



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	Sparks, NV	<b>Accident Number:</b>	WPR16FA172
<b>Date &amp; Time:</b>	08/30/2016, 1801 PDT	<b>Registration:</b>	N985CA
<b>Aircraft:</b>	BEECH A36	<b>Aircraft Damage:</b>	Destroyed
<b>Defining Event:</b>	Aircraft wake turb encounter	<b>Injuries:</b>	2 Fatal
<b>Flight Conducted Under:</b>	Part 91: General Aviation - Business		

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## Analysis

The 73-year-old commercial pilot was on the fourth and final leg of a 950-mile round trip same day flight. As the airplane neared the airport, the pilot was told by the air traffic controller to expect runway 25 for landing. After the controller informed him of a delay for that runway, the pilot stated that he could accept runway 16L; the pilot was told to proceed for runway landing, but the runway was not specified, an instruction which he acknowledged. Shortly after establishing contact with the tower controller, who instructed the pilot to continue for runway 25, the pilot reported that the airplane was on a downwind leg for landing on runway 16L. The controller acknowledged and, rather than correcting the pilot, instructed him to continue inbound for 16L. At the time, runway 16R was being used for landing by two Boeing 757 (B757) airplanes in sequence, separated from each other by about 7 miles. The controller advised the accident pilot that a B757 was on a 9-mile final for runway 16R and cautioned him about wake turbulence, then cleared the accident airplane to land. Shortly thereafter, the pilot reported that he had "the airliner" in sight. At this time, one of the B757s was on a short final approach for 16R, about 4.5 miles ahead of and below the accident airplane. The other B757, which was the potential conflict, was about 5 miles away from the accident airplane at its 2-to-3-o'clock position. Given that the pilot's attention was likely focused toward the runway during this portion of the approach, it is likely that he misidentified the ATC-reported traffic as the B757 on short final, which landed soon after and likely resulted in the pilot relaxing his vigilance in looking for traffic. Shortly thereafter, the controller issued an all-aircraft advisory that the wind was from 250° at 17 knots with gusts to 20 knots. Although these wind conditions met or exceeded the airplane's maximum demonstrated crosswind capability for a landing on 16L, and the airplane was still well-positioned to revert to an approach to runway 25, the pilot continued toward 16L.

About 70 seconds after the pilot reported sighting the traffic, just after turning the airplane onto the base leg of the traffic pattern, the B757 passed about 1 mile ahead of and about 100 ft below the accident airplane. The investigation was unable to determine whether the pilot saw that B757, or if he did, whether he was cognizant of the potential for a wake vortex encounter and the flight path alterations necessary to avoid such an encounter. The pilot made no radio

communications or flight path adjustments to indicate that he saw the B757 or tried to avoid its wake.

According to witnesses, the airplane's flightpath appeared normal as it approached the runway for landing. When the airplane was on about a 1/2-mile final approach, at an altitude of less than 200 ft above ground level, it suddenly rolled and descended to the ground. Ground scars and debris distribution was consistent with a near-vertical descent and impact. Examination of the wreckage did not reveal any evidence of pre-impact mechanical deficiencies or malfunctions that would have precluded normal operation. A wake vortex analysis study revealed that the airplane most likely encountered the wake vortices that were generated by a B757 landing on the parallel, upwind runway. The vortices were of sufficient size and strength to radically upset the airplane at an altitude too low to recover.

Had the controller informed the pilot that there were two B757s on final approach for 16R, it is likely that the pilot's traffic situational awareness would have been more complete. The pilot likely would have altered his traffic scan or questioned ATC further to ensure that he had identified the correct B757. The pilot's radio communications did not indicate any doubt about whether he had properly identified his traffic, and in postaccident interviews, the controller stated that he was certain that the pilot had correctly identified it. Had either the controller or the pilot specified the location of the traffic once the pilot reported it in sight, that information would have significantly improved the likelihood of detecting the pilot's identification error.

The safety of the approach sequence was dependent on assured separation of the airplane from the B757 and its wake. In this case, because both airplanes were being controlled by ATC in a radar environment, aircraft and wake turbulence (vortex) separation was the responsibility of the controller until explicitly transferred to the accident pilot. Although ATC requirements to apply pilot-based visual separation had been satisfied and it was the controller's intent to have the accident pilot maintain visual separation from the B757, the controller relinquished his separation responsibility without explicitly transferring that responsibility to the accident pilot. As a result, no separation services were being provided by the controller. The accident pilot's likely misidentification of his traffic, the controller's lack of awareness of that apparent error, and the controller's failure to monitor, detect, or intervene in a situation conducive to a wake vortex encounter enabled the accident to occur.

At the time of the accident, the pilot had been awake about 14.5 hours and had flown about 8.5 hours that day. Given the pilot's experience level, it is unlikely that he was not aware of the effect of either the extreme landing crosswinds or wake vortex behaviors and hazards, but for reasons that could not be determined during the investigation, the pilot nevertheless continued his approach to land on 16L. Investigators were also unable to determine the effect of the pilot's long duty day on his mental acuity or explain the reasons behind several of his actions and decisions, including his vague communications with ATC regarding the landing runway, his decision to forego landing on a runway more favorable to the wind conditions, and his misidentification of the conflicting traffic.

## Probable Cause and Findings

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

The pilot's selection of a landing runway which, given the wind and traffic conditions, was susceptible to high crosswinds and the translation of wake turbulence across its approach path, and the controller's and pilot's failure to ensure separation from the B757 and its wake, which resulted in a low-altitude encounter with wake vortices that the pilot was unable to recover from.

## Findings

### Personnel issues

- Decision making/judgment - Pilot (Cause)
- Monitoring other aircraft - Pilot (Cause)
- Accuracy of communication - ATC personnel (Cause)
- Accuracy of communication - Pilot (Cause)
- Aircraft control - Pilot (Cause)
- Alertness/Fatigue - Pilot

### Environmental issues

- Wake turbulence - Effect on operation (Cause)
- Wake turbulence - Contributed to outcome (Cause)
- Crosswind - Effect on operation
- Crosswind - Contributed to outcome

## Factual Information

### History of Flight

Approach	Miscellaneous/other
Approach-VFR pattern final	Aircraft wake turb encounter (Defining event) Loss of control in flight
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On August 30, 2016, about 1801 Pacific daylight time, a Beechcraft A-36 Bonanza airplane, N985CA, was destroyed when it impacted the ground in a recreational vehicle (RV) park about one-half mile prior to the threshold of runway 16L at Reno/Tahoe International Airport (RNO), Sparks, Nevada. The commercial pilot and passenger received fatal injuries, but there were no ground injuries. The airplane was registered to a private individual, and operated by Flying Start Aero, a flight school based at RNO. The flight was conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91. Visual meteorological conditions prevailed, and no flight plan was filed. The flight departed Henderson Executive Airport (HND), Las Vegas, Nevada, about 1600, and was destined for RNO.

