

AD-A121 732

ZIP II POST FLIGHT REPORT (FLIGHT A246S-I-2)(U) SPACE
VECTOR CORP NORTHRIDGE CA R E SCARBORO 30 OCT 81
AFGL-TR-82-0156 F19628-77-C-0257

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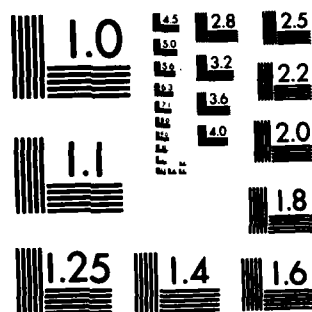
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SECTION 1.0

GENERAL SUMMARY

- 1.1 Under the cognizance of the Air Force Geophysics Laboratory, an ARIES, designated Flight No. A24.6S1-2, was launched at 0400 hours (MST) on 31 July 1981 from White Sands Missile Range.
- 1.2 The vehicle had a gross liftoff weight of 13,889 pounds. Separated payload weight was 1,256 pounds and recovery weight was 1,212 pounds. The M56A-1 booster produced a burnout velocity of 8,027 fps, (2,539 mps) lifting the payload to an apogee of 244.4 miles. Zenith altitude was reached at 337 seconds into the flight and the payload was at an altitude greater than 300K feet for approximately 525 seconds.
- 1.3 The boost phase of the flight was successful with the guidance system maintaining the vehicle in a stable attitude.
- 1.4 The payload/booster delta velocity system functioned properly, producing a stable separation with a final separation velocity of 13-14 fps. The nose tip ejection system also functioned properly at the scheduled time during the reentry phase resulting in a successful recovery.
- 1.5 An overall vehicle description is presented in Figure 1-1 and a Flight Summary is presented on Table 1-1.

ZIP

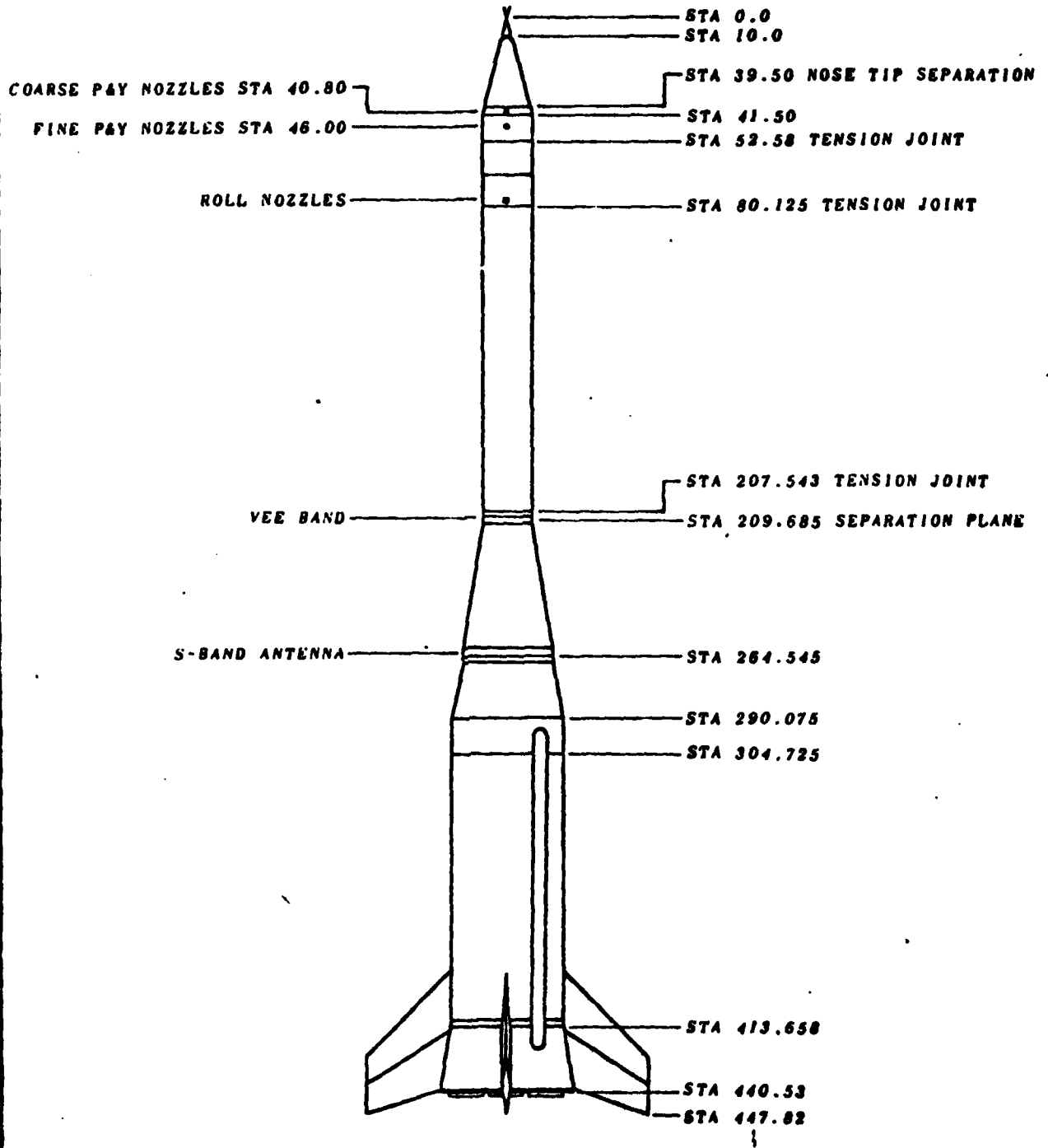


Fig. 1-1

TABLE 1-1

ZIP II FLIGHT SUMMARY

Vehicle Identification	A24.6S1-1
ARIES Model Number	11740
M56A-1 Booster Serial Number	22770
Launch Date/Time	31 Jul 81/0400 MST
Launch Site	WSMR/LC36
Vehicle Launch Azimuth (Pitch Plane)	004° True
Vehicle Launch Angle	Vertical
Vehicle Gross Liftoff Weight	13.889.2 Pounds
Separated Payload Weight	1,256.5 Pounds
Recoverable Payload Weight	1,212.5 Pounds
Vehicle Overall Length	437.82 Inches
Peak Longitudinal Acceleration	8.1 g's
Burnout Time	60.3 Seconds
Burnout Velocity	8027 FPS
Burnout Altitude	171,441 Feet (32.4 Miles)
Predicted Apogee Altitude	1,257,373 Feet (238.2 Miles)
Actual Apogee Altitude	1,290,560 Feet (244.4 Miles)
Predicted Apogee Time	329.8 Seconds
Actual Apogee Time	337.3 Seconds
Predicted Booster Impact Time	603 Seconds
Actual Booster Impact Time	767 Seconds

TABLE 1-1

SECTION 2.0

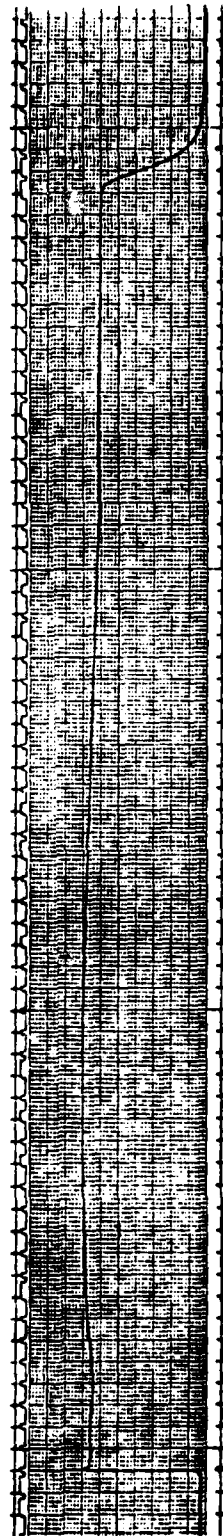
BOOSTER DATA

- 2.1 Booster Serial Number 22770 was flown on the ZIP II Campaign. It performed within the predicted specifications established by the Aging and Surveillance Program which is administered by Hill Air Force Base. A performance summary is presented on Table 2-1 and Figure 2-1.
- 2.2 The booster was prepared for flight at Hill Air Force Base facilities in the beginning months of 1981 and was accepted for flight on 3 March 1981. The Booster was then shipped to White Sands Missile Range where it remained in storage until July 1981. A copy of the Certificate of Acceptance is presented in Figure 2-2.
- 2.3 This Booster remained in a temperature controlled environment until its launch on 31 July 1981. A copy of the temperature records for the last seven days it was on the launch pad is presented on Figure 2-3.

TABLE 2-1

BOOSTER DATA SUMMARY

Serial Number	22770
Type	M56A-1
Date Propellant Casted	11 June 64
Date of Booster Buy-off	3 Mar 81
Nozzle Ratio	11.8:1
Ignition Delay	.1 Seconds
Max P_c	+14/+21 Sec ± 517 PSIA
Decay P_c	59.5 Seconds
Burnout	61.5 Seconds



T-0
Sec.

Motor Chamber Pressure

0-750 PSIA

T-0
Sec.

Fig. 2-1
6

CERTIFICATE OF ACCEPTANCE

The undersigned certify that Second Stage Motor S/N 22770 meets the criteria established in the Air Force Geophysics Laboratory Booster Refurbishment and Configuration Baseline Requirements Document and is accepted for use as an ARIES booster.

This certification is valid for 12 months after receipt of booster at its launch location.

