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ACCURACY VALIDATION OF THE MODIFIED NIKE HERCULES RADAR. (U)
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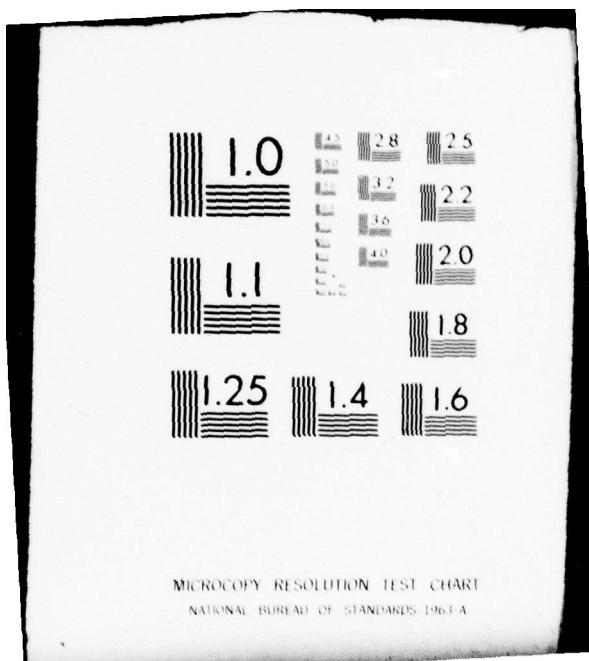
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ACCURACY VALIDATION OF THE MODIFIED NIKE HERCULES RADAR

MAY 1979

By

EDWARD M. D'ARCY



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US Army Electronics Research and Development Command
Atmospheric Sciences Laboratory

White Sands Missile Range, NM 88002

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INTRODUCTION

For many years the Atmospheric Sciences Laboratory (ASL) has been engaged in programs of testing and evaluating new meteorological instruments or techniques. These programs included the determination of the accuracy of the T-9 radar and the RD-65A and the desirability of using a jimsphere instead of a regular pibal. In testing any new system or instrument, one must have a standard to use for comparison, and the accuracy of this standard must be known before any valid conclusions can be made concerning the object of the test. The ASL has most often relied on the use of an FPS-16 or similar range radar as a standard for comparison. Independent tests¹ made by this laboratory have shown the FPS-16 to be a very accurate instrument, but two limitations--cost and availability--have prompted researchers to investigate the use of other instruments. The least powerful FPS-16 radar is a 1-megawatt radar that requires a two- or three-man operating team, use of range operations, and range scheduling personnel, all of which become very costly. Aside from cost, ASL is not the only agency or project vying for the use of range radars. The ASL must wait its turn if a specific test time or radar is required; otherwise, it must take what time is available. With control of its own inexpensive radar that could be available when a test was desired, ASL could complete projects in a more timely and cost effective manner. For these reasons, the author decided to establish the accuracy of the modified Nike Hercules radar so that it could be used as a standard of comparison in future tests. (NOTE: Column labeled FPS-16 is really MPS-36.)

DISCUSSION

During the week of 7-11 February 1977, 12 balloons were tracked simultaneously by a range radar and the Nike Hercules. Lock-on times vary among the runs because the range radars used were at several different locations. Some of the radars were below the horizon and had to wait until the balloon was high enough to be seen. Balloon tracking time was scheduled for 90 minutes, but premature balloon bursts caused the tracks to have variable termination times.

The range radars used were MPS-36s. These radars have the same stated accuracy as the FPS-16 (± 0.15 milliradian in azimuth and elevation and ± 3 yards range) but have twice the noise because of sequential instead of simultaneous readings of the azimuth and elevation error signals. Since the balloon does not experience any large accelerations, there should be little difference between the MPS-36 and an FPS-16.

¹E. M. D'Arcy, 1975, "Some Behavior Characteristics of the Rawinsonde and AN/FPS-16 Radar when used as Balloon Tracking Devices," ECOM-5555, Atmospheric Sciences Laboratory, US Army Electronics Command, White Sands Missile Range, NM

The data from both the Nike and range radars were processed by the same filtering and smoothing routines so that the two sets of data would be handled the same. The data were then averaged to obtain the 1-minute layer winds centered on the whole minute.

The data are displayed in two formats. The first set of tables (1-12) shows speed and direction versus time. The second set of tables (13-24) shows height and component winds versus time. Tables 25 and 26 show the mean, standard deviation, and variance of the parameters displayed in tables 1-24. Table 27 gives the same values for all runs taken together.

Average speed for the 12 runs varied from a low of 25 knots to a high of 64 knots with an average over the entire set of 34 knots. Of 850 one-minute intervals, the radar winds differed by more than 1 knot only two times. The mean speed difference varied from 0.03 to 0.08 knot with a composite mean of 0.05 knot and standard deviation of 0.24 knot. Azimuth errors were largest at low speeds and were very small at speeds over 10 knots. These errors varied between -0.63 and 0.002 degree with a mean of -0.1 degree and a standard deviation of 1.66 degrees.

The parameter exhibiting the largest amount of variability was height. For single flights, the mean altitude differences vary from -5.4 to +32.0 meters with a mean over the 12 runs of +3.5 meters and a standard deviation of 21.3 meters. Individual differences in the runs varied from -91 to 0 to +47.1 meters, a rather large individual variance. On the other hand, component wind speeds differed from 0 to only 0.07 knot with a mean for the 12 runs of 0 (N-S) and 0.041 (E-W) knots and a standard deviation of 0.27 (N-S) and 0.32 (E-W) knots. Standard deviations of individual runs varied between 0.14 and 0.77 knot.

CONCLUSIONS

Admittedly, 12 samples is not a large number, but one can make some valid conclusions. The individual runs and the composite statistics in table 27 indicate that the errors are random and normally distributed. Considering the range of values, the means for all composite parameters are effectively zero. The causes of the occasional large excursions in the height are not known; however, the excursions do not seem to affect the calculation of wind speed and direction.

Although the Nike Hercules radar is not of the same caliber as an FPS-16, it is quite qualified to be used as a standard of comparison when testing instruments such as the GMD or as a candidate to replace the GMD. The large standard deviation in altitude might prove to be a problem if very fine scale structure is to be investigated. This should not pose any problem when the Nike Hercules radar is used for mesoscale research where averaging times of 1 minute or more and layer thicknesses greater than 200 meters are desired. Possibly, the standard deviation could be reduced by careful peaking of the instrument before each flight; but even at its present stage, the Nike Hercules radar can prove to be a valuable tool.

TABLE 1

LAUNCH 1

7 February 1977

Time	Speed		Direction	
	Knots		Deg	
6	9.51	9.46	138.70	138.72
7	11.51	11.87	136.90	136.84
8	10.22	10.27	145.04	145.20
9	6.72	6.64	128.95	128.65
10	1.48	1.62	193.14	189.49
11	1.61	1.87	337.34	332.72
12	4.79	4.73	312.85	312.66
13	5.93	6.07	290.06	290.48
14	7.10	7.00	276.55	275.32
15	10.58	10.82	260.56	261.09
16	15.65	15.51	266.44	265.81
17	16.88	17.16	263.02	263.64
18	18.63	18.50	277.26	277.39
19	18.70	18.84	279.26	279.21
20	15.82	15.90	283.22	283.35
21	16.00	15.97	285.02	285.14
22	15.34	15.40	273.54	273.17
23	14.76	14.90	276.93	277.09
24	12.87	12.82	279.17	279.06
25	14.24	14.28	275.81	276.08
26	12.28	12.09	272.93	272.30
27	10.15	9.91	277.29	276.95
28	9.26	9.22	285.10	285.19
29	9.71	9.37	271.25	271.70
30	9.74	10.01	243.76	244.05
31	11.10	11.08	240.99	239.84
32	12.39	12.40	241.56	241.51
33	12.98	13.05	250.15	250.05
34	16.11	16.19	248.91	249.03
35	17.35	17.56	242.25	242.24
36	16.01	15.91	244.23	244.34
37	17.34	17.38	262.28	262.82
38	17.86	18.26	273.52	273.38
39	30.04	30.37	285.69	285.87
40	37.72	37.57	292.50	292.90
41	43.88	43.92	296.26	296.08
42	48.49	48.32	295.01	295.10
43	45.39	45.28	294.24	294.48
44	45.01	44.95	285.98	285.86
45	52.58	52.86	284.90	284.73
46	52.97	52.89	289.54	289.70

LAUNCH 1 (Cont'd)

7 February 1977

Time	Speed		Direction	
	Knots		Deg	
47	57.45	57.56	289.69	289.68
48	60.43	60.53	293.45	293.64
49	58.20	58.14	297.21	297.36
50	55.47	55.81	291.64	291.42
51	62.44	62.39	286.74	286.75
52	71.39	71.65	288.97	288.94
53	70.25	70.03	293.83	293.89
54	64.19	64.31	295.81	295.94
55	59.92	59.86	296.77	296.77
56	49.62	49.57	293.08	292.91
57	52.55	52.63	292.74	292.80
58	54.74	54.86	289.56	289.61
59	57.41	57.73	293.97	294.32
60	58.31	58.28	291.15	291.28
61	61.73	61.85	290.58	290.64
62	66.25	66.05	294.78	294.88
63	66.82	66.94	290.54	290.58
64	70.82	71.05	293.60	293.59
65	67.63	67.30	291.15	291.38
66	59.48	59.50	297.18	296.97
67	61.43	61.49	294.06	294.18
68	62.55	62.85	289.64	289.88
69	66.19	66.01	289.80	289.52
70	66.50	66.57	290.47	290.51
71	62.68	62.71	293.69	294.03
72	62.32	62.45	298.68	298.79
73	59.61	59.41	297.01	296.49
74	52.19	58.07	294.50	294.81
75	50.98	51.27	295.49	295.78
76	57.38	57.62	291.75	291.67
77	56.75	56.34	292.57	291.95
78	53.70	53.77	290.22	291.08
79	47.47	47.43	294.39	294.29
80	45.17	45.21	289.28	289.29
81	47.47	47.57	285.24	285.24
82	47.91	47.88	290.21	290.44
83	41.00	41.03	296.35	295.76
84	35.96	36.36	296.11	297.46
85	34.34	34.16	286.76	287.17
86	35.59	36.06	283.43	281.22
87	43.34	43.52	286.20	285.89

TABLE 2

LAUNCH 2

7 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
3	9.66	9.93	128.98	128.78
4	11.13	10.97	126.88	127.03
5	7.40	7.31	118.45	119.02
6	2.85	2.43	174.75	170.34
7	5.76	6.55	107.37	107.33
8	3.31	3.26	78.56	78.22
9	3.52	3.59	345.43	343.50
10	Missing Data			
11				
12	15.75	15.70	264.60	264.40
13	19.11	19.23	270.49	271.13
14	17.75	17.93	286.00	286.34
15	16.09	15.87	275.79	275.42
16	13.46	13.28	267.81	268.41
17	8.83	8.88	267.04	266.73
18	8.44	8.67	262.48	262.65
19	13.12	13.05	275.31	275.68
20	13.60	13.53	284.94	284.95
21	8.86	8.84	282.72	282.29
22	6.37	6.42	265.56	266.40
23	10.27	10.37	268.65	268.01
24	9.29	9.27	241.84	241.77
25	9.73	9.77	229.21	230.07
26	12.20	12.33	259.87	259.61
27	30.71	30.81	285.82	286.08
28	41.61	42.57	296.33	296.15
29	41.45	41.45	293.94	293.83
30	44.43	44.48	287.61	287.68
31	53.49	53.66	288.53	288.54
32	57.03	57.14	295.38	295.66
33	61.24	61.49	292.32	292.24
34	70.44	70.59	286.47	286.55
35	72.22	72.08	289.22	289.35
36	67.65	67.68	299.25	299.50
37	59.76	59.72	293.79	293.72
38	60.80	60.90	288.43	288.59
39	58.04	58.13	289.72	289.67
40	67.34	67.61	293.89	293.92
41	68.82	68.65	297.11	297.15

LAUNCH 2 (Cont'd)

7 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
42	64.20	64.30	297.61	297.65
43	66.21	66.32	290.01	290.07
44	71.99	72.22	288.70	288.77
45	69.85	69.66	293.88	293.91
46	61.56	61.81	293.15	293.36
47	62.75	62.89	291.67	291.68
48	63.77	63.79	290.97	290.88
49	66.95	66.91	291.67	291.65
50	65.37	65.19	291.02	290.98
51	61.88	62.05	292.31	292.47
52	50.25	49.96	299.57	299.97
53	43.46	43.33	299.39	299.33
54	36.68	36.87	292.81	292.75
55	41.87	41.82	282.79	283.27
56	36.24	35.96	301.30	301.41
57	20.58	20.37	304.78	304.59
58	20.55	20.97	284.15	284.11
59	20.20	19.95	286.17	285.57
60	25.17	25.38	259.83	260.41
61	28.69	28.84	276.61	276.71
62	21.69	21.53	282.86	282.95
63	22.87	22.76	290.60	292.87
64	22.39	22.36	315.67	315.47
65	14.51	14.15	316.18	315.69
66	12.17	11.64	352.32	351.00
67	6.70	6.83	286.83	290.22
68	7.57	7.76	257.78	255.75
69	8.90	9.24	274.52	273.70
70	10.44	10.41	270.49	268.90
71	13.12	12.94	265.13	265.07
72	13.64	13.46	255.14	258.35
73	22.27	22.89	248.61	247.85
74	24.42	24.21	261.66	262.64
75	32.82	33.17	256.47	255.60
76	35.07	35.27	263.18	263.82
77	36.98	36.99	278.44	278.62
78	36.35	36.15	284.01	284.24

TABLE 3

LAUNCH 1

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
3	5.05	5.07	43.02	44.55
4	3.73	3.74	40.71	40.57
5	2.63	2.68	263.72	263.00
6	8.08	8.44	321.20	321.33
7	7.37	7.17	13.28	15.05
8	10.17	10.27	31.35	30.36
9	11.23	11.24	35.87	36.27
10	11.51	11.49	41.64	42.16
11	11.85	12.01	30.84	30.33
12	6.13	6.13	34.78	35.30
13	7.31	7.38	16.13	15.14
14	12.74	12.79	39.45	38.86
15	17.12	17.25	48.39	48.28
16	16.10	15.99	41.23	42.04
17	12.61	12.94	45.92	45.35
18	8.04	7.82	28.53	29.35
19	20.96	21.14	284.49	284.57
20	36.05	36.17	289.41	289.26
21	47.00	47.07	292.27	292.27
22	55.02	55.10	292.02	291.96
23	59.75	59.96	287.30	287.20
24	63.66	63.62	282.32	282.17
25	63.96	64.03	284.07	284.20
26	63.59	64.01	285.95	285.89
27	60.72	60.86	280.37	280.26
28	57.99	58.25	284.10	284.16
29	69.13	69.24	279.77	279.63
30	79.37	79.53	282.04	282.03
31	63.29	63.24	276.87	276.65
32	68.42	68.60	274.23	274.15
33	72.88	72.67	283.71	283.70
34	60.09	60.23	284.17	284.19
35	52.06	51.94	271.94	272.04
36	44.40	44.58	276.03	276.04
37	48.03	47.80	263.14	263.34
38	54.37	54.65	265.29	265.29
39	58.15	58.22	258.60	258.72
40	48.13	48.21	270.11	270.11
41	30.80	30.84	273.50	273.30
42	23.57	23.55	274.10	273.04

LAUNCH 1 (Cont'd)

