NASA TECHNICAL MEMORANDUM

NASA TM X-64990

ATMOSPHERIC ENVIRONMENT FOR ASTP (SA-210) LAUNCH

By D. L. Johnson
Space Sciences Laboratory

February 1976

NASA

George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
NASA TM X- 64990		

4. TITLE AND SUBTITLE	5. REPORT DATE
Atmospheric Environment for ASTP (SA-210) Launch	February 1976
	6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT #
D. L. Johnson	

9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. WORK UNIT NO.
George C. Marshall Space Flight Center Marshall Space Flight Center, Alabama 35812	11. CONTRACT OR GRANT NO.
	13. TYPE OF REPORT & PERIOD COVERED
12. SPONSORING AGENCY NAME AND ADDRESS	Technical Memorandum
National Aeronautics and Space Administration Washington, D.C. 20546	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

Prepared by Space Sciences Laboratory, Science and Engineering

16. ABSTRACT

This report presents a summary of selected atmospheric conditions observed near ASTP/SA-210 launch time on July 15, 1975, at Kennedy Space Center, Florida. Values of ambient pressure, temperature, moisture, ground winds, visual observations (cloud), density, index of refraction, and wind/wind shear aloft are included. A final meteorological data tape for the ASTP launch, consisting of wind and thermodynamic parameters versus altitude, has been constructed.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
ASTP Launch Atmospheric Summary Pressure Temperature Relative Humidity Density Winds Clouds, Solar Radiation	Unclassified – Unlimited D. L. Johnson

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
Unclassified	Unclassified	33	NTIS

ACKNOWLEDGMENTS

The author thanks Messrs. Paul Harness and Edgar Seely of the MSFC Data Systems Laboratory and Mr. G. Wade Batts of Computer Sciences Corporation for their assistance in processing the upper air data used in producing the SA-210 Final Meteorological Data tape.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

TECHNICAL MEMORANDUM X-64990

ATMOSPHERIC ENVIRONMENT FOR ASTP (SA-210) LAUNCH

I. INTRODUCTION

The successful launch and mission of the Apollo-Soyuz Test Project (ASTP) concluded a phase in NASA's space vehicle/flight program. This report presents an evaluation of the atmospheric environmental data taken during the launch of the Saturn ASTP/SA-210 vehicle. This Saturn IB vehicle was launched from Pad 39B at Kennedy Space Center (KSC), Florida, on a bearing of 44.85° east of north at 1950Z (1550 EDT) on July 15, 1975.

This report is issued to complete the documented history of atmospheric conditions observed during the launching of all Marshall Space Flight Center (MSFC) supported launch vehicles. Previous Saturn launch atmospheric environmental conditions have been published as Appendix A of individual MSFC Saturn Flight Evaluation Working Group reports [1]. Office memorandums have also been issued for previous flights giving launch pad wind information. However, since no Flight Evaluation Working Group publication was issued, both of these type atmospheric summaries are included in this report for the ASTP launch. A report has also been published [2] which summarizes most launch atmospheric conditions observed for the past 155 MSFC/ABMA related vehicle launches through SA-208 (Skylab 4).

This report presents a summary of the atmospheric environment at launch time (T-0) of the SA-210 together with detailed pad wind data at the 139 m (457 ft) launch umbilical tower (LUT) and 18 m (60 ft) pad light pole reference levels, from L-16 h through liftoff. The general weather situation for the launch and flight area is described, and surface and upper level wind/thermodynamic observations near launch time are given. The format of these data is similar to that presented on previous launches of Saturn vehicles to permit comparisons.

II. SOURCES OF DATA

Atmospheric observational data used in this report were taken from weather maps made by the U.S. Weather Service, plus all available surface observations and measurements from around the launch area. Upper air observations were taken from balloon-released instruments sent aloft from KSC Air Force Station. High-altitude winds and thermodynamic data were measured by the Loki Dart rocketsonde launched from the KSC Air Force Station. Table 1 presents a listing of systems used to obtain the upper level wind profiles used in compiling the final meteorological tape. Only the rawinsonde balloon and Loki Dart rocket data were used in the upper level atmospheric thermodynamic analyses. Data cutoff altitudes are also given in Table 1.

III. GENERAL SYNOPTIC SITUATION AT LAUNCH TIME

During the afternoon launch of SA-210, the KSC launch area was experiencing warm temperatures, good visibility conditions, and light surface winds. A ridge of high pressure was located off, and parallel to, the northeast United States coast extending into Florida and bringing southeasterly wind flow throughout the lower levels at Cape Canaveral. This southeasterly wind flow caused a decrease in afternoon thunderstorm activity that had taken place during the preceding week. Figure 1 gives the surface weather map 8 h prior to launch. Wind flow aloft is shown in Figure 2 (500-mb level). The maximum wind belt was located well north of Florida, giving less intense wind flow aloft over the KSC area.

IV. SURFACE OBSERVATIONS AT LAUNCH TIME

Surface observations at launch time for selected locations of interest are given in Table 2. The NASA 150 m Ground Wind Tower is considered by MSFC as the location from which to obtain the official T-0 weather observations.

At midmorning, a line of cumulonimbus developed approximately 25 miles offshore and moved westward but dissipated by the time it was approximately 12 miles from Pad 39B. This proved to be the closest approach during the day

of any cloud that could have threatened launch. Neither precipitation nor lightning was observed at launch time. The vehicle did pass through clouds, and its contrail was visible 1 min and 20 s after T-0.

Solar radiation values for the day of launch are given in Table 3. Solar radiation measured values of total horizontal, normal incident, and calculated values of diffuse (sky) radiation are included by hour.

V. PAD WIND VALUES

Table 4 presents surface wind data recorded for the launch of SA-210 from Complex 39B. Values for wind speed and direction at the 139 m (457 ft) LUT reference level and 18 m (60 ft) pad light pole level are included.

Average and peak wind values are presented on-the-hour from L-16 h to L-1 h, and on-the-minute from T-15 min to T-1 min. Ten-s wind values are also presented from T-50 to T-10 s. The range time of T-0 was 1550:00 EDT.

Procedures used to obtain average and peak wind values are as follows:

a. Ten-min values are calculated for ±5 min from the beginning of each hour.

b. One-min values are calculated for ±30 s on-the-minute.

c. Ten-s values are calculated for ±5 s on-the-tenth-second.

d. Hourly peak wind speeds are calculated for ±30 min from the beginning of each hour.

Location and evaluation of Pad 39B anemometers measuring these data are:

Pad 39B Anemometers			Elevation Above					
			MSL		Ground		Deck "0"	
Location	Symbol	Number	ft	m	ft	m	ft	m
Pad Light Pole	PLP (SE)	26K01&02	66	20.1	60	18.3	-	-
Launch Umbilical Tower	LUT (NE)	26C11&12	463	141.1	457	139.3	365	111.3

Figure 3 depicts the general layout and relative position of anemometers and other meteorological instrumentation on Launch Complex 39B at KSC. Table 5 presents the T-0 launch winds taken near ground level at various recording sites around the Pad 39B area. The locations of these wind tower sites are shown in Figure 4. A U.S. Air Force report has been published [3] which gives further information as to the locations and operations of the Cape Canaveral wind tower system network.

VI. UPPER AIR MEASUREMENTS

The FPS-16 Jimsphere (2005Z). GMD rawinsonde (2000Z), and Loki Dart rocketsonde (2105Z) systems were used to measure the upper level wind and thermodynamic parameters. A summary of each parameter is given in the following paragraphs.

A. Wind Speed

Wind speeds were light, being 4.0 m/s (7.8 kn) at the surface and increasing to a maximum of 13.0 m/s (25.3 kn) blowing from 038°. The maximum occurred at an altitude of 11 875 m (38 960 ft). This maximum wind speed was near the 50 percentile level for July. The winds decreased above this altitude and then became stronger again, as shown in Figure 5. The overall maximum speed was 76.0 m/s (147.7 kn) at 59.00 km (193 570 ft) altitude.

B. Wind Direction

At launch time the surface wind direction was from the east (100°) and remained east or southeastern throughout the troposphere and stratosphere. Figure 6 shows the complete wind direction versus altitude profile. As shown in Figure 6, wind directions became quite variable at altitudes with low wind speeds.

C. Pitch Wind Component

The pitch wind velocity component (component parallel to the horizontal projection of the flight path) at the surface was a head wind of 2.3 m/s (4.5 kn). The maximum wind, in the altitude range of 8 to 16 km (26 247 to 52 493 ft), was a head wind of 12.9 m/s (25.2 kn) observed at 11.88 km (38 960 ft) altitude (Fig. 7).

D. Yaw Wind Component

The yaw wind velocity component (cross range wind component) at the surface was a wind from the right of 3.3 m/s (6.4 kn). The peak yaw wind velocity in the high dynamic pressure region (max Q) was a wind from the left of 7.7 m/s (14.9 kn) at 11.08 km (36 335 ft). Figure 8 presents the entire profile of yaw wind components versus altitude.

