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

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[redacted]

Witness Visibility Study
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National Transportation Safety Board
Office of Research and Engineering

A. ACCIDENT: DCA-96-MA-070

Location:	East Moriches, New York
Date:	July 17, 1996
Time:	203I Eastern Daylight Time
Airplane:	Boeing 747-131, N93119

B. GROUP

Not Applicable

C. SUMMARY

On July 17, 1996, at 2031 EDT, a Boeing 747-131, N93119, crashed into the Atlantic Ocean, about 8 miles south of East Moriches, New York, after taking off from John F. Kennedy International Airport (JFK). 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 to Charles De Gaulle International Airport (CDG), Paris, France, as Trans World Airlines (TWA) Flight 800. The airplane was destroyed by explosion, fire, and impact forces with the ocean. All 230 people aboard were killed.

In support of the investigation into the TWA Flight 800 accident, the angular visibility of the TWA800 aircraft by several witnesses was calculated. Visibility was calculated for the following witnesses: #32, aboard USAir flight 217; #546, the pilot of Eastwind flight 507; #648, the witness on a boat near Great Gun Beach; #571, the witness on Beach Lane bridge. The geographic locations of these witnesses at the time of the initial center wing tank (CWT) explosion are shown overlaid on a map of the area in

attachment I-1. For witnesses on airplanes, arrows on the plot denote the approximate direction of travel of the airplane at the time of the CWT explosion. Calculations were performed for the aircraft prior to the center wing tank explosion, in crippled flight and during subsequent breakup. The visibility was assumed to be unlimited for four of the witnesses, and view obstructions that may have been present for witness #32 aboard USAir flight 217 were examined.

C. DETAILS OF THE INVESTIGATION

Section I - Relative Positions and Calculated Visibility

Since two of the witnesses (#32 and #546) examined in this study were on aircraft, the three-dimensional position data of Eastwind flight 507, USAir flight 217, TWAXOO, and the Navy P-3 Orion were obtained from the Aircraft Performance Group Chairman'. For the TWAXOO aircraft in crippled flight, data was obtained from the Main Wreckage Flight Path Study'. Radar position data, aircraft data, weather data and the local magnetic variation were used to calculate the corresponding time history of aircraft orientation parameters such as roll angle, pitch angle, and ground track angle. Parameters were mathematically smoothed to remove erratic data trends, and may not accurately reconstruct any short-duration flight path deviations.

The calculated aircraft orientation angles time histories and the time history position data for both viewing and observed aircraft were used to calculate viewing angles. The calculated azimuth and elevation angles of the observed aircraft account for the roll and pitch of the viewing aircraft, and are presented as they would appear relative to the viewing aircraft as a function of time. Relative azimuth angle is defined as the angle relative to the longitudinal axis of the aircraft. The zero degree position is the front of the aircraft with positive direction in a clockwise direction. For example, the 90-degree relative azimuth position would be in the direction out the right hand side of the airplane. Relative elevation angle is the angle relative to the longitudinal and lateral axis of the aircraft. Positive elevation angle is in the skyward direction, with a 90-degree relative elevation angle corresponding to the overhead vertical axis of the viewer[3]. The horizontal, vertical, and three-dimensional distances of the viewing and observed aircraft were also calculated as a function of time.

This procedure was also used to calculate the observed motion of TWAXOO for the fixed location witnesses (#648 and #571). On all of the visibility plots, the viewed target trajectories are labeled with seconds relative to the CWT explosion on TWA 800 (e.g. +10 seconds is 10 seconds after the CWT explosion, and –5 seconds is 5 seconds prior to the CWT explosion).

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[1] See the Airplane Performance Study, Exhibit 13A for details of the radar data.

'See the Trajectory Study, Exhibit 22A, Main Wreckage Flight Path Study, Exhibit 22C, and Trajectory Study - Addendum I to Main Wreckage Study, Exhibit 22D.

[3] For a viewer in an airplane, the 90-degree elevation angle would he aligned vertically to the airplane, regardless of the viewing airplane hank angle and pitch angle.

Witness # 32

Attachment I-2 shows the viewed position of the Navy P-3 Orion aircraft and TWAXOO relative to USAir 217, for the timeframe from 2.5 minutes prior to the CWT explosion until main wreckage impact with the water. For the trajectories of both TWAXOO and the P-3 Orion, each data (circles for TWAXOO, triangles for the Navy P-3) point represents one second elapsed time, and major events are noted. The Navy P-3 is denoted by the red curve, and TWAXOO denoted by the blue curve. Viewing angle limits for a passenger seated in seat 5F, (the reported location of witness #32) on a 737-400 were obtained from the Viewing Angle Study[4], and are noted on attachment I-2.