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
43	32.31	32.63	257.15	257.39
44	33.05	33.06	268.88	268.50
45	28.61	28.78	289.68	288.78
46	23.45	23.54	290.78	291.67
47	20.42	20.67	277.45	277.06
48	16.11	16.37	265.15	264.21
49	16.12	16.15	277.95	278.11
50	5.87	5.87	293.10	293.17
51	3.07	3.22	258.67	251.89
52	10.80	11.06	297.91	299.95
53	11.93	11.72	289.00	285.79
54	15.14	15.16	290.13	290.96
55	15.93	16.10	267.65	267.84
56	16.77	16.66	273.50	273.33
57	18.61	18.46	274.11	274.30
58	15.28	15.48	271.34	271.05
59	19.49	19.79	274.67	273.71
60	31.25	31.38	273.62	273.76
61	32.43	32.20	269.34	270.34

TABLE 4

LAUNCH 2

8 February 1977

Time	Speed		Direction	
	Knots		Deg	Nike
4	3.36	3.28	22.03	32.58
5	4.52	4.60	29.12	31.04
6	3.23	3.15	20.92	23.23
7	3.76	3.88	299.41	299.88
8	5.75	5.63	309.32	309.44
9	5.25	5.37	359.02	358.41
10	7.19	7.13	14.83	15.85
11	9.10	9.15	38.32	38.35
12	11.09	11.10	54.40	54.87
13	14.42	14.61	51.05	49.36
14	13.84	13.83	47.11	47.95
15	11.67	11.65	47.38	47.44
16	9.24	9.27	38.08	37.96
17	6.09	6.10	38.96	38.50
18	6.80	6.81	37.80	37.97
19	10.33	10.36	42.49	42.61
20	13.24	13.44	55.47	54.58
21	15.07	15.07	58.21	58.75
22	15.95	15.96	60.13	60.22
23	13.30	13.21	62.73	63.00
24	12.64	12.81	57.06	56.55
25	13.70	13.73	49.41	49.51
26	13.26	13.17	57.00	57.07
27	8.03	8.04	56.10	55.74
28	6.98	6.98	345.94	345.58
29	11.87	11.91	314.35	314.07
30	12.30	12.41	308.70	308.79
31	19.12	19.22	296.92	296.31
32	23.65	23.73	294.92	295.19
33	30.59	30.80	293.59	293.81
34	37.98	38.18	286.03	285.64
35	45.95	46.18	279.22	279.19
36	50.72	50.84	280.57	280.56
37	53.70	53.82	280.32	280.16
38	58.05	58.10	280.71	280.52
39	58.81	58.99	280.40	280.46
40	55.21	55.16	282.48	282.52
41	54.06	53.99	280.35	280.31

LAUNCH 2 (Cont'd)

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
42	56.96	57.23	275.15	274.91
43	64.37	64.71	274.37	274.31
44	73.51	73.58	276.99	276.96
45	73.57	73.79	279.16	279.19
46	72.51	72.64	284.18	284.24
47	67.77	67.77	278.61	278.40
48	68.72	68.84	276.92	277.04
49	56.97	56.64	265.87	265.68
50	63.83	63.93	270.98	271.22
51	58.02	58.14	284.79	284.72
52	53.57	53.86	279.48	279.36
53	49.76	49.46	269.11	269.24
54	46.34	46.10	262.01	261.59
55	39.59	39.88	257.30	257.48
56	40.03	39.91	261.61	261.33
57	49.52	49.71	257.88	257.89
58	50.26	50.53	265.85	265.72
59	43.02	43.06	271.47	270.71
60	44.62	44.43	267.91	268.13
61	49.11	49.44	267.96	268.04
62	40.89	40.90	270.16	269.56
63	32.71	32.48	258.76	258.99
64	28.18	28.46	255.21	255.06
65	25.22	25.34	261.28	261.11
66	35.83	36.07	260.19	259.97
67	41.64	41.54	260.93	260.44
68	37.14	37.22	282.59	282.05
69	27.14	27.27	287.95	287.89
70	19.97	20.08	286.91	286.14
71	21.00	21.00	291.69	292.47
72	16.96	16.98	270.23	270.95
73	20.92	21.05	260.58	261.25
74	21.72	21.46	261.74	261.35
75	19.17	19.22	257.58	256.97
76	23.08	23.05	275.29	275.54
77	15.79	16.22	290.12	288.84
78	14.28	13.94	301.87	302.00
79	7.26	7.37	268.32	270.64
80	14.12	14.30	239.12	238.35
81	14.45	14.52	317.57	316.81

LAUNCH 2 (Cont'd)

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
82	8.54	8.35	301.82	302.75
83	12.81	12.94	273.23	274.35
84	12.56	12.33	283.09	283.61
85	12.30	12.50	269.71	269.47
86	14.31	14.49	282.04	280.53
87	10.82	10.86	311.94	311.77
88	6.97	6.71	261.17	261.63
89	12.05	12.27	269.93	270.25
90	14.44	14.48	276.53	275.57
91	12.42	12.36	262.72	265.40
92	19.44	19.84	261.41	258.79
93	20.09	19.68	268.80	271.38

TABLE 5

LAUNCH 3

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
4	3.43	2.98	302.82	299.58
5	4.96	5.43	273.03	272.19
6	0.59	1.06	156.69	126.29
7	8.16	8.22	102.58	100.61
8	7.89	7.95	80.72	81.75
9	8.87	9.14	72.87	72.48
10	13.56	13.62	79.34	79.31
11	11.87	11.76	60.33	59.91
12	10.27	10.45	54.76	53.81
13	14.49	14.84	78.16	79.19
14	19.74	19.90	71.94	71.29
15	22.45	22.42	72.34	71.92
16	21.12	21.15	74.68	75.01
17	16.67	16.85	82.44	83.81
18	16.54	16.11	85.19	84.52
19	14.59	14.46	81.04	80.32
20	11.88	12.09	56.29	54.83
21	11.53	11.18	33.94	32.80
22	9.00	9.20	309.76	307.24
23	17.63	18.37	280.77	279.97
24	32.90	33.88	273.85	274.23
25	38.28	38.59	278.30	278.22
26	41.31	41.44	284.14	283.67
27	49.49	49.91	280.06	280.51
28	49.97	49.79	285.21	285.45
29	40.96	40.83	287.44	286.94
30	37.62	37.63	288.62	288.35
31	39.47	39.44	276.18	275.92
32	45.39	46.15	267.94	267.77
33	42.20	42.06	275.15	275.51
34	46.37	47.01	285.70	285.99
35	59.85	60.27	279.84	279.25
36	59.76	59.92	276.34	276.27
37	57.18	56.69	276.48	276.55
38	49.16	48.75	269.02	268.09
39	46.56	46.71	260.90	260.65
40	55.50	56.23	262.69	263.52
41	50.27	49.22	277.98	278.61
42	36.39	36.52	280.98	280.64
43	34.81	34.80	266.25	265.49
44	38.03	38.76	254.16	253.28

LAUNCH 3 (Cont'd)

8 February 1977

Time	Speed		Direction	
	Knots		Deg	
45	50.00	50.21	255.54	255.87
46	43.78	43.23	263.29	263.73
47	37.11	37.15	263.59	262.86
48	38.91	38.87	265.91	266.34
49	35.31	35.42	263.15	262.89
50	33.76	33.72	263.70	264.10
51	32.09	31.89	264.88	264.31
52	34.61	35.08	252.22	252.30
53	42.86	43.10	255.36	255.23
54	40.27	39.77	267.82	268.49
55	29.16	28.69	283.24	283.91
56	20.34	20.73	274.66	273.49
57	29.87	30.08	270.23	270.55
58	25.57	25.55	268.03	266.87
59	30.63	30.94	268.08	268.02
60	30.90	30.83	273.77	274.81
61	24.46	24.00	290.00	289.47
62	19.70	19.87	290.66	291.73
63	11.41	10.66	310.32	314.30
64	4.78	4.40	351.22	345.01
65	12.47	12.98	249.85	250.21
66	20.72	20.45	270.97	272.35
67	5.39	4.68	317.12	313.19
68	9.69	9.96	274.53	276.15
69	13.24	13.40	294.10	293.43
70	11.30	10.67	285.71	284.08
71	8.05	8.50	241.08	244.17
72	18.08	18.78	266.89	266.25
73	23.72	23.82	260.61	260.71
74	22.85	22.48	279.86	280.82
75	22.62	23.07	279.59	279.13
76	22.17	22.29	287.54	287.46
77	21.95	22.05	278.93	278.27
78	24.36	23.91	276.96	277.39
79	21.82	21.53	275.31	274.68

TABLE 6

LAUNCH 1

9 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
4	3.38	3.36	213.70	214.53
5	7.16	7.39	218.41	218.40
6	12.50	12.33	219.92	217.66
7	8.50	8.50	185.63	186.85
8	5.88	5.84	151.25	151.59
9	7.07	7.30	117.75	116.90
10	10.13	10.08	110.40	110.70
11	7.89	7.63	85.67	85.30
12	8.21	8.36	112.38	111.68
13	9.86	9.81	107.00	107.88
14	10.11	9.97	125.36	124.65
15	11.78	11.79	92.18	91.77
16	12.00	11.98	87.60	87.40
17	8.99	8.98	86.61	86.31
18	5.25	5.30	48.38	49.45
19	5.03	5.04	45.27	43.21
20	3.02	3.02	323.84	321.67
21	6.99	7.16	306.63	305.49
22	17.42	17.48	298.40	298.27
23	23.66	23.84	293.25	293.52
24	29.93	30.02	293.08	292.93
25	33.39	33.30	300.16	300.28
26	26.83	26.96	301.54	301.47
27	31.42	31.50	301.63	301.53
28	36.45	36.50	303.80	303.88
29	32.11	31.95	306.67	306.50
30	31.68	31.72	304.06	303.90
31	32.76	33.04	299.84	299.72
32	34.01	33.98	291.10	291.00
33	48.12	48.43	280.35	280.39
34	53.30	53.28	284.34	284.34
35	50.96	50.98	296.64	296.67
36	42.29	42.28	299.04	298.88
37	47.07	47.26	282.21	282.21
38	35.75	35.56	287.04	287.14
39	36.97	37.05	282.91	282.79
40	32.53	32.60	272.47	272.34
41	36.02	36.29	267.55	267.90
42	34.49	34.15	282.19	282.15
43	32.40	32.66	268.00	267.88
44	38.28	38.44	259.81	259.89
45	35.08	34.89	274.44	274.33

LAUNCH 1 (Cont'd)

9 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
46	27.79	27.71	275.65	275.93
47	27.69	27.49	284.54	284.60
48	24.25	24.49	283.75	284.01
49	38.68	38.62	290.80	290.66
50	25.53	26.40	297.25	296.86
51	21.58	21.17	297.67	297.57
52	20.08	20.05	302.38	302.47
53	15.84	15.96	310.40	310.34
54	14.67	14.80	288.27	288.00
55	15.38	15.40	284.88	284.93
56	14.24	14.47	259.32	259.19
57	12.50	12.08	285.69	285.49
58	8.96	9.02	292.75	293.30
59	10.97	11.26	262.09	262.70
60	1.35	1.31	238.02	237.86
61	8.13	7.90	257.57	256.88
62	11.96	12.05	271.51	270.74
63	7.30	7.46	346.58	345.73
64	4.97	5.04	266.06	268.95
65	8.41	8.50	253.66	252.42
66	8.66	8.66	273.43	272.31
67	15.98	16.02	272.67	273.72
68	16.53	16.67	278.33	278.20
69	19.45	19.77	270.40	270.13
70	33.62	34.01	266.20	266.08
71	36.66	36.49	266.52	266.29
72	37.10	37.24	270.91	270.55
73	42.65	42.68	269.38	269.41
74	34.71	34.54	283.54	283.23
75	49.01	49.66	281.28	281.39
76	45.33	45.08	280.05	279.60
77	49.80	49.75	262.91	263.19
78	47.23	46.99	261.41	261.20
79	51.02	51.28	262.24	262.31
80	58.95	59.27	273.41	273.38
81	56.11	56.31	250.30	249.85
82	53.66	53.38	259.80	259.75

TABLE 7

LAUNCH 2

9 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
3	9.33	9.36	171.43	171.68
4	8.22	8.16	174.14	174.64
5	6.24	6.26	189.31	190.56
6	8.27	8.37	226.80	226.94
7	9.50	9.62	207.74	206.72
8	7.77	7.85	172.16	171.24
9	11.62	11.63	151.89	151.99
10	7.53	7.59	150.28	150.40
11	5.81	5.86	144.09	142.69
12	5.27	5.16	145.13	147.94
13	3.94	4.01	141.63	140.64
14	3.60	3.63	138.54	137.27
15	4.27	4.29	116.28	117.00
16	0.61	0.56	152.89	166.89
17	2.03	1.96	230.11	229.59
18	9.01	9.17	278.74	278.94
19	16.51	16.66	285.96	286.06
20	18.63	18.78	285.02	285.22
21	21.78	21.87	287.54	287.38
22	22.16	22.31	294.69	294.69
23	24.94	24.90	299.24	299.29
24	27.96	28.07	288.91	288.76
25	30.98	31.13	291.29	291.28
26	31.84	31.86	283.58	283.59
27	32.44	32.58	283.64	283.58
28	35.68	35.63	284.41	284.48
29	37.72	38.01	285.80	285.72
30	42.32	42.23	284.46	284.43
31	43.95	44.14	278.42	278.38
32	48.16	48.21	281.11	281.11
33	53.57	53.66	296.11	296.26
34	59.29	59.40	301.51	301.47
35	59.32	59.52	306.21	306.34
36	56.66	56.60	306.05	306.27
37	53.90	54.12	303.65	303.57
38	51.56	51.41	303.46	303.45
39	43.22	43.36	297.91	297.86
40	40.92	40.94	284.02	283.82
41	36.91	36.60	279.29	279.27
42	28.74	28.80	282.25	282.41
43	37.32	37.71	267.01	266.90

LAUNCH 2 (Cont'd)

9 February 1977

Time	Speed		Direction	
	Knots		Deg	
44	49.79	49.94	273.02	272.94
45	56.46	56.52	278.73	278.74
46	49.20	49.30	280.29	280.40
47	49.88	49.99	281.94	281.66
48	48.73	48.63	285.42	285.31
49	45.79	45.66	280.52	280.49
50	44.95	45.13	279.44	278.92
51	39.80	39.71	280.23	280.25
52	42.98	43.18	272.16	272.45
53	44.23	44.24	267.30	266.83
54	46.82	47.17	273.34	273.38
55	46.24	46.08	279.31	279.04
56	39.49	39.18	284.44	284.56
57	31.71	31.78	294.47	294.20
58	34.79	34.79	298.02	298.04
59	29.47	29.66	293.45	293.16
60	24.48	24.43	288.70	289.07
61	25.04	24.91	285.69	285.72
62	29.82	29.80	284.89	284.59
63	28.93	29.00	288.85	288.69
64	22.42	22.76	288.68	289.50
65	19.46	19.27	270.06	269.11
66	20.10	20.26	267.83	267.55
67	14.74	14.81	289.30	289.78
68	13.78	13.68	287.02	286.24
69	13.19	13.12	268.37	270.21
70	18.18	18.38	259.35	258.09
71	17.34	17.55	258.38	258.42
72	21.13	21.07	270.79	271.39
73	18.62	18.65	283.14	282.15
74	18.33	18.30	295.38	294.84
75	14.63	14.56	304.51	304.96
76	14.19	14.28	292.90	292.00
77	9.91	9.63	290.89	289.61
78	16.82	16.96	283.78	286.12
79	12.09	12.24	270.12	270.46
80	9.83	9.61	231.47	232.67
81	15.45	15.66	259.86	256.86
82	10.92	11.17	298.23	299.10
83	11.45	11.68	318.86	320.09

