

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering *gr*
Washington, D.C. 20594

February 19, 2002

Flight Path Study - American Airlines Flight 77

A. SUBJECT AIRCRAFT

Location: Arlington, VA
Date: September 11, 2001
Time: 09:38 AM Eastern Daylight Time
Flight: American Airlines Flight 77
Aircraft: Boeing 757-200, registration: N644AA
NTSB#: DCA01MA064

B. GROUP

N/A

C. SUMMARY

This document provides a brief description of the flight path of the aircraft based on information obtained from various sources of recorded radar of the subject aircraft both before and after the hijacking events. Information from the Flight Data Recorder (FDR) recovered on scene is also used to develop the description. Flight paths are overlaid onto maps of the area, and time histories of altitude data are presented

American Airlines Flight 77 – Flight Profile

The following description of American Airlines Flight 77 is based on data from the flight data recorder (FDR) recovered from the crash site, as well as radar data obtained from the Federal Aviation Administration's Air Route Traffic Control Centers, approach control at Washington Dulles Airport, and the U.S. Air Force 84th Radar Evaluation Squadron.

Figure 1 shows the flight path of the aircraft from take off at Washington Dulles airport to the crash site at the Pentagon. Figure 2 shows the aircraft's altitude profile for the 1 hour and 17 minute duration of the flight, and figure 3 shows the flight path during the final maneuver before impact.

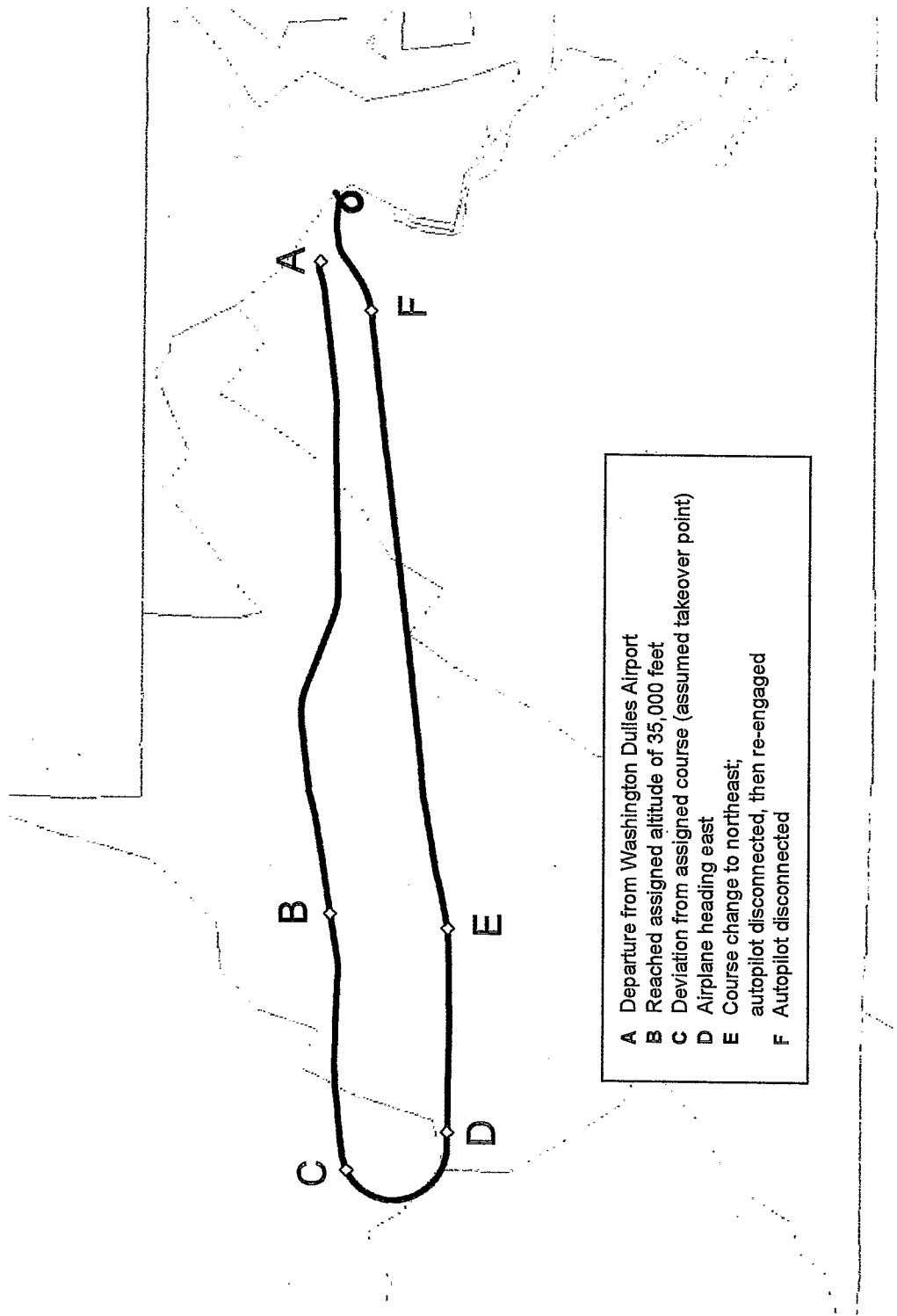
American Airlines Flight 77 departed Washington Dulles at 8:20 AM (point A in Figures 1 and 2) and reached its assigned cruising altitude of 35,000 feet at about 8:46 AM (B). The final routine radio transmission from the flight was received at 8:51 AM. The flight appeared normal until a deviation from the assigned course occurred at approximately 8:55(C), when the aircraft started a turn to the south. One minute later, radar stations stopped receiving transponder returns from AA77. At 8:56, FAA's Indianapolis Center Air traffic control facility attempted to contact the flight several times, with no response. By 9:00 (D) the airplane was heading to the east, and shortly thereafter began to descend from 35,000 feet. The autopilot remained engaged during the turn, and during the initial descent from 35,000 feet.

