TABLE I

FIRST STAGE SEQUENCE OF EVENTS

EVENTS	TIME (SEC)	SOURCE
100% liquid oxygen float switch dropout	-168.13	E. A. Recorder
Start tanks pressurizion	- 33.13	E. A. Recorder
Vernier start command	- 3.13	E. A. Recorder
Vernier pressure switches actuated	- 2.67	E. A. Recorder
Main chamber pressure switch actuated	- 0.19	E. A. Recorder
Liftoff*	0.000	Telemetry (FM/FM)
Roll command in	2.3	Telemetry (PDM/FM)
Roll command out	9.3	Telemetry (PDM/FM)
First programmed pitch command in	10.4	Telemetry (PDM/FM)
Second programmed pitch command in	28.4	Telemetry (PDM/FM)
Third programmed pitch command in	70.5	Telemetry (PDM/FM)
Head suppression valve activation	80.0	Telemetry (PDM/FM)
Fourth programmed pitch command in	98.2	Telemetry (PDM/FM)
Fourth programmed pitch command out	140.3	Telemetry (PDM/FM)
Fuel float switch actuation	155.90	Telemetry (PDM/FM)
Liquid oxygen float switch actuation**	151.81	Telemetry (PDM/FM)
MECO command	160.08	Telemetry (PDM/FM)
Gas generator blade valve closed	160.16	Telemetry (PDM/FM)
Main fuel valve closed	160.44	Telemetry (PDM/FM)
Main liquid oxygen valve closed	160.44	Telemetry (PDM/FM)
Vernier burnout	168.14	Telemetry (PDM/FM)

*Obtained from second stage liftoff switch (umbilical) activation recorded on FM/FM telemetry at 0923:22.239 EST. This time is used as zero time reference for events.

**Reopened at 155.46.

Reading accuracies of time:	PDM/FM Telemetry	±0.03	sec.
	FM/FM Telemetry	±0.005	sec.
	E. A. Recorder	±0.04	sec.

TABLE II

FIRST STAGE SYSTEMS PERFORMANCE

SYSTEMS	TIME (SEC)	PRESSURE (PSIA)	EXPECTED VALUE
Main Engine Functions*			
Duration	160.44		
Chamber pressure at start**		576	525
Chamber pressure at cutoff**		555	525
Vernier Engine #1 Functions*			
Duration prior to main engine operation	2.94		
Duration during main engine operation	160.44		
Duration subsequent to main engine operation	7.70		
Chamber pressure tank fed prior to main engine operation		282	272
Chamber pressure pump fed during main engine operation		350	350
Chamber pressure tank fed subsequent to main engine operation		308	300
Turbine Functions			
Gas generator chamber pressure at start		428	395
Gas generator chamber pressure at cutoff		417	395

NOTE: Turbopump speed at start was 8,500 rpm (expected value - 6,095 rpm).

*See Glossary for definitions.
**Actually fuel injector pressure. See Section 3.1.2.

FUNCTION	QUANTITY		SOURCE
WEIGHT DATA			
Dry missile weight less second, third, and fourth stages	7,560	lbs.	Measured
Weight of second, third, and fourth stages	5,048	lbs.	Measured
Firing weight	111,516	lbs.	Measured
Liftoff weight	110,918	lbs.	Measured
MECO weight	13,600	lbs.	AZUSA
FLIGHT MECHANICS			
Acceleration at liftoff	43.2	ft/sec^2	Computed
Altitude above launcher at MECO	52.0	n.m.	AZUSA
Range from launcher at MECO	85.1	n.m.	AZUSA
Flight path angle from launch horizontal at MECO	22.1	deg.	AZUSA
Velocity at MECO	15,100	ft/sec	AZUSA
Acceleration at MECO	405.3924	ft/sec^2	AZUSA

TABLE II

FIRST STAGE SYSTEMS PERFORMANCE
(Continued)

FUNCTION	QUANTITY		SOURCE
THRUST			
Main engine sea-level thrust at start	147,000	lbs	Kinematic
Vernier engine #1 sea-level thrust (pump fed)	987	lbs	Computed
Total vacuum thrust at MECO	172,000	lbs	Kinematic
Vernier engine #1 vacuum thrust (solo)	1,016	lbs	Computed
PROPELLANTS			
Liquid oxygen			
Usable at liftoff	67,305	lbs	Computed
Usable remaining at MECO*			Float Switch
Usable remaining at MECO	0	lbs	Kinematic
RP-1			
Usable at liftoff	30,247	lbs	Computed
Usable remaining at MECO	0	lbs	Float Switch
Usable remaining at MECO	0	lbs	Kinematic
Propellant Utilization			
Propellant Utilization at MECO**			Float Switch
Propellant Utilization at MECO	100.0	%	Kinematic
Ultimate Propellant Utilization**			Float Switch

Reading accuracy of amplitude $\pm 2\%$.

*Liquid oxygen float switch malfunctioned.
**Unable to determine P.U. from float switch data due to malfunction of liquid oxygen float switch.

TABLE III

SEQUENCE OF EVENTS FOR SECOND, THIRD, AND FOURTH STAGES

EVENTS*	TIME (SEC) Actual	Nominal
Arm second stage	142.0	140.0
Second stage ignition/pitch program initiation	162.2	162.0
First/second stage separation bolts activated	162.5	162.4
First/second stage separation	162.6	162.4
HGA activated	171.6	172.0
Fairing ignition	188.8	187.0
Fairing separation	188.9	187.0
Pitch program termination	262.8	262.0
Second stage TPS shutdown	279.2	275.8
Spin rockets ignited	281.2	277.8
Solar paddles up	282.0	276.9
Third stage ignition	282.2	278.9
Second/third stage strut release	282.2	278.9
Third stage burnout	320.8	315.7
Third/fourth stage separation	433.7	427.0

*Liftoff time was obtained from second stage liftoff switch (umbilical) activation recorded on FM/FM telemetry at 0923:22.239 EST. This time is used as zero time reference for events.

TABLE IV

SYSTEMS PERFORMANCE FOR SECOND, THIRD, AND FOURTH STAGES

WEIGHT SUMMARY

Line Ref.	ITEM		WEIGHT (LBS)
1	ABLE-3 AT STAGE 4 SEPARATION FROM STAGE 3		(143.9)
2	Stage 3 Weight At Burnout	54.8	
3	ABLE-3 AT STAGE 3 BURNOUT		(198.7)
4	Stage 3 Expendables	463.7	
5	ABLE-3 AT STAGE 3 SEPARATION FROM STAGE 2		(662.4)
6	Stage 2 Minimum Shutdown Weight	953.4	
7	ABLE-3 AT STAGE 2 BURNOUT		(1615.8)
8	Stage 2 Shutdown Transient Propellants	35.0	
9	ABLE-3 AT STAGE 2 SHUTDOWN		(1650.8)
10	Stage 2 Expendables	3177.9	
11	Nose Fairing Jettison	122.6	
12	ABLE-3 AT STAGE 2 SEPARATION FROM STAGE 1		(4951.3)
13	Stage 1 Jettisoned Weight	8598.0	
14	ABLE-3 AT STAGE 1 VERNIER BURNOUT		(13,549.0)
15	Stage 1 Vernier Period Expendable Propellants	18.0	
16	ABLE-3 STAGE 1 MAIN ENGINE BURNOUT		(13,567.0)
17	Stage 1 Expendables	97,403.0	
18	ABLE-3 AT LAUNCH		(110,970.0)

