NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 17, 2014

STRUCTURES

Group Chairman's Factual Report

DCA13MA133

A. ACCIDENT: DCA13MA133

Operator:	United Parcel Service flight 1354
Location:	Birmingham, Alabama
Date:	August 14, 2013
Time:	0440 Central Daylight Time (CDT)
Aircraft:	Airbus A300-600
Registration Number:	N155UP

B. STRUCTURES GROUP

Chairman: Clinton R. Crookshanks
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C. SUMMARY

On August, 14, 2013, at about 0447 central daylight time (CDT), United Parcel Service (UPS) flight 1354, an Airbus A300-600, N155UP, crashed short of runway 18 while on approach to Birmingham-Shuttlesworth International Airport (BHM), Birmingham, Alabama. The captain and first officer were fatally injured and the airplane was destroyed. The scheduled cargo flight was operating under the provisions of 14 Code of Federal Regulations (CFR) Part 121 and originated from Louisville International-Standiford Field Airport (SDF), Louisville, Kentucky.

D. DETAILS OF THE INVESTIGATION

1.0 Aircraft

The Airbus A300-600 Freighter is a twin turbofan engine, medium range, wide body cargo airplane. See Figure 1 for a 3-view drawing of the airplane[1]. The airplane is equipped with low wings, a conventional tail and tricycle landing gear. The airplane measures 177 feet, 5.2 inches long, 54 feet, 2.4 inches high at the tail, and has a wingspan of 147 feet, 1.3 inches. The airplane primary structure is constructed of metal with the exception of the carbon fiber reinforced plastic (CFRP) vertical stabilizer, rudder and elevators. Various doors, fairings, and secondary structure are constructed of CFRP, glass fiber reinforced plastic (GFRP), and Aramid fiber reinforced plastic (AFRP). The accident airplane, manufacturer serial number (MSN) 0841, had a maximum takeoff weight (MTOW) of 375,880 pounds and was configured to carry 22 cargo containers on the main deck and 7 cargo containers on the lower deck. The total weight of cargo on the accident flight was 89,227 pounds.

2.0 Debris Field

The airplane first impacted down-sloping terrain in a large gulley about 5,024 feet north of the threshold of runway 18. The major debris field extended down to the bottom of the gulley and up the adjacent side about 1,446 feet south from the initial ground impact. Prior to the initial ground impact the airplane struck several trees and ingested tree debris into both engines. The first tree impact occurred about 6,440 feet north of the runway threshold. Airplane parts were recovered beginning adjacent to the first tree strike. The airplane continued impacting trees for about 950 feet and impacted a power pole and power lines about 5,535 feet north of the threshold. The items recovered near the trees included the outboard portion of the center flap, one main landing gear strut door, engine inlet structure, left wing slat structure, outboard left wing upper and lower skins, outboard left wing spar structure, a portion of one of the air conditioning pack fairings, and miscellaneous left flap structure. A portion of the left wing tip about 4 feet long was recovered between the initial tree impact and initial ground impact about 5,206 feet north of the threshold. The airplane was highly fragmented but there were two major portions of wreckage in the debris field. The forward fuselage was located about 4,070 feet north of the threshold on the top of the southern ridge of the gulley and the aft fuselage and right wing were located about 3,650 feet north of the threshold on the down-sloping terrain to the runway. The two engines were located within 25 feet of each other in the debris field about 4,200 feet north of the runway threshold and about 1,000 feet northwest of the forward fuselage. An aerial photo of the debris field is provided as Attachment 1 to this report. The photo does not include the area where the airplane first impacted trees.

There was extensive ground scarring in the dirt and grass from the initial ground impact through the debris field. Beginning at the initial ground impact, the dirt was wet with a strong, distinct fuel odor. There were several pieces of wing structure embedded in the dirt starting at the initial ground impact. The first evidence of fire began about 4,637 feet from the runway threshold and continued all the way to the aft fuselage section. The forward fuselage section was displaced to the left side of the debris field as viewed looking along the intended route of flight towards the

[1] All figures are presented in Appendix A to this report.

runway. There was no evidence of fire on the forward fuselage section. There was an extensive post-crash fire that consumed most of the aft fuselage of the airplane. The entire airplane was accounted for at the accident site.

