



National Transportation Safety Board Aviation Accident Final Report

Location:	Fort Lauderdale, FL	Accident Number:	DCA05MA099
Date & Time:	09/18/2005, 1812 EDT	Registration:	N583NK
Aircraft:	Airbus A321-231	Aircraft Damage:	Substantial
Defining Event:		Injuries:	197 None
Flight Conducted Under:	Part 121: Air Carrier - Scheduled		

Analysis

Upon landing, an Airbus A321, experienced a tail strike upon landing. The First Officer (FO) stated that over the threshold at an altitude of about 50 feet, "it just literally felt like we lost inertia." The Captain believed that the flare was initiated too late and was incomplete. The FO stated that before touchdown, he lowered the nose a little bit and the aircraft touched down firmly. The aircraft bounced and the FO believed he again lowered the nose to prevent a tail strike. The Captain remembered that as the nose of the aircraft was lowering prior to the second touchdown, he may have pulled back on his side stick controller slightly to prevent the nose gear from striking the runway at too great a speed. After the aircraft touched down a second time the tailstrike occurred. Information extracted from the aircraft's flight data recorder revealed that both side stick controllers were activated simultaneously during the tailstrike. According to the manufacturer, when both side stick controllers are activated simultaneously (at least 2 degrees deflection off the neutral position) in the same or opposite directions and neither pilot takes priority via the takeover push button, the system adds the signals of both pilots algebraically. Airbus had issued Flight Crew Operating bulletins concerning bounced landings and tailstrikes but the pilots stated that no classroom or simulator training was received to reinforce the meaning and contents of the bulletins.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

Following a bounced landing, the pilot in command activated his sidestick controller while the first officer was in control of the airplane, which subsequently resulted in the overcontrol of pitch and a tailstrike. Contributing to the circumstances of this accident were the pilot-in-command's failure to properly activate his sidestick takeover push button prior to his remedial action, and the operator's insufficient emphasis on bounced landing recovery techniques and tailstrike avoidance procedures.

Findings

Occurrence #1: DRAGGED WING, ROTOR, POD, FLOAT OR TAIL/SKID
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings

1. (C) FLARE - IMPROPER - COPILOT/SECOND PILOT
2. (C) REMEDIAL ACTION - IMPROPER - PILOT IN COMMAND
3. (F) IMPROPER USE OF PROCEDURE - PILOT IN COMMAND
4. (F) CONDITION(S)/STEP(S) INSUFFICIENTLY DEFINED - COMPANY/OPERATOR MANAGEMENT

Factual Information

HISTORY OF FLIGHT

On September 18, 2005, at 1812 Eastern Daylight Time, an Airbus A321, N583NK, operated by Spirit Airlines as flight 171, experienced a tail strike upon landing at Fort Lauderdale Hollywood International Airport (FLL), Fort Lauderdale, Florida. The flight was operating under the provisions of Title 14 CFR Part 121 and was en route to FLL from La Guardia International Airport in New York. The tail strike resulted in substantial damage to the lower rear fuselage of the airplane. There were no injuries to the two pilots, four flight attendants or 191 passengers.

The First Officer was the flying pilot. The flight to Fort Lauderdale was uneventful. The pilots received periodic ATIS reports for FLL and the First Officer noted that the wind gust speeds slowly diminished to a steady state wind condition while en route. Upon approach, the flight descended to 7000 feet agl while on a downwind leg for runway 9L. Full spoilers were deployed to enhance the descent rate. The flight was cleared to 4000 feet and asked to slow to 210 knots. As the approach continued, the aircraft was fully configured for landing about one mile from the touchdown zone. At about 1000 feet, the First Officer disconnected the autopilot. He noted that there was no excessive rate of descent, no large changes in airspeed, no evidence of wind shear, and no GPWS warnings. As the aircraft passed over Interstate Highway 95, the first officer noted a little turbulence.

As the airplane crossed the runway threshold at an altitude of about 50 feet, the first officer recalled that "it just literally felt like we lost inertia." The captain, on the other hand, stated that the flare was initiated too late and was incomplete. The first officer stated that at some point during the flare, he lowered the nose a little bit and the aircraft touched down firmly and bounced.

The first officer stated that, following the bounce, he again lowered the nose to prevent a tail strike upon second touchdown. The captain stated that as the nose of the aircraft was lowered, he may have pulled back on his side stick controller slightly to prevent the nose gear from striking the runway at too great a descent rate. After the second touch down, the auto brakes activated at the medium setting and the aircraft remained close to the centerline of the runway. During rollout, a flight deck annunciation of a "flap/slat lock" condition sounded. Taxi to the gate was uneventful except that the flight crew did not retract the flaps because of the flap/slat annunciation.

Data from the flight data recorder (FDR) revealed that two seconds before the initial touchdown, the pitch attitude was about one degree nose up but increased to 6.5 degrees nose up at touchdown. About 2 seconds later, the pitch attitude increased to a maximum of about 10.3 degrees nose up. According to Airbus, the pitch attitude at which a tail strike will occur with the gear struts compressed is 9.7 degrees nose up, and 11.7 degrees nose up with the gear struts extended.