According to one passenger who was on 3 of the flight legs that day, the plan was for the pilot to depart RNO with 2 passengers, pick up a third passenger in Las Vegas, Nevada, and continue on to southern California, where the 3 passengers were to attend a business meeting. Later that day, they planned to reverse that sequence, with the airplane, pilot, and 2 passengers returning to RNO in the late afternoon or early evening. All 3 passengers were employees of the same company, which was based near RNO.

According to the passenger, he and another passenger arrived at the Atlantic Aviation facility at RNO at 0350; the pilot was already there, and they proceeded to board the airplane. The flight departed RNO about 0410, and landed at Henderson Executive Airport (HND), Las Vegas, Nevada, sometime after 0600. That flight leg was smooth and uneventful.

HND fueling records indicated that the airplane took on 30 gallons of fuel sometime between 0624 and 0647. The airplane departed HND, and landed at French Valley Airport (F70), Murrieta/Temecula, California sometime after 0900. The 3 passengers then left the airport by car for their meeting and returned about 1300. The passenger did not know what the pilot did during the intervening hours.

The 3 passengers then re-boarded the airplane for the flight to HND. That trip leg was very bumpy. Prior to departure for the last leg of the flight to RNO, two of the passengers decided not to accompany the pilot and the third passenger on the flight back to RNO.

According to a flight instructor at Flying Start Aero, the pilot had telephoned sometime during the day to report that his passengers were running late, and that he would be returning to RNO later than originally planned. According to HND fueling records, the airplane was "topped off" with 24.3 gallons of fuel sometime between 1520 and 1530. Federal Aviation Administration

(FAA) records indicate that the airplane took off from HND about 1600, and that the pilot requested and received flight following services for the visual flight rules flight.

The pilot first contacted the RNO air traffic control tower (ATCT) when the airplane was about 9 miles southeast of RNO. About 2 minutes later, the pilot reported that he was on downwind for runway 16L. About 2 minutes after that, the pilot was advised that his traffic was a Boeing 757 (B757) on a 9-mile final for runway 16R, was provided with the wind information, and was cleared to land. About 1 minute later, the pilot advised that he had "the airliner" in sight, and the accident airplane turned from westbound to southwest-bound, towards runway 16L. The pilot squared off the pattern once it got closer to the airport and turned onto the final approach leg to runway 16L about 1 mile from the runway threshold.

Multiple eyewitnesses reported that the airplane appeared to be approaching normally, without any unusual sounds or dynamics, or any smoke or other outward signs of distress. Just as the airplane was over the RV park, and at an altitude of less than 200 ft, it rapidly rolled and descended to the ground.

Ground scar and debris information was consistent with a near-vertical descent, in a near-vertical, nose down attitude. The airframe and engine incurred significant impact damage and were then further damaged or consumed by the post-impact fire.

## Pilot Information

<b>Certificate:</b>	Flight Instructor; Commercial	<b>Age:</b>	73, 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>	Unknown
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	No
<b>Instructor Rating(s):</b>	Airplane Single-engine; Instrument Airplane	<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	Class 3 With Waivers/Limitations	<b>Last FAA Medical Exam:</b>	03/24/2016
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>	(Estimated) 11326 hours (Total, all aircraft), 150 hours (Last 90 days, all aircraft), 25 hours (Last 30 days, all aircraft), 9 hours (Last 24 hours, all aircraft)		

## Pilot

The 73-year-old pilot and his wife were the co-owners of Flying Start Aero, and the pilot was also the chief flight instructor. FAA information indicated that the pilot held commercial and flight instructor certificates with airplane single engine and instrument ratings. He reported a total flight experience of 11,100 hours on his most recent application for an FAA third-class medical certificate, which was issued in March 2016. The pilot's most recent flight review was

completed in October 2014.

### Pilot Logbook

Copies of the pilot's logbook were provided by the Flying Start Aero attorney. The most recent entry in the logbook was dated August 13, 2016. The logbook indicated that as of that date, the pilot had accrued a total flight experience of about 11,326 hours, all of which was in single engine airplanes. About 9,846 of those hours were logged as provision of flight instruction.

A review of the pilot's flight logbook back to August 2015 revealed 8 entries that were cataloged as something other than flight instruction. Six of those entries were conducted in a C-172, and the remarks included "scenic" for each of those entries. The entries did not contain any information regarding whether they were conducted in support of any charitable, non-profit, or community events, and did not indicate their range from the airport of origin. The other 2 entries, dated April 11-14, 2016 and June 12, 2016, were conducted in the accident airplane, and did not contain the "scenic" annotation in the remarks section. Both entries indicated that the flights originated and terminated at RNO, with a stop at an interim location. Neither of the interim landing locations were decipherable. The entries did not contain any information regarding whether they were conducted in support of any charitable, non-profit, or community events. The remarks for the April 11-14 flights appeared to state "visit Lin" but the remarks for the June 12 flight were not decipherable.

### Pilot Schedule/Activity

According to the pilot's wife, the evening before the accident, he went to sleep about 2000, and awakened at 0330 the morning of the accident. She also reported that the pilot was "in good health" without any "significant related issues or problems."

According to Google Maps, the pilot's home was located a minimum driving distance of 6.3 miles from Flying Start Aero, with a drive time of about 17 minutes. The pilot's presence at the airport at 0350 was consistent with his leaving his home about 0330.

The direct distance from RNO to HND was 305 nm, and 174 nm from HND to F70, for a minimum total round-trip distance of 958 nm. Based on witness information, the flight time from RNO to HND was about 2 hours and 20 minutes, and from HND to F70, somewhat less than 2 hours. The investigation was unable to determine how or where the pilot spent the approximately 4 hours between his arrival at and departure from F70. The return trip leg duration from F70 to HND appeared to be about 2 hours. FAA air traffic control ATC information indicated that the return leg from HND to RNO was also about 2 hours.

Based on this information, the pilot's total flight time for the day was about 8.5 hours and included 4 takeoffs and 3 landings. The accident occurred about 14 hours after the flight's departure from RNO.