TABLE 8

LAUNCH 1

10 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
4	13.97	13.65	222.77	224.06
5	15.52	15.63	231.46	231.06
6	22.61	22.73	211.76	211.03
7	24.96	25.13	210.25	210.86
8	27.01	27.01	205.27	205.23
9	25.24	25.22	201.59	201.61
10	21.17	21.34	204.94	205.41
11	24.32	24.16	215.28	215.71
12	23.04	23.17	218.16	218.01
13	24.48	24.36	222.41	222.55
14	30.78	31.26	224.45	224.61
15	36.92	37.11	229.29	229.37
16	47.71	47.94	227.56	227.38
17	49.24	49.25	223.80	223.81
18	53.36	53.79	233.44	233.72
19	71.72	72.08	235.99	236.09
20	75.20	75.26	234.91	234.85
21	76.75	77.01	235.19	235.25
22	80.05	79.88	237.03	237.12
23	78.16	78.36	239.10	239.17
24	74.67	74.70	244.58	244.68
25	82.48	82.47	248.22	248.31
26	81.79	81.85	248.55	248.43
27	83.22	83.39	247.12	247.14
28	83.32	83.39	246.27	246.23
29	85.96	86.21	246.25	246.21
30	86.15	86.18	246.41	246.36
31	86.91	87.10	243.46	243.58
32	86.08	85.96	241.95	241.91
33	85.69	85.49	241.91	241.85
34	83.46	83.44	241.10	240.91
35	82.27	82.54	242.85	242.91
36	82.93	83.08	241.66	241.76
37	81.84	81.73	238.99	239.10
38	82.72	82.70	235.64	235.72
39	85.04	85.62	239.65	239.58
40	90.77	90.36	247.20	247.41
41	82.37	82.29	253.66	253.58
42	74.72	74.43	253.27	253.36
43	63.13	63.06	252.95	252.97
44	60.48	60.66	246.54	246.32

LAUNCH 1 (Cont'd)

10 February 1977

Time	Speed		Direction	
	Knots		Deg	
45	62.94	62.95	243.54	243.50
46	58.84	58.81	251.58	251.67
47	50.98	50.79	266.79	267.52
48	40.49	40.17	264.73	264.20
49	41.54	42.07	265.77	267.01
50	42.49	42.03	266.12	264.49
51	38.42	38.68	266.92	267.65
52	33.55	33.27	271.20	270.94
53	35.15	35.16	279.09	278.73
54	40.89	41.23	279.23	279.76
55	39.97	39.71	283.74	284.04
56	38.63	38.96	272.55	272.81
57	36.94	37.00	268.58	267.77
58	35.60	35.64	268.05	268.35
59	35.39	35.06	271.94	271.91
60	31.34	31.90	269.86	271.22
61	33.21	32.73	287.03	286.88
62	26.90	26.61	305.35	305.60
63	19.09	19.04	303.49	302.58
64	24.84	25.05	289.98	289.36
65	33.65	33.34	292.36	292.32
66	28.97	28.85	285.51	285.08
67	24.73	24.84	299.99	301.38
68	3.02	2.49	319.11	321.47
69	4.37	4.72	289.79	289.43
70	14.02	14.11	279.31	275.63
71	21.13	21.63	280.62	283.60
72	17.05	16.80	301.61	302.20
73	8.31	8.52	290.52	289.10
74	11.22	11.13	297.37	295.68
75	13.44	13.28	317.38	318.74
76	6.79	6.95	297.61	297.77
77	0.82	0.78	269.69	247.10
78	11.52	11.08	206.03	209.03
79	8.30	7.92	251.85	245.50
80	8.08	8.43	275.12	275.68
81	7.69	8.20	285.44	286.16
82	12.92	12.60	299.18	300.00
83	10.61	10.82	280.51	276.71
84	9.60	9.42	266.09	266.88
85	13.22	13.31	244.38	242.01
86	8.16	8.49	282.22	283.05
87	8.55	8.49	278.73	278.63
88	10.53	10.61	268.79	270.93

TABLE 9
LAUNCH 2
10 February 1977

Time	Speed		Direction	
	Knots		Deg	
6	16.63	16.68	230.76	230.55
7	22.99	23.08	210.41	210.54
8	20.72	20.74	201.65	201.44
9	18.93	18.96	195.98	196.13
10	19.03	19.07	196.81	196.71
11	25.22	25.34	186.44	186.30
12	27.79	27.82	197.98	198.37
13	26.85	26.73	216.85	216.79
14	36.66	37.63	225.16	225.52
15	40.27	39.91	223.08	222.86
16	47.44	47.79	229.68	229.79
17	57.15	57.18	234.63	234.67
18	63.51	63.43	234.37	234.35
19	62.05	62.22	234.98	235.02
20	66.44	66.38	242.21	242.22
21	75.80	75.81	246.38	246.38
22	81.46	81.81	245.81	245.79
23	80.43	80.40	243.47	243.52
24	81.56	81.62	239.06	239.17
25	85.00	85.13	233.69	233.78
26	83.33	83.38	233.65	233.59
27	84.92	85.10	234.56	234.61
28	86.41	86.42	235.19	235.18
29	86.86	86.75	236.01	235.92
30	85.59	85.73	235.69	235.80
31	88.10	87.98	235.74	235.89
32	84.21	84.23	233.07	232.91
33	84.09	84.21	229.44	229.46
34	84.10	84.17	228.39	228.32
35	85.15	85.34	225.25	225.38
36	88.59	88.73	230.01	230.01
37	90.73	90.39	233.93	233.88
38	90.01	90.31	236.29	236.23
39	90.47	90.49	236.61	236.70

TABLE 10

LAUNCH 3

10 February 1977

Time	Speed		Direction	
	Knots		Deg	
7	13.20	13.38	233.40	234.10
8	16.48	16.16	232.48	231.89
9	18.67	18.71	233.43	233.14
10	23.26	23.20	232.53	233.08
11	22.51	22.57	238.78	238.78
12	32.81	32.74	236.91	236.55
13	36.20	35.83	241.94	241.96
14	39.97	39.93	235.47	235.90
15	41.95	41.85	231.22	231.12
16	43.99	43.99	235.55	235.39
17	53.76	53.50	238.69	238.68
18	62.89	62.76	234.39	234.50
19	66.65	66.38	234.96	234.90
20	73.93	74.00	238.06	238.03
21	75.87	75.91	241.92	242.01
22	83.08	82.78	239.21	239.20
23	91.68	91.63	235.98	236.09
24	92.60	92.98	231.22	231.35
25	91.85	91.89	232.80	232.71
26	86.10	86.37	234.91	234.74
27	78.38	78.64	233.91	234.18
28	71.03	71.43	230.67	230.70
29	71.13	70.96	229.05	229.11
30	71.77	72.06	234.28	234.07
31	66.98	67.40	238.13	237.98
32	55.46	55.55	240.47	240.27
33	50.27	50.50	244.25	244.52
34	41.51	42.02	252.81	251.56
35	31.73	31.77	265.54	266.05
36	39.88	39.69	254.40	254.36
37	43.89	43.49	254.01	254.40
38	40.41	41.15	262.85	262.87
39	38.80	38.75	262.90	262.50
40	30.36	30.26	267.40	267.50
41	35.17	35.15	269.91	269.69
42	34.18	34.28	272.66	272.66
43	39.67	39.39	275.23	274.80
44	34.98	35.23	272.73	272.98

LAUNCH 3 (Cont'd)

10 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
45	32.52	32.72	276.18	276.50
46	35.65	35.62	276.59	276.40
47	31.48	31.90	290.27	289.86
48	22.02	22.19	288.22	288.39
49	29.14	28.58	295.60	295.12
50	23.10	23.44	292.04	293.14
51	22.37	22.63	269.32	269.04
52	14.90	14.62	282.81	280.71
53	25.40	24.99	271.59	272.45
54	23.87	24.31	287.67	286.30
55	17.85	18.10	279.96	281.28
56	14.86	15.12	284.03	284.22
57	10.80	10.84	278.20	279.19

TABLE 11

LAUNCH 2

11 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
8	35.29	35.43	340.92	340.95
9	40.17	40.21	342.95	343.12
10	34.94	35.05	348.50	348.45
11	37.62	37.61	344.67	344.93
12	41.13	41.09	340.20	340.00
13	37.72	37.90	340.25	340.28
14	37.42	37.12	337.73	337.82
15	34.11	34.29	336.44	336.45
16	32.42	32.45	334.08	334.25
17	29.93	29.95	337.80	337.75
18	33.07	33.11	334.75	334.64
19	33.46	33.32	329.65	329.82
20	32.97	33.27	318.39	318.69
21	36.63	36.55	308.46	308.19
22	35.10	35.16	312.54	312.78
23	33.33	33.32	321.90	321.72
24	36.38	36.41	309.64	309.58
25	37.75	37.78	291.31	291.37
26	39.66	39.97	284.35	283.92
27	41.09	41.25	277.25	277.64
28	49.31	49.60	275.18	274.87
29	50.62	50.53	269.44	269.40
30	55.69	55.78	262.77	262.89
31	71.01	70.92	262.45	262.73
32	73.97	74.22	265.12	264.95
33	76.85	76.92	270.48	270.59
34	68.85	68.85	271.63	271.70
35	57.55	57.48	273.83	273.49
36	63.04	63.27	251.96	252.03
37	79.26	79.46	253.90	254.09
38	74.34	74.17	274.97	275.18
39	56.75	56.75	276.22	275.61
40	50.37	50.01	268.60	268.87
41	49.12	49.31	272.17	272.19
42	45.52	45.55	269.12	268.93
43	44.68	44.69	262.14	262.37
44	47.05	46.97	257.77	258.07

LAUNCH 2 (cont'd)

11 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
45	46.16	46.08	260.52	260.91
46	44.74	44.64	270.80	271.01
47	36.37	36.56	265.92	265.85
48	40.43	42.06	278.06	272.44
49	36.46	36.38	287.09	287.70
50	25.21	25.42	272.58	271.80
51	20.27	20.02	254.27	254.61
52	21.64	22.22	240.61	239.99
53	37.06	37.31	251.56	251.80
54	33.07	32.97	268.06	268.47
55	27.76	27.75	271.00	271.13
56	24.33	24.14	277.17	276.63
57	19.04	19.02	291.53	291.73
58	19.32	19.19	303.50	302.88
59	7.46	7.55	277.42	279.45
60	12.59	12.71	225.29	224.68
61	13.48	12.95	240.50	242.51
62	11.10	11.11	251.82	250.31
63	6.85	7.12	214.84	216.07
64	17.11	17.21	251.71	252.33
65	11.16	11.08	239.52	239.56
66	12.53	13.03	248.44	247.42
67	17.79	17.91	276.74	276.37
68	14.98	14.83	308.08	308.56
69	11.69	11.48	291.06	292.62
70	15.11	15.32	262.28	261.45
71	15.60	15.76	251.17	250.88
72	23.03	23.44	250.80	251.56
73	27.69	27.48	267.48	265.99
74	34.74	34.95	267.38	268.43
75	35.85	35.69	275.43	275.04
76	25.69	25.72	273.47	274.88

TABLE 12

LAUNCH 3

11 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
2	17.66	17.95	295.12	294.77
3	21.41	21.49	286.27	286.57
4	24.41	24.37	307.85	307.94
5	21.57	21.79	322.80	323.05
6	25.43	25.51	332.92	332.97
7	30.91	31.17	333.16	333.16
8	30.66	30.37	323.47	323.59
9	26.17	26.27	328.40	328.17
10	29.13	29.38	322.20	322.23
11	30.74	30.59	326.84	326.92
12	28.66	28.81	319.24	319.13
13	25.57	25.54	312.23	312.35
14	30.43	30.19	319.36	319.31
15	30.81	30.82	308.70	308.75
16	26.93	27.35	294.52	294.40
17	28.72	28.74	294.44	294.97
18	23.23	22.95	288.88	288.59
19	19.95	20.04	285.99	286.24
20	22.35	22.39	280.41	280.20
21	22.39	22.49	274.15	274.07
22	26.62	26.89	272.05	271.49
23	31.66	31.63	266.66	266.83
24	36.68	36.90	272.35	272.11
25	40.45	40.41	281.86	281.98
26	45.49	45.79	261.04	260.86
27	60.24	60.36	254.68	254.60
28	63.52	63.61	254.23	254.36
29	68.80	68.85	260.07	260.24
30	61.42	61.09	257.18	257.15
31	68.90	69.47	243.70	243.53
32	87.26	87.73	243.87	243.90
33	85.91	86.08	256.38	256.63
34	65.09	64.70	266.95	267.07
35	47.43	47.36	274.21	274.36
36	45.97	46.04	285.84	285.68
37	38.95	38.73	277.10	277.15
38	45.43	45.87	255.18	255.10
39	53.96	53.93	257.25	257.69
40	57.37	57.24	266.27	266.19
41	54.30	54.51	265.29	265.43
42	46.87	46.59	268.80	268.46
43	48.57	48.62	265.12	265.11
44	49.90	50.00	271.26	271.57

LAUNCH 3 (Cont'd)

11 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
45	40.32	40.24	273.56	272.90
46	25.06	24.96	269.59	269.99
47	30.32	30.45	251.23	250.62
48	38.41	38.51	239.97	240.50
49	39.07	38.92	247.76	247.44
50	31.40	31.49	254.81	255.13
51	29.95	30.03	256.79	256.34
52	25.71	25.95	267.78	267.32
53	26.42	26.17	269.99	270.51
54	16.50	16.60	263.50	263.83
55	7.64	7.91	208.10	207.47
56	10.74	10.87	260.17	257.49
57	12.38	12.20	270.81	272.53
58	19.39	19.49	255.30	255.59
59	23.23	23.36	266.05	266.13
60	11.19	11.03	233.21	231.95
61	16.86	17.30	271.71	272.72
62	16.09	15.46	311.68	310.98
63	13.18	13.16	279.22	281.43
64	12.00	12.31	290.73	291.07
65	6.08	5.77	245.54	241.93
66	8.15	8.35	232.91	233.29
67	14.80	15.33	255.21	253.70
68	25.50	25.42	249.20	250.45
69	26.31	26.10	257.89	258.35
70	24.47	24.81	272.05	271.94
71	25.76	25.55	279.94	279.88
72	31.69	31.73	274.63	274.33
73	32.61	32.93	262.31	262.58
74	42.04	42.44	254.32	254.03

TABLE 13

LAUNCH 1

7 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
6	2379.5	2360.2	7.11	7.14	-6.24	-6.27
7	2538.2	2520.2	8.66	8.41	-8.12	-7.87
8	2713.0	2699.1	8.43	8.38	-5.86	-5.86
9	2885.8	2873.2	4.15	4.23	-5.19	-5.23
10	3055.4	3045.4	1.60	1.45	0.27	0.34
11	3248.8	3240.4	-1.66	-1.49	0.86	0.62
12	3449.8	3442.4	-3.21	-3.26	3.48	3.51
13	3652.0	3636.1	-2.12	-2.03	5.69	5.57
14	3855.9	3834.9	-0.65	-0.81	6.97	7.05
15	4065.9	4049.5	1.68	1.74	10.69	10.43
16	4278.3	4262.3	1.13	0.97	15.47	15.62
17	4479.4	4464.8	1.90	2.05	17.05	16.76
18	4683.3	4667.7	-2.38	-2.35	18.34	18.48
19	4885.8	4867.4	-3.02	-3.01	18.60	18.45
20	5073.1	5052.9	-3.67	-3.62	15.47	15.40
21	5253.5	5233.6	-4.17	-4.15	15.42	15.46
22	5443.6	5425.1	-0.85	-0.95	15.38	15.31
23	5631.3	5611.7	-1.84	-1.78	14.79	14.66
24	5812.4	5791.6	-2.02	-2.05	12.66	12.71
25	5989.7	5969.7	-1.51	-1.44	14.20	14.16
26	6167.9	6149.5	-0.49	-0.63	12.08	12.26
27	6352.0	6339.0	-1.20	-1.29	9.83	10.07
28	6541.5	6531.9	-2.42	-2.41	8.90	8.94
29	6730.9	6725.7	-0.28	-0.21	9.37	9.71
30	6915.1	6913.9	4.38	4.31	9.00	8.74
31	7101.1	7099.2	5.57	5.38	9.58	9.70
32	7297.3	7293.8	5.91	5.90	10.89	10.89
33	7503.1	7497.2	4.45	4.41	12.27	12.21
34	7706.4	7698.7	5.79	5.80	15.12	15.03
35	7893.2	7882.7	8.18	8.08	15.54	15.36
36	8084.5	8074.0	6.89	6.96	14.34	14.41
37	8275.3	8266.9	2.17	2.33	17.25	17.19
38	8458.7	8446.4	-1.08	-1.09	18.23	17.82
39	8644.5	8627.3	-8.31	-8.12	29.21	28.93
40	8814.6	8799.8	-14.62	-14.44	34.61	34.85
41	8973.7	8962.5	-19.31	-19.42	39.45	39.35
42	9126.5	9117.5	-20.50	-20.50	43.75	43.94
43	9279.7	9273.2	-18.76	-18.63	41.21	41.39
44	9450.1	9445.3	-12.28	-12.39	43.24	43.27
45	9627.9	9624.1	-13.44	-13.52	51.13	50.81

