

DOCKET NO. **SA - 510**

EXHIBIT NO. **13X - G**

**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.**

FAA Documentation of Wake Vortex Flight Test

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, D.C.

November 8, 1995

FAA Documentation of Wake Vortex Flight Test

A. ACCIDENT DCA-94-MA-076

Location : Aliquippa, Pennsylvania
Date : September 8, 1994
Time : 1904 Eastern Daylight Time
Aircraft : Boeing 737-300, N513AU

B. GROUP IDENTIFICATION

The Aircraft Performance Group met in Atlantic City, New Jersey from September 25 to October 1, 1995 to perform wake vortex flight tests. The following group members participated in the activity:

Chairman : Thomas R. Jacky, NTSB
Member : Bob McCullough, USAir
Member : Keakini Kaulia, ALPA
Member : James Kerrigan, Boeing

Additionally, the following persons participated in the investigative effort:

Marty Ingham, Boeing
Jim Wilborn, Boeing
Sarah Lewis, Boeing
Keith Beihl, FAA
Larry Van Hoy, FAA
John Tatham, FAA
Carl Jezierski, FAA

C. SUMMARY

On September 8, 1994 at 1904 Eastern Daylight Time, USAir Flight 427, a Boeing 737-3B7, N513AU, crashed while maneuvering to land at Pittsburgh International Airport, Pittsburgh, Pennsylvania. The airplane was being operated on an instrument flight rules (IFR) flight plan under the provisions of Title 14, code of Federal Regulation (CFR), Part 121, on a regularly scheduled flight from Chicago O'Hare International Airport, Chicago, Illinois, to Pittsburgh. The airplane

was destroyed by impact forces and fire near Aliquippa, Pennsylvania. All 132 persons on board the airplane were fatally injured.

D. DETAILS OF INVESTIGATION

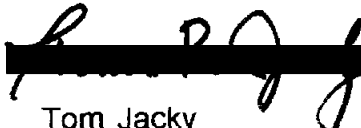
The attached data represent information generated by the Federal Aviation Administration regarding the Wake Vortex Flight Tests accomplished in Atlantic City, New Jersey from September 25 through October 1, 1995. The data represent documentation by Technical Center personnel who participated in the execution of the tests, most notably the usage of the Technical Centers Boeing 727-100 airplane, N40, which was flown throughout the tests as the wake vortex generating airplane.

Smoke generators attached to the underside of each wing, near the wingtip, were used to mark the location of the 727's wake. The generator employed Corvis Oil (pumped from reservoirs in the 727's fuselage, AVGAS (contained in the smoke generator), and a heating element within the generator to produce the smoke.

The following information was provided by the FAA:

- 1) 727 Flight Engineer's Notes
- 2) TCAS II Flight Logs
- 3) FAA NIKE Tracking System Plots of Flight Tracks
- 4) FAA Letter to NTSB regarding CD-ROM Data
- 5) FAA Document regarding CD-ROM Data

Additional data was provided on CD-ROM. A disk was provided for each of the participating parties. Attachment 4 and 5 discuss data recorded on the CD-ROM. The CD-ROM data will be included in the public docket at a later time.


Tom Jacky
Aerospace Engineer

Attachments

1. 727 Flight Engineer's Notes
2. 727 TCAS II Flight Logs
3. FAA NIKE Tracking System Plots of Flight Tracks
4. FAA Letter to NTSB Regarding CD-ROM Data
5. FAA Document Regarding CD-ROM Data

ATTACHMENT 1

727 Flight Engineer's Notes

NTSB WAKE VORTEX

1. RUN #: _____

2. DATE: 09-27-95

3. A/C #: N-40

4. PIC: BINHA 5. SIC: VAN HOY 6. F/E: TRATHUON

7. START TIME: 0940

8. TAXI: 09:55 AFTER NIKK CAL.

9. LANDING TIME: 1145

10: SECURE:

11. ATIS T/O: Rwy 13 100 over 350g 270-4 3002

12. ATIS LANDING: Rwy 13 1100 SK V1310 250-L ^{W/D} AT, 3003

13. A/C TAXI WEIGHT: 129,5

Z.F.W. 96, 984

[illegible]

10:55 50% SIMONA OIL

1100 35% SIMONE 0,2

11 19 Closing Shortoff Values on FWD Trans

NTSB WAKE VORTEX

1. RUN #: _____

2. DATE: 09-27-95

3. A/C #: N-40

2ND RUN OF THE DAY

4. PIC: BIRHL

5. SIC: VAN HOU

6. F/E: TETHAM

7. START TIME: 1405

8. TAXI: 1410

9. LANDING TIME: 1547

10. SECURE: 1557

11. ATIS T/O: 3001 CUBS 2000 RWY "31" Temp 72 Dewpt 54

12. ATIS LANDING: Clear 75 46 2998 RWY 22

13. A/C TAXI WEIGHT: 129,584

2FW 96,984

TIME	FUEL WEIGHT	REMARKS
1415	33.0 SMO ON	JUST AFTER TAKEOFF WITH T33
1420	32.0 SMO ON	LUL @ 6300 HDB SOUTH TO DOUBLE
1427	31.7 SMO OFF	CLIMB TO 10000 FT @ TURN PT TURN AREA
1433	30.3 SMO ON	ALT 10.5 188 KTS NORTH HDB ON TRACK
1438	29.6 SMO OFF	
1439	29.6 SMO ON	10.5 188 KTS OVER ACY NORTH HDB
1448	28.5 SMO OFF	TURN SOUTH ON TRACK
1454	27.9 SMO ON	10.5 ALT DEC + ABOUT 6000 SOUTH BOUND
1459	27.2 SMO OFF	DEC TO 5500 ALT @ ACY
1500	27.1 SMO OFF	START CL TO 10,000 ALT.
1503 LEVUL	26.7 SMO OFF	CLIMB TO 12.5 ALT.
1504 LEVUL	26.7 SMO ON	SOUTH ON TRACK 12.5
1506 DEC	26.6 SMO ON	DEC FROM 12.5 DOWN TO 6000
1509 LEVUL @ 6800 ALT	26.1 SMO OFF	LEVUL @ 6800 SOUTH B TOWN NORTH
1517 LEVUL 12.5 ALT	25.4 SMO ON	DEC FROM 12.5 DOWN TO
1524 LEVUL 6.5 ALT	24.3 SMO OFF	LEVUL 6.5 ALT NORTH BOUND OVER ACY
1529 DEC LEVUL	23.6 SMO ON	LEVUL 10.5 NORTH BOUND
1532 10.5 LEVUL	23.4 SMO OFF	END OF PROJECT 10.5 ALT.

1415 START SMOKE
 1430 75% SMO Oil Remaining
 1443 65% SMO Oil
 1500 50% SMO Oil
 1511 35% SMO Oil
 1525 28% SMO Oil
 1523 22% SMO Oil FINISH LEVUL