E. Component Wind Shears

The largest component wind shear ($\Delta h = 1000$ m) in the maximum dynamic pressure region was a yaw wind shear of 0.0125 s^{-1} at 10.85 km (35 597 ft). The largest pitch wind shear, at these lower levels, was 0.0085 s^{-1} at 9.88 km (32 398 ft) (Fig. 9).

F. Extreme Wind Data in the High Dynamic Region

A summary of the maximum wind speeds and wind components encountered for all previous Saturn IB (200 series) vehicles is given in Table 6. A summary of the extreme wind shear values ($\Delta h = 1000$ m) for Saturn vehicles SA-201 through SA-210 is given in Table 7.

VII. THERMODYNAMIC DATA

Comparisons of the thermodynamic data taken at SA-210 launch time with the annual Patrick Reference Atmosphere, 1963 (PRA-63) [4] for temperature, pressure, density, and optical index of refraction are shown in Figures 10 and 11 and are discussed in the following paragraphs.

A. Atmospheric Temperature

Atmospheric temperature differences were small, with deviations less than 2 percent from the PRA-63 below 36 km (118 110 ft) altitude. In the max Q region, temperatures deviated to +1.89 percent of the PRA-63 value at 10.00 km (32 810 ft). Air temperatures were higher than the PRA-63 values at all levels up through 23 000 m (75 460 ft) and then deviated about the PRA-63 at levels above this point as shown in Figure 10.

B. Atmospheric Pressure

Atmospheric pressure deviations were small in the lower levels of the atmosphere. The surface pressure was only 0.2 percent greater than the PRA-63. Deviations were generally less than 4 percent of the PRA-63 for most altitudes. A maximum of +4.3 percent of the PRA-63 occurred at 24.1 km (79 070 ft). Figure 10 shows the entire pressure profile with altitude.

C. Atmospheric Density

Atmospheric density deviations were small in the lower levels, generally being within 2 percent of the PRA-63 below 20 km (108 266 ft) altitude. The density deviation reached a maximum of 5.8 percent greater than the PRA-63 value at 26.00 km (85 300 ft) as shown in Figure 11.

D. Optical Index of Refraction

The optical index of refraction at the surface was 11.7×10^{-6} units lower than the corresponding value of the PRA-63. The deviation then became less negative with altitude and approximated the PRA-63 at high altitudes, as is shown in Figure 11.

VIII. ATMOSPHERIC ELECTRIC FIELD

The KSC field mil network, consisting of more than 20 field mil instrument locations around launch Complex 39B, was indicating "fair day" atmospheric electric field intensity values (75 to 275 V/m) prior to and during launch of the ASTP vehicle.[1] The field mil measures the electric potential gradient from charged clouds in the vicinity of the sensor in volts per meter. The sensors are located in a cleared area and approximately 1 to 2 feet above natural terrain. The field mil measures only the vertical component of the potential gradient actually occurring in the atmosphere [3].

---

[1]Information provided by James Nicholson of the KSC Technical Support Meteorological Office (TS-MET).

IX. COMPARISON OF SELECTED ATMOSPHERIC DATA FOR SATURN IB LAUNCHES

A summary of the atmospheric data (selected observations) for each Saturn IB launch is given in Table 8. The SA-210 wind and thermodynamic extremes given in this report did not equal or exceed any of the extreme values measured during the previous eight 200-series Saturn vehicle launches [2].

X. CONCLUSION

The T-0 atmospheric summary for the ASTP/SA-210 NASA launch is given in this report. Although graphical outputs representing the final meteorological data summary versus altitude are presented in this report, tabular values are available and kept on file at the MSFC Aerospace Environment Division. All other surface and upper air observations and measurements are also kept on file.

TABLE 1. SYSTEMS USED TO MEASURE UPPER AIR WIND DATA FOR SA-210

Type of Data	Release Time		Portion of Data Used			
			Start		End	
	Time (UT) (h:min)	Time After T+0 (min)	Altitude m (ft)	Time After T+0 (min)	Altitude m (ft)	Time After T+0 (min)
FPS-16 Jimsphere	20:05	15	150 (492)	15	13 000 (42 650)	59
Rawinsonde	20:00	10	13 250 (43 470)	54	24 750 (81 200)	92
Loki Dart	21:05	75	63 000 (206 690)	75	25 000 (82 020)	96

TABLE 2. SURFACE OBSERVATIONS AT SA-210 LAUNCH TIME

Location[b]	Time After, T-0 (min)	Pressure, N/cm² (psia)	Temperature, K (°F)	Dew Point, K (°F)	Relative Humidity (%)	Visibility, km (miles)	Sky Cover[e]			Wind[a]	
							Cloud Amount (Tenths)	Cloud Type	Height of Base Meters (ft)	Speed m/s (kn)	Direction (deg)
NASA 150 m Ground Wind Tower Winds Measured at 16.5 m (54 ft)	0	10.200 (14.79)	302.0 (84.0)	295.9 (73.0)	70	16 (10)	2	Cb	884 (2900)	5.7[c] (11.0)	110[c]
							2	Ac	427 (14000)		
							4	Ci	10058 (33000)		
KSC AFS[d] Surface Measurements 5 m (16.4 ft) level	10	10.193 (14.78)	302.8 (85.3)	295.3 (71.8)	64	16 (10)	-	-	-	4.0 (7.8)	100
Pad 39B Lightpole SE 18.3 m (60.0 ft)	0	-	-	-	-	-	-	-	-	4.6 (9.0)	115
Pad 39B LUT (Top-NE) 139.3 m (457 ft)	0	-	-	-	-	-	-	-	-	7.2 (14.0)	135

a. Instantaneous readings at T-0, unless otherwise noted.
b. Altitudes of wind measurements are above natural grade.
c. 1 min average about T-0.
d. Balloon release site.
e. 5/10 total sky cover.

TABLE 3. SOLAR RADIATION AT SA-210 LAUNCH TIME, LAUNCH PAD 39B

Date	Hour Ending EST[a]	Total Horizontal Surface g-cal/cm^2-min	Normal Incident g-cal/cm^2-min	Diffuse (Sky) g-cal/cm^2-min
July 15, 1975	07.00	0.00	0.00	0.00
	08.00	0.01	0.02	0.00
	09.00	0.19	0.38	0.00
	10.00	0.43	0.64	0.00
	11.00	0.66	0.75	0.00
	12.00	0.62	0.55	0.08
	13.00	0.59	0.29	0.31
	14.00	0.71	0.40	0.34
	15.00	1.06	0.88	0.34
	16.00	1.13	0.85	0.57
	17.00	1.13	0.93	0.68

a. Add 1 h to EST to obtain EDT.

