



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety

Washington, D.C. 20594

STRUCTURES GROUP CHAIRMAN'S FACTUAL REPORT

October 29, 2019

A. ACCIDENT: DCA19MA086

Operator: Atlas Air flight 3591
Location: Trinity Bay, Texas
Date: February 23, 2019
Time: 1239 Central Standard Time
Aircraft: Boeing 767-375BCF
Registration: N1217A

B. STRUCTURES GROUP

Chairman: Clinton R. Crookshanks
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C. SUMMARY

On February 23, 2019, at 1239 central standard time, Atlas Air flight 3591, a Boeing 767-375BCF, N1217A, entered a rapid descent from 6,000 ft and impacted a marshy bay area about 40 miles

southeast of George Bush Intercontinental Airport (KIAH), Houston, Texas. The two pilots and one nonrevenue jumpseat pilot were fatally injured. The airplane was destroyed and highly fragmented. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 121 domestic cargo flight, which originated from Miami International Airport (KMIA), Miami, Florida, and was destined for KIAH.

D. DETAILS OF THE INVESTIGATION

1.0 Airplane Overview

The Boeing 767-375BCF airplane is a twin-engine, wide-body, transport category airplane (Figure 1¹). The airplane is equipped with a conventional tail and retractable tricycle landing gear. The accident airplane was manufactured as a passenger airplane in 1992 and had winglets installed in 2010 while in service with a different operator. The airplane was converted to a freighter airplane in 2017 by Boeing. The conversion added a large, main-deck cargo door and the airplane was redesignated as a Boeing Converted Freighter (BCF). The BCF airplane is 180 feet, 3 inches long, 52 feet tall at the tail, has a fuselage diameter of 17 feet, 1 inch, has a wingspan of 166 feet, 11 inches, and has a horizontal stabilizer span of 61 feet, 1 inch. The airplane primary structure is of all metal construction, primarily aluminum alloys. The elevators, rudder, ailerons, winglets, and flaps are of composite construction along with many of the fairings, doors and panels.

2.0 Accident Site

The airplane impacted the ground in a shallow, muddy swamp area about 2 miles west-southwest of Anahuac, Texas, near where the Trinity River enters Trinity Bay (Figure 2). The initial impact crater was located at 29° 45' 50.6" North latitude and 94° 42' 44.7" West longitude. The main debris field was oriented east to west, extended west about 350 yards from the initial impact point, and was about 170 yards wide (Figure 3). Almost all the airplane wreckage was located in the main debris field (Figure 4). Several items, including a portion of the #2 (right) engine, both engine fan disks, and some main landing gear components were found beyond the main debris field up to 670 yards west of the initial impact point. Lightweight composite airplane components and a large portion of the cargo floated southward and were recovered up to 20 miles away. The wreckage was highly fragmented and scattered. The water was 0 to 3 feet deep in the main debris field depending on the tide and wind conditions. The larger pieces of wreckage were sticking out of the water but much of it was buried up to 10 feet deep in the soft mud. At times, about half of the main debris field had little or no water (Figure 5).

The shallow water made accessing the site impossible with conventional boats. Access to the site could only be accomplished with airboats. Initial airboat support was provided by the Harris County Sheriff's Office and the Texas Parks & Wildlife Department. Airboat access to the site was established at the Fort Anahuac Park boat ramp. The park and boat ramp were closed to the public for most of the recovery operation. Site security was maintained at the park and in the bay by the local authorities throughout the recovery operation.

An initial survey of the debris field identified components from all 4 corners of the airplane. The

¹ All figures are presented in Appendix A.

horizontal stabilizer jackscrew was located about 40 yards west of the initial impact point. The left and right winglets were located about 165 yards west of the initial impact point on the south and north side of the debris field, respectively. A section of the upper fuselage structure above the cockpit and portions of the windshields were located about 310 yards west of the initial impact point and a portion of the rudder was located about 340 yards west of the initial impact point. A portion of the #1 (left) engine was located about 30 yards west of the initial impact point and a portion of the #2 (right) engine was located about 670 yards west of the initial impact point.