3.0 Aircraft Examination

Forward Fuselage

The forward fuselage separated from the airplane near the leading edge of the wing and came to rest on the left side of the debris field. The forward fuselage was upright and oriented on a heading of about 120 degrees true. Most of the lower fuselage structure below the main deck floor was torn off during the accident sequence and recovered in the debris field. The lower left side of the forward fuselage sustained more damage than the lower right side. The fuselage is divided into 9 sections numbered from 11 to 19 along production breaks. See Figures 2 and 3 for the fuselage frame and station locations and Figure 4 for the fuselage contour and stringer locations. Figure 5 shows the right side of the forward fuselage wreckage and Figures 6 and 7 show the left side of the forward fuselage wreckage.

Section 11 – Forward Nose Section, Frame 1 to Frame 10

The radome was fragmented into 3 major pieces, 2 of which were separated from the nose but recovered adjacent to the forward end of the fuselage. There was significant crushing of the honeycomb radome on the lower and left sides. The upper piece of radome remained attached to the fuselage. Windows R1, R2, R3, and L2 were intact and installed. Windows L1 and L3 were installed but the outer pane was fractured on both. Both the R2 and L2 windows were not seated in their frames and the exterior levers were in the open position. The nose of the airplane was crushed aftward and upward from the lower edge of the windows on the left side underneath to about 56 inches below the lower edge of the windows on the right side. The lower portion of the forward pressure bulkhead was deformed aftward. There was some minor skin buckling below the windows on the right side. The skin was fractured along frame 10 on the right side. The skin below the windows on the left side was deformed, torn and fractured with mud and dirt embedded in the skin folds and fractures. There was minor buckling of the crown skin just forward of frame 10. The cockpit floor was extensively fractured and deformed upward.

Section 12 – Aft Nose Section, Frame 10 to Frame 18

The L1 entry door was separated from the fuselage and recovered in the debris field about 310 feet north of the door frame. The door frame was deformed and buckled at the lower edge and about 18 inches above the lower edge. There was dirt and mud embedded in the fuselage around frame 18 where the skin was fractured. The lower fuselage was deformed and crushed from about 18 inches above the lower edge of the L1 door underneath to about 24 inches below the lower edge of the skinned over R1 door opening. There was inter-frame buckling between frames 10 and 12A on the left side and between frames 10 and 12 on the right side with several areas of fractured skin. The right side skin was fractured along frame 17 on the right side below stringer (STGR) 26. There was some minor skin buckling above the L1 entry door. The L1 door upper stabilization arms were fractured but remained attached to the door frames. The hinge arms were separated from the door frame and the upper lug

was fractured while the lower lug was intact. The supernumerary[2] floor was fractured and deformed upward. The nose landing gear (NLG) and portions of the left wheel well structure were separated from the fuselage and recovered in the debris field. The upper NLG strut was recovered adjacent to the lower forward fuselage structure and the left trunnion was fractured from the strut. The right trunnion was intact. The retract actuator was recovered in the extended position in the section 12 wreckage. The lower NLG strut was recovered in the aft fuselage wreckage with the wheels attached. The tires were consumed by fire.

Section 13 – Forward Fuselage Section, Frame 18 to Frame 29
The main cargo door was installed in the closed position with no significant damage. The skin at the lower forward corner of the cargo door was separated. There was mud and grass splattered on the left side of the fuselage. The lower fuselage structure was separated from the lower edge of the cargo door underneath to the lower edge of the lower cargo door on the right side and recovered in several pieces in the debris field. The lower cargo door on the right side was installed with some minor buckling of the skin. The lower cargo door frame was fractured at both the lower forward and lower aft areas. There was minor dirt and grass splattered on the right side of the fuselage.

