



National Transportation Safety Board Aviation Accident Final Report

Location:	Bethany, OK	Accident Number:	FTW02LA154
Date & Time:	05/20/2002, 0801 CDT	Registration:	N13VP
Aircraft:	Cessna 550	Aircraft Damage:	Substantial
Defining Event:		Injuries:	1 Minor, 5 None
Flight Conducted Under:	Part 91: General Aviation - Business		

Analysis

The twin-tubofan airplane overran the runway during an aborted takeoff, impacting two fences before coming to rest. The pilot reported experiencing no anomalies with the airplane during the preflight inspection and taxi portion of the flight. During takeoff roll, at V₁ (103 knots), the pilot began to pull aft on the control yoke. The pilot noticed the nose landing gear was not coming off of the runway and at 120 knots, with full aft control input, elected to abort the takeoff. He pulled the power to idle and applied maximum braking. Upon seeing the localizer antennas approaching the airplane at the departure end of the runway, the pilot veered the airplane to the right of centerline. The airplane departed the runway surface and impacted the fences. Post-accident examination of the runway revealed tire skid marks on the runway that led to the airplane's final resting place. The tire skid marks measured 1,765 feet in length. Examination of the wreckage revealed no pre-existing brake system anomalies that would have hindered the airplane's braking capability. Examination of the elevator trim system revealed it was 12 degrees out of trim in the nose down direction. The airplane underwent a Phase B and Phase 1 through 5 inspections approximately 5 months prior to the accident. The manufacturer's inspection manual indicates the elevator system should be examined every Phase 5 inspection. The aircraft's flight manual informs the pilot that the right elevator and trim tab should be inspected during the exterior inspection to ensure the elevator trim tab position matches its indicator.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: the anomalous elevator trim system and the pilot's failure to note its improper setting prior to takeoff.

Findings

Occurrence #1: OVERRUN

Phase of Operation: TAKEOFF - ABORTED

Findings

1. (C) FLT CONTROL SYST,ELEVATOR TRIM/TAB CONTROL - INACCURATE
2. (C) FLT CONTROL SYST,ELEVATOR TRIM INDICATOR - FALSE INDICATION
3. (C) CHECKLIST - NOT FOLLOWED - PILOT IN COMMAND

Factual Information

HISTORY OF FLIGHT

On May 20, 2002, at 0801 central daylight time, a Cessna 550 Citation twin-turbofan airplane, N13VP, was substantially damaged when it impacted a perimeter fence and road during a runway overrun following an aborted takeoff at the Wiley Post Airport, Bethany, Oklahoma. The airplane was registered to Airlease Inc., of Oklahoma City, Oklahoma, and was operated by Avalon Correctional Services, Inc., of Oklahoma City, Oklahoma. The airline transport pilot, who was type-rated in the Cessna 550, and four passengers were not injured. One passenger sustained minor injuries. Visual meteorological conditions prevailed and an instrument flight rules flight plan was filed for the 14 CFR Part 91 business flight. The cross-country flight was originating at the time of the accident and was destined for the Greeley-Weld County Airport, Greeley, Colorado.

According to the pilot's written statement and interviews conducted by the NTSB investigator-in-charge (IIC), the pilot did not observe any anomalies with the airplane during the preflight examination, or while taxiing for takeoff. He checked the flight controls and found them to be "free and correct." The flight was cleared to takeoff from runway 17L (7,198 feet by 150 feet). He initiated the takeoff roll from the approach end of the runway, and upon reaching V₁ (103 knots) he began to pull back on the control column. The pilot noticed the nose landing gear did not lift off of the runway surface with full aft control input, and elected to abort the takeoff. The last time the pilot referenced the airspeed indicator the needle was indicating 120 knots. The pilot applied maximum braking, and upon seeing the localizer antenna draw closer, he steered to the right to miss the array of antennas. The airplane departed the runway surface, impacted and proceeded through the southern airport perimeter fence, crossed a road, proceeded through another fence located on the opposite side of the road, and eventually came to rest upright in a muddy field.

PERSONNEL INFORMATION

The pilot was employed by the operator and reported he was the only pilot who flew the airplane for the company. He held an airline transport pilot certificate with type-ratings in Cessna CE-500, Douglas DC-3, HS-125, and Learjet airplanes. He also held flight instructor certificates for single-engine, multi-engine, and instrument airplanes. He was issued a first-class medical certificate on October 5, 2001, with a limitation to wear corrective lenses. According to the Pilot/Operator Aircraft Accident Report, he accumulated approximately 13,000 hours total flight time, of which approximately 150 hours were accumulated in the accident airplane make and model. The pilot last attended Cessna Citation flight training at SimuFlight International in December 2001.