Ed M. Renna
AFGL/LCR

3 Mar 81
Date

For Mr. Seaman
Space Vector Corporation

3 MAR 81
Date

Mr. Kenneth L. Cole-SD
Space Division

3 Mar 81

Mr. H. And
Aerospace

3 Mar 81

The following waivers were granted:

1. NCU BATT. HAS ONLY 6 MOS REMAINING ON SERVICE LIFE. (REF. PAGE 4).
2. FWD "Y" JOINT NOT X-RAY EVERY 150 (REF PAGE 3).

AFGL BOOSTER REFURBISHMENT AND CONFIGURATION

BASELINE CERTIFICATION CHECKLIST

STEP N 2270

DATE 3 MAY 64 1P

	SPECIFIC REQUIREMENTS	ACCEPTANCE CRITERIA	APPLICABILITY		COMMENTS
			INIT. CERT.	RECENT	
1.	Review Motor Manufacturer's Log Book	A. Evaluate all Class I deviations. B. Determine casting dates (18 Nov. 63 through 27 Jan. 64 are not to be certified).	OK.	N/A	NO DEVIATIONS.
2.	Booster Historical Review	A. Review downstage trace-ability record. B. Review history of booster since last certified.	OK.	N/A	6-11-64.
3.	Booster Work Control Document (Form 959)	A. All entries completed. B. "P" and "Q" stamps on all required operations. C. Operations completed within 6 months of shipping date.	N/A	N/A	
4.	Booster In-Coming TEMS Data	A. Temperature limits (+60°F to +100°F). B. Transportation limits (<2G transverse or longitudinal).	OK.	JAN 81.	NO DATA RECORD. VERBAL - NO CON

AFGL BOOSTER REFURBISHMENT AND CONFIGURATION

BASELINE CERTIFICATION CHECKLIST

BOOSTER S/N 22770

DATE _____

SPECIFIC REQUIREMENTS	ACCEPTANCE CRITERIA	APPLICABILITY		COMMENTS
		INIT. CERT	RECEIPT	
5. Booster Visual Inspection (Form 100)	A. Evaluate all discrepancies noted.	OK		
	B. In-coming component record (Form 557).	OK		
6. Leak Test/In-Coming (Form 557)	A. Evaluate an out of tolerance condition (<1.0 ounces per year).	OK	N/A	
7. Borescope Inspection (Form 557)	A. Evaluate data recorded (T.O. 33B4-2-11-1).	OK		
8. Igniter Port Forward Boot Gap Inspection (SVC Dwg)	A. Evaluate data (<.75 maximum allowed).	OK		
9. Nozzle Torque and Deflection (Form 557)	A. Evaluate data - 2 required (42 ft/lbs maximum).	OK		
	B. "Q" stamp required.	OK		
10. Nozzle Cut-Off (Form 557)	A. Evaluate data (11.8:1 expansion ratio, throat = 4.28/4.30, exit = 14.915/14.88).	—	N/A	NO DATA SHEET. VERBAL REPORT 14.8
	B. S/N on outgoing component record (Form 557).	OK	N/A	

AFGL BOOSTER REFURBISHMENT AND CONFIGURATION

BASELINE CERTIFICATION CHECKLIST

REPORT N 22770

	SPECIFIC REQUIREMENTS	ACCEPTANCE CRITERIA	APPLICABILITY		DATE	COMMENTS
			INIT. CERT	RECEIPT		
11.	Nozzle Alignment (Form 557)	A. Confirm "X" dimensions are for nozzles installed Reference component records (Form 557). B. Confirm alignment tolerance (+.048). C. Confirm NCU S/N on component record (Form 557). D. Confirm "Q" stamp.	OK			
12.	Leak Check - Out-Going (Form 557)	A. Evaluate out of tolerance condition (<1.0 ounce per year).	OK			
13.	Motor Radiograph Inspection (Form 432)	A. Evaluate out of tolerance conditions (2K+SRM56-3). B. Forward and aft "Y" joint every 15°.	OK			SMALL VOIDS
14.	Igniter Radiograph Inspection (Form 432)	A. Evaluate out of tolerance conditions (2K+SRM56-3). B. P/N 366277-9 required.	OK			X-RAY EVERY 30° ONLY.
			-9			

AFGL BOOSTER REFURBISHMENT AND CONFIGURATION

BASELINE CERTIFICATION CHECKLIST

AFGL SN 22770

DATE

SPECIFIC REQUIREMENTS	ACCEPTANCE CRITERIA	APPLICABILITY		COMMENTS
		INIT. CERT.	RECEIPT	
15. NCU Work Control Document (Form 959)	A. All entries completed. B. "P" and "Q" stamps on all required entries. C. Operations completed within 6 months of shipping date.	OK		
16. NCU Overhaul (Dart Package)	A. Battery has 12 months remaining life. B. Battery squib check completed. C. Nozzle actuators overhauled. D. Pump/motor overhaul completed. E. Pump pressure switch test completed. F. TVC amplifier overhauled and tested. G. APS vibration completed. H. Functional test completed (no leakage).	OK		BATT. HAS 6 MOS REMAINING. SERV. LIFE 212 MOS. DATE 13 DEC 68. EST. LIFE 24 MOS.
			N/A	
			N/A	
			N/A	
			N/A	
			N/A	
			N/A	
			N/A	

JAN 81.
Date Complete
Note: This overhaul is good for three (3) years.

AFGL BOOSTER REFURBISHMENT AND "CONFIGURATION

BASELINE CERTIFICATION CHECKLIST

STEP 3 N 22770

DATE

SPECIFIC REQUIREMENTS	ACCEPTANCE CRITERIA	APPLICABILITY		COMMENTS
		INIT. CERT.	RECENT	
17. Safe and Arm Work Control Document (Form 959)	I. Filter test completed.	OK		
	J. Confirm "Q" stamp for final close up.	OK		
	K. All component S/Ns recorded.	OK		
	A. All entries completed.	OK		
	B. "P" and "Q" stamp on all required entries.	OK		
	C. Operations completed within 6 months of shipping date.	JAN 81		
	D. P/N KR80000-09 only.	-09		
	E. S/N below 27605 only.	23789.		
	F. 30V test 1. Limits for Step 1 and 13 is 11 to 30 ohms.	OK		
	G. Visual inspection completed (Form 100).	OK		
	H. Bench test completed (Form 600E).	OK		

FORM 959 NOT IN PACKAGE.

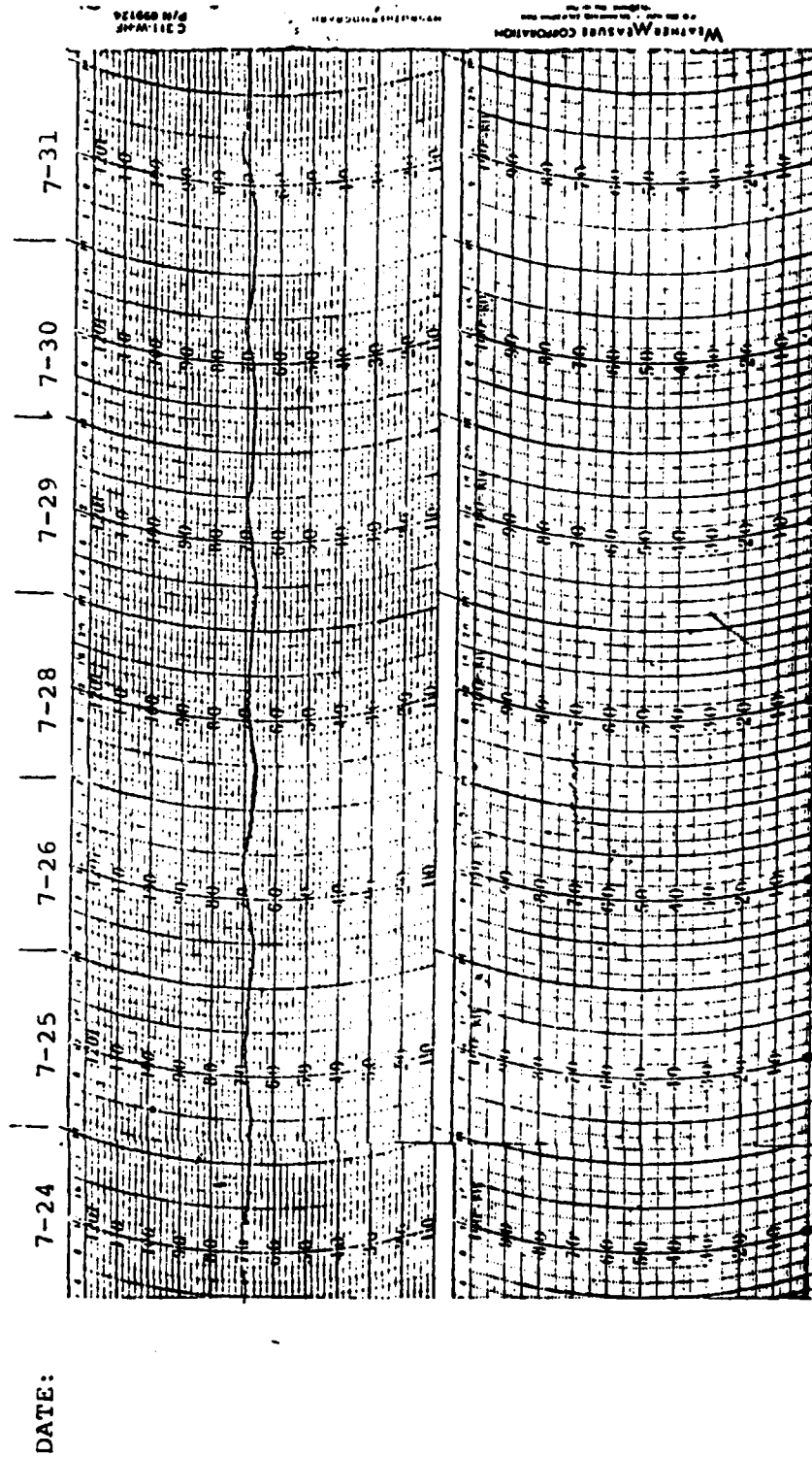
AFGL BOOSTER REFURBISHMENT AND CONFIGURATION

BASELINE CERTIFICATION CHECKLIST

SYSTEM S/N 22770

DATE _____

	SPECIFIC REQUIREMENTS	ACCEPTANCE CRITERIA	APPLICABILITY		COMMENTS
			INIT. CERT.	RECERT	
		I. Installed to igniter using fixture. No gap after torquing. "Q" stamp required.	OK.		
18.	OPT Inspection (Form 679)	A. Bench test completed (Form 600E).	OK.		
		B. Calibration completed (Form 679).	OK.		
		C. Operations completed within 6 months of shipping date.	JAN 81		
19.	NCU Heat Shield	A. Not installed.	OK.	N/A	
20.	TEMS Installed for Transportation	A. Confirm.			
21.	Out-Going Inspection Record	A. S/N of all installed components.	OK.		
22.	Additional Requirements (List Below)	A. Confirm completion as required.	NONE		



BOOSTER TEMPERATURE CONDITIONINGS
T-7 DAYS THRU T-O DAYS

SECTION 3.0

HEAT SINK

- 3.1 A heat sink SVC P/N 11008, was flown on the forward dome of the motor. The heat sink was assembled to the motor dome on 31 June 1981. Assembly Data is shown in Figure 3-1.

Twenty-one thermistors were installed as indicated in Figure 3-2 and Table 3-1. Average values of the heat sink and TC-5 thickness are also shown in Table 3-1. The specific installation data for the inner, middle, and outer ring is presented in Figure 3-1.

- 3.2 The heat sink instrumentation system was designed and provided by Wentworth Institute. The system consisted of a computer, resistor bridge, +5VDC power supply and twenty-one (21) GA51J11 Fenwal thermistors. Space Vector provided the mounting hardware in the interstage.

- 3.3 Digital reduction of the telemetered voltages is presented in Table 3-2 with a conversion from degrees C to degrees F_3 and a Delta Rise analysis. The +60 second flight point has historically been used as a convenient maximum temperature point.

- 3.4 The dome temperature rise for ZIP II is compared to previous flight data in Table 3-3.