LAUNCH 1 (Cont)

7 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
46	9802.0	9797.5	-17.83	-17.72	49.80	49.92
47	9978.3	9974.2	-19.39	-19.35	54.19	54.09
48	10147.7	10148.1	-24.27	-24.05	55.45	55.44
49	10311.2	10314.1	-26.72	26.62	51.64	51.76
50	10483.3	10483.6	-20.38	-20.46	51.96	51.56
51	10673.6	10673.4	-17.99	-17.98	59.74	59.79
52	10858.5	10862.5	-23.26	-23.21	67.77	67.51
53	11029.7	11036.0	-28.36	-28.38	64.03	64.26
54	11199.1	11206.9	-28.13	-27.94	57.83	57.78
55	11375.2	11383.8	-26.96	-26.99	53.45	53.50
56	11553.6	11563.5	-19.29	-19.45	45.66	45.65
57	11729.4	11741.9	-20.40	-20.31	48.51	48.46
58	11900.9	11916.6	-18.41	-18.32	51.68	51.58
59	12064.5	12080.2	-23.78	-23.33	52.61	52.46
60	12225.8	12236.2	-21.16	-21.04	54.31	54.39
61	12387.9	12401.5	-21.80	-21.70	57.88	57.79
62	12562.5	12581.7	-27.79	-27.77	59.92	60.15
63	12748.6	12767.7	-23.53	-23.44	62.67	62.57
64	12929.5	12951.1	-28.43	-28.35	65.11	64.90
65	13136.7	13157.9	-24.54	-24.40	62.67	63.07
66	13351.1	13374.5	-26.98	-27.17	53.03	52.91
67	13538.5	13565.0	-25.19	-25.05	56.10	56.10
68	13714.5	13749.6	-21.37	-21.02	59.11	58.91
69	13889.1	13927.5	-22.05	-22.42	62.21	62.27
70	14079.9	14114.4	-23.33	-23.25	62.35	62.30
71	14275.7	14313.6	-25.53	-25.18	57.27	57.39
72	14458.8	14507.4	-30.07	-29.91	54.73	54.67
73	14634.8	14689.3	-26.50	-27.07	53.17	53.11
74	14828.1	14862.7	-24.37	-24.13	52.70	52.95
75	15042.6	15067.7	-22.29	-21.94	46.17	46.02
76	15246.0	15291.0	-21.27	-21.26	53.55	53.30
77	15448.5	15498.5	-21.06	-21.78	52.25	52.41
78	15646.7	15686.2	-19.33	-18.56	50.17	50.39
79	15842.5	15873.7	-19.51	-19.61	43.23	43.24
80	16036.4	16064.6	-14.94	-14.91	42.67	42.63
81	16214.6	16250.6	-12.51	-12.48	45.90	45.80
82	16407.7	16448.3	-16.72	-16.55	44.86	44.96
83	16610.0	16659.4	-17.83	-18.20	36.95	36.74
84	16806.2	16870.1	-16.77	-15.83	32.27	32.29

LAUNCH 1 (Cont)

7 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
85	17010.8	17073.0	-10.09	-9.90	32.63	32.88
86	17213.6	17278.6	-7.01	-8.27	35.37	34.62
87	17414.1	17491.4	-11.91	-12.09	41.86	41.62

H	N-S	E-W
$\bar{X} = -7.6$ meters	$\bar{X} = -.017$ knots	$\bar{X} = .025$ knots
$\sigma = 24.9$	$\sigma = .263$	$\sigma = .193$
$\sigma^2 = 621.33$	$\sigma^2 = .069$	$\sigma^2 = .037$

TABLE 14
LAUNCH 2
7 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
3	2005.7	2004.6	6.22	6.08	-7.74	-7.51
4	2244.1	2242.7	6.61	6.68	-8.76	-8.91
5	2492.8	2495.5	3.55	3.53	-6.39	-6.51
6	2753.9	2758.9	2.40	2.84	-0.41	-0.26
7	3011.6	3022.1	1.95	1.72	-6.25	-5.50
8	3268.4	3286.9	-0.66	-0.66	-3.19	-3.24
9	3536.3	3554.6	-3.44	-3.41	1.02	0.89
10	3728.4	3819.4	1.82	0.01	-0.51	4.10
11	3993.4	4083.7	0.72	2.52	16.99	12.30
12	4330.0	4346.7	1.53	1.48	15.63	15.68
13	4591.2	4606.4	-0.38	-0.16	19.23	19.11
14	4856.9	4866.9	-5.04	-4.89	17.20	17.06
15	5125.3	5134.5	-1.50	-1.62	15.80	16.00
16	5397.6	5409.6	0.37	0.51	13.27	13.45
17	5672.7	5686.1	0.51	0.46	8.87	8.82
18	5948.6	5961.0	1.11	1.10	8.60	8.36
19	6221.8	6232.7	-1.29	-1.21	12.98	13.06
20	6489.4	6501.7	-3.49	-3.51	13.07	13.14
21	6757.7	6771.9	-1.88	-1.95	8.63	8.64
22	7030.6	7044.4	0.40	0.49	6.40	6.35
23	7305.7	7317.7	0.36	0.24	10.36	10.26
24	7578.8	7590.7	4.38	4.39	8.17	8.19
25	7854.4	7866.1	6.27	6.36	7.49	7.37
26	8138.2	8148.7	2.22	2.15	12.13	12.01
27	8421.4	8432.4	-8.54	-8.37	29.61	29.55
28	8709.8	8709.4	-18.76	-18.46	38.21	37.29
29	8998.4	8986.0	-16.75	-16.82	37.91	37.88
30	9277.5	9268.1	-13.51	-13.44	42.38	42.35
31	9558.0	9549.9	-17.07	-17.00	50.87	50.71
32	9847.5	9837.7	-24.74	-24.45	51.50	51.53
33	10146.9	10137.0	-23.27	-23.26	56.91	56.65
34	10445.0	10433.5	-20.10	-19.97	67.67	67.55
35	10731.9	10719.7	-23.88	-23.77	68.01	68.19
36	11016.5	11006.1	-33.32	-33.06	58.91	59.03
37	11315.9	11307.5	-24.02	-24.11	54.67	54.68
38	11623.1	11614.0	-19.41	-19.22	57.72	57.68
39	11934.5	11926.5	-19.57	-19.58	54.74	54.64
40	12250.8	12243.7	-27.41	-27.27	61.80	61.58
41	12561.3	12558.1	-31.32	-31.37	61.09	61.26
42	12880.4	12881.4	-29.84	-29.76	56.96	56.89
43	13206.0	13206.2	-22.76	-22.66	62.29	62.21

LAUNCH 2 (Cont)

7 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
44	13525.2	13528.4	-23.24	-23.08	68.38	68.19
45	13855.2	13857.5	-28.24	-28.28	63.68	63.87
46	14175.0	14176.5	-24.50	-24.20	56.74	56.61
47	14482.6	14487.6	-23.23	-23.18	58.44	58.31
48	14805.9	14816.5	-22.74	-22.82	59.60	59.55
49	15136.9	15147.7	-24.69	-24.72	62.18	62.22
50	15477.1	15477.9	-23.34	-23.44	60.87	61.02
51	15824.5	15825.9	-23.72	-23.49	57.34	57.25
52	16180.4	16188.5	-24.96	-24.80	43.28	43.70
53	16529.5	16543.0	-21.23	-21.33	37.77	37.87
54	16857.1	16875.8	-14.26	-14.22	34.01	33.81
55	17193.0	17208.0	-9.60	-9.27	40.71	40.83
56	17535.8	17553.2	-18.74	-18.83	30.69	30.97
57	17891.8	17910.7	-11.57	-11.74	16.77	16.91
58	18259.7	18275.3	-5.11	-5.03	20.34	19.93
59	18615.7	18638.5	-5.35	-5.63	19.22	19.40
60	18975.3	19007.4	4.23	4.45	25.03	24.78
61	19333.5	19364.9	-3.37	-3.30	28.64	28.50
62	19687.4	19716.5	-4.83	-4.83	20.98	21.14
63	20065.8	20091.8	-8.85	-8.04	20.97	21.40
64	20453.9	20476.8	-15.94	-16.01	15.68	15.64
65	20839.7	20857.5	-10.12	-10.47	9.88	10.05
66	21206.8	21227.6	-11.50	-12.06	1.82	1.63
67	21567.6	21596.5	-2.36	-1.94	6.41	6.41
68	21962.9	21980.8	1.91	1.60	7.52	7.40
69	22348.8	22369.1	-0.60	-0.70	9.22	8.87
70	22724.8	22753.8	0.20	-0.09	10.41	10.44
71	23125.6	23143.9	1.11	1.11	12.89	13.07
72	23530.3	23542.5	2.72	3.50	13.18	13.19
73	23941.6	23963.1	8.63	8.12	21.20	20.74
74	24367.6	24400.2	3.10	3.54	24.01	24.16
75	24802.3	24831.4	8.25	7.68	32.13	31.91
76	25244.1	25264.3	3.80	4.17	35.07	34.82
77	25677.8	25693.0	-5.55	-5.43	36.58	36.58
78	26108.0	26122.5	-8.89	-8.80	35.04	35.27

$$\bar{X} = -10.75 \text{ meters}$$

$$\sigma = 18.3$$

$$\sigma^2 = 336.66$$

$$\bar{X} = -.041 \text{ knots}$$

$$\sigma = .377$$

$$\sigma^2 = .142$$

$$\bar{X} = .019 \text{ knots}$$

$$\sigma = .773$$

$$\sigma^2 = .597$$

TABLE 15
LAUNCH 1
8 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
3	2187.4	2189.3	-3.61	-3.69	-3.56	-3.45
4	2495.4	2501.3	-2.84	-2.83	-2.44	-2.44
5	2802.9	2806.9	0.33	0.29	2.66	2.61
6	3115.2	3115.3	-6.59	-6.30	5.27	5.06
7	3430.7	3429.3	-6.92	-7.17	-1.86	-1.69
8	3743.3	3741.9	-8.86	-8.69	-5.19	-5.29
9	4054.4	4053.1	-9.06	-9.10	-6.65	-6.58
10	4364.6	4364.8	-8.51	-8.60	-7.71	-7.65
11	4679.0	4677.9	-10.36	-10.18	-6.06	-6.08
12	5001.1	4998.3	-5.00	-5.03	-3.54	-3.49
13	5333.3	5328.7	-7.12	-7.02	-1.93	-2.04
14	5668.4	5660.6	-9.96	-9.84	-8.02	-8.10
15	6005.9	5997.0	-11.48	-11.37	-12.87	-12.80
16	6346.0	6338.9	-11.88	-12.10	-10.71	-10.62
17	6691.6	6682.9	-9.09	-8.77	-9.21	-9.06
18	7044.7	7037.0	-6.81	-7.07	-3.83	-3.84
19	7406.9	7402.2	-5.32	-5.24	20.46	20.29
20	7780.4	7771.2	-11.93	-11.98	34.14	34.01
21	8158.7	8145.6	-17.84	-17.81	43.55	43.49
22	8535.9	8521.4	-20.61	-20.63	51.10	51.00
23	8915.0	8901.1	-17.73	-17.77	57.28	57.05
24	9305.6	9293.0	-13.41	-13.59	62.19	62.19
25	9703.1	9688.2	-15.71	-15.55	62.07	62.04
26	10096.1	10077.1	-17.53	-17.47	61.56	61.15
27	10488.2	10465.2	-10.84	-10.93	59.88	59.73
28	10887.5	10861.0	-14.25	-14.13	56.48	56.24
29	11295.9	11270.2	-11.58	-11.73	68.27	68.13
30	11700.4	11672.9	-16.64	-16.56	77.77	77.62
31	12092.6	12063.2	-7.91	-8.17	67.78	67.80
32	12494.4	12468.3	-4.97	-5.05	68.42	68.23
33	12912.2	12887.2	-17.21	-17.27	70.61	70.80
34	13333.3	13309.9	-14.77	-14.71	58.39	58.26
35	13748.5	13726.7	-1.85	-1.76	51.91	52.03
36	14171.6	14152.3	-4.69	-4.66	44.34	44.15
37	14614.8	14597.2	5.55	5.74	47.48	47.73
38	15053.4	15032.0	4.49	4.46	54.47	54.19
39	15465.0	15447.3	11.39	11.50	57.09	57.01
40	15867.6	15854.4	-0.09	-0.09	48.21	48.13
41	16291.3	16273.0	-1.78	-1.88	30.79	30.75
42	16715.0	16690.5	-1.25	-1.68	23.52	23.51

LAUNCH 1 (Cont)

8 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
43	17132.7	17114.3	7.12	7.19	31.85	31.50
44	17569.9	17561.3	0.86	0.65	33.05	33.04
45	18029.3	18015.9	-9.27	-9.63	27.24	26.93
46	18496.3	18481.8	-8.69	-8.32	21.87	21.93
47	18961.2	18949.7	-2.54	-2.65	20.51	20.25
48	19417.9	19405.8	1.65	1.36	16.29	16.05
49	19872.8	19857.5	-2.28	-2.23	15.99	15.97
50	20345.2	20327.3	-2.31	-2.30	5.40	5.40
51	20823.8	20810.5	1.00	0.60	3.06	3.01
52	21319.4	21298.7	-5.52	-5.06	9.59	9.55
53	21829.1	21802.2	-3.19	-3.88	11.28	11.28
54	22348.6	22324.2	-5.42	-5.21	14.15	14.22
55	22883.4	22860.3	0.61	0.65	16.09	15.92
56	23427.5	23408.4	-0.97	-1.02	16.63	16.73
57	23991.9	23967.8	-1.38	-1.34	18.41	18.66
58	24581.5	24555.6	-0.28	-0.36	15.48	15.27
59	25184.3	25164.4	-1.28	-1.59	19.75	19.43
60	25793.1	25774.9	-2.06	-1.97	31.31	31.18
61	26400.5	26386.2	-0.19	0.37	32.20	32.42
	$\bar{X} = 14.32$ meters		$\bar{X} = .023$ knots		$\bar{X} = .059$ knots	
	$\sigma = 8.97$		$\sigma = .200$		$\sigma = .195$	
	$\sigma^2 = 80.46$		$\sigma^2 = .040$		$\sigma^2 = .038$	