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	BEECH	<b>Registration:</b>	N985CA
<b>Model/Series:</b>	A36 UNDESIGNAT	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>	1981	<b>Amateur Built:</b>	No
<b>Airworthiness Certificate:</b>	Normal	<b>Serial Number:</b>	E-1901
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	6
<b>Date/Type of Last Inspection:</b>	11/17/2015, Annual	<b>Certified Max Gross Wt.:</b>	3651 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	1 Reciprocating
<b>Airframe Total Time:</b>	5528 Hours as of last inspection	<b>Engine Manufacturer:</b>	Continental Motors
<b>ELT:</b>	Installed, not activated	<b>Engine Model/Series:</b>	IO-550
<b>Registered Owner:</b>	VENTURE AVIATION SERVICES LLC	<b>Rated Power:</b>	
<b>Operator:</b>	Flying Start Aero	<b>Operating Certificate(s) Held:</b>	None

### General

FAA information indicated that the airplane was manufactured in 1981 and was equipped with a Continental Motors IO-550 series engine. Delivery documents indicate that the airplane was not equipped with a supplemental oxygen system. The airplane was owned by Venture Aviation Services of Reno Nevada and was placed on leaseback to Flying Start Aero in November 2014. The leaseback contract between the airplane owner and Flying Start Aero explicitly limited the airplane use to "commercial pilot flight training" and "rental to pilots approved by [the Flying Start Aero owner, who was also the accident pilot], as per insurance policy." The airplane owner told the investigator-in-charge that Flying Start Aero took very good care of the airplane, and did not defer any maintenance items.

### Maintenance Records

The most recent annual inspection was completed in November 2015. According to the records for that inspection, the airplane had a total time (TT) in service of about 5,528 hours, the engine TT and time since overhaul (TSMOH) were about 998 hours, and the tachometer registered about 3,747 hours.

The only maintenance record entry subsequent to the 2015 annual inspection was for an oil and oil filter change in February 2016. At that time the airplane had a TT of 5,550 hours, the engine TT and TSMOH were about 1020 hours, and the tachometer registered about 3,769 hours. The investigation was unable to determine the airplane TT at the time of the accident.

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	RNO, 4415 ft msl	Distance from Accident Site:	1 Nautical Miles
Observation Time:	1755 PDT	Direction from Accident Site:	160°
Lowest Cloud Condition:	Few / 10000 ft agl	Visibility	10 Miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	17 knots / 20 knots	Turbulence Type Forecast/Actual:	/
Wind Direction:	290°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.01 inches Hg	Temperature/Dew Point:	31° C / -5° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Las Vegas, NV (HND)	Type of Flight Plan Filed:	None
Destination:	Sparks, NV (RNO)	Type of Clearance:	VFR Flight Following
Departure Time:	1600 PDT	Type of Airspace:	

### Observations and Reports

The 1755 RNO automated weather observation included wind from 290° (true) at 17 knots, gusting to 20 knots, visibility 10 miles, few clouds at 10,000 ft above ground level, temperature 31° C, dew point -5° C, and an altimeter setting of 30.01 inches of mercury.

About 1757:18, the RNO ATCT controller advised the pilot that the wind was from 260° (magnetic) at 13 knots, with gusts to 18 knots.

About 1758:53, the RNO ATCT controller advised "all aircraft" that automated terminal information service (ATIS) information "Kilo" was current, and that the wind was from 250° (magnetic) at 17 knots, with gusts to 20 knots.

### Wind and Position Information for Bonanza N985CA

When the airplane was about 35 miles southeast of RNO, and about 17 minutes before the accident, the pilot confirmed to the NCT controller that he had RNO ATIS information "Juliet." Based on the available evidence, ATIS Juliet was likely based on the 1655 (PDT) METAR, which included wind of 230° (true) at 13 knots. The ATIS Juliet information prompted the pilot to respond that he wanted runway 25 when he was asked by the NCT controller. A wind from 230° (true, 216° magnetic) would have resulted in a 50° crosswind for a runway 16L landing.

At the time of the 1757:18 LC1 wind advisory (260° mag/13G18), the airplane was about 6.7 miles east-northeast of RNO, turning northwest, at an indicated altitude of about 7,900 ft.

At the time of the 1758:53 LC1 ATIS "Kilo" broadcast (250° mag/17G20), the airplane was

about 3.5 miles northeast of RNO, on a wide, diagonal left base leg for runway 16L, at an indicated altitude of about 5,700 ft. From that location, if it turned about 50° to the left, the accident airplane could have entered a right base leg that would result in a 2 mile final for runway 25.

### Sun Position

US National Oceanic and Atmospheric Administration data indicated that at RNO, about 3 minutes before the accident, the sun was at a true azimuth of about 267°, and an elevation about 17° above the theoretical horizon.

### Airport Information

<b>Airport:</b>	Reno/Tahoe International (RNO)	<b>Runway Surface Type:</b>	Concrete
<b>Airport Elevation:</b>	4415 ft	<b>Runway Surface Condition:</b>	Dry
<b>Runway Used:</b>	16L	<b>IFR Approach:</b>	None
<b>Runway Length/Width:</b>	9000 ft / 150 ft	<b>VFR Approach/Landing:</b>	Traffic Pattern

RNO was situated at an elevation of 4,415 ft above mean sea level (msl). RNO was equipped with 3 paved runways, designated 7/25, 16L/34R, and 16R/34L. Runway 7/25 measured 6,102 ft by 150 ft, runway 16L/34R measured 9,000 ft by 150 ft, and runway 16R/34L measured 11,001 feet by 150 ft. Magnetic variation was about 14° east.

The centerlines of runways 16R and 16L were separated by 700 ft. Although the paved approach (north) ends of runways 16R and 16L were abeam one another, runway 16R had a displaced threshold of 1,000 ft. Runway 16R was equipped with a 4-light PAPI (precision approach path indicator) system with an approach slope of 3.06°, and a threshold crossing height (TCH) of 77 ft. It was also equipped with an ILS (instrument landing system) approach with a glide slope of 3.1°, and a TCH of 59 ft. Runway 16L was equipped with a 4-light PAPI system with at 3.0° slope, and a TCH of 75 ft. Runway 16L did not have an ILS approach system or procedure. This geometry results in the 16R approach path being higher than the 16L approach path for a given distance from the pavement ends; for 2 aircraft abeam one another and on the respective approach slopes, the aircraft on approach to runway 16R would be higher than the aircraft on runway 16L.