WEIGHT SUMMARY DETAILS

2	Stage 3 at burnout					54.8
	X248-A4 at burnout (incl. Erosion Loss)				49.8	
	3 to 4 Interstage				5.0	
6	Stage 2 Minimum Shutdown Weight					953.4
	Stage 2 Dry Weight (incl. 2 to 3 Interstage)				849.9	
	Residuals	H_e	Oxid.	Fuel		
	Trapped in tanks	9.0	11.2	5.9		
	2.5 sec bias in tank		52.5			
	Residual in lines		3.8	2.6		
	Residual in TCA		18.5			
		9.0	86.0	8.5	103.5	

TABLE IV

SYSTEMS PERFORMANCE FOR SECOND, THIRD, AND FOURTH STAGES
(Continued)

WEIGHT SUMMARY DETAILS

Line Ref.	ITEM					WEIGHT (LBS)	
8	Stage 2 Shutdown Transient Propellants						35.0
	Oxidizer					30.0	
	Fuel					5.0	
10	Stage 2 Expendables						3177.9
	Oxidizer (See Note 1)					2328.4	
	Fuel (See Note 2)					847.5	
	Helium					2.0	
13	Stage 1 Jettisoned Weight						8598.0
	Dry Thor Booster No. 134					7560	
	1 to 2 Interstage					96	
	Stage 1 Residuals	Fuel	Oxid	Oil	H_e		
	In Motor	201	115				
	In Piping	215	54				
	In Tanks	(See Note 3)					
	In Verniers	12	12				
	Lube Oil			20			
	Press. Gas		294		13		
		428	475	20	13	936	
	Stage 2 Start Loss					6	
15	Stage 1 Vernier Period Expendable Propellants						18
	Oxidizer					12	
	Fuel					6	
17	Stage 1 Expendables						97,403
	Oxidizer (See Note 4)					66,871	
	Fuel (See Note 5)					30,241	
	Gaseous Oxygen					128	
	Lube Oil					112	
	Vernier Expended					51	

NOTES:
1 Density at loading = 1.494 x 62.366 = 93.17 lbs./cu. ft.
2 Density at loading = .784 x 62.366 = 48.89 lbs./cu. ft.
3 Until more definite data are available, 100% utilization is assumed.
4 Density at loading = 71.33 lbs./cu. ft
5 Density at loading = 49.70 lbs./cu. ft. at 90° F.

TABLE V

PHYSICAL CONFIGURATION

THOR ABLE-3

	DIMENSIONS
FUSELAGE	
Length	
First Stage	736.0 in.
Second Stage	229.0 in.
Third Stage	58.5 in.
Fourth Stage	31.7 in.
Diameter	
First Stage	
Station 42	54 in.
Station 151	75 in.
Station 336	96 in.
Station 722	96 in.
Second Stage (Constant)	32 in.
Third and Fourth Stage Fairing (Max. Dia.)	32 in.
STABILIZING FINS, FIRST STAGE	
Planform	30° Right Triangle
Panel Area	6.0 $ft.^2$
MAIN ENGINE, FIRST STAGE	
Exit Cone Area	1640 $in.^2$
Throat Area	205 $in.^2$
Ratio, Exit Cone to Throat Area	8.0:1.0
MAIN ENGINE, SECOND STAGE	
Ratio, Exit Cone to Throat Area	20.0:1.0
VERNIER ENGINES, FIRST STAGE	
Pivot Point of Vernier #1 to Pivot Point of Vernier #2	79.25 in.

EXTERNAL MARKINGS

The first stage was painted white with black markings as required for determining roll during the early portion of flight. Significant markings included a six inch spiral between stations 164 and 336, bounded on each end by a six inch band around the missile. The spiral begins and ends in the ballistic plane and moves in a clockwise direction looking forward. The missile fins were numbered 1 through 4. They were numbered clockwise looking forward with fin #1 in the upper

TABLE V

PHYSICAL CONFIGURATION
(Continued)

THOR ABLE-3

EXTERNAL MARKINGS (Continued)

left hand quadrant, 45° from the horizontal plane. Fin #1 was all black, fin #2 was white with a black dot in the center, fin #3 was white with a six inch black stripe at 45° starting at the lower inboard corner and running outboard, and fin #4 was white with a six inch black stripe at 45° starting at the lower outboard corner and running inboard. For documentary purposes the number 134 appeared twice on the missile, once at station 212 in the quadrant of fin #4 and once at station 266 in the quadrant of fin #2.

The second stage was painted white with three inch high black Roman Numerals I, II, III and IV clockwise around the missile at station 296 at 90° intervals. The Numeral II was in the ballistic plane on the down range side. Two stripes originating at station 308 in the ballistic plane converged at station 254 directly over Roman Numeral III and a single stripe extended vertically to station 188. The single black stripe was resumed at station 158 and ran to the forward end of the second stage. For documentary purposes United States was painted vertically the full length of the second, third and fourth stages in the ballistic plane on both sides of the missile.

The third and fourth stage fairing was painted white.

Axial measurements are with respect to origin of Y axis which is 32 inches forward of the nose fairing of the fourth stage.

TABLE VI

EXTERNAL OPTICAL INSTRUMENTATION

METRIC OPTICS

SITE	LOCATION	CAMERA	TYPE	SPECIAL NOTE
Theodolite 1, 20	Cape	Theodolite	Tracking	Good data coverage obtained
Theodolite 1, 40	Cape	Theodolite	Tracking	Good data coverage obtained
Theodolite 1, 50	Cape	Theodolite	Tracking	Good data coverage obtained
Theodolite 1, 60	Cocoa Beach	Theodolite	Tracking	Good data coverage obtained
Theodolite 1, 3	PAFB	Theodolite	Tracking	Good data coverage obtained
U6R108	Cape	CZR	Tracking	Good data coverage obtained
U15R146	Cape	CZR	Tracking	Good data coverage obtained
U61R121	Cape	CZR	Tracking	Good data coverage obtained
U73R95	Cape	CZR	Tracking	Good data coverage obtained
U73R95	Cape	35mm Mitchell	Tracking	Good data coverage obtained
U19R172	Cape	35mm Mitchell	Tracking	Good data coverage obtained

DOCUMENTARY OPTICS

Alert	Complex 17	16mm Cine Special	Movie	Processed at S. M.
Alert	Complex 17	4x5 Speed Graphic	Still	Processed at PAFB
Alert	Complex 17	16mm Auricon	Sound	Processed at S. M.
Service Tower 17A	Complex 17	35mm Mitchell	Fixed	Processed at S. M.
17A-C, 20' Tower	Complex 17	35mm Mitchell	Fixed	Processed at S. M.
Umb. Mast, Lower	Complex 17	16mm Cine Special	Fixed	Processed at S. M.
Umb. Mast, Upper	Complex 17	16mm Cine Special	Fixed	Processed at S. M.
Service Tower 17A	Complex 17	K-25	Fixed	Processed at PAFB
CZR 1, 11	Cape	35mm Mitchell	Tracking	Processed at S. M.
U15R146	Cape	35mm Mitchell	Tracking	Processed at S. M.
Pad 17A	Complex 17	8x10 View	Fixed	Processed at PAFB
Pad 17A	Complex 17	(2) 4x5 Speed Graphics	Fixed	Processed at PAFB
Pad 17A	Complex 17	(2) 4x5 Speed Graphics	Fixed	Processed at PAFB