NTSB WAKE VORTEX

1. RUN #: _____

2. DATE: 09-28-95
1st RUN

3. A/C #: N-40

4. PIC: L. H. Hoy

5. SIC: B. H. H.

6. F/E: T. H. H.

7. START TIME: 0700

8. TAXI: 0706

9. LANDING TIME: 0906

10. SECURE: _____

11. ATIS T/G: VIS 7 WIND 320-5 7 3004 Clear. RWY 4

12. ATIS LANDING: VIS 10 TLM 64 ALT 3014 RWY 31

13. A/C TAXI WEIGHT: 129,584

Ord. Beration 0716 @ 6000 FT. HDG South To TURN POINT (Smooth Air)
ZFW. 96,984

TIME	FUEL WEIGHT	REMARKS
07:27 SIMO ON	31.0 LBS 6300 ALT	TURN North LEV. SNET RUN 190 KTS
07:29 SIMO OFF	30.6 LBS 6300 ALT	LEV. North HDG 190 KTS
07:31 SIMO ON	30.4 LBS 6300 ALT	LEV. North HDG 190 KTS
07:37 SIMO ON	29.8 LBS 6300 ALT	LEV. North HDG over ACY 190 KTS
07:38 SIMO OFF	29.7 LBS 6300 ALT	LEV. North HDG 190 KTS
07:40 SIMO ON	29.4 LBS 6300 ALT	LEV. North HDG 14 miles DME N. 190 KTS
07:42 SIMO OFF	29.3 LBS 6300 ALT	TURN To South REV
07:43 SIMO ON	28.7 LBS 6300 ALT	South HDG 190 KTS
07:58 SIMO OFF	27.2 LBS 6300 ALT	South HDG 190 KTS
07:59 SIMO ON	27.1 LBS 6300 ALT	South HDG 25 mile South ACY 190 KTS
08:04 SIMO OFF	26.8 LBS 6300 ALT	TURN To North
08:10 SIMO OFF	25.9 LBS 6300 ALT	LEV. North HDG 35 DME S ACY 190 KTS
08:20 SIMO ON	24.2 LBS 6300 ALT	LEV. over ACY North HDG 190 KTS
08:26 SIMO OFF	23.8 LBS 6300 ALT	CLIMB To 7500 FT TURN To South HDG
08:32 SIMO ON	22.9 LBS 7500 ALT	START South DEC 7500 To 190 KTS
08:33 SIMO OFF	OVERLOAD! 22.9 LBS	RIGHT GEAR FAIL
08:34 SIMO ON + OFF	OVERLOAD! 22.9 LBS	RIGHT GEAR FAIL CLIMB To 7000 FT 190 KTS
08:36 SIMO ON + OFF	22.4 LBS 7000 ALT	DEC To 5500 LEV. off 195 KTS
08:38 SIMO ON	22.1 LBS 6500 ALT	CLIMB To 6500 South HDG 185 KTS
08:51 SIMO ON	20.8 LBS 6300 ALT	25 DME S ACY North HDG 190 KTS

08:55 SIMO OFF 20.0 LBS FINISH RUNS RETURN To ACY
Smoke oil To REMAINING

0739 = 80%

0747 = 70%

0759 = 60%

0706 = 50%

08:26 = 25%

08:38 = 15%

08:57 = 08%

Smoke - 60%

NTSB WAKE VORTEX

1. RUN #: _____

2. DATE: 09-29-95

3. A/C #: N 40

4. PIC: Birch

5. SIC: Van Hout

6. F/E: Tithum

7. START TIME: 0635

8. TAXI: 0638

9. LANDING TIME: 0933

10. SECURE: _____

11. ATIS T/O: 40° C 3028 RWY 13

12. ATIS LANDING: 3034 020-5 US RWY 31 TLM 50

13. A/C TAXI WEIGHT: 129,584

14. ZFW: 96,984

Calibration 6000FT 190 KTS 0845

TIME		FUEL WEIGHT	REMARKS
0659	SMOKE ON	30.5 6300 190 KTS	SOUTH AND NORTH 78 miles FROM 1304
0703	SMOKE OFF	30.0 6300 190 KTS	26 miles South of 1304
0704	SMOKE ON	29.8 6300 190 KTS	21 miles South of 1304
0707	SMOKE OFF	29.5 6300 190 KTS	10 miles South of 1304
0708	SMOKE ON	29.4 6300 190 KTS	6.3 miles South of 1304
0712	SMOKE OFF	29.0 6300 190 KTS	4.0 miles North of 1304
0713	SMOKE ON	28.9 6300 190 KTS	2.2 miles North of 1304
0714	SMOKE OFF	28.8 6300 190 KTS	11.7 miles North of 1304
0716	SMOKE ON	28.5 6300 190 KTS	18.3 miles North of 1304
0718	SMOKE OFF	28.3 6300 190 KTS	26.1 miles North TURN TO THE SOUTH
0729	SMOKE ON	26.8 6300 190 KTS	60 DE 1304 South 1304
0740	SMOKE OFF	25.6 6300 190 KTS	TURN POINT North 1304 FROM THE SOUTH
0745		25.0 6300 190 KTS	TURN POINT TO THE NORTH 50 miles South of 1304
0753	SMOKE AS REQ'D	23.8 6500 190 KTS	DE C TO 5500 BOTH P/C (6500)
0755	"	23.8 6500 190 KTS	DE C TO 5500 BOTH P/C (5500)
0800	"	23.5 6300 190 KTS	TURN POINT North 1304
0805		22.8 6300 190 KTS	TURN POINT South 1304 23 miles North of 1304
0820		21.7 6300 190 KTS	TURN NORTH 21 miles South of 1304
0837		18.7 6500 190 KTS	TURN South 29 miles North of 1304
0900		16.0 6300	Calibration with 0010 FROM 1304

SMOKE OIL REMAINING

0721 70% @ North TURN POINT END OF FIRST RUN

0742 60% @ South TURN POINT " " 2ND RUN

0803 50% @ North TURN POINT END OF 3RD RUN

0821 45% @ South TURN POINT END OF 4TH RUN (25 DINE SOUTH)

0831 40% @ North TURN POINT END OF 5TH RUN 20 DINE NORTH

NTSB WAKE VORTEX

1. RUN #: _____

2. DATE: 09-29-95
2ND FLIGHT

3. A/C #: N-40

4. PIC: VAN HOLY 5. SIC: BIEHL 6. F/E: TATHAM

7. START TIME: 11:20

8. TAXI: 1126

9. LANDING TIME: 12:37 10. SECURE: 12:45

11. ATIS T/O: 4308 68 WD 10 3036 Rev4 WDSH/ADJ.

12. ATIS LANDING: 080-14 13PM U/S 12LT3036 68TEMP

13. A/C TAXI WEIGHT: 129,584. 14. ZFW: 96,984.

Cal. Break 6000 FT 190 KTS

[illegible]

START SMOKE OIL 90%

OVER ACY 1208 75%

NTSB WAKE VORTEX

1. RUN #: _____

2. DATE: 05-30-91

3. A/C #: 11-40

4. PIC: L. Worsley 5. SIC: Digital 6. F/E: T. J. Wilson

7. START TIME: 0625 8. TAXI: 0632

9. LANDING TIME: 0829 10. SECURE: 0737

11. ATIS TIO: AKI 3030 3608 Day 31 Temp 50

12. ATIS LANDING: VIS 35 WD 360-L 3031 RWY 31

13. A/C TAXI WEIGHT: 129 584 14. ZFW: 96 984
WIND @ 0645 / 283-11 KTS /

No Cnd. Brextion. Level @ 6300 BT.

[illegible]

SMPHE ON SHRT 0640 = 100% Remaining

0725 65 %

0735 50 % 11

8747 25% "

0 757 10 70 "

NTSB WAKE VORTEX

1. RUN #: _____

2. DATE: 10-02-95
1ST RUN FLIGHT

3. A/C #: N-40

4. PIC: Bizeth 5. SIC: VAN HOY 6. F/E: Traffick

7. START TIME: 10:36 8. TAXI: 10:37

9. LANDING TIME: 1212 10. SECURE: 1220

	ALT	Temp	Press	Clim	WD	U/S
11. ATIS T/O:	2999	62	59	5000	270-8	5

12. ATIS LANDING: ¹¹⁰
UHS 320.8 2995 RWY 31

13. A/C TAXI WEIGHT: 129.584 14. ZFW: 69.984

TOTAL off fuel 33,600 LBS

CALIBRATION FLIGHT 11:40

[illegible]

100% oil @ 1127

75% 11:37

66% 1144

50% 12:12

1226

$$\frac{\text{TIME } 1030}{1.8} \quad \text{HOBBS } \frac{3642.3}{3640.7}$$

1.8

ATTACHMENT 2

727 TCAS II Flight Logs

A.M.