The 16/34 runways intersected runway 7/25 at its approximate mid point, while runway 7/25 crossed the 16/34 runways about 6,300 ft from the north ends of the 16/34 runways. The available landing distance from the runway 25 threshold to the eastern edge of runway 16R was about 3,327 ft. The Flying Start Aero ramp and office were located northeast of the runway intersections.

## Wreckage and Impact Information

Crew Injuries:	1 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:	1 Fatal	Aircraft Fire:	On-Ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Fatal	Latitude, Longitude:	39.521111, -119.765556 (est)

The airplane impact location was situated on the extended centerline of runway 16L/34R, 2,843 ft north of the runway 16L threshold. Site elevation was 4,436 ft msl. With the exception of a few small fragments and the forward right cabin door, the wreckage was entirely contained within a semi-circular area approximately 25 ft in radius.

The bulk of the wreckage was very tightly contained, and consisted of the remains of both wings, the fuselage, empennage, engine, and propeller. All components in the main wreckage exhibited extensive aft crushing and/or thermal damage or consumption. The cabin roof, floor, and seat were mostly destroyed by post impact fire.

Portions of both ailerons and both flaps were identified in the wreckage. Aileron control cable continuity was verified, but no information regarding cable routing could be determined. The available evidence was insufficient to determine the flap position at impact.

Both horizontal stabilizers remained attached to the aft fuselage, and both elevators remained attached to their respective stabilizers. Both elevator balance weights were located in the wreckage. Due to impact and thermal damage, elevator control continuity could not be verified. The extensions of the 2 pitch trim actuators were consistent with a neutral (faired) position.

The vertical stabilizer remained attached to the fuselage, and the rudder remained attached to the vertical stabilizer. The rudder balance weight remained attached to the rudder. Due to impact and thermal damage, rudder control continuity could not be verified.

Most of the cockpit instruments and controls were destroyed by the combination of impact and fire. The fuel selector valve was determined to be set to the "right tank" position. The landing gear retraction/extension bellcrank assembly was consistent with the landing gear being in the extended position at impact. The only identifiable component of the ELT was the battery pack, which sustained impact and thermal damage. No evidence of any supplemental oxygen system components was identified in the wreckage.

The engine crankcase halves were mostly intact. The crankshaft propeller flange separated and remained with the propeller. All cylinders remained attached to their respective mounts on the crankcase halves and exhibited impact and external thermal damage. Most engine accessories were fracture-separated from the engine. Almost all engine components exhibited significant impact- and/or thermal damage. A lighted borescope examination of all 6 cylinders revealed that all exhaust and intake valves were intact, in-place, and exhibited normal combustion deposits and coloration.

The propeller and hub assembly were fracture-separated from the engine crankshaft. All 3 blades remained installed in the hub. The assembly was found with the forward ("blade back," or cambered) side down, partially embedded in the asphalt. The propeller impact damage and the ground scars were consistent with the impact occurring with the plane of rotation parallel to the ground plane.

No evidence of pre-impact failure of the airframe, engine, or propeller was observed. Additional information regarding the wreckage can be found in the NTSB public docket for this accident.

## Communications

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### General and RNO ATCT Staffing

Approaching RNO, the flight first communicated with Northern California Terminal Radar Approach Control (NCT), and then with the RNO ATCT local controller

A segment of the ATC recording was provided to a flight instructor at Flying Start Aero who knew the accident pilot well; he was asked whether he could identify the person on the radio in the accident airplane. It was his determination that the person on the radio was his colleague, the accident pilot.

According to the RNO ATCT personnel and position logs, at the time of the accident, there were 2 controllers on duty in the RNO ATCT. One controller was assigned to the local control position 1 (LC1) and the other was assigned to operational supervisor 1 (OS1) and ground control (GC) positions. Multiple position assignments for 1 individual during a work shift is normal operational practice.

The LC1 controller was the individual who communicated with the accident airplane from the time the pilot contacted the RNO ATCT until the accident. According to an NTSB interview the LC1 controller began working for the FAA in July 2010, and transferred to the RNO ATCT in May 2015. He was qualified on all operating positions within the ATCT and was designated a controller in charge (CIC).

The LC1 controller started his work shift at 1030, and ended it at 2300, for a total "on duty" time of 12 hours, 30 minutes. The Position Logs indicated that his "Position Duties" time was 5 hours, 16 minutes, and his "Non-Position Duties" time was 4 hours, 27 minutes.

After returning from his second break period, the controller was assigned to the LC1 position, and about 21 minutes later, the accident pilot made his initial contact with RNO ATCT, with the LC1 controller.

### ATC Communications and Ground Track

About 1744, when the accident airplane was about 35 miles south-southeast of RNO, the pilot checked on with NorCal approach control (NCT) and advised the LC1 controller that he had RNO ATIS information Juliet. The LC1 controller asked for the pilot's runway preference, and the pilot stated that he wanted runway 25.

About 1751, the NCT controller issued a heading vector of 350°, and restricted the minimum altitude to 8,500 ft. The NCT controller advised the pilot to expect runway 25. At that time, the airplane's flight track was approximately perpendicular to, and about 7 miles east of, runway 25; this position and heading were consistent with a wide left base leg for runway 25.

About 1754, the NCT controller advised the pilot that there would be a "slight delay for runway 25," that he was "number four now for the airport," and advised that "traffic on a fifteen mile straight in is a Boeing seven fifty seven for one-six right." The pilot acknowledged, and advised the NCT controller that he could accept runway 16L. The NCT controller advised the pilot of N958CA to "proceed to the downwind" and contact RNO ATCT. The NCT controller did not specify which runway he was referring to, and the pilot did not ask or specify which runway that downwind assignment was for.

About 1754:33 the pilot contacted the RNO LC1 controller and transmitted "Reno tower good afternoon, Bonanza niner eight five charlie alpha restricted heading three-five-zero, eight thousand five hundred." About 1754:42, the NCT controller contacted the RNO LC1 controller via an interfacility landline to advise him that the pilot could accept runway 16L. The NCT controller stated that the airplane was being sent to "the downwind," but again the NCT controller did not specify which runway he was referring to, and the RNO LC1 controller did not ask or specify which runway that downwind assignment was for.

About 1754:50, the RNO local controller responded to the accident airplane pilot, and instructed the pilot to continue inbound for runway 25. The pilot acknowledged with the response "continue inbound for two five...". At that time, the airplane was at an altitude of about 8,600 ft, about 7.6 miles southeast of the runway 25 threshold. The airplane position and heading were consistent with it being on a left base leg for runway 25, about 3.5 miles south of a 6.5 mile final approach leg.