TABLE VI

EXTERNAL OPTICAL INSTRUMENTATION
(Continued)

ENGINEERING SEQUENTIAL OPTICS

SITE	LOCATION	CAMERA	TYPE	SPECIAL NOTE
Top of Blockhouse 17	Complex 17	16mm Mitchell	Fixed	Emergency camera
17AB-3	Complex 17	16mm Mitchell	Fixed	Emergency camera
50' Tower; 250°,200'	Complex 17	16mm Mitchell	Fixed	Film not processed
17A-C, 20' Tower	Complex 17	16mm Fastax	Fixed	Film not processed
17A-C, 20' Tower	Complex 17	16mm Fastax	Fixed	Film not processed
17A-C, 20' Tower	Complex 17	16mm Fastax	Fixed	Film not processed
Launcher Ring, North	Complex 17	16mm Millikin	Fixed	Good quality coverage
Launcher Ring, South	Complex 17	16mm Millikin	Fixed	Good quality coverage
Launcher Ring, West	Complex 17	16mm Traid	Fixed	Bad timing
Service Tower 17A	Complex 17	16mm Fastax	Fixed	Good quality coverage
Pad 5.6-1	Cape	16mm Mitchell	Tracking	Film not processed
U61R121	Cape	16mm Mitchell	Tracking	Lost track in clouds once
U61R121	Cape	16mm Mitchell	Tracking	Film not processed
U19R172	Cape	16mm Mitchell	Tracking	Film not processed
U178L52	Cape	35mm Mitchell	Tracking	Film not processed
U62R204	Cape	35mm Mitchell	Tracking	Film not processed
U158R0	Cape	35mm Mitchell	Tracking	Film not processed
D42R53	Cape	35mm Mitchell	Tracking	Film not processed
IGOR	False Cape	70mm IGOR	Tracking	Film sent to S.T.L.
IGOR	PAFB	70mm IGOR	Tracking	Film sent to S.T.L.
Special Tracking	New Smyrna Beach	35mm Mitchell	Tracking	Zero coverage

TABLE VII

EXTERNAL ELECTRONIC INSTRUMENTATION

SITE	LOCATION	INSTRUMENTATION	COVERAGE FROM	COVERAGE TO
Radar 1.4	Cape	Mod II Radar	Pad	81.9 NM
Radar 1.5	Cape	Mod II Radar	Pad	81.9 NM
Radar Mod IV	Cape	Mod IV Radar	Pad	25.7 NM
Radar FPS-16	Cape	AN/FPS-16 Radar	Pad	108.5 NM
Radar XN-1	PAFB	AN/FPS-16 Radar	Pad	98.7 NM
Radar XN-2	Grand Bahama I.	AN/FPS-16 Radar	161.2 NM	172.8 NM
AZUSA	Cape	AZUSA	T+13	T+250
Minitrack	Grand Turk I.	Telemetry Receiver	T+195	T+500
Telemetry Building #2	Cape	Telemetry Receiver	T+0	T+630
Telemetry Van	Spruce Creek	Telemetry Receiver	T+15	T+620
Telemetry Van	Vero Beach	Telemetry Receiver	T+10	T+620
Telemetry Station 3	Grand Bahama I.	Telemetry Receiver	T+45	T+630

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TABLE VIII

INTERNAL TELEMETRY INSTRUMENTATION FOR PDM/FM SET #1 - FREQUENCY 225.5 MC

CH.	FUNCTION	TYPE OF INSTRUMENT	RANGE
1	Turbopump Bearing #5 Temperature	Thermocouple & Magnetic Amplifier	0-1300 Degrees F
2	Pitch Attitude Error	HIG Demodulator Signal from C.E.A.	±2.0 Degrees
3	Hydraulic Pressure	Bourdon Tube	0-3500 PSIA
4	Pitch Rate (Fine)	Rate Demodulator Signal from C.E.A.	±2.0 Deg/Sec
5	Pitch Main Engine Position (Fine)	Control Potentiometer (Linear)	±2.0 Degrees
6	Vernier Roll Deflection (Fine)	Control Potentiometer (Rotary)	±20.0 Degrees
7	Sequences #1		0-5.0 Volts
8	Sequences #2		0-5.0 Volts
9	Roll Attitude Error	HIG Demodulator Signal from C.E.A.	±4.0 Degrees
10	Roll Rate	Rate Demodulator Signal from C.E.A.	±6.0 Deg/Sec
11	Turbopump Speed	Tachometer & Converter	3,000-8,000 RPM
12	Yaw Attitude Error	HIG Demodulator Signal from C.E.A.	±2.0 Degrees
13	Gas Generator Liquid Oxygen Injector Pressure	Bourdon Tube	0-1000 PSIA
14	Yaw Rate (Fine)	Rate Demodulator Signal from C.E.A.	±2.0 Deg/Sec
15	Yaw Main Engine Position (Fine)	Control Potentiometer (Linear)	±2.0 Degrees
16	Main Engine Chamber Pressure	Bourdon Tube	0-1000 PSIA
17	Gas Generator Chamber Pressure	Bourdon Tube	0-1000 PSIA
18	Vernier #1 Chamber Pressure	Bourdon Tube	0-1000 PSIA
19	#5 Bearing Lube Oil Pressure	Bourdon Tube	0-500 PSIA
20	Main Liquid Oxygen Tank Pressure (Top)	Bourdon Tube	0-100 PSIA
21	Main Liquid Oxygen Injector Press.	Bourdon Tube	0-1000 PSIA
22	Main Fuel Tank Pressure (Top)	Bourdon Tube	0-100 PSIA
23	Regulated 5 Volt Reference	Zener Diode	5.0 Volts
24	400 cps Voltage (Control Inverter)	AC Voltage Detector	110-120 Volts
25	Fuel Pump Inlet Pressure	Bourdon Tube	0-200 PSIA
26	Main Fuel Injector Pressure	Bourdon Tube	0-1000 PSIA
27	Instrumentation 5 Volt Reference	Instrumentation Battery	0-5.0 Volts
28	Ground		

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TABLE IX

INTERNAL TELEMETRY INSTRUMENTATION

FOR

FM/FM FREQUENCY 238.5 MC
(SECOND STAGE)