AIRCRAFT INFORMATION

The airplane was manufactured in 1978 and was originally certified as a Cessna 551 (serial number 551-0009), but was later converted to a Cessna 550 (serial number 550-0263). In August 1996, the airplane was involved in a landing accident in Coberg, Germany, while it was being operated by the previous owner. The airplane sustained substantial structural damage, which was repaired by Cessna Aircraft Company at the Citation Service Center in Wichita, Kansas, in 1999.

The airplane was sold to AirLease Inc., in December 2001. The aircraft was in compliance with

FAA Exemption No. 40501 (Operation of model 550 under Part 91 as a one pilot crew). In early 2002, the airplane was at the Citation Service Center to get some aircraft discrepancies corrected and inspections accomplished. The airplane's last Phase B inspection and Phase 1 through 5 inspections began on January 3, 2002, at a total airplane time of 2,861 hours. As of May 19, 2002, the airplane had accumulated a total of 2,956.9 hours.

According to Cessna, their inspection manuals indicate that the elevator system should be inspected during the Phase 5 inspection, every 1,200 hours, or 36 calendar months, whichever occurs first.

According to the pilot, he last flew the airplane on May 16, 2002, and did not notice any anomalies with the elevator trim system or braking.

The pilot calculated the weight and balance for the accident flight to be 12,740 pounds with a center of gravity (CG) of 278.7 inches aft of datum. The airplane's CG range was between 276.1 and 285.8 inches aft of datum. Post-accident weight and balance calculations revealed the pilot's calculations were accurate.

Cessna Aircraft Company engineers calculated an accelerate/stop distance for the accident airplane utilizing a stop initiation speed of 120 knots. According to their calculations, with zero degrees of flaps utilized, the accelerate/stop distance would have equated to approximately 5,000 feet.

METEOROLOGICAL INFORMATION

The recorded weather report at 0807, for the Wiley Post Airport indicated the wind was from 060 degrees at 5 knots, the visibility was 10 statute miles, and a few clouds were present at 12,000 feet.

FLIGHT RECORDERS

A Fairchild A-200S cockpit voice recorder (CVR), serial number 06141, was installed on the accident airplane. The CVR was shipped to the NTSB's audio laboratory in Washington, DC for readout. The exterior of the CVR unit showed no evidence of structural damage. The interior of the recorder contained tape that was in good condition. The tape's recording consisted of four channels of good quality audio information.

Unfortunately, the single pilot operation contributed only two words during the takeoff roll, which did not contribute to determining the probable cause. Therefore, no transcript was prepared. The only sound signatures, aside from the pilot's words, consisted of the engine spool-up (at 28 minutes, 54.7 seconds from the start of the recording), engine spool-down (at 29 minutes, 35.0 seconds), first impact (at 29 minutes, 47.9 seconds), and second impact (29 seconds, 49.0 seconds). The end of the recording occurred 29 minutes, 56.7 seconds after the start of the recording.

WRECKAGE AND IMPACT INFORMATION

The airplane came to rest facing approximately the opposite direction from takeoff. Post-accident examination of the wreckage revealed the fuselage sustained deformation and wrinkling damage to the belly skins from fuselage station (FS) 29.0 to 280.0. The forward pressure bulkhead sustained structural damage. The nose landing gear and right main landing gear separated from the airplane during the accident sequence.

The right main landing gear penetrated the bottom and upper wing skins during its collapse and separation at wing station (WS) 47.0. The right flap and railing edge wing skins also sustained scraping and bending damage.

Leading edge wing damage was noted to both wings, and substructure damage was noted.

An FAA inspector, who responded to the accident site, measured tire skid marks that were visible on the runway. The skid marks measured 1,765 feet until they departed the runway surface. The FAA inspector then measured the visible tire tracks that extended beyond the runway surface. The total length of tire skid marks and tire tracks measured 2,373 feet until the point where the right main landing gear separated.

Photographs of the airplane taken after the accident revealed the cockpit elevator trim wheel was positioned in the takeoff range. Photographs of the elevator trim tab revealed it was deflected up (nose down).

The airplane was recovered to the operator's maintenance facility located on the airport where it was examined on May 22, 2002, by the NTSB IIC, an FAA inspector, and investigators from Cessna Aircraft Company. During that examination, the NTSB IIC removed the following equipment for further testing (manufacturer names follow the various components):

Cockpit Voice Recorder (Fairchild - CVR)

Anti-skid Control Unit (Crane Aerospace/Hydro-Aire Inc.)

