NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, D.C. 20594

November 16, 2006

Aircraft Performance Study

I. ACCIDENT

NTSB Number:	DCA07MA003
Description:	Midair collision with apartment building
Location:	Manhattan, New York
Date:	October 11, 2006
Time:	1442 Eastern Daylight Time (EDT)
Aircraft:	Cirrus Design SR-20, N929CD

II. GROUP

Chairman	Kevin J. Renze, Ph.D. National Transportation Safety Board Vehicle Performance Division, RE-60

1.0 INTRODUCTION

On October 11, 2006, about 1442 eastern daylight time, a Cirrus Design SR-20, N929CD, crashed into an apartment building while maneuvering above Manhattan, New York. The airplane was destroyed by impact forces and a post-crash fire. The certificated private pilot owner of the airplane, and a certified flight instructor were fatally injured. Marginal Visual Flight Rules conditions prevailed, and no flight plan was filed for the flight that departed Teterboro Airport (TEB), Teterboro, New Jersey. The personal sightseeing flight was conducted under the provisions of 14 Code of Federal Regulations Part 91. There were 1 severe and 2 minor injuries on the ground.

2.0 RADAR DATA

Federal Aviation Administration (FAA) radar data were collected from the Newark (EWR), White Plains (HPN), and New York (JFK) Airport Surveillance Radar (ASR-9) sites. The radar data were provided in Continuous Data Recording (CDR) format. Radar data corresponding to beacon codes 0312[1] and 1200 were extracted and beacon code 1200 data were subsequently sorted to isolate the accident flight.

[1] The accident flight was squawking beacon code 0312 at departure from Teterboro, NJ and beacon code 1200 at the time of the accident.

The ASR-9 antenna has the capability of tracking targets up to 60 nautical miles. The antenna rotates at about 13 revolutions per minute, providing a status of the range, azimuth, mode C altitude and a return time stamp every 4.6 seconds. The measurement tolerances for the ASR-9 radar range, azimuth, and altitude data are ±1/16 nm (±380 feet), ±2 azimuth pulse counts (±0.176°), and ±50 feet, respectively.

The accident flight range-azimuth data were converted to latitude-longitude coordinates using the radar site data listed in Table 1. The radar-based airplane ground track is presented in Attachment 1, Figures 1-2. Beacon code 1200 radar data for the accident flight are documented in Attachments 3-5 for the EWR, HPN, and JFK sites, respectively.

Table 1: FAA radar site data.

Station	Location (latitude/longitude)	Magnetic Variation (°)	Elevation (feet)	DataTime Range, UTC (hhmm:ss.ss)
EWR	N40-40-23.61, W074-11-08.69	W13	3.9	1832:52.60 to 1841:35.05
HPN	N41-04-22.03, W073-42-55.31	W13	439.7	1832:53.47 to 1841:35.14
JFK	N40-38-22.4, W073-45-59.20	W13	13	1832:56.20 to 1841:38.50

3.0 AIRPLANE TURN PERFORMANCE

The accident flight was traveling in a north to northeasterly direction along the east channel of the East River at an altitude of 600 feet and attempted a 180° turn to the west near the Roosevelt Island bridge. A commercial aircraft that landed at Newark Liberty International Airport (KEWR) at the time of the accident was equipped with a weather reporting capability that indicated that the winds at 700 feet pressure altitude were from 095 degrees at 13 knots.

The airplane turn performance and the effects of the easterly wind on the airplane during the turn were evaluated by calculating bank angle, normal load factor, and drift due to wind as a function of airspeed and turn diameter. The calculated bank angle, normal load factor, and drift due to wind as a function of airspeed during a steady, level 180° turn for turn diameters between 1,000 and 2,400 feet are presented in Attachment 2, Figures 3-5. Performance calculations were based on a Cirrus Design SR-20 clean wing stall speed of 67 knots, an assumed airplane weight of 3,000 pounds, a wing reference area of 135.2 square feet, and a maximum lift coefficient of 1.46.