Page 1 of 1

Target aircraft info: Boeing 737 N533AU

TCAS configuration notes: High-Speed TCAS Recorder, All times UTC (Local + 4 hours)

[illegible]

WEATHER: Location: ACY ATIS ALPHA 1056Z
 temperature 60 F dew point 58
 altimeter 29.94 in visibility 10 nm
 wind 030 18 kts ceiling VAR 600 ft

Page 1 of 1

Target aircraft info: Boeing 737 N533AU

3.

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TCAS II Flight Log 09/27/95

Aircraft N40

Page 1 of 1

P.M.

Test: NTSB Flight Test

Area: _____

TCAS hardware info: Honeywell SN 92071090

Tracking: GPS

Target aircraft info: Boeing 737 N533AU

TCAS personnel

1. PAUL QUICK
2. MICHAEL PETRI
- 3.
- 4.
- 5.
- 6.

Flight Crew

1. KEITH BIEHL
2. LARRY VANHOY
3. JOHN TATMAN

Intruder Flight Crew

- 1.
- 2.
- 3.

TCAS configuration notes: High-Speed TCAS Recorder ~~All times UTC (Local + 4 hours)~~

Run Start Stop Comments

			Due to keyboard entry error, 2 Hours must be ADDED TO LOG TIMES TO YIELD UTC
	161125		Aircraft Sensor Recorder (ASR) ON
	163500		TAKEOFF
			162125 PALT=5980'
			173400 PALT=10400'
		173409	ASR OFF
			BACK UP FILES ONTO TAPE
		1800	LANDING AT ACY
			ADD 2 HOURS TO LOG TIMES FOR UTC!
			FILES AFFECTED:
			92751611.FIX / .RED
			92751640.FIX / .RED
			92751705.FIX / .RED

	own	intr #1	intr #2
a/c tail #	N40	N533AU	
xpdr type	HW4061400 -905		
xpdr serial #	92070912		

WEATHER: Location: ACY ATIS 1756Z
 temperature 73 F dew point 50
 altimeter 30.00 in visibility >10 nm
 wind 230 15 kts ceiling Clear below ft
12000

Page 1 of 1

Target aircraft info: Boeing 737 N533AU

3.

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TCAS II Flight Log 09/29/95 A.M.

Aircraft N40

Page 1 of 2

Test: NTSB Flight Test

Area: _____

TCAS hardware info: Honeywell SN 92071090

Tracking: GPS

Target aircraft info: Boeing 737 N533AU

TCAS personnel

1. Carl Jezewski
2. Paul Quick
- 3.
- 4.
- 5.
- 6.

Flight Crew

1. Keith Biehl
2. Larry VanHoy
3. John Tatham

Intruder Flight Crew

- 1.
- 2.
- 3.

TCAS configuration notes: High-Speed TCAS Recorder, All times UTC (Local + 4 hours)

Run	Start	Stop	Comments	↑↑ increase climb
	104005		Aircraft Sensor Recorder (ASR) ON	
	104109		Takeoff	
Q	104700		AIRSPEED/ALTIMETER CALIBRATION	
			104707 TA @ +00 & 0.9 NM & 150°	
		105020	104737 RA ↑ ; 104907 RA ↑↑	
1	105938	110418		
2	110545	110840	N40 @ 5960' & 190 KIAS	
3	111008	111254	N40 @ 5960' & 190 KIAS	
4	111406	111530	N40 @ 5960' & 190 KIAS	
5	111720	111943	N40 @ 5960' & 190 KIAS	
6	112410	112430	N40 @ 5960' & 210 KIAS	
7	112648	112717	N40 @ 5964' & 190 KIAS	
8	112819		N40 @ 5964' & 190 KIAS	
			TCAS RECYCLED	
9	113040	113148	N40 @ 5963' & 190 KIAS	
10	113327	113455	N40 @ 5965' & 190 KIAS	
11	113710	113740	N40 @ 5969' & 190 KIAS	
12	113847	113913	N40 @ 5966' & 190 KIAS	
13	114009	114030	N40 @ 5966' & 190 KIAS	
			114600 NASA AIRCRAFT ≈ 5 NM	
14	114828	114852	N40 @ 5975' & 190 KIAS ; 737 @ 2.1 NM ; NASA @ 6.7 NM	
15	114948	115032	N40 @ 5971' & 190 KIAS	
			115140 ; 737 @ 1.9 NM ; NASA @ 8.7 NM	
16	115237	115318	N40 DESCENDING	
17	115455	115532	N40 DESCENDING, 190 KIAS	
18	120108	120318	N40 @ 5959 & 190 KIAS ; 737 @ 3.0 NM	
19	121040	121205	N40 @ 5990 & 190 KIAS ; 737 @ 2.8 NM	
20	121323	121448	N40 @ 5982 & 190 KIAS ; 737 @ 2.9 NM	

	own	intr #1	intr #2
a/c tail #	N40	N533AU	
xpdr type	HW4061400 -905		
xpdr serial #	92070912		

WEATHER: Location: ACY ATIS SIERRA 0956Z
 temperature 48 F dew point 44
 altimeter 30.28 in visibility 10 nm
 wind CALM kts ceiling CLEAR ft
BELOW 12000

Run	Start	Stop	Comments
21	121626		N40 @ 5992' & 190 KIAS; 737 @ 2.9 NM
		121801	121732 INTRUDER @ -01 & 2.6 NM & 270°
			122017 ASR RESTARTED FROM HANGUP
22	122550	122644	N40 @ 5967' & 190 KIAS; 737 @ 3.0 NM
23	122729	122816	" 5967' 190 " " 3.0 "
24	122858	122944	" 5981' 188 " " 2.9 "
25	123044	123136	" 5977' 194 " " 2.9 "
26	123222	123336	" 5982' 193 " " 3.1 "
			123638 NASA @ -03 & 150° & 5 NM
27	123732	123805	N40 @ 190 KIAS & DESCENDING
28	124352		N40 @ 185 KIAS & 6130'; 737 @ 3.1 NM
			125010 TA @ -07↓ & 3.0 NM
			125144 TA @ -04↑ & 0.9 NM
	125307		ALTITUDE/AIRSPD CALIBRATION WITH NASA
29	125604		N40 @ 5957' & 184 KIAS
		130318	RANGE TO NASA INCREASES FROM 0.1 TO 7.0 NM
			130944 TCAS RECYCLED
30	131021		N40 @ 5954' & SPEED INCREASES FROM 182 TO 200 KIAS
		131637	RANGE TO NASA INCREASES FROM 0.7 TO 9.0 NM
		131730	ASR OFF
			BACK UP FILES
	132031		ASR ON
			APPROACH & LANDING
		133249	ASR OFF

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Target aircraft info: Boeing 737 N533AU

- 1.
- 2.
- 3.

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TCAS II Flight Log 09/30/95

Aircraft N40

Page 1 of 1

Test: NTSB Flight Test

Area:

TCAS hardware info: Honeywell SN 92071090

Tracking: GPS

Target aircraft info: Boeing 737 N533AU

TCAS personnel

1. Carl Jezierski
2. Paul Quick
3. Michael Petri
- 4.
- 5.
- 6.

Flight Crew

1. Larry Voulton
2. Keith Briel
3. John Tatham

Intruder Flight Crew

- 1.
- 2.
- 3.