Section 14 – Forward Intermediate Fuselage Section, Frame 29 to Frame 40
The forward fuselage was separated at Frame 38 on the left side. On the right side the fuselage was separated at frame 38.2 between STGR-5L and STGR-5R, at frame 38 down to STGR-13R, at frame 35 down to STGR-22R, and at frame 34 below STGR-22R. The left fuselage skin was deformed outward along a diagonal line from STGR-28L at the forward end to STGR-22L at the aft end. The main deck cargo floor was installed and undamaged from the flexible joint at frame 40 forward to the supernumerary area. There were cargo containers installed in all the available positions in the forward fuselage with 4 on the right side and 3 on the left side. There was no noticeable deformation of the forward rigid cargo barrier. There were 2 damaged cargo containers and numerous loose cargo items recovered aft of the forward fuselage. There were 2 lower deck cargo containers recovered underneath the forward fuselage.

Aft Fuselage
The aft fuselage from about frame 40 to the tail and the right wing was located closest to the runway threshold and was the furthest wreckage in the debris path. There was an extensive post-crash fire that consumed a large portion of the aft fuselage. The aft fuselage, aft of frame 54, was oriented about 80 degrees left of the center wing and fuselage such that the aft fuselage and right wing were almost in line (Figure 8).

Section 15/21 – Center Fuselage Section, Frame 40 to Frame 54
The center wing area was almost entirely consumed by fire. The right rib 1 was intact and in position with heavy fire damage that consumed most of the web. The left rib 1 and upper and lower skin structure was mostly consumed by fire. There was a large section of fuselage skin

[2] The supernumerary compartment, which is present on some cargo airplanes, is located directly aft of the cockpit and forward of the main deck cargo compartment. This area was where the lavatory, galley, and non-flight crew seats were located.

attached to the wing junction. The fracture at the forward end matched the fracture described for the right side of section 14. The lower fuselage skin was separated below S-32R. The skin extended up to S-6R between frames 38 and 43 and up 2 stringers from the upper wing surface between frames 43 and 47.

Section 16 – Aft Intermediate Fuselage Section, Frame 54 to Frame 58 and Section 17 – Frame 58 to Frame 72
The lower fuselage skin structure was evident from frame 54 to 72 and measured about 240 inches wide with heavy fire damage. The skin structure above this was entirely consumed by fire and the internal airplane structure and cargo was mostly consumed by fire. There was a section of main deck floor about 10 feet wide by about 20 feet long that was recovered from this area of the fuselage with extensive fire damage.

Section 18 – Aft Fuselage Section, Frame 72 to Frame 80
The lower fuselage skin structure was evident from about the main deck floor level between frames 72 and 76 and about 3 stringers above the main deck floor level between frames 76 and 80 on the right side underneath to about stringer 11 between frames 72 and 80 on the left side with heavy fire damage. The upper portion of the fuselage and the internal structure was consumed by fire.

Section 19 – Tail Section, Frame 80 to Tail
Section 19 was essentially intact from the aft pressure bulkhead (APB) at frame 80 to the tail. The APB was consumed by fire from about 2 o'clock to about 9 o'clock as viewed looking aft. The remaining portions exhibited heavy fire damage. The fuselage skin was intact with the exception of a burn through area on the left side aft of the horizontal stabilizer from frame 93 to 96. There was dirt and grass packed into the Auxiliary Power Unit (APU) inlet duct and the drain masts were intact. The APU was intact and installed in the lower portion of section 19. There was no damage noted to the underside of section 19 when the structure was lifted.

Right Wing
See Figure 9 for a drawing of the left wing with the ribs and components identified. The right wing is similar. The right wing was attached to the fuselage but was subjected to an intense post-crash fire. According to the fire department, there was a large explosion in the right wing during the firefighting efforts that separated a portion of the wing and deformed another portion. A section of the upper skin between the forward and aft spars from rib 8 to 14 was deformed forward and inboard from the explosion. The bending of the upper skin extended inboard to about rib 6. The edge of the deformed skin structure was lodged between the fixed leading edge and slat 1. A section of aft spar from rib 9 to 11 and a section of rib 10 remained attached to the deformed skin. Another section of upper wing skin between the forward and aft spars and from rib 14 to 23 was thrown about 150 feet east of the wing by the explosion as identified by the yellow arrow in Figure 8. Ribs 16, 17, 19, 20, and 21 remained attached to this portion of the upper wing skin structure. There was heavy fire damage from rib 11 to 15 and from the forward spar to the trailing edge that consumed most of the wing structure. The false spar inboard of the aileron was consumed by fire. The lower skin structure was pillowed downward from rib 15 to 22 between the forward and aft spars. There was a small pick tool with an orange handle in the