3.0 Recovery

After performing an initial survey of the debris field, the focus was on attempting to find and recover the CVR and FDR. Members of the group started by utilizing Underwater Locator Beacon (ULB) locating equipment provided by Boeing. The entire debris field was searched with the locator on February 25 when there was more water in the bay with no indications. Follow up work was performed with the locator and a test ULB to establish the feasibility of hearing the pings in the shallow water conditions. In areas where there was no debris, the signal could be heard up to 30 yards away in shallow water. In areas of significant wreckage, the signal could not be heard at any appreciable distance through the wreckage. It was also determined that the signal could not be heard if the ULB was submerged in any amount of mud.

Lone Star Retrieval (LSR) was contracted by the airline's insurance company to recover the wreckage and began operations on February 25 under the supervision of the group. Recovery of the wreckage was very difficult in the swampy conditions because visibility in the water was poor and the muddy bottom could not support normal heavy equipment. LSR brought in personnel and specialized equipment including multiple airboats, barges, an amphibious crane and two amphibious excavators to search for the recorders and retrieve the wreckage (Figure 6).

The initial recovery efforts involved a hand search in the mud for the flight recorders. Several people were spread out starting at the initial impact point to search by hand in the mud working to the west. The search protocol was to utilize feet or sticks to feel for wreckage in the mud and recover the pieces by hand. Portions of the CVR frame were recovered in the mud near the initial impact point on the morning of March 1. The crash survivable memory unit (CSMU) from the CVR was recovered about 40 yards west of the frame location on the afternoon of March 1. The ULB was separated from the CVR CSMU. The FDR frame and CSMU were recovered within 15 yards of the CVR CSMU location on March 3. The ULB was separated from the FDR CSMU.

LSR began retrieving the larger items of visible wreckage on the western side of the debris field on February 26 using the airboats and cranes. Wreckage was staged on barges until they were full and then transferred to Fort Anahuac Park where it was loaded on trailers. The excavation of the site commenced on March 7 once the large item retrieval was done. A specialized screen was designed and fabricated to be fitted to the excavator buckets that would allow the water and mud to drain while still retaining wreckage larger than about 4 inches (Figure 7). LSR developed a grid system to excavate the site and ensure complete coverage of the main debris field. The smaller items recovered by hand or with the excavators were placed in large Tyvek bags with a volume of about 43 cubic feet. By the end of the recovery operations, about 200 bags of wreckage were

recovered with an average bag weight of about 500 pounds. The wreckage recovery continued until April 11 at the main debris field.

The group worked with the insurance company to secure a storage location for all of the airplane wreckage. A portion of a warehouse in Baytown, TX, measuring 200 feet by 190 feet was chosen for storage. The first load of recovered wreckage arrived at the warehouse on March 4. Wreckage continued to be delivered to the warehouse as it was recovered until April 12.

The county authorities set up a collection location for floating debris recovered by citizens at the Anahuac airport the day after the accident. The collection site remained open until March 5. LSR recovered additional floating debris along the east and west sides of Trinity Bay during the recovery operations. The recovered floating debris was transferred to the storage warehouse.

4.0 Wreckage Reconstruction

The entire airplane was highly fragmented. The decision was made to lay all of the identifiable debris on the floor of the warehouse in a two dimensional reconstruction. The floor was measured and taped with specific locations for the fuselage, wing upper and lower surfaces, horizontal stabilizer upper and lower surfaces, vertical stabilizer and rudder, engines, systems components, center wing structure, cargo handling components, rigid cargo barrier, and flight deck components. The grid was set up using defined station and stringer locations with a 10% expansion to allow for wreckage deformation and personnel movement.