TCAS configuration notes: High-Speed TCAS Recorder. All times UTC (Local + 4 hours)

Run	Start	Stop	Comments
	103330		Aircraft Sensor Recorder (ASR) on
	103335		Takeoff roll
1	104230	104442	N40@5942' & 189 KIAS; 737 @ 4.0 NM
2	104640	104800	
			105004 TCAS RECYCLED
3	104937	105151	N40@5942' & 189 KIAS; 737 @ 4.0 NM
4	105353	105530	N40@5942' & 185 KIAS; 737 @ 3.8 NM
			DIFFICULTIES WITH RIGHT SMOKE GENERATOR
5	105755	105833	
6	110724		N40@5942' & 198 KIAS & 30° RIGHT BANK; 737 @ 3.2 NM
			BOTH SMOKE GENERATORS O.K.
			111040: N40@5942' & 191 KIAS; 737 @ 3.9 NM
			111630: N40@5958' & 189 KIAS; 737 @ 4.2 NM
		112058	N40 Decreases altitude to 5616'
			112108: NEW FILE STARTED
7	112513		N40 @ 6118' & 182 KIAS; 737 @ 3.9 NM
			114245: TCAS RECYCLED
		115949	114635: N40 IN 30° LEFT BANK
			120015: NEW FILE STARTED
8	110254	120330	N40@5650' & 190 KIAS; 737 @ 2.0 NM
9	120605	121217	N40@5992' & 201 KIAS; 737 @ 2.4 NM
		121315	DEPLETED CORVUS OIL
			121933 TA @ +00 & 0.8 NM
			122039 RA ↑
		122359	ASR OFF

	own	intr #1	intr #2
a/c tail #	N40	N533AU	
xpdr type	HW4061400 -905		
xpdr serial #	92070912		

WEATHER: Location: ACY ATIS 0956Z
 temperature 54 F dew point 49
 altimeter 30.30 in visibility 10 nm
 wind 360 18 kts ceiling 3700 ft
 SCATTERED

TCAS II Flight Log 10/2/95

Aircraft N40

Page 1 of 1

Test: NTSB Flight Test

Area: DELAWARE BAY

TCAS hardware info: Honeywell SN 92071090

Tracking: GPS & NIKE

Target aircraft info: Boeing 737 N533AU

TCAS personnel

1. Paul Quick
2. Michael Petri
- 3.
- 4.
- 5.
- 6.

Flight Crew

1. Keith Biehl
2. Larry VanHoy
3. John Tatham

Intruder Flight Crew

- 1.
- 2.
- 3.

TCAS configuration notes: High-Speed TCAS Recorder, All times UTC (Local + 4 hours)

Run	Start	Stop	Comments
			N49 ALSO AIRBORNE, TRANSPONDER OFF
	1438		TAKE OFF
			CIRCLING OVER DELAWARE BAY WAITING FOR RENDEZVOUS
	151035		ASR ON;
			TA ON NASA AIRCRAFT
0	1512		↓ ; CROSSING ↓
			N40 @ 200 KTAS & PALT = 6950'
			INCREASE ↓ ; ↑ REVERSAL
		151510	END OF CALIBRATION
1	151725		SMOKE ON
			TARGET SLOWLY INCREASING RANGE BEHIND N40
			152057 3 MILES BEHIND N40
			152203 4.3 MILES BEHIND N40
			152404 7 MILES BEHIND N40
		152430	SMOKE OFF
			1527: TCAS DATA RECORDER FILE RESET
2	152750		START RUN: NASA APPROACHES FROM LEFT OF N40
			↓ ; INCREASE ↓ ; TRACK DROPPED
	153038		SMOKE ON ; ↓ ; ↑ REVERSAL ; DC1000 ; DC0
		153738	SMOKE OFF
3	154000		↓ CROSS ; ↑ REV ; TARGET AHEAD OF N40
			TRACK DROPPED VERY CLOSE TO N40 (↓ DROPPED)
	154302		SMOKE ON
		154816	SMOKE OFF
4	155044		SMOKE ON : TA ; ↓ ; INCREASE ↓ ; CDC ; PROBLEMS W/SMOKE
			1553 PROBLEMS WITH RIGHT SMOKE GENERATOR
		160121	LEFT SMOKE TURNED OFF ; DATA COLLECTION STOPPED

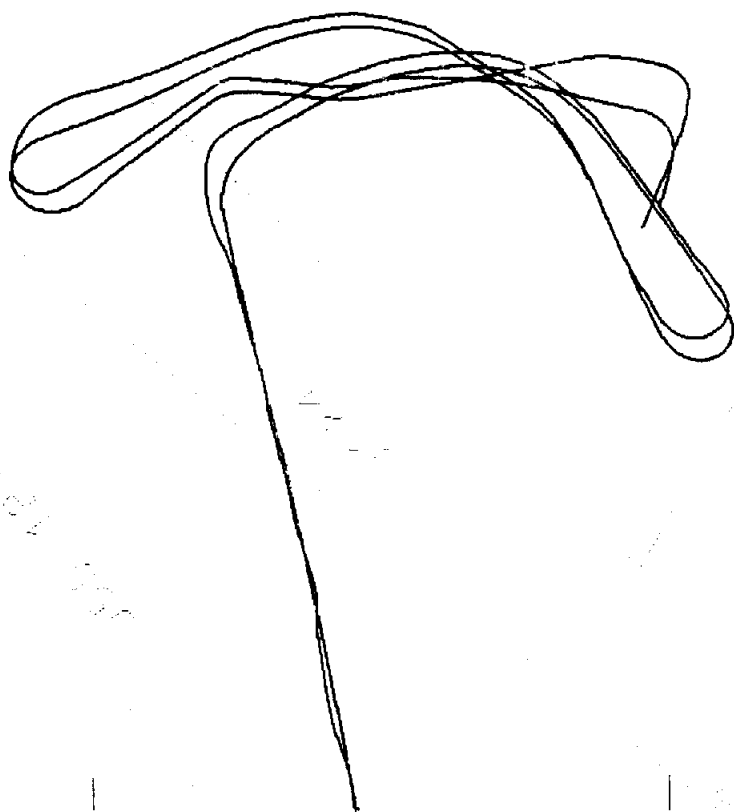
	own	intr #1	intr #2
a/c tail #	N40	NASA	N49
xpdr type	HW4061400-905		
xpdr serial #	92070912		

WEATHER: Location: ACY ATIS GOLF 1356Z
 temperature 66 F dew point 60
 altimeter 29.98 in visibility > 5 nm
 wind 270 / 8 kts ceiling > 5000 ft