FDR data also indicated that inputs to the first officer's side stick controller were made from about 2.5 seconds prior to the first touchdown until about 1.5 seconds after the second touchdown. In addition, inputs were also being made to the captain's side stick controller from about 1.5 seconds prior to the first touchdown until about 0.5 seconds after the second touchdown.

Airspeed for the first touchdown was about 140 knots and bled off to about 130 knots for the second touchdown. Bank angle peaked at 2 degrees right during the bounce. The vertical acceleration was about 2.85 g for the first touchdown and 2.0 g for the second touchdown.

DAMAGE TO AIRCRAFT

The aircraft sustained damage to the lower fuselage between stations 3630 and 3901, stringers 42L and 42R. One frame was severed at station 3736 and one frame was buckled and cracked at station 3683. A buckled shear tie was also found at station 3630. The aircraft skin was buckled inward and exhibited three abraded breaches at station 3683.

PERSONNEL INFORMATION

The Captain, age 41, held airline transport, flight instructor, and commercial pilot certificates, with multi-engine land and single-engine land ratings. His instructor certificate was for single-engine airplanes. He was hired by Spirit Airlines in September, 1999. His total flight time was 13,026 hours with 532 pilot-in-command hours in the Airbus A321. He had flown 170 hours, 84 hours, and 6 hours in the last 90 days, 30 days, and 24 hours, respectively. He held a first class medical certificate with no waivers or limitations and his last medical examination was in September 2005.

The First Officer, age 47, held airline transport and commercial certificates, with multi-engine land, single-engine land and helicopter ratings. He was hired by Spirit Airlines in June, 2001. His total flight time was 12,000 hours with 500 hours as a First Officer in the Airbus A321. He had flown 232 hours, 86 hours, and 6 hours in the last 90 days, 30 days, and 24 hours, respectively. He held a second class medical certificate with no waivers or limitations and his last medical examination was in December 2004.

AIRCRAFT INFORMATION

The accident aircraft was an Airbus A321-231 powered by two IAE V2533-A5 turbofan engines. At the time of its last inspection on September 13, 2005, it had accumulated a total of 16,473 flight hours. It exhibited no maintenance deficiencies prior to or during the flight that would have affected the accident sequence of events. According to the manufacturer, the A321 model had accumulated approximately 2,900,000 flight cycles as of September 13, 2005, and experienced 29 landing tail strikes, two takeoff tail strikes, and one tail strike during a touch and go landing. Two other tail strikes also occurred, but the data reported to Airbus was insufficient to determine the flight mode for these events.

The Airbus A321 primary flight controls are operated by two side stick controllers located on consoles to the left and right of the captain and first officer, respectively. The captain operates his side stick controller with his left hand and the first officer operates his controller with his right hand. Full control of the aircraft can be taken from the flying pilot by activating a side stick takeover push button on the non-flying pilot's side stick. Although both crew members made inputs during the landing, according to FDR data, this button was not activated on either side stick controller.

According to the Airbus A321 Flight Crew Operating Manual, when inputs are made simultaneously on both side stick controllers (of 2 degrees or more) without activation of either takeover button, the flight control system adds the signals of both pilots algebraically. The total signal is limited to the signal that would result from the maximum deflection of a single side stick. In other words, if one pilot pulls back on his side stick 10 degrees, and the other

pilot also pulls back on his own side stick 10 degrees, the airplane would pitch up as if a single pilot had pulled back on his side stick 20 degrees. Or, if one pilot pushes forward 10 degrees and the other pilot pulls back 10 degrees, the aircraft would not respond in pitch.

In the event of simultaneous input on both side sticks the two green SIDE STICK PRIORITY lights on the glare shield come on (all aircraft) and central aural warning system "DUAL INPUT" synthetic voice message is heard (if this optional feature is programmed into the central aural warning system (CAWS) on the aircraft). These warnings occur within 500 milliseconds of simultaneous input more than 2 degrees in any direction.

N583NK is one of three A321s purchased from a European carrier that did not have the "DUAL INPUT" CAWS feature activated. They have since been modified. Prior to the accident, Spirit management was unaware that this feature was not active in all its Airbus A321s. Also prior to the accident, flight crews were trained that all Spirit Airlines A321s were equipped with the "DUAL INPUT" warning.

METEOROLOGICAL INFORMATION

Weather observations at 1753 edt, nineteen minutes prior to the accident revealed visibility of 10 statute miles, scattered clouds at 2400 feet, a temperature of 86 degrees F, a dew point of 73 degrees F, and winds out of 070 degrees at 16 knots. At 1853 edt, there were few clouds at 2400 feet, and the winds had changed to being out of 060 degrees at 13 knots.

At the time of the accident the Miami WSR-88D weather radar showed that the closest convective activity (radar echoes) were approximately 6 to 10 miles southwest of the airport. No defined gust front or sea breeze front was identified on the radar images in the base reflectivity or radial velocity data.

Toxicological samples provided by the flight crew to representatives of Spirit Airlines tested negative.