TABLE 16
LAUNCH 2
8 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
4	2140.8	2143.7	-2.76	-2.85	-1.76	-1.78
5	2336.4	2338.2	-3.94	-3.95	-2.37	-2.20
6	2530.4	2533.4	-2.89	-3.02	-1.24	-1.15
7	2729.7	2731.1	-1.93	-1.85	3.36	3.28
8	2937.6	2937.4	-3.58	-3.64	4.35	4.45
9	3144.9	3144.3	-5.37	-5.25	0.15	0.09
10	3338.1	3336.8	-6.86	-6.95	-1.95	-1.84
11	3519.2	3518.4	-7.17	-7.14	-5.68	-5.64
12	3701.4	3700.4	-6.39	-6.45	-9.08	-9.01
13	3892.1	3889.0	-9.52	-9.07	-11.09	-11.22
14	4082.2	4078.3	-9.26	-9.42	-10.27	-10.14
15	4264.4	4262.9	-7.88	-7.90	-8.58	-8.59
16	4450.9	4448.7	-7.31	-7.28	-5.70	-5.70
17	4645.9	4642.4	-4.77	-4.73	-3.80	-3.83
18	4838.2	4835.6	-5.37	-5.38	-4.19	-4.17
19	5021.5	5018.6	-7.63	-7.61	-7.02	-6.98
20	5207.5	5201.9	-7.79	-7.50	-10.95	-10.91
21	5401.3	5394.2	-7.82	-7.94	-12.88	-12.81
22	5598.6	5591.7	-7.93	-7.94	-13.85	-13.83
23	5795.5	5789.2	-6.00	-6.09	-11.77	-11.82
24	6000.4	5993.5	-7.06	-6.87	-10.69	-10.60
25	6217.6	6208.9	-8.91	-8.91	-10.44	-10.40
26	6439.4	6431.2	-7.16	-7.22	-11.06	-11.12
27	6672.3	6666.9	-4.53	-4.48	-6.65	-6.66
28	6918.3	6912.4	-6.76	-6.77	1.74	1.70
29	7164.4	7157.8	-8.28	-8.30	8.56	8.49
30	7400.5	7392.7	-7.77	-7.69	9.67	9.60
31	7627.9	7616.5	-8.52	-8.66	17.23	17.05
32	7851.6	7838.5	-10.10	-9.96	21.47	21.44
33	8079.7	8064.5	-12.43	-12.24	28.18	28.03
34	8325.7	8310.6	-10.29	-10.49	36.77	36.50
35	8583.0	8566.8	-7.38	-7.36	45.59	45.36
36	8841.5	8822.2	-9.32	-9.31	49.98	49.86
37	9105.0	9085.7	-9.49	-9.62	52.98	52.83
38	9373.6	9354.5	-10.61	-10.79	57.13	57.04
39	9639.0	9617.9	-10.71	-10.61	58.01	57.84
40	9900.9	9878.5	-11.95	-11.93	53.84	53.91
41	10185.2	10163.5	-9.66	-9.71	53.12	53.19
42	10481.3	10461.0	-4.90	-5.11	57.02	56.73
43	10775.5	10754.1	-4.86	-4.91	64.53	64.19

LAUNCH 2 (Cont)

8 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
44	11074.3	11050.4	-8.91	-8.94	73.04	72.96
45	11366.6	11343.4	-11.78	-11.71	72.85	72.63
46	11639.3	11616.3	-17.87	-17.76	70.41	70.30
47	11902.3	11879.2	-9.90	-10.14	67.04	67.00
48	12176.3	12154.5	-8.44	-8.28	68.32	68.22
49	12465.1	12442.9	4.27	4.11	56.48	56.82
50	12753.4	12731.6	-1.36	-1.09	63.91	63.82
51	13033.0	13012.2	-14.77	-14.81	56.23	56.09
52	13299.6	13285.2	-8.76	-8.82	53.14	52.84
53	13574.5	13554.5	0.66	0.77	49.45	49.75
54	13875.6	13846.5	6.75	6.44	45.61	45.89
55	14173.7	14142.5	8.65	8.71	38.93	38.62
56	14451.4	14410.6	6.01	5.84	39.45	39.60
57	14709.3	14662.2	10.43	10.40	48.60	48.41
58	14951.6	14912.4	3.78	3.63	50.39	50.13
59	15206.3	15168.2	-0.53	-1.10	43.06	43.00
60	15482.9	15440.5	1.45	1.62	44.41	44.59
61	15767.2	15732.0	1.69	1.74	49.41	49.08
62	16053.3	16020.4	0.32	-0.12	40.90	40.89
63	16325.6	16284.7	6.20	6.38	31.88	32.09
64	16581.1	16549.2	7.34	7.20	27.50	27.25
65	16838.4	16824.2	3.92	3.83	25.04	24.93
66	17107.5	17096.3	6.28	6.10	35.52	35.30
67	17376.1	17360.5	6.90	6.56	40.96	41.11
68	17646.7	17629.1	-7.77	-8.09	36.40	36.25
69	17908.6	17893.5	-8.38	-8.36	25.95	25.82
70	18150.6	18145.6	-5.58	-5.81	19.29	19.10
71	18390.2	18390.2	-8.02	-7.76	19.41	19.52
72	18622.2	18623.7	-0.28	-0.07	16.97	16.96
73	18850.7	18851.4	3.20	3.42	20.80	20.63
74	19085.4	19081.8	3.23	3.12	21.22	21.50
75	19315.3	19311.2	4.33	4.12	18.73	18.73
76	19544.9	19542.3	-2.23	-2.13	22.94	22.98
77	19780.5	19783.4	-5.24	-5.43	15.35	14.83
78	20026.8	20029.2	-7.39	-7.54	11.82	12.12
79	20272.0	20276.0	-0.08	0.21	7.37	7.26
80	20509.9	20518.6	7.50	7.24	12.18	12.11
81	20752.1	20762.9	-10.59	-10.67	9.94	9.75
82	21007.4	21017.8	-4.52	-4.50	7.02	7.26
83	21266.4	21279.6	-0.98	-0.72	12.90	12.79

LAUNCH 2 (Cont)

8 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
84	21525.5	21537.3	-2.90	-2.84	11.98	12.24
85	21775.8	21784.1	0.12	0.06	12.50	12.30
86	22012.9	22022.9	-2.65	-2.99	14.25	13.99
87	22249.6	22263.0	-7.24	-7.23	8.10	8.05
88	22498.3	22507.4	0.98	1.07	6.64	6.89
89	22757.6	22759.9	-0.05	0.02	12.27	12.05
90	23003.4	23014.7	-1.41	-1.64	14.42	14.34
91	23252.6	23266.6	0.99	1.57	12.32	12.32
92	23508.1	23515.6	3.86	2.90	19.46	19.22
93	23756.6	23763.1	-0.47	-0.42	19.68	20.08
	$\bar{X} = 9.87$ meters		$\bar{X} = .031$ knots		$\bar{X} = .039$ knots	
	$\sigma = 14.56$		$\sigma = .180$		$\sigma = .184$	
	$\sigma^2 = 211.87$		$\sigma^2 = .032$		$\sigma^2 = .034$	

TABLE 17

LAUNCH 3

8 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
4	2444.3	2428.8	-1.47	-1.86	2.60	2.88
5	2718.3	2702.1	-0.21	-0.26	5.42	4.95
6	3009.3	2988.3	0.63	0.54	-0.86	-0.23
7	3312.5	3291.2	1.51	1.78	-8.07	-7.96
8	3611.9	3591.5	-1.14	-1.27	-7.86	-7.79
9	3915.5	3893.8	-2.75	-2.61	-8.72	-8.48
10	4225.9	4201.6	-2.35	-2.51	-13.39	-13.33
11	4532.6	4507.1	-5.89	-5.88	-10.17	-10.32
12	4823.2	4798.1	-6.17	-5.93	-8.43	-8.39
13	5116.5	5090.2	-2.87	-2.97	-14.58	-14.18
14	5415.6	5387.4	-6.38	-6.12	-18.85	-18.77
15	5714.9	5685.9	-6.96	-6.81	-21.31	-21.39
16	6015.0	5985.9	-5.47	-5.58	-20.43	-20.37
17	6314.9	6287.0	-1.82	-2.19	-16.75	-16.53
18	6617.1	6590.4	-1.54	-1.39	-16.04	-16.48
19	6921.6	6892.7	-2.43	-2.27	-14.25	-14.41
20	7227.1	7196.4	-6.96	-6.59	-9.88	-9.88
21	7521.6	7490.3	-9.40	-9.57	-6.06	-6.44
22	7812.6	7783.5	-5.57	-5.75	7.32	6.92
23	8108.3	8078.2	-3.18	-3.29	18.10	17.31
24	8416.9	8381.5	-2.50	-2.21	33.79	32.82
25	8718.6	8681.8	-5.52	-5.53	38.19	37.88
26	9008.3	8970.0	-9.79	-10.09	40.26	40.06
27	9303.5	9264.1	-9.11	-8.65	49.07	48.73
28	9580.3	9541.2	-13.26	-13.11	47.99	48.22
29	9844.1	9806.3	-11.90	-12.27	39.06	39.08
30	10128.0	10086.7	-11.85	-12.01	35.71	35.65
31	10435.5	10393.7	-4.07	-4.25	39.23	39.24
32	10739.7	10701.0	1.79	1.63	46.12	45.36
33	11019.3	10981.0	-4.04	-3.79	41.87	42.03
34	11292.4	11254.2	-12.95	-12.55	45.19	44.64
35	11570.8	11532.6	-9.69	-10.22	59.49	58.97
36	11848.3	11809.0	-6.54	-6.63	59.56	59.39
37	12121.6	12084.5	-6.47	-6.45	56.32	56.82
38	12385.3	12352.9	1.63	0.84	48.72	49.15
39	12657.0	12620.4	7.59	7.36	46.08	45.97
40	12939.3	12899.6	6.34	7.06	55.87	55.05
41	13242.2	13204.6	-7.37	-6.98	48.67	49.78
42	13540.8	13504.4	-6.74	-6.97	35.89	35.92
43	13814.3	13778.8	2.74	2.28	34.69	34.73
44	14100.8	14063.0	11.15	10.38	37.12	36.58

LAUNCH 3 (Cont)

8 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
45	14391.3	14350.3	12.26	12.48	48.69	48.41
46	14676.5	14638.4	4.73	5.11	42.97	43.48
47	14966.6	14929.5	4.62	4.14	36.86	36.88
48	15255.2	15218.2	2.48	2.77	38.79	38.82
49	15536.4	15507.3	4.38	4.21	35.15	35.06
50	15825.1	15797.6	3.46	3.71	33.54	33.55
51	16120.9	16089.3	3.16	2.86	31.73	31.97
52	16422.9	16388.9	10.66	10.57	33.42	32.96
53	16734.2	16698.8	10.99	10.83	41.68	41.47
54	17031.9	16996.9	1.05	1.53	39.76	40.24
55	17324.0	17288.6	-6.90	-6.68	27.85	28.39
56	17618.7	17586.4	-1.26	-1.65	20.69	20.27
57	17921.1	17890.2	-0.29	-0.12	30.08	29.87
58	18224.5	18198.4	1.39	0.88	25.51	25.55
59	18528.4	18503.4	1.07	1.03	30.92	30.61
60	18836.5	18808.1	-2.59	-2.03	30.72	30.83
61	19142.2	19118.1	-8.00	-8.37	22.62	22.98
62	19457.6	19436.1	-7.36	-6.95	18.46	18.44
63	19785.8	19759.2	-7.44	-7.38	7.63	8.70
64	20111.4	20083.7	-4.25	-4.73	1.14	0.73
65	20423.0	20399.0	4.39	4.30	12.21	11.71
66	20743.2	20715.1	-0.84	-0.35	20.43	20.71
67	21087.1	21058.4	-3.20	-3.95	3.41	3.67
68	21433.2	21404.9	-1.07	-0.77	9.90	9.66
69	21770.7	21737.8	-5.33	-5.41	12.30	12.09
70	22118.4	22081.7	-2.60	-3.06	10.35	10.88
71	22481.6	22445.8	3.71	3.89	7.65	7.04
72	22855.1	22819.8	1.23	0.98	18.74	18.06
73	23219.9	23183.4	3.85	3.87	23.51	23.40
74	23564.1	23528.5	-4.22	-3.91	22.08	22.51
75	23931.2	23894.4	-3.66	-3.77	22.77	22.31
76	24321.9	24285.8	-6.69	-6.68	21.27	21.14
77	24708.9	24672.0	-3.17	-3.41	21.82	21.68

$$\bar{X} = 32.02 \text{ meters}$$

$$\sigma = 3.93$$

$$\sigma^2 = 15.44$$

$$\bar{X} = .042 \text{ knots}$$

$$\sigma = .324$$

$$\sigma^2 = .105$$

$$\bar{X} = .062 \text{ knots}$$

$$\sigma = .408$$

$$\sigma^2 = .166$$

TABLE 18
LAUNCH 1
9 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
4	2422.1	2425.5	2.77	2.81	1.91	1.88
5	2708.3	2709.0	5.79	5.61	4.59	4.45
6	2998.1	2998.3	9.76	9.58	7.54	8.02
7	3281.6	3283.8	8.44	8.46	1.01	0.83
8	3575.5	3575.9	5.13	5.15	-2.78	-2.83
9	3879.6	3880.8	3.30	3.29	-6.51	-6.25
10	4178.8	4182.4	3.56	3.53	-9.43	-9.49
11	4484.4	4483.4	-0.63	-0.60	-7.61	-7.87
12	4791.0	4788.4	3.09	3.12	-7.77	-7.59
13	5091.6	5090.5	3.01	2.88	-9.34	-9.43
14	5389.8	5386.2	5.67	5.85	-8.20	-8.24
15	5687.4	5682.7	0.36	0.45	-11.70	-11.77
16	5975.8	5972.8	-0.54	-0.50	-11.97	-11.99
17	6270.3	6265.2	-0.58	-0.53	-8.97	-8.97
18	6574.8	6569.8	-3.45	-3.48	-4.03	-3.92
19	6872.9	6868.1	-3.67	-3.54	-3.45	-3.57
20	7185.2	7174.0	-2.37	-2.44	1.87	1.78
21	7514.9	7502.8	-4.16	-4.17	5.83	5.61
22	7841.0	7832.3	-8.28	-8.28	15.39	15.32
23	8159.1	8153.5	-9.51	-9.34	21.86	21.74
24	8474.3	8466.9	-11.70	-11.73	27.65	27.54
25	8781.8	8773.7	-16.79	-16.77	28.75	28.87
26	9087.2	9079.7	-14.08	-14.03	22.99	22.86
27	9403.4	9394.2	-16.47	-16.47	26.85	26.75
28	9713.5	9704.7	-20.40	-20.28	30.38	30.29
29	10005.5	9997.5	-19.00	-19.18	25.60	25.76
30	10312.2	10305.3	-17.69	-17.74	26.33	26.24
31	10636.7	10628.5	-16.38	-16.30	28.69	28.41
32	10960.1	10953.0	-12.18	-12.24	31.72	31.73
33	11297.2	11286.7	-8.74	-8.64	47.64	47.34
34	11615.2	11602.7	-13.20	-13.21	51.62	51.64
35	11914.5	11905.7	-22.88	-22.85	45.55	45.55
36	12245.5	12235.6	-20.42	-20.52	37.02	36.97
37	12591.6	12578.5	-10.00	-9.95	46.19	46.01
38	12923.6	12910.1	-10.48	-10.48	33.98	34.18
39	13254.0	13243.6	-8.20	-8.26	36.13	36.04
40	13578.6	13576.9	-1.33	-1.40	32.57	32.50
41	13915.9	13907.2	1.33	1.54	36.27	35.99
42	14249.0	14242.6	-7.19	-7.28	33.39	33.72
43	14595.1	14585.2	1.21	1.13	32.64	32.38
44	14943.0	14931.3	6.75	6.77	37.84	37.68

LAUNCH 1 (Cont)