TABLE 4. PAD 39B SURFACE WIND SPEED AND DIRECTION DATA OBTAINED DURING SA-210 LAUNCH OPERATIONS

Date 1975	Time EDT	457 ft Reference Level (NE)							60 ft Level (SE)						
			Speed							Speed					
			Average		Peak		Hourly Peak			Average		Peak		Hourly Peak	
		$\overline{WD}$ (deg)	(kn)	(m/s)	(kn)	(m/s)	(kn)	(m/s)	$\overline{WD}$ (deg)	(kn)	(m/s)	(kn)	(m/s)	(kn)	(m/s)
7/15	0000	146	10.4	5.4	11.9	6.1	11.9	6.1	135	5.8	3.0	7.9	4.1	8.2	4.2
	0100	134	13.1	6.7	15.0	7.7	16.2	8.3	134	9.0	4.6	12.5	6.4	12.5	6.4
	0200	145	12.7	6.5	13.8	7.1	15.0	7.7	149	7.0	3.6	9.0	4.6	10.8	5.6
	0300	146	13.5	6.9	14.2	7.3	15.8	8.1	146	7.0	3.6	9.0	4.6	10.0	5.1
	0400	149	13.7	7.0	15.7	8.1	15.7	8.1	158	7.8	4.0	10.0	5.1	11.1	5.7
	0500	139	13.0	6.7	14.0	7.2	14.1	7.3	147	7.7	4.0	9.4	4.8	10.1	5.2
	0600	135	11.4	5.9	12.4	6.4	14.1	7.3	140	6.9	3.6	8.1	4.2	10.1	5.2
	0700	134	12.6	6.5	13.1	6.7	15.2	7.8	142	7.5	3.9	9.3	4.8	10.8	5.6
	0800	154	11.2	5.8	13.0	6.7	14.8	7.6	153	8.5	4.4	11.4	5.9	13.0	6.7
	0900	140	7.6	3.9	11.1	5.7	12.9	6.6	152	7.9	4.1	10.9	5.6	12.3	6.3
	1000	142	9.9	5.1	12.6	6.5	13.0	6.7	137	9.5	4.9	12.9	6.6	13.2	6.8
	1100	125	9.5	4.9	10.1	5.2	17.8	9.2	118	8.0	4.1	10.2	5.2	20.0	10.3
	1200	144	11.0	5.7	14.5	7.5	15.5	8.0	144	6.3	3.2	11.4	5.9	14.9	7.7
	1300	133	13.3	6.8	14.9	7.7	14.9	7.7	116	9.8	5.0	12.8	6.6	14.2	7.3
	1400	129	13.2	6.8	15.5	8.0	17.0	8.7	134	13.0	6.7	18.1	9.3	19.4	10.0
	1500	133	11.8	6.1	14.5	7.5	15.5	8.0	121	10.0	5.1	13.2	6.8	15.0[d]	7.7[d]
	1535	128	12.4	6.4	13.6	7.0			131	11.7	6.0	13.3	6.8		
	1536	131	12.2	6.3	13.6	7.0			127	10.9	5.6	14.9	7.7		
	1537	133	12.5	6.4	14.6	7.5			126	11.8	6.1	14.1	7.3		
	1538	132	13.5	6.9	15.1	7.8			129	12.0	6.2	13.4	6.9		
	1539	131	13.0	6.7	14.9	7.7			126	11.9	6.1	14.0	7.2		
	1540	126	12.9	6.6	15.1	7.8			125	11.3	5.8	14.0	7.2		
	1541	130	13.4	6.9	14.0	7.2			119	11.0	5.7	13.7	7.0		
	1542	127	13.7	7.1	14.6	7.5			119	12.0	6.2	13.3	6.8		
	1543	127	13.9	7.2	16.2	8.3	16.2[a]		120	12.0	6.2	14.2	7.3		
	1544	128	14.4	7.4	16.2	8.3	16.2[a]		120	11.8	6.1	13.8	7.1		
	1545	127	13.8	7.1	14.8	7.6			120	11.0	5.7	13.4	6.9		
	1546	130	14.0	7.2	15.6	8.0			134	11.2	5.8	13.2	6.8		
	1547	135	13.7	7.0	15.6	8.0			133	9.9	5.1	12.4	6.4		
	1548	134	14.0	7.2	15.3	7.9			135	11.8	6.1	14.2	7.3		
	1549[b]	135	13.7	7.0	14.5	7.5			132	12.1	6.2	14.8	7.6		
	1549:10	136	13.8	7.1	14.0	7.2			134	11.0	5.7	12.2	6.3		
	1549:20	135	12.9	6.6	14.2	7.3			132	11.2	5.8	11.8	6.1		
	1549:30	135	12.5	6.4	13.4	6.9			126	10.0	5.1	11.1	5.7		
	1549:40	134	12.6	6.5	13.4	6.9			133	9.9	5.1	11.2	5.8		
	1549:50	135	13.9	7.2	14.5	7.5			124	10.9	5.6	12.6	6.5		
T-0[c]	1550:00	135	14.0	7.2					115	9.0	4.6				

a. Peak wind observed within 20 min before launch.
b. Includes data from 1548:30 through 1549:30.
c. T-0 winds are instantaneous and taken at T-0.
d. Time period includes a 14 min gap in which no wind traces were available.

TABLE 5. SURFACE WINDS OBSERVED AT T-0 DURING LAUNCH OF ASTP/SA-210

Location	Altitude Above Natural Grade		Type	Wind				
				Speed		Direction	Peak	
	(ft)	(m)		(kn)	(m/s)	(deg)	(kn)	(m/s)
Pad 39B — LUT (top-NW)	457	139.3	a	14.0	7.2	135	-	-
Pad 39B — Pad Light Pole (SE)	60	18.3	a	9.0	4.6	115	-	-
150 m Met. Tower[d] (~ 2 1/4 miles W of Pad 39B)	32.8	10.0	b	11.0	5.7	110	17.0	8.7
O&C Building (~ 7 1/2 miles SSW of Pad 39B)	135	41.1	b	15.0	7.7	140	21.0	10.8
USAF PanAm. Station (~ 11 1/3 miles SSE of Pad 39B)	30	9.1	b	9.0	4.6	090	not given	
Wind Tower no. 415 (~ 5 1/2 miles NW of Pad 39B)	54	16.5	c	13.0	6.7	119	20.0	10.3
Wind Tower no. 311 (~ 2 1/4 miles SW of Pad 39B)	54	16.5	c	14.0	7.2	136	19.0	9.8
Wind Tower no. 308 (~ 5 1/2 miles S of Pad 39B)	54	16.5	c	11.0	5.7	126	16.0	8.2
Wind Tower no. 110 (~ 4 1/2 miles SSE of Pad 39B)	54	16.5	c	9.0	4.6	112	12.0	6.2

a. Instantaneous.
b. 1 min average about T-0.
c. 30 min average about T-0.
d. Also referred to as Wind Tower no. 313.

TABLE 6. MAXIMUM WIND SPEED IN HIGH DYNAMIC PRESSURE REGION FOR SATURN LAUNCH VEHICLES 201 THROUGH 210

Vehicle Number	Maximum Wind			Maximum Wind Components			
	Speed, m/s (kn)	Direction (deg)	Altitude, km (ft)	Pitch (W_x) m/s (kn)	Altitude, km (ft)	Yaw (W_z) m/s (kn)	Altitude, km (ft)
SA-201	70.0 (136.1)	250	13.75 (45 100)	57.3 (111.4)	13.75 (45 100)	-43.3 (-84.2)	13.25 (43 500)
SA-203	18.0 (35.0)	312	13.00 (42 600)	11.1 (21.6)	12.50 (41 000)	16.6 (32.3)	13.25 (43 500)
SA-202	16.0 (31.1)	231	12.00 (39 400)	10.7 (20.8)	12.50 (41 000)	-15.4 (-29.9)	10.25 (33 600)
SA-204	35.0 (68.0)	288	12.00 (39 400)	32.7 (63.6)	15.25 (50 000)	20.6 (40.0)	12.00 (39 400)
SA-205	15.6 (30.3)	309	14.60 (44 500)	15.8 (30.7)	12.08 (36 800)	15.7 (30.5)	15.78 (47 500)
SA-206	42.0 (81.7)	286	13.38 (43 881)	27.9 (54.2)	14.93 (48 966)	36.3 (70.6)	13.35 (43 799)
SA-207	13.2 (25.7)	014	13.83 (45 357)	-11.7 (-22.7)	12.43 (40 764)	9.6 (18.6)	8.60 (28 215)
SA-208	43.5 (84.5)	254	12.35 (40 518)	41.1 (79.8)	12.20 (40,026)	17.3 (33.6)	12.65 (41 502)
SA-210	13.0 (25.3)	038	11.88 (38 960)	-12.9 (-25.2)	11.88 (38 960)	7.6 (14.9)	11.08 (36 335)

TABLE 7. EXTREME WIND SHEAR VALUES IN THE HIGH DYNAMIC PRESSURE REGION FOR SATURN LAUNCH VEHICLES 201 THROUGH 210

Vehicle Number	Pitch Plane		Yaw Plane	
	Shear (m/s per 1000 m)	Altitude, km (ft)	Shear (m/s per 1000 m)	Altitude, km (ft)
SA-201	0.0206	16.00 (52 500)	0.0205	12.00 (39 400)
SA-203	0.0104	14.75 (48 400)	0.0079	14.25 (46 800)
SA-202	0.0083	13.50 (44 300)	0.0054	13.25 (43 500)
SA-204	0.0118	16.75 (55 000)	0.0116	14.00 (45 900)
SA-205	0.0113	15.78 (48 100)	0.0085	15.25 (46 500)
SA-206	0.0145	14.93 (48 966)	0.0141	14.38 (47 162)
SA-207	0.0063	10.15 (33 300)	0.0083	15.50 (50 852)
SA-208	0.0131	11.50 (37 729)	0.0078	13.53 (44 373)
SA-210	0.0085	9.88 (32 398)	0.0125	10.85 (35 597)

TABLE 8. SELECTED ATMOSPHERIC OBSERVATIONS FOR SATURN LAUNCH VEHICLES 201 THROUGH 210 AT KENNEDY SPACE CENTER, FLORIDA

Vehicle Number	Vehicle Data			Surface Data						Inflight Condition		
							Wind[a]			Maximum Wind in 8-16 km Layer		
	Date	Time Nearest Minute	Launch Complex	Pressure (N/cm^2)	Temperature (°C)	Relative Humidity Percent	Speed (m/s)	Dir (deg)	Clouds	Altitude (km)	Speed (m/s)	Dir (deg)
SA-201	26 Feb 66	1112 EST	34	10.217	16.1	48	6.5	330	Clear	13.75	70.0	250
SA-203	5 Jul 66	0953 EST	37B	10.166	30.2	69	6.3	242	1/10 Cumulus 1/10 Altocumulus 1/10 Cirrus	13.00	18.0	312
SA-202	25 Aug 66	1216 EST	34	10.173	30.0	70	4.1	160	8/10 Cumulus 1/10 Cirrus	12.00	16.0	231
SA-204	22 Jan 68	1748 EST	37B	10.186	16.1	93	4.2	45	3/10 Cumulus	12.00	35.0	288
SA-205	11 Oct 68	1103 EDT	34	10.180	28.3	65	10.2	90	3/10 Cumulonimbus	14.60	15.6	309
SA-206	25 May 73	0900 EDT	39B	10.105	26.1	85	5.5 6.1	212 224	5/10 Fractocumulus 5/10 Altocumulus 1/10 Cirrus	13.38	42.0	286
SA-207	28 Jul 73	0711 EDT	39B	10.162	23.9	93	2.6 6.9	264 274	9/10 Altocumulus 5/10 Cirrus	13.83	13.2	014
SA-208	16 Nov 73	0901 EST	39B	10.186	22.2	79	3.6 3.9	202 257	Clear	12.35	43.5	254
SA-210	15 Jul 75	1550 EDT	39B	10.200	28.9	70	4.6 7.2[b]	115 135[b]	2/10 Cumulonimbus 2/10 Altocumulus 4/10 Cirrus	11.88	13.0	038

a. Instantaneous readings from charts at T-0 (unless otherwise noted) from anemometers on launch pad light poles at the following levels: Pad 34 at 19.5 m (59.4 ft), Pad 37B at 20.7 m (63.1 ft), and Pad 39B at 18.3 m (60.0 ft). Beginning with SA-206, wind measurements were required at the 161.5 m (530 ft) level from anemometer charts on the LUT. These instantaneous LUT winds are given directly under the listed pad light pole winds. Heights of anemometers are above natural grade.

b. Beginning with SA-210, LUT wind measurements were taken at the 139.3 m (457 ft) level.

