Area No. 1	Caution Time
All power switching & instrumentation checks	Blockhouse No. 1	Danger Time II
All launcher settings	Launch Area No. 1	Danger Time I
Manually Disconnect Umbilical	Launch Area No. 1	Danger Time I
Launch	Launch Area No. 1	Danger Time II

DETAILED PAD SAFETY REQUIREMENTS AND PROCEDURES

POWER SWITCHING LIMITATIONS: Reference: Volume IV, Section II, page 190, "Final Preparations", WALLOPS STATION HANDBOOK-Safety

SPECIAL TEST AND/OR MONITORING REQUIREMENTS: None

RADIO FREQUENCY SILENCE REQUIREMENTS: Reference: Volume IV, Section II, page 193, "RF Radiation Hazards", WALLOPS STATION HANDBOOK- Safety

MISFIRE PROCEDURE:
HANGFIRE
ABORT PROCEDURE

Reference: Volume IV, Section II, page 194, "Launch Abort, Misfire, or Hangfire", WALLOPS STATION HANDBOOK-Safety

OTHER PAD SAFETY CONSIDERATIONS: The payload umbilical will be manually disconnected at "T" -1 minute.

LAND IMPACT CONVOY: Reference: Volume IV, Section II, page 195, "Land Impact Procedures:, WALLOPS STATION HANDBOOK-Safety

APPENDIX E

NASA

REPORT OF SOUNDING ROCKET LAUNCHING

Vehicle No.:	Rocket Type:	Launching Site:	Coordinates:
NASA 14.111 GT	Nike Apache	Wallops Island, Virginia	Lat.: 37° 50' N
Wallops No.:			Long.: 75° 29' W
G2-1281			

NASA Project Scientist(s): Mr. Lloyd Williams - Code 321
GSFC, Greenbelt, Maryland

Experimenter(s) and Location: Mr. Lloyd Williams - Code 321
GSFC, Greenbelt, Maryland

OBJECTIVES AND INSTRUMENTATION:

1. Define vibration environment imposed on payload during launch and flight.
2. Define thermal environment and structural integrity of payload housing during launch and flight.
3. Qualification test of PPM telemeter aboard high performance vehicle.

REMARKS:

Launching Date:	Time:	Peak Altitude:
31 October 1963	2117 Z	134.15 Km * (83.3 st. mi.)

Rocket Performance: Satisfactory - 12 Km. below predicted.

Instrumentation Performance: Excellent.

PRELIMINARY EXPERIMENTAL RESULTS:

A cursory inspection of records indicates that good data were obtained on this firing. This data will be used in establishing Test and Evaluation Test Parameters for future Nike Apache flights.

COMMENTS AND RECOMMENDATIONS:

*Based on plot board date

Prepared 1 November 1963

APPENDIX F

NASA

SOUNDING ROCKET

POST FLIGHT SUMMARY

IDENTIFCATION:	NASA 14.111 GT
Engine/Motor Numbers:	1st Stage 44063, 2nd Stage BP-15-613-2
Wallops Model Number:	G2-1281
Rocket Type:	Nike Apache
Number of Stages:	2
Place of Firing:	Wallops Island, Virginia
Date of Firing:	31 October 1963
Time of Firing:	2117 Z
Instrumenting Agencies:	NASA-GSFC
Instrumenting Agency Chief Scientist:	Mr. Lloyd Williams - Code 321
NASA Project Scientist:	Mr. Lloyd Williams - Code 321
NASA Rocket Vehicle Manager:	Mr. C. M. Hendricks - Code 671.4
Wallops Island Project Engineer:	Mr. Ralph Welsh

BRIEF OF FLIGHT OBJECTIVES:

(1) To define the vibration environment imposed on the payload during launch and flight.

(2) To define the thermal environment and structural integrity of the payload housing during launch and flight.

(3) Provide a qualification test of the PPM Telemeter aboard a high performance vehicle.

FLIGHT INFORMATION*

	Predicted**	Observed
Peak Altitude	90.74 st. mi.	83.3 st. mi.
Peak Time	191.2 sec.	185.12 sec.