At approximately 9:07 AM, the airplane leveled off at 25,000 feet and made a slight course change to the east-northeast (E). One minute later, the autopilot was disconnected for approximately 3 minutes. During these three minutes, heading remained steady, yet variations in altitude as low as 22,000 feet are noted. When the autopilot was re-engaged, the airplane leveled again at 25,250 feet, and then began to descend again at 9:22 AM. At approximately 9:29 AM, when the aircraft was approximately 35 miles west of the Pentagon, the autopilot was disconnected (F) as the aircraft leveled near 7000 feet. Slight course changes were initiated, during which variations in altitude between 6800 and 8000 feet were noted.

At 9:34 AM, the aircraft was positioned about 3.5 miles west-southwest of the Pentagon, and started a right 330-degree descending turn to the right. At the end of the turn, the aircraft was at about 2000 feet altitude and 4 miles southwest of the Pentagon. Over the next 30 seconds, power was increased to near maximum and the nose was pitched down in response to control column movements. The airplane accelerated to approximately 460 knots (530 miles per hour) at impact with the Pentagon. The time of impact was 9:37:45 AM.


Jim Ritter
Chief, Vehicle Performance Division
NTSB

American Airlines Flight 77 (Simple Map Background)



- A Departure from Washington Dulles Airport
- B Reached assigned altitude of 35,000 feet
- C Deviation from assigned course (assumed takeover point)
- D Airplane heading east
- E Course change to northeast;
autopilot disconnected, then re-engaged
- F Autopilot disconnected

