



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	Colorado Sprngs, CO	<b>Accident Number:</b>	DEN06LA090
<b>Date &amp; Time:</b>	06/22/2006, 0953 MDT	<b>Registration:</b>	N350SJ
<b>Aircraft:</b>	Excel Jet Sport Jet	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>		<b>Injuries:</b>	1 Serious, 1 Minor
<b>Flight Conducted Under:</b>	Part 91: General Aviation - Personal		

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## Analysis

According to the pilot, passenger, and several witnesses, during takeoff the light jet became airborne momentarily, and then banked aggressively to the left. It impacted the runway in a left wing low attitude and cartwheeled down the runway. An examination of the airplane's systems revealed no anomalies. Approximately 1.5 minutes before the airplane was cleared for takeoff, a DeHavilland Dash 8 (DH-8) airplane departed. A wake turbulence study conducted by an NTSB aircraft performance engineer concluded that even slight movement in the atmosphere would have caused the circulation of the vortices near the accident site to decay to zero within two minutes, that is, before the time accident jet would have encountered the wake from the DH-8. The study states, in part: "Given the time of day of the accident, consistent reports of easterly surface wind speeds on the order of 6 to 7 knots, higher wind speeds aloft, and the mountainous terrain near Colorado Springs, it is unlikely that the atmosphere was quiescent enough to allow the wake vortices near the Sport-Jet to retain any significant circulation after two minutes. Furthermore, easterly surface winds would have blown the wake vortices well to the west of the runway by the time of the accident. Consequently, while in smooth air the wake vortices from the DH-8 that preceded Sport-Jet off of the runway may have retained enough circulation after two minutes to produce rolling moments on Sport-Jet on the order of the rolling moment available from the Sport-Jet's ailerons, it is most likely that the wake vortices were neither strong enough nor close enough to the Sport-Jet to cause the violent roll to the left reported by the pilot and witnesses to the accident."

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A loss of control for an undetermined reason during takeoff-initial climb that resulted in an in-flight collision with terrain.

## Findings

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Occurrence #1: LOSS OF CONTROL - IN FLIGHT  
Phase of Operation: TAKEOFF - INITIAL CLIMB

### Findings

1. (C) REASON FOR OCCURRENCE UNDETERMINED  
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Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER  
Phase of Operation: DESCENT - UNCONTROLLED

### Findings

2. TERRAIN CONDITION - RUNWAY

## Factual Information

### HISTORY OF FLIGHT

On June 22, 2006, at 0953 mountain daylight time, an Excel Sport-Jet experimental turbojet airplane, N350SJ, operated by a commercial pilot, was substantially damaged when it impacted terrain after takeoff from the City of Colorado Springs Municipal Airport (COS), Colorado Springs, Colorado. Visual meteorological conditions prevailed at the time of the accident. The personal flight was being conducted under the provisions of Title 14 Code of Federal Regulations Part 91 without a flight plan. The pilot sustained serious injuries and his passenger sustained minor injures. The local flight was originating at the time of the accident.

According to the COS air traffic control (ATC) tower, the airplane departed runway 17 R (11,022 feet by 150 feet, asphalt), became airborne only momentarily, and then impacted the runway and surrounding terrain. Several witnesses reported that approximately 15 feet above ground level (agl), the airplane rolled hard to the left and began to "cartwheel" down the runway. The airplane came to rest off the left side of the runway, between the Charlie 1 and Charlie 2 intersections (3,400 feet from the runway threshold).

According to a written statement submitted by the pilot, the preflight inspection, engine start, and taxi were normal and without any problems. The pilot stated that he "taxied to [runway] 17R without delay and was immediately cleared for takeoff with no need to stop." He stated that he rotated at 65 knots and "immediately upon becoming airborne, the aircraft began a roll to the left" for which he was not able to correct. The pilot stated that he had a right roll command; however, the roll to the left continued until the impact.

According to the passenger, the ground roll and rotation pitch were normal. He stated that once the airplane was airborne, they encountered a slight burble, and then an "abrupt roll to the left." The passenger stated that the control stick was pushed to the right and aft; this did not result in a recovery from the roll.

