



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	Denver, CO	<b>Accident Number:</b>	DCA09FA047
<b>Date &amp; Time:</b>	05/04/2009, 1218 MDT	<b>Registration:</b>	N311US
<b>Aircraft:</b>	AIRBUS A320	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>	Tailstrike	<b>Injuries:</b>	4 Minor, 150 None
<b>Flight Conducted Under:</b>	Part 121: Air Carrier - Scheduled		

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## Analysis

The flight crew was conducting a straight-in approach during visual meteorological conditions. The approach was backed up by an instrument landing system and was stable at 1000 feet above touchdown. During the final approach the crew noted an increasing tailwind. As the first officer (FO) entered the flare, the “retard” automatic callout sounded; this automatic call-out is designed to remind the pilot to move the thrust levers to idle. Despite the callout, the thrust levers remained at climb and the autothrust system commanded increased engine power in an attempt to recover airspeed. The airplane touched down, but then bounced as a result of excess thrust and the position of the thrust levers forward of idle, which prevented deployment of the spoilers. The FO then retarded the thrust levers, which allowed spoiler deployment, and the airplane touched down firmly. During the second touchdown, the FO began pitching the airplane nose up to about 12.5 degrees, which is greater than the specified maximum pitch angle and which resulted in the tailstrike. The captain attempted to add nose-down pitch to prevent the tailstrike but was too late. The aircraft experienced heavy abrasions, dents, and perforations of the skin; the aft galley drain mast and two aircraft antennas were broken; the auxiliary power unit air intake sustained damage and the rear pressure bulkhead was buckled and cracked.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The first officer’s excessive pitch-up of the airplane while landing with a tailwind, which resulted in a tailstrike following a bounced landing. Contributing to the bounced landing were a high descent rate and excessive thrust resulting from the first officer’s delay in retarding the thrust levers to idle, thereby providing residual thrust and preventing spoiler deployment.

## Findings

<b>Aircraft</b>	Power lever - Incorrect use/operation (Factor)
<b>Personnel issues</b>	Aircraft control - Copilot (Cause) Use of equip/system - Copilot (Factor)
<b>Environmental issues</b>	Tailwind - Effect on operation

## Factual Information

### HISTORY OF FLIGHT:

On May 4, 2009, at 1218 Mountain Daylight Time (MDT) an Airbus 320-211, registration N311US, operated by Northwest Airlines as flight 557, experienced a tailstrike resulting in substantial damage upon landing on runway 16L at Denver International Airport (DEN). The flight was a regularly scheduled passenger flight which departed from Minneapolis-St. Paul Airport (MSP) at 1139 Central Daylight Time (CDT)

The flight to the DEN area was reported as routine, with VFR weather prevailing. At about 1202, as the flight was entering the DEN terminal area, the crew briefed an approach speed of 139 knots for a visual approach to runway 16L. The First Officer (FO) was the pilot flying (PF) and reported the approach was stable at 1,000 feet above the runway threshold. At 1216:15 ATC cleared the flight to land and issued a wind advisory of 260 degrees at 5 knots. The flight crew extended the gear and selected flaps 3.

The autopilot was disengaged at 1217:38, at approximately 750 feet above touchdown. The auto-thrust and flight directors were engaged. During the approach, the crew noted that the aircraft was experiencing approximately 7 knots of tailwind, and as the approach progressed FDR data indicated the tailwind component increased to approximately 11 knots.

As the airplane passed approximately 50 feet above touchdown the rate of descent was about 800 feet per minute (fpm). The Captain stated he expected nothing more than a firm touchdown. The FO initiated the flare at about 45 feet. He stated that he attempted to arrest the sink rate with larger than normal aft stick deflection. During the flare, passing 20 feet above the runway, the automated "retard" call-out began a sequence of three annunciations. This automatic call-out is designed to remind the pilot to move the thrust levers to the idle detent. The thrust levers remained in the climb detent (CLB).

During the flare, the airplane pitched up to about eight degrees nose up and airspeed decreased to about 132 knots. The airplane touched down on both main landing gear with a vertical load of about 1.56 G. At the time of initial touchdown, the thrust levers were still in CLB, and engine N1 increased from approximately 54% to 64% over 3 seconds.