ATTACHMENT 3

FAA NIKE Tracking System Plots of Flight Tracks

TARGET ON	ALTITUDE	X	Y
53678	13812	51813	-58418
-59862			



REF & SCALE
 X - 2050
 Y - -85253
 S - 46923
 AUTO

269.08 54:26

#1

737/NTSB TEST

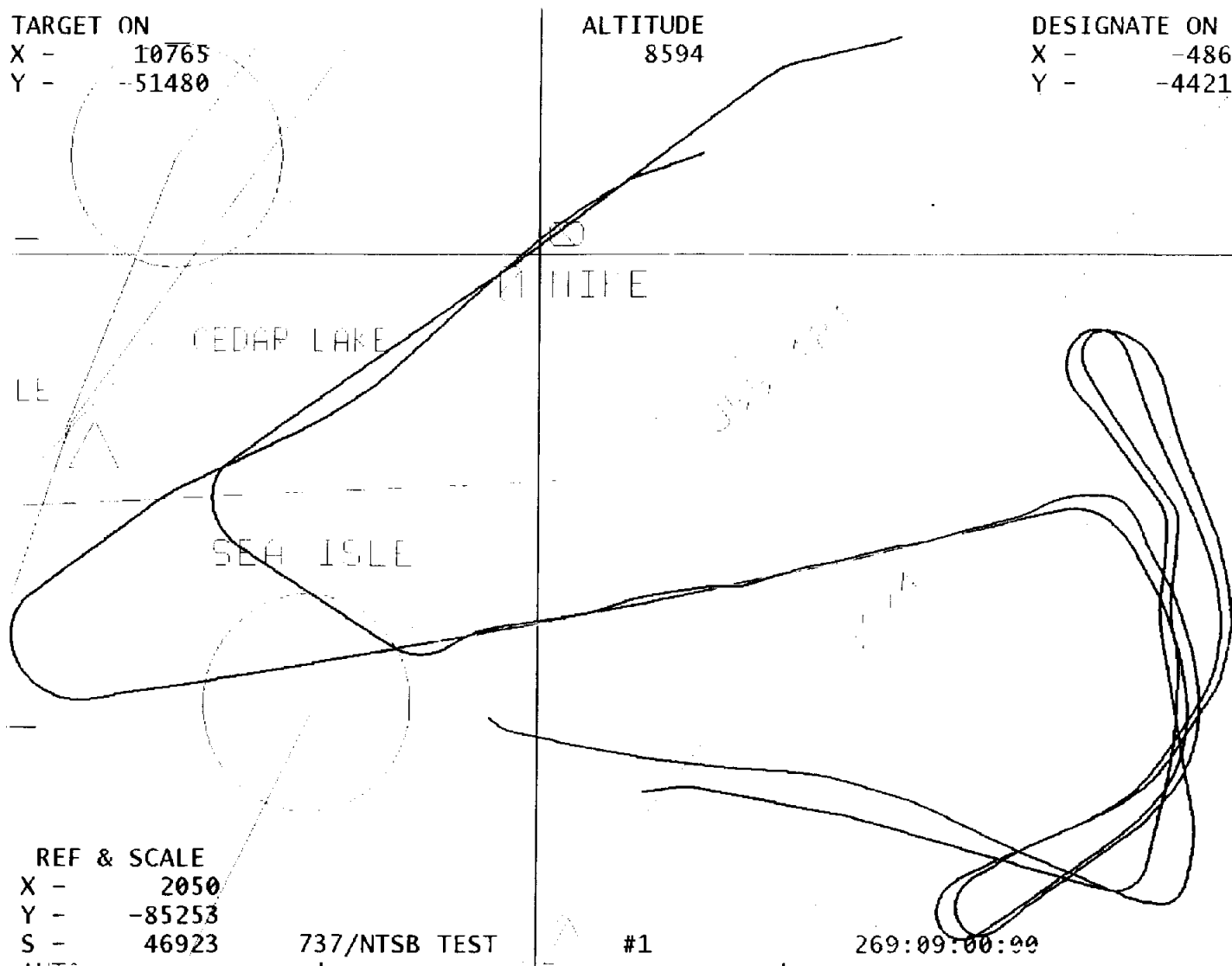
TARGET ON

X - 10765
Y - -51480

ALTITUDE
8594

DESIGNATE ON

X - -4869
Y - -44219



REF & SCALE

X - 2050
Y - -85253
S - 46923

737/NTSB TEST

#1

269:09:00:00

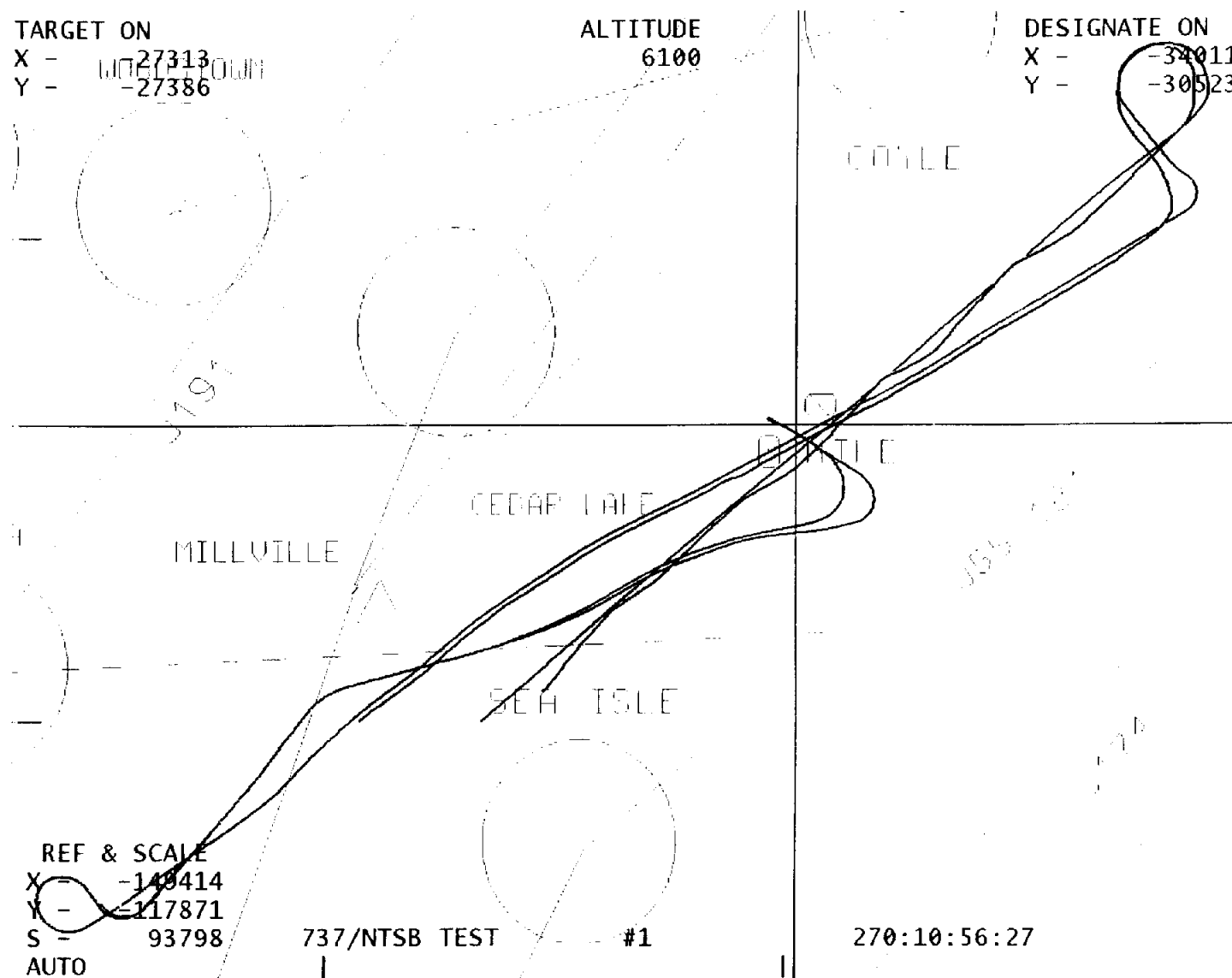
TARGET ON

X - 27313
Y - -27386

ALTITUDE
6100

DESIGNATE ON

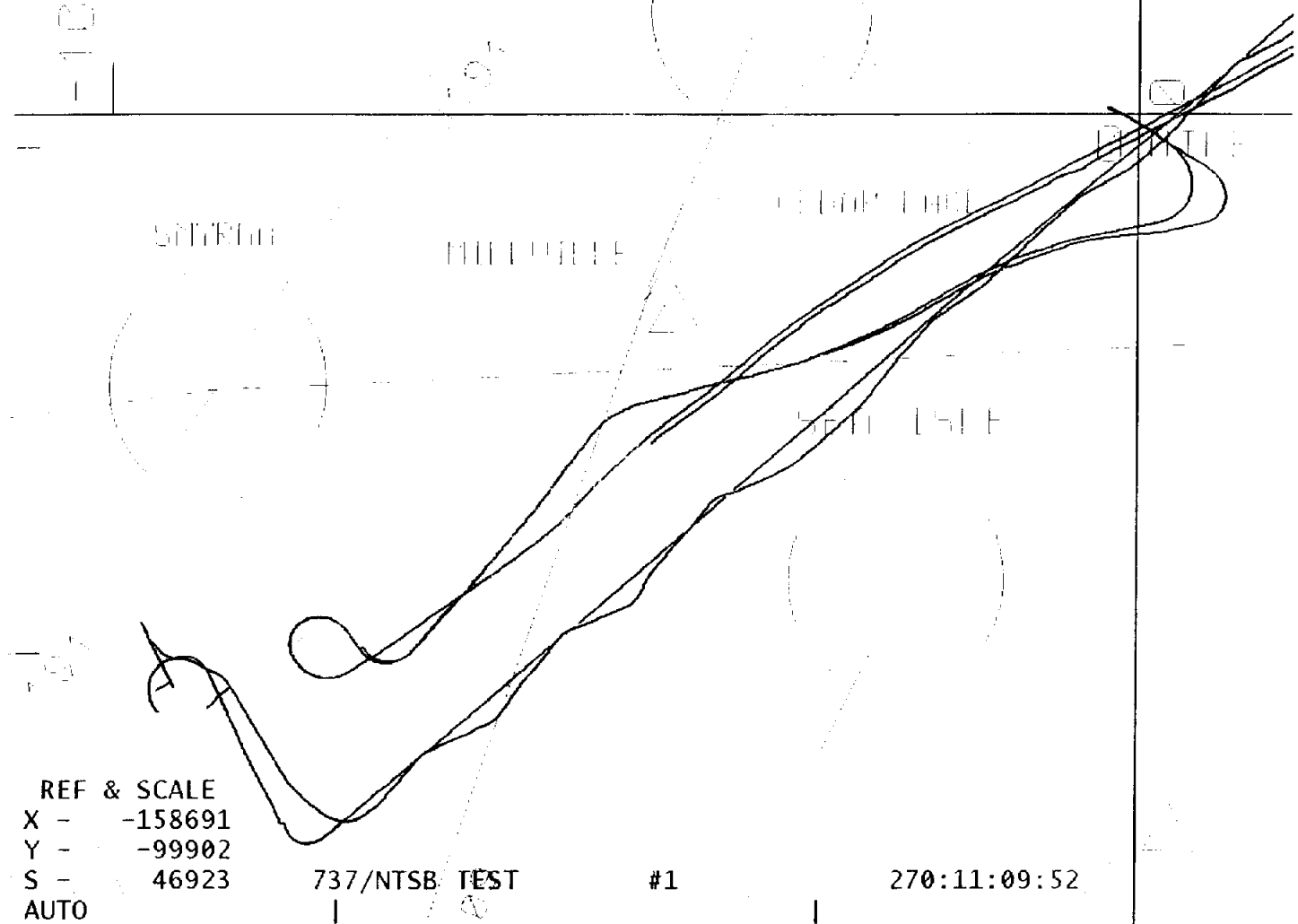
X - -34011
Y - -30523



TARGET ON
X - -95352
Y - -55303

ALTITUDE
6648

DESIGNATE ON
X - -88194
Y - -52878



TARGET ON
X - -77186