### PERSONNEL INFORMATION

The pilot, age 64, held a commercial pilot certificate with airplane single engine land and instrument ratings. The pilot held a second class airman medical certificate that was issued on March 9, 2005. The certificate contained a limitation for corrective lenses. According to the National Transportation Safety Board Pilot/Operator Aircraft Accident/Incident Report (Form 6120.1/2) submitted by the pilot, he had logged 5,308 hours total time, 11.6 of which were in the accident airplane.

### AIRCRAFT INFORMATION

The accident airplane, an Excel Sport-Jet (serial number 001), was registered with the Federal Aviation Administration (FAA) on an experimental (proof of concept) airworthiness certificate in August of 2005. The airplane was equipped with a Williams FJ 33 jet engine rated for 1,500 pounds of thrust. The airplane was designed with a maximum gross takeoff weight of 4,900 pounds. According to the operator, the aircraft weighed approximately 3,450 pounds at the time of departure.

The airplane was registered to and operated by Excel-Jet Ltd., and was maintained under a conditional inspection program. A review of the airplane test logs indicated the airplane had flown for 23.8 hours prior to the accident flight. The first flight was performed on March 12,

2006. A review of the airplane maintenance records indicated that the airplane underwent a routine inspection on June 21, 2006.

According to the aircraft maintenance log and company personnel, maintenance was performed on the aileron control system on June 21, 2006. The gear on the control yoke was replaced with a gear that was smaller in diameter by one tooth. The purpose of the replacement was to produce a lighter aileron while in flight. During the maintenance, the tension was loosened on the left wing at the turnbuckle. At no time were the cables removed. Following the maintenance, a load test and control continuity test were performed several times by the pilot, mechanic, and one other employee.

#### METEOROLOGICAL CONDITIONS

The routine aviation weather report (METAR) for COS (elevation 6,187 feet mean sea level (msl)), issued at 0954, reported, winds, 090 degrees at 7 knots; visibility, 10 statute miles; sky condition, few clouds 6,000 feet; temperature 21 degrees Celsius (C); dewpoint, 09 degrees C; altimeter, 30.33 inches.

According to the ATC recordings, the winds reported prior to the accident are as follows:

100 degrees at 3 knots

080 degrees at 7 knots (wind report issued to the DH-8)

080 degrees at 6 knots

090 degrees at 6 knots (wind report issued to N350SJ)

#### COMMUNICATIONS

According to ATC partial transcripts Air Shuttle 7052, a DeHavilland Dash 8-200 (DH-8), departed runway 17R prior to the Excel Sport-Jet. Air Shuttle 7052 was cleared to taxi to runway 17R via runway 12. According to National Track Analysis Program (NTAP) radar data, Air Shuttle 7052 entered the runway environment at the intersection of runway 12 and runway 17R. The ATC controller issued a takeoff clearance to Air Shuttle 7052 at 0950:11. At 0951:05, the pilot of N350SJ called ATC, ready for takeoff. The controller instructed the pilot to hold short of runway 17R and the pilot acknowledged. At 0951:50, the controller issued a wake turbulence advisory, the wind, and cleared N350SJ for takeoff. The pilot acknowledged the takeoff clearance.

#### AIRPORT INFORMATION

The City of Colorado Springs Municipal Airport is located 6 miles southeast of Colorado Springs, Colorado, within Class Charlie airspace. The airport is located at a field elevation of 6,187 feet msl and provides aviation services to general aviation, commercial aviation, airlines, and the military. The airport has 3 runways: runway 17 L/35 R, 13,501 feet by 150 feet, concrete/grooved, runway 17 R/35 L, 11,022 feet by 150 feet, asphalt/grooved, and runway 12/30, 8,269 feet by 150 feet, asphalt/grooved.

Runway 17L/35R was closed at the time of the accident and had been closed since January 17, 2006. Runway construction is scheduled to be complete towards the end of October. All commercial traffic was departing from runway 17R/35L.

#### WRECKAGE AND IMPACT INFORMATION

The FAA airworthiness inspector and operations inspector arrived on scene approximately 1500 on June 22, 2006.

The initial impact point, as identified by the FAA, was located 48 feet left of the runway centerline, near the 3,000 foot runway stripe, at a measured distance of 3,060 feet from the runway threshold. The first ground scar was approximately 4 feet in length and was oriented on a heading of approximately 155 degrees. A second ground scar initiated 2 feet from the end of the initial ground scar and continued at a 45-degree angle, off the runway surface. Additional ground scars continued in the dirt and vegetation up to the main wreckage.