wing fuel tank area between ribs 20 and 22 (Figure 10). The wing skin above the right main landing gear wheel well was consumed by fire. The Krueger flap, slats 1-3, spoilers 5, 6, and 7, and the inner, center, and outer flaps remained attached to the wing. The Krueger flap was deformed upward about 3.5 inches from its normal position. Slat 1 was fractured into two pieces about 88 inches from the inboard end. The slat was deformed and crushed aftward on both sides of the fracture. There was corresponding impact damage to the lower wing skin and forward spar in line with the slat damage that separated a portion of the lower wing skin. The trailing edge of slat 1 was deformed and damaged where the deformed wing skin was lodged. There were punctures in slat 1 from the aft side about 46 inches from the inboard end and about 63 inches from the outboard edge with the skin deformed outward. Both puncture locations corresponded to the location of slat screw jacks that were separated from the slat. Slat 2 had a semi-circular impression in the leading edge that was about 10 inches wide about 156 inches from the inboard edge (Figure 11). There were wood fibers trapped in the damaged slat at the damage location, as identified by the yellow arrow in Figure 11, and the skin was fractured along a rivet line for about 20 inches aft of the impact. Slat 3 had a puncture about 64 inches from the outboard edge. About 40% of the wingtip navigation light lens was broken and the lens for the aft position and strobe lights was broken away entirely. The outer flap was installed and attached with no major damage. The lower portions of the outer flap track fairings 5 and 6 were crushed where they impacted the ground. The center flap trailing edge was evident and in position at the trailing edge of the wing. The inboard 2/3 and forward half of the center flap was consumed by fire. Flap tracks 3 and 4 were installed but the fairings were consumed by fire. The inner flap trailing edge was evident and in position at the trailing edge of the wing. The forward half of the inner flap was consumed by fire along its length. Flap tracks 1 and 2 were installed but the fairings were consumed by fire. All of the flap screw jacks were in the aft most position. The aileron was attached but fractured in two pieces with heavy fire damage that consumed about 20%. Spoilers 1 through 4 were consumed by fire. Spoiler 5 was installed with heavy fire damage to the inboard half and entire lower skin. Spoiler 6 was installed with moderate fire damage to the forward, inboard corner. Spoiler 7 was installed with a fore-aft crease about mid-span. There were several pieces of internal wing structure and fuel tubes recovered near the wing and between the main right wing wreckage and separated portion of skin.

The right main landing gear had all the main sub-assembly parts attached and was in the retracted position with moderate fire damage. The forward and aft trunnions were intact and the side brace attach point was melted from the wing. The right actuator was in the gear up position. The bogie beam was fractured in half forward of the pivot point. All four tires were consumed by fire.

The forward portion of the right engine pylon was deformed and bent inboard consistent with the engine separating to the inboard side. The forward engine mount bolts were separated and not recovered. The aft engine mount separated from the pylon and 3 of the four bolts were fractured with the shank of the bolts in the holes. The fourth bolt was not identified in the wreckage.