Channel (IRIG)	Function	Range
1 (400 cps)	Inverter Frequency	370-430 cps
7 (2.3 kc)	Helium Regulated Output Pressure	0-350 psig
9 (3.9 kc)	Thrust Chamber Pressure	0-225 psig
11 (7.35 kc)	Commutated (5 cps)	
	11.1 Angular Accelerometer	
	11.2 Ground	
	11.3 Ground	
	11.4 Integrating Accelerometer (Fine shift)	
	11.5 Angular Accelerometer	$\pm$1.25 rad/sec^2
	11.6 Zero-volt Reference	
	11.7 Zero-volt Reference	
	11.8 Zero-volt Reference	
	11.9 Angular Accelerometer	$\pm$1.25 rad/sec^2
	11.10 Ground	
	11.11 Ground	
	11.12 Integrating Accelerometer (Fine shift)	
	11.13 Angular Accelerometer	$\pm$1.25 rad/sec^2
	11.14 5-volt Reference	
	11.15 5-volt Reference	
	11.16 5-volt Reference	
12 (10.5 kc)	Third Stage and Command Events (0-5 volts coded)	
	a. Stage II Arm	
	b. Nose Fairing Separate	
	c. Pitch Up Command	
	d. Pitch Down Command	
	e. Pitch Stop Command	
	f. Yaw Right Command	
	g. Yaw Left Command	
	h. Yaw Stop Command	
	i. Spin Initiation	
	j. Stage III Ignite, II/III Separation Bolts, Band	

TABLE IX
(Continued)

Channel (IRIG)		Function	Range
13 (14.5 kc)		Commutated (5 cps)	
	13.1	28-volt Reference	25-30 V
	13.2	Roll Demodulator Output	± 6°
	13.3	Pitch Demodulator Output	± 6°
	13.4	Yaw Demodulator Output	± 6°
	13.5	Pitch Gimbal	± 3°
	13.6	Yaw Gimbal	± 3°
	13.7	Pitch Control Field	
	13.8	Yaw Control Field	
	13.9	10-Volts 400 Cycles Amplitude	8-12 V
	13.10	Ground	
	13.11	Control Compartment Temperature Opposite Side	0-750°F
	13.12	Control Compartment Temperature Target Side	0-750°F
	13.13	Skirt Temperature Opposite Side	0-500°F
	13.14	Engine Compartment Temperature Target Side	0-500°F
	13.15	Skirt Temperature Target Side	0-500°F
	13.16	Shroud Temperature Target Side	700-1600°F
	13.17	Zero Reference	
	13.18	5-Volt Master Pulse	
	13.19	5-Volt Master Pulse	
	13.20	5-Volt Master Pulse	
14 (22 kc)		Second Stage Events (0-5 volt coded)	
	a.	Liftoff	
	b.	Arm Stage II	
	c.	MECO	
	d.	Stage II Fire	
	e.	Stage II Separate Bolts	
	f.	Stage I/II Separate	
	g.	HGA, Nose Fairing	
	h.	CW and CCW Roll	
	i.	Command Enable	
	j.	Stage II Command Cut-off or TPS Shutdown	
	k.	Stage III Igniter Current	
	l.	Stage II/III Strut Release	

TABLE X

INTERNAL TELEMETRY INSTRUMENTATION

FOR

FOURTH STAGE

Measurement	Transmitter A	Transmitter B	Transmitter C
Cosmic Ray (single)	D		6
(triple)	D	2	
Micrometeorite (high momentum)	D		
Micrometeorite (low momentum)	D		
Micrometeorite			3
Scintillation Counter	D	5	
Magnetometer (search coil)	D	1	
Univ. of Minnesota (ion chamber)	D		
Univ. of Minnesota (Geiger tube)	D		
Univ. of Minnesota			4
Megnetometer (flux gate)	D	3	
Magnetometer (phase)	D	4	
Aspect Indicator	D		
Accelerometer (by command only)			1
Facsimile Scanner (by command only)			1
VLF (Stanford)	D	8	
Blip Strip			5
a. Solar Cell Paddles Locked			
b. Stage III/IV Separation			
c. Stage IV Ignition Current			
Subcommutated Measurements (16)	D		2
a. Paddle Temperature Outboard No. 1			
b. Paddle Temperature Outboard No. 2			
c. Paddle Temperature Inboard No. 1			
d. Shell Temperature No. 2			
e. Solar Cell Temperature			
f. Solar Cell Voltage			
g. Solar Cell Current Monitor			
h. Battery Voltage			
i. Transmitter Heat Sink Temperature			
j. Converter Receiver Sink Temperature			
k. Command Receiver Phase Error			
l. Battery Temperature			
m. Shell Temperature No. 3			
n. Shell Temperature No. 1			
o. Disk Angle			
p. Reference			

TABLE X

INTERNAL TELEMETRY INSTRUMENTATION
FOR
FOURTH STAGE
(Continued)

Code: Transmitter

A = 378.21 mc
B = 108.06 mc
C = 108.09 mc

D = Digital Coding
1 = IRIG Channel (400)
2 = IRIG Channel (530)
3 = IRIG Channel (760)
4 = IRIG Channel (960)
5 = IRIG Channel (1300)
6 = IRIG Channel (1700)
8 = IRIG Channel (2.5 kc)