About 1755:08, an unidentified transmission consistent with those from the accident airplane queried "and ah tower, how about the restrictions?" The LC1 controller only partially heard this transmission, did not know which airplane it was from, did not acknowledge the communication, and did not request either a repeat or clarification of the transmission. The pilot did not repeat that transmission or transmit any related inquiries. Instead, the LC1 controller cleared a FedEx B757 to land on runway 16R and advised the FedEx pilots that their traffic was another B757 on a 5 mile final for the same runway. The LC1 controller never explicitly cancelled the NCT-assigned altitude and heading restriction, and never assigned any other heading or altitude to the accident airplane.

About 1756:20, the accident pilot reported that he was on a "wide downwind" for runway 16L, to which the RNO LC1 controller replied "Bonanza five charlie alpha roger continue inbound for one six left." At that time, the airplane was about 7 miles east of runway 16L. It had already crossed through the extended centerline of runway 25, and was on a track of about 350°, at an altitude of 8,600 ft.

About 1757:12, the pilot transmitted "And tower five charlie alpha is turning a wide left base one six left." At that time, the airplane was about 7 miles east-northeast of RNO, and descending through 8,000 ft. The RNO controller responded with "...roger traffic niner mile final for one six right is a Boeing seven fifty seven, caution wake turbulence wind two six zero at one three gust one eight runway one six left cleared to land." The pilot acknowledged the landing clearance and reported that he did not have the traffic in sight.

The LC1 controller only told the accident pilot about a FedEx B757, which was about 7 miles in trail behind a UPS B757. At that point, the accident airplane was approximately north-northwest bound, and the FedEx B757 was about 10 miles out in front of the accident airplane; it was traveling southbound, aligned on its inbound final approach course, and about 10 miles from the runway 16R threshold. The UPS B757 was about 3 miles from the runway 16R threshold.

1758:17, when the accident airplane was about 6 miles northeast of RNO, just after turning from west to southwest, and descending through 6,300 ft, the pilot advised that he had "the airliner" in sight. At that point, the UPS B757 was on about a 3/4 mile final to runway 16R, about 4.5 miles directly ahead of, and 1,700 ft below, the accident airplane. At that same time, the still-southbound FedEx B757 was about 5.3 miles from the accident airplane, at it's 2 to 3 o'clock position, and about 100 ft lower than the accident airplane. The LC1 controller was not required to verify that the accident pilot had correctly identified his traffic, and the LC1 controller did not respond to the accident pilot. Instead, the LC1 controller radioed "FedEx thirteen fifty nine traffic on a four mile left base for one six left six thousand two hundred feet, Bonanza, they do have you in sight."

About the same time that the pilot reported visual contact with "the airliner," the accident airplane rolled out onto a diagonal base leg towards runway 16L, and continued its descent. By about 1758:45, while the accident airplane was inbound on the diagonal base leg, the UPS B757 had landed, and was being given taxi instructions by the LC1 controller. Aside from the controller's 1758:53 "all aircraft" advisory that ATIS information Kilo was current, there were no communications to or from the accident airplane subsequent to the pilot's report that he had the "airliner" in sight.

About 1800:21, when it was at an altitude of about 4,900 ft, the accident airplane joined an abbreviated base leg situated about 1 mile north of the runway 16L threshold. At that point, the FedEx B757 was just over 1 mile from the accident airplane, at it's 12 to 1 o'clock position, and about 200 ft lower. About 24 seconds later, at an altitude of about 4,700 ft, the accident airplane began its left turn onto final for runway 16L. At that point, the FedEx B757 was about 1 mile from the accident airplane, approximately at it's 10 to 11 o'clock position, still about 200 ft lower. The last radar return from the accident airplane was recorded at 1800:59, when it was at a radar-indicated altitude of 4,600 ft, and about 1/2 mile north of the runway 16L threshold.

#### Aircraft Separation Responsibility

FAA document JO 7110.65W "Air Traffic Control" delineates nearly all the air traffic controllers' procedures and responsibilities; it is often referred to as "the controllers' handbook." According to JO 7110.65W Section 2-1-1 (ATC SERVICE), the "primary purpose of the ATC system is to prevent a collision between aircraft... and to provide a safe, orderly and

expeditious flow of traffic..." The document also stated that in addition to its primary function, the ATC system has the capability to provide additional services, with "certain limitations," limited by "many factors," including traffic volume, frequency congestion, controller workload, and higher priority duties. Regarding the provision of those additional services, the document stated that those "services cannot be provided in cases in which the provision of services is precluded by" the cited factors. Conversely, the document also stated that "controllers must provide additional service procedures to the extent permitted by higher priority duties and other circumstances. The provision of additional services is not optional on the part of the controller, but rather is required when the work situation permits."

Per the above guidance, the LC1 controller's primary responsibility was traffic separation for collision-avoidance purposes. Separation of traffic for wake vortex avoidance purposes was also the LC1 controller's responsibility, and the guidance explicitly delineated the applicable criteria, procedures and separation minima for both collision and wake vortex avoidance. The guidance differentiated these criteria and procedures as a function of the operating airspace category; RNO was categorized as Class C airspace. JO 7110.65W Section 2-1-2 (DUTY PRIORITY) guidance for ATC services in Class C airspace stated: "Give first priority to separating aircraft and issuing safety alerts as required in this order. Good judgment must be used in prioritizing all other provisions of this order based on the requirements of the situation at hand."

JO 7110.65W specified that when simultaneously handling both instrument flight rules (IFR) aircraft (such as the B757s) and VFR aircraft (such as the accident airplane), the controller could transfer the separation responsibilities to the VFR aircraft once the controller ascertained that the required radar separation minima had been met, and that the visual separation criteria were or could be met. JO 7110.65W required that unless and until separation responsibilities were explicitly transferred from the controller to the VFR aircraft, the controller was responsible for ensuring that the minimum required distance between the IFR aircraft and the following VFR aircraft was maintained.

When the controller first advised the accident pilot of the (FedEx) B757, the two airplanes were just over 9 miles apart. When the pilot erroneously advised that he had the controller-cited traffic in sight, the two airplanes were about 5.2 miles apart. That distance, the existing flight visibility, and the controller's knowledge and expectations of the airplanes' flight paths to the two parallel runways satisfied the requirements to permit the controller to transfer separation responsibilities to the accident pilot. Although the controller ceased providing separation services to the accident airplane after the pilot reported the traffic in sight, the controller did not explicitly transfer that separation responsibility to the pilot by any verbal instructions.