Radar data indicate that the airplane was flying over the East Channel of the East River at groundspeeds between 90 and 100 knots prior to initiating a 180° turn. At the turn location, the East River is about 2,100 feet wide and the East Channel is about 700 feet wide. If the airplane was located over the middle of the East Channel at the start of the turn, the available turn width would have been about 1,750 feet. At an assumed airspeed of 97 knots, the prevailing wind from the east would have caused the airplane to drift about 300 to 400[2] feet toward the buildings during the turn, reducing the available turn width to about 1,400 feet.

A 2,100-foot turn diameter at 97 knots would have required a constant bank angle of about 39° and a load factor of 1.3 Gs on the airplane. However, a 1,400-foot turn diameter at 97 knots would have required a constant bank angle of 50° and a load factor of 1.55 Gs. At this airspeed, the wing would stall if the bank angle exceeded 61°. If the airspeed decreased during the turn, for example, due to a tailwind component, the bank angle margin to stall

[2] The calculated westward drift is about 300 feet based on a turn diameter of 1,750 feet and about 400 feet based on a turn diameter of 2,100 feet (see Attachment 2, Figure 5).

would also decrease. If the initial portion of the turn was less aggressive than a constant bank angle of 50°, a sufficiently greater bank angle would have been required as the turn progressed, which would have placed the airplane dangerously close to an aerodynamic stall.

4.0 SUMMARY

The radar data indicate that the accident flight was traveling in a north to northeasterly direction over the East Channel of the East River at an altitude of about 600 feet when it attempted a 180° turn. During the turn the airplane collided with an apartment building and the airplane was destroyed. The reported winds were 095 degrees at 13 knots. Airplane steady, level turn performance calculations indicate that the easterly winds would have decreased the available turn diameter and required the pilot to plan for and accomplish an aggressive turn within the airplane stall constraints.

Attachment 1: Radar Data Plots

Figure 1: Color encoded radar ground track data with UTC time and altitude (Roosevelt Island is shown in center of image).

DeLORME

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ACCIDENT SITE
332 ft

EWR RADAR
HPN RADAR
JFK RADAR

WINDS 095 AT 13 KNOTS

SCALE
0 1000 FEET

18:41:35 700 ft
18:41:35 600 ft
18:41:39 500 ft
18:41:31 700 ft
18:41:29 700 ft
18:41:26 600 ft
18:41:24 600 ft
18:41:21 600 ft
18:41:20 600 ft
18:41:15 600 ft
18:41:17 600 ft
18:41:12 600 ft
18:41:12 600 ft
18:41:11 600 ft
18:41:08 600 ft
18:41:06 600 ft
18:41:03 600 ft
18:41:03 600 ft
18:41:01 600 ft
18:40:58 600 ft
18:40:57 600 ft
18:40:58 600 ft
18:40:54 600 ft
18:40:54 600 ft
18:40:52 600 ft
18:40:49 600 ft
18:40:49 600 ft
18:40:48 600 ft
18:40:44 600 ft
18:40:44 500 ft
18:40:43 500 ft
18:40:40 500 ft
18:40:40 500 ft
:40:38 600 ft

Roosevelt Island
West Channel
East Channel
Queensboro Bridge
Rockefeller University

E 72ND ST, E 75TH ST, E 74TH ST, E 73RD ST, E 71ST ST, E 70TH ST, E 69TH ST, E 68TH ST, E 67TH ST, E 66TH ST, E 65TH ST, E 63RD ST, E 62ND ST, E 61ST ST, E 60TH ST, E 58TH ST
1ST AVE, 2ND AVE, YORK AVE
F D R DR
WEST RD, EAST RD, MAIN ST, ROAD 10, CENTRAL RD N, ROAD 6, ROAD 5, ROAD 3, RIVER RD
ROOSEVELT ISLAND BRG
35TH AVE, 36TH AVE, 37TH AVE, 38TH AVE, 40TH AVE, 41ST AVE, 43RD AVE, 44TH AVE, 45TH AVE, 44TH DR, 44TH RD, 45TH RD
VERNON BLVD, 5TH ST, 10TH ST, 11TH ST, 12TH ST, 13TH ST, 21ST ST, 22ND ST, 24TH ST, 9TH ST, 43RD AVE, 43RD RD
QUEENS PLZ S, QUEENS PLZ N, 41ST RD, HUNTER ST, 11TH PL

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TN
MN (0.0°E)

Scale 1 : 6,400
1" = 533.3 ft
Data Zoom 15-0

Figure 2: Radar data points from EWR, HPN, and JFK ASR-9 radar sites connected with respective straight line segments, projected to the earth's surface, and overlaid on satellite image (Roosevelt Island is shown in the center of the image).