FIGURE 1

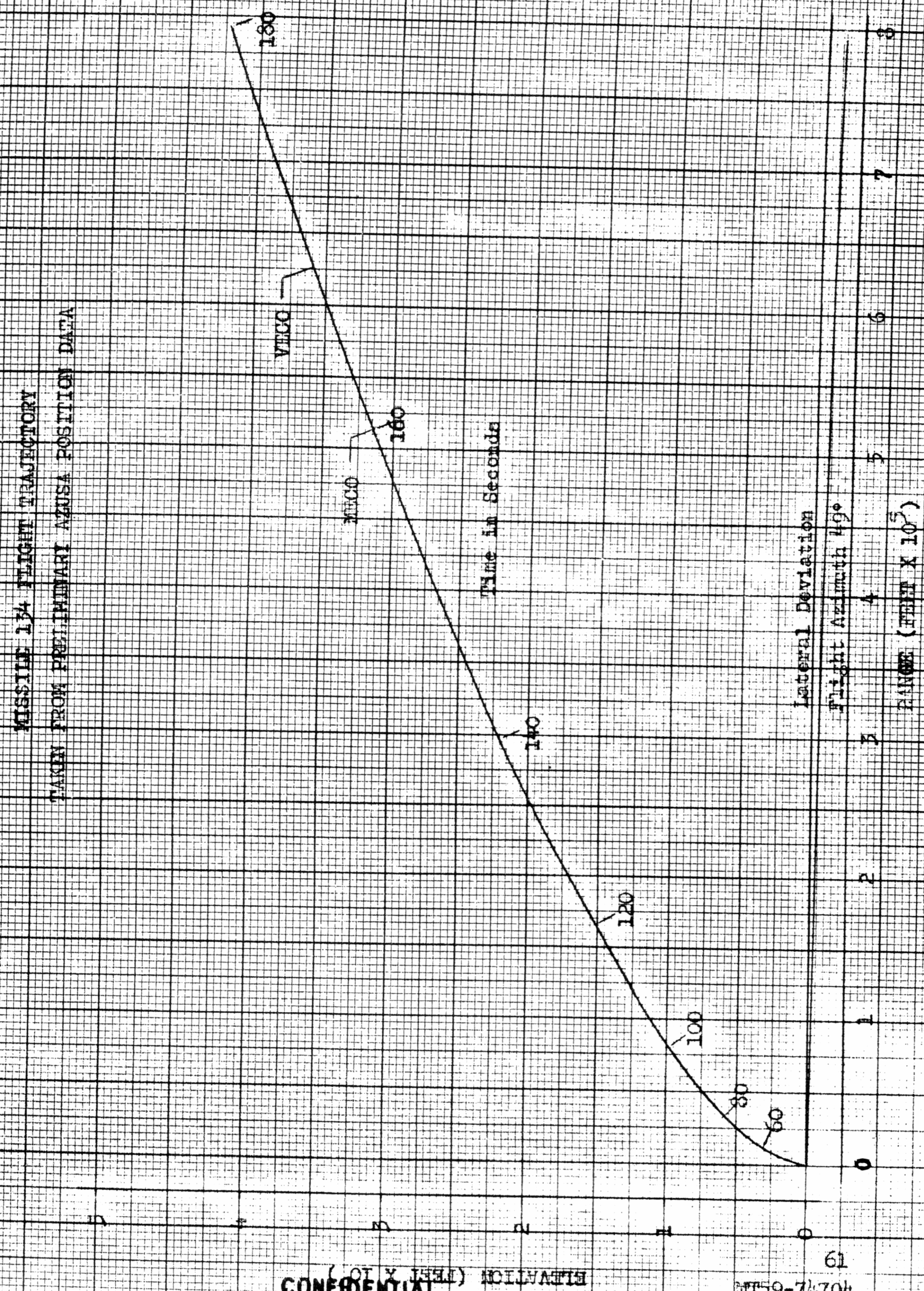
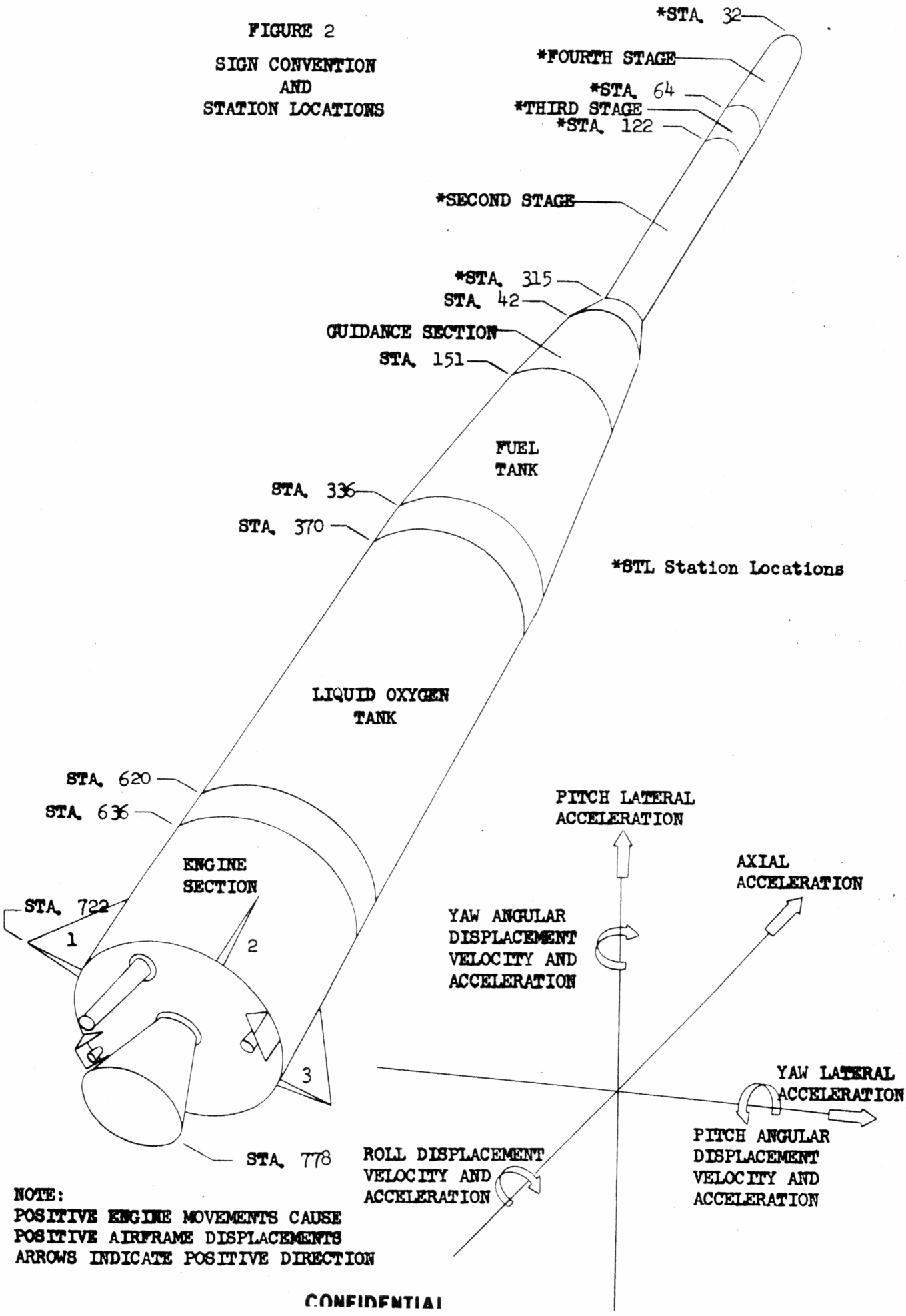

MISSILE 134 FLIGHT TRAJECTORY
TAKEN FROM PRELIMINARY AZUSA POSITION DATA
Time in Seconds
180
VECO
160
MECO
140
120
100
80
60
Lateral Deviation
Flight Azimuth 49°
RANGE (FEET X 10^5)
0
1
2
3
4
5
6
7
8
ELEVATION (FEET X 10)