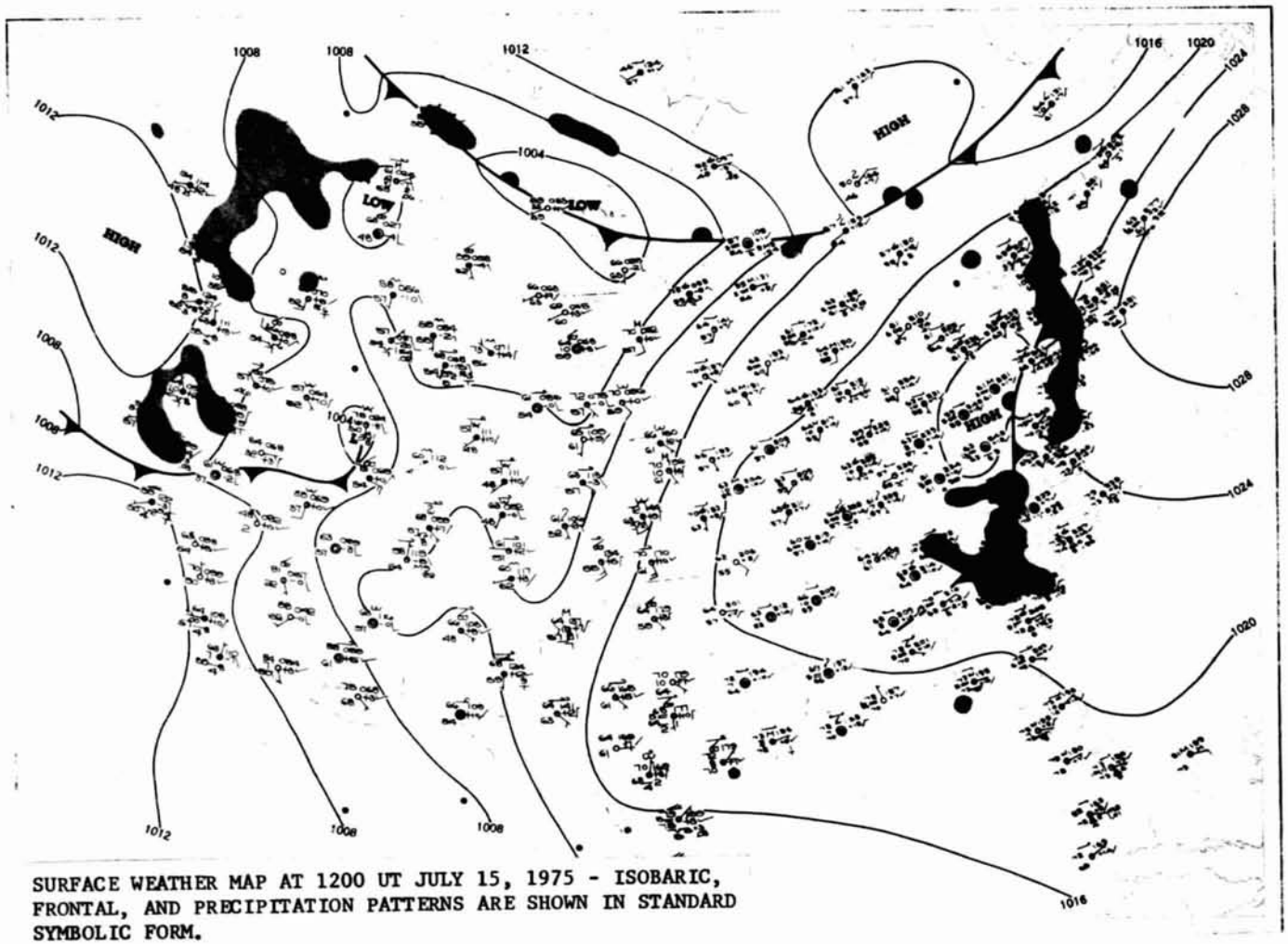
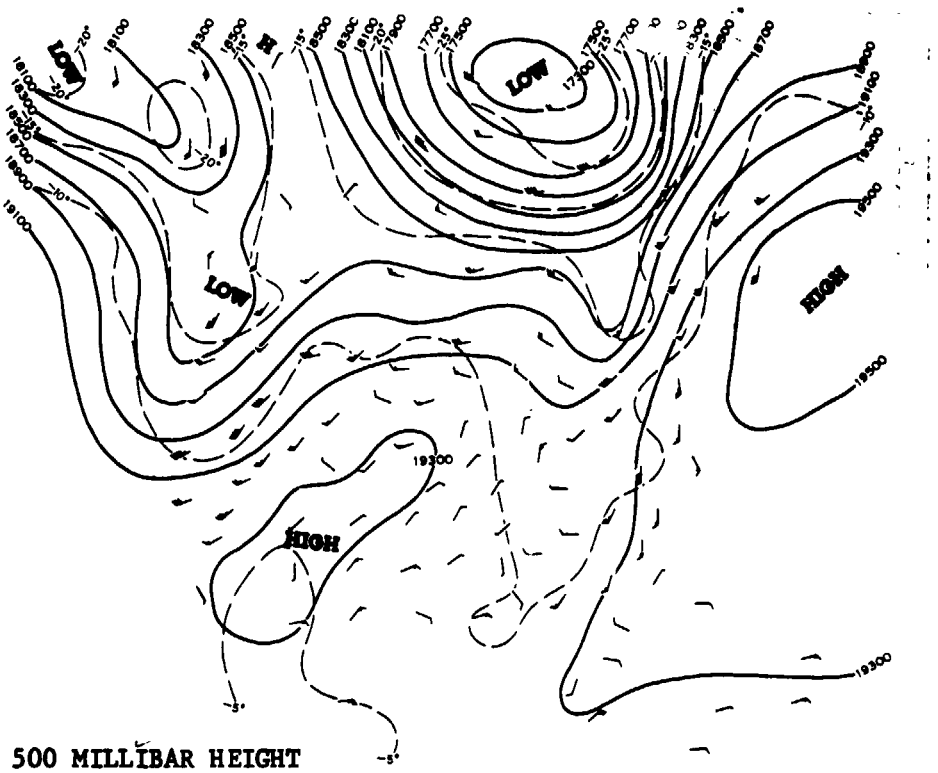


Figure 1. Surface weather map approximately 8 h before launch of SA-210/ ASTP.



500 MILLIBAR HEIGHT CONTOURS AT 1200 UT JULY 15, 1975.
CONTINUOUS LINES INDICATE HEIGHT CONTOURS IN FEET ABOVE SEA LEVEL. DASHED LINES ARE ISOTHERMS IN DEGREES CENTIGRADE. ARROWS SHOW WIND DIRECTION AND SPEED AT THE 500 MB LEVEL. (ARROWS SAME AS ON SURFACE MAP).

Figure 2. 500 mb map approximately 8 h before launch of SA-210/ASTP.