HEAT ASST	USED ON	QTY	DESCRIPTION	DATE	APPROVED
	10830	-	Prod Rel	7 FEB 77	JK JK
		A	SEE DCN	4-20-78	JK JK

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES $\pm .XX \pm \pm$ $.XXX \pm$	CONTRACT NO.		SPACE VECTOR Corporation  NORTHBRIDGE, CALIFORNIA			
	APPROVALS		DATE	FIELD OPERATION HEAT SINK INSTALLATION		
	DRAWN	R.O.	7 FEB 77			
	CHECKED	JK	7 FEB 77			
MATERIAL	J. Kunitani 7 FEB 77		SIZE	CODE IDENT NO.	DRAWING NO.	A
FINISH			A	54459	90113	
DO NOT SCALE DRAWING			SCALE		SHEET 1 OF 6	

BISHOP GRAPHICS/ACCUPRESS
 REORDER NO. A-7531



Fig. 3-1

1.0 SCOPE

This document describes the installation procedure to be followed to mount the heat sink, part no. 11008, on the M56A1 motor dome.

2.0 DOCUMENTS AND MATERIALS REQUIRED

2.1 Drawing number: 11008 Heat Sink

2.2 Materials:

1. MEK or equivalent
2. TC-5 Eccotherm
3. S-11 Eccosil primer
4. Vendor: Emerson & Cummings, Inc.
Canton, MA

2.3 Tools:

1. Wide blade putty knife
2. 60942 Template, radius marking
3. 60943 Spatula, dome contour
contour no. 1
contour no. 2
contour no. 3
4. 60944 Spatula, tile contour
contour no. 1
contour no. 2
contour no. 3
5. Vernier calipers or depth mic.

3.0 PREPARATION

3.1 Clean surface of heat sink and dome with MEK or equivalent.

3.2 Mark dome with ink pen indicating 0° radial. OD of heat sink to be marked on dome to establish thermistor location (use radius marking template, P/N 60942 to approximate 5.00, 9.25 and 12.12 radii).

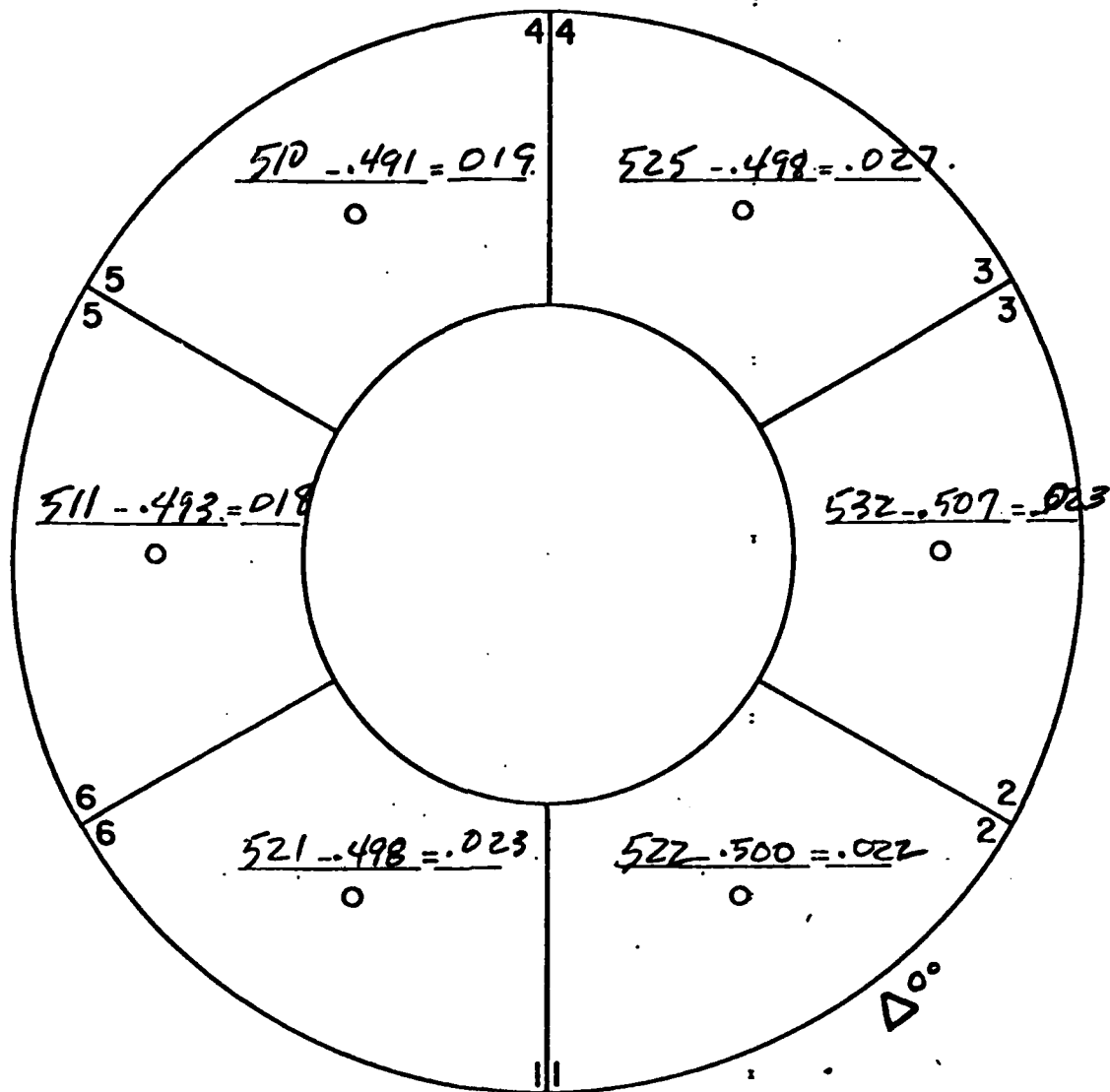
4.0 THERMISTOR INSTALLATION

4.1 Install thermistors along outer edge of circumferential lines using high temperature adhesives:

1. Eccobond 286 for adherence to dome.

5.0 HEAT SINK INSTALLATION

- 5.1 Prime heat sink and dome by wiping with S-11 primer.
- 5.2 Load pressure cartridge with TC-5. Apply TC-5 to area around igniter boss to 5.00 inch radius line. Use spatula to smooth TC-5 onto dome using high pressure until entire area is covered. Use 60943, no. 1 spatula to smooth TC-5 to required thickness. Spatula to be held vertical to surface and at right angle to ignitor boss. A smooth continuous surface approximately 0.025 inch thick is required.
- 5.3 Apply TC-5 to "inner" tiles and smooth with spatula. Contour TC-5 using tool 60944, no. 1. Surface to be smooth and continuous.
- 5.4 Apply each tile with a circumferential motion and with significant pressure. Each tile is marked with sequence numbers: 1-2, 2-3, 3-4, 4-5, 5-6 and 6-1. Orientation with reference to "0°" to be noted on Figure 1. Depth of TC-5 to be determined with depth gauge through center hole. Tile thickness and depth to be subtracted to determine thickness of TC-5. Record value on Figure 1 (tile thickness is marked on each tile). TC-5 thickness to be .015-.032 thick.
- 5.5 Repeat steps 5.1, 5.2 and 5.3 for middle and outer tiles using appropriate tools 60943, no. 2 and 3 spatulas and 60944, no. 2 and 3 spatulas. Record TC-5 thickness values on Figures 2 and 3.
- 5.6 Install links to maintain tiles in ring.
- 5.7 Install 0.125 inch thick lead segments in 5.00 and 9.25 inch radius cracks.



AVE. .022

FLIGHT NUMBER ZIP II

SERIAL NUMBER SN 13

INNER RING

FIGURE I

OVERALL AVE .024

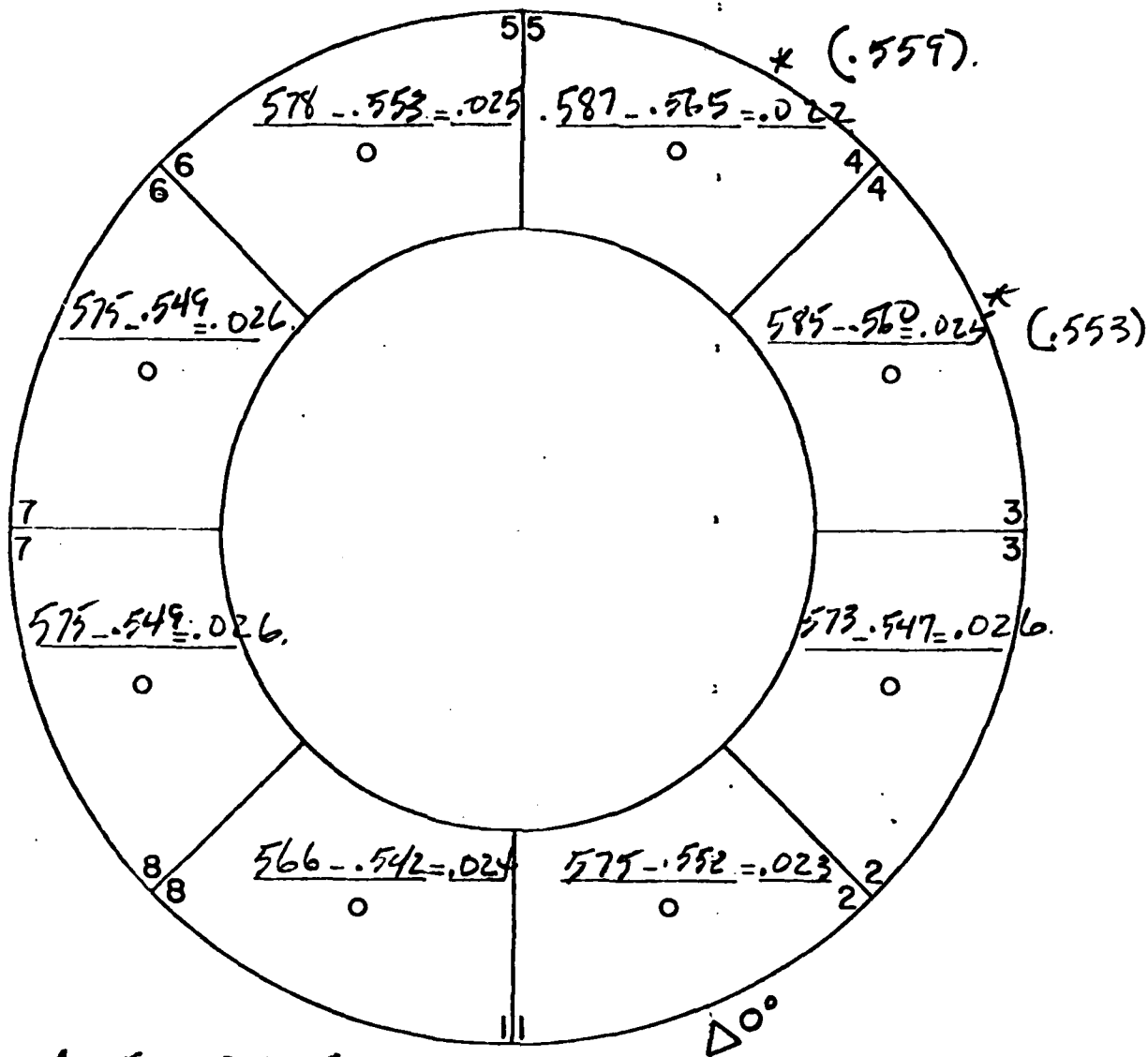
Felipe
H. Guise
R. L. ...