FIGURE 2

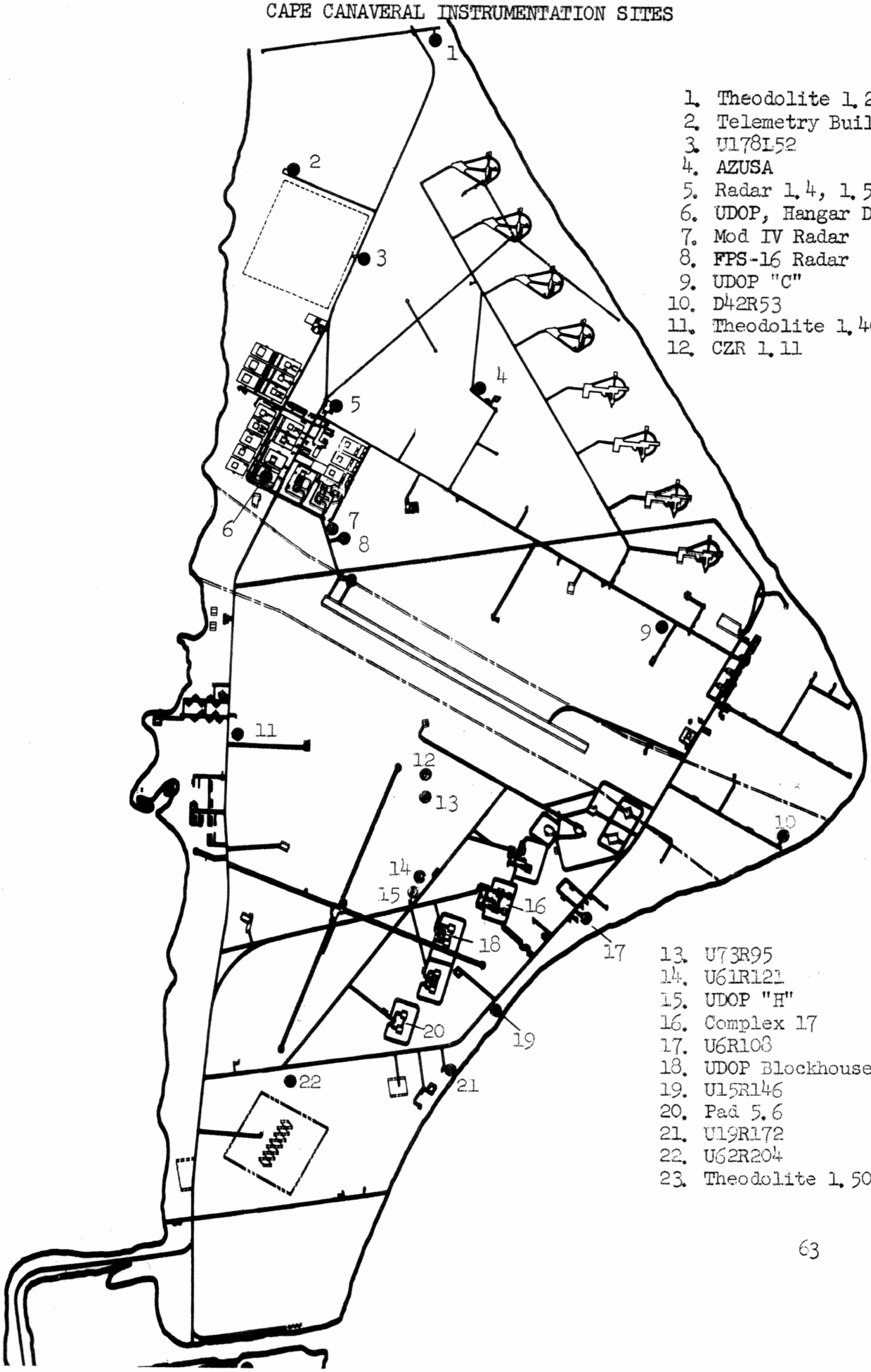
SIGN CONVENTION
AND
STATION LOCATIONS



NOTE:
POSITIVE ENGINE MOVEMENTS CAUSE
POSITIVE AIRFRAME DISPLACEMENTS
ARROWS INDICATE POSITIVE DIRECTION

FIGURE 3

CAPE CANAVERAL INSTRUMENTATION SITES

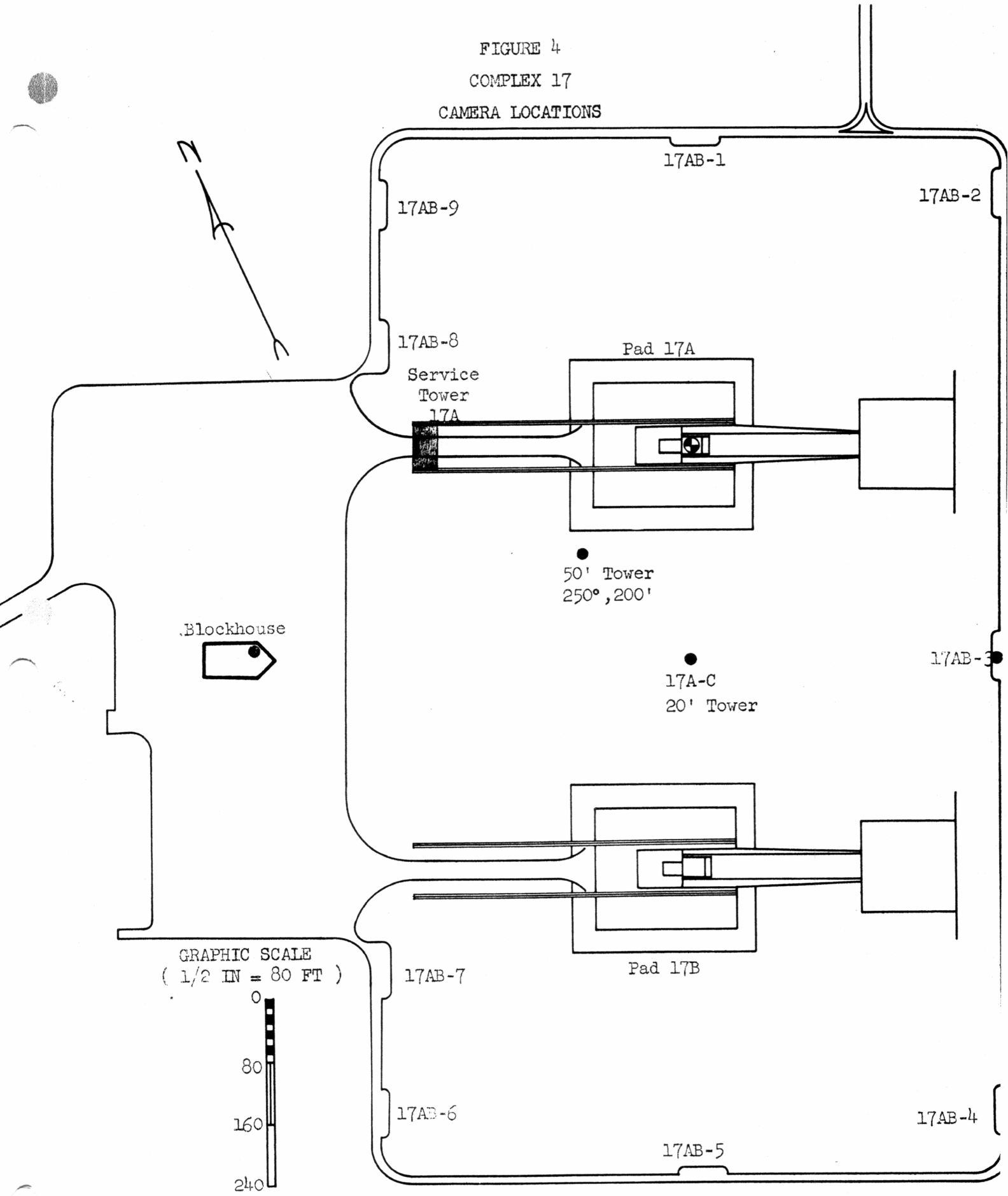


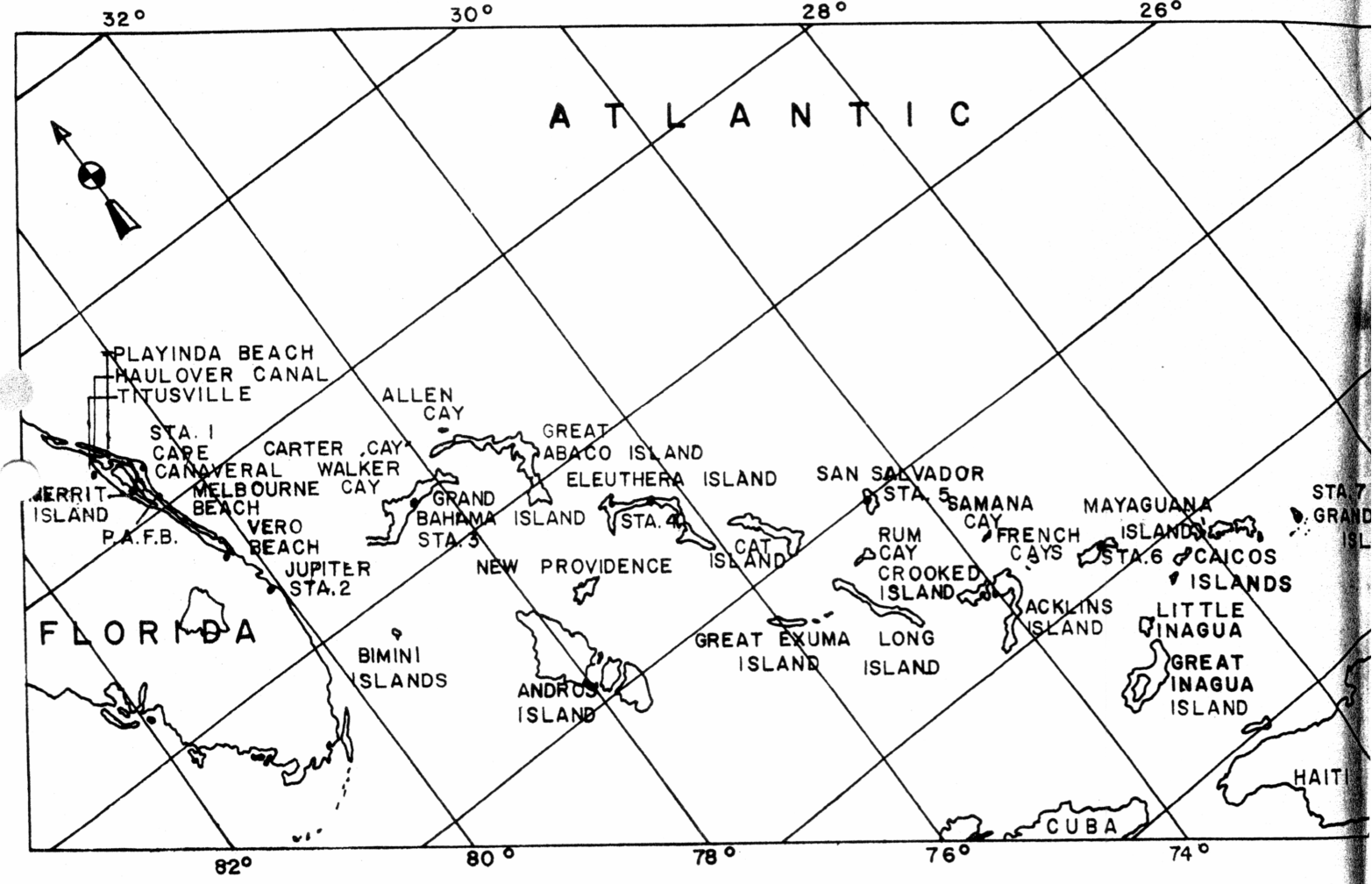
1. Theodolite 1.20
2. Telemetry Building #2
3. U178I52
4. AZUSA
5. Radar 1.4, 1.5, U158RO
6. UDOP, Hangar D
7. Mod IV Radar
8. FPS-16 Radar
9. UDOP "C"
10. D42R53
11. Theodolite 1.40
12. CZR 1.11
13. U73R95
14. U61R121
15. UDOP "H"
16. Complex 17
17. U6R108
18. UDOP Blockhouse 26
19. U15R146
20. Pad 5.6
21. U19R172
22. U62R204
23. Theodolite 1.50