The airplane came to rest 454 feet from the initial impact point, on an approximate heading of 150 degrees. The main wreckage consisted of the wing assemblies, the empennage, the engine, and the fuselage. Portions of the left aileron and the horizontal stabilizer and elevator separated from the airplane during the impact sequence. These were located within the debris field leading up to the main wreckage.

An examination of the airplane control systems was conducted by the FAA, revealing no anomalies. Control continuity to ailerons, elevator, and rudder was established. The pitch trim actuator was examined revealing no anomalies. The pitch trim setting was not determined, as the actuator linkage was broken, allowing the tab to move freely.

The airplane was recovered and relocated to a hangar at COS for further examination.

## TESTS AND RESEARCH

### Wreckage Examination

The airplane wreckage was examined by the NTSB in Colorado Springs on June 29, 2006.

An examination of the right wing assembly, to include the right aileron, and right wing flap, was unremarkable. Six vortex generators were mounted towards the wing root and had been mounted there for the previous flights. The right aileron was deflected up and down manually. This movement resulted in the deflection of the control yoke and the movement of the corresponding control cables in the proper direction.

The left wing remained attached to the fuselage at the wing root. The wing tip separated, leaving a splintered edge, exposing wires and cables. Six vortex generators and tuffs were mounted towards the wing root and had been mounted there for the previous flights. A camera and battery were also mounted to the inboard portion of left wing. This camera recorded tuff activity while in flight and had been mounted in the same location for the previous seven flights. The entire trailing edge of the wing was torn and splintered, revealing the control cables and pulleys. The control cables were routed through the pulleys and were continuous. When the cables were pulled in their appropriate direction deflection of the control yoke and movement of the right aileron in the proper direction was observed.

The nosecone was crushed aft, broken, and splintered. The bottom of the fuselage was crushed up at the double bulkhead, aft of the cabin door, between the left and the right wings. The control cables were routed through this area and were compressed up, preventing complete free movement of the control cables.

The engine exhaust, at the aft portion of the fuselage, was crushed up and forward. The elevator and horizontal stabilizer separated during the impact sequence. The rudder was crushed up and wrinkled. Control continuity to the elevator and rudder could not be

established.

### Wake Turbulence Study

In this Study, an NTSB implementation of NASA's APA program (an engineering numerical model of the behavior of aircraft trailing vortices) was used to compute a "snapshot" of the DH-8 wake vortices at the time of the accident. Airport Surveillance Radar data from COS was utilized during this study. The data showed that at 0952:58 N350SJ was at the same position that the DH-8 was at 0950:47, two minutes and 11 seconds earlier. The APA results were searched for the wake position and strength values at the time of interest, which was assumed to be at 0952:57, one second before the time of the radar return received from N350SJ.

Two wind profiles were used for this study; the first was based on the surface winds from the COS METAR taken at 0954 and upper air wind data from NOAA. The surface winds in the second profile were adjusted to force the right vortex from the DH-8 to remain over the runway at the time of the accident. According to the study, "It can be the case that the winds vary in speed and direction over different parts of the airport environment, and that the winds over different sections of the runway differ from those reported by the tower." The study states, "if this is the case, then it is unlikely that the air was perfectly still and quiescent, and that at least some slight turbulence was present." The two values of the eddy dissipation rate (EDR) that were used in the APA model were smooth air ( $0.00001 \text{ m}^2/\text{sec}^3$ ) and slightly turbulent air ( $0.001 \text{ m}^2/\text{sec}^3$ ).

The study further reported, "the wake vortex trajectory for the first wind profile placed the vortex west and south of the accident occurrence location. The wake vortex trajectory for the second wind profile placed the right vortex on the runway. The circulation strength of the vortices was calculated with the second wind profile, using both the smooth air and slightly turbulent air values of EDR. The circulation strength in a smooth air case was calculated to be 160 ft<sup>2</sup>/sec at the accident location and 240 ft<sup>2</sup>/sec about 0.1 nautical miles from the accident site. The circulation strength for a slightly turbulent air case was calculated to decay to zero within 0.25 nautical miles of the accident site."

The study showed that "if N350SJ encountered a vortex with a circulation of 240 ft<sup>2</sup>/sec, with the vortex core perfectly aligned with the airplane's longitudinal axis, a rolling moment coefficient of about 0.04 could have been generated. By way of comparison, assuming a rolling moment coefficient per degree of aileron deflection of about 0.0026, a 20 degree aileron input would generate a rolling moment coefficient of about 0.05."