The calculated viewing angles show that approximately 13 seconds prior to the CWT explosion on TWAXOO the P-3 Orion aircraft enters the field of view of the witness. The earliest initial view of the P-3 would be approximately 9 degrees down in the window, and 20 degrees to the right of the nose of the aircraft. Over the next several seconds, the P-3 aircraft moves further into the unobstructed relative viewing position to the witness on USAir 217. As the P-3 gets closer to USAir217 (as denoted by the longer viewing angles traversed between each I-second data point), the P-3 passes out of the viewing limit of the passenger in seat 5F approximately I second prior to the CWT explosion of TWAXOO.

When the CWT explosion occurs on TWAXOO, the aircraft is not yet in view of seat 5F. The earliest initial view of TWAXOO would be approximately 28 degrees down in the window, and 20 degrees to the right of the nose of the aircraft. TWAXOO would first enter the field of view of the witness in seat 5F approximately I second after the CWT explosion[5]. As TWAXOO continues its crippled flight, it continues to move further into the field of view of seat 5F, at a relative elevation angle between 30 and 42 degrees down, and remains in the calculated field of view for most of its trajectory. Assuming the best case head viewing positions, the crippled aircraft would have been visible to the witness in seat 5F for approximately 40-46 seconds of its flight.

Witness # 546

Attachment I-3 shows the viewed position of TWAXOO relative to Eastwind flight 507, for the timeframe from 2.5 minutes prior to the CWT explosion until main wreckage impact with the water. The data points shown on this plot are at one-second intervals. The entire trajectory of the crippled flight of TWAXOO remained slightly to the left of the nose of Eastwind 507, and varied between slightly above level and slightly below level.

[4] See Witnesses 4 – Viewing Angle Study for Witness #32, Exhibit 4, for a complete description and photographs of the viewing angle limitations from seat 5F on a 737-400.

[5] If the witness were in a more relaxed position, TWA800 would come into view at a greater angle to the right of the nose of the airplane, and a longer time after the CWT explosion.

Witness # 648

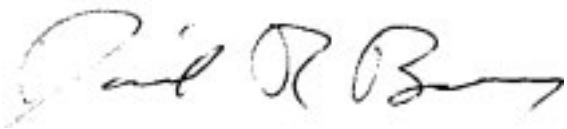
Attachment I-4 shows the position of TWAXOO relative to the witness on a boat near Great Gun Beach. The viewing position used for the visibility study was the approximate location determined by the witness at a visit to the area after the accident. It was assumed the witness was facing 160 degrees True (south-southeast) for this calculation. This witness has a view of the TWAXOO aircraft from the initial CWT explosion, and would be able to view a slight climb and apex of the crippled flight trajectory, and a clear view of the aircraft during the subsequent breakup fireball and impact with the ocean.

Witness # 571

Attachment I-5 shows the position of TWAXOO relative to the witness on the Beach Lane bridge. The viewing position used for the visibility study was the location on the bridge specified by the witness, with a viewing angle of 180 degrees True (due South). This witness had an unobstructed view of the initial CWT explosion, and would be able to view the TWAXOO aircraft ascend in crippled flight at what would appear to be a 40 degree angle relative to the horizon. This witness would then be able to view the crippled flight during its descent, until the houses on the South side of Dune Road block the witness's view. The azimuth viewing angle difference from the initial CWT explosion, to the descent to the ocean is approximately 14 degrees.

To examine what this witness would have seen in the event of a missile launch, two hypothetical high-performance missile flyouts[6] were plotted for their visibility to this witness. Launch positions were chosen that would provide an intercept at about the same instant as missile rocket motor burnout. Maximum eastern and maximum western launch positions along the TWAXOO flightpath were used to calculate the largest range of possible views of a hypothetical launch and missile motor burn of 7.8 seconds.

These results are shown in Attachment I-6. The missile flyout data points represent 0.10 seconds, whereas the TWAXOO data is 1.0 second per data point. The blue line denotes the easternmost launch position flyout, and the red denotes the westernmost launch position flyout. The times labeled on the plot for the westernmost hypothetical missile flyout are in seconds relative to the CWT explosion. For an unobstructed view of the missile launch, the missile would have been in view for 7.8 seconds. In comparison to TWAXOO, at the time of intercept the missile would have appeared to travel approximately 4 times faster than TWAXOO.



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[6] The missile flyout was assumed to he a SAM-2 high performance missile. See the Missile Self Destruct Performance Study, Exhibit 22E, for details on the missile performance and flyout trajectories.