Ignition Data	Time (sec.)	Altitude (ft.)	Velocity (ft./sec.)
Stage 1	0	0	0
Stage 2	21.95	40,967	1,382

Burnout Data	Time (sec.)	Altitude (ft.)	Velocity (ft./sec.)
Stage 1 Est.	3.5	5,339	3,195.5
Stage 2	28.95	64,154	5,801

Impact Data	Time (sec.)	Range (N. mi.)	Azimuth (deg.)
Stage 1	NA	NA	NA
Stage 2	361.5	73.1	112.95

Launcher Setting	Actual	Effective
Azimuth from true North	102°	115°
Elevation above Horizontal	77°	80°

ROCKET INFORMATION

	Weight (lbs.)	C.G. (in.)	C.G. Reference	Length (in.)
Stage 1	1319.66	75	NEP	151
Stage 2	217.8	50.125	NEP	107.875
Stage 2 (+ payload)	294	72.25	NEP	189.875
Payload	77	28	Aft End	82
Total	1613.66			340.875

ROCKET BORNE EQUIPMENT USED

Upper Air Instrumentation - Pitch-yaw ogive, Magnetometers, Accelerometers, Strain gages, Thermocouples, Thermistors, and Altitude switches.

Telemetry Instrumentation - FM/FM 244.3 Mc/s, FM/FM 240.2 Mc/s @ 2 Watts. PPM 231.4 Mc/s @ 35 Watt peak

GROUND BASED EQUIPMENT USED

Telemetry Instrumentation - Wallops Island Main Base Ground Station, Aerobee Blockhouse Ground Station, and Stations "A" and "C" for PPM

Tracking Instrumentation - FPS-16 and SPANDAR

PRELIMINARY RESULTS

Rocket Performance - Satisfactory, with apogee being 7.4 miles below predicted. The spin rate profile exhibits a pronounced spin down at Apache ignition, and a 40 degree coning angle (i.e. 20 degree half angle) at T +41 seconds.

Telemetry - All three telemetry systems functioned perfectly. The signal drop-out of PPM is attributed to vehicle attitude (40 degree coning angle).

Tracking Instrumentation - The FPS-16 and Spandar tracked the vehicle from +5.75 seconds to +361.12 seconds.

Upper Air Instrumentation - All scientific instrumentation on board functioned normally during the entire flight.

Total Experiment - Successful. Data in process of being reduced.

* Source: FPS-16 and SPANDAR.
** Prediction based on flight weight - not estimated weight.

Prepared 5 February 1964

APPENDIX G

CAJUN-APACHE ROLL RATE

By Reed B. Jenkins
Code 616.2

NASA Goddard Space Flight Center

It is recommended that all Cajun and Apache rocket vehicles used as second stages in the Nike-Cajun and Nike-Apache configurations be rolled by the addition of fin wedges to a rate of at least 5 cycles per second at burnout of the second stage. This roll rate is necessary to insure maximum performance and minimum coning motion in space. In the event that good attitude in space is not desired or the nature of the scientific instrumentation is such that a 5 cps roll is impractical, it is recommended that a roll rate of as close to zero as possible be planned. It is strongly suggested that second stage burnout roll rates between 1 and 4 cps be avoided.

The reasons behind the suggested roll rates are based on the dynamic response of the vehicle due to pitch-roll resonance. The best flights are obtained by rolling the vehicle at a high rate so that pitch-roll resonance is passed while the rolling moment due to fin cant (the result of spin tabs) is high as compared with induced rolling moment encountered at high angles of attack during pitch-roll resonance. The use of high roll rates reduces the possibility of pitch-roll lock-in which usually results in very large coning angles, a flat spin, or even catastrophic failure. In the event high (5 cps) roll rate cannot be tolerated every attempt should be made to keep the roll rate as low as possible. The reason for this is to delay pitch-roll resonance until the dynamic pressure is as low as possible and thus eliminate the possibility of catastrophic failure. It should be noted that, in this case, the attitude of the vehicle in space will normally be relatively poor.

Rolling at 2-3 cps will usually result in pitch-roll resonance during burning of the second stage and about at the time of maximum second stage dynamic pressure. Such a condition can affect performance and may even result in structural failure of the vehicle in the event of marginal fin or payload designs.

To control roll during Cajun or Apache flights, NASA uses the fin wedge technique. With this method it is a simple process to make adjustments in the field. If the entire fins were to be canted, it would be necessary to mill canted fin slots in the fin assembly shroud during manufacture and it would be impossible to make field adjustments. Use of wedges allows adjustment for any desired roll rate in the field.