13 JUN 81

SIZE	CODE IDENT NO.	DRAWING NO.	
A	54459	90113	A
SCALE		SHEET 4	OF 6

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FLIGHT NUMBER _____

SERIAL NUMBER SN 13

MIDDLE RING
FIGURE 2

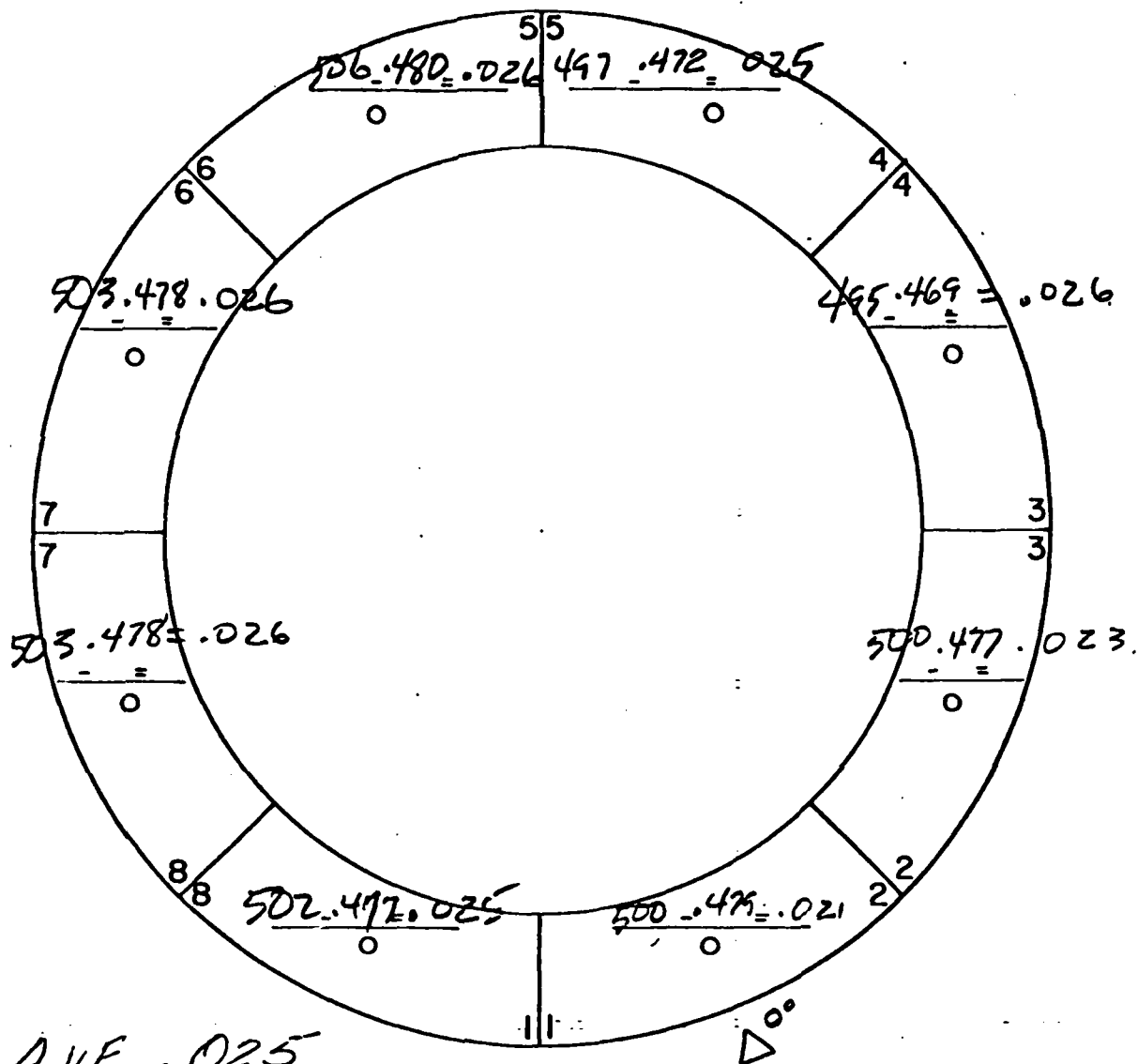
* CORRECTION TO QC
READING

R. J. [unclear] Jun 13, 81
L. [unclear]

SIZE	CODE IDENT NO.	DRAWING NO.	
A	54459	90113	A
SCALE		SHEET 5 OF 6	

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REORDER NO. A-7582





AVE. .025
 FLIGHT NUMBER ZIP II
 SERIAL NUMBER SNI 13

OUTER RING
 FIGURE 3

*Philip
 H. Gause
 R. D. Gause Jan 13, 81*

SIZE	CODE IDENT NO.	DRAWING NO.	
A	54459	90113	A
SCALE		SHEET	OF
		6	6

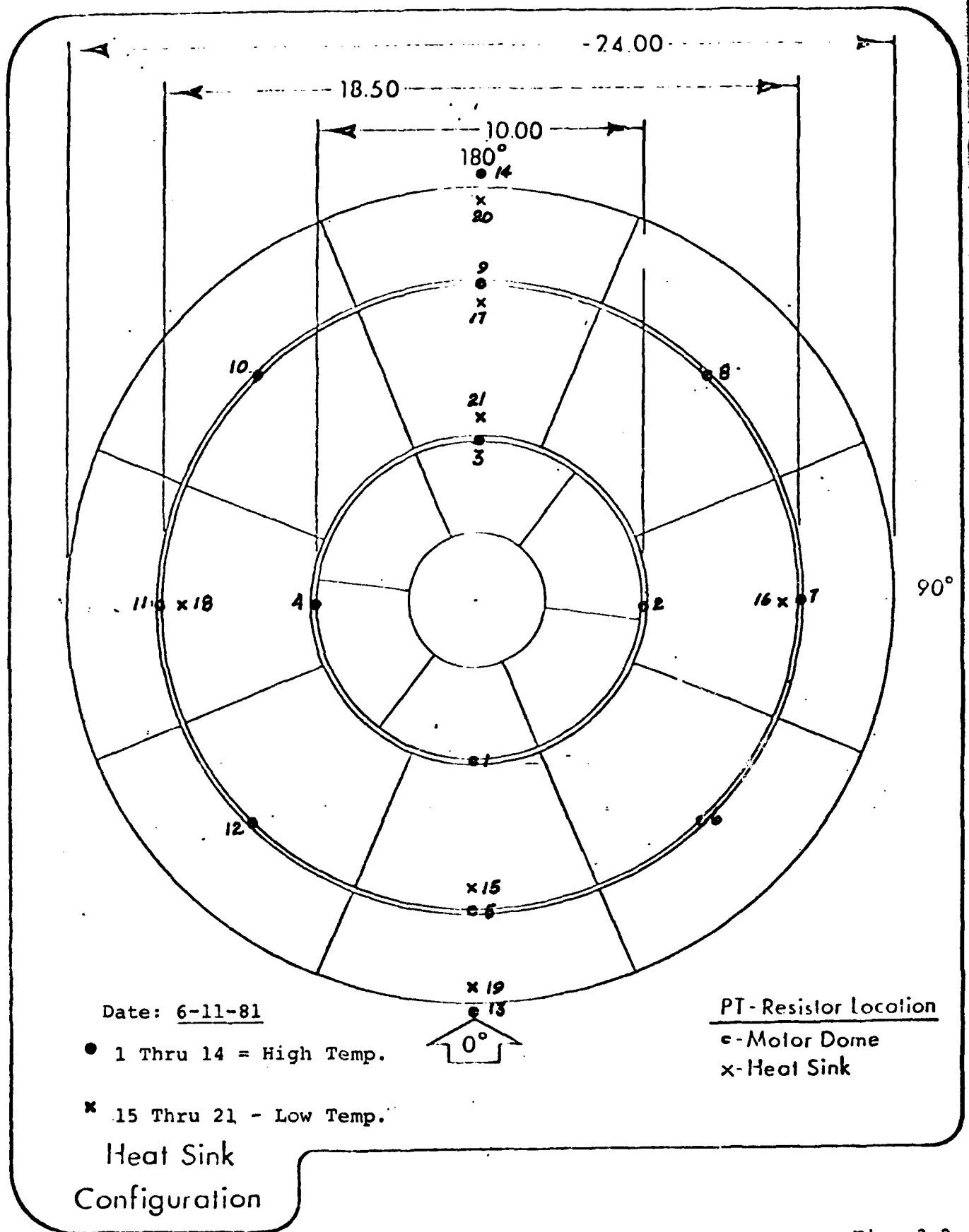


Fig. 3-2

TABLE 3-1

ZIP II Heat Sink Installation.			
		Average Aluminum Thickness	Average Interface Thickness
Inner Ring		.505 in.	.022 in.
Middle Ring		.561 in.	.025 in..
Outter Ring		.480 in.	.025 in.
Sensor Location			
Angle (degrees)	Radius (in.)		
	5	9.25	12
0	0#1	0#5 X#15	0#13 X#19
45		0#6	
90	0#2	0#7 X#16	
135		0#8	
180	0#3 X#21	0#9 0#17	0#14 0#20
225		0#10	
270	0#4	0#11 X#18	
315		0#12	

TABLE 3-2
ZIPII
Dome Temperature at +60 Seconds

Therm. No.	Deg. C	Deg. . F	Delta Rise Deg. F
1.	115	239.0	167.0
2.	104	219.2	147.2
3.	122	251.6	179.6
4.	96	204.8	132.8
5.	63	145.4	73.4
6.	82	179.6	107.6
7.	71	159.8	87.8
8.	70	158.0	86.0
9.	70	158.0	86.0
10.	70	158.0	86.0
11.	65	149.0	77.0
12.	85	185.0	113.0
13.	100	212.0	140.0
14.	100	212.0	140.0
15.	52	125.6	53.6
16.	37	98.6	26.6
17.	58	136.4	64.4
18.	40	104.0	32.0
19.	35	95.0	23.0
20.	41	105.8	33.8
21.	42	107.6	35.6

NOTE: A Ambient Temperature of 72°
F was used to establish a Delta Rise.

1 Thru 14 = High Temp.
15 Thru 21 = Low Temp.

TABLE 3-3

Comparison of
Motor Dome Temperature Rises (°F)

@ T+60 Second
@ 9.25 Inch Radius

Rocket	Angular Location, DEG			
	0	90	180	270
Test Rocket	253	52	151	83
IMS #3	97	-	144	-
IMS #4	122	-	86	-
TEM I	70	34	56	68
TEM II	51	22	28	39
ZIP I	63	22	18	32
IRBS	99	61	66	72
ZIP II	73	88	86	77

SECTION 4.0

FLIGHT PERFORMANCE ANALYSIS

- 4.1 The boost phase of the flight was successful with all systems functioning properly. Available radar data and telemetry records were used to develop this analysis. A summary is presented in Table 4-1. A pre-launch trajectory is included in Table 4-2.