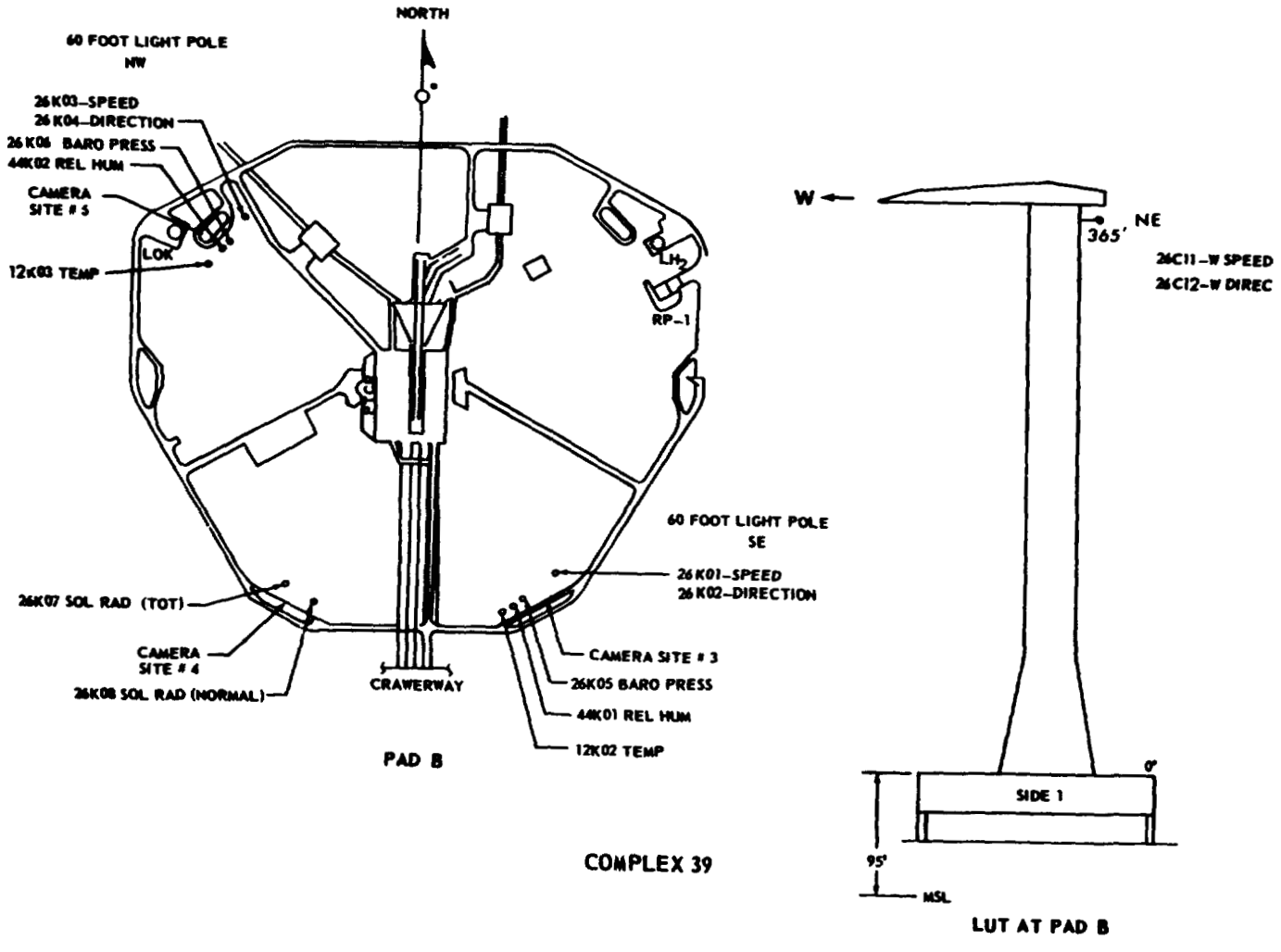


Figure 3. Wind instrumentation locations at Launch Complex 39B, Kennedy Space Center, Florida.

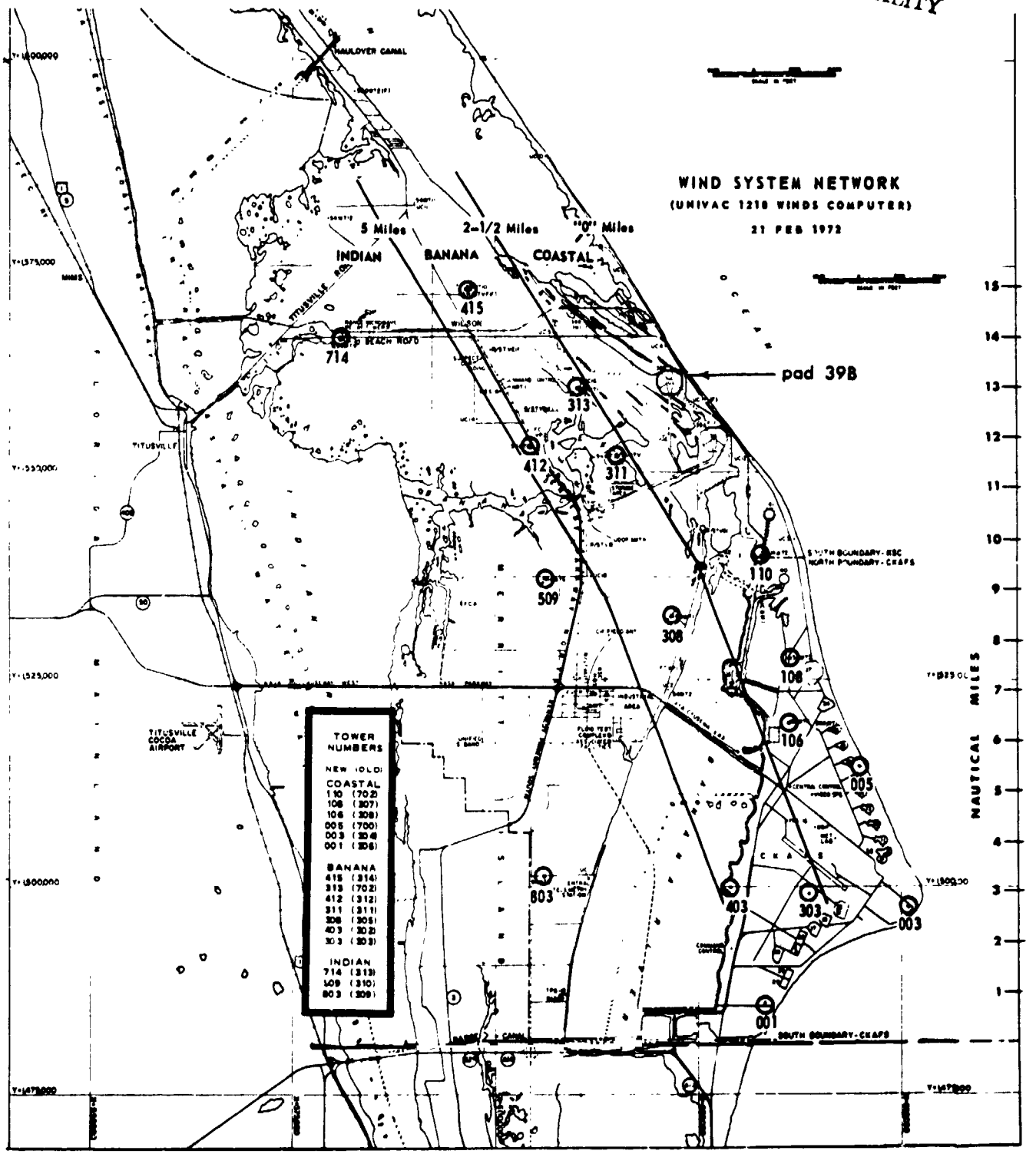


Figure 4. Cape Canaveral wind system network [3].