#### Wake Turbulence Advisories

JO 7110.65W Section 2-1-20 (WAKE TURBULENCE CAUTIONARY ADVISORIES) presented the controller responsibilities regarding these advisories. The guidance applied to arriving VFR aircraft that were not being radar vectored but were behind larger aircraft that require wake turbulence separation. The guidance required controllers to issue wake turbulence cautionary advisories "including the position, altitude if known, and direction of flight" to "VFR arriving aircraft that have previously been radar vectored and the vectoring has been discontinued." The guidance also stated "Issue cautionary information to any aircraft if in your opinion, wake

turbulence may have an adverse effect on it." The guidance did not include any information regarding the quantity or frequency of such wake turbulence advisories, nor did it include any other amplifying guidance regarding those advisories. The Section then cited Advisory Circular 90-23 as an additional reference.

#### ATC Wake Turbulence Separation Distances

FAA air traffic controller guidance for wake turbulence avoidance related aircraft separation distances was published in the JO 7110.65W. The separation distances are based upon the weight classes of the aircraft involved. Appendix A (Pilot/Controller Glossary) specified the following weight classes for "the purposes of Wake Turbulence Separation Minima."

ATC classifies aircraft as Super, Heavy, Large, and Small as follows:

- a) Super - The Airbus A-380-800 (A388) and the Antonov An-225 (A225) are classified as super.
- b) Heavy - Aircraft capable of takeoff weights of 300,000 pounds or more whether or not they are operating at this weight during a particular phase of flight.
- c) Large - Aircraft of more than 41,000 pounds, maximum certificated takeoff weight, up to but not including 300,000 pounds.
- d) Small - Aircraft of 41,000 pounds or less maximum certificated takeoff weight.

The Appendix then referred the reader to the FAA Aeronautical Information Manual.

The wake turbulence minimum separation distances are specified in Section 5-5-4 of JO 7110.65W. That guidance stated that operations on parallel runways less than 2,500 ft apart should be considered as a single runway, and that the minimum separation distance between a small aircraft (such as the accident airplane) behind a large aircraft (such as the B757s) is 4 nm.

In June 2009, the FAA published Notice NJO 7110.504 with the stated subject of "Boeing 757-200 Weight Class." That Notice specified that for wake turbulence avoidance purposes, the minimum separation distance between a following aircraft with a maximum takeoff weight of 41,000 lbs or less and B757-200 airplanes was 5 nm. Notice NJO 7110.504 expired in February 2010. In February 2010, the FAA published Notice NJO 7110.519, which was cited as a "continuation" of Notice NJO 7110.504, and contained the same information, including the 5 nm minimum separation distance between "Small" class aircraft and B757 airplanes. Notice NJO 7110.519 expired in February 2011 and was not re-issued as another NJO Notice. The 5-mile separation was not integrated into the then-current or subsequent versions of the JO 7110.65. The investigation was unable to determine the reasons for this change in minimum B757 following distances.

#### RNO ATCT LC1 Controller Actions

Much of the following information was derived from a telephonic interview of the LC1 controller, which was conducted by the NTSB-led ATC group about 3 weeks after the accident.

During the accident pilot's initial transmission to RNO ATCT, the LC1 controller was coordinating with the RNO ground controller (GC), and therefore did not immediately respond to the accident pilot. The controller observed that the airplane data block scratchpad on his

tower display workstation (TDW) indicated that the airplane was being sequenced for runway 25 by NCT. The TDW was a slaved radar display from NCT to the RNO ATCT.

About 90 seconds after he was instructed to continue for runway 25, the pilot transmitted that he was on a downwind for runway 16L, and the controller did not discuss or counter the pilot's independent change of landing runway. The controller's interview did not provide any reasons for his unchallenging acceptance of the pilot's landing runway decision.

Although there were two B757 airplanes on final approach for runway 16R, the controller stated that he did not consider the leading (UPS) B757 to be a factor for the accident airplane, and therefore did not advise the pilot of the fact that there were two B757s on final for runway 16R. The controller expected both B757s to land prior to the accident airplane.

When the pilot advised the controller that he had the "airliner" in sight, the controller was confident that the pilot had properly identified the FedEx B757, and not the UPS B757, as his traffic. The controller stated that his rationale for his certainty was that because the FedEx B757 could not have traversed the 9 miles to the runway 16R threshold in the minute or so between the controller's traffic advisory and the pilot's sighting acknowledgement, the pilot must be viewing and referring to the FedEx B757. The controller also stated that if he believed that there was any confusion on the part of the accident pilot that the FedEx B757 was the traffic of concern, the controller would have advised the accident pilot that there were 2, and not just 1, B757 airplanes on approach to RNO runway 16R. Finally, although the controller intended for the accident airplane to land after the FedEx B757, the controller was uncertain as to whether the accident pilot was aware of his intentions regarding that sequence.

Per the JO 7110.65W guidance, once the pilot (erroneously) reported that he had the controller-advised traffic in sight, the controller had 2 options regarding separation; the controller could either retain separation responsibility, or he could explicitly delegate that responsibility to the accident pilot by instructing the pilot to maintain visual separation. The controller did not accomplish either of those options. Instead, after the accident pilot's erroneous traffic sighting report, the controller advised the FedEx B757 that the accident airplane had the B757 in sight. In his post accident interview, the controller did not provide any reasons for his failure to accomplish one of the separation options.

In his interview, the controller reported that he was aware that the wind and runway orientation would result in the FedEx B757 wake vortices traveling towards the accident airplane's flight path and landing runway. Despite his expectation of that wake vortex movement, the controller was not concerned because "runway 16L arrivals normally remained above the flight path of the B757s landing on runway 16R provided they had the other aircraft in sight." According to the controller's understanding of the current RNO ATCT procedures, the facility was permitted to sequence aircraft this way, and it was a normal practice. According to the controller, general aviation aircraft landing on runway 16L would avoid the wake vortices of heavier airplanes landing on runway 16R by altering their approach paths in order to remain above the heavier airplanes, and the general aviation airplanes would typically touch down on runway 16L about 2,000 to 3,000 ft down the runway.