Figure 1 shows the dimensions of the wedges commonly used on NASA vehicles. The thickness of the trailing edge of the wedge above the surface of the fin, delta (Δ), is variable dependent upon the desired roll rate. Figure 2 gives the dimensions for delta (Δ) for various roll rates as a function of burnout velocity of the second stage where wedges are used on 2 fins only (180° apart).

In the event it is desired to install wedges on all four fins (as is now NASA practice), the dimension of delta (Δ) given in figure 2 should be reduced by one half. For example, if on a vehicle having a burnout velocity of 6500 fps, we desired a roll rate at burnout of 5 cps, the delta (Δ) thickness of the wedge would be 0.252 inches if wedges were to be installed on two opposite fins. If wedges were to be installed on all four fins, a Δ of 0.126 inches would be used.

It should be noticed that the delta (Δ) thickness is that over and above the portion of the wedge that is recessed into the fin panel. The wedge is recessed to improve air flow over the wedge and to prevent thermal errosion of the wedge leading edge.

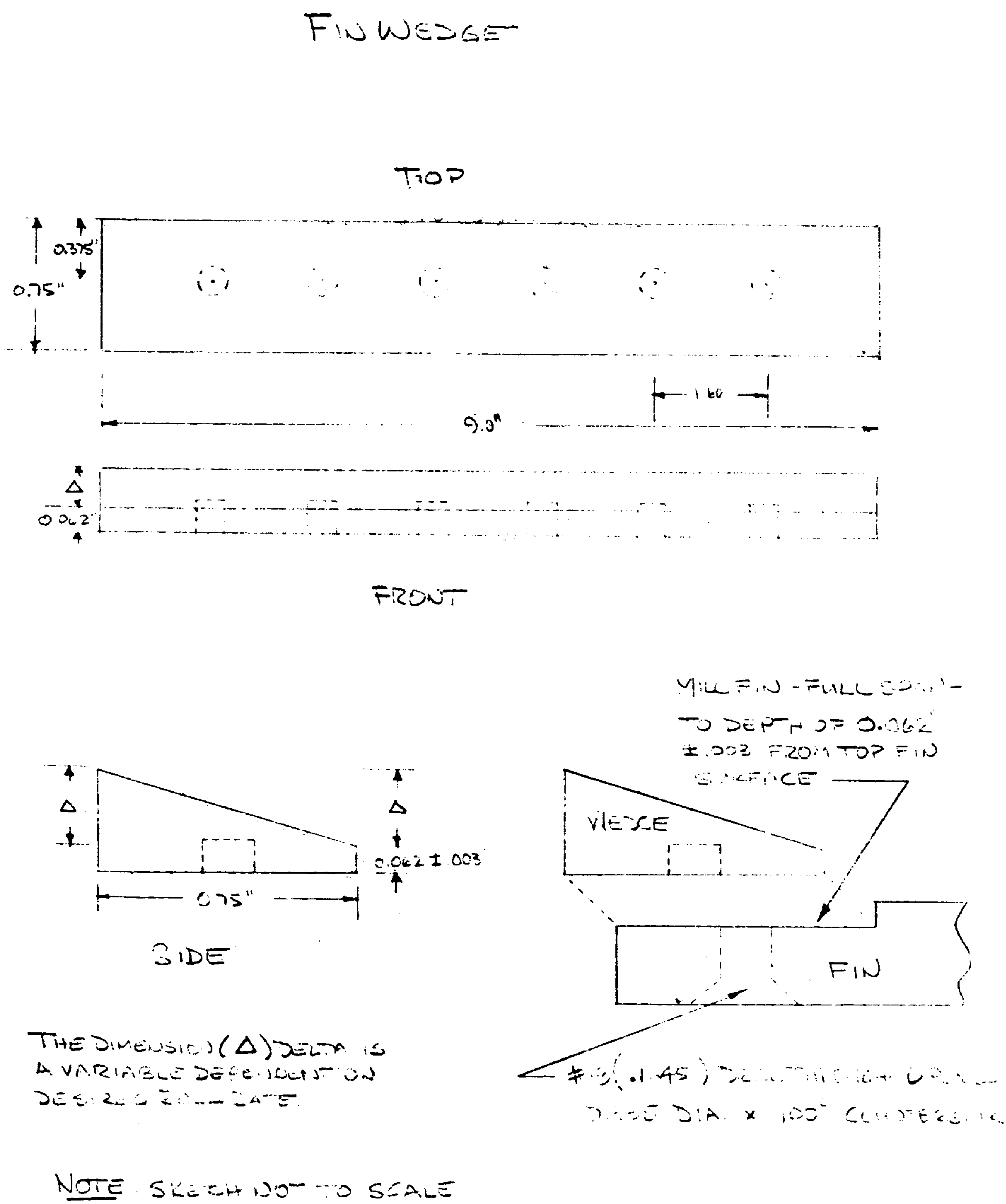

FIN WEDGE
TOP
0.375"
0.75"
1.60
9.0"
Δ
0.062"
FRONT
MILL FIN - FULL
TO DEPTH OF 0.062"
±.003 FROM TOP FIN
WEDGE
Δ
0.062 ± .003
0.75"
SIDE
FIN
#3 (.145)
DIA. x 100°
THE DIMENSION (Δ) DELTA IS
A VARIABLE
NOTE: SKETCH NOT TO SCALE

FIGURE 1

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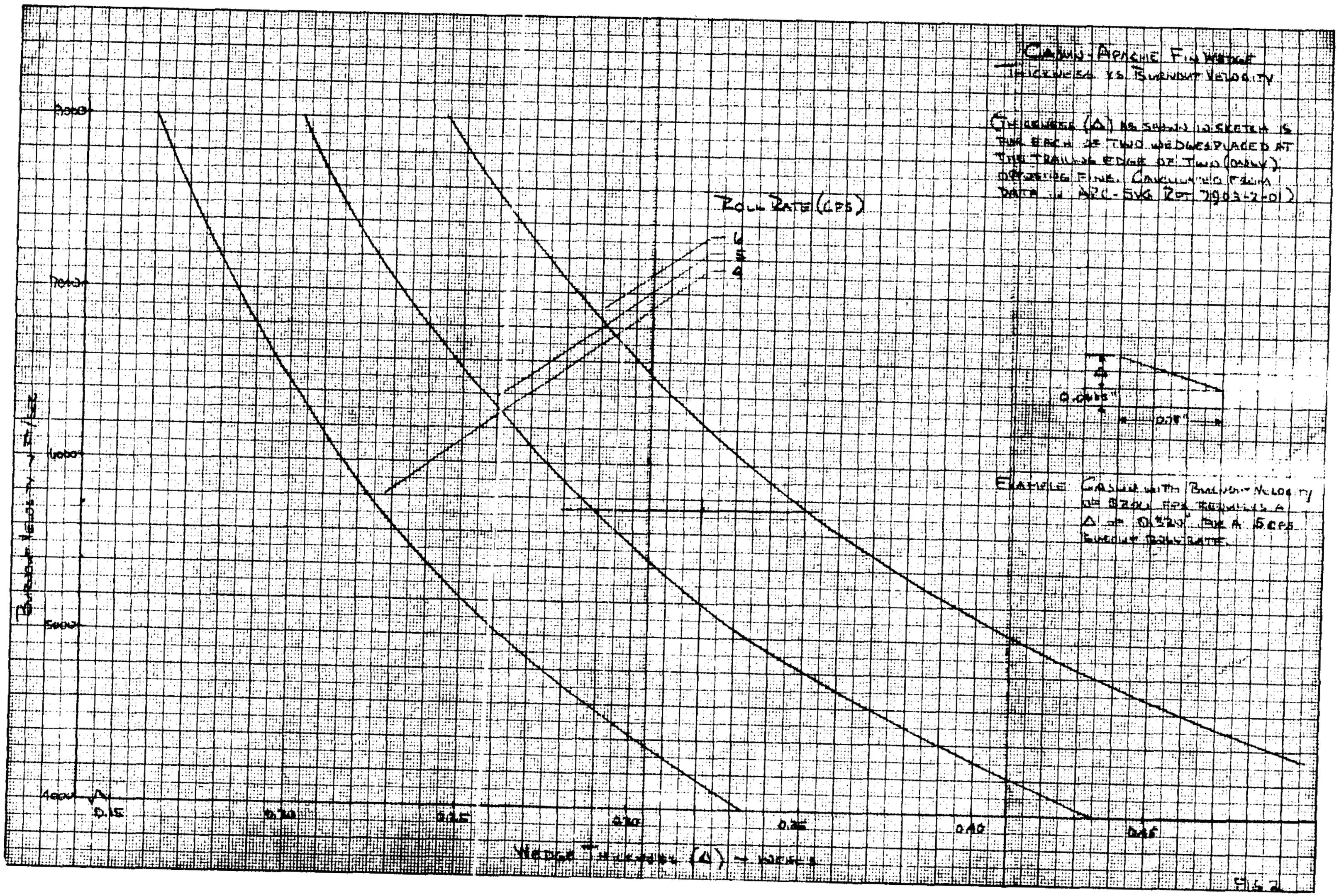
CAJUN-APACHE FIN WEDGE
THICKNESS VS BURNOUT VELOCITY
ROLL RATE (CPS)
6
5
4
8000
7000
6000
5000
4000
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.028"
WEDGE THICKNESS (Δ) ~ INCHES
FIG 2

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ATLANTIC RESEARCH CORP.
Space Vehicles Group El Monte, Calif.