<u>Table 4-1</u>		
<u>Booster Performance</u>		
	Predicted	Actual
Weight, lbs	13,893	13,889
Velocity @ B.O., ft/sec.	8,027	8,330
Peak altitude, miles	238	244
Impact, miles		
North	51	52
West	5.2	8.2

- 4.2 Telemetry records of the Boost Control System are presented in Figure 4-1 and 4-2. The pitch program followed its pre-programmed maneuver throughout the boost phase of the flight. Yaw and roll position data indicate no adverse or unusual maneuvers were experienced during powered flight. Small deviations in the flight path are noted during the coast period between +60 and +80 seconds. A velocity/time plot of the powered flight is presented in Figure 4-3. This plot was developed from radar data.
- 4.3 Separation of the Booster from the Payload occurred at T+80 seconds as programmed. Figure 4-4 and 4-5 depicts the separation distance between the two bodies. Analysis of the accelerometer data indicates that a separation velocity of 13/14 feet per second was obtained. Figure 4-6 is a reproduction of the separation pulse. Analysis of the Radar data

indicates a total separation distance of 2100 feet was obtained in the first 100 seconds after separation. This indicates a separation velocity of approximately 21 FPS was imparted by the bellows separation system. Figures 4-4 and 4-5 show this distance. A predicted separation velocity of 32.8 FPS was made prior to the flight.

TABLE 4-2

04/13/81 03:26 PM PAGE 1

ZIP 11

TIME, SEC THRST, LB ENRGY, FT PATM, PSF	VEL, FPS WGT, LB 11P, FT ACCEL, G	ALT, FT H-DOT XDBLDOOT GRVTY	RANGE, FT R-DOT YDBLDOOT IMP, LBSC	MACH CD CNA DUAERO	O, PSF DPAG, LB LIFT, LB DUGRAU	GMM, DEG THTA, DEG ALFA, DEG THTA-DOT
0.00	0.00	4040	0	0.000	0.00	0.000
0	13893.00	0.00	0.00	0.237	0.00	0.000
4040	0	0.01	0.00	0.000	0.00	0.000
1819.30	0.00	32.16	0	0.00	0.00	0.000
0.06	0.13	4040	0	0.000	0.00	0.000
21574	13887.94	0.13	0.00	0.237	0.00	0.000
4040	0	17.82	0.00	10.240	0.00	0.000
1819.30	0.55	32.16	460	0.00	1.93	0.000
10.00	568.59	6647	69	0.521	313.95	2.141
39847	12196.23	568.19	21.24	0.243	806.66	2.119
11676	967	70.86	1.15	10.443	13.32	0.022
1650.17	2.20	32.15	362180	6.05	321.51	0.040
20.00	1295.53	16008	468	1.230	1210.39	2.585
43300	10357.22	1294.21	58.42	0.804	10278.55	2.518
42164	5664	70.48	0.78	13.483	203.34	0.068
1142.91	2.19	32.12	778616	149.84	642.63	0.023
30.00	2104.53	32776	1261	2.131	1756.57	2.805
44356	8530.93	2102.01	102.99	0.558	10359.01	2.748
102049	16031	96.18	0.87	9.100	177.27	0.060
552.49	2.99	32.07	1219318	527.67	963.29	0.023
40.00	3321.17	59409	2613	3.431	1279.90	3.008
43838	6786.94	3316.59	174.29	0.392	5303.42	2.978
233226	41377	150.73	1.32	8.146	71.17	0.037
155.35	4.68	31.99	1661976	859.77	1283.24	0.021
50.00	5175.39	101192	4877	5.215	419.97	3.197
42627	5130.46	5167.34	288.61	0.287	1274.31	3.188
530046	103248	227.52	1.69	6.562	11.14	0.022
22.06	7.07	31.87	2090925	1018.36	1602.10	0.021
59.00	7634.30	158085	8110	7.067	73.02	3.335
39870	3625.88	7621.37	444.05	0.238	183.53	3.377
1119484	228925	320.52	1.87	5.775	-1.60	-0.021
2.09	9.96	31.69	2467105	1055.42	1887.70	0.021
60.00	7928.39	165861	8560	7.327	58.46	3.346
27587	3466.50	7914.86	463.02	0.234	144.28	3.338
1207270	247530	223.09	1.88	5.675	-1.65	-0.021
1.56	6.93	31.67	2503166	1056.91	1888.33	0.021
63.00	8027.73	189918	8963	7.571	21.77	3.335
0	3352.53	8013.72	473.99	0.231	20.10	3.331
1261420	259022	-32.12	1.90	5.536	-1.25	-0.021
0.62	-1.00	31.60	2524041	1059.68	2014.07	0.021

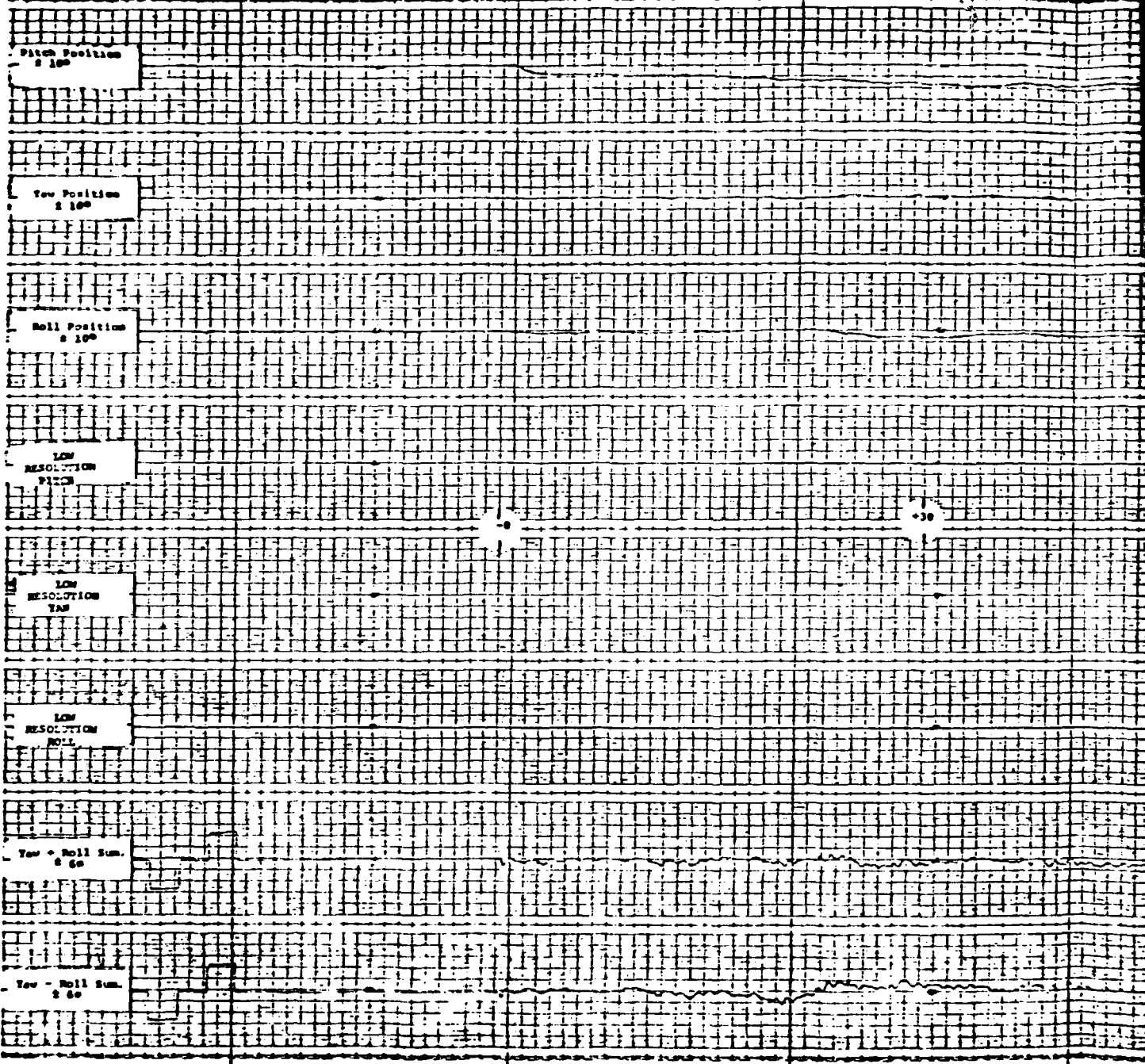
TIME, SEC	VEL, FPS	ALT, FT	RANGE, FT	MACH	Q, PSF	GNMA, DEG
THRST, LB	WGT, LB	H-DOT	R-DOT	CO	DRAG, LB	THTA, DEG
ENRGY, FT	11P, FT	XDBL DOT	YDBL DOT	CNA	LIFT, LB	ALFA, DEG
PATN, PSF	ACCEL, G	GRVTY	IMP, LBSC	DVAERO	DUGRAU	THTA-DOT
70.00	7805.88	245234	13243	8.369	2.65	3.472
0	3352.53	7791.56	472.70	0.219	6.13	3.608
1260966	258948	-31.43	1.96	5.406	-0.26	-0.100
0.05	-0.98	31.43	2524041	1061.31	2234.28	0.000
OK 80.00	7493.15	321581	17898	7.952	0.04	3.604
0	3352.53	7478.33	470.99	0.000	0.00	3.608
1260929	258942	-31.15	1.94	0.000	0.00	0.045
0.00	-0.97	31.21	2524041	1061.45	2546.87	0.000
90.00	7182.79	394808	22520	7.183	0.00	3.747
0	3352.53	7167.44	469.38	0.000	0.00	3.608
1260929	258942	-30.93	1.92	0.000	0.00	0.200
0.00	-0.96	30.99	2524041	1061.45	2857.23	0.000
100.00	6874.57	464937	27112	6.875	0.00	3.902
0	3352.53	6858.63	467.84	0.000	0.00	3.608
1260929	258942	-30.73	1.90	0.000	0.00	0.368
0.00	-0.95	30.79	2524041	1061.45	3165.45	0.000
150.00	5361.99	769776	49661	5.362	0.00	4.935
0	3352.53	5342.12	461.26	0.000	0.00	3.608
1260929	258942	-29.88	1.81	0.000	0.00	1.463
0.00	-0.93	29.93	2524041	1061.45	4678.03	0.000
200.00	3889.43	999763	71660	3.889	0.00	6.739
0	3352.53	3862.56	456.43	0.000	0.00	3.608
1260928	258942	-29.25	1.74	0.000	0.00	3.327
0.00	-0.90	29.31	2524041	1061.45	6150.58	0.000
250.00	2451.14	1156463	93274	2.451	0.00	10.655
0	3352.53	2408.88	453.19	0.000	0.00	3.608
1260928	258942	-28.84	1.69	0.000	0.00	7.302
0.00	-0.88	28.89	2524041	1061.45	7588.85	0.000
300.00	1070.83	1240914	114654	1.071	0.00	24.935
0	3352.53	971.01	451.46	0.000	0.00	3.608
1260928	258942	-28.63	1.65	0.000	0.00	21.641
0.00	-0.81	28.67	2524041	1061.45	8968.11	0.000
333.91	451.13	1257373	129091	0.451	0.00	90.000
0	3352.53	-0.00	451.13	0.000	0.00	3.608
1260928	258942	-28.58	1.63	0.000	0.00	86.745
0.00	0.00	28.63	2524041	1061.45	9589.19	0.000
350.00	444.75	1253558	135932	0.445	0.00	135.589
0	3352.53	-460.57	451.20	0.000	0.00	3.608
1260928	258942	-28.59	1.62	0.000	0.00	132.353
0.00	0.64	28.54	2524041	1061.45	9394.75	0.000