The Study concludes, "Even slight turbulence in the atmosphere would have caused the circulation of the vortices within 0.25 nautical miles of the accident to decay to zero within two minutes, i.e., before the time N350SJ would have encountered the wake from the DH-8. Given the time of day of the accident, consistent reports of Easterly surface wind speeds on the order of 6 to 7 knots, higher wind speeds aloft, and the mountainous terrain near Colorado Springs, it is unlikely that the atmosphere was quiescent enough to allow the wake vortices near N350SJ to retain any significant circulation after two minutes. Furthermore, Easterly surface winds would have blown the wake vortices well to the West of the runway by the time of the accident.

Consequently, while in smooth air the wake vortices from the DH-8 that preceded N350SJ off of runway 17R may have retained enough circulation after two minutes to produce rolling moments on N350SJ on the order of the rolling moment available from the Sport-Jet's ailerons, it is most likely that the wake vortices were neither strong enough nor close enough to N350SJ to cause the violent roll to the left reported by the witnesses to the accident."

#### ADDITIONAL INFORMATION

Parties to the investigation include the FAA as represented by an airworthiness inspector and an operations inspector from the Denver Flight Standards District Office, and Excel-Jet. The wreckage was released to the owner on June 29, 2006.

#### Pilot Information

<b>Certificate:</b>	Commercial	<b>Age:</b>	64, Male
<b>Airplane Rating(s):</b>	Single-engine Land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	No
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 2 With Waivers/Limitations	<b>Last Medical Exam:</b>	03/01/2005
<b>Occupational Pilot:</b>		<b>Last Flight Review or Equivalent:</b>	03/01/2006
<b>Flight Time:</b>	5307 hours (Total, all aircraft), 11 hours (Total, this make and model)		

#### Aircraft and Owner/Operator Information

<b>Aircraft Manufacturer:</b>	Excel Jet	<b>Registration:</b>	N350SJ
<b>Model/Series:</b>	Sport Jet	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>		<b>Amateur Built:</b>	No
<b>Airworthiness Certificate:</b>	Experimental	<b>Serial Number:</b>	001
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	2
<b>Date/Type of Last Inspection:</b>		<b>Certified Max Gross Wt.:</b>	4800 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	1 Turbo Jet
<b>Airframe Total Time:</b>		<b>Engine Manufacturer:</b>	Williams
<b>ELT:</b>	Not installed	<b>Engine Model/Series:</b>	FJ334A-15
<b>Registered Owner:</b>	On file	<b>Rated Power:</b>	1500 lbs
<b>Operator:</b>	On file	<b>Air Carrier Operating Certificate:</b>	None

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	COS, 6184 ft msl	Observation Time:	0954 MDT
Distance from Accident Site:	1 Nautical Miles	Direction from Accident Site:	180°
Lowest Cloud Condition:	Few / 6000 ft agl	Temperature/Dew Point:	21 °C / 9 °C
Lowest Ceiling:	None	Visibility	10 Miles
Wind Speed/Gusts, Direction:	7 knots, 90°	Visibility (RVR):	
Altimeter Setting:	30.33 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Colorado Sprngs, CO (COS)	Type of Flight Plan Filed:	None
Destination:		Type of Clearance:	None
Departure Time:	0953 MDT	Type of Airspace:	

## Airport Information

Airport:	CITY OF COLORADO SPRINGS MUNI (COS)	Runway Surface Type:	Asphalt
Airport Elevation:	6184 ft	Runway Surface Condition:	Dry
Runway Used:	17R	IFR Approach:	None
Runway Length/Width:	11022 ft / 150 ft	VFR Approach/Landing:	None

## Wreckage and Impact Information

Crew Injuries:	1 Serious	Aircraft Damage:	Substantial
Passenger Injuries:	1 Minor	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Serious, 1 Minor	Latitude, Longitude:	38.800556, -104.700556

## Administrative Information

Investigator In Charge (IIC):	Jennifer S Kaiser	Adopted Date:	04/25/2007
Additional Participating Persons:	Mike Davey; FAA Flight Standards District Office; Denver, CO Robert Bornhofen; Excel-Jet, LTD; Monument, CO		
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 <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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