## Medical And Pathological Information

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The Washoe County Medical Examiner's Office, Reno, Nevada, autopsy report indicated that the pilot's cause of death was "multiple blunt force injuries," with "no gross evidence of soot inhalation." The FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, conducted forensic toxicology examinations on specimens from the pilot, and reported the detection of the following drugs:

- Amlodipine detected in Urine
- Losartan detected in Liver and Urine
- Rosuvastatin detected in Liver and Urine
- Naproxen detected in Urine

The pilot had reported the Amlodipine, Losartan, and Rosuvastatin to his Aviation Medical Examiner on his FAA medical certificate application, and he was issued an FAA medical certificate. Those 3 medications are not considered impairing. Naproxen is in a class of medications called non-steroidal anti-inflammatory drugs (NSAID), and its use is generally considered not to present a hazard to aviation safety.

## Organizational And Management Information

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### Flying Start Aero

According to its website, "Flying Start Aero is a full-service flight school and aviation resource center" that specialized "in flight training from student pilot to Airline Transport Pilot." Flying Start Aero also offered "scenic-photo flight over Lake Tahoe and the surrounding points of interest." The web site stated that the Bonanza (the accident airplane) was "perfectly suited for commercial pilot training and/or fast and comfortable trips to faraway places for our renters."

As of the date of the accident, Flying Start Aero did not hold an FAA Part 135 operating certificate, which would enable them to offer chartered transportation of passengers for hire.

### Airplane Sign-out/Dispatch Records

A common practice of flight schools or fixed base operators (FBOs) is to utilize systems of electronic or paper sign out/dispatch records to track the times that students or renters accrue on the aircraft. The information is then principally utilized for both billing and maintenance scheduling purposes.

In response to an NTSB request for the accident airplane's dispatch records, the Flying Start Aero attorney stated that the "rental book records containing...copies of the dispatch [paperwork] of N985CA were in the aircraft at the time of the accident and destroyed in the fire." This attorney-cited practice of keeping the rental records onboard the airplane was not consistent with typical FBO business practices. In addition, the attorney's response was dated September 21, 2016; as of that date, the wreckage had not been released by the investigation, and therefore neither Flying Start Aero nor its attorney had any access to, or any knowledge of, the recovered airplane components or contents.

## FAA Regulations re Non-Instructional Flights

FAA regulations set the requirements and limitations for pilots and operators to be reimbursed for carrying passengers. Because Flying Start Aero did not hold a Part 135 operating certificate, any carriage of persons for compensation, for purposes other than flight instruction, must comply with either paragraph 91.146 and 91.147, which delineate the applicable requirements and limitations for such flights. Paragraph 91.146 permits limited operations for carriage of passengers for "charitable, non-profit, and community events." The guidance defines those events, and imposes strict limits in terms of calendar frequency, departure and landing airports, flight distance, and overflight areas. Specifically, the flight must be nonstop, begin and end at the same airport, and must be conducted within a 25-statute mile radius of that airport. There was no evidence that the accident flight was in support of any charitable, non-profit, or community event. In addition, the accident flight did not comply with the 91.146 airport or distance limitations.

Paragraph 91.147 permits the carriage of persons for profit, but the flights are subjected to strict limitations, and the Operator must be granted a Letter of Authorization (LOA) by the FAA Flight Standards District Office (FSDO) "nearest [the operator's] principal place of business." That LOA would be very specific regarding the applicable conditions for those flights. In the case of Flying Start Aero, the nearest FSDO was Reno. Flying Start Aero had never applied for, and was never granted, any such LOA by the Reno FSDO.

An FAR Part 135 operating certificate would have permitted Flying Start Aero to carry passengers for hire. For fatigue avoidance and flight safety reasons, FAR Part 135 specifies flight- and duty-time limits for pilots. FAR 135.265 imposed limits on planned flights to 1,200 hours in any calendar year, 120 hours in any calendar month, 34 hours in any 7 consecutive day, and 8 hours during any 24 consecutive hours for a flight crew consisting of one pilot.

## Flight Arrangements

Although some initial information indicated that the flight was an instructional flight, and because Flying Start Aero did not hold a Part 135 certificate, the investigation attempted to determine the exact nature of the flight. The investigation found that, although the passenger who was the owner of the local company had taken one or two flight lessons the year before the accident, he did not possess an FAA student pilot certificate. Furthermore, the passenger who deplaned in HND stated that there did not appear to be any flight instruction occurring during the time that he was on board the airplane, and that the pilot conducted all activities associated with the operation of the airplane, including radio communications.

In response to an NTSB inquiry, the Flying Start Aero attorney stated that he believed that company owner passenger "intended to become an active student" pilot, and that the flight was to be fully paid for by the passenger and/or his company. The attorney noted that subsequent to the accident, there was "never any billing" for the flight. The accident airplane owner's representative stated that the owner was normally not kept apprised of the airplane flight types or related payment specifics. Several subsequent inquiries to representatives of the passengers and the company the passengers worked for regarding the nature of the flight, and particularly how it was to be paid for, were not answered.

## Additional Information

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### Airplane Landing Distances

Performance data from the Pilot's Operating Handbook (POH) indicated that for the ambient RNO conditions and a 17-knot headwind, the accident airplane would have required about 1,500 ft to land over a 50 foot obstacle. This distance represents about half of the available landing distance from the runway 25 threshold to the eastern edge of runway 16R.

POH landing distance over a 50 foot obstacle for the ambient RNO conditions and no headwind was about 1,700 ft. A landing planned for 3,000 ft beyond the runway 16L threshold (as cited by the LC1 controller), which would be 1,000 ft beyond the estimated touchdown location of the FDX B757, would provide a runway distance margin of 4,700 ft.

### Airplane Crosswind Capability

The FAA Airplane Flying Handbook (AFH, FAA 8083-3) section entitled "MAXIMUM SAFE CROSSWIND VELOCITIES" included the following:  
Takeoffs and landings in certain crosswind conditions are inadvisable or even dangerous. If the crosswind is great enough to warrant an extreme drift correction, a hazardous landing condition may result. Therefore, the takeoff and landing capabilities with respect to the reported surface wind conditions and the available landing directions must be considered.

Before an airplane is type certificated by the Federal Aviation Administration (FAA), it must be flight tested to...[demonstrate that it is]...satisfactorily controllable with no exceptional degree of skill or alertness on the part of the pilot in 90° crosswinds up to a velocity equal to 0.2 VSO. This means a windspeed of two-tenths of the airplane's stalling speed with power off and landing gear/flaps down.

The AFH also stated that "It is imperative that pilots determine the maximum crosswind component of each airplane they fly, and avoid operations in wind conditions that exceed the capability of the airplane."