Figure 1 – Flight Path

American Airlines Flight 77 FDR Pressure Altitude

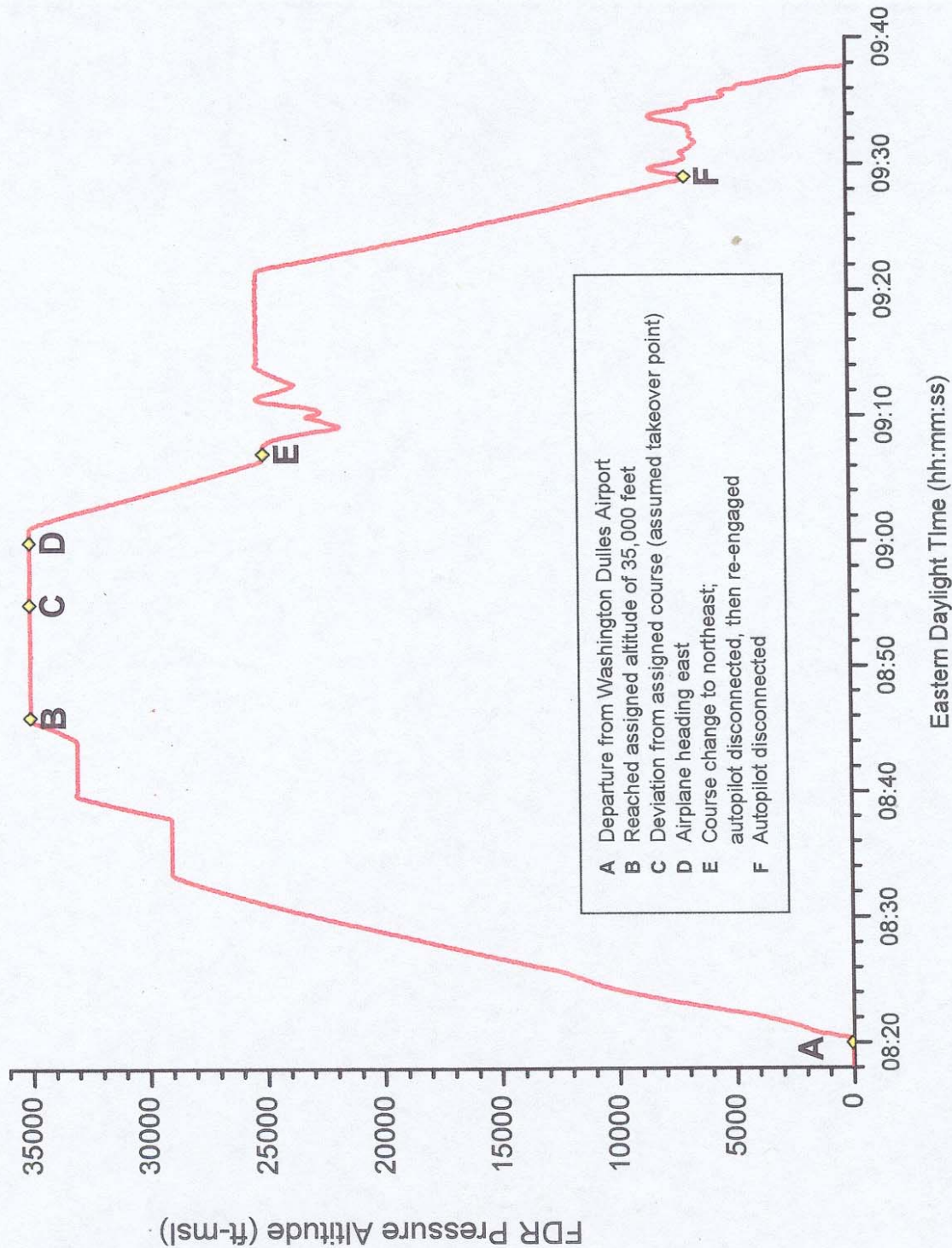
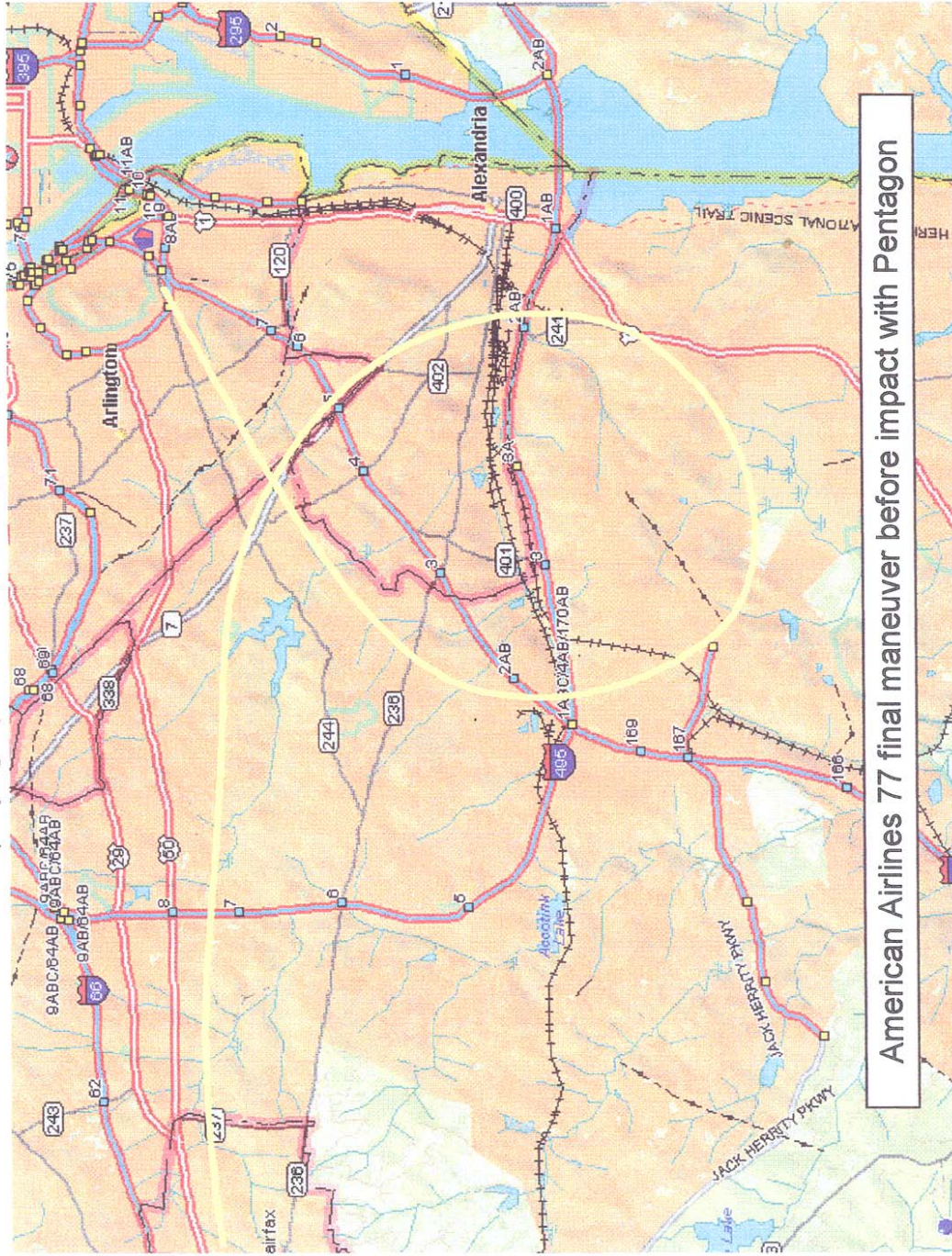