Attachment 2: Calculated Steady, Level 180° Turn Data

Figure 3: Calculated Cirrus SR-20 Bank Angle to Complete a Steady, Level, 180° Turn

(Assumptions: Clean wing, CL_{max} = 1.46, W = 3000 lb, V_{stall} = 67 knots)

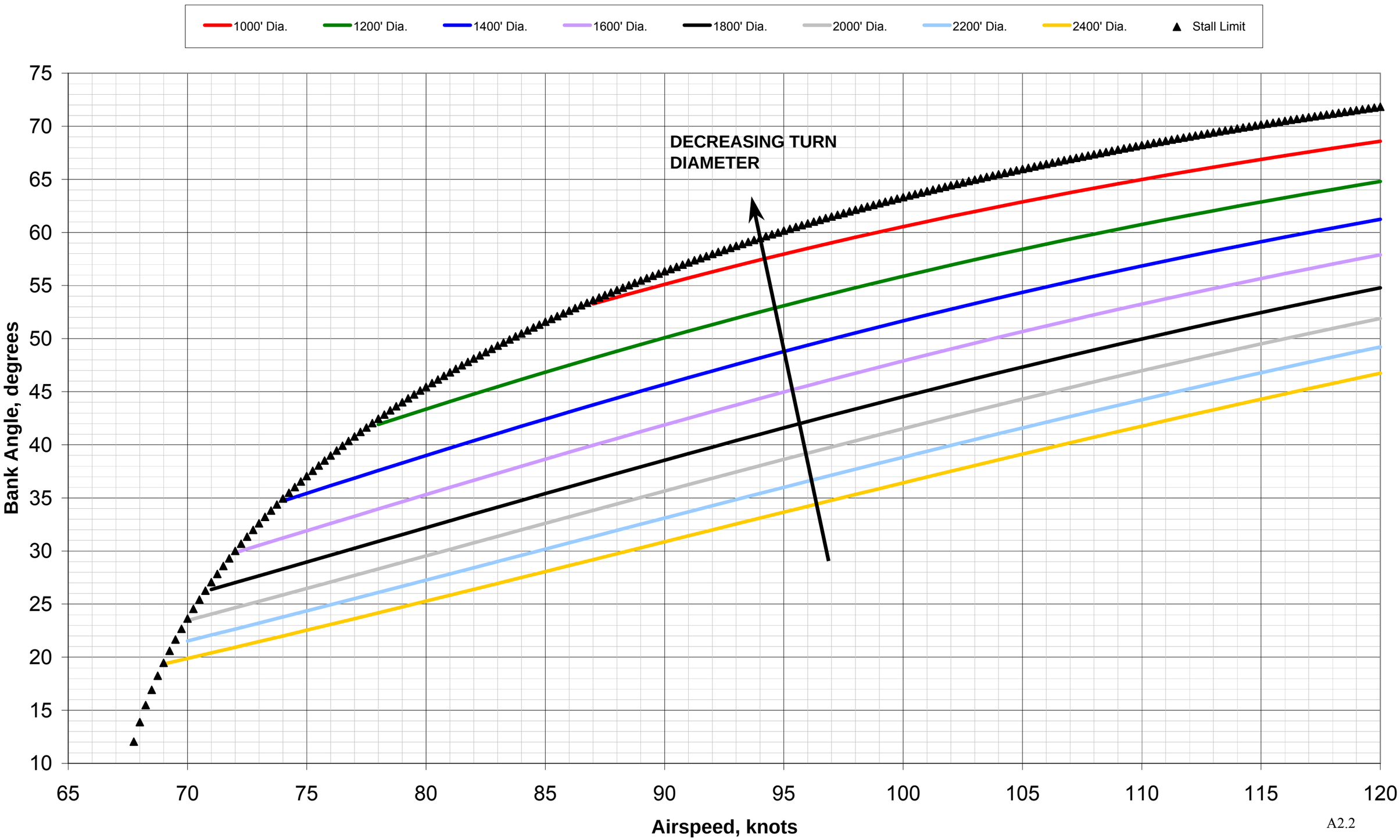


Figure 4: Calculated Cirrus SR-20 Load Factor to Complete a Steady, Level, 180° Turn