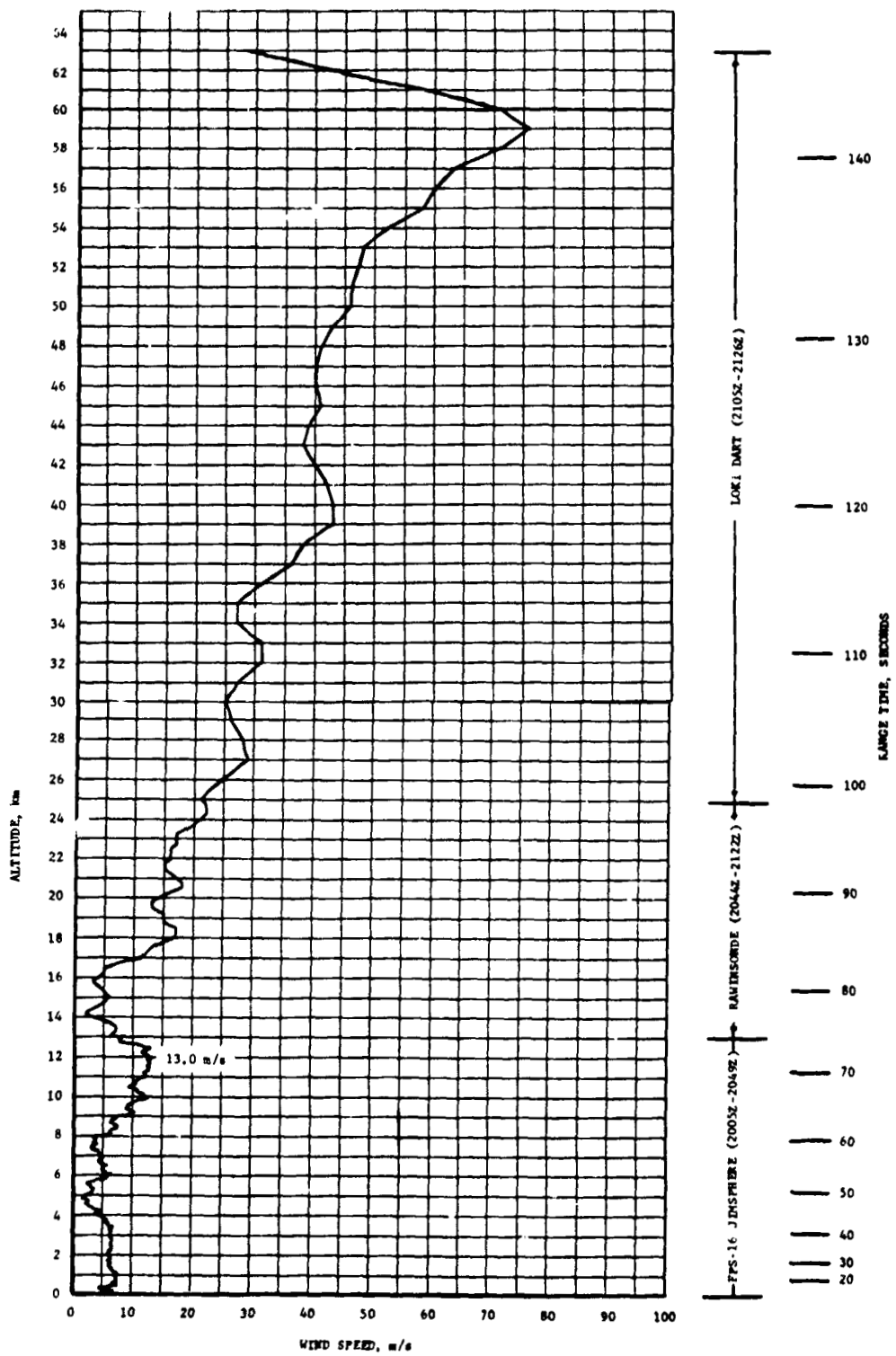


Figure 5. Scalar wind speed at launch time of SA-210/ASTP.

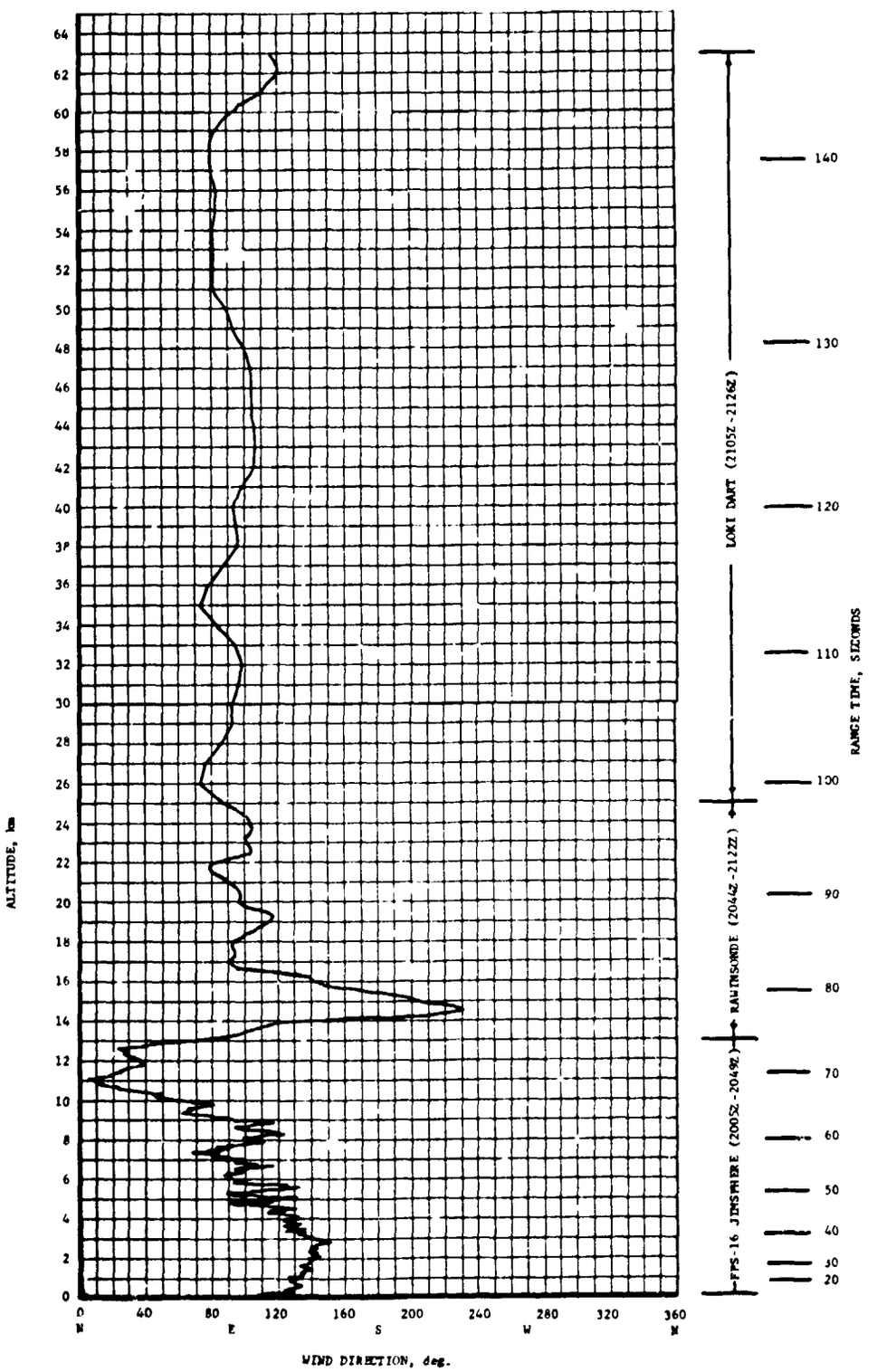


Figure 6. Wind direction at launch time of SA-210/ASTP.

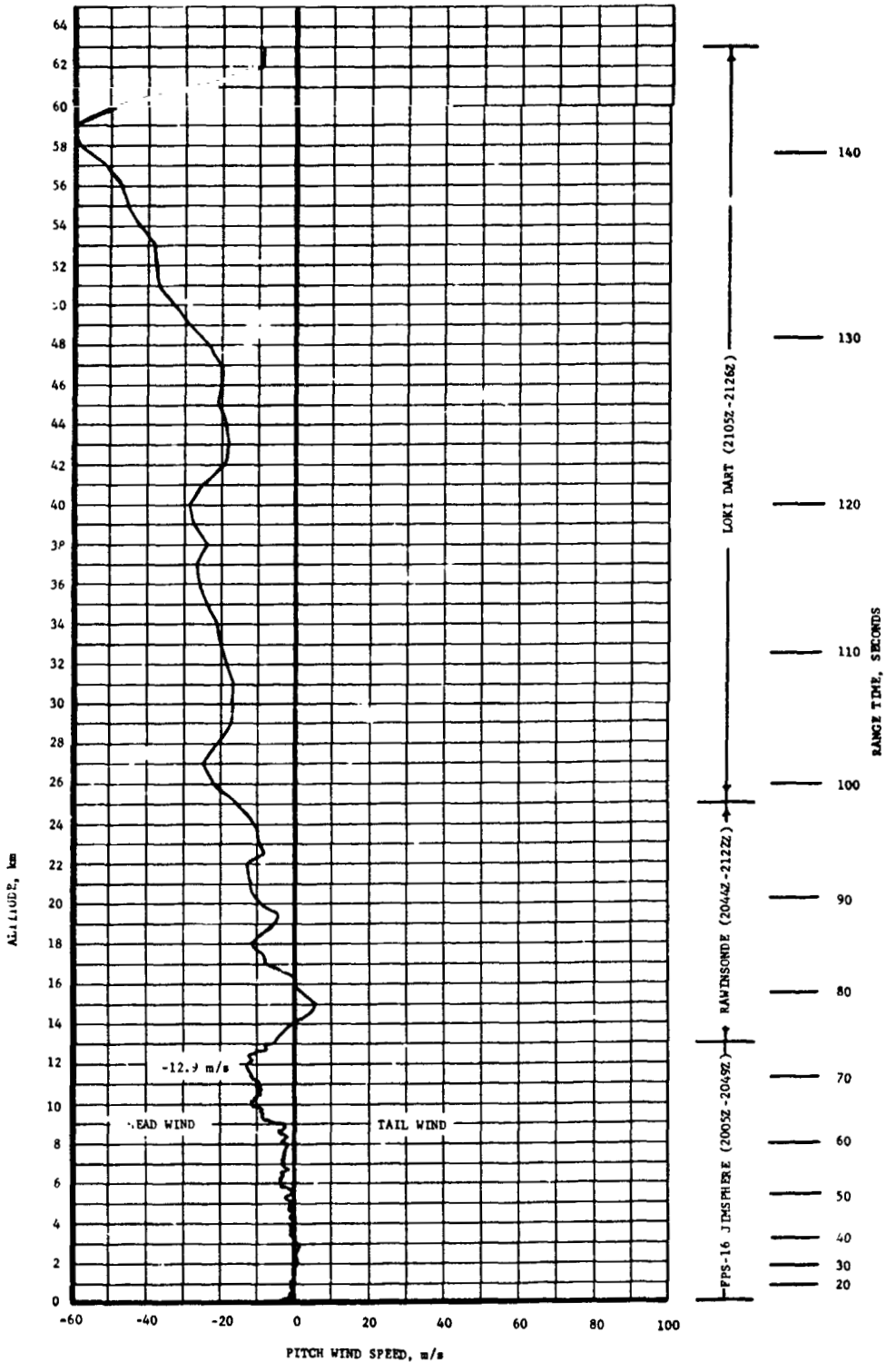


Figure 7. Pitch wind velocity component (W_x) at launch time of SA-210/ASTP.