Radio altimeter values increased, indicating the aircraft then bounced. The FO held 16 degrees aft stick input (approximately full aft travel), and moved the thrust levers to idle during the bounce. Ground spoilers deployed (thrust lever position and wheel spin up logic was satisfied) and the airplane touched down a second time in an eleven degree nose up attitude, with FO still applying full aft stick input. At this point the Captain began adding some nose down stick input however pitch attitude continued increasing to about 12.5 degrees nose up. The Airbus FCOM indicates that the max pitch up angle with gear compressed is 11.7 degrees. A "dual input" automatic call-out was recorded, indicating the system detected both pilots making stick inputs, and the sound of a loud bang was heard on the cockpit voice recorder. As the Captain stick input moved further forward, in the airplane nose down direction, and the FO stick back pressure relaxed, the airplane began to pitch downward and about 3 seconds after the loud bang the nose wheel touched down. Thrust levers were then moved to the reverse position and autobraking began. The remainder of the roll out was normal.

### INJURIES TO PERSONS:

The four flight attendants reported minor injuries. No other injuries were reported among the 3 flight crew or 147 passengers.

#### DAMAGE TO AIRCRAFT:

The aircraft experienced heavy abrasions, dents and perforations of the skin along the lower rear fuselage between frames 62 and 76. Additionally, the aft galley drain mast and two aircraft antennas were broken, and the APU air intake sustained damage. The rear pressure bulkhead damage was buckled and cracked. The lower segment of frame 70 was cracked and had heavy abrasions. Interior damage also consisted of minor deformation of frames, damage to stringers, frame clips, fasteners, floor support strut fittings and flange.

#### OTHER DAMAGE:

None.

#### PERSONNEL INFORMATION:

The captain, age 49, had worked for Northwest Airlines since July 22, 1988. He held an Airline Transport Pilot certificate, multi-engine land, with type ratings in A320 and DC9. He held an FAA first class medical certificate with a limitation to wear corrective lenses. He had 14,619 hours total time with 2,677 hours as pilot-in-command on the Airbus 320.

The first officer, age 48, had worked for Northwest Airlines since February 1, 1999. He held an Airline Transport Pilot certificate, multi-engine land, with type ratings in A320, DC-9, B707 and B720. He held an FAA first class medical certificate with no limitations or waivers. He reported a total of 5,901 flight hours, with 200 hours in the A320, none of which were as pilot-in-command. This was FO's third trip to Denver, and second landing there.

An observer pilot was seated in the cockpit. He was a Northwest Airlines pilot, type rated in the A320 with 7,094 total time. He was not performing check airman or other required duties at the time of the accident.

#### AIRCRAFT INFORMATION:

N311US, manufacturer serial number 0125, Northwest Airlines ship number 3211, was an Airbus A320-211 equipped with CFM56-5A1/F engines. The airplane had approximately 57,600 hours total time on the airframe. Recorded data and airline records indicated no relevant maintenance issue with the airplane. At the time of the accident the estimated landing weight was 140,000 pounds with a center of gravity at 35.2% mean aerodynamic chord, well within the weight and balance limits.

Pilot statements after the accident indicated that they may have heard an automated "tailstrike warning." Review of the CVR recording found no evidence of such an automated callout. Only the "retard" and "dual input" callouts as noted in the history of flight were heard. Research by Airbus and Northwest revealed that Airbus has developed a feature for the Flight Warning Computer (FWC) intended to increase pilot awareness of an impending tailstrike. On A320 and A321 airplanes fitted with FWC standard H2F3 or H2F3P and Flight Augmentation Computer standard 618 or 619, an automated "pitch pitch" call-out activates when pitch is greater than a certain threshold and if TOGA (takeoff/go-around power) is not selected. At the time of the accident, no Northwest Airlines airplanes had been fitted with the "pitch pitch" feature. The Northwest A319/320 aircraft and simulators had recently incorporated the "dual input" FWC feature and a related Flight Operations was published.

#### METEOROLOGICAL INFORMATION:

The current observation at the time of the accident was effective at 11:53 MDT, winds 240 degrees at 4 knots, visibility 10 miles, scattered clouds at 8,000 and 10,000 feet above ground level, broken clouds at 20,000 feet.

The following official observation at 12:53 MDT indicated winds from 330 degrees at 13 knots, gusts to 17 knots, visibility and cloud cover the same. Following the accident an Embraer 145 commuter jet executed a go-around due to greater than a 10 knot tailwind for runway 16R, and ATC indicated they had then switched active runway. Doppler weather radar data indicated some returns at 700 feet moving west to east approximately 30 knots in the vicinity of the airport.

#### AIDS TO NAVIGATION:

The instrument landing system (ILS) runway 16L indicated no anomalies.

#### COMMUNICATIONS:

No communications problems were noted at any time during the accident sequence.