(Assumptions: Clean wing, CL_{max} = 1.46, W = 3000 lb, V_{stall} = 67 knots)

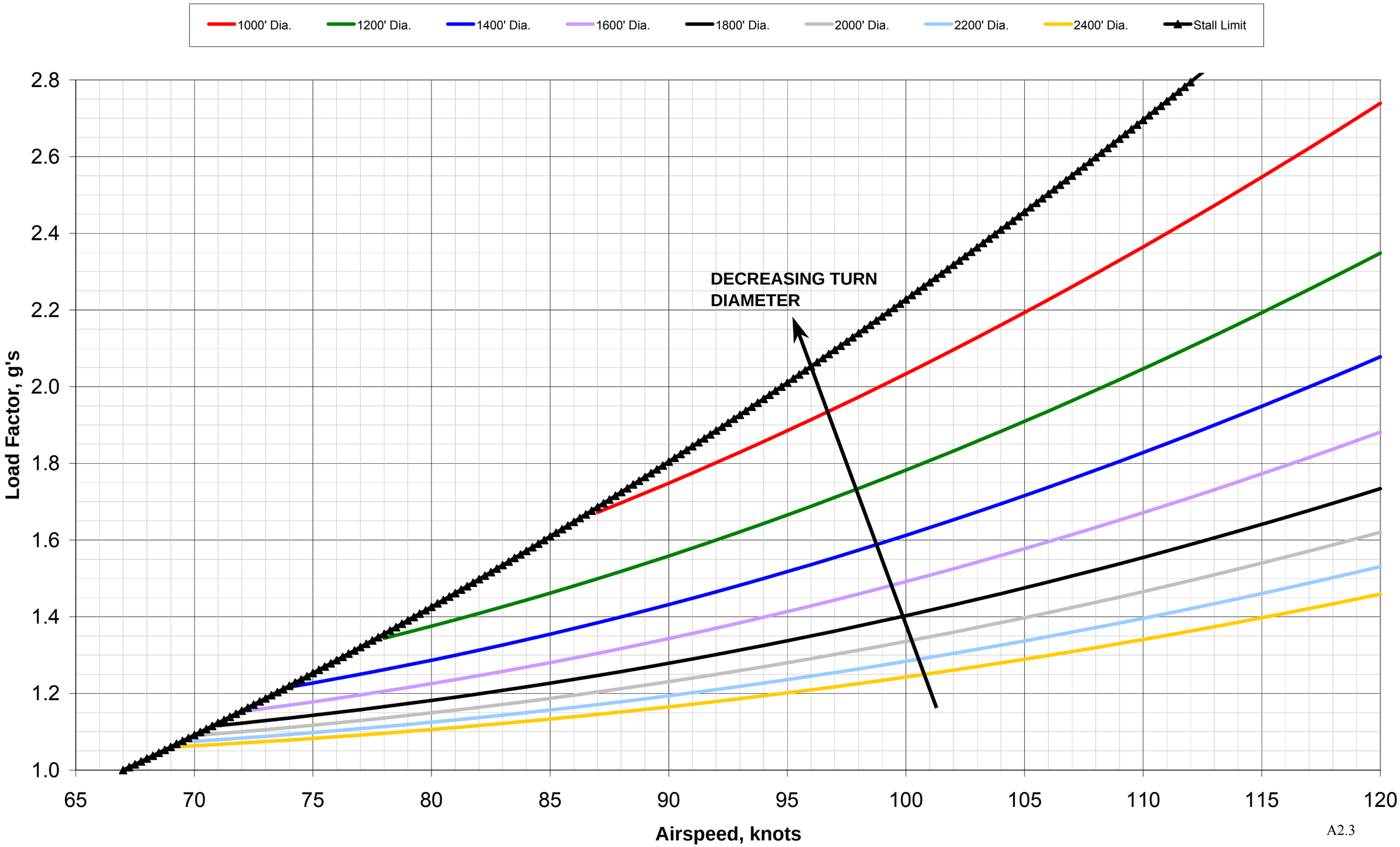
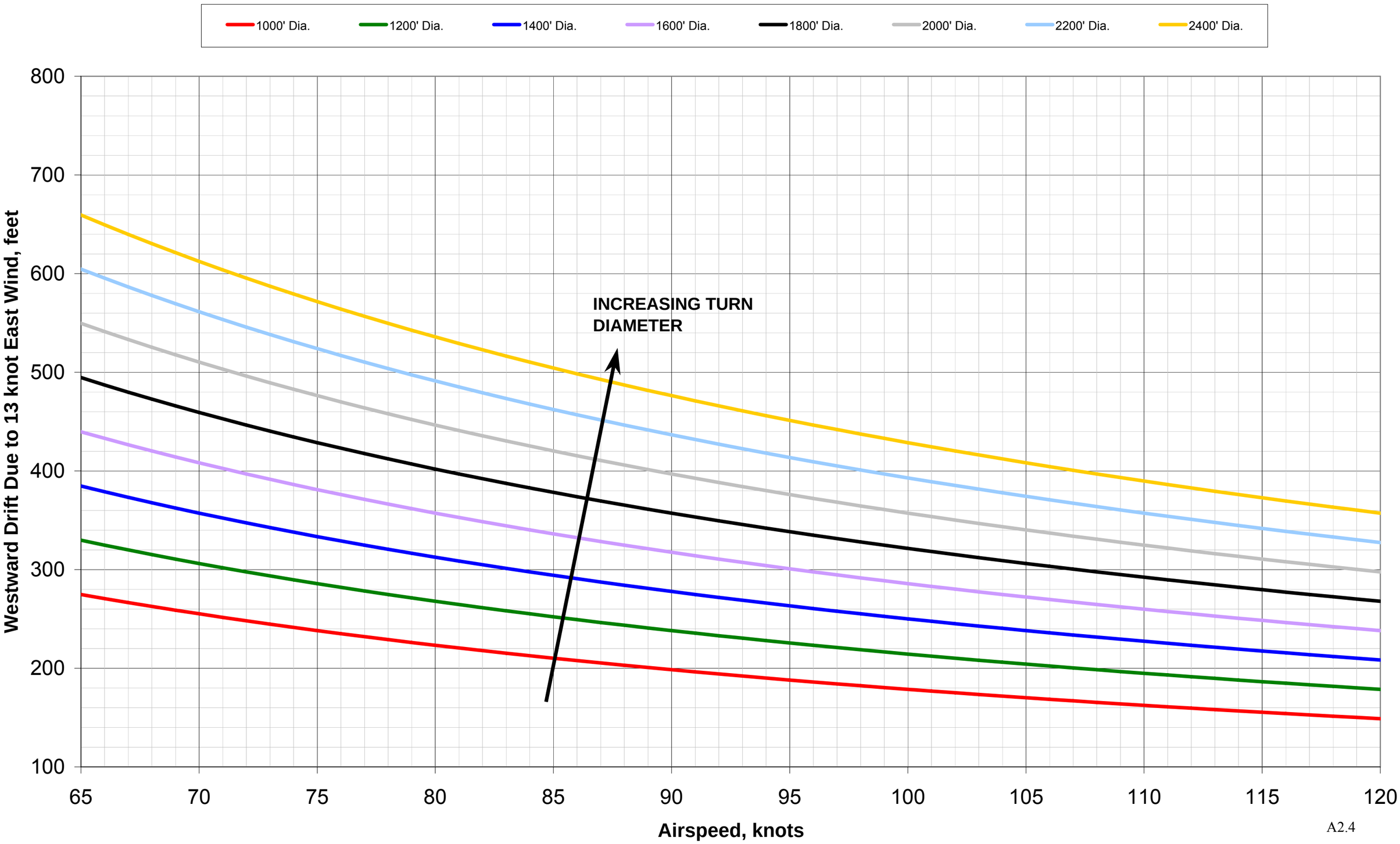