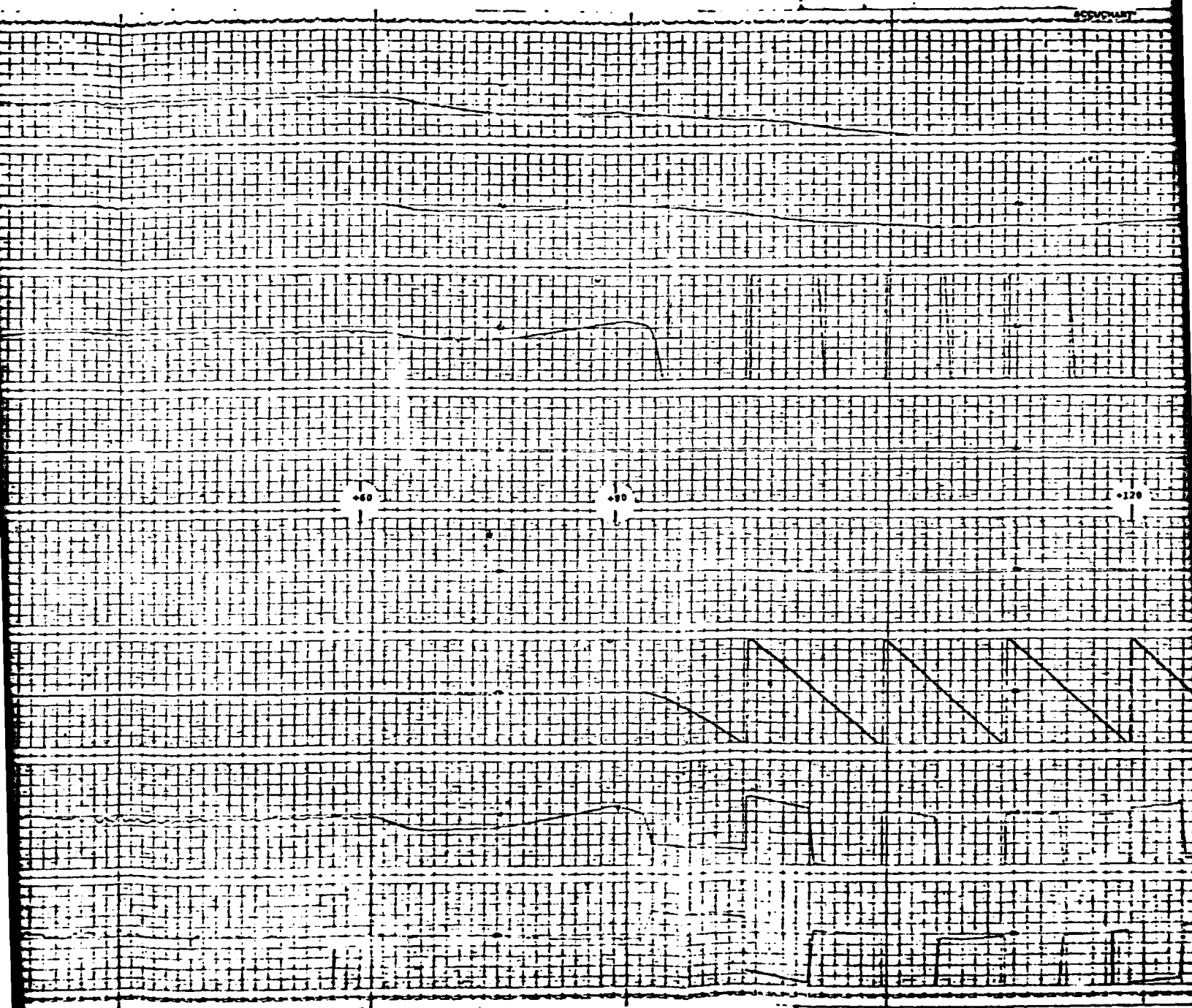
TIME, SEC	VEL, FPS	ALT, FT	RANGE, FT	MACH	Q, PSF	GNMA, DEG
THRST, LB	WGT, LB	H-DOT	R-DOT	CD	DRAG, LB	THTA, DEG
ENRGY, FT	11P, FT	XDBLDDOT	YDBLDDOT	CNA	LIFT, LB	ALFA, DEG
PATM, PSF	ACCEL, G	GRVTY	IMP, LBSC	DVAERO	DUGRAU	THTA-DOT
400.00	1948.38	1194807	157269	1.948	0.00	166.574
0	3352.53	-1895.13	452.40	0.000	0.00	3.608
1260928	258942	-28.75	1.60	0.000	0.00	163.396
0.00	0.87	28.79	2524041	1061.45	8097.97	0.000
450.00	3372.90	1063949	178783	3.373	0.00	172.246
0	3352.53	-3342.06	455.09	0.000	0.00	3.608
1260928	258942	-29.09	1.59	0.000	0.00	169.127
0.00	0.90	29.14	2524041	1061.45	6673.53	0.000
500.00	4833.06	860232	200627	4.833	0.00	174.546
0	3352.53	-4811.19	459.35	0.000	0.00	3.608
1260928	258942	-29.64	1.58	0.000	0.00	171.487
0.00	0.92	29.68	2524041	1061.45	5213.38	0.000
550.00	6330.30	582284	222960	6.330	0.00	175.785
0	3352.53	-6313.18	465.29	0.000	0.00	3.608
1260929	258942	-30.41	1.59	0.000	0.00	172.787
0.00	0.94	30.46	2524041	1061.45	3716.14	0.000
600.00	7875.27	328168	245959	8.046	5.59	176.557
0	3352.53	-7861.05	473.02	0.222	13.11	177.230
1261218	258939	31.55	1.91	0.000	0.00	173.622
0.12	0.98	31.48	2524041	1062.51	2172.22	0.000
610.00	8181.99	148004	250655	7.650	125.88	176.677
0	3352.53	-8168.23	474.30	0.228	303.68	177.363
1259739	258937	28.76	1.84	0.000	0.00	0.012
3.07	0.89	31.72	2524041	1071.31	1856.74	0.000
620.00	8175.25	65502	255339	8.431	5780.33	176.790
0	3352.53	-8162.43	457.77	0.218	13323.93	177.489
1165421	258915	-95.94	1.52	0.000	0.00	0.011
116.16	-2.98	31.97	2524041	1395.01	1538.78	0.000
629.28	4096.89	4040	258722	3.722	17638.35	176.934
0	3352.53	-4091.02	219.12	0.369	68718.94	177.642
268274	258762	-627.38	1.72	0.000	0.00	0.000
1819.28	-19.50	32.16	2524041	5771.53	1241.62	0.000

Section 4.3 continued

Telemetry data indicated that one of the separation monitors went blank at about +30 seconds. A cause for this abnormality could not be determined.

- 4.4 At the same time that separation occurred (T+80 sec.), the Booster Roll Jet System was actuated. Analysis of the available data indicates that two(2) seconds after separation, the spent Booster was rolling at a rate of $10.07^{\circ}/\text{sec}$.
- 4.5 A peak acceleration of 8.1 g was experienced during the flight. Figure 4-7 is a copy of the telemetry data for the vehicle Logitudinal Accelerometer.
- 4.6 The recovery system, through its pre-set baro-sensing system, was activated and functioned as designed. Minimum damage was inflicted on the recovered module.





Pitch Rate
2100/sec

Yaw Rate
2100/sec

Roll Rate
2100/sec

Pitch Sum.
2 60/sec

WCU
Nozzle #1
260

WCU
Nozzle #2
260

WCU
Nozzle #3
260

WCU
Nozzle #4
260



20 X 20 PER INCH
MADE IN U.S.A.

20 X 20 PER INCH
MADE IN U.S.A.

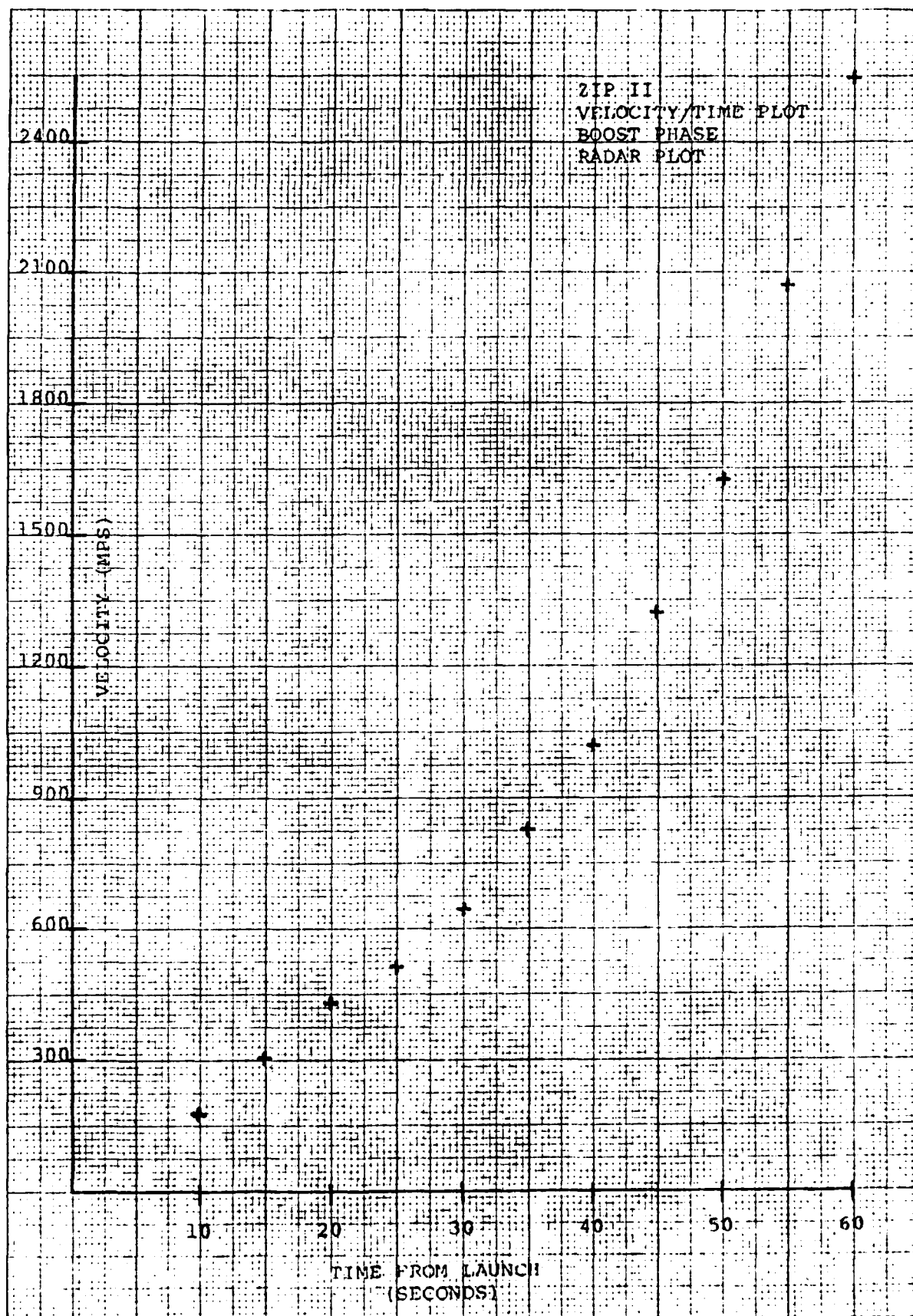


Fig. 4-3

K-S 20 x 20 TO THE INCH = 1 x 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1240