Left Wing

The left wing was fragmented into many pieces that were scattered throughout the debris field. A small portion of the inboard left wing was recovered adjacent to the aft fuselage with heavy fire damage. The portion included the aft and false spars from ribs 5 to 10 and the upper and lower

skin structure between the spars and the upper and lower skin structure about 32-44 inches forward of the aft spar. A small portion of the aileron aft of the actuators remained attached to the wing with heavy fire damage. The outboard 45 inches of the aileron was recovered in the debris field about 145 feet north of the remains of the inboard left wing. A section of the left wing structure between ribs 6 and 9 and between the forward and aft spars remained attached to the left wing pylon which remained attached to the left engine in the debris field. A large section of the lower wing skin was recovered in the debris field and was deformed into a circular shape. The section extended from ribs 8 to 23 and from the forward to aft spars. All or portions of ribs 8, 11, 15, 18, and 22 remained attached to the skin structure. A section of forward spar between ribs 16 and 18 was also attached. There was a large section of the inboard forward spar with a portion of slat 1 attached that was recovered between the two engines in the debris field. This section was about 160 inches long and included slat 1 from the inboard edge to the pylon cutout. There was a large section of upper wing skin recovered in the debris field that extended from ribs 10 to 18 and from the forward to aft spars. Rib 14 remained attached to this section.

The left main landing gear was attached to the inboard wing section and in the extended position with moderate fire damage. The forward and aft trunnions were intact but the side brace attach point was melted from the wing structure. The two aft tires were consumed by fire. The forward half of the bogie beam was fractured and separated from the main landing gear and recovered in the debris field next to the left engine. The axle and right forward wheel assembly remained attached to the bogie beam. The left forward wheel and brake assembly were recovered separately near a large crater in the debris field.

The left pylon attachments at both the wing and engine were intact. There was damage and deformation of the pylon structure between the mounting points and the engine was rolled right and yawed outboard with respect to its normal position.

Vertical Stabilizer and Rudder

The vertical stabilizer and rudder exhibited extensive fire damage to the lower third such that only the fabric of the composite structure remained. Both had fallen to the left side of the empennage and were resting on top of the left horizontal stabilizer. The two forward vertical stabilizer attachment lugs had the pins installed and the burned fabric was sandwiched in the aluminum clevis but the fuselage structure below the clevises was consumed by fire. The right center and aft and left center and aft vertical stabilizer attach lugs were intact with the pins installed but had heavy fire damage. The rudder was positioned along the aft edge of the vertical stabilizer with heavy fire damage. The leading edge of the rudder and the 3 lower hinges were consumed by fire. The rudder actuators remained installed in the vertical stabilizer.

Right Horizontal Stabilizer and Elevator

The right horizontal stabilizer and elevator were intact and attached to the empennage with light sooting. The lower leading edge skin had numerous dents and scrapes oriented about 30-45 degrees from the normal airflow direction. There were multiple small dents in the outboard leading edge but none fractured the skin. There was dirt and mud splattered on the lower surface of the stabilizer and elevator along its entire length. The paint on the upper composite trailing edge panels was bubbled.

Left Horizontal Stabilizer and Elevator

The left horizontal stabilizer was damaged and deformed. The inboard portion had heavy fire damage. About 78 inches outboard of the fuselage the stabilizer was buckled downward and the upper skin and spars were fractured. About 183 inches outboard of the fuselage the stabilizer was buckled upward and the spars were fractured. The stabilizer tip was recovered in the debris field. A section of aft spar about 48 inches long was separated from the stabilizer starting about 112 inches outboard of the fuselage. The inboard trailing edge panels were consumed by fire and a section in the center was separated. The left elevator was fractured into 4 pieces. The inboard 74 inches remained attached to the stabilizer and had moderate to heavy fire damage. The remaining portions of elevator were found in the debris field about 200 feet north of the tail with moderate fire damage. The elevator tip was separated and also recovered in the debris field. The outboard section of separated elevator was about 121 inches long, the center section of separated elevator was about 67 inches long and the inboard portion of separated elevator was about 74 inches long.

The engine, auxiliary power unit, and cargo halon fire bottles were released to UPS on August 26, 2013, for the safe recovery of the hazardous contents and destruction of the bottles.

4.0 Cargo

During the on-scene portion of the investigation the cargo was released to UPS for recovery on August 17, 2013, after initial examination by the NTSB. The remnants of the cargo containers were released to UPS for recycling on August 19, 2013. All components of the cargo were recovered and removed prior to airplane recovery.

Submitted by:
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