Y - -44977

ALTITUDE
6236

DESIGNATE ON
X - -71141
Y - -41105

ODS TOWN

COYLE

CEDAR LAKE

MILLVILLE

SEA ISLE

REF & SCALE

X - -158691
Y - -99902
S - 46923
AUTO

737/NTSB TEST

#1

270:11:12:44

TARGET ON
X - 30199
Y - 21089

ALTITUDE
6403

DESIGNATE ON
X - 25302
Y - 17796

COYLE

MILLUTLEF

CEDHP LAME

SEA TGLE

REF & SCALE
X - 20199
Y - 23144
S - 46923
AUTO

737/NTSB TEST

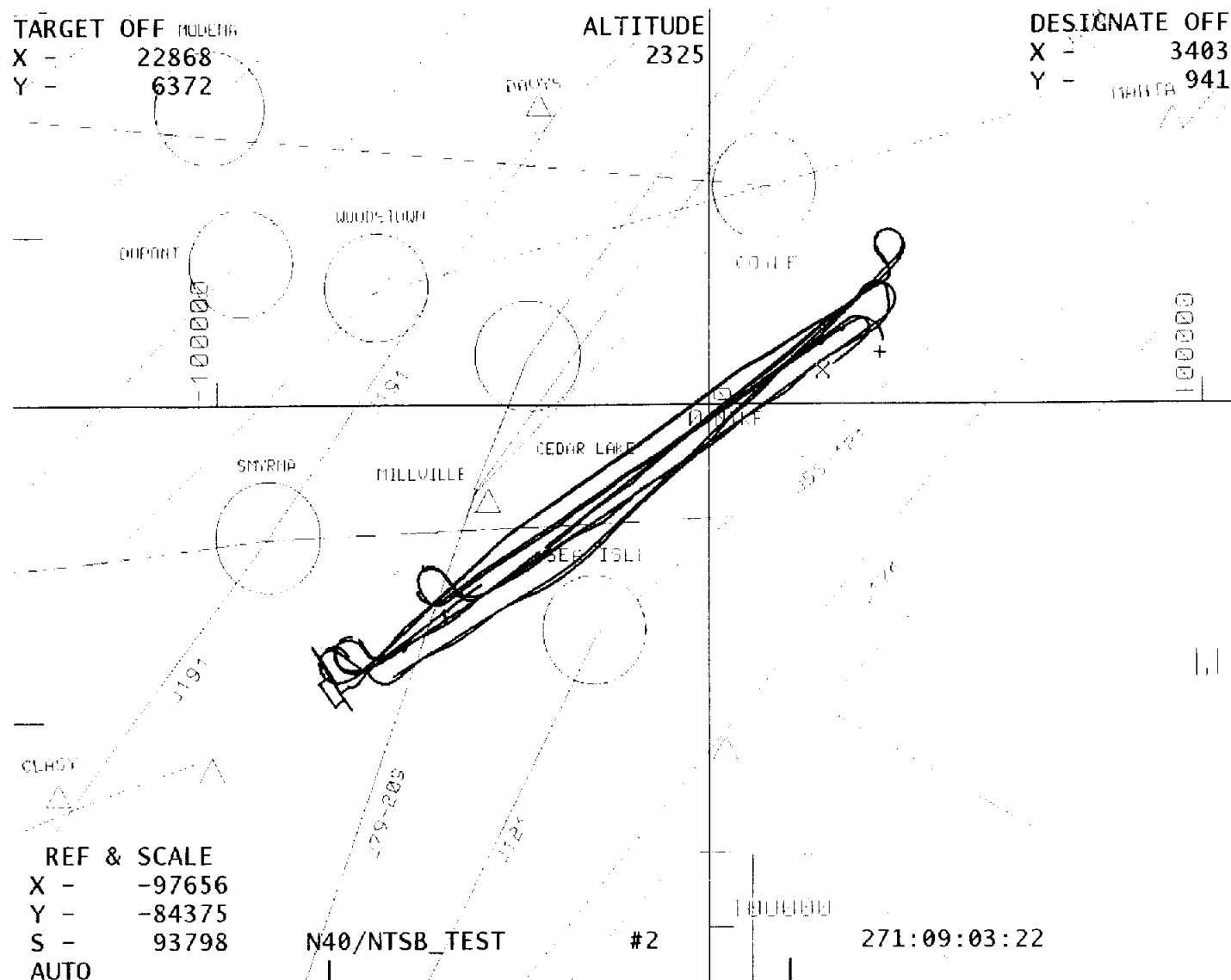
#1

271:08:30:57

X -	22868
Y -	6372

ALTITUDE
2325

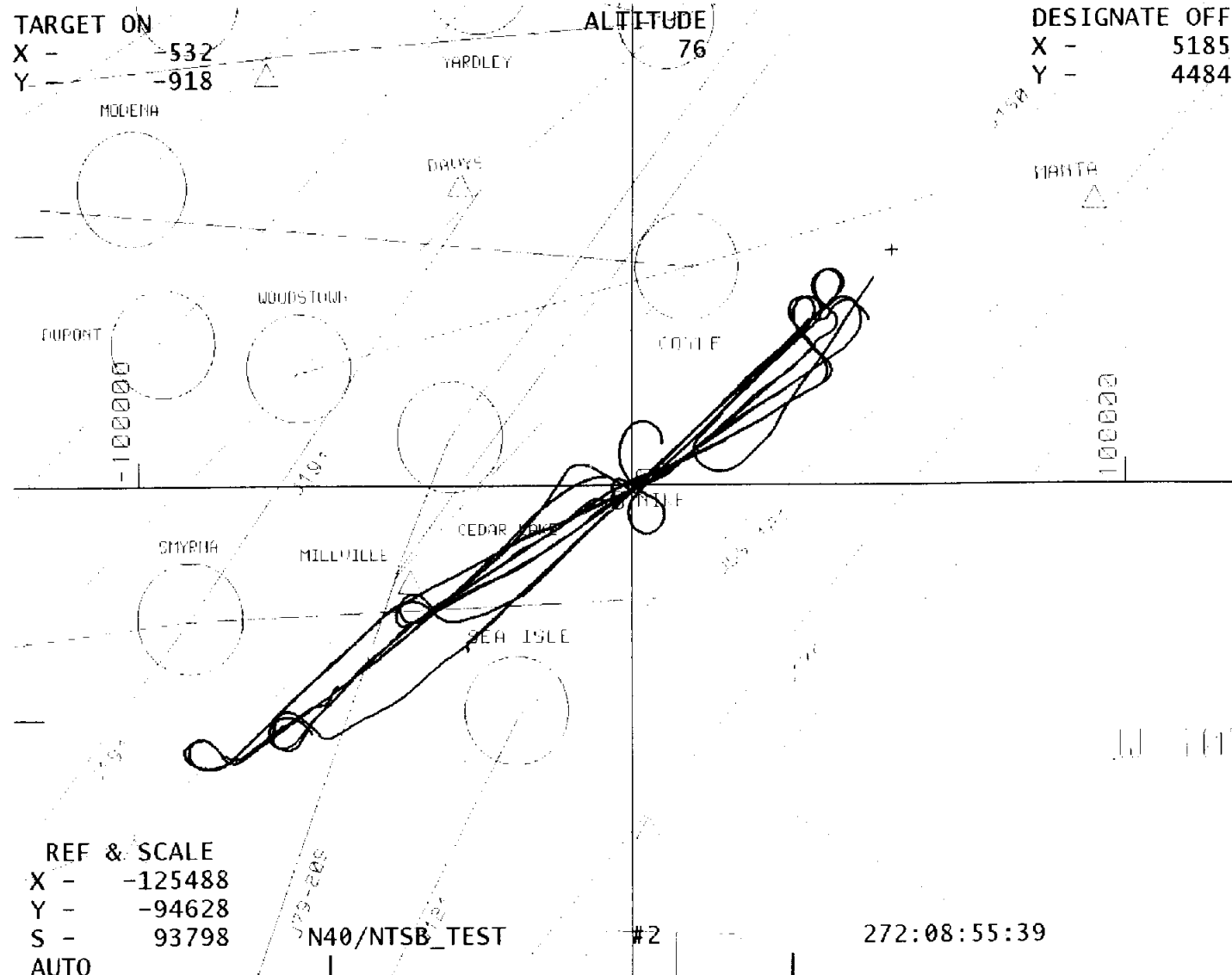
DESIGNATE OFF
X - 34037
Y - 9419



X -	-532
Y -	-918

ALTITUDE
76

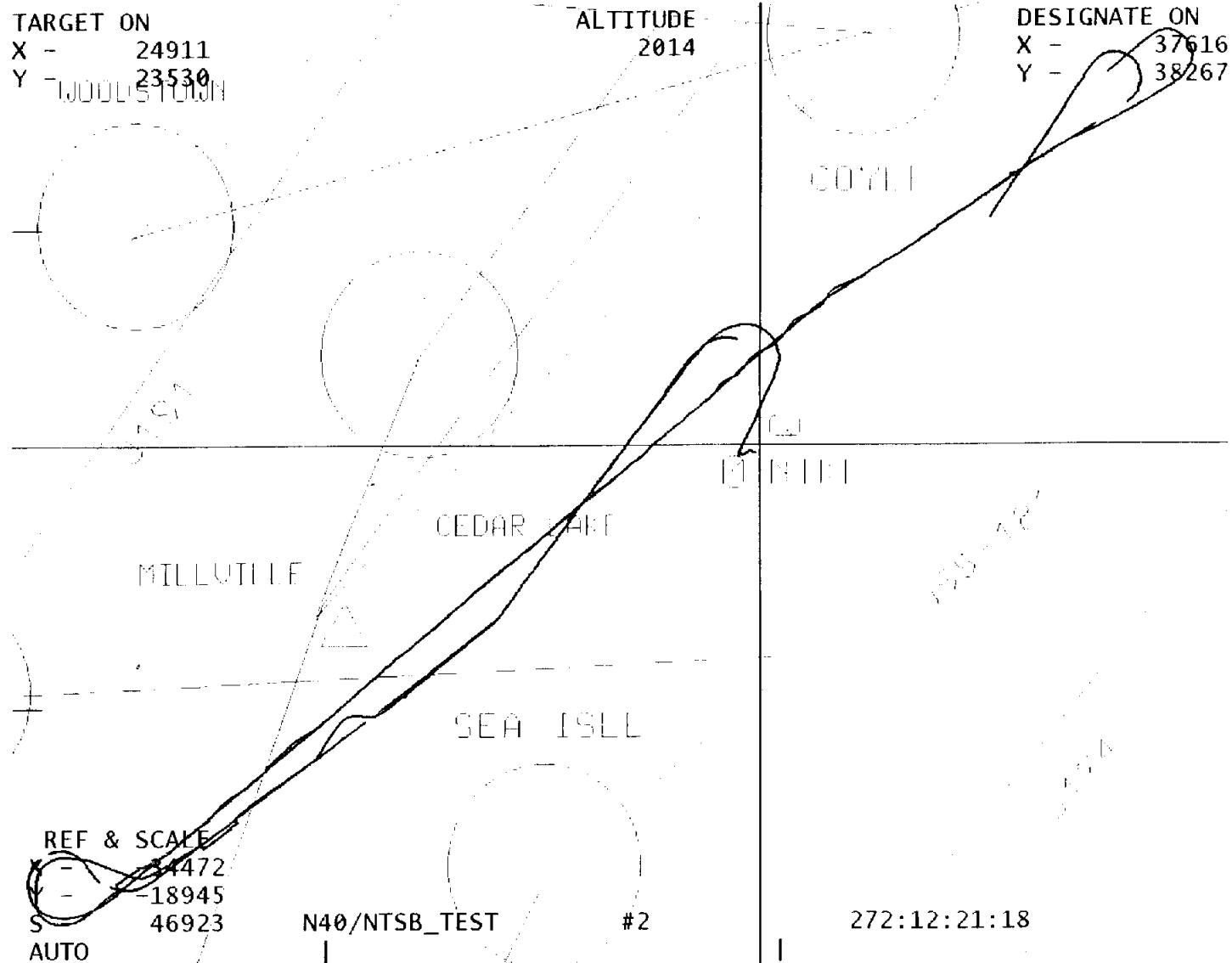
DESIGNATE OFF
X - 51855
Y - 44844



TARGET ON
X - 24911
Y - 23530

ALTITUDE
2014

DESIGNATE ON
X - 37616
Y - 38267



ATTACHMENT 4

FAA Letter to NTSB Regarding CD-ROM Data



U.S. Department
of Transportation
**Federal Aviation
Administration**

Technical Center

Atlantic City Int'l Airport
New Jersey 08405

OCT 03 1985

Mr. Thomas Jacky
National Transportation Safety Board/RE-60
490 L'Enfant Plaza East, S.W.
Washington, D.C. 20594

Dear Mr. Jacky:

Enclosed are the five CD-ROMS, as requested, for the U.S. Air 427 accident investigation flight test program conducted during the period September 26 to October 2. Data for the two single aircraft flights of September 25, are not included on these CD-ROMS but are available if required.