Figure 5: Calculated Cirrus SR-20 Westward Drift During a Steady, Level, 180° Turn

(Assumptions: Clean wing, CL_{max} = 1.46, W = 3000 lb, V_{stall} = 67 knots)



Attachment 3: ASR-9 Radar Data (EWR)

HOURS	MINUTES	SECONDS	RANGE (NM)	AZIMUTH (ACP)	ALTITUDE (FEET)
18	32	52.6	11.7	714	500
18	32	57.22	11.55	716	500
18	33	1.99	11.39	724	500
18	33	6.58	11.23	728	500
18	33	11.08	11.08	730	500
18	33	15.85	10.92	732	500
18	33	20.47	10.77	739	500
18	33	25.09	10.61	742	500
18	33	29.86	10.45	746	500
18	33	34.33	10.3	751	600
18	33	38.95	10.16	754	600
18	33	43.72	10.02	760	600
18	33	48.34	9.88	763	600
18	33	52.96	9.72	767	600
18	33	57.58	9.59	773	600
18	34	2.05	9.45	778	500
18	34	6.67	9.31	785	500
18	34	16.06	9.05	797	600
18	34	20.68	8.92	805	600
18	34	25.3	8.78	814	600
18	34	34.54	8.58	830	600
18	34	39.16	8.47	839	600
18	34	43.78	8.38	849	700
18	34	48.43	8.3	857	700
18	34	53.17	8.22	867	700
18	34	57.64	8.13	878	700
18	35	2.26	8.06	888	700
18	35	6.88	7.97	900	700
18	35	11.5	7.89	910	700
18	35	16.12	7.8	919	700
18	35	20.92	7.72	932	700
18	35	25.51	7.66	943	600
18	35	34.78	7.52	968	600
18	35	39.4	7.44	983	600
18	35	43.99	7.38	994	600
18	35	48.64	7.3	1005	600
18	35	53.38	7.19	1015	600
18	35	57.88	7.08	1028	600
18	36	2.62	6.94	1036	600
18	36	7.24	6.78	1044	600
18	36	11.89	6.61	1046	600
18	36	16.48	6.42	1049	600
18	36	21.1	6.27	1055	600

18	36	25.72	6.14	1065	700
18	36	30.34	6.03	1077	700
18	36	34.96	6	1092	700
18	36	39.61	6.02	1107	700
18	36	44.2	6.11	1118	700
18	36	48.82	6.22	1125	700
18	36	53.56	6.34	1125	600
18	36	58.06	6.48	1121	600
18	37	2.68	6.61	1118	500
18	37	7.33	6.73	1115	500
18	37	11.92	6.88	1109	500
18	37	16.66	7	1102	600
18	37	21.16	7.13	1097	600
18	37	25.78	7.23	1092	600
18	37	30.4	7.36	1087	600
18	37	34.99	7.48	1083	600
18	37	39.64	7.59	1079	600
18	37	44.26	7.72	1075	600
18	37	48.88	7.84	1072	600
18	37	53.35	7.97	1067	600
18	37	58.12	8.09	1064	600
18	38	2.74	8.22	1061	600
18	38	7.36	8.33	1055	600
18	38	11.98	8.45	1048	600
18	38	16.6	8.58	1043	600
18	38	20.92	8.7	1037	600
18	38	25.57	8.83	1035	600
18	38	30.46	8.95	1031	600
18	38	34.93	9.08	1021	600
18	39	16.54	10.13	1020	600
18	40	21.22	10.84	925	600
18	40	25.72	10.95	919	600
18	40	30.31	11.05	913	600
18	40	35.08	11.14	911	600
18	40	39.58	11.25	905	500
18	40	44.32	11.34	902	600
18	40	48.82	11.45	896	600
18	40	53.59	11.56	895	600
18	40	58.06	11.66	891	600
18	41	2.71	11.77	888	600
18	41	7.33	11.88	885	600
18	41	11.92	11.97	878	600
18	41	16.54	12.09	878	600
18	41	35.05	12.17	857	700

Attachment 4: ASR-9 Radar Data (HPN)