2 Wheel Speed Transducers (Crane Aerospace/Hydro-Aire Inc.)

Power Brake Anti-skid Valve (Crane Aerospace/Hydro-Aire Inc.)

Anti-skid Servo Valve (Crane Aerospace/Hydro-Aire Inc.)

Electro-Hydraulic Servo Valve (Cessna Aircraft Company)

Hydraulic Power Pack Assembly (Cessna Aircraft Company)

Air Data Control Unit (Honeywell)

TESTS AND RESEARCH

On June 5, 2002, an FAA inspector, along with an investigator and two mechanics from Cessna Aircraft Company examined the airplane's elevator and trim systems. The mechanics followed the inspection/check instructions spelled out in the manufacturer's maintenance manuals. It was noted that with the elevator trim wheel indicator was positioned to the takeoff position, the measured elevator trim tab deflection was 10.5 degrees tab up (nose down). According to the Cessna Aircraft Company maintenance manual, the elevator trim tab should be 1.5 degrees tab down (nose up) with the elevator trim wheel indicator set at the takeoff position. The total deflection difference equated to 12 degrees.

During the elevator and trim system check it was noted that the elevator trim wheel wobbled when it was rotated. The phenolic trim wheel assembly was removed. Inspection of the wheel grooves revealed evidence of a prior repair with an epoxy-type substance. In addition, worn grooves were visible. The bolt that secures the trim wheel assembly had a bend in its shank.

Post-accident manual checks of the air data control unit indicated the unit functioned normally.

On February 13, 2003, under the auspices of an FAA inspector, Cessna Aircraft Company

performed an operational test on the Electro-Hydraulic Servo Valve and Hydraulic Power Pack Assembly. All parameters of the tests met the manufacturer's specifications.

The Cessna 550 antiskid system uses a dual power brake valve with a single antiskid servo valve to implement power boost and antiskid control on both left and right brake pressures. The power brake valve incorporates left and right power gain stages to proportionally increase (boost) the pilot's commanded level of brake pressure. A single antiskid servo valve modulates both left and right boosted brake pressures in response to signals from the antiskid control unit to implement antiskid control.

On June 2, 2003, Crane Aerospace Hydro-Aire Inc., examined the antiskid components from the accident airplane. Initial examination of the units revealed damage to the servo valve cover. The power brake valve was subjected to a functional test. The power brake function, pressure boost, was acceptably within limits. The antiskid pressure-current plots for both left and right brakes showed a left shift in the performance curve, which resulted in the unit being out of limits for the antiskid function with commanded pressures of less than 500 psi. According to Hydro-Aire, the curve's left shift "would represent an antiskid gain shift but would still yield maximum brake pressure unless antiskid activity was needed. For less than maximum commanded brake pressure, the actual brake pressure would be lower than the expected brake pressure because of the antiskid control current. However, it must be noted that if the pilot felt a lower level of airplane deceleration, the normal pilot reaction would be to increase commanded pressure. With an increased pressure command, antiskid control would correct and allow normal brake pressures."

Hydraulic fluid samples were taken from the power brake valve and were subjected to particle count analysis. The contamination noted is typical for a valve removed from service. The performance results of the valve functional test did "not indicate a particular contamination problem."

Antiskid control unit functional testing revealed no failures or anomalous results. Functional tests of the two wheel speed transducers resulted in no failures found.

As a result of the out-of-tolerance condition noted during the antiskid pressure-current plots, Hydro-Aire requested permission from the NTSB to perform a more complete analysis of the servo valve to attempt to establish the cause of the antiskid characteristic shift. Hydro-Aire was granted permission to conduct additional testing, which included the following. The manufacturing procedures call for the adjustment of the servo valve's magnetic path adjustment setscrews in an attempt to bring the characteristic curves into limits. According to Hydro-Aire, the required adjustment could not be achieved with the setscrews and so adjustment to the servo valve's nozzles was attempted. Since smooth adjustment of the nozzles could not be accomplished, this approach also failed to bring the valve into specification limits. The servo valve was then disassembled in an attempt to establish the cause of the left shift.