FIGURE 4

COMPLEX 17

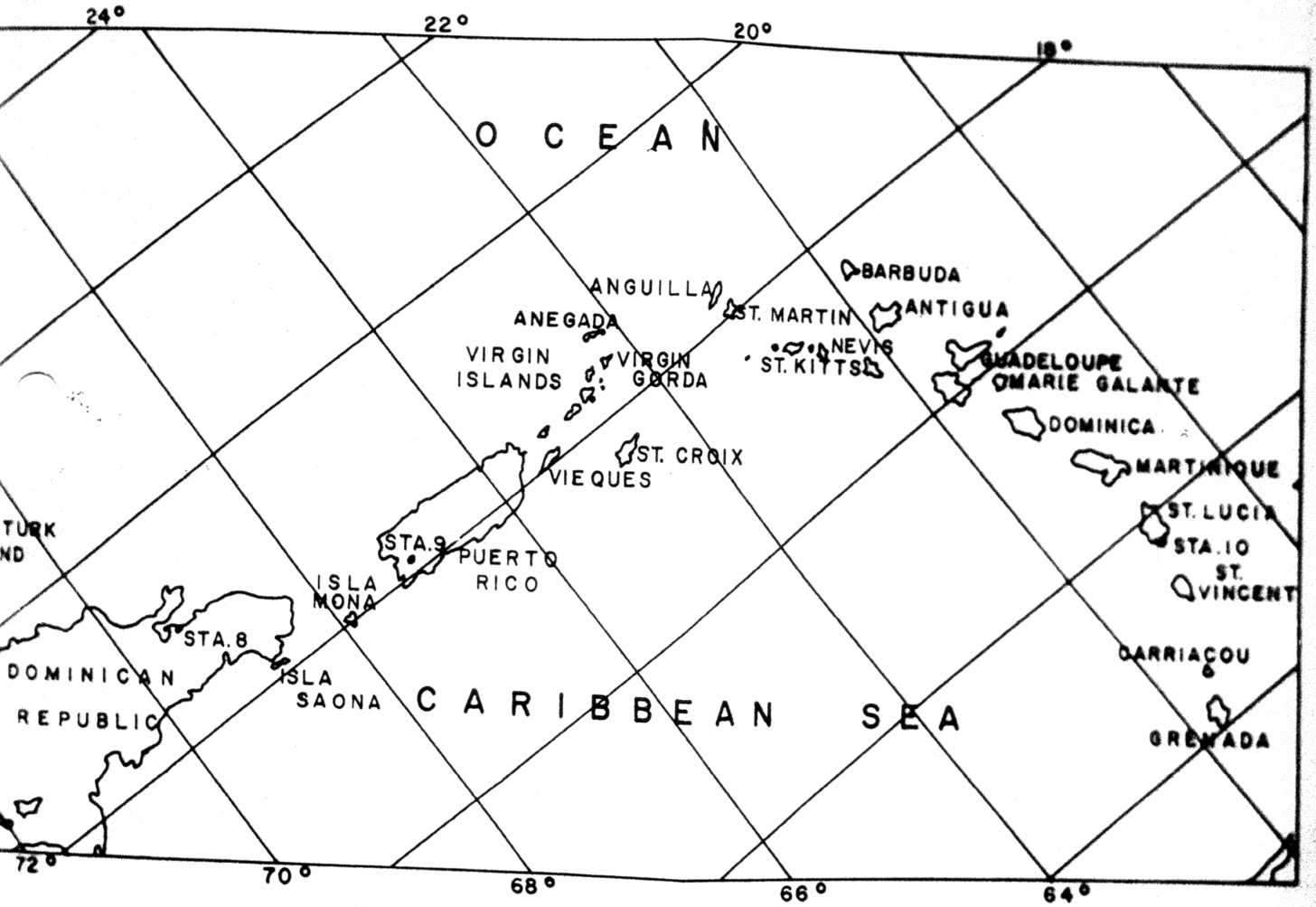
CAMERA LOCATIONS




LOCATION
INSTRUME
APPROX
110.24 MILE
STATU
32°
30°
28°
26°
ATLANTIC
PLAYINDA BEACH
HAULOVER CANAL
TITUSVILLE
ALLEN CAY
GREAT ABACO ISLAND
STA. 1
CAPE CANAVERAL
CARTER CAY
WALKER CAY
MELBOURNE BEACH
ELEUTHERA ISLAND
SAN SALVADOR
STA. 5
SAMANA CAY
MAYAGUANA ISLAND
STA. 7
GRAND ISL
GRAND BAHAMA ISLAND
STA. 3
STA. 4
FRENCH CAYS
STA. 6
CAICOS ISLANDS
VERO BEACH
P.A.F.B.
JUPITER
STA. 2
NEW PROVIDENCE
CAT ISLAND
RUM CAY
CROOKED ISLAND
ACKLINS ISLAND
LITTLE INAGUA
FLORIDA
BIMINI ISLANDS
GREAT EXUMA ISLAND
LONG ISLAND
GREAT INAGUA ISLAND
ANDROS ISLAND
HAITI
CUBA
82°
80°
78°
76°
74°

IGURE 5

OF DOWN RANGE
NTATION SITES
IMATE SCALE
S TO THE INCH
TE MILES 250 500



GLOSSARY

MAIN ENGINE FUNCTIONS

Duration — Interval from 85% of nominal chamber pressure at start to 85% of nominal chanber pressure at cut-off.

Chamber Pressure at Start — Value obtained three (3) seconds after reaching 85% of nominal chamber pressure, assuming stabilization.

Chamber Pressure at Cut-off — Value obtained one (1) second prior to pressure drop at cut-off.

Gas Generator Chamber Pressure — Value obtained three (3) seconds after reaching 85% of nominal main chamber pressure, assuming stabilization.

VERNIER ENGINE FUNCTIONS

Duration

- **Prior to Main Engine** — Interval from 70% nominal vernier chamber pressure to 85% of main engine chamber pressure at start.
- **Subsequent to Main Engine** — Interval from 85% of main engine chamber pressure at cut-off to 70% vernier chamber pressure, vernier tank fed, after main engine.

Chamber Pressure

- **Tank Fed Prior to Main Engine** — Value obtained two (2) seconds after vernier chamber pressure switches pickup.
- **Pump Fed** — Value obtained three (3) seconds after attaining 85% of nominal main chamber pressure, assuming stabilization.
- **Tank Fed After Main Engine** — Value obtained one (1) second prior to pressure drop at cut-off.

INSTRUMENT RANGE

The nominal range to which the instrument is normally calibrated. The numbers quoted for extremes of nominal range are rounded off to convenient whole numbers.

GLOSSARY
(Continued)

ENGINE FUNCTIONS (SECOND STAGE)

Duration	Interval from TVS1 pickup to 90% chamber pressure on SECO.
Chamber Pressure At Start	Value five (5) seconds after fire signal.
Chamber Pressure At SECO	Value one (1) second prior to chamber pressure drop at SECO.

COORDINATE SYSTEMS USED IN THIS REPORT

Coordinate System Description for Range Furnished Trajectory Data	The rectangular cartesian coordinate system in which data are expressed is oriented as follows: The origin is at the launcher center. The XY plane is tangent to the earth at the origin. The positive X axis is east. The positive Y axis north. The positive Z axis is perpendicular upward from the XY plane.
Coordinate System for Weight and Balance Data (First Stage)	The coordinate system employed for referencing missile components has its origin 42 inches forward of the nose of the first stage, on the missile axis, positive aftward. The X axis is in the plane of the vernier engines, positive to the right, looking aft. The Z axis is in the ballistic plane, positive direction defining a left-handed coordinate system.
(Second Stage)	Axial measurements are with respect to origin of Y axis which is 32 inches forward of the nose fairing of the fourth stage.

TIME

All times in this report are referenced to lift-off.

GLOSSARY
(Continued)

PROPELLANT CALCULATIONS

Float Switch Data:

$RP_o = w_1 - \dot{w}_o \Delta t$ (Calculated at MECO)

$RP_F = w_2 - \dot{w}_F \Delta t$ (Calculated at MECO)

$PU = \frac{RP_o + RP_F}{w_3}$ (Calculated at MECO)

$PU\ (\text{Ultimate}) = \frac{RP_o + RP_F}{w_3}$ (Calculated at time of depletion of one propellant)

PU	Propellant Utilization
RP_o	Residual Liquid Oxygen
RP_F	Residual Fuel
w_1	Weight of liquid oxygen remaining at time of liquid oxygen float switch closure.
w_2	Weight of fuel remaining at time of fuel float switch closure
w_3	Total weight of usable propellant at lift-off
$\dot{w}_o$	Liquid oxygen flow rate
$\dot{w}_F$	Fuel flow rate
Δt	Time interval between respective float switch and MECO or depletion

PROPELLANT CALCULATIONS (Continued)

Differential Pressure Gauge Data:

$$\Delta P_F = \frac{a}{g} D_F H_F$$

$$\Delta P_o = \frac{a}{g} D_o H_o$$

RP_F — Is determined from plot of H_F vs RP_F

RP_o — Is determined from plot of H_o vs RP_o

$$PU = \frac{RP_F + RP_o}{W_3}$$

ΔP_F — Main fuel tank differential pressure

ΔP_o — Main liquid oxygen tank differential pressure

D_o — Density of liquid oxygen

D_F — Density of fuel

H_o, H_F — Propellant level above reference point

$\frac{a}{g}$ — Missile axial acceleration (g's)

DISTRIBUTION

1	J. R. Gabrielson	A-20
2	D. V. Black	A-260
3	R. W. Hallet	"
4	W. T. Hunter	"
5	H. J. Ide	"
6	J. M. Jensen	"
7	L. E. Lundquist	"
8	D. McCallum	"
9	R. H. Milliken	"
10	R. Stoner	"
11-12	H. M. Thomas	"
13	H. O. Varner	"
14	R. R. Waters	"
15	K. J. Young	"
16	E. W. Kahelin	A-750
17	G. Ogden	A2-260
18	E. P. Henricks	A31-260
19	T. R. Edlin	A41-260
20	G F. Hanson	"
21	B. E. Stitt	"
22	W. J. Stone	"
23	J. F. Goodman	A45-260
24	J. A. Lasco	A47-260
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31-35	W. E. Overstreet	GE
36-39	J. R. Morello	Rocketdyne
40-55	WDGMI	AFBMD
56-82	M. Ross	STL
83-86	B. A. Bunch	STL
87-90	L. B. Pruett	AGC
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92-93	J. C. Lindsay	NASA
94-95	R. Gray	NASA