INSPECTION REPORT
Cajun & Apache Fin Assy's.

Prepared by: Serial No.: 8946-28

Checked by: Date: APR 18 1962

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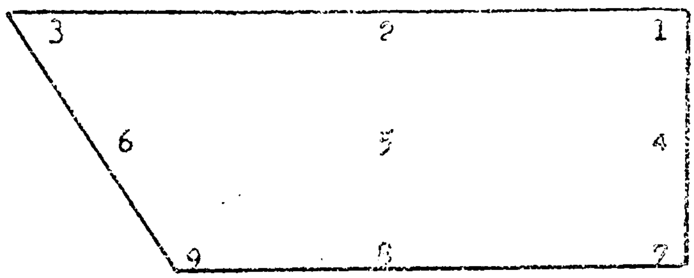
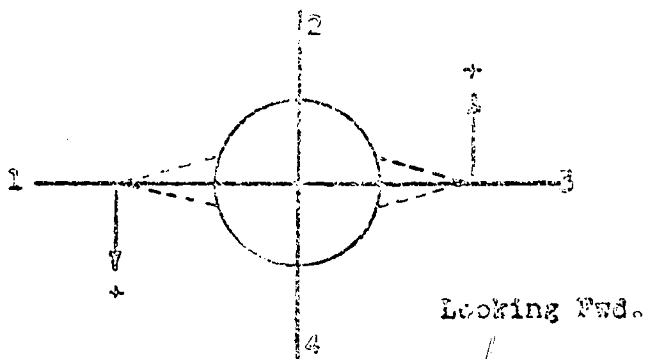
G2-1281
14.111 JT





Looking Fwd.

	Chk. Pt.	1	3	2	4	Σ
ROOT	1	0	0	0	0	0
	2	-.007	-.007	-.001	+.010	
	3	-.013	-.025	0	+.011	-.027
MID SPAN	4	+.006	+.012	+.002	+.005	+.025
	5	+.003	+.002	-.003	-.003	
	6	+.003	-.005	0	-.002	-.004
TIP	7	-.003	+.010	+.007	+.012	+.026
	8	0	0	0	0	
	9	-.002	-.003	-.001	-.002	-.008

Σ3-Σ1	Σ6-Σ4	Σ9-Σ7	2×Col.2	3×Col.3	Col.1+4+5	9.5×Col.6
-.027	-.029	-.034	-.058	-.102	-.187	-1.74
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7

Files

APPENDIX I

FINAL STATUS REPORT: December 18, 1963

PROJECT: Wallops Model G2-1281 (Goddard Model Nike-Apache 14.111 GT)

WALLOPS PROJECT ENGINEER: Mr. Ralph D. Welsh, Jr.

STATUS: On October 31, 1963, at 2117Z, Wallops Model G2-1281 (Goddard Model Nike-Apache 14.111 GT) was launched from the Military Launcher, Launch Area No. 2, this Station. The primary objective of this flight was to define the vibration environment imposed on a Nike-Apache payload during launch and flight. The secondary objective was to define the thermal environment and structural integrity of the payload housing during launch and flight. Additional instrumentation was flown to determine the flight characteristics of the vehicle. This flight was also used as a qualification test of the PPM telemetry system, prior to use on scientific missions aboard high-performance vehicles. All flight objectives were satisfied; however, roll rate of this model was not as predicted. The Nike fins on this model were canted at 25 minutes to give a 2 rps (cw) roll rate at Nike burnout. The Apache fins had a .201-inch wedge attached to the fin trailing edge of all four fins to give the second stage and payload 5 to 5.5 rps roll rate at Apache burnout. The actual roll rate for the Apache motor was 5 to 6 rps prior to ignition; however, during Apache thrusting, the spin rate dropped to 2 rps. Since the pitch natural frequency is 2 to 3 rps at Apache burnout, the motor w/payload apparently experienced pitch-roll coupling, causing a severe & detrimental coning angle. This condition caused the payload to experience a flight environment which cannot be considered typical.