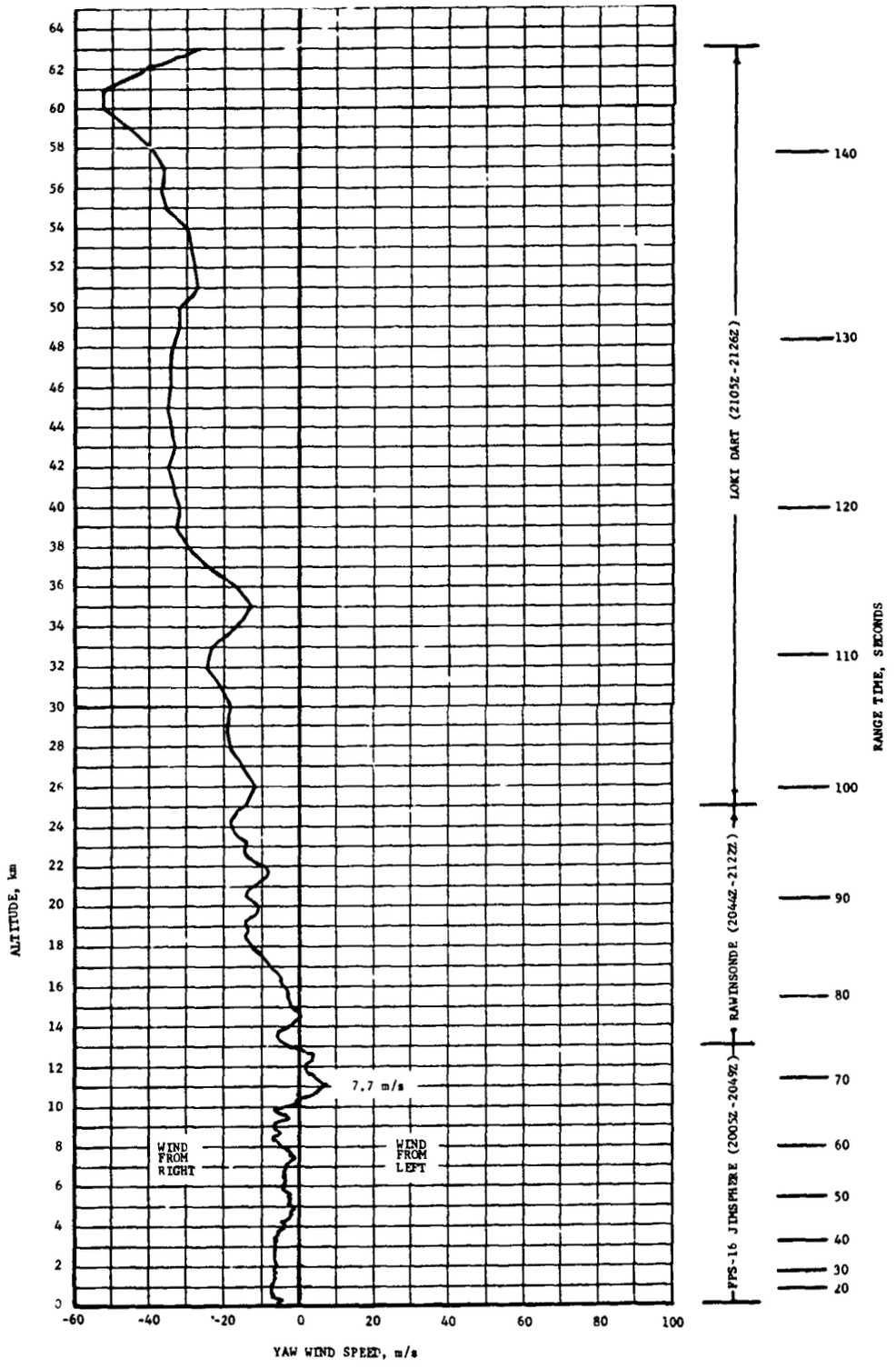


Figure 8. Yaw wind velocity component (W_z) at launch time of SA-210/ASTP.

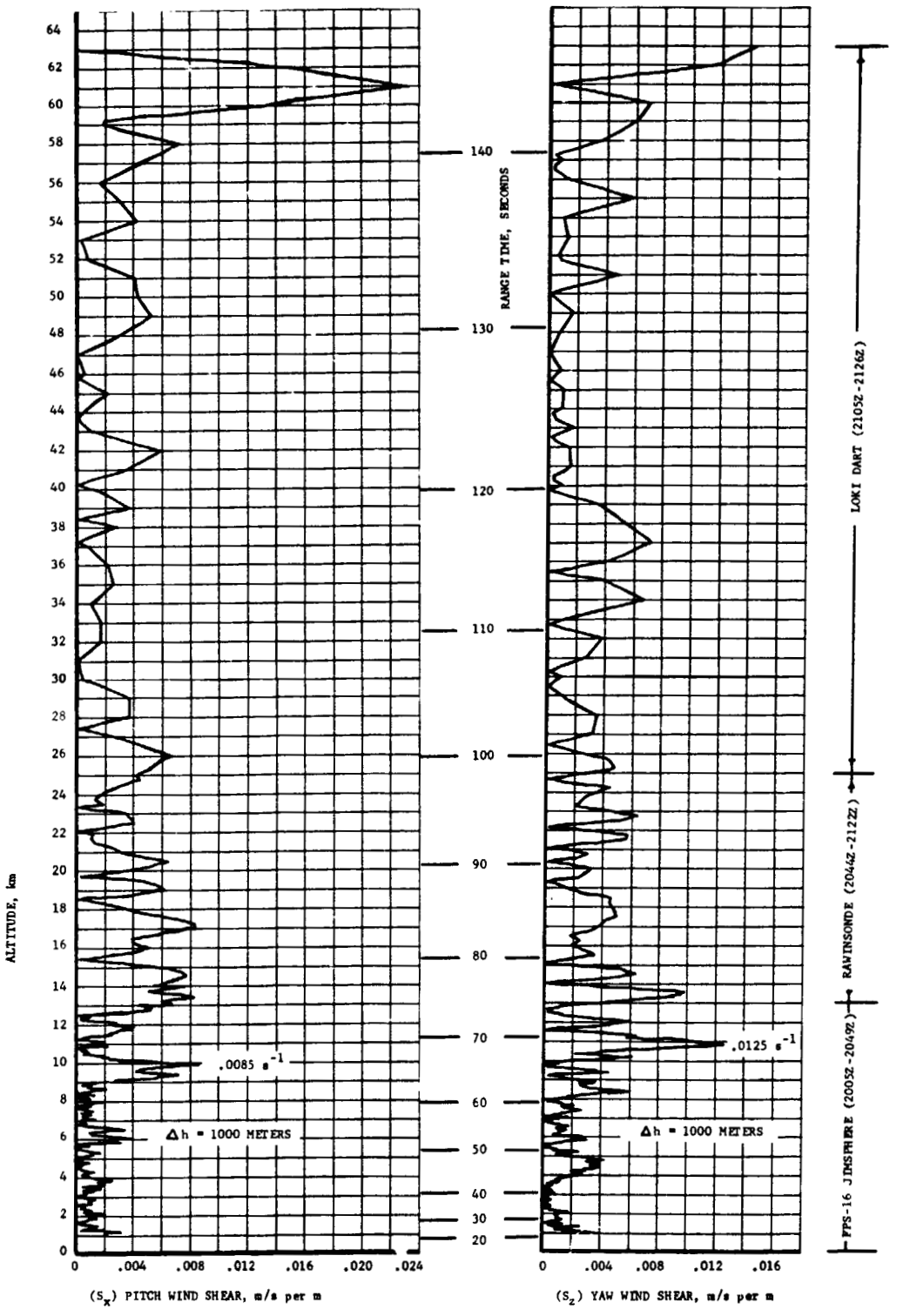


Figure 9. Pitch (S_x) and yaw (S_z) component wind shears at launch time of SA-210/ASTP.