ORGANIZATIONAL AND MANAGEMENT INFORMATION

Airbus has published and distributed to customers three documents concerning bounced landings and tail strike avoidance:

1. Flight Crew Training Manual page 02.160 (prepared for Spirit Airlines) - Normal Operations section - Landing subsection, paragraph titled Bouncing at Touch Down, dated July 7, 2005. This training manual page states: In case of a high bounce, maintain the pitch attitude and initiate a go around.
2. Flight Operations Briefing Notes titled Landing Techniques - Bounce Recovery - Rejected Landing Revision 2, dated May 2005. This document states in part,

In case of a light bounce, the following typical recovery technique can be applied:

Maintain a normal landing pitch attitude:

- Do not increase pitch attitude as this could cause a tailstrike; and,
- Do not allow the pitch attitude to increase, particularly following a firm touchdown with a high pitch rate.
- Note: Spoiler extension may induce pitch up effect.

In case of a more severe bounce, do not attempt to land, as the remaining runway length might

not be sufficient to stop the aircraft. The following generic go-around technique can be applied:

- Maintain a normal landing pitch attitude

3. A318/A319/A320/A321 FCOM Bulletin No. 806/1 Subject: Avoiding Tailstrikes, dated June, 2004. This document states in part:

Deviations from normal landing techniques are the most common causes of tailstrikes, [among] the main reasons for this being:

e) Bouncing at touchdown - In case of bouncing at touchdown, the pilot may be tempted to increase the pitch attitude so as to ensure a smooth second touchdown. If the bounce results from a firm touchdown associated with a high pitch rate, it is important to control the pitch so that it does not further increase beyond the critical angle.

The FCOM also states - The PNF (pilot not flying) should monitor the pitch attitude on the PFD and call "PITCH", whenever the following pitch value is reached: For the A321: 7.5 degrees.

Both crew members received training in the A321 by Airbus in October, 2004, at its Miami, Florida, facility. During this initial training they were given copies of the Airbus Flight Crew Operating Manual (FCOM). Their copies of the FCOM did not contain any of the supplementary bulletins provided to the company by Airbus. Spirit Airlines did furnish crew members with the bulletins in June 2005, about 4 months prior to the accident. However, according to the accident pilots, no classroom or simulator training was received to reinforce the meaning and contents of the bulletins.

Pilot Information

Certificate:	Airline Transport; Flight Instructor; Commercial	Age:	41, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Seat Occupied:	Left
Other Aircraft Rating(s):		Restraint Used:	Seatbelt, Shoulder harness
Instrument Rating(s):		Second Pilot Present:	Yes
Instructor Rating(s):	Airplane Single-engine	Toxicology Performed:	No
Medical Certification:	Class 1 Without Waivers/Limitations	Last Medical Exam:	09/01/2005
Occupational Pilot:		Last Flight Review or Equivalent:	05/01/2005
Flight Time:	13026 hours (Total, all aircraft), 565 hours (Total, this make and model), 7323 hours (Pilot In Command, all aircraft), 170 hours (Last 90 days, all aircraft), 84 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	Airbus	Registration:	N583NK
Model/Series:	A321-231	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	1195
Landing Gear Type:	Retractable - Tricycle	Seats:	198
Date/Type of Last Inspection:	09/01/2005, Continuous Airworthiness	Certified Max Gross Wt.:	196210 lbs
Time Since Last Inspection:		Engines:	2 Turbo Fan
Airframe Total Time:	16473 Hours	Engine Manufacturer:	International Aero Engines
ELT:	Installed, not activated	Engine Model/Series:	V2533-A5
Registered Owner:	Wilmington Trust Company	Rated Power:	33000 lbs
Operator:	SPIRIT AIRLINES INC	Air Carrier Operating Certificate:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	GTIA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	KFLL	Observation Time:	1753 EDT
Distance from Accident Site:		Direction from Accident Site:	
Lowest Cloud Condition:	Scattered / 2400 ft agl	Temperature/Dew Point:	30° C / 23° C
Lowest Ceiling:	None	Visibility	10 Miles
Wind Speed/Gusts, Direction:	16 knots, 70°	Visibility (RVR):	
Altimeter Setting:	29.94 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	New York, NY (KLGA)	Type of Flight Plan Filed:	IFR
Destination:	Fort Lauderdale, FL (KFLL)	Type of Clearance:	IFR
Departure Time:	1518 EDT	Type of Airspace:	

Airport Information

Airport:	Hollywood Intl Airport (FLL)	Runway Surface Type:	Asphalt
Airport Elevation:	9 ft	Runway Surface Condition:	Dry
Runway Used:	9L	IFR Approach:	ILS
Runway Length/Width:	9000 ft / 150 ft	VFR Approach/Landing:	

Wreckage and Impact Information

Crew Injuries:	6 None	Aircraft Damage:	Substantial
Passenger Injuries:	191 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	197 None	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC):	Robert P Benzon	Adopted Date:	02/26/2007
Additional Participating Persons:	Robert Drake; Federal Aviation Administration, ASF-100,; Washington, DC		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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