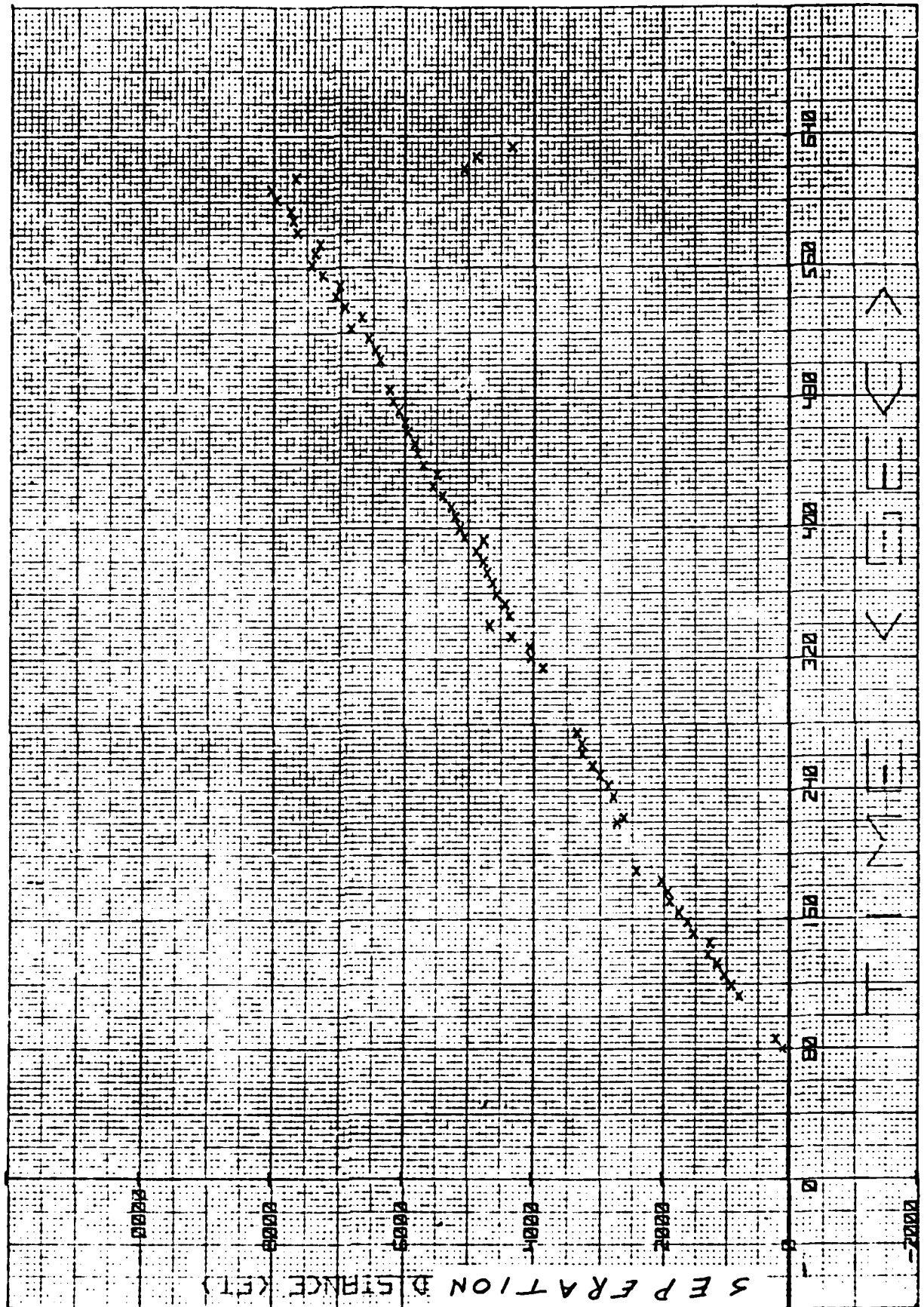


Fig. 4-4

K-E 20 X 20 TO THE INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1240

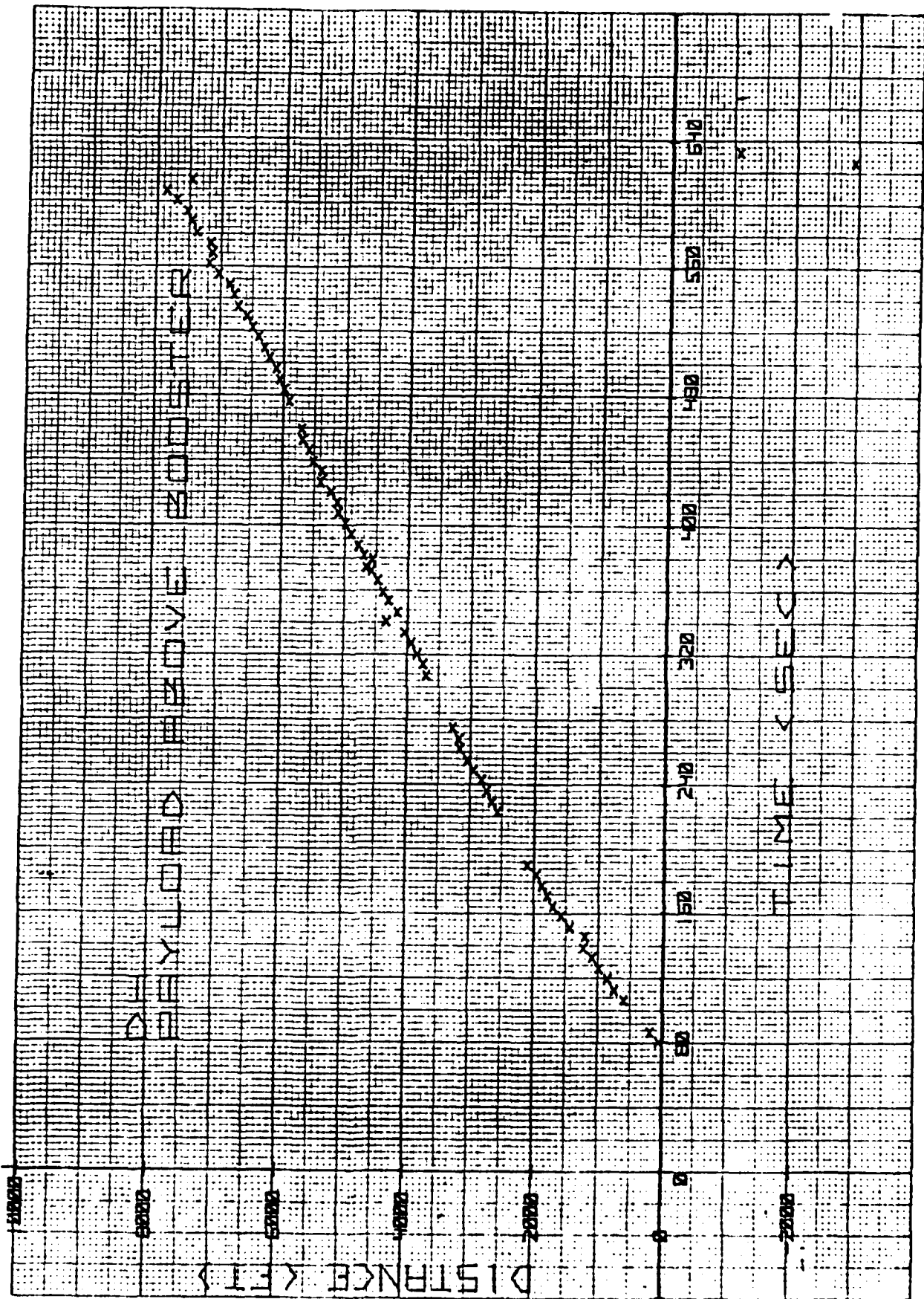
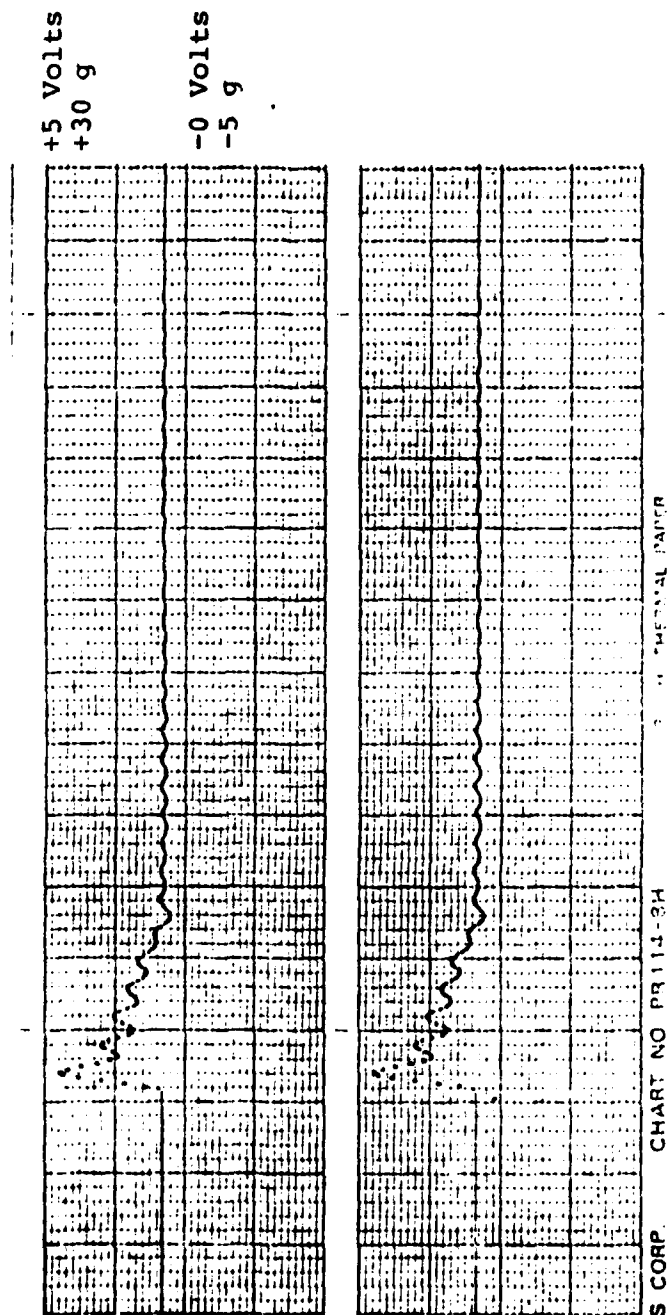