9 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
45	15289.3	15278.1	-2.63	-2.71	34.80	34.97
46	15644.6	15632.2	-2.86	-2.74	27.56	27.65
47	16006.1	15993.0	-6.93	-6.95	26.60	26.81
48	16366.9	16353.5	-5.93	-5.77	23.76	23.56
49	16731.4	16716.8	-13.62	-13.74	36.13	36.15
50	17117.1	17096.2	-11.93	-11.69	23.56	22.70
51	17493.2	17470.4	-9.80	-10.02	18.77	19.11
52	17864.7	17843.1	-10.76	-10.75	16.92	16.96
53	18244.2	18225.5	-10.33	-10.23	12.17	12.06
54	18616.9	18601.6	-4.57	-4.60	14.07	13.93
55	18999.6	18980.5	-3.97	-3.95	14.88	14.87
56	19389.8	19374.6	2.71	2.64	14.21	13.99
57	19788.1	19775.1	-3.23	-3.38	11.64	12.04
58	20194.7	20177.3	-3.57	-3.47	8.29	8.26
59	20603.3	20588.6	1.43	1.51	11.17	10.87
60	21007.7	20998.4	0.69	0.72	1.11	1.15
61	21428.4	21414.0	1.79	1.75	7.69	7.94
62	21868.5	21849.6	-0.16	-0.31	12.05	11.96
63	22314.0	22294.5	-7.23	-7.10	1.84	1.69
64	22760.8	22746.5	0.09	0.34	5.04	4.96
65	23219.4	23205.8	2.57	2.37	8.11	8.07
66	23697.5	23682.0	-0.35	-0.52	8.65	8.64
67	24184.6	24169.7	-1.04	-0.74	15.98	15.96
68	24667.5	24648.1	-2.38	-2.39	16.50	16.35
69	25146.4	25127.8	-0.04	-0.14	19.77	19.45
70	25647.9	25626.6	2.32	2.23	33.93	33.54
71	26167.6	26142.0	2.36	2.23	36.41	36.59
72	26690.3	26667.0	-0.36	-0.59	37.24	37.10
73	27221.4	27198.5	0.44	0.46	42.68	42.65
74	27753.2	27730.0	-7.91	-8.13	33.63	33.74
75	28292.4	28270.7	-9.81	-9.58	48.68	48.06
76	28842.1	28816.8	-7.52	-7.91	44.45	44.63
77	29369.6	29342.4	5.90	6.15	49.40	49.42
78	29877.8	29844.5	7.19	7.05	46.44	46.70
79	30415.0	30373.2	6.86	6.89	51.82	50.55
80	30944.1	30909.3	-3.49	-3.51	59.17	58.85
81	31437.5	31409.2	19.40	18.91	52.86	52.82

$$\bar{X} = 12.51 \text{ meters}$$

$$\sigma = 9.03$$

$$\sigma^2 = 81.59$$

$$\bar{X} = .011 \text{ knots}$$

$$\sigma = .138$$

$$\sigma^2 = .019$$

$$\bar{X} = .057 \text{ knots}$$

$$\sigma = .207$$

$$\sigma^2 = .043$$

TABLE 19

LAUNCH 2

9 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
3	2115.8	2117.1	9.26	9.23	-1.35	-1.39
4	2391.5	2389.3	8.13	8.18	-0.76	-0.84
5	2662.6	2656.2	6.15	6.15	1.15	1.01
6	2943.2	2934.8	5.71	5.66	6.11	6.03
7	3222.6	3214.6	8.59	8.41	4.33	4.42
8	3491.1	3484.0	7.75	7.69	-1.20	-1.06
9	3748.1	3738.9	10.26	10.25	-5.46	-5.47
10	3993.6	3981.4	6.60	6.54	-3.75	-3.73
11	4228.2	4219.0	4.66	4.71	-3.55	-3.41
12	4469.3	4458.0	4.37	4.33	-2.74	-3.01
13	4720.2	4706.0	3.10	3.09	-2.54	-2.45
14	4960.1	4944.8	2.66	2.70	-2.46	-2.38
15	5197.6	5178.9	1.95	1.89	-3.82	-3.83
16	5446.4	5426.1	0.55	0.54	-0.13	-0.28
17	5684.2	5662.7	1.27	1.30	1.49	1.56
18	5927.7	5906.8	-1.43	-1.37	9.06	8.91
19	6197.0	6175.2	-4.61	-4.54	16.01	15.87
20	6468.8	6446.1	-4.93	-4.83	18.12	18.00
21	6719.8	6698.6	-6.53	-5.56	20.87	20.77
22	6951.2	6930.3	-9.32	-9.26	20.27	20.13
23	7193.9	7174.2	-12.18	-12.18	21.72	21.76
24	7455.6	7438.3	-9.03	-9.06	26.58	26.45
25	7735.1	7715.5	-11.30	-11.25	29.01	28.87
26	8003.9	7984.1	-7.49	-7.48	30.96	30.95
27	8246.7	8229.7	-7.65	-7.65	31.67	31.52
28	8490.1	8473.2	-8.91	-8.88	34.50	34.55
29	8747.3	8727.6	-10.30	-10.27	36.59	36.30
30	9010.0	8990.0	-10.53	-10.57	40.90	40.98
31	9273.6	9256.3	-6.43	-6.44	43.66	43.48
32	9521.6	9503.6	-9.29	-9.28	47.31	47.26
33	9769.7	9751.4	-23.74	-23.58	48.12	48.10
34	10009.9	9992.2	-31.01	-30.99	50.67	50.55
35	10234.7	10214.7	-35.27	-35.05	47.94	47.86
36	10491.7	10471.4	-33.48	-33.34	45.63	45.80
37	10751.3	10732.2	-29.93	-29.87	45.10	44.87
38	10991.9	10972.4	-28.34	-28.43	42.90	43.01
39	11233.6	11214.7	-20.26	-20.23	38.34	38.20
40	11459.9	11447.4	-9.78	-9.91	39.76	39.70
41	11694.2	11684.0	-5.90	-5.96	36.12	36.43
42	11936.3	11920.5	-6.19	-6.10	28.13	28.08
43	12165.5	12148.1	2.04	1.95	37.66	37.27
44	12396.0	12383.3	-2.56	-2.62	49.88	49.72

LAUNCH 2 (Cont)

9 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
45	12627.0	12618.9	-8.59	-8.57	55.86	55.81
46	12858.6	12850.3	-8.89	-8.79	48.49	48.41
47	13088.6	13079.3	-10.10	-10.32	48.96	48.80
48	13302.7	13297.0	-12.84	-12.95	46.90	46.97
49	13532.8	13530.8	-8.31	-8.36	44.90	45.02
50	13780.8	13774.7	-7.00	-7.37	44.58	44.34
51	14012.9	14003.7	-7.07	-7.07	39.07	39.17
52	14243.7	14236.0	-1.84	-1.62	43.14	42.95
53	14472.1	14466.7	2.44	2.08	44.18	44.18
54	14699.9	14697.3	-2.78	-2.72	47.09	46.74
55	14930.6	14928.8	-7.24	-7.48	45.51	45.63
56	15155.7	15154.2	-9.85	-9.85	37.93	38.24
57	15381.9	15382.9	-13.03	-13.14	28.99	28.86
58	15611.6	15612.0	-16.35	-16.34	30.71	30.71
59	15851.7	15854.3	-11.66	-11.73	27.27	27.04
60	16097.9	16102.7	-7.98	-7.85	23.09	23.19
61	16339.7	16340.6	-6.75	-6.77	23.98	24.11
62	16570.8	16577.6	-7.51	-7.66	28.84	28.82
63	16800.0	16812.6	-9.30	-9.35	27.48	27.38
64	17045.3	17055.2	-7.60	-7.18	21.46	21.24
65	17293.0	17298.0	0.30	-0.02	19.27	19.46
66	17534.7	17534.0	0.86	0.76	20.24	20.09
67	17789.1	17796.9	-5.01	-4.87	13.94	13.91
68	18042.7	18053.3	-3.83	-4.03	13.14	13.18
69	18294.2	18304.9	-0.05	0.37	13.12	13.19
70	18547.8	18556.7	3.79	3.36	17.98	17.87
71	18792.3	18800.1	3.52	3.49	17.19	16.99
72	19033.9	19040.1	-0.51	-0.29	21.06	21.13
73	19278.2	19284.7	-3.92	-4.23	18.23	18.13
74	19533.7	19539.3	-7.69	-7.85	16.60	16.56
75	19791.9	19801.6	-8.34	-8.29	11.93	12.05
76	20047.0	20057.0	-5.35	-5.52	13.24	13.07
77	20316.9	20310.4	-3.23	-3.53	9.08	9.26
78	20582.6	20572.7	-4.71	-4.00	16.29	16.33
79	20833.9	20836.1	-0.10	-0.03	12.24	12.09
80	21086.0	21095.1	5.83	6.12	7.64	7.69
81	21340.8	21349.2	3.56	2.72	15.25	15.21
82	21600.4	21606.9	-5.43	-5.16	9.76	9.62
83	21869.7	21877.1	-8.96	-8.62	7.49	7.53

LAUNCH 2 (Cont)

9 February 1977

H MSL Meters		-N+S Knots		-E+W Knots	
NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
\bar{X}	= 7.10 meters	\bar{X}	= .011 knots	\bar{X}	= .042 knots
σ	11.03	σ	.200	σ	.140
σ^2	121.64	σ^2	.040	σ^2	.019

TABLE 20

LAUNCH 1

10 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
4	2778.1	2751.2	9.81	10.25	9.49	9.48
5	3064.8	3059.7	9.82	9.67	12.15	12.14
6	3335.3	3332.2	19.47	19.23	11.71	11.90
7	3593.5	3591.0	21.57	21.56	12.89	12.58
8	3826.8	3821.6	24.44	24.43	11.51	11.53
9	4046.4	4040.1	23.45	23.47	9.29	9.29
10	4272.3	4264.1	19.28	19.20	9.16	8.93
11	4490.6	4481.2	19.62	19.86	14.10	14.05
12	4689.4	4681.7	18.25	18.11	14.27	14.24
13	4900.0	4892.9	17.95	18.07	16.47	16.51
14	5140.9	5134.0	22.25	21.97	21.96	21.56
15	5382.3	5374.6	24.16	24.08	28.16	27.98
16	5612.7	5605.3	32.46	32.20	35.27	35.21
17	5833.7	5828.2	35.54	35.54	34.10	34.08
18	6071.7	6064.8	31.83	31.78	43.36	42.86
19	6338.6	6329.7	40.21	40.11	59.82	59.45
20	6586.3	6579.5	43.33	43.23	61.54	61.53
21	6817.7	6811.3	43.90	43.81	63.28	63.01
22	7045.2	7039.8	43.37	43.56	67.08	67.16
23	7270.7	7269.2	40.16	40.14	67.28	67.07
24	7512.9	7510.0	31.94	32.06	67.53	67.44
25	7725.5	7722.5	30.47	30.60	76.63	76.60
26	7889.9	7887.7	30.09	29.91	76.12	76.12
27	8047.7	8047.6	32.39	32.36	76.84	76.67
28	8218.8	8223.1	33.61	33.53	76.32	76.28
29	8407.8	8414.1	34.78	34.62	78.88	78.68
30	8604.1	8607.8	34.55	34.47	78.95	78.95
31	8799.2	8800.7	38.75	38.83	78.01	77.75
32	9000.9	9003.8	40.47	40.47	75.84	75.97
33	9200.7	9214.7	40.33	40.35	75.38	75.60
34	9436.0	9457.7	40.57	40.34	72.92	73.06
35	9717.3	9732.9	37.59	37.54	73.49	73.21
36	9984.0	10003.2	39.31	39.37	73.19	72.99
37	10232.4	10260.3	41.97	42.17	70.13	70.15
38	10476.2	10502.7	46.57	46.69	68.34	68.28
39	10701.8	10730.2	43.35	42.96	73.83	73.39
40	10941.0	10967.2	34.71	35.18	83.43	83.68
41	11202.8	11222.0	23.25	23.17	78.93	79.04
42	11454.6	11476.7	21.32	21.51	71.31	71.56
43	11688.8	11717.7	18.47	18.51	60.30	60.36
44	11904.4	11941.9	24.36	24.08	55.56	55.48

LAUNCH 1 (Cont)

10 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
45	12113.1	12145.2	28.09	28.04	56.33	56.34
46	12319.6	12346.8	18.49	18.88	55.83	55.73
47	12574.3	12606.5	2.19	2.85	50.74	50.90
48	12846.2	12881.4	4.06	3.72	39.97	40.32
49	13103.8	13134.6	2.19	3.06	42.01	41.43
50	13348.7	13380.5	4.03	2.87	41.84	42.40
51	13569.8	13609.6	1.59	2.06	38.64	38.36
52	13800.3	13840.9	-0.55	-0.70	33.27	33.54
53	14036.8	14078.6	-5.34	-5.55	34.76	34.71
54	14261.1	14303.6	-6.99	-6.56	40.63	40.36
55	14484.2	14513.7	-9.63	-9.49	38.52	38.82
56	14710.5	14731.2	-1.91	-1.72	38.91	38.60
57	14938.3	14972.3	1.44	0.92	36.98	36.93
58	15191.8	15228.6	1.03	1.21	35.63	35.58
59	15461.0	15491.8	-1.17	-1.20	35.05	35.37
60	15712.1	15751.0	-0.68	0.08	31.89	31.34
61	15971.2	16015.4	-9.50	-9.73	31.32	31.75
62	16263.4	16296.0	-15.49	-15.57	21.64	21.94
63	16568.6	16597.2	-10.25	-10.54	16.04	15.92
64	16842.2	16882.2	-8.31	-8.49	23.63	23.34
65	17076.8	17122.9	-12.66	-12.80	30.84	31.12
66	17318.8	17363.6	-7.51	-7.75	27.85	27.92
67	17601.6	17615.4	-12.93	-12.36	21.21	21.42
68	17903.4	17906.9	-1.94	-2.28	1.55	1.97
69	18206.9	18234.4	-1.57	-1.48	4.45	4.11
70	18497.2	18531.0	-1.39	-2.27	14.05	13.84
71	18768.2	18797.5	-5.09	-3.89	21.02	20.76
72	19032.4	19054.6	-8.95	-8.94	14.22	14.52
73	19269.3	19301.8	-2.79	-2.92	8.05	7.79
74	19508.0	19560.2	-4.82	-5.16	10.03	9.97
75	19787.0	19833.0	-9.98	-9.89	8.76	9.10
76	20057.4	20104.1	-3.24	-3.15	6.15	6.01
77	20331.3	20386.4	0.30	0.00	0.72	0.82
78	20632.6	20671.0	9.96	10.35	5.38	5.06
79	20919.0	20950.8	3.28	2.58	7.20	7.88
80	21194.7	21230.3	-0.83	-0.72	8.38	8.04
81	21464.9	21509.5	-2.28	-2.05	7.87	7.41
82	21745.8	21791.5	-6.30	-6.30	10.91	11.28
83	22025.2	22067.3	-1.26	-1.94	10.74	10.43
84	22310.1	22350.6	0.51	0.66	9.41	9.58
85	22606.8	22644.6	6.25	5.72	11.76	11.92

LAUNCH 1 (Cont)

10 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
86	22893.0	22939.0	-1.92	-1.73	8.28	7.98
87	23174.3	23220.0	-1.27	-1.30	8.40	8.45
88	23456.4	23501.7	-0.17	0.22	10.61	10.52
	$\bar{X} = \sim 20.58$ meters		$\bar{X} = .006$ knots		$\bar{X} = .019$ knots	
	$\sigma = 20.25$		$\sigma = .354$		$\sigma = .260$	
	$\sigma^2 = 410.18$		$\sigma^2 = .126$		$\sigma^2 = .067$	