The reconstruction effort was continuously staffed by the structures and systems groups between March 4 and April 12 with the support of party members from Boeing, Atlas Air, and the International Brotherhood of Teamsters. An effort was made to identify and locate each piece of airplane wreckage that arrived at the warehouse. The larger items of wreckage were staged near the warehouse entrance until they could be conclusively identified and located. The group used printed part or serial numbers, data tags, unique features, and the airplane livery (Figure 8) to help in the identification and location of wreckage. The parts that could be positively identified and located were placed on the reconstruction grid (Figure 9). A full georeferenced orthomosaic map and 3-dimensional point cloud of the reconstruction can be found in the public docket for this accident. Areas were set aside to collect items identified to be from a particular part of the airplane but without enough information for a precise location. Each of the Tyvek bags of smaller wreckage was dumped and sifted by the structures and systems group personnel and items were segregated into personal effects, US Mail, cargo, identifiable structure, systems components, and circuit cards. The small unidentifiable airplane wreckage was repacked in bags and stored in secured shipping containers outside the warehouse. Larger items of wreckage identified to be cargo container components or those without conclusive identification were also stored in shipping containers.

Each identified part placed on the reconstruction grid had a unique identifying number affixed with red tape. The alphanumeric identification number consisted of a letter or letters designating the part of the airplane followed by a 3 digit sequential number. One or more photos were taken of each part placed on the grid. A database and photo storage system was set up in the warehouse to catalog all of the major parts identified and included in the reconstruction. The database entries for each part included the assigned identification number, a short description, location information,

and any identifying features. Digital maps of the major sections of the airplane were created to provide a visual indication of the recovered and identified items. In all of the maps presented in this report, the uncolored areas represent portions where nothing was positively identified in the recovered debris.

Fuselage

Pieces identified to be from the fuselage had an F number affixed. The fuselage pieces were laid out in the warehouse with the exterior surface up and with an imaginary cut through the lower centerline. There were 479 items positively identified and placed on the fuselage grid. Many smaller parts were not able to be conclusively identified or located. Numerous small fragments of fuselage skin, frames and stringers remained in bags. Much of the lower fuselage structure below S-25L and S-25R was not positively identified in the wreckage. The larger pieces of fuselage structure consisted of upper fuselage skin panels with partial stringers and frames attached. The largest piece of fuselage recovered was a section 46 skin panel that spanned from fuselage station 1197+120 to 1420 and from S-12L to S-17R. The identified fuselage parts were digitally mapped as shown in Figure 10. Fuselage structure that could be identified but not accurately placed on the grid was grouped by section on the side of the fuselage grid.

The rigid cargo barrier (RCB) components installed at the forward end of the main deck as part of the freighter conversion were identified in the recovered wreckage and affixed with an RCB number. There were no impact marks noted on the aft side of the RCB. A total of 12 items from the RCB were positively identified and mapped as shown in Figures 11, 12, and 13. Nine pieces of honeycomb core from the RCB were recovered separately.

The aft pressure bulkhead (APB) components were segregated and placed on the grid near the aft end of the fuselage grid with the aft surface up. These parts were affixed with an F number. Six of the pieces were accurately placed and an additional 10 pieces were identified but could not be accurately placed. The identified and located APB parts were digitally mapped as shown in Figure 14.

Empennage

Pieces identified to be from the horizontal stabilizer and elevators had an H number affixed. The horizontal stabilizer was laid out with the interior surfaces up with an imaginary cut through the leading edge. There were 74 pieces of the horizontal stabilizer and elevators identified and placed on the grid. Much of the upper surface of the horizontal stabilizer was placed on the grid. There were very few parts positively identified from the lower surface of the horizontal stabilizer. The center section of the horizontal stabilizer, jackscrew assembly, and attach points were identified in the wreckage. The horizontal stabilizer pivot fittings were identified in the wreckage and the lugs, clevises, and pins were intact. The identified horizontal stabilizer and elevator parts were digitally mapped as shown in Figures 15 and 16. Horizontal stabilizer structure that could be identified but not accurately placed on the grid was grouped near the horizontal stabilizer grid.