The data comes from the five instrumentation recorders aboard the Technical Center's Boeing 727-100 (N-40), the ground based radar tracker and differential GPS reference station. The file named "README.1ST" describes the content, format, and naming convention for all files on the CD-ROM.

A sixth CD-ROM is being retained for internal FAA Technical Center use only. Additional copies will be produced **only** at the direction of your office.

Sincerely,

Carl Jezierski
TCAS Technical Program Manager

Enclosures
N-40 Flight Logs (1 set)
CD-ROMS (5)

cc:
ACT-370 (Keith Biehl)

ATTACHMENT 5

FAA Document Regarding CD-ROM Data

2 October 1995

This file describes the structure of the data and file formats on this C.D.

DATA SOURCES:

1. The Aircraft Sensor Recorder (ASR). Parameters from the TCAS traffic display, Air Data Computer, Radio Altimeter, Inertial Reference System, Sperry Gyrocompass, Magnavox MX-7120 GPS (center antenna position,), Angle-of-attack probes, and Total Air Temperature probe are recorded.

The GPS was operated with differential corrections received from a commercial source (DCI, Differential Corrections Incorporated). These signals from Philadelphia (Baltimore?, 9/30/95) were received except at either end of the testing area.
2. TCAS II. Track file extracts from this sensor gives range with accuracy of better than 60 feet.
3. Magnavox MX-7120 GPS (Left and right antenna positions). Data is recorded in Magnavox format. Can be post-processed with differential data for improved accuracy. These receivers were operated without any real-time differential corrections.
4. Differential GPS receiver (ground based). An Ashtech Z-12 receiver provides data recorded in raw Ashtech format and RINEX formats. Position of reference for this data is:

N 39°26'58.72625"	Latitude
W 74°34'00.04518"	Longitude
10.95 meters	Height (ellipsoid)
5. Nike instrumentation radar. Data in Latitude, Longitude, and height above mean sea level (MSL).

DIRECTORY STRUCTURE:

```

092995.TST      All data collected on September 29, 1995
  ASR           Aircraft Sensor Recorder subdirectory
    BOEING      Extracts of parameters at sample rates specified by Boeing.
    NASA        Extracts of parameters at sample rates specified by NASA.
    SOURCE      ASR data base from which the BOEING and NASA subdirectories
                  were created.
    DGPS        Data files from the Ashtech DGPS ground station.
    GPS         Data files from the left, center, and right airborne GPS
                  receivers
    NIKE        Data files from the FAATC instrumentation radar
    TCAS        Extracted data from the TCAS track file

```

FILE DESCRIPTION:

92951040.FIX

```

//////
//////_____ File start time (ZULU)
//////_____ Month (Hexadecimal) , day, and year (MDDY)

```

This file contains all data from the aircraft sensor recorder (ASR) in ASCII format.

92951040.ZIP

FIX file compressed using PKZIP v2.04g.

92951040.RED

Extracts from the aircraft sensor recorder and are in ASCII format. Same format as FIX file.

H951002A.NAS (or any TCAS track plot file for Mode-C targets)
 \\\\\\\\\\\ Designates the target aircraft (NASA OVN-10)
 \\\\\\\\\\\ Session A (1st session)
 \\\\\\\\\\\ Flight date (YYMMDD)
 \\\\\\\\\\\ TCAS Sensor (H=Honeywell)

Own Aircraft (N-40)				Tracked Mode-C Aircraft			
15:10:51.4,	2561.540,	6964,	,	1,	0.600,	6148,138,	\\\\\\\\\\\\\\\\\\\\
15:10:52.6,	2562.600,	6964,	,	1,	0.606,	6170,138,	\\\\\\\\\\\\\\\\\\\\
\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\		\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	Bearing Angle (ø)
Log Time	System	29.92"		\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	Altitude (feet)
(UTC)	Time	Altitude		\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	Range (nm)
	(sec)	(feet)		\\\\\\\\\\\\\\			Track Number

H951002A.737 (or any TCAS track plot file for Mode-S targets)
 \\\\\\\\\\\ Designates the target aircraft (Boeing 737)
 \\\\\\\\\\\ Session A (1st session)
 \\\\\\\\\\\ Flight date (YYMMDD)
 \\\\\\\\\\\ TCAS Sensor (H=Honeywell)

Own Aircraft (N-40)				Tracked Mode-S Aircraft			
15:14:32.6,	2782.660,	6988,	,	4,	8.154,	11900,118,	DES, , , ,
, , ,	AB2B45,						
15:19:15.8,	3065.810,	6892,	,	43,	31.110,	2200,270,	, , , ,
, , ,	A3E273,						
\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\		\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	Resolution Advisory
\\\\\\\\\\\\\\				\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	Bearing Angle (ø)
Log Time	System	29.92"		\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	Altitude (feet)
(UTC)	Time	Altitude		\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	\\\\\\\\\\\\\\	Range (nm)
\\\\\\\\\\\\\\	(sec)	(feet)		\\\\\\\\\\\\\\			Mode-S I.D. ___/
\\\\\\\\\\\\\\				\\\\\\\\\\\\\\			Track Number

9275C737.NIK

\\\\\\\\\\\\\\ Designates Nike Radar
 \\\\\\\\\\\ Designates target (727/737/NAS)
 \\\\\\\\\\\ Session "C" (3rd session)
 \\\\\\\\\\\ Flight Date (MDDY), Hexadecimal Month

42226.000 39.457152 -74.639644 266.0

42226.100	39.457152	-74.639639	265.9
42226.200	39.457151	-74.639644	265.9
_____/	_____/	_____/	____/
Time of Day	Latitude	Longitude	Altitude
(seconds)	(ø.ø)	(ø.ø)	(feet)
(Local Time)			Referenced to MSL

DGPS Files: (Ground Station)

S_REF095.270	Site data, Ashtech format (ASCII)
E_REF095.270	Ephemeris data, Ashtech format (BINARY)
B_REF095.270	Raw measurement, Ashtech format
/// ///	Julian date
///	Year
\\	Session
_REF2701.950	Observed data, RINEX format
_REF2701.95N	Nav data, RINEX format
_REF2701.95M	Meteorological data, RINEX format
//// //	Year
////	Session
\\	Julian date

GPS Files: (Airborne, N-40)

M950927A.GPC	
M950927A.GPL	
M950927A.GPR	
//////// //	Designates Left\Center\Right antenna position/receiver
//////// //	Designates GPS file
////////	Designates session "A" (1st session)
////////	Flight date (YYMMDD)
\\	Designates Magnavox MX-7120 Receiver

Recording format is mixed ASCII/Binary and is defined in the operations manual for the MX-7120 GPS receiver.

Log files:

LG9265A0.BMP	
//////// //	File is in Windows bitmap format
////////	Session "0" (first session)
////////	Morning session (P=afternoon session)
////////	Flight date (MDDY), Hexadecimal month
\\	Designates flight log file

Aircraft Sensor Recorder (ASR) documentation:

Detailed description of every record type in .FIX and .RED files.

ASR_DOC2.BMP	
//////// //	File is in Windows bitmap format
////////	Page 2
////////	Designates ASR documentation file