All Wallops radars tracked this vehicle with good results. Following is a comparison between actual and predicted vehicle performance:

	PREDICTED	ACTUAL
Nike Burnout-		
time (+secs)	3.5	3.5
velocity (ft/sec)	3195	3154
roll rate (rps)	2	2
Apache Ignition-		
time (+ secs)	20	21.85
altitude (ft)	39,506	40,839
velocity (ft/sec)	1,511	1,352
roll rate (rps)	—	5.5
horizontal range (ft)	9,330	10,417
flight path angle (degrees)	74.3	71.69
flight azimuth (degrees)	—	112.2

	PREDICTED	ACTUAL
Apache burnout-		
time (+secs)	26.4	28.95
altitude (ft)	61,576.5	64,154
velocity (ft/sec)	5,660	5,801
roll rate (rps)	5.5	2
horizontal range (ft)	15,813.7	17,214
flight path angle (degrees)	73.3	73.72
flight azimuth (degrees)	115	112
Apogee-		
time (secs)	191.2	185.12
altitude (ft)	479,131.3	440,274
horizontal range (ft)	254,626.6	223,418
Impact-		
time (secs)	374.4	364.12
horizontal range (ft)	510,773.9	455,303 (113° Az)

Following are listed radar data:

SPANDAR

Event	Time(+secs)	Altitude(ft)	Horizontal Range(ft)
Acquisition	25	47,334	11,496
Apogee	185	440,274	223,418
Impact	364	0	455,303

FPS-16

Acquisition	5	9,950	1,500
Lost track	150	411,423	165,501

MOD II

Acquisition	5	9,950	1,500
Lost track	58	197,000	59,000

SCR-584

Acquisition	4	6,850	1,000
Lost track	43	134,227	38,070

DOPPLER radar reported 20 seconds of good record. Wallops Main Base and Goddard Blockhouse No. 1 telemetry receiving stations reported good data for 361 seconds on 240.2 mc and 244.3 mc. Camera tracking stations nos. 1, 2, 3, and one fixed camera reported good results.

Launcher settings and flight path angles were as follows:

	Launcher Settings	Desired Flight Path	Actual Flight Path
Azimuth	102°	115°	112° @ + 28.95 secs.
Elevation	77°	80°	73.7° @ + 28.95 secs.

Ballistic wind and direction: 21.8 fps from 247.1°
Surface wind and direction (50-foot level): 17.6 ft/sec from 220°

Tower tilt effect used: 8.4 nautical miles/degree
Unit wind effect used: 1.150 nautical miles/ft/sec

All flight records have been processed and forwarded to Goddard Space Flight Center personnel for further study.

Several attempts were made to launch Nike-Apache G2-1281/Goddard Model 14.111 prior to the October 31, 1963 firing date. These attempts and reasons for postponements are listed below:

First Event:

Set-up G2-1281 for 1800Z, October 29, 1963. The count was held at "T"-1 hour due to trouble with the FPS-16 radar. The shot was postponed at 2039Z due to winds and FPS-16 radar. Winds were varying 20 to 40 ft/sec on Met Tower (050° Azimuth).

Second Event:

Set-up G2-1281 for 1800Z, October 30, 1963. The shot was postponed at 1330Z due to winds.

Third Event:

Set-up G2-1281 for 2030Z, October 31, 1963. Vehicle was launched at 2117Z, October 31, 1963, after a short hold due to interference on 240.2 mc.

APPENDIX J

Range Instrumentation Branch Log for October 31, 1963

Weather: Clear most of the day; some overcast

Two standard 2-3/4-inch test rockets were launched at 1532Z and 1542Z from Launch Areas 1 and 2, respectively, to check Wallops instrumentation with unsatisfactory results due to failure of radars to track. Third and fourth test rockets were launched at 1613Z and 2046Z from Launch Areas 1 and 2, respectively, with satisfactory results.