Figure 2 – Altitude Profile

American Airlines Flight 77 (Topographical Map Background)



American Airlines Flight 77 final maneuver before impact with Pentagon

Figure 3. – DC Area Flight Path

8:19:20	LCW	American seventy seven your departure frequency will be one two five point zero five runway three zero cleared for take off. [IAD 1211-1226 LCW]
8:19:27	AAL-77	twenty five point five cleared for take off runway ah three zero American seventy seven. [IAD 1211-1226 LCW]
8:20:26	LCW	American seventy seven turn left heading two seven zero contact departure. [IAD 1211-1226 LCW]
8:20:31	AAL-77	two seventy heading departure American seventy seven thanks sir good day. [IAD 1211-1226 LCW]
8:20:43	ND	American seventy seven Dulles departure radar contact climb and maintain five thousand. [IAD 1215-1230 ND]
8:20:47	AAL-77	five thousand American seventy seven. [IAD 1215-1230 ND]
8:22:05	ND	American seventy seven climb and maintain one one thousand eleven thousand. [IAD 1215-1230 ND]
8:22:08	AAL-77	up to one one thousand American seventy seven. [IAD 1215-1230 ND]
8:23:23	ND	American seventy seven cleared direct LINDEN contact Dulles one one eight point six seven. [IAD 1215-1230 ND]
8:23:28	AAL-77	direct LINDEN eighteen sixty seven American ah seventy seven **. [IAD 1215-1230 ND]
8:23:43	AAL-77	* American ah seventy seven with you passing nine decimal one for eleven one one thousand. [IAD 1215-1230 NH]
8:23:47	NH	American seven seven Dulles approach climb maintain one seven thousand. [IAD 1215-1230 NH]
8:23:50	AAL-77	one seven thousand American seventy seven. [IAD 1215-1230 NH]
8:25:33	NH	American seventy seven contact Washington center one two zero point six five good flight. [IAD 1215-1230 NH]
8:25:37	AAL-77	twenty six five American seventy seven thank you maam good day. [IAD 1215-1230 NH]
8:25:49	AAL-77	ah center American seventy seven with you passing one three decimal zero for one seven thousand. [ZDC 1220-1236 05R]
8:25:57	05R	American seventy seven Washington center roger climb and maintain flight level two seven zero. [ZDC 1220-1236 05R]
8:26:00	AAL-77	two seven zero American seventy seven. [ZDC 1220-1236 05R]
8:30:38	05R	American seventy seven contact Washington center one three three point two seven. [ZDC 1220-1236 05R]
8:30:42	AAL-77	ah thirty three twenty seven American seventy seven thanks sir good day. [ZDC 1220-1236 05R]
8:31:05	AAL-77	* American seventy seven passing two five decimal one for two seven oh. [ZDC 1223-1246 03R]
8:31:23	03R	American seventy seven ah climb, climb maintain flight level two niner zero sir. [ZDC 1226-1246 03R]
8:31:30	AAL-77	two nine zero American seventy seven. [ZDC 1226-1246 03R]
8:34:16	03R	American seventy seven turn twenty degrees right vector for your climb. [ZDC 1226-1246 03R]
8:34:19	AAL-77	turn twenty right American seventy seven. [ZDC 1226-1246 03R]
8:37:31	03R	American seventy seven recleared direct Charleston climb maintain cor -- correction recleared direct Henderson sir climb maintain flight level three niner zero. [ZDC 1226-1246 03R]
8:37:39	AAL-77	direct HENDERSON out of two nine for three nine oh requesting three five zero for a final American seventy seven. [ZDC 1226-1246 03R]
8:37:55	AAL-77	center American ah seventy seven you copy request for three five zero as a final? [ZDC 1226-1246 03R]
8:37:59	03R	American seventy seven ah roger maintain flight level three five zero I'll show that as your flinal. [ZDC 1226-1246 03R]
8:38:03	AAL-77	ah three five zero for a final American seventy seven thank you sir. [ZDC 1226-1246 03R]