#### AERODROME INFORMATION:

The Denver International Airport is located approximately 16 miles northeast of the city of Denver, Colorado. The airport averages about 1800 operations per day, almost exclusively air carrier and air taxi activity. Runway 16L is 12,000 feet long and 150 feet wide, aligned to 170 degrees magnetic. Touchdown zone elevation is 5,347 feet above sea level. The runway is marked for precision instrument operations, has in-pavement centerline and touchdown zone lighting, and is equipped with a standard medium intensity approach lighting system with runway alignment indicator lights. There is a four light precision approach path indicator light system set to a 3 degree glidepath. A full instrument landing system serves the runway. The runway is unobstructed and was dry at the time of the accident.

#### FLIGHT RECORDERS:

The Digital Flight Data Recorder was an L3 communications, Solid State FDR F1000 model recording 170 parameters.

The Cockpit Voice Recorder was a Honeywell 6020, Solid State CVR, with nominal 30 minute recording duration.

Both recorders were undamaged and provided valid data.

#### MEDICAL AND PATHOLOGICAL INFORMATION:

Toxicological samples provided by the flight crew to representatives of Northwest Air Lines tested negative.

#### FIRE:

None.

#### TESTS AND RESEARCH:

An aircraft damage and performance study was conducted by Airbus. Data from the study is incorporated in the history of flight and damage to aircraft sections of this report.

## History of Flight

Landing-flare/touchdown	Tailstrike (Defining event)
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## Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	49, Male
<b>Airplane Rating(s):</b>	Multi-engine Land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>		<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>		<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	Class 1 With Waivers/Limitations	<b>Last Medical Exam:</b>	11/25/2008
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	09/12/2007
<b>Flight Time:</b>	14619 hours (Total, all aircraft), 2677 hours (Total, this make and model), 7458 hours (Pilot In Command, all aircraft), 209 hours (Last 90 days, all aircraft), 57 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

## Co-Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	48, Male
<b>Airplane Rating(s):</b>	Multi-engine Land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>		<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>		<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	Class 1 Without Waivers/Limitations	<b>Last Medical Exam:</b>	03/11/2009
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	03/22/2009
<b>Flight Time:</b>	5901 hours (Total, all aircraft), 200 hours (Total, this make and model), 100 hours (Last 90 days, all aircraft), 72 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

## Aircraft and Owner/Operator Information

Aircraft Manufacturer:	AIRBUS	Registration:	N311US
Model/Series:	A320 211	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	0125
Landing Gear Type:	Retractable - Tricycle	Seats:	156
Date/Type of Last Inspection:	05/04/2009, Unknown	Certified Max Gross Wt.:	167300 lbs
Time Since Last Inspection:	3 Hours	Engines:	2 Turbo Fan
Airframe Total Time:	57600 Hours	Engine Manufacturer:	CFM
ELT:	Installed, not activated	Engine Model/Series:	CFM56 5A
Registered Owner:	Northwest Airlines	Rated Power:	25000 lbs
Operator:	Northwest Airlines	Air Carrier Operating Certificate:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	NWAA

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	KDEN, 5400 ft msl	Observation Time:	1753 UTC
Distance from Accident Site:	2 Nautical Miles	Direction from Accident Site:	160°
Lowest Cloud Condition:	Scattered / 8000 ft agl	Temperature/Dew Point:	17° C / 1° C
Lowest Ceiling:	Broken / 20000 ft agl	Visibility	10 Miles
Wind Speed/Gusts, Direction:	4 knots, 250°	Visibility (RVR):	
Altimeter Setting:	29.91 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:			
Departure Point:	Minneapolis, MN (KMSP)	Type of Flight Plan Filed:	IFR
Destination:	Denver, CO (KDEN)	Type of Clearance:	IFR
Departure Time:	1139 CDT	Type of Airspace:	

## Airport Information

Airport:	Denver International (KDEN)	Runway Surface Type:	Concrete
Airport Elevation:	5431 ft	Runway Surface Condition:	Dry
Runway Used:	16L	IFR Approach:	ILS; Visual
Runway Length/Width:	12000 ft / 150 ft	VFR Approach/Landing:	Full Stop; Straight-in

## Wreckage and Impact Information

<b>Crew Injuries:</b>	4 Minor, 3 None	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>	147 None	<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	4 Minor, 150 None	<b>Latitude, Longitude:</b>	

## Administrative Information

<b>Investigator In Charge (IIC):</b>	William R English	<b>Adopted Date:</b>	04/22/2010
<b>Additional Participating Persons:</b>			
<b>Publish Date:</b>	04/22/2010		
<b>Investigation Docket:</b>	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 <a href="mailto:pubinq@ntsb.gov">pubinq@ntsb.gov</a> , or at 800-877-6799. Dockets released after this date are available at <a href="http://dms.nts.gov/pubdms/">http://dms.nts.gov/pubdms/</a> .		

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