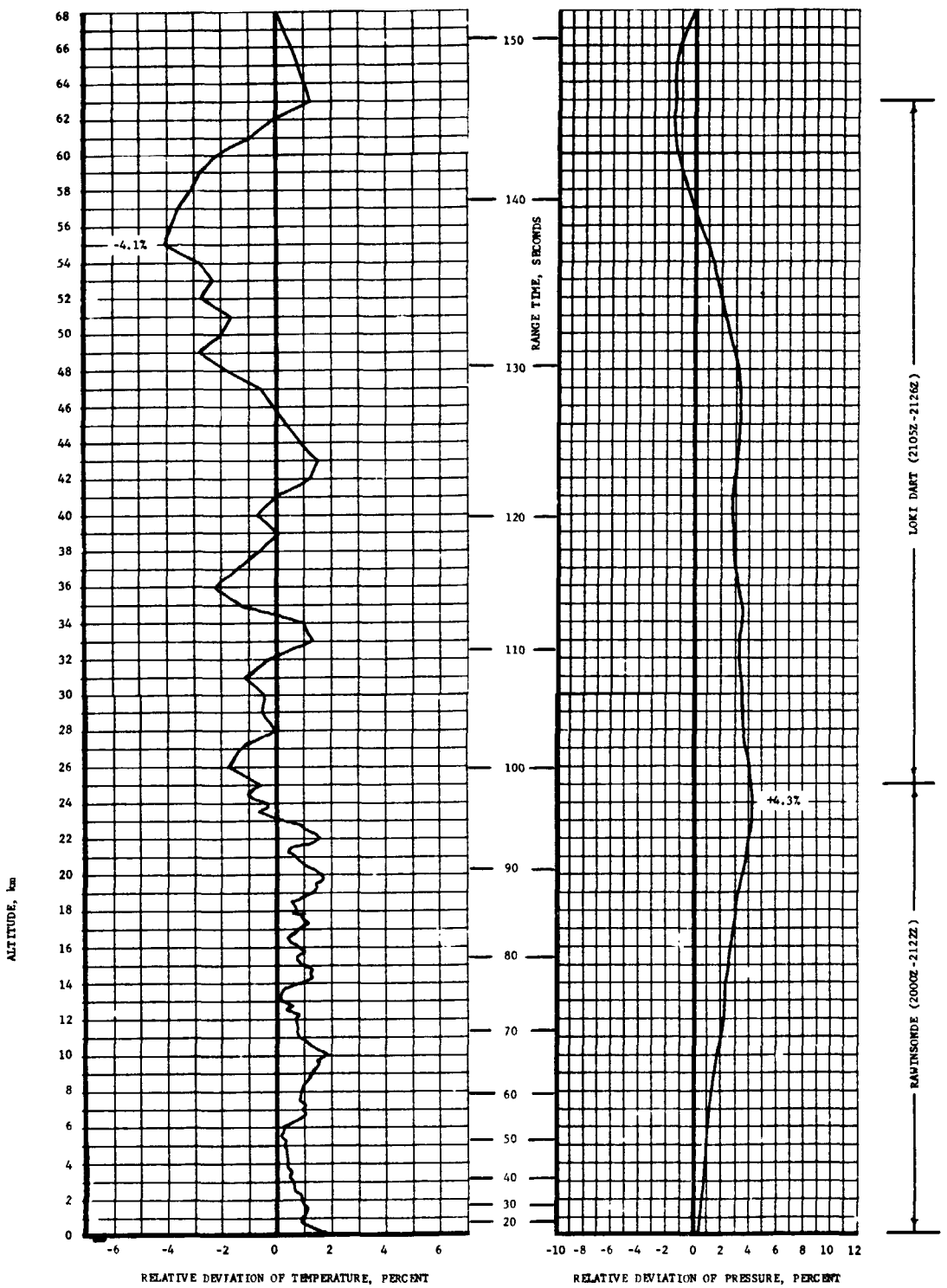


Figure 10. Relative deviation of temperature and pressure from the PRA-63 reference atmosphere, SA-210/ASTP.

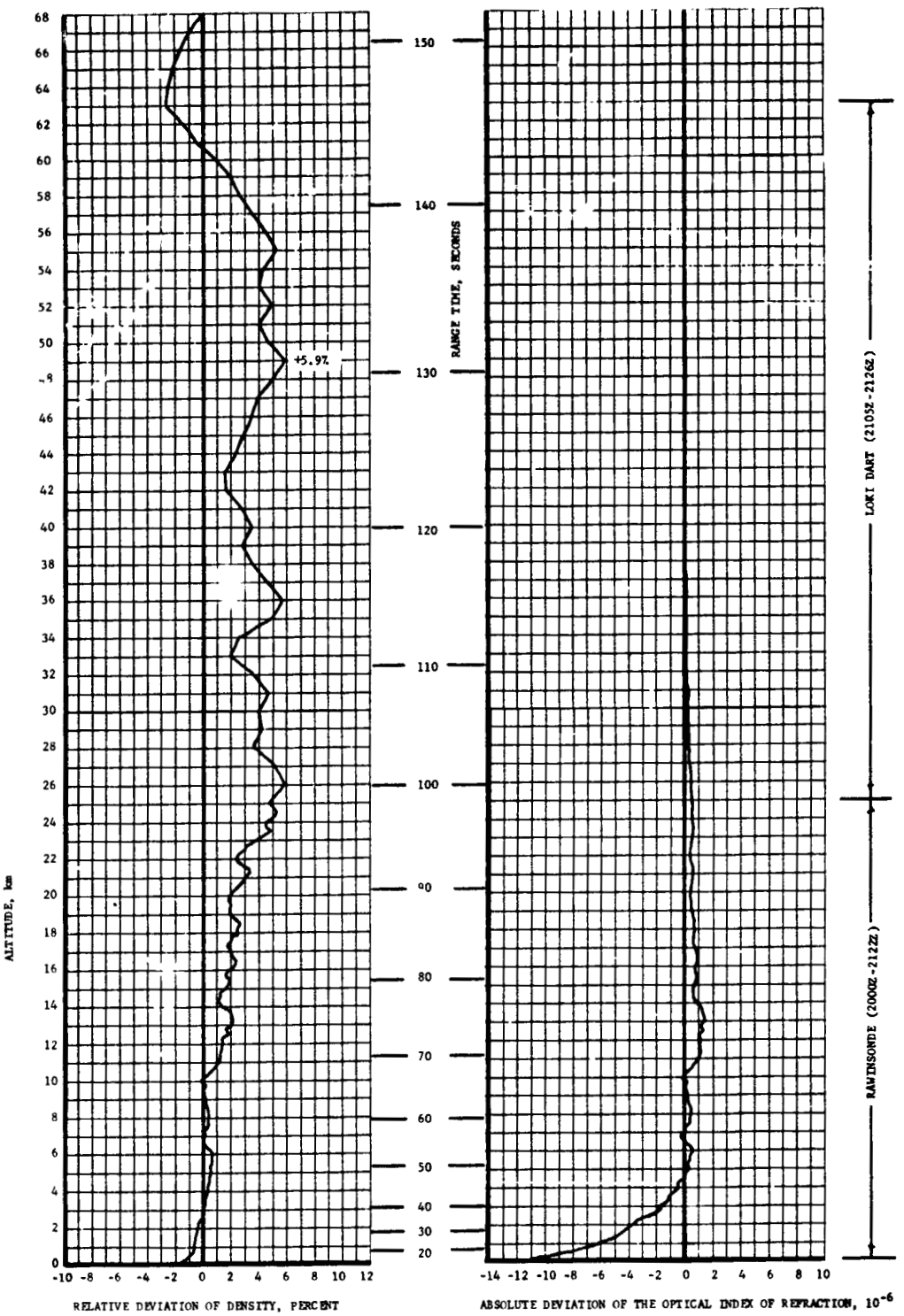


Figure 11. Relative deviation of density and absolute deviation of the index of refraction from the PRA-63 reference atmosphere, SA-210/ASTP.

REFERENCES

1. Saturn Flight Evaluation Working Group: Saturn Launch Vehicle Flight Evaluation Report — Appendix A — Atmosphere (A separate report is prepared for each Saturn Vehicle launch operation). George C. Marshall Space Flight Center, Alabama.

2. Johnson, D. L.: Summary of Atmospheric Data Observations for 155 Flights of MSFC/ABMA Related Aerospace Vehicles. NASA TM X-64796, December 5, 1973.

3. Meteorological Handbook. AFETR Pamphlet 105-1, Headquarters Air Force Eastern Test Range, Patrick AFB, Florida, Department of the Air Force, July 1973.

4. Smith, O. E. and Weidner, D. K.: A Reference Atmosphere for Patrick AFB, Florida, Annual (1963 Revision). NASA TM X-53139, September 23, 1964.

APPROVAL

ATMOSPHERIC ENVIRONMENT FOR ASTP (SA-210) LAUNCH

By D. L. Johnson

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

ORVEL E. SMITH
Chief, Terrestrial Environment Branch

WILLIAM W. VAUGHAN
Chief, Aerospace Environment Division

CHARLES A. LUNDQUIST
Director, Space Sciences Laboratory

☆ U.S. GOVERNMENT PRINTING OFFICE 1976--640-255/308 REGION NO.4