8:39:30	03R	American seventy seven amend your altitude maintain flight level three three zero for traffic. [ZDC 1226-1246 03R]
8:39:36	AAL-77	American seven seven stop at three three zero. [ZDC 1226-1246 03R]
8:40:03	03R	American seventy seven contact Indy center one two zero point two seven. [ZDC 1226-1246 03R]
8:40:06	AAL-77	twenty twenty seven American seventy seven thanks sir good day. [ZDC 1226-1246 03R]
8:40:13	AAL-77	center American seventy seven with you level three three zero. [ZDC 1234-1409 HNN-R]
8:40:15	HNN-R	American seventy seven Indy center roger squawk, three seven four three. [ZDC 1234-1409 HNN-R]
8:40:19	AAL-77	three seven four three American seventy seven. [ZDC 1234-1409 HNN-R]
8:43:51	HNN-R	American seventy seven climb and maintain flight level three five zero. [ZDC 1234-1409 HNN-R]
8:43:55	AAL-77	thirty three, three five oh American seventy seven. [ZDC 1234-1409 HNN-R]
8:47:16	HNN-R	American seventy seven turn ten degrees to the right vectors for traffic. [ZDC 1234-1409 HNN-R]
8:47:20	AAL-77	ten right American seven seven. [ZDC 1234-1409 HNN-R]
8:50:47	HNN-R	American seventy seven cleared direct ah FALMOUTH. [ZDC 1234-1409 HNN-R]
8:50:51	AAL-77	ah direct FALMOUTH American seventy seven thanks. [ZDC 1234-1409 HNN-R]
8:56:32	HNN-R	American seventy seven Indy. [ZDC 1234-1409 HNN-R]
8:56:46	HNN-R	American seventy seven Indy. [ZDC 1234-1409 HNN-R]
8:56:53	HNN-R	American seventy seven American Indy. [ZDC 1234-1409 HNN-R]
8:57:12	HNN-R	American seventy seven American Indy radio check how do you read? [ZDC 1234-1409 HNN-R]
8:57:27	HNN-R	American ah seventy seven American radio check how do you read? [ZDC 1234-1409 HNN-R]
8:58:16	HNN-R	American seventy seven Indy radio check how do you read? [ZDC 1234-1409 HNN-R]
8:58:20	DAC-RA	American seventy seven center. [ZDC 1249-1317 DAC-RA]
8:58:41	HNN-R	American ah seventy seven ah Indy center how do you read? [ZDC 1234-1409 HNN-R]
8:58:51	HNN-R	American seventy seven Indy radio check how do you read? [ZDC 1234-1409 HNN-R]
8:59:32	DAC-RA	American seventy seven center. [ZDC 1249-1317 DAC-RA]
9:00:25	HNN-R	American seventy seven Indy. [ZDC 1234-1409 HNN-R]
9:00:56	DAC-RA	Indy center calling American seventy seven American seventy seven. [ZDC 1249-1317 DAC-RA]
9:00:56	DAC-R	Indy center calling American seventy seven American seventy seven. [ZDC 1249-1317 DAC-R]
9:03:06	HNN-R	American seventy seven Indy. [ZDC 1234-1409 HNN-R]
9:15:15	AAL-683	[called AAL-77 on guard at center request]. [ZDC 1249-1317 DAC-RA]