TABLE 21
LAUNCH 2
10 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
6	2985.7	2989.1	10.60	10.54	12.88	12.86
7	3275.7	3276.4	19.88	19.83	11.73	11.64
8	3561.7	3562.2	19.30	19.25	7.58	7.64
9	3838.6	3839.3	18.22	18.20	5.27	5.21
10	4111.7	4112.1	18.26	18.21	5.48	5.50
11	4393.3	4394.3	25.19	25.07	2.78	2.83
12	4691.8	4691.9	26.41	26.43	8.77	8.58
13	4997.7	4996.9	21.41	21.49	16.01	16.10
14	5276.2	5268.9	26.37	25.85	26.85	25.99
15	5520.6	5509.5	29.25	29.41	27.14	27.51
16	5773.2	5773.4	30.85	30.70	36.50	36.17
17	6064.7	6054.4	33.06	33.08	46.65	46.60
18	6322.8	6314.7	36.97	37.00	51.54	51.63
19	6585.6	6578.8	35.67	35.61	50.98	50.82
20	6856.1	6851.7	30.93	30.98	58.73	58.78
21	7100.5	7096.8	30.38	30.37	69.46	69.45
22	7317.0	7311.6	33.54	33.37	74.62	74.31
23	7538.0	7534.8	35.85	35.93	71.97	71.96
24	7792.8	7794.6	41.82	41.93	70.09	69.95
25	8051.4	8054.6	50.30	50.33	68.69	68.50
26	8280.3	8281.8	49.48	49.39	67.10	67.12
27	8481.9	8486.4	49.28	49.24	69.38	69.18
28	8683.9	8693.7	49.35	49.33	70.95	70.94
29	8906.8	8915.1	48.61	48.56	71.86	72.02
30	9123.3	9131.4	48.19	48.24	70.91	70.70
31	9306.3	9315.6	49.34	49.59	72.84	72.81
32	9481.0	9489.8	50.80	50.60	67.19	67.31
33	9663.8	9672.3	54.73	54.68	64.00	63.88
34	9809.8	9827.8	55.96	55.84	62.86	62.88
35	9927.5	9952.8	59.94	59.95	60.75	60.47
36	10066.8	10090.6	57.02	56.94	67.98	67.87
37	10189.6	10216.9	52.28	53.42	73.01	73.33
38	10268.9	10303.3	50.19	49.95	75.07	74.87
39	10331.5	10374.8	49.68	49.80	75.63	75.53

$$\bar{X} = -5.35 \text{ meters}$$

$$\sigma = 12.53$$

$$\sigma^2 = 157.00$$

$$\bar{X} = -0.001 \text{ knots}$$

$$\sigma = .238$$

$$\sigma^2 = .056$$

$$\bar{X} = .068 \text{ knots}$$

$$\sigma = .208$$

$$\sigma^2 = .043$$

TABLE 22

LAUNCH 3

10 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
3		2348.7		6.07		5.12
4		2719.8		4.00		5.62
5		3104.6		3.95		4.28
6		3461.1		8.13		5.86
7	3789.7	3797.3	7.85	7.87	10.84	10.60
8	4126.3	4131.9	9.98	10.04	12.72	13.07
9	4437.2	4443.7	11.22	11.12	14.97	14.99
10	4744.4	4749.9	13.94	14.15	18.55	18.46
11	5045.9	5048.1	11.70	11.66	19.30	19.25
12	5341.3	5340.5	18.05	17.91	27.32	27.49
13	5601.1	5600.4	16.84	17.03	31.62	31.94
14	5828.4	5828.7	22.38	22.66	33.06	32.93
15	6056.7	6057.9	26.27	26.27	32.58	32.70
16	6308.9	6310.5	24.98	24.89	36.21	36.28
17	6599.2	6601.6	27.81	27.94	45.70	45.93
18	6916.0	6921.2	36.44	36.62	51.10	51.13
19	7245.9	7251.9	38.17	38.27	54.31	54.57
20	7574.9	7581.9	39.18	39.12	62.78	62.73
21	7894.9	7902.9	35.62	35.71	67.03	66.94
22	8202.8	8212.3	42.39	42.53	71.10	71.36
23	8507.5	8517.5	51.12	51.29	76.05	75.99
24	8812.6	8825.2	58.07	58.18	72.62	72.42
25	9120.2	9135.6	55.68	55.54	73.10	73.16
26	9440.9	9455.6	49.86	49.49	70.52	70.45
27	9767.3	9783.5	46.02	46.17	63.77	63.33
28	10105.0	10121.3	45.24	45.02	55.27	54.94
29	10438.1	10453.5	46.45	46.62	53.64	53.72
30	10730.0	10749.1	42.29	41.91	58.34	58.27
31	11002.9	11022.4	35.74	35.36	57.14	56.88
32	11268.3	11292.0	27.54	27.34	48.24	48.26
33	11554.1	11590.6	21.72	21.84	45.59	45.28
34	11897.3	11932.4	13.29	12.27	39.87	39.65
35	12245.7	12273.6	2.19	2.47	31.69	31.63
36	12562.4	12591.9	10.70	10.73	38.22	38.41
37	12859.0	12887.7	11.69	12.09	41.89	42.19
38	13155.3	13187.4	5.11	5.03	40.83	40.10
39	13466.8	13499.6	5.06	4.80	38.42	38.50
40	13779.7	13801.9	1.32	1.40	30.23	30.33
41	14094.3	14118.3	0.19	0.06	35.15	35.17
42	14410.7	14448.8	-1.59	-1.59	34.24	34.15
43	14740.0	14774.2	-3.30	-3.62	39.26	39.51

LAUNCH 3 (Cont)

10 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
44	15074.7	15107.5	-1.83	-1.67	35.18	34.95
45	15408.9	15452.8	-3.71	-3.50	32.51	32.33
46	15753.7	15798.1	-3.97	-4.09	35.40	35.41
47	16096.4	16137.6	-10.84	-10.90	30.00	29.50
48	16436.0	16474.8	-7.00	-6.88	21.05	20.91
49	16770.4	16807.8	-12.13	-12.59	25.88	26.28
50	17110.8	17153.3	-9.21	-8.67	21.55	21.41
51	17468.6	17512.1	0.38	0.26	22.63	22.37
52	17823.1	17867.1	-2.72	-3.31	14.37	14.53
53	18164.0	18213.8	-1.07	-0.71	24.96	25.39
54	18524.1	18558.4	-6.82	-7.24	23.34	22.74
55	18875.6	18912.8	-3.54	-3.09	17.75	17.58
56	19219.6	19266.1	-3.71	-3.60	14.66	14.42
57	19579.1	19618.1	-1.73	-1.54	10.71	10.69
$\bar{X} = -22.52$ meters			$\bar{X} = -.003$ knots		$\bar{X} = .040$ knots	
$\sigma = 15.49$			$\sigma = .278$		$\sigma = .258$	
$\sigma^2 = 240.06$			$\sigma^2 = .077$		$\sigma^2 = .067$	

TABLE 23
LAUNCH 2
11 February 1977

Time	H MSL Meters		-N+S	Knots	-E+W	Knots
	NIKE	FPS-16				
8	3615.1	3613.7	-33.49	-33.36	11.57	11.54
9	3920.5	3919.4	-38.47	-38.40	11.67	11.78
10	4201.5	4201.8	-34.34	-34.24	7.02	6.96
11	4469.5	4469.5	-36.31	-36.28	9.78	9.95
12	4724.5	4722.9	-38.62	-38.70	14.05	13.93
13	4967.7	4966.3	-35.68	-35.50	12.79	12.75
14	5219.1	5219.8	-34.37	-34.62	14.01	14.18
15	5496.1	5500.7	-31.44	-31.26	13.70	13.63
16	5786.2	5790.8	-29.23	-29.16	14.10	14.17
17	6067.9	6073.6	-27.72	-27.71	11.34	11.31
18	6331.5	6340.0	-29.92	-29.91	14.19	14.11
19	6581.8	6592.9	-28.80	-28.87	16.75	16.91
20	6832.2	6841.3	-24.99	-24.66	21.96	21.90
21	7085.3	7090.6	-22.60	-22.78	28.72	28.69
22	7336.5	7337.1	-23.88	-23.73	25.80	25.87
23	7567.0	7568.7	-26.15	-26.23	20.64	20.57
24	7809.4	7819.5	-23.20	-23.21	28.06	28.02
25	8087.7	8097.9	-13.77	-13.72	35.18	35.17
26	8384.4	8396.8	-9.62	-9.83	38.79	38.42
27	8697.3	8712.9	-5.48	-5.18	40.88	40.77
28	9002.8	9015.3	-4.21	-4.45	49.42	49.11
29	9291.5	9301.0	0.53	0.49	50.53	50.61
30	9590.u	9601.5	6.90	7.01	55.36	55.25
31	9907.4	9919.1	8.98	9.33	70.35	70.40
32	10231.3	10237.7	6.53	6.29	73.93	73.70
33	10558.7	10564.5	-0.79	-0.65	76.91	76.85
34	10876.8	10885.0	-2.05	-1.96	68.82	68.82
35	11184.0	11193.4	-3.49	-3.85	57.37	57.43
36	11505.6	11514.2	19.51	19.53	60.18	59.93
37	11834.5	11839.0	21.78	21.98	76.41	76.15
38	12150.9	12151.2	-6.70	-6.44	73.87	74.06
39	12471.4	12470.1	-5.54	-6.15	56.48	56.41
40	12797.6	12797.2	0.99	1.23	50.00	50.36
41	13119.1	13120.2	-1.89	-1.86	49.27	49.08
42	13439.3	13438.7	0.85	0.70	45.55	45.51
43	13750.7	13751.1	5.93	6.11	44.30	44.26
44	14068.3	14070.9	9.71	9.97	45.96	45.99
45	14400.2	14407.6	7.28	7.60	45.50	45.53
46	14736.8	14747.5	-0.79	-0.62	44.63	44.74
47	15080.0	15124.8	BAD	2.64	2.59* NOT	36.47
48	15442.9	15489.8	DATA	-1.79	-5.67* USED	42.02
49	15820.0	15831.5		-11.06	-10.71	34.66

LAUNCH 2 (Cont)

11 February 1977

Time	H MSL Meters		-N+S	Knots	-E+W	Knots
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
50	16185.2	16207.0	-0.80	-1.13	25.41	25.18
51	16550.9	16575.3	5.31	5.50	19.30	19.51
52	16911.8	16934.2	11.11	10.62	19.24	18.86
53	17257.8	17289.1	11.65	11.72	35.44	35.16
54	17607.5	17639.4	0.88	1.12	32.96	33.05
55	17963.6	17996.0	-0.55	-0.48	27.74	27.75
56	18327.9	18353.6	-2.79	-3.04	23.98	24.14
57	18692.1	18707.5	-7.04	-6.99	17.66	17.72
58	19057.9	19071.5	-10.42	-10.66	16.11	16.11
59	19443.9	19459.2	-1.24	-0.96	7.45	7.40
60	19839.5	19859.6	9.03	8.86	8.93	8.95
61	20246.4	20269.2	5.98	6.64	11.49	11.73
62	20664.7	20682.1	3.74	3.46	10.46	10.55
63	21073.0	21088.3	5.76	5.63	4.19	3.92
64	21478.9	21494.5	5.22	5.37	16.40	16.24
65	21890.1	21907.1	5.61	5.66	9.55	9.62
66	22290.4	22313.2	5.00	4.60	12.03	11.65
67	22688.6	22714.0	-1.99	-2.09	17.80	17.67
68	23113.6	23138.0	-9.25	-9.24	11.60	11.79
69	23552.4	23576.4	-4.41	-4.20	10.59	10.91
70	23993.3	24016.8	2.28	2.03	15.15	14.97
71	24443.7	24463.8	5.16	5.04	14.89	14.77
72	24898.9	24922.2	7.41	7.57	22.23	21.75
73	25355.1	25374.3	1.92	1.22	27.41	27.66
74	25844.9	25855.6	0.95	1.59	34.94	34.70
75	26377.4	26388.1	-3.14	-3.39	35.55	35.69
76	26925.0	26938.5	-2.19	-1.55	25.62	25.64

$$\bar{X} = -11.56 \text{ meters}$$

$$\sigma = 9.30$$

$$\sigma^2 = 86.45$$

$$\bar{X} = -.024 \text{ knots}$$

$$\sigma = .265$$

$$\sigma^2 = .070$$

$$\bar{X} = .028 \text{ knots}$$

$$\sigma = .175$$

$$\sigma^2 = .031$$

TABLE 24

LAUNCH 3

11 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
2	2077.7	2075.1	-7.52	-7.50	16.30	15.99
3	2422.0	2420.3	-6.13	-6.00	20.60	20.55
4	2671.6	2670.3	-14.99	-14.98	19.22	19.27
5	2926.7	2924.9	-17.41	-17.18	13.10	13.04
6	3216.4	3215.2	-22.73	-22.65	11.60	11.58
7	3527.2	3527.8	-27.81	-27.58	14.07	13.96
8	3863.0	3866.7	-24.44	-24.63	18.03	18.25
9	4197.5	4204.1	-22.32	-22.29	13.86	13.71
10	4530.0	4536.5	-23.22	-23.02	17.99	17.85
11	4842.9	4849.0	-25.63	-25.73	16.70	16.81
12	5123.3	5131.2	-21.78	-21.70	18.85	18.71
13	5377.4	5387.8	-17.20	-17.19	18.87	18.94
14	5621.5	5624.5	-22.89	-23.09	19.68	19.82
15	5866.5	5863.5	-19.29	-19.26	24.03	24.05
16	6114.2	6116.5	-11.30	-11.18	24.90	24.50
17	6383.1	6390.5	-12.13	-11.88	26.05	26.14
18	6681.6	6694.3	-7.32	-7.52	21.76	21.98
19	7003.7	7018.4	-5.61	-5.50	19.24	19.18
20	7341.0	7352.5	-3.97	-4.04	22.03	21.98
21	7687.1	7697.8	-1.60	-1.62	22.44	22.33
22	8029.9	8040.6	-0.70	-0.95	26.88	26.60
23	8366.2	8375.8	1.75	1.85	31.58	31.61
24	8691.7	8696.6	-1.36	-1.50	36.87	36.65
25	8984.6	8980.5	-8.39	-8.31	39.53	39.58
26	9277.4	9270.8	7.28	7.09	45.21	44.93
27	9599.6	9591.7	16.03	15.91	58.19	58.10
28	9922.6	9914.5	17.15	17.27	61.25	61.12
29	10240.0	10232.2	11.67	11.87	67.85	67.77
30	10549.6	10540.9	13.59	13.63	59.56	59.89
31	10850.5	10843.9	30.96	30.53	62.19	61.77
32	11150.3	11144.5	38.60	38.43	78.78	78.35
33	11468.4	11466.9	19.90	20.23	83.75	83.49
34	11804.1	11808.4	3.31	3.47	64.61	65.00
35	12130.7	12138.7	-3.60	-3.48	47.22	47.30
36	12449.0	12459.0	-12.45	-12.54	44.33	44.23
37	12777.0	12784.0	-4.82	-4.81	38.43	38.65
38	13104.5	13114.2	11.79	11.62	44.33	43.92
39	13421.1	13431.4	11.49	11.91	52.69	52.63
40	13737.0	13743.8	3.80	3.73	57.12	57.25
41	14059.5	14073.0	4.34	4.46	54.33	54.12
42	14389.8	14405.5	1.25	0.98	46.58	46.86

LAUNCH 3 (Cont)