AEROBEE 4.94 (G2-1413) was launched at 1650Z from Launch Area No. 1 for the NASA International Program as part of a joint venture between NASA and the Centre National d'Etudes Spatiales (CNES) of France to investigate the propagation of very low frequency electromagnetic waves in the ionosphere with satisfactory results. The FPS-16 radar went into automatic track at +8 seconds at 5,300 feet slant range, with apogee at +235 seconds at 605,000 feet altitude and 622,000 feet slant range, and dropped track after breakup at +427 seconds at 45,000 feet altitude and 275,000 feet slant range. The Mod II radar went into automatic track at +7 seconds at 4,300 feet slant range and lost track at +94 seconds at 330,000 feet altitude and 333,000 feet slant range. The SCR-584 radar went into automatic track of booster at +9 seconds at 4,300 feet slant range, with apogee at +17 seconds at 5,900 feet altitude and 6,000 feet slant range, and tracked to impact at +40 seconds at 2,700 feet slant range. The SPANDAR radar went into automatic track at +88 seconds at 295,000 feet altitude and 298,000 feet slant range, with apogee at +235 seconds at 605,000 feet altitude and 622,000 feet slant range, and dropped track after breakup at +427 seconds at 45,000 feet altitude and 275,000 feet slant range. The above data were taken from quick-look plotboards. The Doppler radar reported 22 seconds of good data. Fixed Telemeter Receiving Stations Nos. 1 and 2 reported good data on 256.2 MC for 419 seconds. Camera Tracking Stations Nos. 1, 2, 5, 9, and the fixed cameras reported good results.

NIKE-APACHE 14.111 (G2-1281) was launched at 2117Z from Launch Area No. 2 for the Goddard Space Flight Center to define the vibration environment imposed on a Nike-Apache payload during launch and flight with satisfactory results. The FPS-16 radar went into automatic track at +5 seconds at 10,000 feet slant range, lost track at +150 seconds at 421,000 feet altitude and 460,000 feet slant range, reacquired at +203 seconds at 433,000 feet altitude and 500,000 feet slant range, lost at +220 seconds at 412,000 feet altitude and 499,000 feet slant range, reacquired at +240 seconds at 390,000 feet altitude and 491,000 feet slant range, and lost track at +300 seconds at 235,000 feet altitude and 442,000 feet slant range. The Mod II radar went into automatic track at +5 seconds at 10,000 feet slant range and lost track at +58 seconds at 197,000 feet altitude and 206,000 feet slant range. The SCR-584 radar went into automatic track at +4 seconds at 6,900 feet slant range and lost track at +43 seconds at 135,400 feet altitude and 141,000 feet slant range. The SPANDAR radar went into automatic track at +25 seconds at 46,500 feet altitude and 48,500 feet slant range, lost track at +31 seconds at 76,000 feet altitude and 78,000 feet slant range, reacquired at +38 seconds at 110,000 feet altitude and 115,000 feet slant range, with apogee at +183 seconds at 440,000 feet altitude and 494,500 feet slant range, and tracked to impact at +360 seconds at 446,000 feet slant range. The above data were taken from quick-look plotboards. The Doppler radar reported 20 seconds of good data. Fixed Telemeter Receiving Stations Nos. 1 and 2 reported 361 seconds of good data on 240.2 and 244.3 MC. Camera Tracking Stations Nos. 1, 2, 3 and all except one (which reported negative results) of the fixed cameras reported good results.

Actual Observation taken at T-0 time on Wallops Island, Va., by U. S. Weather Bureau personnel for this firing:

NASA 14.111 GT WIFR G2-1281 Fired: 10-31-63/1617 EST (2117Z)

Weather: 0-Time Observation

Island Temperature: 58°F

Dew-Point Temperature: 25°F
Visibility: 10 miles
Barometric Pressure: 1016.2 millibars
Wind: Direction: 235°
Velocity: 10 knots
Cloud Cover: High, thin, scattered clouds (Cirrus).
A few altocumulus clouds present (less than 0.1 sky covered).

Winds measured at "met" tower:

WIND

Level	Direction	Velocity
50'	220°	13 mph
100'	225°	15 mph
150'	235°	15 mph
200'	230°	17 mph
250'	220°	17 mph

INFORMATION FOR MR. J. A. STERHARDT, GSFC, RE NASA 14.111 GT WIFR G2-1281, FIRED, WIFR, 10-31-63/1617 EST

APPENDIX K

36-HOUR FORECAST ISSUED 1800Z 10/30/63
REFERENCE: NIKE-APACHE, NIKE-SMOKE, HASP & AEROBEE
CONFIDENCE: 80% CHANCE OF VERIFYING FIRST HALF; 70% SECOND HALF

SYNOPTIC SITUATION.....HIGH PRESSURE CENTERED OVER ALABAMA WITH A RIDGE EXTENDING NORTHWARD TO THE GREAT LAKES WILL MOVE TO THE SOUTH CAROLINA COASTAL AREA BY WEDNESDAY MORNING AND OFF-SHORE BY WEDNESDAY NIGHT.