HOURS	MINUTES	SECONDS	RANGE (NM)	AZIMUTH (ACP)	ALTITUDE (FEET)
18	32	53.47	20.67	2618	500
18	32	58.09	20.84	2619	500
18	33	2.71	21	2619	500
18	33	7.33	21.17	2617	500
18	33	11.8	21.34	2616	500
18	33	16.54	21.52	2615	500
18	33	21.16	21.67	2615	500
18	33	25.78	21.84	2614	500
18	33	30.4	22	2612	500
18	33	35.02	22.16	2612	600
18	33	39.49	22.33	2612	600
18	33	44.23	22.48	2612	600
18	33	48.88	22.64	2611	600
18	33	53.32	22.8	2609	600
18	33	57.97	22.95	2609	600
18	34	2.56	23.11	2608	500
18	34	7.18	23.27	2607	500
18	34	11.8	23.42	2606	600
18	34	16.57	23.58	2604	600
18	34	21.16	23.73	2604	600
18	34	25.81	23.88	2602	600
18	34	30.25	24.03	2602	600
18	34	35.02	24.19	2599	600
18	34	39.64	24.33	2597	600
18	34	44.29	24.45	2596	700
18	34	48.88	24.59	2595	700
18	34	53.2	24.72	2592	700
18	34	57.97	24.84	2591	700
18	35	2.59	24.98	2589	700
18	35	7.18	25.11	2587	700
18	35	11.98	25.25	2585	700
18	35	16.45	25.39	2584	700
18	36	30.46	27.78	2581	700
18	37	39.46	26.78	2552	600
18	37	48.85	26.58	2548	600
18	37	53.41	26.47	2546	600
18	37	58.06	26.34	2545	600
18	38	2.8	26.23	2543	600
18	38	7.42	26.09	2544	600
18	38	12.04	25.95	2542	600
18	38	16.54	25.81	2540	600
18	38	21.13	25.69	2539	600
18	38	25.9	25.55	2540	600

18	38	30.4	25.44	2538	600
18	38	35.02	25.34	2536	600
18	38	39.61	25.27	2532	600
18	38	44.23	25.19	2530	600
18	38	48.97	25.11	2528	600
18	38	53.62	25.05	2523	500
18	38	58.06	24.98	2523	500
18	39	7.3	24.78	2518	600
18	39	11.92	24.67	2517	600
18	39	16.54	24.55	2516	600
18	39	21.16	24.44	2516	600
18	39	25.93	24.31	2517	500
18	39	35.02	24.09	2519	500
18	39	39.64	23.97	2521	500
18	39	44.26	23.86	2523	500
18	39	48.88	23.75	2524	500
18	39	53.5	23.64	2523	600
18	39	58.24	23.53	2526	600
18	40	2.77	23.42	2528	600
18	40	7.36	23.31	2529	600
18	40	11.98	23.2	2531	600
18	40	16.72	23.09	2532	600
18	40	21.37	22.97	2532	600
18	40	25.81	22.84	2534	600
18	40	30.49	22.72	2534	600
18	40	35.08	22.59	2535	600
18	40	39.73	22.47	2535	500
18	40	44.32	22.34	2534	500
18	40	48.82	22.22	2533	600
18	40	53.59	22.09	2533	600
18	40	58.21	21.97	2532	600
18	41	2.8	21.84	2532	600
18	41	7.6	21.72	2532	600
18	41	12.07	21.59	2532	600
18	41	16.66	21.47	2531	600
18	41	21.28	21.34	2532	600
18	41	25.9	21.22	2532	600
18	41	30.55	21.17	2536	700
18	41	35.14	21.2	2540	600

Attachment 5: ASR-9 Radar Data (JFK)