11 February 1977

Time	H MSL Meters		-N+S	Knots	-E+W	Knots
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
43	14720.5	14733.3	4.14	4.14	48.45	48.39
44	15047.7	15063.8	-1.37	-1.09	49.98	49.89
45	15370.1	15391.8	-2.04	-2.50	40.19	40.24
46	15694.0	15720.1	0.01	0.18	24.96	25.06
47	16035.4	16059.1	10.10	9.75	28.72	28.71
48	16391.0	16412.6	18.97	19.22	33.52	33.25
49	16761.9	16781.1	14.93	14.79	35.94	36.16
50	17141.7	17159.5	8.08	8.22	30.44	30.30
51	17517.8	17539.9	7.09	6.85	29.18	29.16
52	17903.3	17930.3	1.21	1.00	25.92	25.70
53	18272.4	18296.9	-0.23	0.00	26.17	26.42
54	18615.4	18643.8	1.78	1.87	16.50	16.39
55	18958.9	18997.7	7.02	6.74	3.65	3.60
56	19295.0	19341.7	2.35	1.83	10.61	10.59
57	19657.8	19698.6	-0.54	-0.17	12.19	12.38
58	20052.8	20084.5	4.85	4.92	18.87	18.75
59	20453.4	20487.5	1.58	1.60	23.31	23.17
60	20864.9	20900.1	6.80	6.70	8.69	8.96
61	21281.4	21318.4	-0.82	-0.50	17.28	16.85
62	21702.6	21732.3	-10.14	-10.70	11.67	12.02
63	22129.1	22154.5	-2.61	-2.11	12.90	13.01
64	22556.0	22580.9	-4.43	-4.25	11.49	11.22
65	22979.4	22996.2	2.72	2.52	5.09	5.53
66	23427.1	23438.4	4.99	4.91	6.69	6.50
67	23880.6	23894.7	4.30	3.78	14.72	14.31
68	24304.2	24323.9	8.51	9.05	23.95	23.84
69	24733.0	24747.7	5.27	5.52	25.56	25.73
70	25176.3	25196.3	-0.84	-0.88	24.80	24.46
71	25636.8	25651.8	-4.39	-4.45	25.17	25.37
72	26093.1	26095.0	-2.40	-2.56	31.64	31.59
73	26528.0	26536.2	4.25	4.36	32.65	32.32
74	26990.8	27006.3	11.67	11.37	40.80	40.48

$\bar{X} = -12.17 \text{ meters}$

$\sigma = 12.75$

$\sigma^2 = 162.60$

$\bar{X} = - .002 \text{ knots}$

$\sigma = .232$

$\sigma^2 = .054$

$\bar{X} = .048 \text{ knots}$

$\sigma = .217$

$\sigma^2 = .047$

TABLE 25
MEAN, STANDARD DEVIATION AND VARIANCE
OF SPEED AND DIRECTION
7 February 1977

LAUNCH 1

$$\bar{X}_s = .045 \text{ knots} \quad \sigma_s = .182 \text{ knots} \quad \sigma_s^2 = .033 \text{ knots}^2 \quad \bar{V} = 37.54 \text{ knots}$$

$$\bar{X}_\theta = -.102 \text{ deg} \quad \sigma_\theta = .777 \text{ deg} \quad \sigma_\theta^2 = .604 \text{ deg}^2$$

LAUNCH 2

$$\bar{X}_s = .038 \text{ knots} \quad \sigma_s = .243 \text{ knots} \quad \sigma_s^2 = .059 \text{ knots}^2 \quad \bar{V} = 32.45 \text{ knots}$$

$$\bar{X}_\theta = .002 \text{ deg} \quad \sigma_\theta = .957 \text{ deg} \quad \sigma_\theta^2 = .915 \text{ deg}^2$$

8 February 1977

LAUNCH 1

$$\bar{X}_s = .077 \text{ knots} \quad \sigma_s = .159 \text{ knots} \quad \sigma_s^2 = .025 \text{ knots}^2 \quad \bar{V} = 30.91 \text{ knots}$$

$$\bar{X}_\theta = -.119 \text{ deg} \quad \sigma_\theta = 1.147 \text{ deg} \quad \sigma_\theta^2 = 1.316 \text{ deg}^2$$

LAUNCH 2

$$X_s = .050 \text{ knots} \quad \sigma_s = .167 \text{ knots} \quad \sigma_s^2 = .028 \text{ knots}^2 \quad \bar{V} = 27.84 \text{ knots}$$

$$\bar{X}_\theta = .056 \text{ deg} \quad \sigma_\theta = .797 \text{ deg} \quad \sigma_\theta^2 = .635 \text{ deg}^2$$

LAUNCH 3

$$\bar{X}_s = .046 \text{ knots} \quad \sigma_s = .397 \text{ knots} \quad \sigma_s^2 = .157 \text{ knots}^2 \quad \bar{V} = 27.25 \text{ knots}$$

$$\bar{X}_\theta = -.623 \text{ deg} \quad \sigma_\theta = 3.681 \text{ deg} \quad \sigma_\theta^2 = 13.549 \text{ deg}^2$$

9 February 1977

LAUNCH 1

$$\bar{x}_s = .031 \text{ knots} \quad \sigma_s = .212 \text{ knots} \quad \sigma_s^2 = .045 \text{ knots}^2 \quad \bar{V} = 24.98 \text{ knots}$$

$$\bar{x}_\theta = -.121 \text{ deg} \quad \sigma_\theta = .687 \text{ deg} \quad \sigma_\theta^2 = .472 \text{ deg}^2$$

LAUNCH 2

$$\bar{x}_s = .052 \text{ knots} \quad \sigma_s = .144 \text{ knots} \quad \sigma_s^2 = .021 \text{ knots}^2 \quad \bar{V} = 26.92 \text{ knots}$$

$$\bar{x}_\theta = .154 \text{ deg} \quad \sigma_\theta = 1.731 \text{ deg} \quad \sigma_\theta^2 = 2.996 \text{ deg}^2$$

10 February 1977

LAUNCH 1

$$\bar{x}_s = .030 \text{ knots} \quad \sigma_s = .258 \text{ knots} \quad \sigma_s^2 = .066 \text{ knots}^2 \quad \bar{V} = 42.26 \text{ knots}$$

$$\bar{x}_\theta = -.258 \text{ deg} \quad \sigma_\theta = 2.728 \text{ deg} \quad \sigma_\theta^2 = 7.442 \text{ deg}^2$$

LAUNCH 2

$$\bar{x}_s = .081 \text{ knots} \quad \sigma_s = .135 \text{ knots} \quad \sigma_s^2 = .018 \text{ knots}^2 \quad \bar{V} = 63.78 \text{ knots}$$

$$\bar{x}_\theta = .016 \text{ deg} \quad \sigma_\theta = .136 \text{ deg} \quad \sigma_\theta^2 = .019 \text{ deg}^2$$

LAUNCH 3

$$\bar{x}_s = .047 \text{ knots} \quad \sigma_s = .270 \text{ knots} \quad \sigma_s^2 = .073 \text{ knots}^2 \quad \bar{V} = 44.06 \text{ knots}$$

$$\bar{x}_\theta = -.039 \text{ deg} \quad \sigma_\theta = .559 \text{ deg} \quad \sigma_\theta^2 = .312 \text{ deg}^2$$

11 February 1977

LAUNCH 2

$$\bar{x}_s = .063 \text{ knots} \quad \sigma_s = .269 \text{ knots} \quad \sigma_s^2 = .073 \text{ knots}^2 \quad \bar{V} = 35.95 \text{ knots}$$

$$\bar{x}_\theta = -.018 \text{ deg} \quad \sigma_\theta = .928 \text{ deg} \quad \sigma_\theta^2 = .862 \text{ deg}^2$$

LAUNCH 3

$$\bar{x}_s = .059 \text{ knots} \quad \sigma_s = .232 \text{ knots} \quad \sigma_s^2 = .054 \text{ knots}^2 \quad \bar{V} = 33.30 \text{ knots}$$

$$\bar{x}_\theta = -.039 \text{ deg} \quad \sigma_\theta = .743 \text{ deg} \quad \sigma_\theta^2 = .552 \text{ deg}^2$$

TABLE 26
MEAN, STANDARD DEVIATION AND VARIANCE OF
HEIGHT AND COMPONENT WINDS

7 February 1977

LAUNCH 1

$\bar{X}_H = -7.6 \text{ M}$	$\sigma_H = 24.9 \text{ M}$	$\sigma_H^2 = 621.33 \text{ M}^2$
$\bar{X}_{N-S} = -.017 \text{ Kt}$	$\sigma_{N-S} = .263 \text{ Kt}$	$\sigma_{N-S}^2 = .069 \text{ Kt}^2$
$\bar{X}_{E-W} = .025 \text{ Kt}$	$\sigma_{E-W} = .193 \text{ Kt}$	$\sigma_{E-W}^2 = .037 \text{ Kt}^2$

LAUNCH 2

$\bar{X}_H = -10.75 \text{ M}$	$\sigma_H = 18.3 \text{ M}$	$\sigma_H^2 = 336.66 \text{ M}^2$
$\bar{X}_{N-S} = -.041 \text{ Kt}$	$\sigma_{N-S} = .377 \text{ Kt}$	$\sigma_{N-S}^2 = .124 \text{ Kt}^2$
$\bar{X}_{E-W} = .019 \text{ Kt}$	$\sigma_{E-W} = .773 \text{ Kt}$	$\sigma_{E-W}^2 = .591 \text{ Kt}^2$

8 February 1977

LAUNCH 1

$\bar{X}_H = 14.32 \text{ M}$	$\sigma_H = 8.97 \text{ M}$	$\sigma_H^2 = 80.46 \text{ M}^2$
$\bar{X}_{N-S} = .023 \text{ Kt}$	$\sigma_{N-S} = .200 \text{ Kt}$	$\sigma_{N-S}^2 = .040 \text{ Kt}^2$
$\bar{X}_{E-W} = .059 \text{ Kt}$	$\sigma_{E-W} = .195 \text{ Kt}$	$\sigma_{E-W}^2 = .038 \text{ Kt}^2$

LAUNCH 2

$\bar{X}_H = 9.87 \text{ M}$	$\sigma_H = 14.56 \text{ M}$	$\sigma_H^2 = 211.87 \text{ M}^2$
$\bar{X}_{N-S} = .031 \text{ Kt}$	$\sigma_{N-S} = .180 \text{ Kt}$	$\sigma_{N-S}^2 = .032 \text{ Kt}^2$
$\bar{X}_{E-W} = .039 \text{ Kt}$	$\sigma_{E-W} = .184 \text{ Kt}$	$\sigma_{E-W}^2 = .034 \text{ Kt}^2$

February 8 1979 (Cont'd)

LAUNCH 3

$$\begin{array}{lll} \bar{x}_H = 32.02 \text{ M} & \sigma_H = 3.93 \text{ M} & \sigma_H^2 = 15.44 \text{ M}^2 \\ \bar{x}_{N-S} = .042 \text{ Kt} & \sigma_{N-S} = .324 \text{ Kt} & \sigma_{N-S}^2 = .105 \text{ Kt}^2 \\ \bar{x}_{E-W} = .062 \text{ Kt} & \sigma_{E-W} = .408 \text{ Kt} & \sigma_{E-W}^2 = .166 \text{ Kt}^2 \end{array}$$

9 February 1977

LAUNCH 1

$$\begin{array}{lll} \bar{x}_H = 12.51 \text{ M} & \sigma_H = 9.03 \text{ M} & \sigma_H^2 = 81.59 \text{ M}^2 \\ \bar{x}_{N-S} = .011 \text{ Kt} & \sigma_{N-S} = .138 \text{ Kt} & \sigma_{N-S}^2 = .019 \text{ Kt}^2 \\ \bar{x}_{E-W} = .057 \text{ Kt} & \sigma_{E-W} = .207 \text{ Kt} & \sigma_{E-W}^2 = .043 \text{ Kt}^2 \end{array}$$

LAUNCH 2

$$\begin{array}{lll} \bar{x}_H = 7.10 \text{ M} & \sigma_H = 11.03 \text{ M} & \sigma_H^2 = 121.64 \text{ M}^2 \\ \bar{x}_{N-S} = .011 \text{ Kt} & \sigma_{N-S} = .200 \text{ Kt} & \sigma_{N-S}^2 = .040 \text{ Kt}^2 \\ \bar{x}_{E-W} = .042 \text{ Kt} & \sigma_{E-W} = .140 \text{ Kt} & \sigma_{E-W}^2 = .019 \text{ Kt}^2 \end{array}$$

10 February 1977

LAUNCH 1

$$\begin{array}{lll} \bar{x}_H = -20.58 \text{ M} & \sigma_H = 20.25 \text{ M} & \sigma_H^2 = 410.18 \text{ M}^2 \\ \bar{x}_{N-S} = .006 \text{ Kt} & \sigma_{N-S} = .354 \text{ Kt} & \sigma_{N-S}^2 = .126 \text{ Kt}^2 \\ \bar{x}_{E-W} = .019 \text{ Kt} & \sigma_{E-W} = .260 \text{ Kt} & \sigma_{E-W}^2 = .067 \text{ Kt}^2 \end{array}$$

10 February 1979 (Cont'd)

LAUNCH 2

$$\begin{array}{lll} \bar{x}_H = -5.35 \text{ M} & \sigma_H = 12.53 \text{ M} & \sigma_H^2 = 157.00 \text{ M}^2 \\ \bar{x}_{N-S} = -.001 \text{ Kt} & \sigma_{N-S} = .238 \text{ Kt} & \sigma_{N-S}^2 = .056 \text{ Kt}^2 \\ \bar{x}_{E-W} = .068 \text{ Kt} & \sigma_{E-W} = .208 \text{ Kt} & \sigma_{E-W}^2 = .043 \text{ Kt}^2 \end{array}$$

LAUNCH 3

$$\begin{array}{lll} \bar{x}_H = -22.52 \text{ M} & \sigma_H = 15.49 \text{ M} & \sigma_H^2 = 240.06 \text{ M}^2 \\ \bar{x}_{N-S} = -.003 \text{ Kt} & \sigma_{N-S} = .278 \text{ Kt} & \sigma_{N-S}^2 = .077 \text{ Kt}^2 \\ \bar{x}_{E-W} = .040 \text{ Kt} & \sigma_{E-W} = .258 \text{ Kt} & \sigma_{E-W}^2 = .067 \text{ Kt}^2 \end{array}$$

11 February 1977

LAUNCH 1

$$\begin{array}{lll} \bar{x}_H = -11.56 \text{ M} & \sigma_H = 9.30 \text{ M} & \sigma_H^2 = 86.45 \text{ M}^2 \\ \bar{x}_{N-S} = -.024 \text{ Kt} & \sigma_{N-S} = .265 \text{ Kt} & \sigma_{N-S}^2 = .070 \text{ Kt}^2 \\ \bar{x}_{E-W} = .028 \text{ Kt} & \sigma_{E-W} = .175 \text{ Kt} & \sigma_{E-W}^2 = .031 \text{ Kt}^2 \end{array}$$

LAUNCH 2

$$\begin{array}{lll} \bar{x}_H = -12.17 \text{ M} & \sigma_H = 12.75 \text{ M} & \sigma_H^2 = 162.60 \text{ M}^2 \\ \bar{x}_{N-S} = -.002 \text{ Kt} & \sigma_{N-S} = .232 \text{ Kt} & \sigma_{N-S}^2 = .054 \text{ Kt}^2 \\ \bar{x}_{E-W} = .048 \text{ Kt} & \sigma_{E-W} = .217 \text{ Kt} & \sigma_{E-W}^2 = .047 \text{ Kt}^2 \end{array}$$

TABLE 27
MEANS, STANDARD DEVIATIONS AND VARIANCES
OF ALL RUNS TAKEN TOGETHER

$\bar{X}_s = .049$ knots	$\sigma_s = .236$ knots	$\sigma_s^2 = .056$ knots 2	$\bar{V} = 33.94$ knots
$\bar{X}_\theta = -.096$ deg	$\sigma_\theta = 1.657$ deg	$\sigma_\theta^2 = 2.747$ deg 2	
$\bar{X}_H = 3.491$ meters	$\sigma_H = 21.327$ meters	$\sigma_H^2 = 454.860$ meters 2	
$\bar{X}_{N-S} = .004$ knots	$\sigma_{N-S} = .265$ knots	$\sigma_{N-S}^2 = .070$ knots 2	
$\bar{X}_{E-W} = .040$ knots	$\sigma_{E-W} = .323$ knots	$\sigma_{E-W}^2 = .104$ knots 2	

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