CLOUDINESS.....
1800Z 2000 SCATTERED
2200Z CLEAR
1400Z THURSDAY 2000 SCATTERED, HIGH SCATTERED
1900Z THURSDAY 2000 SCATTERED VARIABLE BROKEN, HIGH BROKEN
0100Z FRIDAY 10000-15000 SCATTERED HIGH BROKEN

WEATHER.....HAZE FORMING BY 2000Z THURSDAY

VISIBILITY.....7-12 MILES BECOMING 5-8 MILES BY 2000Z THURSDAY

TEMPERATURE.....35-40 TONIGHT 58-63 THURSDAY

WINDS.....NORTHWESTERLY 18-35 KNOTS DIMINISHING SLOWLY TONIGHT. 1400Z THURSDAY NORTHWEST TO WEST 8-18 KNOTS BECOMING SOUTH TO SOUTHWEST 7-15 KNOTS BY 1900Z.

TIDES.....NEAR NORMAL

12-HOUR FORECAST ISSUED 1300Z 10/31/63
REFERENCE: AEROBEE, NIKE-APACHE, NIKE-SMOKE AND HASP
CONFIDENCE: 75% CHANCE OF VERIFYING

SYNOPTIC SITUATION.....HIGH PRESSURE CENTERED OVER GEORGIA WITH A RIDGE EXTENDING NORTHWARD TO NEW YORK STATE WILL CONTINUE TO DRIFT EAST AND SOUTHEASTWARD REACHING THE NORTHERN FLORIDA COASTAL AREA BY 0100Z.

CLOUDINESS.....
1300Z 10000-15000 BROKEN
1600Z 3000 SCATTERED 12000 SCATTERED
2200Z 10000 SCATTERED VARIABLE BROKEN

WEATHER.....HAZE BY 2000Z

VISIBILITY.....7-10 MILES

TEMPERATURE.....58-63 TODAY

SURFACE WIND.....WEST TO SOUTHWEST 8-18 KNOTS BECOMING SOUTHWEST TO SOUTH BY 1900Z

TIDES.....NEAR NORMAL

36-HOUR FORECAST ISSUED 1800Z 10/31/63
REFERENCE: NIKE-APACHE, NIKE-SMOKE AND HASP
CONFIDENCE: 75% CHANCE OF VERIFYING FIRST HALF; 70% SECOND HALF

SYNOPTIC SITUATION.....THE HIGH NOW OVER NORTHERN FLORIDA WITH A RIDGE EXTENDING TO SOUTHERN NEW ENGLAND WILL MOVE OFF-SHORE TONIGHT. LOW CENTER NOW OVER MISSOURI WILL MOVE NORTH-EASTWARD TO THE LOWER ST. LAWRENCE VALLEY BY FRIDAY MORNING AND TO THE GULF OF ST. LAWRENCE BY LATE FRIDAY NIGHT; THE ASSOCIATED COLD FRONT SHOULD PASS WALLOPS ABOUT 0400Z SATURDAY.

CLOUDINESS.....
1800Z HIGH SCATTERED VARIABLE BROKEN
0100Z FRIDAY 10000-15000 SCATTERED VARIABLE BROKEN HIGH BROKEN
1000Z FRIDAY 10000 BROKEN HIGH OVERCAST
1600Z FRIDAY 3000 SCATTERED 10000 BROKEN HIGH OVERCAST
2200Z FRIDAY 3000 SCATTERED 6000-10000 BROKEN HIGH OVERCAST; OCCASIONALLY 2000 BROKEN

WEATHER.....HAZE BY 1000Z. SCATTERED SHOWERS AFTER 2200Z FRIDAY

VISIBILITY.....7-12 MILES BECOMING 5-8 MILES BY 1000Z. OCCASIONALLY 3-5 MILES AFTER 2200Z FRIDAY.

TEMPERATURE.....48-53 TONIGHT 65-70 FRIDAY

WINDS.....WEST TO SOUTHWEST 7-15 KNOTS BECOMING SOUTH TO SOUTH-WEST 1000Z AND INCREASING TO 10-20 KNOTS BY 1600Z

TIDES.....NEAR NORMAL