No physical discrepancies were noted in the servo valve's coil or magnet. While removing the valve's retaining nut, the fluid barrier (servo valve cap) separated into two pieces. Not only was the cap broken in two, but the portion of the cap that surrounds the armature shaft was also damaged. Removal of the armature shaft revealed it too was damaged in the same area as the cap. The cap's fracture surfaces displayed a rough, grainy texture, along with 45-degree shear lips.

According to Hydro-Aire, the damage to the servo cover, the servo valve cap (fluid barrier), and

the armature shaft more than likely resulted from damage that "occurred as a result of the accident." Hydro-Aire also indicated that if the damage and valve shift "occurred as a result of the accident, it would be reasonable to assume that the power brake/antiskid system was operating completely normally during the stop." If the damage and valve shift occurred at some time prior to the accident, a pilot would have noted a braking problem. Since the noted damage would have resulted in a low brake pressure anomaly, Hydro-Aire opined that anomalies would have appeared to the pilot during the taxi portion of the accident flight. Hydro-Aire noted the pilot reported, "engine start, pre-taxi and taxi...all normal", and therefore concluded that the servo valve damage occurred as a result of the accident or during removal from the airplane.

Despite a left shift of the antiskid control characteristic curves, if the pilot were applying maximum brake pressure, as reported, then the "actual brake pressure would have been within normal limits." The left shift of the antiskid valve characteristic would not have had any effect on braking performance unless antiskid activity was demanded. With a high gross weight airplane and a dry runway, "antiskid activity would be unlikely."

ADDITIONAL INFORMATION

According to the aircraft's flight manual, under the normal procedures exterior inspection section, it states "Right Elevator and Trim Tab - Movement and Condition, to assure the trim tab position matches the elevator trim tab position indicator."

Pilot Information

Certificate:	Airline Transport; Flight Instructor	Age:	60, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	Airplane Multi-engine; Airplane Single-engine; Instrument Airplane	Toxicology Performed:	No
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim.	Last Medical Exam:	10/05/2001
Occupational Pilot:		Last Flight Review or Equivalent:	01/18/2002
Flight Time:	13000 hours (Total, all aircraft), 150 hours (Total, this make and model), 12200 hours (Pilot In Command, all aircraft), 133 hours (Last 90 days, all aircraft), 48 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	Cessna	Registration:	N13VP
Model/Series:	550	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	0263
Landing Gear Type:	Retractable - Tricycle	Seats:	10
Date/Type of Last Inspection:	01/03/2002, AAIP	Certified Max Gross Wt.:	13300 lbs
Time Since Last Inspection:	95.9 Hours	Engines:	2 Turbo Fan
Airframe Total Time:	2956.9 Hours	Engine Manufacturer:	Pratt & Whitney
ELT:	Installed, not activated	Engine Model/Series:	JT15-D4
Registered Owner:	Airlease Inc.	Rated Power:	2500 lbs
Operator:	Avalon Correctional Services Inc.	Air Carrier Operating Certificate:	None
Operator Does Business As:	N/A	Operator Designator Code:	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	PWA, 1299 ft msl	Observation Time:	0807 CDT
Distance from Accident Site:		Direction from Accident Site:	
Lowest Cloud Condition:	Few / 12000 ft agl	Temperature/Dew Point:	14° C / 11° C
Lowest Ceiling:	None	Visibility	10 Miles
Wind Speed/Gusts, Direction:	5 knots, 60°	Visibility (RVR):	
Altimeter Setting:	30.3 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:			
Departure Point:	Bethany, OK (PWA)	Type of Flight Plan Filed:	IFR
Destination:	GreelEy, CO (GXY)	Type of Clearance:	IFR
Departure Time:	0801 CDT	Type of Airspace:	Class D

Airport Information

Airport:	Wiley Post (PWA)	Runway Surface Type:	Concrete
Airport Elevation:	1299 ft	Runway Surface Condition:	Dry
Runway Used:	17L	IFR Approach:	None
Runway Length/Width:	7198 ft / 150 ft	VFR Approach/Landing:	None

Wreckage and Impact Information

Crew Injuries:	1 None	Aircraft Damage:	Substantial
Passenger Injuries:	1 Minor, 4 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Minor, 5 None	Latitude, Longitude:	35.534167, -97.646944

Administrative Information

Investigator In Charge (IIC):	Jason A Ragogna	Adopted Date:	12/03/2004
Additional Participating Persons:	Lloyd R Cook; Federal Aviation Administration; Oklahoma City, OK Greg W Schmidt; Cessna Aircraft Company; Wichita, KS		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov , or at 800-877-6799. Dockets released after this date are available at http://dms.nts.gov/pubdms/ .		

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