Pieces identified to be from the vertical stabilizer and rudder had a V number affixed. Most of the vertical stabilizer and rudder were positively identified in the wreckage. The vertical stabilizer and rudder were placed on the left side with the right side facing up. There were 46 pieces of the vertical stabilizer and rudder positively identified and placed on the grid. The identified vertical

stabilizer and rudder parts were digitally mapped as shown in Figures 17 and 18. Vertical stabilizer and rudder structure that could be identified but not accurately placed on the grid was grouped near the vertical stabilizer grid.

Wings

Pieces identified to be from the left wing had an LW number affixed, those from the right wing had a RW number affixed, and those from the center wing had a CW number affixed. The upper and lower surfaces of the left and right wings were laid out with the interior surfaces up and an imaginary cut through the leading edge. The leading and trailing edge components were positioned next to their respective lower surface grid. There were 205 pieces of the left wing and 175 pieces of the right wing identified and placed on the grid. The identified left wing and right wing upper and lower surface parts were digitally mapped as shown in Figures 19 and 20. The wing leading and trailing edge parts were mapped separately as shown in Figures 21 through 24. The center wing structure was comprised of 96 identified parts. The lower skin, upper skin, and front spar were digitally mapped as shown in Figures 25, 26, and 27, respectively. Some pieces of the rear spar and spanwise beams were identified but not accurately located and were laid out near the other center wing structure. The pressure deck was comprised of 13 identified parts and was digitally mapped as shown in Figure 28. The left and right winglets were digitally mapped as shown in Figures 29 and 30. Wing structure that could be identified but not accurately placed on the grid was grouped near the wing grids.

Landing Gear

The nose landing gear (NLG) and both main landing gear (MLG) were recovered in the main debris field. The NLG was separated from the trunnions and the inner cylinder and axle were separated from the outer cylinder. The right and left MLG were separated from the trunnions. The inner cylinder and truck beam remained attached to the outer cylinder on both MLG, but the forward axle was separated from each MLG. Some MLG wheel and brake assemblies were recovered beyond the main debris field.

Cargo handling

The cargo locks, stops, and guides were segregated and laid out on the warehouse floor for examination. The individual guides were identified based on information provided by Atlas Air.

- Main deck center guides with 2 guide arms - 40 recovered, 3 with an intact housing and both arms fractured, 1 with an intact housing and 1 arm fractured, and the remaining with the housing and both arms intact
- Main deck side guides in 2 guide housing with red vertical restraint tab - 14 recovered with 28 guides, 7 guides were locked down
- Main deck side guides, single, with red vertical restraint tab - 48 recovered, 5 guides were locked down
- Main deck side guides with single guide - 85 recovered, 24 locked down
- Main deck door guides with yellow vertical restraint tab - 13 recovered, 3 locked down, 1 attached to structure with a lock
- Main deck cargo stops - 6 recovered
- Main deck locks, single - 140 recovered, 72 locked down
- Main deck locks, double - 23 recovered with 46 locks, 23 locked down

- Main deck locks, triple - 9 recovered with 27 locks, 18 locked down
- Lower deck side guides with a single guide arm - 14 recovered
- Lower deck center guides with 2 guide arms - 19 recovered
- Lower deck container guides at door - 6 recovered, 1 partially intact
- Lower deck combo guide/restraint at door - 10 recovered
- Lower deck guide with vertical restraint - 3 recovered
- Lower deck forward pallet restraints - 3 recovered
- Lower deck cargo stops - 6 recovered
- Lower deck can fore/aft locks - 18 recovered
- Unidentified locks - 6 recovered

Engines

The wreckage from the left and right engines was segregated in the warehouse and was examined and cataloged by the Powerplants Group.

Systems

The recovered systems components were segregated in the warehouse and were examined and cataloged by the Systems Group.

There was no evidence of fire noted on any of the recovered wreckage. All fracture surfaces examined were consistent with overstress separation.