HOURS	MINUTES	SECONDS	RANGE (NM)	AZIMUTH (ACP)	ALTITUDE (FEET)
18	32	56.2	13.94	3705	500
18	33	0.97	13.89	3697	500
18	33	5.44	13.84	3689	500
18	33	10.18	13.81	3682	500
18	33	14.8	13.78	3671	500
18	33	19.15	13.75	3665	500
18	33	33.16	13.67	3642	600
18	33	42.4	13.64	3626	600
18	33	51.46	13.59	3612	600
18	33	56.26	13.58	3605	600
18	34	0.88	13.56	3599	500
18	34	5.5	13.53	3589	500
18	34	9.94	13.5	3581	500
18	34	14.74	13.47	3573	600
18	34	19.06	13.44	3565	600
18	34	23.95	13.41	3559	600
18	34	28.45	13.38	3551	600
18	34	33.07	13.34	3544	600
18	34	37.54	13.3	3534	600
18	34	42.34	13.25	3527	600
18	34	46.93	13.19	3521	700
18	34	51.55	13.16	3514	700
18	34	56.17	13.09	3508	700
18	35	0.64	13.05	3501	700
18	35	5.26	13.02	3493	700
18	35	10.06	12.98	3487	700
18	35	14.5	12.95	3479	700
18	35	19.27	12.91	3470	700
18	35	23.92	12.88	3463	600
18	35	28.39	12.83	3455	600
18	35	33.01	12.8	3448	600
18	35	37.6	12.75	3440	600
18	35	42.22	12.73	3431	600
18	35	46.99	12.7	3423	600
18	35	51.64	12.72	3416	600
18	35	56.08	12.75	3406	600
18	36	0.73	12.81	3401	600
18	36	5.2	12.91	3391	600
18	36	9.94	13.05	3390	600
18	36	14.44	13.19	3381	600
18	36	23.83	13.44	3371	700
18	36	28.45	13.5	3362	700
18	36	33.1	13.52	3357	700

18	36	37.57	13.47	3349	700
18	36	42.34	13.38	3344	700
18	36	46.96	13.25	3342	700
18	36	51.58	13.13	3343	700
18	36	56.05	13	3345	600
18	37	0.79	12.89	3348	500
18	37	5.29	12.78	3354	500
18	37	9.88	12.66	3357	500
18	37	14.5	12.56	3362	600
18	37	19.3	12.47	3368	600
18	37	23.89	12.38	3373	600
18	37	28.39	12.28	3376	600
18	37	33.16	12.19	3381	600
18	37	37.78	12.09	3391	600
18	37	42.4	12	3391	600
18	37	47.02	11.91	3396	600
18	37	51.61	11.8	3400	600
18	37	56.26	11.7	3406	600
18	38	0.88	11.61	3411	600
18	38	5.5	11.55	3418	600
18	38	10.12	11.47	3425	600
18	38	14.74	11.41	3433	600
18	38	19.36	11.33	3440	600
18	38	23.98	11.25	3447	600
18	38	33.37	11.08	3458	600
18	38	37.99	10.98	3462	600
18	38	42.49	10.88	3466	600
18	38	47.08	10.77	3470	600
18	38	51.88	10.66	3473	500
18	38	56.47	10.55	3477	500
18	39	1.12	10.44	3481	500
18	39	5.74	10.38	3487	600
18	39	10.36	10.31	3495	600
18	39	14.98	10.3	3502	600
18	39	19.48	10.28	3510	600
18	39	23.95	10.28	3517	600
18	39	28.72	10.3	3524	500
18	39	33.34	10.33	3531	500
18	39	38.14	10.38	3539	500
18	39	42.73	10.42	3547	500
18	39	47.32	10.48	3553	500
18	39	51.97	10.53	3560	600
18	39	56.56	10.58	3567	600
18	40	1.21	10.64	3573	600
18	40	5.8	10.7	3580	600
18	40	10.42	10.77	3586	600

18	40	15.07	10.81	3593	600
18	40	19.69	10.88	3600	600
18	40	24.43	10.91	3607	600
18	40	29.05	10.92	3616	600
18	40	33.52	10.92	3622	600
18	40	37.99	10.95	3629	600
18	40	42.91	10.95	3636	500
18	40	47.53	10.97	3644	600
18	40	52.03	10.97	3651	600
18	40	56.8	10.98	3660	600
18	41	1.42	11	3666	600
18	41	6.04	11.02	3672	600
18	41	10.63	11.03	3682	600
18	41	15.28	11.05	3688	600
18	41	20.05	11.06	3697	600
18	41	24.49	11.09	3702	600
18	41	29.26	11.2	3706	700
18	41	38.5	11.36	3699	500