According to the airplane manufacturer's Pilots Operating Handbook (POH), the "Demonstrated Crosswind" capability was cited as 17 knots. The POH contained the following definition for "Demonstrated Crosswind Velocity":  
The velocity of the crosswind component for which adequate control of the airplane during takeoff and landing was actually demonstrated during certification tests. The value shown is not limiting.

Crosswind component calculations for a runway 16L landing using the reported wind directions and speeds yielded values that approached or exceeded the airplane's maximum demonstrated crosswind value. While the 1757:18 winds yielded a steady state crosswind component of about 13 knots, the gusts resulted in an approximate 18 knot crosswind

component. The 1758:53 winds yielded a steady state crosswind component of about 17 knots, and gust crosswind component of about 20 knots.

#### FAA Wake Vortex Behavior Information

Wake Vortex information for pilots is presented in Advisory Circular (AC) 90-23G and Chapters 4 and 13 of the FAA Pilot's Handbook of Aeronautical Knowledge (PHAK, FAA-H8083-25).

According to the PHAK, wing lift generation "triggers the rollup of the airflow aft of the wing resulting in swirling air masses trailing downstream of the wingtips. After the rollup is completed, the wake consists of two counter rotating cylindrical vortices." The strength of the vortex is governed by the weight, speed, and shape of the wing of the generating aircraft. The vortex characteristics of any given aircraft can also be changed by the extension of flaps or other wing configuration devices, as well as by a change in speed.

The AC stated that the "vortices from an aircraft can pose a hazard to encountering aircraft. For instance, the wake of larger aircraft can impose rolling moments that exceed the roll control authority of smaller encountering aircraft." Wake vortices are rarely detectable visually, therefore the PHAK advised pilots to avoid wake vortex encounters by two principal means: separation by flight path, and separation by time. The AC stated that "Pilots must learn to envision the location and movements of the vortices generated by other aircraft and to adjust their flightpath accordingly."

The guidance provided descriptions of vortex behavior, particularly with regard to vertical and lateral travel. The PHAK stated that "trailing vortices have certain behavioral characteristics that can help a pilot visualize the wake location and take avoidance precautions. The vortex circulation is outward, upward, and around the wingtips... Tests have shown that vortices remain spaced a bit less than a wingspan apart, drifting with the wind, at altitudes greater than a wingspan from the ground. Tests have also shown that the vortices sink at a rate of several hundred feet per minute, and once about 100 to 200 feet above the ground, they tend to move laterally at about 2 to 3 knots, away from the generating airplane centerline. Vortices slow their descent and diminish in strength with time and distance behind the generating aircraft."

The guidance provided specific flight path strategies to avoid wake vortex encounters; the avoidance scheme was predicated on the subject airplane traversing a flight path that avoided the expected travel paths of the vortices. Both documents discussed the effects of crosswinds on vortex behavior, and that the vortices could be translated laterally by a crosswind.

Both sets of guidance stated that pilots should wait "at least 2 minutes" for the vortices to dissipate, if they were unable follow a flight path that would ensure minimal potential for a vortex encounter. The AC also presented the two following cautionary "Notes":

- Whether or not a warning or information has been given, the pilot is expected to adjust aircraft operations and flightpath as necessary to preclude wake encounters.
- When any doubt exists about maintaining safe separation distances between aircraft to avoid wake turbulence, pilots should ask ATC for updates on separation distance and groundspeed.

#### Aeronautical Information Manual

The Aeronautical Information Manual (AIM) is a pilot-oriented FAA "Official Guide to Basic Flight Information and ATC Procedures." Chapter 7 (Safety of Flight), Section 3 (Wake Turbulence) presents detailed information regarding wake vortex behavior, avoidance strategies for pilots, and details on ATC procedures for wake vortex avoidance.

Section 7-3-9 of the AIM stated that "Because of the possible effects of wake turbulence, controllers are required to apply no less than specified minimum separation to all IFR aircraft, to all VFR aircraft receiving Class B or Class C airspace services when operating behind super or heavy aircraft, and to small aircraft operating behind a B757."

Review of several recent editions of the AIM indicated that the specified separation distance for "small" aircraft (below 41,000 lbs MTOW) behind B757 aircraft has changed. The January 2015 edition specified a separation distance of 5 nm. The 2016 edition, current at the time of the accident, also specified a 5 nm separation distance. However, the October 2017 edition changed this B757 separation distance to 4 nm. The AIM did not contain any explanation of that change.

#### Advisory Circular AC90-23G

AC90-23G "Aircraft Wake Turbulence," stated that ATC uses four aircraft weight classes for the purposes of wake turbulence separation minima; those classes are the same as specified in JO 7110.65W. However, unlike JO 7110.65W, the AC contained additional information specifically regarding the B757 in a note that stated "The Boeing B757 is classified as a Large, but special wake turbulence separation criteria apply." The AC specified that the minimum separation distance for small aircraft following behind B757 airplanes was 5 miles, which is a 1-mile increase from the separation required from other "Large" aircraft. This 5-mile distance is the same as that specified by the AIM that was current at the time of the accident. It is 1 mile greater than that specified in either the then-current JO 7110.65W or the October 2017 version of the AIM.

#### Radar and Wake Vortex Study

The accident airplane flight path was analyzed to evaluate the possibilities of either an aerodynamic stall or a wake vortex encounter. Detailed results are documented in an Airplane Performance Study, available in the NTSB public docket for this accident. The accident airplane was not equipped with a flight data recorder. As a result, the study is based primarily on FAA ground tracking radar data.

The study developed time histories of several key flight parameters, including body attitudes and angle of attack. The data depict that the approach into RNO was relatively smooth, with bank angles less than 20°, and sufficient airspeed and stall margins for the duration; there were no indications of an incipient or developed aerodynamic stall. The study revealed that wake turbulence from a FedEx B757 was a potential factor in the accident airplane's loss of control. The wake vortex modeling program used for the study estimated that the accident airplane flight path in time and space placed the accident airplane in the vicinity of both wake vortices generated by the FedEx B757 at a geographic location just prior to the ground impact site.

## Administrative Information

<b>Investigator In Charge (IIC):</b>	Michael C Huhn	<b>Report Date:</b>	07/16/2018
<b>Additional Participating Persons:</b>	Lee Oscar; FAA RNO FSDO; Reno, NV Michael Council; Continental Motors; Mobile, AL Andrew Hall; Textron Aviation; Wichita, KS		
<b>Publish Date:</b>	07/16/2018		
<b>Note:</b>	The NTSB traveled to the scene of this accident.		
<b>Investigation Docket:</b>	<a href="http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=93924">http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=93924</a>		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).