Fig. 4-5 37

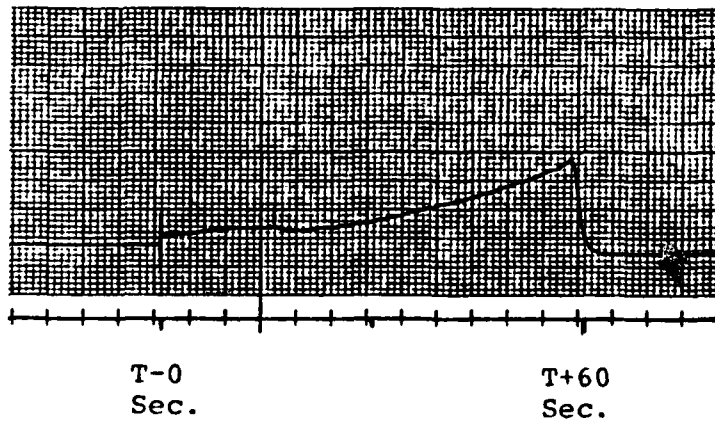


SEPARATION PULSE

13.5 FPS

LONGITUDINAL ACCELERATION

-5 g to +30 g

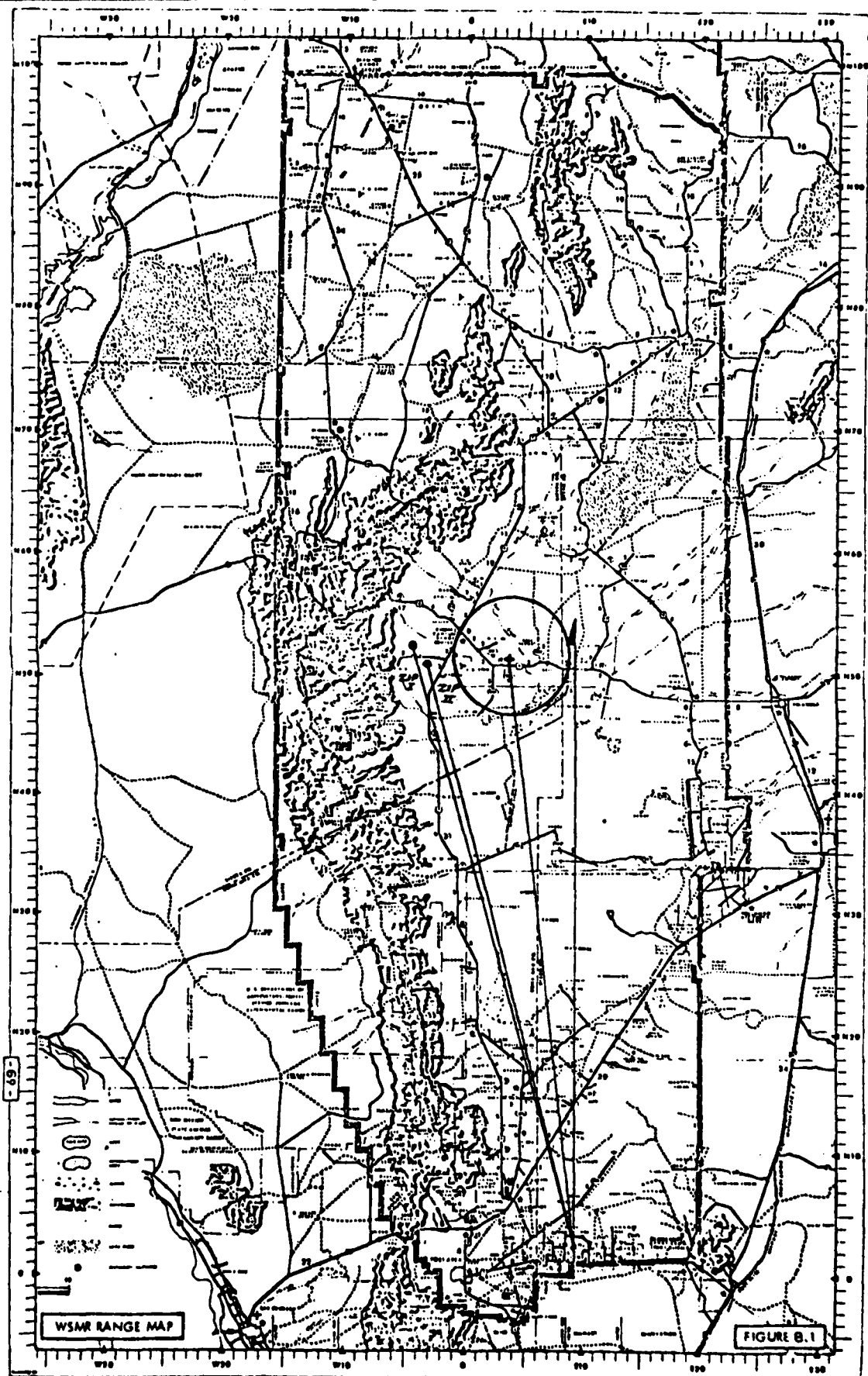


BOOSTER ACCELERATION

SECTION 5.0

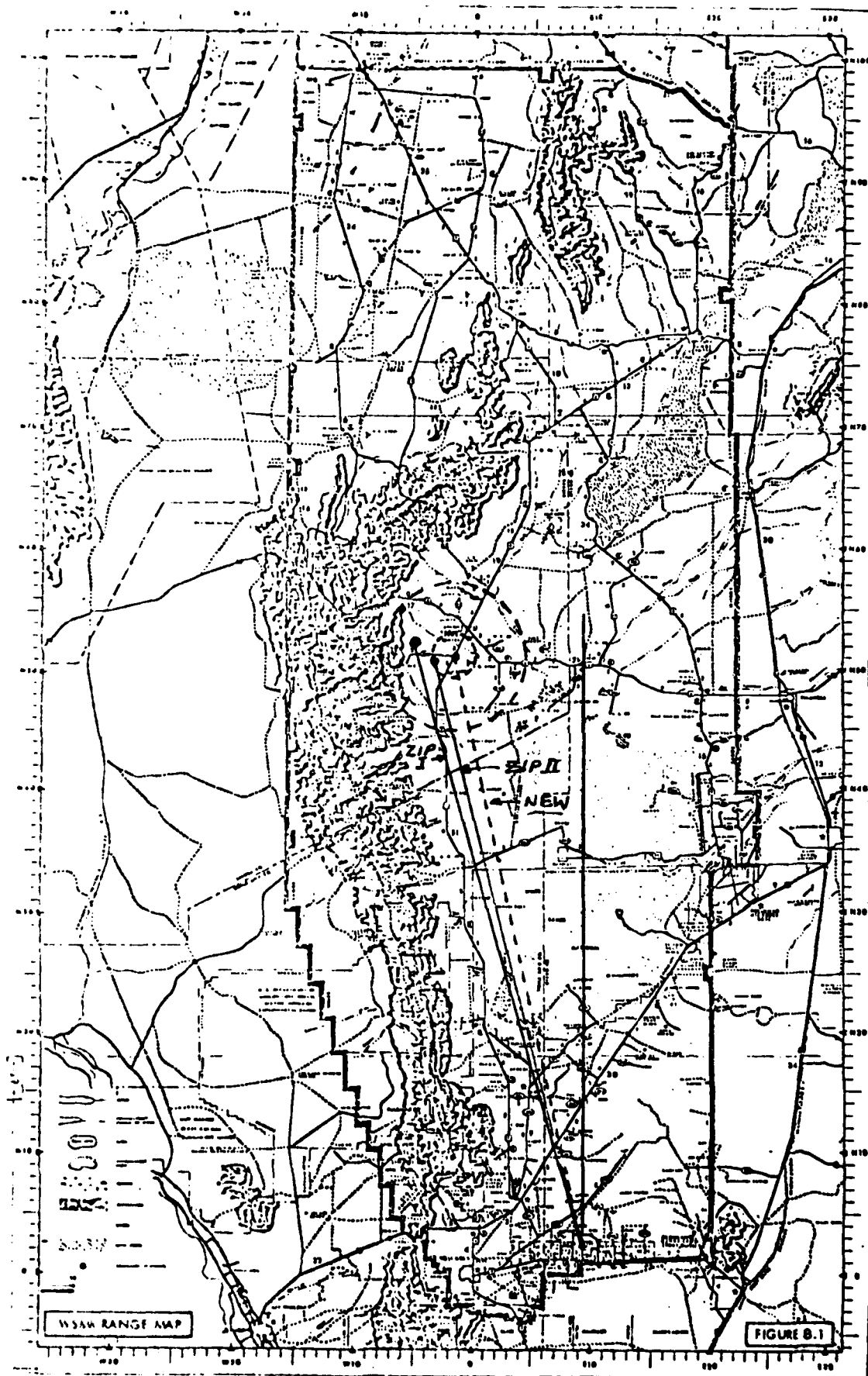
IMPACT PREDICTION

- 5.1 The ZIP II Booster impacted approximately seven miles West of the predicted impact point in Figure 5-1. Although this in itself is not serious, Space Vector has investigated the possible cause of this miss.
- 5.2 Analysis of the impact prediction techniques reveals that the prediction shown in Table 4-1 of 5.2 miles West was obtained by taking the non-rotating earth trajectory data at burnout and predicting the shift in impact point. If a rotating earth trajectory is performed, the predicted impact point is 8.0 miles West. If the effect of flying a MIDAS platform is then added, the predicted impact is 11.1 miles West.
- 5.3 The estimated CEP is 4 miles assuming normal MIDAS drift and alignment errors. This estimated CEP means that 50% of the flights would impact within a circle 4 miles in radius centered 11 miles West of the launch site. The RSS (Root Sum Square) three sigma dispersion is estimated at 13 miles.
- Further analysis of previous ARIES flights is required before a recommendation to change the launch heading can be made.
- 5.4 The corrected impact prediction is shown in Figure 5-2.



PREVIOUS IMPACT PREDICTION

Fig. 5-1



CORRECTED IMPACT PREDICTION

Fig. 5-2

DAT
ILMI